SAP HANA:
In-Memory Data Management for Enterprise Applications

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The Vision by Prof. Hasso Plattner

- Transactional (OLTP) and analytical (OLAP) data processing has to be on **one system again**
- Enterprise applications have to reflect latest developments in:
    - Hardware, such as:
        - Multi-core processors
        - Huge Main Memory
    - Data management, such as:
        - Column-oriented storage
        - Light-weight compression

In-Memory Technology Enables Combining OLTP and OLAP in Real-Time

- Data-centric architecture: In-Memory database serves as **single source** of truth for ERP data

- Architecture based on 4 distinct pillars
    - Multi-Core computing
    - In-Memory
    - Column and Row Store
    - Insert-Only

- Enables informed management decisions based on up-to-the-moment data through real-time combination of
    - Transactional applications
    - Analytical applications
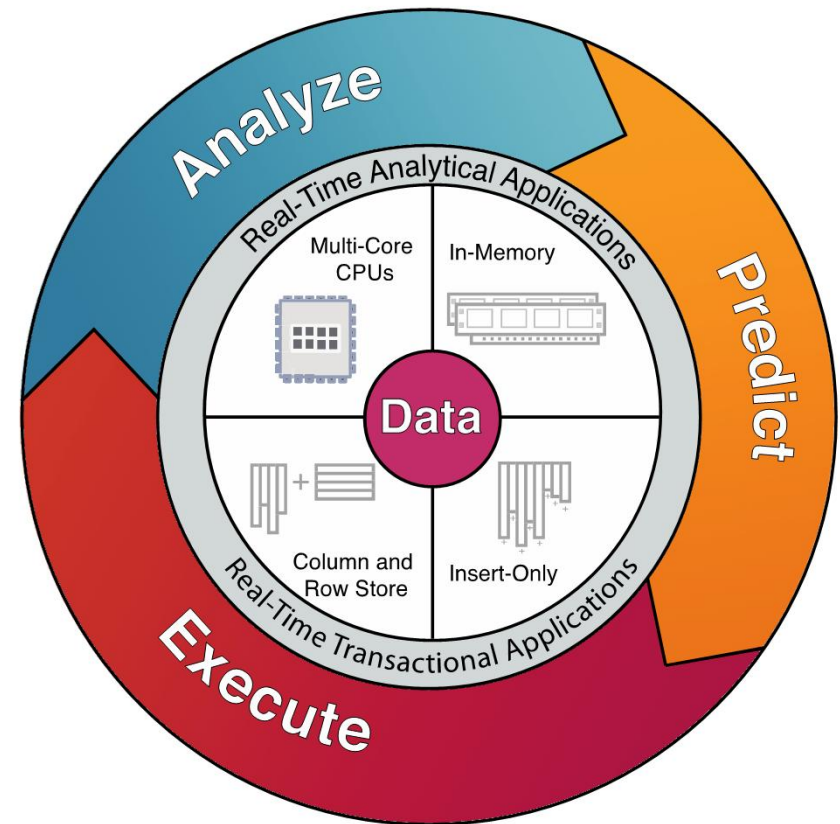
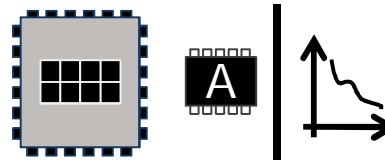Enterprise Performance
In-Memory Circle (EPIC)

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In-Memory Data Management

Advances in Hardware

Multi-Core Architecture
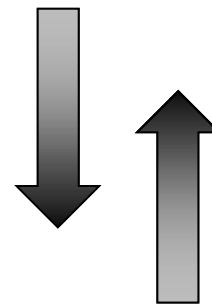(8 x 10core CPU per blade)

Parallel scaling across blades
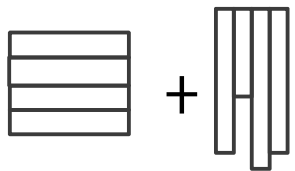
One blade ~$50.000 = 1
Enterprise Class Server

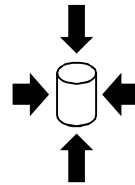64bit address space – 2TB in
current servers

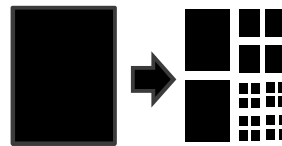100GB/s data throughput

Dramatic decline in
price/performance
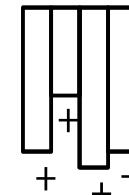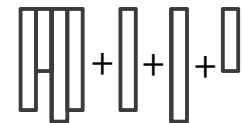
Advances in Software

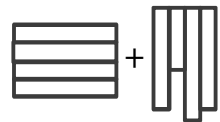Row and
Column Store

Compression

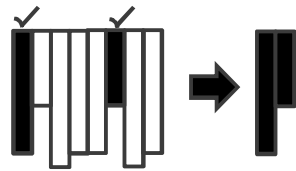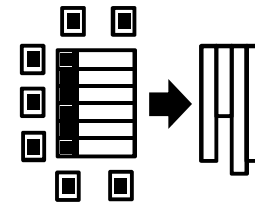Partitioning

No Aggregate
Tables

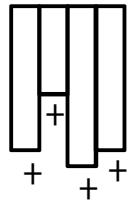Insert Only

On-the-fly
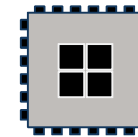extensibility

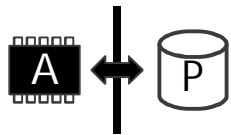Combined column and row store

Minimal projections

Any attribute as index

Insert only for time travel

Bulk load

Multi-core/ parallelization

Active/passive data store
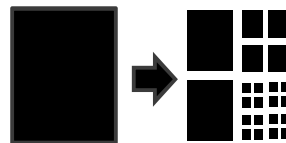
Partitioning
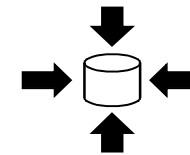
Lightweight Compression
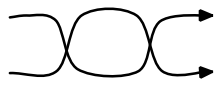
Dynamic multi-threading within nodes
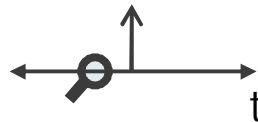
Analytics on historical data

SQL interface on columns & rows
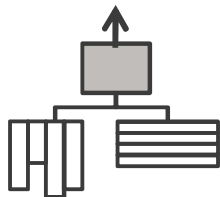
No aggregate tables
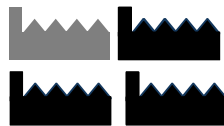
Single and multi-tenancy
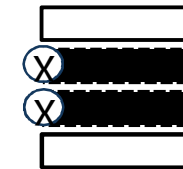
Reduction of layers
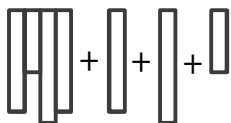
On-the-fly extensibility
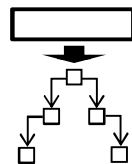
Object to relational mapping
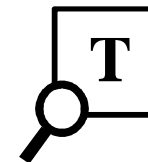
Text Retrieval and EXploration
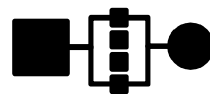
Map reduce

Group Key

No disk

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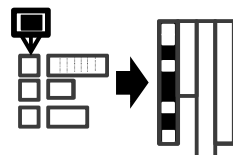
Two Different Principles of Physical Data Storage: Row vs. Column Store

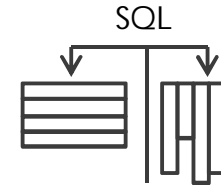| Document Number	Document Date	Sold-To Party	Order Value	Status	Sales Organization	...
95769214	2009-10-01	584	10.24	CLOSED	Germany Frankfurt	...
95769215	2009-10-01	1215	124.35	CLOSED	Germany Berlin	...
95779216	2009-10-21	584	47.11	OPEN	Germany Berlin	...
95779217	2009-10-21	454	21.20	OPEN	Germany Frankfurt	...

Row Store

Column Store

Row 1

Row 2

Row 3

Row 4

Doc Num   Doc Date   Sold-To   Value   Status   Sales Org
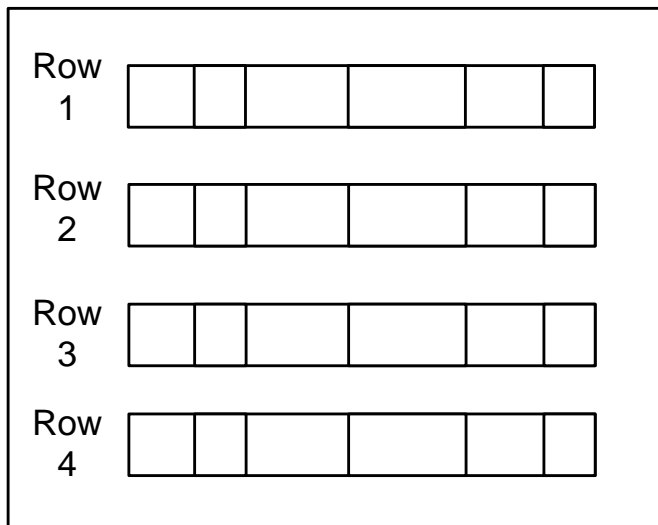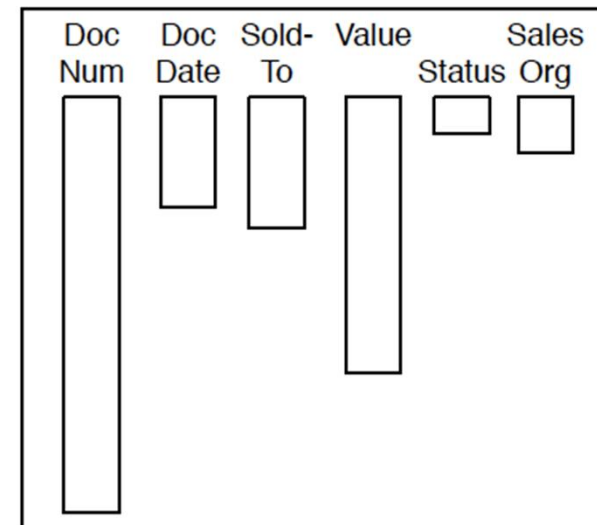
Accessing Enterprise Data

Row Store

Column Store

SELECT *
FROM Sales Orders
WHERE Document Number = '95779216'
(OLTP-style query)

Row 1
Row 2
Row 3
Row 4

Doc Num | Doc Date | Sold-To | Value | Status | Sales Org
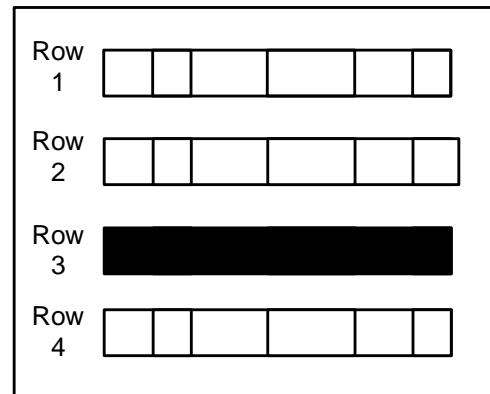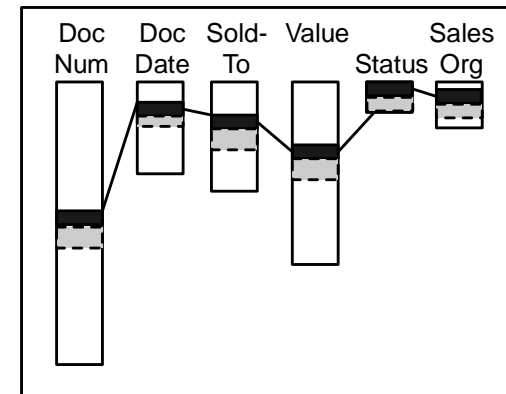
SELECT SUM (Order Value)
FROM Sales Orders
WHERE Document Date > 2009-01-20
(OLAP-style query)

Row 1
Row 2
Row 3
Row 4

Doc Num | Doc Date | Sold-To | Value | Status | Sales Org
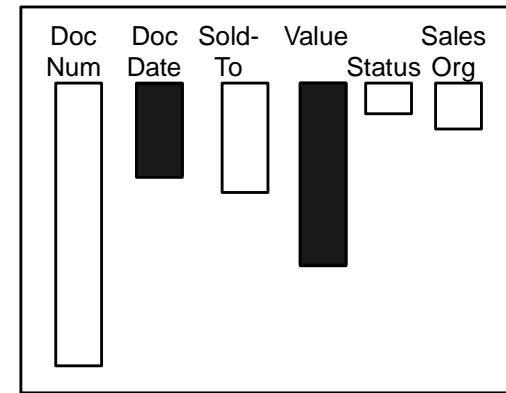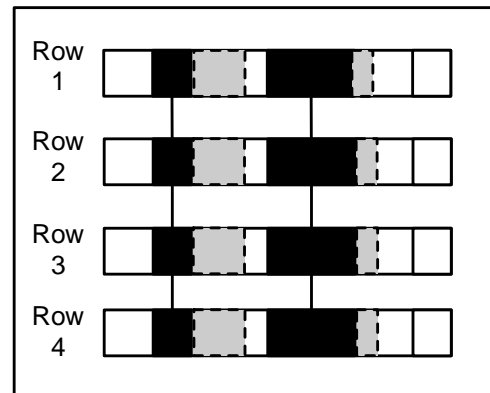
Dictionary Compression

□ Reduces I/O operations to main memory (bottleneck)
□ Operations directly on compressed data

8

Document Number	Document Date	Sold-To Party	Order Value
95769214	2009-10-01	584	10.24
95769215	2009-10-01	1215	124.35
95779216	2009-10-21	584	47.11
95779217	2009-10-21	454	21.20

Dictionaries

Document Number

0	95769214
1	95769215
2	95779216
3	95779217

Order Value

0	10.24
1	21.20
2	47.11
3	124.35

Document Number	Document Date	Sold-To Party	Order Value
0	0	1	0
1	0	2	3
2	1	1	2
3	1	0	0

Document Date

0	2009-10-01
1	2009-10-21

Sold-To Party

0	454
1	584

- Typical compression factor for enterprise software 10
- In financial applications up to 50

Table Characteristics

Row Store

Small tables
Frequent updates
Materialized aggregates

Column Store

Large tables
Rare updates
Dynamic aggregates

Text

Crawler
Join structured &
unstructured data
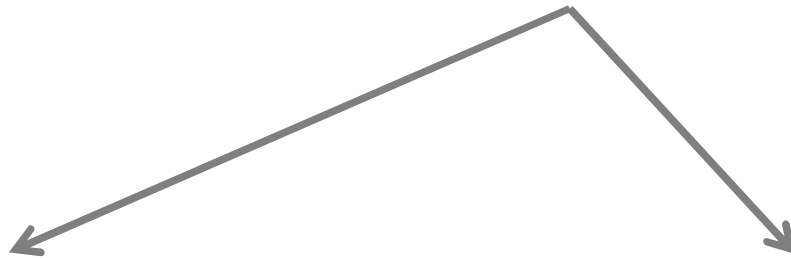
Transactional Data

Direct access to tuples
Blade-local transactions
Status updates
Active / passive

Historical Data

Sequential access
No updates

Innovative In-Memory / HANA Applications

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Nowadays Financials

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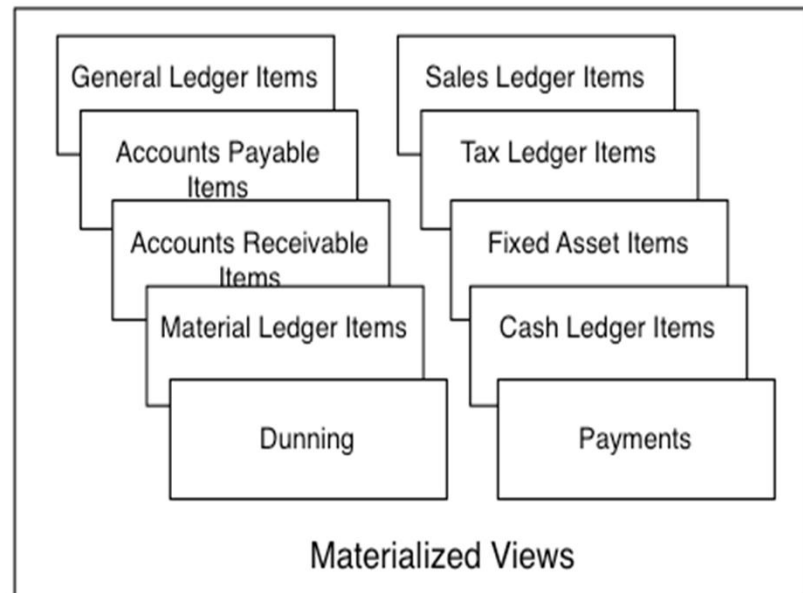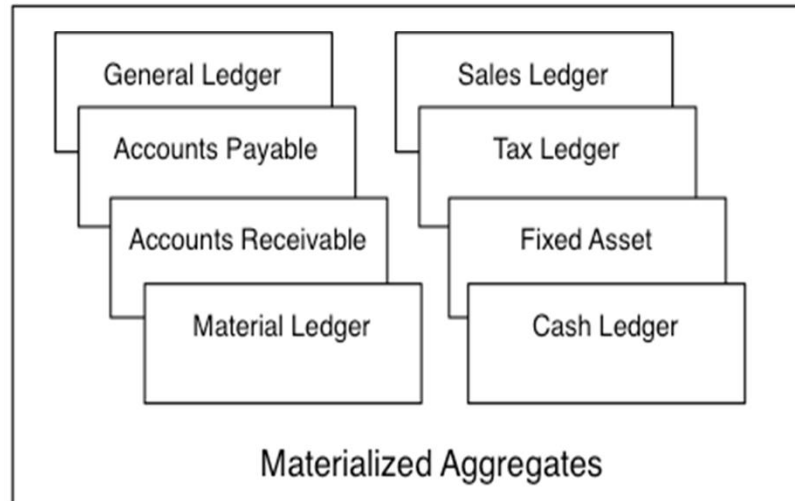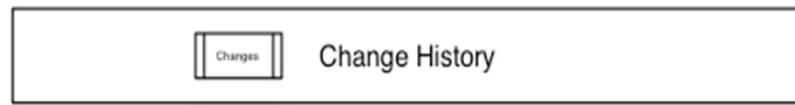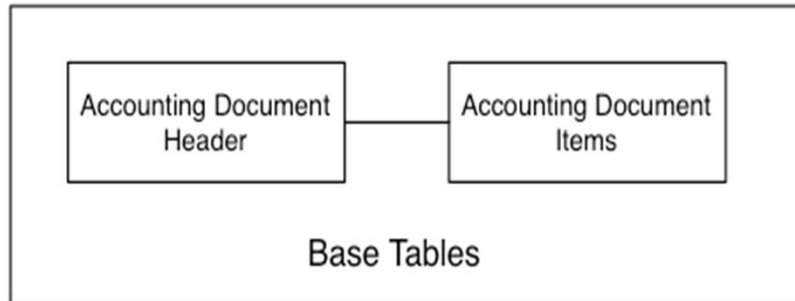
Simplified Financials (Target)

Only base tables, algorithms, and some indices

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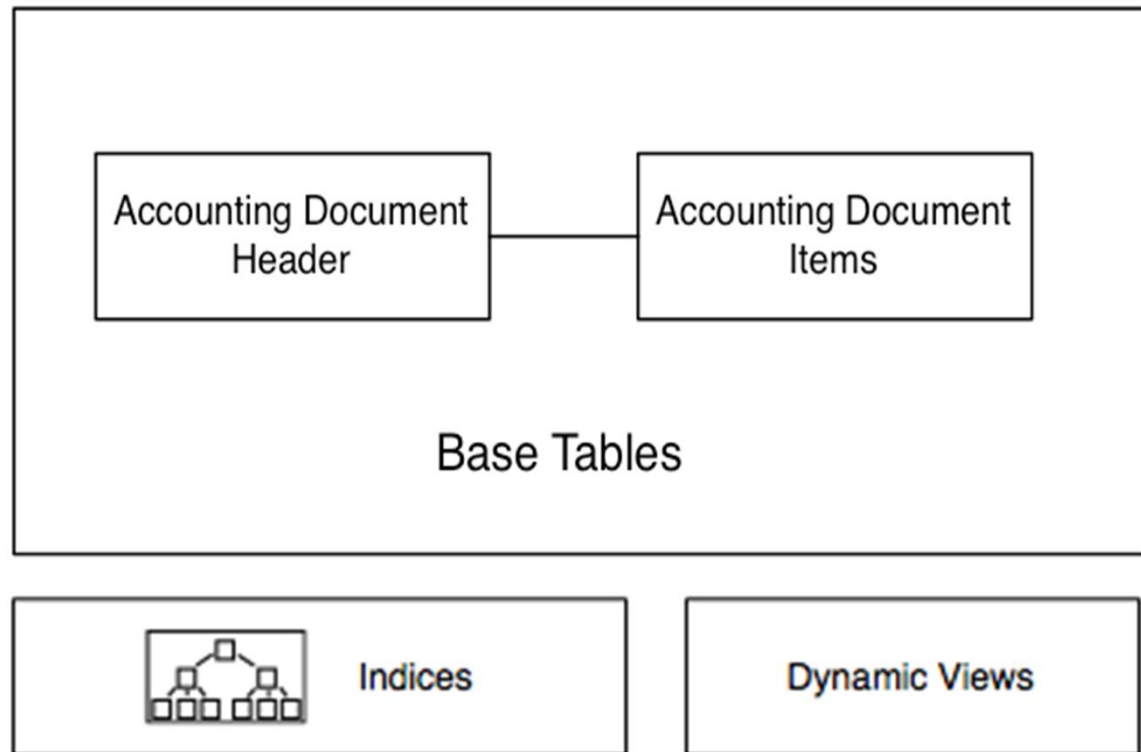
Customer Study 1: Dunning Run in < 1s?

- ☐ Dunning run determines all open and due invoices
- ☐ Customer defined queries on 250M records
- ☐ Current system: 20 min
- ☐ New logic: 1.5 sec
  - In-memory column store
  - Parallelized stored procedures
  - Simplified Financials

Dunning Application

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GORFID

- Tracing pharmaceutical packages in Europe

- 15 bn packages / 35 bn read events per year

Prototype with 12 billions records with response time: 23 ms
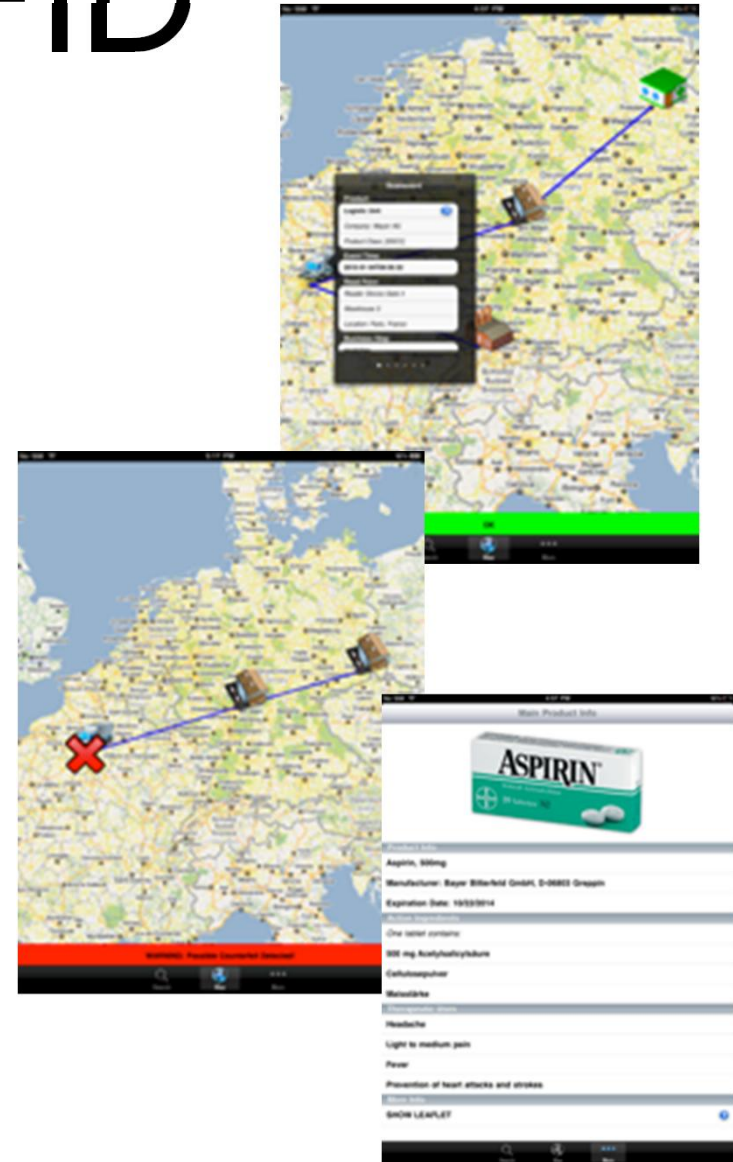
HANA Oncolyzer

- Medical doctors have all patient data at hand to apply personalized medicine

- Medical researchers perform real-time analysis to define cohorts for clinical studies

- International research initiative for exchanging relevant tumor data started at World Health Summit 2011 in Berlin

- In-Memory Technology as

  - key-enabler for real-time analysis

  - provider for information at your fingertips (iPad)

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HANA Oncolyzer - combining Structured and Unstructured Data

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HANA Oncolyzer was presented on CeBIT 2012 to Germany's Chancellor Angela Merkel as SAP`s Innovation 2012

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First Results of Customers using SAP HANA

- 1,000x Faster: Many (Dunning, Aging, …)
- 10,000x Faster: NongFu Spring, Essar Group, SAP IT,
                         Cornell, Charmer Sunbelt
- 100,000X Faster: YodoBashi, MKI

OR

- 24+ Hours to 3.8S: Food and Beverage / Distribution - Logistics
- 15+ Hours To 4.8S: Project Management /
                         Services, Profitability, Performance
- 30 Days to 28S: Manufacturing – Order to Cash
- 3 Days to 2s: Retail / Insurance – Incentives

All Findings are Summarized in the Book "In-Memory Data Management"

This book is the culmination of five years worth of in-memory research

- PART I – An Inflection Point for Enterprise Applications
  - Overview of our vision of how in-memory technology will change enterprise applications
- PART II – A Single Source of Truth through In-Memory
  - Technical foundations of in-memory data management
  - In-depth description of how we intend to realize our vision
- PART III – How In-Memory Changes the Game
  - Resulting implications on the development and capabilities of enterprise applications

-> Book launched at Cebit 2011, SAP Product HANA is available since June 2011.

-> New extended Book Edition "In-Memory Data Management - Technology and Applications " focusing on Application Development will be available for Sapphire May 2012.

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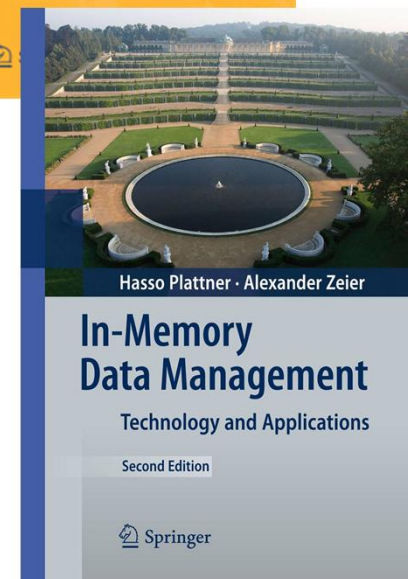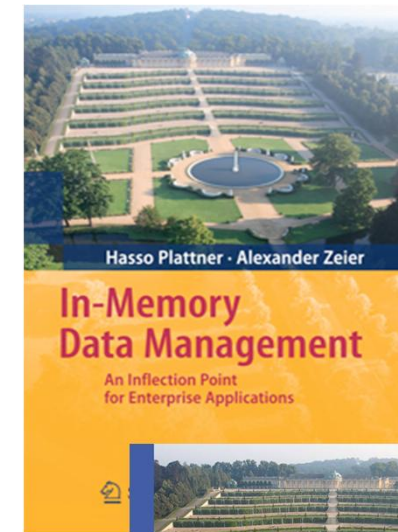
In-Memory/HANA
Drives Worldwide Innovation
Book Launch at CeBIT 2011 with Vice-President of the *European Commission* Neelie *Kroes*

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SAP and HPI win the
German Innovation Award 2012
for SAP HANA!

This year's winners were announced am March 16, 2012 in Munich, Germany.

Please feel free to contact me:

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