



DIGITAL TRANSFORMATION AT INTEL SAP HANA® 2.0 SPS 4.0 & Intel Persistent Memory

Tim Allen, SAP HANA Architect, Intel
Martin Mysyk, Enterprise Architect, SAP

Session ID #ASUG82494

About the Speakers



Tim Allen

- SAP HANA Architect, Intel
- Tim has 20+ years of industry experience including work as a systems analyst, developer, system administrator, enterprise systems trainer, and product marketing engineer.
- Tim holds a BSEE in computer engineering from BYU and an MBA in finance from the University of Portland. Specialties include - PMP, MCSE, RHEL, SLES, AIX, Shell, Java, C++



Martin Mysyk

- Enterprise Architect, SAP
- Martin is part of SAP's Digital Business Services in their Energy and Natural Resources practice. Oil & Gas and Utilities are his specialty industries. He is an enterprise architecture enthusiast and has been involved with SAP HANA implementations since it was launched.
- Martin has been involved with ASUG for over 15 years and is currently the EA POC.

Decades of Intel and SAP Collaboration



Intel® Xeon® processors are tuned for SAP® workloads.

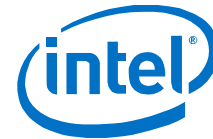
Intel and SAP have worked together on the SAP HANA® platform since 2009.

Intel Xeon processors are the reference architecture for the SAP HANA platform.¹

Intel Xeon Scalable processors and the Intel Xeon processor E7 v4 family are certified by SAP for the SAP HANA 2 platform.

As a Customer

- Since 1995
- TCO, NPV, ROI-based
- Co-innovation & similar challenges as other customers



¹ HP, Intel, SAP, SUSE, and VMware. "Virtualizing Enterprise SAP® Software Deployments." June 2011. [suse.com/docrep/documents/o4r7to9d2y/virtualizing_enterprise_SAP_software_deployments.pdf](https://www.suse.com/docrep/documents/o4r7to9d2y/virtualizing_enterprise_SAP_software_deployments.pdf).

SAP & Intel: SAP HANA® Strategic Co-Innovation

Data Tiering, Archiving & Analytics
with Cloudera* HADOOP

Time Travel (temporal)

SAP HANA Platform
Workload Management

Microsoft* BI support / certification
for SAP HANA Platform

Multi-tenancy
for large scale-out clusters

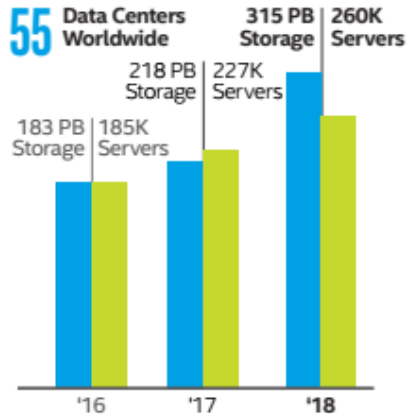
SAP HANA Extension Node

SAP HANA and Intel Persistent Memory

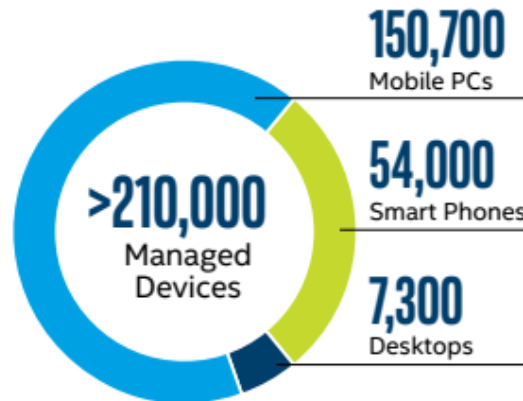
Intel IT Overview

5,422 AT **22** SUPPORT **~107K** AT **147** IN **56**
 Intel IT Employees Intel IT Sites Intel Employees Intel Sites Countries

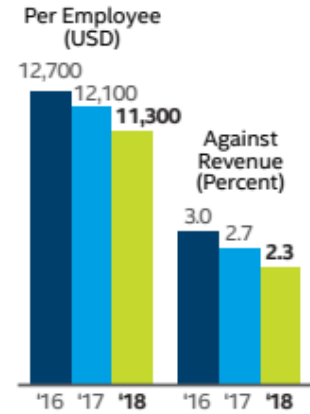
IT Storage and Servers



IT Device Management

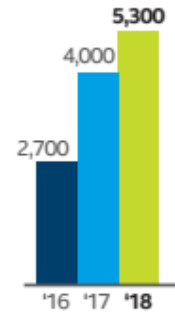


IT Spending¹



IT Supporting

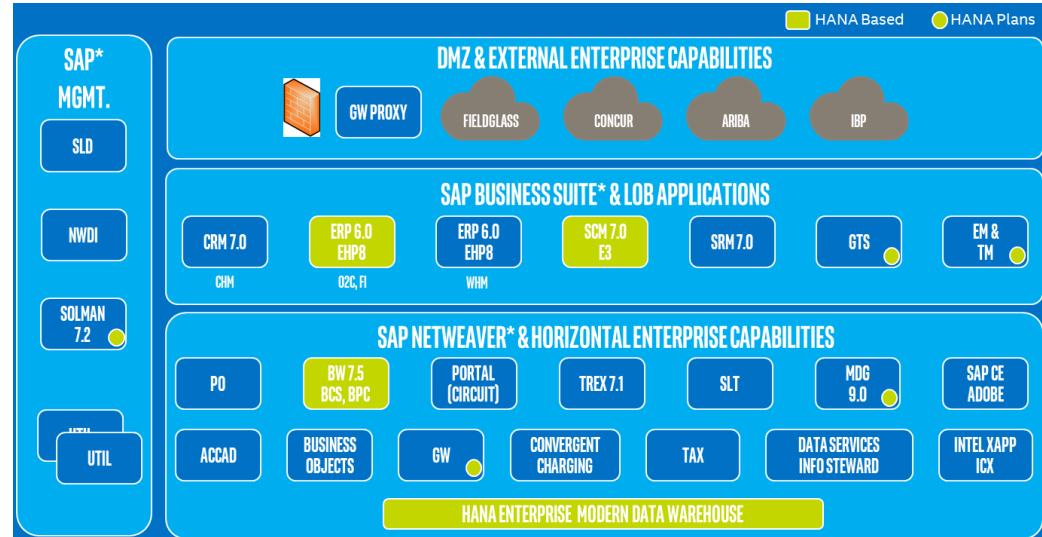
Collaboration Rooms with Intel Unite® Solution



¹Financials restated to include wholly-owned subsidiaries that have since been integrated and exclude divested entities. Employee count represents an average of

SAP Landscape at Intel

- Single global instance supporting key business processes
 - Finance, Order2Cash, Indirect Procurement (Ariba), Supply Chain planning, Global Tax & Trade, AP, Inventory & Warehouse management, T&E, Contingent Worker, Channel Management
- Large NetWeaver and Business Objects footprint scaled for enterprise use (SAP and non-SAP)
- Significant SAP HANA platform investment for SAP Business Suite, Business Warehouse and native SAP HANA data warehouse



SAP Platform Landscape at Intel

- Single global instance of ECC, 26k direct; 120k indirect users, 24x7 usage of all environments – Dev-Prod.
- Agile, Dev/Ops organized teams.
- 13k on-demand change requests to production. Change implementation every 6 hours, 340 days each year.
- Shared development across all SAP systems pipelines.
- Entire landscape is upgraded 2x per year (2 days x 12 hour production downtime)
 - Includes SP, EHP, DB, Kernel, OS, etc.
 - 6 weeks from sandbox->prod-support; no dev lockout.
- Production downtimes windows are 4 hours, 2x / quarter, negotiated with the business 1 year in advance and subject to cancellation.
- SAP Customizations / Mods heavily governed. (< 1200)
- Heavy administrative archiving 200+ jobs / week in ECC alone



IT & Digital Transformation Opportunities

**Supply Chain
Transformation**

**Enterprise
Business
Planning**

**Intel® Optane™
DC Persistent
Memory**

Supply Chain Transformation

16,000
suppliers

6,200
products

100
countries

>1M ORDERS
fulfilled

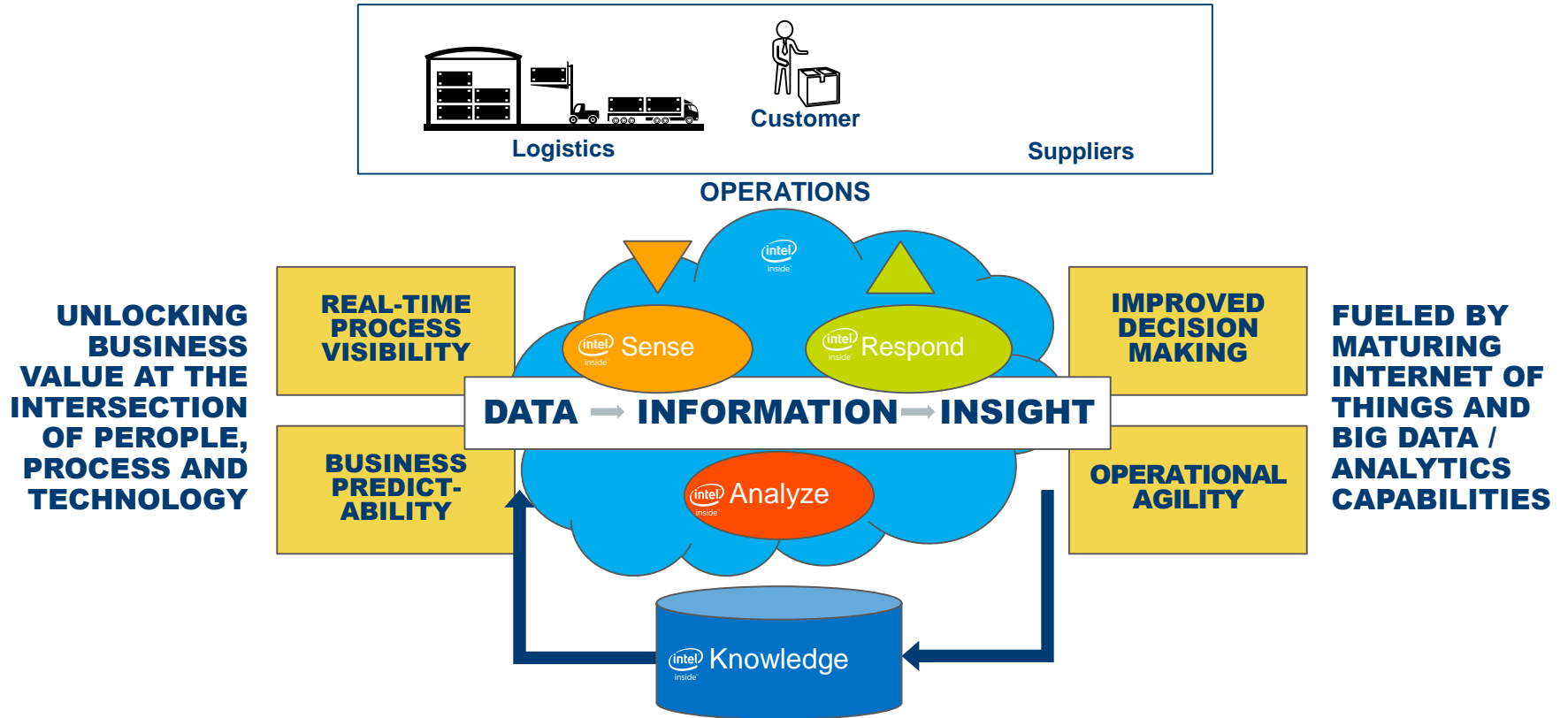
>1B UNITS
shipped

2,000
customers

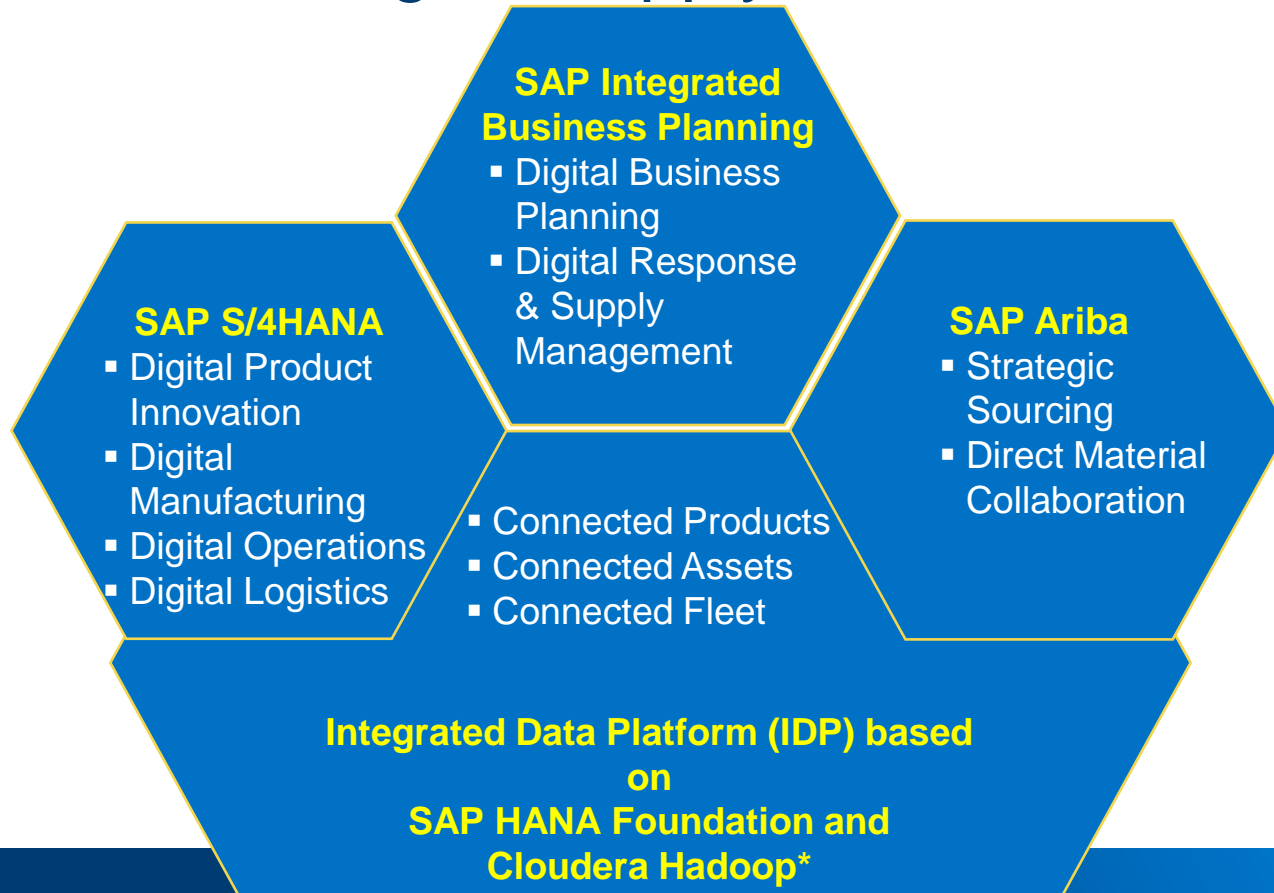
INTEL'S SUPPLY CHAIN IS COMPLEX— AND IT NEEDS TO STAY AHEAD

Strategic partner to the business / Enormous data and AI opportunity / Impact top and bottom lines

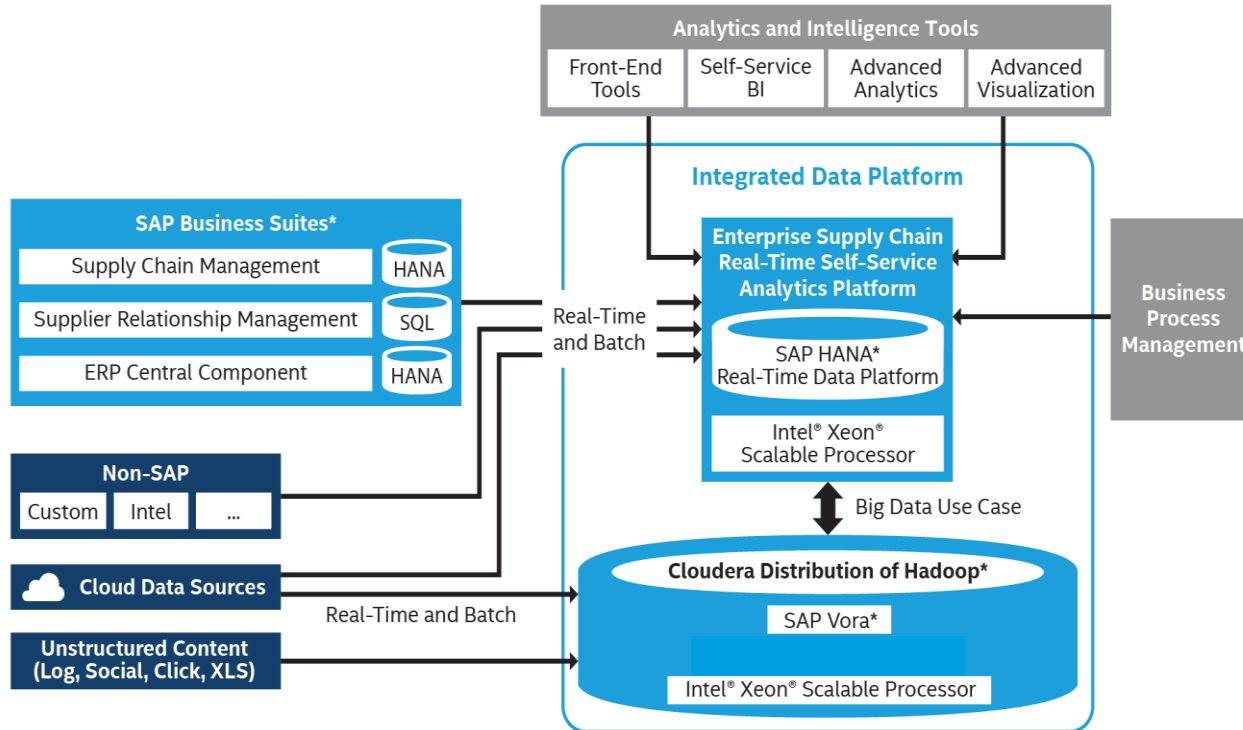
Intel's Vision for Digital Supply Chain



Intel and SAP: Digital Supply Chain Transformation

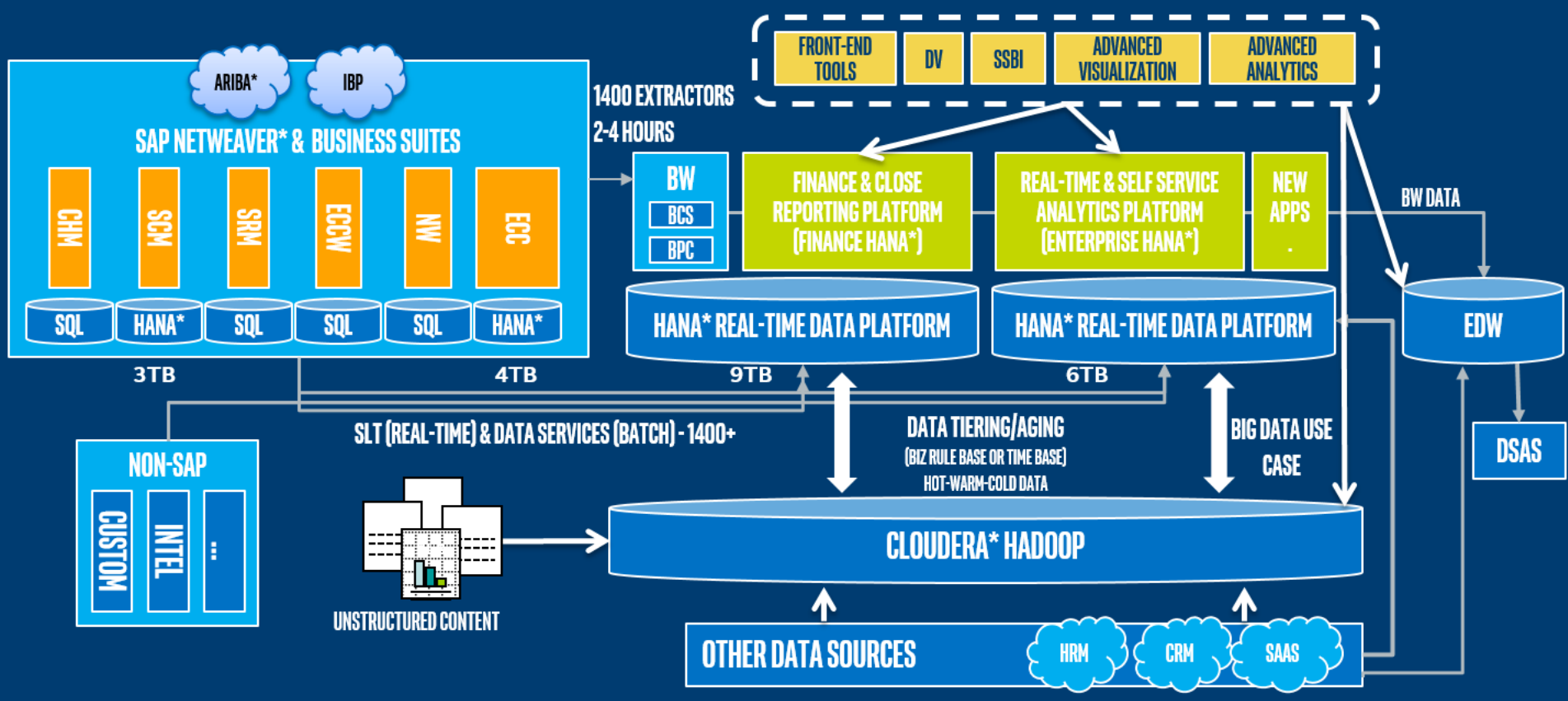


Supply Chain Integrated Data Platform Delivering \$208M in Business Value

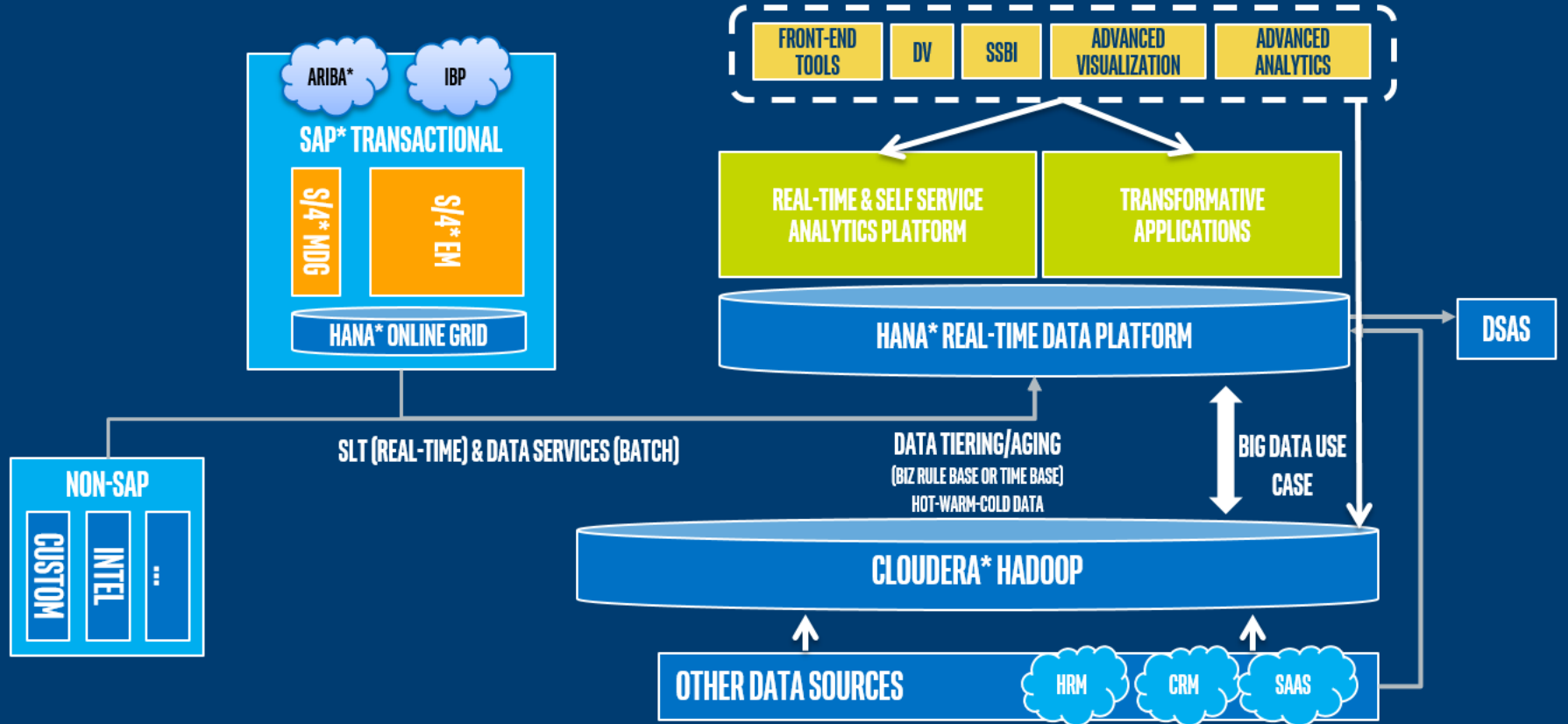


Enterprise Business Planning

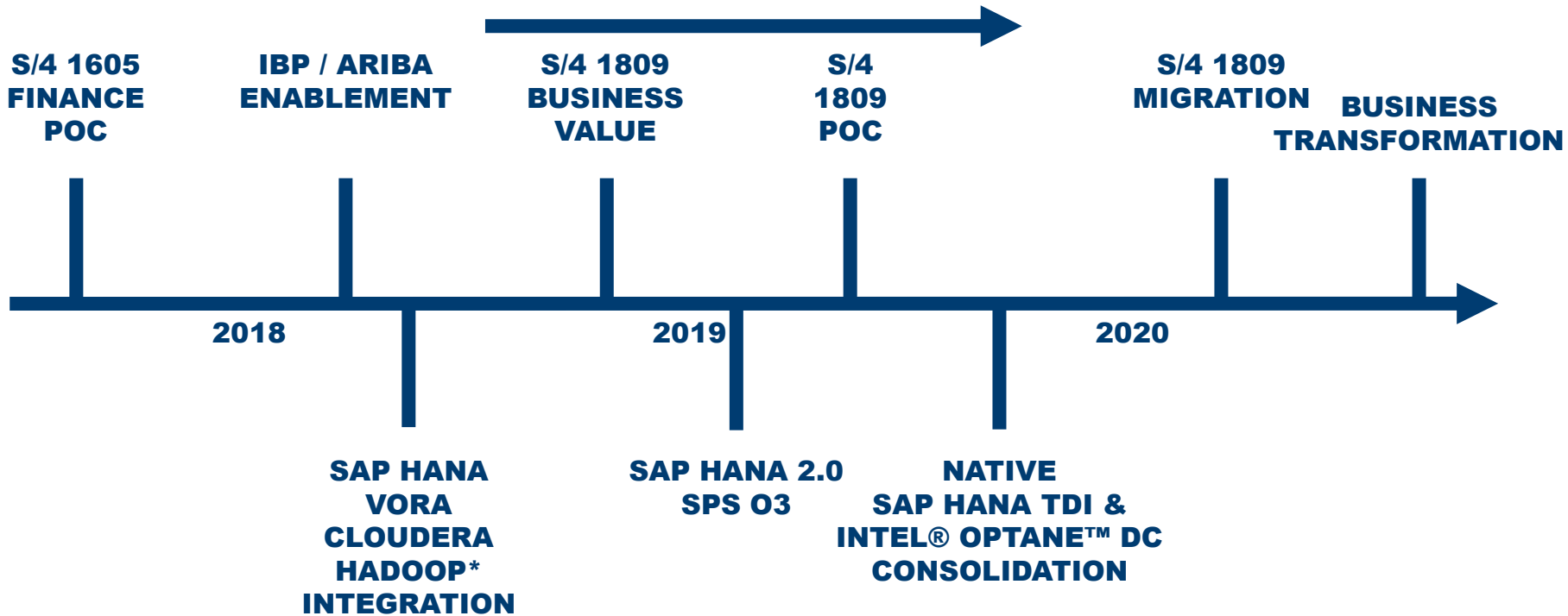
2018 SAP HANA® Landscape



Future State Landscape



Intel Plans for SAP HANA® and S/4 HANA®



Harder, Better, Faster, Stronger

PERSISTENT

BIGGER THAN DRAM

FASTER THAN DISK

MORE OPTIONS FOR YOUR CRITICAL APPLICATIONS

Intel® Xeon® Platinum Processors:

The 2nd generation platform for mixed workloads



intel OPTANE™ DC
PERSISTENT MEMORY



SAP HANA®



SAP HANA



Up to **3X**

More capacity for transactional workloads with Intel® Optane™ DC persistent memory compared to the Intel® Xeon® Platinum processor running SAP HANA® 2.0 SPS 03+²



Up to **6X**

Greater system memory for analytical workloads with Intel Optane DC persistent memory compared to the Intel Xeon Platinum processor³

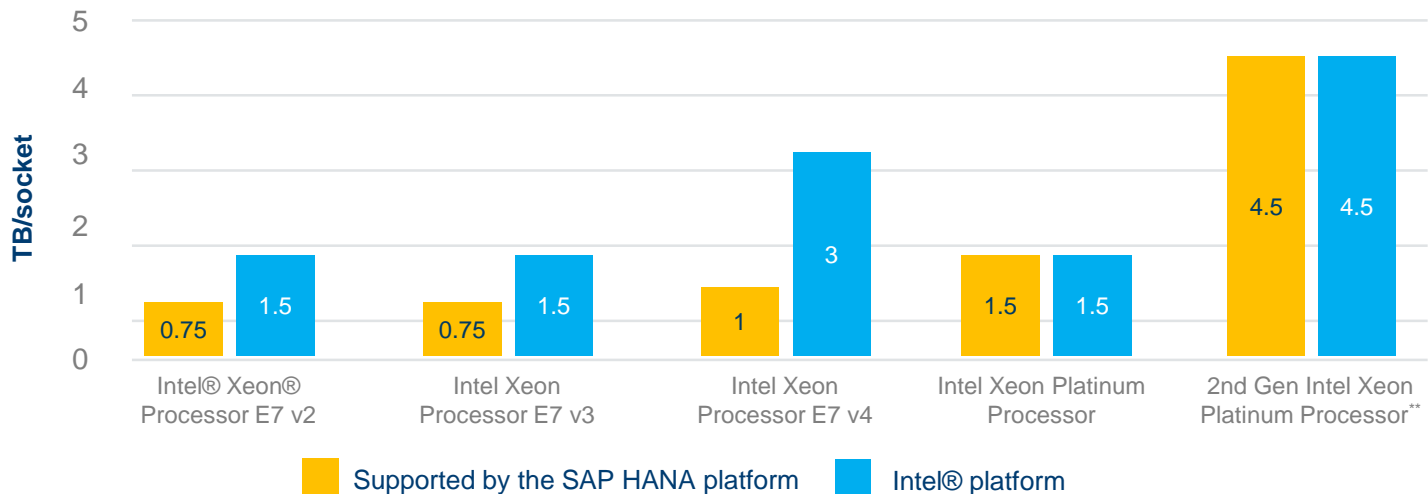
Performance results are based on testing as of the date set forth in the configurations and may not reflect all publicly available security updates. See configuration disclosure for details. No product or component can be absolutely secure.

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark* and MobileMark*, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit intel.com/benchmarks.

^{2,3} For configuration details, see [Endnotes slides](#).

SAP HANA® Appliance

OLTP maximum memory/socket certification⁴



Intel Xeon Platinum processors deliver a balanced memory/CPU ratio

Brickland Platform is Ivy Bridge-EX, Haswell-EX, and Broadwell-EX.

**Note: 4.5 TB per socket allocation is not supported by SAP HANA on 8-socket configurations. (SAP HANA supports up to 24 TB of memory on 8-socket configurations.)

Performance results are based on testing as of the date set forth in the configurations and may not reflect all publicly available security updates. See configuration disclosure for details. No product or component can be absolutely secure.

⁴SAP. "Find Certified Appliances." September 2018. sap.com/dmc/exp/2014-09-02-hana-hardware/enEN/appliances.html.

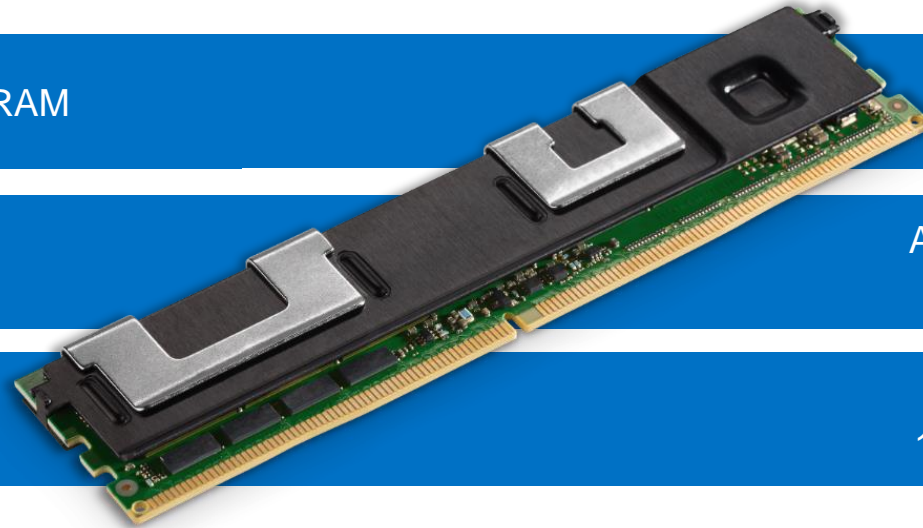
An Innovative, New Type of Memory

Extract more value from larger datasets than previously possible with Intel® Optane™ DC persistent memory

Performance close to DRAM

Low total cost of ownership (TCO)

Data persistency



DIMM Form factor

Available in much larger capacities than DRAM

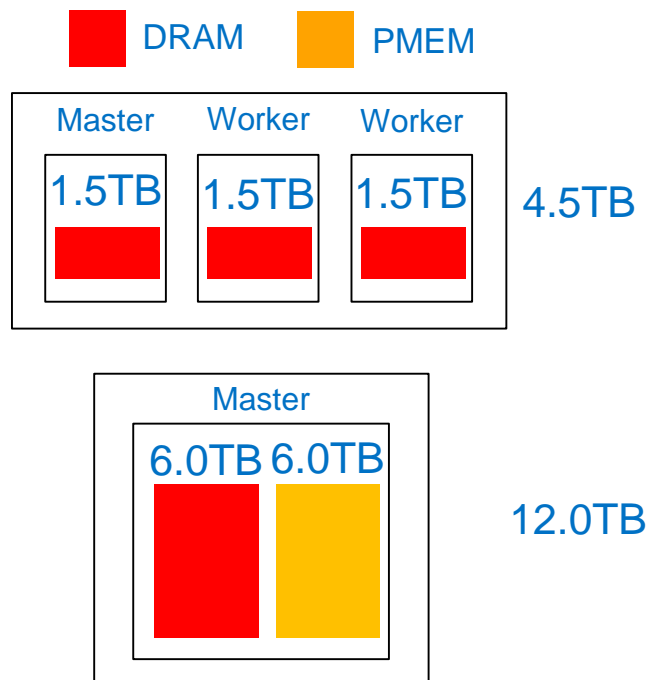
Large DIMM SIZES
128 GB, 256 GB, 512 GB

Use of Intel® Optane™ DC Persistent Memory to Move from Scale Out to Scale up SAP HANA®

Move from three scale-out nodes to a single scale-up node using Intel Optane DC Persistent Memory

Benefits

- Reduced maintenance across SAP HANA landscape
- Eliminate data reorganizations across nodes
- Queries all run within a single node
- Faster startup times



Intel IT Finds Scale-Up Delivers Better Performance

2.4X faster time to insights using one scale-up server with 2nd Generation Intel® Xeon® Scalable processor and Intel® Optane™ DC persistent memory versus a 5 year-old three server system, running an Intel IT benchmark of 50 queries executed 30-50 times each, for a total of 25,000 steps.⁵



Scale-out with three 4-year old servers

3x 4-socket servers (Intel® Xeon® processor E7 8880 v3)
+ 3x 2TB DRAM (6TB total memory)

Scale-up with one new server

1x 4-socket server (2nd Gen Intel® Xeon® Platinum 8260 processor)
+ 1.5TB DRAM + 3TB Intel® Optane™ DC persistent memory (4.5TB total memory)

Performance results are based on testing as of 03/4/19 and may not reflect all publicly available security updates. No product or component can be absolutely secure. Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information go to www.intel.com/benchmarks.⁵ See endnotes for configuration details.

Intel IT Planning Scale-Up for Greater Capacity

A scale-up SAP® HANA® 2 landscape with 2nd Generation Intel® Xeon® Scalable processors, DRAM and Intel® Optane™ DC persistent memory provides **52% more total system memory and at lower cost**, than a scale-out landscape with 2nd Generation Intel Xeon Scalable processors and DRAM only.⁶

Scale-Out Landscape
63TB Memory



**52%
More
Capacity⁶**

Scale-Up Landscape
96TB Memory



21x 4-socket servers (2nd Gen Intel® Xeon® Platinum 8276 processors)
+ 21x 3TB DRAM (63TB total memory)

8x 8-socket servers (2nd Gen Intel® Xeon® Platinum 8276M processors)
+ 8x 6TB DRAM + 6TB Intel® Optane™ DC persistent memory
(96TB total memory)

Landscape	Lab	Development and QA	Bench mark	Production	Disaster Recovery	Production Support	Total
# of servers in scale-out	3	4	4	4	3	3	21
# of servers in scale-up	1	1	2	2	1	1	8

⁶ Results have been estimated by Intel IT as of 3/4/2019 using internal Intel analysis or architecture simulation or modeling, and provided to you for informational purposes. Any differences in your system hardware, software or configuration may affect your actual results. Cost reduction scenarios described are intended as examples of how a given Intel-based product, in the specified circumstances and configurations, may affect future costs and provide cost savings. Circumstances will vary. Intel does not guarantee any costs or cost reduction. See endnotes for configuration details.

Faster Performance, Lower Run Costs



Evonik Tests Proof-of-Concept with Intel® Optane™ DC Persistent Memory and SAP HANA®



Evonik uses SAP HANA for real-time analytics and reporting to better understand customers and complex supply chains

CHALLENGES

- Keeping up with exploding volume of data
- Heterogenous business landscape with multiple ERP systems
- Handling data migrations and integrations from mergers and acquisitions

SOLUTION

1.3 TB SAP HANA DATABASE WITH INTEL® OPTANE™ DC PERSISTENT MEMORY:⁷

17X FASTER

data load at startup:
From 27 minutes to 1:35⁷

1.6X FASTER

system response times⁷

30%

REDUCTION
of run costs⁷

BUSINESS BENEFITS

- **Business continuity:** Systems stable for testing in a short time
- **Fast data load at startup** and shorter maintenance windows for SAP HANA
- **Lower TCO** from reduced infrastructure memory costs and consolidation
- **Adoption with ease:** near-flat learning curves and minimal training
- **Increased productivity** from faster query times

⁷See Endnotes slides.

More Memory and Reduced Downtime



Geberit evaluates persistent memory for two of its existing SAP HANA® systems.

SOLUTION

1.3 TB SAP HANA DATABASE WITH INTEL® OPTANE™ DC PERSISTENT MEMORY:⁸

4.2X FASTER

data load at startup:
From 54 minutes to 13 minutes

8.1X FASTER

system restore:
From 130 minutes to 16 minutes

7.5 TB MEMORY

With 6 TB Intel Optane DC persistent memory per server

CHALLENGES

- Increase memory capacity to meet increasing volumes of data
- Reduce system downtime
- Avoid expanding server landscape or replacing existing hardware

BUSINESS BENEFITS

- Manage more than 30 database instances
- Improve business continuity for planned maintenance
- Maintain the query performance of 5.5 million statements at 99.7 percent of its original speed
- Lower total cost of ownership and improve price-per-terabyte ratio by providing more memory using the same system configuration

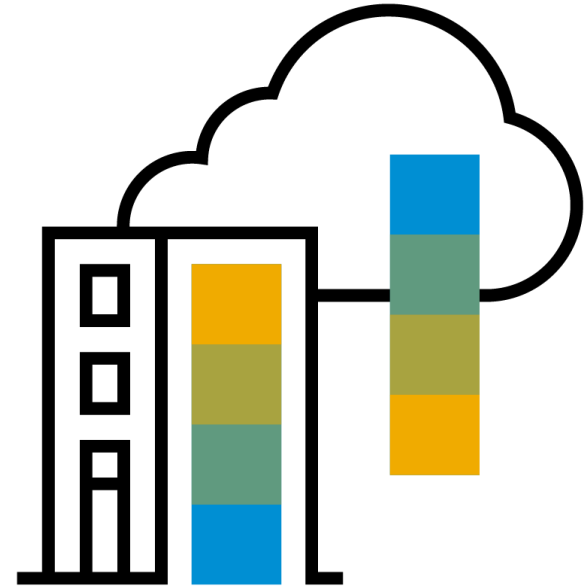
Performance results are based on testing as of the date set forth in the configurations and may not reflect all publicly available security updates. See configuration disclosure for details. No product or component can be absolutely secure.

⁸ See [Endnotes slides](#).

What's New in HANA 2.0 SPS04: Data Tiering Options

Martin Mysyk
Enterprise Architect, SAP
May 5th , 2019

PUBLIC



SAP HANA Data Tiering

Solution: Decouple HANA data location from a fixed storage layer



Hot Store



Hot
Data

This tier is used to store mission-critical data for real-time processing and real-time analytics.

Data is retained in-memory of the SAP HANA database.



Warm Store



Warm
Data

This tier is used to store data with reduced performance SLAs, which is less frequently accessed.

Data is stored on a lower cost storage tier, managed as a unified part of the SAP HANA database.



Cold Store



Cold
Data

This tier is used to store voluminous data for sporadic or very limited access.

Data is stored on low cost storage tiers, like disk or Hadoop, managed separately from the SAP HANA database, but still accessible at any time.

SAP HANA Native Support for Persistent Memory

Officially Supported in SAP HANA 2.3 (April 2018)

Larger memory capacity with high performance (vs. DRAM & lower tier storage)

Lower TCO data storage hierarchy

Faster start time delivers less downtime

Co-innovation with Intel® leads to first fully optimized major DBMS platform

Early Adoption Program with key partners/customers ongoing

Persistent Memory
non-volatile

Data Reliability
faster starts



Higher Capacity
than DRAM

Transforming
the memory hierarchy

Intel® Optane™ DC persistent memory available in 1H 2019



Benefit

Process more data in real-time at a lower TCO with improved business continuity

> 3 TB

Increased total memory capacity per CPU

12.5x

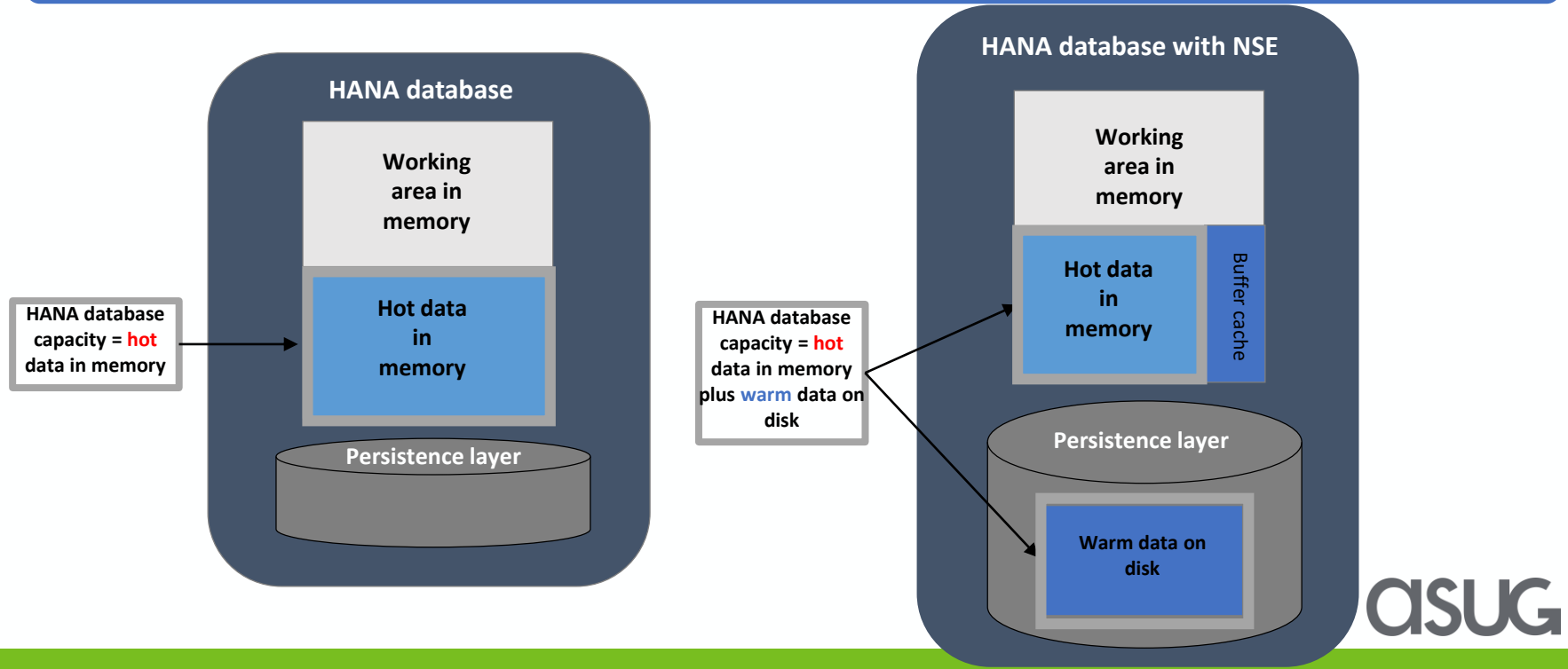
Improvement in startup time*

[First major DBMS vendor to officially support Intel Optane DC persistent memory!](https://www.sap.com/persistent-memory)
[sap.com/persistent-memory](https://www.sap.com/persistent-memory)

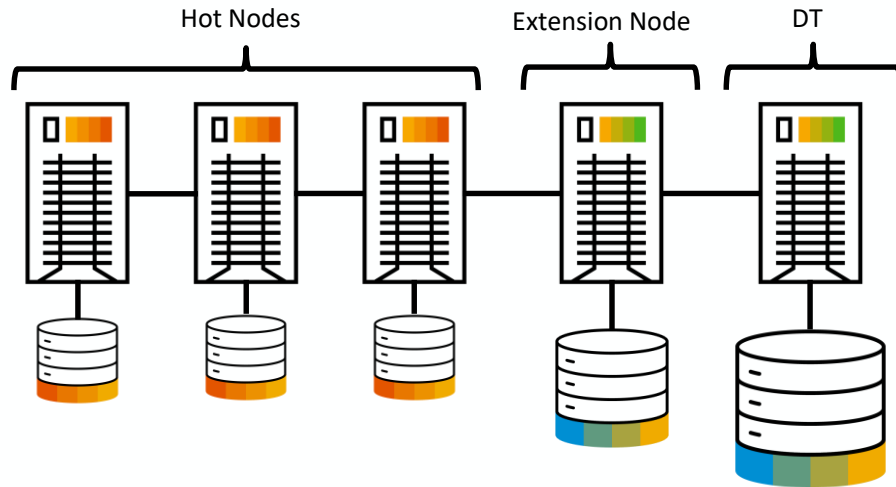
*Internal Benchmark measured with a 6TB dataset in SAP HANA

Native Storage Extension (NSE) Adds Native Warm Data Tier to SAP HANA Database

NSE manages “page loadable” warm data in the HANA database with expanded disk capacity, and an intelligent buffer cache to transfer pages of data between memory and disk.



Deployment Option with Dynamic Tiering and Extension Node



- Only one DT host on a separate machine is supported in a HANA scale-out landscape
- HANA Table Distribution doesn't support multistore tables (planned for SPS04)
- You can use DLM to move data to Dynamic Tiering
- Multistore Tables can be created on Extension Node or on any other HANA node
 - Multistore tables should not be created across hot nodes, extension node and DT

Native Storage Extension (NSE) Value Proposition and Use Cases

Value proposition:

- Increase HANA data capacity at low TCO
- Deeply integrated warm data tier, with full HANA functionality
- Will support all HANA data types and data models
- Simple system landscape
- Scalable with good performance
- Supported for both HANA on-premise and HANA-as-a-Service (HaaS)
- Available for any HANA application
- Complements, without replacing, other warm data tiering solutions (extension nodes, dynamic tiering)

Use cases:

- Any customer built or SAP built HANA application that is challenged by growing data volumes
- S/4HANA data aging (NSE is an evolution of “paged attributes”)
- BW team currently uses extension nodes, but may evaluate NSE in the future

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Presentation Materials

Access the slides from 2019 ASUG Annual Conference here:

<http://info.asug.com/2019-ac-slides>

Q&A

For questions after this session, contact us at:
tim.allen@intel.com and martin.mysyk@sap.com.

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Endnotes

¹ HP, Intel, SAP, SUSE, and VMware. “Virtualizing Enterprise SAP® Software Deployments.” June 2011. [suse.com/docrep/documents/o4r7to9d2y/virtualizing_enterprise_SAP_software_deployments.pdf](https://www.suse.com/docrep/documents/o4r7to9d2y/virtualizing_enterprise_SAP_software_deployments.pdf).

² Up to 3x greater system memory supported versus recently available solutions (representing the currently installed data center base). For online transaction processing (OLTP) workloads, SAP has certified its SAP HANA® 2 platform to support up to 18 TB of memory per system for a 4-socket configuration (or 36 TB for an 8-socket configuration) using the 2nd Generation Intel® Xeon® processor Scalable family installed with Intel® Optane™ DC persistent memory. Systems using the previous-generation Intel Xeon processor Scalable family (representing the typical data center installed base infrastructure) could only support 6 TB in a 4-socket configuration (or 12 TB in an 8-socket configuration). For comparative purposes, SAP certifies support for up to 6 TB of memory for the current Intel Xeon processor Scalable family in a 4-socket configuration, so upcoming Intel Xeon processor Scalable family–based systems are certified to support up to 50 percent greater system memory than the generation they replace.

³ Up to 6x greater system memory supported versus recently available solutions (representing the currently installed data center base). For online analytical processing (OLAP) workloads, SAP has certified its SAP HANA® 2 platform to support up to 18 TB of memory per system for a 4-socket configuration (or 36 TB for an 8-socket configuration) using the 2nd Generation Intel® Xeon® processor Scalable family installed with Intel® Optane™ DC persistent memory. Systems using the previous-generation Intel Xeon processor Scalable family (representing the typical data center installed base infrastructure) could only support 3 TB for a 4-socket configuration (or 6 TB for an 8-socket configuration). For comparative purposes, SAP certifies support for up to 3 TB of memory for the current Intel Xeon processor Scalable family in a 4-socket configuration, so upcoming Intel Xeon processor Scalable family–based systems are certified to support up to 50 percent greater system memory than the generation they replace.

Up to 3x greater system memory supported versus available solutions from four years ago (representing the currently installed data center base). For online transaction processing (OLTP) workloads, SAP has certified its SAP HANA® 2 platform to support up to 6 TB of memory per system for the Intel® Xeon® processor Scalable family for a 4-socket configuration (or 12 TB for an 8-socket configuration). Systems available four years ago (representing the typical data center installed base infrastructure) could only support 2 TB in a 4-socket configuration (or 4 TB in an 8-socket configuration), respectively.

Endnotes

⁴ SAP. "Find Certified Appliances." September 2018. sap.com/dmc/exp/2014-09-02-hana-hardware/enEN/appliances.html.

⁵ **2.4X better runtime performance:** performance results are based on testing by Intel IT as of March 12, 2019 and may not reflect the publicly available security updates. No system can be absolutely secure.

Baseline: three-node (1-master + 2-slave) SAP HANA 2 scale-out configuration. Per Node: 4x Intel® Xeon® processor E7-8880 v3 (2.3 GHz, 150 W, 18 cores), CPU sockets: 4; Microcode:0x400001c; RAM capacity: 64 x 32GB DIMM, RAM model: DDR4 2133 Mbps; storage: GPFS, approximately 21.8TB of formatted local storage per node, SAN storage for backup space only; network: redundant 10GbE network for storage and access, redundant 10G network for node-to-node; OS: SUSE 12 SP2, SAP HANA: 2.00.035, GPFS: 4.2.3.10. Average time of 50 individual test queries executed 30-50 times each, for a total of approximately 25,000 steps: 2.81 seconds.

New configuration, one master node SAP HANA 2 scale-up configuration: CPU: 4 x 2nd Generation Intel® Xeon® Platinum 8260 processor (2.2 GHz, 165 W, 24 cores), CPU sockets: 4; Microcode: 0x400001c, RAM capacity: 24 x 64GB DIMM, RAM model: DDR4 2133 Mbps; Intel Optane DC persistent memory: 24 x 126GB PMM; storage: XFS, 21TB; network: redundant 10GbE network; OS: SUSE 15, SAP HANA: 2.00.035, Intel BKC: WW06. Average time of 50 individual test queries executed 30-50 times each, for a total of approximately 25,000 steps: 1.13 seconds.

⁶ **52% more data capacity at same or lower cost:**

Scale up configuration: eight node SAP HANA 2 landscape. Per node: 8-socket 2nd Generation Intel® Xeon® Platinum 8276M processors. Memory capacity per socket: 6X 128GB DDR4 2 133 MHz. and 6X 128 GB Intel® Optane™ DC persistent memory. Estimated total cost is \$2,369,496. Estimated cost per server is \$296,187 (CPU=\$93,776; memory=\$119,808; storage=\$45,000; other=\$37603).

Scale Out configuration: twenty-one node SAP HANA 2 landscape. Per node: 4-socket 2nd Generation Intel® Xeon® Platinum 8276 processor. Memory Capacity per socket: 12x 64GB DDR4 2,133 MHz. Estimated total cost is \$2,834,433. Estimated cost per server is \$134,973 (CPU=\$34,876; memory=\$33,994; storage=\$21,000; other=\$45,103).

Endnotes

- ⁷ Based on Evonik implementation. Configuration with a combination of DRAM and Intel® Optane™ DC persistent memory: Intel Lightning Ridge SDP with 4 x CXL QQ89 A0 processor (24 cores, 165W, 2.20 GHz). Total memory consists of 24 x 32GB DDR4* 2666 MHz and 24 x 128GB AEP ES2, and 1x Intel® SSD DC S3710 800GB, 3x Intel® SSD DC P4600 2.0TB, 3x Intel® SSD DC S4600 1.9TB TB capacity. BIOS version WW33'18. The operating system is SUSE* Linux* Enterprise Server 15 and uses SAP HANA 2.0 SPS 03 (a specific PTF Kernel from SUSE was applied) with a 1.3 TB dataset. Average start time for optimized tables preload (17x improvement).
- ⁸ Based on Geberit implementation. Configuration: 4 socket Intel® Xeon® Platinum 8276M processor at 2.20 GHz. Memory: DRAM: 24 x 64 GB = 1.5 TB; Intel® Optane™ DC persistent memory: 24 x 256 GB = 6 TB; total capacity: 7.5 TB. SUSE* Linux* Enterprise Server (SLES*) 15, SAP HANA® 2.0 SPS 03 Rev. 35.

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Performance results are based on testing as of the date set forth in the configurations and may not reflect all publicly available security updates. See configuration disclosure for details. No product or component can be absolutely secure.

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