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SAP HANA Workshop

Kapitola 2: Technologie

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SAP Gold Partner

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SAP HANA – Technologie

Koncept – in-memory

1974 – IBM System R research project – Codd's relational model
(tuples grouped into relations and work with SQL) – later evolved into DB2

	Memory reference / Disk seek
1970's ~ $100 000 USD / Mb	
1990's ~ $100 USD / Mb	200 nanoseconds / 20 milliseconds
Now SIMMs and DIMs ~ $10 USD / Gb	100 nanoseconds / 2 milliseconds

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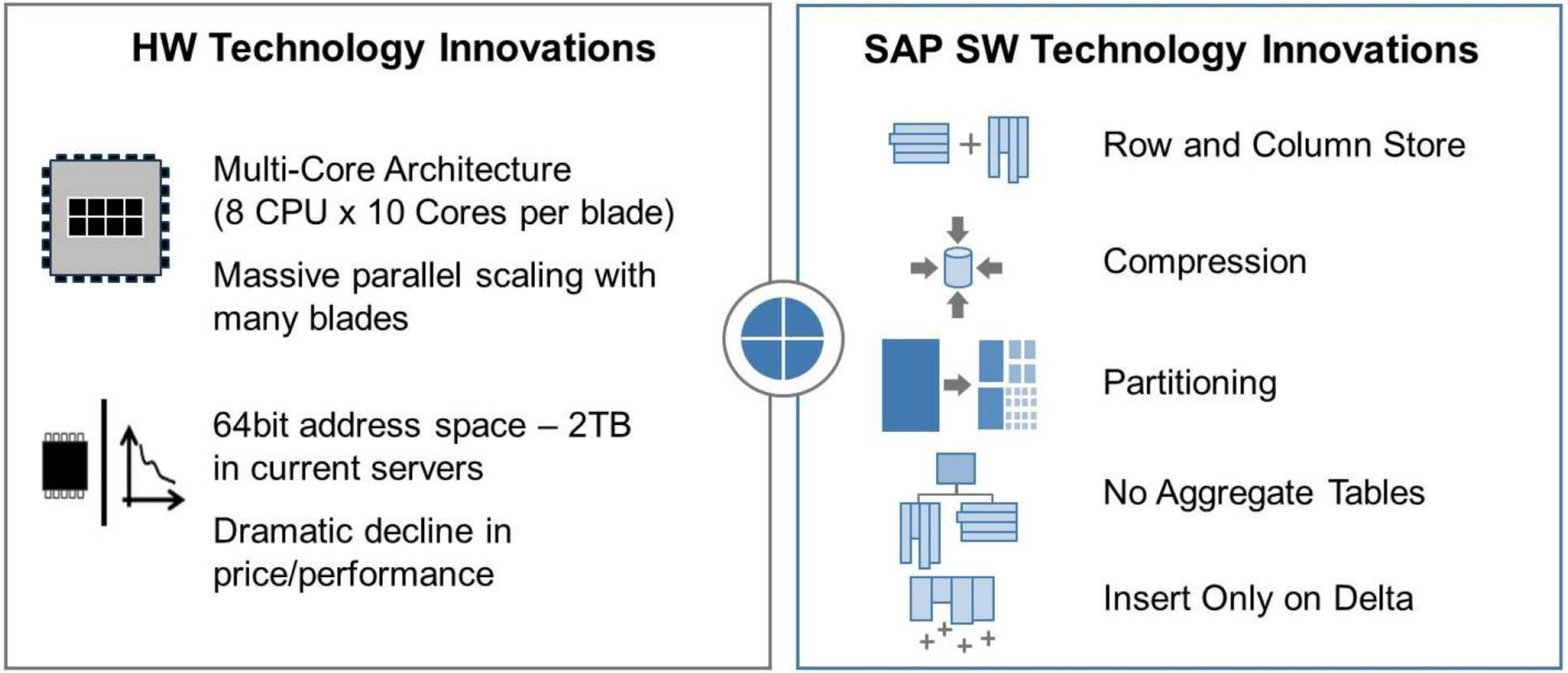
SAP HANA – Technologie

Koncept – in-memory



SAP HANA – Technologie

Koncept – in-memory

Data:

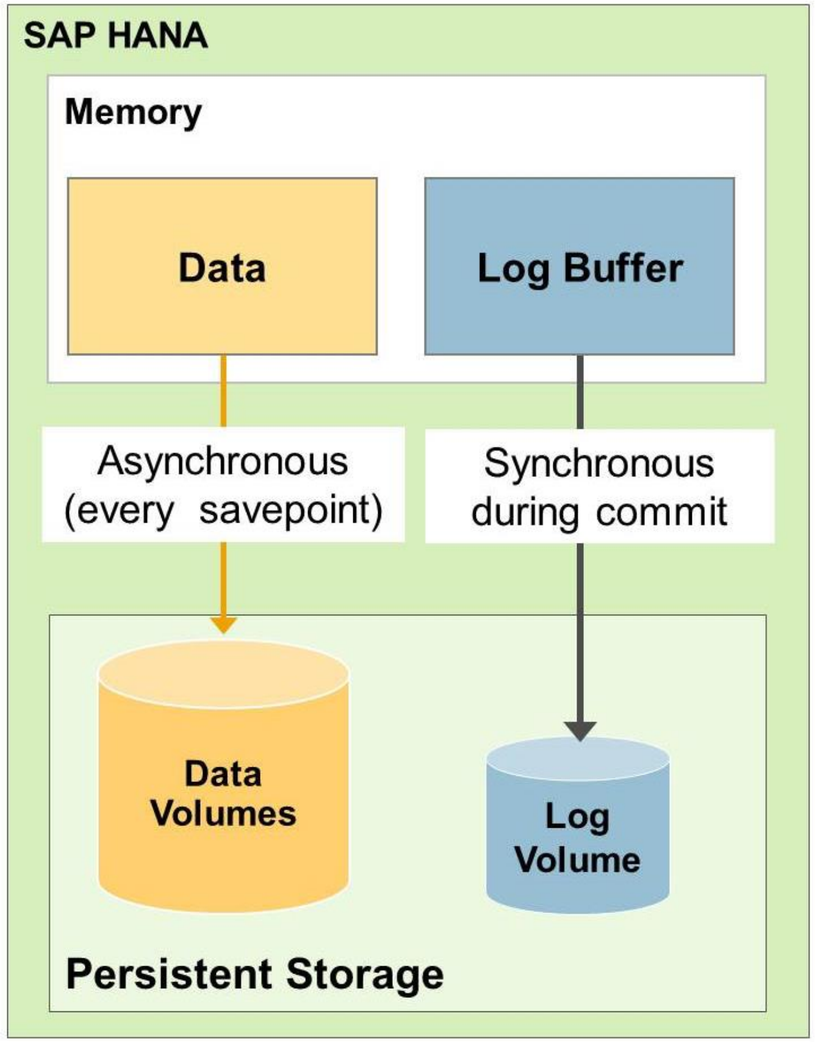
- SQL data and undo log information
- Additional SAP HANA information, such as modeling data
- Kept in-memory to ensure maximum performance
- Write process is asynchronously

Log:

- Information about data changes (redo log)
- Directly saved to persistent storage when transaction is committed

Savepoint:

- Changed data and undo log is written from memory to persistent storage
- Automatic
- At least every 5 minutes



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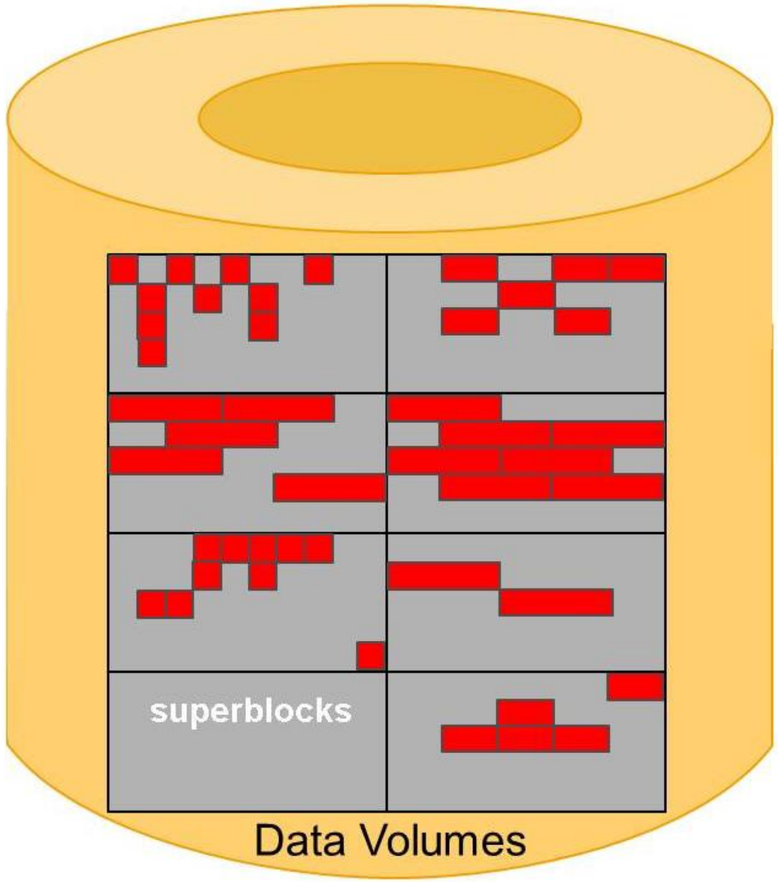
SAP HANA – Technologie

Koncept – in-memory (struktura na disku)

Data Volumes are located in file systems

Per instance one data volume

- Growing until disk or LUN is full
- Logical Volume Manger (LVM) or similar needed on OS level to extend the file systems or dedicated partition/LUN
- Growing with number of data volumes currently not available (unlike MaxDB)
- Different Page Sizes (4k, 16k, ...16M), which are arranged in superblocks of 64M



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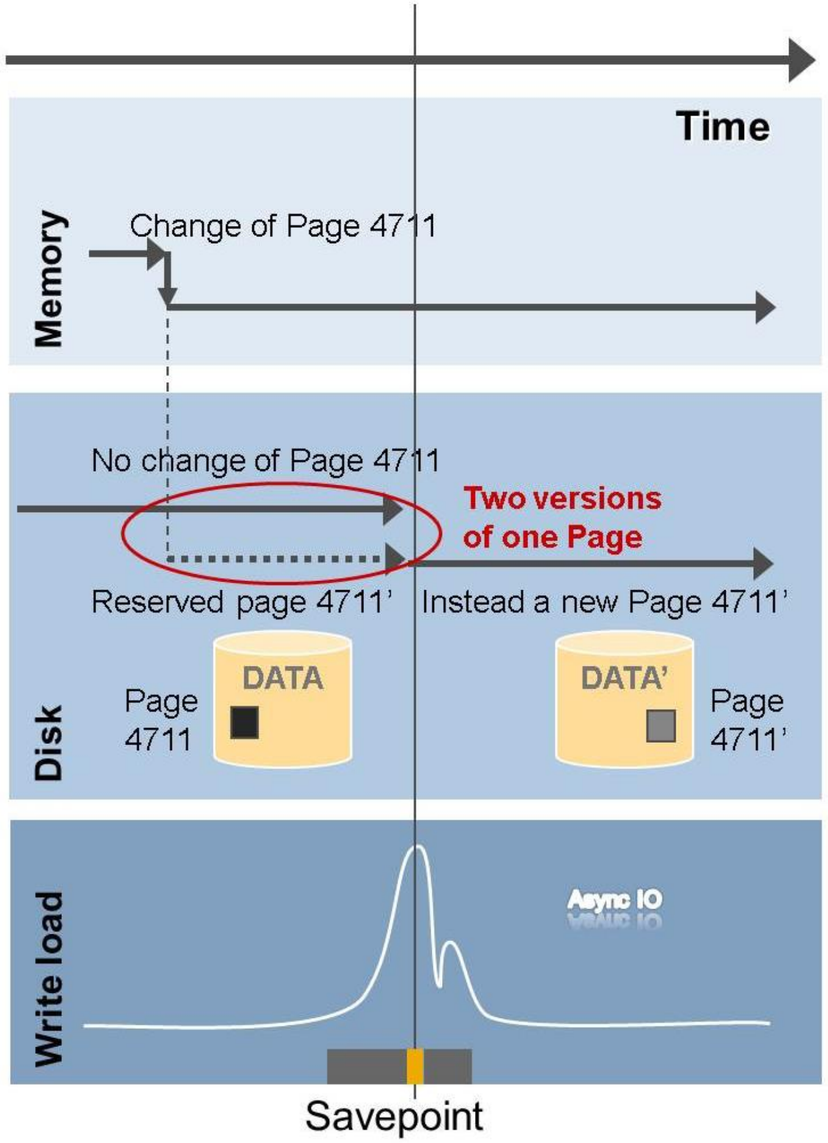
SAP HANA – Technologie

Koncept – in-memory – Savepoint



Savepoint Phases

Write changed pages in parallel

very short

- **Acquire lock to prevent modification of pages**
- **Determine log position**
- **Remember open transactions**
- **Copy modified pages and trigger write**
- **Increase savepoint version**
- **Release lock**

Wait for IO-requests to finish

Write anchor page

Savepoint is similar to Copy on write

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SAP HANA – Technologie

Koncept – in-memory – HANA database start

Restart: Loading of data from storage → RAM

- Only essential tables loaded into RAM
- Optimized for fast start of system

ROW Store

- Loaded completely into memory during startup and has to stay there
- Secondary indexes are created during load

Columnar Store

- Columns loaded “lazy” on demand during startup
  - At first query execution partial loading of tables into main memory
- Optional Pre-Load
  - Marking important data containers for pre-load
  - Entire tables or individual columns
- Ensures early availability (slightly lesser performance for a short time after restart)

SAP HANA – Technologie

Koncept – in-memory – HANA database re-start

Restart Sequence:

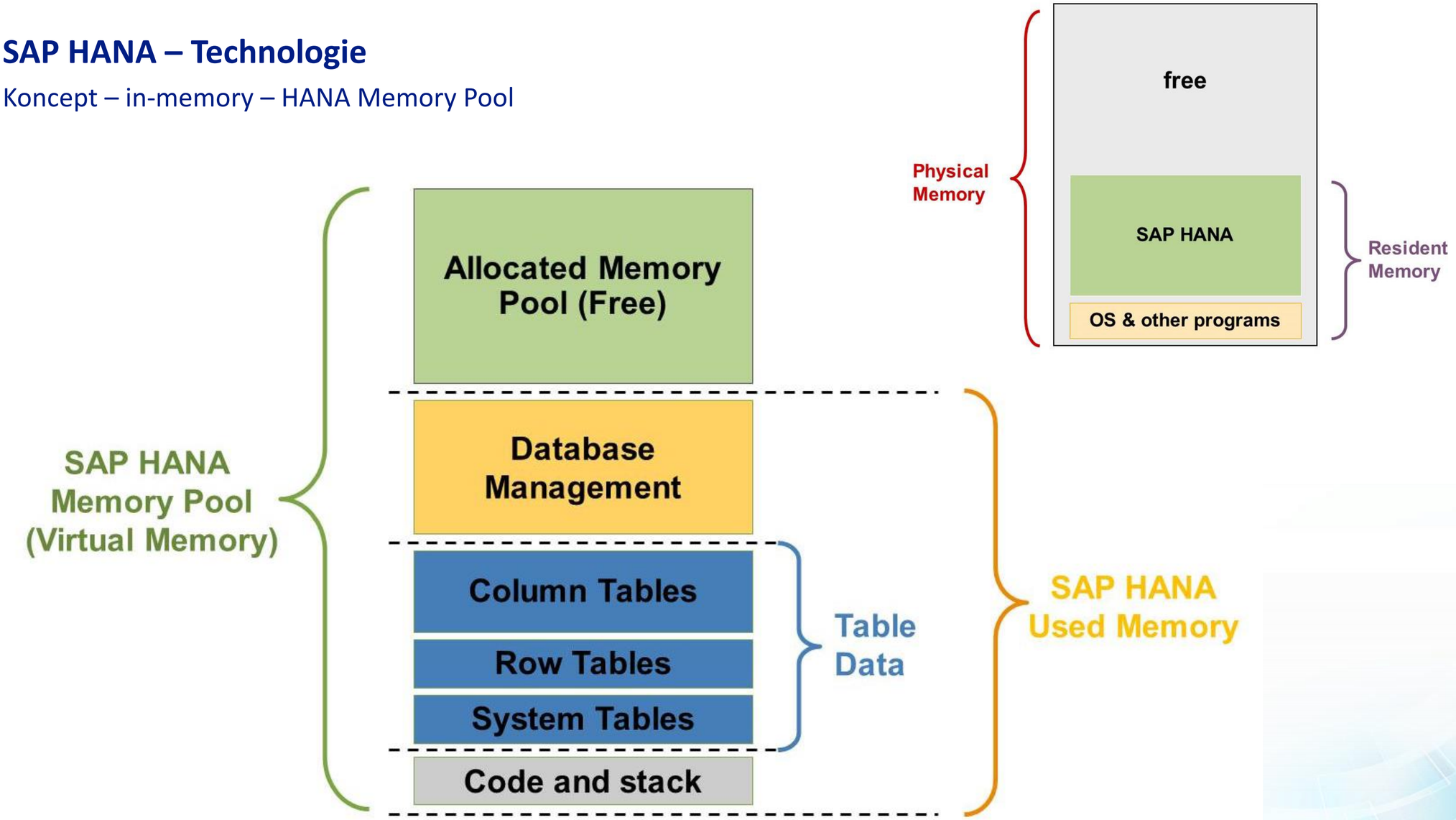
1. The data volume of each service is accessed.
2. The list of open transactions is read into memory.
3. Row tables are loaded into memory.
4. Open transactions are recovered.
5. Aborted transactions are determined and rolled back.
6. A save point is performed with the restored consistent state of the database.
7. Column tables that are marked for preload are asynchronously loaded.
8. Column tables that were loaded before restart start reloading asynchronously

Important factors for startup

- Remaining Log to be rolled forward
- I/O performance of data and log disks
- Separate log, data, and backup disk areas not only logically, but also physically for the best performance

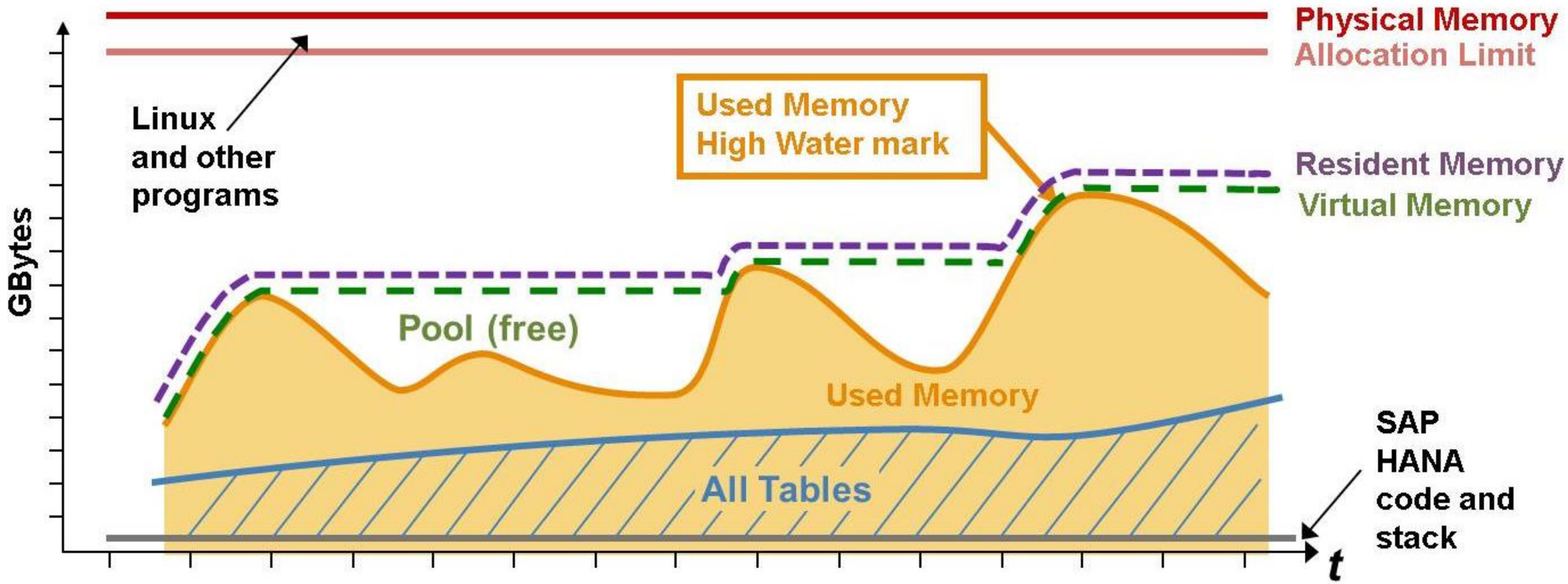
SAP HANA – Technologie

Koncept – in-memory – HANA Memory Pool



SAP HANA – Technologie

Koncept – in-memory – HANA Memory Pool



SAP HANA – Technologie

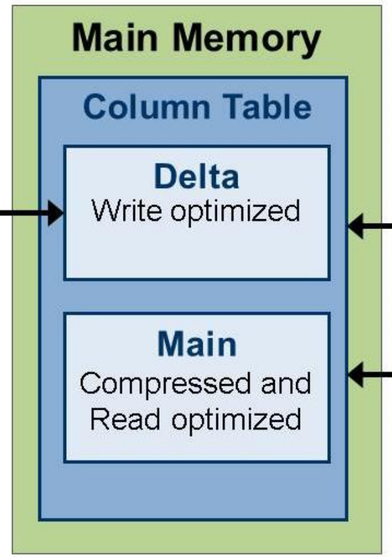
Koncept – in-memory – HANA Store Memory Management

Storage separation (Main and Delta)

- Enables **high compression** and **high write performance** at the same time

Data compression in Main storage

- Compression by creating **dictionary** and applying further compression methods
- Speed up
  - Data load into CPU cache
  - Equality check → Search



Write Operation

- **Only** in **delta storage** because write optimized.
- The update is performed by **inserting** a new entry into the **delta storage**.

Read Operation

- Always have to read from **both** main and delta storages, and merge the results.

Delta merge operation

- To move changes in **delta storage** into the **main storage** because main storage is **read optimized**.
- Happens asynchronously (several events to trigger it)

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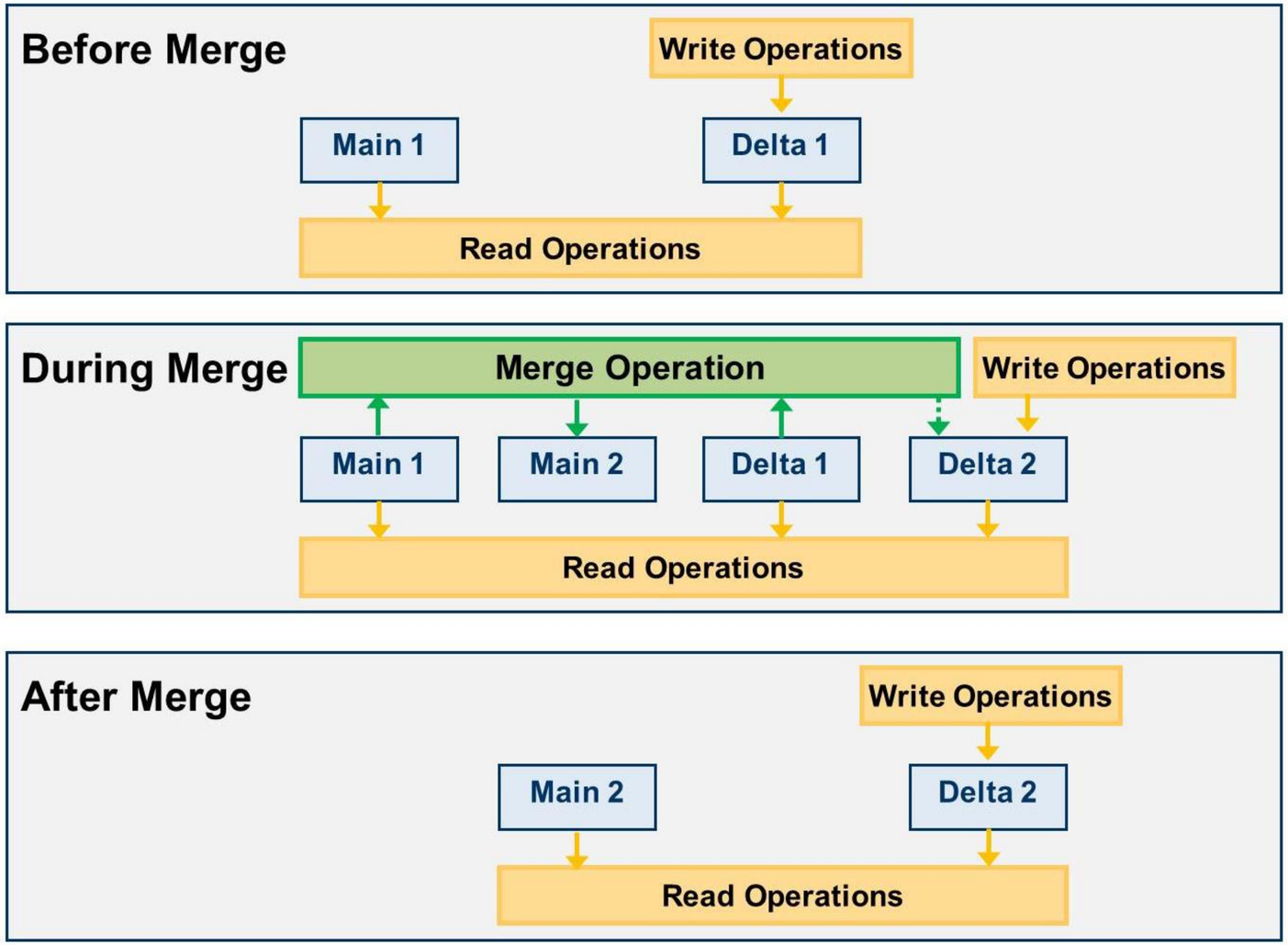
Koncept – in-memory – Delta Merge Process



In-memory koncepty

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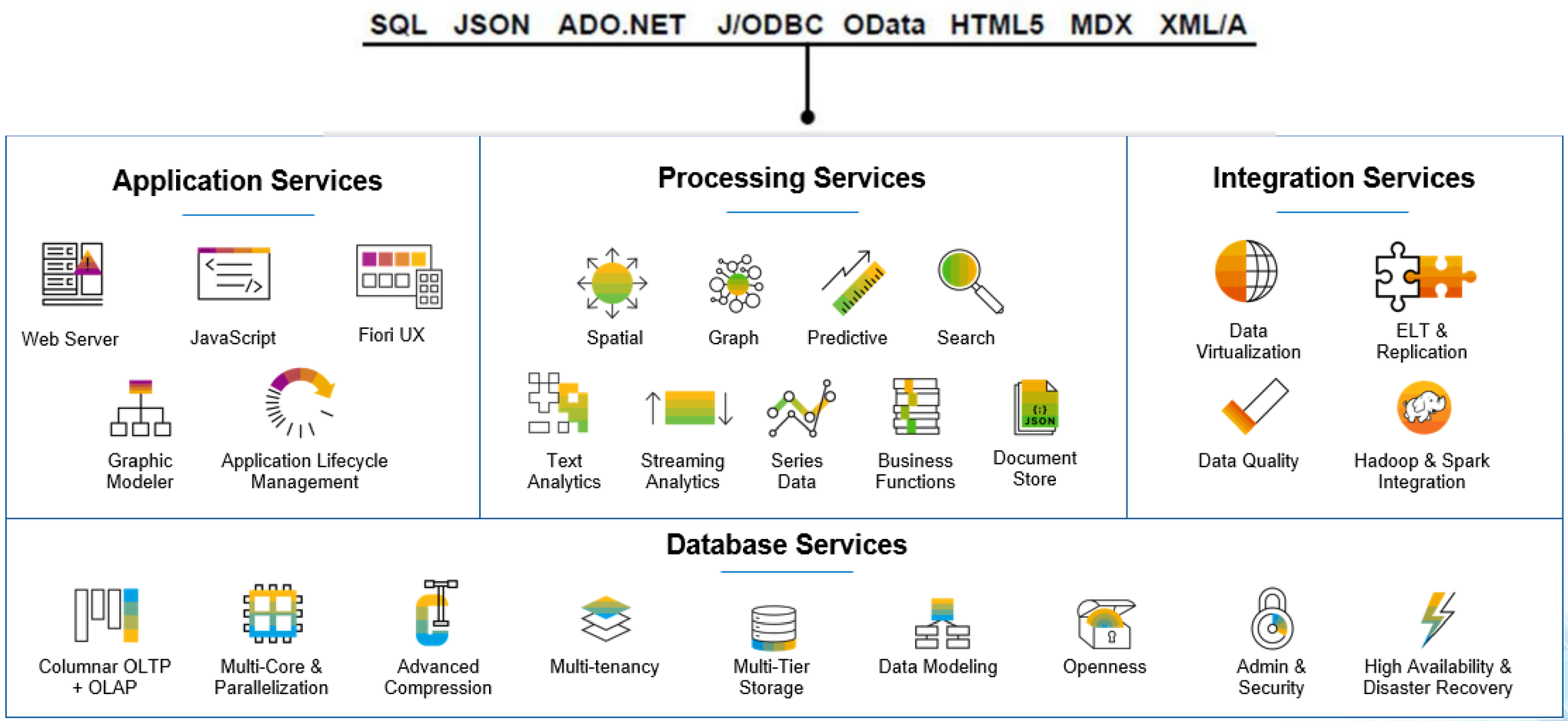
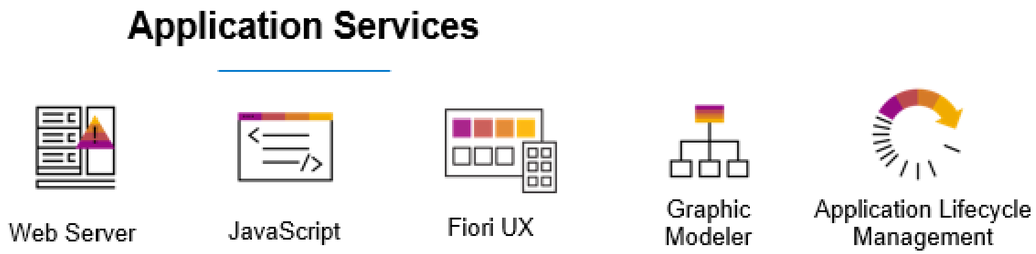
SAP HANA – Technologie

Architektura – rozdělení dle vrstev



SAP HANA – Technologie

Aplikační vrstva – Procesní vrstva – Databázová vrstva – Integrační vrstva



Podpora otevřených standardů (J/ODBC, XML/A)

Web Server podporuje server side JavaScript a Odata

Fiori UX knihovny staví na standardu HTML5

Application LCM = doinstalování součástí/aktualizace

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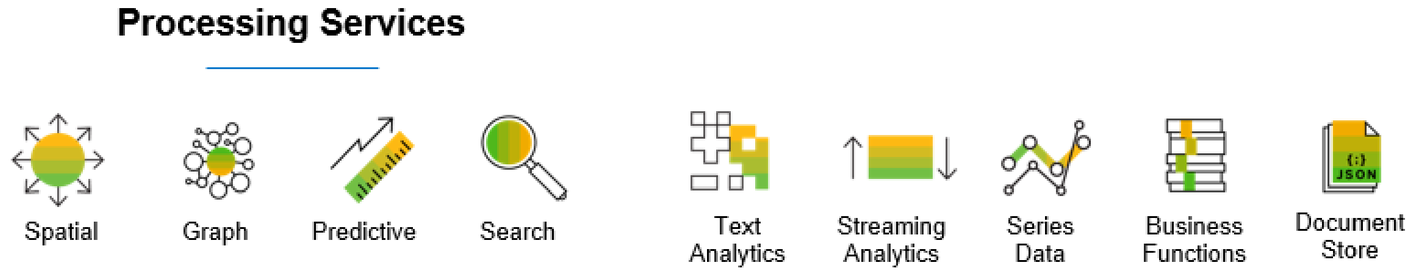
SAP HANA – Technologie

Aplikační vrstva – Procesní vrstva – Databázová vrstva – Integrační vrstva



Doinstalace funkcionalit pomocí AFL

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SAP HANA – Technologie

Aplikační vrstva – Procesní vrstva – Databázová vrstva – Integrační vrstva

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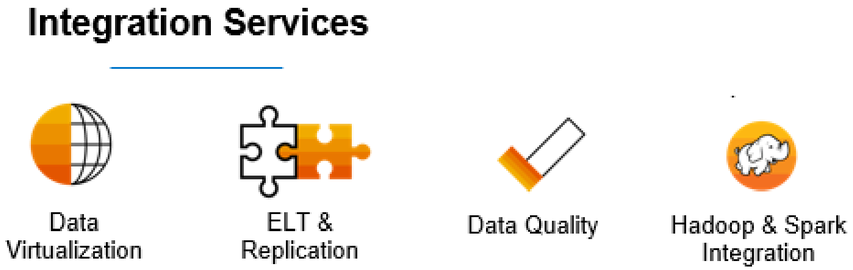
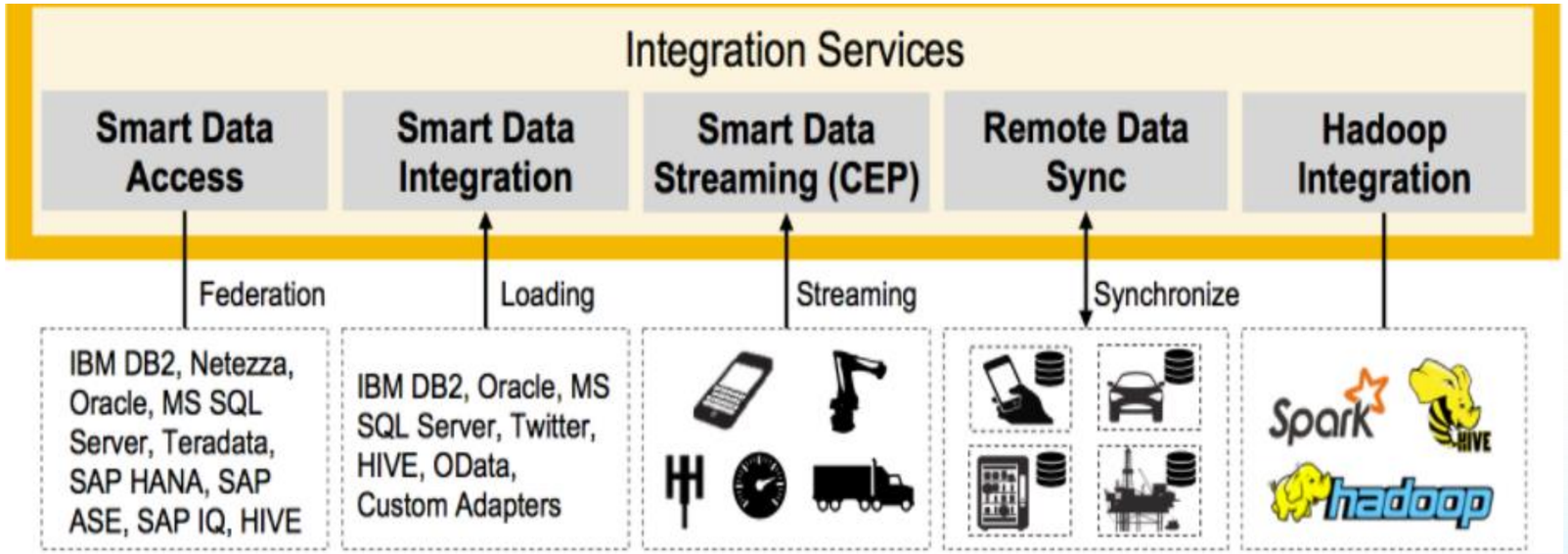
SAP HANA – Technologie

Aplikační vrstva – Procesní vrstva – Databázová vrstva – Integrační vrstva





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SAP HANA – Technologie

Architektura – komponenty

SAP HANA Components

SAP HANA mandatory components

SAP HANA Database

SAP HANA Client

SAP HANA additional components

SAP HANA Studio

SAP HANA XS Advanced Runtime

SAP HANA XS Engine

SAP HANA Advanced Data Processing

SAP HANA Spatial

SAP HANA Options and Capabilities

SAP HANA Accelerator for SAP ASE option

SAP HANA Dynamic Tiering

SAP HANA Remote Data Sync

SAP Landscape Transformation Replication Server

SAP HANA Smart Data Streaming

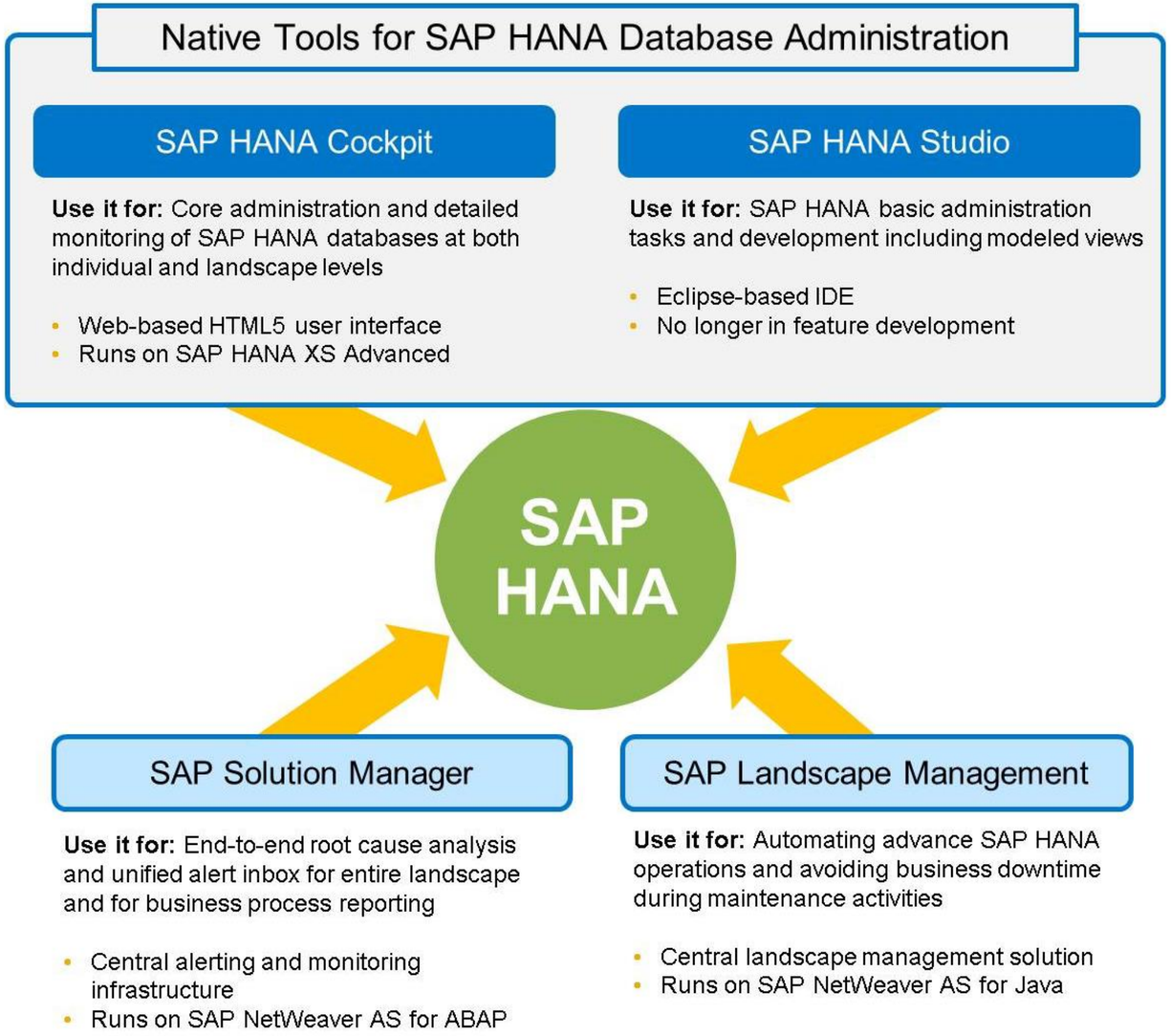
SAP HANA – Technologie

Architektura – Administrační nástroje

- SAP HANA Cockpit & Database Explorer
- Linux command line tools (HDB)
- SAP HANA database interactive terminal (hdbsql)
- SAP HANA client suite
- SAP HANA Studio
- SAP Solution Manager, SAP Landscape Management

SAP HANA – Technologie

Architektura – Administrační nástroje



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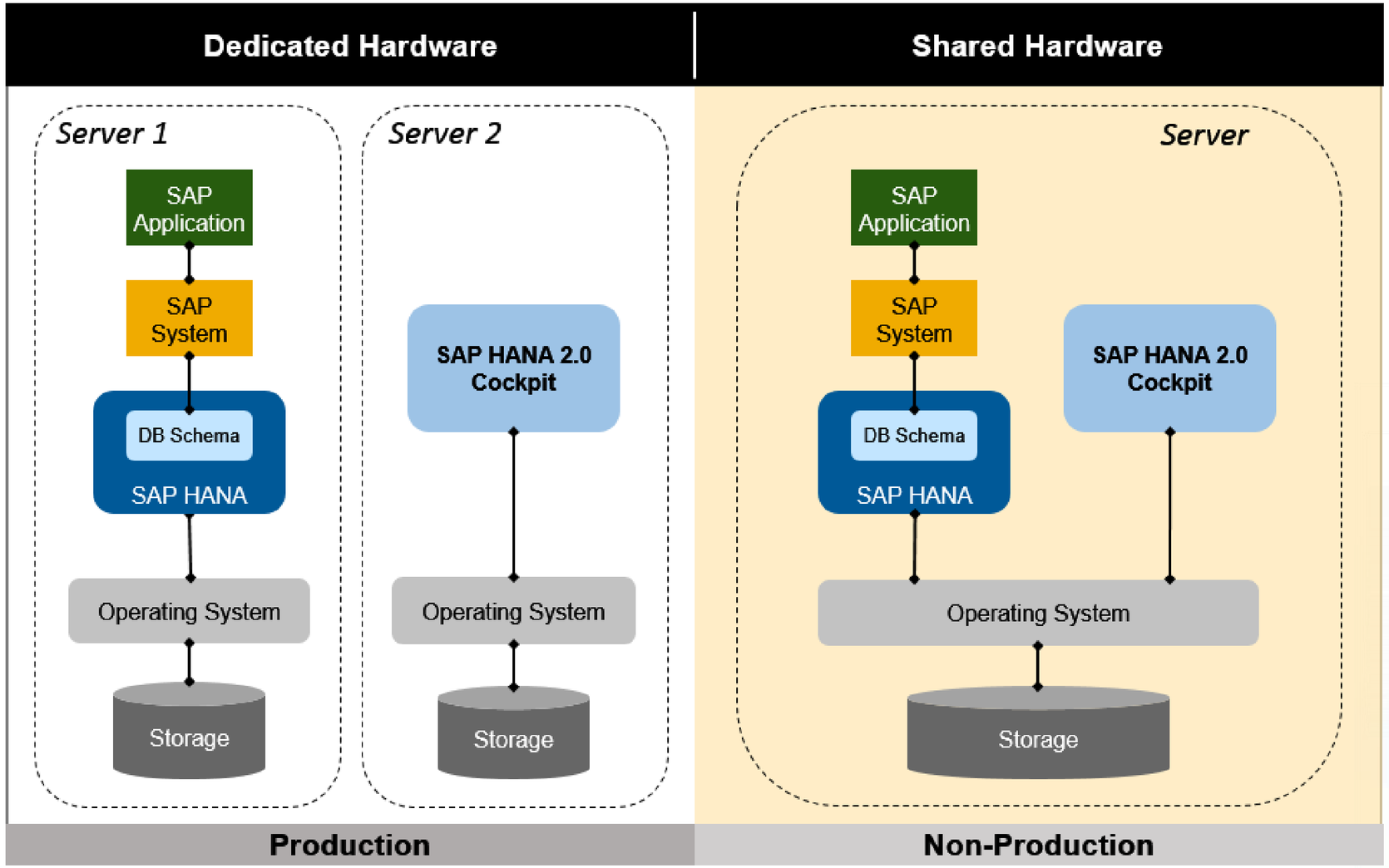
SAP HANA Cockpit & Database Explorer

https://launchpad.support.sap.com/#/notes/2380291



SAP HANA Client 2.0

https://tools.hana.ondemand.com/#hanatools

SAP Development Tools

tools.hana.ondemand.com/#hanatools

SAP Development Tools | Legal Disclosure | Privacy | Terms of Use | More

HOME ABAP BW CLOUD CLOUD INTEGRATION **HANA** IDM ML FOUNDATION MOBIL

SAP HANA Client 2.0

The SAP HANA Client provides a set of drivers that developers can use to connect client applications to SAP HANA. SAP HANA Client 2.0 drivers connect to SAP HANA 1.0 and SAP HANA 2.0 databases as described in SAP Note 1906576.

Installation instructions are provided in the SAP HANA Client Installation and Update Guide, and programming information is provided in the SAP HANA Client Interface Programming Reference.

Available SAP HANA Client Downloads

Component (Show Subcomponents)	Operating System	Version	File Size	Download
Client Install	Linux x64	2.5.109	407.1 MB	hanaclient-2.5.109-linux-x64.tar.gz (sha1) hanaclient-latest-linux-x64.tar.gz (sha1)
Client Install	macOS x64	2.5.109	92.9 MB	hanaclient-2.5.109-macosx-x64.tar.gz (sha1) hanaclient-latest-macosx-x64.tar.gz (sha1)
Client Install	Windows x64	2.5.109	128.1 MB	hanaclient-2.5.109-windows-x64.zip (sha1) hanaclient-latest-windows-x64.zip (sha1)
JDBC	Java 8 and above	2.5.52	1.2 MB	ngdbc-2.5.52.jar (sha1) ngdbc-latest.jar (sha1)

- For Python driver installs, use pip:

```
pip install hdbcli
```

- For node.js driver installs, use npm:

```
npm install @sap/hana-client
```

- The JDBC driver is also available via the Maven Central Repository

SAP HANA Database Client Installation 2.5.109.1598303414

SAP HANA
Lifecycle Management

1 Define Client Properties — 2 Review & Confirm — 3 Install Software — 4 Finish

Summary

- SAP HANA Database Client Installation
  - Installation Path: C:\Program Files\sap\hdbclient
  - ODBC Driver Name: HDBODBC
  - Software Components (209.78 MB)
    - .NET Core (15.73 MB)
    - ADO.NET (36.69 MB)
    - Calculation View API (5.71 MB)
    - Client Installer (23.66 MB)
    - Code Examples (0.02 MB)
    - DBCAPI (15.31 MB)
    - Environment Script (0.00 MB)
    - HALM Client (0.23 MB)
    - JDBC (1.16 MB)
    - ODBC (17.80 MB)
    - ODBO (2.09 MB)
    - Product Manifest (0.00 MB)
    - Python DB API (10.01 MB)
    - Python Machine Learning API (0.37 MB)
    - R Machine Learning API (0.57 MB)
    - REPOTOOLS (18.34 MB)
    - Ruby Client (3.46 MB)
    - SQLDBC (48.57 MB)
    - golang Client (0.11 MB)
    - node.js Client (9.94 MB)

< Previous | Install | Cancel

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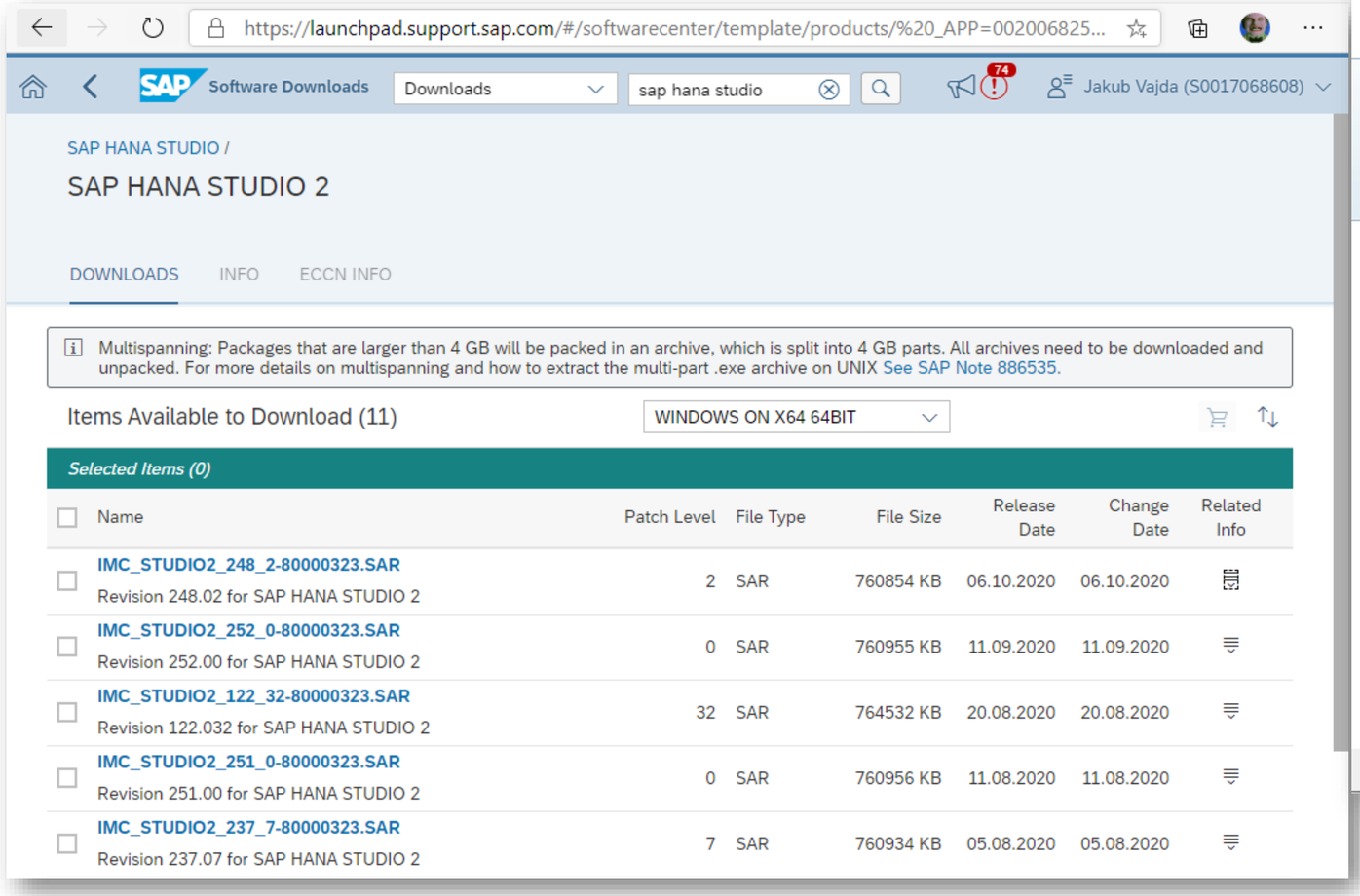
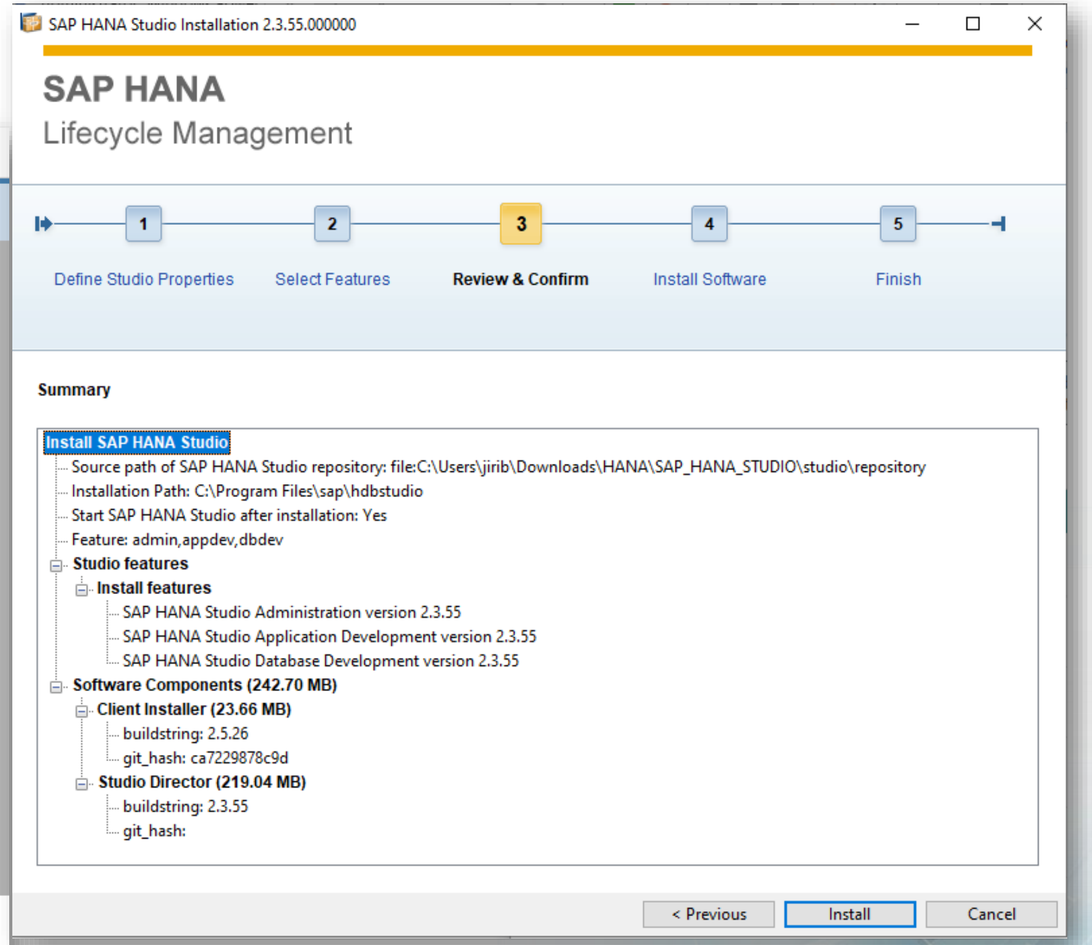
SAP HANA Studio 2.0

https://launchpad.support.sap.com/





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SAP HANA – Technologie

SAP HANA Options & Additional Capabilities

SAP offers options and additional capabilities for SAP HANA. The SAP HANA options and capabilities listed below are available in connection with the platform and enterprise editions of SAP HANA, depending on the software license used.

SAP HANA Accelerator for SAP ASE

SAP HANA Client Interfaces

SAP HANA Data Warehousing Foundation

SAP HANA Dynamic Tiering

SAP HANA Smart Data Integration and SAP HANA Smart Data Quality

SAP HANA Hadoop Integration

SAP HANA Streaming Analytics

SAP HANA Real-Time Replication with SAP Landscape Transformation Replication Server

SAP Web IDE for SAP HANA

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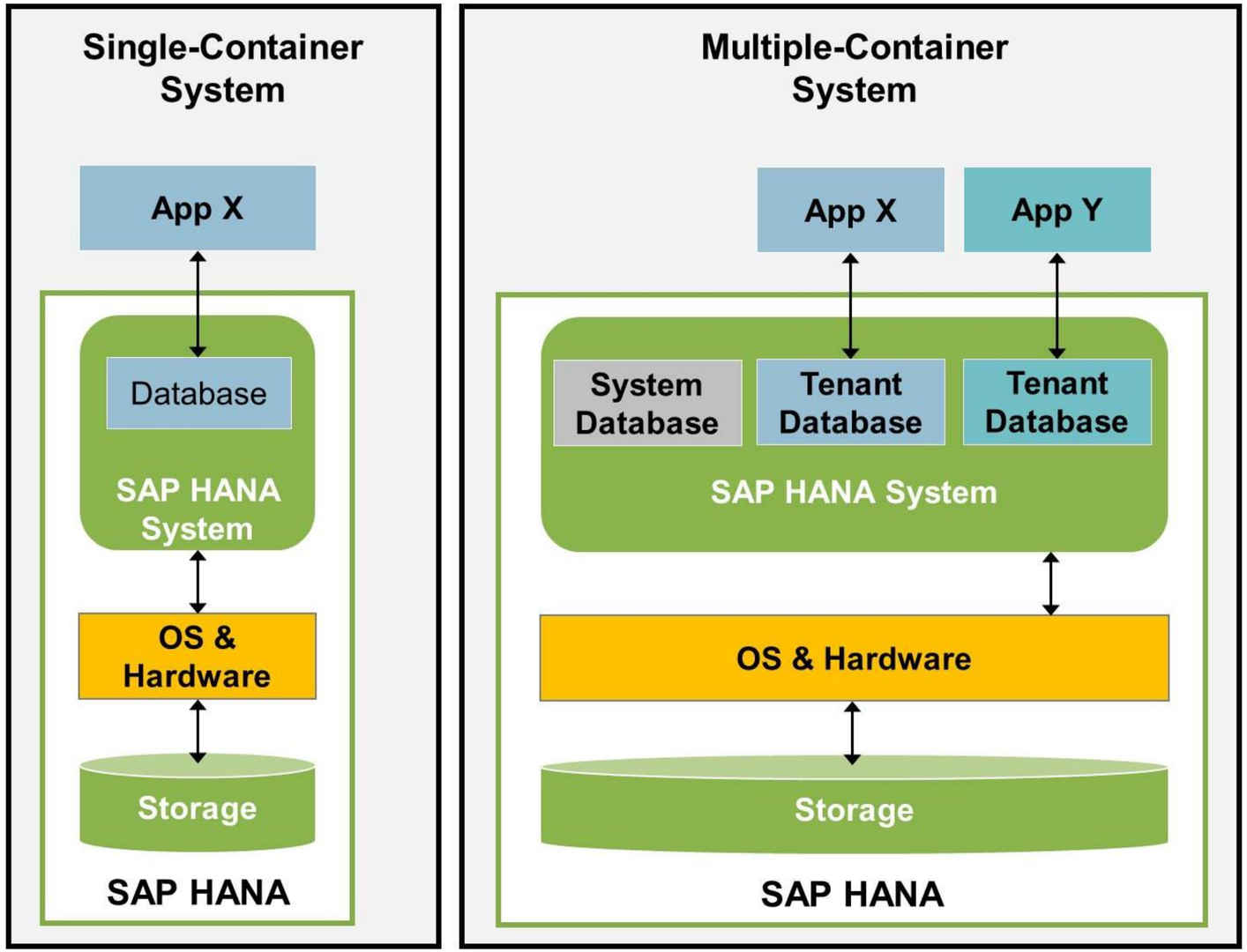
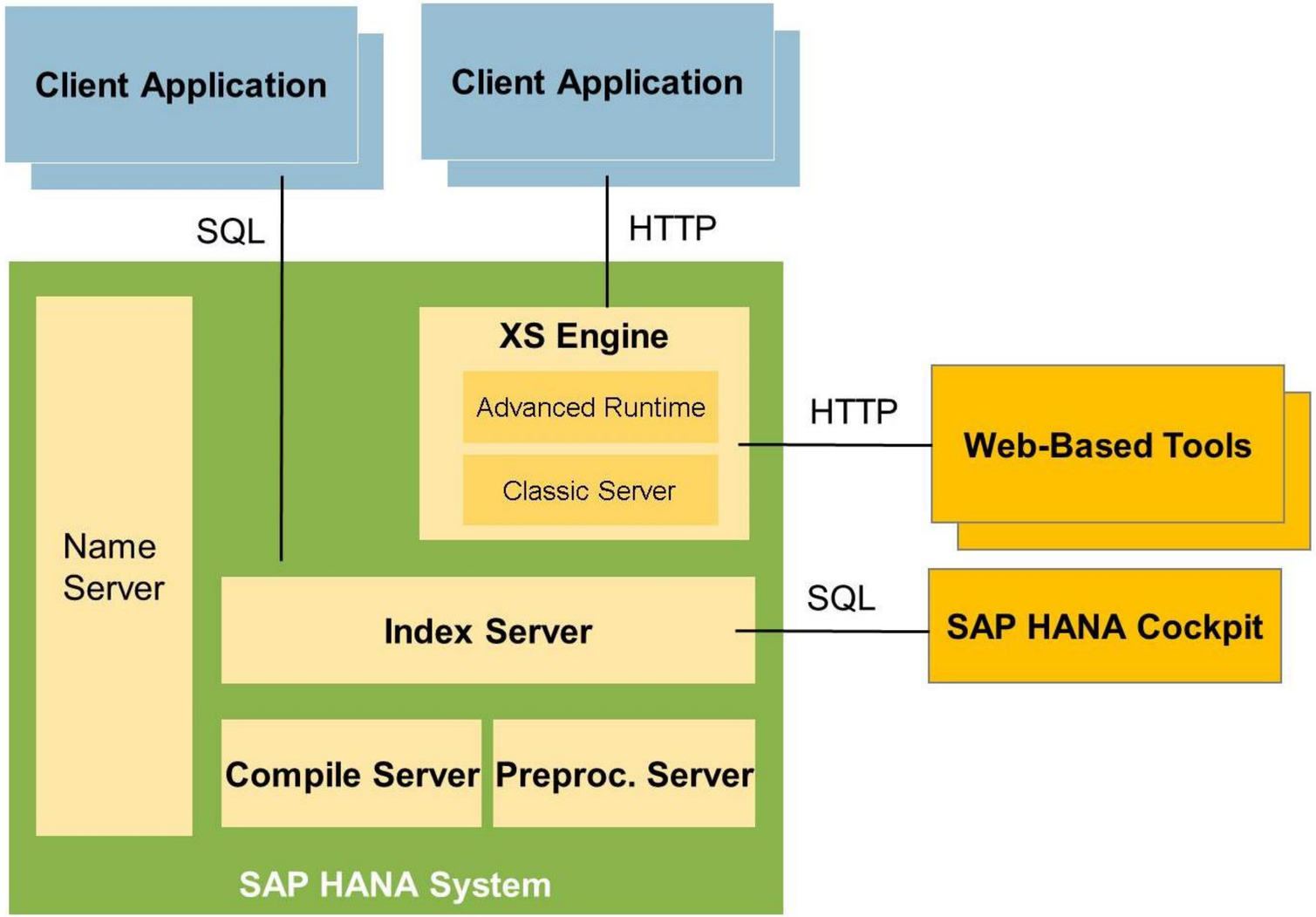
SAP HANA – Technologie

SAP HANA Single/Multiple Container



SAP HANA – Technologie

SAP HANA Main Components



SAP HANA – Technologie

SAP HANA Core processes

- Daemon
  - Starts all other processes and keeps them running
- Index server
  - The main database process
  - Data loads, queries, calculations, and so on
  - Provides the embedded statistics service
- Name server
  - Knows DB Landscape
  - Knows data distribution
- Preprocessor
  - Feeds unstructured data (for example, text documents) into SAP HANA
- Compile Server
  - Performs the compilation of stored procedures and programs
- XS-Engine
  - Web service component, sometimes termed “application server”
- SAP Web Dispatcher
  - Entry point for HTTP(s) requests
- SAP start service
  - Responsible for starting and stopping the other services

Host	Status	Service
wdflbmt7195	Running	daemon
	Running	nameserver
	Running	preprocessor
	Running	indexserver
	Running	webdispatcher
	Running	xsengine
	Running	compileserver

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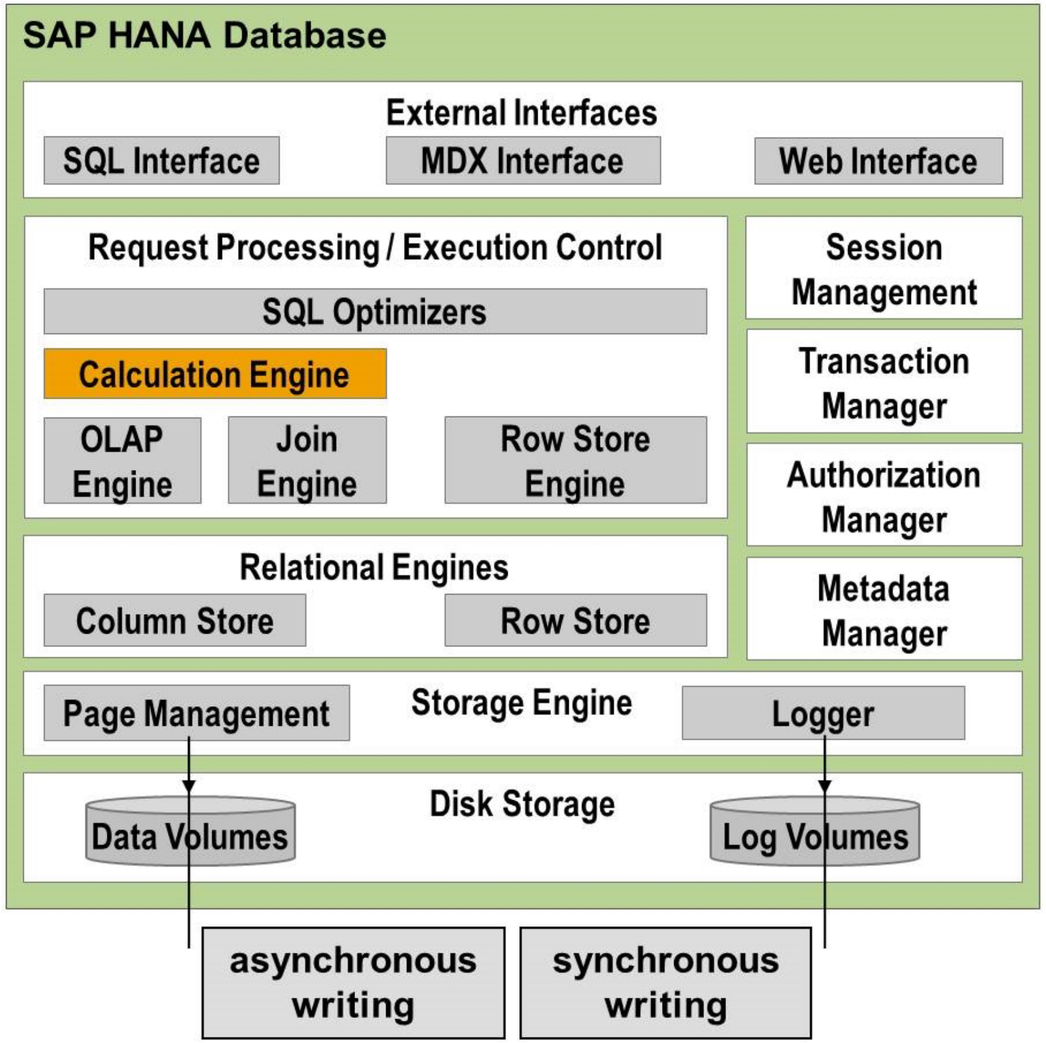
SAP HANA – Technologie

SAP HANA Index Server

Simplified Architecture

- SAP HANA Core Process
- External Interfaces
  - Communicate with SAP HANA
  - Queries, Data Loads, Admin, …
- Processing Engines
  - Operate on data
  - Execute Queries, …
- Relational Engines
  - Store data (in Memory)
- Storage Engine
  - Handles data pages
  - Handles transfer RAM ⇔ Disk
- Disk Storage
  - Non-volatile data storage



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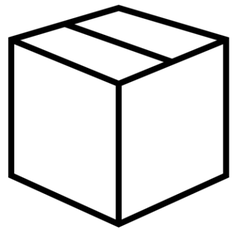
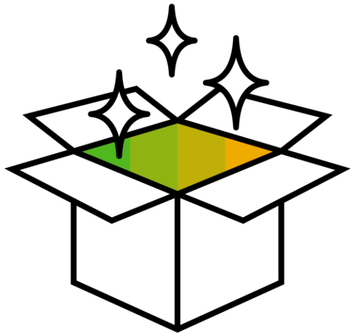
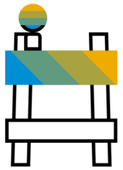




Runtime edition

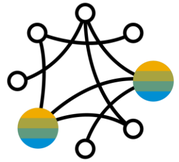
Pay a fee to run SAP applications on SAP HANA



The runtime edition offers a **limited platform** exclusively for SAP applications, with capabilities restricted to the application layer.

Enterprise edition

Purchase the SAP HANA platform



The enterprise edition provides an **unrestricted platform** for all systems and distributed data in modern hybrid environments.

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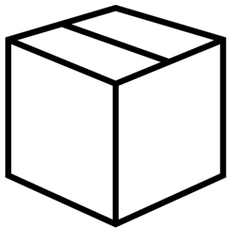
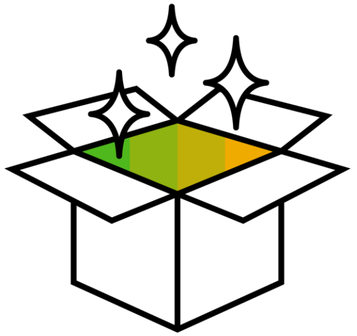
SAP HANA – Technologie

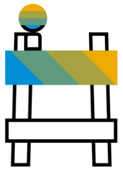
Edice





Standard edition

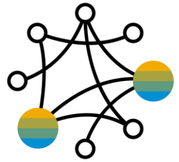
Purchase the SAP HANA platform with limited features



Includes up to 8x dynamic tiering, add options as needed.

Express edition

Out of the box



Limited to 32 GB RAM, single instance.

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SAP HANA – Úvod

Software license type

Select SAP HANA software license type:

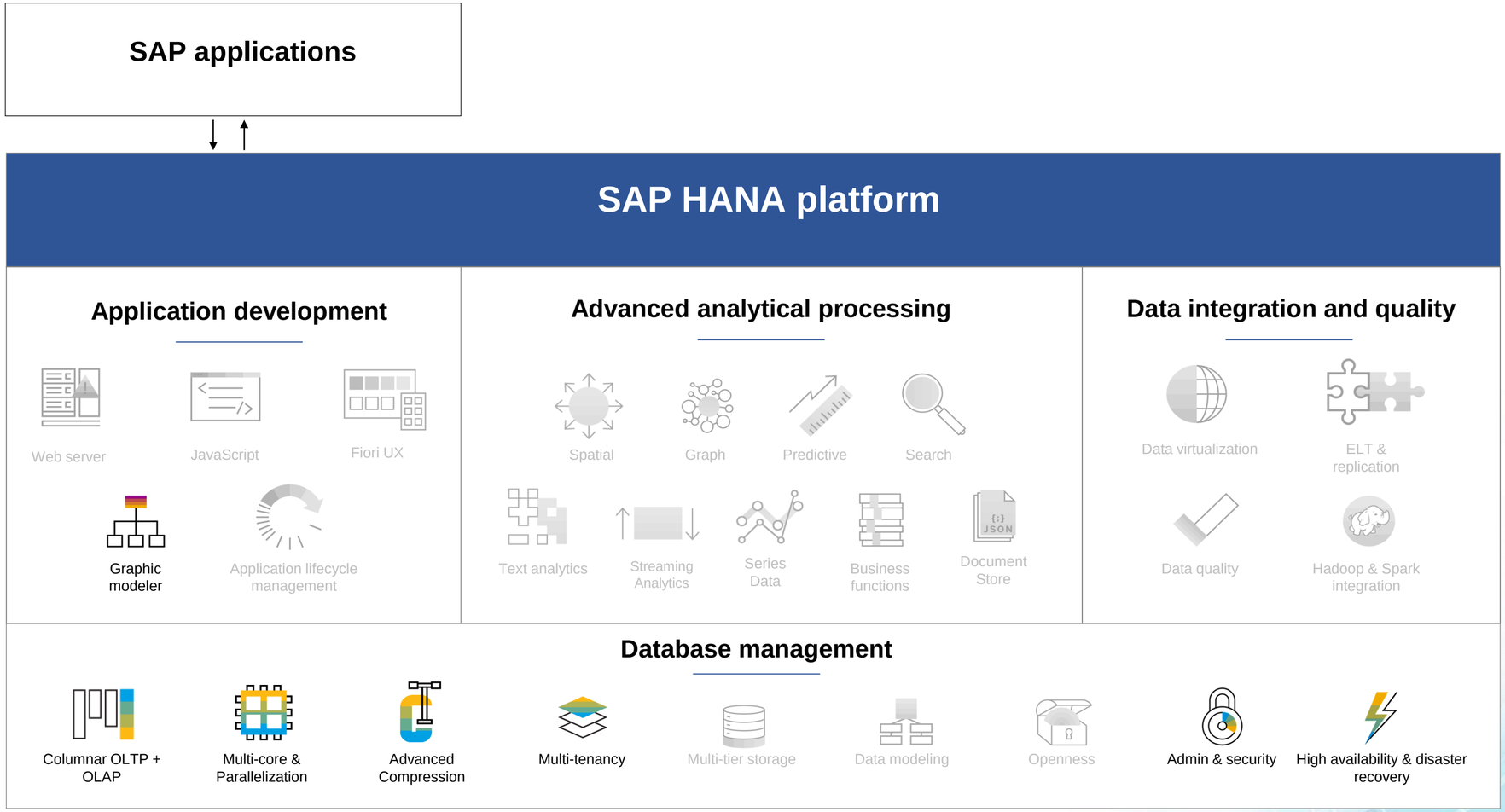
SAP HANA, runtime edition

SAP HANA, enterprise edition

SAP HANA, runtime edition

- The advanced capabilities of the SAP HANA business data platform are only available by and through the licensed SAP application with the only exception being the use of the graphic modeler to build views to be used only for reporting purposes.
- Direct data platform connection is limited to SAP or certified 3rd-party business intelligence tools only.
- All data extraction must occur via the application layer.

SAP HANA, runtime edition, can only be used by applications from SAP.



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SAP HANA – Úvod

Software license type

Select SAP HANA software license type:

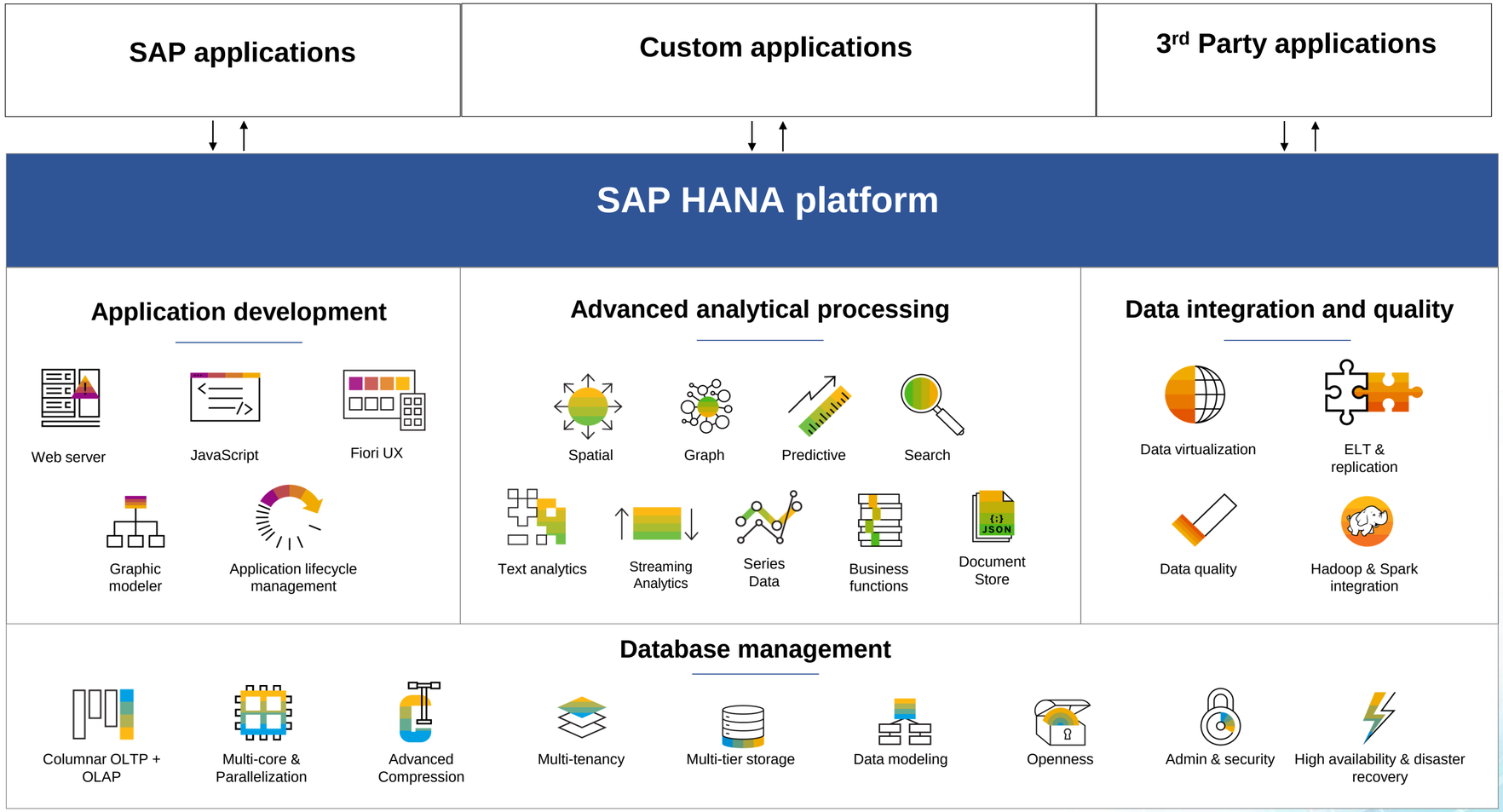
SAP HANA, runtime edition

SAP HANA, enterprise edition

SAP HANA, enterprise edition

- The advanced capabilities of the SAP HANA business data platform are available for use either via an application layer (SAP, 3rd Party, or Custom) or directly via the data platform.
- Direct data platform connection is available via open standards by any tool.
- Data extraction may be performed either via an application layer or directly from SAP HANA platform.

SAP HANA, enterprise edition, can be used for any application (SAP, 3rd Party, or Custom)



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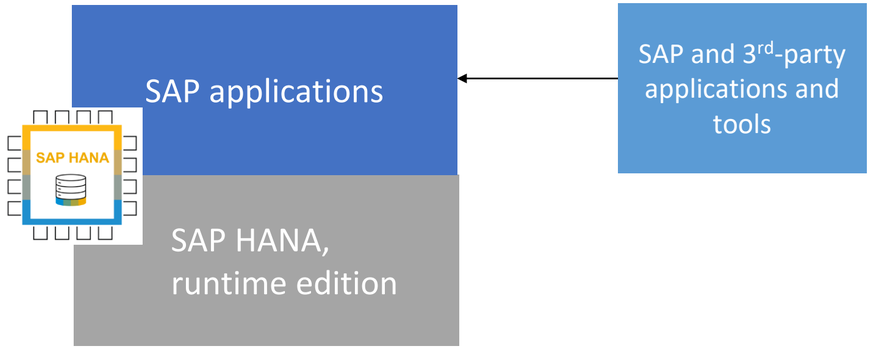
SAP HANA – Úvod

SQL Data Access

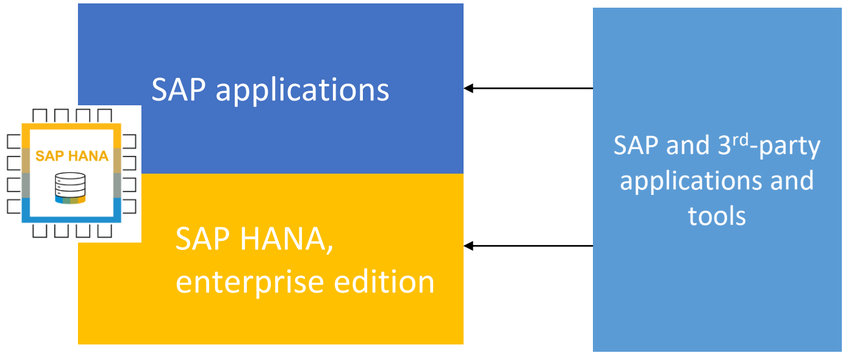
Runtime edition

- Data extraction only at the application layer
- Connection methods primarily based on proprietary protocol (remote function call [RFC]) and language (ABAP)
- Typically requires SAP-specific skillset



Enterprise edition

- Data extraction at application layer or database layer
- Connection methods based on standard protocols (ODBC, JDBC, ODBO, and OData) and languages (SQL and MDX)
- Industry-standard skillset not unique to SAP



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SAP HANA – Úvod

Srovnání edicí - https://www.sap.com/products/hana/pricing.html

✓ Included
✓ Only for SAP applications
O Optional
– Not included

Expand all	SAP HANA, enterprise edition	SAP HANA, standard edition	SAP HANA, express edition	SAP HANA, runtime edition
Database services				
Application services				
Processing services				
Integration and quality services				
Deployment mode	Cloud and on premise	Cloud and on premise	Cloud and on premise	Cloud and on premise
Support model	Full SAP support	Full SAP support	Community support	Full SAP support
Real-time enablement	✓	✓	–	✓
Big Data optimization	✓	✓	–	✓
	Learn more	Learn more	Learn more	Learn more

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SAP HANA – Úvod

Srovnání edicí - https://www.sap.com/products/hana/pricing.html

✓ Included
✓ Only for SAP applications
O Optional
– Not included

Expand all	SAP HANA, enterprise edition	SAP HANA, standard edition	SAP HANA, express edition	SAP HANA, runtime edition
Database services ▲				
Columnar OLTP & OLAP	✓	✓	✓	✓
Columnar RDBMS	✓	✓	✓	✓
Online analytical processing (OLAP)	✓	✓	✓	✓
Online transactional processing (OLTP)	✓	✓	✓	✓
Multicore and parallelization	✓	✓	✓	✓
Advanced compression	✓	✓	✓	✓
Multitenancy	✓	✓	✓	✓
Multitier storage	✓	✓	–	✓
Data modeling	✓	✓	✓	✓
Openness (standard interface)	✓	✓	✓	✓
Administration and security	✓	✓	✓	✓
High availability and disaster recovery	✓	✓	–	✓

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SAP HANA – Úvod

Srovnání edicí - https://www.sap.com/products/hana/pricing.html

✓ Included
✓ Only for SAP applications
O Optional
– Not included

Expand all	SAP HANA, enterprise edition	SAP HANA, standard edition	SAP HANA, express edition	SAP HANA, runtime edition
Database services				
Application services				
Web server	✓	✓	✓	✓
JavaScript	✓	✓	✓	✓
SAP Fiori UX	✓	✓	✓	✓
Graphic modeler	✓	✓	✓	✓
Application lifecycle management	✓	✓	✓	✓
Big Data optimization	✓	✓	–	✓
	Learn more	Learn more	Learn more	Learn more

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SAP HANA – Úvod

Srovnání edicí - https://www.sap.com/products/hana/pricing.html

✓ Included
✓ Only for SAP applications
O Optional
– Not included

Expand all	SAP HANA, enterprise edition	SAP HANA, standard edition	SAP HANA, express edition	SAP HANA, runtime edition
Database services ▼				
Application services ▼				
Processing services ▲				
Spatial	✓	O	✓	✓
Graph	✓	O	✓	✓
Predictive	✓	O	✓	✓
Search	✓	O	✓	✓
Text analytics	✓	O	✓	✓
Streaming analytics	✓	O	✓	–
Series data	✓	✓	✓	✓
Business functions	✓	✓	✓	✓

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SAP HANA – Úvod

Srovnání edicí - https://www.sap.com/products/hana/pricing.html

✓ Included
✓ Only for SAP applications
O Optional
– Not included

Expand all	SAP HANA, enterprise edition	SAP HANA, standard edition	SAP HANA, express edition	SAP HANA, runtime edition
Database services				
Application services				
Processing services				
Integration and quality services				
Data virtualization	✓	✓	✓	✓
ETL and replication	✓	O	–	✓
Data quality	✓	O	–	✓
Hadoop and spark integration	✓	O	✓	✓
Remote data synch	✓	O	✓	–

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SAP HANA – Úvod

Srovnání edicí - https://www.sap.com/products/hana/pricing.html

✓ Included
✓ Only for SAP applications
O Optional
– Not included

Expand all	SAP HANA, enterprise edition	SAP HANA, standard edition	SAP HANA, express edition	SAP HANA, runtime edition
Database services				
Application services				
Processing services				
Integration and quality services				
Deployment mode	Cloud and on premise	Cloud and on premise	Cloud and on premise	Cloud and on premise
Support model	Full SAP support	Full SAP support	Community support	Full SAP support
Real-time enablement	✓	✓	–	✓
Big Data optimization	✓	✓	–	✓
	Learn more	Learn more	Learn more	Learn more

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In-memory koncepty

Architektura systému

Edice

Nasazení

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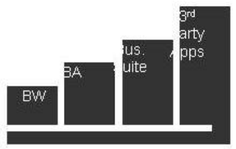
SAP HANA – Úvod

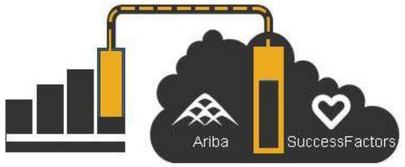
Nasazení



On Premise

Run All SAP Solutions on SAP HANA

- Build or deploy your own solutions on SAP HANA
- Maintain all within your firewall
- Upgrade or leverage existing infrastructure



Hybrid

Leverage SAP Cloud

- Migrate some solutions to the cloud
- Create or deploy new SaaS apps in the cloud
- Use cloud hosting and managed services
- Deploy via SAP HANA Enterprise Cloud or public cloud

Cloud

Build, Run, Deploy all Applications in the Cloud

- Consider Virtual Private Cloud option
- Enable faster innovations
- Simplify landscape
- Migrate or build new applications in SAP HANA Enterprise Cloud

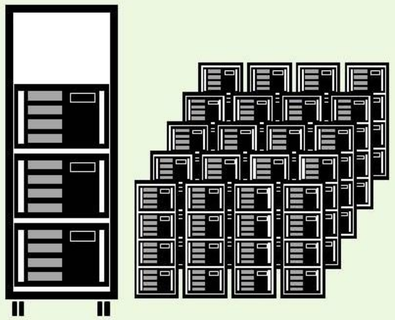
SAP HANA – Úvod

Nasazení – On-Premise

Single Server

- For datamarts or accelerators
- Support for high availabilty and disaster recovery

Scale Out Cluster



- Scale out by clustering multiple nodes together
- To be used when single server is not enough (or example, SAP BW)
- Usually, 2 to 16 servers per cluster
- Largest certified configuration: 56 servers
- Largest tested configuration: 100+ servers
- Support for high availability and disaster recovery

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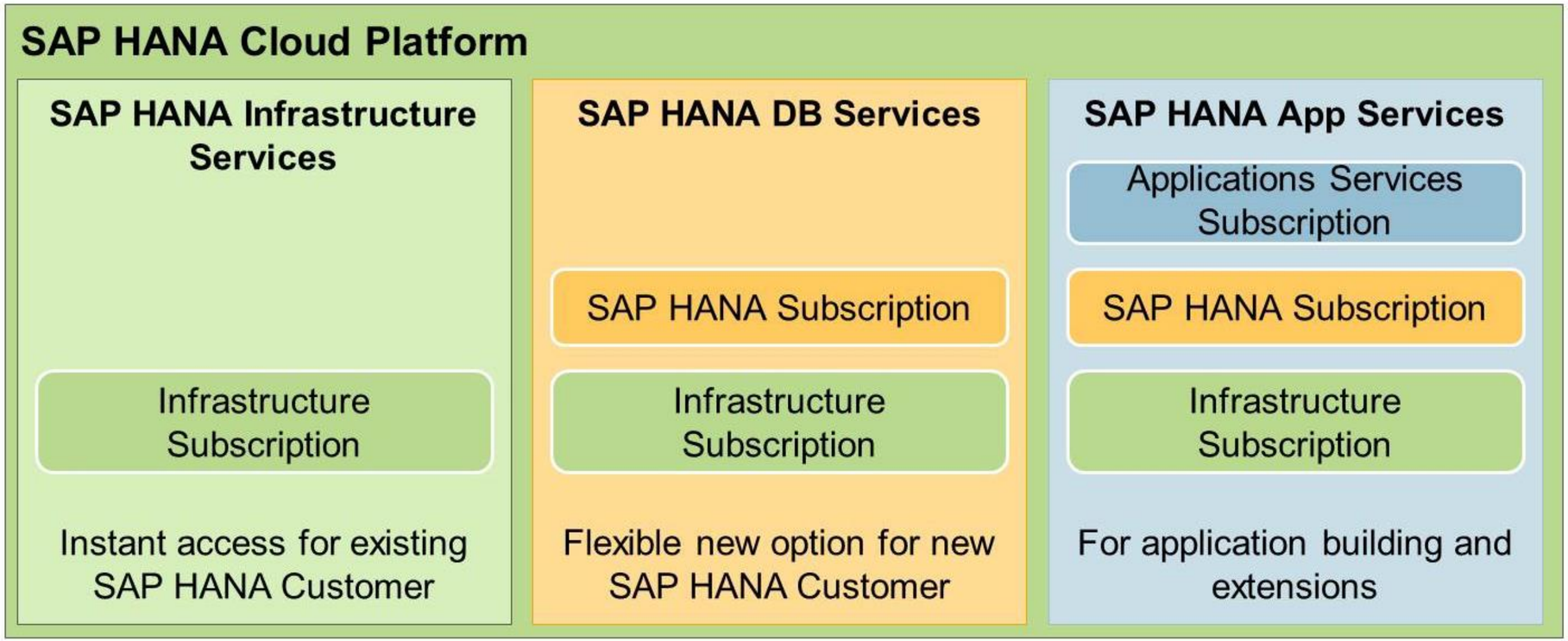
SAP HANA – Úvod

Nasazení – Cloud Platform



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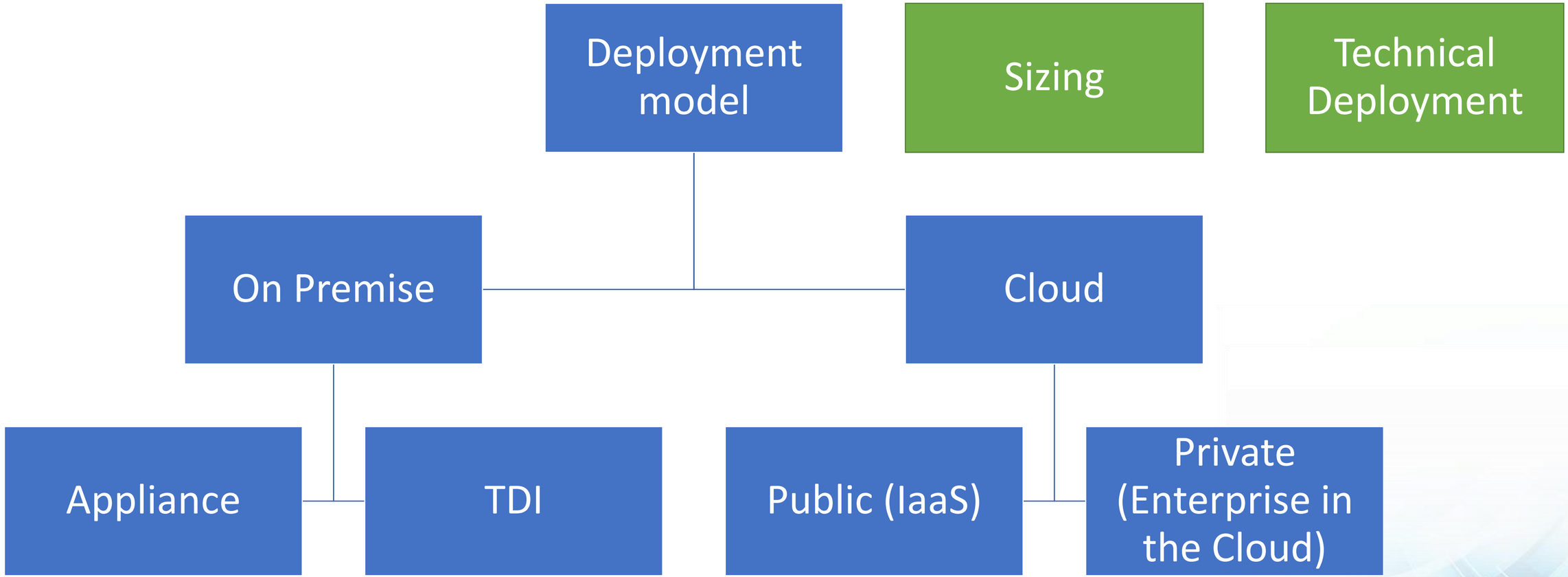
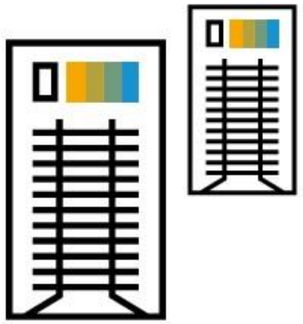
SAP HANA – Úvod

Nasazení - typy



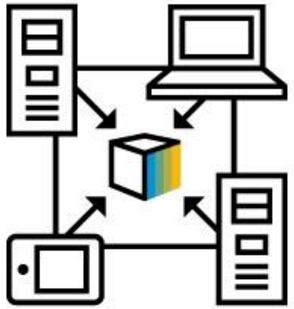
SAP HANA – Úvod

Škálovatelnost



Single server

- 2 CPU/128 GB to 8 CPU/8 TB (special layout for SAP® Business Suite powered by SAP HANA® or SAP S/4HANA® with up to 20 TB per host)
- Single deployments of SAP HANA for data marts or accelerators with performance demands (socket-to-memory ratio)
- Support for high availability and disaster recovery



Scale-out cluster

- 2 to *n* servers per cluster
- Each server either 4 CPU/2 TB or 8 CPU/4 TB
- Largest certified configuration: 112 servers
- Largest tested configuration: 250+ servers
- Support for high availability and disaster recovery

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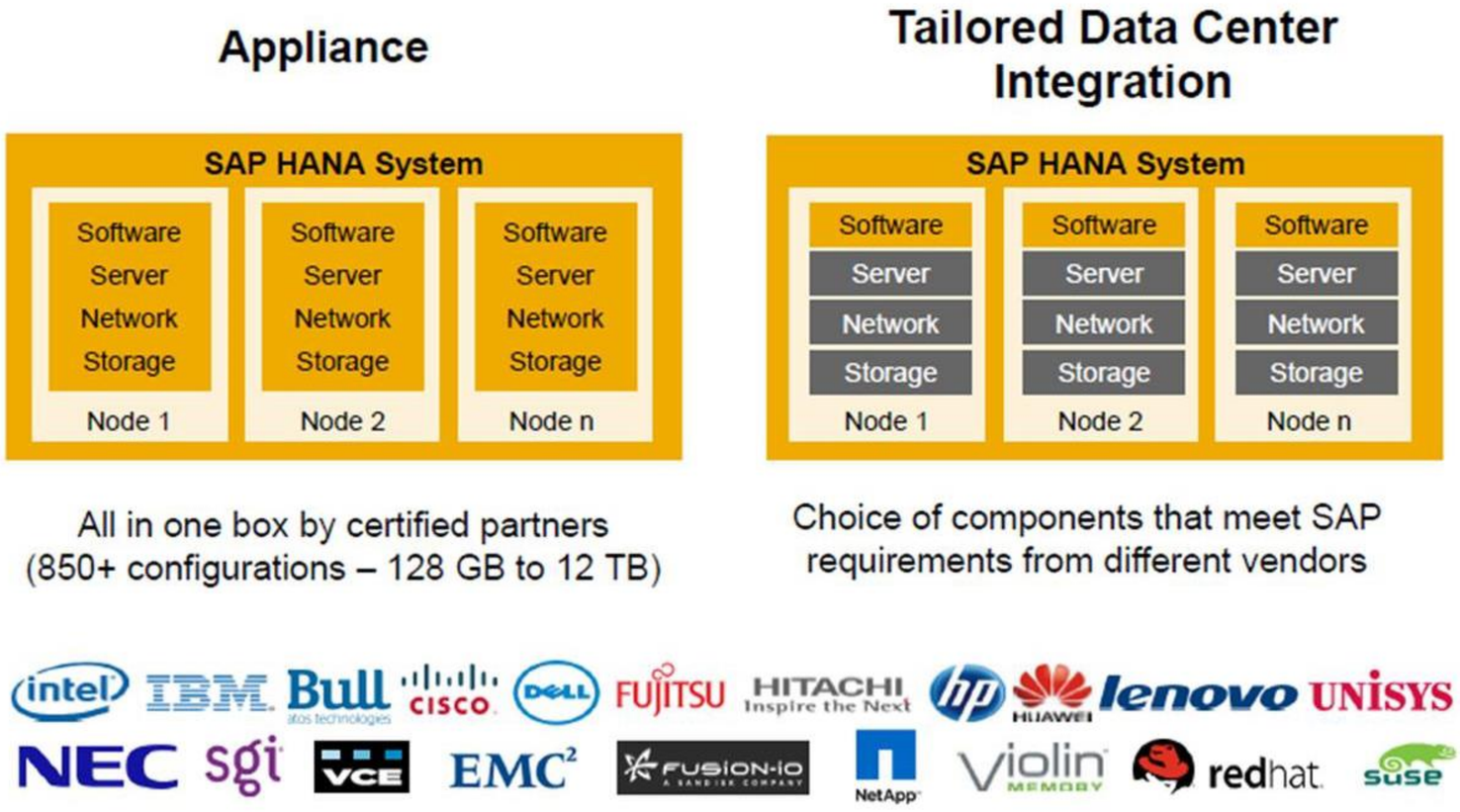
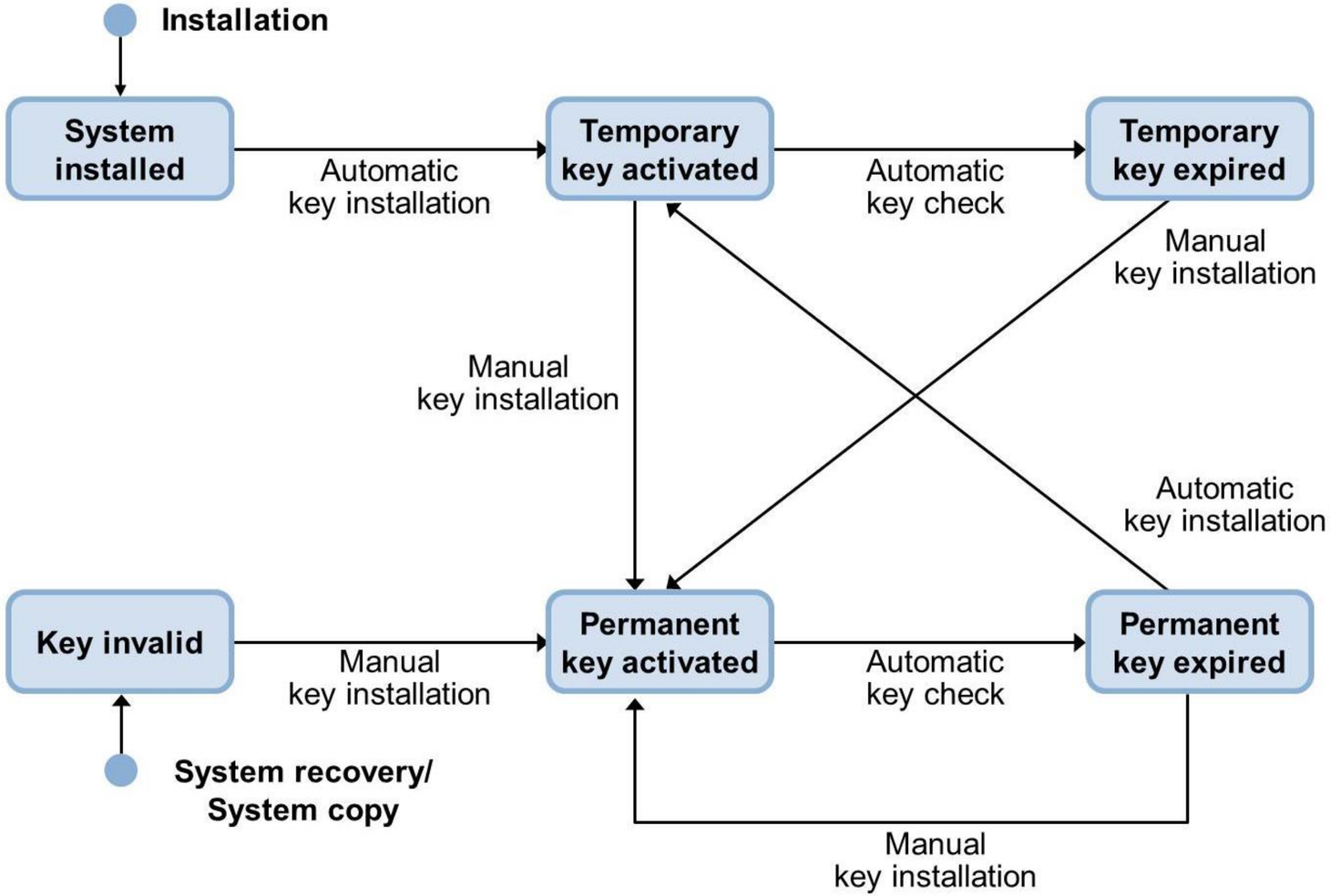
SAP HANA – Úvod

Škálovatelnost



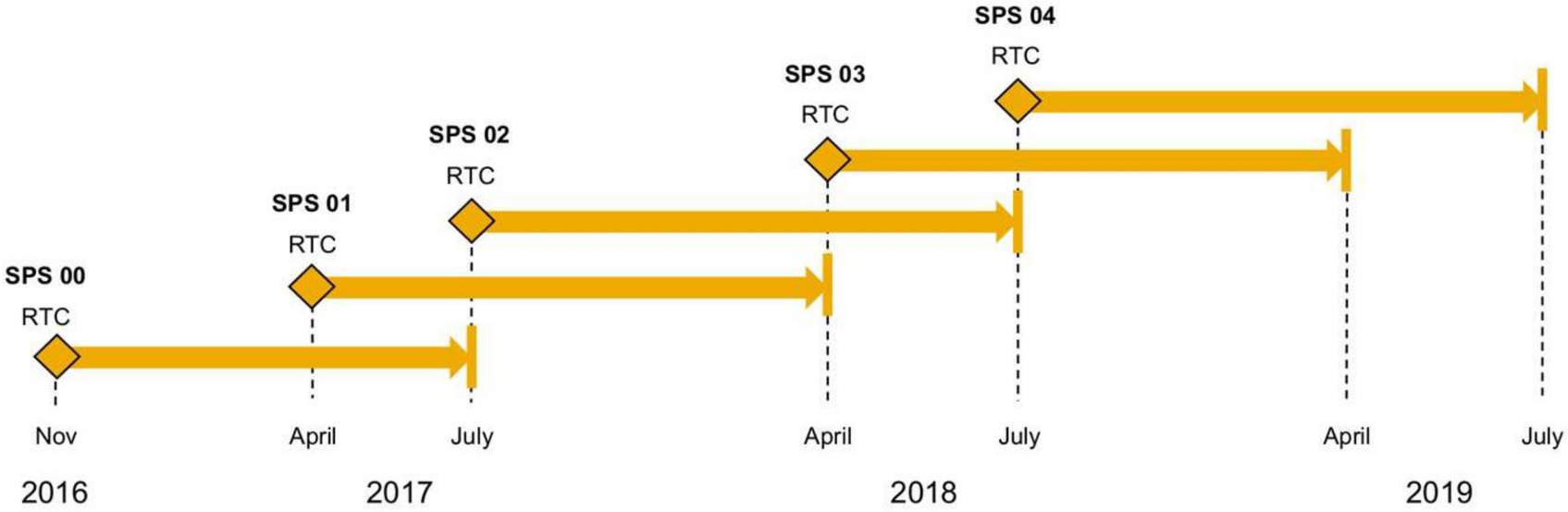
SAP HANA – Úvod

Nasazení - licensování



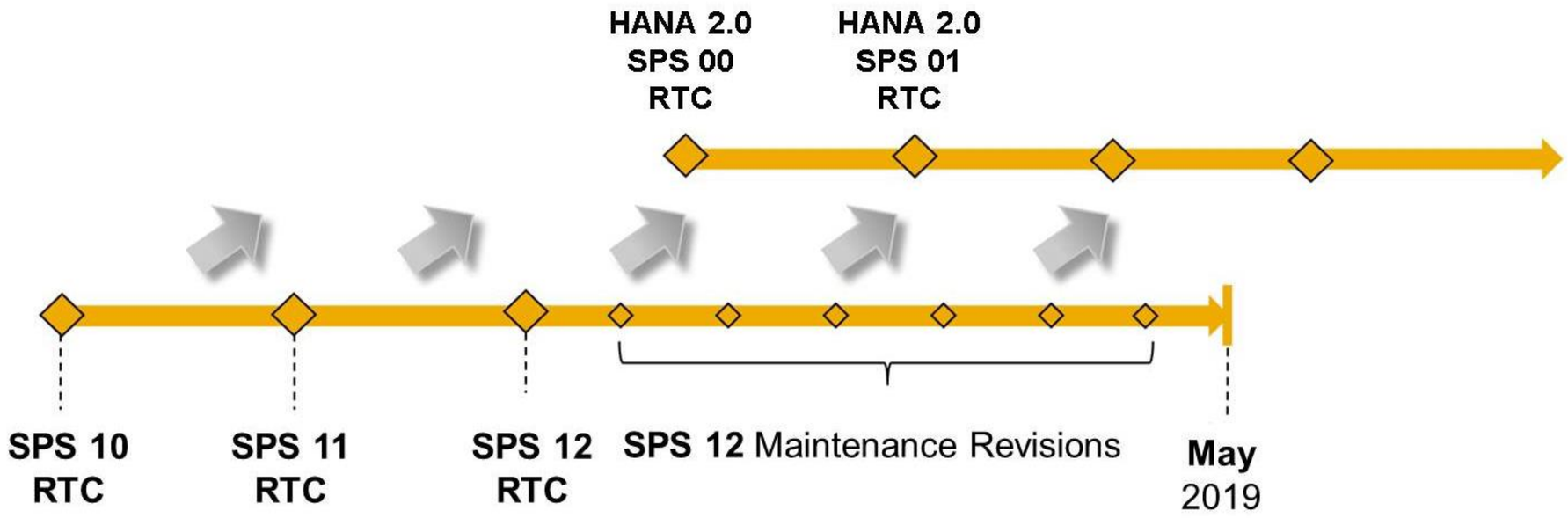
SAP HANA – Úvod

Nasazení – strategie aktualizací



SAP HANA – Úvod

Nasazení – strategie aktualizací



SAP HANA – Úvod

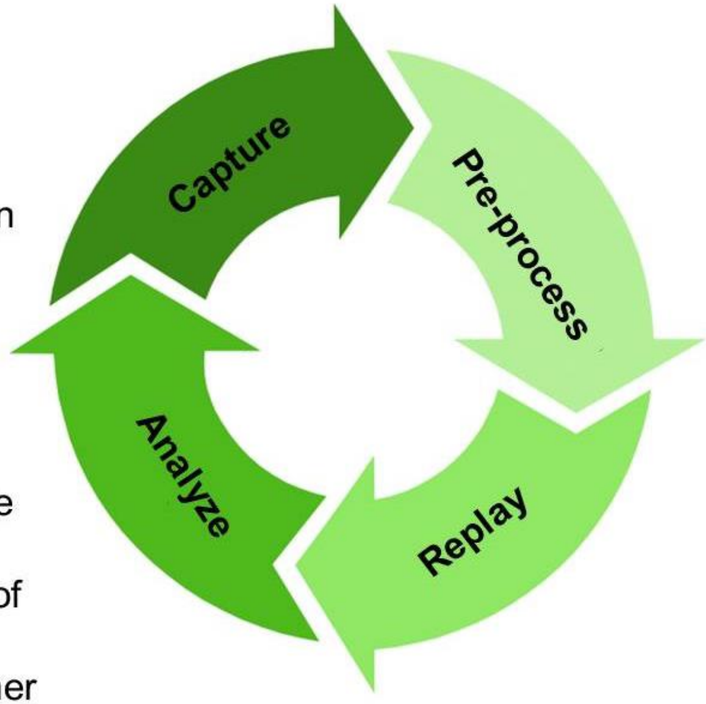
Nasazení – capture & replay

Features

- Capture real system workload in productive environments
- Pre-process & replay captured workload on target systems
- Analyze runtimes and compare performance between system setups

Benefits

- Provides competitive replay, analysis and tuning capabilities for SAP HANA Database
- Helps ensure that landscape changes do not degrade system performance
- Enables real simulation of workload without the use of other 3rd party tools
- Reduces manual effort for testing changes in customer deployments



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