What's New in the SAP HANA Platform 2.0
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1 What's New in the SAP HANA Platform 2.0

Find out about the new and enhanced features of SAP HANA Platform 2.0 in support package stacks (SPSs) and corresponding revisions.

Note
The PDF version of this document does not contain links to detailed information in other SAP HANA guides and reference works. Therefore, we recommend that you use the HTML version at https://help.sap.com/viewer/42668af650f84f9384a3337bcd373692/latest/en-US.

Support Package Stack (SPS) | First Released with Revision... | Feature Overview | Release Note
--- | --- | --- | ---
03 | 2.00.030 | SAP HANA Platform 2.0 SPS 03 Features [page 7] | SAP Note 2551355
02 | 2.00.020 | SAP HANA Platform 2.0 SPS 02 Features [page 89] | SAP Note 2460914
01 | 2.00.010 | SAP HANA Platform 2.0 SPS 01 Features [page 148] | SAP Note 2404375
00 | 2.00.000 | SAP HANA Platform 2.0 SPS 00 Features [page 201] | SAP Note 2380257

Related Information

SAP HANA Academy playlist for SPS 02
SAP HANA 2.0: Deprecations reported by the HANA statistics server (SAP Note 2425002)
Deprecation of SAP HANA extended application services, classic model and SAP HANA Repository (SAP Note 2465027)
SAP HANA 2.0 revision strategy
Additional guidance on SAP HANA 2.0 revisions (SAP Note 2378962)
2 SAP HANA Platform 2.0 SPS 03 Features

Find out about the new and changed features introduced with the SAP HANA platform 2.0 SPS 03.

2.1 Installation and Update

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for installation and update.

SAP HANA Server Installation and Update (New and Changed) [page 7]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the installation and update of SAP HANA.

2.1.1 SAP HANA Server Installation and Update (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the installation and update of SAP HANA.

Software Authenticity Verification (New)

Before installation and update of SAP HANA software components, the authenticity and integrity of the software can be verified with the 'verify_signature' parameter.

Resume Update after DU Import Error (Changed)

Previously, if an update failed because of a delivery unit import error, hdbupdrep had to be used to import delivery units manually. Now, you can rerun the SAP HANA database lifecycle manager to resume the update.
System Information for System Landscape Directory (SLD) Configuration (New)

The SAP HANA database lifecycle manager (HDBLCM) Web user interface now offers a system information page with a tab for SLD configuration parameters.

Usability Improvement (Changed)

When configuring the System Landscape Directory (SLD) registration, existing values of the configuration parameters are listed as default values.

Administering Offline Resources (Changed)

The SAP HANA cockpit for offline administration is no longer offered for the administration of offline resources. With SAP HANA cockpit SP 04, the SAP HANA cockpit includes all capabilities that could formerly be performed only through the SAP HANA cockpit for offline administration.

2.2 Security

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for security.

SAP HANA Database Security (New and Changed) [page 8]
SAP HANA Platform 2.0 SPS 03 introduces new and changed security-related features for the SAP HANA database.

2.2.1 SAP HANA Database Security (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed security-related features for the SAP HANA database.

Data Anonymization (New)

SAP HANA now provides native support for data anonymization. This allows you to gain statistically valid insights from data containing personal or sensitive information while protecting the privacy of individuals.
Data anonymization capabilities are integrated into SAP HANA calculation views and can be configured using the calculation view editor of the SAP Web IDE for SAP HANA. Two anonymization methods are supported: k-anonymity and differential privacy. Which method provides the most appropriate level of privacy depends on your data and the potential attack scenarios and attackers.

Access to anonymized views is secured using standard SAP HANA authorization mechanisms.

**Shared Business Authorizations in SAP HANA (New)**

“Authorization objects ” form the basic layer of authorization for ABAP-based SAP applications such as S/4 HANA or SAP Business Warehouse. It is possible to create analytic privileges in SAP HANA that reuse these authorizations.

**User Group-Specific Password Policies (New)**

You can now configure a customized password policy for user groups. The passwords of users in the group must adhere to the group-specific password policy if enabled. The password policy configured for the database applies for those parameters that do not have a group-specific configuration.

**LDAP-Based Authentication and User Provisioning (New)**

Users accessing SAP HANA directly via JDBC/ODBC database clients can now be authenticated against an LDAP directory server using the user name and password provided by the client.

In addition, by allowing the LDAP provider to create database users in SAP HANA, LDAP-authenticated users can be automatically provisioned in SAP HANA. Once it is verified that the authenticated user is a member of at least one LDAP group mapped to an SAP HANA role, the required database user is automatically created in SAP HANA and granted the relevant role(s).
Data Encryption (New and Changed)

Password hash algorithm (Changed)

Database user passwords are now stored in hashed and salted form using PBKDF2 (Password-Based Key Derivation Function 2). For downward compatibility, they also continue to be hashed using secure hash algorithm SHA-256.

The SAP HANA implementation of PBKDF2 uses the SHA-256 secure hash algorithm and 15,000 iterations.

Encryption configuration in tenant databases (Changed)

The default status of data-at-rest encryption services in tenant databases (on or off) is no longer inherited from the system database. It is now controlled in the system database with parameters in the new `database_initial_encryption` section of the `global.ini` configuration file. All encryption services are off by default.

It is also possible to specify who initially has control over enabling and disabling encryption in tenant databases: the tenant administrator in the tenant database (default), or the system administrator in the system database. Responsibility can switched later if necessary.

Client-side data encryption (New)

With client-side data encryption, columns that contain sensitive data, such as credit card numbers or social security numbers, are encrypted by using an encryption key accessible only by the client. Column data is encrypted and decrypted on the client.

To use client-side encryption, your interface must meet a number of requirements. These are documented in the SAP HANA Client Interface Programming Reference.

Numerous new privileges and SQL statements have been added to support client-side encryption. For more information, see support for client-side encryption in the section SAP HANA SQL and System Views Reference.

SAP HANA SQL and System Views Reference (New and Changed) [page 58].

Data Masking (Changed)

In addition to views, you can now also mask data in tables.
Auditing (Changed)

- Auditing for SAP HANA extended application services, advanced model (SAP HANA XS advanced) has been integrated into the SAP HANA auditing framework. SAP HANA XS advanced audit entries may now be written to the standard SAP HANA audit targets, database table and syslog.

- A number of new actions can be audited. For more information, see changes to the CREATE AUDIT POLICY statement in the section SAP HANA SQL and System Views Reference.

SAP HANA SQL and System Views Reference (New and Changed) [page 58]

Authorization Enhancements (Changed)

- Any user with the system privilege ROLE ADMIN can now revoke catalog roles granted by another user.
- A user can now grant all currently available privileges on a schema by granting the ALL PRIVILEGES object privilege.

SAP HANA Cockpit (New and Changed)

For more information, see the section on SAP HANA cockpit.

SAP HANA Cockpit (New and Changed) [page 14]

2.3 Planning and Design

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for planning and design.

SAP Enterprise Architecture Designer, Edition for SAP HANA (New and Changed) [page 12]

SAP HANA Platform 2.0 SPS03 introduces new and changed features in SAP Enterprise Architecture Designer, Edition for SAP HANA.
2.3.1 SAP Enterprise Architecture Designer, Edition for SAP HANA (New and Changed)

SAP HANA Platform 2.0 SPS03 introduces new and changed features in SAP Enterprise Architecture Designer, Edition for SAP HANA.

Core Features

- **Symbol Format**
  A new format toolbar allows you to change the fill, outline, and font color of symbols.

- **Open Diagram**
  A new `Open Diagram` tool in object property sheets lets you open any of the diagrams in which the object appears.

- **Exporting and Importing Models**
  You can now transfer models from one SAP EA Designer repository to another by exporting and importing generated zip files.

- **Analysis Criteria and Heat Map Enhancements**
  You can now search for and apply analysis criteria to multiple objects at once and change the analysis values applied to objects on the fly when heat map coloring is active.

- **Capability Coverage**
  A new `Capability Coverage` list on the Dependencies tab of application property sheets allows you to add business capabilities to the list and specify the maturity of the application’s coverage of them.

Requirements Management

- **Requirement Diagrams**
  New requirement diagrams allow you to visualize the hierarchy and other relationships between all or some of the requirements from your requirements list.

Information Architecture

- **CDM to PDM Generation**
  You can now generate a conceptual data model (CDM) to a physical data model (PDM). You can generate multiple PDMs from a single CDM, and regenerate to these PDMs as necessary to push updates from your CDM.
- **CDS Extensions**
  We now provide support for HANA CDS extensions for entities.

**Administration**

- **Configuration Enhancements**
  Custom properties now support **URL** and **Date** data types. You can also now modify the values appearing in drop-down lists for certain properties and add new types of dependencies.

- **Change List Reassignment**
  If the creator of a draft change list is unavailable, an administrator can now re-assign the draft changes to another user.

### 2.4 Administration

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for administration.

- **SAP HANA Cockpit (New and Changed) [page 14]**
  SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the SAP HANA cockpit with SAP HANA cockpit support package (SP) 06.

- **SAP HANA System Administration (New and Changed) [page 32]**
  SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the administration of SAP HANA.

- **SAP HANA High Availability (New and Changed) [page 36]**
  SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA high availability.

- **SAP HANA Database Backup and Recovery (New and Changed) [page 37]**
  SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA backup and recovery.

- **SAP HANA XS Advanced Cockpit (New) [page 37]**
  SAP HANA Platform 2.0 SPS 03 introduces the new and enhanced version of SAP HANA XS Advanced Administration tool called SAP HANA XS Advanced Cockpit.

- **SAP HANA Application Run-Time Services (New and Changed) [page 38]**
  SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the application run-time services in SAP HANA.

- **SAP HANA Smart Data Access (New and Changed) [page 39]**
  SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA smart data access.
2.4.1 SAP HANA Cockpit (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the SAP HANA cockpit with SAP HANA cockpit support package (SP) 06.

SAP HANA Cockpit SP 06 (New)

SAP HANA cockpit SP 06 is available with SAP HANA Platform 2.0 SPS 03.

SAP HANA Cockpit SP 06 Features [page 15]

About SAP HANA Cockpit SPs

The SAP HANA cockpit is part of the SAP HANA platform 2.0. An SAP HANA cockpit SP is released with every SAP HANA platform support package stack (SPS), but additional SAP HANA cockpit SPs may be released between SAP HANA platform SPSs. For more information about the revision and maintenance strategy of the cockpit, see SAP Note 2433181.

SAP HANA cockpit SPs are cumulative. This means that a higher SP includes all features and fixes available in earlier SPs.

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<th>SAP HANA Cockpit SP</th>
<th>Release Note</th>
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<td>06</td>
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<td>Included with revision 2.00.030</td>
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<td>SAP HANA cockpit 2.0: Revision and Maintenance Strategy</td>
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2.4.1.1 SAP HANA Cockpit SP 06 Features

Administration and Monitoring [page 16]
SAP HANA cockpit SP 06 introduces new and changed features for system administration and monitoring.

SAP HANA Database Explorer [page 16]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA Database Explorer.

Performance Monitoring and Analysis [page 17]
SAP HANA cockpit SP 06 introduces new and changed features for performance monitoring and analysis.

User Management and Security Administration [page 19]
SAP HANA cockpit SP 06 introduces new features for user management and data anonymization.

Backup and Recovery [page 19]
SAP HANA cockpit SP 06 introduces new and changed features for backup and recovery.
2.4.1.1 Administration and Monitoring

SAP HANA cockpit SP 06 introduces new and changed features for system administration and monitoring.

Memory Analysis (Changed)

In the Memory Analysis application, you can now opt to view a selected service in the Performance Monitor or the Workload Analyzer.

Table Redistribution (New)

Beginning in SP 06, you can view and save current table distributions, automatically generate an optimized table distribution, re-run a previously executed plan, or restore a saved plan.

Documentation on Required Privileges (New)

We’ve added a help topic listing the SAP HANA privileges you need to access applications and tools in the SAP HANA cockpit.

2.4.1.2 SAP HANA Database Explorer

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA Database Explorer.

Catalog Browser

The catalog browser tree now shows the following new object types:

- Graph Workspaces
- Table Types

Graph Workspaces Visualizer

Right-clicking the Graph Workspaces object opens a new editor that shows the properties of the graph workspace and allows you to apply filters and algorithms to your graph workspace. For more information about graph workspaces, see the SAP HANA Graph Reference guide.
Preferences

- New Database Explorer Section
  - Set session-based debug logging by clicking the Enable debug logging checkbox. A red circle appears at the top of the catalog browser in the database explorer perspective to indicate that logging is enabled. Session-based debug logging is useful if you encounter a problem and need to send session log reports to SAP support.
  - Delete personal data by clicking Remove all user data.

Data Preview

The Data Preview editor for dimension calculation views and CUBE calculation views now contains a Hierarchies tab that shows hierarchies and measures details if they are available for the view. For more information about hierarchies see the SAP HANA Hierarchy Developer Guide, and for hierarchy function syntax, see the SAP HANA SQL and System Views Reference guide.

Background Activities

- You can now run a query as a background activity, which is a task that persists even after the session in which it was created has ended.
- A Background Activities Monitor has been created to manage background activities and to view their progress and results.
- You can now run a SQL query on multiple databases by clicking Run on Multiple Databases. The query runs as a background activity.

SQLScript Code Analyzer

You can now analyze a procedure or function written in SQLScript to search for patterns indicating problems in code quality, security or performance. Choose the Analyze SQLScript Code option from the context menu of a database, schema, procedure, or function.

SQL Debugger (SAP Web IDE)

The SQL debugger has adopted the common look and feel of the Development perspective’s Node.js and Java debugger user interface, creating a common user experience when debugging Node.js, Java, or SQLscript code.

Remote Sources

You can now create remote sources in the database explorer and create virtual objects from those remote sources. For more information about how to create and work with remote sources in database explorer, see the SAP HANA Smart Data Access section in the SAP HANA Administration Guide.

2.4.1.1.3 Performance Monitoring and Analysis

SAP HANA cockpit SP 06 introduces new and changed features for performance monitoring and analysis.

Capture and Replay (New)

Capture and Replay offers the following new functionalities:

- When analyzing the comparison report, it is now possible to filter specific statement-related aspects on the Overview tab using the drop down arrow. In the Different Statements block, you can filter the statements by time or by the number of records that have different results. In the Replay Failed Statements block, you can filter the statements by time or error code.
From a capture-replay comparison report, it is now possible to export replay results and store them outside the database choosing the arrow on top right. Back on the Replay List you can import a replay on top right.

**Performance Monitor (New)**

It is now possible to examine the performance of your selected KPIs at different time intervals on the Performance Comparison page.

**SQL Analyzer (New and Enhanced)**

SQL Analyzer offers the following new and enhanced functionalities:

- The Manage plan stability link allows you to ensure the fast performance of queries by capturing query plans in a source system and reusing them in a target system.
- SQLScript V3 is now supported.
- The Plan Graph view is enhanced with edge information details.
- It is now possible to access SQL plans saved from a previously executed query using the Manage saved plans link.

**Workload Analyzer (Enhanced)**

The Workload Analyzer Based on Thread Samples now opens on a chart displaying the most expensive SQL statements based on lock time.
2.4.1.4  User Management and Security Administration

SAP HANA cockpit SP 06 introduces new features for user management and data anonymization.

**SAML Identity Provider (New)**

It is now possible to create the SAML identity providers required for SAML-based single sign-on. On the Overview page, choose the link Manage SAML identity providers under Security Related Links.

**Data Anonymization Views (New)**

To enable analytics on data while still keeping the privacy of individuals, data anonymization capabilities are integrated into SAP HANA calculation views. You can see a list of all calculation views that have one or more anonymization node views configured in the SAP HANA cockpit.

On the Overview page, choose the link View anonymization report under Security Related Links.

**Configuration of SSO Access to SAP HANA Cockpit (Changed)**

You now use SAP HANA XS advanced cockpit to set up SSO access to SAP HANA cockpit.

2.4.1.5  Backup and Recovery

SAP HANA cockpit SP 06 introduces new and changed features for backup and recovery.

**Recovering Older SAP HANA Releases**

SAP HANA cockpit 2.0 SP06 can be used to recover SAP HANA 2.0 and SAP HANA 1.0 databases with Support Package Stack (SPS) 12.

For more information about compatible database revisions of SAP HANA 1.0, see SAP Note 2616241 (Recovery of SAP HANA 1.0 with SAP HANA Cockpit 2.0).
Related Information

SAP Note 2616241

2.4.1.2 SAP HANA Cockpit SP 05 Features

Find out about the new and changed features introduced with the SAP HANA cockpit SP 05.

Administration and Monitoring [page 20]
SAP HANA cockpit SP 05 introduces new and changed features for system administration and monitoring.

SAP HANA Database Explorer [page 23]
The following features are new or changed for this release of SAP HANA database explorer.

Performance Monitoring and Analysis [page 23]
SAP HANA cockpit SP 05 introduces new and changed features for performance monitoring and analysis.

User Management and Security Administration [page 25]
SAP HANA cockpit SP 05 introduces new and changed features for user management and security-related administration.

High Availability and Scalability [page 26]
SAP HANA cockpit SP 05 introduces new and changed features for high availability and scalability.

Backup and Recovery [page 26]
SAP HANA cockpit SP 05 introduces new and changed features for backup and recovery.

2.4.1.2.1 Administration and Monitoring

SAP HANA cockpit SP 05 introduces new and changed features for system administration and monitoring.

Cockpit Roles (Changed)

In addition to the existing cockpit roles of Cockpit Administrator, Cockpit Resource Administrator, and Cockpit User, the SAP HANA cockpit now includes the roles of Cockpit User Administrator and Cockpit Power User. Each of these roles is permitted access to specific aspects of the cockpit or the Cockpit Manager administration tool. Multiple roles can be assigned to an individual user. The COCKPIT_ADMIN master user, created during cockpit installation, has all three administrator roles (Cockpit Administrator, Cockpit Resource Administrator, and Cockpit User Administrator), and you can use it to configure users and resources during initial set-up.
Cockpit Settings (Changed)

- The Cockpit Manager administration tool now offers additional functionality for sizing collections.
- A Cockpit Administrator can now specify the length of time that the cockpit should wait for a connection before initiating a timeout.
- You can specify which, if any, of the auto-generated resource groups should be visible in the cockpit and the Cockpit Manager. These auto-generated groups (Production, Test, Development) are based on the system usage type of each resource.

Register Resources (Changed and New)

- When registering or editing a resource in the Cockpit Manager, Cockpit Resource Administrators now have the option of naming the resource with a custom name.
- If you import a resource, the Cockpit Manager can now register that resource in an offline state.
- You can now register a resource whose statistics server isn’t running or is unreachable.

Start or Stop a Resource (Changed)

In the cockpit’s System Overview, cockpit users can now start or stop a resource directly from the Overall Database Status tile (for a single container) or the Overall System Database Status tile (for a system database).

Memory Analysis (Changed)

- Beginning in SP05, you can launch the Dump Viewer (in the SAP Database Explorer) to view trace files related to out-of-memory events displayed in the Memory Analysis application.
- Memory Analysis is now directly accessible from the System Overview.
Monitor Volumes (New)

Using the new Disk Volume Monitor, you can now check disk statistics in order to ensure that there is enough space on disk for data volumes and log volumes.

Configure System Properties (Changed)

In the Configuration of System Properties application, the ability to update the layers for an existing parameter has been enhanced with a more interactive dialog offering additional choices.

Workload Classes (Changed and New)

- Workload classes can now be imported from another system, and exported in preparation for importing them into another system.

- Two new properties have been added to the dialog for creating workload class mappings: application component name and application component type.

- You can now open the Workload Classes app to set up or modify workload classes from the Expensive Statements app and the Statements Monitor.

Configure Admission Control (New)

Using the new Workload Admission Control Settings application, you can now manage peak load by applying processing limits and determining how to handle new requests if a system is close to the point of saturation.

System Health (Changed)

In the System Health application, by selecting specific system health information, you can now drill down to details on specific KPIs displayed in the Performance Monitor and the Workload Analyzer.
Audit Logging for the Cockpit (New)

You can use the Audit Log to identify log entries for cockpit events that you want to track, such as logins or the creation and deletion of user accounts.

2.4.1.2.2 SAP HANA Database Explorer

The following features are new or changed for this release of SAP HANA database explorer.

Tracing Enhancements

**Kernel Profiling**
You can now configure tracing for the kernel profiler to analyze performance issues with systems on which third-party software cannot be installed, or for parts of the database that are not accessible by the performance trace.

**Expensive Statements Traces**
You can now configure tracing for expensive statements whose execution time exceeded a configured threshold. Right-click your database, click Trace Configuration, and click Edit on the Expensive Statements Trace tile.

**Statement Library**
The new statement library contains default system statements. You can also create user-defined statements in the SQL console and add them to the statement library.

2.4.1.2.3 Performance Monitoring and Analysis

SAP HANA cockpit SP 05 introduces new and changed features for performance monitoring and analysis.

Capture and Replay (New)

Capture and Replay offers the following new functionalities:

- It is now possible to create a full database backup turning on the Create Full Backup setting on the Configure New Capture page. If you didn’t create a backup when starting the capture, you can also start a full backup from the Capture Monitor page.
- When dealing with statements that have minor runtime differences, the tolerance ratio can lead to unexpected results after validating the runtime delta. It is now possible to change this threshold value during the preprocessing step to avoid unintended and misleading classifications in the replay report.
- It is now possible to synchronize the replay with an existing database backup on the Replay Configuration page.
Performance Monitor (new and changed)

*Performance Monitor* offers the following new and changed functionalities:

- It is now possible to define the monitored time frame by selecting from *Presets*.
- It is now possible to compare the performance of your selected KPIs at different times with the *Performance Comparison* functionality.

Threads (new and changed)

*Threads* offers the following new and changed functionalities:

- It is now possible to filter threads by host, service, and thread type.
- It is now possible to select the sorting parameters of the threads via the *Group and Sort* option.
- *Call Stack* information is now available for the selected thread.
- It is now possible to define the columns by choosing parameters that will be displayed in the table.

Statements Monitor (changed)

On the *Statements Monitor* page, it is now possible to set up or modify the workload class of a statement.

Expensive Statements (changed)

On the *Expensive Statements* page, it is now possible to set up or modify the workload class of a statement.

SQL Analyzer (new and changed)

*SQL Analyzer* offers the following new and changed functionalities:
• It is now possible to see the details of table accesses performed during a processing of a table on the Table Accesses tab, like offset, processing time, and location. You can also get aggregated information for each column and choose aggregator functions, filter and sort the results, and customize columns.

• It is now possible to re-execute the SQL query with parameter changes.

• SQL Analyzer can now be opened through the Statement Hints page.

• It is now possible to move to Operator List after selecting the Tables Used tile in Overview.

• It is now possible to split the areas between the operators and the timeline chart.

• The Plan Graph now displays critical paths.

Workload Analyzer (new)

The Workload Analyzer Based on Thread Samples now opens on a chart displaying top SQL statements by lock time. You can choose different operation periods to be displayed, and choose an entry on the chart to have more information displayed below along with the full SQL statement. Once a bar is selected, the corresponding information will be added to the filter on the analysis page. You can navigate to the original analysis page by clicking Analyze in the footer bar.

2.4.1.2.4 User Management and Security Administration

SAP HANA cockpit SP 05 introduces new and changed features for user management and security-related administration.

User Management (New and Changed)

• It is now possible to assign privileges to users directly using the new Assign Privileges app. Note that it is still recommended that you assign roles to users instead of granting privileges individually.

• You can now navigate from the Users app to both the Assign Privileges and Assign Roles app.

Auditing (Changed)

• If the audit trail target is or was a database table, you can now view the audit trail in the Auditing app. Several options are available for sorting and filtering the audit trail.
2.4.1.2.5 High Availability and Scalability

SAP HANA cockpit SP 05 introduces new and changed features for high availability and scalability.

Reinitializing the Secondary System (New)

You can register again a previously stopped secondary system. You must do this when a full data shipping is needed or when you want to change the operation mode.

Monitoring the Network for Multiple Hosts (Changed)

It is possible to monitor the network for multiple hosts using the Monitor Network link:

- Use the Network Traffic tab to understand the role of each host and the size of the sent (Request Size) and received data (Response Size) between the hosts.
- **Network Speed Check (Internal Communication)**
  The list offers an overview of all network channels between the involved hosts starting with the slowest network connection.
  The Measure Network Speed link offers the possibility to measure the network speed between the hosts in a scale-out SAP HANA database.
- **Network Speed Check (System Replication Communication)**
  The list offers an overview of all network channels between the involved hosts in the system replication configuration.
  The Measure Network Speed link offers the possibility to measure the network speed between the hosts in a system replication configuration.

2.4.1.2.6 Backup and Recovery

SAP HANA cockpit SP 05 introduces new and changed features for backup and recovery.

Backup Configuration

SAP HANA Cockpit now offers a dedicated app for backup configuration. Using this app, you can:

- Get an overview of the active backup and recovery configuration settings for each database
- Change the default backup and recovery configuration settings for all the tenant databases and the system database

For more information, see Configure Backups in the SAP HANA Administration Guide (SAP HANA Database Backup and Recovery).
2.4.1.3 SAP HANA Cockpit SP 04 Features

Find out about the new and changed features introduced with the SAP HANA cockpit SP 04.

Administration and Monitoring [page 27]
SAP HANA cockpit SP 04 introduces new and changed features for system administration and monitoring.

SAP HANA Database Explorer [page 29]
SAP HANA cockpit SP 04 introduces new and changed features for SAP HANA database explorer.

Performance Monitoring and Analysis [page 30]
SAP HANA cockpit SP 04 introduces new and changed features for performance monitoring and analysis.

User Management and Security Administration [page 31]
SAP HANA cockpit SP 04 introduces new and changed features for user management and security-related administration.

High Availability and Scalability [page 32]
SAP HANA cockpit SP 04 introduces new and changed features for high availability and scalability.

2.4.1.3.1 Administration and Monitoring

SAP HANA cockpit SP 04 introduces new and changed features for system administration and monitoring.

Single-Sign On

Along with the option to enable or enforce single-sign on (SSO) for a specific resource (thus removing the need for providing database user credentials each time you connect to the resource), you can choose to configure SSO access to the cockpit itself. Doing so means that cockpit users, cockpit resource administrators and the cockpit administrator need not provide cockpit user credentials in order to access the cockpit or the cockpit manager.

Administering Offline Resources (Changed)

The SAP HANA cockpit for offline administration is no longer offered for the administration of offline resources. With SP 04, the SAP HANA cockpit includes all capabilities that could formerly be performed only through the SAP HANA cockpit for offline administration.
Registering Offline Resources (New)

You can now register a resource with SAP HANA cockpit even when the cockpit is unable to connect to the resource. Once the resource is registered, you can use the cockpit to start it or update its license.

Collecting Diagnosis Information (New)

To help SAP Support analyze and diagnose problems with your system, you can collect a range of diagnosis information from your system into a zip file. You can now trigger the collection of diagnosis information from the SAP HANA cockpit. (This was previously only available through the SAP HANA studio, the SAP HANA cockpit for offline administration, and by using the command line).

Workload Classes (Changed)

It is now possible to disable or enable an existing workload class.

Managing Tenant Databases (Changed)

The Manage Databases app now has additional capabilities. For a selected tenant, you can now:

- Copy or move a tenant.
- Change the SYSTEM password for a tenant from the system database.

Memory Analysis (Changed)

You can now display details about which allocators are consuming the most memory for the host and service, in the given time period.
Tenant-Specific Licenses (Changed)

As a tenant database administrator, you can now install and delete tenant-specific licenses in your tenant using the Licensing app.

Cockpit API (New)

SAP HANA cockpit now offers REST APIs that you can use with a third-party tool to register resources, create users and groups, and add users and resources to groups.

2.4.1.3.2 SAP HANA Database Explorer

SAP HANA cockpit SP 04 introduces new and changed features for SAP HANA database explorer.

Catalog Browser Enhancements

New Connection Information Context Menu Item
When you right-click a database in the catalog browser, you can now click Connection Information, which allows you to view information about an existing connection.

New Generate SELECT statement Context Menu Item
When you right-click on a view or a table, you can now click Generate SELECT statement which opens the SQL console and generates a SELECT statement based on the specific view or table.

New Add Filter Button in Object Definition View for Tables, Views, or Columns
When you click Open Data Add Filter on a table, view, or column, a counter is now displayed that shows the number of filters that have been applied to that object.

SQL Console Enhancements

New Run Statement Option in the Run Drop-Down Menu
The Run drop-down menu in the SQL console now contains the Run Statement option, which has the corresponding shortcut key F9. Choosing
New Option to Continue Running SQL After Error is Returned

You can now choose whether to continue or cancel your SQL execution once an error is returned.

Security Enhancements

Increased Security to Prevent Collection of Personal Information

Information logged for debugging or diagnostic purposes is subject to strict standards that prevent the collection of personal information.

2.4.1.3.3 Performance Monitoring and Analysis

SAP HANA cockpit SP 04 introduces new and changed features for performance monitoring and analysis.

Performance Monitor (New)

On the Performance Monitor page, you can now import and export collected data.

Capture and Replay (New)

Capture and Replay offers the following new functionalities:

- On the Replay Configuration page in the User Authentication area it is now possible to reset the password for the database users captured in the source system.
- On the Overview tab it is now possible to view an overall comparison of the SQL statements based on results and runtime information. This overall comparison makes it possible to identify for example the SQL statements, which have a different performance in the execution time, or to identify the reasons why the replay failed.

Workload Analyzer (New and changed)

On the Workload Analyzer Based on Thread Samples page, the filters adjustable in the header bar now apply to all charts.
Workload Analyzer Based on Engine Instrumentation offers the following new functionalities:

- It is now possible to view and compare information on a traced workload in the Capture Information page that opens by clicking a desired workload. You can also load the trace from that page.
- From the SQL Statements tab on the Workload Analyzer page, you can select a desired workload to analyze its Plans and Jobs.
- It is possible to perform a hierarchical analysis of data by adding Request ID to the dimensions in the SQL Statements tab on the Workload Analyzer page.

2.4.1.3.4 User Management and Security Administration

SAP HANA cockpit SP 04 introduces new and changed features for user management and security-related administration.

Database User and Role Management (Changed)

- If you are implementing user authorization based on LDAP group membership, you can now map LDAP groups to roles using the Role app. Users configured for LDAP authorization who belong to the specified group(s) are automatically granted the role in line with your LDAP configuration for SAP HANA.
- The Role app now shows the role type. A role can be:
  - A catalog role
  - A catalog role with LDAP group mappings
  - A HDI role, that is role created using the SAP HANA deployment infrastructure (SAP HANA XS advanced model)
  - A HDI role with LDAP group mappings
  - A repository role, that is a role created in the repository of the SAP HANA database (SAP HANA XS classic model)

Auditing (Changed)

If the audit trail target is a database table, you now delete old audit entries in the Auditing app.
2.4.1.3.5 High Availability and Scalability

SAP HANA cockpit SP 04 introduces new and changed features for high availability and scalability.

Monitoring System Replication (New)

New monitoring features are available for system replication:

- On the System Replication Overview in the Log Shipping Backlog Site 1 to 2 tab, the system replication log shipping backlog for the last 24 hours is shown in a graph. If this backlog exceeds the thresholds set for alert 104, the graph columns indicate this with a different colour.
- The replication status tenantcopy is displayed in the Replicated Services tab on the System Replication Overview when a tenant is being copied or moved in the primary system.
- On the System Replication Overview the tables providing information on the replicating services also display the corresponding tenant database names.

2.4.2 SAP HANA System Administration (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the administration of SAP HANA.

Tenant Database Management (New)

Fallback Snapshots for Tenant Databases (New)

You can create a fallback snapshot for a tenant database. It allows you to revert to a particular database state. A fallback snapshot may be useful if you perform changes to the contents of a database that you may need to roll back quickly, e.g. if you upgrade to a new version of an application.

Reinitialization of an Unrecoverable System Database (New)

You can reinitialize the system database with information on all tenant databases of the SAP HANA instance using the command-line tool hdbmdcout i1. This may be necessary if the persistency of the system database has been damaged and cannot be recovered.

SAP Note 2588284

Port Number Change of Tenant (New)

You can change the port number of a tenant database by executing the ALTER DATABASE statement.
Persistent Data Storage (New and Changed)

Persistent Memory (New)
Persistent memory (non-volatile RAM, also referred to as Storage Class Memory) is supported in SAP HANA as a persistent storage type. The persistent storage functions as DRAM memory and is used specifically for main data fragments of the column store. Delta data continues to be stored in DRAM. Usage of this feature can be configured so that it can be applied independently at four levels: database, table, partition, column.

SAP Note 2618154 – SAP HANA Persistent Memory (NVM)

Partitioning Data Volumes (New)
Data volumes on the indexserver can be partitioned so that read and write operations can run in parallel with increased data throughput. The indexserver data volume can be partitioned so that data can be segmented and distributed over several stripes on the disk to improve performance.

Table Maintenance (New and Changed)

Default Table Type (Changed)
The default table type has been changed in SAP HANA 2.0 SPS 03 to column-type tables. A configuration parameter is available to override this behavior if necessary.

SAP HANA 2551355 – SAP HANA 2.0 SPS 03 Release Note

Heterogeneous Partitioning (New)
Heterogeneous partitioning makes it possible to apply a more flexible second-level partition schema to tables with different second-level range specifications for each first level partition. Among other options this feature also supports locating subpartitions on hosts which support extended storage for dynamic tiering.

System-Versioned Tables (New)
System-versioned tables have been introduced in SAP HANA SPS 03 and will eventually replace the existing history tables feature. They support the tracking of changes on column store tables by capturing the validity period of each record.

Table Redistribution (Changed)
New configuration options have been introduced to table redistribution to provide a series of weighting parameters to influence the priorities of the redistribution. When executed from the command line using the CALL REORG_GENERATE() command you can include configuration parameter values with the call which apply only for the current session. In this way you can test redistribution options by repeatedly generating, reviewing, and optimizing the plan before it is finally executed.
**Table Consistency Check (Changed)**

Several new configuration parameters are available for the Table Consistency Check so that the run-time of the job can be better managed.

**Workload Management and Engines (New)**

**Configuration Parameter Tracking (New)**

To improve traceability of configuration changes, parameter tracking is now available. This feature maintains a history of changes to configuration values including details of the time the change was made, the user name, the current and previous values. Optionally, a reason for each change can be entered in a comment value.

**Workload Management (Changed)**

In the area of workload management new configuration parameters are available for admission control so that timeout values can be set for queued jobs, and workload classes also now support a statement timeout value which can either be set in a workload class or as a configuration parameter.

**SQL Plan Stability (New)**

SQL Plan Stability is a feature to protect the performance of queries by capturing query plans in a source system and reusing them in a target system to regenerate the original query plan. The Plan Stability feature could be used, for example, when upgrading from SAP HANA 1.0 to SAP HANA 2.0 (the feature is also available for capture purposes in SAP HANA 1.0 SPS 12).

**Processing Engines for Improved Statement Performance (Changed)**

New processing engines offering better performance when executing SQL queries continue to be developed and are being phased in to SAP HANA: the SAP HANA Execution Engine (HEX) and the Extended SQL Executor (ESX). Configuration parameters are available to disable these engines if necessary; hints for queries are also available to either avoid or prefer the use of these engines.

**Embedded Statistics Service (New)**

**STATISTICS_ALERT_THRESHOLDS_HISTORY (New)**

A history of changes made to alert thresholds is now maintained and can be retrieved from this system view: STATISTICS_ALERT_THRESHOLDS_HISTORY.
Alerts (New)

The following new alerts have been introduced:

<table>
<thead>
<tr>
<th>Alert ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>105</td>
<td>Total open transactions check: monitors the number of open transactions per service.</td>
</tr>
<tr>
<td>106</td>
<td>ASYNC replication: checks if local in-memory buffer overflows.</td>
</tr>
<tr>
<td>107</td>
<td>Checks if fallback snapshots are consistent.</td>
</tr>
<tr>
<td>108</td>
<td>Fallback snapshots: checks for out of date fallback snapshots.</td>
</tr>
<tr>
<td>109</td>
<td>Backup history: checks if the backup history is incomplete or inconsistent.</td>
</tr>
<tr>
<td>110</td>
<td>Catalog consistency: an alert is raised if the catalog consistency check detects errors (identifies the number of errors and affected objects).</td>
</tr>
<tr>
<td>117</td>
<td>Checks record count of non-partitioned column-store tables (only include tables are checked).</td>
</tr>
<tr>
<td>127</td>
<td>Checks record count of column-store table partitions (only include tables are checked).</td>
</tr>
<tr>
<td>128</td>
<td>Checks for the vulnerability where users may be enabled for LDAP Authentication but SSL is not enabled.</td>
</tr>
</tbody>
</table>

Client-Side Data Encryption (New)

With client-side data encryption, columns that contain sensitive data, such as credit card numbers or social security numbers, are encrypted by using an encryption key accessible only by the client. Column data is encrypted and decrypted on the client.

To use client-side encryption, your interface must meet a number of requirements. These are documented in the SAP HANA Client Interface Programming Reference.

Numerous new privileges and SQL statements have been added to support client-side encryption. For more information, see support for client-side encryption in the section SAP HANA SQL and System Views Reference.

SAP HANA SQL and System Views Reference (New and Changed) [page 58].

SAP HANA HDBSQL Options (New)

- The new -strictSeparatorLine option removes the parsing of a single quote, double quote, and BEGIN...END nesting. Separator line matching is strict and no leading or trailing spaces are allowed. When -c is not used, the default separator is a semi-colon on its own line.
The new `/read` interactive option reads commands from the specified batch file.

The new `-printoutput` option specifies how output from the SQLScript print library is handled.

### 2.4.3 SAP HANA High Availability (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA high availability.

#### getTakeoverRecommendation.py (New)

The `getTakeoverRecommendation.py` script evaluates the status of the primary system and of the system replication to help decide if a takeover is justified.

#### Alert ID 106: System Replication Log Shipping Backlog (New)

Alert 106 is raised when the local in-memory buffer in the ASYNC replication mode is running full indicating possible network issues with the connection to the secondary system.

#### Multitarget System Replication (New)

The primary system can replicate data changes to more than one secondary system.

#### Invisible Takeover (New)

After an invisible takeover, the client keeps the connections to the primary system and the sessions are restored to the secondary system.
Secondary Time Travel (New)

It is now possible to start the secondary system in online mode on a previous point in time. Secondary time travel can be used to quickly access again data, which was deleted in the original system.

Host Auto-Failover Parameters (New)

- nameserver.ini/[failover]/enable_master_failover
  When set to false, the masterize check of the nameserver master candidates is disabled. Furthermore, adding a new host does not modify the master candidates list.
- daemon.ini/[failover]/startup_error_restart_retries
  The number of retries if a service fails in the startup procedure.

2.4.4 SAP HANA Database Backup and Recovery (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA backup and recovery.

New Features in SAP HANA Cockpit SP05 and SP06

SAP HANA cockpit now offers a dedicated app for backup configuration, and capabilities to recover older SAP HANA releases.

For more information, see Backup and Recovery [page 26] (SAP HANA cockpit SP 05), Backup and Recovery [page 19] (SAP HANA cockpit SP 06).

2.4.5 SAP HANA XS Advanced Cockpit (New)

SAP HANA Platform 2.0 SPS 03 introduces the new and enhanced version of SAP HANA XS Advanced Administration tool called SAP HANA XS Advanced Cockpit.

SAP HANA XS Advanced Cockpit (New)

SAP HANA XS Advanced Cockpit provides an user interface that enables you to maintain the XS advanced runtime environment. It also allows you to configure identity management settings, assign permissions, and
execute actions on applications. At runtime, you can use SAP HANA XS Advanced Cockpit to perform the following:

- Manage Organizations and Spaces
- Manage Users
- Manage Hosts
- Monitor Applications
- Configure Trust and Manage Identities
- Manage Tenant Databases

2.4.6 SAP HANA Application Run-Time Services (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the application run-time services in SAP HANA.

The following changes are included with SAP HANA 2.0 SPS 03 for the management of the XS advanced run-time component:

- Support for TCP routes at the platform router
- XS advanced now provides support for Python application run times
- Support the automatic detection of renamed tenants
- Support resource quotas for organizations
- Support separate platform sizing profiles for application-usage and platform-usage scenarios
- Provide support for "procf files", which enables applications to define custom start commands
- Simplify the setup of certificates required for SSL connections between platform components and the SAP HANA database
- Provide stable URL for registered services
- The XS command-line interface (CLI) now provides support for the following components and actions:
  - The management of tenant databases (with the command `xs tenant-databases`)
  - The management of application roles and role collections (for example, with the commands `xs role-templates`, `xs create-role`, and `xs role-collections`)
  - Viewing information about uploaded domain certificates (with the command `xs domain-certificates`)
  - Providing stable URLs for registered services, by redirecting requests to `<API_URL>/go/<service_name>` to the actual application endpoint (with the command `xs create-service-url`)
- The XSA command-line interface (CLI) now provides support for the following components and actions:
  - Managing the deletion of personal data (with the XSA `delete-personal-data` command)
  - System configuration checks (with the new XSA command `XSA diagnose`)
  - The backup of the file-system service (with the new XSA commands `XSA backup-fss` and `XSA recover-fss`
2.4.7 SAP HANA Smart Data Access (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA smart data access.

Remote Sources (New)

You can create a remote source to a Google BigQuery database.

Remote Sources (Changed)

Smart data access supports Teradata 15.10 with some functional restrictions.

2600176 - Smart Data Access - Supported Databases and Versions

Virtual Tables Support Spatial Data Types (New)

Virtual tables support the spatial data type, for SAP HANA remote sources only, with some functional restrictions.

Universal ITAB (Changed)

Some behavior has changed since SPS 02.

2514255 - Universal ITAB for SAP HANA Smart Data Access

Optimized Mode for Linked Database (New)

Introduces an optimized mode, which provides better performance and eliminates maintenance.
Boolean Data Type (New)

Boolean data type now supported.

2.5 Development

SAP HANA Platform 2.0 SPS 03 introduces new and changed features as described in the development documentation.

SAP HANA XS Advanced Development (New and Changed) [page 40]
For SAP HANA Platform 2.0 SPS 03, SAP HANA supports development and deployment of SAP HANA extended application services (XS) advanced model applications.

SAP Web IDE for SAP HANA (New and Changed) [page 43]
SAP HANA Platform 2.0 SP03 introduces new and changed features for SAP Web IDE and integrated SAP HANA tools.

SAP HANA Spatial (New and Changed) [page 50]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA Spatial.

SAP HANA Graph (New and Changed) [page 52]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA Graph.

SAP HANA Interactive Education (SHINE) for XS Advanced (New and Changed) [page 53]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA Interactive Education (SHINE) for XSA.

Text Search and Text Analysis (New and Changed) [page 54]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for text search and text analysis.

2.5.1 SAP HANA XS Advanced Development (New and Changed)

For SAP HANA Platform 2.0 SPS 03, SAP HANA supports development and deployment of SAP HANA extended application services (XS) advanced model applications.

This section contains details of changes and additions to the following development related tools and features:

Application Migration (New and Changed)

- Support for integrated one-view migration, which helps migrate the following views automatically:
  - Scripted calculation views
- Attribute views
- Analytic views
- Analytic privileges

- Extended support for data migration:
  - Move an SAP HANA database table to an HDI container on the same instance.
  - Migrate data using virtual tables.
- Extend the configuration of the synonym-target-provider for individual objects.
- More filter options for migrated object types

### Application Run-Time Environment (New)

- JavaScript Run-Time Environment
  - Support for Node.js 8.x
  
  **Note**
  
  The XS advanced JavaScript run-time environment no longer provides support for Node.js 4.x.

  - SAP NPM Registry
    - CHANGELOG
    - What’s New
- Python Run-Time Environment
  - XS advanced model now supports the Python run-time environment with new build packs and libraries

### Deployment Service (New and Changed)

- Service keys and service tags
  - It is also now possible to inject service keys into an application environment
- MTA module- and resource-type updates
- Application router as a service (MTA module type)
- Optional MTA resources
- TCP routes in XS advanced are now supported
- Support for the MTA module parameter enable-ssh
- Zero-downtime update of MTAs (with HDI persistence not requiring data migration)

### SAP HANA Deployment Infrastructure (New and Changed)

- Extended support for existing design-time artifacts and their associated plug-ins, for example, .hdblibrary (supports SQLScript)
- Support for new plug-in types:
  - System-versioning table (.hdbsystemversioning)
Transforms a design-time, system-versioned table that refers to a current and history table into a system-versioned table database object.

- New administration parameters
- Export and Import containers

**Core Data Services (New)**

- Support for multi-store tables (including multi-level partitions)
- Support for time-selection partitions
- Support for tables in extended storage
- Updated data-type compatibility support

**XS Advanced Services (New and Changed)**

The following new or updated services are available:

- SAP UI5 (new)
- Messaging (ActiveMQ) (new)

**XS Command Line Interface (New)**

- Tenant database administration
- Role collections (and role assignment) administration

**Developer Documentation (New and Changed)**

The following additions and changes have been made to the documentation provided for XS advanced application developers:

- **SAP HANA Developer Information Map**
  - Extended and improved all existing areas with more links, descriptions, and visual aids
  - Added graphical maps and interactive tables in all sections to help you locate and navigate to the desired information target more easily and quickly
  - Added a new Development Journey section
  - Added a new Security section to the Information by Scenario section
- **SAP HANA Developer Guide for XS Advanced**
  - Includes updates and improvements to the following high-level areas:
    - The tutorials in the Getting Started section
    - The Deployment Descriptors section
2.5.2 SAP Web IDE for SAP HANA (New and Changed)

SAP HANA Platform 2.0 SP03 introduces new and changed features for SAP Web IDE and integrated SAP HANA tools.

SAP Web IDE for SAP HANA is a browser-based integrated development environment (IDE) for the development of SAP HANA-based applications comprised of web-based or mobile UIs, business logic, and extensive SAP HANA data models. SAP Web IDE works in conjunction with the SAP HANA deployment infrastructure (HDI), the Application Lifecycle Management tools (ALM), the XS Advanced runtime platform, and various SAP HANA tools.

**SAP Web IDE [page 44]**
SAP HANA Platform 2.0 SP03 introduces new and changed features for SAP Web IDE.

**Calculation View Editor (Modeler) [page 45]**
SAP HANA Platform 2.0 SP03 introduces new and changed features for the calculation view editor in SAP Web IDE.

**CDS Graphical Editor [page 47]**
SAP HANA Platform 2.0 SP03 introduces new and changed features for the CDS graphical editor in SAP Web IDE.

**Annotation Modeler [page 48]**
As of version 2.0 SP03, SAP Web IDE for SAP HANA includes Annotation Modeler, which was previously available on SAP HANA Cloud Platform only.

**Node.js Development [page 48]**
SAP HANA Platform 2.0 SP03 introduces new and changed features for Node.js development in SAP Web IDE.

**SAP HANA Database Explorer [page 48]**
SAP HANA Platform 2.0 SP03 introduces new and changed features for SAP HANA Database Explorer.

**SAP Web IDE Flowgraph Editor [page 49]**
SAP HANA Platform 2.0 SP03 introduces new and changed features for SAP HANA Flowgraph Editor.
2.5.2.1 SAP Web IDE

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP Web IDE.

Enhanced Source Control (Git) Capabilities

Executing Commands from the Git History Pane

You can now execute the following commands from the Git History pane:

- Tag a commit
- Cherry-pick a change
- Revert a commit
- Check out a commit
- Compare commits

Connecting to Git Repositories with Personal Access Tokens

It is now possible to connect to a Git repository on Team Foundation Server (TFS) with a personal access token.

1. In TFS, generate a personal access token, and store it in a text file for future use.
2. In SAP Web IDE, when you connect to a remote repository on TFS, supply this token as the password in the Authentication dialog box.

Performing Administration Tasks in SAP HANA XS Advanced Cockpit

As of SPS 03, you perform the SAP Web IDE administration tasks in SAP HANA XS Advanced Cockpit, which replaces the previously available XS Advanced Administration tool.

You can access the cockpit directly from the main menu in SAP Web IDE. Choose Tools SAP HANA XS Advanced Cockpit.

The Trust Certificates tool in SAP HANA XS Advanced Cockpit replaces the previously available SAP Web IDE SSL Certificate Management tool, which is deprecated as of this version.

Multi-Target Application Development

- For resources of the org.cloudfoundy.managed-service type that are defined in the MTA descriptor, the corresponding services are now automatically generated.
• The visual MTA editor enhances user experience by providing value selection boxes for various entries.

2.5.2.2 Calculation View Editor (Modeler)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the calculation view editor in SAP Web IDE.

Anonymizing Data Using Calculation Views (New)

Users can use the anonymization capabilities in SAP HANA to anonymize calculation view output. Anonymization methods help gain statistically valid insights from your data while protecting the privacy of individuals.

Extracting Semantics (Changed)

Users can extract and copy variables defined in the underlying views to the semantic definition of the target calculation view.

Renaming and Refactoring (New and Changed)

Users can rename a calculation view, its output columns, or input parameters and refactor them to retain the behavior of the impacted objects.

Creating Pruning Configuration Tables (Changed)

Users can use a form-based editor to create a pruning configuration table that helps prune data in union view nodes.
Data Preview (New and Changed)

Enhanced support to preview output of calculation views with hierarchies.

Creating Joins (New and Changed)

- Users can create multi joins (creating multiple join definition within a single join view node) and specify the multi join order and the central table.
- Users can create non equi joins.

Performing Currency Conversion

- Support for banking currency conversion functions.
- Support for reverse lookup in currency conversions.

Generating Time Data

In addition to generating time data in the `SYS_BI` schema, users can now create time-related tables in an SAP HANA Database Module and generate time data. They can use these tables as data sources in a calculation view to add a time dimension to the view.

ORDER BY and Sort the Result Set of Calculation Views

Users can use one or more output columns of a calculation view to `ORDER BY` and sort the result set of a calculation view. They can also specify the sort direction.
Using SAP HANA Hierarchy Functions (New)

Users can model calculation views with the new hierarchy function view nodes that allow them to use several SAP HANA hierarchy functions in the view definition. The hierarchy functions typically help work with hierarchical data.

Enhancements to Graph View Nodes (New and Changed)

In addition to the already supported SAP HANA Graph actions, the graph view nodes in calculation views now also support the action, Shortest Path (One-to-One). This SAP HANA Graph action when executed on a graph workspace returns the shortest path from the provided start vertex to the provided target vertex.

2.5.2.3 CDS Graphical Editor

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the CDS graphical editor in SAP Web IDE.

Preview Output of CDS Views and Entities (New)

After modeling and activating a CDS view or an entity, you can preview the output data using the SAP Database Explorer.

Importing Elements (Changed)

When defining the elements in an entity, you can also do so by importing elements from other catalog tables. These catalog tables can be available in the same HDI container in which you are creating the entity or a synonym that points to catalog table in another HDI container.
Support for Cross Joins (Changed)

When creating a join, in addition to the already supported join types, the tool now also supports cross joins as a join type.

2.5.2.4 Annotation Modeler

As of version 2.0 SPS 03, SAP Web IDE for SAP HANA includes Annotation Modeler, which was previously available on SAP HANA Cloud Platform only.

Annotation Modeler is a new feature that provides an intuitive user interface for annotating OData services. It enables you to build and enhance the user interface of model-based applications in SAP Web IDE. In addition, you can also override annotations from other sources, such as metadata, by cloning them to your local annotation files and editing them locally in your SAP Web IDE project.

2.5.2.5 Node.js Development

SAP HANA Platform 2.0 SPS03 introduces new and changed features for Node.js development in SAP Web IDE.

Debugging Node.js Modules (Changed)

We switched the Node.js version for the debugger in SAP Web IDE. With SAP HANA SPS03 the debugger only supports Node.js 8.1 or higher.

2.5.2.6 SAP HANA Database Explorer

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA Database Explorer.

Catalog Browser

The catalog browser tree now shows the following new object types:

- Graph Workspaces
- Table Types
Graph Workspaces Visualizer

Right-clicking the Graph Workspaces object opens a new editor that shows the properties of the graph workspace and allows you to apply filters and algorithms to your graph workspace. For more information about graph workspaces, see the SAP HANA Graph Reference guide.

Preferences

- New Database Explorer Section
- Set session-based debug logging by clicking the Enable debug logging checkbox. A red circle appears at the top of the catalog browser in the database explorer perspective to indicate that logging is enabled. Session-based debug logging is useful if you encounter a problem and need to send session log reports to SAP support.
- Delete personal data by clicking Remove all user data.

Data Preview

The Data Preview editor for dimension calculation views and CUBE calculation views now contains a Hierarchies tab that shows hierarchies and measures details if they are available for the view. For more information about hierarchies see the SAP HANA Hierarchy Developer Guide, and for hierarchy function syntax, see the SAP HANA SQL and System Views Reference guide.

Background Activities

- You can now run a query as a background activity, which is a task that persists even after the session in which it was created has ended.
- A Background Activities Monitor has been created to manage background activities and to view their progress and results.
- You can now run a SQL query on multiple databases by clicking Run on Multiple Databases. The query runs as a background activity.

SQLScript Code Analyzer

You can now analyze a procedure or function written in SQLScript to search for patterns indicating problems in code quality, security or performance. Choose the Analyze SQLScript Code option from the context menu of a database, schema, procedure, or function.

SQL Debugger (SAP Web IDE)

The SQL debugger has adopted the common look and feel of the Development perspective’s Node.js and Java debugger user interface, creating a common user experience when debugging Node.js, Java, or SQLscript code.

Remote Sources

You can now create remote sources in the database explorer and create virtual objects from those remote sources. For more information about how to create and work with remote sources in database explorer, see the SAP HANA Smart Data Access section in the SAP HANA Administration Guide.

2.5.2.7 SAP Web IDE Flowgraph Editor

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA Flowgraph Editor.

Automatically Create Partitions (Changed)

You have an additional choice for partitioning your data. In addition to manually choosing the columns and selecting the partitioning type (list, range, or column), you can also let the application choose the columns or
you can suggest some columns that you want to use to partition your data. The advantage of automatically selecting columns is that the application finds the columns to be used for partitioning.

### 2.5.3 SAP HANA Spatial (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA Spatial.

**ST_AddMeasure Method (new)**

Returns a derived linestring with added or altered M values.

**ST_AddPoint Method (new)**

Adds a point to a given linestring.

**ST_LineInterpolatePoint Method (new)**

Returns a point linearly interpolated on a given linestring.

**ST_LineLocatePoint Method (new)**

Finds the point on a given linestring that is closest to a given point.

**ST_LineSubstring Method (new)**

Returns a sub-linestring of the given linestring.
**ST_MakeLine Method (new)**

Creates a linestring from two given points.

---

**ST_AlphaShapeAggr Method (new)**

Aggregation function that returns the alpha shape geometry of a set of input geometries, based on a specified radius value.

---

**ST_AlphaShapeArea Method (new)**

Returns an alpha shape of the input geometry, based on a specified area fraction.

---

**ST_AlphaShapeAreaAggr Method (new)**

Aggregation function that returns the alpha shape geometry of a set of input geometries, based on a specified area fraction.

---

**ST_AlphaShapeEdge Method (new)**

Returns an alpha shape of the input geometry, based on a specified edge fraction.

---

**ST_AlphaShapeEdgeAggr Method (new)**

Aggregation function that returns the alpha shape geometry of a set of input geometries, based on a specified edge fraction.
ST_ConcaveHull Method (new)

Returns a subset of an alpha shape of the input geometry.

ST_ConcaveHullAggr Method (new)

Aggregation function that returns the alpha shape geometry of a set of input geometries.

ST_GeomFromGeoJSON Constructor (new)

Constructs a geometry from an RFC 7946 compliant GeoJSON geometry object.

ST_InvalidReason Method (new)

Returns the reason why a geometry is invalid.

2.5.4 SAP HANA Graph (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA Graph.

GraphScript Extensions (New and Changed)

- The WEIGHTEDPATH data type specifies a path with an associated weight.
- The SHORTEST_PATH function returns a shortest path within a given parent graph from a start vertex to a target vertex.
- The WITH ORDINALITY option was added to the following constructs:
  - Projection Expression
Foreach Loop

Filter Expression

- The data type TIMESTAMP has been added.
- The data type SEQUENCE has been added.
- The SEQUENCE data type can be used in FOREACH constructs.

openCypher Support (New and Changed)

- Usage of the IS NULL attribute has been extended for pattern matching.
- Multiple MATCH clauses are supported in openCypher.
- Simple text predicates (starts with, ends with, contains) are supported in openCypher.
- The search function SYS.TEXT_Contains() has been integrated into openCypher.

2.5.5 SAP HANA Interactive Education (SHINE) for XS Advanced (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for SAP HANA Interactive Education (SHINE) for XSA.

Fiori Elements (New)

The user CRUD tile in Fiori Launchpad is now implemented by using Fiori elements.

Full-Text Search (New)

The SAP Search UI on SAP HANA provides an easy way to perform full-text search on content stored in tables or exposed via views. Here the search is performed on Product Categories and also on Business Partners.
SAP HANA Secure Store (New)

SAP HANA Secure Store is used to store securely the credentials of HERE maps.

CDS Enhancements (Changed)

Comments field is added to CDS artifacts and usage of table functions in CDS views is enabled.

Data Generator Code Push-Down (Changed)

The time-based data generation is implemented entirely in HANA procedures.

ES6 Standard Enhancements (Changed)

Node.js code is updated to use ECMA Script (ES6) features.

SAP HANA Interactive Education (SHINE)

2.5.6 Text Search and Text Analysis (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for text search and text analysis.

Text Search (New and Changed) [page 55]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for text search.

Text Analysis (New and Changed) [page 57]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for text analysis.
2.5.6.1  Text Search (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for text search.

Built-In Procedure `sys.esh_config()` and CDS (new and changed)

Note the following new features for built-In procedure `sys.esh_config()` and CDS:

- New annotation `@EnterpriseSearch.filteringFacet.noIntervals` to avoid interval generation for date and numeric facets.
- New annotation `@EnterpriseSearch.snippets.maximumLength` to define maximum/expected length of a snippet.

Built-In Procedure `sys.esh_search()` (new and changed)

Note the following new features for built-In procedure `sys.esh_search()`:

- The `GetSuggestion()` function accepts the parameter `fuzzinessThreshold`. With this optional numeric parameter the user can control the fuzziness of the suggestion terms. The default fuzziness is 0.85. The value range of the parameter is (0, 1]. `getSuggestion()` supports new parameter 'type' to enable suggestions for searchable views.

- The `whyfound` information contains complete text with highlighting for text columns without the `snippets` annotation. The full content of the column with highlighting is returned for all columns that do not have an `@EnterpriseSearch.snippets.enabled` annotation set to true. This ensures that the application always receives the complete column to display in the UI. Otherwise, only a snippet would be returned and, for example, one half of a longer document title could be missing. A snippet of the column content is returned for all columns with `@EnterpriseSearch.snippets.enabled` set to true.

- Snippets are returned for columns with presentation mode only.
- Either snippets or complete column values are returned instead of returning both values.

- `$apply` to support groupby operations and optionally an aggregation by count.

- Definition of stopwords to improve search performance.
- Score functions for columns of type ST_POINT.

- Query language extension to define fuzzy search options in a search term.

- Privileges on _SYS_RT views and on built-in procedures sys.esh_search() are now part of the PUBLIC role.

- Search results filtering (changed)
  Search results now only include data in the user's own language (languages in language vector). Before all languages were included.

### Freestyle search with CONTAINS() (new and changed)

Freestyle search with CONTAINS() can now return fuzzy scores instead of TF/IDF scores by setting search option 'textSearch=compare'.

Some text search parameters (bestMatchingTokenWeight, considerNonMatchingTokens, excessTokenWeight) are now allowed for freestyle search calls, too.

(Freestyle search in this case means a search with CONTAINS() over multiple columns).

### Search Rule Sets (new and changed)

Execute privileges on procedure SYS.EXECUTE_SEARCH_RULE_SET are now part of the database role PUBLIC.

A new error table for the batch mode provides error messages for each record which caused an error during processing.

Added support for further SQL types (like, for example, VARBINARY).

Added support for NULL values (rule condition 'isMissing').

Dynamic configuration options for term mapping list ids and stopword list ids (names of the list ids are taken from a column in the input record).

Ignore fulltext index on a column if the search rule set defines string column options (and therefore cannot use the full-text index). Search rule set does not fail if a full-text index is added later.
Session variable `CDS_CLIENT` (new and changed)

The session variable `CDS_CLIENT` is now preferred to define the ABAP client number to be used for the current database call.

Note that ABAP also defines a second session variable `CLIENT`, this is always the logon client of the user.

2.5.6.2 Text Analysis (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for text analysis.

Sentiment Analysis for Japanese (new)

Sentiment analysis is supported for text in Japanese.

For general information about using the sentiment analysis, see .

For more information about the sentiment analysis as it applies to each language, see .

Tolerant Spelling Support for Catalan, Indonesian, Norwegian, Polish, Romanian, and Serbian

Linguistic analysis of Catalan, Indonesian, Norwegian, Polish, Romanian, and Serbian is more tolerant of variations in capitalization, diacritics, accents, and hyphenation. This increases recall for full text search and text analysis applications that process inputs in those languages.

For example, "nordkorea" is recognized as a variation of "Nord-Korea" in Norwegian. Similarly, "slucha" is recognized as a variation of "słuchać" in Polish, and "coveka" is recognized as a variation of "ćovek" in Serbian.

For more information about the stemming feature as it applies to each language, see .

Expanded Entity Normalization

Text analysis can now normalize the values of `CURRENCY`, `DATE`, `MEASURE`, `PERCENT`, `TIME_PERIOD`, and `YEAR` entities. (`CURRENCY` and `PERCENT` were introduced for English in SPS02.)
For example, when a German DATE entity containing “7. März 2016” is extracted by text analysis, the TA_NORMALIZED column in the TA results table will contain “2016-03-07”. Or, when an English MEASURE entity containing “five hundred meters” is extracted, the TA_NORMALIZED column will contain “500 m”. Similarly, a French MEASURE entity containing “5 centimètres” will have “5 cm” in the TA_NORMALIZED column.

This feature is only supported for English, French, and German, and only for selected entity types.

This feature must be activated using a custom text analysis configuration, see .

For more details refer to in the SAP HANA Text Analysis Language Reference Guide.

2.6 Reference

SAP HANA Platform 2.0 SPS 03 introduces new and changed features as described in the reference documentation.

SAP HANA SQL and System Views Reference (New and Changed) [page 58]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the SAP HANA SQL and System Views Reference.

SAP HANA Client Interfaces Reference (New and Changed) [page 76]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features, as documented in the SAP HANA Client Interface Programming Reference.

SAP HANA SQL Command Network Protocol Reference (New and Changed) [page 79]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features, as documented in the SAP HANA SQL Command Network Protocol Reference.

SAP HANA Predictive Analysis Library (New and Changed) [page 80]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the Predictive Analysis Library (PAL).

SAP HANA SQLScript Reference (New and Changed) [page 83]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the SAP HANA SQLScript Reference.

SAP HANA Analytics Catalog (BIMC Views) Reference (New and Changed) [page 87]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the SAP HANA Analytics Catalog (BIMC Views) Reference.

SAP HANA External Machine Learning (New and Changed) [page 88]
SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the External Machine Learning Library (EML).

2.6.1 SAP HANA SQL and System Views Reference (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the SAP HANA SQL and System Views Reference.
SQL Statements (New and Changed)

ALTER COLLECTION Statement (new)

Alters a collection table. Specifically, this new statement checkpoints the collection table.

ALTER DATABASE Statement (enhanced)

You can now turn encryption on or off for a tenant database using the new [ PERSISTENCE | LOG | BACKUP ] ENCRYPTION [ ON | OFF ] syntax. You can also specify whether encryption configuration for a tenant database is controlled by the tenant database using the ENCRYPTION CONFIGURATION CONTROLLED BY LOCAL DATABASE syntax.

You can now update the port of a service using the new ALTER <service_type> clause.

You can now create and drop a fallback snapshot for a tenant database using the new {CREATE | ALTER} FALLBACK SNAPSHOT command.

ALTER SYSTEM ALTER CONFIGURATION Statement (enhanced)

You can now provide a reason in the format of a comment when changing a configuration parameter.

ALTER SYSTEM ALTER DATAVOLUME { ADD | DROP } PARTITION Statements (new)

Use these two new statements to add and drop data volume partitions to/from all index servers in the topology.

ALTER SYSTEM {ENABLE | DISABLE | REMOVE} ABSTRACT SQL PLAN Statement (new)

Enables or disables execution plan generation and or removes Abstract SQL Plans from the system landscape.

ALTER SYSTEM START APPLY ABSTRACT SQL PLAN Statement (new)

Starts applying stored Abstract SQL Plans.

ALTER SYSTEM START CAPTURE ABSTRACT SQL PLAN Statement (new)

Starts capturing Abstract SQL Plans.

ALTER SYSTEM { START | STOP | CLEAR } SQLSCRIPT PLAN PROFILER Statement (new)

Manages the new SQLScript plan profiler.

ALTER | REFRESH | DROP STATISTISTICS Statements (enhanced)

You can now specify more than one data statistics objects when executing these statements.

ALTER SYSTEM CLEAR CACHE Statement (new)

Clears one or more cache instances.

ALTER SYSTEM CLEAR INIFILE CONTENT HISTORY Statement (new)
Clears .ini file content history from the catalog.

ALTER SYSTEM ENCRYPTION CONFIGURATION Statement (new)

Use the ALTER SYSTEM ENCRYPTION CONFIGURATION Statement to control whether the system database or tenant databases control encryption configuration.

ALTER SYSTEM MIGRATE ABSTRACT SQL PLAN Statement (new)

Migrates the Abstract SQL Plan to a new SAP HANA system.

ALTER SYSTEM START DATABASE Statement (enhanced)

You can now start a tenant database using its fallback snapshot, which effectively restores the database to the state it was at when the fallback snapshot was created.

ALTER SYSTEM STOP APPLY ABSTRACT SQL PLAN Statement (new)

Stops applying stored Abstract SQL Plans.

ALTER SYSTEM STOP CAPTURE ABSTRACT SQL PLAN Statement (new)

Stops capturing Abstract SQL Plans.

ALTER SYSTEM UPDATE ABSTRACT SQL PLAN Statement (new)

Updates the location information for Abstract SQL Plans.

ALTER TABLE Statement (enhanced)

ONLINE keyword

A new ONLINE keyword allows you to MOVE a target table or partition without blocking DML operations while DDL operations are executing.

ALTER USER Statement (enhanced)

You can now add and remove users from user groups using the ALTER USER statement.

ANNOTATE Statement (new)

Annotates objects such as tables, views, columns, table functions, procedures, and parameters.

CREATE AUDIT POLICY Statement (enhanced)

The following new auditing actions have been added:

- CREATE | DROP AGENT GROUP
- PERSONAL DATA ACCESS
- PERSONAL DATA MODIFICATION
- CONFIGURATION CHANGE
- SECURITY EVENT

CREATE | DROP LIBRARY Statements (new)

You can now create SQLScript user-defined libraries.

CREATE | ALTER FUNCTION Statement (enhanced)

You can now specify if a function is deterministic using the new DETERMINISTIC keyword.
CREATE | ALTER PROCEDURE Statement (enhanced)

You can now specify if a procedure is deterministic using the new DETERMINISTIC keyword.

CREATE | ALTER TABLE Statement (enhanced)

Support added for a new index type

A new lightweight index type with reduced memory footprint is supported: INVERTED INDIVIDUAL.

Support added for hidden columns

A new column constraint, HIDDEN, can be specified for a column to hide the column. A hidden column is excluded from a SELECT * on a table. It is also excluded in an INSERT INTO...VALUES operation unless the column list specifically references it. A hidden column still appears in system views such as TABLE_COLUMNS, INDEX_VIEWS, PARTITIONS, and so on. In the TABLE_COLUMNS system view, a new column called IS_HIDDEN is provided to indicate whether a column is hidden.

Additional functions supported when defining columns as GENERATED ALWAYS

The following functions are now supported with GENERATE ALWAYS when defining a column: BASE64_ENCODE / BASE64_DECODE / BITAND / BITOR / BIT_COUNT / HASH_MD5 / HASH_SHA256

Support added for data masking

You can now create and alter tables and columns that contain masked data, which is only visible to users with the required privileges.

<alter_constraint_clause>

The new <alter_constraint_clause> clause allows you to enable and disable enforcement and validation of a constraint.

HETEROGENEOUS partitioning

Use HETEROGENEOUS partitioning to create and manage first and second level partitions. HETEROGENEOUS partitioning introduces new syntax and clauses to add, modify, and drop partitions.

CREATE | ALTER USERGROUP Statement (enhanced)

You can now set password policy options at a usergroup level using the new parameter-set related clauses in these statements.

CREATE | ALTER VIEW Statement (enhanced)

You can now define expression macros on a view. Expression macros allow you to perform aggregation calculations on the results from a query on a view before the results are returned.

CREATE | ALTER WORKLOAD CLASS Statement (enhanced)

A new property, WORKLOAD TIMEOUT, allows you to specify an expiry time for running statements.

CREATE | ALTER WORKLOAD MAPPING Statement (enhanced)
The CREATE WORKLOAD MAPPING and ALTER WORKLOAD MAPPING statements now have the `<wildcard-option>` clause, which allows you to specify a wildcard for the workload mapping property for value-matching purposes.

CREATE INDEX Statement (enhanced)

A new lightweight index type with reduced memory footprint is supported: INVERTED INDIVIDUAL.

CREATE PROJECTION VIEW Statement (enhanced)

The CREATE PROJECTION VIEW statement has been extended to support table associations using the new WITH ASSOCIATIONS clause.

CREATE ROLE Statement (enhanced)

The new NO GRANT TO CREATOR option prevents the automatic granting of the role to the user who created it.

CREATE TABLE Statement (enhanced)

Using the new ADD `<identity_column>` syntax, you can now add an identity column to tables created with the AS `<subquery>` syntax during actual table creation.

Using the new WITH clause, you can define the data that is inserted into the columns at creation time.

A new RECORD COMMIT TIMESTAMP option has been added that tracks the commit timestamp of a specified row.

CREATE USERGROUP Statement (enhanced)

The new NO GRANT TO CREATOR option prevents the automatic granting of all object rights of the user group to user creating it.

DELETE Statement (enhanced)

A new WHERE CURRENT OF `<cursor>` syntax, allows you to delete the record at the current location in a cursor.

DROP COLLECTION Statement (enhanced)

The DROP COLLECTION statement now supports either a CASCADE or RESTRICT option to control the cascade behavior when there objects that are dependent on the collection table.

EXPORT Statement (enhanced)

The following enhancements have been made to this statement:

- You can now export to a single archive file by specifying a path to a file with the extension `.tar.gz` or `.tgz` that contains the data.
- You can now filter the data exported from a table using the new WHERE clause syntax.
- You can now export invalid objects such as a view for which the underlying table has been dropped.
GRANT Statement (enhanced)

The following new privileges have been added:

ALL PRIVILEGES
Grants all schema privileges that exist at the time that the statement is executed.

CLIENT PARAMETER ADMIN
Authorizes a user to override the secure behavior of the CLIENT user parameter when it is enabled.

The following privileges have changed:

UNMASKED object privilege
The UNMASKED object privilege is now supported for the table object type.

IMPORT Statement (enhanced)

You can now import catalog objects from a single archive file by specifying a path to a file with the extension .tar.gz or .tgz that contains the data. Also, the AS <format_option> clause has been extended to support a new LOAD_HISTORY option to support importing from a load history file.

You can now import invalid objects such as a view for which there is no base table.

IMPORT FROM Statement (enhanced)

Previously, when using the IMPORT FROM statement to import data from a CSV file, you could only import data into a table. Now, you can also import data into views and synonyms.

Also, support for importing from a GZIP (.gz) file is now supported by specifying the location and name of the GZIP file in the file path option.

INSERT Statement (enhanced)

Using the new WITH clause, you can define the data being inserted into the table. Using the new AS clause, you can specify an alias for the table that can be referenced later in the statement.

LOAD | UNLOAD Statements for JSON Document Store (new)
Statement (new)

You can now explicitly load and unload a collection table that stores JSON documents.

MERGE INTO Statement (enhanced)

The new WHEN MATCHED clause specifies the update to perform when values match, while the new WHEN NOT MATCHED clause specifies the insert to perform when values do not match.

RENAME TABLE Statement (enhanced)
You can now safely rename a table even if there are foreign keys that reference it; the foreign key references can remain during the renaming process.

**REVOKE Statement (enhanced)**

The new `GRANTED BY <grantor>` clause allows a user with the ROLE ADMIN privilege to revoke a role that they did not grant. `<grantor>` specifies the user who granted `<role_name>` to `<grantee>`.

**SELECT Statement (enhanced)**

SELECT .. FOR UPDATE is now supported on one or more column tables. SELECT .. FOR UPDATE IGNORE LOCKED is now supported on column tables.

A new option, SELECT .. FOR SHARE LOCK, acquires shared locks on the queried records. This causes the locked records stay intact until the transaction is committed or rolled back.

**UPDATE Statement (enhanced)**

A new WHERE CURRENT OF `<cursor>` syntax, allows you to update the record at the current location in a cursor.

**SQL Functions (New and Changed)**

**ADD_NANO100 Function (new)**

Adds the specified number of microseconds to the specified TIMESTAMP value and returns a value.

**DAYS_BETWEEN Function (behavior change)**

Previously, the DAYS_BETWEEN function calculated its result differently from other similar ‘BETWEEN’ functions such as SECONDS_BETWEEN; specifically, calculation of days did not factor whether a day was a complete 24 hour block of time. This has been changed.

The DAYS_BETWEEN function now calculates a day to be a full (24 hour) block of time, consistent with how other ‘BETWEEN’ functions perform their calculations.

For more information about how this behavior change may impact you, including a work around if the old behavior is part of your business logic, see the following SAP Note: 2573900 - Changed Behavior of the SQL function DAYS_BETWEEN in HANA 2.0 SPS03

**EXPRESSION_MACRO Function (new)**

Allows you to perform an expression macro on results returned from querying a view.

**GENERATE_PASSWORD Function (new)**

The new GENERATE_PASSWORD function allows you to generate a new password of configurable length.

Enhancements to hierarchy functions
Complete documentation for the hierarchy feature, including for the functions listed here, is located in the SAP HANA Hierarchy Developer Guide.

Three new hierarchy functions have been added, as described below:

**HIERARCHY_ANCESTORS_AGGREGATE Function (new)**
Traverses a hierarchy from the top (ancestors) to the bottom and returns an aggregation as a result set.

**HIERARCHY_COMPOSITE_ID_LENGTH Function (new)**
Calculates the maximum length of a hierarchy composite node identifier based on a source object and a list of component attributes.

**HIERARCHY_DESCENDANTS_AGGREGATE Function (new)**
Traverses a hierarchy from the bottom (descendants) to the top and returns an aggregation as a result set.

Several new specifications have been added to the generator functions, as noted below:

- `<hierarchy_genfunc_recurse_spec>`
  Identifies the PARENT_ID and NODE_ID source columns using an association. This specification is applicable to the HIERARCHY, HIERARCHY_TEMPORAL, and HIERARCHY_SPANTREE functions.

- `<hierarchy_genfunc_order_spec>`
  Defines the sort order of sibling nodes, overriding any sort order defined in the source specification. This specification is applicable to the HIERARCHY, HIERARCHY_LEVELED, HIERARCHY_TEMPORAL, and HIERARCHY_SPANTREE functions.

- `<hierarchy_genfunc_multiparent_spec>`
  Specifies the multi-parent processing policy. This specification is applicable to the HIERARCHY and HIERARCHY_TEMPORAL functions.

- `<hierarchy_genfunc_cycle_spec>`
  Specifies the cycle processing policy. This specification is applicable to the HIERARCHY and HIERARCHY_TEMPORAL functions.

- `<hierarchy_genfunc_load_spec>`
  Provides a hint as to how the hierarchy source should be loaded. This specification is applicable to the HIERARCHY, HIERARCHY_TEMPORAL, and HIERARCHY_SPANTREE functions.

**NORMALIZE Function (new)**
Returns a normalized string result.

**RECORD_COMMIT_TIMESTAMP Function (new)**
Returns a commit timestamp for the specified row of the given table.

**RECORD_ID Function (new)**
Returns an ID for each row of a column store or row store table.

**TO_NVARCHAR Function (enhanced)**
New syntax for the optional `<format>` option allows you more flexibility in formatting the output values of this function.

**TO_VARCHAR Function (enhanced)**

New syntax for the optional `<format>` option allows you more flexibility in formatting the output values of this function.

**System Views (New and Changed)**

**ABSTRACT_SQL_PLANS System View (new)**
Provides information about Abstract SQL Plans.

**ADAPTER_CAPABILITIES System View (new)**
Specifies supported capabilities for each created adapter.

**ANNOTATIONS System View (new)**
Provides information about annotations that have been added to SQL objects.

**ALL_AUDIT_LOG System View (new)**
This new system view provides general audit information in addition to audit information for XSA events.

**AUDIT_LOG System View (enhanced)**
The data types of the KEY, PREV_VALUE, and VALUE columns, have been changed to the following:
- The KEY column data type is now NVARCHAR(2000)
- The PREV_VALUE data type is now NVARCHAR(5000)
- The VALUE data type is now NVARCHAR(5000)

**CS_VIEW_PARAMETERS System View (enhanced)**
The new EVALUATED_DEFAULT_VALUE column specifies the result of the evaluation of the expression in the DEFAULT_VALUE column. The new IS_DEFAULT_VALUE_VOLATILE column specifies whether or not the default value is volatile.

**DATA_STATISTICS System View (enhanced)**
The new INVALIDATION_REASON column specifies the reason that the data statistics object is invalid.

**EFFECTIVE_STRUCTURED_PRIVILEGES System View (enhanced)**
The data type for the EFFECTIVE_FILTER and the STRUCTURED_PRIVILEGE_FILTER columns is now NCLOB.

**ENCRYPTION_ROOT_KEYS System View (enhanced)**
The ROOT_KEY_VERSION column has been deprecated.

**LIBRARIES System View (enhanced)**
A new CREATE_TIME column provides the creation time for the library.

**LIBRARY_MEMBERS System View (new)**

Provides member information for SQLScript user-defined libraries.

**M_ACTIVE_PROCEDURES System View (enhanced)**

The new ITAB_MATERIALIZATION_TIME column specifies the internal table materialization time. The new ITAB_MATERIALIZATION_MEMORY_SIZE column specifies the memory size of the internal table materialization.

**M_CE_CALCSCENARIO_HINTS System View (new)**

Exposes all hints that are defined in a calculation scenario.

**M_COLLECTION_TABLE_VIRTUAL_FILES System View (new)**

The new M_COLLECTION_TABLE_VIRTUAL_FILES system view provides information about the virtual tables for JSON collections.

**M_COLLECTIONS_TABLES System View (new)**

The new M_COLLECTIONS_TABLES system view provides information about JSON collections.

**M_CS_ALL_COLUMN_STATISTICS (new)**

Provides information on how many scans and index searches were performed on a specified columns.

**M_CS_COLUMNS System View (enhanced)**

The INDEX_TYPE column has been extended to include a MINMAX value, which specifies a minimum and maximum value of the index to scan for the given column.

**M_CS_TABLES System View (enhanced)**

The new HAS_RECORD_COMMIT_TIMESTAMP column returns TRUE if the table is tracking commit timestamps, and FALSE otherwise.

**M_DATABASES System View (enhanced)**

A new column, FALLBACK_SNAPSHOT, indicates whether a fallback snapshot exists for the tenant database.

**M_DISKS System View (enhanced)**

The new TOTAL_DEVICE_SIZE column specifies the total device size returned by the operating system for the value in the PATH column.

**M_EFFECTIVE_PASSWORD_POLICY System View (new)**

The new M_EFFECTIVE_PASSWORD_POLICY view lets you check password policy parameters for users.

**M_ENCRYPTION_OVERVIEW System View (enhanced)**

A new column, CONFIGURATION_CONTROL, indicates whether encryption configuration is controlled by the system database or the local database.

**M_EXPENSIVE_STATEMENT_EXECUTION_LOCATION_STATISTICS System View (enhanced)**

The new CPU_TIME column specifies the tracked CPU time that each location consumed.
M_INIFILE_CONTENT_HISTORY System View (new)
Provides change history information for configuration (*.ini) files.

M_METADATA_CACHE_STATISTICS System View (new)
Provides information regarding the efficiency and use of the metadata cache.

M_MULTIDIMENSIONAL_STATEMENT_STATISTICS System View (new)
Displays all multidimensional statement statistics gathered since server startup.

M_PERSISTENCE_ENCRYPTION_STATUS System View (enhanced)
The USED_ROOT_KEY_VERSION column is deprecated and the new USED_ROOT_KEY_HASH column specifies the hash of the root key that the service is using.

M_REMOTE_SOURCE_STATISTICS System View (enhanced)
The new SUBSCRIPTION_SCHEMA_NAME and SUBSCRIPTION_NAME columns specify subscription information.

M_REMOTE_STATEMENTS System View (enhanced)
The new STATEMENT_ID column specifies the ID of HANA statements. Users who run multiple statements that generate SQL for a remote source (such as an extended store) can join M_REMOTE_STATEMENTS with statement monitoring views such as M_PREPARED_STATEMENT, and analyze the remote activity for any given HANA statement.

M_RS_TABLES System View (enhanced)
The new HAS_RECORD_COMMIT_TIMESTAMP column returns TRUE if the table is tracking commit timestamps, and FALSE otherwise.

M_SNAPSHOTS System View (enhanced)
A new column, PURPOSE, indicates the purpose of the snapshot.

M_SQL_PLAN_CACHE System View (enhanced)
The new APPLICATION_SOURCE column specifies the application source information.

M_SQL_PLAN_STATISTICS System View (enhanced)
The new APPLICATION_SOURCE column specifies the application source information.

M_SQLSCRIPT_PLAN_PROFILERS System View (new)
Lists the sessions and procedures that are currently being profiled by the SQLScript plan profiler.

M_SQLSCRIPT_PLAN_PROFILER_RESULTS System View (new)
Stores the results generated by the SQLScript plan profiler.

M_SYSTEM_LIMITS System View (enhanced)
The following limits have been added to the view:
MAXIMUM_SIZE_OF_MEMORY_LOB_IN_COLUMN_STORE
Maximum size of an in-memory LOB for a column store table.
MAXIMUM_SIZE_OF_MEMORY_LOB_IN_ROW_STORE
Maximum size of an in-memory LOB for a row store table.

**MAXIMUM_SIZE_OF_PACKED_LOB**

Maximum size of a packed LOB.

**MAXIMUM_SIZE_OF_DISK_LOB**

Maximum size of a LOB on disk

**M_SYSTEM_REPLICATION_TAKEOVER_HISTORY System View (new)**

Provides access to a history of HSR takeover executions.

**M_TABLE_PARTITION_STATISTICS System View (new)**

Returns the table partition runtime statistics.

**M_TABLE_PARTITIONS System View (new)**

Holds information about disk and memory used by aging tables.

**M_TABLE_PRUNING_STATISTICS System View (new)**

Provides an interface to access statistics for historical data.

**M_TABLES System View (enhanced)**

The new HAS_RECORD_COMMIT_TIMESTAMP column returns TRUE if the table is tracking commit timestamps, and FALSE otherwise.

**Monitoring System View Enhancements (enhanced)**

The following monitoring system views have been enhanced to include columns that provide information regarding the on-disk and in-memory size of paged data:

- **M_CS_ALL_COLUMNS**
- **M_CS_COLUMNS**
- **M_CS_COLUMNS_PERSISTENCE**
- **M_CS_TABLES**

**REFERENTIAL_CONSTRAINTS System View (enhanced)**

The IS_ENFORCED and IS_VALIDATED columns have been added to specify whether a referential constraint is currently enforced and validated.

**STRUCTURED_PRIVILEGES System View (enhanced)**

The data type of the OPERAND column is now NCLOB.

**TABLE_COLUMNS System View (enhanced)**

The TABLE_COLUMNS system view has the new columns IS_MASKED and MASK_EXPRESSION, which return whether a column is masked and specifies the masked expression to users who have the required privileges.

**TABLES System View (enhanced)**

- The TABLES system view contains the new column HAS_MASKED_COLUMNS which returns TRUE if the table has a mask definition for at least one column.
- The new HAS_RECORD_COMMIT_TIMESTAMP column returns TRUE if the table is tracking commit timestamps, and FALSE otherwise.
VIEW_EXPRESSION_MACRO System View (new)
Describes the expression macros defined for views.

WORKLOAD_CLASSES System View (enhanced)
A new column, STATEMENT_TIMEOUT, specifies the statement timeout property for the workload class.

WORKLOAD_MAPPINGS System View (enhanced)
The WORKLOAD_MAPPINGS system view contains the following new columns to support wildcard functionality:
- APPLICATION_NAME_WILDCARD
- APPLICATION_COMPONENT_NAME_WILDCARD
- APPLICATION_COMPONENT_TYPE_WILDCARD
- CLIENT_WILDCARD

XSA_AUDIT_LOG System View (new)
This new system view provides XSA auditing information.

Other changes by feature name

Enhancements to the CONTAINS Predicate
A new search specifier, `<fulltext>`, allows you to specify whether a fulltext index on a column is used or not.

Support for persist memory storage of tables, columns and partitions
SAP HANA now supports storage of tables, columns, and partitions in persistent memory. The following changes have been made to support this feature:

CREATE | ALTER TABLE Statements (enhanced)
New grammar has been added to allow you to specify persistent memory storage settings at the table, column, and partition level.

System view changes
The following views have new or changed columns to store persistent memory settings:
- TABLES System View (enhanced).
- TABLE_PARTITIONS System View (enhanced).
- TABLE_COLUMNS System View (enhanced).
- M_CS.Tables System View (enhanced).
- M_CS_Columns System View (enhanced).
- M_CS_ALL_COLUMNS System View (enhanced).
- M_PERSISTENT_MEMORY_VOLUMES System View (new).
- M_PERSISTENT_MEMORY_VOLUMES_DATA_FILES System View (new).
Behavior changes for sequences

Sequence values are now stored as DECIMAL instead of BIGINT. As well, the limit for MINVALUE and MAXVALUE have changed (see details the CREATE SEQUENCE Statement).

The return type behavior for CURRVAL and NEXTVAL has changed. Previously, the return type was always BIGINT. Now if MAXVALUE > 2^63-1(INT64_MAX) or MINVALUE < -2^63(INT64_MAX), then the return type of NEXTVAL or CURRVAL is DECIMAL type; otherwise, the return type is BIGINT. You can check the current value of a sequence by querying the M_SEQUENCES system view.

The following system view columns have changed data type to DECIMAL:
- SEQUENCES.START_NUMBER
- SEQUENCES.MIN_VALUE
- SEQUENCES.MAX_VALUE
- SEQUENCES.INCREMENT_BY
- M_SEQUENCES.START_VALUE
- M_SEQUENCES.END_VALUE
- M_SEQUENCES.CURRENT_VALUE

Similarly, the following system view columns have changed data type to INT:
- SEQUENCES.CACHE_SIZE
- M_SEQUENCES.CACHE_SIZE

CONTAINS Predicate (enhanced)

The CONTAINS predicate syntax has been extended to support a new FULLTEXT ({ ON | OFF | AUTOMATIC }) clause. This clause allows you to control the behavior of the CONTAINS predicate in the presence/absence of a full text index.

Support for LDAP User Authentication

Enhanced support for LDAP user authentication has been added.

USERS System View (enhanced)

A new column, IS_LDAP_ENABLED, indicates whether a user may authenticate using LDAP authentication.

M_CONNECTIONS System View (enhanced)

The AUTHENTICATION_METHOD column now contains LDAP when a connection used LDAP authentication to successfully authenticate a user.

ALTER USER Statement (enhanced)

You can now specify LDAP as a user authentication method with the {ENABLE|DISABLE} <authent_mech_options clause>.

CREATE USER Statement (enhanced)

You can now specify FOR LDAP PROVIDER as an option for the WITH IDENTITY clause to create a user enabled to use LDAP authentication.

VALIDATE LDAP PROVIDER Statement (enhanced)

Two new options, NO AUTHORIZATION CHECK and PASSWORD, have been added. If either of these options are specified with the CHECK USER clause, then LDAP authentication validations are performed instead of authorization checks.

Support for automatic user creation for LDAP providers
Support for automatic user creation using an LDAP provider has been added.

**CREATE | ALTER LDAP PROVIDER Statements**

The following new clauses support automatic user creation:

- **ATTRIBUTE_USER_NAME clause** - Specifies a login name for the new SAP HANA user.

**ALTER LDAP PROVIDER** also has a new clause, **DISABLE USER CREATION FOR LDAP**, to disable automatic user creation for an LDAP provider.

**VALIDATE LDAP PROVIDER Statement (enhanced)**

A new clause, **CHECK USER CREATION FOR LDAP**, verifies the LDAP configuration required for automatic user creation with LDAP authentication.

**LDAP_PROVIDERS System View (enhanced)**

The following columns support automatic user creation:

- ```ATTRIBUTE_USER_NAME```
- ```IS_USER_CREATION_ENABLED_FOR_LDAP```
- ```IS_USER_CREATED_AS_RESTRICTED_FOR_LDAP```

**USERS System View (enhanced)**

The column ```IS_CREATED_BY_LDAP_PROVIDER``` has been added to the view as part of the changes to support automatic user creation.

### Support for system-versioned tables

The following changes have been made to support system-versioning of column tables.

**CREATE | ALTER TABLE Statements (enhanced)**

A new set of clauses and options in the CREATE TABLE and ALTER TABLE statements (`<system_versioning_configuration>` syntax) have been added to allow you to configure and enable system versioning for a table.

**SELECT Statement (enhanced)**

A new FOR SYSTEM_TIME clause allows you to return records that were active in a specified validity period. This new clause is for use when querying system-versioned tables.

**TABLES System View (enhanced)**

A new TEMPORAL_TYPE column stores whether a table is history table (HISTORY), or a system-versioned table (TEMPORAL). Otherwise, the value is NULL.

**TABLE_COLUMNS System View (enhanced)**
Two new generation types, ALWAYS AS ROW START and ALWAYS AS ROW END, are now possible for the GENERATION_TYPE column. These values reflect a GENERATED ALWAYS AS ROW START | END... specification on a column.

**TEMPORAL_TABLES System View (new)**

The new TEMPORAL_TABLES system view stores information on temporal tables such as history tables and system-versioned tables.

**SET | UNSET [SESSION] Statement (enhanced)**

A new TEMPORAL_SYSTEM_TIME_AS_OF <timestamp> session variable allows you set the session to records that occur after a specified time.

### Support for client-side encryption

Support for client-side encryption has been added.

**CLIENTSIDE_ENCRYPTION_COLUMN_KEYS System View (new)**

Provides column encryption key information.

**CLIENTSIDE_ENCRYPTION_KEYPAIRS System View (new)**

Provides information about all of the column encryption key pairs in the SAP HANA database.

**TABLE_COLUMNS System View (enhanced)**

The following new columns provide information about client-side column encryption in the SAP HANA database: CLIENTSIDE_ENCRYPTION_STATUS, CLIENTSIDE_ENCRYPTION_COLUMN_KEY_ID, and CLIENTSIDE_ENCRYPTION_MODE.

**VIEW_COLUMNS System View (enhanced)**

The following new columns provide information about client-side column encryption in the SAP HANA database: CLIENTSIDE_ENCRYPTION_STATUS, CLIENTSIDE_ENCRYPTION_COLUMN_KEY_ID, and CLIENTSIDE_ENCRYPTION_MODE.

**GRANT Statement (enhanced)**

The following new privileges support the client-side encryption feature:

**CLIENTSIDE_ENCRYPTION_COLUMN_KEY ADMIN**

Allows a user to create, alter, and drop column encryption keys (CEKs). CEK admins can also create a key copy of a CEK.

**CREATE CLIENTSIDE ENCRYPTION KEYPAIR**

Authorizes a user to create client-side encryption key pairs.

**DROP CLIENTSIDE ENCRYPTION KEYPAIR**

Authorizes a user to drop client-side encryption key pairs.

**USAGE ON CLIENTSIDE ENCRYPTION COLUMN KEY**

Authorizes a user to create or alter a table that uses a column encryption key (CEK) and to export data from the table.
CREATE AUDIT POLICY Statement

The following audit actions have been added in support of the client-side-encryption feature:

- CREATE CLIENTSIDE ENCRYPTION COLUMN KEY
- ALTER CLIENTSIDE ENCRYPTION COLUMN KEY
- DROP CLIENTSIDE ENCRYPTION COLUMN KEY
- CREATE CLIENTSIDE ENCRYPTION KEYPAIR
- DROP CLIENTSIDE ENCRYPTION KEYPAIR

EXPORT Statement (enhanced)

Use the new CLIENTSIDE ENCRYPTION COLUMN KEY clause to export a client encryption key.

IMPORT Statement (enhanced)

Use the new CLIENTSIDE ENCRYPTION COLUMN KEY clause to import a client encryption key.

CREATE TABLE Statement (enhanced)

Use the new CLIENTSIDE ENCRYPTION ON WITH <key_name> clause to define a column that contains client-side encrypted data.

ALTER TABLE Statement (enhanced)

Use the new ALTER <column_name> SET CLIENTSIDE ENCRYPTION { ON | OFF } WITH <key_name> clause to enable client-side encryption on an existing table column.

Use the new ALTER CLIENTSIDE ENCRYPTION WITH <key_name> clause to change the column encryption key for a column containing client-side encrypted data. Additional ALTER TABLE commands have been added to support changing the column encryption key for a column, as described below:

CONTINUE CLIENTSIDE ENCRYPTION clause

In cases where encryption of the column data has been interrupted, this statement instructs the SAP HANA server to continue encryption where it left off.

CANCEL CLIENTSIDE ENCRYPTION clause

Instructs the SAP HANA server to roll back the encryption changes after encryption has been interrupted.

CREATE CLIENTSIDE ENCRYPTION COLUMN KEY Statement (new)

Creates a column encryption key that you can use to encrypt and decrypt client-side encrypted data.

DROP CLIENTSIDE ENCRYPTION COLUMN KEY Statement (new)

Drops a column encryption key.

ALTER CLIENTSIDE ENCRYPTION COLUMN KEY Statement (new)
Alters a column encryption key (CEK) to grant or remove access to it, and to populate it with encryption key information.

**CREATE CLIENTSIDE ENCRYPTION KEYPAIR Statement (new)**

Allows you to create a client key pair.

**DROP CLIENTSIDE ENCRYPTION KEYPAIR Statement (new)**

Allows you to drop a client key pair.

**New datetime session variables**

The following datetime session variables have been added, allowing you to override the system default datetime formats for the current session: `DATE_FORMAT`, `TIME_FORMAT`, `SECONDDATE_FORMAT`, `TIMESTAMP_FORMAT`.

**Changes to hints**

View the new and updated hints in the HINT Details topic.

**DOUBLE_JOIN_THRU_UNION_ALL Hints (new)**

The new `DOUBLE_JOIN_THRU_UNION_ALL` hint prefers a pushdown join through double union all, while the `NO_DOUBLE_JOIN_THRU_UNION_ALL` hint avoids a pushdown join through double union all.

**HEX_HASH_JOIN and NO_HEX_HASH_JOIN SQL Hints (new)**

The new `HEX_HASH_JOIN` hint guides the SQL optimizer to prefer HEX hash joins over other joins, while the `NO_HEX_HASH_JOIN` hint guides the SQL optimizer to avoid HEX hash joins.

**RESULT_LAG Hint (updated)**

The `RESULT_LAG` hint guides the optimizer to access source or replica tables by evaluating stale data with the `<seconds>` parameter.

**NO_LARGE_EXPR_MATERIALIZATION Hint (new)**

Disables the early materialization of a large expression created by the SQL Optimizer.

**OPTIMIZATION_TRANSFORMATION_LIMIT(<integer>) Hint (new)**

The new `OPTIMIZATION_TRANSFORMATION_LIMIT(<integer>)` hint sets the maximum number of transformation rules to apply during plan enumeration.

**PREAGGR BEFORE CASE AGGR Hints (new)**

The `PREAGGR BEFORE_CASE AGGR` hint prefers pre-aggregation before case expression aggregation while the `NO_PREAGGR BEFORE_CASE AGGR` hint avoids pre-aggregation before case expression aggregation.
2.6.2 SAP HANA Client Interfaces Reference (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features, as documented in the SAP HANA Client Interface Programming Reference.

**Support for Client-Side Encryption**

With client-side data encryption, columns that contain sensitive data, such as credit card numbers or social security numbers, are encrypted by using an encryption key accessible only by the client. Column data is encrypted and decrypted on the client.

To use client-side encryption, ensure that your interface meets the following requirements. See [page 58].

A new SQLDBC connection property, CLIENTSIDE_ENCRYPTION_KEYSTORE_PASSWORD, and a corresponding JDBC connection property, cseKeyStorePassword, provide the password for the local key store and are required when using client-side encryption.

Numerous new privileges and SQL statements have been added to support client-side encryption. See SAP HANA SQL and System Views Reference (New and Changed) [page 58].

**Support for SOCKS Proxy and WebSockets Protocol**

The following ODBC connection attributes have been added to support the SOCKS proxy and WebSockets communication protocol:

- SQL_SQLDBC_PROXY_HOST
- SQL_SQLDBC_PROXY_PORT
- SQL_SQLDBC_PROXY_SCP_ACCOUNT
- SQL_SQLDBC_PROXY_USERID
- SQL_SQLDBC_PROXY_PASSWORD
- SQL_SQLDBC_PROXY_SERVICENAME

The following SQLDBC connection properties have been added to support the SOCKS proxy and WebSockets communication protocol:

- PROXY_HOST
- PROXY_PASSWORD
- PROXY_SCP_ACCOUNT
- PROXY_USERID

**Ruby API**

SAP HANA now includes the SAP HANA for Ruby project that provides two separate packages for developing Ruby applications.

**New plug-in for Microsoft Visual Studio 2017**

The plug-in for earlier versions of Microsoft Visual Studio supports Entity Framework connections to a database and read-only browsing. In addition to this functionality, the new plug-in supports tasks such as running scripts and creating objects.
New and changed node.js methods and functions

The following new node.js methods have been added or changed:

- `connection.clearPool([Function]) Method (new)`
  Creates a connection pool, which can improve performance when you open connections.

- `connection.state() Method (new)`
  Returns a string that indicates the state of the connection.

- `connection.{disconnect | close | end}([Function]) Method (changed)`
  An `end` function has been added to this method for compatibility with older SAP HANA database drivers.

- `connection.exec[ute](String[, Array][, Object] [, Function]) Method and statement.exec[ute]([, Array][, Object][, Function]) Method (changed)`
  A new `options` object has been added to both the `exec[ute]` method and the `exec[ute]` method to specify the optional object containing the options for specifying the representation of rows in the result.

- `resultset.close([callback]) Method (changed)`
  An optional `callback` function has been added to the `close([callback])` method.

- `statement.getData(Integer, Integer, Buffer, Integer, Integer[, Function]) Method (new)`
  Reads a stream of bytes from the specified output LOB parameter.

- `Stream Module createParameterLobStream(statement, paramIndex, options) Function (new)`
  Creates a readable stream by using an output LOB parameter.

- `Stream Module createStatement(connection, sql, callback) Function (new)`
  Creates a statement object which executes a SQL statement with readable streams for input LOB parameters.

node.js Support for Encrypted Connections

The node.js driver supports the `key`, `cert`, and `ca` connection properties, which allow you to specify encryption credentials in environments where you may not have access to the file system. These can be specified in a string or an array format.

node.js Support for Connection Pooling

The node.js driver supports the `POOLING` connection property and `Connect.clearPool` Method to use connection pools.

JDK Support Updates (changed)

The SAP HANA JDBC driver now includes support for the Java Development Kit (JDK) 9. Support for JDK 1.6 has been removed.
Prepared Statement Caching (new)

The new prepared statement caching feature optimizes an application by automatically recognizing a cached prepared statement. The following connection properties have been added to support prepared statement caching:

- The STATEMENTCACHESIZE connection property has been added for all SQLDBC-based APIs.
- The statementCacheSize connection property has been added for JDBC.

Connection Properties are Case Insensitive for all Interfaces (changed)

Connection properties for all client interfaces are now case insensitive except where otherwise noted.

Show Timestamp JDBC Trace Option (new)

The new show timestamps JDBC trace option enables/disables timestamps for each trace record.

connectTimeout JDBC Connection Property (new)

The new connectTimeout JDBC connection property aborts connection attempts after the specified timeout. Setting this option to 0 disables the timeout.

transactionalLobs connection property (new)

The new transactionalLobs JDBC connection property simulates LOB behaviour as required by the JDBC specification.

Empty and Invalid SERVERNODE Connection Properties Are No Longer Supported

SQLDBC and SQLDBC-based client interfaces no longer allow invalid SERVERNODE connection property values or a <host>:<port> location. Depending on the interface, the <host>:<port> location can be specified using the SERVERNODE connection property or using a different process. The location value syntax must be "<host>:<port>" where the host specifies a valid host name or IP address and the port specifies a valid number between 0 and 65535. If there is more than one <host>:<port> location, then they must be separated by a comma. An invalid or empty location now returns an error.

CommonCryptoLib is Available in the Client Installer (new)

There are now two versions of the SAP HANA client installer, one which includes the CommonCryptoLib and one that does not. In the version that includes the CommonCryptoLib, you must set the $SECUDIR environment variable to the location of the libcrypto.dll or libsapcrypto.so shared library.

SQLDBC Tracing (updated)

SQLDBC does not delete previous trace content when starting a new trace and archives the original file, if any, by appending ".archive" to the original name.

Finding the Native Microsoft ADO.NET DLL (updated)

There is a new algorithm for finding the native Microsoft ADO.NET DLL.

SAP HANA HDBSQL Options (new)

The new -history and \history options specify the number of items to keep in the history buffer. The default is 50.
ODBC Attributes
(new)

To support PrintAPI there is a new driver defined statement attribute, SQL_ATTR_PRINTLINE, that retrieves the next print line from the SQLSCRIPT_PRINT library.

BOOLEAN data type
(behavior change)

Previously, the SAP HANA server returned BOOLEAN data to a client as type TINYINT, with values 1 or 0. If these values were fetched from the client interface as strings, their string representation was always "1" or "0".

Now, with the default data format version, and with certain client versions and interfaces, fetching a Boolean value from a client interface as a string could return "true"/"false" or "TRUE"/"FALSE" instead of "1"/"0". In addition, certain client interfaces can return a more specific BOOLEAN data type in the meta data for Boolean values.

SAP Note 2638379

Related Information

SAP Note 2036111

2.6.3 SAP HANA SQL Command Network Protocol Reference
(New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features, as documented in the SAP HANA SQL Command Network Protocol Reference.

Input and Output Field Formats
(new)

The following input and output field formats have been added:

- BOOLEAN Input and Output Field Format
- FIXED8 Input and Output Field Format
- FIXED12 Input and Output Field Format
- FIXED16 Input and Output Field Format

LDAP Authentication
(new)

Securesly transmits a client-specified password to an SAP HANA database, which then securely forwards the password to an LDAP server.

Terminology
(new)

The following new terms have been added:

- I12: Specifies a 12-byte integer in little-endian format.
- I16: Specifies a 16-byte integer in little-endian format.

New PRINTOPTIONSPART Part
Data Format

This format contains output from the SQLSCRIPT_PRINT library.

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2.6.4 SAP HANA Predictive Analysis Library (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the Predictive Analysis Library (PAL).

General and Architectural Changes

- **Model Evaluation and Parameter Selection (new)**
  PAL supports model evaluation by re-sampling techniques (k-fold cross-validation and bootstrapping) and hyper-parameter tuning by grid or randomized search. Evaluation results and some extra information are provided in the STATISTIC table. And for parameter selection, selected optimal parameters are written into the last OPTIMAL_PARAM table. A final model is trained using optimal parameters and whole data set.
  Algorithms that support model evaluation and parameter selection:
  - _SYS_AFL.PAL_FRM
  - _SYS_AFL.PAL_ALS
  - _SYS_AFL.PAL_LINEAR_REGRESSION
  - _SYS_AFL.PAL_POLYNOMIAL_REGRESSION
  - _SYS_AFL.PAL_LOGISTIC_REGRESSION
  - _SYS_AFL.PAL_MULTILAYER_PERCEPTRON
  - _SYS_AFL.PAL_NAIVE_BAYES
  - _SYS_AFL.PAL_DECISION_TREE
  - _SYS_AFL.PAL_SVM
  - _SYS_AFL.PAL_KNN_CV

- **State Enabled Prediction in Prediction Function (changed)**
  PAL can insert the STATE information, generated by the _SYS_AFL.CREATE_PAL_MODEL_STATE type-any procedure into the parameter table of the predict procedure.
  Functions that support state-enabled prediction:
  - _SYS_AFL.PAL_SVM_Predict
  - _SYS_AFL.PAL_RANDOM_DECISION_TREES_Predict
  - _SYS_AFL.PAL_DECISION_TREE_Predict
  - _SYS_AFL.PAL_CLUSTER_ASSIGNMENT
  - _SYS_AFL.PAL_LATENT_DIRICHLET_ALLOCATION_INFERENCE
  - _SYS_AFL.PAL_BINNING_ASSIGNMENT
  - _SYS_AFL.PAL_NAIVE_BAYES_PREDICT
  - _SYS_AFL.PAL_PCA_PROJECT
  - _SYS_AFL.PAL_MULTILAYER_PERCEPTRON_PREDICTT
  - _SYS_AFL.PAL_KNN
  - _SYS_AFL.PAL_FRM_PREDICT
  - _SYS_AFL.PAL_LINEAR_REGRESSION_PREDICT
  - _SYS_AFL.PAL_LOGISTIC_REGRESSION_PREDICT
  - _SYS_AFL.PAL_ALS_PREDICT
Numerical Computation (new)
PAL uses a new performed numerical library in SPS03. Matrix operation related PAL algorithms, such as logistic regression, linear regression, GLM, SVM, recommender system, PCA, and factor analysis, can benefit from the new library with better runtime performance.

Calling PAL Procedures in Parallel with MAP_REDUCE (new)
MAP_REDUCE allows you to embed procedures directly without table functions. It has a built-in grouping algorithm for parallelization.

Calling PAL Procedures in Parallel with Hint PARALLEL_BY_PARAMETER_VALUES (new)
Hint PARALLEL_BY_PARAMETER_VALUES enables parallel execution of PAL functions. Use a dedicated column in input table(s) to indicate the grouping to use this hint.

New and Changed Algorithms

Alternating Least Square (new)
Alternating least squares (ALS) is a powerful matrix factorization algorithm for building both explicit and implicit feedback based recommender systems.

Field-aware Factorization Machine (new)
Field-aware Factorization Machine (FFM) introduces a concept of field to indicate that some similar features belong to the same field. Features spanned from the same categorical variable are considered as the same field. FFM can be applied to a variety of prediction tasks, for example, binary classification, regression, and ranking.

Hierarchical Forecast (new)
Hierarchical Forecast provides three forecast methods, namely bottom-up, top-down, and optimal combination, to adjust the time series forecast results with hierarchical structure.

PageRank (new)
PageRank is an algorithm used by a search engine to determine a page’s relevance or importance. PageRank counts the number of links to a page to roughly estimate how important the website is. A page is considered important if it has a higher rank.

Logistic Regression (changed)
- Returns convergence status (reached or not reached)
- Exposes exit-threshold for Proximal Gradient Descent optimization method
- Allows L2 penalty for Newton, L-BFGS optimization methods
- Performance enhancement when using proximal gradient descent optimization or cyclic coordinate descent

Generalized Linear Model (changed)
- Supports negative binomial regression
- Supports categorical variable
- Supports ordinal regression
• Gradient Boosting Decision Tree (changed)
  Added the SEED parameter

• ARIMA (changed)
  Performance enhancement

• DBSCAN (changed)
  ○ Performance enhancement
  ○ Added the SAVE_MODEL parameter to control whether to store the JSON format model
  ○ Added the METHOD parameter to indicate how to search neighbors in specified radius

• Triple Exponential Smoothing (changed)
  Optimized the initialization method

• Kmeans/Kmedoids/Kmedians (changed)
  Added COSINE as distance

• KNN (changed)
  ○ Added COSINE as distance
  ○ Performance enhancement

• Random Decision Trees (changed)
  Enhanced performance for sampling, out-of-bag calculation, and prediction function

• Multi-class Logistic Regression (changed)
  Added p-value, z-score, and other statistics

• Multi-layer Perceptron (changed)
  ○ Added the ReLU active function
  ○ Added the weight initialization option
  ○ Returns convergence status of optimization
  ○ Supports mini-batch stochastic gradient decent

• Multiple Linear Regression (changed)
  ○ Supports training without intercept
  ○ Performance enhancement when using cyclic coordinate descent

• Random Distribution Sampling (changed)
  Supports multi-threaded number generation for Poisson Distribution

• Croston’s Method (changed)
  Enhanced initialization method based on historical values
2.6.5 SAP HANA SQLScript Reference (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the SAP HANA SQLScript Reference.

Error Handling for FOR UPDATE NOWAIT (Changed)

It is now possible to define an exit handler for the statement FOR UPDATE NOWAIT with the error code 146.

BETWEEN Operator in SQLScript (New)

The predicate \( x \ \text{[NOT]} \ \text{BETWEEN} \ \text{lower AND} \ \text{upper} \) can now also be used in IF and WHILE statements in SQLScript. It works just like \( [\ \text{NOT}] \ \ (x \ \geq \ \text{lower AND} \ x \ \leq \ \text{upper}) \).

BOOLEAN Support in SQLScript (New)

SQLScript supports the boolean data type, and a boolean variable can be declared, assigned, and returned as other data types.

Variable Declaration Using LIKE (New)

When you declare a variable, you can specify its type by using the type of a persistent table, a view, or another variable.

USING and INTO Clauses in DSQL (New)

This feature introduces additional support for parameterized dynamic SQL. It is now possible to use table variables in USING and INTO clauses and CALL-statement parameters with USING and INTO clauses are supported.
SELECT INTO with DEFAULT Values (New)

The SELECT INTO statement is widely used for assigning a result set to a set of scalar variables. The introduction of DEFAULT values makes it possible to assign default values to the target variables when the result set is empty.

Row Type Variable (New)

You can declare a row type variable that is a collection of scalar data types. You can use such variables to easily fetch a single row from a table.

Updatable Cursor (New)

When you iterate over each row of a result set, you can use the updatable cursor to change a record directly on the row, to which the cursor is currently pointing.

CREATE OR REPLACE (Changed)

The command now supports any change to a procedure or a function without any of the currently existing limitations. You can now change:

- the security mode (INVOKER, DEFINER)
- the parameter signature (parameter name, parameter type, default value)
- the result view object
- the route target

SQLScript Plan Profiler (New)

SQLScript Plan Profiler is a new performance analysis tool designed mainly from the perspective of stored procedures and functions. When SQLScript Plan Profiler is enabled, a single tabular result per call statement is generated.
Procedure Result Cache / Deterministic Procedure Cache (New)

Procedure Result Cache (PRC) is a server-wide in-memory cache that caches the output arguments of procedure calls using the input arguments as keys. Deterministic Procedure Cache is an automatic application of PRC for deterministic procedures.

Map Reduce Operator (New)

MAP_REDUCE is a programming model introduced by Google that allows easy development of scalable parallel applications for processing big data on large clusters of commodity machines. The MAP_REDUCE operator is a specialization of the MAP_MERGE operator.

Built-in Library SQLSCRIPT_STRING (New)

The SQLSCRIPT_STRING library offers a handy and simple way for manipulating strings. You can split libraries with given delimiters or regular expressions, flexibly format or rearrange strings, and convert table variables into the already available strings.

Built-in Library SQLSCRIPT_PRINT (New)

The PRINT library offers the option to print strings or even whole tables. It is especially useful when used together with the STRING library.

Consistent Scalar Function Result (New)

The implicit SELECT statements used within a procedure (or an anonymous block) are executed after the procedure is finished and scalar user-defined functions (SUDF) are evaluated at the fetch time of the SELECT statement, due to the design of late materialization. To avoid unexpected results for statements, that are out of the statement snapshot order within a procedure or a SUDF, implicit result sets will now be materialized in case the SUDF references a persistent table.
User-Defined Libraries (New)

LIBRARY is a metadata object that includes multiple variables, procedures and functions. By combining relevant procedures and functions into a single metadata object, you reduce metadata management cost. Additionally, the atomicity of relevant objects is guaranteed because they are managed as a single object.

Search in Table Variables (New)

An efficient way to search by key-value pairs in table variables.

New Rules in the SQLScript Code Analyzer (New)

Detect SELECT Statements in Scalar UDFs (New)

SELECT statements in scalar user-defined functions can have a negative impact on performance. If table operations are really needed, procedures or table UDFs should be used instead.

COMMIT or ROLLBACK in Dynamic SQL (New)

This rule detects dynamic SQL using the COMMIT or ROLLBACK statement. It is recommended to use COMMIT and ROLLBACK directly in SQLScript.

DML Statements in Loops (New)

The rule detects the following DML statements inside loops: INSERT, UPDATE, DELETE, REPLACE/INSERT. It is recommended to check those findings, if you have performance problems in your SQLScript code.

Use of CE Functions (New)

The new rule USE_OF_CE_FUNCTIONS checks whether Calculation Engine Plan Operators (CE functions) are used. Since they make optimization more difficult and lead to performance issues, they should be avoided.

Use of Unassigned Scalar Variables (New)

The rule detects scalar variables that are used but have never been explicitly assigned.
2.6.6 SAP HANA Analytics Catalog (BIMC Views) Reference (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the SAP HANA Analytics Catalog (BIMC Views) Reference.

**Conversion Indicator (New)**

The property `IS_UNCONVERTED` guarantees that a measure has not been converted either in the underlying data sources, or in the current calculation view.

**Scale (New)**

The property `SCALE` represents the scaling factor the UI should use to present a number. It contains the number of decimal places with which the number should be shifted to the right.

**Attribute Display Folder (New)**

The property `ATTRIBUTE_DISPLAY_FOLDER` represents the path to be used when displaying the attribute in the user interface. Folder names are separated by a semicolon. Nested folders are indicated by a backslash (`\`).

**View BIMC_ALL_VARIABLES_VIEW (Changed)**

The view `BIMC_ALL_VARIABLES_VIEW` now supports multi-language texts and can be queried via an MDX SELECT statement.
2.6.7 SAP HANA External Machine Learning (New and Changed)

SAP HANA Platform 2.0 SPS 03 introduces new and changed features for the External Machine Learning Library (EML).

PREDICTM (New)

The PREDICTM function supports multiple inferences within a single AFL call. To distinguish the different sets of inputs and results, each input table has an INTEGER "tag" column. Spans of adjacent rows with the same INTEGER tag value are formatted into a separate inference call. The results are tagged with the corresponding INTEGER tag in the output table’s "tag" column and appear in consecutive rows per partial result set. Where possible, the inference calls are processed in parallel.

Data Types (Changed)

The additional SAP HANA data type INTEGER maps to the DT_INT32 and DT_INT64 TensorFlow data types and is supported in rank 2 shapes.

Remote Sources (Changed)

New attributes allow Web proxies to be handled in gRPC remote sources:

- **proxyhost**: The HTTP CONNECT enabled proxy server, specified by its DNS name and port
- **proxyuser**: Optional proxy credentials, consisting of the proxy user and an optional proxy password

Software Versions (Changed)

- The recommended TensorFlow version is 1.6.
- The recommended TensorFlow Serving version is 1.5. The minimum supported version is 0.5.1.
- The gRPC version now used in EML is 1.6.2.
3 SAP HANA Platform 2.0 SPS 02 Features

Find out about the new and changed features introduced with the SAP HANA platform 2.0 SPS 02.

3.1 Installation and Update

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for installation and update.

SAP HANA Server Installation and Update (New and Changed) [page 89]
SAP HANA Platform 2.0 SPS 02 introduces new and changed features for the installation and update of SAP HANA.

3.1.1 SAP HANA Server Installation and Update (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for the installation and update of SAP HANA.

Installing XS Advanced Runtime (New)

The installation of the XS advanced runtime is now supported in high availability scenarios.

Updating SAP HANA Components (Changed)

Some AFL components can be updated without the need for a database restart and system downtime. A component supports this feature if its manifest file contains the entry

```plaintext
online-upgrade-plugin: 1
```
3.2 Security

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for security.

SAP HANA Database Security (New and Changed) [page 90]

SAP HANA Platform 2.0 SPS 02 introduces new and changed security-related features for the SAP HANA database.

3.2.1 SAP HANA Database Security (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed security-related features for the SAP HANA database.

User Groups (New)

It is now possible to manage related users together with user groups. Group administrators can be assigned to manage individual user groups exclusively and independently of each other.

To be a group administrator, a user requires the new object privilege GROUP OPERATOR on the group.

LDAP Group Authorization (New)

- For user authorization based on LDAP group membership, it is now possible to obtain the groups that users are indirectly members of through nested groups. Nested group lookup can be configured with the NESTED GROUP LOOKUP URL clause of the CREATE LDAP PROVIDER and ALTER LDAP PROVIDER statements.
- LDAP group authorization can be disabled in tenant databases if it is not required.
- LDAP group authorization is now integrated into the SAP HANA database trace. Use the new LDAP trace component to obtain diagnostic information not only from SAP HANA, but also the OpenLDAP library.
Authorization and Authentication Enhancements (New and Changed)

- It is now possible to add comments to users, roles, and user groups using the COMMENT ON statement.
- User names may now include hyphen-minus (-).
- The new system privileges DATABASE START and DATABASE STOP are now available in the system database. They authorize a user to stop or start tenant databases, as well as access the M_DATABASES system view.

Encryption (Changed)

You must now back up a new data volume encryption root key or a new internal application encryption root key before you can activate it. If you don’t have an up-to-date backup of your encryption root keys you might not be able to recover your database to its most recent state.

hdbuserstore (Changed)

hdbuserstore key names containing underscores (_), hyphens (-), and periods (.) are now supported.

SAP HANA Cockpit (New and Changed)

The SAP HANA cockpit has a number of new and enhanced features for user and role management and encryption configuration. For more information, see the section on SAP HANA cockpit.

SAP HANA Cockpit SP 03 Features [page 103]

3.3 Planning and Design

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for planning and design.

SAP Enterprise Architecture Designer, Edition for SAP HANA (New and Changed) [page 92]
3.3.1 SAP Enterprise Architecture Designer, Edition for SAP HANA (New and Changed)

SAP HANA Platform 2.0 SP02 introduces new and changed features in SAP Enterprise Architecture Designer, Edition for SAP HANA.

SAP Enterprise Architecture Designer, Edition for SAP HANA Core Features [page 92]
SAP HANA Platform 2.0 SP02 introduces new and changed features in SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA for all architectural domains.

Requirements Management [page 97]
SAP HANA Platform 2.0 SP02 introduces new features in SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA for requirements management.

Process Architecture [page 98]

Information Architecture [page 98]

SAP Enterprise Architecture Designer, Edition for SAP HANA Administration [page 101]
SAP HANA Platform 2.0 SP02 introduces new administration features in SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA.

3.3.1.1 SAP Enterprise Architecture Designer, Edition for SAP HANA Core Features

SAP HANA Platform 2.0 SP02 introduces new and changed features in SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA for all architectural domains.

Homepage (Changed)
The new homepage combines the old homepage and workspace screens. It provides access to all your draft diagrams and those awaiting your review and comment. You can add your favorite diagrams and repository folders to your homepage and also access your recently viewed diagrams.

Toolbox and Reuse of Local Model Objects (Changed)

The behavior of the toolbox has changed. You now create objects in your diagrams from a toolbox docked to the left side of the diagram by drag and drop. A new local search tool allows you to reuse objects created in the current model in your diagram.

Navigation in Model Structure and Creation of New Diagrams in Models (New)

A new toolbar above the diagram contains a new breadcrumbs control, which allows you to navigate through the structure of models subdivided into packages, and a view selector, which lets you navigate between diagrams in the current package, create new diagrams in the package, and open the new list viewer to list the diagrams in the package.

List Viewer (New)
The new list viewer provides an alternative tabular view of the objects in the current package, and is accessed through the view selector in the toolbar above the diagram. You can filter the list by name or other properties and choose the columns to display.

CSV Import (New)

You can import lists of objects defined in CSV files into your diagram. For example, if you have lists of sites, servers, people, and applications, you can import them rather than creating them manually.

Heat Map Coloring of Diagrams (New)

You can apply heat map coloring to any diagram. The coloring can be used to highlight objects impacted by the selected object or, for enterprise architecture diagrams, to display their level of compliance with analysis criteria:
Analysis Criteria (New)

Criteria allow you to define a benchmark, standard, or scale, and then rank your enterprise artifacts against it. Criteria can be used to drive heat map coloring of your enterprise architecture diagrams:
AutoLayout for Diagrams and Composite Symbols (Changed)

New autolayout options help you organize symbols and links in your diagrams and sub-symbols inside composite symbols.

Impact Analysis (Changed)

The impact and lineage analysis will now provide, by default, up to three expanded levels of impacts (comprising up to 100 objects) and lineages. To pursue the analysis further, click on a plus sign on the edge of the tree. Link objects are no longer displayed in order to simplify the analysis diagram, and you can open any object displayed in the tree in its original diagram.
Architecture Areas (Changed)

Architecture areas, which allow a loose grouping of objects are now available in database diagrams and in NoSQL diagrams.

Share Links to Repository Folders, Documents, and Objects (New)

You can now share links to these repository objects.

Business Function Renamed to Business Capability (Changed)

This change aligns the object more closely with common industry terminology.

3.3.1.2 Requirements Management

SAP HANA Platform 2.0 SP02 introduces new features in SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA for requirements management.

Import and Export ReqIF Files (New)

Requirements Interchange Format (ReqIF) files are XML files used to exchange requirements between different requirement management tools. You can import a .reqif file or a .reqifz ZIP archive containing a .reqif file and associated images to a requirement list and export all or parts of a requirements list (including any images contained in your requirements) to a .reqifz ZIP archive.
Compare Requirements Document Versions

You can now compare two versions of a requirements document to obtain a color-coded visualization of differences between them.

3.3.1.3 Process Architecture


Import SAP Solution Manager v7.2 Process Diagrams (New)

You can now import SAP Solution Manager 7.2 process diagrams. You can share and comment on Solution Manager business process diagrams, link their objects to objects in other models, and include them in impact analysis.

3.3.1.4 Information Architecture


Data Movement Diagrams (New)
Data movement diagrams help you design and analyze the transfer of data between data stores, and the transformations that they undergo on the way. SAP EA Designer supports the creation of data movement diagrams manually or by reverse-engineering of FlowGraph files. You can model ETL flows and generate FlowGraph files for import to SAP Web IDE for activation.

**NoSQL Diagrams (New)**

NoSQL diagrams help you design, analyze, and document the JSON structures that are accepted and generated by your systems. SAP EA Designer supports the creation of NoSQL JSON Schema models manually, or by reverse-engineering of a schema or sample data file. You can model JSON artifacts and generate JSON schema and sample data files.

**Reverse of SQL Scripts (New)**

You can reverse a .sql script file to your database diagram.

**Graphical SQL views (New)**
You can visualize your SQL view in a read-only diagram, showing each of the view’s data sources and joins.

**HDI DataStores (New)**

You can model, generate, and reverse-engineer DataStores (also known as NDSOs) in your HANA HDI diagrams.

**Visible Dependencies for Calculation Views (New)**

Your calculation views now point to their sources in the HANA HDI diagram:
**Teradata v15 (New)**

SAP EA Designer supports the creation of Teradata v15 data models manually, by reverse-engineering, or by generation from another data model.

**Git Support (New)**

You can reverse HDI files from and generate them to your Git repository. Git is also supported as a source and target for the reverse and generation of JSON files, and as a target for generating FlowGraph files.

**3.3.1.5 SAP Enterprise Architecture Designer, Edition for SAP HANA Administration**

SAP HANA Platform 2.0 SP02 introduces new administration features in SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA.

**XSA User Authentication (New)**

Users with SAP HANA accounts can log in using their XS Advanced user and password. XSA is only used for authentication. Rights and permissions on repository folders and documents are controlled in the repository.

**Push Folders and Diagrams to Users' Homepages (New)**

The repository administrator can push diagrams and folders to users' homepages to give them personalized entry points to the repository. Diagrams appear as cards in the user's homepage, and folders as entries in the Quick Links card. You can push diagrams and folders to individual users or to groups.
3.4 Administration

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for the administration of SAP HANA.

SAP HANA Cockpit (New and Changed) [page 102]
SAP HANA Platform 2.0 SPS 02 introduces new and changed features for the SAP HANA cockpit with SAP HANA cockpit support package (SP) 03.

SAP HANA System Administration (New and Changed) [page 108]
SAP HANA Platform 2.0 SPS 02 introduces new and changed features for the administration of SAP HANA.

SAP HANA Application Lifecycle Management (New and Changed) [page 111]
SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA Application Lifecycle Management for SAP HANA extended application services, advanced model (XS advanced).

SAP HANA High Availability (New and Changed) [page 112]
SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA high availability.

SAP HANA Database Backup and Recovery (New and Changed) [page 112]
SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA backup and recovery.

SAP HANA Application Run-Time Services (New and Changed) [page 113]
SAP HANA Platform 2.0 SPS 02 introduces new and changed features for the application run-time services in SAP HANA.

SAP HANA Smart Data Access (New and Changed) [page 114]
SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA smart data access.

3.4.1 SAP HANA Cockpit (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for the SAP HANA cockpit with SAP HANA cockpit support package (SP) 03.

SAP HANA Cockpit SP 03 (New)

SAP HANA cockpit SP 03 is now available.

SAP HANA Cockpit SP 03 Features [page 103]

About SAP HANA Cockpit SPs

SAP HANA cockpit SPs are available independently of the SAP HANA 2.0 platform revision, but may be included as part of SAP HANA platform revisions.
SAP HANA cockpit SPs are cumulative. This means that a higher SP includes all features and fixes available in earlier SPs.

### Feature Available with Earlier SPs

- SAP HANA Cockpit SP 02 Features [page 153]
- SAP HANA Cockpit SP 01 Features [page 158]

#### 3.4.1.1 SAP HANA Cockpit SP 03 Features

Find out about the new and changed features introduced with the SAP HANA cockpit SP 03.

- **Administration and Monitoring** [page 104]
  - SAP HANA cockpit SP 03 introduces new and changed features for system administration and monitoring.

- **SAP HANA Database Explorer** [page 105]
  - SAP HANA cockpit SP 03 introduces new and changed features for SAP HANA database explorer.

- **Performance Monitoring and Analysis** [page 105]
  - SAP HANA cockpit SP 03 introduces new and changed features for performance monitoring and analysis.

- **User Management and Security Administration** [page 106]
  - SAP HANA cockpit SP 03 introduces new and changed features for user management and security-related administration.

- **High Availability and Scalability** [page 107]
  - SAP HANA cockpit SP 03 introduces new and changed features for high availability and scalability.

- **Backup and Recovery** [page 108]
  - SAP HANA cockpit SP 03 introduces new and changed features for backup and recovery.
3.4.1.1 Administration and Monitoring

SAP HANA cockpit SP 03 introduces new and changed features for system administration and monitoring.

Managing Tenant Databases (Changed)

The Database Services app now has additional capabilities. For a selected tenant, you can now:

- Set limits for memory allocation and for CPU cores
- Change the number of reserved instances
- Set backup options
- Restrict or blacklist tenant features
- Enable or disable auto-restart

System Health (Changed)

The System Health app for multi-host systems has been enhanced with additional functionality.

Resource Registration (Changed)

You can now import and export resources.

Administering Offline Resources (Changed)

The SAP HANA cockpit for offline administration is no longer required for the administration of offline resources. With SP 03, the SAP HANA cockpit includes all capabilities that could formerly be performed only through the SAP HANA cockpit for offline administration. While the SAP HANA cockpit for offline administration is still available, it is recommended that you instead use the SAP HANA cockpit.
### 3.4.1.1.2 SAP HANA Database Explorer

SAP HANA cockpit SP 03 introduces new and changed features for SAP HANA database explorer.

#### SQL Console Enhancements

- **Ability to determine which database system a SQL console is connected to**
  
The SQL console now displays the database system that is connected to on the console toolbar.

- **Ability to rename SQL console tabs**
  
The SQL console now allows you to rename the console tab by right-clicking the tab and clicking *Rename*.

#### Database Object Searching Enhancements

The *Object Search* now allows you to limit your search to a specific database.

#### Connection Enhancements

A *Connection Status Dialog* now appears if you experience network connectivity problems. The dialog allows you to re-establish the connection.

### 3.4.1.1.3 Performance Monitoring and Analysis

SAP HANA cockpit SP 03 introduces new and changed features for performance monitoring and analysis.

#### Performance Monitor (Changed)

On the *Performance Monitor* page, you can zoom into a specific time frame by selecting it directly on the load chart.

#### Threads (Changed)

On the *Threads* page, you can identify what transaction is blocking a statement in a dedicated column.
Capture and Replay (Changed)

Capture and Replay offers the following new functionalities:

- On the Replay Configuration page it is now possible to select more than one replayer from the Replayer List in the Replayer Information section.
- On the Replay Configuration page you can set optional filters (for example, statement type) in the General Information section.
- On the Replay Configuration page it is possible to see which type of requests are not supported for the replay step.

Workload Analyzer (Changed)

The workload analyzer based on thread samples offers now the possibility to import and export datasets in order to store the data in an application and to analyze it in another system.

The workload analyzer based on engine instrumentation offers now the possibility to set specific filters (for example, statement hash, thread type, or application source) on the upper part of the screen.

3.4.1.1.4 User Management and Security Administration

SAP HANA cockpit SP 03 introduces new and changed features for user management and security-related administration.

Database User and Role Management (Changed)

- If you are implementing user authorization based on LDAP group membership, you can now set the authorization mode of a user to LDAP on the User page. Users configured for LDAP authorization are then automatically granted the roles that are mapped to the groups of which they are a member. A user with authorization mode LDAP is granted roles exclusively based on their LDAP group membership. It is not possible to grant such a user other roles or privileges directly.
- You can now add a comment to user definitions.
**Encryption Configuration and Encryption Key Management (New)**

- In addition to data volume encryption, it is now possible to see and change the status of redo log encryption and backup encryption on the Data Encryption tile of the Overview page.
- The Data Encryption tile now opens the new Data Encryption Configuration page. Here, you can see the status of all data encryption services, enable and disable each service, and access the page for managing encryption keys.
- The new Manage Keys page allows you to see the status and version history of all encryption root keys in your database. You can also perform all steps required to change your root keys safely, including creating a password-protected root key backup.

**3.4.1.1.5 High Availability and Scalability**

SAP HANA cockpit SP 03 introduces new and changed features for high availability and scalability.

**Secondary Read Access (New)**

On the System Replication Overview it is now possible to see when the SQL ports of the secondary system are open for read access.

**Network Security Settings (New)**

It is now possible to view the specific network security details configured between the primary and secondary systems using the Network Security Settingstab on the System Replication Overview.

**Monitor Network (New)**

It is possible to monitor the network using the Monitor Network link in the SAP HANA cockpit. The Measure Network Speed link on the Monitor Network page offers the possibility to measure the network speed between the hosts in a scale-out SAP HANA database. The Network Speed Check list offers an overview of all network channels between the involved hosts starting with the slowest network connection.
3.4.1.6 Backup and Recovery

SAP HANA cockpit SP 03 introduces new and changed features for backup and recovery.

Copying an SAP HANA Database

SAP HANA cockpit now allows you to copy a database using backup and recovery.
You can copy a system database or a tenant database within the same system or to a different system.
It is possible to copy an SAP HANA database using file-based backups or backups created with third-party tools.

Backup Encryption (Changed)

SAP HANA native backup encryption can now be enabled and disabled from SAP HANA cockpit.

3.4.2 SAP HANA System Administration (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for the administration of SAP HANA.

Tenant-Specific Licenses (New)

It is now possible to install licenses individually in tenant databases. A license installed in a tenant database is valid only for that database. If no license is available in a tenant database, the license installed in the system database applies.
Workload Management (Changed)

Admission control

The Admission Control feature (first introduced in SPS 01) is now enabled by default. Default values for a number of the configuration parameters for this feature have been revised in the SPS 02 release.

Workload Classes

Two additional properties are now available in workload classes: TOTAL STATEMENT MEMORY LIMIT and TOTAL STATEMENT THREAD LIMIT. These set limits which apply to all statements currently running for the class as a whole.

Table Replication: Row Store to Column Store Tables (New)

You can now replicate data asynchronously from a row store source table to a column store target table in a scale-out environment. Row store tables typically provide better performance for transactional (OLTP) workload in comparison to column store tables. Similarly, column store tables offer the best performance for analytics (OLAP) workload. Row to column table replication may therefore be an optimal replication configuration for mixed workload types to get the best performance from both types of table. SQL commands are now available to implement this kind of table replication.

Partitioning: Dynamic Partition Pruning (New)

Pruning is a background process which optimizes query processing on partitioned tables. Static partition pruning analyzes queries to determine whether or not they match the given partitioning specification of a table. Dynamic partition pruning is a new extension of this feature which applies pruning to aging tables. It uses pre-calculated statistics to identify the specific columns and partitions which are required for the query currently running; this avoids the need to access and load into memory partitions which are not required.

Configure Host-Independent Tenant Addresses (New)

The client connection to a tenant database is established over port 3<instance_no>13. If a tenant database is moved to another system, the instance number of the system and consequently the connection port will change. To establish a connection independent of its current host, you can specify additional port numbers and map them to the tenant.
Restricted SQL Access (New)

You can open additional SQL ports to prevent SQL access on port $3^{instance}13$. This prevents the exposure of the system database SQL administration port to the external network. You enable this feature by setting the property `[multidb] systemdb_separated_sql_port` to `true` in the `global.ini` file.

Prevent the Start of a Tenant Database at System Startup (New)

By default, all tenant databases that were running before the SAP HANA system was stopped are restarted upon system startup. For troubleshooting purposes you may want to prevent a particular database from starting until the issue is resolved.

Authorization for Database Stop/Start (New)

Two new system privileges were introduced to authorize users to start and stop a database: `DATABASE START` and `DATABASE STOP`. Both system privileges are part of `DATABASE ADMIN`.

Table Consistency Check (Changed)

To perform table consistency checks, it is no longer necessary to enable the corresponding collector. These checks are now performed automatically.

SAP HANA HDBSQL (Changed)

HDBSQL Recognizes BEGIN...END Blocks in a File

HDBSQL has been enhanced to recognize BEGIN...END blocks in a file or interactive input so that you no longer need to modify the script and use the `-separatorownline` option. The `-separatorownline` behavior remains available when the option is specified, but it has been marked as deprecated.
New option - attemptencrypt

The new `-attemptencrypt` option specifies that encrypted data transmission is used. If the connection fails, it attempts to use unencrypted connections which results in the following warning, "The encrypted communication attempt failed. Retrying the connection attempt without encryption options."

3.4.3 SAP HANA Application Lifecycle Management (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA Application Lifecycle Management for SAP HANA extended application services, advanced model (XS advanced).

Integration of XSA Application Lifecycle Management Graphical User Interface in SAP HANA Cockpit (Changed)

You can start the SAP HANA Application Lifecycle Management Graphical User interface for a particular resource using one of the following links in the SAP HANA Cockpit.

The following links are available:

- Installing, updating and uninstalling XS advanced components
- Installing, updating and uninstalling XS advanced products
- Displaying the installation history of XS advanced components and products

Installing and Updating Products and Software Components in SAP HANA XS Advanced Model (New and Changed)

- If an extension descriptor is used for the installation process, the system checks that the extension descriptor file does not exceed a specific file size and that the syntax of the extension descriptor file is correct. If the file is too big or if the syntax is incorrect, the system will not start the installation process.
- Installing and Updating Using the Command Line Interface: The new command `display-installation-history` was introduced that allows you to display the installation history.
3.4.4 SAP HANA High Availability (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA high availability.

srReadAccessInitialized (New)

The srReadAccessInitialized() hook shows on the primary system when the SQL ports are open on the secondary system.

Alert ID 104: System Replication Increased Log Shipping Backlog (New)

Alert 104 is raised when the system replication log shipping backlog is increased. In this case, the log shipping to the secondary system is delayed or will not work properly causing data loss on the secondary system in case a takeover is executed.

Copying and Moving Tenant Databases in a System Replication Landscape (Changed)

It is now possible to copy or move a tenant database to a primary system in a running system replication configuration. It is also possible to copy or move a tenant database from a primary system in a running system replication configuration to another target system, which is different from the secondary system.

3.4.5 SAP HANA Database Backup and Recovery (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA backup and recovery.

SAP Business Warehouse Extension Nodes

SAP HANA backup and recovery now provides extended support for worker groups.
If you are using extension nodes for SAP Business Warehouse, and have defined worker groups, information about the worker groups for each volume are stored as part of SAP HANA full backups (complete data backups and data snapshots).

Before you start a recovery, you must ensure that the worker groups in the SAP HANA system and the backups have the same names.

**Documentation (Changed)**

From now on, the term *data snapshot* is used instead of *storage snapshot*, which was used in previous SAP HANA releases.

### 3.4.6 SAP HANA Application Run-Time Services (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for the application run-time services in SAP HANA.

The following changes are included with SAP HANA 2.0 SPS 02 for the management of the XS advanced run-time component:

- **XSA CLI**
  - The XSA command-line interface enables you to manage XS advanced instances and services without stopping the SAP HANA database.

- **XS CLI**
  - The xs command-line interface enables you to manage the XS advanced run-time environment and its components.

**XSA CLI (Changed)**

Additions, changes, and improvements have been made to the XSA CLI in the following areas:

- **set-certificate**
  - Set the certificate for the default domain after the XS controller is shut down

- **save-ssfs-to-dbss**
  - Create a backup copy of the XS advanced file-system secure store and save it in the database secure store; the file-system secure store is then included automatically in the regular database backup operation

- **restore-dbss-to-ssfs**
  - Restore the XS advanced file-system secure store from the backup copy saved in the database secure store
• show-stored-parameters-from-secure-store-db
  Display a list of the parameters stored within the secure-store database after the last successful startup of the XS advanced controller
• delete-user-data
  Ensure data privacy rules are respected by erasing user data from the log files

XS CLI (Changed)

Additions, changes, and improvements have been made to the xs CLI in the following areas:
• Application management
  Added the wait-for-apps command
• Services management
  Updated the marketplace and services commands
• Routes
  Added the --path option for specifying the application context (for example, /path/myapp to the create-route, delete-route, map-route, and unmap-route commands in the Routes section
• Administration
  Moved the service-urls command to the Other Commands section
• Other Commands
  Added the service-urls command
• Plug-ins
  Updated the display-installation-logs command
  Added the display-installation-history command

3.4.7 SAP HANA Smart Data Access (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA smart data access.

Linked Database (Changed)

Linked database is now extended to any smart data access remote source.

Remote Source Failover (New)

If a connection to a remote source becomes unavailable, the smart data access remote source reconnects to one of the hosts specified in the host list. Automatic failover is enabled through the ODBC connection configuration and is dependent of whether the remote source itself supports failover.
Safe Mode For ODBC Connections (New)

HANA Smart Data Access provides the capability to load ODBC drivers and execute ODBC calls from within the scriptserver process. This reduces potential issues with the indexserver caused by third-party ODBC drivers.

Setting Session Specific Information for Connections to SAP HANA Remote Sources

Session specific client information can now be set for connections to SAP HANA remote sources.

Remote Statement Details

The Remote Statement Details page in SAP HANA Cockpit now includes the size of fetched records in bytes.

3.5 Development

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for development.

SAP HANA XS Advanced Development (New and Changed) [page 116]
For SAP HANA Platform 2.0 SPS 02, SAP HANA supports development and deployment of SAP HANA extended application services (XS) advanced model applications.

Text Search, Text Analysis, and Text Mining [page 121]
SAP HANA Platform 2.0 SPS 02 introduces new and changed features for text search, text analysis, and text mining.

SAP Web IDE for SAP HANA (New and Changed) [page 125]
SAP HANA Platform 2.0 SP02 introduces new and changed features for SAP Web IDE and integrated SAP HANA tools.

SAP HANA Graph (New and Changed) [page 131]
SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA Graph.

SAP HANA Spatial (New and Changed) [page 132]
SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA Spatial.

SAP HANA Interactive Education (SHINE) for XS Advanced (New) [page 133]
SAP HANA Platform 2.0 SPS 02 introduces new features for SAP HANA Interactive Education (SHINE) for XS Advanced.
SAP HANA Extended Application Services classic model (XS classic) and SAP HANA Repository [page 133] are deprecated as of SAP HANA 2.0 SPS 02.

3.5.1 SAP HANA XS Advanced Development (New and Changed)

For SAP HANA Platform 2.0 SPS 02, SAP HANA supports development and deployment of SAP HANA extended application services (XS) advanced model applications.

This section contains details of changes and additions to the following development related tools and features:

- Application Migration (new) [page 116]
- Application Run-Time Environment [page 117]
- Application Router [page 117]
- Deployment Service (New and Changed) [page 118]
- SAP HANA Deployment Infrastructure (New and Changed) [page 118]
- Core Data Services (new) [page 118]
- Command-Line Interface [page 118]
- Developer Documentation [page 119]

**Application Migration (new)**

The XS Advanced Migration Assistant enables you to migrate an XS classic application to run in the XS advanced run-time environment. For SAP HANA 2.0 SPS 01 and SPS 02, the migration assistant includes the following new or changed features:

- Staged migration (changed)
  Migrate an XS classic application to XS advanced in semantic units using the XS Advanced Migration Assistant.

- HTA mode (changed)
  A new option (--hta) for the XS Advanced Migration Assistant, which produces output that does not include information about permissions defined in .hdbgrants artifacts or role artifacts that are used to enable public access to synonym targets.

- Migrating flow graphs (new) and time-series models (new)
  Flow graphs and time-series models are part of the completely automated migration strategy using the XS Advanced Migration Assistant.
Application Run-Time Environment

With SAP HANA 2.0 SPS 02, SAP HANA XS advanced provides the following run-time environments for your application:

- **JavaScript/Node.js (changed)**
  SAP HANA XS, advanced model, provides a JavaScript run time to which you can deploy your Node.js and XS JavaScript applications.

  **Note**
  The XS JavaScript (XSJS) run time is a compatibility layer that runs on top of Node.js and enables you to execute your existing code base, for example, .xsjs and .xsjslib files.

  ○ **SAP NPM Registry (New)**
    SAP-specific Node.js packages are now available on a public registry (npm.sap.com)

- **Java (changed)**
  SAP HANA XS, advanced model, provides a Java run time to which you can deploy your Java applications. The Java run time for SAP HANA XS advanced provides a Tomcat or TomEE run time to deploy your Java code. The following components are new (or changed) for SAP HANA 2.0 SPS 02:

    ○ **sap-java-hdi (changed)**
      Version 2.0 of the SAP HANA DI (HDI) client library for Java applications, sap-java-hdi, wraps the HDI SQL APIs in Java classes and methods.

    **Tip**
    Version 2.0 of sap-java-hdi is not compatible with sap-java-hdi version 1.0.

- **Custom run time (changed)**
  You can also create and run a custom run-time environment of your own in XS advanced, so that you can deploy applications written using languages such as Python or PHP, which are not supported by any of the default run-time environments included in the XS advanced run-time store.

  **Restriction**
  SAP does not provide support for custom language, buildpack, or run-time scenarios.

  Applications deployed to a custom run-time environment in XS advanced do not have automatic access to (or use of) some important features that are built into and supported by the XS advanced framework, including (but not limited to): authentication and security, logging and auditing, and connections to the database. If you deploy an application to a custom run-time environment in XS advanced, you must configure these components manually for the custom application.

Application Router

For SAP HANA Platform 2.0 SPS 02, SAP HANA XS advanced provides the following updates and new features for the Node.js application router (approuter.js):

- **CORS**
  The XS advanced Node.js-based application router includes a new environment variable that you can use to enable support for cross-origin request sharing (CORS). CORS enables you to override a Web browser’s
security policy so that Web pages from other domains can make HTTP requests to your application domain.

**Deployment Service (New and Changed)**

For SAP HANA Platform 2.0 SPS 02, SAP HANA XS advanced provides the following updates and new features for the deployment service, for example, in the deployment descriptor (mtad.yaml) and the XS CLI command `xs deploy`:

- Updates to MTA module and resource types (changed)
- Support for “optional” resources with XS advanced applications (new).
  In this scenario, the application must be able to compensate for the absence of any “optional” resources during deployment.

**SAP HANA Deployment Infrastructure (New and Changed)**

For SAP HANA Platform 2.0 SPS 02, SAP HANA XS advanced provides the following updates and new features for SAP HANA Deployment Infrastructure (HDI):

- HDI administration tools (new)
- HDI artifact types and build plug-ins (changed):
  - Database table constraints (.hdbconstraint)
  - DocStore Collections (.hdbcollection)

**Core Data Services (new)**

For SAP HANA Platform 2.0 SPS 02 SAP HANA XS advanced provides the following updates and new features for Core Data Services (CDS):

- Tables and views defined in CDS can now be enhanced with comments.

**Command-Line Interface**

For SAP HANA Platform 2.0 SPS 02, SAP HANA XS advanced provides the following updates and new features for the XS advanced command-line interfaces (CLI):

- XSA CLI
  Use the `xsa` command-line interface to manage XS advanced instances and services without stopping the SAP HANA database.
- XS CLI
  Use the `xs` command-line interface (CLI) to manage the XS advanced run-time environment and its components.
XSA CLI (New)
Numerous additions, changes, and improvements have been made to the XSA CLI in the following areas:

- **set-certificate**
  Set the certificate for the default domain after the XS controller is shut down
- **save-ssfs-to-dbss**
  Create a backup copy of the XS advanced file-system secure store and save it in the database secure store; the file-system secure store is then included automatically in the regular database backup operation
- **restore-dbss-to-ssfs**
  Restore the XS advanced file-system secure store from the backup copy saved in the database secure store
- **delete-user-data**
  Erase user data from the log files

XS CLI (Changed)
Numerous additions, changes, and improvements have been made to the xs CLI in the following areas:

- **Application management**
  Added the `wait-for-apps` command
- **Services management**
  Updated the `marketplace` and `services` commands
- **Administration**
  Moved the `service-urls` command to the `Other Commands` section
- **Other Commands**
  Added the `service-urls` command
- **Plug-ins**
  Updated the `display-installation-logs` command
  Added the `display-installation-history` command

Developer Documentation
This section contains information about additions or changes to the following development-related documents for SAP HANA 2.0 SPS 02:

- **SAP HANA Developer Information Map**
- **SAP HANA Developer Quick Start Guide**
- **SAP HANA Developer Guide for SAP HANA XS Advanced Model**

SAP HANA Developer Information Map
For SAP HANA 2.0 SPS 02, the *SAP HANA Developer Information Map* has been improved and expanded to enable much quicker and easier access to the library of information available to help develop XS advanced applications. You can now access the information from the following perspectives:

- **Developer Guide**
  Which document am I interested in (developer, reference, programming language), what is its title, what information does it contain, and where do I find it?
- **Developer Tasks**
What am I trying to do, what tasks are required to do it, and where do I find the information about these tasks?

- **Developer Scenario**
  Which developer role or persona is most typically associated with the information I need to find: database development, application development, or user-interface client design?

**SAP HANA Developer Quick Start Guide**

For SAP HANA 2.0 SPS 02, the *SAP HANA Developer Quick Start Guide* has been greatly simplified allowing much quicker and easier access to the tutorials designed to get you started with the process of developing applications for the XS advanced run-time environment.

**SAP HANA Developer Guide for SAP HANA XS Advanced Model**

The *SAP HANA Developer Guide for SAP HANA XS Advanced Model* describes the recommended process to follow when building and deploy applications that run in the SAP HANA extended application services, advanced model (XS advanced) run time; it also describes the required technical structure of applications that can be deployed to the XS advanced run-time platform using either SAP Web IDE for SAP HANA along with administration and command-line tools.

The following areas in the *SAP HANA Developer Guide for XS advanced model* are new, updated, or improved:

- Maintaining Application Development and Deployment Descriptors
  Improved and more comprehensive descriptions of the configuration files used to define and describe the build and deployment of a Multi-Target Application (MTA)
- Defining the Data Model in XS Advanced
  - Configuring the HDI Deployer
  - Maintaining JSON Collections in the SAP HANA Document Store
  - Using Synonyms to Access External Schemas and Objects in XS Advanced
- Defining Web-Based Data Access:
  - Defining OData Services for XS Advanced Applications
    Improved and more comprehensive tutorials for creating validation and modification exits with JavaScript for OData version 2 services
  - Data Access with XMLA in SAP HANA XS
    Improved and expanded the tutorial for setting up and using the XMLA interface in XS advanced
- Writing the XS Advanced Application Code:
  - Expanded the JavaScript run-time section to include information about new and updated SAP-specific Node.js packages as well as details of how to make use of the new @SAP public NPM Registry (npm.sap.com)
- Maintaining Application Services in XS Advanced
  Expanded the section to include much more details of default services and, in particular, how and when to use them
- Service Plans
  Expanded and improved the information concerning the mapping of service plans to resource types
- Service Types
  Expanded and improved the information about XS advanced service types (for example, managed services and user-provided services) and when and how to use them
- Maintaining XS Advanced Application Routes and Destinations
  Improvements to and extension of existing information as well as new information about features and functionality added with SAP HANA Platform 2.0 SPS 02
- SAP Web IDE
Expanded and improved the reference section for SAP Web IDE for SAP HANA, a browser-based integrated development environment (IDE) for the development of SAP-HANA-based applications, to included details of the new tools, features, and general improvements in functionality for this release.

- HDI Artifact Types and Build Plug-ins Reference
  Improvements and additions to the list of available plugins providing support for a wide variety of database artifacts types, for example, .hdbconstraint (constraints on foreign keys in database tables) and .hdbcollection (JSON collections for the SAP HANA DocStore)

- XS Command-Line Interface
  Numerous improvements and additions to the parameters and options already available with existing commands, for example, marketplace and services as well as important additions to the installation and deployment functions including more control of the application version deployed and the services bound to the deployed application

3.5.2 Text Search, Text Analysis, and Text Mining

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for text search, text analysis, and text mining.

- **Text Search (New and Changed)** [page 121]
  SAP HANA Platform 2.0 SPS 02 introduces new and changed features for text search.

- **Text Analysis (New and Changed)** [page 122]
  SAP HANA Platform 2.0 SPS 02 introduces new and changed features for text analysis.

- **Text Mining (New and Changed)** [page 125]
  SAP HANA Platform 2.0 SPS 02 introduces new and changed features for text mining.

3.5.2.1 Text Search (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for text search.

**Built-In Procedure `sys.esh_config()` and CDS**

Note the following new features for built-in procedure `sys.esh_config()` and CDS:

- **new annotation** `@Consumption.labelElement` to define a label column for a facet
- **new annotation** `@EnterpriseSearch.filteringFacet.displayPosition` to define the sequence of the facets in the search response
- **new annotation** `@EnterpriseSearch.filteringFacet.order` to define the order of values within a facet
- **new annotation** `@EnterpriseSearch.filteringFacet.countNullValues` to count NULL values within a facet
Built-In Procedure sys.esh_search()

Note the following new features for built-In procedure `sys.esh_search()`:

- Use a timeout parameter to specify a timeout value for each search of a bulk request or a federated search.
- Use a language vector as an input parameter to define a prioritized list of languages.
- new annotation `@com.sap.vocabulary.Search.v1.Language` in the search result returns language codes
- new annotation `@com.sap.vocabulary.Search.v1.Text` in facet results returns labels for facet columns
- new annotation `@com.sap.vocabulary.Search.v1.CPUTime` returns the active cpu time of a search
- new $metadata annotation `@EnterpriseSearchHana.isSortable`

Privileges

The EXECUTE privilege on `sys.esh_search()` has been granted to database role PUBLIC.

3.5.2.2 Text Analysis (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for text analysis.

Web IDE Extensions for Text Analysis

SAP Web IDE for SAP HANA (on-premise version) adds support for developing custom text analysis configurations (in addition to dictionaries and extraction rules). Custom text analysis configurations can be generated using one of the standard SAP HANA configurations as a starting point, and can be tested using the TA Batch Test feature.

Users will be able to ensure that they have a working text analysis configuration for their custom dictionaries and rules, ready for immediate deployment, at the end of the development process.
Automatic Word Form Handling in Custom Dictionaries

Text analysis dictionaries can optionally perform matching on the base forms (stems) of the words used in the dictionary entries, instead of requiring exact string matches (the default). By enabling this option for a dictionary, an entity string can be specified once (in a natural form) and the matching process will consider all inflected forms of the words automatically when searching for matches. This reduces the effort required to create dictionaries, improves recall in highly-inflected languages, and, depending on the dictionary terms defined, can yield smaller, more manageable dictionaries.

Automatic word form handling is supported for all languages. For English, German, French, Italian and Spanish, this feature can additionally handle inflected forms for specialized entries not included in the internal text analysis lexicons (e.g., medical terms).

See chapter Extraction Dictionary Syntax inside the SAP HANA Text Analysis Extraction Customization Guide for details.

Entity Normalization

Text analysis can now normalize the values of CURRENCY and PERCENT entities.

For example, when a CURRENCY entity for "150 dollars" is extracted by text analysis, the TA_NORMALIZED column in the TA results table will contain "150 USD". Similarly, when a PERCENT entity for "15.8 percent" is extracted, the TA_NORMALIZED column will contain "15.8%".

This feature is only supported for English.

This feature must be activated using a custom text analysis configuration.

Improved Sentiment Analysis in Arabic

The precision and recall of Sentiment Analysis for Arabic has been improved.

For example, the input "5/5 منتج" is recognized as a Sentiment with Topic "منتج" and StrongPositiveSentiment "5/5".

Improved Handling of Dates in Arabic

The recognition of dates has been improved in Arabic.

Improvements in Linguistic Analysis (part-of-speech detection):

- "02/02/12" Before: "Unknown" Now: "Number"
- "26-33-27" Before: "Unknown" Now: "Number"
Improvements in Entity Extraction (DATE entities):

- “02/02/12” Before: (not extracted) Now: DATE
- “26-33-27” Before: DATE Now: (not extracted)

**Improved Linguistic Analysis in Korean**

Numerous incremental changes to Korean increase the accuracy of full text search and text analysis when processing Korean text.

Tokenization improvements in linguistic analysis:

- 백만 달러 Before: “Noun” and “Verb” Now: “Number” (”백만”) and “Noun” (”달러”)

Parenthesized Hangul characters:

- (ㅅ) Before: “Unknown” Now: “Noun”
- (charAt) Before: “Unknown” Now: “Noun”

**Tolerant Spelling Support for Danish, Swedish, and Russian**

Linguistic analysis of Danish, Swedish, and Russian is more tolerant of variations in capitalization, accents, and hyphenation. This increases recall for full text search and text analysis applications that process inputs in those languages.

For example, “sverige” is recognized as a variation of the proper name “Sverige” in Swedish. Likewise, “danmark” is recognized as a variation of “Danmark” in Danish, and “москве” is recognized as a variation of “Москва” in Russian.

**Improved Emoji Support**

Emojis are now split into their own separate token. For example, previously, “happy☺” would be treated as a single token. Now it will be treated as two distinct tokens, “happy” and “☺”. This results in improved recall for Emoticon entities when using sentiment analysis.
3.5.2.3   Text Mining (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for text mining.

Support for using stems (base forms) or raw tokens as terms

Text Mining now includes optional support for using word stems (base forms) or raw tokens as terms when constructing the term-document matrix. The use of stems may provide better text mining results for certain languages like Korean, and possibly also when using limited amounts of reference text (i.e., very small reference documents and/or very small sets of reference documents).

This feature must be activated using a custom text mining configuration.

3.5.3   SAP Web IDE for SAP HANA (New and Changed)

SAP HANA Platform 2.0 SP02 introduces new and changed features for SAP Web IDE and integrated SAP HANA tools.

SAP Web IDE for SAP HANA is a browser-based integrated development environment (IDE) for the development of SAP HANA-based applications comprised of web-based or mobile UIs, business logic, and extensive SAP HANA data models. SAP Web IDE works in conjunction with the SAP HANA deployment infrastructure (HDI), the Application Lifecycle Management tools (ALM), the XS Advanced runtime platform, and various SAP HANA tools.

SAP Web IDE [page 126]
SAP HANA Platform 2.0 SP02 introduces new and changed features for SAP Web IDE.

Calculation View Editor (Modeler) [page 126]
SAP HANA Platform 2.0 SP02 introduces new and changed features for the calculation view editor (modeler) of SAP Web IDE.

CDS Graphical Editor [page 128]
SAP HANA Platform 2.0 SP02 introduces new and changed features for the CDS graphical editor of SAP Web IDE.

Database Explorer [page 129]
SAP HANA Platform 2.0 SP02 introduces new and changed features for the database explorer in SAP Web IDE.

Java and Node.js Development [page 130]
SAP HANA Platform 2.0 SP02 introduces new and changed features for Java and Node.js development in SAP Web IDE.

SAP HANA Streaming Analytics Plugin [page 130]
SAP HANA Platform 2.0 SP02 introduces new and changed features in the SAP HANA streaming analytics plugin for SAP Web IDE.
3.5.3.1   SAP Web IDE

SAP HANA Platform 2.0 SP02 introduces new and changed features for SAP Web IDE.

**Ability to create remote branches in Git**

You can now create remote branches for your Git projects. Right-click your project and choose `Git > Create Remote Branch`.

**Ability to deploy an application directly from SAP Web IDE to the XS Advanced or Cloud Foundry**

You can deploy the results of an application build, packaged into an .mtar file, to a runtime platform of your choice.

**Ability to enable or disable optional features in SAP Web IDE**

3.5.3.2   Calculation View Editor (Modeler)

SAP HANA Platform 2.0 SP02 introduces new and changed features for the calculation view editor (modeler) of SAP Web IDE.

**Renaming and Refactoring Objects**

Rename calculation views and refactor them to automatically adjust references in all dependent objects.
Using the Outline Pane for Calculation Views

Use the outline in SAP Web IDE for SAP HANA to obtain a quick overview of the modeler objects (view nodes and columns) in a calculation view. You can also select an object in the outline pane, and navigate to the editor to identify where the object is used in the calculation view.

Creating Virtual Tables with a Form-Based Editor

Use the new form-based editor in SAP Web IDE for SAP HANA to create virtual tables.

Enhancements in Currency Conversion and Unit Conversion

- When assigning conversion semantics (unit conversion or currency conversion) to a column, you can reuse the conversion semantics of another column as a reference.
- You can set the behavior of intermediate conversions to either compatible or highest precision. This helps to obtain accurate and desired currency or unit conversion results.

Enhancements in Auto Documentation

In SAP Web IDE for SAP HANA, you can automatically generate documentation of multiple calculation views at a time.

Enhancements in Filtering View Nodes

- In addition to defining filters on projection, aggregation, and join view nodes, you can also define filters on union, rank, minus and intersect view nodes.
- If you are using the same view node as an input to multiple other nodes, and if you have defined filters in any of these nodes (top nodes), the engine cannot push down the filters to the below node at execution. But, with SAP HANA 2.0 SPS 02 version onwards, you can control the behavior of filter push down for such cases. You can set a flag that enables the below node to ignore multiple outputs, push down filters, and provide filtered output to each top node.
- If you are using a rank node as an input to any of the top nodes, and if you have defined a filter on the top node, the engine cannot push down the filter to nodes below the rank node at execution. But, with SAP HANA 2.0 SPS 02 version onwards, you can set a flag at each rank node to push down filters to the below nodes.
Automatically Creating Files for Synonym Definitions

In SAP Web IDE for SAP HANA, you can use synonyms to consume modeler objects from user-defined schemas (non HDI). The tool can automatically create the files necessary for the synonym definition.

3.5.3.3 CDS Graphical Editor

SAP HANA Platform 2.0 SP02 introduces new and changed features for the CDS graphical editor of SAP Web IDE.

Creating Subqueries

You can use the CDS graphical editor in SAP Web IDE for SAP HANA to define CDS views with subqueries. Subqueries are nested SQL queries that enable you to create CDS views for complex business scenarios.

Using the LIMIT and OFFSET SQL Clauses

You can use the SQL clauses LIMIT and OFFSET in a CDS view definition. The LIMIT SQL clause enables you to restrict the number of output records to a specified “limit”. The OFFSET SQL clause specifies the number of records to skip before displaying the records defined by the LIMIT SQL clause.

Creating Parameters in a CDS View

You can use the CDS graphical editor in SAP Web IDE for SAP HANA to define CDS views with parameters. The parameters enable you to pass additional values to modify the results of the CDS view at runtime.

Creating Entities to Store Series Data

You can use the CDS graphical editor in SAP Web IDE for SAP HANA to create entities that can efficiently store series data.

Publishing CDS artifacts with contexts as OData Services

You can publish CDS artifacts at the context level as OData v4 services.
Enhancements in Modeling CDS Views

When modeling a CDS view, you can use elements from structure types in the CDS view definition.

Define Editor Preference

Define your preferred CDS editor in Tools > Preferences > Default Editor > HANA CDS Source.

3.5.3.4 Database Explorer

SAP HANA Platform 2.0 SP02 introduces new and changed features for the database explorer in SAP Web IDE.

Ability to limit database object search

The Object Search now allows you to limit your search to a specific database.

Ability to determine which database system a SQL console is connected to

The SQL console now displays the database system that is connected to on the console toolbar.

Ability to rename SQL console tabs

The SQL console now allows you to rename the console tab by right-clicking the tab and clicking Rename.

New Connection Status Dialog

A Connection Status Dialog now appears if you experience network connectivity problems. The dialog allows you to re-establish the connection.
3.5.3.5  Java and Node.js Development

SAP HANA Platform 2.0 SP02 introduces new and changed features for Java and Node.js development in SAP Web IDE.

**Java development**

Improved debugging
- You can attach the debugger on demand to your running Java application in addition to the option to start the application in debug mode.
- You can debug multi module applications like Spring Boot.

3.5.3.6  SAP HANA Streaming Analytics Plugin

SAP HANA Platform 2.0 SP02 introduces new and changed features in the SAP HANA streaming analytics plugin for SAP Web IDE.

**Plugin name change**

SAP HANA smart data streaming has been renamed SAP HANA streaming analytics.

**Enabling the plugin and the link to the streaming analytics runtime tool**

The streaming analytics plugin for SAP Web IDE is no longer enabled when you first log in to the SAP Web IDE, even if you have installed all the required components. You have to enable the plugin, and the link to the streaming analytics runtime tool, through Preferences ➔ Features.

**CCL Graphical viewer properties pane**

The CCL graphical viewer can now display detailed properties for any object in the diagram. Enable the properties pane by clicking the icon, then selecting the checkbox. To see the properties for an element, open this pane, then select an element in the diagram.
New build option to custom server and workspace

In addition to Build, which compiles and deploys the streaming module to the XSA space you're already working in, you can now also use Build to... This method asks for a host, port, workspace, and user credentials. If you enter the name of a workspace that doesn't exist, a new workspace gets automatically created.

Related Information

What's New in SAP HANA Streaming Analytics

3.5.4 SAP HANA Graph (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA Graph.

GraphScript Extensions (New and Changed)

- Tabular results can be produced in GraphScript, effectively allowing non-scalar GraphScript results to be returned.
- The EDGES function returns all edges between a start set or vertex and a target set or vertex.
- WHILE loops as known from other languages are now supported.
- The data type NVARCHAR is supported.
- Filter expressions can be used to evaluate complex predicates on vertex or edge multisets.
- Subgraphs can be constructed for a given graph induced by a given set of vertices or edges.
- An inverse graph can be constructed from a given graph. In an inverse graph the edge directions are flipped.

Various Performance Improvements (Changed)

Various performance improvements in GraphScript, pattern matching, and built-in algorithms.
3.5.5 SAP HANA Spatial (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA Spatial.

Support of NULL M Values (New)

SAP HANA Spatial supports NULL measure values (NULL M values). NULL M values indicate that there is no M value for a point in a geometry.

Column Configuration (New)

You can configure table columns with column type ST_GEOMETRY to perform the following checks:

- **VALIDATION {NONE | FULL}**
  Checks whether a geometry is a valid geometry. The default value is NONE.

- **BOUNDARY CHECK {OFF | ON}**
  Checks whether a geometry is inside the boundary defined by the Spatial Reference System (SRS) of the checked geometry. The default value is OFF.

ST_AlphaShape Method (New)

Returns the alpha shape geometry of the input geometry, based on a specified radius value.
3.5.6 SAP HANA Interactive Education (SHINE) for XS Advanced (New)

SAP HANA Platform 2.0 SPS 02 introduces new features for SAP HANA Interactive Education (SHINE) for XS Advanced.

Fiori Launchpad (New)

Dynamic data is displayed in the tiles of Fiori Launchpad.

Audit Logging (New)

The audit log service allows you to perform audit log tasks within the SAP HANA XS advanced runtime environment. In SHINE, the audit log service is used to log the changes to transactional data which take place when a user runs the Data Generator.

CDS Enhancements (New)

CDS enhancements include constraints for referential integrity and comments for tables.

SQL Script Enhancements (New)

SQL Script enhancements include INSERT, UPDATE and DELETE operators for table variables.

3.5.7 SAP HANA Extended Application Services classic model (XS classic) and SAP HANA Repository

SAP HANA Extended Application Services classic model (XS classic) and SAP HANA Repository are deprecated as of SAP HANA 2.0 SPS 02.

Related Information

Deprecation of SAP HANA extended application services, classic model and SAP HANA Repository (SAP Note 2465027)
3.6 Reference

SAP HANA Platform 2.0 SPS 01 introduces new and changed features as described in the reference documentation.

- **SAP HANA SQL and System Views Reference (New and Changed) [page 134]**
  SAP HANA Platform 2.0 SPS 02 introduces new and changed features, as documented in the SAP HANA SQL and System Views Reference.

- **SAP HANA Client Interfaces Reference (New and Changed) [page 141]**
  SAP HANA Platform 2.0 SPS 02 introduces new and changed features, as documented in the SAP HANA Client Interface Programming Reference.

- **SAP HANA SQL Command Network Protocol Reference (Changed) [page 143]**
  SAP HANA Platform 2.0 SPS 02 introduces new and changed features, as documented in the SAP HANA SQL Command Network Protocol Reference.

- **SAP HANA SQLScript Reference (New and Changed) [page 144]**
  SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA SQLScript.

- **SAP HANA Analytics Catalog (BIMC Views) Reference (New and Changed) [page 145]**
  SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA Analytics Catalog (BIMC Views).

- **SAP HANA Predictive Analysis Library (New and Changed) [page 145]**
  SAP HANA Platform 2.0 SPS 02 introduces new and changed features for the Predictive Analysis Library (PAL).

- **SAP HANA External Machine Learning Library (New) [page 147]**
  The SAP HANA External Machine Learning Library is a new application function library (AFL) introduced in SAP HANA Platform 2.0 SPS 02 that supports the integration of Google TensorFlow, as an external machine learning framework, with SAP HANA.

3.6.1 SAP HANA SQL and System Views Reference (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features, as documented in the SAP HANA SQL and System Views Reference.

**SQL Statements (New and Changed)**

- **ALTER SYSTEM APPLICATION ENCRYPTION Statement (changed)**
  When you create a new root key with the ALTER SYSTEM APPLICATION ENCRYPTION statement, the WITHOUT ACTIVATE clause is now mandatory.
The COMMENT ON statement now allows you to add a comment on users, roles, and user groups.

A RESTART clause, allows you to specify the restart behavior of the tenant database after a system restart.

A new LOCATION allows you to specify a location for the cache.

The CREATE FUNCTION statement has been extended to support an optional OR REPLACE specification. A CREATE OR REPLACE FUNCTION statement allows you to create a function if it does not exist, or alter its definition if it does exist.

A new clause, NESTED GROUP LOOKUP URL, allows you to specify the URL from which the user’s group membership (both direct and indirect) can be obtained. The previously-required ATTRIBUTE MEMBER OF clause is now optional; however, one of NESTED GROUP LOOKUP URL or ATTRIBUTE MEMBER OF is required for an LDAP provider.

A new data statistics object type, SAMPLE, is provided for creating samples of data that the SQL optimizer can use during optimization.

Two new properties VALID FOR ESTIMATION and VALID FOR DATA DEPENDENCY have been added.

The following enhancements have been made to the CREATE TABLE and ALTER TABLE statements.

- IDENTITY columns are now supported in global and local temporary tables, both in row store and column store tables.
- Primary keys are now supported for local temporary row store tables.
- ALTER TABLE statement: you can now swap a source and replica so that the replica becomes the source by using the new SET REPLICA SOURCE AT '<host_name>:<port_number>' clause.
- ALTER TABLE statement: You can now alter the owner of a table using the new OWNER TO clause. Use of this clause removes the need to copy a table between users.

A new parameterized view clause allows you to define the columns for the view as parameters.

A new LOCATION allows you to specify where the view is stored in the cache.
**CREATE | ALTER WORKLOAD CLASS Statement (changed)**

Two new properties, the TOTAL STATEMENT MEMORY LIMIT and the TOTAL STATEMENT THREAD LIMIT, are provided to check whether the limits of all ongoing statement executions for a specific workload class are exceeded.

**CREATE | ALTER | DROP USERGROUP Statements (new)**

New CREATE | ALTER | DROP USERGROUP statements allow you to create, alter and drop user groups.

**CREATE AUDIT POLICY Statement (changed)**

Three audit actions have been introduced as part of the new user group feature support: CREATE USERGROUP, ALTER USERGROUP, and DROP USERGROUP. Three audit actions have been introduced to support renaming of database objects: RENAME COLUMN, RENAME INDEX, and RENAME TABLE.

**CREATE PROCEDURE Statement (changed)**

The CREATE PROCEDURE statement has been extended to support an optional OR REPLACE specification. A CREATE OR REPLACE PROCEDURE statement allows you to create a procedure if it does not exist, or alter its definition if it does exist.

**CREATE USER Statement (changed)**

A new clause, SET USERGROUP, allows you to add a user to a user group.

**GRANT Statement (changed)**

The following privileges can now be granted using the GRANT statement.

<table>
<thead>
<tr>
<th>PRIVILEGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>USERGROUP OPERATOR</td>
<td>Authorizes a user to configure the parameters of, and membership in, a user group.</td>
</tr>
<tr>
<td>DATABASE START</td>
<td>Authorizes a user to start any database in the system and to select from the M_DATABASES view.</td>
</tr>
<tr>
<td>DATABASE STOP</td>
<td>Authorizes a user to stop any database in the system and to select from the M_DATABASES view.</td>
</tr>
</tbody>
</table>

**IMPORT FROM Statement (changed)**

A new ESCAPE clause allows you to specify the escape character used in the import data.

**INSERT Statement (changed)**

The INSERT statement now allows the FOR XML clause in the subquery.

**RECOVER DATA Statement (changed)**

A new IGNORE WORKERGROUPS clause allows you to recover data even if the target system does not have worker groups with the same names as those on the indexserver that was backed up.

**RECOVER DATABASE Statement (changed)**

A new IGNORE WORKERGROUPS clause allows you to recover a database even if the target system does not have worker groups with the same names as those on the indexserver that was backed up.
You can now rename a tenant database using the new RENAME DATABASE statement.

The following privileges can now be revoked using the REVOKE statement.

- **USERGROUP OPERATOR**: Authorizes a user to configure the parameters of, and membership in, a user group.
- **DATABASE START**: Authorizes a user to start any database in the system and to select from the M_DATABASES view.
- **DATABASE STOP**: Authorizes a user to stop any database in the system and to select from the M_DATABASES view.

The UPDATE statement now allows the FOR XML clause in the subquery.

The FOR XML clause is now supported in table and scalar subqueries. You can now use the SELECT statement to select from parameterized views.

Use the new IS SET | UNSET clause to test for values that have been set or unset for the specified key.

**SQL Functions (New and Changed)**

- **ENCRYPTION_ROOT_KEYS_HAS_BACKUP_PASSWORD Function (new)**: Returns a value that indicates whether the root key backup password is set.
- **HIERARCHY_SPANTREE Function (new)**: Creates a partial hierarchy based on parent-child source data and an (optional) maximum recursion depth input parameter, as well as an orphan-handling directive.
- **HIERARCHY_TEMPORAL Function (new)**: Generates a time-dependent hierarchy on recursive parent-child source data whose edges are additionally qualified by validity intervals.
- **NDIV0 Function (new)**: Prevents divide by zero errors.
- **TO_JSON_BOOLEAN Function (new)**: Converts a given `<value>` to a boolean value in JSON format.
XMLTABLE Function (new)

Creates a relational table from an XML string.

System Views (New and Changed)

DEPEN DENCY_RULES System View (new)
For internal use only, provides a list dependency rules in the system.

DEPEN DENCY_RULE_COLUMNS System View (new)
For internal use only, provides a list dependency rule columns in the system.

DYNA米C_RESULT_CACHE System View (new)
Provides information about metadata objects that are enabled for a dynamic result cache.

ENCRIPTION_ROOT_KEYS System View (changed)
Two new columns, IN_BACKUP and ROOT_KEY_HASH, have been added to provide information about the root key hash value and whether it has ever been backed up.

HIERARCHY_OBJECTS System View (new)
Provides the list of objects that hierarchy navigation functions can be run on.

M_DATA_VOLUME_PAGE_STATISTICS System View (changed)
The new PARTITION_ID column provides the ID for the data volume partition.
The new STATE column provides information on the data volume state.

M_DATA_VOLUME_PARTITION_STATISTICS System View (new)
Provides information on data volume partition statistics.

M_DATA_VOLUME_STATISTICS System View (new)
Provides information on data volume statistics.

M_DATA_VOLUME_SUPERBLOCK_STATISTICS System View (changed)
The new PARTITION_ID column provides the ID for the data volume partition.
The new STATE column provides information on the data volume state.

M_EVENTS System View (changed)
The new SOURCE_HOST column specifies the original host if the event was created via another HOST.
The new SOURCE_PORT column specifies the original port if the event was created via another HOST.

M_HOST_AGENT_INFORMATION System View (new)
Displays computer system information retrieved from the SAP Host Agent.
M_HOST_AGENT_METRICS System View (new)

Displays performance metrics retrieved from the SAP Host Agent.

M_LICENSE System View (updated)

The new IS_DATABASE_LOCAL column specifies whether the tenant is using a local license or a global license.

M_LICENSES System View (updated)

The new IS_DATABASE_LOCAL column specifies whether the tenant is using a local license or a global license.

M_LOAD_HISTORY_SERVICE System View (changed)

The following columns have been added:

- INTERNAL_CONNECTION_COUNT specifies the number of open internal SQL connections.
- EXTERNAL_CONNECTION_COUNT specifies the number of open external SQL connections.
- IDLE_CONNECTION_COUNT specifies the number of open idle SQL connections.
- INTERNAL_TRANSACTION_COUNT specifies the number of internal transactions.
- EXTERNAL_TRANSACTION_COUNT specifies the number of external transactions.
- USER_TRANSACTION_COUNT specifies the number of user transactions.

M_REMOTE_STATEMENTS System View (changed)

The new FETCHED_SIZE column specifies the byte size of fetched records.

M_RESULT_CACHE System View (changed)

The new IS_EVICTED column specifies TRUE if a cache entry is evicted, FALSE otherwise.

M_SERVICE_REPLICATION System View (changed)

The following columns have been added:

- REPLAY_BACKLOG_SIZE - specifies the size of all log buffers that have been shipped to the secondary site but have not yet been replayed on the secondary site.
- REPLAY_BACKLOG_TIME - specifies the time difference between the time of the last shipped log buffer and the last replayed log buffer on the secondary site.
- MAX_REPLAY_BACKLOG_SIZE - specifies the maximum value of the REPLAY_BACKLOG_SIZE since the system startup.
- MAX_REPLAY_BACKLOG_TIME - specifies the maximum value of REPLAY_BACKLOG_TIME since the system startup.
<table>
<thead>
<tr>
<th>View Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M_SERVICE_THREAD_SAMPLES System View (changed)</td>
<td>The data types for the following columns have been updated: PASSPORT_ROOTCONTEXT_ID is now VARBINARY(16), PASSPORT_TRANSACTION_ID is now NVARCHAR(32), and PASSPORT_CONNECTION_ID is now VARBINARY(16).</td>
</tr>
<tr>
<td>M_SERVICE_THREADS System View (changed)</td>
<td>The data types for the following columns have been updated: PASSPORT_ROOTCONTEXT_ID is now VARBINARY(16), PASSPORT_TRANSACTION_ID is now NVARCHAR(32), and PASSPORT_CONNECTION_ID is now VARBINARY(16).</td>
</tr>
<tr>
<td>M_SQL_PLAN_CACHE System View (changed)</td>
<td>The new LAST_INVALIDATION_REASON column specifies the reason for the last invalidation.</td>
</tr>
<tr>
<td>M_WORKLOAD_CAPTURES System View (changed)</td>
<td>Two new columns have been added: CAPTURE_FAILED_STATEMENT_COUNT specifies the number of failed current or capture statements while CAPTURE_FAILED_FETCH_COUNT specifies the number of failed current or capture fetch operations.</td>
</tr>
<tr>
<td>M_WORKLOAD_REPLAY_PREPROCESSES System View (changed)</td>
<td>Two new columns have been added: CAPTURE_FAILED_STATEMENT_COUNT specifies the number of failed capture statements while CAPTURE_FAILED_FETCH_COUNT specifies the number of failed fetch operations during capture.</td>
</tr>
<tr>
<td>REMOTE_SUBSCRIPTION_DATA_CONTAINERS System View (new)</td>
<td>Provides information regarding remote subscription data.</td>
</tr>
<tr>
<td>REORG_PLAN System View (changed)</td>
<td>Two new columns have been added: STEP_GROUP specifies the ID of the table redistribution group of steps that the item belongs to and PRECONDITION indicates the preconditions that have to be fulfilled before the table redistribution step can be executed.</td>
</tr>
<tr>
<td>REORG_STEPS System View (changed)</td>
<td>Two new columns have been added: STEP_GROUP specifies the ID of the table redistribution group of steps that the item belongs to and PRECONDITION indicates the preconditions that have to be fulfilled before the table redistribution step can be executed.</td>
</tr>
<tr>
<td>RESULT_CACHE System View (changed)</td>
<td>A new CACHE_LOCATION column provides the location of the result cache.</td>
</tr>
<tr>
<td>USERGROUPS System View (new)</td>
<td>Lists all the user groups in the HANA system.</td>
</tr>
</tbody>
</table>
A new column, IS_RESTRICTED_DETAILS, specifies the missing privilege(s): ROLE PUBLIC, CREATE ANY ON OWN SCHEMA.

A new column, USERGROUP_NAME, specifies the name of the user groups that the user belongs to.

Provides the parameters specified for each parameterized view in the database.

A new column, HAS_PARAMETERS, indicates whether the view is defined with parameters.

Two new columns, TOTAL_STATEMENT_MEMORY_LIMIT and TOTAL_STATEMENT_THREAD_LIMIT, have been added to provide information about the limits of all ongoing statement executions for a specific workload class.

You can now include hyphens in user names.

Previously, when defining a column as BOOLEAN, you could not define the default value as UNKNOWN. This has changed; you can now define the default value of a boolean column as UNKNOWN. For example, CREATE TABLE table1(a BOOLEAN DEFAULT UNKNOWN...).

The JSON object expression generates a JSON object, and looks very similar to a JSON document. JSON object expressions can be referenced by some statements and operators.

3.6.2 SAP HANA Client Interfaces Reference (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features, as documented in the SAP HANA Client Interface Programming Reference.

Updated Python Support

The new SAP HANA driver for Python provides support for Python 2.7 and Python 3.4 and later. You can install the driver into local Python environments by using the pip installer. The driver is built on the same C++ native library used by ODBC, ADO.NET, and other interfaces. As a result it provides all the protocol support built into that
library, including support for Active/Active database configurations, network compression, and more.

**Go (golang) Support**

The new dedicated Go driver interface allows Go applications to access the SAP HANA server by using the Go SQL API.

**JDBC Enhancements**

<table>
<thead>
<tr>
<th>New Statistics Trace Level</th>
<th>The new JDBC statistics trace level sets tracing for connection statistics, including durations, packet and byte counts, and compression ratios.</th>
</tr>
</thead>
</table>

**ODBC Enhancements**

| COMPACT command for hdbodbc_cons | The new COMPACT command for hdbodbc_cons compacts the trace configuration store of ODBC-based clients. |

**Node.js Enhancements**

- `createLobStream (resultset, columnIndex, options)` function
  
  This function in the Stream Module creates a node.js readable stream by using a result set that fetches data as LOB columns.

- `sendParameterData(columnIndex, buffer[, callback])` Method
  
  This method sends LOB data to the server in chunks.

**API Version Support (changed)**

Complete API version support information is now available at [2499500](#).

**SQLDBC Enhancements (changed)**

| COMPACT command for hdbsqldbc_cons | The new COMPACT command for hdbsqldbc_cons compacts the trace configuration store of SQLDBC-based clients. |

**Network compression**

Network compression is supported by JDBC and all SQLDBC-based APIs. To enable network compression for all client connections, set the `indexserver.ini > session > compression` configuration parameter to TRUE. To enable network compression for a specific connection, set the new SQLDBC or JDBC COMPRESS connection property to TRUE.

**Batch Routing Enhancement (changed)**
Using a unique constraint, the indexserver can now order the client to use the optimal statement route defined by the first row of parameters in a batch, which guides the entire batch of parameters without having to calculate the best route per row. This new feature applies to both range partitioned and hash partitioned tables and is implemented for SQLDBC-based drivers as well as the JDBC driver.

**Behavior Changes**

**Parameter Conversion**

Previously, for JDBC and SQLDBC-based clients, the conversion of parameter data types to the type used on the server was performed the server side. Now, this conversion is performed on the client side.

If this conversion involves an inexact floating-point type, then the value may be slightly different near the limits of the precision of the floating-point type. For example, in the following statement, if a C DOUBLE parameter is bound to an INSERT parameter for a VARCHAR(100) column, (COL1 in the statement below), then the inserted value may differ in the sixteenth digit, but is still the same when rounded to 15 significant digits.

```sql
INSERT INTO MY_TABLE(COL1) VALUES(?);
```

Inexact floating-point client data types include DOUBLE and FLOAT. Examples of inexact floating-point server data types include REAL, DOUBLE, and FLOAT.

**Node.js Driver Renamed**

The name of the Node.js driver has changed to @sap/hana-client.

For example, previously you called `require('hana')`. Now you call `require('@sap/hana-client')`.

**Related Information**

*SAP Note 2036111*

### 3.6.3 SAP HANA SQL Command Network Protocol Reference (Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features, as documented in the SAP HANA SQL Command Network Protocol Reference.

**Terminology (changed)**

The new I12 abbreviation has been added to describe 12-byte integers in little-endian format. The new I16 abbreviation describes 16-byte integers in little-endian format.
The following new input and output field formats have been added: BOOLEAN, FIXED8, FIXED12, and FIXED16.

3.6.4 SAP HANA SQLScript Reference (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA SQLScript.

SQLScript Code Analyzer (New)

The SQLScript Code Analyzer consists of two built-in procedures that scan CREATE FUNCTION and CREATE PROCEDURE statements and search for patterns indicating problems in code quality, security or performance.

Functionality for Avoiding Busy Waiting Times (New)

In some scenarios, you may need to let certain processes wait for a while (for example, when executing repetitive tasks). The manual implementation of such waiting times leads to "busy waiting" and the CPU performs unnecessary work during that time. To avoid this, SQLScript offers a built-in library SYS.SQLSCRIPT_SYNC containing the procedures SLEEP_SECONDS and WAKEP_CONNECTION.

CREATE OR REPLACE (New)

When creating a SQLScript procedure or a function, you can use the OR REPLACE option to change that procedure or function, if it already exists.

System Variable for Line Numbers (New)

SQLScript procedures, functions and triggers can now return the line number of the current statement by means of the system variable ::CURRENT_LINE_NUMBER.

NOT NULL Constraint for Return Table Types (New)

You can now apply the NOT NULL constraint on columns in table types used in SQLScript.
Support for SELECT Statements in Explicit Parallel Blocks (New)

SELECT statements are now supported in explicit parallel blocks.

Enhancement of the INSERT Operator on Table Variables (Changed)

With this enhancement you can insert the content of one table variable into another table variable with a single operation without using SQL.

Encryption for Functions and Procedures (New)

When application developers want to secure their intellectual property, they can use the new SQLScript encryption feature to hide procedure and function definitions from all users.

3.6.5 SAP HANA Analytics Catalog (BIMC Views) Reference (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for SAP HANA Analytics Catalog (BIMC Views).

Support for Null Values (New)

A new field IS_NULLABLE has been added to the table BIMC_DIMENSION_VIEW to support NULL values.

3.6.6 SAP HANA Predictive Analysis Library (New and Changed)

SAP HANA Platform 2.0 SPS 02 introduces new and changed features for the Predictive Analysis Library (PAL).

General and Architectural Changes

In SPS 02, we provide new Type-Any interfaces to call PAL functions. The wrapper procedure generation is no longer necessary for PAL functions. When the SAP HANA Application Function Library (AFL) component is
installed, all PAL functions will be pre-installed as store procedures in schema _SYS_APL, and those procedures can accept different input table types (as for example for various data inputs). For example, there is only one k-means procedure and the user can pass a 10-feature table or 100-feature table to that procedure and the procedure will automatically determine the output structure, including the column type and the column name.

In SPS 02, the following **new** general procedure parameters are introduced:

- **THREAD_RATIO**
  Set an upper limit of thread usage in proportion to the currently available threads on the system, as a accompanying approach to limit resource usage along with the SAP HANA Workload Management capabilities. Further the parameter allows the users to enable multithreading in a convenient way.

- **DEPENDENT_VARIABLE**
  For all classification or regression algorithms, enable the user to explicitly set the dependent variable (i.e. \(Y\), \(<\text{response}\>, ...) by its column name instead of requiring it to be the last input column.

- **HAS_ID**
  Indicate if the input data's first column is the ID column and should not be used as an input column for the processing of the algorithm.

- **CATEGORICAL_VARIABLE**
  For all related PAL functions, allow the user to explicitly set an integer column as a "categorical" column by column name in a string. By default with SAP HANA Platform 2.0 SPS 02, integer columns are considered as a continuous column for all PAL functions.

### New and Enhanced PAL Algorithms

In SPS 02, additions and changes apply in the following PAL algorithms:

- **Factor Analysis (New)**
  Factor Analysis is a statistical method that tries to extract a low number of unobserved variables, i.e. factors, that can best describe the correlation pattern of a larger set of observed variables. Factor Analysis can be used to reduce the dimension of the data as well as reveal the underlying relationships between the observed variables. It is related to PCA, but they are not the same.

- **Multidimensional Scaling (MDS) (New)**
  This function serves as a tool for dimensional reduction or data visualization. It embeds the samples in \(N\)-dimension in a lower \(P\)-dimension by applying the classic multi-dimensional scaling.

- **State enabled scoring functions (New)**
  The following algorithms now newly support to keep the parsed model in-memory and to enable faster real-time predictions: LDA Inference, NBC, BPNN, decision tree, PCA projection, cluster assignment, binning assignment, LDA project, LDA CLASSIFY, Posterior Scaling

- **Algorithm Enhancements:**
  - **Distribution Fitting (Enhanced)**
    Added support for Poisson distribution and Exponential distribution

  - **Random Distribution Sampling (Enhanced)**
Added support for many univariate distributions, for example: Bernoulli, beta, binomial, Cauchy, chi-squared, exponential, extreme value, Fisher’s F, geometric, lognormal, negative binomial, PERT, “student’s t.”
Added a new function named \texttt{DISTRRANDOMMVVAR} to support multivariate distribution: multinomial.
Added support for multithreading.

- **KNN (Enhanced)**
  - Added an additional output table, which returns $k$-nearest neighbors in the training data, and the distances.

- **State enabled scoring functions (Enhanced)**
  - The following new algorithms are supported: LDA Inference, NBC, BPNN, decision tree, PCA projection, cluster assignment, binning assignment, LDA project, LDA CLASSIFY, Posterior Scaling.

- **Auto Exponential Smoothing (Enhanced)**
  - Added seasonal mode detection for model selection
  - Automatically select damped model if the damped model returns a smaller measure error
  - Enabled user defined PHI value and range

- **K-Means (Enhanced)**
  - Added elbow method for “k determination”
  - Avoided duplicate initial centers when init method = 2|3

- **Accelerated K-Means (Enhanced)**
  - Added Hamerly’s accelerate method
  - Enhanced the memory consumption model

### 3.6.7 SAP HANA External Machine Learning Library (New)

The SAP HANA External Machine Learning Library is a new application function library (AFL) introduced in SAP HANA Platform 2.0 SPS 02 that supports the integration of Google TensorFlow, as an external machine learning framework, with SAP HANA.

The External Machine Learning (EML) Library makes use of Google’s gRPC remote procedure call package. These combined capabilities allow you to remotely invoke predefined TensorFlow models, hosted on the TensorFlow Serving server, through gRPC calls encapsulated inside AFL procedures.

The EML API provides the following features:

- **PREDICT function**: The PREDICT function is wrapped using \texttt{SYS.AFLLANG.WRAPPER_PROCEDURE_CREATE}, which exposes the given TensorFlow model within SAP HANA and allows it to be invoked like a normal AFL function.
- **\_SYS\_AFL\_EML\_MODEL\_CONFIGURATION table**: The mappings of models to remote sources.
- **CHECKDESTINATION procedure**: Validates that a model can be reached and has a valid serving state.
- **A set of privileges for EML development and administration tasks.**
4 SAP HANA Platform 2.0 SPS 01 Features

Find out about the new and changed features introduced with the SAP HANA platform 2.0 SPS 01.

4.1 Installation and Update

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for installation and update.

Documentation Changes [page 148]
SAP HANA Platform 2.0 SPS 01 introduces changes to the documentation for SAP HANA installation and update.

SAP HANA Server Installation and Update (New and Changed) [page 149]
SAP HANA Platform 2.0 SPS 01 introduces new and changed features for the installation and update of SAP HANA.

4.1.1 Documentation Changes

SAP HANA Platform 2.0 SPS 01 introduces changes to the documentation for SAP HANA installation and update.

SAP HANA Server Installation and Update Guide (Changed)

The SAP HANA Server Installation and Update Guide now includes a new section called Updating a Single-Container System. This section contains information about the automatic migration of a single-container system to a tenant database system with SAP HANA 2.0 SPS 01.
4.1.2 SAP HANA Server Installation and Update (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for the installation and update of SAP HANA.

Installing and Updating an SAP HANA System (Changed)

As of SAP HANA 2.0 SPS 01, the multi-container database mode is the only database mode. By default, a single tenant database is created during installation. The upgraded system will have one tenant database that corresponds to the old single container. You can add additional tenant databases later using the SAP HANA cockpit.

SAP HANA options hosts or host roles can be automatically provisioned to a system that is installed with a single tenant. If the SAP HANA system contains multiple tenant databases, the SAP HANA options host or host role must be manually provisioned to the tenant.

A single-container system will be automatically converted to a tenant database system during the update. The database of a single-container system is converted into a system database and a tenant database. The upgraded system will have one tenant database that corresponds to the old single container. A new user (SYSTEM) is created in the system database (SYSTEMDB). During the update, a password has to be specified for this user. The database superuser (SYSTEM) of the single-container system becomes the SYSTEM user of the tenant database. You may have to adapt your operations concept to include the new system database. Detailed information can be found in the new section Updating a Single-Container System in the SAP HANA Tenant Databases Operations Guide or the SAP HANA Server Installation and Update Guide.

Related Information

2423367 - Multitenant database containers will become the standard and only operation mode

4.2 Security

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for security.

SAP HANA Database Security (New and Changed) [page 150]
SAP HANA Platform 2.0 SPS 01 introduces new and changed security-related features for the SAP HANA database.
4.2.1 SAP HANA Database Security (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed security-related features for the SAP HANA database.

Authorization and Authentication (New and Changed)

- Data masking represents an additional layer of access control that can now be applied to SQL and calculation views. A column mask protects sensitive or confidential data in a particular column of a view by transforming the data in such a way that it is rendered meaningless, while still appearing real and consistent. Mask expressions can be specified using constants or built-in functions directly in the view definition using the CREATE VIEW or ALTER VIEW statements. The ability to see unmasked data is controlled by the new object privilege UNMASKED.

- It is now possible to reset the password of the SYSTEM user of a tenant database from the system database using the ALTER DATABASE statement.

- It is now possible to configure the password policy so that a minimum number of a particular character type is required, for example, at least 3 digits. You can configure the password layout in the SAP HANA cockpit (recommended) or in the indexserver.ini configuration file with the parameter [password policy] password_layout. For example, if passwords must contain at least 3 digits, you could specify the layout with the value a123A or 789Fg.

Secure Communication (Changed)

- Secure communication between SAP HANA and an LDAP server has been enhanced as follows:
  - CommonCryptoLib is now used to implement TLS-secured communication. OpenSSL is no longer supported.
  - The trust store for secure communication must now be an in-database certificate collection with the purpose LDAP.
  - The following system properties for configuring secure communication are now available in the ldap section of the global.ini file:
    - sslMinProtocolVersion
    - sslMaxProtocolVersion
    - sslCipherSuites
    - timeout
  - The LDAP configuration file ldap.conf on the file system is no longer used. See SAP Note 2438641.

- The new parameter [communication] skip_in_memory_pse_store_for_purposes in the global.ini configuration allows you to force the usage of personal security environments (PSEs) in the file system instead of in-database certificate collections for specified purposes (for example, SAML-based user authentication).
Encryption

- You can now enable the encryption of data and log backups. Backups are encrypted using the new backup encryption root key, which is fully integrated into the existing encryption key management of SAP HANA.
- Two new `hdbuserstore` commands have been added. The `ADDFROMDIR` command adds entries from a store specified by the `DIR` parameter to the secure user store without overwriting existing keys. The `LISTFROMDIR` command lists entries from a store in the store directory.

Security Administration with SAP HANA Cockpit (New and Changed)

The SAP HANA cockpit available with SAP HANA Platform 2.0 SPS 01 has a number of new and enhanced features for security administration. For more information, see the section on SAP HANA cockpit.

Related Information

SAP HANA Cockpit (New and Changed) [page 152]
SAP Note 2438641

4.3 Administration

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for administration.

Documentation Changes [page 152]
- SAP HANA Platform 2.0 SPS 01 introduces new and changed documentation for SAP HANA administration.

SAP HANA Cockpit (New and Changed) [page 152]
- SAP HANA Platform 2.0 SPS 01 introduces new and changed features for SAP HANA cockpit.

SAP HANA System Administration (New and Changed) [page 161]
- SAP HANA Platform 2.0 SPS 01 introduces new and changed features for the administration of SAP HANA.

SAP HANA High Availability (New and Changed) [page 163]
- SAP HANA Platform 2.0 SPS 01 introduces new and changed features for SAP HANA high availability.

SAP HANA Database Backup and Recovery (New and Changed) [page 163]
- SAP HANA Platform 2.0 SPS 01 introduces new and changed features for SAP HANA backup and recovery.

SAP HANA Application Lifecycle Management (New) [page 164]
- SAP HANA Platform 2.0 SPS 01 introduces new and changed features in SAP HANA application lifecycle management.
SAP HANA Smart Data Access (New and Changed) [page 165]
SAP HANA Platform 2.0 SPS 01 introduces new and changed features for SAP HANA smart data access.

SAP HANA Hadoop Integration (New and Changed) [page 166]
SAP HANA Platform 2.0 SPS 01 introduces new and changed features for SAP HANA Hadoop integration and SAP HANA Spark controller.

4.3.1 Documentation Changes

SAP HANA Platform 2.0 SPS 01 introduces new and changed documentation for SAP HANA administration.

SAP HANA Multitenant Database Containers Operations Guide (New and Changed)

The SAP HANA Multitenant Database Containers Operations Guide has been renamed to SAP HANA Tenant Databases Operations Guide.

The SAP HANA Tenant Databases Operations Guide now includes a new section called Updating a Single-Container System. This section contains information about the automatic migration of a single-container system to a tenant database system with SAP HANA 2.0 SPS 01.

Related Information

2423367 - Multitenant database containers will become the standard and only operation mode

4.3.2 SAP HANA Cockpit (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for SAP HANA cockpit.
SAP HANA cockpit support package (SP) 02 is now available. SP 02 also contains features that were made available with SP 01, which was released after SAP HANA Platform 2.0 SPS 00.

About SAP HANA Cockpit SPs

SAP HANA cockpit SPs are available independently of the SAP HANA 2.0 platform revision, but may be included as part of SAP HANA platform revisions.
SAP HANA cockpit SPs are cumulative. This means that a higher SP includes all features and fixes available in earlier SPs.

SAP HANA Cockpit SP 02 Features [page 153]
Find out about the new and changed features introduced with the SAP HANA cockpit SP 02.

SAP HANA Cockpit SP 01 Features [page 158]
Find out about the new and changed features introduced with the SAP HANA cockpit SP 01.

### 4.3.2.1 SAP HANA Cockpit SP 02 Features

Find out about the new and changed features introduced with the SAP HANA cockpit SP 02.

- **Administration and Monitoring** [page 154]
  SAP HANA cockpit SP 02 introduces new and changed features for system administration and monitoring.

- **SAP HANA Database Explorer** [page 155]
  SAP HANA cockpit SP 02 introduces new and changed features for SAP HANA database explorer.

- **Performance Monitoring and Analysis** [page 157]
  SAP HANA cockpit SP 02 introduces new and changed features for performance monitoring and analysis.

- **Security Administration** [page 157]
  SAP HANA cockpit SP 02 introduces new and changed features for security administration.

- **High Availability** [page 158]
  SAP HANA cockpit SP 02 introduces new and changed features for high availability.

- **Backup and Recovery** [page 158]
  SAP HANA cockpit SP 02 introduces new and changed features for backup and recovery.
4.3.2.1.1 Administration and Monitoring

SAP HANA cockpit SP 02 introduces new and changed features for system administration and monitoring.

Multi-container Database Mode (Changed)

You can use the cockpit to monitor and manage multiple systems, each running version SAP HANA 1.0 SPS 12, or later. For all SAP HANA 2.0 SPS 01 systems, the multi-container database mode is the only database mode. However, the cockpit can also monitor single-container systems running earlier versions of SAP HANA.

Add and Remove Services for Tenant Databases (Changed)

You can now use the cockpit to modify the built-in services of an existing tenant database. You can do this through the Manage Services app, which you will need to access by drilling down from the system database, rather than through the tenant itself.

Cockpit User Roles (New)

There are now three roles for cockpit users, which the COCKPIT_ADMIN user can assign through the cockpit manager configuration tool. Each cockpit user must be assigned at least one cockpit role, which will govern what portions of the cockpit or the cockpit manager they can access. (Cockpit roles are unrelated to the roles assigned to database users which govern which SAP HANA privileges belong to that database user).

<table>
<thead>
<tr>
<th>Cockpit Role</th>
<th>Permits access to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cockpit Administrator</td>
<td>The Manage Users and Cockpit Settings sections of the Cockpit Manager. This role is assigned automatically to the COCKPIT_ADMIN user, created during the installation process, and cannot be revoked.</td>
</tr>
<tr>
<td>Cockpit Resource Administrator</td>
<td>The Registered Resource and Resource Groups sections of the Cockpit Manager, where they can register resources, create resource groups, and assign cockpit users to resource groups.</td>
</tr>
<tr>
<td>Cockpit User</td>
<td>The SAP HANA cockpit, where they can view all resources in any assigned resource groups.</td>
</tr>
</tbody>
</table>

A user who has only the Cockpit User role, will not be able to access the Cockpit Manager. Conversely, a user who has only the Cockpit Resource Administrator or the Cockpit Administrator role will not be able to access the cockpit.
Single Sign-On (SSO) (New)

Cockpit resource administrators now have the option to enable or enforce SSO for a specific resource. You can edit this and other settings for the resource through the Cockpit Manager configuration tool. If you enforce SSO, cockpit users must use SSO to access the resource. If you enable SSO, but do not enforce it, cockpit users can choose whether to access this resource with SSO or to enter alternate database user credentials.

Memory Analysis (Changed)

Analyze Memory Allocation Statistics has been redesigned and enhanced as Memory Analysis. This application, which you access by drilling down through Manage Services, enables you to visualize and explore the memory allocation of every service of a selected host during a specified time range. If you notice an increase in overall memory usage, you can investigate whether it’s due to a particular component, subcomponent, or table.

Host Failover (New)

For multi-host systems, you can now use the cockpit to configure host auto-failover so that if an active host fails, standby hosts take over to ensure the continued availability of the database. You can monitor the status of individual hosts and switch the configured roles of hosts; you cannot increase or decrease the number of worker hosts and standby hosts in relation to each other.

4.3.2.1.2 SAP HANA Database Explorer

SAP HANA cockpit SP 02 introduces new and changed features for SAP HANA database explorer.

Database Browser Enhancements

| Database Object Editor Enhancements | Database object editors have been added for nearly all database objects and can be used to view, filter, and search for all objects of a specific type. Database object editors can be accessed by right-clicking the database object in the database browser and clicking Show <database-object>, for example, Show Tables. Improvements have also been made to the database object editors to ensure that they look and behave consistently. |
| Data Preview Enhancements | The data preview now has two tabs, the Raw Data tab that shows the current data preview result in table format, and the Analysis Tab that provides the option to limit the result data to the subset of columns selected by the user and represents the result data in graphical format. The data preview can be accessed for columns, tables, and views by right-clicking the object in the database browser and clicking Open Data. |
MDX Console Enhancements

Improvements have been made to the MDX console to make it easier to create MDX queries. New features include the ability to search for MDX objects in the Object Search and the ability to look up MDX syntax elements in the API reference.

SQL Console Enhancements

A new administrative SQL console is available for HDI administrators to grant privileges on the container’s target schema to other users. Access the administrative console by right-clicking the HDI container in the database browser and clicking Open SQL Console (Admin).

Tracing Enhancements

- **View Diagnostic Files for Offline Cockpit Resources**
  The new Host Diagnostic Files folder contains diagnostic files for cockpit resources that are either online or offline and contains all diagnostic files that have been configured for the SAP Host Agent.

- **Support for Tracing Configuration**
  Database explorer now supports database tracing, SQL tracing, user-specific tracing, and end-to-end tracing. These traces are configurable in their respective tracing editors in the database explorer.

Connection Enhancements

- **Support for User-defined HDI Containers**
  When adding an HDI container to the database explorer, user-defined containers now appear in the drop-down list of available HDI containers.

- **Support for HDI-containers Contained in Instance Managers**
  When adding a database to the database explorer, the Database type drop-down list now offers the Application Managed Service Instances option, which allows you to add an HDI container that is contained in an instance manager.

- **Support for Advanced Connection Options**
  When adding an HDI container or database, the Add Database editor now contains the Advanced Options field, which allows you to specify advanced connection options, such as encryption options and isolation levels. The new CLIENT option has also been added, which allows you to set the session client for the connection.
4.3.2.1.3 Performance Monitoring and Analysis

SAP HANA cockpit SP 02 introduces new and changed features for performance monitoring and analysis.

SQL Analyzer

The SQL analyzer offers the following functionalities:

- It is now possible to generate a graphical view of the plan to help you understand and analyze the execution plan of an SQL statement.
- It is now possible to have a complete overview of the execution plan based on the visualization of sequential time-stamps in the timeline view.
- It is now possible to view detailed information of operators using the detailed properties view.

Capture and Replay

The Capture and Replay offers the following functionalities:

- In the Comparison Report it is now possible to view statement details by clicking the bar chart displayed in the report.
- In the Comparison Report it is now possible to export replay reports to PDF.

Manage Statement Hints

The Manage statement hints allows you to add statement hints to an SQL statement without modifying the actual statement in the application.

4.3.2.1.4 Security Administration

SAP HANA cockpit SP 02 introduces new and changed features for security administration.

Database User Management

- When creating or changing a database user, you can now configure JSON Web token (JWT) as an authentication mechanism.
- When configuring the password policy for the SAP HANA database, you can now enforce the use of a specific number of a particular character type, for example, two digits, three special characters.
Database Role Management

You can now view the details of all roles available in the SAP HANA database on the new Role page. You can also create, change, and drop catalog roles.

To access the Role page, choose the Manage roles link on the overview page of the system.

4.3.2.1.5 High Availability

SAP HANA cockpit SP 02 introduces new and changed features for high availability.

Configuring System Replication

It is possible to configure system replication only from the primary system. If the configuration was interrupted, it is possible to continue starting from the last successful step.

4.3.2.1.6 Backup and Recovery

SAP HANA cockpit SP 02 introduces new and changed features for backup and recovery.

SAP HANA cockpit now allows you to perform the following tasks:
- Recover single-tenant SAP HANA systems from a storage snapshot.
- Display the backup encryption status information.

4.3.2.2 SAP HANA Cockpit SP 01 Features

Find out about the new and changed features introduced with the SAP HANA cockpit SP 01.

Administration and Monitoring [page 159]
- SAP HANA cockpit SP 01 introduces new and changed features for system administration and monitoring.

Performance Monitoring and Analysis [page 159]
- SAP HANA cockpit SP 01 introduces new and changed features for performance monitoring and analysis.

Security Administration [page 160]
- SAP HANA cockpit SP 01 introduces new and changed features for security administration.

High Availability [page 160]
- SAP HANA cockpit SP 01 introduces new and changed features for high availability.

Backup and Recovery [page 161]
SAP HANA cockpit SP 01 introduces new and changed features for backup and recovery.

4.3.2.2.1 Administration and Monitoring

SAP HANA cockpit SP 01 introduces new and changed features for system administration and monitoring.

License Management

You can now view the details, including memory usage data, of all licenses installed in your SAP HANA system on the new License page. Here, you can also perform the following tasks:

- Request and install a new permanent license key
- Delete permanent license keys
- Export memory usage data for license auditing purposes

To access the License page, choose the Manage licenses link on the overview page of the database.

4.3.2.2.2 Performance Monitoring and Analysis

SAP HANA cockpit SP 01 introduces new and changed features for performance monitoring and analysis.

Performance Monitor

The Performance Monitor offers the following functionalities:

- It is now possible to define the monitored timeframe by manual entry.
- By using the Add Chart button, it is now possible to create custom charts displaying the host and services selection, as well as selected KPIs.
- In the Settings menu, it is possible to configure Alerts according to category and priority status, and to customize your graphs by including hosts and services, as well as additional KPIs.
- Customized user parameters are now saved for the next logon.

Capture and Replay

When replaying preprocessed workloads, it is now possible to turn the Transactional Replay on or off on the Replay Configuration page. When the Transactional Replay is on, the Comparison Report displays a report on the results comparison. When the Transactional Replay is off, the Comparison Report displays a report on the runtime comparison.
**Workload Analyzer**

The workload analyzer based on engine instrumentation offers the following functionalities:

- It is now possible to start the tracing process from the *Workload List* page by clicking *Start Trace* on the bottom right.
- After starting the tracing process it is possible to turn on the *Collect Performance Details, CPU Consumption*, and the *Memory Consumption* options. These statement-level statistics will be displayed in the timeline view.

The workload analyzer based on thread samples offers the following functionalities:

- It now displays the number of thread samples next to each legend in the area chart on the lower part of the screen.
- When customizing the information displayed on the load graph on the upper part of the screen it is now possible to choose all available services from the host and services combo box. Previously, it was possible to select only index server services.

### 4.3.2.2.3 Security Administration

SAP HANA cockpit SP 01 introduces new and changed features for security administration.

**Database User Management**

It is now possible to convert a standard database user to a restricted database user and vice versa. New options on the *User* page allow you grant (or revoke) the PUBLIC role and grant (or revoke) authorization to create objects in the user’s own schema.

### 4.3.2.2.4 High Availability

SAP HANA cockpit SP 01 introduces new and changed features for high availability.

**Retention Time Estimation**

For the operation modes *logreplay* and *logreplay_readaccess*, it is now possible to view a retention time estimation on the *System Replication Overview*. The *Estimated log retention time* is an estimation of the time left before the primary system starts to overwrite the *RetainedFree* marked log segments and a full data shipping becomes necessary to get the primary and the secondary systems back in sync after a disconnect situation. The *Estimated log full time* is an estimation of the time left before the primary system runs into a log full. The value displayed in the header shows the situation into which the system could run first: log retention or log full.
The estimated log retention time as well as the estimated log full time for all system replication relevant services are displayed in the Log Replay tab.

**Network Speed Check**

It is now possible to measure the network speed of the system replication host-to-host network channel mappings using the Network Speed Check tab on the System Replication Overview.

### 4.3.2.2.5 Backup and Recovery

SAP HANA cockpit SP 01 introduces new and changed features for backup and recovery.

SAP HANA cockpit now allows you to perform the following tasks:

- Back up tenant databases from the system database.
- Recover tenant databases from the system database.
  - A database can be recovered to its most recent state or to a specific point in time.
- Data backups can be scheduled through the tenant database.
- From the system database, view the backup history and details in the backup catalog for tenant databases.

### 4.3.3 SAP HANA System Administration (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for the administration of SAP HANA.

#### JSON Document Store (New)

The SAP HANA Document Store (often referred to as 'DocStore') is a store for JSON artifacts and allows native operations on JSON including filtering, aggregation, and joining JSON documents with HANA column or row store tables. JSON documents (JavaScript Object Notation) are stored in collections, these appear to users like tables and users can read data from tables and collections in a single statement and can combine tables and collections by joining as with any other column or row store table.

The Document Store is an optional feature of the SAP HANA database which you have to create for each tenant database.

#### Dynamic Result Cache (New)

Result caching may be used to improve the performance of queries which are frequently executed. In comparison to the static result cache, a dynamic result cache eliminates the risk of querying stale data and will
always return transactionally consistent data. The dynamic result cache can dramatically improve performance in situations which involve intensive parallel querying of large tables and extensive use of aggregation. The dynamic result cache guarantees up to date results by firstly incrementally updating the cache with delta records of newly changed data and then returning the query result from the cache.

Workload Management (Changed)

Changed features in the area of workload management include the following:

**Event Details for Admission Control**: Additional configuration parameters to manage queued transactions and a monitoring view (M_ADMISSION_CONTROL_EVENTS) to provide information about why a statement was queued have been introduced in this release to extend the functionality of Admission Control.

**Hint for Workload Classes**: A workload class hint has been introduced so that administrators can apply an alternative workload class at the time when the query is executed.

Statistics Server (Changed)

The statistics server is the component of the SAP HANA database that provides internal monitoring functions. It continuously collects information about system status, performance, and resource usage, and issues alerts in the event of problems.

As of SAP HANA 1.0 SPS 07, it was possible to switch to the embedded statistics service, which is an alternative implementation of the statistics server.

An SAP HANA system that is still running the statistics server is automatically migrated to use the embedded statistics service after an upgrade to SAP HANA 2.0 SPS 01. This change only affects single-container systems.

New SAP HANA HDBSQL Options (Changed)

The following new options have been added to modify the operation of SAP HANA hdbsql commands:

- The new `-fn` option returns all SQL statements that are sent to the database instance and formats them with numbered lines. Numbered lines make it easier to determine on which file line a potential error has occurred.
- The new `-batchreset` option specifies a reset command (for example, `<reset>`), which tells SAP HANA HDBSQL to ignore the most recent query sent to the server. In order to specify batchreset, you must also set the `-separatorownline` option. The reset command should not be an SQL statement or a separator. Setting `-batchreset` on the same line as the separator command results in an error because it is not a valid query.
4.3.4 SAP HANA High Availability (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for SAP HANA high availability.

srServiceChange Hook (New)

The srServiceStateChanged() hook allows monitoring state changes of the SAP HANA services. This allows to trigger a takeover to the secondary system rather than a long lasting indexeserver restart.

Data Shipping Parallelization (New)

A more performant initialization through data shipping via multiple network connections is now possible. The datashipping_parallel_channels parameter defines the number of network channels used by full or delta datashipping. The actual number of channels for each shipping can be adjusted by the system to reduce overhead depending on the current amount of data to be shipped.

4.3.5 SAP HANA Database Backup and Recovery (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for SAP HANA backup and recovery.

Backup Encryption (New)

SAP HANA supports native backup encryption.

For more information:

- Points to Note: SAP HANA Backup Encryption in the SAP HANA Administration Guide (SAP HANA Database Backup and Recovery)
- Backup Encryption and Encryption Key Management in the SAP HANA Security Guide
- ALTER SYSTEM BACKUP ENCRYPTION Statement (System Management) in the SAP HANA SQL and System Views Reference
Support for Third-Party Backup Tools (New)

It is now possible to copy a database by recovering it from backups created using a third-party tool:

- A tenant database can be copied using backups created with a third-party tool.
- A single-container system can be recovered to a tenant database using backups created with a third-party tool.

Recovery From Storage Snapshots (New)

It is now possible to create a storage snapshot for a single-tenant system.

To create a storage snapshot, you need to use native SQL.

To recover SAP HANA from a storage snapshot, you need to recover the system database and the tenant database separately.

For more information, see Storage Snapshots in the SAP HANA Administration Guide (SAP HANA Database Backup and Recovery).

Enhancement for Tenant Databases (Changed)

It is now possible to add or remove a service without breaking the backup history.

This means that it is now possible to recover an SAP HANA database using backups that were created before a topology change was made to recover to a point in time after the topology was changed.

After adding or removing a service, it is no longer necessary to create a full data backup.

4.3.6 SAP HANA Application Lifecycle Management (New)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features in SAP HANA application lifecycle management.

The new graphical user interface XSA Application Lifecycle Management is available. It can be used for the installation, update, and uninstallation of products and software components in SAP HANA XS advanced model and represents an alternative to the XS advanced command line interface.
4.3.7 SAP HANA Smart Data Access (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for SAP HANA smart data access.

Linked Database (New)

Linked database allows DML queries on remote data sources without the need to first create virtual tables. Linked database uses a three-part namespace to directly identify the remote database, schema, and table name. This makes ad-hoc queries against remote sources convenient.

Support for Three-part Namespace (Changed)

The following SQL statements now support three-part namespace, required for the linked database feature:

- CREATE/ALTER/DROP/REFRESH STATISTICS Statement
- CREATE SYNONYM Statement
- DELETE Statement
- INSERT Statement
- SELECT Statement
- REPLACE | UPSERT Statement
- TRUNCATE Statement
- UPDATE Statement

LINKED DATABASE System Privilege (New)

LINKED DATABASE is a new source privilege to support the linked database feature.

Drop and Refresh Metadata for Linked Database (New)

When the metadata in a remote table changes, use the ALTER REMOTE SOURCE statement to refresh the linked object to reflect the change. The ALTER REMOTE SOURCE statement can also be used to perform housekeeping of the internally generated virtual tables.

REMOTE_SOURCES System View (Changed)

A new linked database column was added to indicate if the linked database feature is supported for the remote source.
New Section Added to `indexserver.ini` file

A new section named `linked_database` was added to the `indexserver.ini` file. It contains the parameter `linked_database_cleanup_interval`, which specifies the interval in seconds to wake up the job that performs linked object housekeeping tasks.

**EXPORT/IMPORT Virtual Tables (Changed)**

The IMPORT statement now supports the ability to transport some or all of the existing virtual tables in the source system to a new system. You can specify a new schema or database name during the process. You can also use this statement with a loopback remote source to reproduce a virtual table workflow in a local environment for troubleshooting purposes.

**4.3.8 SAP HANA Hadoop Integration (New and Changed)**

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for SAP HANA Hadoop integration and SAP HANA Spark controller.

**Proxy Server Parameters**

SAP HANA Spark controller facilitates parallel data transfer between SAP HANA and Spark controller executor nodes, which requires the port range of 56000 to 58000 to remain open in environments where there is firewall between SAP HANA and Hadoop. However, keeping this port range open can be a security risk. Spark controller has introduced the `sap.hana.p2p.transfer.enabled` configuration parameter, which, when disabled, can be used to stream the data through a single port. This allows for stricter monitoring for security related issues.

Some Hadoop configurations require the proxy server to be positioned in-between SAP HANA and Spark controller. In this type of configuration, the `sap.hana.p2p.transfer.enabled` parameter can be used to configure Spark controller to work in single-channel data streaming mode to enable communication through the proxy server.

**Support for Parcels Binary Distribution Format**

When installing SAP HANA Spark controller with Cloudera Manager, you need to use the parcels binary distribution format rather than packages. Parcels offer several advantages over packages, including single object installation and third party support for parcels.

With parcels, the path to the CDH libraries is now `/opt/cloudera/parcels/CDH/lib` instead of `/usr/lib`.
Additional Data Format Support

The new configuration parameter `sap.hana.es.data.format` allows you to specify the data storage format when moving data to Hadoop. The following values can be specified: `parquet`, `orc`, or `auto`. The default is `auto`.

Support for RedHat 7

Set up of SAP HANA Spark controller using the Cloudera Manager on Red Hat Enterprise Linux 7 is now supported.

For more information, see SAP HANA Spark Controller

4.4 Development

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for development.

SAP HANA XS Advanced Development (New and Changed) [page 168]
For SAP HANA Platform 2.0 SPS 01 SAP HANA supports development and deployment of SAP HANA extended application services (XS) advanced model applications.

Search, Text Analysis, and Text Mining [page 173]
SAP HANA 2.0 SPS 01 introduces new and changed features for search, text analysis, and text mining.

SAP HANA Graph (New and Changed) [page 176]
SAP HANA Platform 2.0 SPS 01 introduces new and changed features for the administration of SAP HANA Graph.

Hierarchy Functions (New and Changed) [page 177]
SAP HANA Platform 2.0 SPS 01 introduces new and changed features for hierarchy functions.

SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA (New and Changed) [page 177]
SAP HANA Platform 2.0 SPS 01 introduces new and changed features in SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA.

SAP Web IDE for SAP HANA (New and Changed) [page 178]
SAP HANA Platform 2.0 SP01 introduces new and changed features in SAP Web IDE and integrated SAP HANA tools.

SAP HANA Interactive Education (SHINE) for XS Advanced (New and Changed) [page 184]
SAP HANA Platform 2.0 SPS 01 introduces new features in SAP HANA Interactive Education (SHINE) for XS Advanced - demo content delivered as a package with sample data and design-time developer objects that makes it easy to learn how to build applications on SAP HANA Extended Application Services Advanced Model.
4.4.1 SAP HANA XS Advanced Development (New and Changed)

For SAP HANA Platform 2.0 SPS 01 SAP HANA supports development and deployment of SAP HANA extended application services (XS) advanced model applications.

Application Run-Time Environment

SAP HANA XS advanced provides the following run-time environments for your application:

- **JavaScript/Node.js**
  JavaScript run time to which you can deploy your Node.js and XS JavaScript applications.

  **Note**
  The XS JavaScript (XSJS) run time is a compatibility layer that runs on top of Node.js, which enables you to execute your existing code base, for example, `.xsjs` and `.xsjslib` files.

- **Java (Tomcat 8/TomEE)**
  SAP HANA XS advanced model provides a Java run time to which you can deploy your Java applications. The Java run time for SAP HANA XS advanced provides a Tomcat or TomEE run time to deploy your Java code.

- **Custom run time**
  You can also create and run a custom run-time environment of your own in XS advanced, so that you can deploy applications written using languages such as Python or PHP, which are not supported by any of the default run-time environments included in the XS advanced run-time store.

  **Restriction**
  SAP does not provide support for custom language, buildpack, or run-time scenarios.

Applications deployed to a custom run-time environment in XS advanced do not have automatic access to (or use of) some important features that are built into and supported by the XS advanced framework, including (but not limited to): authentication and security, logging and auditing, and connections to the database. If you deploy an application to a custom run-time environment in XS advanced, you must configure these components manually for the custom application.

JavaScript Run Time

SAP HANA XS advanced provides the following updates and new features for the SAP HANA Platform 2.0 SPS 01 JavaScript run-time environment:

- **@sap/hdbext**
  The names of all packages in XS_JAVASCRIPT have been changed names; new package names start with the "@sap/", for example, sap-hdbext is now @sap/hdbext.
Java Run Time

SAP HANA XS advanced provides the following updates and new features for the SAP HANA Platform 2.0 SPS 01 Java run-time environment:

- Provides the XS_JAVA archive, which includes a selection of client Java libraries for SAP HANA XS advanced.
- Support for Apache Tomcat 8.5.x

Application Router

For SAP HANA Platform 2.0 SPS 01, SAP HANA XS advanced provides the following updates and new features for the Node.js application router (approuter.js):

- Routes are matched by both URL path and HTTP methods
- The following new environment variables are available for advanced configuration of the application router:
  - <COMPRESSION> Configures the compression level
  - <SECURE_SESSION_COOKIE> Enforces the secure flag of the application router’s session cookie
  - <REQUEST_TRACE> Enable enhanced request tracing
- Additional checks for regular expressions during startup of the application router
- Support for custom error pages (errorPage) in the application descriptor (xs-app.json). You can use this parameter to specify the files containing the custom page to display for various, standard HTTP status-codes, for example: 400, 404, 500.
- Extended and improved support for sizing
- Support for PATCH HTTP method (httpMethods) in the application descriptor configuration.
- Improved extensions support for the application router
- Previous component name in SAP Passport has been changed to “XSA Approuter”

Deployment Service

For SAP HANA Platform 2.0 SPS 01, SAP HANA XS advanced provides the following updates and new features for the deployment service, for example, in the deployment descriptor (mtad.yaml) and the XS CLI command xs deploy):

- Support for Zero DownTime Maintenance (ZDM) for XS advanced applications with HDI
- CTS+ integration allows the deployment of multiple MTAs
- Disallow cross-MTA configuration visibility without explicit target organization or space in the MTA specification
- New and updated MTA module and resource types
- Renamed XS CLI plug-in option used to specify a target URL for a deployment service end-point from -h to -u, for example:
  ```
  xs deploy [-i <OPERATION_ID>] [-a <ACTION>] [-u <URL>]
  ```
● Renamed the option “TARGETPLATFORM” to “DEPLOY_TARGET”, for example, in the XS CLI commands, deploy or bg-deploy, etc.
● Renamed all target-platform* commands to deploy-target*, for example, deploy-target, create-deploy-target, update-deploy-target, and delete-deploy-target
● Update module and resource parameters
  ○ New “plural” parameters to enable the specification of multiple values, for example: hosts, domains, ports
  ○ Support for the no-start option when pushing and deploying applications to the XS advanced runtime environment
  ○ Support for tasks in the modules section

SAP HANA Deployment Infrastructure

For SAP HANA Platform 2.0 SPS 01, SAP HANA XS advanced provides the following updates and new features for SAP HANA Deployment Infrastructure (HDI):

● HDI Configuration Parameter Reference
● HDI Parameter Reference
● HDI Build Plug-ins and File Formats Reference 2.0
● HDI Admin Documentation
● HDI Deployer

Core Data Services

For SAP HANA Platform 2.0 SPS 01, SAP HANA XS advanced provides the following updates and new features for Core Data Services (CDS):

● CDS Views can now be enhanced with parameters
● Multiple top level artifacts are allowed in a single CDS document
● Enhancements for query features

JSON Document Store (New)

The SAP HANA Document Store (DocStore) is a place where applications can collect JSON documents, that is; files with content that is formatted according to the rules defined in the JavaScript Object Notation. The DocStore allows the creation and maintenance of JSON collections as well as native operations on JSON documents, for example: filtering and aggregation, and joins with SAP HANA column- or row-store tables.

The DocStore is an optional feature of the SAP HANA database which you have to create for each tenant database.
XMLA Services

For SAP HANA Platform 2.0 SPS 01, SAP HANA XS advanced provides the following updates and new features for XMLA services:

- An XML for Analysis (XMLA) application running in SAP HANA application services (SAP HANA XS) is used to provide the consumption model for client applications exchanging MDX queries (wrapped in XMLA documents) with the SAP HANA database.

  The XMLA service is defined by deploying the Node.js application `xmla`.

**Note**

XS advanced supports XMLA version 1.1.

XS Advanced Command-Line Interface

For SAP HANA Platform 2.0 SPS 01, SAP HANA XS advanced provides the following updates and new features for the XS command-line interface:

- Numerous improvements and additions to the parameters and options already available with existing commands
- User administration
  - New options for updating role collections, `update-role-collection`, for example, to assign, reassign, or change roles.
- XS application tasks
  - Maintain and manage application-related tasks in the XS advanced run-time environment, for example: list all tasks (`xs tasks`), run tasks (`xs run-task`), and cancel tasks (`xs cancel-task`).
- Renamed XS CLI plug-in option used to specify a target URL for a deployment service end-point from `-u` to `-h`, for example,

  ```bash
  xs deploy [-i <OPERATION_ID>] [-a <ACTION>] [-h <URL>]
  xs deploy [-i <OPERATION_ID>] [-a <ACTION>] [-h <SERVICE_ENDPONIT>]
  ```

- Renamed the option "TARGET_PLATFORM" to "DEPLOY_TARGET", for example, in the XS CLI commands, `deploy` or `bg-deploy`, etc.
- Renamed all `target-platform*` commands to `deploy-target*`, for example, `deploy-target`, `create-deploy-target`, `update-deploy-target`, and `delete-deploy-target`

OData Services

For SAP HANA Platform 2.0 SPS 01, SAP HANA XS advanced provides the following updates and new features for the OData services:

- Support in the JavaScript runtime for annotations in metadata
Documentation

This section contains information about the following new or changed development-related documents:

- SAP HANA Developer Information Map for SAP HANA XS advanced model
- SAP HANA Developer Guide for SAP HANA XS advanced model
- SAP HANA XS Migration Guide

**SAP HANA Developer Guide for SAP HANA XS Advanced Model**

The SAP HANA Developer Guide for SAP HANA XS advanced model describes the recommended process to follow when building and deploy applications that run in the SAP HANA extended application services, advanced model (XS advanced) run time; it also describes the required technical structure of applications that can be deployed to the XS advanced run-time platform using either the SAP Web IDE for SAP HANA or the XS command line tools.

The following areas in the SAP HANA Developer Guide for XS advanced model have been added, updated, or improved:

- **Getting Started**
  New and updated tutorials for the SAP HANA Run time Tools (a.k.a SAP HANA Database Explorer)

- **Maintaining Application Development and Deployment Descriptors**
  Improved and more comprehensive descriptions of the configuration files used to define and describe the build and deployment of a Multi-Target Application (MTA)

- **Defining the Data Model in XS Advanced**
  ○ Maintaining JSON Collections in the SAP HANA Document Store
  ○ Using Synonyms to Access External Schemas and Objects in XS Advanced

- **Defining OData Services for XS Advanced Applications**
  Improved and more comprehensive explanations of how to create and deploy OData services in XS advanced, for example: changes and additions to the service-definition syntax and many some examples of working service definitions.

- **Writing the XS Advanced Application Code**
  ○ JavaScript/Node.js Run-Time Environment
    Improved and more comprehensive explanations of how to make use of the features available in the JavaScript/Node.js run-time environments, for example, which Node.js packages are available by default and how you can consume them with your MTA. There is also some new information about the unit-test framework, which you can use from within SAP Web IDE for SAP HANA.
  ○ Java Run-Time Environment
    Improved and more comprehensive explanations of how to make use of the features available in the Java run-time environments, for example, how to set up connections to the SAP HANA database, how to configure logging and tracing, how to set up audit logs, how to configure authentication and authorization, how to debug your Java application, and how to enable Java Data Services (a native Java client for using Core Data Services functionality in the XS advanced Java run time).

- **Maintaining XS Advanced Application Routes and Destinations**
  Improvements to and extension of existing information as well as new information about features and functionality added with SAP HANA Platform 2.0 SPS 01.

- **SAP Web IDE**
  A complete reference for SAP Web IDE for SAP HANA, a browser-based integrated development environment (IDE) for the development of SAP-HANA-based applications comprised of web-based or mobile UIs, business logic, and extensive SAP HANA data models. SAP Web IDE works in conjunction with
the SAP HANA Run-time Tools (HRTT), the SAP HANA deployment infrastructure (HDI), the Application Lifecycle Management tools (ALM) and the XS advanced run-time platform

- HDI Artifact Types and Build Plug-ins Reference
  Improvements and additions to the list of available plugins providing support for a wide variety of database artifacts types, for example, `.hdbcollection` (JSON collections for the SAP HANA DocStore).

- XS Command-Line Interface
  Numerous improvements and additions to the parameters and options already available with existing commands as well as important additions to the installation and deployment functions including more control of the application version deployed and the services bound to the deployed application.

## 4.4.2 Search, Text Analysis, and Text Mining

SAP HANA 2.0 SPS 01 introduces new and changed features for search, text analysis, and text mining.

### 4.4.2.1 Search (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for search.

The following list contains features for use with built-in procedures `sys.esh_search()` and `sys.esh_config()` and for use in search models created with CDS.

#### Support for Spatial Datatypes

It is now possible to define filters on the spatial data types `ST_POINT` and `ST_GEOMETRY`.

Columns of SQL type `ST_POINT` and `ST_GEOMETRY` are returned in GeoJSON format. GeoJSON is a geospatial data interchange format based on JavaScript Object Notation (JSON).

The attribute conditions `:WITHIN:`, `:COVERED_BY:`, and `:INTERSECTS:` are available and are internally mapped to the SQL functions `ST_Within`, `ST_CoveredBy`, and `ST_Intersects`.

#### Facets

With this release, spatial facets for `ST_POINT` columns are supported. They are calculated using the grid-based aggregation functions of SAP HANA.

In addition, you can use the new annotation

```java
@EnterpriseSearch.filteringFacet.caseInsensitiveAggregation. If set to true, a case-insensitive aggregation of facet values is done. If not given or set to false, the default aggregation is case-sensitive.
```
Dynamic Search Configurations

Some applications define their own persistence to store search configurations. Other applications define varying configurations that depend on, for example, the user settings or other parameters. For the above use cases, `sys.esh_search()` allows the definition of dynamic search configurations at runtime. If a search configuration is passed to `sys.esh_search()`, all search configurations already stored in the SAP HANA configuration tables are ignored.

New Numeric Ranking Weights

With this release, the new annotation `@EnterpriseSearchHana.weight` is always returned instead of `@Search.ranking`. ‘HIGH’, ‘MEDIUM’, and ‘LOW’ are returned as their numeric values (‘HIGH’ = 1.0, ‘MEDIUM’ = 0.7, and ‘LOW’ = 0.5).

Built-In Procedure `sys.esh_config()` and CDS

Note the following new features for built-in procedure `sys.esh_config()`:

- The new annotation `@EnterpriseSearch.filteringFacet` replaces the use of mode AUTO_FACET.
- The new annotation `@EnterpriseSearch.defaultValueSuggestElement` replaces usage mode SUGGESTION.
- There is the new annotation `@EnterpriseSearchHana.identifier` to define the OData identifier of a view.
- There is the new annotation `@EnterpriseSearchHana.uiResource.label` to define resource bundles and resource keys, used by the search UI to get label texts.

Built-In Procedure `sys.esh_search()`

- Note the following new features for built-in procedure `sys.esh_search()`:
- Interval facets are available on numeric columns.
- Search results are written to a database table.
- The user language can be used as an input parameter.
- The query language, for performance optimizations, allows the separation of search terms and filter conditions used for authorization checks, boosting, and other features.
- It is now possible to limit search and metadata requests to one database schema.
Fuzzy Search

With this release, a set of new score functions for numeric and date types are available. For DATE columns are functions for linear and Gaussian scores available, for NUMERIC columns linear, Gaussian, logarithmic.

4.4.2.2 Text Analysis (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for text analysis.

Web IDE Extensions for Text Analysis

SAP Web IDE returns the line number of any errors that exist in your custom text analysis dictionaries, rules, and configuration settings. These errors appear in the Problem View in the Web IDE after building your custom TA resources. Clicking on an error opens the TA object and places the cursor on the line containing the error.

In addition, many improvements have been made to the error messages to make them clearer and more useful. Users can locate and repair errors in their custom text analysis dictionaries and rules faster and with less effort.

See chapter Managing Custom Text Analysis Configurations with XS Advanced inside the SAP HANA Text Analysis Developer Guide for details.

Improved Linguistic Analysis in Korean

Numerous incremental changes to Korean increase the accuracy of full text search and text analysis when processing Korean text.

Stemming improvements in Linguistic Analysis:

- Numerical tokens: Before: 11시 Now: 11#시
- Compound nouns: Before: 전문회사 Now: 전문#회사

More granular part-of-speech tags:

- Addition of PoS tags for numerical tokens: Num-Day, Num-Month, Num-Year, Num-Meas, Num-Time, Num-Floor, Num-Money, Num-Percent, Num-Phone, Num-Date, and Num-RRN.

Request Extraction in Arabic Sentiment Analysis

Sentiment analysis in Arabic extracts customer requests to help determine what consumers desire.

A simple example is ممكن تزودوا زر؟ (Would it be possible to add a switch?). From this, text analysis returns the GeneralRequest entity ممكن (would it be possible) with the Topic تزودوا زر (add a switch).
**Tolerant Spelling Support for Portuguese**

Portuguese linguistic analysis is more tolerant of variations in capitalization, accents, and hyphenation. This increases recall for full text search and text analysis applications that process Portuguese inputs.

For example, rodrigo is recognized as a variation of Rogrigo, acafrao a variation of açafrão, and afrobrasileiro a variation of afro-brasileiro.

**Topic Normalization in Portuguese**

Determiners such as "O" and "A" are not included in the topics extracted by Voice of the Customer (sentiment analysis), simplifying the aggregation and matching of topics and making Portuguese consistent with sentiment analysis in other languages.

As an example, if the input text contains O livro me fascina!, the Topic extracted by Text Analysis is livro.

4.4.2.3 **Text Mining (New and Changed)**

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for text mining.

**Improved Term Input Handling**

You can specify multiple input terms with optional term types and wildcarding in the TM_GET_RELATED_TERMS and TM_GET_RELEVANT_DOCUMENTS functions. When the term type is unspecified, any term type should be allowed. It allows a combination of terms and all instances of an entity type.

4.4.3 **SAP HANA Graph (New and Changed)**

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for the administration of SAP HANA Graph.

- The graph algorithm Shortest Path (One-to-One) has been added.
- Support for the openCypher query language has been enhanced:
  - Handling of paths
  - Handling of undirected edges
  - A list of reserved keywords for openCypher has been added.
Support for the GraphScript query language has been enhanced:

- Set operations on multisets of vertices and edges have been added.
- Explicit scalar value casting functionality has been added.
- Support for neighborhood queries has been added.
- Null value handling has been added.

### 4.4.4 Hierarchy Functions (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for hierarchy functions.

#### SAP HANA Hierarchy Developer Guide (New)

This release includes a new SAP HANA Hierarchy Developer Guide. This guide explains how to use the hierarchy functions that are an integral part of SAP HANA core functionality.

#### SQL Functions (New and Changed)

For information about new and changed hierarchy functions, see SAP HANA SQL and System Views Reference (New and Changed) in this guide.

#### Related Information

SAP HANA SQL and System Views Reference (New and Changed) [page 186]

### 4.4.5 SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features in SAP Enterprise Architecture Designer, Edition for SAP HANA.

- Export to PowerPoint - Select Export to PowerPoint to download the diagram as a *.pptx file for opening in Microsoft PowerPoint 2013 or higher.
- Diagram Overview Panel - This new panel allows you to navigate in a diagram that is larger than the viewer by dragging the view box over a thumbnail of the full diagram image. The panel is collapsed by default and can be opened by clicking the Show Overview arrow in the bottom-right corner of the diagram viewer.
- Dependencies Tab - This new object property tab combines and replaces the former Impacts and Depends On tabs.
- **Share Menu** - A new Share menu regroups the various features for sharing and exporting diagrams, and a new option in the Share Link dialog allows you to choose between generating a link that points to the specific version of the diagram you are viewing, or one that will always point to the latest published version of a diagram.

- **Physical Data Model Enhancements:**
  - Tolerant SQL Parsing - The parsers that interpret reversed SQL code to model views and physical options will now display a warning when they encounter syntax that they do not understand and will continue to parse and extract properties from the remainder of the SQL statement.
  - Reverse-Engineering Options - A new Options tab allow you to optimize reversing objects by controlling the extent of the information captured for them.
  - Rebuild References - A new command, which can be invoked through a reverse-engineering option or from the tools menu, will attempt to re-create references between tables by matching primary key columns to columns in other tables by code.

- **User Administration Enhancements:**
  - A new log at Administration/Activities/Security Log allows administrators to review events relating to user accounts including successful and unsuccessful logins, password changes, user updates, and blocked and deactivated users.
  - Each user can now review the information associated with their account by clicking their name in the homescreen and selecting User Account.

### 4.4.6 SAP Web IDE for SAP HANA (New and Changed)

SAP HANA Platform 2.0 SP01 introduces new and changed features in SAP Web IDE and integrated SAP HANA tools.

SAP Web IDE for SAP HANA is a browser-based integrated development environment (IDE) for the development of SAP HANA-based applications comprised of web-based or mobile UIs, business logic, and extensive SAP HANA data models. SAP Web IDE works in conjunction with the SAP HANA deployment infrastructure (HDI), the Application Lifecycle Management tools (ALM), the XS Advanced runtime platform, and various SAP HANA tools.

#### SAP Web IDE

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTA Editor</td>
<td>In addition to a text-based code editor, a graphical editor is now available for editing the MTA application descriptor (mta.yaml).</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>Use of SAP-scoped packages</td>
<td>When customizing your environment during SAP Web IDE installation, you can now define an upstream link specific for the SAP-scoped Node.js packages (package names with the @sap prefix), so that these packages can be fetched from a specific npm registry.</td>
</tr>
<tr>
<td>Database development: Support for earlier SAP HANA database versions</td>
<td>When creating an SAP HANA Database module, you can select the target SAP HANA version that is equal to or earlier than the one used in your development environment, starting from 1.0 SPS12. This enables you to develop applications in the new development environment and deploy them to an earlier version of the database.</td>
</tr>
<tr>
<td>Database development: Support for multitenant database containers (MDC)</td>
<td>You can now use SAP Web IDE for SAP HANA to develop applications in a development environment with the MDC configuration.</td>
</tr>
<tr>
<td>UI Development: OData service connection in the SAP Fiori Master-Detail template</td>
<td>When creating an SAP Fiori Master-Detail HTML5 module, you can now configure a connection to a live OData service exposed by a running Java or Node.js module within the same project, or to a service definition available in the workspace or in the file system.</td>
</tr>
<tr>
<td>UI Development: SAP Fiori Component on Sandbox run configuration</td>
<td>You can now run an HTML5 module as SAP Fiori Component on Sandbox (in the SAP Fiori launchpad sandbox environment).</td>
</tr>
<tr>
<td>UI Development: Running with mock data</td>
<td>You can now configure and use mock data for running and testing HTML5 modules.</td>
</tr>
<tr>
<td>UI Development: Layout Editor</td>
<td>You can now use smart controls in the Layout Editor for the development of SAPUI5 HTML5 modules.</td>
</tr>
<tr>
<td>SAP Fiori Launchpad module</td>
<td>It is now possible to run the SAP Fiori launchpad on SAP HANA XS Advanced Model. To enable this, you develop SAP Fiori Launchpad modules with SAP Web IDE for HANA, where the launchpad skeleton is created automatically. You can also develop the launchpad modules manually in other IDEs. We recommend working with the SAPUI5 version that is provided by SAP HANA 2.0 SPS 01. All SAP Fiori runtime capabilities are available, including personalizing the launchpad, the apps, and the theme in use, applying a custom theme, translation, role filtering, and SAP Fiori 2.0 capabilities.</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>Support for the Microsoft Internet Explorer and Edge browsers</td>
<td>You can now run SAP Web IDE for SAP HANA in the Microsoft Internet Explorer and Edge browsers.</td>
</tr>
<tr>
<td>Git: connecting local projects to local and remote Git repositories</td>
<td>You can now connect a local project to a Git repository by right-clicking your project and choosing <code>Git &gt; Initialize Local Repository</code>. Once you have a local repository, you can connect to a remote repository. Choose <code>Git &gt; Set Remote</code> and enter the URL of the remote Git repository to connect.</td>
</tr>
<tr>
<td>Native DataStore Object</td>
<td>You can now create and manage native datastore objects (NDSOs) as central persistency objects for Data Warehouse environments. The objects are represented as specialized CDS artifacts, and allow merging of delta and full loads into its reportable content. Providing delta data for subscribers will reduce the amount of data to be processed and improve the performance. It is possible to merge attributes with a simple move or aggregation, and mark records in delta loads for deletion. The object provides interoperability between native Data Warehouses and SAP BW/4HANA. Native datastore object is available with DWF 2.0 and higher.</td>
</tr>
</tbody>
</table>

### SAP HANA Tools

**Calculation View Editor (Modeler)**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performing Intersect and Minus Set Operations</td>
<td>You can perform intersect or minus set operations on data sources in calculation views using the new intersect or minus views nodes respectively. This is in addition to the already supported union set operations on data sources.</td>
</tr>
<tr>
<td>Support for CDS Views as Data Sources</td>
<td>In addition to the already supported data source types (such as tables, calculation views, table functions, and much more), you can also use CDS views or its synonyms as data sources for modeling calculation views in SAP Web IDE for SAP HANA.</td>
</tr>
</tbody>
</table>
### Feature

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphical Data Preview</td>
<td>In addition to the existing support to preview output data of calculation views in tabular format, you can also preview output data of calculation views in graphical formats such as line charts, pie charts, bar graph, heat maps, and other graphical representations.</td>
</tr>
<tr>
<td>Associating Attributes with Other Related Attributes</td>
<td>You can associate each attribute in the calculation view with its one or more related attributes from the same calculation view. The system internally stores the attribute relations in the <code>BIMC_ATTRIBUTE_RELATIONS</code> table.</td>
</tr>
<tr>
<td>Masking Column Values</td>
<td>You can define data masking on column values of type VARCHAR and NVARCHAR by creating expressions that define how to mask these column values in query results. Based on the masking expression that you define, unauthorized users will only see masked or partially masked column values in query results.</td>
</tr>
<tr>
<td>Use data sources from any tenant database</td>
<td>You can model calculation views in SAP Web IDE for SAP HANA using data sources from any tenant database available in the same SAP HANA instance.</td>
</tr>
<tr>
<td>Model table functions as view nodes</td>
<td>Use the new table function view node to model a table function with both tabular input parameters and scalar input parameters.</td>
</tr>
</tbody>
</table>

### CDS Graphical Editor

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support for Additional Data Source Types</td>
<td>In addition to using entities as data sources, you can also use other CDS views, SQL views, or calculation views as data sources when modeling a CDS view in SAP Web IDE for SAP HANA.</td>
</tr>
<tr>
<td>Creating Associations Between Structure Types and Entities</td>
<td>You can define managed associations between structure types and entities using the CDS graphical editor tool in SAP Web IDE for SAP HANA.</td>
</tr>
<tr>
<td>Support for Additional Entity Element Modifiers</td>
<td>You can use SAP HANA SQL clauses “generated always as expression” and “generated [always [by default] as identity”, when defining elements in entities using the CDS graphical editor.</td>
</tr>
<tr>
<td>Enhancements in CDS View Modeling</td>
<td>When modeling a CDS view using a selected entity as data source, and if associations are defined for the selected entity with other entities, then you can use elements from the associated entities in the CDS view definition.</td>
</tr>
</tbody>
</table>
## Database Explorer

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Database Object Editor Enhancements</strong></td>
<td>Database object editors have been added for nearly all database objects and can be used to view, filter, and search for all objects of a specific type. Database object editors can be accessed by right-clicking the database object in the database browser and clicking <em>Show &lt;database-object&gt;</em>. For example, <em>Show Tables</em>. Improvements have also been made to the database object editors to ensure that they look and behave consistently.</td>
</tr>
<tr>
<td><strong>MDX Console Enhancements</strong></td>
<td>Improvements have been made to the MDX console to make it easier to create MDX queries. New features include the ability to search for MDX objects in the Object Search and the ability to look up MDX syntax elements in the API reference.</td>
</tr>
<tr>
<td><strong>SQL Console Enhancements</strong></td>
<td>A new administrative SQL console is available for HDI administrators to grant privileges on the container’s target schema to other users. Access the administrative console by right-clicking the HDI container in the database browser and clicking <em>Open SQL Console (Admin)</em>.</td>
</tr>
<tr>
<td><strong>View Diagnostic Files for Offline Cockpit Resources</strong></td>
<td>The new <em>Host Diagnostic Files</em> folder contains diagnostic files for cockpit resources that are either online or offline and contains all diagnostic files that have been configured for the SAP Host Agent.</td>
</tr>
<tr>
<td><strong>Support for Tracing Configuration</strong></td>
<td>Database explorer now supports database tracing, SQL tracing, user-specific tracing, and end-to-end tracing. These traces are configurable in their respective tracing editors in the database explorer.</td>
</tr>
<tr>
<td><strong>Support for User-defined HDI Containers</strong></td>
<td>When adding an HDI container to the database explorer, user-defined containers now appear in the drop-down list of available HDI containers.</td>
</tr>
<tr>
<td><strong>Support for HDI-containers Contained in Instance Managers</strong></td>
<td>When adding a database to the database explorer, the <em>Database type</em> drop-down list now offers the <em>Application Managed Service Instances</em> option, which allows you to add an HDI container that is contained in an instance manager.</td>
</tr>
<tr>
<td><strong>Support for Advanced Connection Options</strong></td>
<td>When adding an HDI container or database, the <em>Add Database</em> editor now contains the <em>Advanced Options</em> field, which allows you to specify advanced connection options, such as encryption options and isolation levels.</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
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</tr>
<tr>
<td>New Advanced Connection Option CLIENT</td>
<td>The new CLIENT advanced option sets the session client for the connection. The value for this option is a three-character string, for example: CLIENT=100.</td>
</tr>
<tr>
<td>Data Preview Enhancements</td>
<td>The data preview now has two tabs, the <strong>Raw Data</strong> tab that shows the current data preview result in table format, and the <strong>Analysis Tab</strong> that provides the option to limit the result data to the subset of columns selected by the user and represents the result data in graphical format. The data preview can be accessed for columns, tables, and views by right-clicking the object in the database browser and clicking <strong>Open Data</strong>.</td>
</tr>
</tbody>
</table>

**Java and Node.js Development**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build Results in Workspace</td>
<td>Find the build result of the latest build for each module in your workspace in a separate folder.</td>
</tr>
<tr>
<td>Outdated Dependency</td>
<td>Trigger a dependency check and get warnings if dependencies are outdated.</td>
</tr>
<tr>
<td>Run Java Archives</td>
<td>You can now build and run Spring Boot applications.</td>
</tr>
<tr>
<td>Java Unit Tests</td>
<td>Trigger a build with unit tests and review the result in the test result pane.</td>
</tr>
<tr>
<td>Java Debugging</td>
<td>Build your Java application in debug mode and use the built-in debug tools.</td>
</tr>
<tr>
<td>Provide Snippets in CDS Code Editor</td>
<td>You can insert snippets in your HDBCDS files. These snippets cover different use cases and updated syntax. This is part of feature parity to XS Classic.</td>
</tr>
<tr>
<td>Beautify your CDS Code</td>
<td>Beautify your CDS code per your preferences set in the project settings. Define general settings and settings for alignment, whitespaces and line breaks in detail.</td>
</tr>
<tr>
<td>Conditional Breakpoints for Node.js</td>
<td>Debug your Node.js module using conditional breakpoints. The list of all breakpoints in your workspace is located in the debugger pane.</td>
</tr>
</tbody>
</table>
### Text Analysis

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensions for Text Analysis</td>
<td>SAP Web IDE returns the line number of any errors that exist in your custom Text Analysis (TA) dictionaries, rules, and configuration settings. These errors appear in the Problem View in the Web IDE after building your custom TA resources. Clicking on an error opens the TA object and places the cursor on the line containing the error. In addition, many improvements have been made to the error messages to make them clearer and more useful. Users can locate and repair errors in their custom Text Analysis dictionaries and rules faster and with less effort.</td>
</tr>
</tbody>
</table>

### SAP HANA Smart Data Streaming Plugin

Refer to What’s New in SAP HANA Smart Data Streaming (Release Notes).

### Related Information

What’s New in SAP HANA Smart Data Streaming (Release Notes)

### 4.4.7 SAP HANA Interactive Education (SHINE) for XS Advanced (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new features in SAP HANA Interactive Education (SHINE) for XS Advanced - demo content delivered as a package with sample data and design-time developer objects that makes it easy to learn how to build applications on SAP HANA Extended Application Services Advanced Model.

The following new features included in this release of SHINE for XSA:

- **Fiori Launchpad**
  A new entry point to SHINE via the Fiori Launchpad. The tiles in the Fiori Launchpad appear based on the user role.

- **SAPUI5 as a central service**
  SAPUI5 no longer needs to be bundled with an application. Applications can access SAPUI5 as a central service and bind it to the web module. SHINE now uses SAPUI5 a central service.

- **Spatial**
  Spatial data describes the position, shape, and orientation of objects in a defined space. HANA supports spatial data types, which are, in their turn, used in SHINE to visually represent on a map the sales and geographic distribution of business partners.

- **Jobscheduler token-based authentication**
  In SHINE, jobs can be scheduled by using the token-based authentication feature of the Jobscheduler XSA service. This avoids the need for specifying a user name and a password for scheduling jobs.
● **Local time-dimensional data**
  Time-dimensional data needs to be generated and populated into M_TIME_DIMENSIONAL table under the _SYS_BI schema for displaying charts and reports with respect to time. There are MDX statements available for populating the application local time-dimensional table within the application HDI container with time dimensional data. SHINE now uses a local time-dimensional table instead of the global M_TIME_DIMENSIONAL table under the _SYS_BI schema.

● **Time-based data generator**
  The time-based data generator in SHINE allows end users to generate random Purchase Orders and Sales Orders, distributed across a specified time period, thus producing dynamic charts and reports.

### 4.5 Reference

SAP HANA Platform 2.0 SPS 01 introduces new and changed features as described in the reference documentation.

- **SAP HANA SQL and System Views Reference (New and Changed) [page 186]**
  SAP HANA Platform 2.0 SPS 01 introduces new and changed features, as documented in the SAP HANA SQL and System Views Reference.

- **SAP HANA Client Interfaces Reference (New and Changed) [page 194]**
  SAP HANA Platform 2.0 SPS 01 introduces new and changed features, as documented in the SAP HANA Client Interface Programming Reference.

- **SAP HANA SQLScript Reference (New and Changed) [page 195]**
  SAP HANA Platform 2.0 SPS 01 introduces new and changed features, as documented in the SAP HANA SQLScript Reference.

- **SAP HANA Predictive Analysis Library (New and Changed) [page 195]**
  SAP HANA Platform 2.0 SPS 01 introduces new and changed features for the Predictive Analysis Library (PAL).

- **SAP HANA Analytics Catalog (BIMC Views) Reference (New and Changed) [page 200]**
  SAP HANA Platform 2.0 SPS 01 introduces new and changed features, as documented in the SAP HANA Analytics Catalog (BIMC Views) Reference.
4.5.1 SAP HANA SQL and System Views Reference (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features, as documented in the SAP HANA SQL and System Views Reference.

SQL Statements (New and Changed)

**ALTER DATABASE Statement (changed)**
You can now change the system user password for a tenant database by using the new `ALTER DATABASE <database_name> SYSTEM USER PASSWORD <password>` syntax.

**ALTER REMOTE SOURCE Statement (changed)**
This statement has new syntax to refresh or drop linked objects for the linked database feature.

**ALTER SYSTEM ALTER TABLE PLACEMENT Statement (changed)**
A new table placement property, `SAME_PARTITION_COUNT`, causes all partitions tables in a group to be configured to contain the same number of partitions.

**ALTER SYSTEM BACKUP ENCRYPTION Statement (new)**
This statement Creates and manages backup encryption root keys.

**ALTER SYSTEM [UN]PIN PLAN CACHE ENTRY Statement (changed)**
When you are specifying to PIN a plan cache entry, the hint is now optional, and there is new behavior. `ALTER SYSTEM PIN...WITH HINT` binds the target query to the HINT table. `ALTER SYSTEM PIN` without the `WITH HINT` clause pins the plan to the SQL plan cache.

The ability to specify hosts (index servers) by using the `AT [ LOCATION ]` clause has been deprecated. The statement now applies to all index servers.

**ALTER SYSTEM VALIDATE ENCRYPTION ROOT KEYS BACKUP Statement (new)**
This statement verifies that the encryption root key backup password that is specified on the command line is the same as the one stored in the encryption root key store.

**BACKUP DATA { CREATE | CLOSE | DROP } SNAPSHOT**
A new clause, `FOR FULL SYSTEM`, allows you control whether the statement is applied to the current connected database, or to all databases in the system.

**CREATE AUDIT POLICY Statement (changed)**
A new audit action, `VALIDATE USER`, has been added that validates a user’s credentials.

**CREATE | ALTER | REFRESH | DROP STATISTICS Statement (changed)**
You can now include the name of a linked database when you are specifying the table that the data statistics object is built on.

**CREATE | ALTER USER Statement (changed)**
You can now configure JWT provider-user mappings for a user.
For ALTER USER, you can specify a new user parameter, RSERV REMOTE SOURCES.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREATE</td>
<td>ALTER</td>
</tr>
<tr>
<td>CREATE</td>
<td>ALTER TABLE</td>
</tr>
</tbody>
</table>
| CREATE | ALTER VIEW | Statement (changed) | ● New syntax allows you to mask confidential data in view columns.  
● For the linked database feature, `<database_name>` refers to the name of the remote source. |
| CREATE COLLECTION | Statement (new) | Creates a collection table for storing JSON documents. |
| CREATE SYNONYM | Statement (changed) | For the linked database feature, `<database_name>` refers to the name of the remote source. |
| CREATE TABLE | Statement (changed) | When creating a table using CREATE TABLE...LIKE, you can now specify WITHOUT CONSTRAINT to not copy constraints such as the primary key or UNIQUE constraints. |
| CREATE TRIGGER | Statement (changed) | You can now specify the order of trigger execution. |
| DELETE | Statement (changed) | For the linked database feature, `<database_name>` refers to the name of the remote source. |
| DELETE Statement - JSON Document Store | (new) | This statement deletes documents (rows) from a collection table. |
| DROP COLLECTION | Statement (new) | This statement drops a collection table. |
| DROP DATABASE | Statement (changed) | Previously, when dropping a tenant database, the backups for the tenant database were dropped too; this behavior has changed. Now, the backups for the database are no longer dropped. Instead, to drop them when dropping the tenant database, specify the (new) DROP BACKUPS clause. |
| GRANT Statement | (changed) | ● The new UNMASKED privilege allows you to mask confidential data in views.  
● The new LINKED DATABASE privilege allows you to use the new linked database feature. |
<p>| INSERT Statement | (changed) | For the linked database feature, <code>&lt;database_name&gt;</code> refers to the name of the remote source. |
| IMPORT Statement | (changed) | Two new parameters were added to <code>&lt;import_option&gt;</code> to support the export import of virtual tables between systems. The LOOPBACK REMOTE SOURCE parameter allows the reproduction of a virtual tables scenario in a local environment for troubleshooting purposes. RENAME REMOTE OBJECT allows the renaming of schema and database names when importing virtual tables into a different system. |</p>
<table>
<thead>
<tr>
<th>Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCK TABLE Statement (changed)</td>
<td>A new <code>WAIT &lt;unsigned_integer&gt;</code> option allows you to specify a period of time to wait for a table lock.</td>
</tr>
<tr>
<td>RENAME COLLECTION Statement (new)</td>
<td>This statement renames a collection table.</td>
</tr>
</tbody>
</table>
| SELECT Statement (changed) | - A new FOR XML clause allows you to return results as an XML document.  
- A new `WAIT <unsigned_integer>` option allows you to specify a period of time to wait for a record lock.  
- The FROM clause allows you to specify associated tables.  
- For the linked database feature, `<database_name>` refers to the name of the remote source. |
| SELECT Statement - JSON Document Store (new) | You can now select data from a collection table. |
| TRUNCATE COLLECTION Statement (new) | This statement truncates a collection table. |
| TRUNCATE TABLE Statement (changed) | - You can now specify a projection view for truncation.  
- For the linked database feature, `<database_name>` refers to the name of the remote source. |
| UPDATE Statement (changed) | For the linked database feature, `<database_name>` refers to the name of the remote source. |
| VALIDATE USER Statement (new) | Validates the credentials for a user without causing a login using the credentials. |

### SQL Functions (New and Changed)

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABAP_ALPHANUM Function (new)</td>
<td>Converts a string to what would result if the string were transformed into an ALPHANUM type and then converted back to a string.</td>
</tr>
<tr>
<td>ABAP_NUMC Function (new)</td>
<td>Converts an input string to a string of a specified length, containing only digits.</td>
</tr>
<tr>
<td>CURRENT_MVCC_SNAPSHOT_TIMESTAMP Function (new)</td>
<td>Returns a timestamp snapshot of the current statement.</td>
</tr>
<tr>
<td>CURRENT_OBJECT_SCHEMA Function (new)</td>
<td>Returns the current schema name.</td>
</tr>
<tr>
<td>ENCRYPTION_ROOT_KEYS_EXTRACT_KEYS Function (changed)</td>
<td>Now extracts backup encryption root keys.</td>
</tr>
</tbody>
</table>
**INITCAP Function (new)**
Converts the first character of each word in a specified string to uppercase and converts remaining characters to lowercase.

**HIERARCHY_ANCESTORS Function (changed)**
The START specification is now optional. Also, the DISTANCE clause now supports an expression for a value.

**HIERARCHY_COMPOSITE_ID Function (new)**
Concatenates multi-column tuple-like node identifiers into single scalar values.

**HIERARCHY_DESCENDANTS Function (changed)**
The START specification is now optional. Also, the DISTANCE clause now supports an expression for a value.

**HIERARCHY_LEVELED Function (new)**
Creates a hierarchy based on source data having a leveled format.

**HIERARCHY_SIBLINGS Function (changed)**
The START specification is now optional.

**INSERT Statement - JSON Document Store (new)**
Inserts data into a collection table.

**SOUNDEX Function (new)**
Converts alphabet characters into a code that represents their sound.

**SUBSTRING Function (behavior change)**
Previously, this function handled binary values similarly to how string values would be handled. For example, `SELECT SUBSTRING(x'ABCDEF',1,2) "substring" FROM DUMMY;` would return 'AB'. This behavior has been changed. The SUBSTRING function now interprets the offsets as byte positions, so the returned value would be 'ABCD'.

**WIDTH_BUCKET Function (new)**
Returns the bucket number that the result of a given expression is assigned to after it is evaluated.

**XML_EXTRACT Function (changed)**
The new `<NamespaceDeclarations>` parameter specifies a namespace declaration of type VARCHAR or NVARCHAR.

**XML_EXTRACT_VALUE Function (changed)**
The new `<NamespaceDeclarations>` parameter specifies a namespace declaration of type VARCHAR or NVARCHAR.

**System Views (New and Changed)**

**CDS_ANNOTATION_ASSIGNMENTS System View (new)**
Provides CDS annotation assignments.
CS_CONCAT_COLUMNS System View (new)  Provides information on concat columns in the database.

DATA_STATISTICS System View (changed)  The following column is new: DATA_STATISTICS_SCHEMA_NAM.
The following columns have new data types: CREATE_MEMORY_PERCENT (now REAL) and LAST_REFRESH_MEMORY_PERCENT (now REAL).
Many columns are now deprecated and should no longer be used. See the DATA_STATISTICS System View topic for information on which columns are deprecated.

EFFECTIVE_MASK_EXPRESSIONS System View (new)  Provides information as to how data is exposed to certain users in terms of data masking.

ENCRYPTION_ROOT_KEYS System View (changed)  Supports the backup root key type.
The new WORKLOAD_CLASS hint designates a certain workload class for statement execution.

HINT Details (changed)  Lists all JWT provider-user mappings.

JWT_PROVIDERS System View (new)  Lists all JWT users.

JWT_USER_MAPPINGS System View (new)  Displays information about significant events.

M_ADMISSION_CONTROL_EVENTS System View (new)  Provides detailed information regarding queued session requests by Session-Wise Admission Control.

M_ADMISSION_CONTROL_QUEUES System View  Provides the overall statistics value of the Session-Wise Admission Control feature.
The new ENCRYPTION_ROOT_KEY_HASH column specifies the key used, if any, for encrypting the backup.
The new SOURCE_DATABASE_NAME column specifies the name of the database that creates the backup.

M_ADMISSION_CONTROL_STATISTICS System View (new)  Provides column persistence information for column tables.
The new CONCAT_COLUMN_NAME column specifies the name of the concat column in the case of multi-column indexes. This value is empty in the case of a single-column index.
**M_CS_LOG_REPLAY_QUEUE_STATISTICS System View (new)**
Provides information about column store log replay queue statistics.

**M_CS_LOG_REPLAY_QUEUE_STATISTICS_RESET System View (new)**
Provides information about column store log replay queue statistics and the last time when the queue was reset.

**M_CS_TABLES System View (changed)**
The new LAST_CONSISTENCY_CHECK_TIME column specifies the last time the table consistency was checked with the CHECK_TABLE_CONSISTENCY procedure. The new LAST_CONSISTENCY_CHECK_ERROR_COUNT column specifies the number of errors found in the last table consistency check.

**M_DATA_STATISTICS System View (new)**
Provides an overview of the current state of data statistics objects, including their current content and properties. Many columns from the DATA_STATISTICS view are now deprecated, and their information is stored in this new view.

**M_DYNAMIC_RESULT_CACHE System View (changed)**
The following columns have been added: IS_REFRESHING, CURRENT_REFRESH_DURATION, CURRENT_REFRESH_REASON, LAST_REFRESH_DURATION, and LAST_REFRESH_REASON.

**M_ENCRYPTION_OVERVIEW System View (changed)**
Now specifies whether SCOPE includes backup.

**M_EXPENSIVE_STATEMENT_EXECUTION_LOCATION_STATISTICS System View (new)**
Provides location statistics for expensive statements.

**M_HOST_INFORMATION System View (changed)**
A new key, cpu_sockets, has been added to store the number of sockets per CPU.

**M_JOINENGINE_STATISTICS System View (new)**
Provides statistics about join engine runtime objects that are used for column store join operations.

**M_LICENSE_MEASUREMENT_STATISTICS (new)**
Collects license measurement statistics from tenant databases.

**M_LOAD_HISTORY_SERVICE System View (changed)**
The following columns have been added: ADMISSION_CONTROL_ADMIT_COUNT, ADMISSION_CONTROL_REJECT_COUNT, ADMISSION_CONTROL_QUEUE_SIZE, and ADMISSION_CONTROL_WAIT_TIME.
M_LOG_REPLAY_QUEUE_STATISTICS System View (new)
Provides information about log replay queue statistics.
M_LOG_REPLAY_QUEUE_STATISTICS_RESET System View (new)
This view contains values that have been accumulated since the last reset of the main view M_LOG_REPLAY_QUEUE_STATISTICS.
M_MEMORY_OBJECT_DISPOSITIONS (changed)
The new CATEGORY column specifies the allocator category, the corresponding allocator, and/or some of its sub-allocators that were used to allocate memory objects.
M_MVCC_SNAPSHOTS System View (new)
Provides detailed snapshot information of the Multiversion Concurrency Control (MVCC) manager.
M_NUMA_NODES System View (new)
Provides resource availability information on each NUMA node in the hardware topology, including inter-node distances and neighbor information.
M_NUMA_RESOURCES System View (new)
Provides information on overall resource availability for the system.
M_PASSWORD_POLICY System View (changed)
The VALUE column has been extended from VARCHAR(16) to VARCHAR(128).
M_SAVEPOINTS System View (changed)
The new BLOCKING_PHASE_START_TIME column specifies the last blocking phase start time. The new BLOCKING_PHASE_DURATION column specifies the blocking phase duration.
M_SERVICE_NETWORK_METHOD_IO System View (new)
Provides service network method I/O statistics.
M_SERVICE_NETWORK_METHOD_IO_RESET System View (new)
Provides service network method I/O statistics since the last reset.
M_SERVICE_THREADS System View (changed)
The following columns have been added: LOCKS OWNED, PASSPORT_ROOTCONTEXT_ID, PASSPORT_TRANSACTION_ID, PASSPORT_CONNECTION_ID, PASSPORT_CONNECTION_COUNTER, PASSPORT_COMPONENT_NAME, and PASSPORT_ACTION.
M_SERVICE_THREAD_SAMPLES System View (changed)
The following columns have been added: PASSPORT_ROOTCONTEXT_ID, PASSPORT_TRANSACTION_ID, PASSPORT_CONNECTION_ID, PASSPORT_CONNECTION_COUNTER,
M_SQL_PLAN_CACHE System View (changed)
The new LOGICAL_CONNECTION_VOLUME_ID column specifies the volume ID of the logical connection. This value is 0 if there is no session context defining it as a global plan.

M_SYSTEM_REPLICATION System View (changed)
The new SECONDARY_READ_ACCESS_STATUS column indicates whether the secondary system is read-enabled and if read access is activated.

M_TABLES System View (changed)
The TABLE_TYPE column now displays COLLECTION for collection tables.

M_VOLUME_IO_DETAILED_STATISTICS System View (changed)
The following columns have been added: SUM_APPEND_TIME, SUM_APPEND_SIZE, SUM_READ_SIZE, SUM_READ_TIME, SUM_TRIGGER_ASYNC_READ_SIZE, SUM_TRIGGER_ASYNC_READ_TIME, SUM_TRIGGER_ASYNC_WRITE_SIZE, SUM_TRIGGER_ASYNC_WRITE_TIME, SUM_WRITE_SIZE, and SUM_WRITE_TIME.

M_WORKLOAD_CAPTURES System View (changed)
A new column, CAPTURE_FETCH_COUNT, has been added.
The new CAPTURE_FILE_NAME column specifies the file name of the captured workload.

M_WORKLOAD_REPLAY_PREPROCESSES System View (changed)
A new column, CAPTURE_FETCH_COUNT, has been added.

M_WORKLOAD_REPLAY_REPLAYS System View (changed)
The following new columns have been added: REPLAY_SESSION_COUNT, REPLAY_STATEMENT_COUNT, REPLAY_FETCH_COUNT, and REPLAY_COMMITTED_TRANSACTION_COUNT.

REMOTE_SOURCES System view (Changed)
a new column, IS_LINKED_DATABASE_SUPPORTED, has been added to indicate if linked database is supported for the remote source.

TABLE_GROUPS System View (changed)
New PINNED and LEADING_TABLE columns record whether the location of a table group is manually pinned, and whether a table is the lead table in the table group, respectively.
TABLE_PLACEMENT System View (changed)

A new column, SAME_PARTITION_COUNT, has been added to record whether all partitions tables in a group contain the same number of partitions.

TRIGGER_ORDERS System View (new)

Provides information about triggers that are defined for tables, including how the triggers are ordered.

VIEW_COLUMNS System View (changed)

The new IS_MASKED column specifies whether the column is masked.

VIEWS System View (changed)

The new HAS_MASKED_COLUMNS column records whether the view has at least one masked column.

4.5.2 SAP HANA Client Interfaces Reference (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features, as documented in the SAP HANA Client Interface Programming Reference.

Client Support for Mac OS (new)

The SAP HANA client is now supported on Mac OS.

ODBC Enhancements

The new PREFETCH connection property requests the next block of rows of a result set while the application is still processing the current block of rows.

Node.js Enhancements

- Support for Node.js Streaming
  
  The new node.js stream module exposes the new createArrayStream and createObjectStream functions, which allow you to create readable streams by using a result set and to return data as either a JSON object or a JavaScript array.

- New Statement Class Method
  
  The Statement class has a new method, functionCode(), that retrieves the function code of the statement.

- Node.js Driver Included in the Client Install Package
  
  The node.js driver is included with the client install package. View the readme file for installation instructions.

Microsoft ADO.NET Support Enhancements

- Support for MSDTC
  
  The SAP HANA Data Provider for Microsoft ADO.NET now supports the Microsoft Distributed Transaction Coordinator.

API Version Support (changed)

194 PUBLIC
The JDBC driver now supports version 4.2.

**SQLDBC Enhancements (changed)**

SQLDBC now allows multiple threads to concurrently access the same connection. Previously, concurrent access could have resulted in internal errors or other issues. Using the same connection from multiple threads concurrently can result in operations being serialized. For maximum performance of database calls from concurrent threads, each thread should use its own connection. This enhancement also affects ODBC, ADO.NET, and other interfaces that are based on SQLDBC.

### 4.5.3 SAP HANA SQLScript Reference (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features, as documented in the SAP HANA SQLScript Reference.

The following syntax extensions have been added:
- Support for insertion of single rows into table variables
- Support for removal of single and multiple rows from table variables
- Dynamic SQL with IN/OUT scalar parameters
- Enhancement of the SET SESSION expression: support key as variable
- Support for the LOB type in scalar user-defined functions
- Explain Plan for CALL

### 4.5.4 SAP HANA Predictive Analysis Library (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features for the Predictive Analysis Library (PAL).

**General**

Scoring functions are composed of two steps: parsing model and applying the model on data. In PAL, these two steps are performed in single functions. It is also possible to run them separately. In this way, the model parsing (de-serializing content from database table, converting text-format content into model object, etc.) is executed only once. Then the model is kept and repeatedly applied to data. This is especially beneficial to the scenarios where the model is complex and the same model is applied by scoring functions multiple times. In such scenarios, parsing the model takes significant amount of time compared with the whole execution time of scoring functions. It is wise to avoid doing it over and over again.

Splitting parsing model and executing scoring are achieved by a family of PAL functions called stated enabled functions. As the name suggests, after being parsed, the model is kept in a container called state. A PAL function state’s lifecycle is longer than that of a PAL scoring function. There are three types of operations on the state.
Creation of state. Trained models are read from database tables and fed to PAL function `CREATE_PAL_MODEL_STATE`. It generates states which contain the parsed models and returns the identifiers of the states.

List of states. This can be done by SQL statement:
```
SELECT * FROM SYS.M_AFL_STATES;
```

Scoring with state. Together with the data to be scored on, the state is given to PAL function `PREDICT_WITH_PAL_MODEL_STATE`. This function enables state based scoring for certain algorithms such as support vector machine and random forest.

Clearing of state. States, as containers of parsed model, consume memory. It is necessary to clear them when they are obsolete. This is done by PAL function `DELETE_PAL_MODEL_STATE`.

The list of state enabled scoring functions:

- Support vector machine
- Random forest

### New Algorithms

- **Factorized Polynomial Regression Models**
  Recommender system analyzes patterns of user interest in items (products) and provides personalized recommendations that suit a user’s taste. Normally it seeks to predict the “ratings” or “preferences” that users would give to items and make recommendations according to those predictions. Recommender system in PAL supports the Factorized Polynomial Regression Models/Factorization Machines approach. Factorization approach, for example matrix factorization, provides high accuracy in several important prediction problems, including recommender systems. In its basic form, matrix factorization characterizes both users and items by vectors of latent factors inferred from user-item rating patterns and high correspondence between user and item factors will lead to a recommendation. Factorization machines approach for recommender system is more general than common factorization approaches as it can characterize latent factors not only for users and items themselves, but also for side features related to them by making use of additional information, and therefore, makes the predictions more accurate. PAL supports three kinds of additional side information besides the user-item ratings:
  - Global side features which are related to each specific user-item rating/transaction. For example, location or time of a movie was rated by or lent to a user;
  - User side features which are related to each user, such as gender, age, education, etc.;
  - Item side features which are related to each item, such as genre of a movie.

- **ANOVA**
  Analysis of variance (ANOVA) is a collection of statistical models used to analyze the differences among group means and their associated procedures (such as “variation” among and between groups). It is useful for comparing (testing) three or more means (groups or variables) for statistical significance. ANOVA is conceptually similar to multiple two-sample t-tests, but is more conservative (results in less type I error) and is therefore suitable for a wide range of practical problems. The current release of PAL supports one-way ANOVA and one-way repeated measures ANOVA.

- **One-sample Median Test**
  This is a one-sample non-parametric test to check if the median of the data is different from a user specified one. It implements the sign test which does not have any assumption on the underlying distribution of data.

- **T Test**
  ```
This function is used to test if the mean of one sample or the mean difference of two samples is significantly different from a user specified value. The most frequently used t-tests are:
- One Sample T-Test
- Paired Sample T-Test
- Independent Sample T-Test

- Wilcoxon Signed Rank Test
  This is a one-sample or paired two-sample non-parametric test to check if the median of the data is different from a specific value. It assumes that the underlying distribution of the data set is symmetric. This function is able to work in two modes:
  - One-sample: with one column of data, it tests the null hypothesis that if the population where the data is drawn from is symmetric about a user defined location parameter $\mu_0$.
  - Paired two-sample: with two equal sized columns of data, it tests the null hypothesis that the underlying distribution of the difference of these two is symmetric about 0.

- Accelerated K-Means
  The new accelerated k-means greatly improves the algorithm performance by applying triangle inequality to avoid unnecessary distance calculations.

- Decision Tree
  Unify the three decision tree algorithms (C4.5, CHAID, and CART) into one DECISIONTREE function.

**Enhanced Algorithms**

- **Random Forest**
  - Added stratified sampling for random data selection during training.
  - Added the “ALLOW_MISSING_LABEL” parameter to allow missing target value in the training data.
  - Added the “MAXDEPTH” parameter to set the largest depth of a tree during the training.
  - Added the “PRIORS” parameter to set the prior probability for the class label during the training.
  - Added the “VERPOSE” parameter to output all classes and the corresponding confidence for scoring data.
  - Outputs sample standard error for prediction of regression tasks.
  - Simplified the trained model.

- **Generalized Linear Models**
  - Added elastic net regularization which minimizes
    \[
    \min_{(\beta, \beta)} \frac{1}{2N} \sum_{i=1}^{N} (y_i - \beta^T \cdot X_i)^2 + \lambda \beta^T \beta
    \]

    Where $P_\lambda(\beta) = (1-\alpha)\frac{1}{2}||\beta||_2^2 + \alpha ||\beta||_1$

    Here $\alpha \in [0, 1]$ and $\lambda \geq 0$. If $\alpha = 0$, we have the ridge regularization; if $\alpha = 1$, we have the LASSO regularization.

- **Logistic Regression**
  - Added proximal gradient descent as the method to fit elastic net regularized logistic regression. The implementation of proximal gradient descent is parallelized.
  - Added objective/log-likelihood, iteration number as the output statistics.

- **Sampling**
  - Added the “RANDOM_SEED” parameter to indicate the seed to initialize the random number generator.
• Support Vector Machine
  ○ Added one class SVM.
  
  One class SVM is an unsupervised algorithm that learns a decision function for outlier detection: classifying new data as similar to or different from the given dataset.

• ARIMA
  ○ For the sake of interpretability, the ARIMA model output table still takes key-value style, but has some adaptation of the key names. The new key names are listed as below:

<table>
<thead>
<tr>
<th>Key name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>Number of AR parameters</td>
</tr>
<tr>
<td>AR</td>
<td>Coefficients of AR parameters</td>
</tr>
<tr>
<td>d</td>
<td>Degree of first differencing</td>
</tr>
<tr>
<td>q</td>
<td>Number of MA parameters</td>
</tr>
<tr>
<td>MA</td>
<td>Coefficients of MA parameters</td>
</tr>
<tr>
<td>s</td>
<td>The seasonal period</td>
</tr>
<tr>
<td>P</td>
<td>Number of SAR parameters</td>
</tr>
<tr>
<td>SAR</td>
<td>Coefficients of SAR parameters</td>
</tr>
<tr>
<td>D</td>
<td>Degree of seasonal differencing</td>
</tr>
<tr>
<td>Q</td>
<td>Number of SMA parameters</td>
</tr>
<tr>
<td>SMA</td>
<td>Coefficients of SMA parameters</td>
</tr>
<tr>
<td>mu</td>
<td>The constant part</td>
</tr>
<tr>
<td>regressor</td>
<td>The covariates' names</td>
</tr>
<tr>
<td>beta</td>
<td>The coefficients of covariates</td>
</tr>
<tr>
<td>sigma^2</td>
<td>The variance</td>
</tr>
<tr>
<td>log-likelihood</td>
<td>Log likelihood of the fitted series</td>
</tr>
<tr>
<td>AIC</td>
<td>Akaike information criterion</td>
</tr>
<tr>
<td>AICc</td>
<td>Akaike information criterion correction</td>
</tr>
<tr>
<td>BIC</td>
<td>Bayesian information criterion</td>
</tr>
<tr>
<td>dy(n-p:n-1)_aux</td>
<td>An indicator to the number of rows dy(n-p:n-1) occupies</td>
</tr>
<tr>
<td>dy(n-p:n-1)_i</td>
<td>ith row of last p elements of the differenced series</td>
</tr>
</tbody>
</table>
### Key name | Description
--- | ---
`dy_aux` | An indicator to the number of rows `dy` occupies
`dy_i` | `ith` row of the whole differenced series
`y(n-d:n-1)_aux` | An indicator to the number of rows `y(n-d:n-1)_occupies`
`y(n-d:n-1)_i` | `ith` row of last `d` elements of original series
`epsilon(n-q:n-1)_aux` | An indicator to the number of rows `epsilon(n-q:n-1)_occupies`
`epsilon(n-q:n-1)_i` | `ith` row of last `q` elements of [GRAPHIC REMOVED – INSERT HERE] [HYPERLINK REMOVED]

To ensure forward compatibility, the forecast algorithm can parse the old ARIMA model, too.

- Added the “INCLUDE_MEAN” parameter to allow ARIMA model to include a constant part.
- Added the “DISPLACEMENT” parameter to set the displacement for finite-difference calculation of gradient.
- Added the “FORECAST_METHOD” parameter to select forecast method from formula forecast or innovation algorithm.
- Performance improvement for ARIMA train when the “SEASONAL_PERIOD” is large.

#### Auto ARIMA
- Added the “METHOD” parameter to allow selection of different methods
- Added the “ALLOW_LINER” parameter to check linear model ARMA(0,0)(0,0)m.
- Added the “DISPLACEMENT” parameter to set the displacement for finite-difference calculation of gradient.
- Added the “FORECAST_METHOD” parameter to select forecast method from formula forecast or innovation algorithm.

#### Back Propagation Neural Network
- Outputs the training log if the corresponding training log table is provided through the function call. Currently the training log contains the mean squared error between predicted values and target values for each iteration.

#### K-Medoids
- Added Jaccard distance metric for categorical features.

#### Forecast Smoothing
- Modified logic for model selection path in forecast smoothing. Set beta and trend_start to 0 when there is no trend in a TESM model.

#### LiteApriori
- Replace the OPTIMIZATION_TYPE parameter by the new SAMPLE_PROPORTION parameter. For backward compatibility, the usage of OPTIMIZATION_TYPE is still valid.
4.5.5 SAP HANA Analytics Catalog (BIMC Views) Reference (New and Changed)

SAP HANA Platform 2.0 SPS 01 introduces new and changed features, as documented in the SAP HANA Analytics Catalog (BIMC Views) Reference.

- A new column IS_HDI_OBJECT (a flag to indicate whether the view is created in HDI (1) or Repo1 (0)) has been added to the table BIMC_ALL_CUBES.
- A new view BIMC_REPORTABLE_VIEWS, used by clients for easier retrieval of rows in cubes and dimensions (master data reporting), has been added.
- The former table BIMC_ATTRIBUTE_RELATIONS is now a view with row-level security on table BIMC_ALL_ATTRIBUTE_RELATIONS.
- The former table BIMC_VARIABLE_RANGE_DEFAULTS is now a view with row-level security on table BIMC_ALL_VARIABLE_RANGE_DEFAULTS.
- The former table BIMC_VARIABLE_MAPPING is now a view with row-level security on table BIMC_ALL_VARIABLE_MAPPINGS.
- The former table BIMC_VARIABLE_VALUE is now a view with row-level security on table BIMC_ALL_VARIABLE_VALUES.
5  SAP HANA Platform 2.0 SPS 00 Features

Find out about the new and changed features introduced with the SAP HANA platform 2.0 SPS 00.

5.1  Installation and Update

SAP HANA Platform 2.0 SPS 00 introduces new and changed features for installation and update.

Documentation Changes [page 201]
As of SAP HANA Platform 2.0 SPS 00, the SAP HANA installation and update documentation has been changed.

SAP HANA Server Installation and Update (New and Changed) [page 202]
SAP HANA Cockpit Installation and Update (New) [page 203]
As of SAP HANA Platform 2.0 SPS 00, a new and enhanced implementation of SAP HANA cockpit is available for installation.

5.1.1  Documentation Changes

As of SAP HANA Platform 2.0 SPS 00, the SAP HANA installation and update documentation has been changed.

SAP HANA Master Guide (Changed)

The information in the SAP HANA Master Update Guide is now available in the section Updating an SAP HANA System Landscape. This section also contains information about updating from SAP HANA Platform 1.0 to SAP HANA Platform 2.0 SPS 00.

Parts of the information in the SAP HANA Technical Operations Manual is now available in the section Operating SAP HANA.

Only an introduction into network-related information is now available in the SAP HANA Master Guide. The SAP HANA Administration Guide now includes a new section called Landscape Management and Network Administration.
SAP HANA Master Update Guide (Deleted)

The SAP HANA Master Update Guide is no longer available. The information contained in this document is now available in the SAP HANA Master Guide.

SAP HANA Server Installation and Update Guide (Changed)

The Troubleshooting section has been updated. The chapter Importing Delivery Units Manually was added. The section Updating the SAP HANA System was re-structured.

SAP HANA Cockpit Installation and Update Guide (New)

The SAP HANA Cockpit Installation and Update Guide is now available. This guide describes how to install and update the SAP HANA cockpit. The SAP HANA cockpit provides core system and database administration features, for example, database monitoring, user management, and data backup.

SAP HANA Platform Lifecycle Management in SAP HANA Cockpit (New)

The SAP HANA database lifecycle manager (HDBLCM) Web user interface now includes a link to the SAP HANA Platform Lifecycle Management documentation.

5.1.2 SAP HANA Server Installation and Update (New and Changed)

Integrated Download, Extract and Update with HDBLCM Web User Interface (New)

The SAP HANA database lifecycle manager (HDBLCM) Web user interface now allows you to download, extract and update SAP HANA components and XS advanced applications.

Worker Host Grouping (New)

To implement a multi-temperature memory strategy, you can assign hosts to worker groups.
Uninstall component with existing component-specific hosts/roles in one step (Changed)

In previous versions of SAP HANA, you had to remove component-specific host roles and hosts first before you could uninstall additional components. Components including their host roles and hosts can now be uninstalled in one step.

SUSE Linux Enterprise Server (SLES) 12 SP1 and Red Hat Enterprise Linux (RHEL) 7.2 as Required Operating System Versions (Changed)

The SAP HANA database lifecycle manager performs a check to see if the minimal operating system requirements are fulfilled. SAP HANA 2.0 SPS 00 is supported on SUSE Linux Enterprise Server (SLES) 12 SP1 and Red Hat Enterprise Linux (RHEL) 7.2.

Related Information

SAP Note 2235581 - SAP HANA: Supported Operating Systems

5.1.3 SAP HANA Cockpit Installation and Update (New)

As of SAP HANA Platform 2.0 SPS 00, a new and enhanced implementation of SAP HANA cockpit is available for installation.

The new SAP HANA cockpit unifies the administration of single, multiple and tenant databases. It replaces both the SAP HANA cockpit and the SAP DB Control Center that were available with SAP HANA 1.0. The new cockpit can be used for the administration of systems running SAP HANA 2.0 or SAP HANA 1.0 SPS12.

The new cockpit represents a separate administration environment from the managed production databases. The SAP HANA database lifecycle manager (HDBLCM) is used to install and update the SAP HANA cockpit in a graphical user interface or the command-line interface.

5.2 Security

SAP HANA Platform 2.0 SPS 00 introduces new and changed features for security.

Documentation Changes [page 204]
As of SAP HANA Platform 2.0 SPS 00, the SAP HANA security documentation has been changed.

SAP HANA Database Security (New and Changed) [page 204]
As of SAP HANA Platform 2.0 SPS 00, new and changed security-related features are available in the SAP HANA database.

5.2.1 Documentation Changes

As of SAP HANA Platform 2.0 SPS 00, the SAP HANA security documentation has been changed.

- The SAP HANA Security Guide contains a new chapter on data protection.
- The SAP HANA Security Checklists and Recommendations document contains a new chapter on SAP HANA XS advanced.

5.2.2 SAP HANA Database Security (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, new and changed security-related features are available in the SAP HANA database.

Encryption (New and Changed)

- The SAP HANA database now supports redo log encryption.
- The management of the encryption root keys used for data volume encryption, redo log encryption, and the internal application encryption service has been enhanced:
  - All root keys can be conveniently changed by SQL statement.
  - The new system privilege ENCRYPTION ROOT KEY ADMIN is required to change all root keys. A user with RESOURCE ADMIN can no longer change the data volume encryption root key and the internal application encryption root key.
  - You can create a dedicated password-protected root key backup to a secure location.

Authorization (New and Changed)

- If you use an LDAP-compliant identity management server to manage users and their access to resources, you can now leverage LDAP group membership to authorize SAP HANA users. The new system privilege LDAP ADMIN is required to configure LDAP group authorization.
- A user administrator can now convert a restricted user into a standard user, and vice versa. It is possible to grant and revoke both the PUBLIC role as well as authorization to create objects in a user’s own schema.
- A new and enhanced implementation of the SAP HANA cockpit is available with SAP HANA 2.0. The delivery units used to deploy the original implementation of the SAP HANA cockpit in SAP HANA 1.0 as auto content exist for downward compatibility reasons, but they no longer contain any content. The following roles delivered in the these DUs are therefore no longer available:
  - sap.hana.admin.roles:::*
Security Administration with SAP HANA Cockpit (New and Changed)

A new and enhanced implementation of the SAP HANA cockpit is available with SAP HANA 2.0. The new cockpit continues to support the monitoring of critical security settings, the granting of roles to database users, as well as tasks related to auditing, data volume encryption, and certificate management. In addition, the new SAP HANA cockpit supports the creation and management of database users.

5.3 Administration

SAP HANA Platform 2.0 SPS 00 introduces new and changed features for administration.

Documentation Changes [page 206]
As of SAP HANA Platform 2.0 SPS 00, the SAP HANA administration documentation has been changed.

SAP HANA System Administration (New and Changed) [page 206]
As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for the administration of SAP HANA.

SAP HANA Database Backup and Recovery (New and Changed) [page 210]
As of SAP HANA 2.0 Platform SPS 00, new and changed features are available for SAP HANA backup and recovery.

SAP HANA High Availability (New and Changed) [page 212]
As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for SAP HANA High Availability.

SAP HANA Performance Monitoring and Analysis (New and Changed) [page 213]
As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for SAP HANA Performance Monitoring and Analysis.

SAP HANA Smart Data Access (New and Changed) [page 214]
SAP HANA Platform 2.0 SPS 00 introduces new and changed features for SAP HANA smart data access.

SAP HANA Hadoop Integration (New and Changed) [page 215]
SAP HANA Platform 2.0 SPS 00 introduces new features for the SAP HANA and Hadoop integration.
5.3.1 Documentation Changes

As of SAP HANA Platform 2.0 SPS 00, the SAP HANA administration documentation has been changed.

SAP HANA Technical Operations Manual (Deleted)

The SAP HANA Technical Operations Manual is no longer available. The information contained in this document is now available in the SAP HANA Master Guide and the SAP HANA Administration Guide.

SAP DB Control Center Guide (Deleted)

The SAP DB Control Center Guide is no longer available. With SAP HANA 2.0, SAP DCC is replaced by the SAP HANA cockpit, which is documented in the SAP HANA Administration Guide.

SAP HANA Administration Guide (Changed)

The SAP HANA Administration Guide now includes a new section called Landscape Management and Network Administration. This section consolidates the documentation for landscape management tasks such as copying and moving SAP HANA systems. It also includes information required to integrate SAP HANA into your network environment, for example ports and connections. In the SAP HANA 1.0 documentation, network-related information was primarily available in the SAP HANA Master Guide.

The section SAP HANA Platform Lifecycle Management has also been restructured.

5.3.2 SAP HANA System Administration (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for the administration of SAP HANA.

SAP HANA 2.0 Cockpit (New)

A new and enhanced implementation of SAP HANA cockpit is now available. In SAP HANA 1.0, the cockpit was used to manage a single resource while SAP DB Control Center was used to manage multiple systems. The functionalities of both have now been rolled into one comprehensive tool that unifies individual, multiple, and tenant database management.

You can use the SAP HANA 2.0 cockpit to monitor and manage systems running SAP HANA 2.0 or SAP HANA 1.0 SPS 12.
The new SAP HANA cockpit continues to provide database administrators with a single point of access to a range of Web-based tools for the administration and detailed monitoring of SAP HANA databases, including system resource monitoring, alerting, and tenant database administration. In addition, it provides the following new and enhanced features:

- Creation of groups of systems so that specific cockpit users can monitor aggregate information
- Enhanced monitoring of alert information, across multiple databases, and within a single system
- Configuration of system properties, (*.ini files), an administration task which was previously accomplished only through the SAP HANA studio
- Monitoring of system health metrics for multi-host systems, including indicators for the resource utilization of hardware components (CPU, memory, network, and storage)
- The ability to start or stop a system through Manage Services app
- The ability to browse your database catalogs by using the newly integrated SAP HANA database explorer. This database explorer is similar in functionality and appearance to the database explorer provided with the SAP Web IDE for SAP HANA. The database explorer includes:
  - An SQL console for executing SQL queries and SQLScript procedures
  - An SQL analyzer for viewing query plans and analyzing the performance of SQL queries
  - An MDX console for executing MDX queries
  - A trace feature for viewing diagnostic files

The SAP HANA cockpit also provides new and enhanced features for:

- Performance monitoring and analysis
- Security administration
- Backup and recovery
- System replication

For more information about these feature enhancements, see the relevant section in this document.

See also SAP Note 2380291.

**SAP HANA 1.0 Cockpit (Deleted)**

The delivery units used to deploy the original implementation of the SAP HANA cockpit in SAP HANA 1.0 as auto content exist for downward compatibility reasons, but they no longer contain any content. This includes the following DUs:

- HANA_ADMIN
- HANA_BACKUP
- HANA_HDBLCM
- HANA_SEC_BASE
- HANA_SEC_CP
- HANA_SYS_ADMIN
SAP DB Control Center (Deleted)

SAP HANA 2.0 does not support SAP DB Control Center (SAP DCC). The SAP HANA 2.0 cockpit replaces SAP DCC.

If you’re upgrading a system running SAP DCC to SAP HANA 2.0, SAP recommends that you remove the SAP DCC delivery unit, as described in SAP Note 2385193.

Multitenant Database Containers (New and Changed)

- A backup of a single database (single-container system) can be recovered into a tenant database in an MDC system and retains the backup history. Backups can be located in the file system as well as in a third-party backup tool using the HANA BACKINT API.
- The standard copy/move process of tenant databases requires an initial certificate configuration in order to enable communication between systems. In non-production setups or isolated environments, it may be reasonable to allow a process without the need for trusted communication. The internal communication of the copy/move processes may now also run unencrypted.
- The performance trace can be enabled for multiple tenant databases at the same time to analyze cross-database queries.

Workload Management (New)

In the area of Workload Management the admission control feature gives administrators the option to apply processing limits and to decide how to handle new requests if the system is close to the point of saturation.

User-defined thresholds can be applied using configuration parameters to define an acceptable limit of activity in terms of the percentage of memory usage or percentage of CPU capacity. Administrators can then configure the system so that, for example:

- if the system approaches this limit then new requests will be queued until processing capacity is available
- if the system exceeds the load thresholds then new requests will be rejected and a message returned to the client that the server is temporarily overloaded.

A query timeout feature has now been implemented which can be used to apply a maximum time limit to process any SQL statement. This is available through client programming interfaces (for example for JDBC: `java.sql.statement.setQueryTimeout`). The timeout is not active by default (set to 0 seconds for no timeout). This feature can be used as a way of automatically canceling client queries which are hanging or looping indefinitely.

Extension Node for Scaled-Out SAP Business Warehouse (New)

For scaled-out SAP Business Warehouse systems (version 7.50 and above) where a multi-temperature storage strategy is required, the extension node feature is now available which makes it possible to use a different (heterogeneous) type of host in the server landscape which is used exclusively for warm data.
In this case, the normal hardware sizing guidelines for storage can be relaxed: whereas normally a 2:1 ratio of RAM to hot data is required, the extension node supports significantly more storage capacity for warm data.

The configuration for this type of node is based on a new host sub role and a location value in the TABLE_PLACEMENT system view. Once the data has been correctly modeled it is then distributed by the landscape redistribution process to the appropriate server node.

**Client-Side Statement Routing (New)**

- Client-side routing now routes statements for range-partitioned tables.
- Client-side routing for hash-partitioned tables now routes batches, as well as prepared statements.

**SAP HANA HDBSQL (New and Changed)**

- Use the new `-V` configuration option in SAP HANA HDBSQL to define a substitution variable.
- The default for the `-b` option is now 32 bytes. You can now use `-b all` to always display the whole binary length.
- The new `-quiet` option hides the SAP HANA HDBSQL welcome banner.
- The new `-oldexecetimes` option uses SAP HANA 1.0 execution-only timing. SAP HANA HDBSQL in SAP HANA 1.x only reports time for client and server executions, not fetches for result sets. As of SAP HANA 2.0, SAP HANA HDBSQL includes times for executions and fetches by default.

**Related Information**

SAP Note 2380291
SAP Note 2385193
5.3.3 SAP HANA Database Backup and Recovery (New and Changed)

As of SAP HANA 2.0 Platform SPS 00, new and changed features are available for SAP HANA backup and recovery.

Enhancements for Log Backups

- To improve the performance of log backups, SAP HANA can write all the log segments of a service that are ready to be backed up at a particular time to a single log backup. You can define the maximum size of this single log backup. This option is supported for both file-based log backups and third-party tools. More information: Writing Multiple Log Segments to One Log Backup in Related Information
- With SAP HANA 2.0, you can define events to trigger a log backup. By default, a log backup is created immediately after a log segment becomes full, or when the service-specific timeout has been reached for a log segment. Alternatively, you can specify that a log backup is created only after a service-specific timeout has been reached. This option is supported for both file-based log backups and third-party tools. More information: Set the Interval Mode for Log Backups in Related Information

Encryption and Backup and Recovery

SAP HANA 2.0 supports data encryption in the persistence layer.

A database administrator must ensure that the encryption root keys are backed up. If a recovery is performed, a database administrator must also ensure that the root keys are imported before the recovery is started. More information: Points to Note: SAP HANA Backups and Encryption, Root Key Backup, and Import Backed-up Root Keys in Related Information

Location of the Backups of the Backup Catalog

The location of the log backups is configured separately from the location of backups of the backup catalog. Before you recover SAP HANA, you are prompted to specify path to search for the backup catalog. More information: Destination for Backups of the Backup Catalog in Related Information
SAP HANA Multitenant Database Containers

It is now possible to use a data backup of an SAP HANA single-container system to recover to a tenant database.

More information: Points to Note: Copying a Database Using Backup and Recovery, Points to Note: SAP HANA Multitenant Database Containers and Backup, Points to Note: SAP HANA Multitenant Database Containers and Recovery in Related Information

Extension Node for Business Warehouse

Database recovery with SAP HANA 2.0 supports extension node for Business Warehouse.

More information: Points to Note: SAP HANA Recovery and Data Temperature: Extension Node for Business Warehouse in Related Information

SAP HANA on IBM Power Systems: Release Compatibility

SAP HANA 2.0 supports only IBM Power Little Endian (LE) systems.

Backups created with SAP HANA 2.0 are compatible with both supported hardware platforms (Intel and IBM Power). You can recover SAP HANA 2.0 using backups created with SAP HANA 2.0 on either an Intel-based system or an IBM Power-based system.

Backups created with SAP HANA 1.0 SPS 10 or newer running on an Intel-based system can be used to recover SAP HANA 2.0 to both Intel-based and IBM Power-based systems. Backups created with SAP HANA 1.0 on an IBM Power-based system cannot be used to recover SAP HANA 2.0.

More information: Points to Note: SAP HANA on IBM Power Systems in Related Information

SAP HANA Cockpit (Changed)

A new and enhanced implementation of the SAP HANA cockpit is now available.

The SAP HANA Administration Guide has been updated to reflect the changed procedure to recover SAP HANA and to schedule SAP HANA backups using SAP HANA cockpit.

More information: SAP HANA System Administration (New and Changed), Schedule Data Backups (SAP HANA Cockpit), and Recover a Database (SAP HANA Cockpit) in Related Information

Related Information

SAP HANA System Administration (New and Changed) [page 206]
5.3.4 SAP HANA High Availability (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for SAP HANA High Availability.

Active/Active (Read Enabled) (New)

Starting with SAP HANA 2.0 active/active (read enabled) is integrated into the System Replication solution and allows read-only access on the secondary system.

For more information on this new feature, see the following topics in the SAP HANA Administration Guide:

- Active/Active (Read Enabled)
- High Availability for SAP HANA
- Configure the Secondary System
- System Replication with Operation Mode Logreplay
- Log Retention
- System Replication Configuration Parameters
- System Replication Command Line Reference
- System Replication Details

Required Configuration Step for SAP HANA System Replication Authentication (New)

Starting with SAP HANA 2.0 a new configuration step is required to setup SAP HANA System Replication. The secondary system needs to be prepared for authentication by copying the system PKI SSFS .key and the .dat file from the primary system to the secondary system.

For more information, see Set up System Replication with hdbnsutil in the SAP HANA Administration Guide.

SAP HANA Cockpit (Changed)

A new and enhanced implementation of SAP HANA cockpit is now available.

The following administration activities are possible:

- Performing the initial set-up, that is enabling system replication and establishing the connection between two identical systems
- Monitoring the status of system replication to ensure that both systems are in sync
- Performing a takeover to the secondary system in the event of a disaster and failback once the primary system is available again
- Disabling system replication

For more information about these feature enhancements, see Managing System Replication in the SAP HANA Cockpit in the SAP HANA Administration Guide.
5.3.5 SAP HANA Performance Monitoring and Analysis (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for SAP HANA Performance Monitoring and Analysis.

Starting with SAP HANA 2.0 the following tools provide new and enhanced features:

**Capture and Replay (Changed)**

With SAP HANA 2.0 new features are available for the capture and replay tool in the SAP HANA cockpit:

- When configuring new captures it is possible to set the conditions under which the capture is overwritten based on two criteria:
  - The duration of the capture
  - The disk usage of the capture
  For more information, see *Capture a Workload* in the Related Links section.

- When replaying the workload it is possible to compare replays based on the same capture with each other.
  For more information, see *Compare Replayed Workloads* in the Related Links section.

- After replaying the workloads it is possible to compare results of queries in the *Replay Report*. Furthermore, the tab *Load* visualizes the system load during the replay process.
  For more information, see *Replay a Preprocessed Workload* in the SAP HANA Administration Guide.

**Workload Analyzer (Changed)**

With SAP HANA 2.0 the workload analyzer tool available in the SAP HANA cockpit has two versions. The workload analyzer from SAP HANA 1.0 is now called “workload analyzer based on thread samples”. The new version of the workload analyzer is called “workload analyzer based on engine instrumentation”. The following changed and new features are available for the workload analyzer tool:

- Workload analyzer based on thread samples (changed)
  The chart visualizing the system resource usage displays both a real-time and a historical analysis. It is possible to visualize the system load using a timeline view mapped to the load graph.

- Workload analyzer based on engine instrumentation (new)
  This is a feature for analyzing captured workloads. Similar to the sampling-based workload analyzer it includes load graph visualization, as well as a timeline view with application and statement hierarchy.
  For more information, see *Analyzing Workloads* in the SAP HANA Administration Guide.

**SQL Analyzer (New)**

With SAP HANA 2.0 SPS 00, the SQL Analyzer is available in the SAP HANA cockpit and the SAP HANA Database Explorer.
With this tool it is possible to analyze and understand query execution and performance aspects of the SAP HANA database. It can be used to view detailed information on each query and can help evaluate potential bottlenecks for these queries. The tool is similar to the Plan Visualizer tool in the SAP HANA studio.

The following features are available for the SQL Analyzer:

- Overview
- Operator list
- Tables used
- Statement statistics

For more information, see Analyzing Statement Performance in the SAP HANA Administration Guide.

Other Performance Management Tools (Changed)

The following performance management tools in the SAP HANA cockpit have been enhanced:

- Performance Monitor
  For more information, see Monitor and Analyze Past Performance and Collecting Performance Monitor Data for SAP Support in the SAP HANA Administration Guide.
- Monitor Statements
  For more information, see Monitor and Analyze Critical Statements in the SAP HANA Administration Guide.
- Threads
  For more information, see Monitor and Analyze Threads in the SAP HANA Administration Guide.
- Sessions
  For more information, see Monitor and Analyze Sessions in the SAP HANA Administration Guide.
- Expensive Statements
  For more information, see Monitoring and Analyzing Expensive Statements in the SAP HANA Administration Guide.
- SQL Plan Cache
  For more information, see Monitoring and Analyzing Statements with SQL Plan Cache in the SAP HANA Administration Guide.

5.3.6 SAP HANA Smart Data Access (New and Changed)

SAP HANA Platform 2.0 SPS 00 introduces new and changed features for SAP HANA smart data access.

SELECT FOR UPDATE on Virtual Tables (New)

The FOR UPDATE clause on the SELECT statement is extended to include virtual tables.
Refresh Virtual Tables Metadata (New)

When the metadata in a remote table is changed, use the ALTER VIRTUAL TABLE statement to refresh the virtual table to reflect the change.

Support for SAP SDA Adapter for SAP MII (Deprecated)

As of SAP HANA 2.0, the SAP HANA Smart Data Access (SDA) adapter for SAP Manufacturing Integration and Intelligence (MII) is no longer supported.

5.3.7 SAP HANA Hadoop Integration (New and Changed)

SAP HANA Platform 2.0 SPS 00 introduces new features for the SAP HANA and Hadoop integration.

Create Custom Virtual Procedures

Create custom Spark procedures in SAP HANA to perform compilation and execution on a Hadoop cluster. You can easily access Spark libraries from SAP HANA, then compile and execute the procedures on Spark Controller. The new CREATE VIRTUAL PROCEDURE syntax supports Scala, providing a method for simple, and strongly typed code. Use these custom procedures to access Hadoop’s distributed file system (HDFS) libraries, such as the machine learning libraries, and return the data model to SAP HANA for prediction.

Enable Remote Caching Using Spark Controller

When using the Spark controller to connect SAP HANA and Hadoop, you can enable remote caches in Spark for queries with complex calculations. This allows you to use materialized data for the repetitive execution of the same query.

SAP HANA Vora ODBC Connectivity (Requires SAP HANA Vora 1.3)

A more direct connectivity method between Hadoop and Vora has been implemented. You can establish a connection between SAP HANA and Hadoop using the SAP HANA Vora remote source adapter voradbc and Vora’s Wire protocol. With this new implementation you can join data by creating a remote source, then use virtual tables to represent the SAP HANA Vora remote source tables you want to access.
Kerberos Authentication Support in Spark Controller

You can now set up a Hadoop cluster with Kerberos authentication for SparkSQL using Spark Controller.

Support for Spark Controller Installation and Configuration Through the Cloudera Manager

Support for installing and configuring Spark Controller using Cloudera Manager has been added. Using the Cloudera Manager Web UI you can:

- Install Spark Controller.
- Distribute the Spark Controller package to each hosts on your Cloudera cluster.
- Start and stop Spark Controller.
- Change or add Spark Controller configuration parameters.

5.4 Development

SAP HANA Platform 2.0 SPS 00 introduces new and changed features for development.

SAP HANA XS Advanced Development (New and Changed) [page 217]
For SAP HANA Platform 2.0 SPS 00 SAP HANA supports development and deployment of SAP HANA extended application services (XS) advanced model applications.

SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA (New) [page 222]
As of SAP HANA Platform 2.0 SP00, SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA is available.

SAP Web IDE for SAP HANA (New and Changed) [page 223]
As of SAP HANA Platform 2.0 SP00, the following new features and changes are available in SAP Web IDE and integrated SAP HANA tools.

SAP HANA Spatial (New) [page 230]
As of SAP HANA Platform 2.0 SPS 00, new features are available in the SAP HANA Spatial.

SAP HANA Graph (New and Changed) [page 230]
As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for the administration of SAP HANA Graph:

Hierarchy Functions (New) [page 230]
Hierarchy functions are available as of SAP HANA Platform 2.0 SPS 00:

Search, Text Analysis, and Text Mining [page 231]
SAP HANA 2.0 SPS 00 introduces the following new and changed features for search, text analysis, and text mining.

SAP HANA Interactive Education (SHINE) for XS Advanced (New and Changed) [page 235]
SHINE for XSA is a demo content that makes it easy to learn how to build applications on SAP HANA Extended Application Services Advanced Model. This demo content is delivered as a package
containing sample data and design-time developer objects for application database tables, views, OData and user interfaces.

5.4.1 SAP HANA XS Advanced Development (New and Changed)

For SAP HANA Platform 2.0 SPS 00 SAP HANA supports development and deployment of SAP HANA extended application services (XS) advanced model applications.

Application Run-Time Environment

SAP HANA XS advanced provides the following run-time environments for your application:

- **JavaScript/Node.js**
  JavaScript run time to which you can deploy your Node.js and XS JavaScript applications.

  **Note**
  The XS JavaScript (XSJS) run time is a compatibility layer that runs on top of Node.js, which enables you to execute your existing code base, for example, .xsjs and .xsjslib files.

- **Java (Tomcat 8/TomEE)**
  SAP HANA XS advanced model provides a Java run time to which you can deploy your Java applications. The Java run time for SAP HANA XS advanced provides a Tomcat or TomEE run time to deploy your Java code.

- **Custom run time**
  You can also create and run a custom run-time environment of your own in XS advanced, so that you can deploy applications written using languages such as Python or PHP, which are not supported by any of the default run-time environments included in the XS advanced run-time store.

  **Restriction**
  SAP does not provide support for custom language, buildpack, or run-time scenarios.

Applications deployed to a custom run-time environment in XS advanced do not have automatic access to (or use of) some important features that are built into and supported by the XS advanced framework, including (but not limited to): authentication and security, logging and auditing, and connections to the database. If you deploy an application to a custom run-time environment in XS advanced, you must configure these components manually for the custom application.

JavaScript Run Time

SAP HANA XS advanced provides the following updates and new features for the SAP HANA Platform 2.0 SPS 00 JavaScript run-time environment:

- **sap-hdbext**
  sap-hdbext is included in the XS_JAVASCRIPT software component for XS advanced and extends the functionality of the hdb package, which is a JavaScript client for SQLDBC. With this release, sap-hdbext supports SAP HANA DB connection pooling for Node.js applications.
• XS JavaScript (XS classic compatibility layer in XS advanced)
  ○ Support for $.util.Zip (with limitations)
  ○ Support for $.util.SAXParser (with limitations)
  ○ Support for $.text.mining

Java Run Time

SAP HANA XS advanced provides the following updates and new features for the SAP HANA Platform 2.0 SPS 00 Java run-time environment:

• A central audit-log service
• A new Java API for the audit log
• A graphical user interface to manage the audit logs
• Support for Apache Tomcat 8.0.36
• Support for Apache TomEE 1.7.4
• A personalized database connection, for example, including: the application name, the organization, and the space
• Configuration of the maximum header size for incoming HTTP requests

Application Router

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for the Node.js application router (approuter.js):

• Routes are matched by both URL path and HTTP methods
• Use of the Content-Security-Policy header as a “best practice”
• CSRF token is generated once per session
• Route sources can be matched in a case-insensitive way
• Configure a maximum client-connection timeout
• The application router supports extensions, for example, custom middleware
• CSRFs tokens can be fetched with the HEAD request
• Support for configuring the Cache-Control header in the application-router descriptor (xs-app.json); the header is used when serving static resources.

Deployment Service

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for the deployment service (xs deploy):

• List the last “n” MTA operations
• Broaden support for the MTA specification:
  ○ Support for partial MTA specification version values
  ○ Support for metadata for properties and parameters
  ○ Support for “!sensitive” parameter (property tag)
Support for MTA-Module multiple entries
Support for the proper merging of structured parameters
Support for context-path routing (new MTA module parameter)
Allow references from resources to "modules" or "resources"

- CTS+ Integration: Adaptation of deploy process
- Provide blue-green (bg-deploy) command in the XS CLI plug-in
- Enable the deployment of a Multi-Target Application (MTA) from a Git repository
- Provide support for the management of the XS advanced Service Broker

**SAP HANA Deployment Infrastructure**

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for SAP HANA Deployment Infrastructure (HDI):

- HDI Configuration Parameter Reference
- HDI Parameter Reference
- HDI Build Plug-ins and File Formats Reference 2.0
- HDI Admin Documentation
- HDI Deployer
  Support for many new features in the deployment service. For more information, see Deployment Service above.
- New design-time artifacts:
  - Result Cache
- Updated design-time artifacts:
  - Synonym
    Support for "database" field (Cross-Database Access)

**Core Data Services**

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for Core Data Services (CDS):

- Support for subqueries
- Support for LIMIT/OFFSET in queries
- Support for the clause GENERATED ALWAYS AS <expression clause> in an entity definition
- Support for the clause GENERATED [ALWAYS | BY DEFAULT] AS IDENTITY in an entity definition
- Java OData support for CDS
- The CDS text editor now includes a “beautify” (pretty-print) feature that formats code for easier scanning.

**Gerrit-Git Service for XS Advanced**

As of SPS12, SAP HANA includes a Gerrit server that is integrated with the XS advanced run time. Gerrit for XS advanced is an optional component of the XS Advanced platform which can be used to store and manage...
versions of the source code for XS Advanced applications, for example SAPUI5 and JavaScript or Java applications, in Git repositories. Gerrit for XS Advanced is attached to the user account and authentication (UAA) service in the XS Advanced platform.

**XS Advanced Command-Line Interface**

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for the XS command-line interface:

- Numerous improvements and additions to the parameters and options already available with existing commands

**OData Services**

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for the OData services:

- Support for annotations in metadata
- Java OData support for CDS annotations (for example, `@OData.publish : true`)

**Tools**

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following new and updated development tools:

- **CDS**:
  - Beautify (a.k.a. "pretty-print") feature for code formatting in the CDS text editor
  - Code completion for tables and views in same HDI container
  - Report syntax errors in the new Problems View in SAP Web IDE for SAP HANA
- **Node.js**:
  - Testing: the plain Node.js template now contains a sample Jasmine test
  - Testing: improvements to the design of the Test Result pane
  - Debugger: on-demand debugging of already running applications
  - Debugger: improvements to the design of the UI
  - New and improved run configuration for the Node.js run time
- **Java**:
  - Support for the building of Java Modules in the SAP Web IDE for SAP HANA
  - Support for the building of Java modules (WARs) with Maven
  - Support for the running of Java modules (WARs) with TomEE buildpack on XS advanced, including:
    - Creation of Java Modules
    - Tighter integration with the SAP HANA Deployment Infrastructure (HDI)
    - Java OData support for CDS
Migration (XS classic to XS advanced)
New tool to help migrate legacy XS classic applications to run in the new XS advanced run-time environment

Note
The new SAP HANA XS Migration Guide is also available to guide you through the migration process.

Documentation

This section contains information about the following new or changed development-related documents:

- SAP HANA Developer Guide for SAP HANA XS advanced model
- SAP HANA XS Migration Guide
- SAP HANA Analytics Catalog (BIMC) Reference

SAP HANA Developer Guide for SAP HANA XS advanced model

The SAP HANA Developer Guide for SAP HANA XS advanced model describes the recommended process to follow when building and deploy applications that run in the SAP HANA extended application services, advanced model (XS advanced) run time; it also describes the required technical structure of applications that can be deployed to the XS advanced run-time platform using either the SAP Web IDE for SAP HANA or the XS command line tools.

The following areas in the SAP HANA Developer Guide for XS advanced model have been added, updated, or improved:

- Getting Started
  New and updated tutorials for the SAP HANA Run time Tools (a.k.a SAP HANA Database Explorer)
- Maintaining Application Development and Deployment Descriptors
  Improved and more comprehensive descriptions of the configuration files used to define and describe the build and deployment of a Multi-Target Application (MTA)
- Defining the Data Model in XS Advanced
  ○ Improved and more comprehensive explanations of how to create and deploy the database artifacts used to store and provision data for your application’s back end and user interface.
  ○ New section describing how to configure the HDI deployer
  ○ New section describing how to configure access policies in CDS, for example, with Data Control Language (DCL) “aspects” and role definitions
  ○ New and updated sections describing how to use new CDS features, for example, support for subqueries or element modifiers such as “GENERATED ALWAYS”
- Defining OData Services for XS Advanced Applications
  Improved and more comprehensive explanations of how to create and deploy OData services in XS advanced, for example; changes and additions to the service-definition syntax and many some examples of working service definitions.
- Writing the XS Advanced Application Code
  ○ JavaScript/Node.js Run-Time Environment
    Improved and more comprehensive explanations of how to make use of the features available in the JavaScript/Node.js run-time environments, for example, which Node.js packages are available by
default and how you can consume them with your MTA. There is also some new information about the unit-test framework, which you can use from within SAP Web IDE for SAP HANA.

- **Java Run-Time Environment**
  Improved and more comprehensive explanations of how to make use of the features available in the Java run-time environments, for example, how to set up connections to the SAP HANA database, how to configure logging and tracing, how to set up audit logs, how to configure authentication and authorization, how to debug your Java application, and how to enable Java Data Services (a native Java client for using Core Data Services functionality in the XS advanced Java run time).

- **Maintaining XS Advanced Application Routes and Destinations**
  Improvements to and extension of existing information as well as new information about features and functionality added with SAP HANA Platform 2.0 SPS 00.

- **SAP Web IDE**
  A complete reference for SAP Web IDE for SAP HANA, a browser-based integrated development environment (IDE) for the development of SAP-HANA-based applications comprised of web-based or mobile UIs, business logic, and extensive SAP HANA data models. SAP Web IDE works in conjunction with the SAP HANA Run-time Tools (HRTT), the SAP HANA deployment infrastructure (HDI), the Application Lifecycle Management tools (ALM) and the XS advanced run-time platform.

- **XS Command-Line Interface**
  Numerous improvements and additions to the parameters and options already available with existing commands as well as important additions to the installation and deployment functions including more control of the application version deployed and the services bound to the deployed application.

**SAP HANA XS Migration Guide**

The SAP HANA XS Migration Guide describes the process of migrating legacy applications running in the XS classic run-time environment to the new XS advanced run-time environment. The guide describes the tools and provides an example migration using the SAP HANA Interactive Education (SHINE) demo application available with SAP HANA XS classic model.

**SAP HANA Analytics Catalog (BIMC) Reference**

The SAP HANA Analytics Catalog (BIMC) Reference lists and describes the tables and views with the prefix BIMC located in the schema _SYS_BI. It contains metadata required by analytic clients such as Analysis Office and Business Cloud. The metadata is also required for access by Multi-Dimensional Expressions (MDX). The SAP HANA Analytic Catalog is an analytic extension of the database catalog (schema SYS).

**5.4.2 SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA (New)**

As of SAP HANA Platform 2.0 SPO0, SAP Enterprise Architecture Designer, Edition for SAP HANA, edition for SAP HANA is available.

SAP Enterprise Architecture Designer, Edition for SAP HANA (SAP EA Designer) lets you capture, analyze, and present your organization's landscapes, strategies, requirements, processes, data, and other artifacts in a shared environment. Using industry-standard notations and techniques, organizations can leverage rich metadata and use models and diagrams to drive understanding and promote shared outcomes in creating innovative systems, information sets, and processes to support goals and capabilities.

SAP EA Designer supports consuming your content through:
- Browsing diagrams and model objects online.
- Exporting diagrams as SVG images or printing them.
- Generating reports on your diagrams and model objects.
- Running an impact analysis.
- Posting comments to diagrams and model objects.

SAP EA Designer supports the creation and editing of the following kinds of diagrams:

- **Business Process** - Business process diagrams help you identify, describe, and decompose business processes. SAP EA Designer supports:
  - BPMN 2.0 Descriptive, which provides a small subset of objects suitable for business process design and analysis.
  - BPMN 2.0 Executable, which includes all the standard BPMN 2.0 objects, and is aimed at technical modelers and those who are reverse-engineering from SAP BPM or Eclipse BPMN2 Modeler.

- **Database** - Physical data models help you analyze and optimize the structure of your database. You can reverse-engineer any supported database to create a physical data model. Generation to SAP HANA, directly to the catalog, or to Web IDE via HDI is also supported.

- **Enterprise Architecture Diagram** - Enterprise architecture diagrams help you analyze and document your organization, its functions and processes, the applications and systems that support them, and the physical architecture on which they are implemented.

- **Process Map** - A process map provides a graphical view of your business architecture, and helps you identify your business functions and high-level processes, independent of the people and business units who fulfill them.

- **Requirements List** - Requirements documents display a hierarchical list of written requirements.

### 5.4.3 SAP Web IDE for SAP HANA (New and Changed)

As of SAP HANA Platform 2.0 SPO0, the following new features and changes are available in SAP Web IDE and integrated SAP HANA tools.

SAP Web IDE for SAP HANA is a browser-based integrated development environment (IDE) for the development of SAP HANA-based applications comprised of web-based or mobile UIs, business logic, and extensive SAP HANA data models. SAP Web IDE works in conjunction with the SAP HANA deployment infrastructure (HDI), the Application Lifecycle Management tools (ALM), the XS Advanced runtime platform, and various SAP HANA tools.
**SAP Web IDE**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Git Features (new)</strong></td>
<td>The Git tools have been enhanced with new capabilities. Now you can:</td>
</tr>
<tr>
<td></td>
<td>● Set up Git</td>
</tr>
<tr>
<td></td>
<td>● Configure Git repositories</td>
</tr>
<tr>
<td></td>
<td>● Use multiple branches</td>
</tr>
<tr>
<td></td>
<td>● View the History pane</td>
</tr>
<tr>
<td><strong>HTML5 Module Templates (new)</strong></td>
<td>Two new templates are now available for HTML5 modules:</td>
</tr>
<tr>
<td></td>
<td>● SAPUI5 application with a basic project structure</td>
</tr>
<tr>
<td></td>
<td>● SAP Fiori Master-Detail application</td>
</tr>
<tr>
<td><strong>Layout Editor (new)</strong></td>
<td>A visual designer is now available for the development of SAPUI5-based HTML5 modules.</td>
</tr>
<tr>
<td><strong>Problems View (new)</strong></td>
<td>A new pane is available to view and analyze information about problems in the modules and projects in your workspace.</td>
</tr>
<tr>
<td><strong>Run Console (changed)</strong></td>
<td>The enhanced Run console provides a holistic view of all running modules in a project and a quick access to their logs.</td>
</tr>
<tr>
<td><strong>Selective Build (changed)</strong></td>
<td>You can selectively build artifacts in an HDB module rather than build the entire module. This supports incremental development and shortens the processing time.</td>
</tr>
<tr>
<td><strong>User-defined Schema Names (new)</strong></td>
<td>You can now define the name of the database schema that is automatically created for an HDB module.</td>
</tr>
<tr>
<td><strong>SAP HANA Tools (new and changed)</strong></td>
<td>Various SAP HANA tools are now available in SAP Web IDE. For details, see below.</td>
</tr>
</tbody>
</table>

**SAP HANA Tools**

**Calculation View Editor (Modeler)**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank Node (enhanced)</td>
<td>You can now generate an additional output column for rank nodes to store rank values.</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>Assigning Semantics (enhanced)</td>
<td>In addition to the existing support for assigning semantics to measures, you can now also assign semantics to attributes in a calculation view.</td>
</tr>
<tr>
<td>Column Lineage (enhanced)</td>
<td>Column lineage support is now extended to trace source of columns used in calculated column expressions, and also for base measures used in restricted columns.</td>
</tr>
<tr>
<td>Cache Invalidation (enhanced)</td>
<td>Transaction-based cache invalidation is performed whenever the underlying data is modified.</td>
</tr>
<tr>
<td>Restricted Columns (new)</td>
<td>You can create restricted columns as an additional measure based on attribute restrictions. For example, you can choose to restrict the value for the REVENUE column only for REGION = APJ, and YEAR = 2016.</td>
</tr>
<tr>
<td>Support to Convert Attribute Values to Required Formats (new)</td>
<td>You can assign conversion functions to attribute columns. These functions help maintain conversion from any internal to external format and from any external to internal format.</td>
</tr>
<tr>
<td>Support for Debugging Calculation Views (new)</td>
<td>You can execute debug queries on calculation views and analyze the runtime performance of views. For example, based on the query that you execute, you can identify pruned and unpruned data sources in calculation views and at design-time.</td>
</tr>
<tr>
<td>Handling Null Values in Columns (new)</td>
<td>Define default values for columns (both attributes and measures). The system uses these default values in the reporting tools to replace any null values in columns.</td>
</tr>
<tr>
<td>Support for Virtual Tables (new)</td>
<td>In addition to the already supported data source types, you can now also use virtual tables as a data source for modeling calculation views.</td>
</tr>
<tr>
<td>Hierarchies (new)</td>
<td>You can use graphical modeling tools to create and define hierarchies. The tool supports both level hierarchies and parent-child hierarchies.</td>
</tr>
<tr>
<td>Support for Generating Time Data and Creating Calculation Views with Time Dimension (new)</td>
<td>You can generate time data into default time-related tables present in the _SYS_BI schema and use these tables in calculation views to add a time dimension.</td>
</tr>
<tr>
<td>Spatial Joins (new)</td>
<td>You can create spatial joins to query data from database tables that contain spatial data.</td>
</tr>
<tr>
<td>Time Travel Queries (new)</td>
<td>Calculation views now support time travel queries, which help query the past state of data. You can use input parameters to specify the timestamp in time travel queries.</td>
</tr>
<tr>
<td>Validation Rules to Validate Performance of Calculation Views (new)</td>
<td>The tool supports certain validation rules, which when executed, validate the calculation view and help identify whether there are any design-time factors that could impact the performance of calculation views at runtime.</td>
</tr>
<tr>
<td>Time-Dependent Hierarchies (new)</td>
<td>You can create parent-child hierarchies with time dependency. If elements in the hierarchy are changing elements (time-dependent elements), then enabling the parent-child hierarchy as a time-dependent hierarchy helps display different versions of that hierarchy at runtime.</td>
</tr>
</tbody>
</table>
### Currency Conversion and Unit Conversion (enhanced)

You can reuse the currency conversion or unit conversion definition of a selected measure in multiple other measures at a time.

You can also now associate measures with currency code or unit values in any aggregation node (not only the default aggregation node) in the calculation view.

### Additional Features for Calculation Views

You can now do the following:

- Create input parameters derived from scalar functions.
- Use improved user interface for creating synonyms.
- Use improved user interface for creating analytic privileges.
- Create dynamic analytic privileges and hierarchy analytic privileges.
- Generate calculation view documentation.
- Prune data in union nodes to optimize query execution.
- Preview data for intermediate nodes in calculation views.
- Perform pattern matching and pattern matching with Cypher query in graph nodes. (Cypher is a registered trademark of Neo Technology, Inc.).
- Group related measures.

### CDS Graphical Editor

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating CDS Views (new)</td>
<td>You can use the graphical modeling tools in SAP Web IDE for SAP HANA to create a design time CDS view. A CDS view is a virtual table based on the dynamic results returned in response to a SQL statement.</td>
</tr>
<tr>
<td>Creating Calculated Columns (new)</td>
<td>You can create additional columns in a CDS View. The values of these columns are calculated at runtime based on the result of an expression.</td>
</tr>
<tr>
<td>Creating Associations Using Graphical Tools (new)</td>
<td>You can create associations using graphical modeling tools in SAP Web IDE for SAP HANA to define the relationship between entities.</td>
</tr>
<tr>
<td>Import Entity Definitions (new)</td>
<td>You can import elements from other entities and use the definition of imported elements to define the elements of a selected entity.</td>
</tr>
</tbody>
</table>
### Feature

#### Support for additional types of data types (new)

- **Scalar Types**
  You can create and use scalar types for defining the data types of elements. Scalar types are user-defined scalar data types that reference existing structured types (for example, user-defined) or the individual types (for example, field, type, or context) used in another data-type definition.

- **Entity Elements**
  For defining the data type of elements in an entity or structure, you can use the data type of elements in other entities.

- **Structure Elements**
  For defining the data type of elements in an entity or structure, you can use the data type of elements in other structure.

### Database Explorer

#### Feature

The SAP HANA Runtime Tools application is no longer a separate application. It has been integrated into SAP Web IDE for SAP HANA as a perspective that is named the database explorer.

#### Description

The database explorer contains the same functionality as the old runtime tools application, with the addition of several new features and enhancements. These additions include:

- **Connecting to SAP HANA databases in addition to HDI containers.** With this feature you can view tracing files for your SAP HANA databases.

- **Analyzing the performance of SQL queries with the SAP HANA SQL analyzer.** This new tool, available from the SQL console, allows you to analyze and understand query execution and performance aspects of your SAP HANA database. It can be used to view detailed information on each query and can help evaluate potential bottlenecks for your queries.

- **Importing and exporting catalog objects to and from HDI containers and databases.**

- **Executing MDX queries using the new MDX console.**

- **Adding generated time data into default, time-related tables to help test and model applications.**

Also, improvements have been made to the navigation of catalog objects in the database browser tree. A second pane has been added, which lists the items for a chosen database object.
### Flowgraph Editor

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flowgraph Editor (new)</td>
<td>The Flowgraph Editor is now available in SAP Web IDE. It is a modeling tool for assessing, transforming, cleansing, and enriching data.</td>
</tr>
</tbody>
</table>

#### Available nodes

The following nodes are available:

- Aggregation
- Cleanse
- Case
- Data Mask
- Data Source
- Data Target
- Date Generator
- Geocode
- History Preserving
- Join
- Lookup
- Map Operation
- Procedure (Stored)
- Projection (Filter)
- Row Generator
- Table Comparison
- Union

#### Additional features

Additional features include:

- Quick View
- More intuitive prompts and messages
- License validation
- Improved navigation between views
- Separate input/output ports
- Better recovery from invalid state
- Better security based on user rights

### Java and Node.js Development

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDS textual editor</td>
<td>You can now:</td>
</tr>
<tr>
<td></td>
<td>- Beautify sources, also known as pretty-print.</td>
</tr>
<tr>
<td></td>
<td>- Use code completion for tables and views in the same HDI container.</td>
</tr>
<tr>
<td></td>
<td>- Report syntax errors in Problems View (see SAP Web IDE features above).</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Node.js development</td>
<td>Includes the following improvements:</td>
</tr>
<tr>
<td></td>
<td>- The template for new plain node.js modules now contains a sample Jasmine test.</td>
</tr>
<tr>
<td></td>
<td>- Slight redesign of the Test Results pane and Debugger pane.</td>
</tr>
<tr>
<td></td>
<td>- On-demand debugging of already running applications (no need to start in debug mode first).</td>
</tr>
<tr>
<td>Java Development (new)</td>
<td>You can now create, build, and run Java (WAR) modules.</td>
</tr>
</tbody>
</table>

**Text Analysis**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensions for Text Analysis</td>
<td>SAP Web IDE now supports developing custom text analysis dictionaries and rules, including:</td>
</tr>
<tr>
<td></td>
<td>- Creating and maintaining custom text analysis dictionaries and rule sets within SAP Web IDE.</td>
</tr>
<tr>
<td></td>
<td>- Snippets feature simplifies editing of text analysis dictionaries.</td>
</tr>
<tr>
<td></td>
<td>- Interactively test custom text analysis dictionaries and rules within SAP Web IDE using text analysis run configurations.</td>
</tr>
</tbody>
</table>

**SAP HANA Smart Data Streaming Plugin**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCL editor</td>
<td>Simplified CCL text editing with new smart data streaming-specific features:</td>
</tr>
<tr>
<td></td>
<td>- Automatic code completion</td>
</tr>
<tr>
<td></td>
<td>- Case-insensitive syntax highlighting</td>
</tr>
<tr>
<td></td>
<td>- Error validation and syntax checking</td>
</tr>
<tr>
<td></td>
<td>- Code snippets</td>
</tr>
<tr>
<td>CCL graphical viewer</td>
<td>You can now view CCL elements in a data flow diagram, and see a list of all elements in your smart data streaming project in an outline view.</td>
</tr>
<tr>
<td>Closer connection to the runtime tool</td>
<td>Smart data streaming projects from SAP Web IDE are deployed to the streaming runtime tool for testing, management, and monitoring. You can open the streaming runtime tool directly from the Tools dropdown in the main menu.</td>
</tr>
</tbody>
</table>

For more information, see What’s New in SAP HANA Smart Data Streaming (Release Notes).
5.4.4 SAP HANA Spatial (New)

As of SAP HANA Platform 2.0 SPS 00, new features are available in the SAP HANA Spatial.

The following method is new:
- `ST_IntersectsRectPlanar`

5.4.5 SAP HANA Graph (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for the administration of SAP HANA Graph:

- SAP HANA Graph provides two options for executing graph pattern queries. Besides using a graphical pattern editor of the Graph Viewer tool, SAP HANA Graph also allows you to describe the pattern in Cypher query language (Cypher is a registered trademark of Neo Technology, Inc.). The action for pattern matching is MATCH_SUBGRAPHS. With SAP HANA Platform 1.0 SPS 12, the name of the action for pattern matching is GET_ISOMORPHIC_SUBGRAPHS.
- GraphScript has been added to SQLScript. GraphScript is a high-level, domain-specific language. GraphScript is specifically designed to ease the development and integration of complex graph algorithms into the existing data management workflow. At the same time, GraphScript provides competitive execution performance for manually written and tuned graph algorithm implementations in a low-level programming language.

5.4.6 Hierarchy Functions (New)

Hierarchy functions are available as of SAP HANA Platform 2.0 SPS 00:

- SAP HANA provides a public hierarchy SQL interface.
- Core elements are table functions for hierarchy generation and navigation.
- Hierarchy enables ad hoc hierarchical queries accelerated by internal caching.

SAP HANA provides the following table functions:

- `HIERARCHY` creates a (partial) hierarchy based on parent-child source data, an optional maximum recursion depth input parameter and an orphan handling directive.
- The following functions are provided for navigation inside a hierarchy:
  - `HIERARCHY_DESCENDANTS` returns all descendants of a set of origin nodes, pre-filtered (optional) by a distance window.
  - `HIERARCHY_ANCESTORS` returns all ancestors of a set of origin nodes, pre-filtered (optional) by a distance window.
  - `HIERARCHY_SIBLINGS` returns all siblings of a set of origin nodes.
5.4.7 Search, Text Analysis, and Text Mining

SAP HANA 2.0 SPS 00 introduces the following new and changed features for search, text analysis, and text mining.

- Search (New) [page 231]
- Text Analysis (New and Changed) [page 232]
- Text Mining (New and Changed) [page 234]
- SAP File Processing (New) [page 234]
- File Loader (Changed) [page 234]

5.4.7.1 Search (New)

Batch Processing for Search Rules

Search rules support a batch processing mode. This batch mode allows to compare a set of records given in an input table with a reference set of records with a single call to the search rule set procedure to find any duplicates within these two sets of data. The batch mode is described in section Search Rule Sets in Batch Mode.

The Search Rule Sets Batch mode is introduced to provide the possibility to do mass data processing based on Search Rule Sets.

Dynamic Search Rule Sets

With this feature, you can use the functionality of search rule sets without having the need to first activate the search rule set via the SAP HANA repository or SAP HANA HDI. Within the XML-Tag <ruleset>, you can store a complete rule set definition.

Filtering on Date Data Type

You can now filter on a date data type, be it partial (e.g. 2016/09), decimal or string in faceted navigation applications.
New Similarity Calculation Modes

The fuzzy search option `similarCalculationMode` offers two more modes: `typeAhead` and `searchCompare`. The mode `typeAhead` is used when the user enters the beginning of a string and all strings starting with the user input will be returned. The mode `searchCompare` combines the strength of modes `compare` and `search` while eliminating some of the shortcomings of search mode `search`.

New CDS Annotation

The new `Semantics` annotation contains a subset of the semantic annotations defined as CDS core annotations. The annotations on element level define language codes and dates or time stamps.

5.4.7.2 Text Analysis (New and Changed)

Web IDE Extensions for Text Analysis

SAP Web IDE now includes support for developing custom text analysis dictionaries and rules.

- Create and maintain custom text analysis dictionaries and rule sets within the Web IDE.
- Snippets feature simplifies editing of text analysis dictionaries.
- Interactively test custom text analysis dictionaries and rules within the Web IDE using text analysis run configurations.

See chapter Managing Custom Text Analysis Configurations with XS Advanced inside the SAP HANA Text Analysis Developer Guide for details.

XS Advanced Integration

The standard Node.js packages for the SAP HANA XS Advanced Model now include an API for text analysis. This API provides a convenient JavaScript interface to the text analysis functionality in SAP HANA, and also allows you to perform text analysis on any data, not just data stored in the SAP HANA database for which a full-text index is being created. In addition, the XSJS compatibility layer has been extended to include the XS Classic API for text analysis, making it easier to migrate your existing applications to the XS Advanced Model.

Refer to the SAP HANA Developers Guide for SAP HANA XS Advanced Model for information on how to obtain and deploy these optional Node.js packages.
The new `TA_ANALYZE SQL` procedure allows text analysis functions to be performed on arbitrary inputs, not just data stored in the SAP HANA database. The procedure accepts both plain text and binary document input, and provides access to all of the text analysis capabilities in SAP HANA.

**Voice of the Customer for Arabic**

Voice of the customer (sentiment analysis) functionality is supported for text in Arabic.

**Neutral Language Support**

Text analysis can now be performed in a "language-neutral" manner on whitespace-delimited languages. This allows text analysis and text mining to be used, at least in a limited manner, with whitespace-delimited languages for which SAP does not currently provide full support (e.g., Irish Gaelic). The language-neutral processing can be requested using the new "UD" language code. This code can be used with the `LANGUAGE`, `LANGUAGE_COLUMN`, and `LANGUAGE_DETECTION` parameters on the `CREATE FULLTEXT INDEX` SQL statement.

Refer to the SAP HANA Search Developer Guide for more information on how to use the neutral ("UD") language code.

**Turkish Parts of Speech for Negated Verbs**

The Turkish language modules now define unique part-of-speech tags to identify negated verbs. For example, one form of the first person singular English verb to *like* is *seviyorum* in Turkish. The negated form (*to not like*) is *sevmiyorum*. The new part of speech tag for *sevmiyorum*, which is unique to Turkish, is V-Sg1-Neg, first person singular negated verb.

**Expanded Part of Speech Tags in the $TA Table**

Expanded part-of-speech information can now be requested from text analysis and accessed via the `$TA` table. This expanded information is not generated by default; it must be explicitly requested using a custom text analysis configuration. The expanded information is provided in a new `$TA` table column called `TA_TYPE_EXPANDED`. (The `TA_TYPE` column continues to provide simplified part-of-speech names for backward-compatibility.)

For example, the English words *run*, *runs*, *running*, and *ran* have the same value in `TA_TYPE`: verb. In the `TA_TYPE_EXPANDED` column however, the respective values are V-Pres, V-Pres-3-Sg, V-PrPart, and V-Past.
5.4.7.3 Text Mining (New and Changed)

XS Advanced Integration

The standard Node.js packages for the SAP HANA XS Advanced Model now include an API for text mining. This API provides a convenient JavaScript interface to the text mining functionality in SAP HANA. In addition, the XSJS compatibility layer has been extended to include the XS Classic API for text mining, making it easier to migrate your existing applications to the XS Advanced Model.

Refer to the SAP HANA Developer Guide for XS Advanced Model for information on how to obtain and deploy these optional Node.js packages.

New DEFAULT Keyword for Text Mining SQL functions

The NEAREST NEIGHBORS and TOP parameters in the SQL functions for text mining can specify the value as DEFAULT, instead of a numeric value. Using DEFAULT causes the function to use the same value that was used at text mining initialization (either the original value from the text mining configuration, or an override value specified using the TEXT MINING CONFIGURATION OVERLAY parameter or the initialize function in the text mining XS classic or advanced APIs).

5.4.7.4 SAP File Processing (New)

SAP File Processing is an optional capability of SAP HANA 2.0 that provides a set of HTTP services to extract structured information (text and metadata) from unstructured files.

The rich set of HTTP APIs enables application programmers to integrate SAP File Processing features in client applications.

Before you can start, you have to deploy SAP File Processing with the SAP HANA Database Lifecycle Manager hdb1cm to your SAP HANA system that is running XS Advanced.

5.4.7.5 File Loader (Changed)

The File Loader component was introduced with SAP HANA 1.0 SPS 09. It can be used with SAP HANA 2.0 as well.

**Note**

However, if you start the development of new projects on SAP HANA 2.0, we recommend the use of the new HTTP services that are delivered with SAP File Processing for SAP HANA.
5.4.8 SAP HANA Interactive Education (SHINE) for XS Advanced (New and Changed)

SHINE for XSA is a demo content that makes it easy to learn how to build applications on SAP HANA Extended Application Services Advanced Model. This demo content is delivered as a package containing sample data and design-time developer objects for application database tables, views, OData and user interfaces.

As of SAP HANA Platform HANA 2.0 SPS00, the following new features are available in SAP HANA Interactive Education (SHINE) for XS Advanced:

- **Java Runtime**: the Java implementation has been added to SHINE to showcase Create Read Update Delete (CRUD) operations on oData V4 services implemented by using the new Java OData support for CDS annotations in XS Advanced. This scenario is a part of the new User CRUD tile.
- **Automated Role Collection Creation**: a role collection needs to be created via XS Advanced Administration tool to access SHINE Data Generator. This procedure now be performed automatically within the SHINE application.
- **Cross-Container Access**: cross-container access is required to access database artifacts in another HANA Deployment Infrastructure (HDI) container or in a foreign schema (for example, SYS or _SYS_BI). SHINE now has two HDI containers (core-db and user-db) and it showcases how to access user-db artifacts in core-db by defining and granting roles. SHINE also showcases how to access foreign schema objects (for example, view within a SYS schema) via a User-Provided Service (CUPS) in the core-db container.
- **Service Replacement**: service replacements in the MTA deployment descriptor (mtad.yaml) are required to map real services to logical services. This feature is used in SHINE to map the User-Provided Service (CUPS) to logical service names.
- **Schema Config**: the Schema Config MTA Deployment Descriptor in allows you to provide an actual schema name for a container instead of the default guid assigned by HDI. This feature is used in SHINE to provide a schema name for the user-db HDI container.
- **MTA Deployment Extension Descriptor**: it allows you to provide system-specific information only known to the system administrator. MTA Deployment Extension Descriptor (mtaext) is used in SHINE to pass the parameters required for CUPS creation.
- **oData Batch**: batch requests allow grouping of multiple operations. This implementation in nodejs oData v2 is used in SHINE for creation of multiple users with one request.
- **oData Metadata Caching**: allows the caching of a metadata document in the browser for a defined time period and the browser no longer needs to make repeated requests to the $metadata document.

5.5 Reference

SAP HANA Platform 2.0 SPS 00 introduces new and changed features which are described in the reference documentation.

SAP HANA SQL and System Views Reference (New and Changed) [page 236]
As of SAP HANA Platform 2.0 SPS 00, the following new features and changes are available in the SAP HANA SQL syntax and are documented in the SAP HANA SQL and System Views Reference.

SAP HANA Client Interfaces (New and Changed) [page 243]
As of SAP HANA Platform 2.0 SPS 00, the SAP HANA Client Interface Programming Reference Guide contains documentation for the following new and changed features.
5.5.1 SAP HANA SQL and System Views Reference (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, the following new features and changes are available in the SAP HANA SQL syntax and are documented in the SAP HANA SQL and System Views Reference.

SQL Statements (New and Changed)

- **ALTER DATABASE Statement (changed)**
  You can now cancel a replica to clean up the system.

- **ALTER ROLE Statement (new)**
  Adds or drops the mapping of LDAP groups for a role.

- **ALTER STATISTICS Statement (new)**
  Alters existing data statistics objects.

- **ALTER SYSTEM APPLICATION ENCRYPTION Statement (new)**
  Manages encryption keys for applications by using the internal data encryption service.

- **ALTER SYSTEM CLEAR TIMEZONE CACHE Statement (new)**
  Removes cached timezone definitions.

- **ALTER SYSTEM CLEAR RESULT CACHE Statement (changed)**
  Clears the result cache.

- **ALTER SYSTEM LOG ENCRYPTION Statement (new)**
  Manages encryption keys for logs by using the internal data encryption service.
<table>
<thead>
<tr>
<th>SQL Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>ALTER SYSTEM PERSISTENCE ENCRYPTION Statement</code></td>
<td>Controls whether persistent data is stored on disk in an encrypted or non-encrypted format.</td>
</tr>
<tr>
<td><code>ALTER SYSTEM REFRESH RESULT CACHE Statement</code></td>
<td>You can now specify static or dynamic caching.</td>
</tr>
<tr>
<td><code>ALTER SYSTEM REFRESH RESULT CACHE ENTRY Statement</code></td>
<td>You can now refresh the result cache entry.</td>
</tr>
<tr>
<td><code>ALTER SYSTEM REMOVE RESULT CACHE ENTRY Statement</code></td>
<td>You can now remove the result cache entry.</td>
</tr>
<tr>
<td><code>ALTER SYSTEM STOP DATABASE Statement</code></td>
<td>Removes any user-defined hints from the system that are associated with the specified statement.</td>
</tr>
<tr>
<td><code>ALTER SYSTEM REMOVE STATEMENT HINT Statement</code></td>
<td>Creates a password for root key backups.</td>
</tr>
<tr>
<td><code>ALTER SYSTEM SET ENCRYPTION ROOT KEYS BACKUP PASSWORD Statement</code></td>
<td></td>
</tr>
<tr>
<td><code>ALTER SYSTEM SET ENCRYPTION ROOT KEYS BACKUP PASSWORD Statement</code></td>
<td></td>
</tr>
<tr>
<td><code>ALTER TABLE Statement</code></td>
<td></td>
</tr>
<tr>
<td><code>ALTER VIEW Statement</code></td>
<td></td>
</tr>
<tr>
<td><code>ALTER VIRTUAL TABLE Statement</code></td>
<td></td>
</tr>
<tr>
<td><code>BACKUP DATA Statement</code></td>
<td></td>
</tr>
<tr>
<td>`CREATE</td>
<td>ALTER FUNCTION Statement`</td>
</tr>
<tr>
<td>`CREATE</td>
<td>ALTER</td>
</tr>
<tr>
<td><code>CREATE AUDIT POLICY Statement</code></td>
<td>Create, alter, validate, and drop LDAP providers.</td>
</tr>
<tr>
<td><code>The following new audit actions have been added:</code></td>
<td>The following new audit actions have been added:</td>
</tr>
<tr>
<td>- ALTER APPLICATION ENCRYPTION</td>
<td></td>
</tr>
<tr>
<td>- ALTER APPLICATION ENCRYPTION ROOT KEY</td>
<td></td>
</tr>
<tr>
<td>- ALTER LOG ENCRYPTION</td>
<td></td>
</tr>
<tr>
<td>- ALTER LOG ENCRYPTION ROOT KEY</td>
<td></td>
</tr>
<tr>
<td>- ALTER ROOT KEYS BACKUP PASSWORD</td>
<td></td>
</tr>
<tr>
<td>- CREATE GRAPH WORKSPACE</td>
<td></td>
</tr>
</tbody>
</table>
DROP GRAPH WORKSPACE

CREATE FUNCTION Statement (changed)
For scalar functions, you can now specify the DETERMINISTIC keyword to indicate that the function always returns the same value (when using the same input parameters). Deterministic functions are advantageous because they only need to be calculated once; the cached value can be used for subsequent calls to the function.

CREATE PROCEDURE Statement (changed)
- The new MAP_MERGE operator allows you to use the mapper function to unite intermediate result tables.
- You can now use the graph script programming language in procedures by specifying the GRAPH option of the LANGUAGE clause.

CREATE ROLE Statement (changed)
You can now create a role and associate it with an LDAP DN.

CREATE STATISTICS Statement (changed)
The enhancements listed below are also available in the new ALTER STATISTICS Statement as well.
- New REFRESH TYPE clause allows you to control the refresh behavior for a data statistics object.
- New ENABLE clause allows you to control whether the data statistics object is used by the optimizer.
- New TOPK data statistics object type.
- New ACCURACY and PREFIXBITS properties for data statistics objects.

CREATE | ALTER USER Statement (changed)
- You can now configure LDAP group authorization for a user.
- ALTER USER statement only: a new GRANT | REVOKE CREATE ANY ON OWN SCHEMA clause allows a user with USER ADMIN to control another user’s ability to create objects in their own schema.
- ALTER USER statement only: a new GRANT | REVOKE ROLE PUBLIC clause allows a user with USER ADMIN to control whether another user has PUBLIC role.

CREATE VIEW Statement (changed)
- You can now specify static or dynamic caching.
- Use association propagation by specifying the WITH ASSOCIATIONS clause.

CREATE VIRTUAL PROCEDURE Statement (new)
You can now create virtual procedures.

EXPORT Statement (changed)
Two new export options, STATISTICS ONLY and NO STATISTICS, allow you to control the export of data statistics objects.

GRANT Statement (changed)
- The new CREATE VIRTUAL PROCEDURE object privilege authorizes access to create custom virtual procedures.
- The new ENCRYPTION ROOT KEY ADMIN system privilege authorizes all commands related to management of root keys.

IMPORT Statement (changed)
Two new import options, STATISTICS ONLY and NO STATISTICS, allow you to control the import of data statistics objects.
IMPORT FROM Statement (changed)

Two new import options, STATISTICS ONLY and NO STATISTICS, allow you to control the import of data statistics objects.

MERGE INTO Statement (new)

Merges data into an existing column store table.

RECOVER DATABASE Statement (changed)

You can now specify a distinct destination for backups of the backup catalog.

SELECT Statement (changed)

The FOR UPDATE clause now supports virtual tables.

UNLOAD Statement (changed)

A new PARTITION clause unloads the specified partition(s) from memory.

### SQL Functions (New and Changed)

**ADD_MONTHS_LAST Function (new)**

Computes the specified date plus the specified number of months, with the output date being the last day of the month if the input date is the last day of the month, even if those two dates differ.

**ENCRYPTION_ROOT_KEYS_EXTRACT_KEYS Function (new)**

Extracts root keys and sends them to a client session as a CLOB.

**GRANT Statement (changed)**

Support has been added for the new ENCRYPTION ROOT KEY ADMIN system privilege.

**HIERARCHY Function (new)**

Generates a hierarchy.

**HIERARCHY_ANCESTORS Function (new)**

Returns all ancestors of a set of start nodes from a hierarchy.

**HIERARCHY_DESCENDANTS Function (new)**

Returns all descendants of a set of start nodes from a hierarchy.

**HIERARCHY_SIBLINGS Function (new)**

Returns all siblings of a set of start nodes, including the start nodes, from a hierarchy.

**JSON_QUERY Function (new)**

Extracts a JSON text from a JSON text using a SQL/JSON path expression.

**JSON_TABLE Function (new)**

Queries a JSON text and presents it as a relational table.

**JSON_VALUE Function (new)**

Extracts an SQL value of a predefined type from a JSON value.

**NEWUID Function (new)**

Creates a unique identifier within the database.

**XMLEXTRACT Function (new)**

Returns an XML element matching the specified XPath query.

**XMLEXTRACTVALUE Function (new)**

Returns an XML value matching the specified XPath query.
# System Views (New and Changed)

**APPLICATION_ENCRYPTION_KEYS System View** (new)
Provides information about encryption keys used by applications.

**AUDIT_LOG System View** (changed)
- The new XS_APPLICATION_USER_NAME column specifies the name of the XS application user.
- Previously, the AUDIT_ACTION column was VARCHAR(40). Now, it is VARCHAR(64).

**AUDIT_POLICIES System View** (changed)
Previously, the EVENT_ACTION column was VARCHAR(32). Now, it is VARCHAR(64).

**DATA_STATISTICS System View** (changed)
New DATA_SOURCE_STORAGE_TYPE, REFRESH_TYPE, IS_ENABLED, and LAST_REFRESH_REASON columns to support additional data statistics functionality.

**ENCRYPTION_ROOT_KEYS System View** (changed)
New ROOT_KEY_STATUS column specifies the key state.

**FUNCTIONS System View** (changed)
The new CREATE_TIME column specifies the creation time of the function.

**GRANTED_ROLES System View** (changed)
New IS_GRANTED_BY_LDAP column specifies whether the role is granted by LDAP.

**HINT Details** (changed)
The new RESULT_LAG hint for Active/Active (read-enabled) routes a statement to a secondary system on an Active/Active (read-enabled) system.

**LDAP_PROVIDER_URLS System View** (new)
Lists all LDAP provider URLs.

**LDAP_PROVIDERS System View** (new)
Lists all LDAP providers.

**LDAP_USERS System View** (new)
Lists all LDAP users.

**MASYNCHRONOUS_TABLE_REPLICAS** (deprecated)
This view is now deprecated.

**M_BACKUP_CATALOG_FILES System View** (changed)
In the case of a log backup, the new LOG_SEGMENT_COUNT column specifies the number of log segments contained in the backup.

**M_BACKUP_CONFIGURATION System View** (changed)
- The new BACKINT_CATALOG_BACKUP_PATH column specifies the directory for backint-based catalog backups.
- The new FILE_CATALOG_BACKUP_PATH column specifies the directory for file-based catalog backups.
- The new LOG_BACKUP_TIMEOUT column specifies the log backup timeout.
- The new LOG_BACKUP_INTERVAL_MODE column specifies the log backup interval mode.
M_CONNECTIONS System View (changed)

There is a new SOURCE_SITE_LOGICAL_CONNECTION_ID column, which is the logical connection ID of the origin site. Additionally, the IS_HISTORY_SAVED column is deprecated. Do not use this value.

M_CS_LOB_SPACE_RECLAIMS System View (new)

Provides information regarding executed LOB garbage collection runs.

M_DELTA_MERGE_STATISTICS System View (changed)

There is a new CRITICAL value, which is triggered based on a critical decision function, has been added to the MOTIVATION column.

M_DISKS System View (changed)

The data type for the USAGE_TYPE column has changed from VARCHAR(32) to VARCHAR(64) and a new usage type, CATALOG_BACKUP, has been added.

M_DYNAMIC_RESULT_CACHE System View (new)

Lists statistics for the dynamic result cache.

M_DYNAMIC_RESULT_CACHE_EXCLUSIONS System View (new)

Lists cache exclusions of the dynamic result cache.

M_ENCRYPTION_OVERVIEW System View (new)

Reports the encryption status for all data at rest where encryption is supported.

M_EXECUTED_STATEMENTS System View (changed)

The new SCHEMA_NAME column shows the name of the schema in whose context the statement is executed.

M_EXPENSIVE_STATEMENTS System View (changed)

The new SCHEMA_NAME column shows the name of the schema in whose context the statement is executed.

M_LANDSCAPE_HOST_CONFIGURATION System View (changed)

The new WORKER_CONFIG_GROUPS and WORKER_ACTUAL_GROUPS columns assign hosts to logical worker groups.

M_LOAD_HISTORY_SERVICE System View (changed)

The new MUTEX_COLLISION_COUNT column displays the number of collisions on mutexes while the new READ_WRITE_LOCK_COLLISION_COUNT column displays the number of collisions on read/write locks. Additionally, the TRANSACTION_ID_RANGE column has been removed.

M_MEMORY_OBJECTS System View (changed)

The following new columns have been added:

- MOVE_IN_COUNT - The total number of objects moved in from a different statistic.
- MOVE_IN_SIZE - The total size of objects moved in from a different statistic.
- MOVE_OUT_COUNT - The total number of objects moved out to a different statistic.
- MOVE_OUT_SIZE - The total size of objects moved out to a different statistic.

M_REMOTE_STATEMENTS System View (changed)

The new REMOTE_STATEMENT_DETAILS column specifies the statement details.
M_SECURESTORE System View (deprecated)
The M_SECURESTORE System View is now deprecated.

M_SQL_PLAN_STATISTICS System View (new)
Provides statistics of a live or evicted individual execution plan.

M_SYSTEM_REPLICATION_MVCC_HISTORY System View (new)
Displays the global MVCC timestamp history in the secondary site for system replication.

M_TABLE_LOB_STATISTICS System View (changed)
The new LOB_STORAGE_TYPE column returns a packed LOB container or file LOB.

M_TABLE_STATISTICS System View (changed)
The new MERGE_COUNT column returns the count of merge into statements for the table.

M_WORKLOAD_CAPTURES System View (changed)
The new PROGRESS column displays the progress of the load process used for Workload Analyzer based on engine instrumentation.

M_WORKLOAD_REPLAYS System View (changed)
The new REPLAY_NAME and REPLAY_DESCRIPTION columns display the user-specified name and description of the replayed workload.

PROCEDURES System View (changed)
The new CREATE_TIME column specifies the creation time of the procedure.

ROLE_LDAP_GROUPS System View (new)
Lists all of the LDAP group roles.

SCHEMAS System View (changed)
The new CREATE_TIME column specifies the creation time of the schema.

SEQUENCES System View (changed)
The new CREATE_TIME column specifies the creation time of the sequence.

STATEMENT_HINTS System View (changed)
New SYSTEM_HINT_STRING column displays when a system hint conflicts with an existing hint.

SYNONYMS System View (changed)
The new CREATE_TIME column specifies the creation time of the synonym.

TABLES System View (changed)
The new CREATE_TIME column specifies the creation time of the table.

USERS System View (changed)
New AUTHORIZATION_MODE column specifies the authorization mode of a user, which can be either local or LDAP.

VIEWS System View (changed)
- New cache types for HAS_CACHE column.
- New CREATE_TIME column specifies the creation time of the view.

Privileges (New and Changed)

LDAP ADMIN privilege (new)
Authorizes administration of LDAP providers.
5.5.2 SAP HANA Client Interfaces (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, the SAP HANA Client Interface Programming Reference Guide contains documentation for the following new and changed features.

BINTEXT_IS_NCLOB ODBC Connection Property (New)

Determines which SQL type is used to describe BINTEXT columns.

Client Support for Additional Operating Systems (New)

The SAP HANA client is now supported on Linux on PowerPC (Little Endian) and Windows Server 2016.

Client-Side Support for Active/Active (Read Enabled) (New)

Active/Active (read enabled) allows SAP HANA system replication to support read-only access to the secondary system. The SQL Console in the SAP HANA Database Explorer is unable to use Active/Active (read enabled).

Node.js Client (New)

A Node.js driver is available for download. See 2391549 for the download location. The Node.js JavaScript API can be used to connect to SAP HANA databases, issue SQL queries, and obtain result sets.
sessionVariable Option (New)

Use the new sessionVariable option to set session variables when connecting to your database via JDBC or ODBC.

API Support for Query Timeout (New)

You can set SQL_ATTR_QUERY_TIMEOUT on an ODBC Statement Handle via SQLSetStmtAttr(). The client now supports the Microsoft ADO.NET Command.CommandTimeout property. Additionally, SAP HANA HDBSQL now supports the -qto (/querytimeout) option to set a server-side timeout for all SQL operations.

New Default Value for SPATIALTYPES (Changed)

The SPATIALTYPES connection property has a new default value of 2.

New Default Value for emptyTimestampIsNull (Changed)

The emptyTimestampIsNull JDBC connection property now defaults to TRUE rather than FALSE.

Empty Timestamp Is Null Connection Property Supported for ODBC and ADO.NET

Support has been added for the Empty timestamp is null ADO.NET connection parameter, and the EMPTYTIMESTAMPISNULL ODBC connection property. When enabled, both these connection options specify that DAYDATE, SECONDTIME, SECONDDATE, and LONGDATE values inserted as empty strings are returned as NULLs.

SAP HANA Clients Only Support SPS 10 and Higher (Changed)

SAP HANA clients support connecting to SAP HANA 1.0 SPS 10 and higher servers. Connecting to SAP HANA 1.0 SPS 9 and earlier servers results in an error.
JDBC Driver Uses JDK 1.8 (Changed)

The SAP HANA JDBC driver now includes support for the Java Development Kit (JDK) 1.7 (JDBC 4.1) and JDK 1.8 (JDBC 4.2) APIs. Previously, support was limited to the JDK 1.6 (JDBC 4.0) APIs. The minimum JDK version supported by the SAP HANA JDBC driver is now JDK 1.6 (JDBC 4.0). Previously, it was JDK 1.4 (JDBC 3.0).

New ODBC Data Type SQL_TYPE_DST_GEOMETRY for SPATIALTYPES ODBC Connection Property

Both ST_POINT and ST_GEOMETRY columns are described with this type, by default.

5.5.3 SAP HANA Predictive Analysis Library (New and Changed)

As of SAP HANA Platform 2.0, new and changed features for the Predictive Analysis Library (PAL) are available.

General

In the new release of PAL, it is possible to run parallel execution of selected PAL functions with partition table as input from SAP HANA SQLScript using the "WITH HINT (PARALLEL_BY_PARAMETER_PARTITIONS ()") clause. The main scenario is to run scoring function with a trained model from PAL supervised learning algorithms, such as decision trees and random forest. Given a partitioned data table, the parallel execution of the scoring function will be initiated on each data partition, sharing the same trained model and other function parameters from the other unpartitioned tables. This feature works on both single-node and multiple-node SAP HANA environment. An example is illustrated below:

```sql
CREATE COLUMN TABLE PAL_C45_DATA_TBL (  
  ...  
)  
GROUP TYPE "MULTI_NODE"  
GROUP NAME "NODE_ALL"  
PARTITION BY 'ROUNDROBIN 8';  
...  
CALL PAL DT_SCORING_PROC(PAL_C45_DATA_TBL, PAL_C45_CONTROL_TBL, PAL_C45_TREEMODEL_TBL, ?) WITH HINT (PARALLEL_BY_PARAMETER_PARTITIONS(p1));
```

New Algorithms

Generalized Linear Models

Generalized linear models (GLM) is used to regress responses satisfying exponential distributions, for example, Normal, Poisson, Binomial, Gamma, inverse Gaussian, etc. Compared with the classical linear regression, GLM...
regresses a linear predictor $\eta$ instead of the response itself. The linear predictor and the expected response $\mu$ is connected via link function, $n=g^{-1}(\eta)$, which guarantees that the regressed responses are in the valid range. Possible link functions are identity, log, reciprocal, logit, probit, complementary log-log, and inverse square.

Given observations $y_i, i=1, 2, \ldots, n$ of response, and covariates $x_i, i=1, 2, \ldots, n$, where $x_i$ is a p-dimensional vector, the coefficients are to estimated.

$$q(y_i) = \beta' + x_i' \beta$$

where $\beta_0$ is the intercept, and $\beta$ is a p-dimensional vector, corresponding to the coefficients with respect to the covariates.

**Cox Proportional Hazard Model**

Cox proportional hazard model (CoxPHM), a special generalized linear model, is a well-known realization of survival model demonstrating the failure/death at some time. It has the following generalization:

$$h(t,x) = h_0(t,\alpha) \exp(x^T \beta)$$

where $h_0$ is called baseline hazard function, and $\alpha$ is a parameter influencing the baseline hazard function. In contrast to standard generalized linear models, CoxPHM does not have an intercept, as it is eliminated by division.

**Sequential Pattern Mining**

Given a database of sequences each of which consists of a list of transactions ordered by timestamp, sequential pattern mining problem is to discover all frequent sequential patterns with a user-defined threshold (i.e. support). For example, 7% of customers buy travel insurance two days after they buy international flight ticket. In PAL, state-of-the-art algorithm is implemented which is efficient for large search space and long pattern dense dataset.

**Gradient Boosting Decision Tree**

Gradient boosting and decision tree (GBDT) is an ensemble machine learning technique for regression and classification problems. GBDT builds the model in a stage-wise fashion and allows optimization of some loss functions. For each iteration/week model, negative gradient (e.g. residual) is the training sample for new classification/regression tree to fit and sum up the output values of all trees to get the final score. In the first version, PAL GBDT supports mixed feature types, both classification and regression, square loss and logistic loss, L1 and L2 regularization, and model evaluation and cross-validation.

**Linear Discriminant Analysis**

Suppose that you are given an $N \times D$ (dataset) matrix $X$ with an $N \times 1$ (label) vector $Y$, each row $x^O$ of $X$ is a D-dimensional sample belonging to class $y_i$ and the total number of classes is $C$. Linear discriminant analysis (LDA) assumes that the samples within each class $k$ obey normal distribution with different means $\mu_k$ but same covariance matrix $\Sigma$:

$$P(x|y=k) \sim N(\mu_k, \Sigma)$$

$$p(x|y=k) = \frac{1}{(2\pi)^{D/2}|\Sigma|^{1/2}} \exp \left\{ -\frac{1}{2} (x-\mu_k)^T \Sigma^{-1} (x-\mu_k) \right\}$$

i.e.

Under this modeling assumption, you can fit the model parameters $\mu_1, \ldots, \mu_C$ and $\Sigma$ by estimating the training dataset.
The implementation of LDA in PAL includes three functions: LDAFIT, LDACLASSIFY and LDAPROJECT, where the main function is LDAFIT. It performs LDA of a given dataset $X$ with label $Y$ and returns:

- A classifier which can be used in LDACLASSIFY to classify further unlabeled data;
- A projection model which can be used in LDAPROJECT to reduce the dimension of dataset $X$ by projection. The projected data can be used for visualization or further classification.
- Empirical prior of each class and some other basic information.

**Fast Fourier Transform**

This function realized discrete Fourier transform (DFT). Consider that a sequence of $N$ complex elements $x_0, x_1, ..., x_{N-1}$ can be transformed into an $N$-periodic sequence of complex numbers, $X_k = \sum_{n=0}^{N-1} x_n \cdot \exp(-i2\pi kn/N)$, $k \in \mathbb{Z}$

which is the so-called discrete Fourier transform (DFT). For simplicity, as it is $N$-periodic, $k=0, 1, ..., N-1$ is often adopted. Likewise, $x_n$ can be transformed back from $X_k$ via inverse discrete Fourier transform (IDFT).

$$x_n = \frac{1}{N} \sum_{k=0}^{N-1} X_k \cdot \exp(i2\pi nk/N)$$, $n \in \mathbb{Z}$

Also, the inverse transform is $N$-periodic, and generally $n=0, 1, ..., N-1$ is used.

Executing DFT straightforwardly will take a time complexity of $O(N^2)$. Danielson-Lanczos formula shows that the discrete Fourier transform can be computed in $O(N \log_2 N)$, which is the so-called fast Fourier transform (FFT).

However, this formula requires that the length of sequence is of order of 2, which is not satisfied generally. In PAL, chirp z-transform algorithm is employed to deal with the situation that length of sequence is not exactly power of 2, taking advantage of convolution, which assures $O(N \log_2 N)$ time complexity.

**Data Summary**

Data summary provides an overview of the data set, which reveals the most important information of each variable. It is able to handle both continuous and categorical variables even with null value in the data set.

For any continuous variable, if one denotes the data in one column as $x_i (i=1, ..., n)$, data summary returns the following statistical quantities of $x_i$. It is worth noting that these statistical quantities are calculated assuming that the data is a sample instead of a population.

For a categorical variable, this algorithm returns the occurrence and the percentage of each category. Note that null is also treated as a category for the categorical variable.

**Correlation Function for Time Series**

A correlation function gives the statistical correlation between random variables. If one considers the correlation function between random variables and itself at different time points, then this is often referred to as an auto-correlation function (ACF). Correlation functions of different random variables are sometimes called cross-correlation functions (CCF). Correlation functions used in astronomy, financial analysis, econometrics, and statistical mechanics differ only in the particular stochastic processes they are applied to.
PAL considers the sample correlation function only. Given a variable with observations $x_1, x_2, \ldots, x_n$, the sample auto-covariance function (ACVF) at lag $h$ is

$$\gamma(h) = \frac{1}{n} \sum_{t=1}^{n-h} (x_t - \bar{x})(x_{t+h} - \bar{x}), \quad -n < h < n$$

And its corresponding auto-correlation function is

$$\rho(h) = \frac{\gamma(h)}{\gamma(0)}, \quad -n < h < n$$

Evidently, $\gamma(h) = \gamma(-h)$ and $\rho(h) = \rho(-h)$.

In contrast with auto-correlation function, partial auto-correlation function (PACF) measures the relationship between $x_t$ and $x_{t+k}$ after removing the effects of other time lags $1, 2, \ldots, k-1$, which is very useful in time series forecast. PACF can be solved iteratively with Durbin-Levinson algorithm.

The cross-covariance function and cross-correlation function between series $x$ and $y$, likewise, has definitions

$$\gamma_{XY}(h) = \mathbb{E}[(x_t - \mu_x)(y_{t+h} - \mu_y)]$$
$$\rho_{XY}(h) = \frac{\gamma_{XY}(h)}{\sigma_X \sigma_Y} = \gamma_{XY}(h) / \sigma_X \sigma_Y$$

where $\mu_x$ and $\sigma_x$ are the mean and the standard deviation of the process $x_t$, which are constant over time due to stationarity; and similarly for $y_t$, respectively.

**Condition Index**

Condition index is used to detect collinearity problem between independent variables which are later used as predictors in a multiple linear regression model. This method firstly employs the principle component analysis (PCA) to find out the eigenvalues and the corresponding eigenvectors of the matrix formed by independent variables, then calculates the condition index and variance decomposition proportion. For example, if you feed in a data matrix $X_{ij} \in \mathbb{R}^{n \times p}$, this function gets singular values $\sigma_i (i=1, \ldots, p)$ and the V matrix $V_{kj} \in \mathbb{R}^{p \times p}$ from the singular value decomposition, then proceeds to calculate condition index

$$CI_i = \sigma_{\max} / \sigma_i$$

and the condition number

$$CN = \sigma_{\max} / \sigma_{\min}$$

which is the largest value of condition indices. Note that a diagonal matrix $D = \text{diag}(\sigma_1, \ldots, \sigma_p)$, you can calculate variance decomposition proportions $\pi_{jk} = \phi_{jk} / \phi_k$, where $\phi_{kj} = \sigma_k / \sigma_i$ and $\phi_k = \sum_{i=1}^p \sigma_i^2 / \sigma_k^2$. This quantity illustrates how much variance of the estimated coefficient for a variable can be explained by the $k$-th principle component.

Generally speaking, a dataset with condition number larger than 30 indicates the existence of a possible collinearity. Variables which are involved in collinearity have variance decomposition proportions greater than 0.5.
Enhanced Algorithms

Multiple Linear Regression
- Added Cholesky decomposition as the new algorithm to solve the linear equation.
- Added ADMM (alternating direction method of multipliers) as the new algorithm to solve elastic net regularization problem.
- Enabled categorical variable support.
- Enhanced multi-thread strategy when using QR decomposition.

Principal Component Analysis (PCA)
- Significant performance enhancement

Latent Dirichlet Allocation (LDA)
- Significant performance enhancement

Random Distribution Sampling
- Added Poisson distribution.

Random Forest
- Added parameter NODE_SIZE to control the minimum number of records in leaf node.
- Added parameter CALCULATE_OOB to control if OOB error is calculated.
- Added parameter SPLIT_THRESHOLD to set the threshold for Gini index to control tree growing.
- Exposed parameter THREAD_NUMBER to allow explicit control over the multi-threading setting.
- Exposed parameter SEED to set the seed for random number generator.

Forecast Smoothing
- Enhanced model selection logic.
- Added range limit of tuning parameters (e.g. ALPHA, BETA, GAMMA).
- Added prediction interval of forecast.

C4.5 Decision Tree
- Default value of parameter SPLIT_THRESHOLD changed to 1e-5.

CART Decision Tree
- Default value of parameter SPLIT_THRESHOLD changed to 1e-5.

Seasonality Test
- Outputs seasonal and trend components in additional to random component for seasonality test.
- Enabled multi-threading.

Trend Test
- Added additional statistics as output.
K-means, K-medians, K-medoids

- Default value of parameter EXIT_THRESHOLD changed to 1.e-6.

Auto ARIMA

- Enabled multi-threading for exhaustive parameter search.

Support Vector Machine (SVM)

- Default value of parameter RBF_GAMMA changed to 1.0 / number of features.

5.5.4 SAP HANA SQLScript Reference (New and Changed)

As of SAP HANA Platform 2.0 SPS00, the following new features and changes are available in SAP HANA SQLScript and are documented in the SAP HANA SQLScript Reference.

- Enhancement of SQLScript Query Export: nested calls, DMLs, DDLs and dynamic SQL can be now exported as well
- Support of explicit parallelization of read-write procedure calls
- Size operator for tabular arguments
- Initialization of declared table variables
- Scalar UDF result cache
- Support for synonyms in HEADER ONLY-artifacts
- MAP_MERGE operator for evaluating each input in parallel and union all intermediate results
- BIND_AS functions for parameterization control.

5.5.5 SAP HANA Core Data Services (CDS) Reference (New and Changed)

As of SAP HANA Platform 2.0 SPS00, the following new features and changes are documented in the SAP HANA Core Data Services (CDS) Reference.

The SAP HANA Core Data Services (CDS) Reference for SAP HANA 2.0 SPS 00 includes information for CDS support in both the XS classic and the XS advanced run-time environments.

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for Core Data Services (CDS), which are documented in the SAP HANA Core Data Services (CDS) Reference:

- Support for subqueries
- Support for LIMIT/OFSET in queries
- Support for the clause GENERATED ALWAYS AS <expression clause> in an entity definition
- Support for the clause GENERATED [ALWAYS | BY DEFAULT] AS IDENTITY in an entity definition
- Java OData support for CDS
- Support for DCL-based access policies in CDS
  CDS access-policy documents are coded in the Data Control Language (DCL). In a CDS access-policy document, you can create CDS roles and CDS aspects for instance-based authorizations.
● Support for CDS aspects
  CDS aspects associate an attribute with permitted values of a user.
● Support for CDS roles
  CDS access-policy documents contain a set of CDS role definitions coded in the Data Control Language (DCL). You can use CDS roles to create instance-based authorizations.

5.5.6 SAP HANA Analytics Catalog (BIMC Views) Reference (New)

As of SAP HANA Platform 2.0 SPS00, the new SAP HANA Analytics Catalog (BIMC Views) Reference is available in the reference library.

The SAP HANA Analytics Catalog (BIMC Views) Reference describes the SAP HANA Analytics Catalog, which consists of tables and views with the prefix "BIMC" located in the schema _SYS_BI. The catalog contains metadata required by analytic clients such as Analysis Office and Business Objects Cloud. The metadata is also required for access via Multi-Dimensional Expressions (MDX).

The SAP HANA Analytics Catalog is populated with metadata when the following analytic models are deployed:

- Calculation views
- Analytic views
- Attribute views (the column CUBE_NAME is filled in with the ‘$ATTRIBUTE’ value for these models)
6 Deprecated Features

A deprecated feature in the SAP HANA platform is a feature that will be removed in a future support package stack, at the earliest one support package stack after the start of deprecation.

Certain features are deprecated in specific support package stacks of the SAP HANA platform, starting with SAP HANA 2.0 SPS 01.

SAP HANA Extended Application Services classic model (XS classic) and SAP HANA Repository are deprecated as of SAP HANA 2.0 SPS 02.

Related Information

SAP HANA 2.0: Deprecations reported by the HANA statistics server (SAP Note 2425002)
Deprecation of SAP HANA extended application services, classic model and SAP HANA Repository (SAP Note 2465027)
For information about the capabilities available for your license and installation scenario, refer to the Feature Scope Description (FSD) for your specific SAP HANA version on the SAP HANA Platform webpage.
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