

Vitaliy Rudnytskiy, SAP
August 2014, Budapest

Big Data && Fast Data

Disclaimer



“

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”

Let's start with...

... me :) **Vitaliy Rudnytskiy**

@Sygzymundovych

SAP's Developer Center team

- developers.sap.com
- Data Management and Analytics

Live in Wrocław, Poland



What is ...



Big Data?

3xV: Volume, Variety, Velocity

4xV: + Veracity

5xV: + Value

6xV: + Vitality ☺

“One Terabyte Club” sounds like terayears ago!

Gartner Inc [US] <https://www.gartner.com/doc/1339726/erp-terabyte-club-joining-later>

Gartner.

WHY GARTNER ANALYSTS RESEARCH EVENTS CONSULTING ABOUT

The ERP Terabyte Club: Are You Joining Now, or Later?

⌚ 27 February 2008 □ G00181467

Analyst(s): Derek Prior

Summary

If you are running large ERP systems, take a look under the hood and determine how much horsepower you have. Not just hardware, but also the staffing level of the ERP operations team to run it all. If the team doesn't have the right software tools to automate its escalating workload, you run the risk of failure.

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Enter Username

Enter Password

SIGN IN

Big Data Definitions accordingly to CIOs



Big Data Definitions

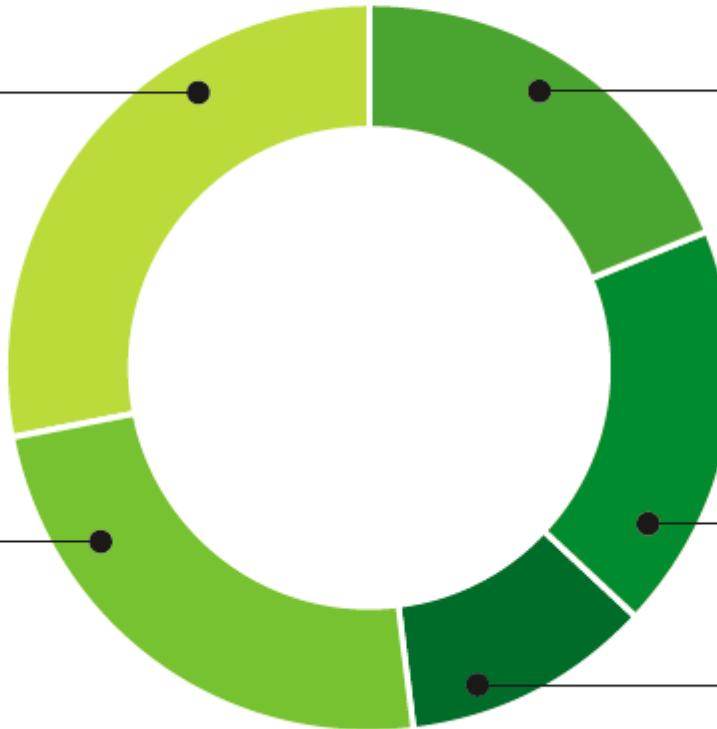
Massive growth of transaction data,
including data from customers
and the supply chain
28%

New technologies
designed to address
the volume, variety, and
velocity challenges
of Big Data
24%

Requirement to store and
archive data for regulatory
and compliance
19%

Explosion of
new data sources
(social media,
mobile device, and
machine-generated
devices)
18%

Some other definition
11%



Source: Harris Interactive, Inc., J41673-Bite Communications C-Suite Study, April 10–23, 2012

Importance of Instant Access to Data in Mobile Business Intelligence and Real-Time Analytics

At least somewhat important (Net)

90%

Absolutely essential

16%

Very important

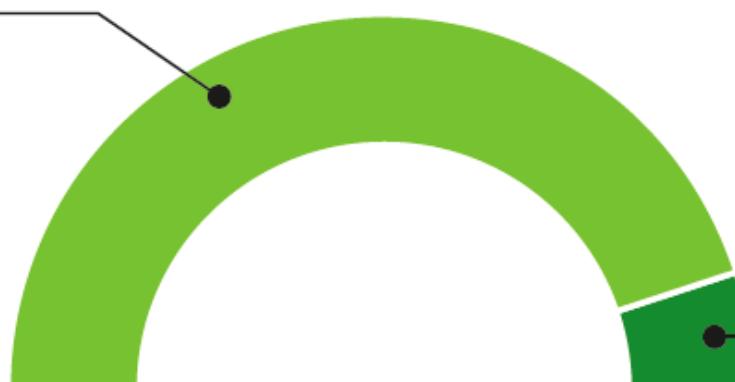
41%

Somewhat important

33%

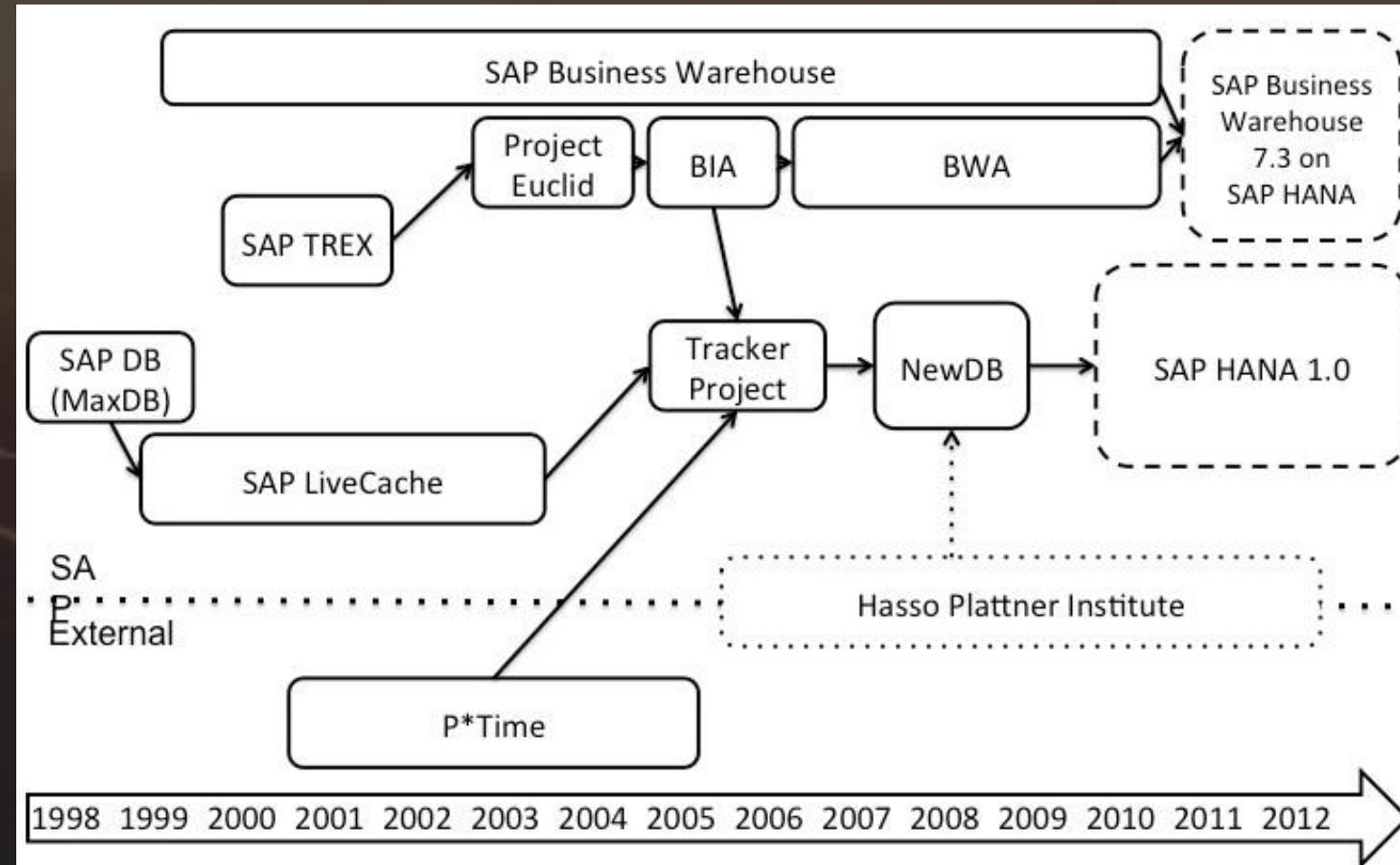
Not at all important

10%



Source: Harris Interactive, Inc., J41673-Bite Communications C-Suite Study, April 10–23, 2012

SAP Road to In-Memory Technology

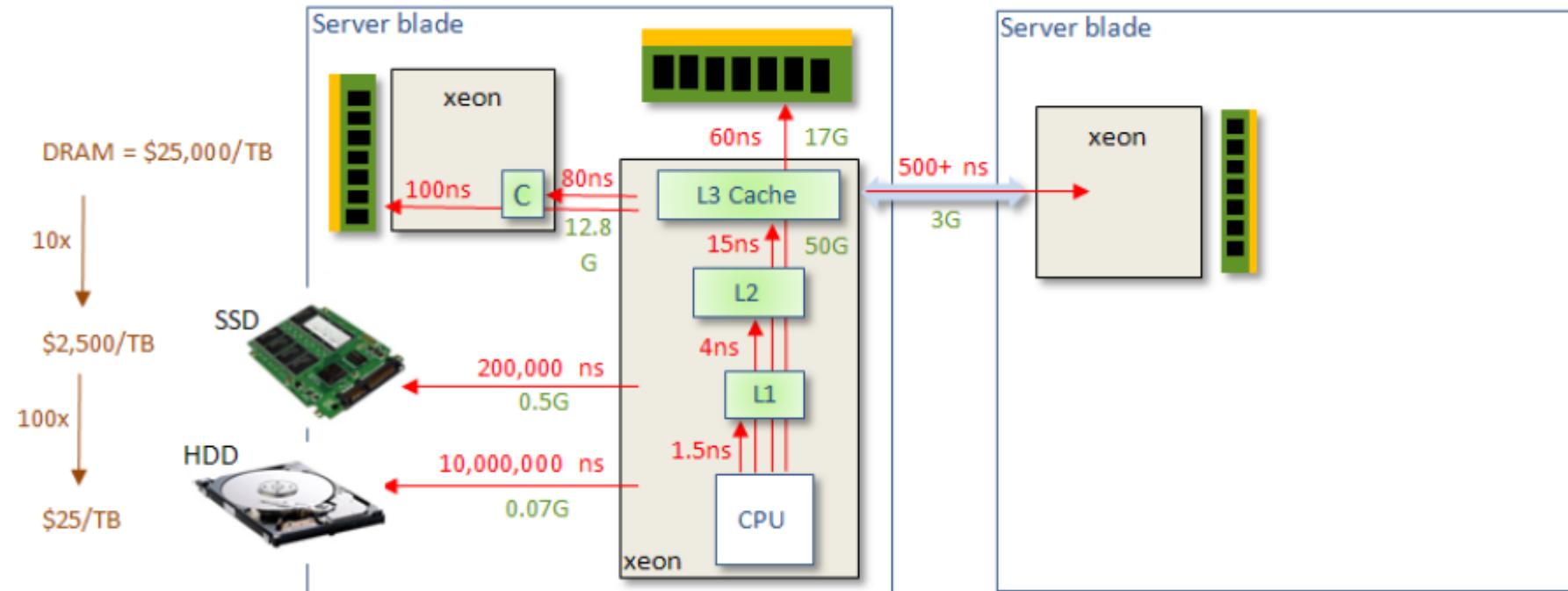


Source: "SAP HANA Essentials", Jeffrey Word

Principle #1

Keep all required data (aka “**hot data**”) in computers’ main memory
Rarely accessed data (aka “**cold data**”) can be moved to cheaper storage

Data Access Latencies and Bandwidth



Source: Intel

Principle #2

Compress data to minimize the footprint

Columnar and Row Based Data Storage

Table

Country	Product	Sales
US	Alpha	3.000
US	Beta	1.250
JP	Alpha	700
UK	Alpha	450

Row Store

	US
Row 1	Alpha
	3.000
	US
Row 2	Beta
	1.250
	JP
Row 3	Alpha
	700
	UK
Row 4	Alpha
	450

Column Store

Country	US
Product	US
	JP
	UK
Product	Alpha
	Beta
	Alpha
Sales	3.000
	1.250
	700
	450

Data Compression in Column Store

Column „Name“
(uncompressed)

Miller
Jones
Millman
Zsuwalski
Baker
Miller
John
Miller
Johnson
Jones
⋮

Column „Name“ (dictionary compressed)

Value-ID sequence
One element for each row in column

4
1
5
N
0
4
2
4
3
1
⋮

Dictionary

0	Baker
1	Jones
2	John
3	Johnson
4	Miller
5	Millman
⋮	⋮

sorted

Value ID implicitly given
by sequence in which
values are stored

1. Dictionary Compression

2. Compression of the Value ID Sequence

- Prefix encoding
- Run Length encoding
- Cluster encoding
- Sparse encoding
- Indirect encoding

3. Further Compression for Main Dictionary

Principle #3

Cache-sensitive data layout and cache-aware algorithms

„RAM Locality is King”

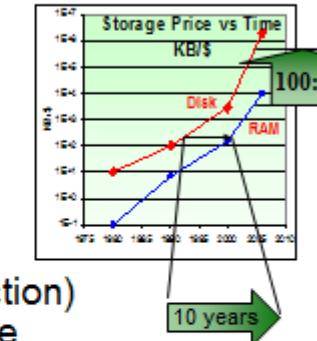
Tape is Dead
Disk is Tape
Flash is Disk

RAM Locality is King

Jim Gray
Microsoft
December 2006

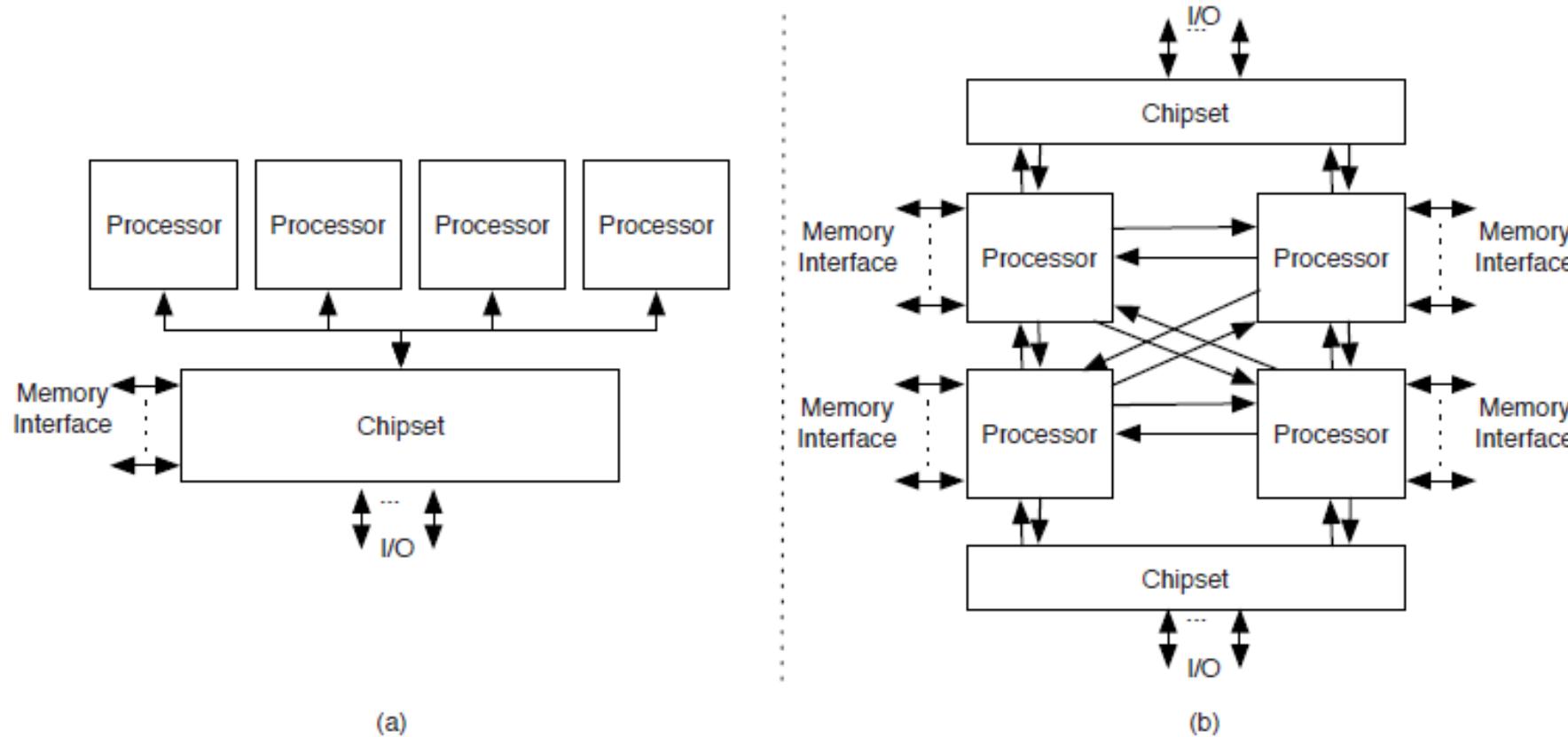
RAM Locality is King

- The cpu mostly waits for RAM
- Flash / Disk are 100,000 ... 1,000,000 clocks away from cpu
- RAM is ~100 clocks away unless you have locality (cache).
- If you want 1CPI (clock per instruction) you have to have the data in cache (program cache is “easy”)
- This requires cache conscious data-structures and algorithms sequential (or predictable) access patterns
- Main Memory DB is going to be common.



Source: Microsoft Research: research.microsoft.com/en.../Flash_is_Good.ppt

Bandwidth between CPU and Main Memory



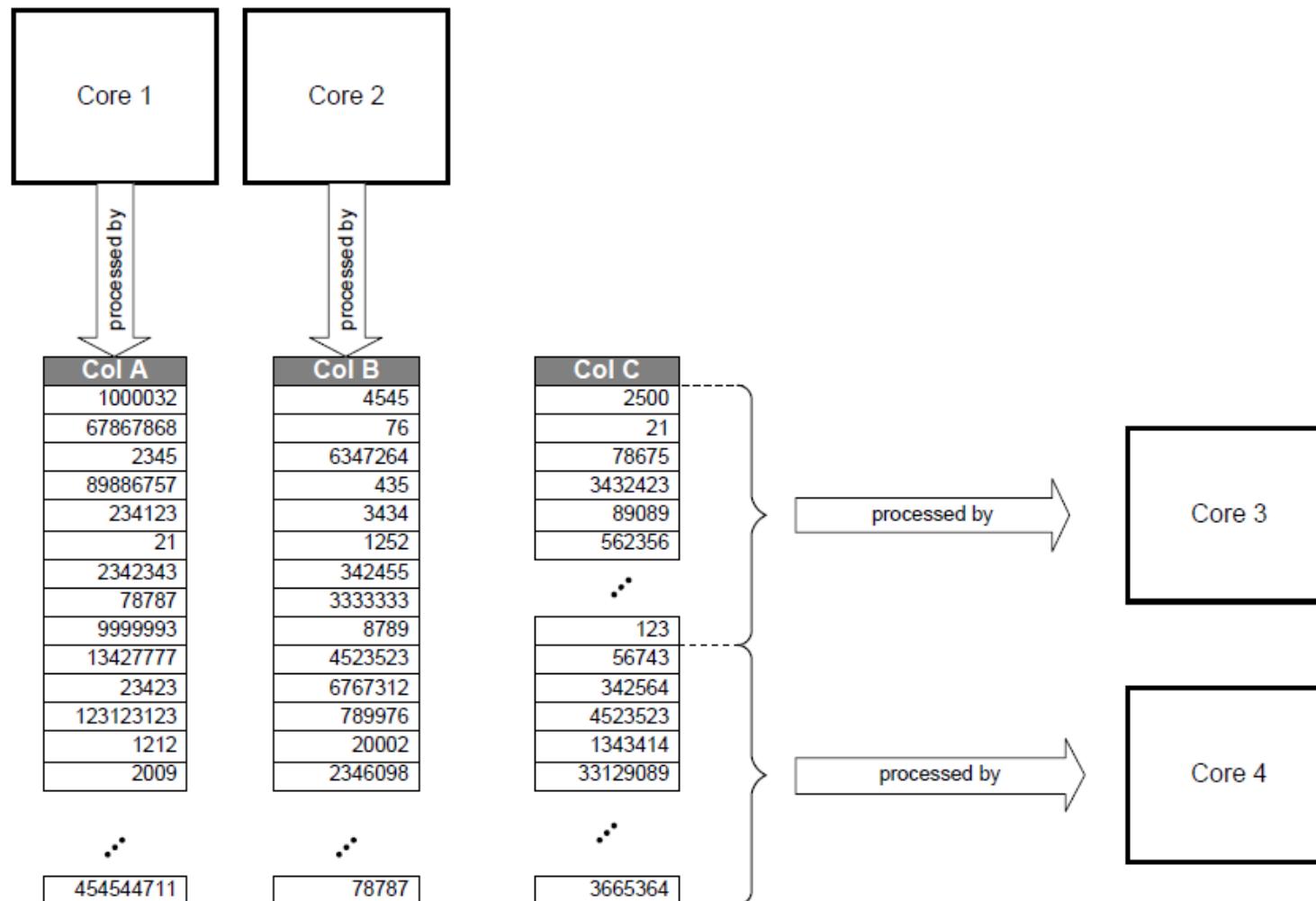
(a) Intel Shared Front Side Bus (UMA Architecture)
(b) Intel Quick Path Interconnect (NUMA Architecture)

Source: "In-Memory Data Management: An Inflection Point for Enterprise Applications" by Hasso Plattner, Alexander Zeier

Principle #4

Software performance growth is in the **parallel processing**,
not in increasing clock speed

Examples of Parallelization in a Column Store



Principle #5

Move **data-intensive operations** to the data layer

Integrate **data processing engines** (relational, text, graph, streaming...)

Include **built-in libraries** (geospatial, predictive, 3rd parties)

Have you seen...



1

Petabyte?

The SAP HANA One Petabyte Test



The System

Single Instance of SAP HANA
100 Servers / 4,000 Cores / 100 TB RAM

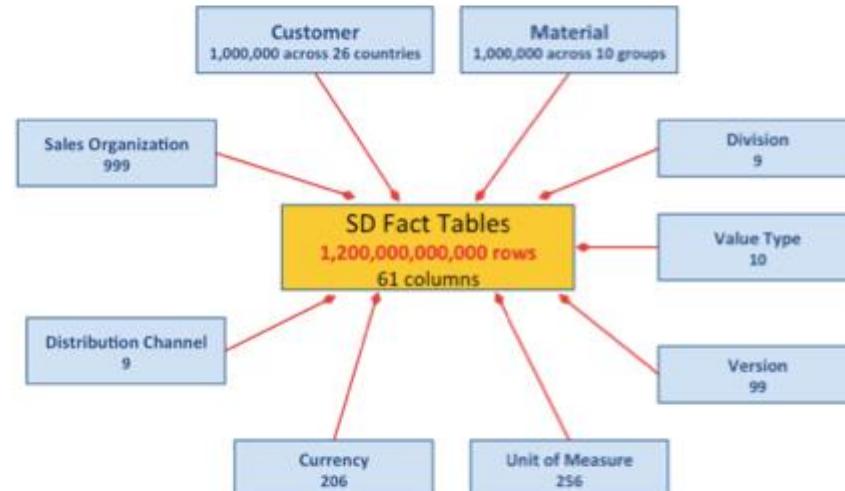


The Queries

Representative BI queries with varying complexity from moderate to very complex

The Data

1 Petabyte of Raw Data
10 Years / 1.2 Trillion rows of ECC SD Data



The Results

Throughput: 60 Streams running 112,602 queries per hour, representing > 5,000 concurrent BI users
Response Time: See below for individual queries.

Guinness World Record: 12.1 PB DW



www.guinnessworldrecords.com/world-records/5000/largest-data-warehouse

You are here: Global Home > Explore Records > Largest data warehouse

LARGEST DATA WAREHOUSE

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FOR THE RECORD

WHO:
SAP, BMMSOFT, HP, INTEL,
NETAPP AND RED HAT

WHAT:
**LARGEST DATA
WAREHOUSE**

WHERE:
UNITED STATES

The largest data warehouse contains 12.1 petabytes (12,100 terabytes) of raw data, achieved by a collaboration between SAP, BMMsoft, HP, Intel, NetApp and Red Hat at the SAP Co-location Lab, Santa Clara, California, USA, on 17 February 2014.

OFFICIALLY AMAZING

GUINNESS WORLD RECORDS™

Source: <http://www.guinnessworldrecords.com/world-records/5000/largest-data-warehouse>

Here comes **Hadoop**



2.8 ZB in 2012
85% from New Data Types
15x Machine Data by 2020
40 ZB by 2020
New Sources (Sentiment,
Clickstream, Geo, Sensor)

Ref: Hortonworks

SAP HANA && Hadoop: Comparison

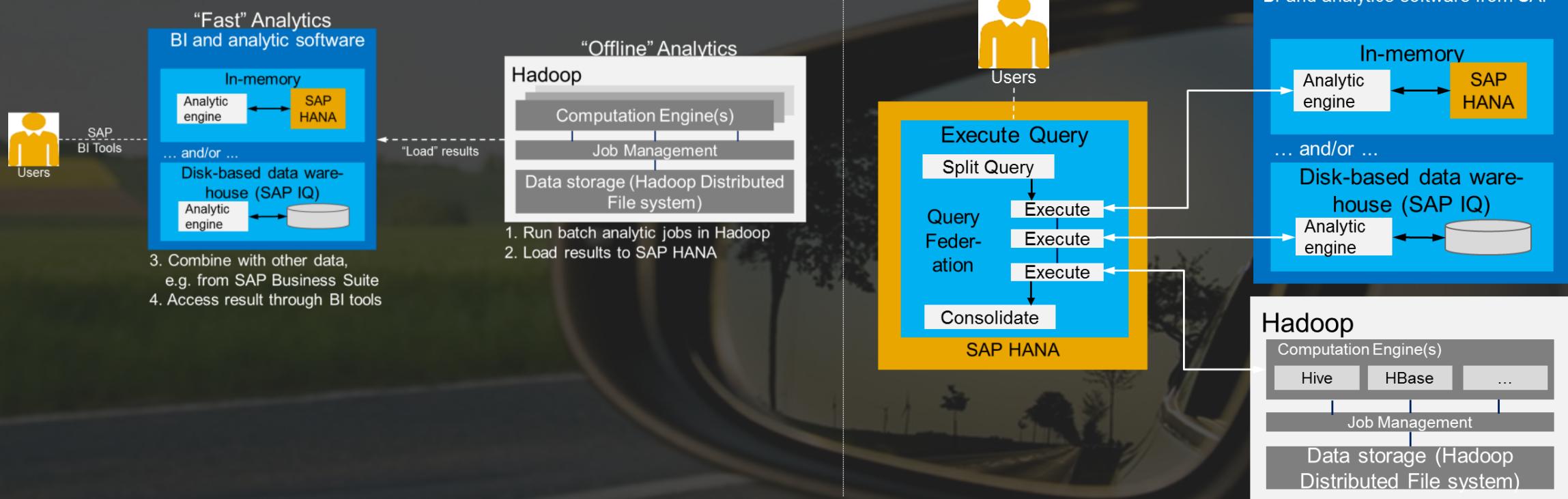


RDBMS, In-Memory (SAP HANA) Databases, and Hadoop

Relational Database Management System	In-Memory (SAP HANA*) Database	Hadoop
Structured data stored on disk	Mainly structured data in memory	Any data or file structure on disk
Slow data access (~10 ms)	Very fast access (~<1 ms)	Very slow data access (seconds to hours)
Predefined schema	Predefined schema	No schema or postdefined schema
1 server (~8 to 32 cores ⁸)	1 or many servers (100s of cores)	Distributed servers
Scale-up architecture	Scale-up/scale-out architecture	Scale-out architecture
Server-level failover	Server-level failover	Query and server-level failover
Existing server technology \$	Database appliance \$	Commodity (low-cost) servers
Excellent OLTP ⁹	Excellent OLTP	No OLTP
Acceptable OLAP ¹⁰	Excellent OLAP	Slow OLAP
High data consistency – based on ACID ¹¹ principles	High data consistency – based on ACID principles	Eventual data consistency (BASE) ¹²
Enterprise-ready administration tools	Enterprise-ready administration tools	Few enterprise-ready administration tools
Evolution rather than innovation	Rapid innovation	Rapid innovation
No IT skills shortage	IT skills shortage	IT skills shortage
License fees required	License fees required	No fees – open source

Source: „How to Use Hadoop with Your SAP® Software Landscape”, <http://www.saphana.com/docs/DOC-3777>

Two-Speed Analytics And / Or Query Federation



Big Data is Strategic to SAP and Partners



Cloudera and SAP

The partnership of SAP and Cloudera offers enterprises compelling solutions to the challenges of Big Data and enterprise data management and analytics. With SAP and Cloudera, forward-thinking enterprises can connect existing business intelligence applications and next-generation analytical systems, like the SAP BusinessObjects BI suite and SAP HANA, directly to their Cloudera-powered Big Data sources.



Meeting the Big Data Challenge with SAP and Cloudera

Enterprises are today at a crossroads in the evolution of their enterprise data architectures. You face the challenge of producing meaningful business value from your growing archives of unstructured data as well as from the expanding array of data sources, both inside and outside your organization.

Industry-leading solutions from SAP and Cloudera offer companies the latitude to discover the value of their data by:

- ✓ Generating high-quality insights from poorly accessible archives
- ✓ Extending practices and analytics to include new data and forms found throughout the organization and beyond
- ✓ Adapting practices and architectures that both gain from current investments and build for future business

The combination of SAP and Cloudera provides you with Big Data architectures that power:

- ✓ Unified data refineries for limitless archives and analysis with CDH
- ✓ Common models and access for ETL and analytics on Hadoop with SAP Business Objects BI suite and SAP Data Services
- ✓ Powerful platforms that harness and combine the advanced analytics of SAP HANA and CDH



Hortonworks

SAP

SAP HANA + Hadoop = instant access + infinite scale

SAP® provides a best-in-class portfolio of databases, information management solutions, analytic tools, and analytic applications.

The strategic relationship between Hortonworks and SAP enables SAP to resell Hortonworks Data Platform (HDP) and provide enterprise support for their global customer base. This means SAP customers can incorporate enterprise Hadoop as a complement within a data architecture that includes SAP HANA and SAP BusinessObjects enabling a broad range of new analytic applications.

SAP HANA + Hadoop = Instant access + Infinite scale

By using SAP HANA and Hadoop together, customers get the power of instant access with SAP HANA¹⁷ and infinite scale with Hadoop. This gives SAP users a broad range of options for storing and analyzing new types of data and the ability to create applications that can uncover new business opportunities from vast amounts of data that would not have been previously possible.

Integrated technologies ease adoption

SAP and HDP are integrated in multiple ways: Through SAP HANA smart data access as well as direct access through SAP Business Objects BI universes. Also, SAP Data Services 4.1 delivers a Hadoop interface that provides high-performance read and load to Hadoop. SAP Data Services identifies, extracts, structures, and transforms the meaningful information from Hadoop and provisions the data to SAP HANA or other data stores for deeper analysis of structured and unstructured information.

<http://www.cloudera.com/content/cloudera/en/solutions/partner/SAP.html>

<http://hortonworks.com/partner/sap/>

SAP HANA and Hadoop

Product road map overview – key themes and capabilities

Integrate:

- **Usability**
 - Data Virtualization (Smart Data Access) to Hive via ODBC connectivity
 - Richer SQL access from SAP HANA studio to Hive Tables
- **Co-processing**
 - Compute SQL operation between Hive and HANA
- **Performance**
 - SDA optimizations: function completion
 - Remote caching of HIVE jobs
- **Enterprise readiness**
 - Hadoop Distributions Offering from our Partners
 - a. Co-innovation & Reselling with Intel and Hortonworks
 - b. Open for other distro's using HIVE odbc drivers

Optimize:

- **Usability**
 - Execute custom map reduce methods from SAP HANA and consume the results from HANA queries via SQL User Defined Function (UDF).
 - SDA support for Data Provisioning for the SAP HANA Service/Adapter Framework
- **Performance**
 - SDA optimization for connectivity, semi joins & relocation when large amounts of data is queried from SAP HANA and the number of Hadoop nodes are increased
 - Concurrent execution of HIVE jobs from SAP HANA
- **Enterprise readiness**
 - * Support for HANA Authorization/ Authentication and encryption capabilities with partner Hadoop Distributions
 - * Integrate and validate Cloudera CDH-5.1 and Hortonworks HDP-2.0 Hadoop distributions with latest SAP HANA platform
 - Support Apache Spark SQL via partners distro

Synthesize:

- **Usability**
 - Trigger and consume output of PIG jobs from HANA
 - Support HBase as a store for HANA federated queries
- **Co-processing**
 - Advanced SDA for Hadoop windowing, table partitioned functions
 - Hadoop as extended data store for HANA (Big Unified Table)
 - Tiered storage: hot/cold data controlled by HANA
- **Performance**
 - Distributed in-memory caching of hot HDFS data
 - Parallel connections from HANA to Hadoop for loading and queries
 - Extend HANA compute engine to Hadoop
- **Enterprise readiness**
 - Integration of Partner Hadoop Distro features into SAP HANA Cockpit
 - Send Hadoop logs to SAP Solution Manager
 - HANA snapshot to HDFS with restore
 - Common authentication and authorization

Today

Planned Innovations

Future Direction

See Appendix for abbreviations

Want to learn and code in...



SAP
HANA?

Free online education: [open.sap.com](https://open.sap.com/courses)



https://open.sap.com/courses

Vitaliy Rudnytskiy Inbox

openSAP

Current Courses



An Introduction to SAP HANA by Dr. Vishal Sikka

This course provides you with a unique insight into SAP HANA. Vishal Sikka, Member of the SAP Executive Board, invites you into his office and shares the ideas behind SAP HANA and how it is different to previous databases. If you have ever asked yourself why did SAP need to build a new database or how does SAP HANA work, or even how does SAP HANA help our customers to run better, then this course is ideal for you.

You don't need any experience with SAP HANA or development to take this course, all you need is the desire to learn about SAP HANA and why it is considered such an innovative product. Take this opportunity to visit Vishal's office and get some insight into SAP HANA.

Start: March 17, 2014
Duration: 4 weeks (2 - 3 hours total learning time)
End: April 14, 2014
Course assignment: March 17 - April 14, 2014
Course language: English

[More Information](#)

Course Assignment due in:

2	8	0	5	4	5	0	4
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DAYS HOURS MINUTES SECONDS

The LEARNING AWARDS 2014 Finalist

Helpdesk

Community and developer access:

<http://developers.sap.com/hana>



- Free developer editions hosted in the cloud (AWS, Azure, CloudShare...)
- How-to guides
- Community support
- Blogs

SAP HANA Developer Center in SAP Developer Center [▼](#)

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SAP HANA Developer Edition

SAP HANA Developer Edition
Start here to create a HANA instance on one of our cloud providers.

[Start Here](#)

HANA Studio & Client Download
To access HANA from your personal computer, download our Studio and Client installations.

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- [Create a poll](#)
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Getting Started with HANA

- [An Introduction to SAP HANA by Dr. Vishal Sikka](#)
- [OpenSAP HANA Learning Material \(videos and lecture materials\)](#)
- [The Road to HANA \(the ultimate link collection for beginners and experts\)](#)
- [SAP HANA Documentation for Developers \(help portal\)](#)

Featured Content - SAP HANA Developer Center

[Developer License expired? You can get a new one. This is how...](#) by Jonathan Baker 
3 months ago

[SAP HANA Developer Edition v1.7.7.2](#) by Craig Cmehil 
4 months ago

[Want to learn SAP HANA? Where to Start?](#)

Heard about SAP HANA but n 

Sponsored Content

 SAP

Examples of some cool ideas from the community

„HADOOP HDFS Explorer built with HANA XS and SAPUI5“ by Aron MacDonald

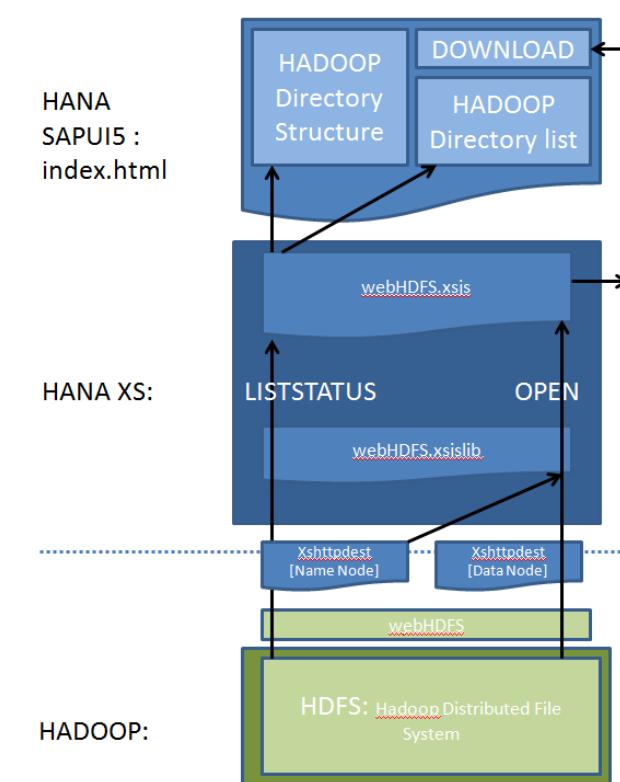
HADOOP Distributed File System (HDFS) Explorer

Download

Type	Name	Size Kb	Date modified
File	_SUCCESS		Sun Mar 09 2014 09:55:35 GMT+0000 (G...
File	part-m-00000	106.200	Sun Mar 09 2014 09:55:35 GMT+0000 (G...

HADOOP Cluster

- HDFS/user/admin
 - .Trash
 - .staging
 - DETA
 - archive.tab
 - archivesmalltab.csv
 - foo
 - hanaDeltaExample
 - month1tab.txt
 - oozie-oozi
 - quakeDETA
 - quakes
 - archive
 - newMonth
 - ytdTAB
 - input
 - newDelta
 - newLoad
 - priorLoad
 - scripts
 - smallDelta
 - smallDelta2



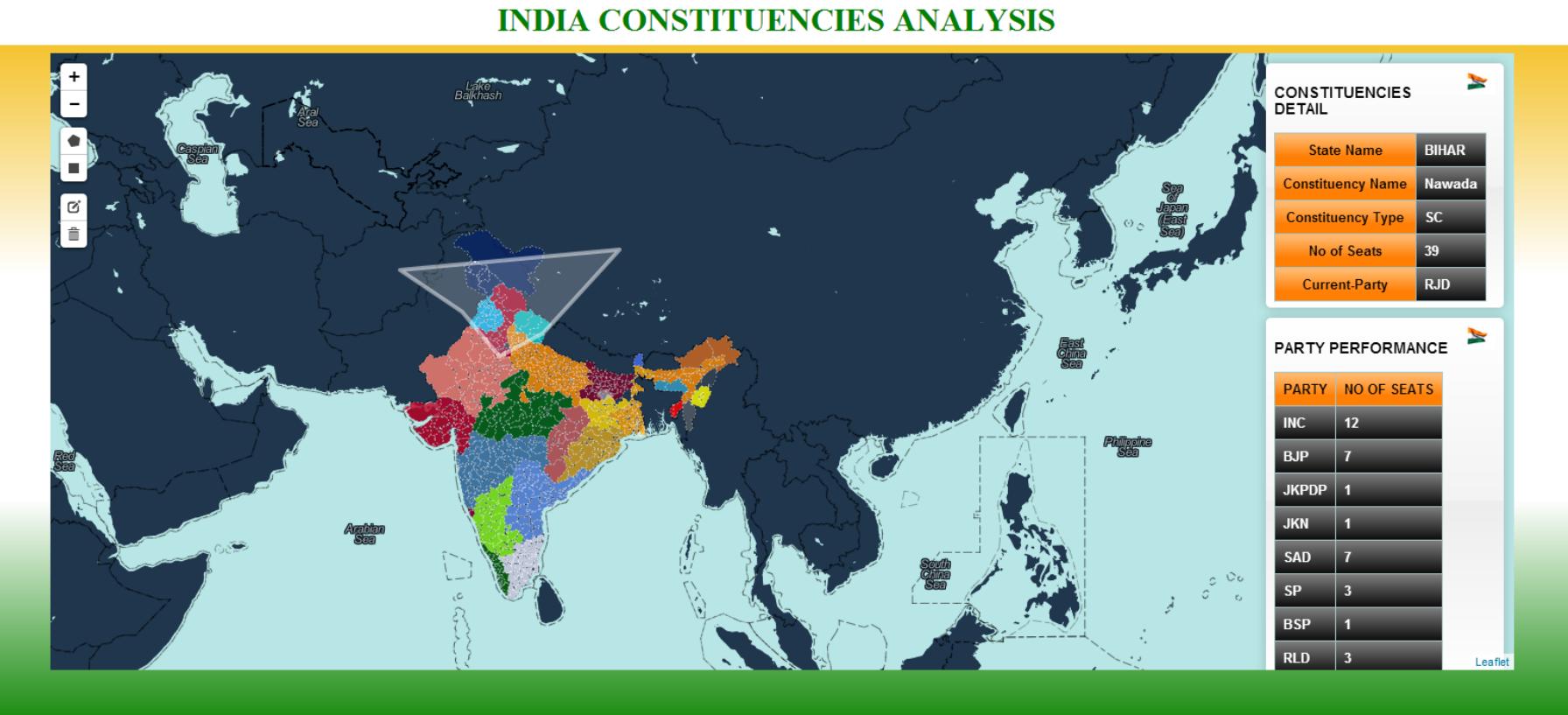
<http://scn.sap.com/community/developer-center/hana/blog/2014/07/03/hadoop-hdfs-explorer-built-with-hana-xs-and-sapui5>

Examples of some cool ideas from the community

„Experiences with SAP HANA Geo-Spatial Features” by Trinoy Hazarika

```
select shape.ST_AsGeoJson() from "DEMO_SPA"."INDIA_PC"

1  SHAPE.ST_ASgeoJSON()
2  {"type": "Polygon", "coordinates": [[[84.2482,18.7921],[84.2286,18.7631],[84.
3  {"type": "Polygon", "coordinates": [[[83.7682,18.9971],[83.7717,18.9804],[83.
4  {"type": "Polygon", "coordinates": [[[82.8853,18.2417],[82.8922,18.2318],[82.
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6  {"type": "Polygon", "coordinates": [[[82.8194,18.3239],[82.8233,18.2615],[82.
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15 {"type": "MultiPolygon", "coordinates": [[[80.6006,16.5029],[80.5878,16.472
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17 {"type": "Polygon", "coordinates": [[[76.9782,15.4992],[76.9833,15.4886],[76.
18 {"type": "Polygon", "coordinates": [[[78.2227,15.9057],[78.2048,15.8581],[78.
19 {"type": "Polygon", "coordinates": [[[77.4439,16.5733],[77.4272,16.5672],[77.
20 {"type": "Polygon", "coordinates": [[[77.7315,16.9378],[77.7413,16.9149],[77.
21 {"type": "Polygon", "coordinates": [[[78.074,17.9207],[78.0915,17.8931],[78.
22 {"type": "Polygon", "coordinates": [[[77.5403,18.3617],[77.5404,18.3534],[77.
23 {"type": "Polygon", "coordinates": [[[78.5276,18.897],[78.5278,18.8794],[78.5
```



<http://scn.sap.com/community/developer-center/hana/blog/2014/02/25/experiences-with-sap-hana-geo-spatial-features-part-1>

Examples of some cool ideas from the community

„Predicting My Next Twitter Follower with SAP HANA PAL“ by Lucas Sparvieri

	FOLLOWER	FOLLOWING	SCORE
1	1,677,534,362	245,564,201	0.000028019052956010088

Recent ID Conversions:
1677534362 => @atul_vaikul

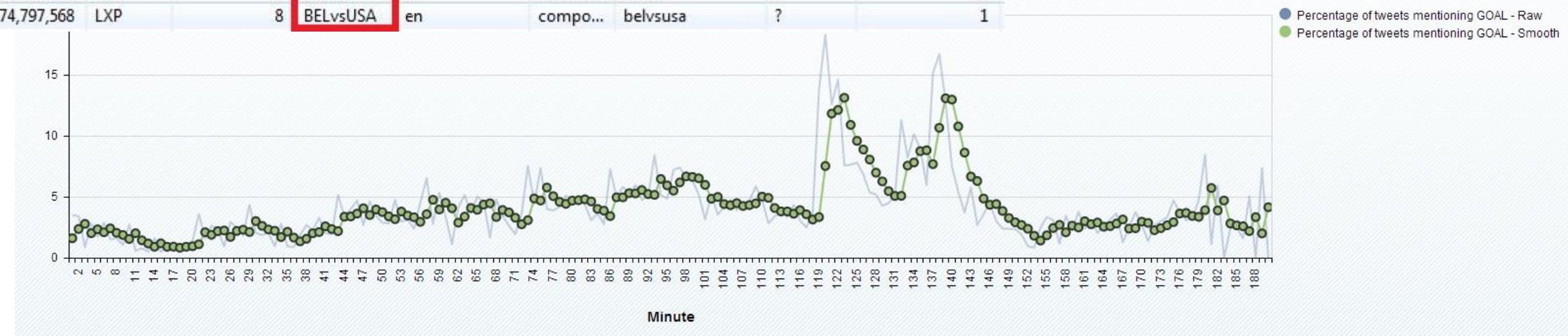
*PAL – Predictive Analysis Library

<http://scn.sap.com/community/developer-center/hana/blog/2013/09/02/predicting-my-next-twitter-follower-with-sap-hana-pal>

Examples of some cool ideas from the community

„Detecting World Cup GOAL using Twitter and SAP HANA“ by Stevanic Artana

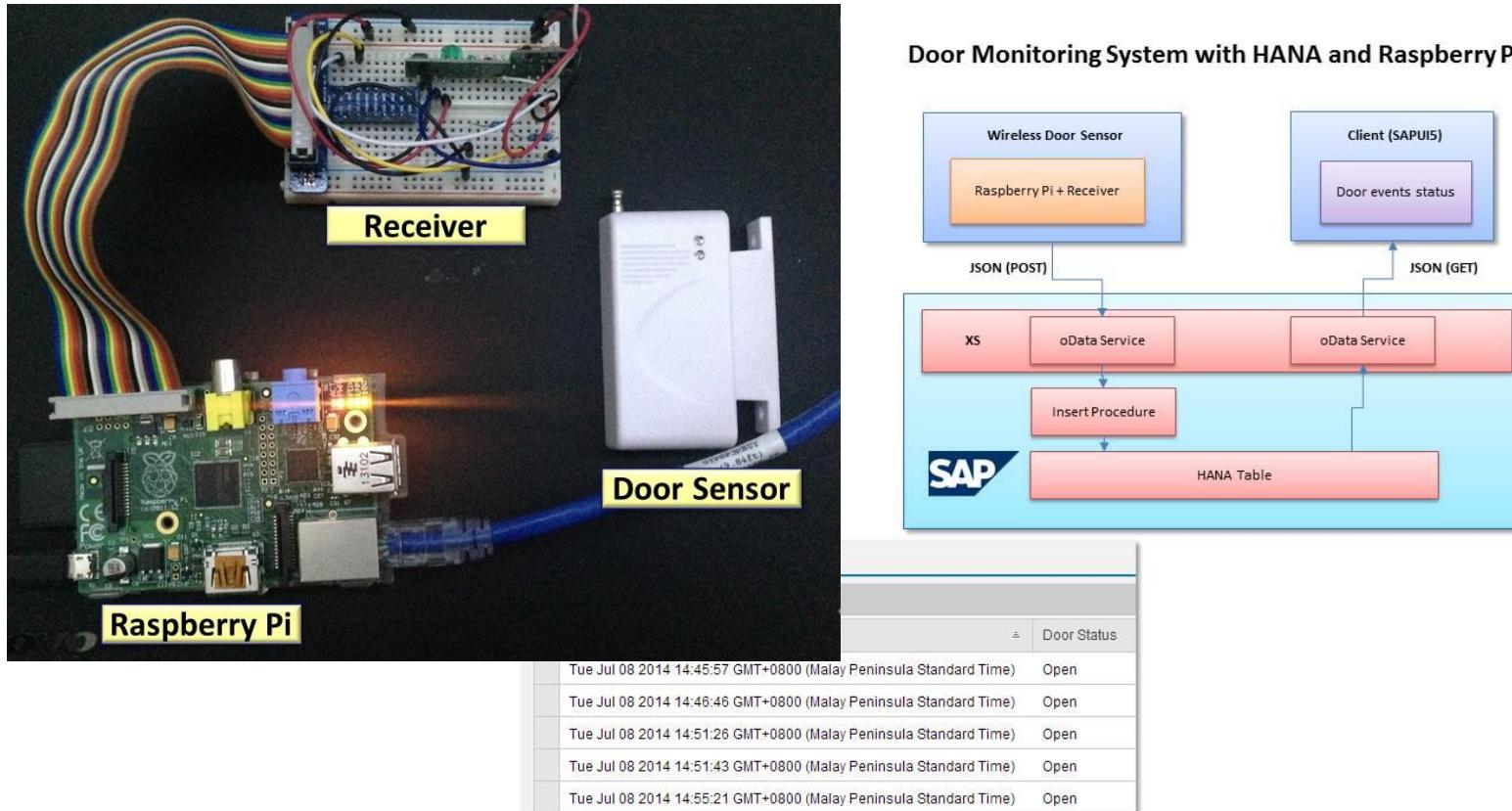
	id_str	TA_RULE	TA_COUNTER	TA_TOKEN	TA_LANGUAGE	TA_TYPE	TA_NORMALIZED	TA_STEM	TA_PARAGRAPH
1	484,094,587,074,797,568	LXP	1	Well	en	adverb	well	?	1
2	484,094,587,074,797,568	LXP	2	deserved	en	adjective	deserved	?	1
3	484,094,587,074,797,568	LXP	3	goal	en	noun	goal	?	1
4	484,094,587,074,797,568	LXP	4	by	en	prepos...	by	?	1
5	484,094,587,074,797,568	LXP	5	the	en	determ...	the	?	1
6	484,094,587,074,797,568	LXP	6	Belgium	en	proper ...	belgium	Belgium	1
7	484,094,587,074,797,568	LXP	7	team	en	adjective	team	?	1
8	484,094,587,074,797,568	LXP	8	BELvsUSA	en	compo...	belvsusa	?	1



<http://scn.sap.com/community/developer-center/hana/blog/2014/07/03/goal-detection-using-twitter-and-sap-hana>

Examples of some cool ideas from the community

„A Simple Door Monitoring System with HANA XS and Raspberry Pi“ by Ferry Gunawan



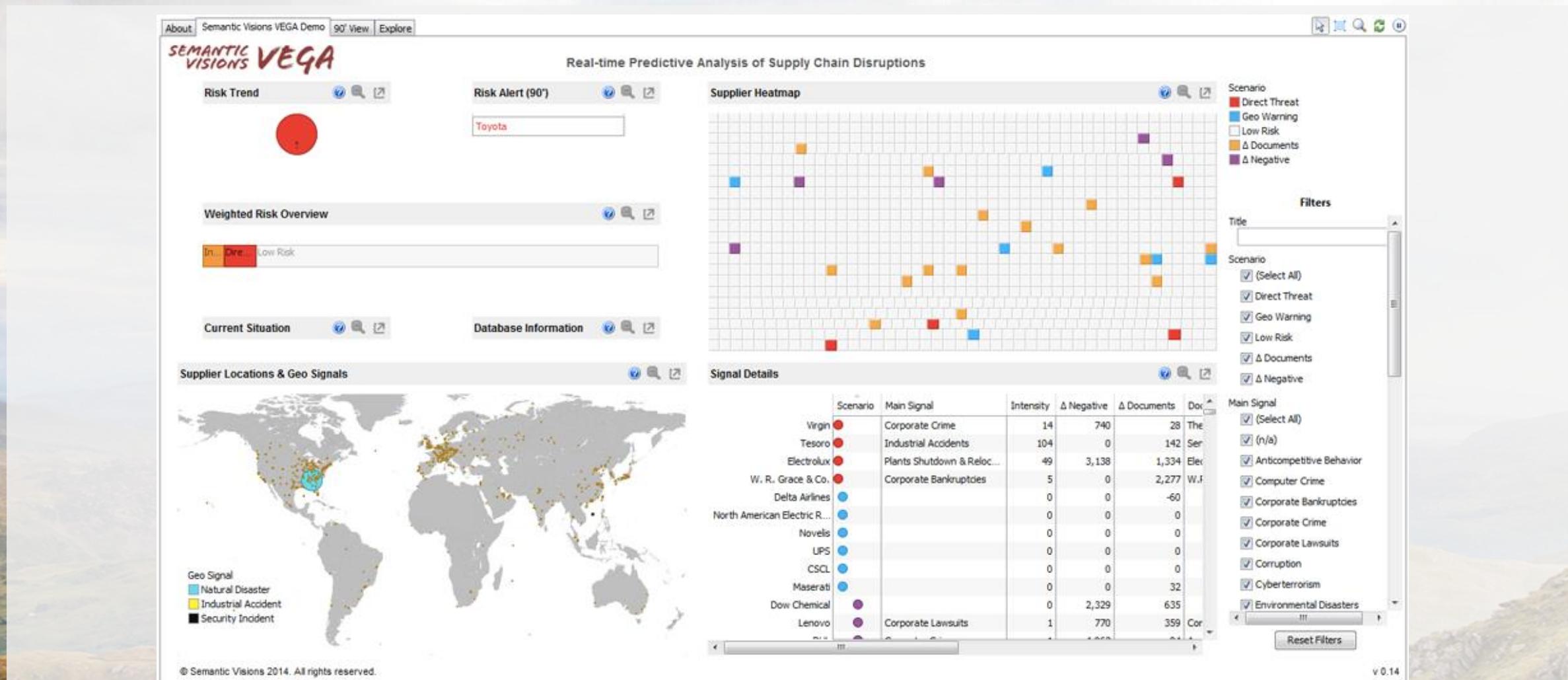
<http://scn.sap.com/community/developer-center/hana/blog/2014/07/09/build-a-door-sensor-with-raspberry-pi-and-hana>

1000+ Startups working with us



More info and how to join: <http://startups.saphana.com>

Semantic Vision from Czech Rep.



More <http://www.saphana.com/community/learn/startups/news-views/blog/2013/10/04/beyond-the-big-hype-using-semantic-search-to-predict-the-way-the-universe-will-behave>

Startups in SAP Startup Forum Program



Area of Startup Focus	% of Startups
Visualization / BI / Market Insight	25%
Social Media / Collaboration / Gaming	17%
Predictive Analytics / Complex Analytics	13%
Sensor Network Data / Internet of Things	10%
Geospatial / Geo-Location / 3D Analysis	8%
Primarily a Mobile Solution	7%
Big Data Infrastructure / Appliance + SAP HANA	6%
Enterprise Process Acceleration	6%
Extension of specific SAP Solutions and SAP Expertise	4%
Energy Management / Sustainability	3%

2/3rds in
these 4
categories

Community and developer access: developers.sap.com

Develop and build your application with SAP Technology

Explore SAP's technology platform and get your free trial access or developer edition.

[Get started!](#)

Jump directly into the most popular tutorials:

- Cloud-hosted Web application, with cloud persistence and HTML5-based UI
- Cloud-hosted mobile Web application, with back-end connectivity (full R/W persistence)
- On-Premise business application or extension, with browser-based UI and in-memory persistence



SAP Technology Offers for Developers

Databases **Cloud Platform** **Mobile Platform**

SAP HANA
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Other Database Developer Centers
SAP Sybase Adaptive Server Enterprise
SAP Sybase IQ
SAP Sybase Advantage Database Server
SAP Sybase SQL Anywhere

Application Platform **Tools & SDKs** **Analytics**

Top Stories

APR 19 SAP HANA Cloud - The DevTalks Series - Episode 4 - The Email functionality

APR 27 SAP and mobile powers combined through SAPUI5 and Phonegap (new SAPUI5 vers.)

MAY 03 Rumbling on HANA to the aid of Diabetics

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Upcoming Developer Events

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MAY 27 Development on SAP HANA (openSAP course - NEW!)

JUN 14 SAP Innojam Netherlands 2013

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