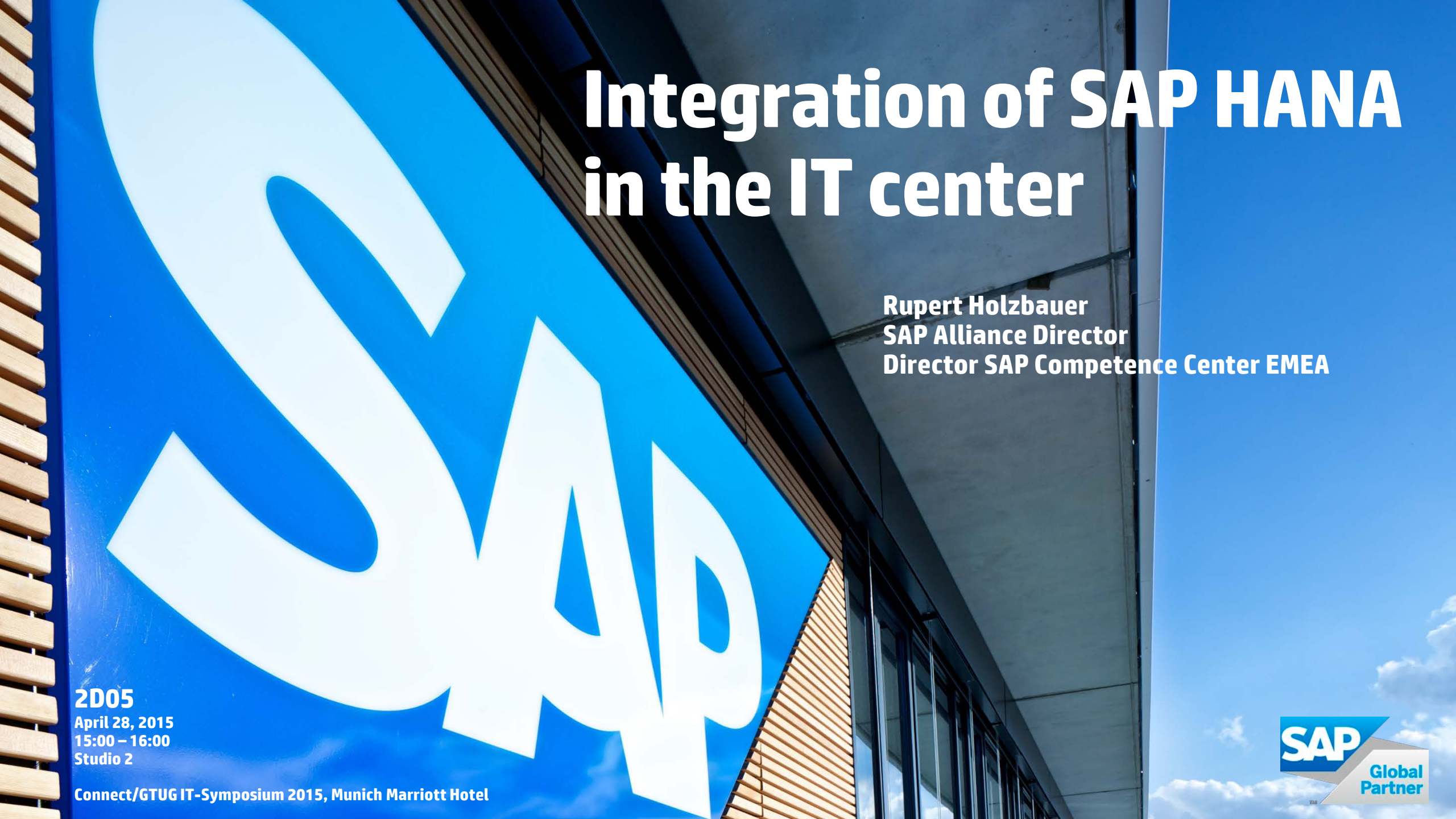


Integration of SAP HANA in the IT center

Rupert Holzbauer
SAP Alliance Director
Director SAP Competence Center EMEA

2D05
April 28, 2015
15:00 – 16:00
Studio 2

Connect/GTUG IT-Symposium 2015, Munich Marriott Hotel

SAP Global Partner

Agenda

- Overview SAP HANA
- Integrating SAP HANA into the Data Center
- References
- Outlook

HP-SAP partnership foundation

Investments from HP and SAP into a unique alliance

Joint hardware and software engineering

Engineers from SAP, HP and Intel are working on solutions in co-innovation Labs in Palo Alto and Walldorf (e.g. 12TB HANA appliance). SAP is reselling HP's security and testing solutions on SAP price list (OEM)

Managed services and cloud

HP runs HEC[1], HP offers SAP in a private, hybrid or public cloud in world wide data centers[2]

SAP Services

over 500 SAP HANA experts and over 15000 SAP consultant from HP together with SAP services (e.g. Max Attention team) are available

Project support

Proof of Concept (PoC) Support, demo equipment, SAP Competence Center, Financing, Trainings and best practices are available

Market leading solutions for the complete SAP stack

[1]HEC: "HANA Enterprise Cloud", SAP's cloud offering for HANA. HP is running some of the SAP Cloud centers in a so called "white labeling" model
[2]HP offers to run HANA as a cloud service as an alternative to HEC.

What is SAP HANA

SAP HANA is a newly written[1] in-memory, column-oriented, database platform developed and marketed by SAP

- Up to **x10000** faster compared to Oracle[2]
  due to revolutionary patented in-memory technology
- Enables new **real-time** business process implementations
  with "SAP S/4HANA" SAP announced porting all SAP ERP and R/3 applications to fully use real-time HANA capabilities ("native HANA"). No batch-runs needed any more.
- Fastest **growing** database[3]
  average+80% growth / year since 2012. SAP wants to be database vendor #2 after Oracle by 2018
- Supports analytics but also real-time transactional data processing (so called **OLAP and OLTP**[4])

Powered by SAP HANA®

SAP S/4 HANA

[1] source: SAP - SAP HANA is completely new developed from scratch, first shipments 2012
[2] source: SAP - 17 customers have achieved a 10,000+ times performance improvement in their existing business processes (so called "10,000 club") compared to Oracle
[3] source: SAP
[4] OLAP = "Online Analytical Processing"; OLTP = "Online Transaction Processing"

SAP HANA Software components

Optional additional licencse needed

SAP HANA Accelerator for SAP ASE
SAP HANA Advanced Data Processing
SAP HANA Dynamic Tiering
SAP HANA Enterprise Information Management
SAP HANA Predictive
SAP HANA Real-time Replication
SAP HANA Smart Data Streaming
SAP HANA Spatial

SAP HANA Options

needed for all SAP HANA deployments

SAP HANA Database | SAP HANA Client | SAP HANA Studio | SAP HANA XS Engine

SAP HANA Base Edition

Technical requirements to run SAP HANA

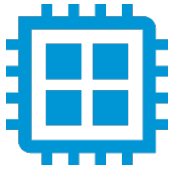
in-memory technology needs new hardware architecture

Intel and Linux

Only Intel x86-64 CPUs with Linux OS (SUSE or Red Hat) are supported[1]

Certification needed

Running productive SAP HANA solutions are supported only on certified appliances[2]. More flexible combination of server and storage are allowed in a "TDI" (Tailored Datacenter Integration) environment, but servers and storage must be TDI certified.



Very large main memory

Persistent data are in main memory only.
Opposite to other column-oriented database extensions from Oracle or DB2 or Vertica, persistent data are in the main memory of the computer. External storage only needed to restore data after power failure.

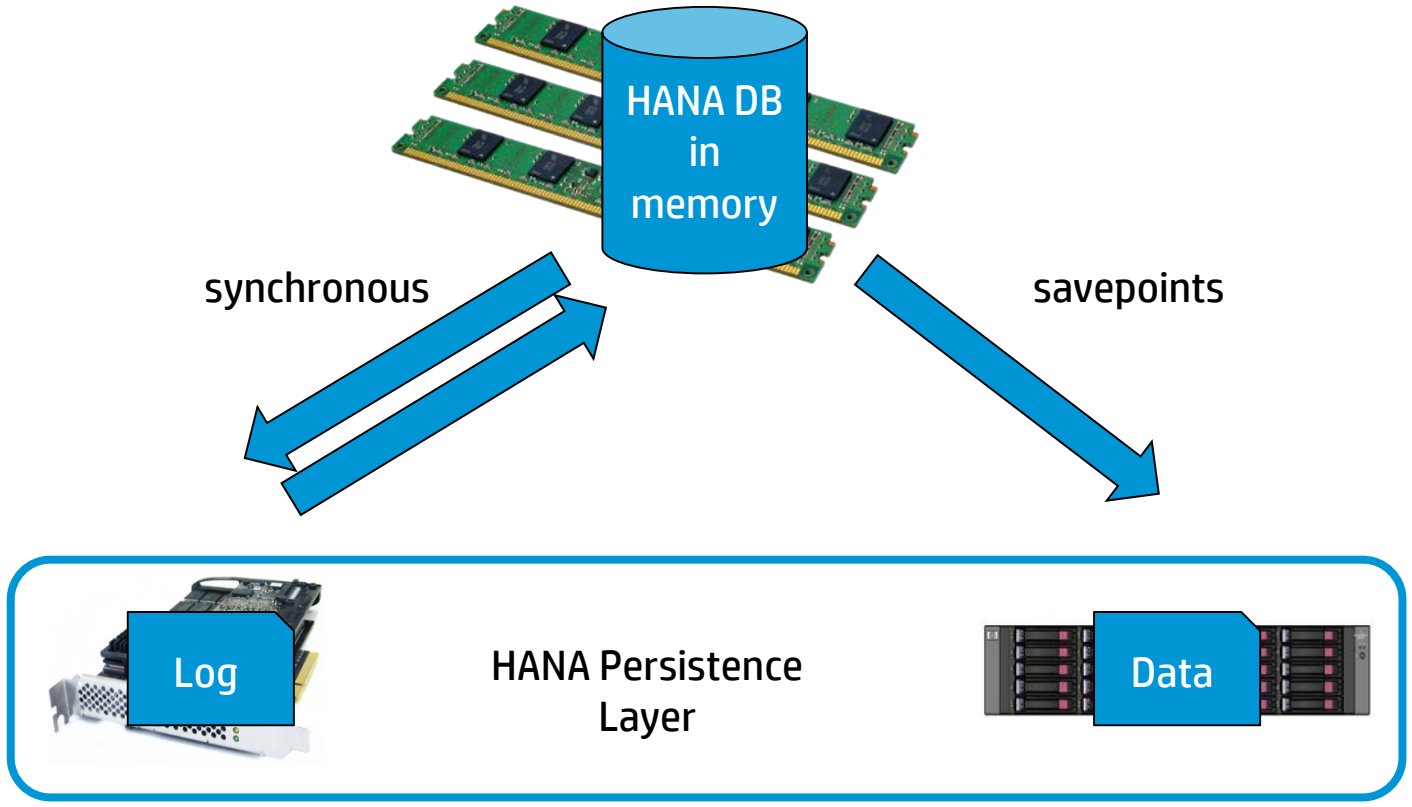
scale-up or scale-out

For performance reason a maximum memory/core is recommended. To realize needed main memory sizes up to 100TB, scale-up or scale-out configurations are supported by SAP

[1] IBM Power / SUSE (no AIX) available as "controlled" pilot project. No certification available. No reference customers.
[2] Latest certified HANA infrastructure: The SAP HANA Hardware Directory

Architecture details

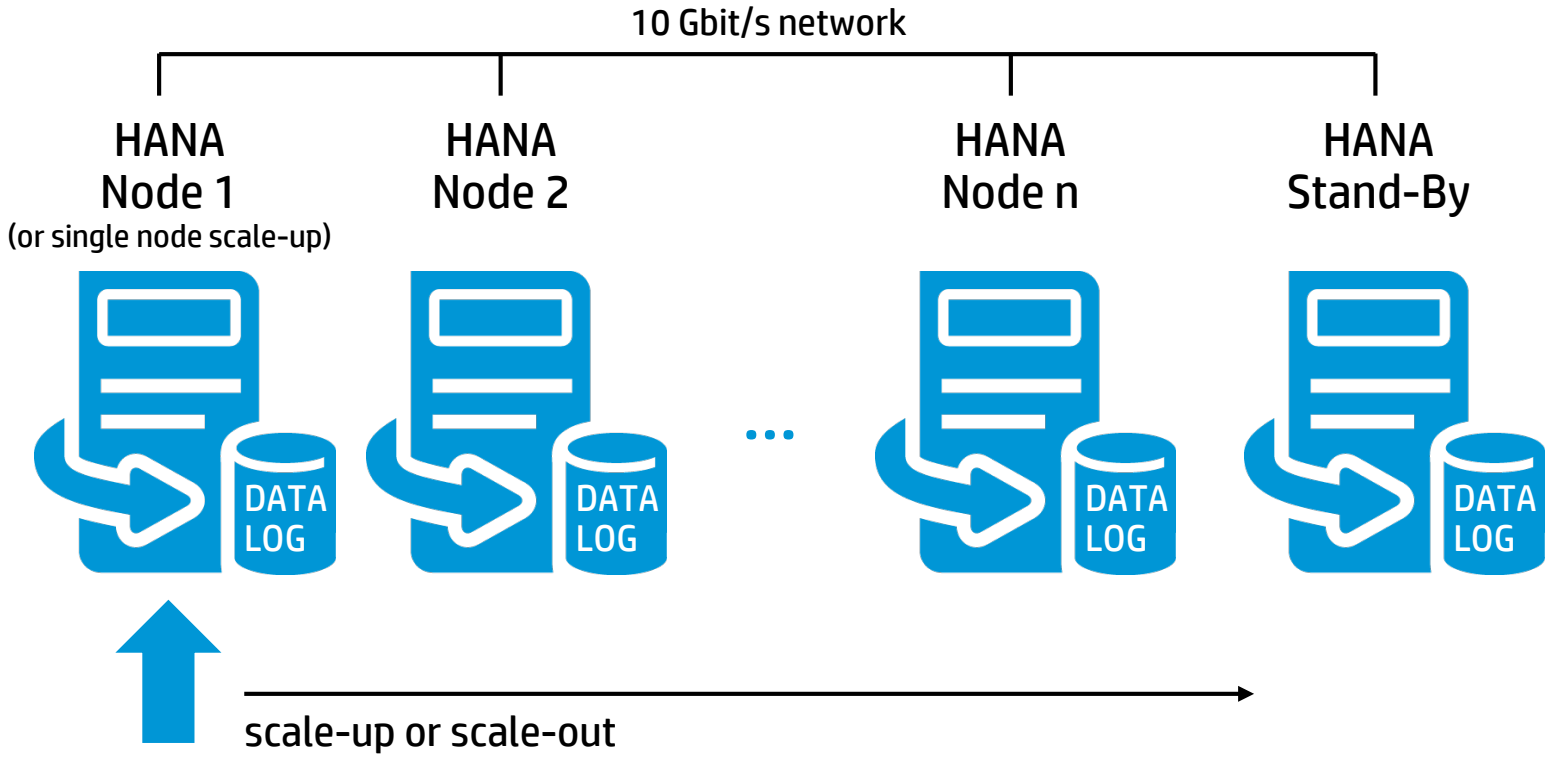
- HANA DB in memory
  - SQL data and undo log information
  - Kept in-memory
- Log
  - Information about data changes
  - Cyclical overwrite (only after backup)
- Data
  - Changed data and undo log
  - Automatic savepoints,
  - maximum every 5 minutes (configurable)



SAP HANA architecture concept

Single host with “shared nothing” concept

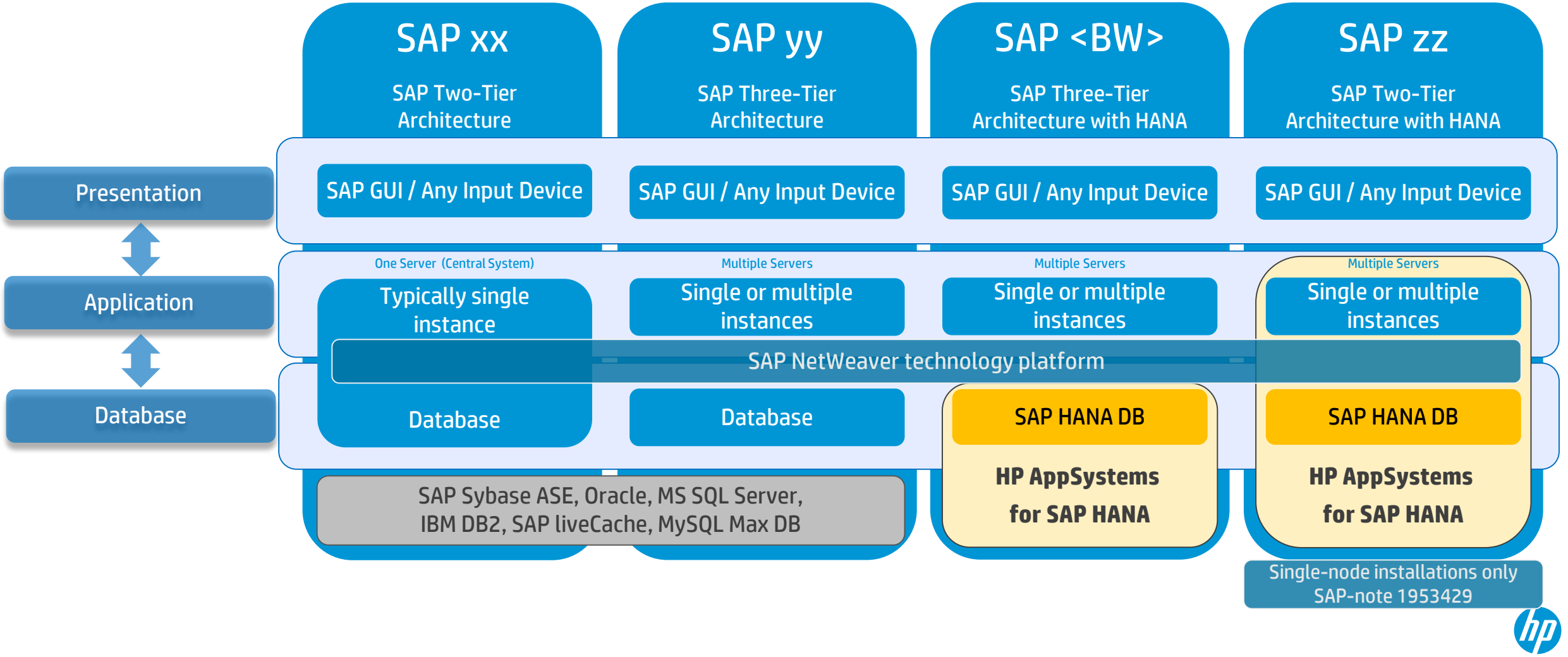
- Persistent data all in main memory
- Storage and file system that provide file access to a standby node(s) in case of a node failure
- High IO bandwidth (MB/s) and low latency for data
- High IO rate (iops) for log
- SQL data and undo log in main memory
- Log files and automatic savepoints on storage
- Scale-up and scale-out configuration possible



Integrating SAP HANA into the Data Center

SAP HANA – How it integrates in SAP landscapes

Typical SAP 2/3-tier client-server architectures



Integrating SAP HANA into the Data Center

Important aspects

- Certified HANA Hardware
- Appliance versus TDI
- Virtualization
- Network Integration
- High Availability / Disaster Recovery
- Backup & Recovery
- Security

Integrating SAP HANA into the Data Center

Important aspects

- **Certified HANA Hardware**
  - Appliance versus TDI
  - Virtualization
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  - Backup & Recovery
  - Security

Certified SAP HANA vendors[1]

Certified scale-up / SoH systems (Intel "Ivy Bridge" only)

Scale-up

# of sockets	HANA database size	HP	Lenovo / IBM (Till end of 2014 only)	Cisco	Fujitsu	Huawei	Hitachi	SGI	Bull	Dell	Unisys	NEC
16 s	24 TB	Technically CS 900 supports up to 24 TB; PoC with selected customers in progress										
	⋮											
16 s	12 TB	CS 900										
16 s	8 TB	CS 900										
8 s	6 TB	CS 900	FS x880 X6 X3950 X6	UCS C880 M4 (OEM Fujitsu)	PQ 2800 B/E/L	RH8100 V3	CB520X B1	UV 300H	bullion S8			
8 s	4 TB	CS 900	FS x880 X6 X3950 X6		PQ 2800 B/E/L	RH8100 V3	CB520X B1	UV 300H	bullion S8			
4 s	3 TB	CS 900	FS x880 X6 x3850 X6 x3950 X	UCS C460 M4 UCS B460 M4	PQ 2800 B/E/L PQ 2400 B/E/L	RH8100 V3 RH5885H V3	CB520X B1	UV 300H	bullion S4 bullion S8	Power Edge R920	Forward! 4150-B	
4 s	2 TB	CS 900 CS 500	FS x880 X6 x3850 X6 x3950 X6	UCS C460 M4	PQ 2800 B/E/L PQ 2400 B/E/L	RH8100 V3 RH5885H V3	CB520X B1	UV 300H	bullion S4 Bullion S8	Power Edge R920	Forward! 4150-B	
2 / 4 s	1 TB	CS 500	FS x880 X6 x3850 X6 x3950 X6	UCS C460 M4	PQ 2800 B/E/L PQ 2400 B/E/L	RH8100 V3 RH5885H V3	CB520X B1	UV 300H	bullion S2 bullion S4 Bullion S8	Power Edge R920	Forward! 4150-B	Express5800/ A2040b

For transactional (OLAP and OLTP) SoH (Suite on HANA) systems, single node scale-up systems are providing best real-time performance.
Only HP delivers certified systems above 6 TB database size.

[1] update from March 26, 2015

Portfolio of SAP HANA real-time data management systems

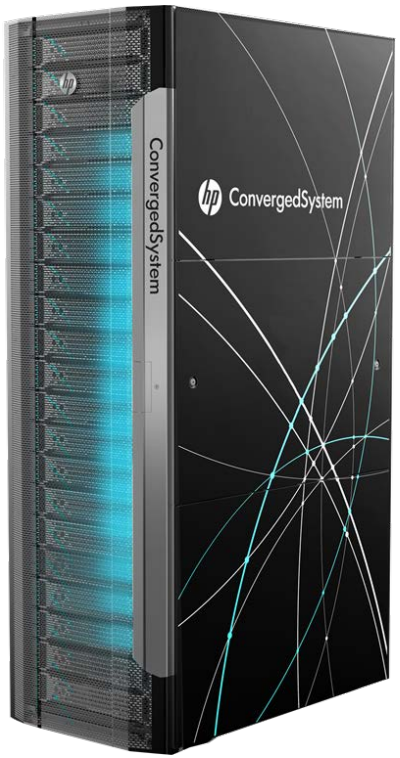
Building blocks for scale-up or scale-out architectures

HP ConvergedSystem 500

- Entry to medium-sized SAP landscapes
- Based on 4 socket ProLiant DL 580 Server
- 2 TB for business apps, up to 16 TB for analytics/data warehouse[1]
- Built-in high availability and data protection
- Virtualization ready

HP ConvergedSystem 900

- Large, demanding, complex SAP landscapes
- Based on 4-16 socket HP Integrity Superdome X Server
- Application aggregation and consolidation
- Configurable and granular **scale-up** systems for Suite on HANA and S/4HANA from 1 TB to 24 TB[2]
- Massive **scale-out** system for Business Warehouse on HANA from 2 TB to 96 TB[3]
- Mission-critical high availability and data protection



[1] larger systems may be available at HP and SAP's discretion
[2] certified up to 12 TB; customers may scale up to 24 TB at HP and SAP's discretion
[3] certified up to 32 TB; customers may scale out to 96 TB at HP and SAP's discretion

Integrating SAP HANA into the Data Center

Important aspects

- Certified HANA Hardware
- **Appliance versus TDI**
- Virtualization
- Network Integration
- High Availability / Disaster Recovery
- Backup & Recovery
- Security

SAP HANA deployment models

Scale-up or scale-out for all deployment models

Appliances

- Certified by SAP HANA
- Most popular HANA deployment and consumption model
- Carry the least amount of risk
- Pre-integrated with all the necessary hardware and software components

Tailored Datacenter Integration

- Offer flexibility and reuse of existing or preferred compute, storage or networking components
- Lower initial hardware cost

Cloud

- Includes public and private clouds
- Offers initial cost savings in the form of HANA as service

Key Takeaways:

HP is the only vendor that has the full suite of offerings, from the hardware to the services for each SAP HANA Deployment model

- **Appliance:** HP ConvergedSystem 500/900 for SAP HANA portfolio
- **Tailored Datacenter Integration:** Compute and Storage blocks
- **Cloud:** HP Enterprise Services hosted HANA as a Service / HANA IaaS

Appliances, or TDI?

Appliances

- In an appliance deployment model, SAP approved hardware partners deliver a turn-key SAP HANA appliance on SAP validated infrastructure
- All required software including operating system, firmware updates, storage software is pre-loaded and pre-configured on the appliance by the hardware vendor, with ongoing support
- Hardware vendor meets performance metrics with SAP HANA appliance certification

Tailored Datacenter Integration

- In the TDI model, SAP approved hardware partners deliver networking, storage, or compute components that are integrated into the customer environment
- Installation, validation and ongoing support of the SAP HANA deployment needs to be consultatively discussed between the customer and the vendor
- SAP KPIs are met via an onsite certification executed collaboratively between the customer and the integrator

Integrating SAP HANA into the Data Center

Important aspects

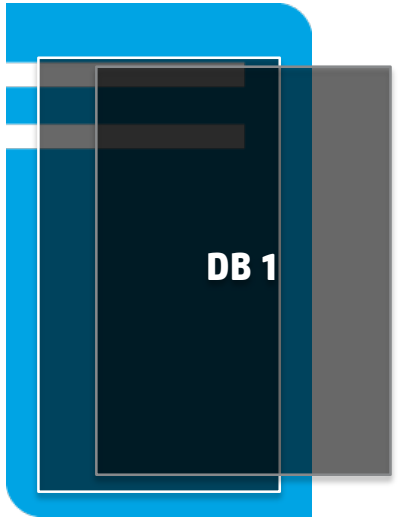
- Certified HANA Hardware
- Appliance versus TDI
- **Virtual machines/Multi tenant/nPars**
- Network Integration
- High Availability / Disaster Recovery
- Backup & Recovery
- Security

Flexible consolidation

Run SAP HANA business apps and analytics side by side safely

Single instance

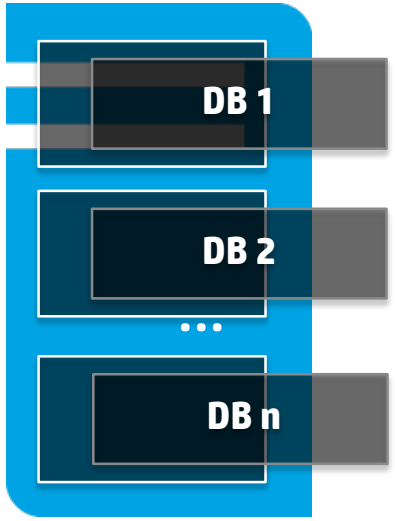
- Single workload, e.g.,
  - Large Business apps
  - Scale-up analytics



Single system

Partitioned

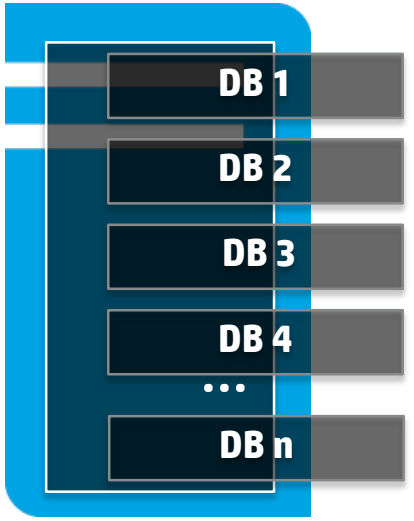
- Mixed workloads with different compute/memory requirements, e.g.
  - Business Apps and analytics
  - Multiple development environments



Hard partitions with electrical isolation

Virtualized

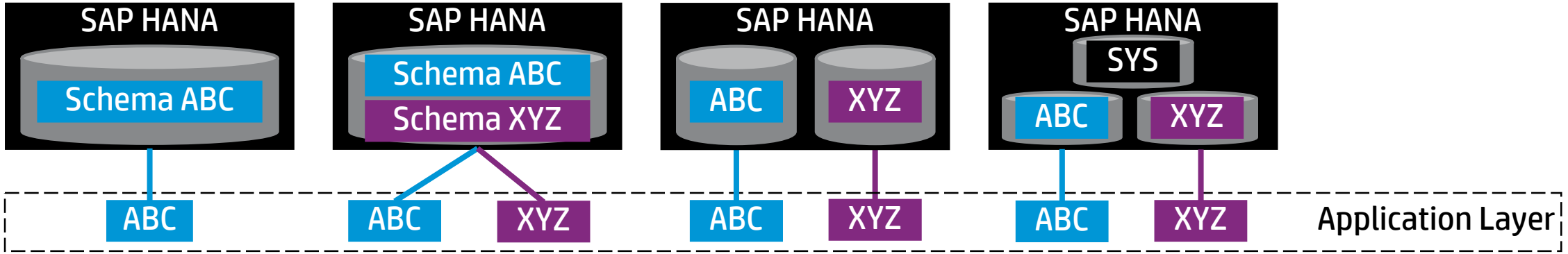
- Mixed workloads with different compute/memory requirements, particularly < 1 blade, e.g
  - Training environments
  - Smaller production environments



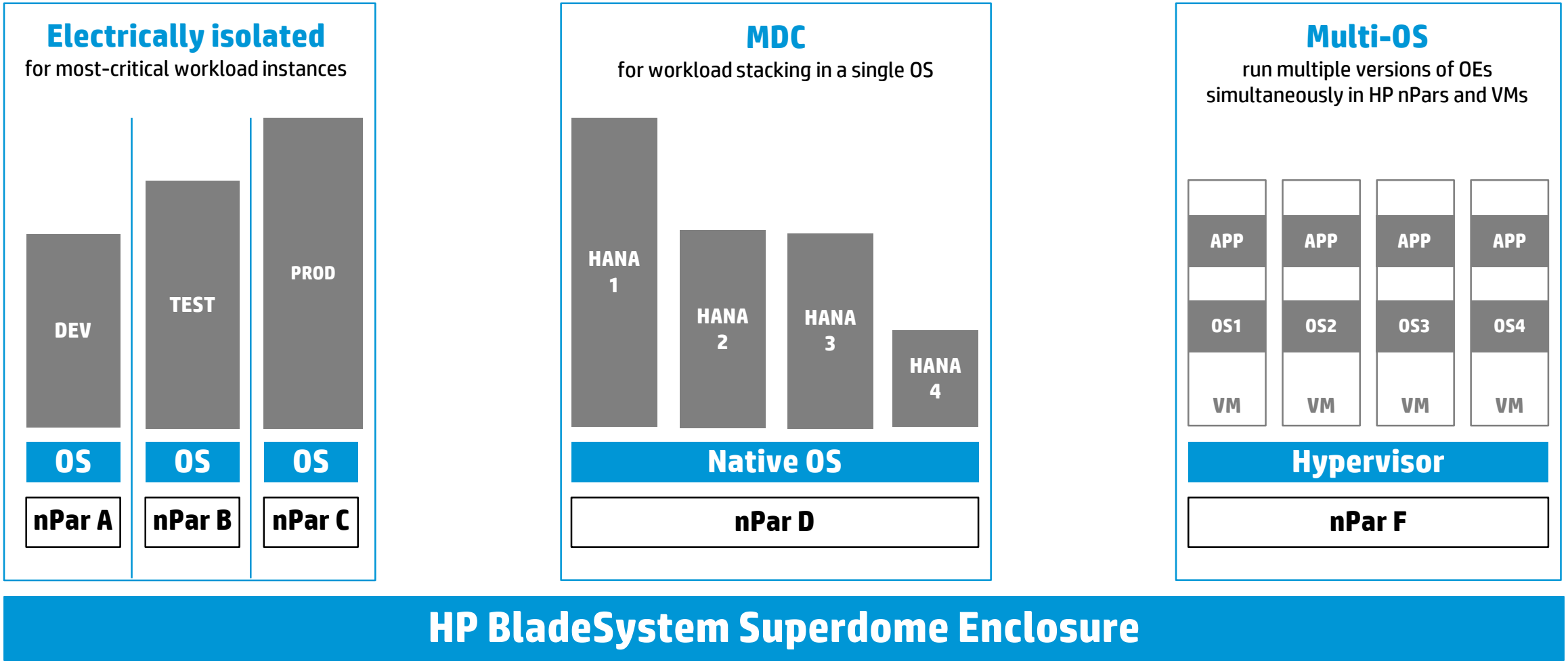
Virtual machines with workload mobility

HANA Deployment Options

Bare Metal	MCOD	MCOS	MDC	Virtualization
• Original appliance approach	• Multiple Components One Database	• Multiple Components One System	• Multi-tenant database container (since HANA SPS09)	• Available for MCOD, MCOS, MDC scenarios
• No restrictions for production	• Restricted usage for production • see sapnote 1661202	• Not for production • see sapnote 1681092, 1826100	• Available for production • see sapnote 2096000	• Several restrictions for production • see sapnote 1788665, 1995460
• 1x Server • 1x HANA DB • 1x DB schema • 1x Application	• 1 x Server • 1 x HANA DB • n x DB schemas • n x Applications	• 1 x Server • n x HANA DBs • n x DB schemas • n x Applications	• 1 x Server • 1 x HANA System • n x Tenant DBs • n x Applications	• 1x Server • n x HANA DBs • n x DB schemas • n x Applications



Maximum flexibility and availability with HP nPars



Integrating SAP HANA into the Data Center

Important aspects

- Certified HANA Hardware
- Appliance versus TDI
- Virtualization
- **Network Integration**
- High Availability / Disaster Recovery
- Backup & Recovery
- Security

Network Integration

Basics

- SAP HANA supports traditional database client connections and, with SAP HANA Extended Application Services (SAP HANA XS), Web-based clients. SAP HANA can be integrated with transaction-oriented databases using replication services, as well as with high-speed event sources. SAP HANA-based applications can be integrated with external services such as e-mail, Web, and R-code execution.
- SAP HANA has different types of network communication channels to support the different SAP HANA scenarios and setups:
  - Channels used for external access to SAP HANA functionality by end-user clients, administration clients, application servers, and for data provisioning via SQL or HTTP
  - Channels used for SAP HANA internal communication within the database or, in a distributed scenario, for communication between hosts
  - To separate external and internal communication, certified SAP HANA hosts use a separate network adapter with a separate IP address for each of the different networks. SAP HANA supports the isolation of internal communication from outside access. In addition, SAP HANA can be configured to use SSL for secure communication.

Network Zones

Minimum number of zones

Client Zone

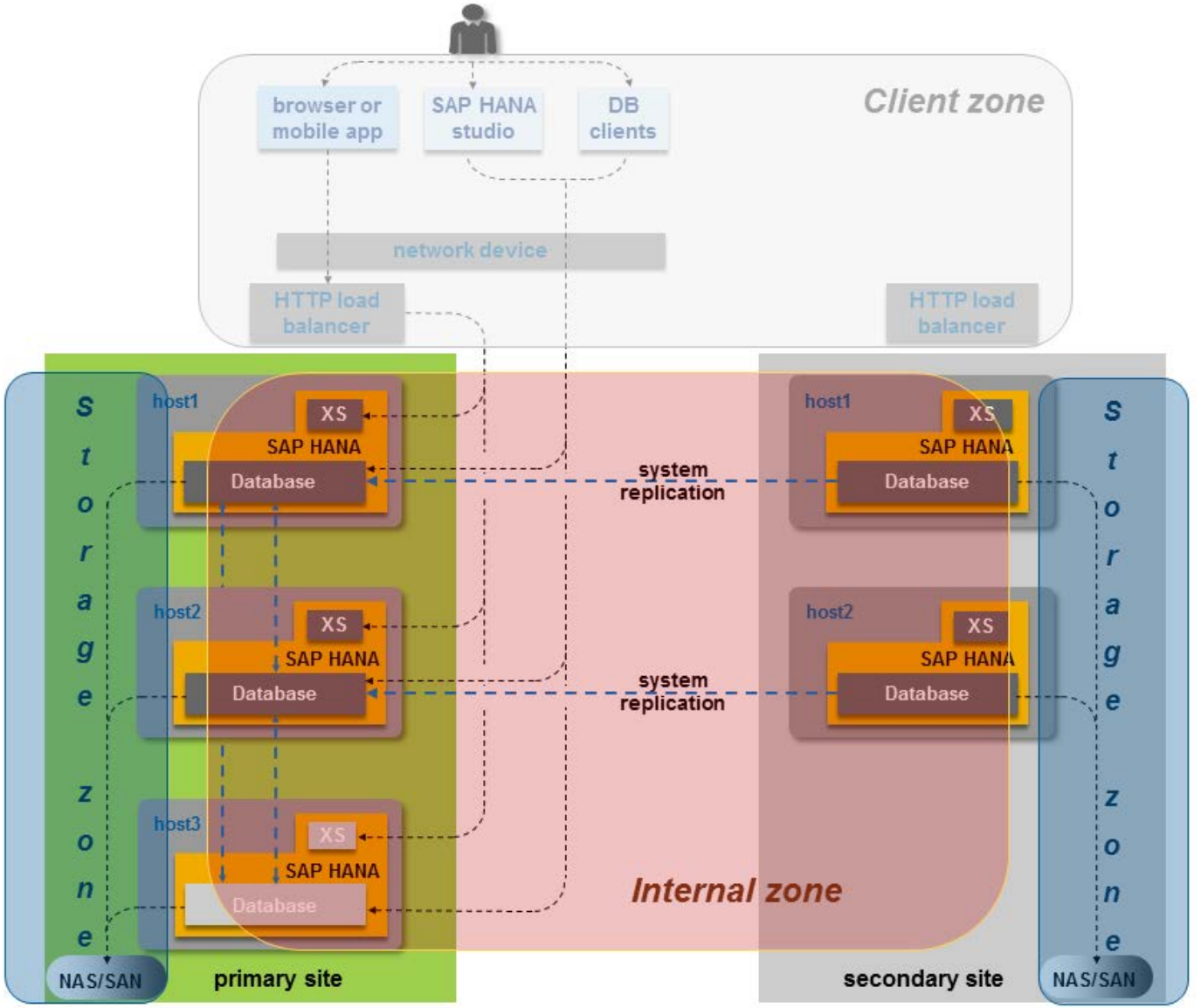
- The network in this zone is used by SAP application servers, by clients such as the SAP HANA studio or Web applications running against the SAP HANA XS server, and by other data sources such as SAP NetWeaver Business Warehouse.

Internal zone

- This zone covers the interhost network betwee hosts in a distributed system as well as the SA HANA system replication network.

Storage zone

- This zone refers to the network connections fo backup storage and enterprise storage.



Integrating SAP HANA into the Data Center

Important aspects

- Certified HANA Hardware
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- Backup & Recovery
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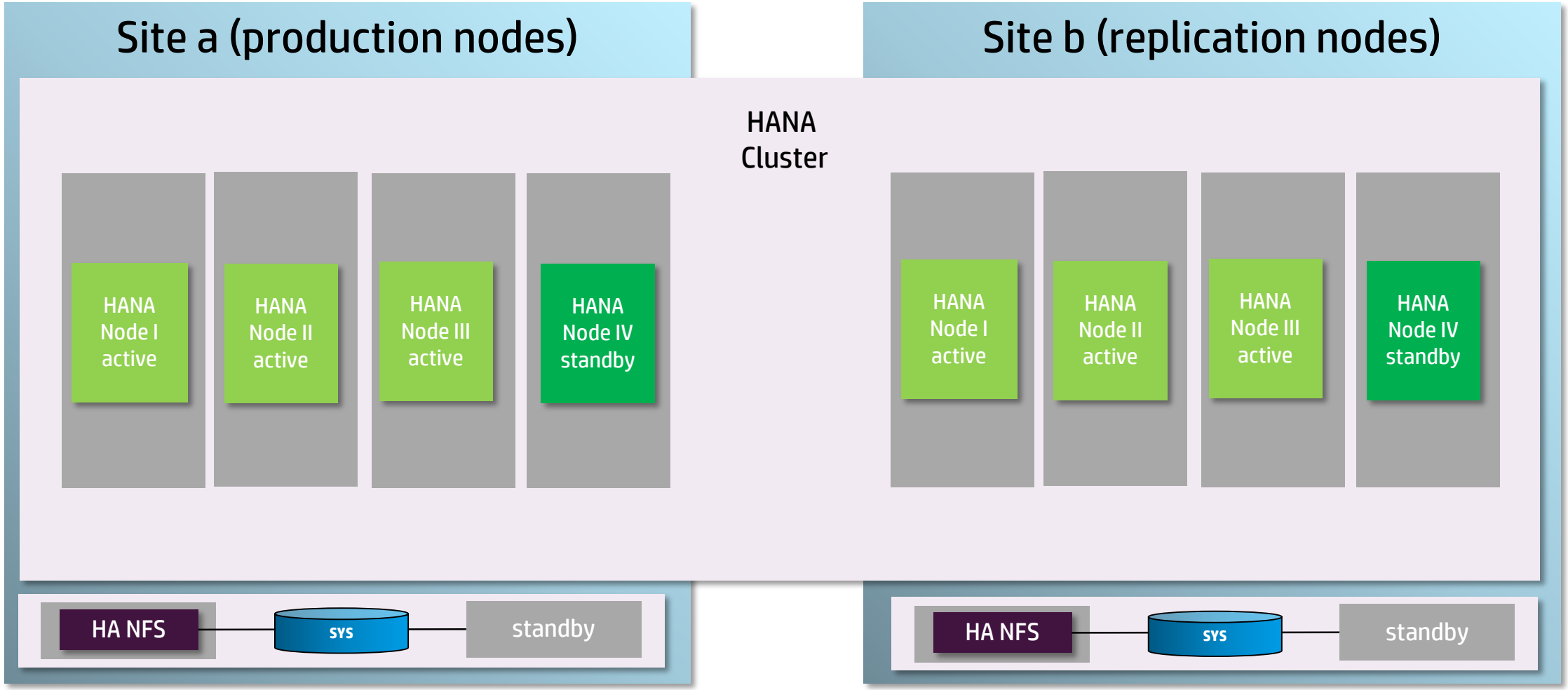
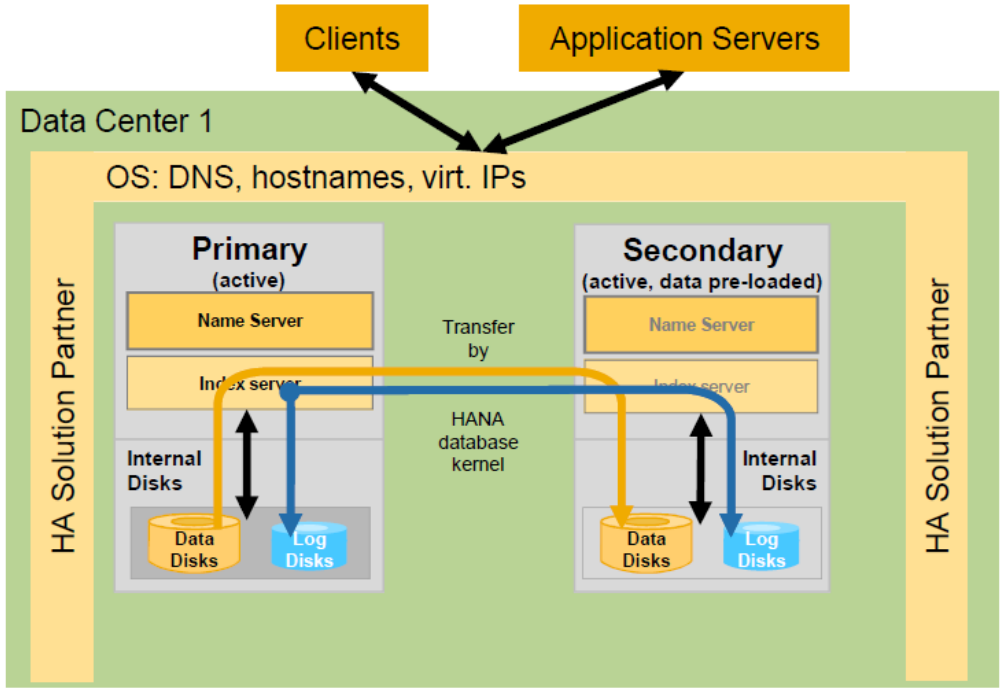
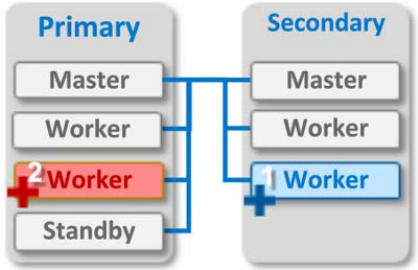
Cluster Topology



HA/DR with SAP HANA System Replication

- Replication options
  - Synchronous (~ <50 km)
  - Sync Mem (~ <50 km)
  - Full Sync (~ <50km)
  - Asynchronous
- Separate replication LAN since SPS08
- System Replication = Replication mechanism, no cluster solution
- Improvements with SPS09
  - Data + Log transfer compression
  - Online* host add + remove in Scale-out environment
  - Delta-Data transfer process
    - Enabled through HANA internal snapshots
- Take-over time between 4 – 15 minutes**

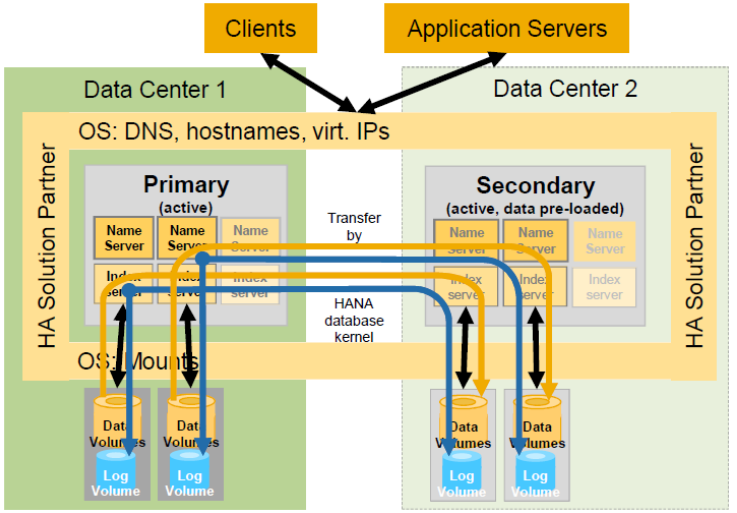




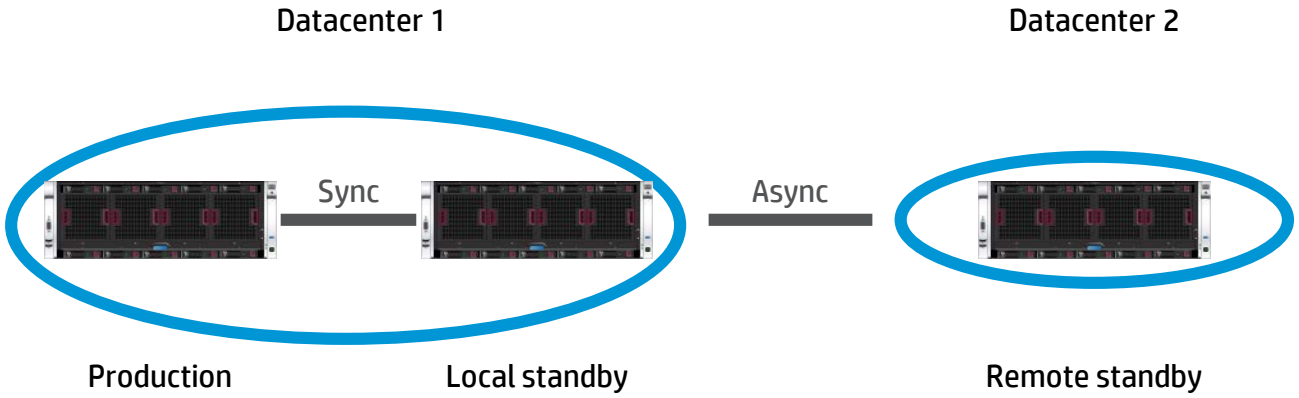
Source: SAP AG

HA/DR with SAP HANA System Replication – HA + DR at the same time

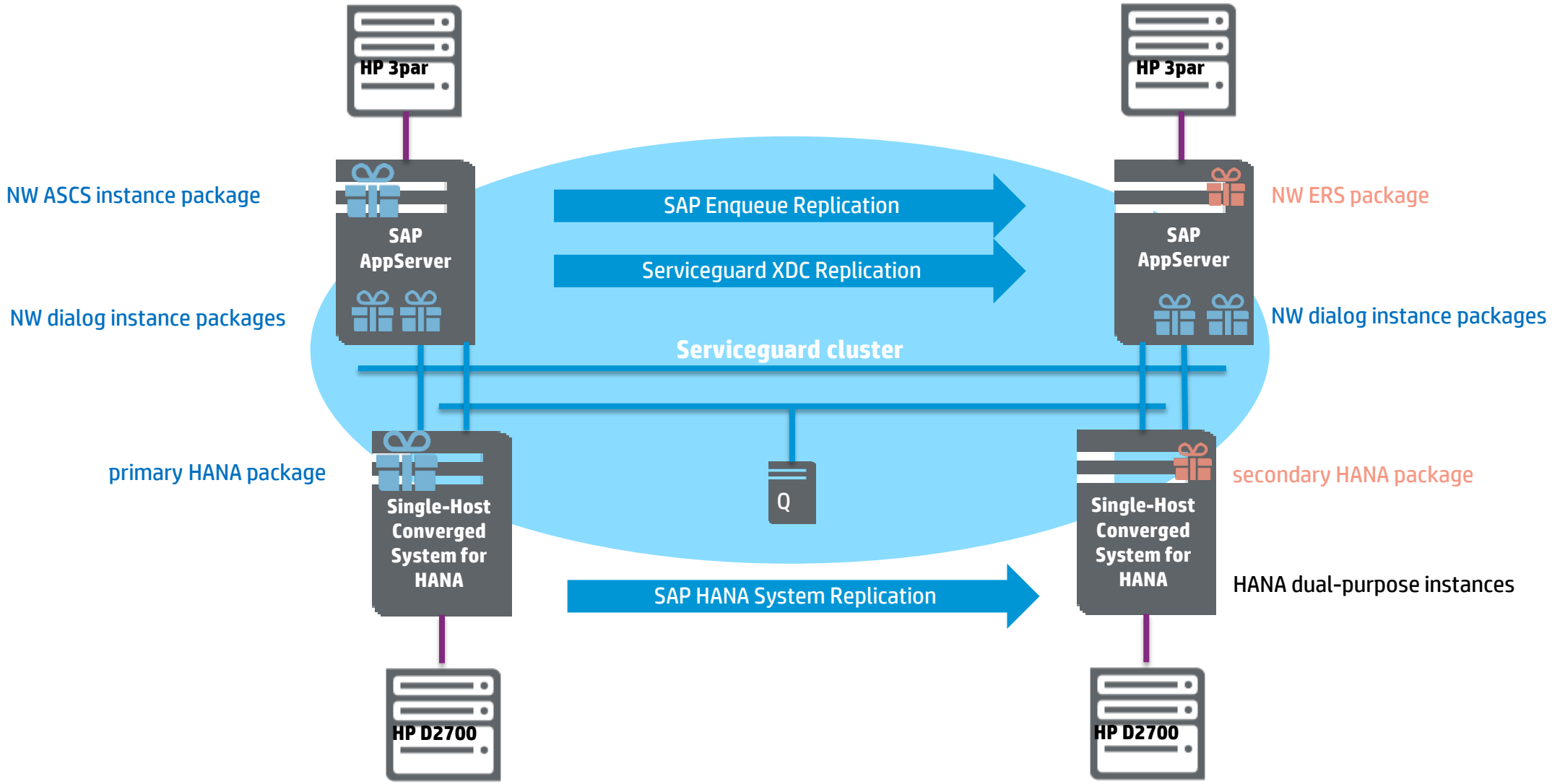
- Scale-out system
  - Primary site
    - One or more standby nodes configured
  - Secondary site
    - Same number of active nodes required
  - Replication either synchronous or asynchronous



- Scale-up (Single node) system
  - HA + DR via Multi Tier System Replication
  - Primary site
    - 2x Scale-up system (Production + local standby)
    - Synchronous replication
  - Secondary site
    - 1x Scale-up system (Remote standby)
    - Asynchronous replication



SAP Business Suite on HANA cluster



Integrating SAP HANA into the Data Center

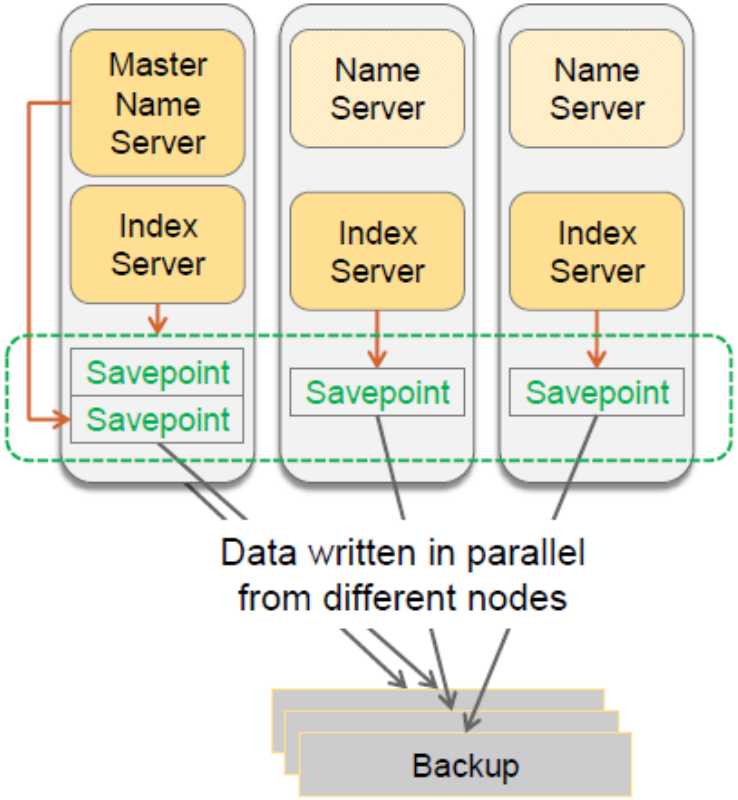
Important aspects

- Certified HANA Hardware
- Appliance versus TDI
- Virtualization
- Network Integration
- High Availability / Disaster Recovery
- **Backup & Recovery**
- Security

SAP HANA Backup and Recovery

Data backup: Single-node and scale-out systems

- SAP HANA automatically handles the synchronization of backups for all nodes
  -> no special user interaction required
- All services that persist data are backed up
  e.g. index servers, master name server
- Global data backup savepoint (= logical Software Snapshot) for all these services
- Logical Snapshot is kept until the backup is finished for all services. If a page is changed during the backup, it's written to a different location (shadow page concept)
- Synchronized across all nodes and services
- One backup file per service
- SPS09 supports removing a host in scale-out

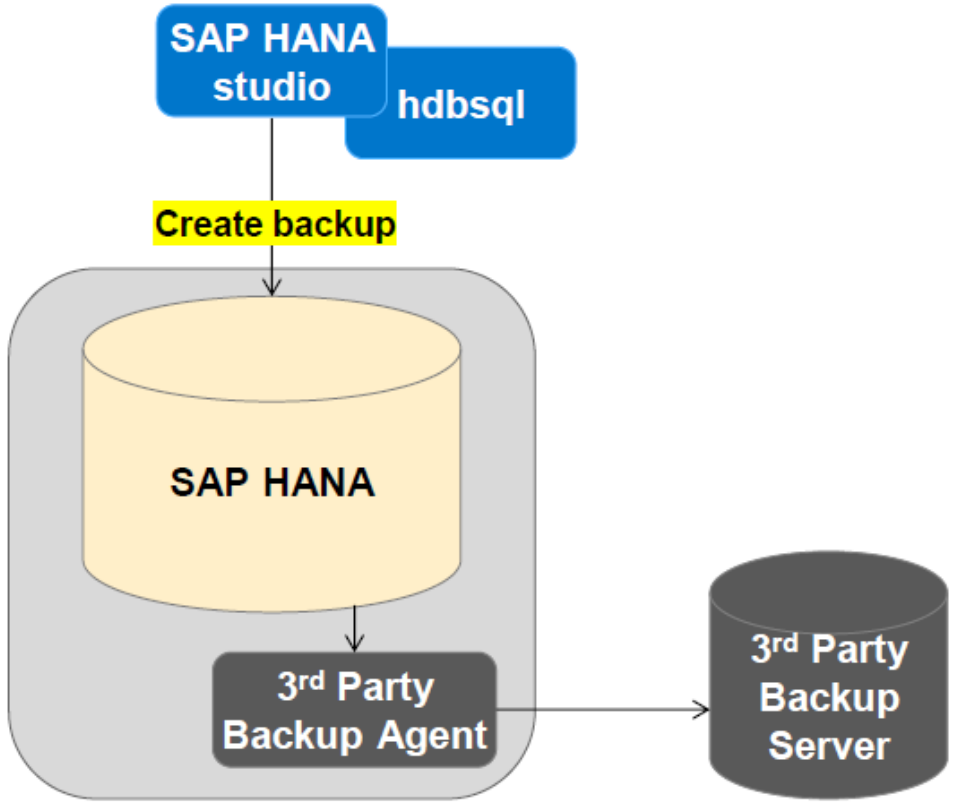


SAP HANA Backup and Recovery

Destination for backups / Backups to 3rd party backup tools (via pipes)

Backups to 3rd party backup tools:

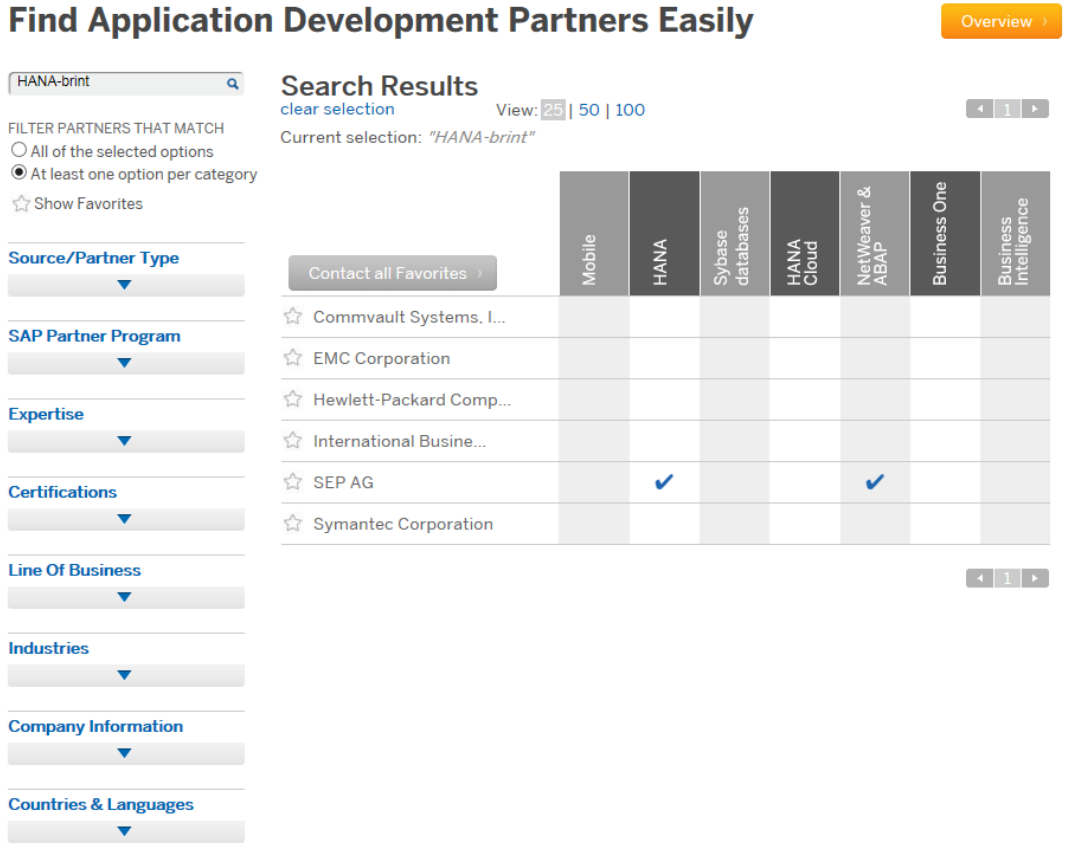
- For both data and log backups
- “Backint for SAP HANA” API can be implemented by a 3rd party backup agent (certification required)
- Provides functions for backup, recovery, query, delete
- 3rd party backup agent runs on the SAP HANA server, communicates with 3rd party backup server
- Backups are transferred via pipe
- Direct integration with SAP HANA:
- Data backups to Backint can be triggered/scheduled using SAP HANA studio, SQL commands, or DBA Cockpit
- Log backups are automatically written to Backint (if configured)



Supported Backup Solutions

- As of Feb 2014 DP7.03 is certified
- As of March 2014 DP8.1 is certified

- http://global.sap.com/community/ebook/2013_09_adpd/enEN/search.html#search=HANA-brint



Security

Important aspects

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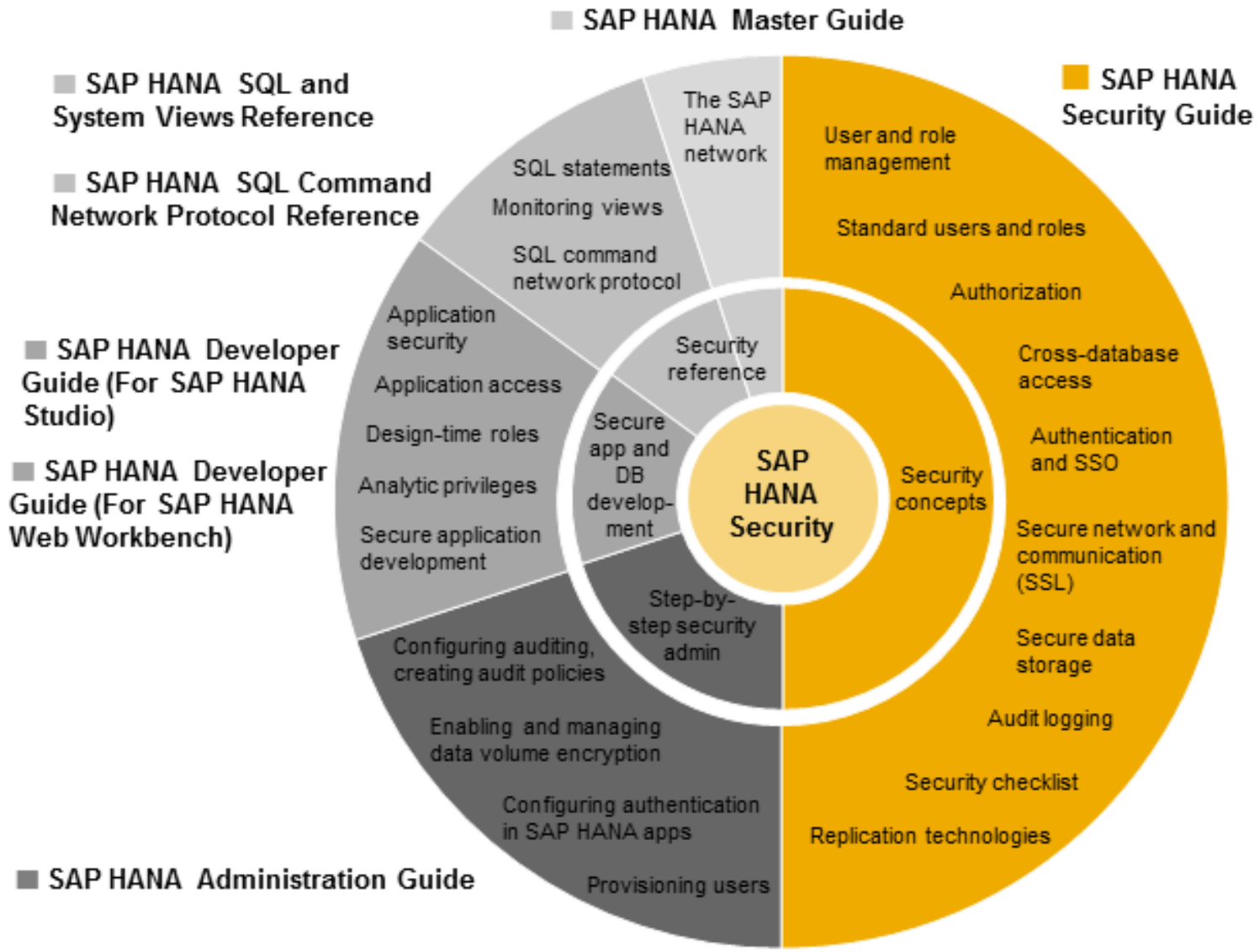
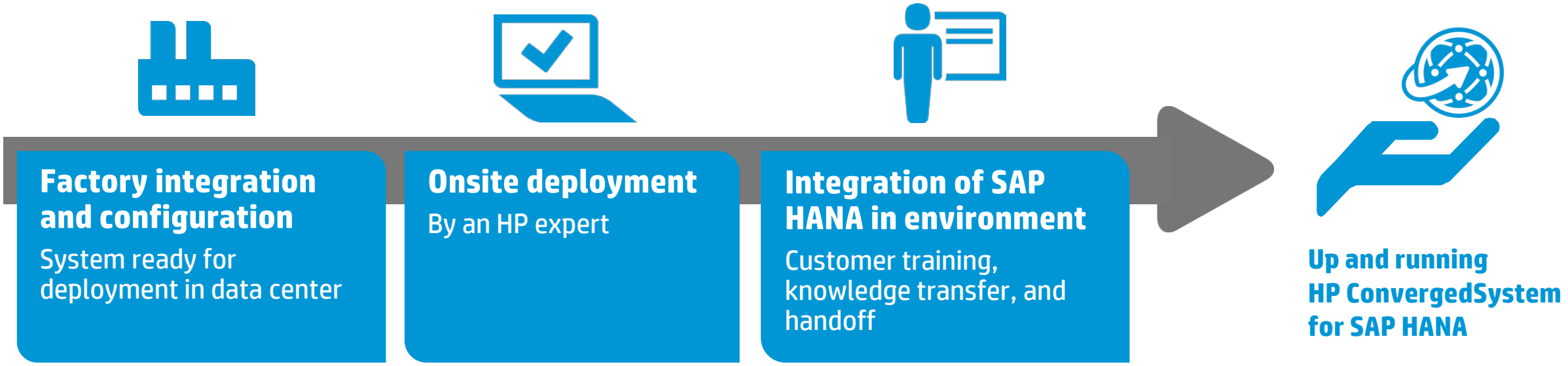
- Backup & Recovery
- **Security**

Security


SAP HANA Master Guide
SAP HANA SQL and System Views Reference
SAP HANA SQL Command Network Protocol Reference
SAP HANA Developer Guide (For SAP HANA Studio)
SAP HANA Developer Guide (For SAP HANA Web Workbench)
SAP HANA Administration Guide
SAP HANA Security Guide
The SAP HANA network
SQL statements
Monitoring views
SQL command network protocol
User and role management
Standard users and roles
Authorization
Application security
Application access
Design-time roles
Analytic privileges
Secure application development
Security reference
Secure app and DB develop-ment
SAP HANA Security
Security concepts
Cross-database access
Authentication and SSO
Secure network and communication (SSL)
Secure data storage
Audit logging
Security checklist
Replication technologies
Step-by-step security admin
Configuring auditing, creating audit policies
Enabling and managing data volume encryption
Configuring authentication in SAP HANA apps
Provisioning users

HP integration and deployment services

Go from order to operations in as few as 15 days



- Accelerate time-to-value
- Transition to a new environment without disrupting operations
- Reduce cost, risk, and frustration

HP's unique position in the SAP HANA market

1800+

HP SAP HANA appliances shipped

Scalability

HP customers can grow in a 16 socket single-node HANA system with up to 24 TB

96 TB

48 node scale-out system with 96 TB available for BW

Service Providers

to leverage HP IaaS recommended configuration for SAP HANA

Innovation

"We have started a co-innovation journey with HP that allows us to build a massively scalable hardware addressing 12 TB main memory. A system which is able to run any key system in the world on HANA"

Bernd Leukert, Member of the Executive Board SAP on stage on SAPPHIRE 2014

Future: The Machine

HP Labs engineering a "new kind of computer", optimized for in-memory

HA/DT

With "Serviceguard for SAP HANA" HP is the only vendor offering a fully automated fail-over solution for mission critical SAP HANA operation

900+

Customers are running SAP HANA on HP

First HP S/4HANA Wins

Experience with over 900 SAP HANA installations

HP is leading the SAP HANA scale-up and scale-out market

Selected references

Scale-up

Scale-out

And many more…

References

SAP offers comprehensive information to integrate SAP HANA

SAP HANA Master Guide
http://help.sap.com/hana/SAP_HANA_Master_Guide_en.pdf

SAP HANA Administration Guide
http://help.sap.com/hana/SAP_HANA_Administration_Guide_en.pdf

SAP HANA High Availability White Paper
http://www.saphana.com/docs/DOC-2775

SAP Note 190823: SAP HANA Storage Connector API
http://service.sap.com/sap/support/notes/1900823

SAP Note 1930853: HDBUserStore contains too many SAP HANA nodes
http://service.sap.com/sap/support/notes/1930853

SAP Note 1913302: Suspend DB connections for short maintenance tasks
http://service.sap.com/sap/support/notes/1913302

SAP Note 1943937: Hardware Configuration Check Tool
http://service.sap.com/sap/support/notes/1943937

SAP Note 1100926: FAQ Network Performance
http://service.sap.com/sap/support/notes/1100926

SAP HANA Security Guide
http://help.sap.com/hana/SAP_HANA_Security_Guide_en.pdf

SAP Note 1999880: FAQ: SAP HANA system replication
http://service.sap.com/sap/support/notes/1999880

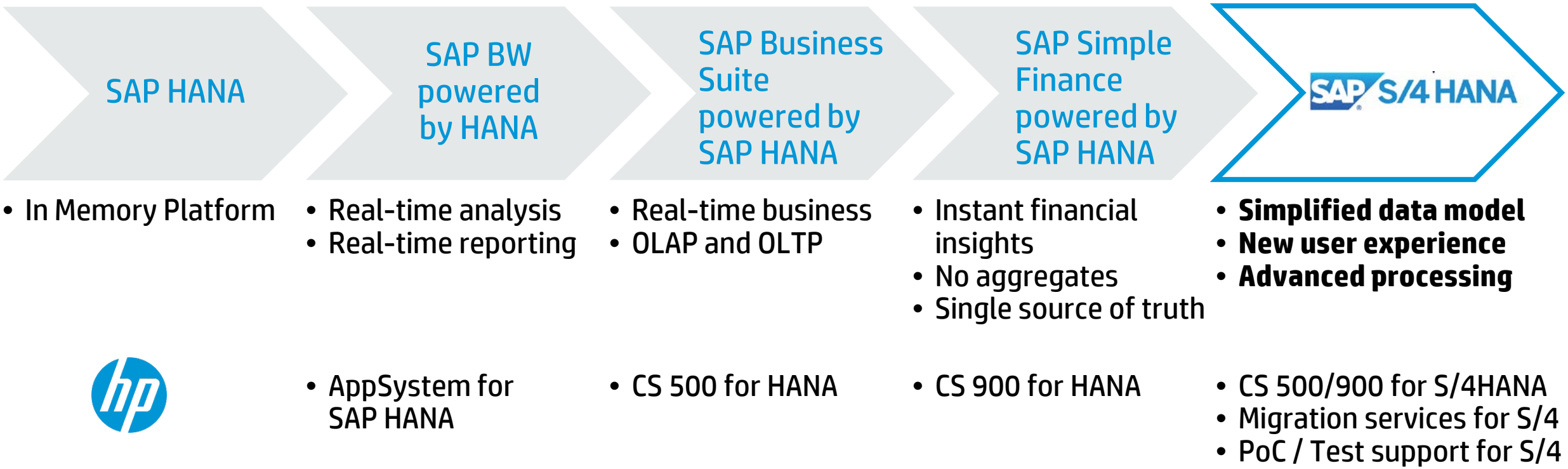
SAP HANA Server Installation Guide
http://help.sap.com/hana/SAP_HANA_Server_Installation_Guide_en.pdf

Outlook

What’s coming next

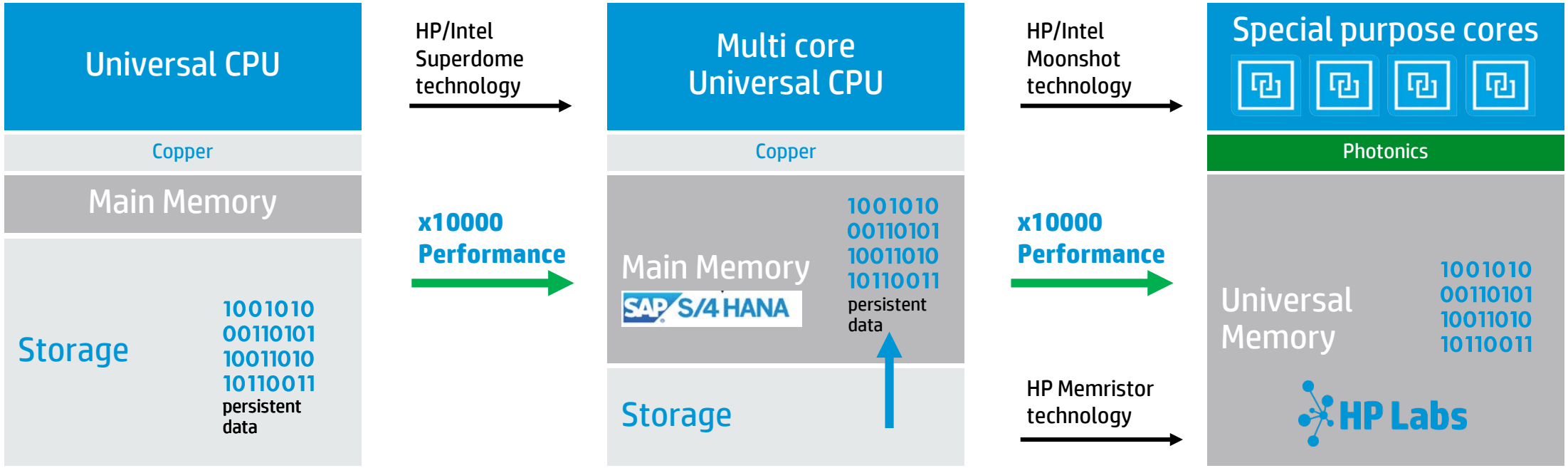
SAP S/4HANA

A new business suite for new business outcomes



Innovating far into the future

A new generation of computers and software is coming



Traditional computing
SAP ERP with Oracle

In-Memory computing
S/4HANA on HP 12 TB scale-up CS 900

Universal-Memory Computing
S/4HANA on „The Machine“ from HP

For 20 years — Today — Starting 2019

SAP Center of Excellence (CoE) Walldorf

All SAP experts in the Walldorf location for over 20 years

- Book a one-day meeting in the SAP Competence Center located on the SAP campus in Walldorf.
- Get closer to SAP HANA including latest announcements about S/4HANA. Agenda covers industry specific use cases, customer references and experiences and various options to operate SAP HANA in a software defined data center.
  Have a look into latest developments co-engineered by SAP and HP (NDA required).
- For a free of charge one-day workshop contact:

  rupert.holzbauer@hp.com

Located on SAP Campus
Walldorf, Germany

Thank you