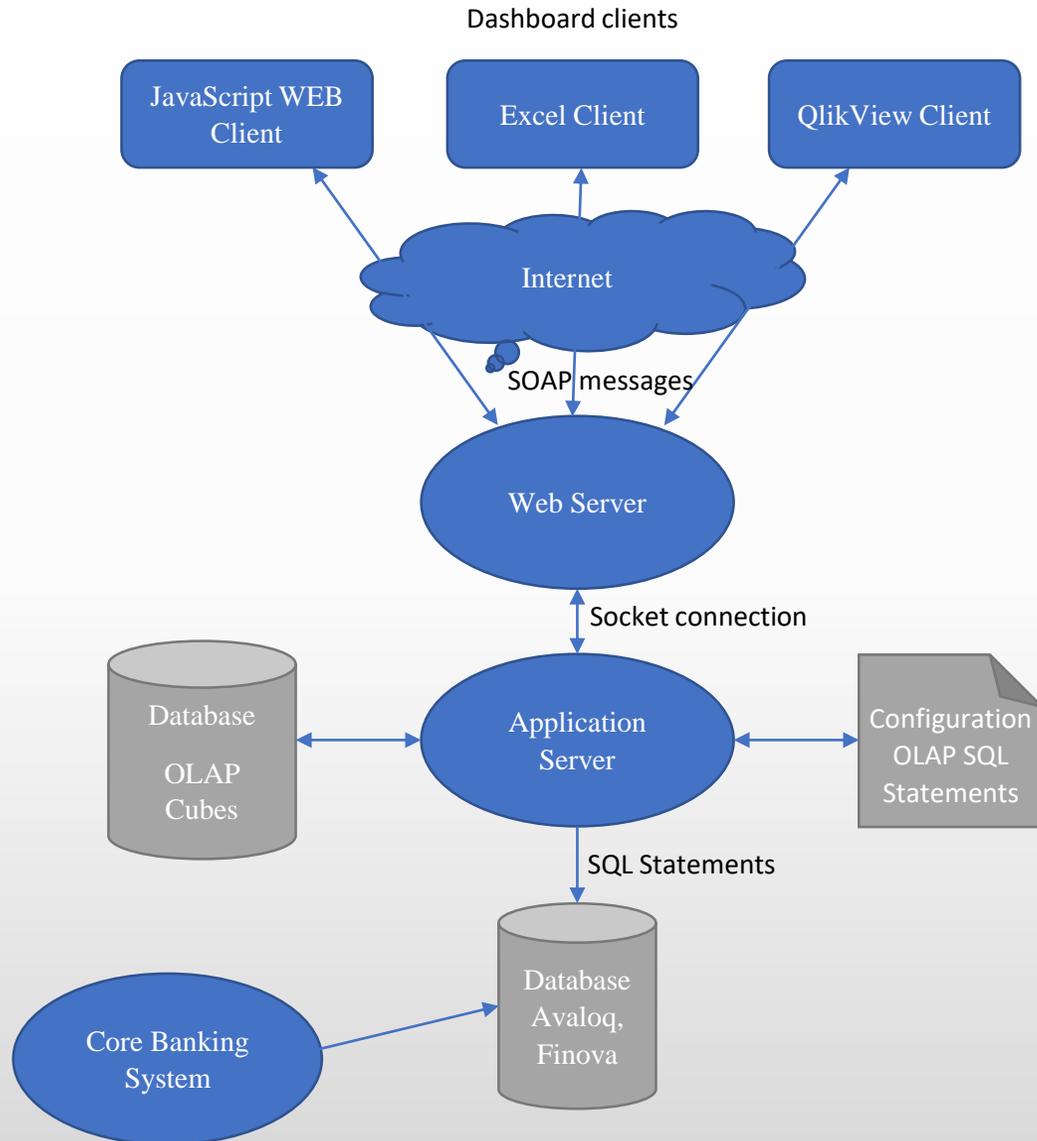


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Visualization of Financial Data

Dr. Anatoliy Antonov

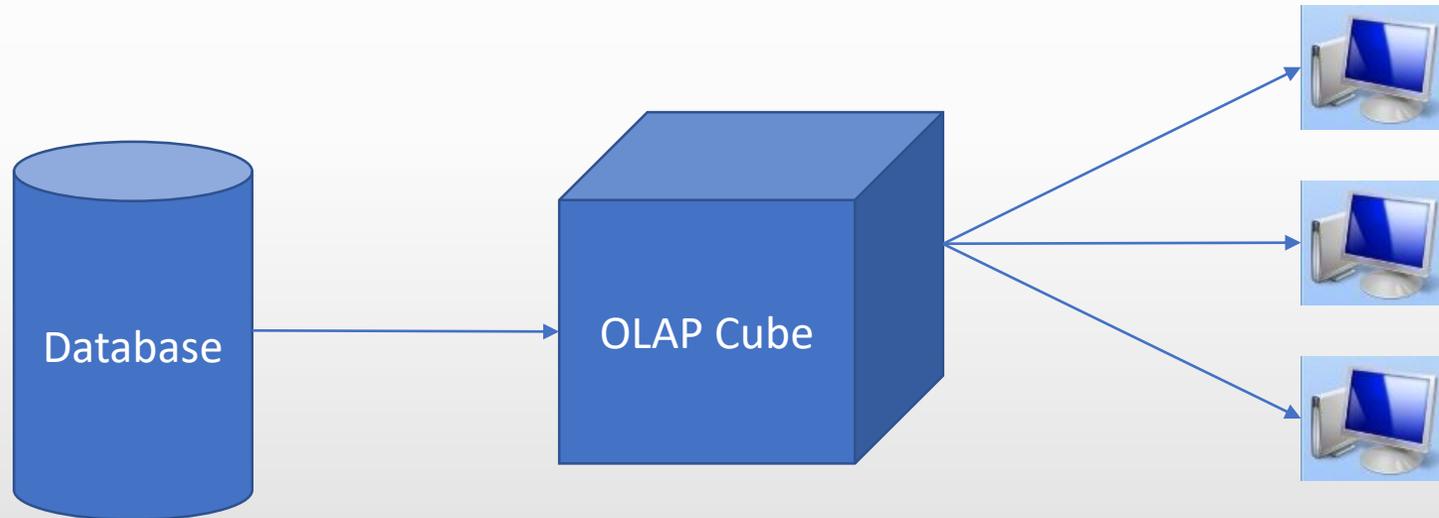
Ivan Bogdanov



To visualize financial data generated from existing Core Banking System one needs the components shown in the diagram left. It is considered that the Core Banking System and its database already exists so following components are needed:

- Application Server to extract data from Core Banking Database and to generate Visualization OLAP Cubes
 - SQL Configuration for the OLAP Cube Load Scripts, ETL (Extract Transform Load) tools can be used too
 - Database to store the created visualization information
- Web Server to exchange commands and data between the clients and the Application Server via SOAP and Sockets
- Available WEB Clients which can represent Dashboards:
 - In JavaScript or in Excel using Pivot and WEB Services
 - In QlikView using the Visualization and WEB Services

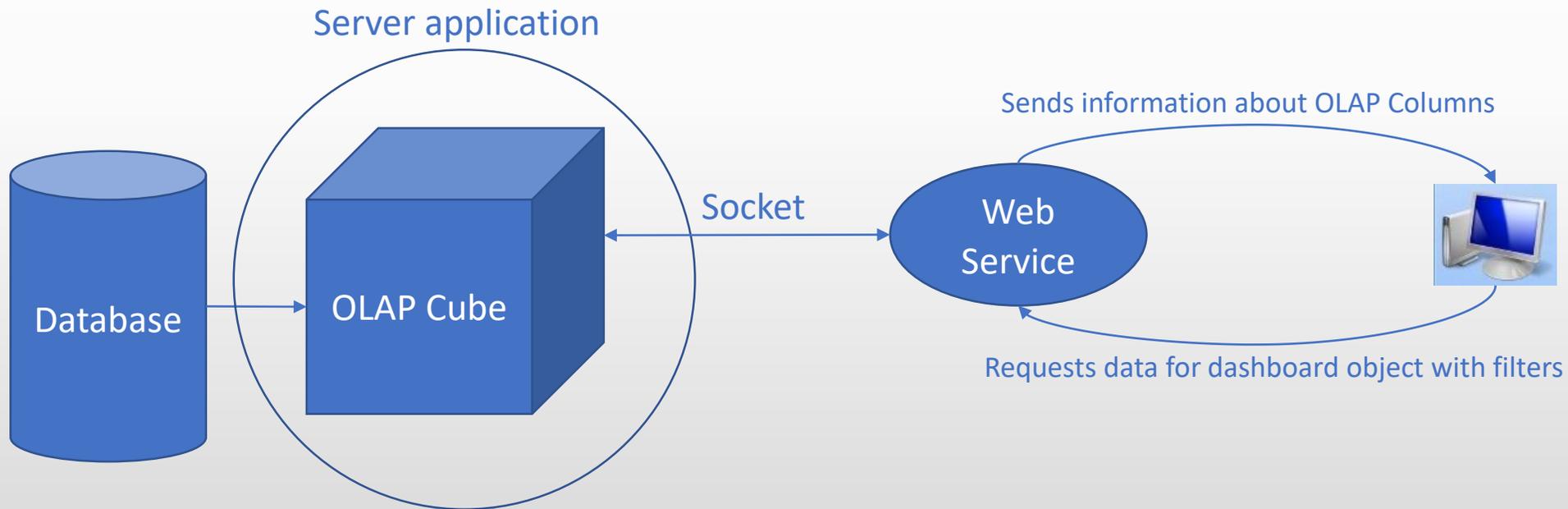
The main purpose of the application server is to access the raw data from the database, generate visualization information as OLAP Cubes and send Sub-Cubes according to commands to the Web server via XML-defined socket protocol. The application server also needs a configuration for the OLAP Cube Load Scripts in which is stored information for the database structure and also SQL statements for generating the OLAP Cube. This is a typical ETL (Extract Transform Load) procedure, so ETL Tools are applicable too, see last slide



The Web Server is communicating with multiple client instances by Internet via SOAP/WSDL, i.e. via WEB Services. It receives commands from the specific client application, requests data from the application server (which have access to already prepared OLAP Cubes) and returns a response message including visualization data to the client. Some of the current functionalities of the application server are:

- getOLAPCubes – returns all available OLAP Cubes as a list
- getCubeMetaData – returns all available columns from the Cube and its types
- getCubeDataByColumnsAndFiltered – returns to the Dashboard specific visualization data (Sub-Cubes) from existing Cube, filtered by column and row selection
- import/export/delete Cubes of the application server database
- manage the OLAP Cube SQL Load Scripts

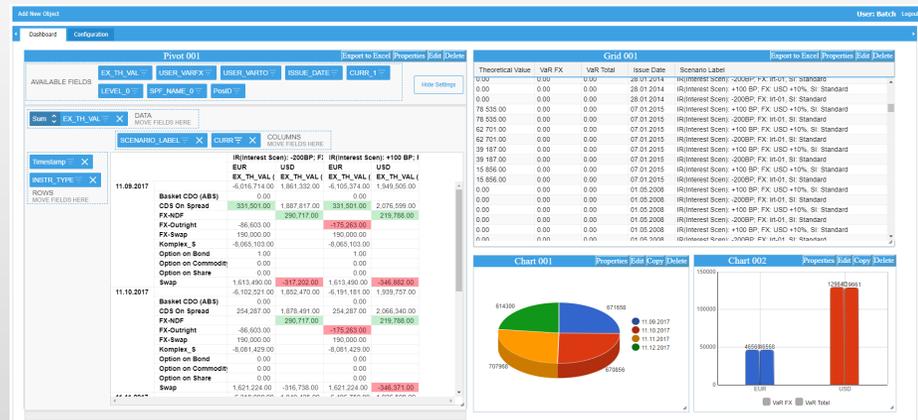
Example workflow of the Web Service and connection to application server and clients is given below:
 At first information about all OLAP Columns available is sent via Web Service to the Client. User selects the columns and rows and filters that want to apply on the dashboard and sends request for building the corresponding dashboard object. The Web server processes the request to the application server which apply the filters over the OLAP Cube and returns the data to the Web Server which transfers it to the client application.



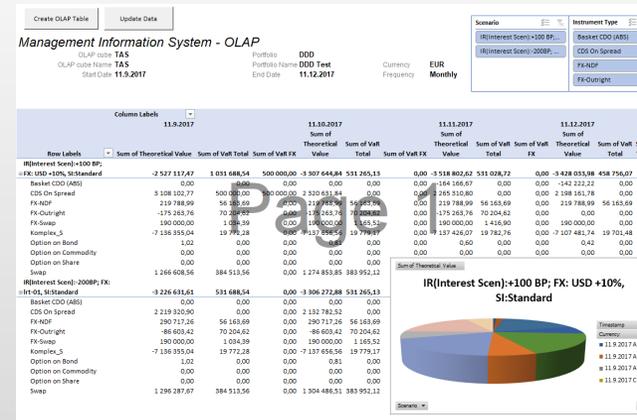
The Client application solutions can be made in different ways. Some proposals are:

- JavaScript WEB Client – JavaScript based GUI developed with DHTMLX library, deployed on a WEB Server and can be accessed via browser. 3D interactive graphic can be added in addition. Both tools are of low cost or cost free
- Excel Document Client – Excel Document including Pivot Tables which is designed to work as a client of the Web Server and which runs according to same protocol as the JavaScript WEB Client
- QlikView Client – It is also possible to provide a client using the visualization features and WEB Service scripts of the QlikView tool in non-server mode

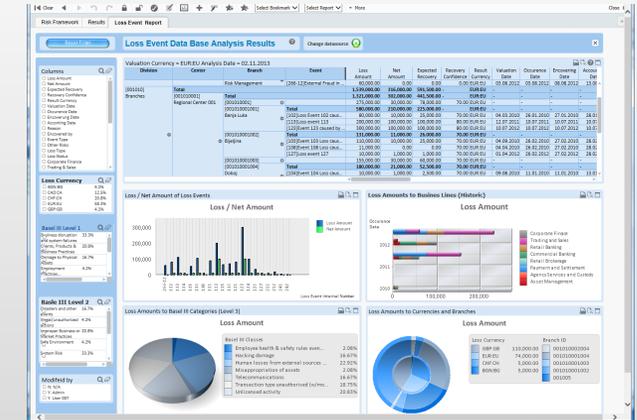
JavaScript WEB client Dashboard



Excel WEB client incl. Pivot Dashboard



QlikView WEB client Dashboard



Pivot 001

Export to Excel Properties Edit Delete

AVAILABLE FIELDS: EX_TH_VAL, USER_VARFX, USER_VARTO, ISSUE_DATE, CURR_1, LEVEL_0, SPF_NAME_0, PosID

Sum EX_TH_VAL DATA MOVE FIELDS HERE

SCENARIO_LABEL CURR COLUMNS MOVE FIELDS HERE

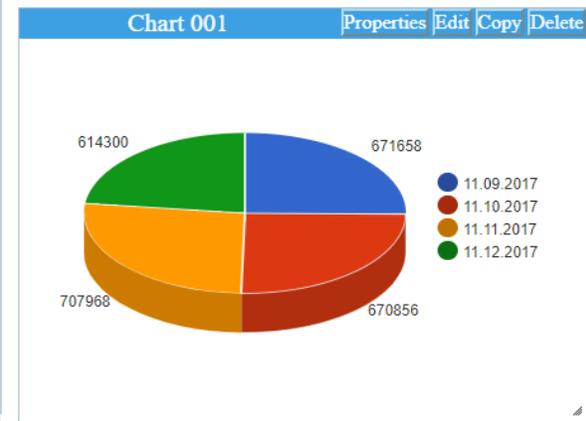
Timestamp INSTR_TYPE ROWS MOVE FIELDS HERE

	IR(Interest Scen): -200BP; F		IR(Interest Scen): +100 BP; f	
	EUR	USD	EUR	USD
EX_TH_VAL (EX_TH_VAL (EX_TH_VAL (EX_TH_VAL (EX_TH_VAL (
11.09.2017	-6,016,714.00	1,861,332.00	-6,105,374.00	1,949,505.00
Basket CDO (ABS)	0.00		0.00	
CDS On Spread	331,501.00	1,887,817.00	331,501.00	2,076,599.00
FX-NDF		290,717.00		219,788.00
FX-Outright	-86,603.00		-175,263.00	
FX-Swap	190,000.00		190,000.00	
Komplex_S	-8,065,103.00		-8,065,103.00	
Option on Bond	1.00		1.00	
Option on Commodity	0.00		0.00	
Option on Share	0.00		0.00	
Swap	1,613,490.00	-317,202.00	1,613,490.00	-346,882.00
11.10.2017	-6,102,521.00	1,852,470.00	-6,191,181.00	1,939,757.00
Basket CDO (ABS)	0.00		0.00	
CDS On Spread	254,287.00	1,878,491.00	254,287.00	2,066,340.00
FX-NDF		290,717.00		219,788.00
FX-Outright	-86,603.00		-175,263.00	
FX-Swap	190,000.00		190,000.00	
Komplex_S	-8,081,429.00		-8,081,429.00	
Option on Bond	0.00		0.00	
Option on Commodity	0.00		0.00	
Option on Share	0.00		0.00	
Swap	1,621,224.00	-316,738.00	1,621,224.00	-346,371.00

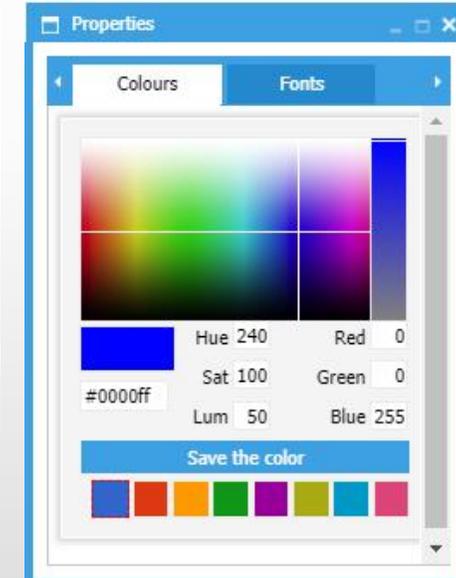
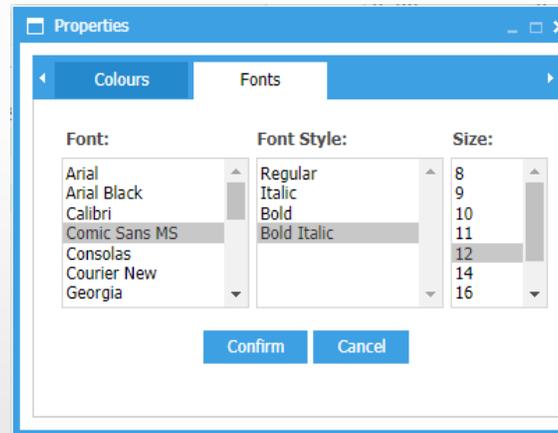
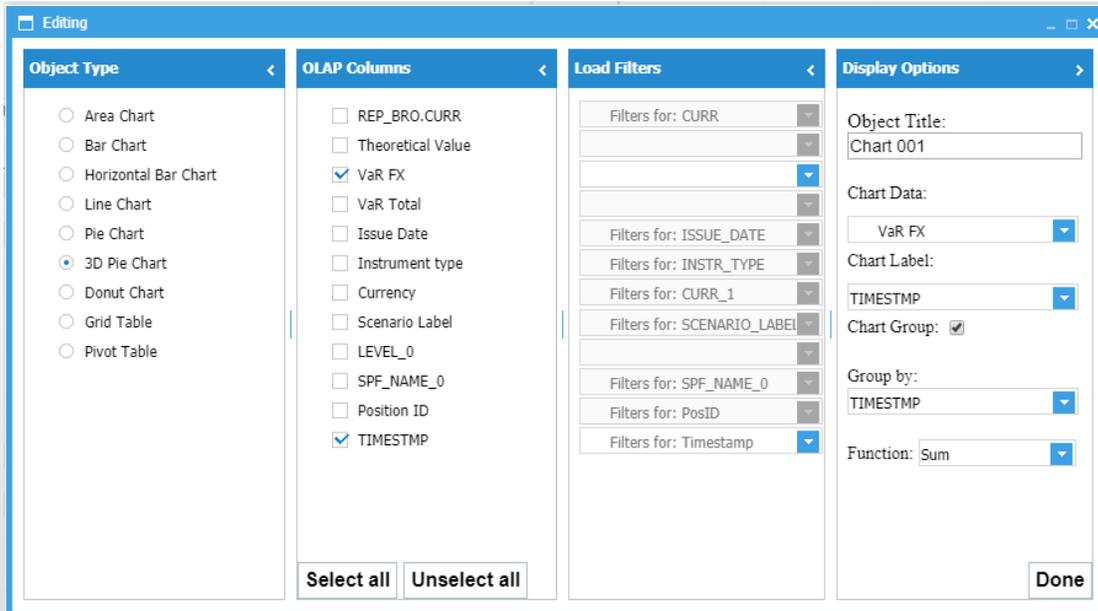
Grid 001

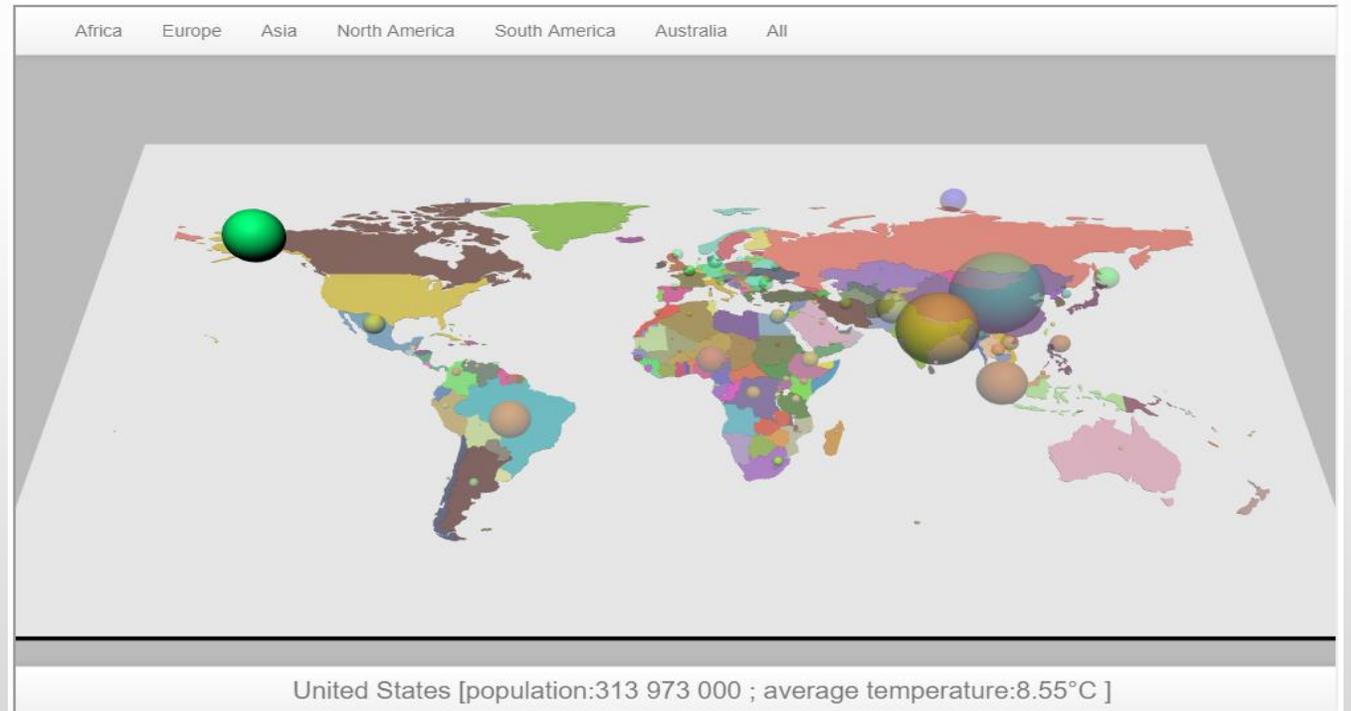
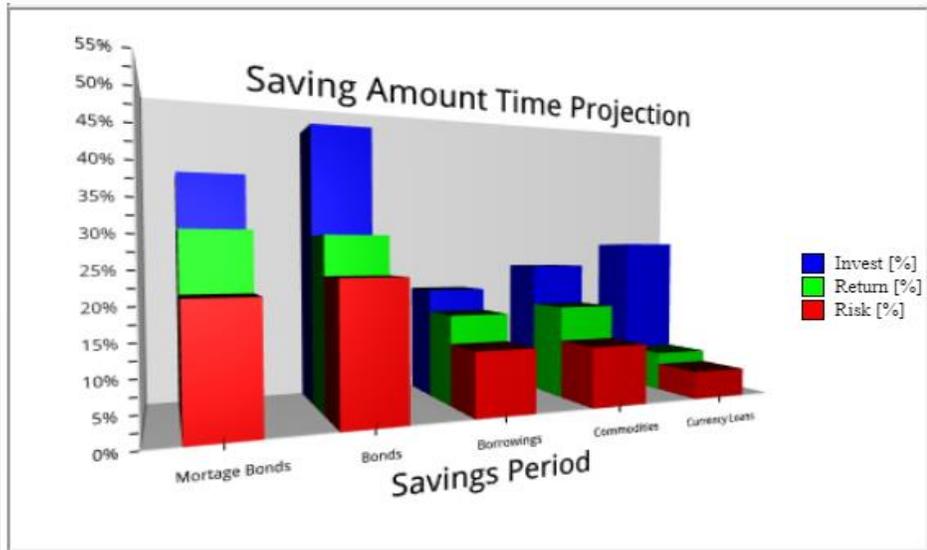
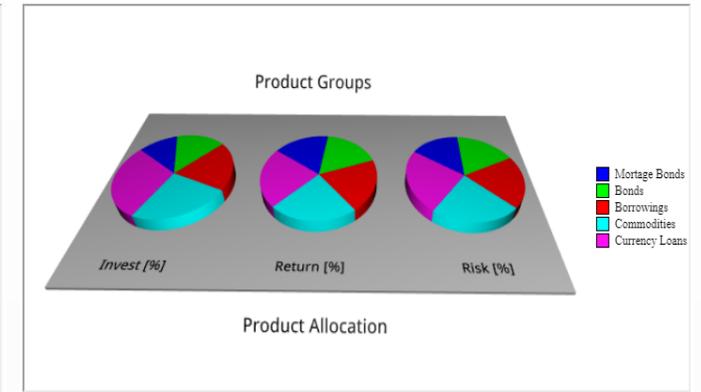
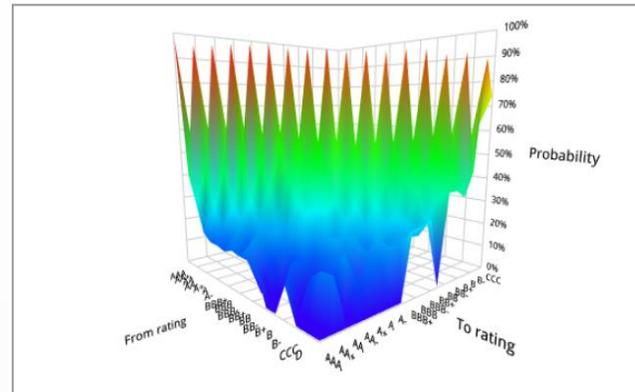
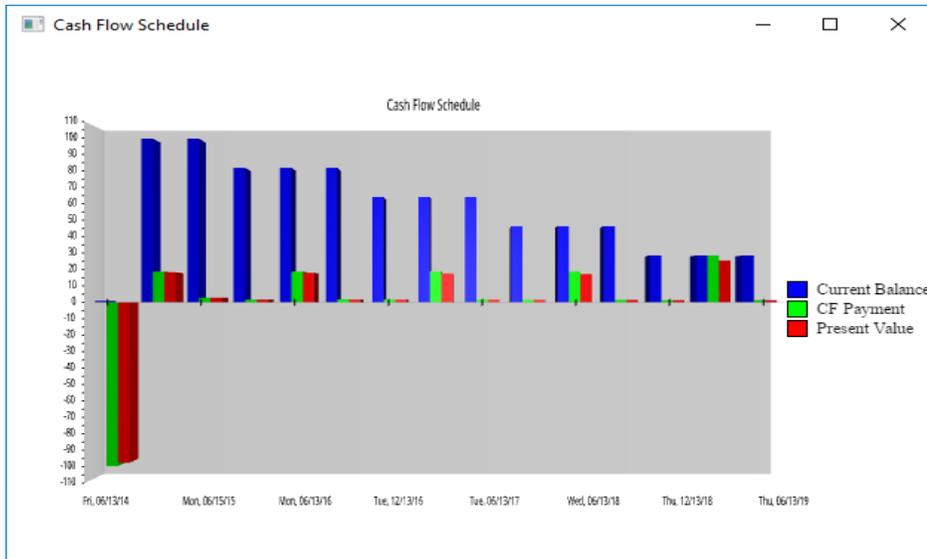
Export to Excel Properties Edit Delete

Theoretical Value	VaR FX	VaR Total	Issue Date	Scenario Label
0.00	0.00	0.00	28.01.2014	IR(Interest Scen): -200BP; FX: Irt-01, SI: Standard
0.00	0.00	0.00	28.01.2014	IR(Interest Scen): +100 BP; FX: USD +10%, SI: Standard
0.00	0.00	0.00	28.01.2014	IR(Interest Scen): -200BP; FX: Irt-01, SI: Standard
78 535.00	0.00	0.00	07.01.2015	IR(Interest Scen): +100 BP; FX: USD +10%, SI: Standard
78 535.00	0.00	0.00	07.01.2015	IR(Interest Scen): -200BP; FX: Irt-01, SI: Standard
62 701.00	0.00	0.00	07.01.2015	IR(Interest Scen): +100 BP; FX: USD +10%, SI: Standard
62 701.00	0.00	0.00	07.01.2015	IR(Interest Scen): -200BP; FX: Irt-01, SI: Standard
39 187.00	0.00	0.00	07.01.2015	IR(Interest Scen): +100 BP; FX: USD +10%, SI: Standard
39 187.00	0.00	0.00	07.01.2015	IR(Interest Scen): -200BP; FX: Irt-01, SI: Standard
15 856.00	0.00	0.00	07.01.2015	IR(Interest Scen): +100 BP; FX: USD +10%, SI: Standard
15 856.00	0.00	0.00	07.01.2015	IR(Interest Scen): -200BP; FX: Irt-01, SI: Standard
0.00	0.00	0.00	01.05.2008	IR(Interest Scen): +100 BP; FX: USD +10%, SI: Standard
0.00	0.00	0.00	01.05.2008	IR(Interest Scen): -200BP; FX: Irt-01, SI: Standard
0.00	0.00	0.00	01.05.2008	IR(Interest Scen): +100 BP; FX: USD +10%, SI: Standard
0.00	0.00	0.00	01.05.2008	IR(Interest Scen): -200BP; FX: Irt-01, SI: Standard
0.00	0.00	0.00	01.05.2008	IR(Interest Scen): +100 BP; FX: USD +10%, SI: Standard
0.00	0.00	0.00	01.05.2008	IR(Interest Scen): -200BP; FX: Irt-01, SI: Standard



The WEB graphical user interface is JavaScript based and developed with DHTMLX library. It can be accessed via any WEB browser, tablet or smartphone. It has a Configuration tab where is specified the settings and filtering of the OLAP Cube and a Dashboard tab where is visualized the data. You can dynamically add, edit or remove dashboard elements with request for data from the server. Each element has its own settings such as OLAP columns, Load row filters, chart colors, font style, font size. You can customize your dashboard and store its settings to external database so you can load it there after.





Create OLAP Table Update Data

Management Information System - OLAP

OLAP cube **TAS** Portfolio **DDD**
 OLAP cube Name **TAS** Portfolio Name **DDD Test** Currency **EUR**
 Start Date **11.9.2017** End Date **11.12.2017** Frequency **Monthly**

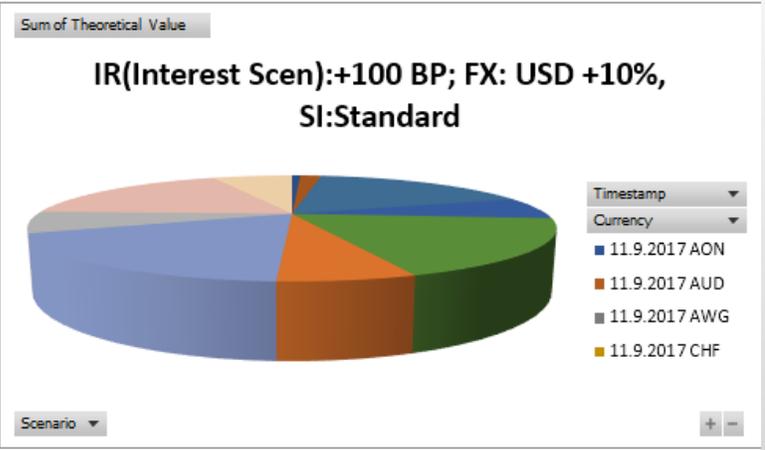
Scenario

- IR(Interest Scen):+100 BP;...
- IR(Interest Scen):-200BP; ...

Instrument Type

- Basket CDO (ABS)
- CDS On Spread
- FX-NDF
- FX-Outright

Column Labels	11.9.2017			11.10.2017			11.11.2017			11.12.2017		
	Sum of Theoretical Value	Sum of VaR Total	Sum of VaR FX	Sum of Theoretical Value	Sum of VaR Total	Sum of VaR FX	Sum of Theoretical Value	Sum of VaR Total	Sum of VaR FX	Sum of Theoretical Value	Sum of VaR Total	Sum of VaR FX
IR(Interest Scen):+100 BP;												
FX: USD +10%, SI:Standard	-2 527 117,47	1 031 688,54	500 000,00	-3 307 644,84	531 265,13	0,00	-3 518 802,62	531 028,72	0,00	-3 428 033,98	458 756,07	0,00
Basket CDO (ABS)	0,00	0,00	0,00	0,00	0,00	0,00	-164 166,67	0,00	0,00	-142 222,22	0,00	0,00
CDS On Spread	3 108 102,77	500 000,00	500 000,00	2 320 631,84	0,00	0,00	2 265 310,80	0,00	0,00	2 198 161,78	0,00	0,00
FX-NDF	219 788,99	56 163,69	0,00	219 788,99	56 163,69	0,00	219 788,99	56 163,69	0,00	219 788,99	56 163,69	0,00
FX-Outright	-175 263,76	70 204,62	0,00	-175 263,76	70 204,62	0,00	-175 263,76	70 204,62	0,00	0,00	0,00	0,00
FX-Swap	190 000,00	1 034,39	0,00	190 000,00	1 165,52	0,00	190 000,00	1 416,90	0,00	190 000,00	0,00	0,00
Komplex_S	-7 136 355,04	19 772,28	0,00	-7 137 656,56	19 779,17	0,00	-7 137 426,07	19 782,76	0,00	-7 107 481,74	19 701,48	0,00
Option on Bond	1,02	0,00	0,00	0,81	0,00	0,00	0,60	0,00	0,00	0,42	0,00	0,00
Option on Commodity	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Option on Share	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Swap	1 266 608,56	384 513,56	0,00	1 274 853,85	383 952,12	0,00	0,00	0,00	0,00	0,00	0,00	0,00
IR(Interest Scen):-200BP; FX:												
Irt-01, SI:Standard	-3 226 631,61	531 688,54	0,00	-3 306 272,88	531 265,13	0,00	-3 226 631,61	531 688,54	0,00	-3 226 631,61	531 688,54	0,00
Basket CDO (ABS)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CDS On Spread	2 219 320,90	0,00	0,00	2 132 782,52	0,00	0,00	2 219 320,90	0,00	0,00	2 219 320,90	0,00	0,00
FX-NDF	290 717,26	56 163,69	0,00	290 717,26	56 163,69	0,00	290 717,26	56 163,69	0,00	290 717,26	56 163,69	0,00
FX-Outright	-86 603,42	70 204,62	0,00	-86 603,42	70 204,62	0,00	-86 603,42	70 204,62	0,00	-86 603,42	70 204,62	0,00
FX-Swap	190 000,00	1 034,39	0,00	190 000,00	1 165,52	0,00	190 000,00	1 416,90	0,00	190 000,00	0,00	0,00
Komplex_S	-7 136 355,04	19 772,28	0,00	-7 137 656,56	19 779,17	0,00	-7 137 426,07	19 782,76	0,00	-7 107 481,74	19 701,48	0,00
Option on Bond	1,02	0,00	0,00	0,81	0,00	0,00	0,60	0,00	0,00	0,42	0,00	0,00
Option on Commodity	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Option on Share	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Swap	1 296 287,67	384 513,56	0,00	1 304 486,51	383 952,12	0,00	0,00	0,00	0,00	0,00	0,00	0,00



Features of the Excel client pivot table:

- Work with dimensions and aggregable columns
- Filters for dimensions
- Aggregation of calculated results
- Drop-Down-Feature
- Excel Charts
- Macros in Visual Basic Script
- WEB Services support

QlikView client interface showing 'Loss Event Data Base Analysis Results'.

Columns:

- Loss Amount
- Net Amount
- Expected Recovery
- Recovery Confidence
- Result Currency
- Valuation Date
- Occurrence Date
- Encouring Date
- Accounting Date
- Reason
- Encovered by
- Event Type
- Other Risks
- Loss Type
- Loss Status
- Corporate Finance
- Trading & Sales

Loss Currency:

- BGN:BG 4.2%
- CAD:CA 12.5%
- CHF:CH 20.8%
- EUR:EU 58.3%
- GBP:GB 4.2%

Basel III Level 1:

- Business disruption and system failures 33.3%
- Clients, Products & Business Practices 20.8%
- Damage to Physical Assets 16.7%
- Employment 4.2%
- Practices... 4.2%

Basel III Level 2:

- Disasters and other events 16.7%
- Illegal/unauthorized actions 4.2%
- Improper Business or Market Practices 20.8%
- Safe Environment 4.2%
- System Risk 33.3%

Modified by:

- N: N/A
- Y: Admin
- Y: User 007

Table: Valuation Currency = EUR:EU Analysis Date = 02.11.2013

Division	Center	Branch	Event	Loss Amount	Net Amount	Expected Recovery	Recovery Confidence	Result Currency	Valuation Date	Occurrence Date	Encouring Date	Accounting Date
[001010]	Total	Risk Management	[266-12]External Fraud in ...	60,000.00	0.00	0.00	0.00	EUR:EU	03.08.2012	03.08.2012	08.08.2012	13.08.2012
Branches	[001010001] Regional Center 001	Total		1,539,000.00	316,000.00	591,500.00	-	EUR:EU	-	-	-	-
		[001010001] Banja Luka	Total	275,000.00	30,000.00	78,000.00	70.00	EUR:EU	-	-	-	-
		[001010001001] Bijeljina	Total	580,000.00	210,000.00	225,000.00	-	EUR:EU	-	-	-	-
			[102]Loss Event 102 caus...	80,000.00	10,000.00	25,000.00	70.00	EUR:EU	04.03.2010	26.01.2010	27.01.2010	28.01.2010
			[113]Loss event 113	200,000.00	100,000.00	100,000.00	80.00	EUR:EU	12.07.2011	10.07.2011	10.07.2011	10.07.2011
			[123]Event 123 caused by ...	300,000.00	100,000.00	100,000.00	80.00	EUR:EU	10.07.2012	10.07.2012	10.07.2012	10.07.2012
		[001010001002] Dobo	Total	131,000.00	11,000.00	26,000.00	70.00	EUR:EU	-	-	-	-
			[103]Event 103 Loss caus...	110,000.00	10,000.00	25,000.00	70.00	EUR:EU	04.09.2010	26.02.2010	27.02.2010	28.02.2010
			[108]Event 108 Loss caus...	11,000.00	0.00	0.00	70.00	EUR:EU	04.04.2010	26.02.2010	27.02.2010	28.02.2010
			[127]Loss event 127	10,000.00	1,000.00	1,000.00	70.00	EUR:EU	01.04.2012	26.02.2012	27.02.2012	28.02.2012
		[001010001003] Dobo	Total	180,000.00	21,000.00	52,500.00	70.00	EUR:EU	-	-	-	-
		[001010001004] Dobo	Total	10,000.00	1,000.00	2,500.00	70.00	EUR:EU	09.08.2010	11.01.2010	11.01.2010	13.01.2010

Loss / Net Amount of Loss Events: Bar chart showing Loss Amount (blue) and Net Amount (green) for various Loss Event Internal Numbers (266-12, 102, 103, 104, 105, 106, 108, 111, 113, 115, 116, 123, 124, 126, 127, 211, 212, 241, 242).

Loss Amounts to Busines Lines (Historic): Horizontal bar chart showing Loss Amount by Occurrence Date (2010, 2011, 2012) across various business lines: Corporate Finance, Trading and Sales, Retail Banking, Commercial Banking, Retail Brokerage, Payment and Settlement, Agency Services and Custody, Asset Management.

Loss Amounts to Basel III Categories (Level 3): Pie chart showing Loss Amount distribution across Basel III Classes:

Basel III Class	Percentage
Employee health & safety rules even...	2.08%
Hacking damage	16.67%
Human losses from external sources ...	22.92%
Misappropriation of assets	2.08%
Telecommunications	16.67%
Transaction type unauthorised (w/mo...	18.75%
Unlicensed activity	20.83%

Loss Amounts to Currencies and Branches: Donut chart showing Loss Amount distribution by Loss Currency and Branch ID.

Loss Currency	Branch ID	Amount
GBP:GB	001010002004	110,000.00
EUR:EU	001010001004	74,000.00
CHF:CH	001010001003	5,000.00
BGN:BG	001010001002	5,000.00
	001005	

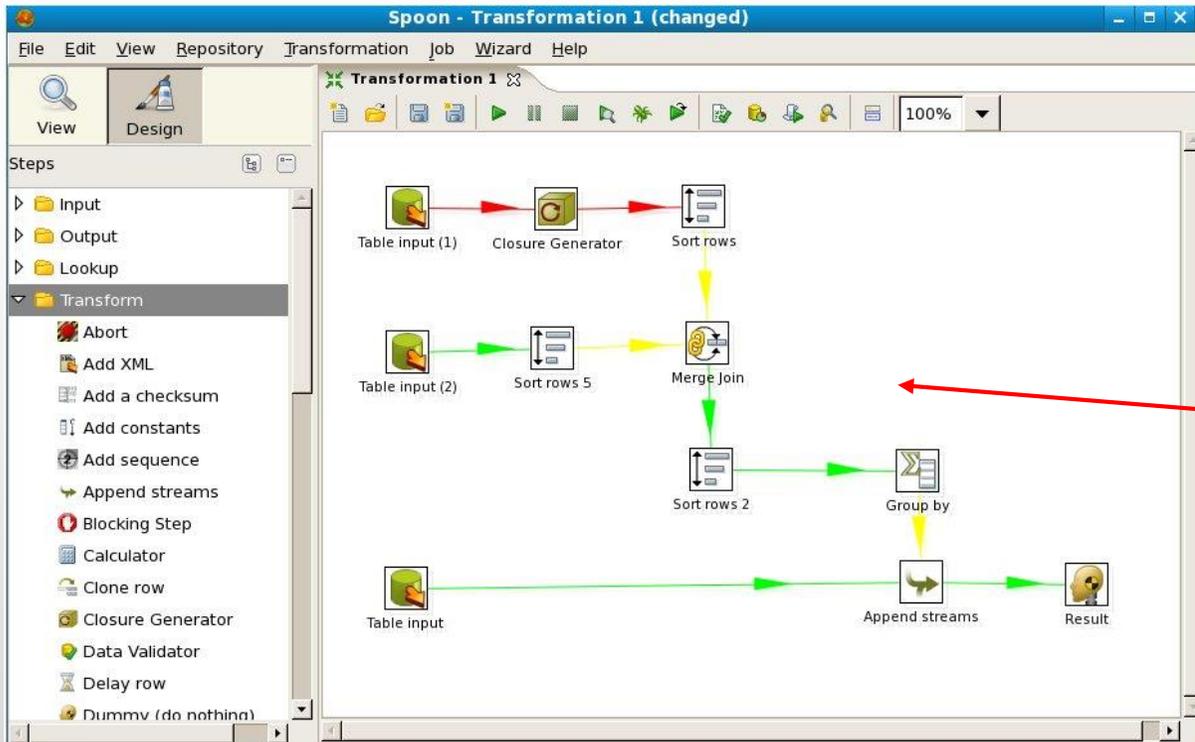
Features of the QlikView client:

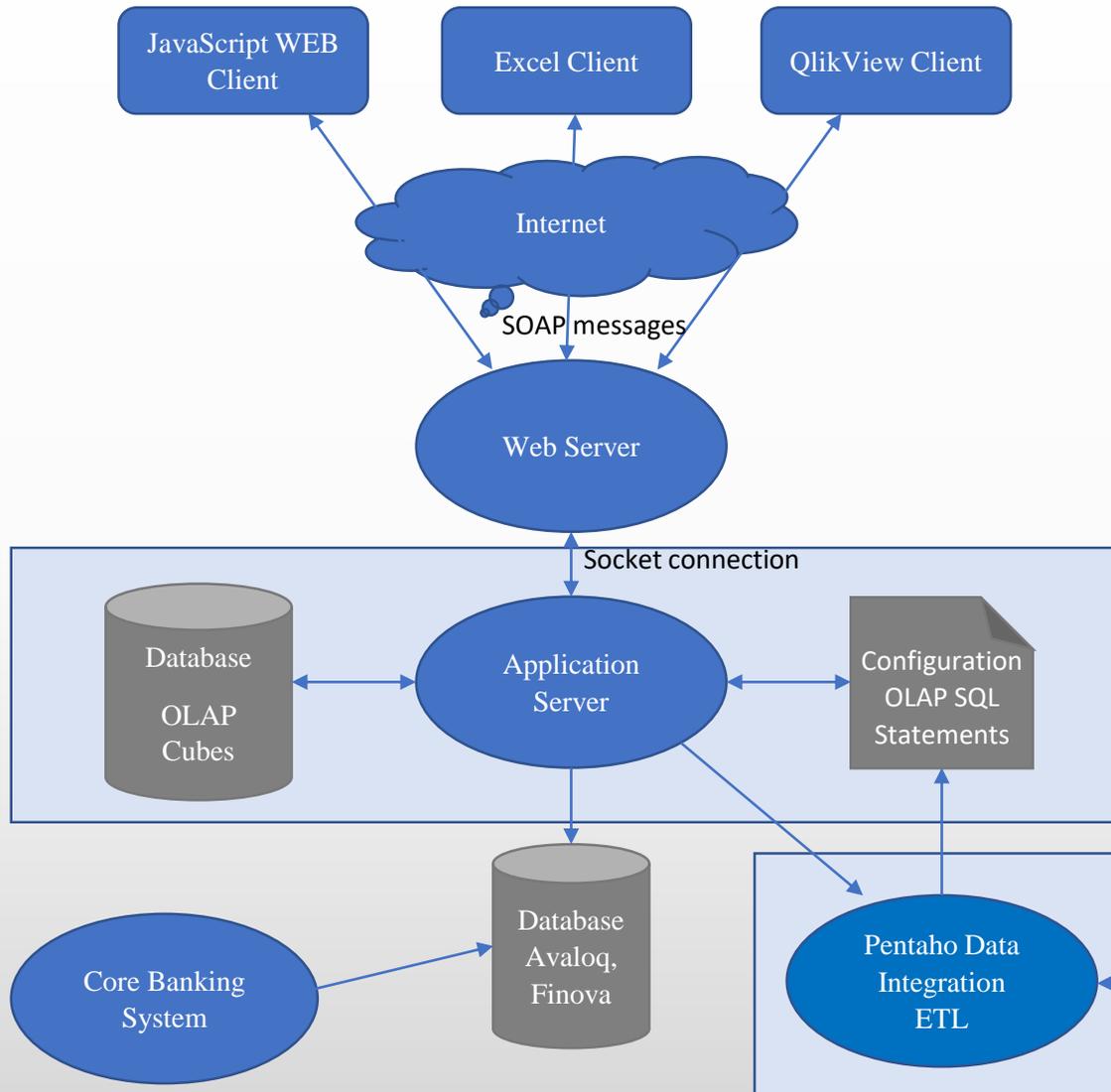
- Work with dimensions and aggregable columns
- Filters of dimensions
- Aggregation of calculated results
- Drop-Down-Feature
- Various charts and table representations
- Selection of table columns
- Macros in JavaScript
- WEB Services support

To become fully working systems there are few steps of installation:

1. Place the application server on server machine in a LAN with access to the database of the Core Banking System
2. Setup the configuration with information for connection to the database of the Core Banking System and create scripts to extract visualization data into OLAP cubes using the ETL Tool, s. Pentaho Data Integration ETL on next slides
3. Install a WEB Server (we suggest Apache Tomcat)
4. Deploy the Web Service package on the WEB Server
5. Configure the settings of the Web Service package
6. You receive there after access to the application via the WEB clients:
 - WEB application via browser and WEB Services or
 - Desktop application in Excel or in QlikView which connects using WEB Services

One of the main task of the application server is to prepare the OLAP cubes via access to the database tables of the Core Banking System using SQL load scripts which extract the visualization data from database of the Core Banking System, transform and reorganize it and load it as OLAP cubes. This is a typical task for configurable ETL (Extract Visualize Load) tools, so this task can be performed alternatively using ETL. An example transformation and a list of provider of ETL integration tools are given below, many of the tools are at low cost or cost free, one example is Pentaho Data Integration ETL.

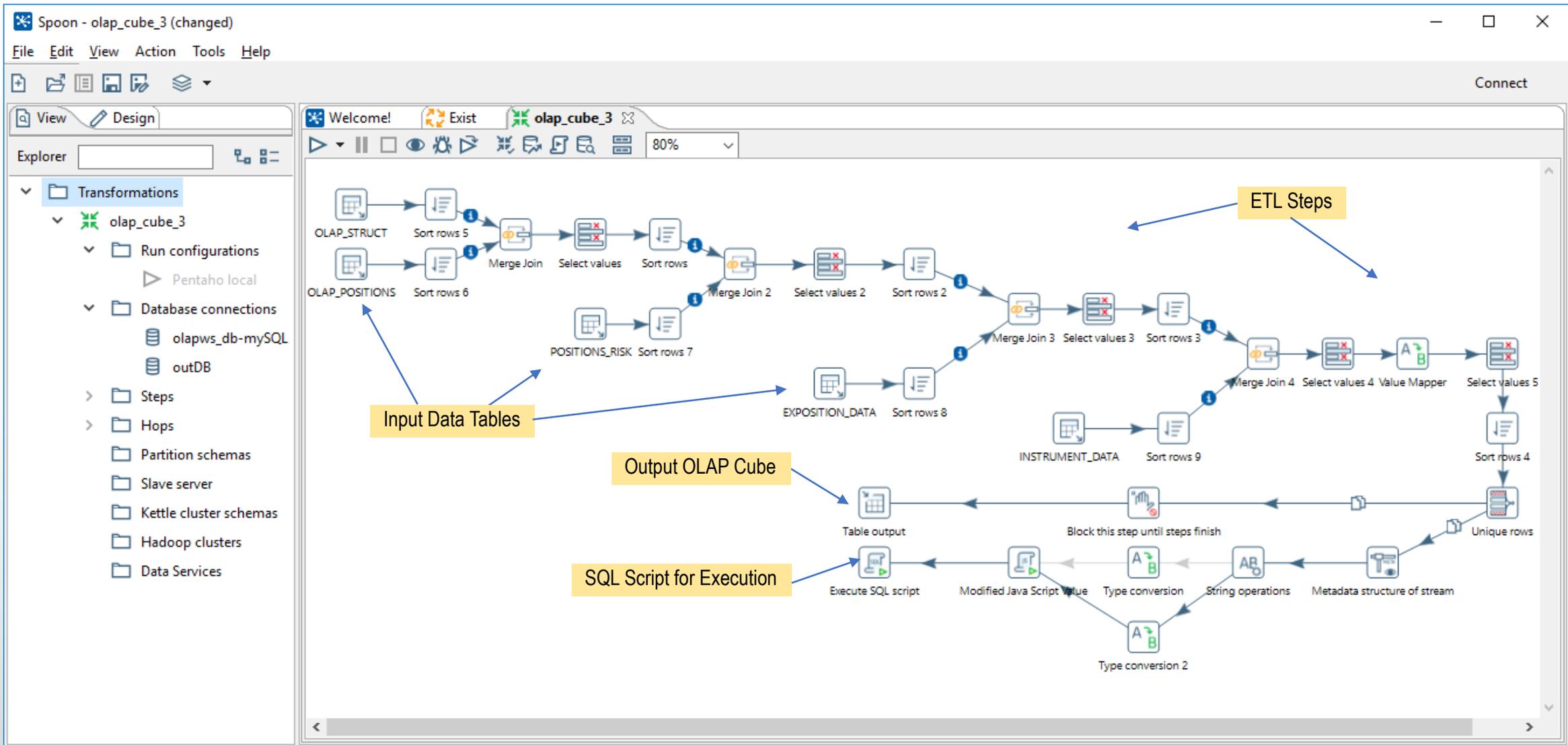




The Pentaho Data Integration ETL (cost free) was selected for the implementation of the Visualization at server side. This ETL Tool is controlled by the Application Server and it performs following tasks on potential large data:

1. Configure the ETL steps by visual GUI, s. next slide.
2. Extract related data from data base tables of same or different DBMS, transform the data and store the data into output data base as OLAP cubes at off-line time, at very large data sets in the night.
3. Extract sub-cubes on-line needed for the visualization and pass them to the clients through the WEB Sever.





Dashboard Settings

Cube: Test Cube Update Data **Refresh Data into Selected Cube**

Date: 2018-06-03

Stored Dashboard Settings

Dashboard: Dashboard 002 Load Dashboard Delete Dashboard **List of Dashboards for Visualization**

New Dashboard Settings

Dashboard: Dashboard 002 Save Dashboard **Dashboard Management Load and Delete**

The client side is able to refresh the cube data and to manage one or more Dashboards of the selected OLAP Cube

The Server Side can be configured via WEB Link including Server Settings and Cubes and Column Mappings

Server settings

[reload](#) [save](#)

Key	Value
className	oracle.jdbc.driver.OracleDriver
DASHBOARD_CHARTS_Delete	DASH_ID_PAR
DASHBOARD_DEF_Delete	DASH_ID
dbCS	jdbc:oracle:thin:IB/IB@192.168.0.24:1521/orauf8
PentahoHomeDir	C:\\programs\\data-integration\\
removeTables	USERS, DASHBOARD_DEF, DASHBOARD_CHARTS
TransformationsDir	C:\\programs\\data-integration\\

Cubes Mapping

[reload](#) [save](#)

Key	Value
OLAP_CUBE_2	Test Cube

Columns Mapping

[reload](#) [save](#)

Key	Value
CURRENCY	Currency (REPORT)
CURRENCY_1	Currency
THEOR_VALUE	Theoretical Value
INSTRUMENT_TYPE	Instrument Type
ISSUE_DATE	Issue Date
POSITION_ID	Position ID
SCENARIO_LABEL	Scenario Label
FX_VAR	VaR FX
TOTAL_VAR	VaR Total