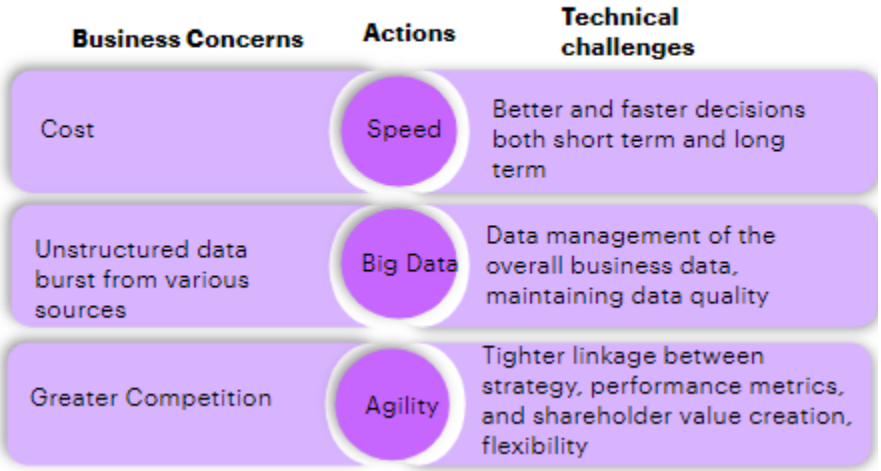
What is HANA?

HANA stands for High performance Analytical Appliance. Hence , HANA can do many things as listed below :

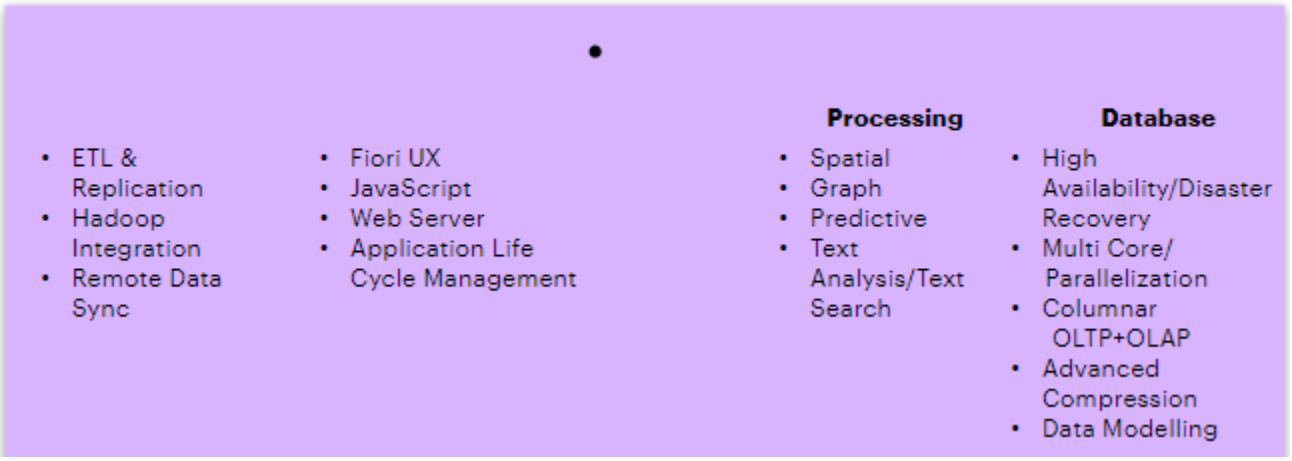
- Database
- Analytics
- HANA Development
- Cloud solution

Why HANA?



Companies need to cut down on their costs and be able to make better and faster decisions with speed.
There is a lot of unstructured data coming from diverse sources which needs to be managed well using Bigdata. Increased competition also means that companies need to be more agile.

On Premise, Cloud and Hybrid Services



HANA can be installed

- On- Premise – Locally on the campus where it is used
- Cloud – Installed on the cloud and accessed via the internet
- Hybrid – Combination of On-Premise and Cloud. Having both a local installation and a cloud based one.

HANA Hardware and Software Features

- Multiple core architecture (8 x 8 core CPU per blade)
- Scales in parallel with numerous blades
- 64bit addressing with 2TB/4TB building blocks
- Minimum of 100GB/s data throughput
- Intense reduction in price

- Row and Column Store
- Compression
- Partitioning
- No Aggregate Tables
- Insert Only on Delta

HANA has a number of Hardware and Software Innovations which helps it to preform better than other databases present in the market. We discuss these features in coming slides.

Massive Parallel Processing (MPP)

HANA has Multi-Node , Multi-Core CPUs which help in parallel processing of the data and hence use the underlying hardware to its full capacity.

HANA has a number of Hardware and Software Innovations which helps it to preform better than other databases present in the market. We discuss these features in coming slides.

- As mentioned in previous slide , write operations in HANA happens on to the cache.
- The memory has several CPU cores and each CPU core has the L1, L2 and L3 Cache and also the register.
- The register is the fastest but is very limited with respect to size.
- The L1,L2,L3 Cache give better speed but have limited size capacity.

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HANA as a database

- In-Memory Database
- Row and Columnar Data Storage
- Compression and Encoding Techniques

HANA is primarily a database. HANA is different from other databases as it is :
In-Memory Database
Has Row and Columnar Data Storage
Has various Compression and Encoding Techniques

In-Memory Database

In the in-memory database, both data storage and processing occurs in the memory.

Using In-Memory databases, accelerates processing.

As of now , it is not compulsory to use HANA as database in SAP.

All the new products of SAP are developed keeping in mind HANA as the database.

In the traditional databases , data is stored on the disk and processed in the memory.

The 3 data temperatures are : HOT / WARM and COLD.

- HOT data is present in the memory and can be readily accessed.
- WARM data is present on the disk and will take longer to access than data in memory but not much of a delay.
- COLD data is historical data that is not being used which is backed up. Accessing this data takes much longer than data in other temperatures.

In-Memory Database

Challenges :

1. Space / Cost

- If the HANA installation is cloud based, you can easily scale-up and scale-down the Infrastructure.
- An architect has to estimate the size of HANA which is called as HANA Sizing. HANA Sizing can be done using :
  - Quickie Tool
  - ABAP Reports
  - DB Scripts
- As we use better and latest hardware , the capacity of HANA also increases accordingly.

2. Power goes off / Loss of data

- The data is still stored in the disk in HANA but mostly as a backup. SAP internally takes care of moving the data between disk and memory.

HANA supports both row-based and column-based storage.
In row-store each row of data is stored in continuous memory blocks. This kind of storage is good for performing Insert/Update and Delete or OLTP or Transactional Operations.
In column-store each column of data is stored in continuous memory blocks. This kind of storage is good for performing Select or OLAP or Analytical Operations.

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In row-store each row of data is stored in continuous memory blocks. This kind of storage is good for performing Insert/Update and Delete or OLTP or Transactional Operations.
In column-store each column of data is stored in continuous memory blocks. This kind of storage is good for performing Select or OLAP or Analytical Operations.
In case we want to perform both transactional and analytical operations on the same table , then we still create a column-based table because :

- When doing Insert/Update/Delete on a column – based table , the delta still gets stored in L1,L2,L3 Cache which are row-based structures. From these cache , which have limited size but better speed , data is written to the column-based structure at regular intervals.
- You get better performance with column table compared to row based tables since various compression methods can be applied on column table which saves database space and MPP can be achieved on top of it.

Column Store and Compression

The SAP HANA database compression makes use of column store technology

Compression and Encoding Techniques

In HANA , string data is converted to numeric format and stored in numeric format as numeric data which takes lesser space to store and gives faster processing.

According to a case study , nearly 500 GB data stored without HANA , took only around 100 GB with the use of HANA which means nearly 1/5th the space.

Compression is applied on column store tables.

- HANA is a Insert-Only Database.
- Whenever there is an update/delete operation performed on HANA , the original record is not modified.
- Instead , a new row is added to the end with the Valid From and Valid To fields updated.
- By looking at the data in the Valid From and Valid To fields , we can know which is the latest data.

Earlier we had separate instances and different databases for each module of SAP. Then it was possible to run the various modules using same instance of the database.
With SAP HANA , all modules could run on same instance of SAP HANA. We could also use it with some custom and third party applications as well.

On-the-fly Aggregation in Tables

- Before HANA, SAP used to maintain the aggregate tables separately and used to pull data from the aggregate tables for reports
- The drawback of maintaining aggregate tables was that most of the times they were not up-to-date and hence used to give wrong data
- But with HANA , SAP does not maintain aggregate tables. Instead data is fetched at real-time from the underlying tables and aggregated as required
- This is termed as on-the-fly aggregation

In Code-Pushdown technique , HANA does the processing as far as possible in the database layer as against doing more processing in the application layer as in the traditional approach. Processing in the database layer leads to better speed than processing in application layer.

Analytics

a. BW on HANA

Composite Provider , Transient Provider ,

Open ODS View , Advanced DSO etc

b. HANA

Attribute View , Analytical View , Calculation View

c. BW/4 HANA

data on the cloud

AMDP , CDS Views (Sources)

d. Embedded Analytics --- S/4 HANA - BW + BO

e. SAP Analytics Cloud --- SAP Cloud Platform(SCP)

- BW was the traditional analytics tool of SAP. With the introduction of HANA , we had many more analytic options provided.
- BW on HANA – BW was replaced with BW on HANA with HANA as the database. There were not much changes in the application layer. We still used the same T-Codes as in BW. Few new providers like the composite provider , transient provider , open ODS view , Advanced DSO etc were introduced.
- HANA – Analytics can be done using Attribute /Analytical or Calculation Views together called as Information Views.
- BW/4 HANA – BW on HANA is replaced by BW/4 HANA. We use BW/4 HANA when we want the data on the cloud. We also need to use AMDP (ABAP Managed Database Procedure) for writing Start , End and Field Routines. We can use CDS (Core Data Service) views as sources in BW/4 HANA and BW on HANA.
- Embedded Analytics – is used in S/4 HANA for analytics and is a combination of BW and BO features.
- SAP Analytics Cloud is your analytics option on SAP Cloud Platform.

UI5/FIORI can be used to create controls required for web development like textbox, checkbox, radio button etc. But it does not have any logic to fetch data from database or take the input from frontend and store in the database. For that , HANA has HANA XSJS and XSODATA. XS is because HANA uses the XS or Extended Services engine for the processing. JS is JavaScript. This is also called as HANA Native development or Classic XS.

Unlike other technologies where web development in 3 tier , in HANA it is 2 tier making it faster.

With HANA 2.0 , SAP recommends you to use HANA XSA (XS Advanced). Development in XS Advanced can be done using node.js , C++ and Java.

Recently SAP announced support for angular , react and Vue js too.

HANA supports the SAP Cloud as well.
As part of IaaS (Infrastructure-as-a-Service) we have HEC (HANA Enterprise Cloud) .
As part of PaaS(Platform-as-a-Service) we have HCP(HANA Cloud Platform) , which was renamed as SCP(SAP Cloud Platform).
As part of SaaS(Software-as-a-Service) we have applications like Concur , Fieldglass, SuccessFactors, Hybris , C4C etc supported on the cloud.

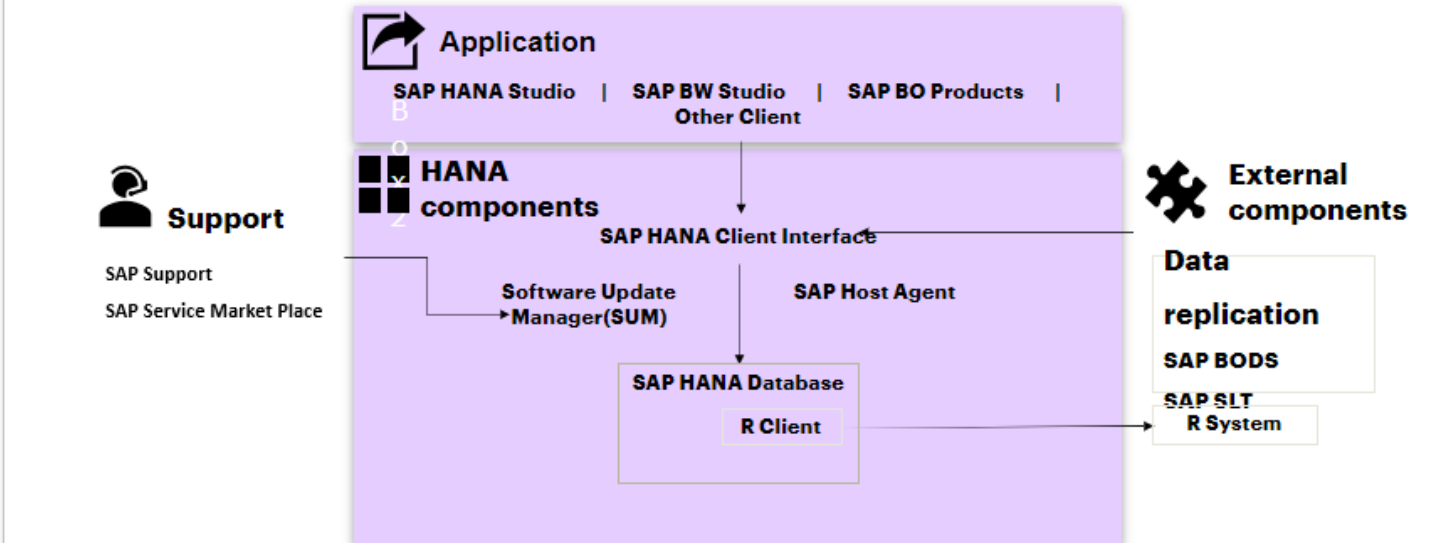
The traditional SAP PI/PO module used for integration between SAP to SAP or SAP and 3rd party applications is an only on-premise one.
So, for the cloud connecting , SAP introduced HCI(HANA Cloud Integration) or renamed as CPI(Cloud Platform Integration).

HANA Implementation can be done using
1. Side Car Approach
2. Green Field Approach

In the Side Car approach , the real time operations are still done on other databases like Oracle, SQL Server etc which act like Primary. For analytics and other critical operations which needs to be speed up , we use HANA which is the secondary database. Data is moved from primary to secondary using SLT mostly.

In the Green Field approach , after the data is transferred from other databases , we stop using them and start using HANA as the primary for all operations.

HANA Architecture



HANA Architecture

HANA Database

- Relational Database
- Covering Backup & Recovery
- Supporting SQL Standard
- Ensures ACID principle for executed transactions

SAP HANA Client interface

- Connector via Network protocol
- Supporting ODBC & JDBC for SQL based access
- Supporting ODBP for MDX based access
- Supporting HTTP access via XS Engine

SAP HANA Studio

- Administration and Developer tool
- Based on Eclipse
- Admin Services:
  - Start / Stop DB service
  - System Monitoring
  - System Parameter settings
  - User Management Store
  - Configuration of Audit logs

HANA Functional Libraries

- C++ based Application Function Libraries AFL)
- Additional manual Installation
- Current Available:
  - Business Function Libraries
  - Predictive Analysis Library

HANA Architecture

Data Replication

- Replication of data out of any DB into HANA
- SAP Landscape Transformation (SLT) Replication Server SAP Data
- SAP Data Services:
  - SAP and NON SAP Data
- Direct Extractor Connection (DXC):
  - Existing Data Extractors (SAP Business Suiete9)

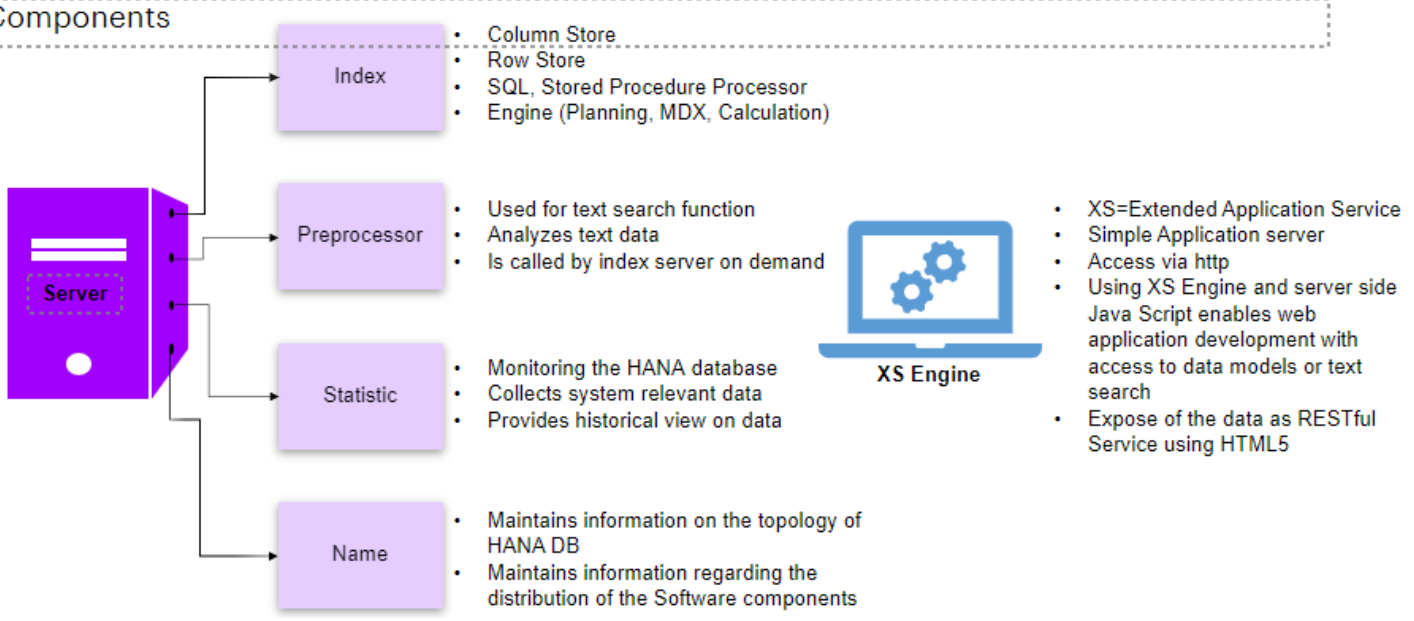
Data Preparation

- Supports access to Data Model
- Client Package for MS Excel:
  - Data accessed direct via Excel
- UI for Information Access:
  - Browser based Search tool for tables and data models
- Information Composer:
  - Creation of simple analytical views

Lifecycle Management

- On Site Configuration Tool for installation of HANA system
- SAP Host Agent for central monitoring
- SUM for deploying SPS and patches
- Support for remote OSS access.

Components



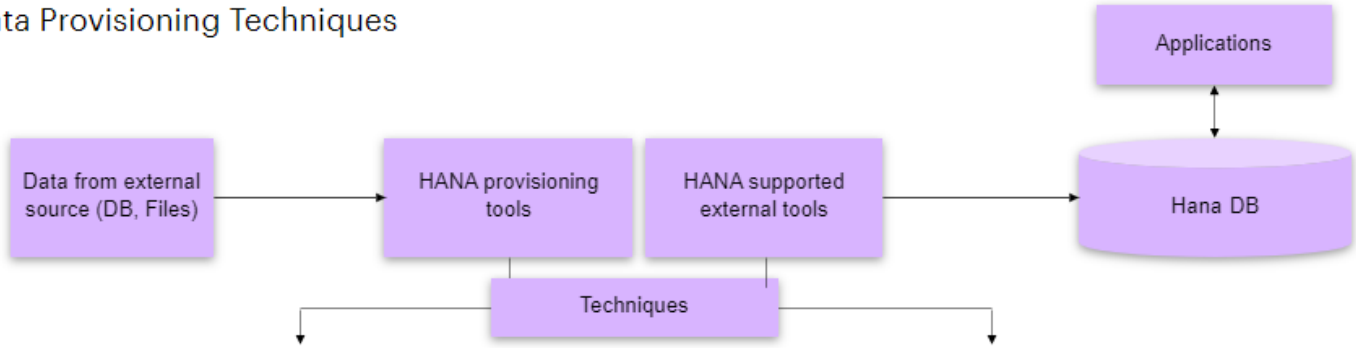
Difference between Stored Procedure and Functions

Stored Procedure	Function
Stored Procedures can have INSERT/UPDATE/DELETE and SELECT statements	Functions can have only SELECT statements
Stored Procedures can have multiple OUT parameters	Functions can RETURN a single value.

What is Data Provisioning?

- DATA Provisioning is a process of creating, preparing, and enabling a network to provide data to its user. Data needs to be loaded to SAP HANA before data reaches to the user via a front-end tool.
- This process involves moving data from different SAP and/or non-SAP system into SAP HANA.
- Data provisioning options are categorized as below:
  - SAP HANA in-built tools
  - External Tools

Data Provisioning Techniques



- Flat File
- Smart Data Streaming (Streaming Analytics)
- Smart Data Access (SDA)
- Enterprise Information Management(EIM)
  - Smart Data Integration (SDI)
  - Smart Data Quality (SDQ)
- Remote data sync

- SAP Landscape Transformation (SLT)
- SAP Business Objects Data Services (BODS)
- SAP Direct Extractor Connection (DXC)
- Sybase Replication Server (SRS)

Provisioning Techniques in HANA

SAP HANA Built-In Provisioning Tool

- Flat File
- Smart Data Streaming (Streaming Analytics)
- Smart Data Access (SDA)
- Enterprise Information Management(EIM)
  - Smart Data Integration (SDI)
  - Smart Data Quality (SDQ)
- Remote data sync

External tool supported by SAP HANA

- SAP Landscape Transformation (SLT)
- SAP Business Objects Data Services (BODS)
- SAP Direct Extractor Connection (DXC)
- Sybase Replication Server (SRS)

Data Provisioning - SLT

SLT stands for System Landscape Transformation Replication Server

Advantages :

- Real – time
- Trigger – based

Disadvantages :

- Requires a separate physical server
- SAP - SAP data movement (RFC connection) better supported
- Transformations - Not supported

Data Provisioning - BODS

BODS stands for Business Objects Data Services

Advantages :

- Any source Any target - File , Database
- Transformation – Complex

Disadvantages :

- Costly - License

Data Provisioning - DXC

DXC stands for Direct Extract Connect

It is a type of extractor.

It is not so frequently used.

Data Provisioning - SDA

SDA stands Smart Data Access

It is used to remotely access the data from various databases like Oracle, SQL Server, Hadoop etc.

2 steps for provisioning using SDA :

- Create a Remote Source
- Create a Virtual Table

Data Provisioning - SDI

SDI stands Smart Data Integration

It is an ETL tool which is freely available in HANA

It has limited transformations compared to BODS. But can be used to call various BFL/PAL functions

Data Provisioning - SDQ

SDQ stands Smart Data Quality

It is a data cleansing tool which is freely available in HANA

It can be used to remove duplicate records , check the semantics

SDI and SDQ together are called EIM (Enterprise Information Management)

Data Provisioning - SDS

SDS stands Smart Data Streaming

It is used mostly with IoT based devices

It is used to filter unwanted information and store the required information as it comes

It is renamed to Streaming Analytics

Data Provisioning - SRS

SRS stands for SAP Sybase Replication Server

SAP HANA is derived from Sybase and hence the replication technique that is used in Sybase can be used for data movement between Sybase and HANA also.

Advantage of using SRS in HANA

- Acts like a internal data transfer between one Sybase to another
- Time efficient
- Cost effective back up device

SRS supports log-based replication from and to heterogeneous databases, except for the homogeneous SAP HANA to SAP HANA replication, which is trigger-based. We can use SAP Replication Server to do an initial load as well as replication in real time to SAP HANA, at both table and database level, from some primary databases.

Also, SRS includes Replication Agent for SAP HANA (RAH), a light-weight server that replicates data from a primary SAP HANA to a replicate SAP HANA database using trigger-based replication, primarily used for real time data distribution and real time reporting.

Data Provisioning - Remote Data Sync

- Remote Data Sync is used to move data from cloud to cloud or cloud to on-premise
- It is used with IoT, Mobility, satellite server use cases

Data Provisioning - Flat File Upload

- Data can be moved from Excel or CSV file to SAP HANA Database
- Data from only one sheet can be moved at a time and hence a restriction of 1 million records at a time
- The headers in the file can be made as the column names in HANA
- By default , it creates a Column-store table
- Datatypes are automatically picked up based on the data currently in the file and can be changed if required

S/4HANA-Evolution

HANA

- HANA was introduced as a database
- Initial HANA DB version was 1.0 SPS 00
- Subsequent release till HANA 1.0 SPS 12
- Later HANA DB 2.0 SPS 00 was released
- Latest version of HANA in HANA 2.0 SPS 03 (subject to change)

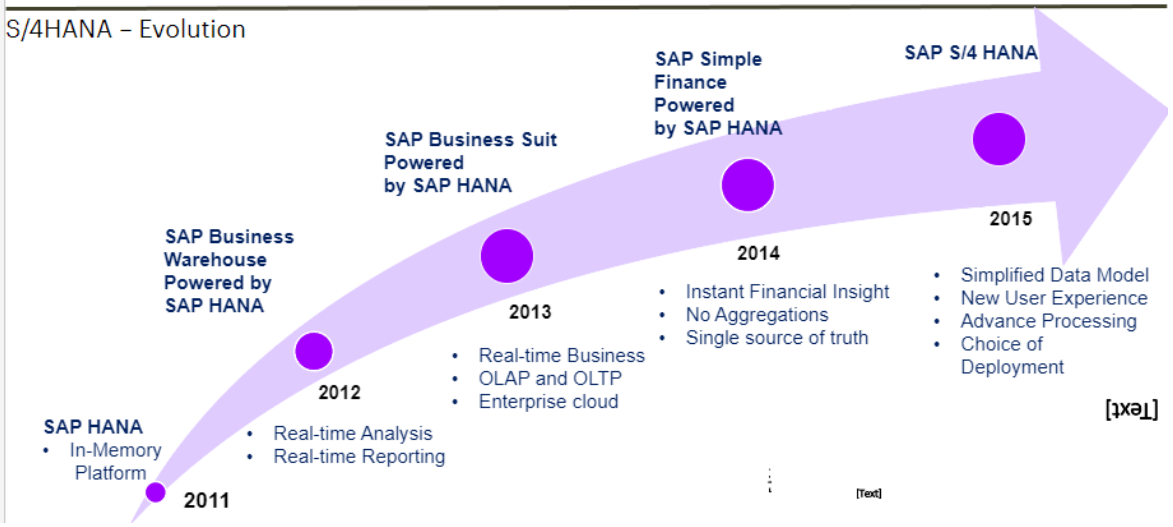
Business Suite on HANA (SOH)

- SAP introduced HANA as database for all modules
- There was no major changes in the application layer
- The T-Codes and system tables for modules remained unchanged mostly
- It increased performance of all modules but not much for FICO and Logistics which lead to S/4 HANA.

S/4 HANA (S4H)

- To overcome drawbacks of SOH , SAP introduced S/4 HANA
- After R/1 , R/2 and R/3 , S/4 HANA is R/4 , 4th Gen ECC, named as S/4 where S stands for Simplified.
- The application layer is completely changed , new T-Codes and lesser and different system tables are used.

S/4HANA – Evolution



S/4HANA Releases

1511	S/4 HANA Major Releases
1610	
1709	
1809	

Major features of S/4 HANA :
1. Fiori support
2. Cloud support
3. Simplified Data Model

C/4 HANA – 4th Generation Customer Experience Suite
- SAP Marketing Cloud
- SAP Commerce Cloud
- SAP Sales Cloud
- SAP Service Cloud

SAP S/4HANA (on-premise) releases are once per year, SAP S/4HANA Cloud releases are quarterly. Version coding for both editions: YYMM example 1709 - September 2017.

Listed above in the slide are the on-premise major releases of S/4 HANA. Initially SAP brought out Simple Finance and Simple Logistics as part of its S/4 HANA release. In later releases of S/4 HANA , more and more modules were added. Simple Finance and Simple Logistics were later called as S/4 Finance and S/4 Logistics.

To be part of S/4 HANA , the modules need to support the below :
1. We should be able to open it using Fiori Launchpad. All standard operations can be done using Fiori itself.
2. They should support cloud based installation along with on-premise support.
3. The modules have lesser and larger tables so that they can all be present in memory.

SAP has recently come up with C/4 HANA which when used along with S/4 HANA promises to solve all major customer centric issues.

Terms with HANA

1. Business Suite on HANA(SOH) --

2.S/4HANA(S4H) - Simplified 4th Gen ECC HANA - R/1 R/2 R/3 R/4

1. Fiori
2. Cloud
3. Simplified Data Model

1511	S/4 HANA Major Releases
1610	
1709	
1809	

3.HANA Live -- 1027 C.V. - IN built - Standard Reports

4. Web IDE -- FIORI/UI5/HANA/SCP

Full Stack Web IDE -- To use

5. HANA Express(Student - Free) / Standard / Platform (Minimized) / Enterprise (Corporates) - DB Editions - 1610

HANA DB Version - 1.0 SPS12

2.0 SPS 0 Latest - 2.0 SPS 3

6. SAP Leonardo ---- Big Data , IoT , ML , AI , Analytics, Blockchain, DT etc

S/4HANA – Simple Finance and Simple Logistics

As a part of initial release, SAP brought out Simple Finance and Simple Logistics

In later releases, more and more modules were added

Simple Finance and Simple Logistics were later called as S/4 Finance and S/4 Logistics

The number of system tables used and their structure and names has significantly changed in the Finance and Logistic modules compared to in R/3

SAP has done below changes in table structure in S/4 HANA:

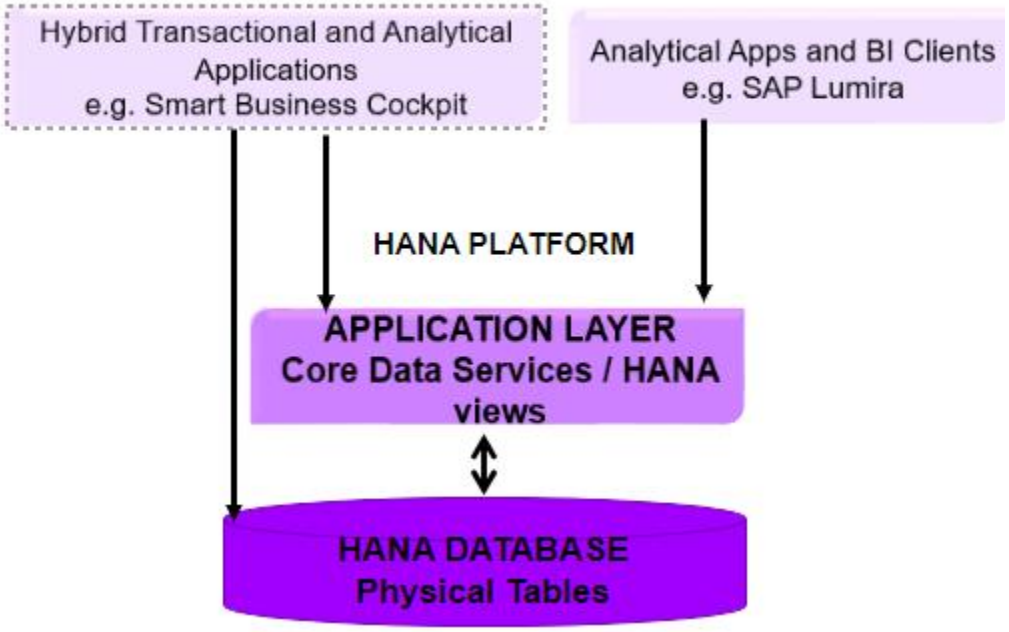
- No Pool / Cluster tables – All tables are transparent tables
- No Aggregate Tables
- No Index tables

We now have lesser number of tables which might have more columns in them and less redundant data

The old table names can still be used and are present as consumption views only

To get the actual benefit of S/4 HANA , we need to use the new table names and hence this affects the ABAP code written too

S/4HANA – Architecture



HANA Studio/Eclipse Overview

Eclipse:

- Integrated development environment for computer programming
- Open source used for working in different programming languages
- Install additional plug-in for ABAP development
- Download from the website eclipse.org

HANA Studio:

- SAP's own Development environment
- Designed based on Eclipse tool
- Can be used for SAP development only
- Download from SAP website(https://accounts.sap.com/saml2/idp/sso/accounts.sap.com)

HANA Studio Overview

HANA Studio is based on the ECLIPSE Platform:

- Open-source framework
- Platform for development tools and environments
- Integration of different development tools
- Supported OS: Windows, MacOS, Linux

ABAP Development Tools:

- SAP GUI-based ABAP Workbench → ECLIPSE platform
- Available for up to AS ABAP 7.5
- Supported ECLIPSE functions: kepler/ Neon / Photon/Oxygen
- ADT – ABAP Development Tools for SAP Netweaver
- SAP HANA Cloud tools
- UI Development Toolkit for HTML5
- SAP NetWeaver Gateway Productivity Accelerator

- The ABAP Development Tools for SAP NetWeaver are SAP's state-of-the-art IDE for ABAP development on the open Eclipse platform. They are designed to significantly increase developers productivity by providing the ABAP developer the unique opportunity to perform development tasks in the comfortable ABAP environment while at the same time benefiting from the proven usability, speed and flexibility of the well-known Eclipse platform. The ABAP Development Tools combines SAP's powerful ABAP application server capabilities like convenient lifecycle management, server-based development paradigm, full integration, effective testing and troubleshooting tools with the powerful Eclipse UI and also provides a modern Eclipse UI client on top of the ABAP platform. The ABAP Development Tools integrates easily with other development tools (SAP HANA Studio, SAP UI5 SDK) on the open Eclipse platform.

Working with Perspective (1 of 2)

In the HANA IDE, choose your perspective by clicking Window->Perspective-> Open Perspective-> Other to open the Perspective window

Key Message(s):

- Perspectives are built up based on views. Views are the basic screen elements such as the navigation pane, properties pane, data foundation pane, etc. A collection of displayed views combined with their placement within the screen builds a perspective. Each view can be moved around via drag and drop.

Key Message(s):

- The SAP HANA Modeler is an eclipse based environment targeted for use by the domain expert also known as the data architect. The Information Modeler displays the data from a data modeling perspective.
- Through the SAP HANA Modeler you can import/export source schemas, models, and data as well as create new views (information models) and analytic privileges.
- To create data models in HANA, switch to the SAP HANA Modeler perspective in the studio by going to Window>Open Perspective>SAP HANA Modeler. You can also switch to the quick launch of the SAP HANA Modeler by clicking the button in the top right corner.
- As of SPS9 Quick Launch got replaced by Quick View: https://scn.sap.com/thread/3168401

- Different schemas are available by default which have its on meaning.

- **SYS:** Stores caches and administrative tables of SAP HANA
- **_SYS_BI:** Contains the metadata of created views and the master data for MDX
- **_SYS_BIC:** Keeps the run-time objects generated from the design-time models which appear under "Content"
- **_SYS_REPO:** Is used to store the design-time models which appear under "Content"
- **_SYS_REPL:** Created by SLT (Landscape Transformation), stores the replication control tables (RS_* tables, to store replication status for example)
- **_SYS_RT**
- **_SYS_STATISTCS:** Contains the tables/views to consume the data collected by the statistics server

Working with HANA Perspective

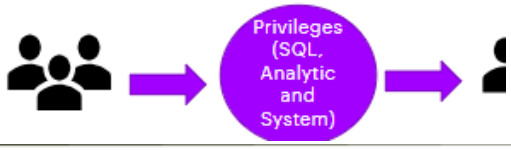
User Management

The user and role concept of SAP HANA allows to manage access control based on the user's jobs. For example:

- Business users
- Modelers who is responsible for creation of models and reports using SAP HANA Studio
- Database administrators who maintains the database and users using SAP HANA Studio

SAP HANA Studio provided privileges to deal with security related activities as mentioned below:

- Users' creation
- Role and hierarchy creation
- Role and privilege assignment to users
- Analytic Privileges' modeling and activation



Working with HANA Perspective

User management process flow

Authentication:

1. Access through direct log in to SAP HANA with user credentials (user name and password: SAP HANA authenticates the user)
2. Authenticate access using third-party authentication provider (by using Kerberos)

Note: All privileges except analytic privileges are built-in

Key Message(s):
- One ECLIPSE client installed on developer PC
- Connection to several backend systems, could be different releases
- Connection via RFC/REST protocol
- Standard tools + additional tools
- Development paradigm is server-based (development objects remain in backend)

ADT Benefits

- Eclipse User Interface with customization options for ADT
- Allows work on several development objects in parallel
- Provides efficient application development through seamless integration within HANA Studio
- Increases developer productivity
- Integration of ABAP and non-ABAP tools is allowed to build cross-platform application
- Provides an open platform with integration of new ABAP and non-ABAP tools

ADT Benefits

- **Natively supported:**
  - **ABAP source code editing**
  - **ABAP OO**
  - **Code completion**
  - **Code template**
  - **Fast navigation, outline**
  - **Version management**
  - **Search and where-used**
  - **Multi-system support**
  - **Refactoring, quick fixes**
  - **Unit testing**
  - **Debugging**
- Visually integrated
  - Data Dictionary
  - Web Dynpro
  - Dynpro tools
  - Enhancement tools
  - Transport management

ADT Features in Eclipse

Navigation within Element Info

Redefine methods via Code Completion (CTRL + SPACE)

Add ABAP Doc comment via Quick Assist (CTRL + 1)

Key Message(s):
- ABAP Object Search & ABAP Source Search (must be enabled on the system)