SAP Product Road Map
SAP Adaptive Server Enterprise (ASE)

Road Map Revision: 2017.10.02

CUSTOMER

SAP Run Simple

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Introduction to product road maps

Purpose

Product road maps are designed to support the product adoption planning activities of SAP customers. A product road map helps a customer match short-term and long-term goals with technology plans.

A product road map describes how the features and function capabilities in an SAP product or technology are planned to progress over time. In general:

- Recent innovations = changes in the current and recent released version(s)
- Planned innovations = changes planned in one or more upcoming development release
- Product direction = proposed themes for major product releases beyond the current development plan
- Product vision = areas in which the product would be evolved based on technological and industry trends

Complementary resources

For a more general description of the business problems and processes being solved and supported by SAP, refer to solution road maps.

For more detailed technical information, please refer to the product availability matrix and product documentation.

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Product Overview

- Product description
- Key trends and customer needs
- Road map overview and major product updates

Product Road Map

- Recent innovations
- Planned innovations
- Product direction
- Product vision

Appendix

Product Overview

- Product description
- Key trends and customer needs
- Road map overview and major product updates

SAP Adaptive Server Enterprise (ASE)

Product description

SAP ASE is a high performance relational enterprise database management system that is designed for mission-critical transactional intensive environments. It provides the most robust, high-performance platform for running custom developed applications, and for running SAP Business Suite applications.

High Performance Transactional Intensive Workloads

- Extreme Online Transaction Processing (XOLTP) focused database engine with in-memory techniques for linear scalability (scale-up vs. scale-out)
- Geographically distributed for low latency and autonomous operations
- #1 SD Benchmark 2, 4, 16 socket Linux x86

Highly Available

- Built-in resiliency, resource governors, workload management, online maintenance
- Integrated HADR clustering w/ multi site via external replication

Multi-Layer Secure

- Full database encryption as well as column encryption w/column obfuscation
- Row-level access controls/predicated privileges, granular permissions
- SSL & network encryption, login/password policies, LDAP/Kerberos/PAM

Low TCO

- Cloud support, ease of use
- Data/index partitioning & compression

Optimized data stores vs. one size fits all

Mike Stonebraker: “one size does not fit all” -- http://dataconomy.com/2015/08/sql-vs-nosql-vs-newsql-finding-the-right-solution/

Optimized data stores are more performant/lower TCO

One size fits all (brute force parallelism)

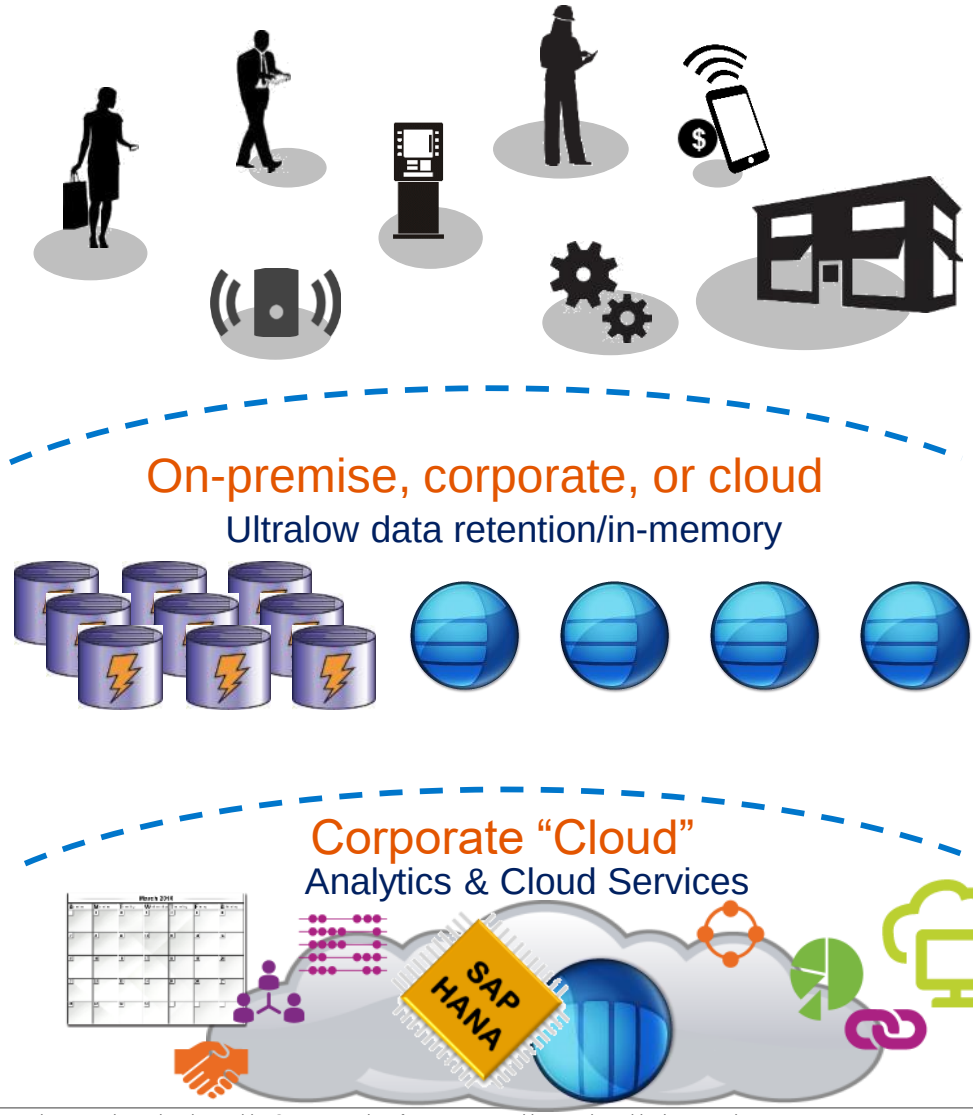
- Requires 10’s to 50+ nodes for performance
- Impacted by shard key requirement & distributed query processing

Optimized data stores

- Low latency row stores for XOLTP
- Column stores for structured/semi-structured analytics
- Hadoop for unstructured data

ASE’s Role

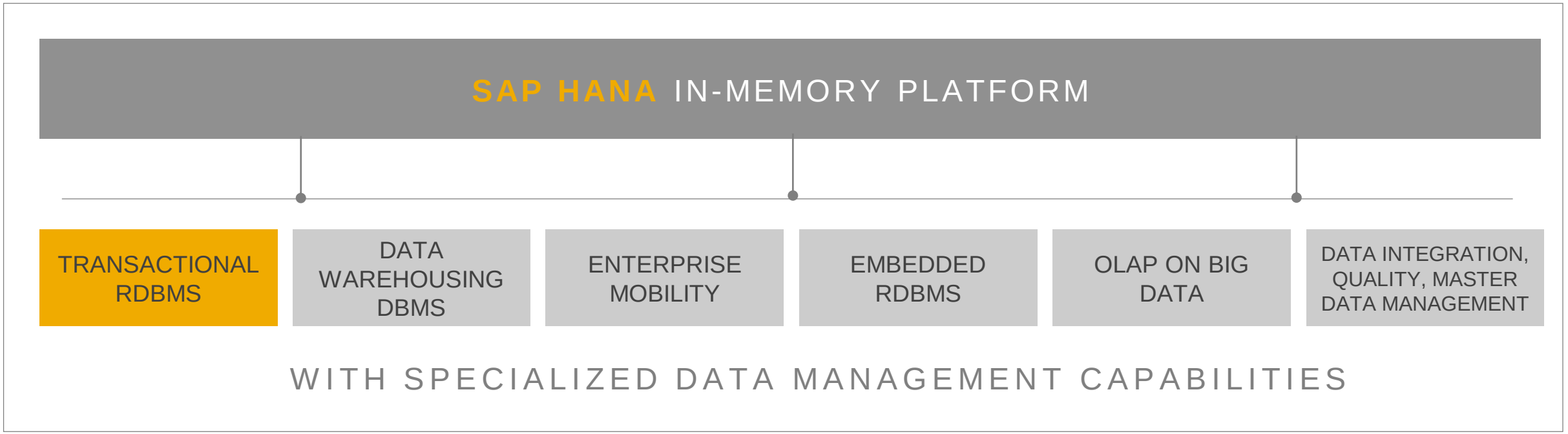
- XOLTP engine for SAP
  - Leverage SRS to get data back to SAP HANA or SAP IQ
  - Data retention in ASE is small
- General purpose OLTP with TCO focus
  - Support common hardware for disk based general purpose OLTP where enterprise reliability & security is desired
  - e.g. SAP ERP



SAP Adaptive Server Enterprise (SAP ASE)

For faster, more reliable transaction-intensive applications

SAP Database and Data Management



Mission-Critical | Trusted | Low TCO

SAP Adaptive Server Enterprise (ASE)

In the database & data management product portfolio

SAP ASE, platform edition

Secure deployment flexibility by incorporating SAP ASE, SAP IQ software, and SAP Replication Server in one licensing model.

3-in-1 Solution

SAP ASE, enterprise edition

Power mission-critical database management systems for a single node environment.

Large Enterprises

SAP ASE, Edge edition

Enable solutions for smaller database deployments and applications with a limitation of eight cores.

Mid Market & ISVs

SAP ASE, express edition

Start building transactional applications on a free, full use license for development and deployment

- 50 GB disk
- 4 engines

Start-Ups/Small Business

SAP ASE, evaluation license

Take advantage of a free download for development environments (unlimited with all options available).

Developers/Education

MemScale option

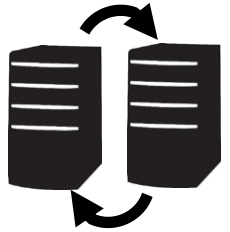
Leverages in-memory and HW optimizations to achieve linear scalability for high concurrency XOLTP workloads

XOLTP

Workload analyzer option

Employs capture/replay techniques to allow production workloads to be replayed in dev/test environments to mitigate upgrade risks and more accurate server tuning

TCO



Always-on option

Leverages streaming replication to provide HADR clustering to support both High Availability and Disaster Recovery including Zero Down Time maintenance and major upgrades

High Availability

The 4 challenges for any DBMS

Transaction Concurrency
- Global/Web Scale
- Smart Devices/Self Service

Transaction Velocity
- Automated Processing
- Streaming Data

Data Volume
- Internet of Things/Sensor Data
- Velocity x Time = Volume

Data Variety
- Structured & Semi-Structured
- Unstructured

Data Volatility

FSI Trading → 3 days
- Algorithmic trading, compute grid pricing

Retail Sales → a few minutes
- Self checkout, local web fulfillment, flash sales, micro-transactions

Healthcare → <72 hours to a few days/weeks
- Home/wearable monitoring, phone/web consults

OLTP

Analytics

Data Value/Retention

FSI → 7 years
- Trade data + phone calls + emails

Retail sales → 2 to 5 years
- Customer data (e.g. phone beacons), habits

Healthcare → lifetime plus

Optimizing for the challenges → different problem sets

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Data Variety
- Structured & Semi-Structured
- Unstructured

OLTP Profile

Single/small number of rows
- Row storage format

Very low latency execution
- Minimize overhead of query optimization, etc.

Low resource usage per query
- Minimal IO/logical or physical

High concurrency parallelism
- Single index access methods

OLTP

Analytics

Analytics Profile

High volume data scan proportion
- Columnar storage format

In-depth optimization
- Scan pruning techniques, etc.

Resource maximization
- Improve response time

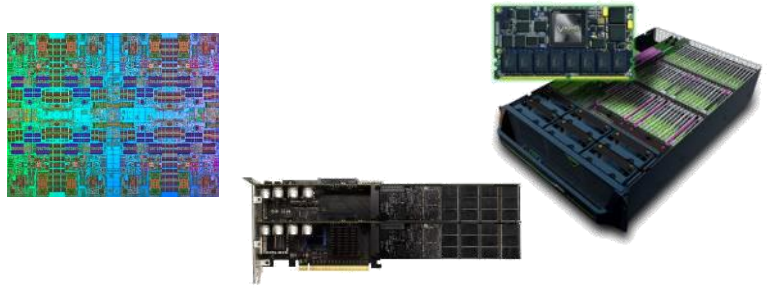
Massive parallel processing
- DQP & federated query processing

SAP Adaptive Server Enterprise (ASE)

Key trends and impacts in business and technology (1)

Hardware is rapidly evolving

- Very high core counts per socket (24+) & chip level API's (TSX, SIMD, etc.)
- Larger memory (>4TB) → in-memory processing
- Movement away from HDD to SSD (PCIe & AFA….NVMe/UltraDIMM next)

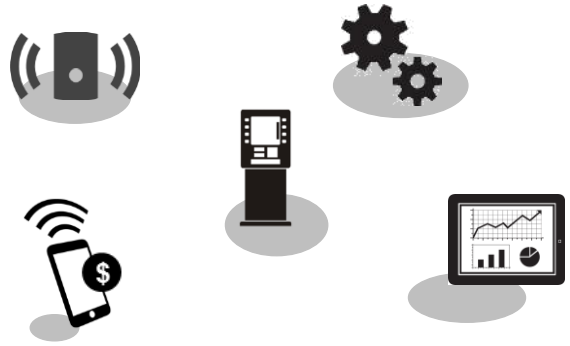


Cost, TCO & ROI are key factors

- Commodity hardware
- OpenSource → reduce acquisition costs for simpler/smaller systems
- Cloud → reduce data center & infrastructure costs for surge applications
- Limitations in data center power & cooling → denser platforms & virtualization

High concurrency – "WebScale"

- No longer a well defined environment with app servers & connection pools
  - Mobile devices, algorithmic trading, automated processing, "bots", etc
  - Sensor driven transactions/proximity marketing, smart devices, etc.
- Existing systems easily overwhelmed – "flash crashes"



SAP Adaptive Server Enterprise (ASE)

Key trends and impacts in business and technology (2)

High Speed/Low Latency Execution

- Apps expect entire screen in sub-second – queries in milliseconds
- Real-time analytics

Architectures & Application development shifting

- JSON not only used for data interchange, but also schema simplification
- Shared nothing clusters for scalability
- Streaming replication for High Availability/Disaster Recovery
- Cloud for dev/test & common micro-services
  - Cloud backups, cloud DR, data tiering to cloud, etc.

Security is crucial

- Data and network protection from hackers
- Regulatory compliance for auditing/access controls
- Data encryption & masking for cloud

SAP Adaptive Server Enterprise (ASE)

Product road map overview - key themes and capabilities

2017 - Recent innovations

XOLTP Enhancements
- In-Memory Row Store (IMRS)
- Hash based index
- MVCC

Data Center Operations & Security
- Always-On Enhancements
- CCL for SSL
- Idle timeout
- Granular Auditing
- On Demand Network Encryption

Cloud
- SAP ASE backup to the cloud [AWS]
- Google Cloud ASE certification

SAP HANA Integration
- SAP HANA Schema
- SAP HANA SQL Script

2018 – Planned innovations

XOLTP Enhancements
- IMRS enhancements
- >4TB memory & >32K connections
- Statement cache enhancements

Data Center Operations & Security
- Always-On Enhancements
  - CI mode for non-HADR (DR+)
- E2E Security in Always-On (Cloud)
- SQL language enhancements
  - Sequence + string f()'s + try/catch….

Cloud
- DBaaS on SAP Cloud Platform
  - [Apollo infrastructure]
- Backup as a Service
- DR as a Service
- Subscription Model

SAP HANA Integration
- A4A Query Enhancements
- A4A IBM P Little Endian Linux

2019 – Product direction

XOLTP Enhancements
- Temporal SQL
- C UDF
- Table variable enhancements
- Showplan() for cached procs
- Separate stats cache for optimizer

Data Center Operations & Security
- Page migration utility
- Always-On Enhancements
  - XA Support for HADR
  - Standby R/O Database for custom
- Security Enhancements
  - Key storage/encryption HSM offload
  - LDAP Groups
  - Data Masking
- Role based resource limits

Cloud
- JSON support
- DBaaS on SCP enhancements
- Performance Tuning as Service
- Workload Analyzer as a Service

SAP HANA / SAP IQ Integration
- A4A Common Tooling (phase 1)

2020 – Product vision

XOLTP Enhancements
- Stream data to SAP HANA or SAP IQ for long term persistence & analytics

Data Center Operations & Security
- Improved P&T analysis and capture replay with Workload analyzer
- Improved SAP ASE diagnostics such as log analyzer/undo/redo

Cloud
- Additional cloud services and cloud platform support

SAP HANA / SAP IQ Integration
- A4A Common Tooling (phase 2)

FSI Solutions
- Blockchain
- Data lineage, Forensic auditing

ASE 16 SP03 PL01 is current release

This is the current state of planning and may be changed by SAP at any time.

SAP Adaptive Server Enterprise (ASE)

Product road map overview – SAP Business Suite on SAP ASE

2017 - Recent innovations

SAP Business Suite/SAP Applications

- CDS functionality Phase 2
- Technical Monitor Cockpit
- Built-in SAP ASE Long term performance Data Repository (BALDR)

2018 – Planned innovations

SAP Business Suite/SAP Applications

- CDS functionality Phase 3
- Read Only Standby with HADR
- MemScale adoption (phase 1)
- User store

2019 – Product direction

Sap Business Suite/SAP Applications

- CDS functionality Phase 4
- MemScale adoption (phase 2)

2020 – Product vision

SAP Business Suite/SAP Applications

- Continued support for R3 developments and enhancements to SAP ASE support for SAP Business Suite

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SAP Adaptive Server Enterprise (ASE)

Major product updates

Summary of major updates and changes in Adaptive Server Enterprise

- SAP ASE will have 4 strategic thrusts
  - OLTP Performance: innovations to drive continued improvements in OLTP performance & scalability
  - Datacenter Operations: innovations in areas such as availability, security, cost reduction
  - Virtualization and Cloud Support
  - SAP ASE & SAP HANA: Integration with SAP HANA as well as unification of development environment and tools
- Latest release is ASE 16 sp02 with key innovations around
  - MemScale: XOLTP performance and scalability
  - Always-On: Hardware independent/cloud friendly high availability
  - Workload Analyzer: Capture/Replay for minimizing risks during upgrades
  - Cloud Readiness: Support for common cloud platforms
  - Accelerator for SAP ASE (A4A): Leveraging SAP HANA to speed SAP ASE reporting systems with no code/application changes

See appendix for details on innovations in SAP ASE 16 sp02 as well as details on individual features in recent releases

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SAP Adaptive Server Enterprise (ASE)

Moving to the digital world

Business Need / Capability	Product Today If you run this product today …	Go-to Product You might want to consider a move to …	Additional Information
OLTP + RealTime Analytics	SAP ASE → SAP Replication Server → SAP ASE	a) SAP ASE Platform Edition (ASE/PE) b) ASE/PE + SAP HANA accelerator for SAP ASE (A4A)	SAP ASE Platform Edition includes SAP ASE, SAP Replication Server, SAP IQ with flexible deployment plus common security, partitioning and compression options
High Availability (HA)	SAP ASE Cluster Edition (CE) SAP ASE high availability option SAP ASE disaster recovery option	SAP ASE always-on option	Always-On supports cloud/hardware agnostic deployments and removes limits on SAP ASE functionality due to Cluster Edition
XOLTP	Multiple SAP ASE instances in loose cluster	SAP ASE Platform Edition + MemScale	MemScale may allow multiple sharded SAP ASE instances be recombined into a single less complex deployment
Production workload simulation/testing	Ad-hoc manual test scripts	SAP ASE cockpit + workload analyzer	Leverage capture/replay to accurately capture production workloads to replay for testing to mitigate risks & improve performance tuning capability

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Product Road Map

- Recent innovations
- Planned innovations
- Product direction
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SAP Adaptive Server Enterprise (ASE)

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  - [Apollo infrastructure]
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- DR as a Service
- Subscription Model

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SAP HANA / SAP IQ Integration
- A4A Common Tooling (phase 1)

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XOLTP Enhancements
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Data Center Operations & Security
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Cloud
- Additional cloud services and cloud platform support

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FSI Solutions
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SAP Adaptive Server Enterprise (ASE) 16 sp03

XOLTP Transaction Processing

Recent innovations

Continue to enhance SAP ASE's XOLTP capabilities by exploiting in-memory techniques to provide faster access and reduced contention when reading or modifying frequently accessed data

XOLTP Enhancements

- MemScale option → gains extensive support from additional in-memory processing techniques to improve scalability in high concurrency environments

Data Center Operations & Security

- Always-on option → support HA/DR for in-memory processing for in-memory row-store
- Security → replaces OpenSSL with CCL for SAP product standardization and reduced vulnerabilities in addition to non-SSL based on demand network encryption and other security enhancements

Cloud Services

- Backup to Cloud → provide certified approaches for backing up to cloud storage as well as a integrated cloud service for backing up directly to the cloud

SAP HANA Integration

- SQL Script support → Allow applications to be developed in a common language for deployment in either SAP ASE or SAP HANA as requirements dictate

XOLTP Performance

In Memory Row Store, HCB, MVCC
(Database MemScale Option)

Data Center Operations

Always-On Enhancements
(Database Always-on Option)

Security Enhancements

SAP Business Suite Enhancements

Cloud Enablement

Cloud Micro-Services

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SAP HANA SQLScript Support

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SAP Adaptive Server Enterprise (ASE) 16 sp03

XOLTP Transaction Processing

Recent innovations

Performance/XOLTP

Functional Area	Feature	Feature Value
MemScale Option	▪ In-Memory Row Store (IMRS) ▪ Hash based index ▪ Multi-Version Concurrency Control (MVCC)	▪ Reduce CPU contention for XOLTP applications ▪ Reduce index access times for hot data ▪ Eliminate reader/writer contention

Data Center Operations & Security

Functional Area	Feature	Feature Value
Always-On Option	▪ Support for IMRS	▪ Provide HA/DR for in-memory transactions
Security Features	▪ CCL for SSL ▪ Idle timeout ▪ Granular Auditing ▪ On Demand Network Encryption	▪ Use common FIPS certified SSL for SAP products ▪ Detect and detach idle connections ▪ Provide more detailed auditing ▪ Encrypt sensitive commands set to ASE w/o SSL

SAP Adaptive Server Enterprise (ASE) 16 sp03

XOLTP Transaction Processing

Recent innovations

Cloud

Functional Area	Feature	Feature Value
SAP ASE backup to the cloud Google Cloud support	▪ SAP ASE backup to the cloud [AWS] ▪ Google Cloud ASE certification	▪ Support backups to AWS secure file systems ▪ Certify SAP ASE to run in Google Cloud environments

SAP HANA Integration

Functional Area	Feature	Feature Value
SAP HANA transportability	▪ SAP HANA Schema ▪ SAP HANA SQL Script	▪ Support non-columnar SAP HANA schema syntax for apps ▪ Support non-columnar SAP HANA SQL syntax for developers

SAP Adaptive Server Enterprise (ASE) 16 sp03

XOLTP Transaction Processing

Recent innovations

Business Suite/SAP Applications

Functional Area	Feature	Feature Value
SAP app compatibility	▪ CDS functionality Phase 2	▪ Support continued evolution of SAP Business Suite R3
DBA Administration/ Performance & Tuning	▪ Technical Monitor Cockpit ▪ Built-in SAP ASE Long term performance Data Repository (BALDR)	▪ Provide improved tooling for SAP DBA's ▪ Provide more detailed and longer term analysis of system performance for SAP DBA's

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Planned innovations

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XOLTP Enhancements

- MemScale option → gains extensive support from additional in-memory processing techniques to improve scalability in high concurrency environments

Data Center Operations & Security

- Always-on option → achieves LTL RepAgent parity allowing advanced replication features to be used in Always-On deployments when replicating to external systems
- Security → replaces OpenSSL with CCL for SAP product standardization and reduced vulnerabilities in addition to non-SSL based on demand network encryption and other security enhancements

Cloud Services

- Backup to Cloud → provide certified approaches for backing up to cloud storage as well as a integrated cloud service for backing up directly to the cloud

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XOLTP transaction processing

Planned innovations

XOLTP Enhancements

Functional Area	Feature	Feature Value
XOLTP & Scalability	▪ IMRS enhancements ▪ >4TB memory & >32K connections ▪ Statement cache enhancements	▪ Improved performance, diagnostics and pre-caching ▪ Increase SAP ASE operational limits ▪ Reduce CPU contention on statement cache

Data Center Operations & Security

Functional Area	Feature	Feature Value
Always-On Option Enhancements	▪ CI mode for non-HADR (DR+) ▪ E2E Security in Cloud (HADR)	▪ Provide support for advanced HA/DR custom topologies developed by end-user not supported by Always-On ▪ Support improved security for Always-On components in cloud deployment environments
SQL Development	▪ Sequence objects ▪ Increased string functions ▪ try/catch exception handling	▪ Provide better application compatibility with other DBMS ▪ Improve SQL for handling character data ▪ Improve/ease exception handling in stored procedures

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2018 Planned innovations

XOLTP transaction processing

Planned innovations

Cloud Services

Functional Area	Feature	Feature Value
Cloud Backup	▪ DBaaS on SAP Cloud Platform ▪ Backup as a Service ▪ DR as a Service ▪ Subscription Model	▪ Support DBaaS on SAP's Apollo Infrastructure ▪ Provide off-site/low cost backup capability using cloud ▪ Provide off-site/low cost DR capability using cloud ▪ Provide reduced entry costs for cloud deployments

SAP HANA Integration

Functional Area	Feature	Feature Value
A4A	▪ Query Enhancements ▪ IBM P Little Endian Linux	▪ Improved pass-thru of SQL queries and procedural logic ▪ Support A4A on IBM P-series running Linux

This is the current state of planning and may be changed by SAP at any time.

SAP Adaptive Server Enterprise (ASE)

XOLTP transaction processing

Planned innovations

Business Suite/SAP Applications

Functional Area	Feature	Feature Value
SAP app compatibility	▪ CDS functionality Phase 3	▪ Support continued evolution of SAP Business Suite R3
SAP application performance	▪ Read Only Standby with HADR ▪ MemScale adoption (phase 1)	▪ Offload reporting to standby ▪ Adopt MemScale features to improve SAP application performance
Security	▪ Secure user store	▪ Provide secure storage of user credentials for automated processes and DBA access in cloud deployments

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SAP Adaptive Server Enterprise (ASE)

Product road map overview - key themes and capabilities

2017 - Recent innovations

XOLTP Enhancements
- In-Memory Row Store (IMRS)
- Hash based index
- MVCC

Data Center Operations & Security
- Always-On Enhancements
- CCL for SSL
- Idle timeout
- Granular Auditing
- On Demand Network Encryption

Cloud
- SAP ASE backup to the cloud [AWS]
- Google Cloud ASE certification

SAP HANA Integration
- SAP HANA Schema
- SAP HANA SQL Script

2018 – Planned innovations

XOLTP Enhancements
- IMRS enhancements
- >4TB memory & >32K connections
- Statement cache enhancements

Data Center Operations & Security
- Always-On Enhancements
  - CI mode for non-HADR (DR+)
- E2E Security in Always-On (Cloud)
- SQL language enhancements
  - Sequence + string f()'s + try/catch….

Cloud
- DBaaS on SAP Cloud Platform
  - [Apollo infrastructure]
- Backup as a Service
- DR as a Service
- Subscription Model

SAP HANA Integration
- A4A Query Enhancements
- A4A IBM P Little Endian Linux

2019 – Product direction

XOLTP Enhancements
- Temporal SQL
- C UDF
- Table variable enhancements
- Showplan() for cached procs
- Separate stats cache for optimizer

Data Center Operations & Security
- Page migration utility
- Always-On Enhancements
  - XA Support for HADR
  - Standby R/O Database for custom
- Security Enhancements
  - Key storage/encryption HSM offload
  - LDAP Groups
  - Data Masking
- Role based resource limits

Cloud
- JSON support
- DBaaS on SCP enhancements
- Performance Tuning as Service
- Workload Analyzer as a Service

SAP HANA / SAP IQ Integration
- A4A Common Tooling (phase 1)

2020 – Product vision

XOLTP Enhancements
- Stream data to SAP HANA or SAP IQ for long term persistence & analytics

Data Center Operations & Security
- Improved P&T analysis and capture replay with Workload analyzer
- Improved SAP ASE diagnostics such as log analyzer/undo/redo

Cloud
- Additional cloud services and cloud platform support

SAP HANA / SAP IQ Integration
- A4A Common Tooling (phase 2)

FSI Solutions
- Blockchain
- Data lineage, Forensic auditing

ASE 16 SP03 PL01 is current release

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SAP Adaptive Server Enterprise (ASE)

Product road map overview – SAP Business Suite on SAP ASE

2017 - Recent innovations

SAP Business Suite/SAP Applications

- CDS functionality Phase 2
- Technical Monitor Cockpit
- Built-in SAP ASE Long term performance Data Repository (BALDR)

2018 – Planned innovations

SAP Business Suite/SAP Applications

- CDS functionality Phase 3
- Read Only Standby with HADR
- MemScale adoption (phase 1)
- User store

2019 – Product direction

Sap Business Suite/SAP Applications

- CDS functionality Phase 4
- MemScale adoption (phase 2)

2020 – Product vision

SAP Business Suite/SAP Applications

- Continued support for R3 developments and enhancements to SAP ASE support for SAP Business Suite

ASE 16 SP03 PL01 is current release

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2019 Product direction

Product direction

SAP Adaptive Server Enterprise (ASE) near-term general direction summary

- Increased XOLTP capabilities by
  - supporting temporal SQL common to time series data streams
  - Improved capacity of table variables to replace heavier weight temp tables
  - Reduced query optimization time and resource usage
- Improved Data Center Operations & Security through
  - Utility to support database migrations from smaller to larger page size (e.g. 2K→16K)
  - Enhancements to Always-On to handle XA transactions
  - Support for a simplified standby database implementation to provide read-only access to the standby without additional setup/maintenance currently required
  - Exploiting Hardware Security Modules for faster network, full database and column encryption, key management
- Provide cloud-based performance and tuning capabilities as a service
  - JSON support for data shredding and peer-to-peer transactions
  - Cloud based detailed analysis
  - Cloud based workload analyzer analysis of workload capture data
- Improved SAP HANA integration through
  - Improved tooling for supporting A4A environments and common SAP HANA SQL development

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2019 – Product direction

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2020 – Product vision

SAP Business Suite/SAP Applications

- Continued support for R3 developments and enhancements to SAP ASE support for SAP Business Suite

ASE 16 SP03 PL01 is current release

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2020 Product vision

Product vision

SAP Adaptive Server Enterprise (ASE) long-term general direction summary

- Continued enhancement of SAP ASE's XOLTP capabilities
- Improved data center operations via more advanced capture/replay integration with monitoring API
- Utilities to facilitate storage infrastructure changes and isolated transaction recovery/undo capability
- Incorporation of technologies key to Financial Technology (FinTech) adoption such as blockchain & JSON

This is the current state of planning and may be changed by SAP at any time.

Summary

SAP Adaptive Server Enterprise

XOLTP focus

- Focus is to greatly improve the low-latency execution and scalability of SAP ASE allowing customers to scale-up on today's & tomorrow's high density compute platforms

Data center operations eco-system

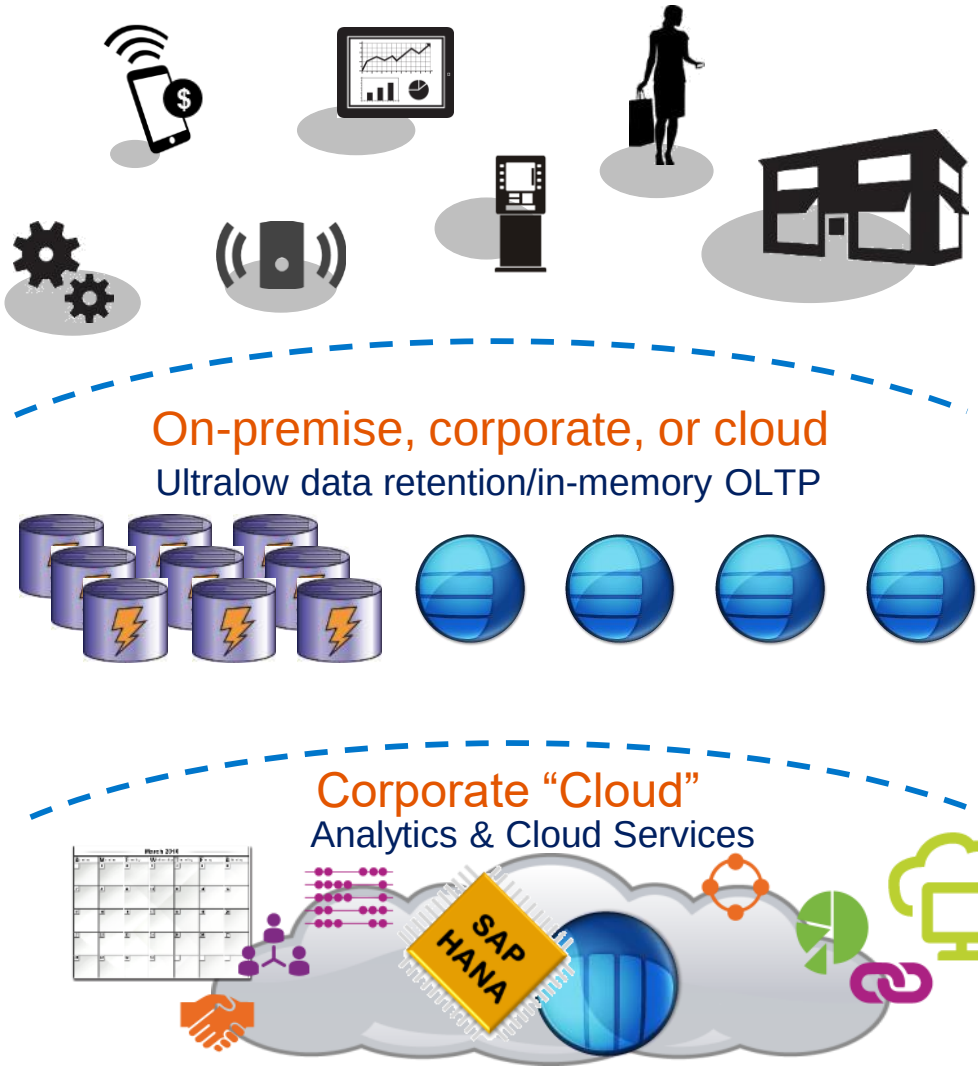
- High availability and security to protect and defend XOLTP systems from outages and attacks

Cloud services

- Flexible on-premise or in cloud deployment options as well as leveraging the cloud for common services for on-premise systems

SAP HANA integration

- Continued more tight integration with SAP HANA providing XOLTP with Real Time Analytics on optimized platforms vs. brute force, less mature technologies and systems.



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Related road maps

SAP ASE EcoSystem Road maps – road maps for products commonly used in SAP ASE deployments

Related product road maps available on sap.com/roadmaps :

- SAP Replication Server
- SAP IQ
- SAP HANA
- SAP SQL Anywhere

Run Simple

Thank you

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Key links for more information

For customers and partners

Key links

- SAP Road Maps http://www.sap.com/roadmaps
- SAP Community Network https://www.sap.com/community/topic/ase.html
- IT Planning Resources https://wiki.scn.sap.com/wiki/x/ggvRGg
- SAP Innovation Discovery http://www.sap.com/innovationdiscovery
- SAP Transformation Navigator http://www.sap.com/transformationnavigator
- Documentation https://help.sap.com/viewer/product/SAP_ASE/16.0.2.0/en-US
- Evaluation Software http://www.sap.com/product/data-mgmt/sybase-ase.html

Where to go to provide product feedback and ideas

- Influence programs http://influence.sap.com/
- SAP User Groups https://www.sap.com/about/customer-involvement/user-groups.html

Appendix

Appendix
Table of contents

Acronym Glossary

Per Feature Detail Slides

- Recent innovations
- Planned innovations

Acronym glossary

Acronym	Full Text
A4A	SAP HANA accelerator for SAP ASE
ACK	Acknowledgement
AES	Advanced Encryption Standard
API	Application Programming Interface
ASE	Adaptive Server Enterprise
BCP	Bulk Copy Program
CI	Canonical Interface
CIS	Component Integration Services
COTS	Commercial Off-The-Shelf
DBA	Database Administrator
DDL, DML	Data Definition Language , Data Manipulation Language
DoD	Department of Defense
DR	Disaster Recovery
DRC	Data Row Cache
DSAM	Dynamic Storage Access Management
EDW	Enterprise Data Warehousing

Acronym glossary

Acronym	Full Text
EIM	Enterprise Information Management
ESP	SAP Event Stream Processor
HA	High Availability
HCB	Hash Cached B-Tree
HSM	Hardware Security Module
IMDB	In-Memory Database
IMRS	In-Memory Row Store
LDAP	Lightweight Directory Access Protocol
LFB	Latch Free B-Tree
LLDC	Lockless Data Cache
LOB	Large Object
MDA	Monitoring & Diagnostics API
MVCC	Multi-Version Concurrency Control
NVCache	Non-Volatile Cache
NUMA	Non-Uniform Memory Access

Acronym glossary

Acronym	Full Text
OLTP	On-Line Transactional Processing
PCI	Pluggable Component Interface
RDBMS	Relational Database Management System
RDDB	Reduced Durability Database
RDS	Rapid Development Solution
SDK	Software Developer Kit
SIMD	Single Instruction, Multiple Data
SMP	Symmetric Multiprocessing
SNAP	Simplified Native Access Plan
SRS	SAP Replication Server
TCO	Total Cost of Ownership
TSX	Transactional Memory
UDB	Universal Database
VLDB	Very Large Database
XOLTP	Extreme Online Transaction Processing

Per Feature Detail Slides

- Recent innovations
- Planned innovations

3 Types of In-Memory Row Stores – Why SAP ASE is unique

Recent innovations

Concurrent DML Aggregator

Often used in column-store analytics focused DBMS's (e.g. SAP IQ) to support concurrent DML operations on the same table

- Reduces the number of IO's for small transactions due to columnar storage

Transient Hot Data

Used to store transient data with limited life expectancy

In-memory tables not persisted to disk – although ACID may be supported (via log writes) or nondurable

- If data is to be persisted to disk for long term storage, app has to copy data from table to table plus app changes to union in-memory rows with on-disk rows for every query (☯ in table)
- Similarly, if data is to be promoted from disk for faster access, app has to copy from table to table

Information Life Cycle Management (ILM)

Extends normal database buffer cache to exploit in-memory techniques to speed access and minimize contention

- Hot data is automatically promoted from DBMS buffer cache to IMRS
- As data ages, it is automatically packed back to the buffer cache from the IMRS

	Analytics		OLTP		
DBMS	**In-Memory Columns**	**DML Aggregator**	**Transient Data**	**ILM**	**HADR**
Oracle	✓				✓
IBM DB2	✓				?
MS SQL		☯	✓		⊘
MemSQL		☯	✓		✓
SAP IQ		✓			⊘
SAP HANA	✓	✓	✓		✓
SAP ASE			✓*	✓	✓

** ASE support for in-memory transient data is via the IMDB capability which is separate from the IMRS*

IMRS in Competitive XOLTP DBMS Solutions

Recent innovations

In-Memory Tables/On Disk Tables are exclusive

A table is either an in-memory (only) table or an on-disk table (with usual buffer caching) – but it can't be both

If data must move from in-memory to on-disk, the application must do so via SQL

- Or if to be promoted to in-memory, it also must be copied from one table to the other

Apps have to be rewritten to handle different tables

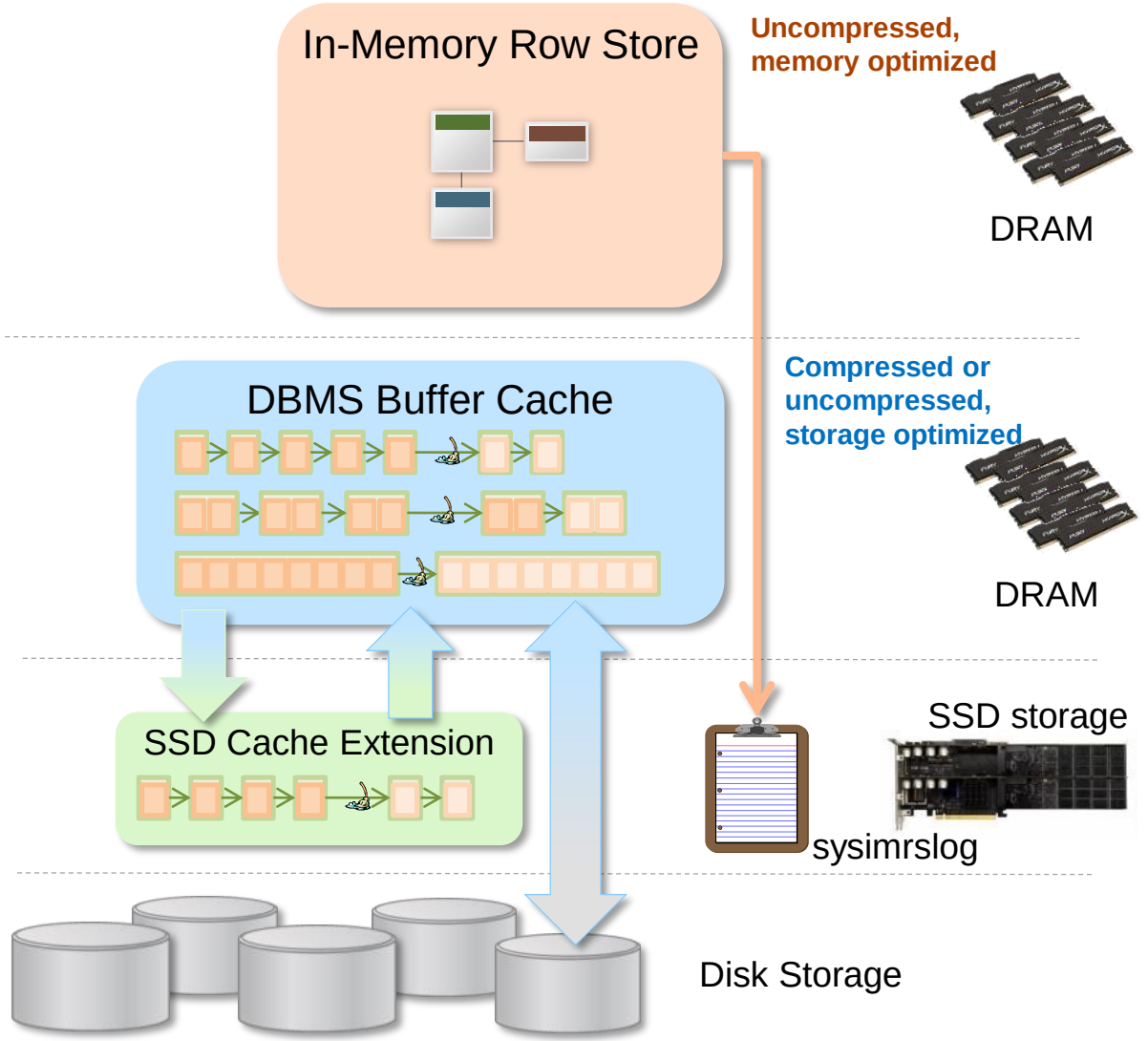
- Either know which table to query, or….
- Perform a union across both

Solution focuses on "transient" data

- Data that needs to be used only for a short period of time and is constantly "hot" during that period
- Data volume constrained by memory limits & recovery speed

Other unrelated fun…

SSD cache extensions are read-only



ASE's Data Row Caching via the In-Memory Row Store

Recent innovations

IMRS as an ILM

Some of the most active tables are also the largest

- For example, transaction tables, etc.

It all won't fit in memory

Today's data hotter than yesterdays, ….

Data Row Caching

Frequently accessed data is promoted to DRC

- Newly inserted rows
- Frequently selected or frequently updated

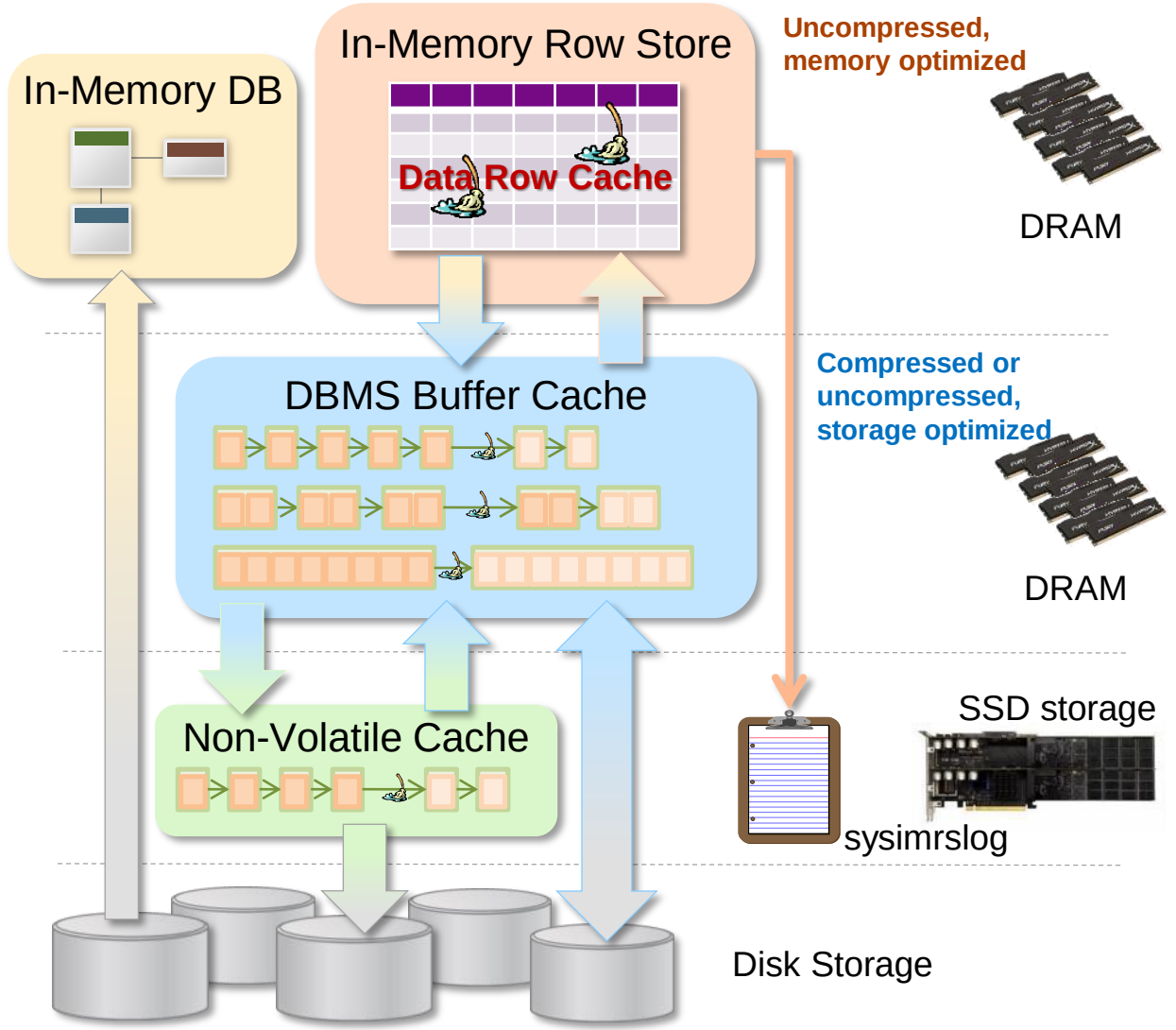
Uses memory optimized cache techniques

- Row versioning for updates
- Data is uncompressed for frequent reads/updates

Optimized IMRS log for ACID durability/recovery

As it "cools", it is packed back to normal DBMS buffer cache

Works in conjunction with MVCC and HCB

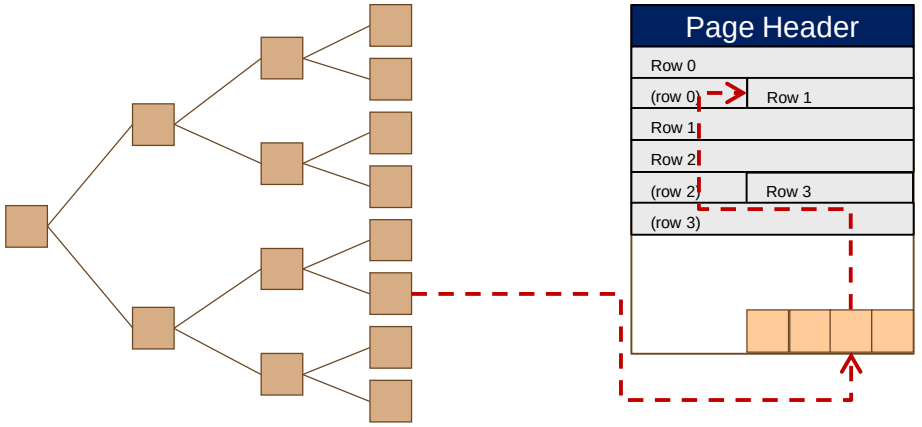


There are 3 common index formats

B-Tree (most common)

Typical tree structure

Nodes are composed of index key values + RID



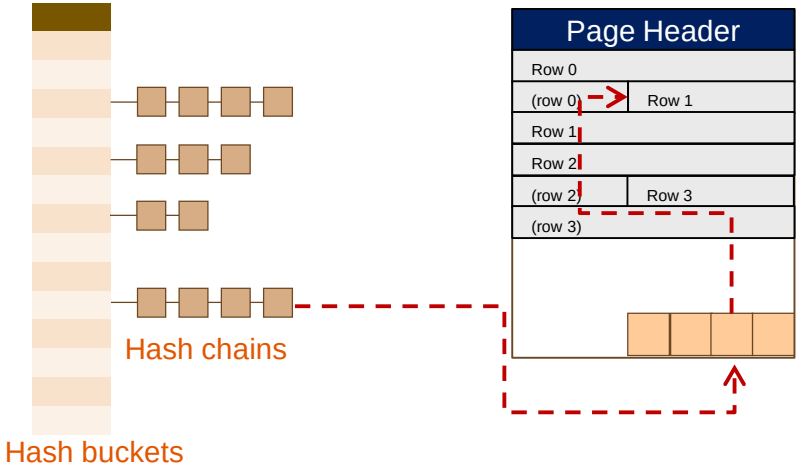
Hash

Consists of hash table/buckets with hash chain of elements

Hash nodes are composed of hashkey value + RID

- Note that the index key value is *not* in the hash table

Used in SAP ASE internals a lot (e.g. cache, locks)



Bitwise

Consists of encoded bits packed into dense large IO pages

Mainly used for analytics and especially for low cardinality values when expecting a large number of rows to qualify

Not part of today's discussion

B-Tree vs. Hash Index

Recent innovations

B-Tree Index

Advantages

Supports partial index usage

- Or scans, etc.

Supports range scans & min/max optimizations

- Leaf nodes are sorted

Supports non-unique values easier

- Shorter RID list implementation

Easier to maintain

- As table grows, index tree can be pruned/expanded as necessary with impact minimized to local tree branches (rare root level impacts)

Disadvantages

Slower - needs multiple string comparisons when traversing the b-tree

Considerable space used - intermediate nodes have copies of index keys

- This is reduced in SAP ASE via suffix compression

Hash Index

Advantages

Can be faster - hash operation & serial scan of hash chain

Denser - hash values much smaller than index keys

- Index keys only stored once on hash nodes

Disadvantages

Doesn't work well on large tables as the number of hash buckets results in longer hash chains (and more time to scan)

- Larger hash tables take up a lot of memory
- Each hash chain value will need string comparisons (data page)

Doesn't work well on non-unique indexes

Doesn't support range, min/max, inequality predicates

- Only works for equisargs and IN() lists

Doesn't support partial index usage

- Full index key values must be present for hash value derivation

Harder to maintain

- If hash buckets are increased, all index keys have to be re-hashed to determine new buckets

Best of Both Worlds: Hash Cache B-Tree (1)

Hash Cache B-Tree

Only on unique indexes for IMRS enabled tables

Rows promoted to IMRS will have unique index keys hashed and added to HCB

- Hash chain node points to IMRS row

If row is demoted from IMRS, unique index keys stay hashed in HCB

- Hash chain node points to row in row offset table same as b-tree index page+RID

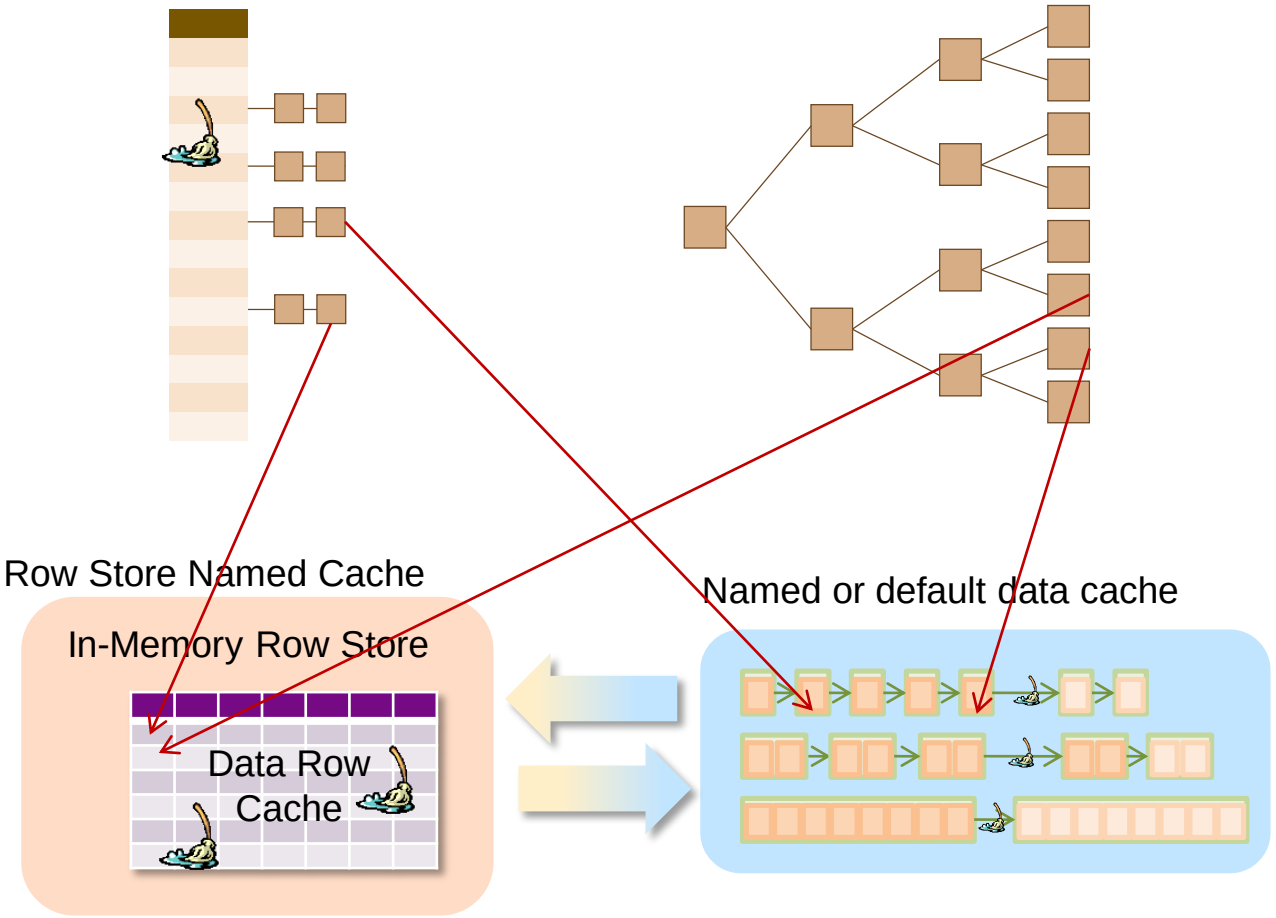
How it works

If query uses equisargs or IN() & unique index

- Index keys are first checked if in HBC, if so, row in either IMRS or page cache is returned
- This includes JOINS!!!

Otherwise, query uses b-tree index

- For non-unique indexes, this also could point to rows in the IMRS



Best of Both Worlds: Hash Cache B-Tree (2)

Recent innovations

Advantages over native Hash Indexing

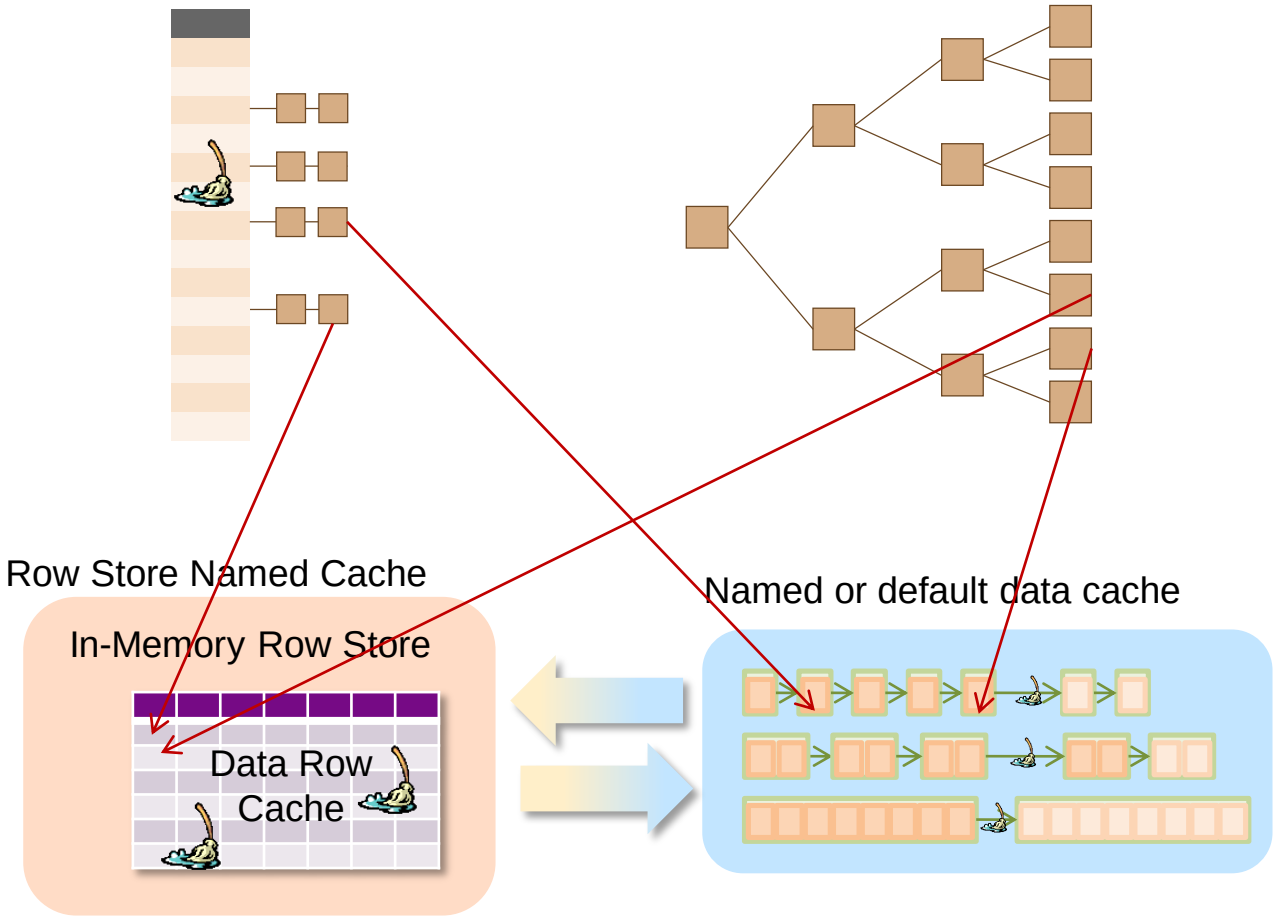
Since only IMRS cached rows are hash indexed, the number of hash buckets can be smaller yet still have short hash chains for fast access

Advantages of B-tree index are retained eliminating need for duplicate indexes on key columns

- Think datetime cols in pkey index and range scans or min/max queries

Disadvantages

Since cache volumes may fluctuate, more difficult to predict the number of hash buckets



Summary of differences between HCB & Native Hash Index

Recent innovations

DML/Operation	B-Tree	HCB+B-Tree	Hash
All rows in index when created	Yes	B-Tree only	Yes
Recovered at server boot	Yes	B-Tree only	Yes
Works well with dynamic tables*	Yes	Yes	No
Works with really large tables*	Yes	Yes	No
Point query with all index keys supported	Yes	Yes	Yes
Point query with partial index keys supported	Yes	(uses B-Tree)	No
Range query supported	Yes	(uses B-Tree)	No

*This takes a bit of thinking. First, consider a table with 1B rows. If we only allow 1M hash buckets, each bucket would cover 1000 rows – far too many for any speed. Even if we reduce to 5 for hash chain length, it then takes 200M buckets which would take 40GB of memory and still not be very effective due to hash chain of 5. Reducing to ~2 would take 100GB of memory. It is possible (of course) to not cache the entire hash index, but this could result in physical reads on index access – which slows down OLTP. On the other hand, it is likely the active portion of the table would be less than 100K rows, which would only need ~4MB of memory for HCB with 1 bucket & 1 node per row

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