Technology, Innovation and Information at Fingrid

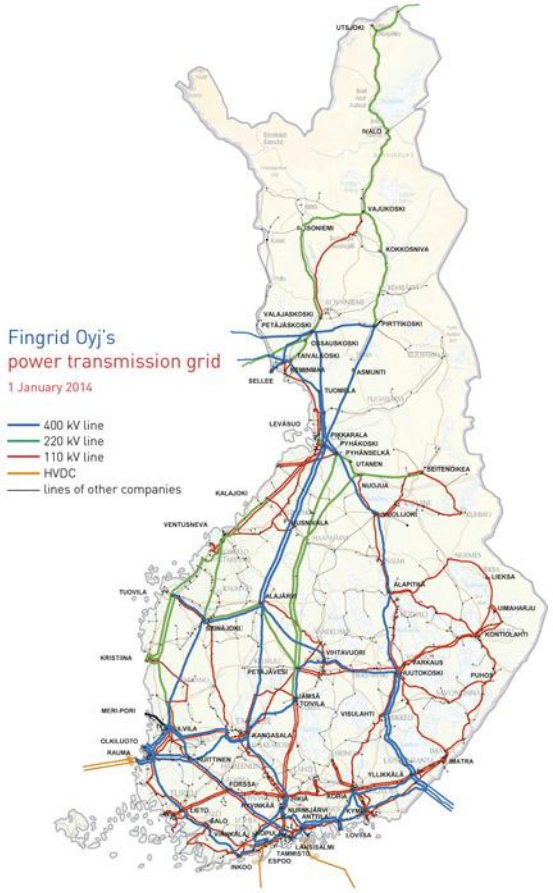
12.6.2014

Kari Suominen, CIO

Agenda

- Fingrid in general
- Innovative use of Technology and Information in running the business
  - Fingrid's condition monitoring system
  - Current use cases with PI
  - Elvis
- Future plans
  - Elvis and PI
  - Datahub

Fingrid is the Finnish transmission system operator (TSO)



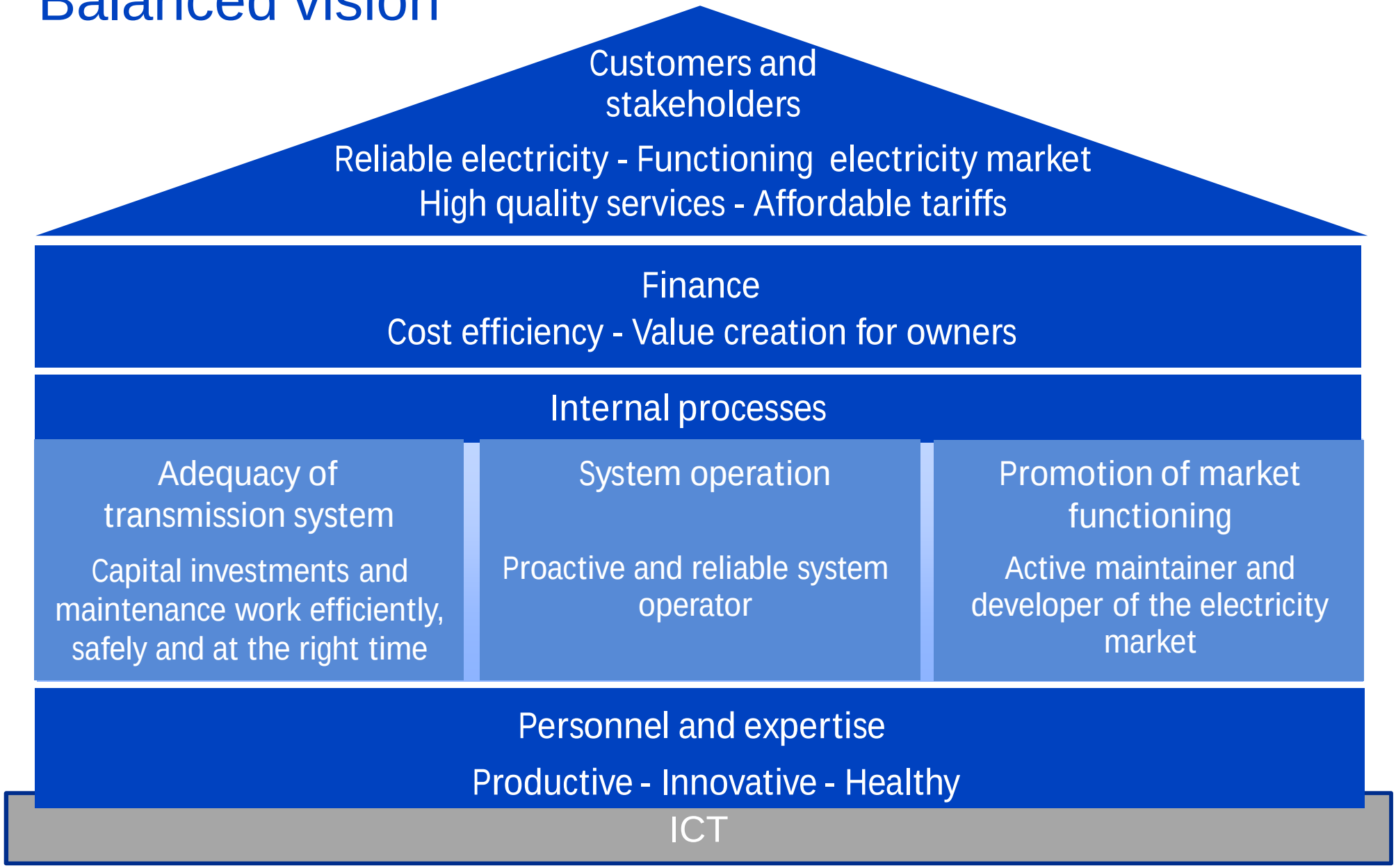
We are responsible for the functioning of the entire power system in Finland. We keep the transmission grid in a good condition and construct it on the basis of the needs of the electricity market.

We transmit electricity continuously from electricity generating companies to distribution network companies and industrial companies. 75% of the electricity in Finland is transmitted in our grid.

We take care of the cross-border connections of electricity transmission. There are direct connections to Finland from Russia, Sweden, Norway and Estonia.

We promote the functioning of the electricity market by keeping the transmission connections between various countries in working order.

Balanced vision

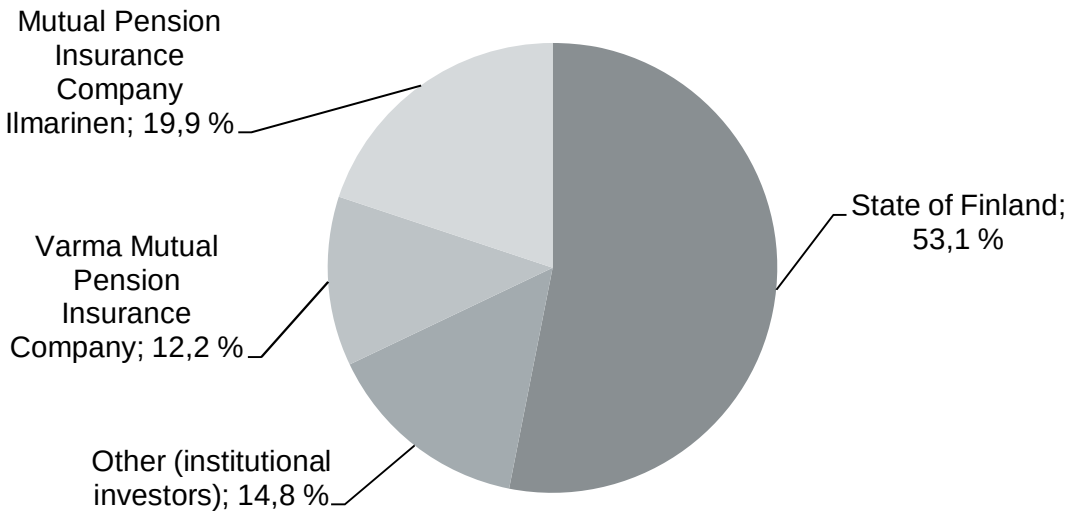


Fingrid in Brief

Fingrid's key figures 2013

Number of customers	112
- Power producers	29
- Power-intensive industries	31
- Distributors	62
Balance service customers	42
Cross-border transmission customers	1
Revenue	543 M€
- Grid revenue	321 M€
- The sales of imbalance power	159 M€
Balance sheet	2182 M€
Grid capital expenditure	209 M€
Other capital expenditure	16 M€
Equity ratio	29.5 %
Personnel at the end of year	287

Ownership (shares)



Fingrid's power system

	Trans-mission lines (km)	Sub-stations (qty)	Transformers (qty)		
400 kV	4 300	39	17 600 MVA	1 900 MVA	
220 kV	2 600	19			3 700 MVA
110 kV	7 500	55			
Total	14 400	113	44	5	23

- 1300 MW DC link between Finland and Sweden
- 935 MW fast disturbance reserve power plants

Efficient operating model

We develop the power system in close co-operation with our customers.

We are a proficient client: we have outsourced the construction and maintenance of the grid to outside service providers.

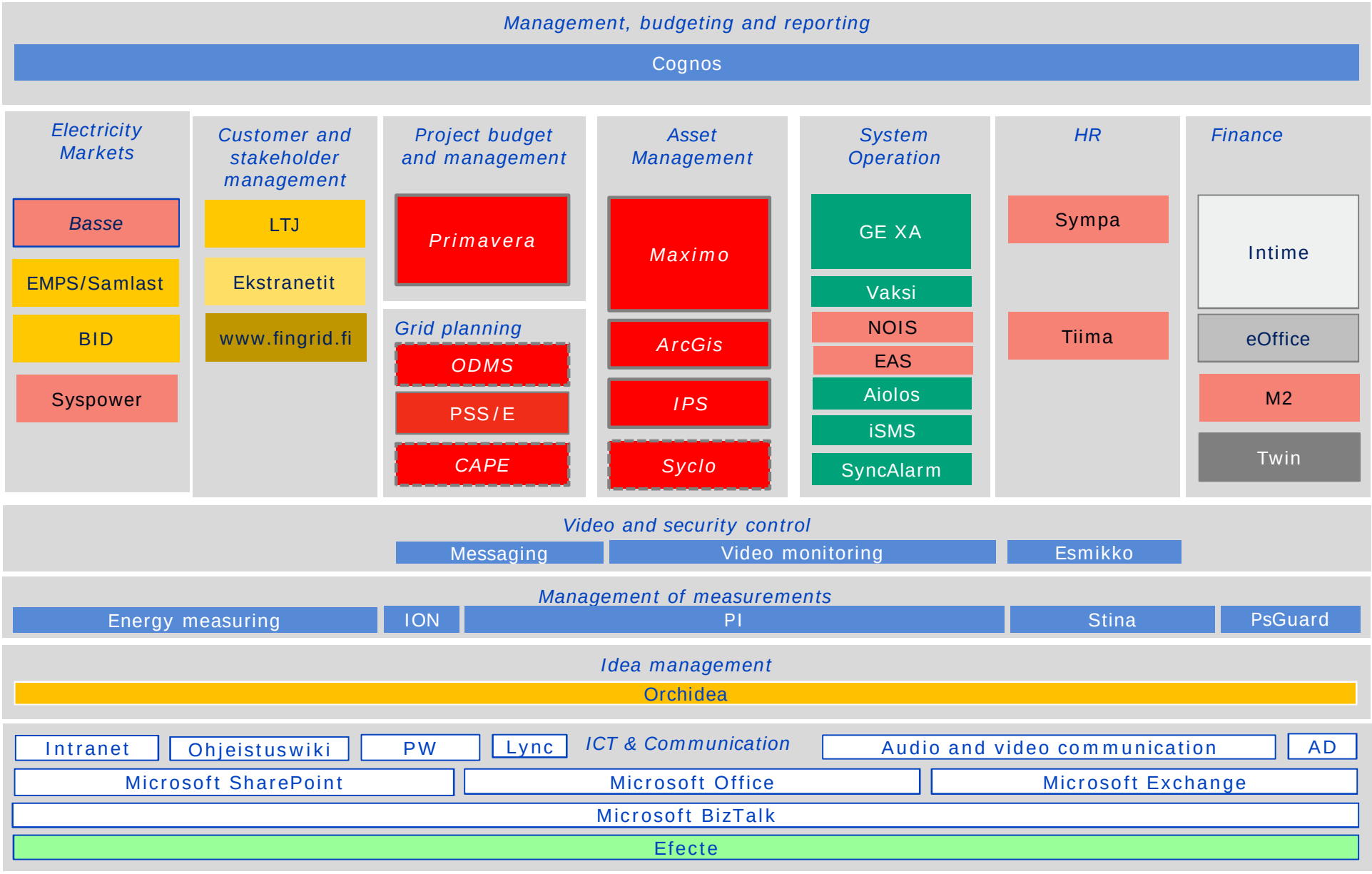
We take care of power system operation ourselves.

Innovative use of Technology and Information in running the business

Real business cases from "Internet of things" and "big data" in Fingrid's Asset Management, Power System Operations and Markets.

- Maximize the network reliability and minimize the maintenance and investment costs at the same time
- Discover the weak performing assets, components and hidden defeacts as early as possible
- Repairs, service schedules and replacement investments can be optimized
- Data analysis and exchange support new businesses like electric vehicle charging and market based development

Fingrid Application map

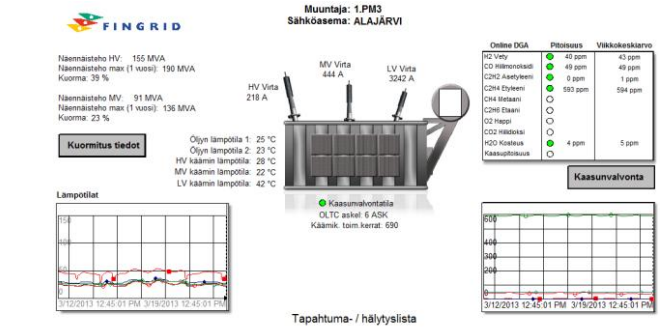


Kari Suominen

Our vision of the Condition Monitoring System

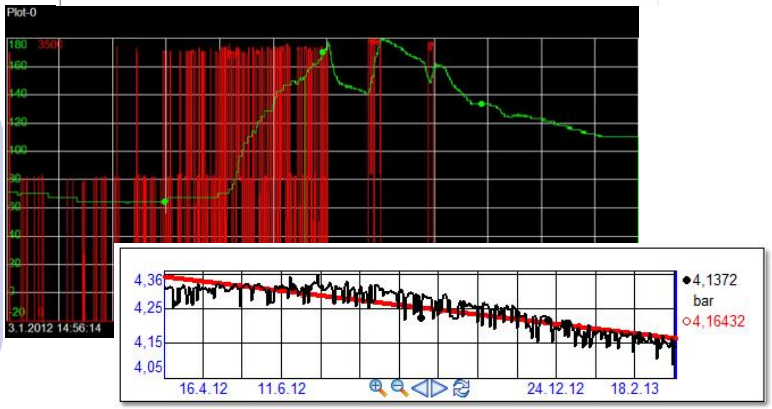
Smart visualization

- different kind of displays
- traffic lights based on alarm values
- gauges, embedded trend windows
- drill-down UI



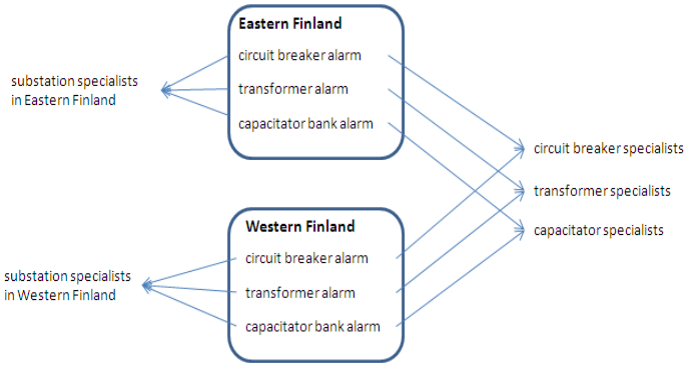
Easy analysis tools

- differences between two points
- maximum, minimum
- ratios (e.g. gas ratios)
- trend curves

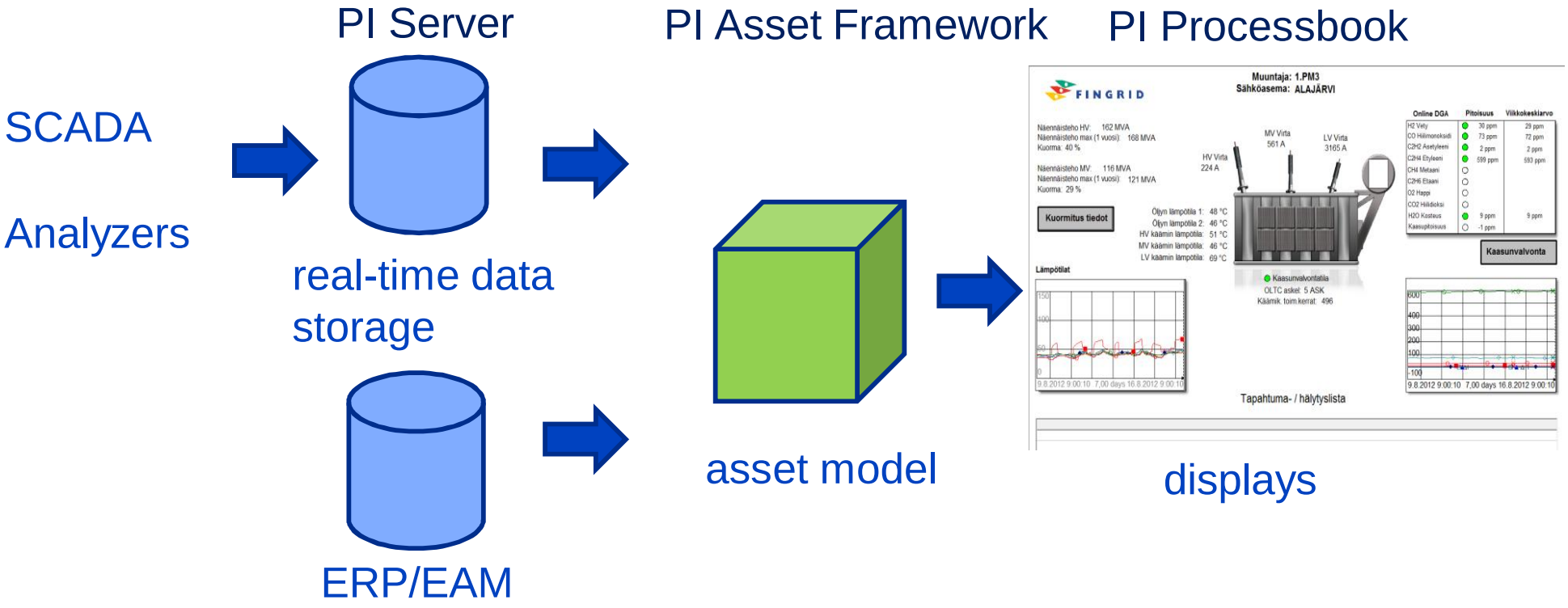


Automatic alarms

- notifications and alarms based on trigger rules
- generate tasks to our asset management system in the future

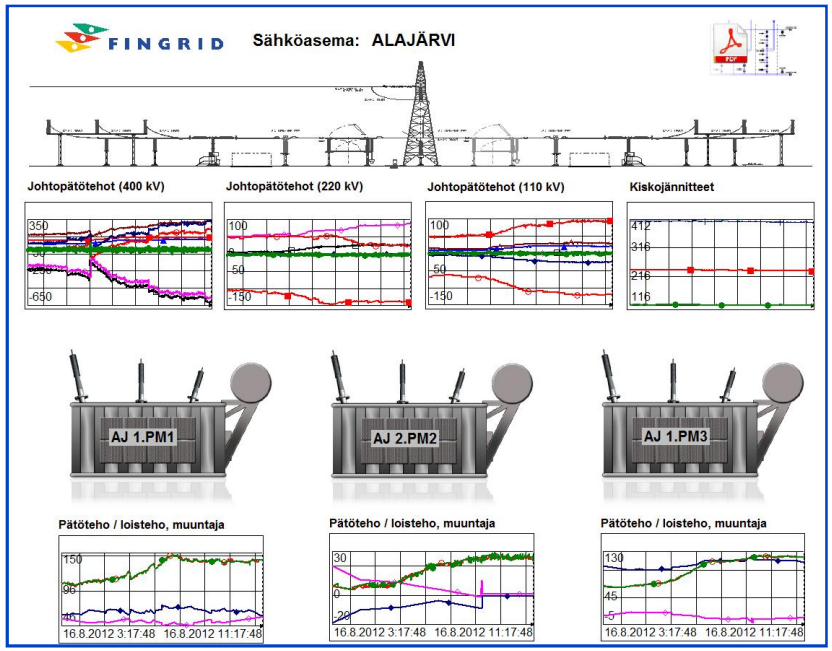


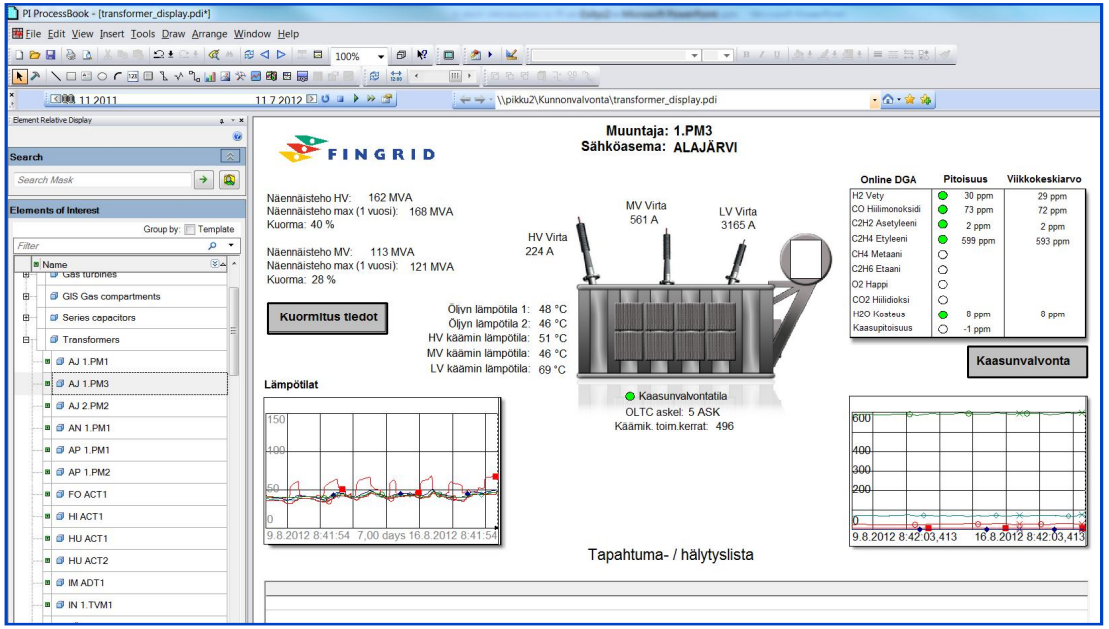
How it works ?

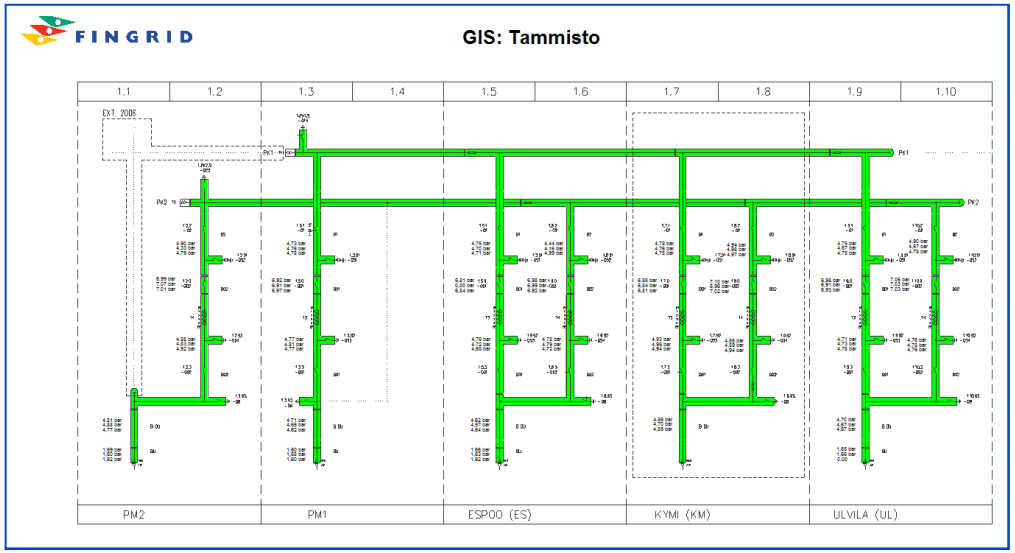


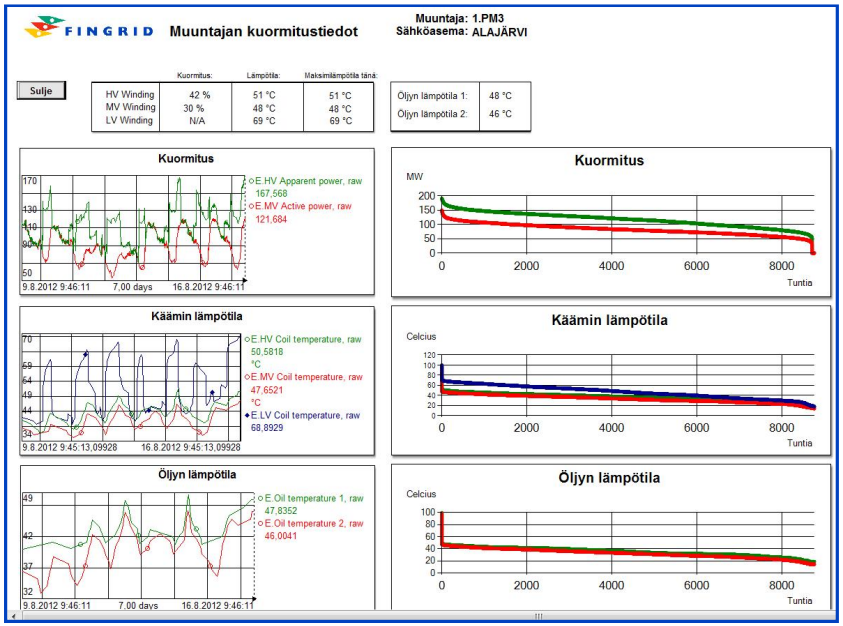
- Transformers, breakers, GIS, serie capacitors, reserve powerplants
- ~ 5 years of online data and ~ 20 years of offline data is ready to be used
- Light implementation by existing PI tools = system is easily configurable and users can make own displays

How does it look like?



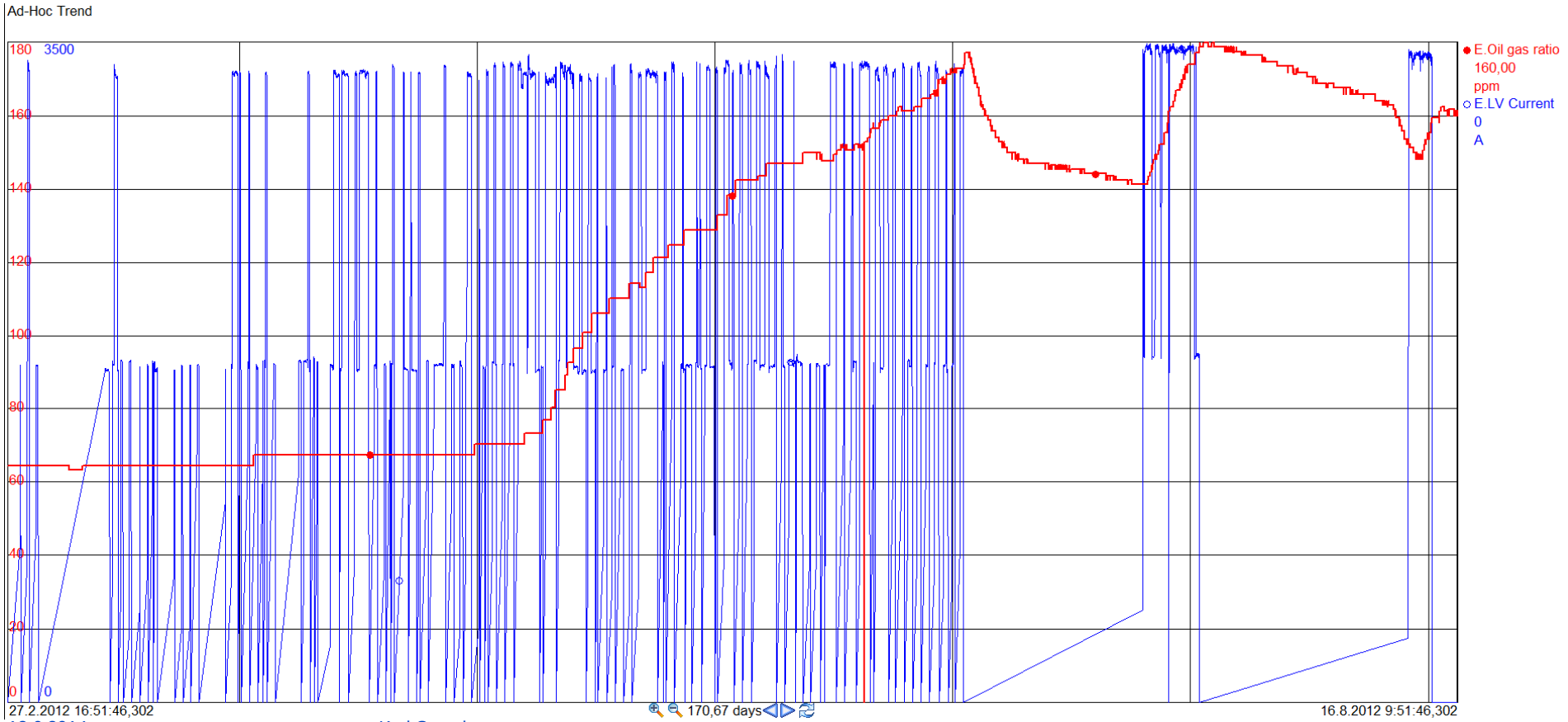






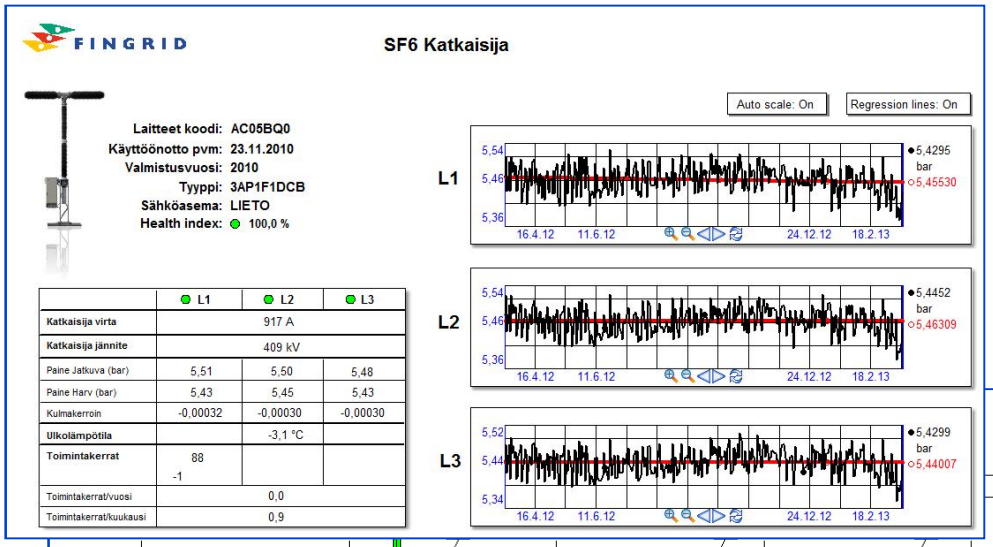
Transformer fault

- Increasing oil gas ratio was noticed and taken under observation in May 2012. Strong correlation between LV current and oil gas ratio was detected by CMS and confirmed with diagnostics measurements. The early notice gave time to react and remedial actions were launched in time.

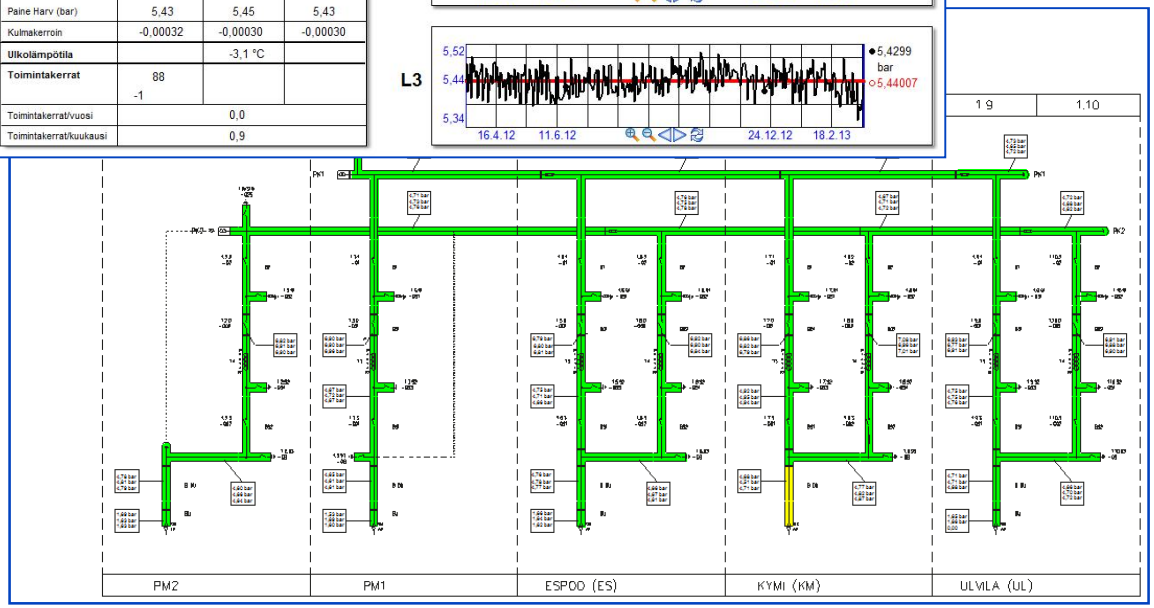


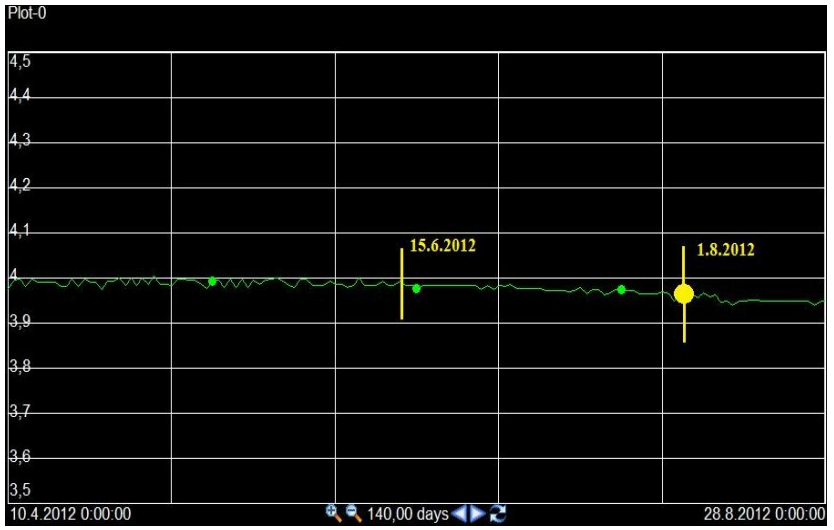
SF6 gas leaks in breakers and GIS

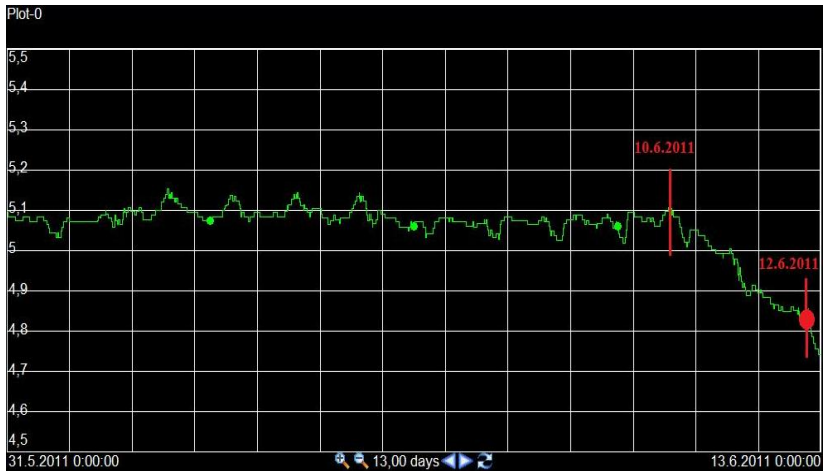
- Several gas leaks and detector failures has been detected by monitoring and automatic notifications.



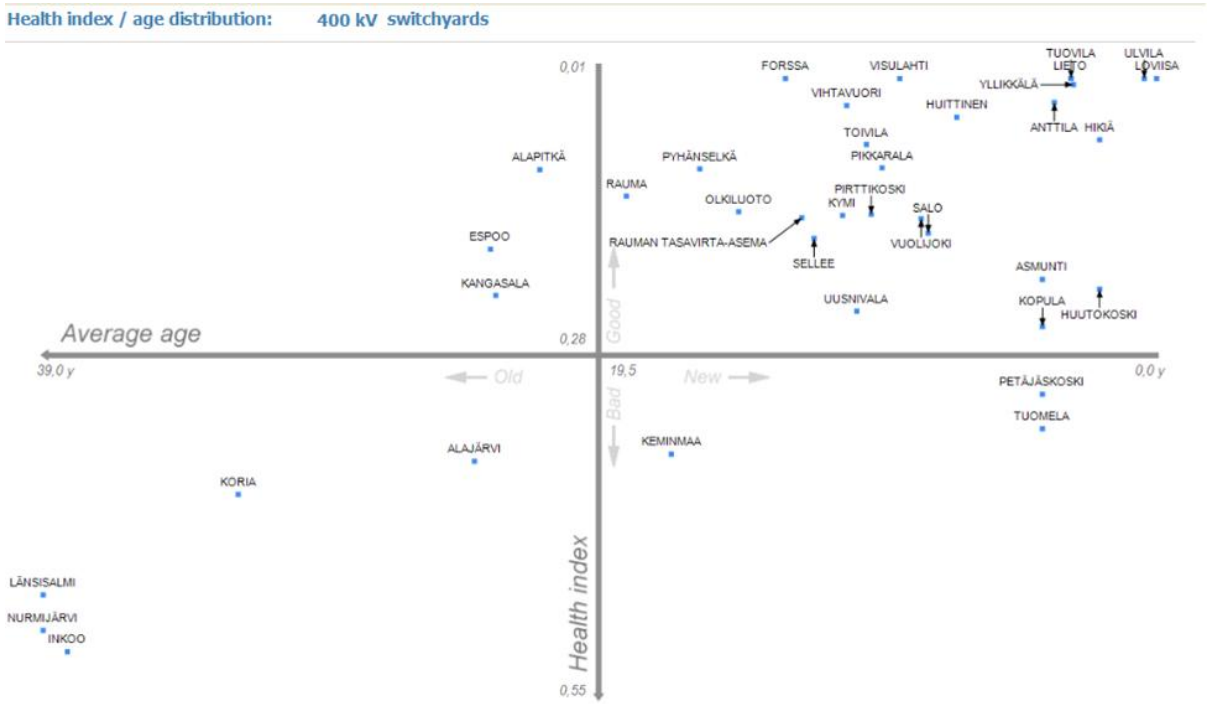
	L1	L2	L3
Katkaisija virta	917 A		
Katkaisija jännite	409 kV		
Paine Jatkuva (bar)	5,51	5,50	5,48
Paine Harv (bar)	5,43	5,45	5,43
Kulmakerroin	-0,00032	-0,00030	-0,00030
Ulkolämpötila		-3,1 °C	
Toimintakerrat	88 -1		
Toimintakerrat/vuosi	0,0		
Toimintakerrat/kuukausi	0,9		







Health index analysis tool for substations



	HIKIÄ 400 kV	Average age	Standard deviation	HUITTINEN 400 kV	Average age	Standard deviation	HUUTOKOSKI 110 kV	Average age	Standard deviation
Circuit breaker average		2,0 y	0,0		7,0 y	0,0		23,4 y	11,4
Disconnector average					7,0 y	0,0		34,0 y	8,9
Earthing switch average		3,5 y	5,7		7,0 y	0,0		30,1 y	11,9
Current transformer average		3,8 y	4,7		7,0 y	0,0		36,3 y	4,8
Voltage transformer average		4,8 y	5,8		8,1 y	3,1		33,0 y	9,9
Total		3,7 y	4,9		7,3 y	1,5		33,1 y	9,4

	HUUTOKOSKI 400 kV	Average age	Standard deviation	IMATRA 110 kV	Average age	Standard deviation	INKOO 110 kV	Average age	Standard deviation
Circuit breaker average		2,0 y	0,0		33,3 y	3,1		29,5 y	12,3
Disconnector average					30,2 y	11,0		35,7 y	13,0
Earthing switch average		6,7 y	10,9		32,3 y	9,2		12,5 y	19,0
Current transformer average		3,7 y	6,8		31,5 y	8,1		31,8 y	14,1
Voltage transformer average		2,0 y	0,0		27,7 y	4,9		41,0 y	0,0
Total		3,5 y	6,4		30,8 y	8,7		32,1 y	14,3

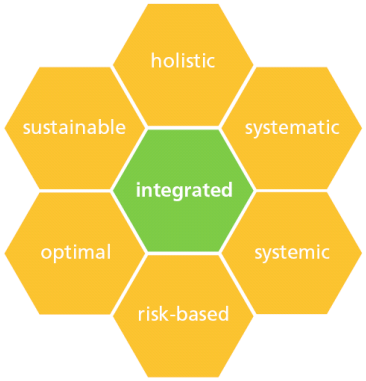
	INKOO 400 kV	Average age	Standard deviation	ISOHAARA 110 kV	Average age	Standard deviation	ISONIEMI 110 kV	Average age	Standard deviation
Circuit breaker average		38,1 y	1,1		20,8 y	9,7		4,0 y	0,0
Disconnector average		38,2 y	0,9		33,2 y	3,7		4,0 y	0,0
Earthing switch average		37,5 y	5,0		35,0 y	3,3		4,0 y	0,0
Current transformer average		21,7 y	5,7		9,5 y	10,6		4,0 y	0,0
Voltage transformer average		38,1 y	1,0		16,5 y	12,0		4,0 y	0,0
Total		33,9 y	8,0		22,6 y	13,4		4,0 y	0,0

- ‘Health index’ identifies the priority in terms of additional maintenance or need of renewal
- Especially essential when the population of components is very large, e.g. circuit breakers and disconnectors.
- Based on the defect statistics in the asset management system over a long time period (>20 years) and weighting coefficients
- The tool enables the user to update all these views and visualize the affects by changing easily the free choice factors and source variables.
- This analysis can strengthen already known component weaknesses but may also point out additional needs for further clarification from different perspectives.

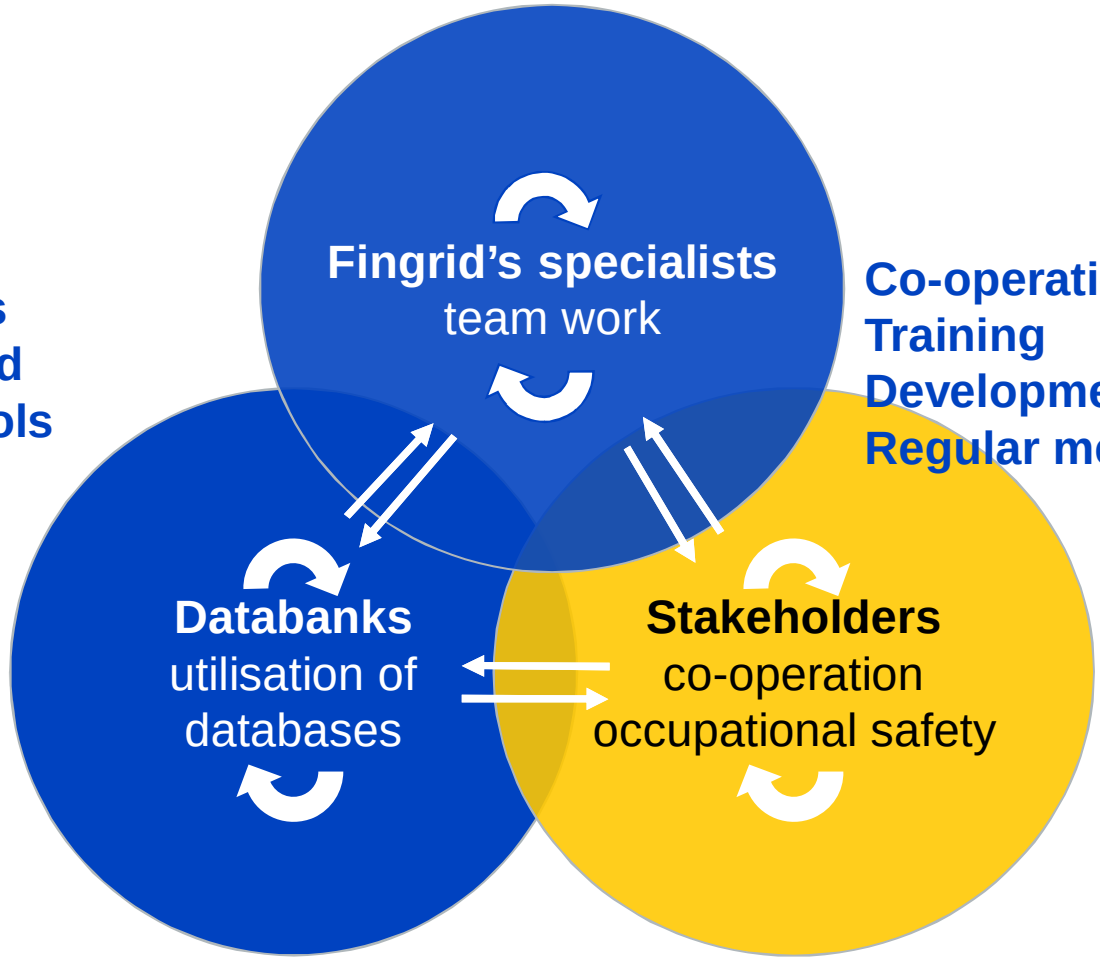

ELVIS
The new point-of-reference tool for
Electricity Transmission
Asset and Operation Management

Shared access to vital information

- outsourcing is based on efficient knowledge management



Grid models
Analysis and planning tools
GIS
EAM



Co-operation forums
Training
Development projects
Regular meetings

Extranet for data management
Compilation, storage and use of mobile data

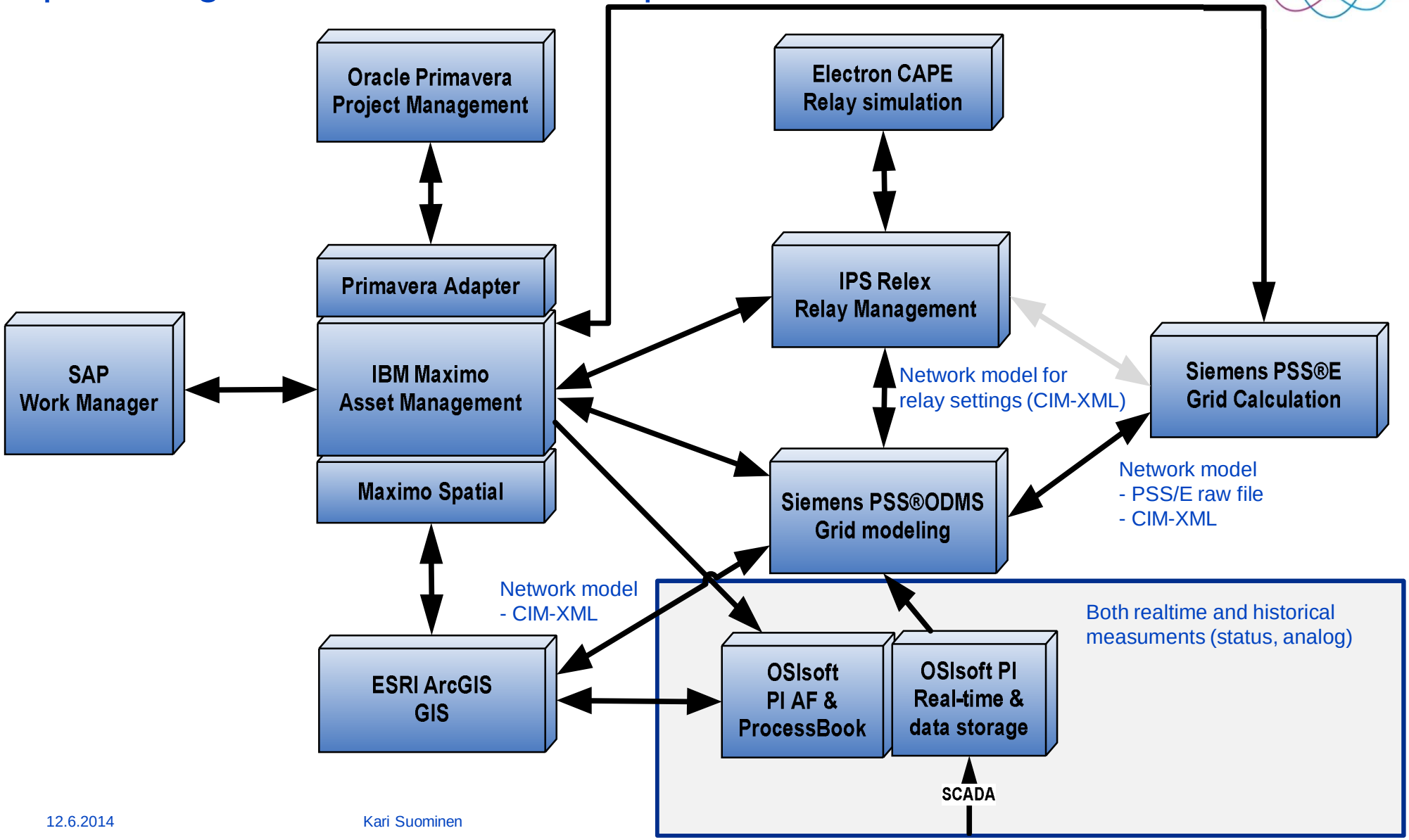
ELVIS high level objectives

- **Increasing operative efficiency**
  - Increasing proactivity in calculations, monitoring and maintenance
- **Single source for power system information**
  - Improving information access and usability within stakeholders
- **Adding cost aspect to operation and power system components**
  - Enhanced business planning through operational cost analytics
- **Platform for further system development with modern solutions**
  - Mobile solutions and data analysis to support Asset Management and Power system operations

A more efficient tool for Fingrid's asset and operation management by replacing existing tailor-made grid information systems by integrated best-of-breed standard software products

The foundation for Asset Management

- provide great tools for the AM specialists



ELVIS will bring us new things

Common accurate grid model

- Common grid model which is synchronized with asset management, operations planning, long term planning and network protection analysis
- All switch gear modeled with real and accurate description of components in the grid. Lot's of additional information about the grid model.

Better utilization of saved measuring data

- Accurate planning grid model linked to real time status and metering data.
- Preparing of calculation model is easy by using status and metering data from the past.

Better visualization of data, grid status and results

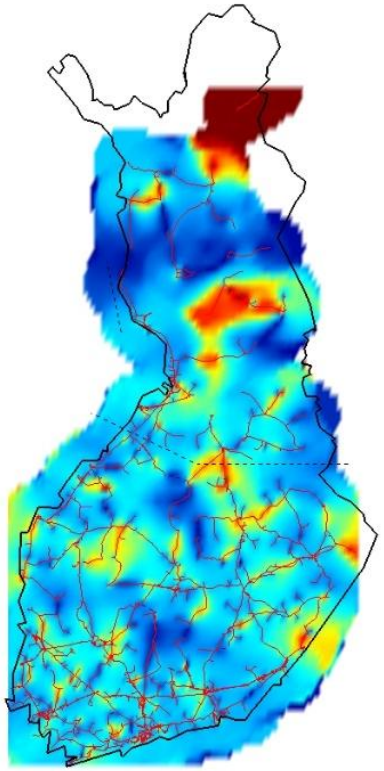
- Attributes for grid components available through the map
- Visualization of real time power and voltage measurements using colours on grid model or map

Common model about the future

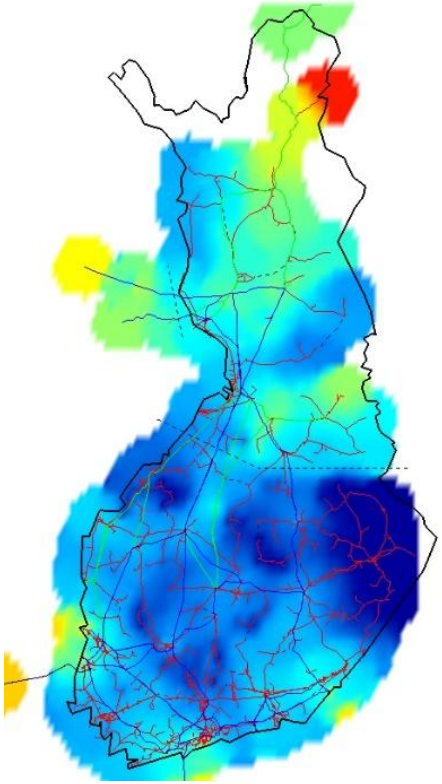
- Common database about future projects where schedules are in sync through the systems
- Easy to build different scenarios

Real time visualization capabilities

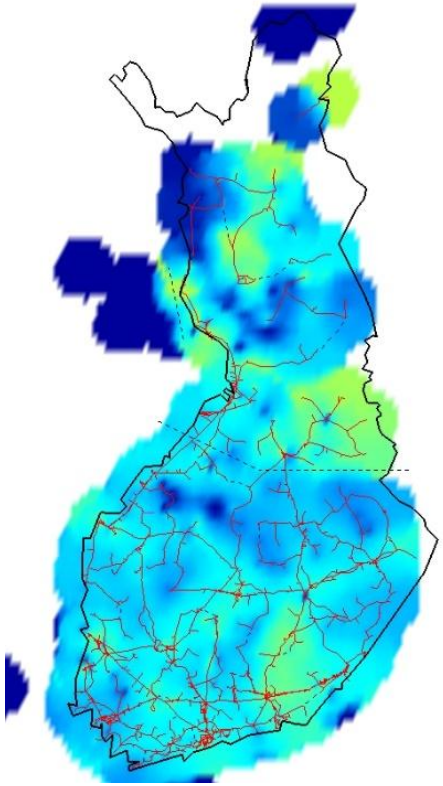
Relative load of transmision lines



Angle of voltage



Voltages

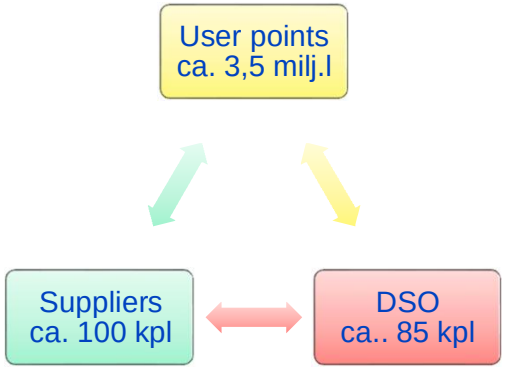


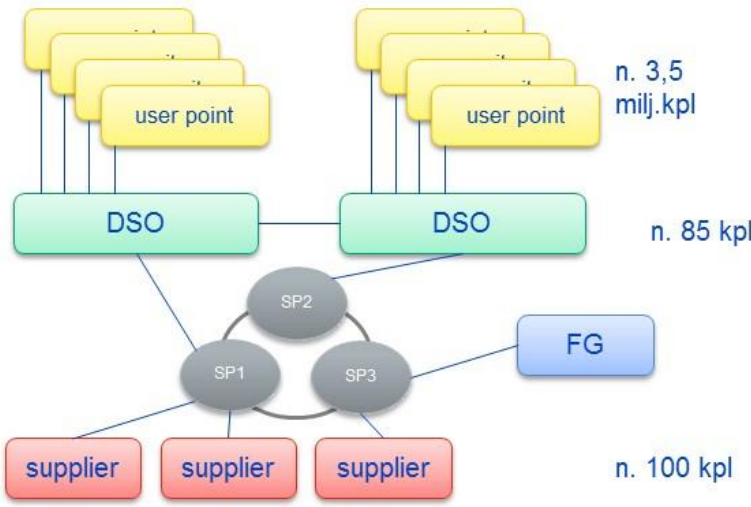
Datahub for market data exchange

What are retail market data exchange?

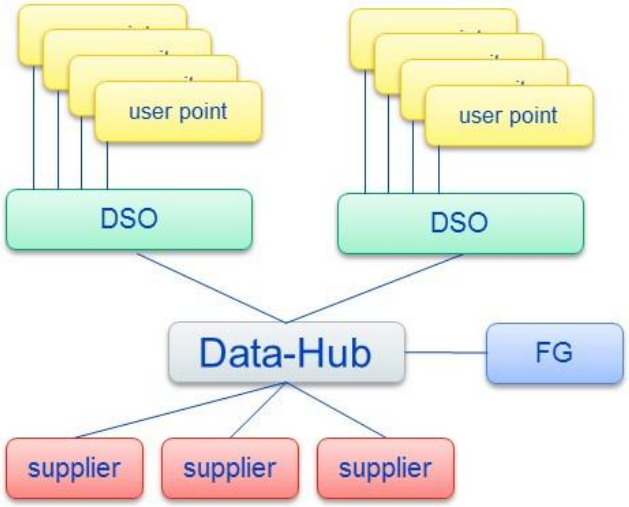
Processes where we need data communication between parties:

- concluding a contract
- termination of a contract
- moving
- supplier switch
- connection / disconnection
- meter reading
- transmitting meter information
- changes in the metering point information / contract
- balance settlement





Today's "spaghettimodell"



Data-Hub

Possible functionalities of a datahub

- Primary functionalities:
  - measurement database
  - quality control
  - DSO's balance settlement
  - metering point registery
  - key market processes
  - legislative reporting
- Possible additional functionalities:
  - open interfaces
  - connect/re-connect operations
  - larger metering point registery/multiutility support
  - enable co-billing
  - New businesses, such as electric vehicle charging, market based development

Fingrid's next steps 2014-2015

- Additional internal resources to PI development and a solid PI architecture
- New improvements based on user experience and feedback e.g Improvements to delivered displays
- Elvis R2 and R3 are connecting PI with components like ODMS and ArcGIS
- Bigdata study focusing on PI
- Datahub business case analysis and implementation

Powering Finland.

FINGRID