RDP302

Understanding SAP HANA Database Performance

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You and SAP HANA

- SAP HANA is, amongst other things, first and foremost a database management system.
- Or short: **it's the DB system for your application**.
- As that it takes care about storing and retrieving your data safely and efficiently.
- That means:
  You don't have to care about that – SAP HANA offers this as a service to you, the application developer.
- Focus on your application code and let SAP HANA figure out how to deal with your data.

Performance dilemma

But how to care about performance if the DB is handling all the data handling for me?

- Use funny SQL coding tricks? *(WHERE 1=1 AND 1 IS NOT NULL…)*
- Put optimizer hints into the SQL? *(/*+ INDEXACCESS … */)*
- Set DB parameters? *(force_fast_query_processing = true)*

- This kills **your** productivity
- This makes **your** system hard to maintain and operate
- This prevents **your** SQL code to benefit from the improvements in SAP HANA revisions

Performance dilemma – EXIT

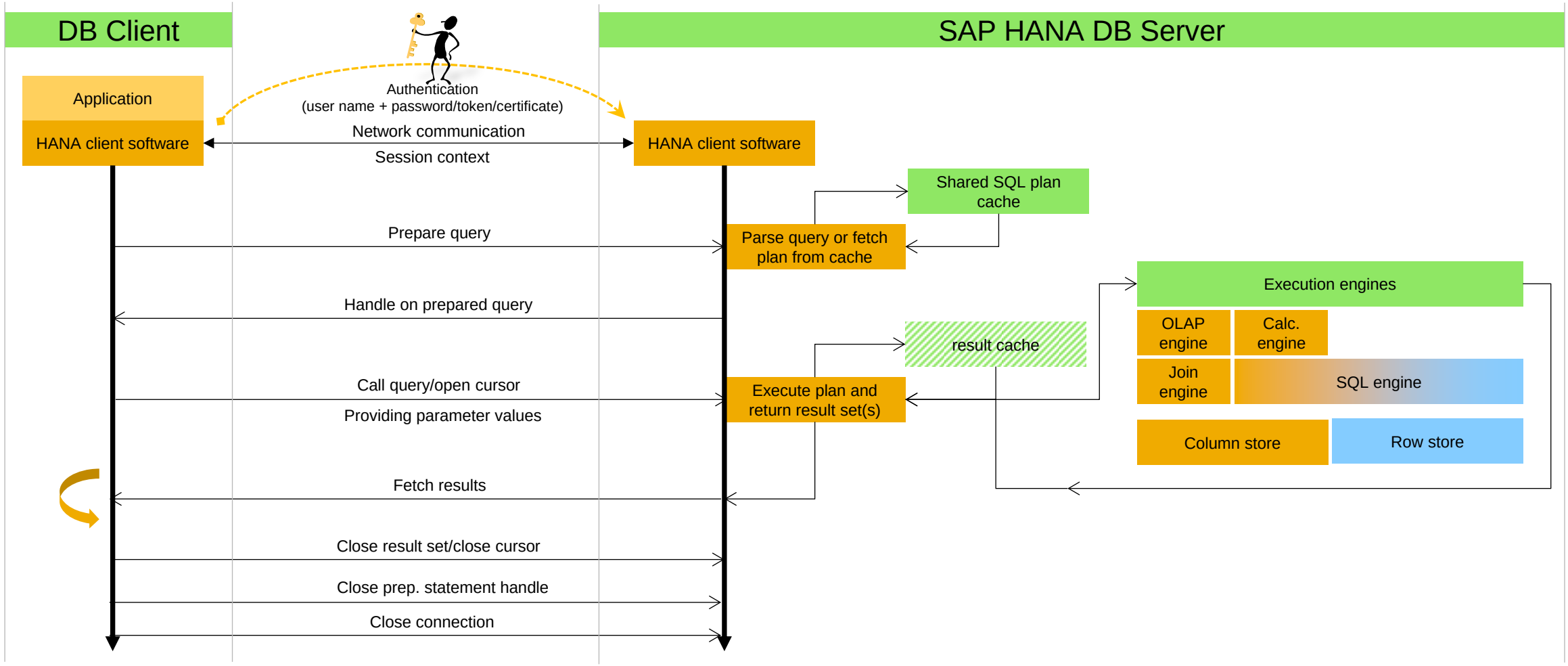
(because system performance is still your responsibility)

- **Don‘t** treat SAP HANA as a black box!
- Understand how it works and use SAP HANA based on that!
- Because: “Garbage in, garbage out” is still true in a client/server situation.

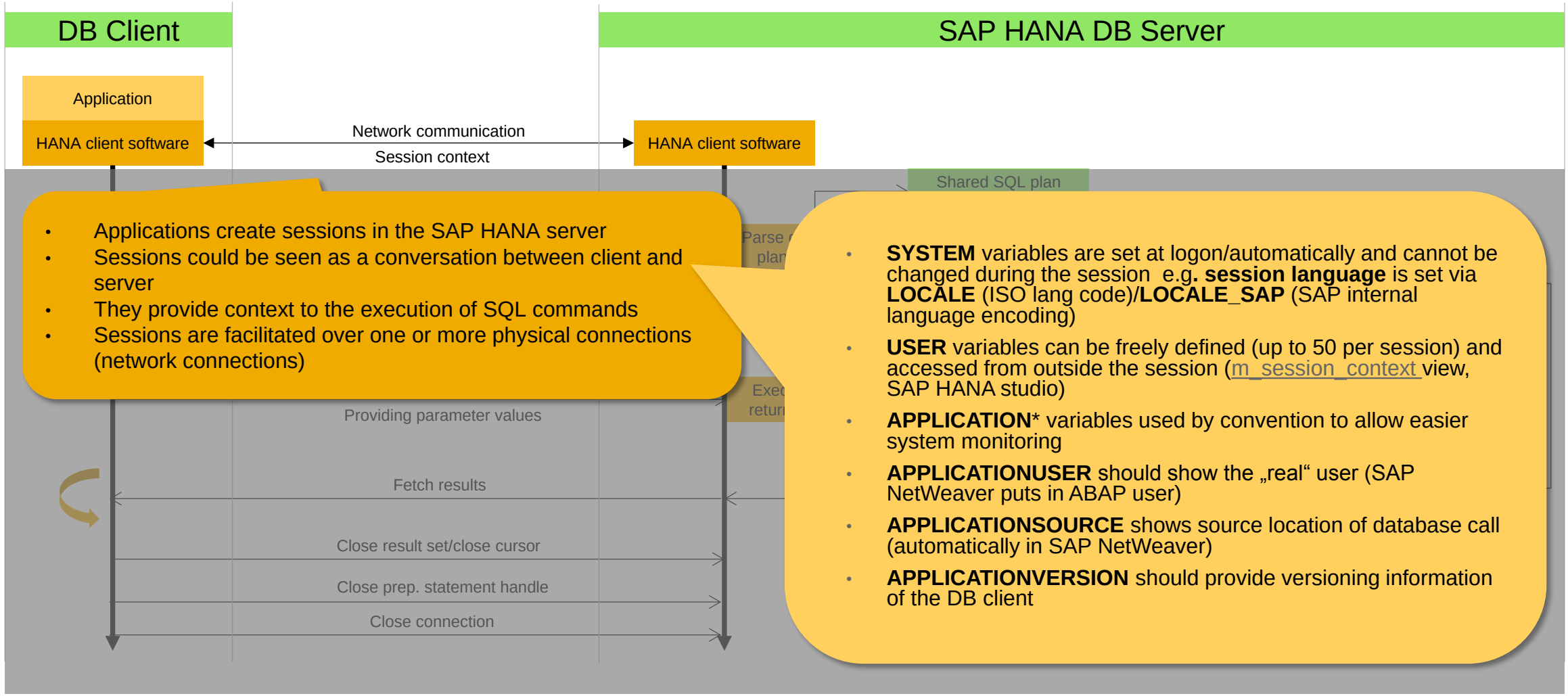
- So, let’s see what SAP HANA does with your queries and how you can find out about it…

The rise and fall of your SQL commands

or the lifetime of a session in SAP HANA



Lifetime of a SAP HANA session



- Applications create sessions in the SAP HANA server
- Sessions could be seen as a conversation between client and server
- They provide context to the execution of SQL commands
- Sessions are facilitated over one or more physical connections (network connections)

- **SYSTEM** variables are set at logon/automatically and cannot be changed during the session e.g**. session language** is set via **LOCALE** (ISO lang code)/**LOCALE_SAP** (SAP internal language encoding)
- **USER** variables can be freely defined (up to 50 per session) and accessed from outside the session (m_session_context view, SAP HANA studio)
- **APPLICATION*** variables used by convention to allow easier system monitoring
- **APPLICATIONUSER** should show the „real“ user (SAP NetWeaver puts in ABAP user)
- **APPLICATIONSOURCE** shows source location of database call (automatically in SAP NetWeaver)
- **APPLICATIONVERSION** should provide versioning information of the DB client

Session context variables

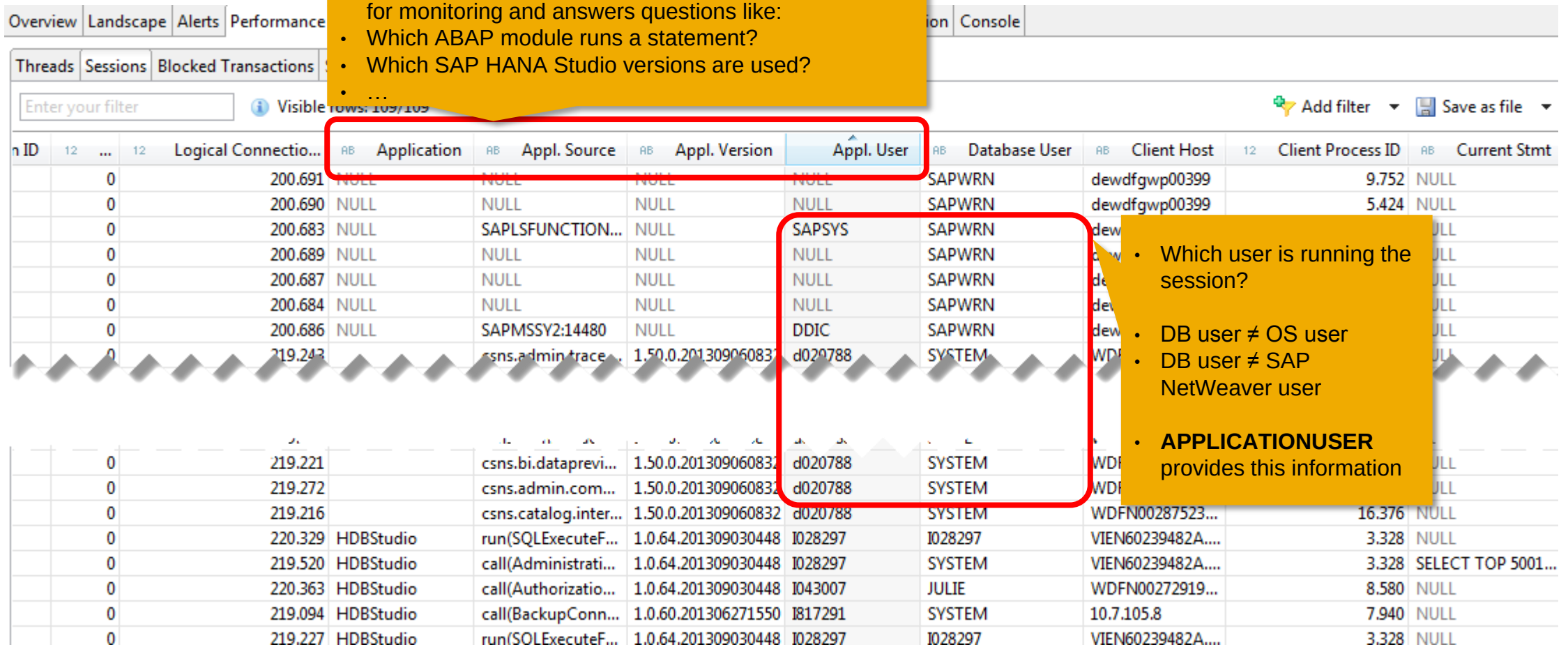
SQL | Result

```
select * from m_session_context where connection_id = current_connection
```

	HOST	PORT	CONNECTION_ID	KEY	VALUE	SECTION
1	Id9506	30.003	220.329	PROTOCOL_VERSION	4.1 (1, 4)	SYSTEM
2	Id9506	30.003	220.329	LOCALE	de	SYSTEM
3	Id9506	30.003	220.329	LOCALE_SAP	D	SYSTEM
4	Id9506	30.003	220.329	APPLICATIONVERSI...	1.0.64.201309030448	SYSTEM
5	Id9506	30.003	220.329	APPLICATION	HDBStudio	SYSTEM
6	Id9506	30.003	220.329	APPLICATIONSOUR...	run(SQLExecuteFormEditor.java:847);	SYSTEM
7	Id9506	30.003	220.329	APPLICATIONUSER	I028297	SYSTEM

Session context variables – used for monitoring

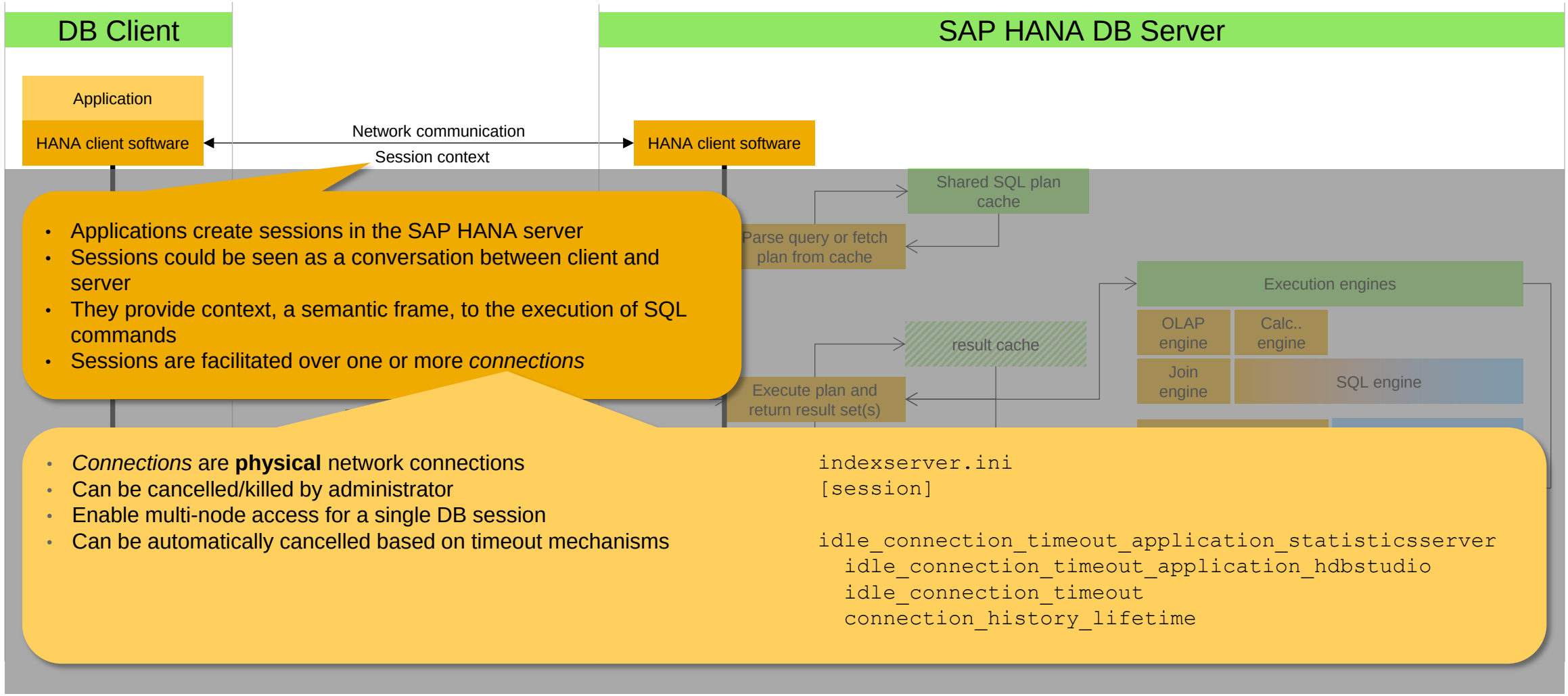
- **APPLICATION***-variables provide additional meta data for monitoring and answers questions like:
- Which ABAP module runs a statement?
- Which SAP HANA Studio versions are used?
- …



n ID	...	Logical Connectio...	Application	Appl. Source	Appl. Version	Appl. User	Database User	Client Host	Client Process ID	Current Stmt
	0	200.691	NULL	NULL	NULL	NULL	SAPWRN	dewdfgwp00399	9.752	NULL
	0	200.690	NULL	NULL	NULL	NULL	SAPWRN	dewdfgwp00399	5.424	NULL
	0	200.683	NULL	SAPLSFUNCTION...	NULL	SAPSYS	SAPWRN	dew		ULL
	0	200.689	NULL	NULL	NULL	NULL	SAPWRN			ULL
	0	200.687	NULL	NULL	NULL	NULL	SAPWRN			ULL
	0	200.684	NULL	NULL	NULL	NULL	SAPWRN			ULL
	0	200.686	NULL	SAPMSSY2:14480	NULL	DDIC	SAPWRN			ULL
	0	219.243		csns.admin.trace...	1.50.0.201309060831	d020788	SYSTEM			
	0	219.221		csns.bi.datapreVi...	1.50.0.201309060832	d020788	SYSTEM			ULL
	0	219.272		csns.admin.com...	1.50.0.201309060832	d020788	SYSTEM			ULL
	0	219.216		csns.catalog.inter...	1.50.0.201309060832	d020788	SYSTEM	WDFN00287523...	16.376	NULL
	0	220.329	HDBStudio	run(SQLExecuteF...	1.0.64.201309030448	I028297	I028297	VIEN60239482A....	3.328	NULL
	0	219.520	HDBStudio	call(Administrati...	1.0.64.201309030448	I028297	SYSTEM	VIEN60239482A....	3.328	SELECT TOP 5001...
	0	220.363	HDBStudio	call(Authorizatio...	1.0.64.201309030448	I043007	JULIE	WDFN00272919...	8.580	NULL
	0	219.094	HDBStudio	call(BackupConn...	1.0.60.201306271550	I817291	SYSTEM	10.7.105.8	7.940	NULL
	0	219.227	HDBStudio	run(SQLExecuteF...	1.0.64.201309030448	I028297	I028297	VIEN60239482A....	3.328	NULL

- Which user is running the session?
- DB user ≠ OS user
- DB user ≠ SAP NetWeaver user
- **APPLICATIONUSER** provides this information

Lifetime of SAP HANA session



- Applications create sessions in the SAP HANA server
- Sessions could be seen as a conversation between client and server
- They provide context, a semantic frame, to the execution of SQL commands
- Sessions are facilitated over one or more *connections*

- *Connections* are **physical** network connections
- Can be cancelled/killed by administrator
- Enable multi-node access for a single DB session
- Can be automatically cancelled based on timeout mechanisms

```
indexserver.ini
[session]

idle_connection_timeout_application_statisticsserver
  idle_connection_timeout_application_hdbstudio
  idle_connection_timeout
  connection_history_lifetime
```

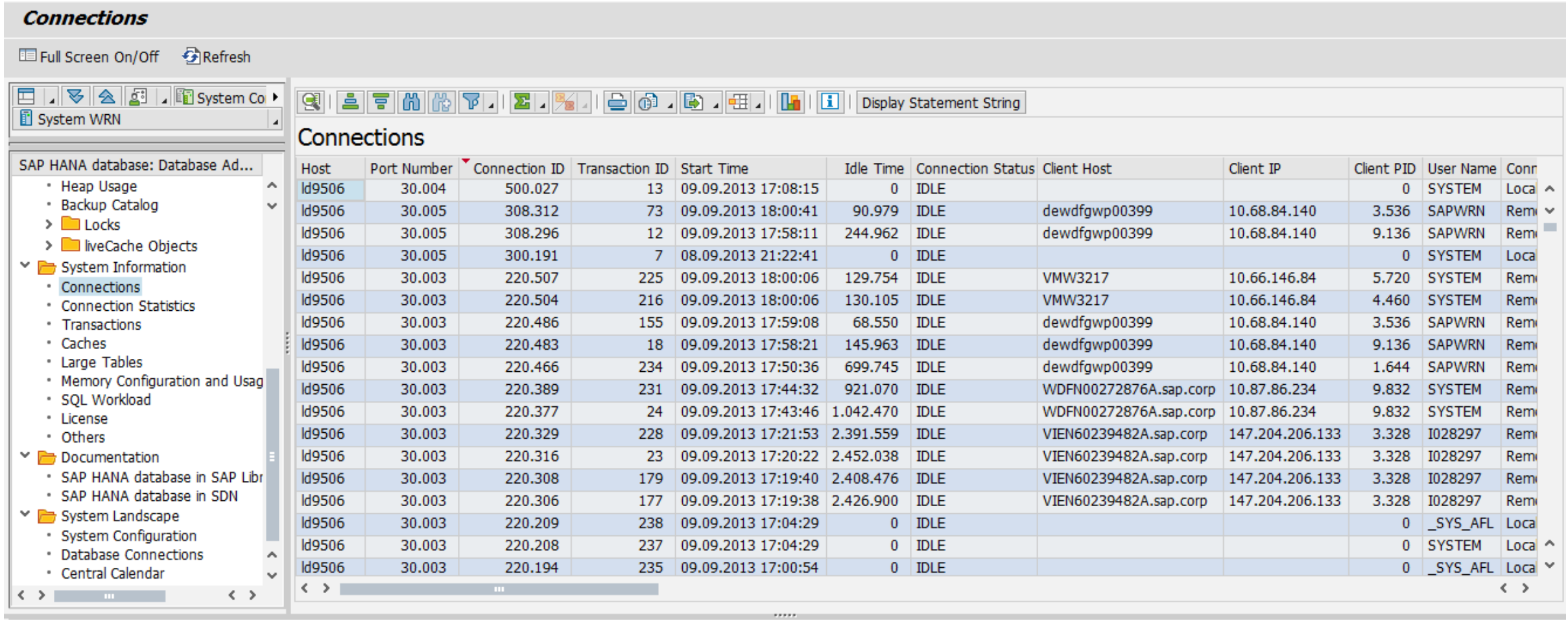
Connection information – SQL

SQL | Result

```
select connection_id, transaction_id
     , client_host, client_pid, connection_status, user_name
     , start_time
     , round(seconds_between (start_time, current_timestamp)/60/60, 2)  as connection_time_h, own
from m_connections
where port = 30003 and connection_type not like '%History%'
order by connection_status desc, start_time desc
```

	CONNECTION_ID	TRANSACTION_ID	CLIENT_HOST	CLIENT_PID	CONNECTION_STATUS	USER_NAME	START_TIME	CONNECTION_TIME_H	OWN
1	219.227	251	VIEN60239482A.sap.corp	3.328	RUNNING	I028297	09.09.2013 14:14:15.910266	1,43	TRUE
2	219.300	256	WDFN00287523A.sap.corp	16.376	IDLE	SYSTEM	09.09.2013 14:33:59.675323	1,1	FALS
3	219.297	260	WDFN00287523A.sap.corp	16.376	IDLE	SYSTEM	09.09.2013 14:33:44.520618	1,11	FALS
4	219.272	254	WDFN00287523A.sap.corp	16.376	IDLE	SYSTEM	09.09.2013 14:24:56.102833	1,25	FALS
5	219.246	258	WDFN00287523A.sap.corp	16.376	IDLE	SYSTEM	09.09.2013 14:17:49.634763	1,37	FALS
6	219.243	255	WDFN00287523A.sap.corp	16.376	IDLE	SYSTEM	09.09.2013 14:17:30.143633	1,38	FALS
7	219.221	241	WDFN00287523A.sap.corp	16.376	IDLE	SYSTEM	09.09.2013 14:10:06.447062	1,5	FALS
8	219.216	250	WDFN00287523A.sap.corp	16.376	IDLE	SYSTEM	09.09.2013 14:09:28.48022	1,51	FALS
9	219.204	264	WDFN00287523A.sap.corp	16.376	IDLE	SYSTEM	09.09.2013 14:07:53.84067	1,54	FALS
10	219.199	263	WDFN00287523A.sap.corp	16.376	IDLE	SYSTEM	09.09.2013 14:07:28.413746	1,54	FALS
11	219.198	259	WDFN00287523A.sap.corp	16.376	IDLE	SYSTEM	09.09.2013 14:07:28.037596	1,54	FALS
12	219.197	257	WDFN00287523A.sap.corp	16.376	IDLE	SYSTEM	09.09.2013 14:07:27.987721	1,54	FALS
13	219.094	253	10.7.105.8	7.940	IDLE	SYSTEM	09.09.2013 13:46:07.664354	1,9	FALS
14	219.062	249	WDFN30002408A.dhcp....	9.172	IDLE	SYSTEM	09.09.2013 13:36:52.686686	2,05	FALS
15	219.060	248	WDFN30002408A.dhcp....	9.172	IDLE	SYSTEM	09.09.2013 13:36:52.433565	2,05	FALS
16	219.030	246	WDFN30002408A.dhcp....	9.172	IDLE	SYSTEM	09.09.2013 13:36:44.515192	2,06	FALS
17	218.988	247	WDFN30002408A.dhcp....	9.172	IDLE	SYSTEM	09.09.2013 13:26:48.799087	2,22	FALS

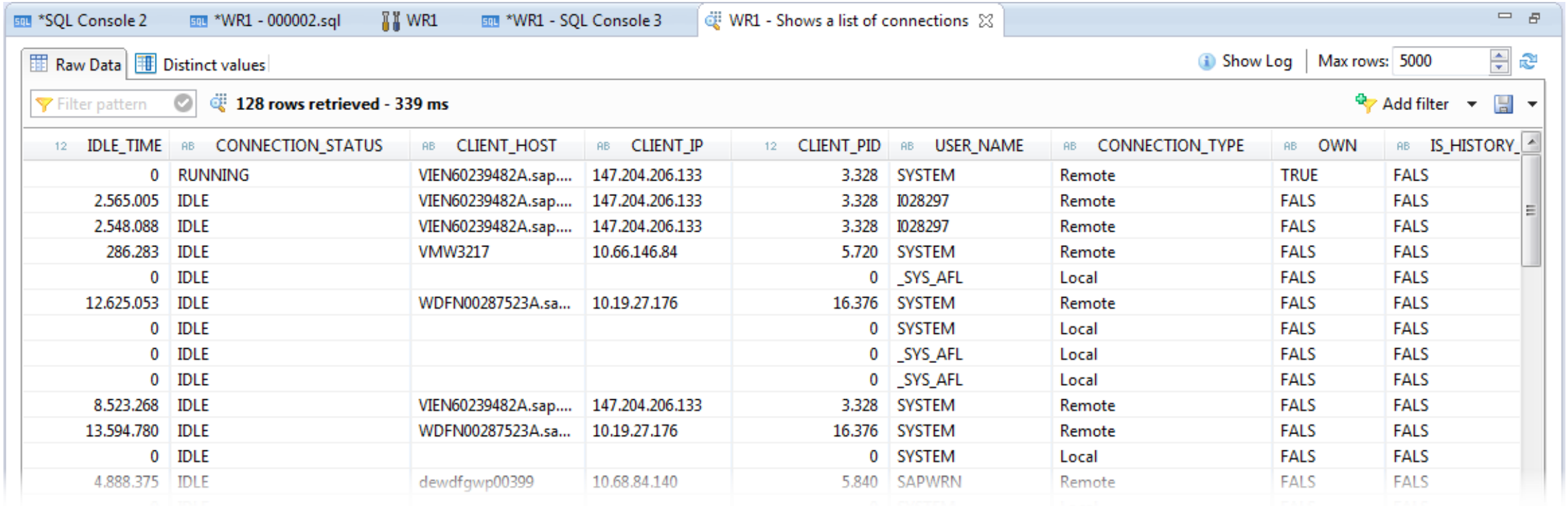
Connection information – DBACockpit



Connections

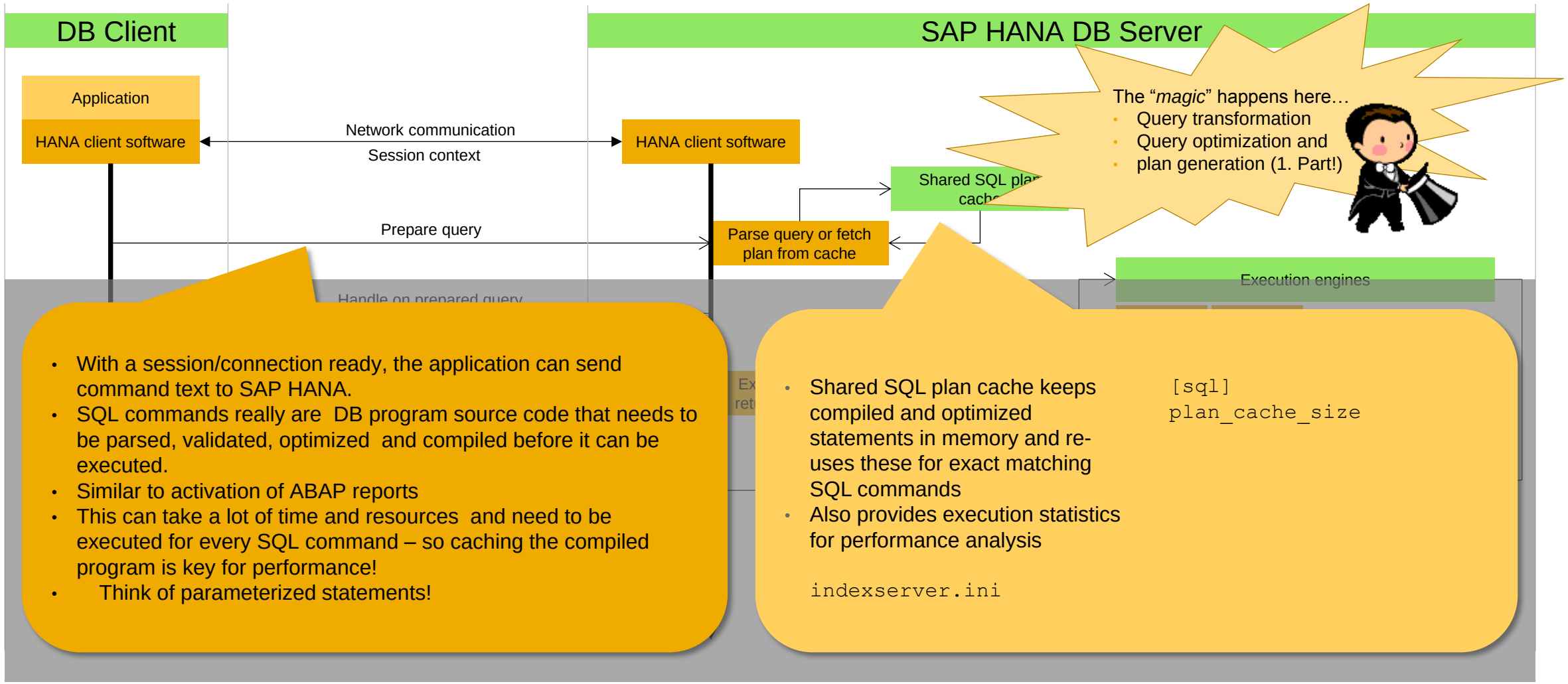
Host	Port Number	Connection ID	Transaction ID	Start Time	Idle Time	Connection Status	Client Host	Client IP	Client PID	User Name	Conn
ld9506	30.004	500.027	13	09.09.2013 17:08:15	0	IDLE			0	SYSTEM	Loca
ld9506	30.005	308.312	73	09.09.2013 18:00:41	90.979	IDLE	dewdfgwp00399	10.68.84.140	3.536	SAPWRN	Rem
ld9506	30.005	308.296	12	09.09.2013 17:58:11	244.962	IDLE	dewdfgwp00399	10.68.84.140	9.136	SAPWRN	Rem
ld9506	30.005	300.191	7	08.09.2013 21:22:41	0	IDLE			0	SYSTEM	Loca
ld9506	30.003	220.507	225	09.09.2013 18:00:06	129.754	IDLE	VMW3217	10.66.146.84	5.720	SYSTEM	Rem
ld9506	30.003	220.504	216	09.09.2013 18:00:06	130.105	IDLE	VMW3217	10.66.146.84	4.460	SYSTEM	Rem
ld9506	30.003	220.486	155	09.09.2013 17:59:08	68.550	IDLE	dewdfgwp00399	10.68.84.140	3.536	SAPWRN	Rem
ld9506	30.003	220.483	18	09.09.2013 17:58:21	145.963	IDLE	dewdfgwp00399	10.68.84.140	9.136	SAPWRN	Rem
ld9506	30.003	220.466	234	09.09.2013 17:50:36	699.745	IDLE	dewdfgwp00399	10.68.84.140	1.644	SAPWRN	Rem
ld9506	30.003	220.389	231	09.09.2013 17:44:32	921.070	IDLE	WDFN00272876A.sap.corp	10.87.86.234	9.832	SYSTEM	Rem
ld9506	30.003	220.377	24	09.09.2013 17:43:46	1.042.470	IDLE	WDFN00272876A.sap.corp	10.87.86.234	9.832	SYSTEM	Rem
ld9506	30.003	220.329	228	09.09.2013 17:21:53	2.391.559	IDLE	VIEN60239482A.sap.corp	147.204.206.133	3.328	I028297	Rem
ld9506	30.003	220.316	23	09.09.2013 17:20:22	2.452.038	IDLE	VIEN60239482A.sap.corp	147.204.206.133	3.328	I028297	Rem
ld9506	30.003	220.308	179	09.09.2013 17:19:40	2.408.476	IDLE	VIEN60239482A.sap.corp	147.204.206.133	3.328	I028297	Rem
ld9506	30.003	220.306	177	09.09.2013 17:19:38	2.426.900	IDLE	VIEN60239482A.sap.corp	147.204.206.133	3.328	I028297	Rem
ld9506	30.003	220.209	238	09.09.2013 17:04:29	0	IDLE			0	_SYS_AFL	Loca
ld9506	30.003	220.208	237	09.09.2013 17:04:29	0	IDLE			0	SYSTEM	Loca
ld9506	30.003	220.194	235	09.09.2013 17:00:54	0	IDLE			0	_SYS_AFL	Loca

Connection information – SAP HANA Studio



IDLE_TIME	CONNECTION_STATUS	CLIENT_HOST	CLIENT_IP	CLIENT_PID	USER_NAME	CONNECTION_TYPE	OWN	IS_HISTORY_
0	RUNNING	VIEN60239482A.sap....	147.204.206.133	3.328	SYSTEM	Remote	TRUE	FALS
2.565.005	IDLE	VIEN60239482A.sap....	147.204.206.133	3.328	I028297	Remote	FALS	FALS
2.548.088	IDLE	VIEN60239482A.sap....	147.204.206.133	3.328	I028297	Remote	FALS	FALS
286.283	IDLE	VMW3217	10.66.146.84	5.720	SYSTEM	Remote	FALS	FALS
0	IDLE			0	_SYS_AFL	Local	FALS	FALS
12.625.053	IDLE	WDFN00287523A.sa...	10.19.27.176	16.376	SYSTEM	Remote	FALS	FALS
0	IDLE			0	SYSTEM	Local	FALS	FALS
0	IDLE			0	_SYS_AFL	Local	FALS	FALS
0	IDLE			0	_SYS_AFL	Local	FALS	FALS
8.523.268	IDLE	VIEN60239482A.sap....	147.204.206.133	3.328	SYSTEM	Remote	FALS	FALS
13.594.780	IDLE	WDFN00287523A.sa...	10.19.27.176	16.376	SYSTEM	Remote	FALS	FALS
0	IDLE			0	SYSTEM	Local	FALS	FALS
4.888.375	IDLE	dewdfgwp00399	10.68.84.140	5.840	SAPWRN	Remote	FALS	FALS

Lifetime of a SAP HANA session



Shared SQL plan cache – SQL monitoring

SQL Result

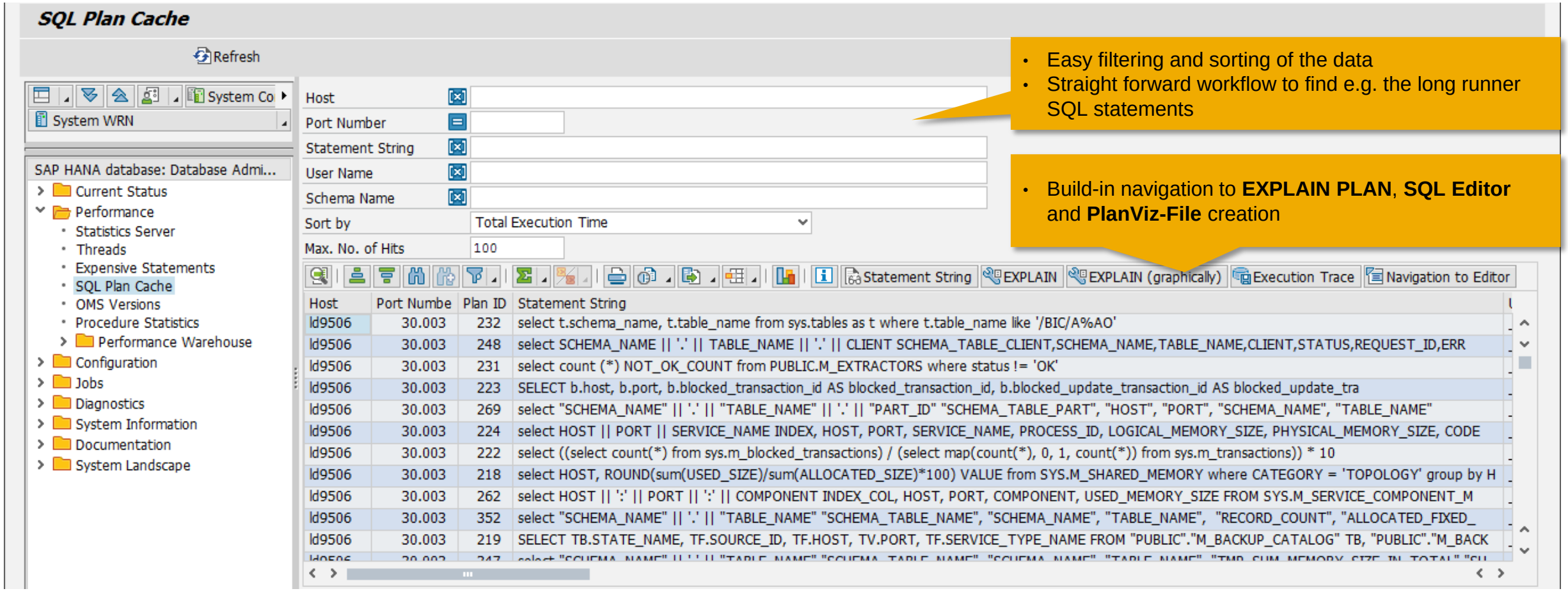
```
select
     plan_id, statement_string, execution_count, avg_execution_time,
     accessed_objects, parameter_count, reference_count, plan_memory_size,
     avg_preparation_time, total_execution_fetch_time, preparation_count

from
        "M_SQL_PLAN_CACHE" pc
join  m_services s on
       s.host = pc.host
   and s.port = pc.port
where
    s.service_name ='indexserver'
and pc.is_internal ='FALSE'
and pc.user_name='I028297'
```

- Most flexible analysis approach
- System views M_SQL_PLAN_CACHE and M_SQL_PLAN_CACHE_RESET provide lots of runtime statistics on statement level

	PLAN_ID	STATEMENT_STRING	EXECUTION_COUNT	AVG_EXECUTION_TIME	ACCESSED_OBJECTS	PARAMETER_COUNT
1	3.592	select connection_id, transaction_id , client_host, client_pid, connection_status, user_na...	1	19.297	131390(36)	0
2	373	SELECT 'PING' FROM SYS.DUMMY	37	88	131390(36)	0
3	6.524	select * from SYS.DUMMY	11	74	131390(36)	0
4	6.523	SELECT VERSION, CURRENT_USER FROM SYS.M_DATABASE	11	84		0
5	6.525	select * from "PUBLIC"."M_FEATURES" where COMPONENT_NAME='SMART DATA ACCESS'	1	136		0
6	6.528	SELECT "HOST","KEY","VALUE" FROM SYS.M_HOST_INFORMATION WHERE UPPER("KEY")...	3	343	131390(36)	0
7	6.522	select * from m_session_context where connection_id = current_connection	3	39.590	131390(36)	0
8	6.531	{ call SYS.REPOSITORY_REST (?,?) }	8	144.006		2
9	6.530	SELECT * FROM M_CLIENT_VERSIONS WHERE CLIENT_TYPE='InformationModeler' AND C...	1	55		0
10	6.529	SELECT "HOST","PORT","SERVICE_NAME","ACTIVE_STATUS","PROCESS_ID","COORDINAT...	3	409	131390(36)	0
11	6.527	SELECT HASSYSTEMPRIVILEGE(CURRENT_USER, 'BACKUP ADMIN') FROM SYS.DUMMY	7	63	131390(36)	0

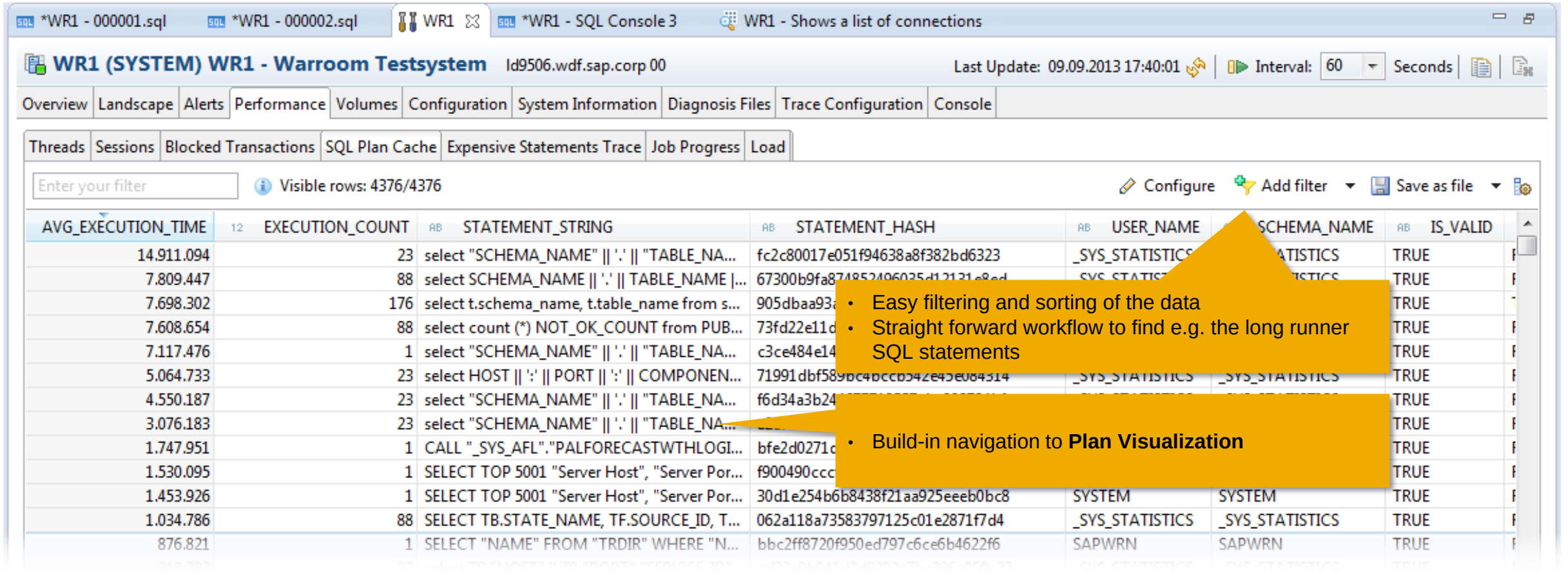
Shared SQL plan cache – DBACockpit monitoring



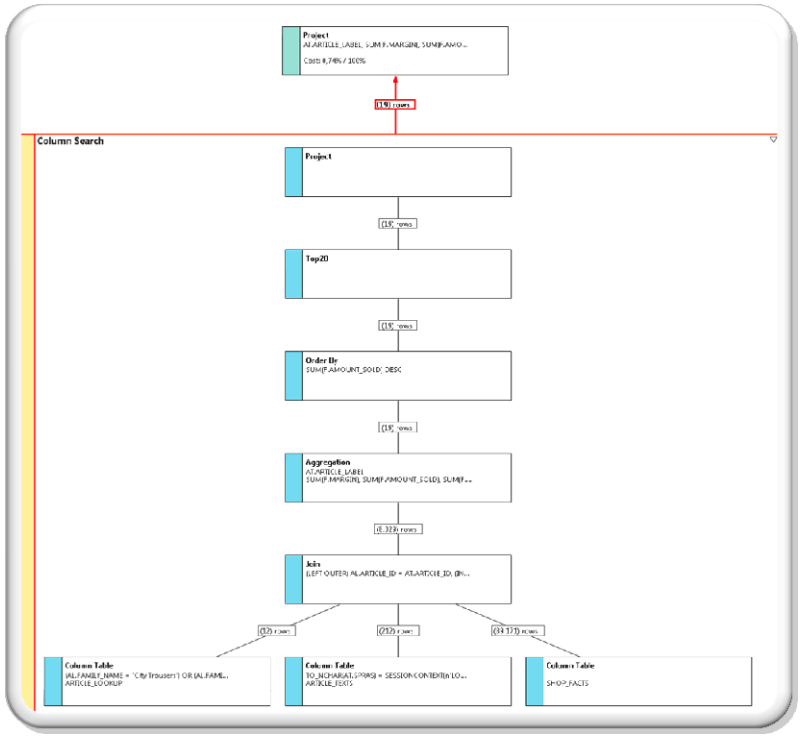
- Easy filtering and sorting of the data
- Straight forward workflow to find e.g. the long runner SQL statements

- Build-in navigation to **EXPLAIN PLAN**, **SQL Editor** and **PlanViz-File** creation

Shared SQL plan cache – SAP HANA Studio monitoring



Query plan information available after preparation



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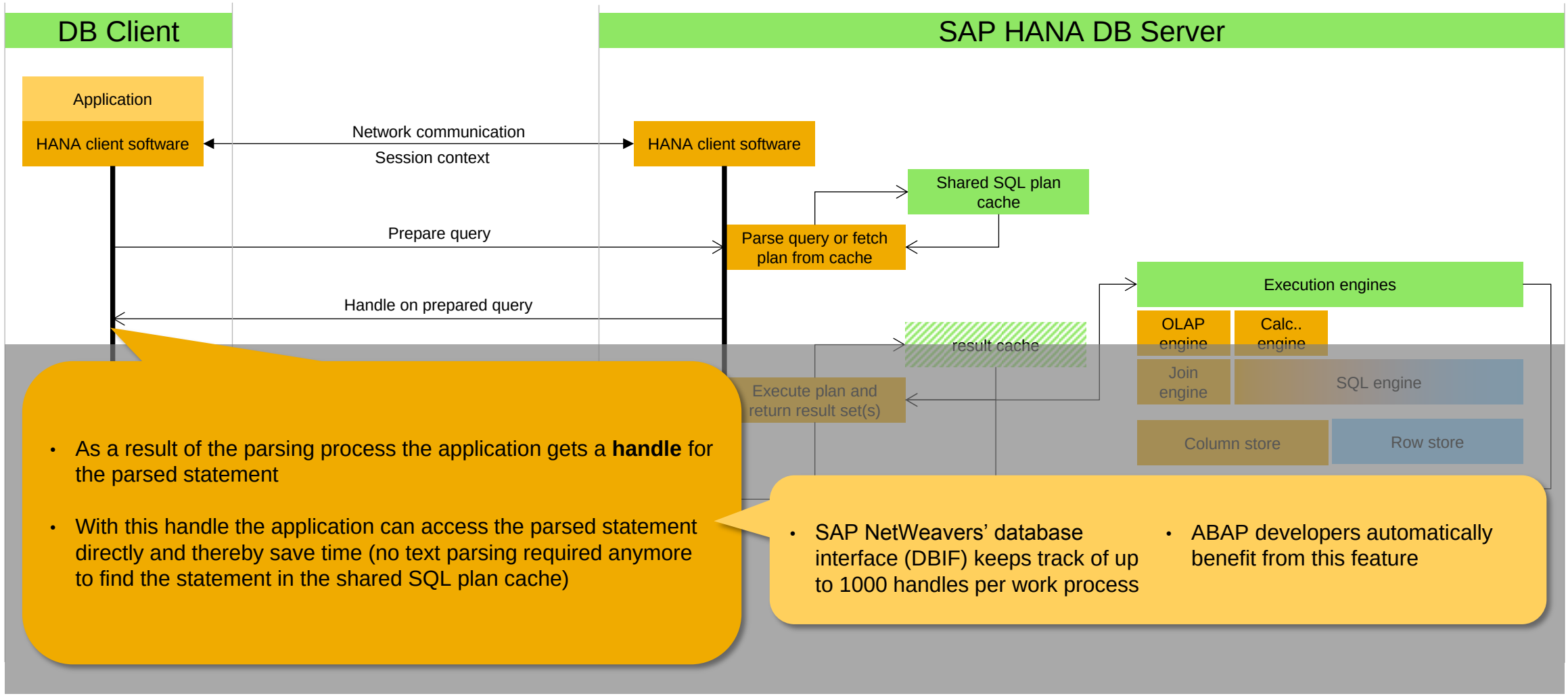
SQL | Result

```
EXPLAIN PLAN FOR
SELECT TOP 20
     at.article_label as "ARTICLE_LABEL_LOCALE",
     sum("MARGIN") AS "MARGIN",
     sum("AMOUNT_SOLD") AS "AMOUNT_SOLD",
     sum("QUANTITY_SOLD") AS "QUANTITY_SOLD"
FROM efashion.shop_facts f
     left outer join efashion.article_lookup al
        on f.article_id = al.article_id
     left outer join efashion.article_texts at
        on al.article_id = at.article_id
        and at.spras = session_context ('LOCALE_SAP')
     left outer join efashion.outlet_lookup ol
        on f.shop_id = ol.shop_id
WHERE "FAMILY_NAME" IN ('City Trousers', 'City Skirts')
GROUP BY
     at.article_label
ORDER BY "AMOUNT_SOLD" desc
```

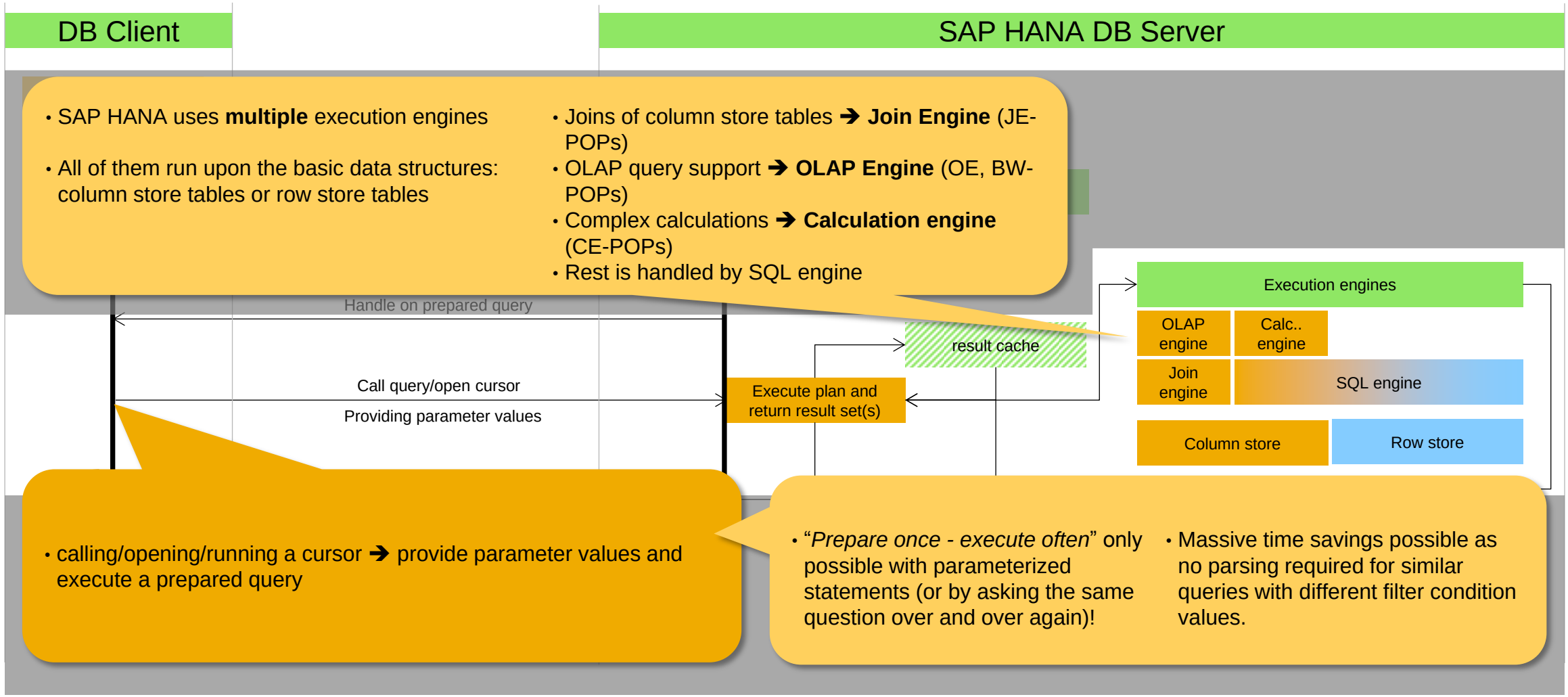
	OPERATOR_NAME	OPERATOR_DETAILS	EXECUTION_ENGINE	SCHEMA_NAME	TABLE_NAME	TABLI
1	COLUMN SEARCH	AT.ARTICLE_LABEL, SUM(F.MARGIN), SUM(F.AMOUNT_SOLD), SUM(F.QUANTITY_SOLD) (...	COLUMN	NULL	NULL	NULL
2	LIMIT	NUM RECORDS: 20	COLUMN	NULL	NULL	NULL
3	ORDER BY	SUM(F.AMOUNT_SOLD) DESC	COLUMN	NULL	NULL	NULL
4	AGGREGATION	GROUPING: AT.ARTICLE_LABEL, AGGREGATION: SUM(F.MARGIN), SUM(F.AMOUNT_SOLD...	COLUMN	NULL	NULL	NULL
5	JOIN	JOIN CONDITION: (LEFT OUTER) AL.ARTICLE_ID = AT.ARTICLE_ID, (INNER) AL.ARTICLE_ID...	COLUMN	NULL	NULL	NULL
6	COLUMN TABLE	FILTER CONDITION: (AL.FAMILY_NAME = 'City Trousers') OR (AL.FAMILY_NAME = 'City S...	COLUMN	EFASHION	ARTICLE_L...	COLU
7	COLUMN TABLE	FILTER CONDITION: TO_NCHAR(AT.SPRAS) = SESSIONCONTEXT(n'LOCALE_SAP')	COLUMN	EFASHION	ARTICLE_TE...	COLU
8	COLUMN TABLE		COLUMN	EFASHION	SHOP_FACTS	COLU

- Explain plan and it's graphical representation represent the **plan** created and optimized by the SQL optimizer.
- It's based on runtime information about the data (e.g. number of records, data distribution etc.) as well as table statistics (if available).
- Upon actual execution, additional optimizations are applied by the execution engines (e.g. column pruning in the calculation engine, join ordering in the join engine, removal of superfluous joins, etc.)
- **That means, the explain plan can not tell us, where time is spent during execution!**

Lifetime of a SAP HANA session



Lifetime of a SAP HANA session



Parameterized Statements…?!

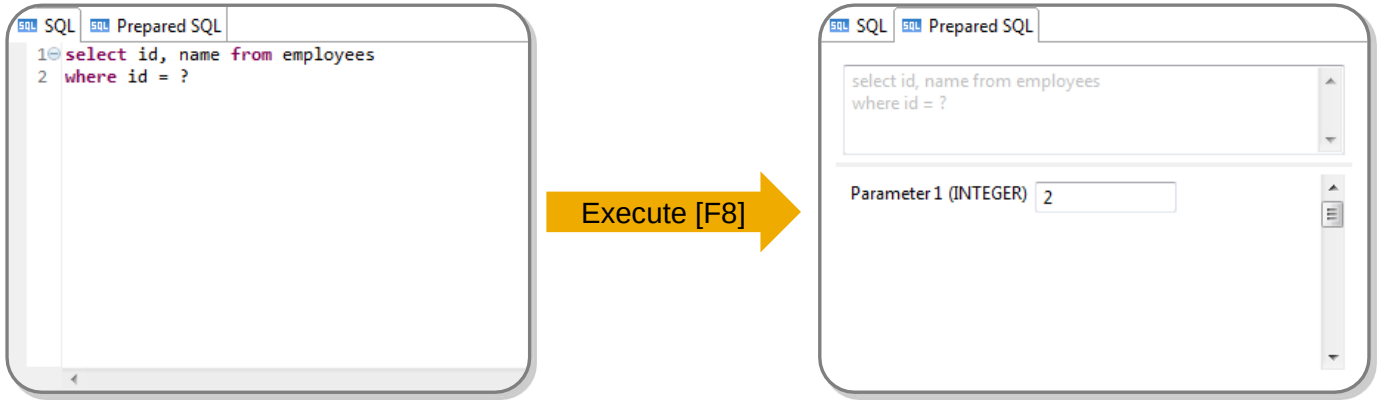
```
select id, name from employees
where id = 1;
```

```
select id, name from employees
where id = 2;
```

- 2 similar, but **different** statements
- 2 x parsing, optimizing
- 2 x storing and keeping the execution plan in memory
- Can be executed only for the hard coded ID number.

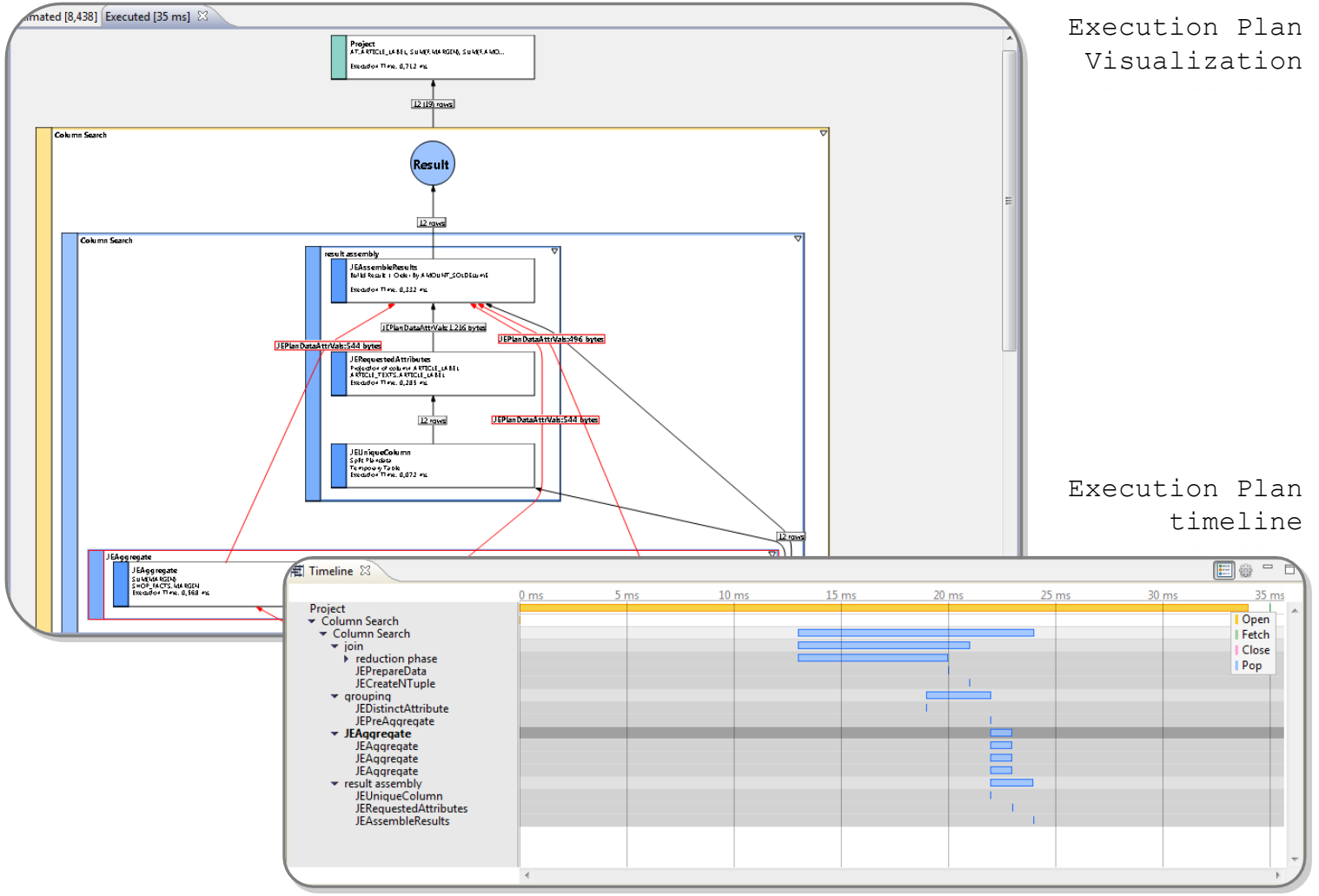
```
select id, name from employees
where id = ?;
```

- Just 1 statement with a parameter
- 1 x parsing, optimizing
- 1 x storing and keeping the execution plan in memory
- Can be re-used indefinitely

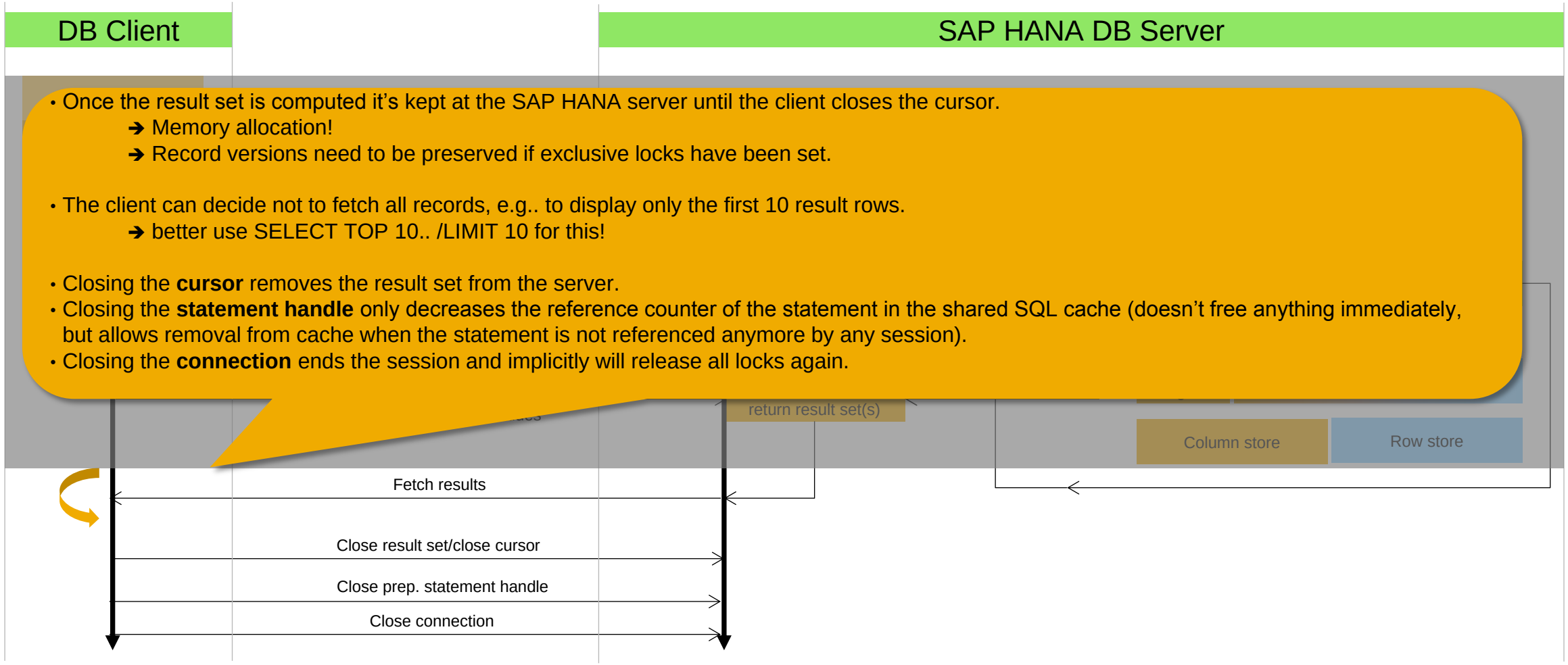


How to know what is really executed?

- The execution engines perform additional optimizations when the parameter values are known.
- This can change the actual execution tremendously.
- Plan Visualization → Execute shows actual operation order, intermediate result set size, parallelism, biggest runtime contributors, etc.



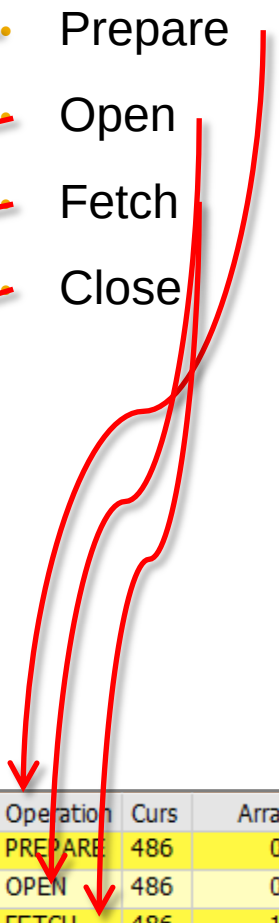
Lifetime of SAP HANA session



How does that look in the real world?

```
3  Connection connection = myHANAconnection.getConnection();
4  ClientInfo myClientInfos = new ClientInfo(connection);
5
6  PreparedStatement prepstmt = connection.prepareStatement
7                ("select * from EFASHION.SHOP_FACTS where shop_facts_id= ?");
8
9  for (int i = 1; i <= LOOPCNT; i++) {
10     prepstmt.setInt(1, i);
11
12     ResultSet resultSet = prepstmt.executeQuery();
13
14     while (resultSet.isAfterLast() == false) {
15         resultSet.next();
16     }
17     resultSet.close();
18
19
20 }
21
22 prepstmt.close();
23 connection.close();
24 System.exit(0);
```

vanilla JAVA code



Program Name	Object name	Operation	Curs	Array	Σ	Recs.	RC	Conn	Statement
SAPLPA_PACKAGE_SERVICES	TDEVC	PREPARE	486	0		0	0	R/3	SELECT WHERE "DEVCLASS" = ?
SAPLPA_PACKAGE_SERVICES	TDEVC	OPEN	486	0		0	0	R/3	SELECT WHERE "DEVCLASS" = 'SM&P'
SAPLPA_PACKAGE_SERVICES	TDEVC	FETCH	486	1		1	0	R/3	

SAP NetWeaver SQL trace (ST05)

Performance Analysis Tools

What tools to you use when…

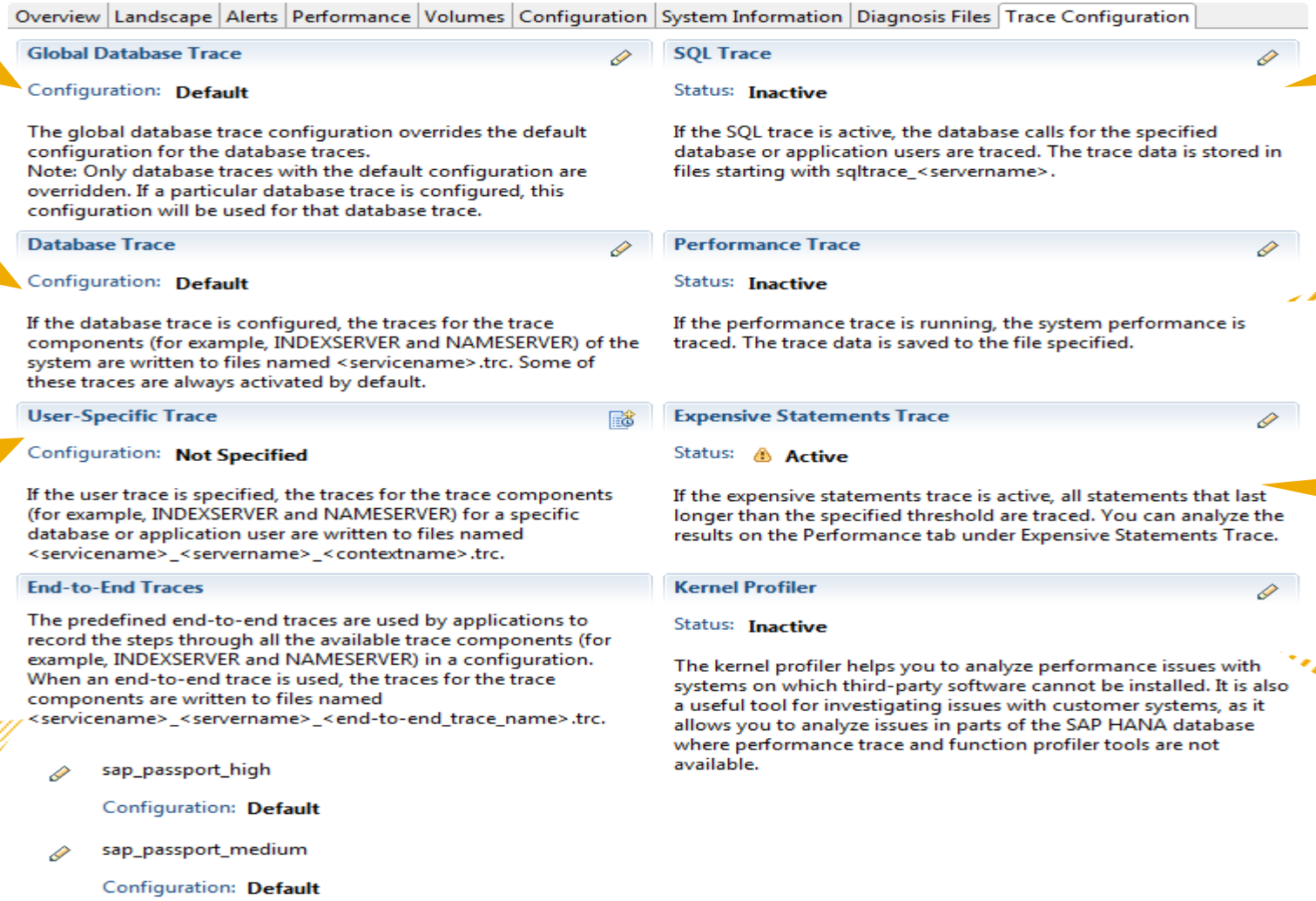
Trace options in SAP HANA Studio

Default settings for traces

Actual system wide trace settings

Actual user specific trace settings

Setup for NetWeaver E2E-traces via SAP PASSPORT



system wide or user specific SQL trace

SAP internal performance trace & profiler

Expensive statement trace

SAP internal sampling profiler

Trace options in SAP HANA Studio

- **SQLTRACE (PYTHON TRACE)**
- **PERFORMANCE TRACE + FUNCTION PROFILER**
- **KERNEL PROFILER**
- **OPTIMIZER TRACES**
- **LOAD GRAPH**
- **STATISTICS SERVER**
- **EXPENSIVE STATEMENTS TRACE**
- **SQL PLAN CACHE**
- **EXPLAIN PLAN**
- **PLAN VISUALIZATION**

SQLTRACE (PYTHON TRACE)

- Incomprehensible w/o SAP HANA development knowledge
- Is like “*taking a sledgehammer to crack a nut*"
- Doesn't provide what *happens* during the execution (rather input → output trace)

PERFORMANCE TRACE + FUNCTION PROFILER

- TREX heritage
- unsupported for non-SAP-Development usage
- requires HANA server access + X11-Window client
- requires special privileges
- doesn't cover row store activity
- tool is barely documented and complex
- function profiler is useless w/o source code

KERNEL PROFILER

- stack code sampling
- profiler tells you how often a specific part of the SAP HANA code was executed and how long that took (approx.)
- again, useless w/o source code

OPTIMIZER TRACES

- `sqlopttime` (runtime information for the query optimization phase)
- `sqloptStep` (single query optimization/transformation steps)
- `trex_qo` (TREX query optimizer → column store plans)

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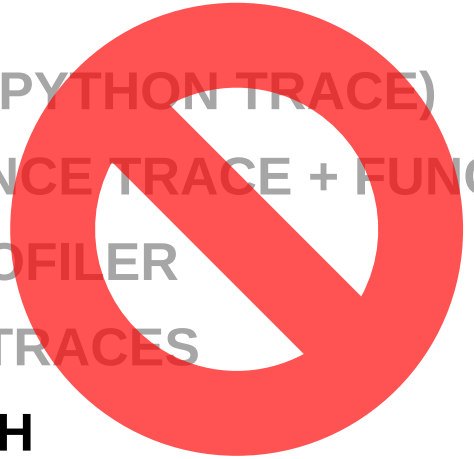
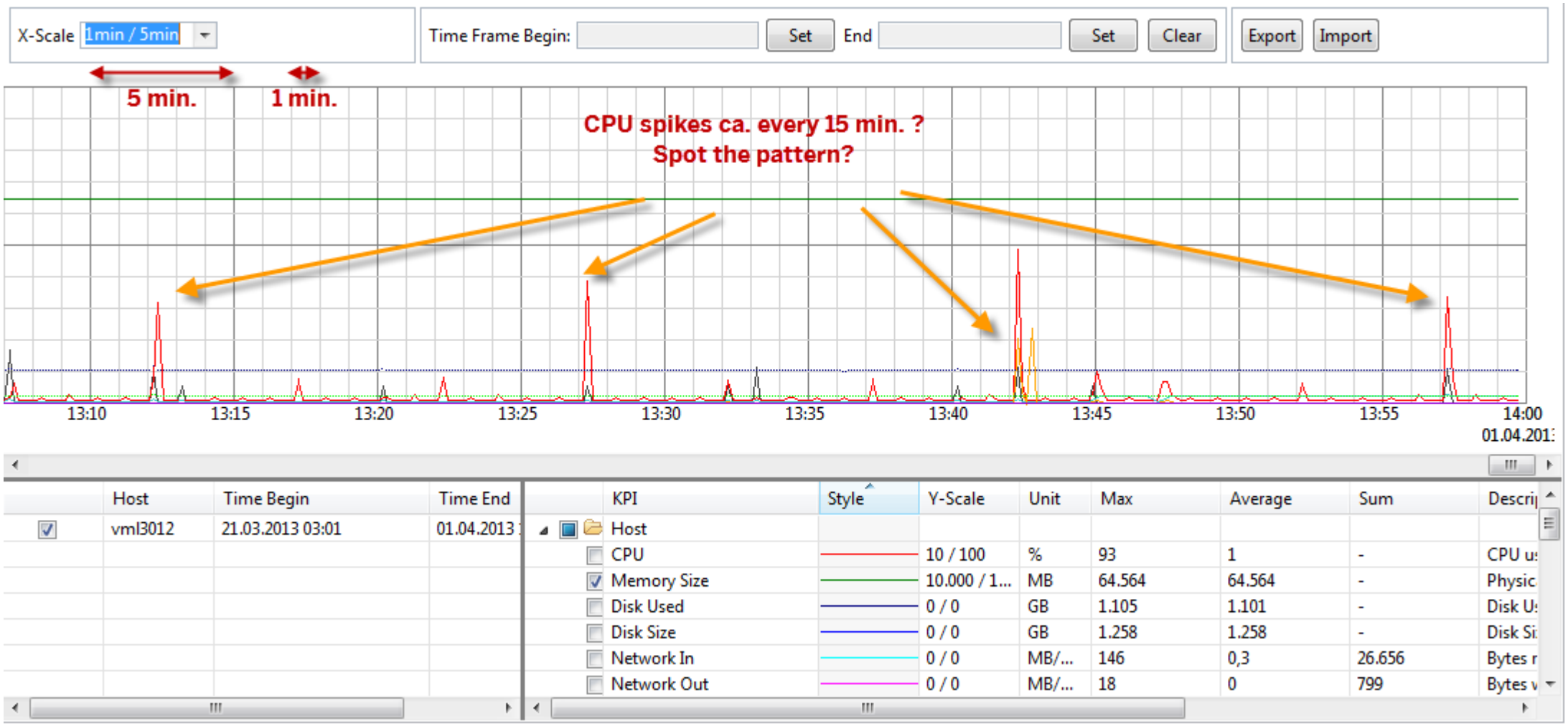


pretty useless for mere mortals like us…

LOAD GRAPH

- Nameserver data (`nameserver_history.trc`)
- TREX heritage
- Highly aggregated data - cannot (easily) be mapped to a specific user action
- Yet, give a "feeling" of how workload "looks like"
- Could be used to give a rough baseline
- No function to compare to time frames side-by-side or by overlay
- MIN/MAX/AVG numbers are highly volatile and fully depend on the chosen time frame

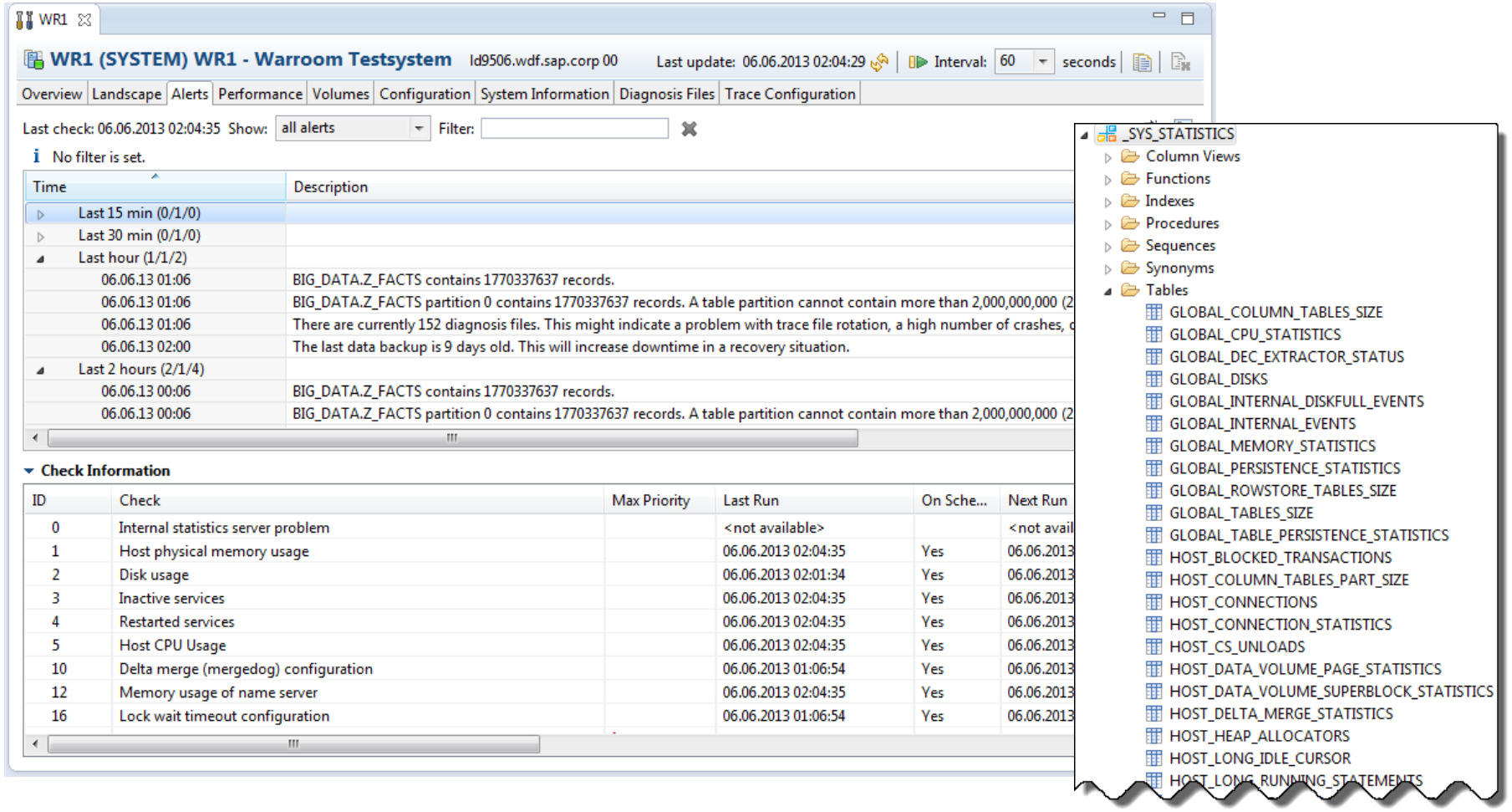
LOAD GRAPH – Screenshot



STATISTICS SERVER

- `_SYS_STATISTICS` schema
- Lots of data, gathered by automatic snapshots
- Are purged automatically
- Is used as the data source for solution manager (performance warehouse)
- Provide alerts for SAP HANA

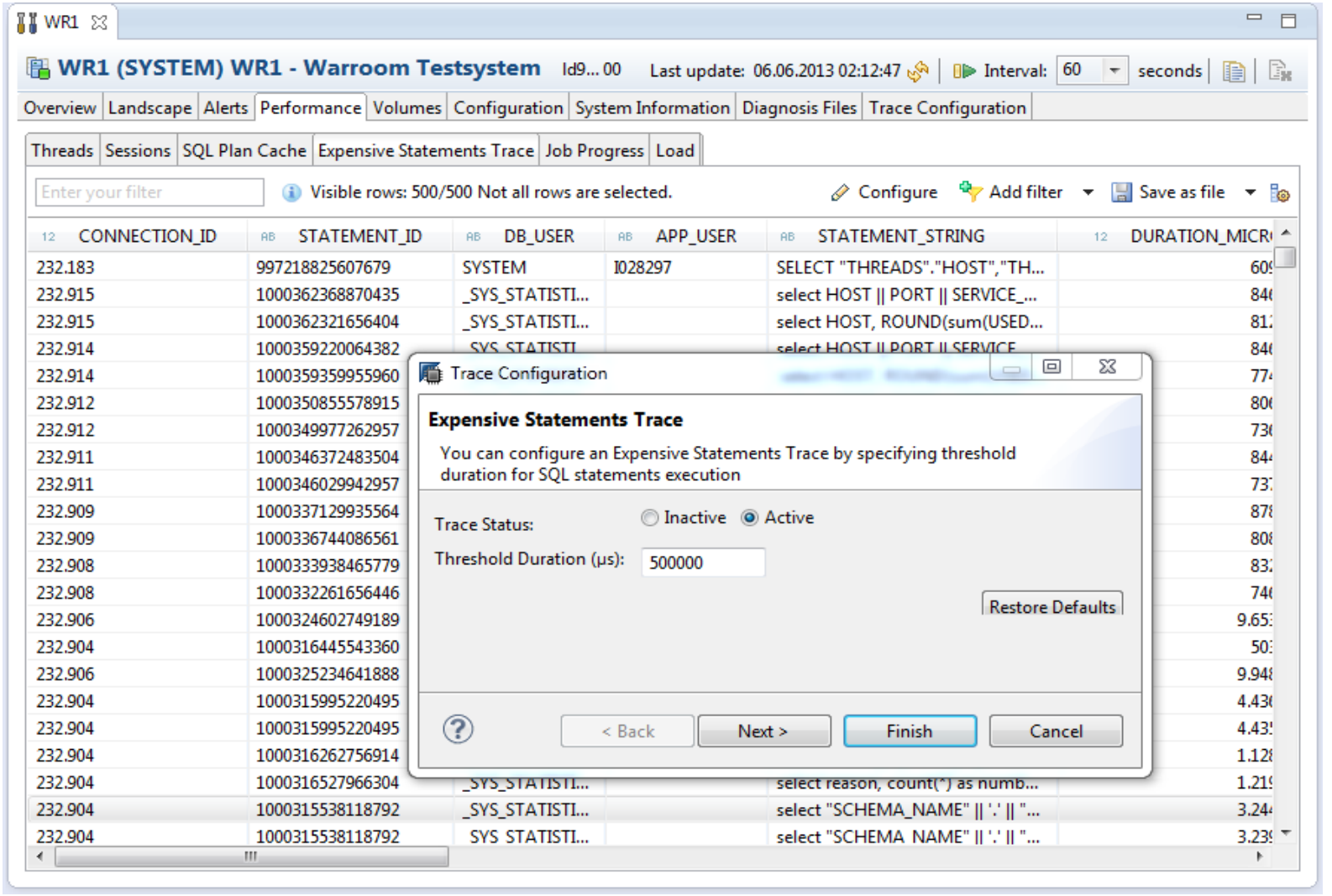
STATISTICS SERVER



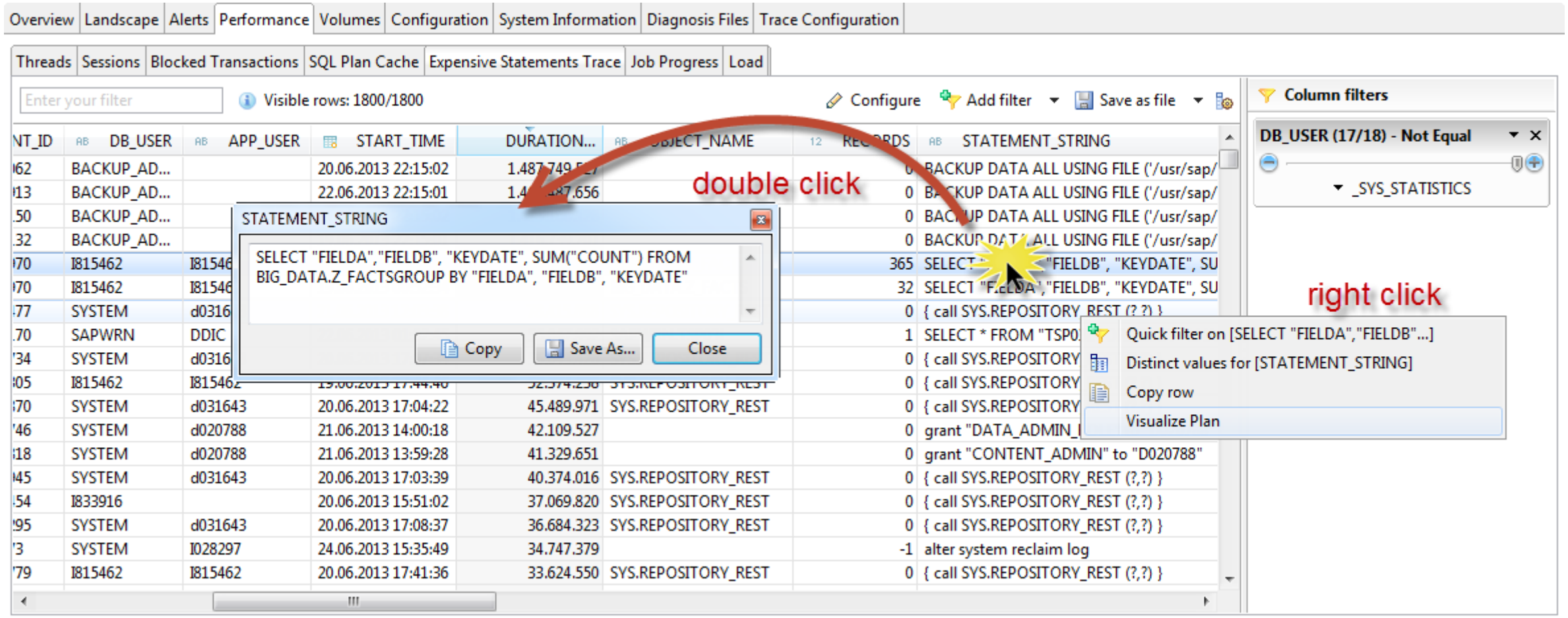
EXPENSIVE STATEMENTS TRACE

- Provides information about runtimes of single statement executions
- Captures the parameter values for parameterized statements
- Can be easily configured to focus on the real long running statements
- What long running statements are, clearly depends on your use case.
- Sometimes this means milliseconds, sometimes it's minutes

EXPENSIVE STATEMENTS TRACE – Setup Screen



EXPENSIVE STATEMENTS TRACE – Navigation



SQL PLAN CACHE

- Contains two kind of information:
  1. parsed statements
  2. call and runtime statistics for these statements

- Can answer questions like:
  - "How much time was spent on actually executing the statement?"
  - "Can my statement be reused or does it need to be optimized over and over again?"

- Depending on the use case, the default cache size can be much to small
  - We're gaining experience with that right now

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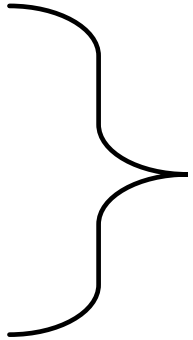


System wide monitoring – the BIG picture

EXPLAIN PLAN

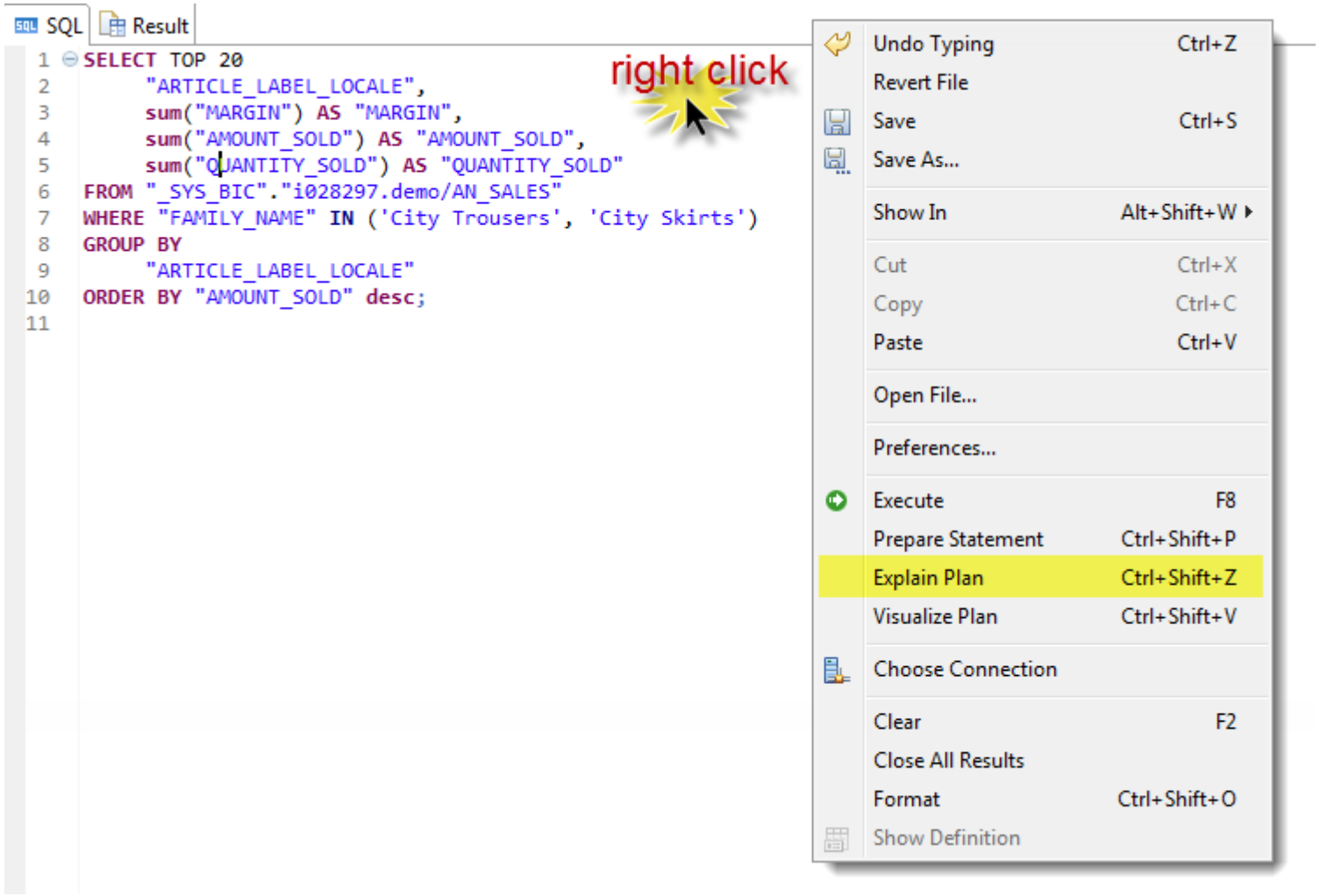
- Can't look "into" modeled views!
- Raw formatting
- Focusses on "costs" and estimated cardinalities (no. of rows)
- First information on which **engine** is used

EXPLAIN PLAN – Demo 1

```
SELECT TOP 20
     "ARTICLE_LABEL_LOCALE",
     sum("MARGIN") AS "MARGIN",
     sum("AMOUNT_SOLD") AS "AMOUNT_SOLD",
     sum("QUANTITY_SOLD") AS "QUANTITY_SOLD"
FROM "_SYS_BIC"."i028297.demo/AN_SALES"
WHERE "FAMILY_NAME" IN ('City Trousers', 'City Skirts')
GROUP BY
     "ARTICLE_LABEL_LOCALE"
ORDER BY "AMOUNT_SOLD" desc;
```

ARTICLE_LABEL_LOCALE	MARGIN	AMOUNT_SOLD	QTY_SOLD
Side Slit Long Skirt	64.437,700000000004	130.569,09999999992	598
Lycra Trousers	45.848,600000000006	105.164,09999999992	600
Corduroy Shorts	26.852,000000000015	76.395,49999999994	429
…			

EXPLAIN PLAN – Demo 2



EXPLAIN PLAN – Demo 3

SQL | Result

```
EXPLAIN PLAN FOR
SELECT TOP 20
     "ARTICLE_LABEL_LOCALE",
     sum("MARGIN") AS "MARGIN",
```

	OPERATOR_NAME	OPERATOR_DETAILS	EXECUTION_ENGINE	SCHEMA_NAME	TABLE_NAME	TABLE_TYPE	TABLE_SIZ
1	COLUMN SEARCH	i028297.demo/AN_SALES.ARTICLE_LABEL_LOCALE, SUM(i028297.d...	COLUMN	NULL	NULL	NULL	NULL
2	LIMIT	NUM RECORDS: 20	COLUMN	NULL	NULL	NULL	NULL
3	ORDER BY	SUM(i028297.demo/AN_SALES.AMOUNT_SOLD) DESC	COLUMN	NULL	NULL	NULL	NULL
4	AGGR...	GROUPING: i028297.demo/AN_SALES.ARTICLE_LABEL_LOCALE, AGG...	COLUMN	NULL	NULL	NULL	NULL
5	CO...	FILTER CONDITION: i028297.demo/AN_SALES.FAMILY_NAME = 'Ci...	COLUMN	_SYS_BIC	i028297...	OLAP VIEW	89.17

Which Engines are used to process the query?

EXPLAIN PLAN – Demo 4

```
OPERATOR_NAME          OPERATOR_DETAILS
COLUMN SEARCH          i028297.demo/AN_SALES.ARTICLE_LABEL_LOCALE,
                       SUM(i028297.demo/AN_SALES.MARGIN),
                       SUM(i028297.demo/AN_SALES.AMOUNT_SOLD),
                       SUM(i028297.demo/AN_SALES.QUANTITY_SOLD)
                       (LATE MATERIALIZATION)
  LIMIT                NUM RECORDS: 20
    ORDER BY           SUM(i028297.demo/AN_SALES.AMOUNT_SOLD) DESC
      AGGREGATION      GROUPING:
                       i028297.demo/AN_SALES.ARTICLE_LABEL_LOCALE,
                       AGGREGATION:
                       SUM(i028297.demo/AN_SALES.MARGIN),
                       SUM(i028297.demo/AN_SALES.AMOUNT_SOLD),
                       SUM(i028297.demo/AN_SALES.QUANTITY_SOLD)
        COLUMN VIEW    FILTER CONDITION:
                       i028297.demo/AN_SALES.FAMILY_NAME = 'City Trousers'
                       OR
                       i028297.demo/AN_SALES.FAMILY_NAME = 'City Skirts'
```

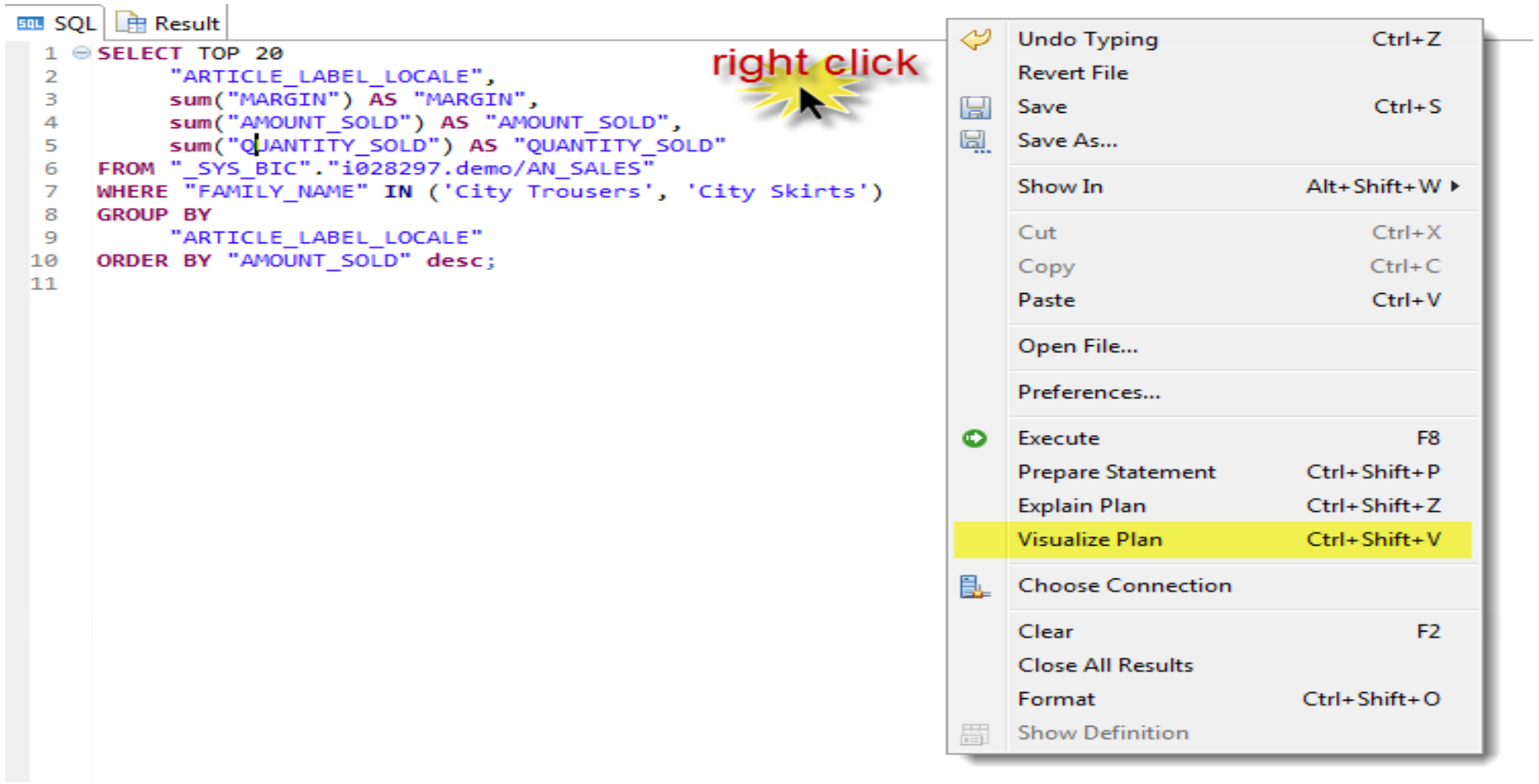
EXPLAIN PLAN – Demo 5

OPERATOR_NAME	EXEC_ENGINE	SCHEMA_NAME	TABLE_NAME	TABLE_TYPE
COLUMN SEARCH				
LIMIT	COLUMN	NULL	NULL	NULL
ORDER BY	COLUMN	NULL	NULL	NULL
AGGREGATION	COLUMN	NULL	NULL	NULL
COLUMN VIEW	COLUMN	NULL	NULL	NULL
	COLUMN	_SYS_BIC	i028297.demo/AN_SALES	OLAP VIEW

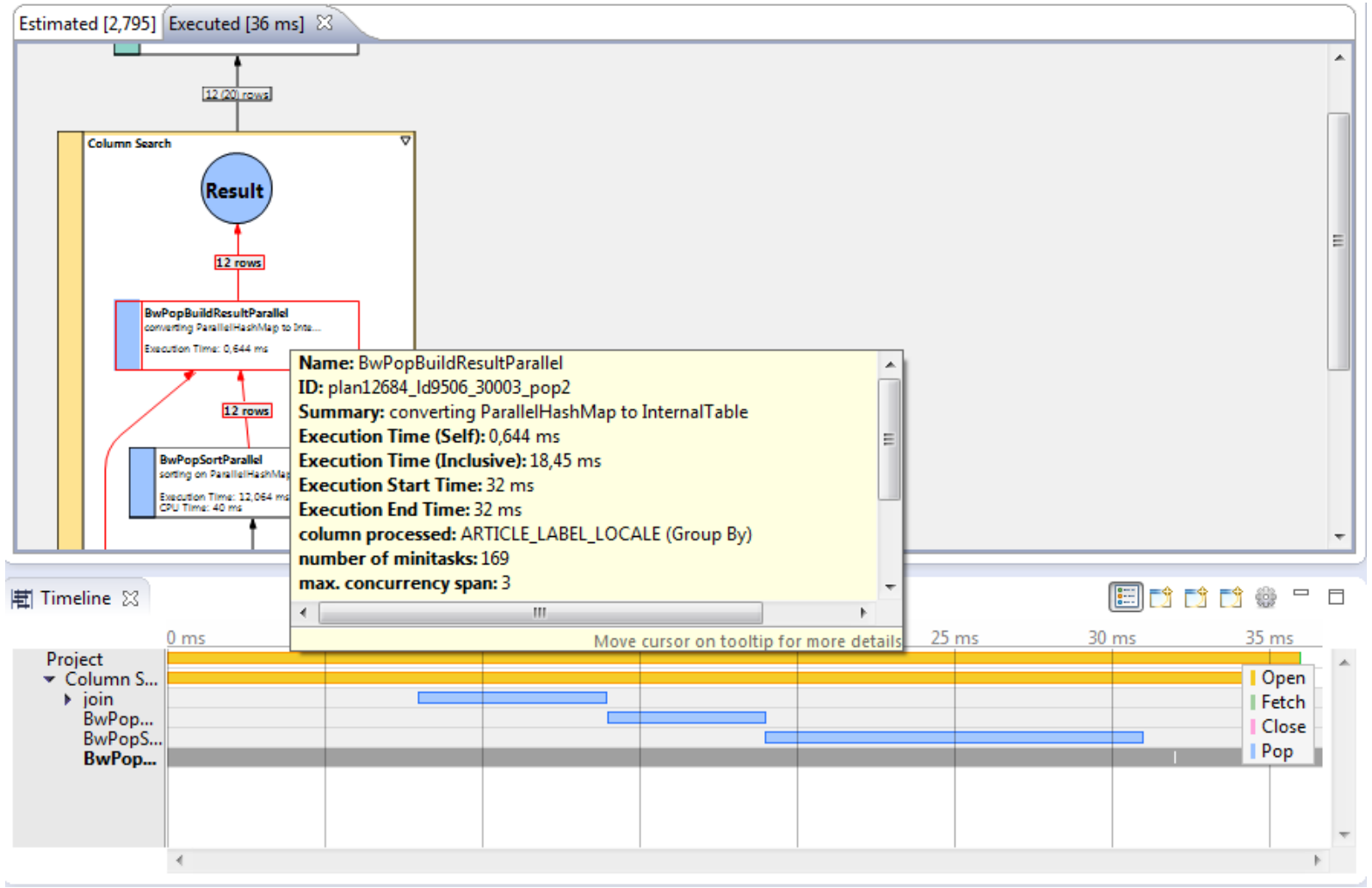
PLAN VISUALIZATION

- Relatively easy to use
- Graphical tool, build into SAP HANA studio
- Provides estimation and actual runtime statistics for memory, CPU time, parallelism and total runtime.
- Can be access via SQL Editor, SQL statement cache view, Expensive statement view
- Can be saved (XML file) and reviewed later on
- THE TOOL OF CHOICE!

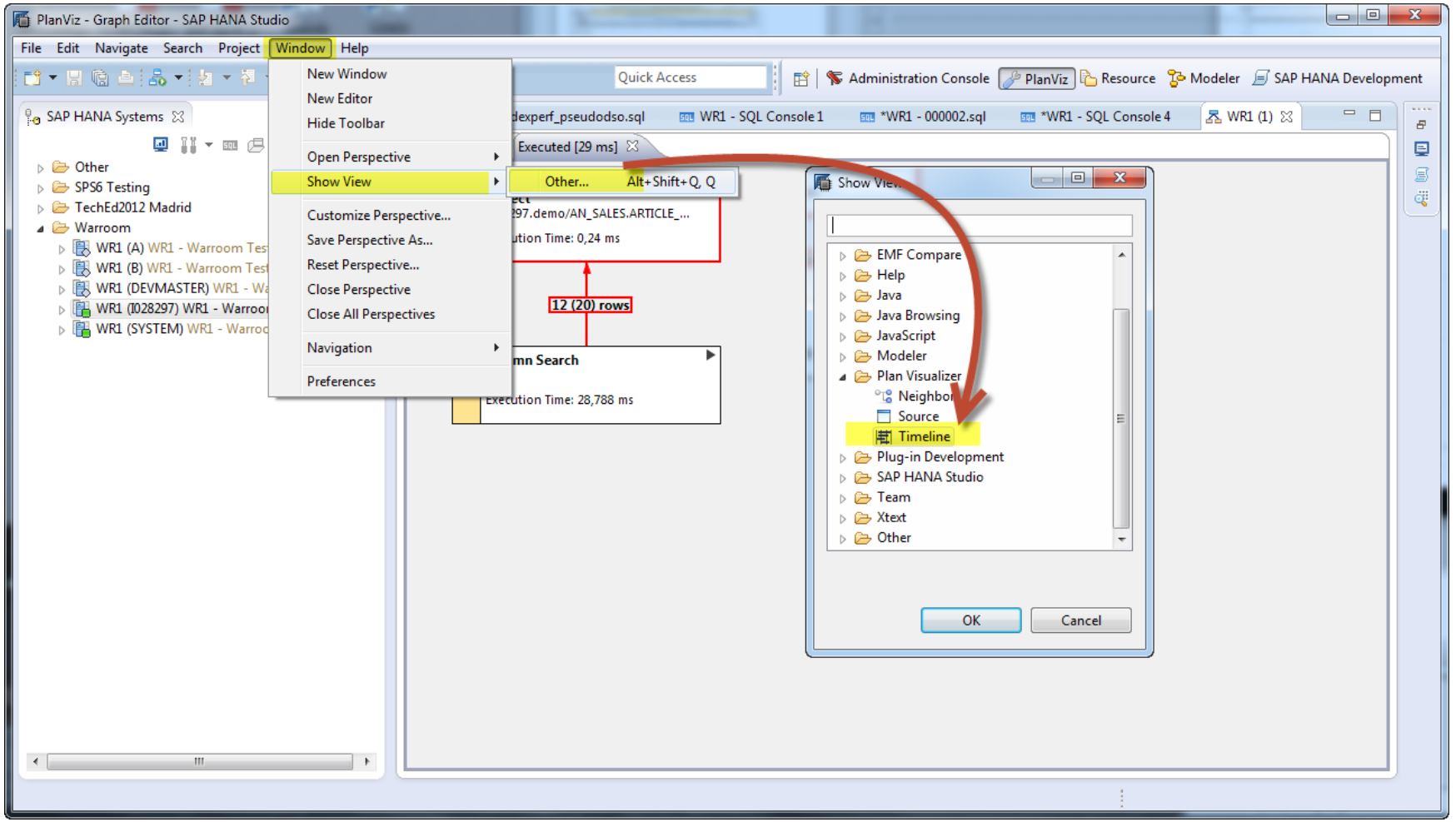
Plan Visualization (PlanViz)



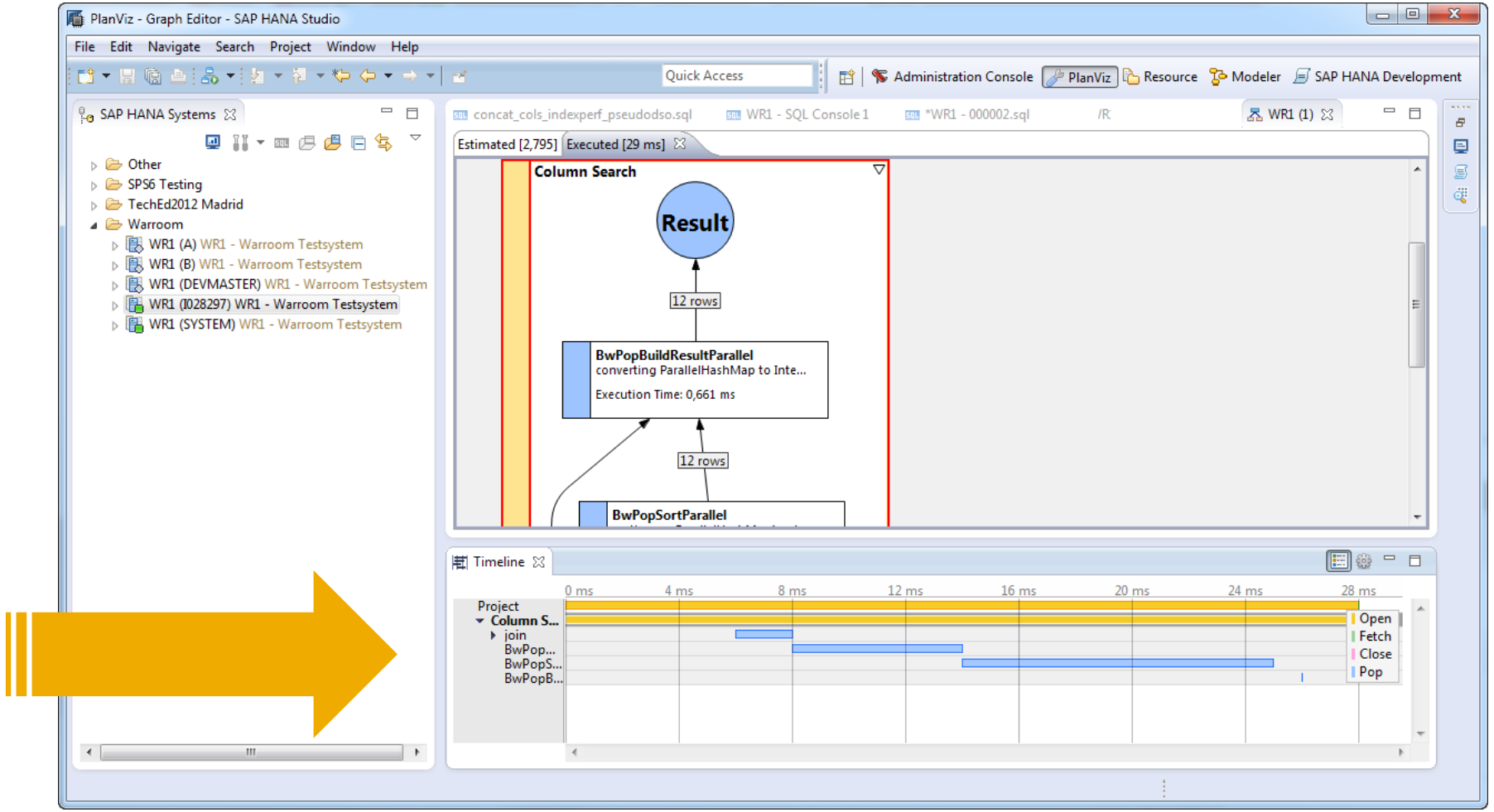
PlanViz



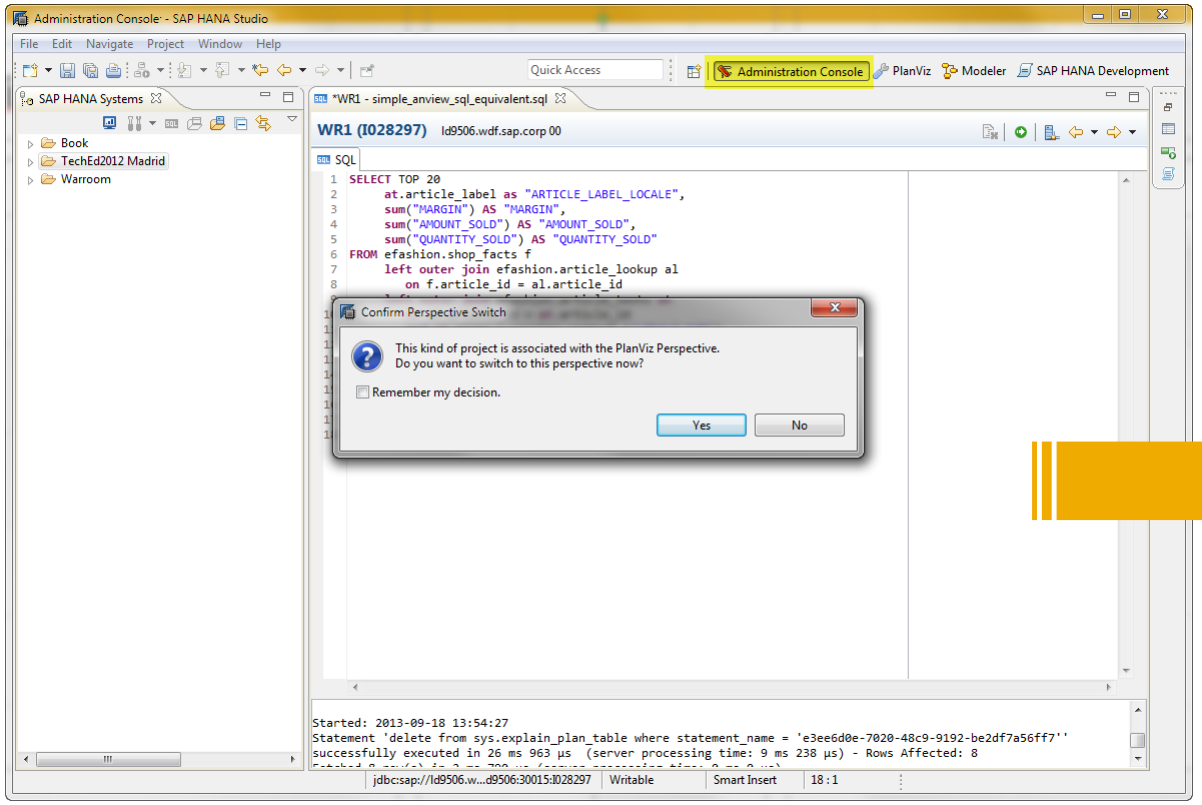
PlanViz – display timelines (pre-SPS 06)

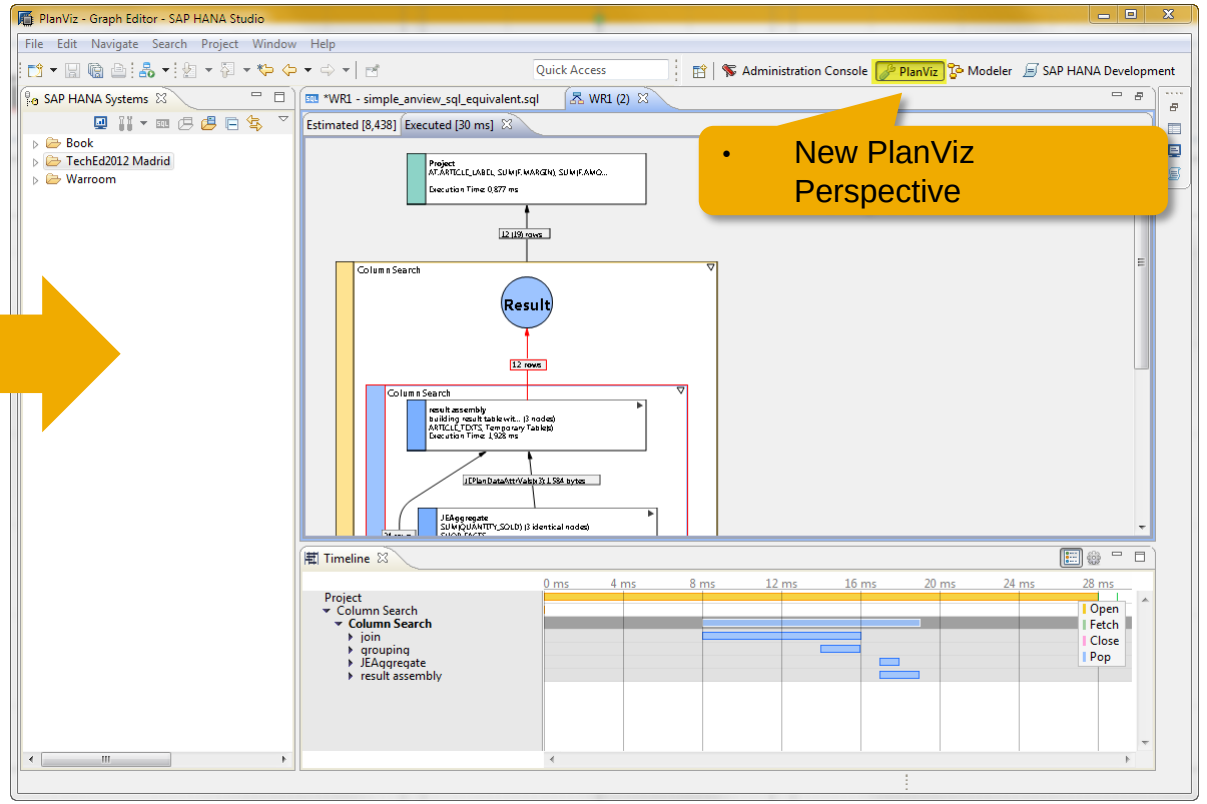


PlanViz – display timelines



PlanViz – display timelines (SPS 06)





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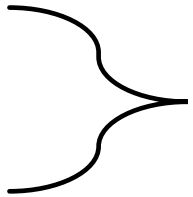

Single statement analysis

Summary

- Use SAP HANA database as a service, but not as a black box!
- In case of performance problems, think about where the problem could occur.
- Use the proper tools to measure if the problem really is where you think it is.

Further Information

SAP Public Web

SCN:
SAP In-Memory computing: http://scn.sap.com/community/hana-in-memory
SAP HANA Developer center: http://scn.sap.com/community/developer-center/hana

Further important information sources:
Public HANA community: http://www.saphana.com/
Public documentation: http://help.sap.com/hana_platform

SAP Education and Certification Opportunities

SAP HANA Training Curriculum
https://training.sap.com/us/en/curriculum/hana-g-en

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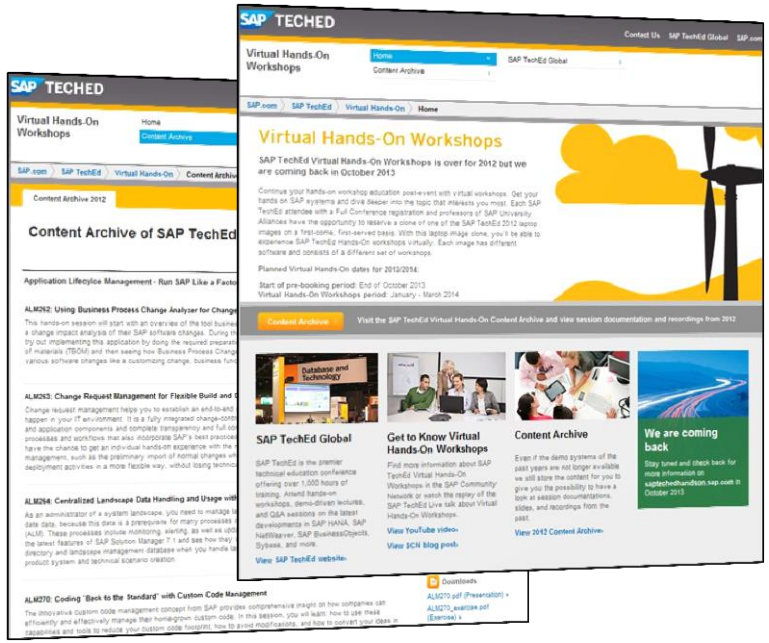

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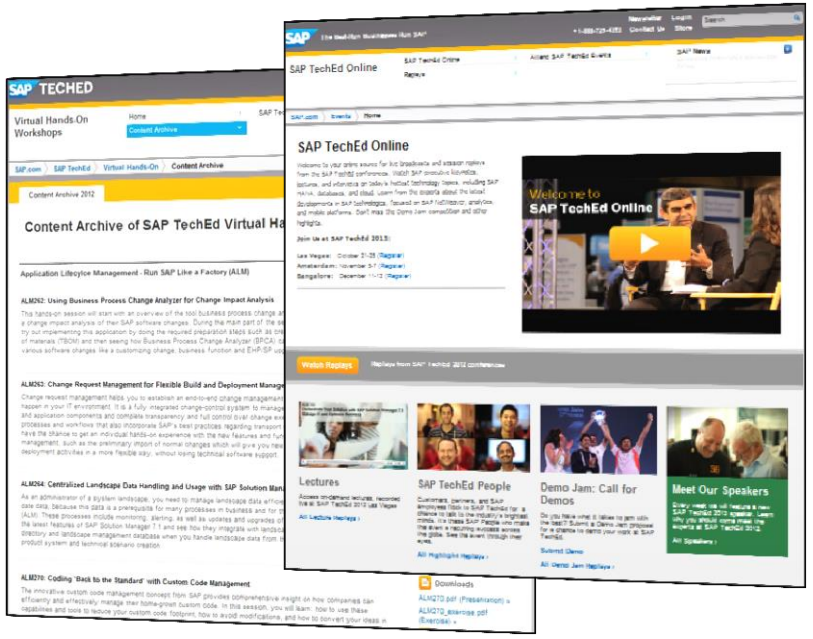
- View content only available online

http://saptecheds.com/online



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