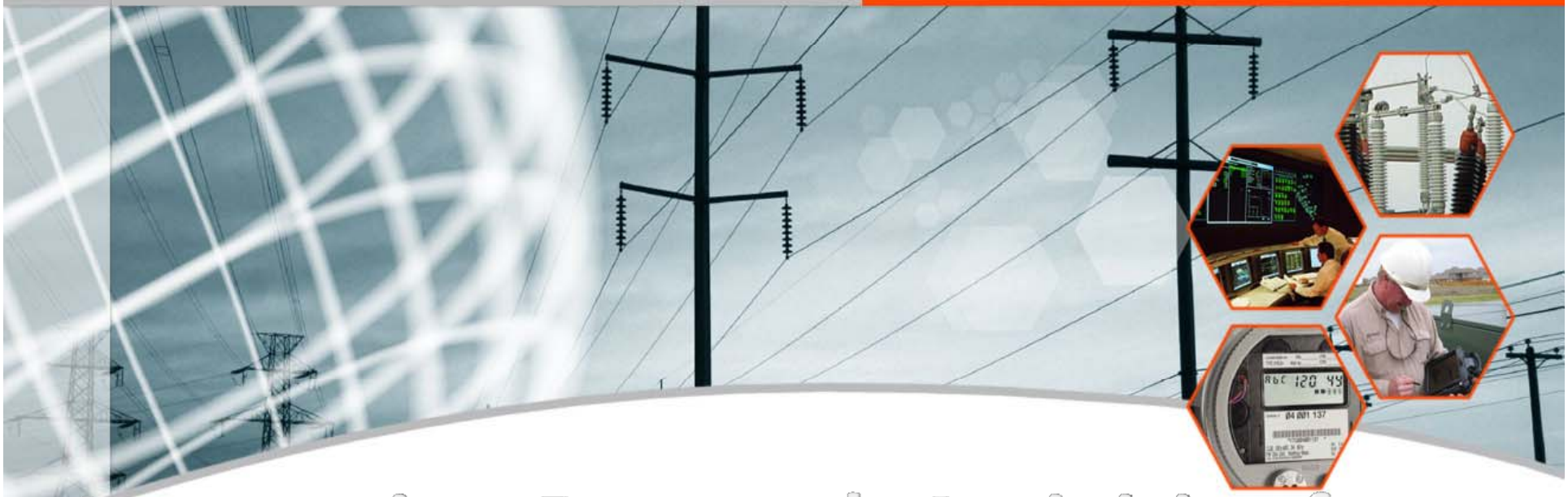
TELVENT DMS

IT for a Sustainable and Secure World



Integration Research Activities from Telvent DMS

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Novi Sad, Serbia

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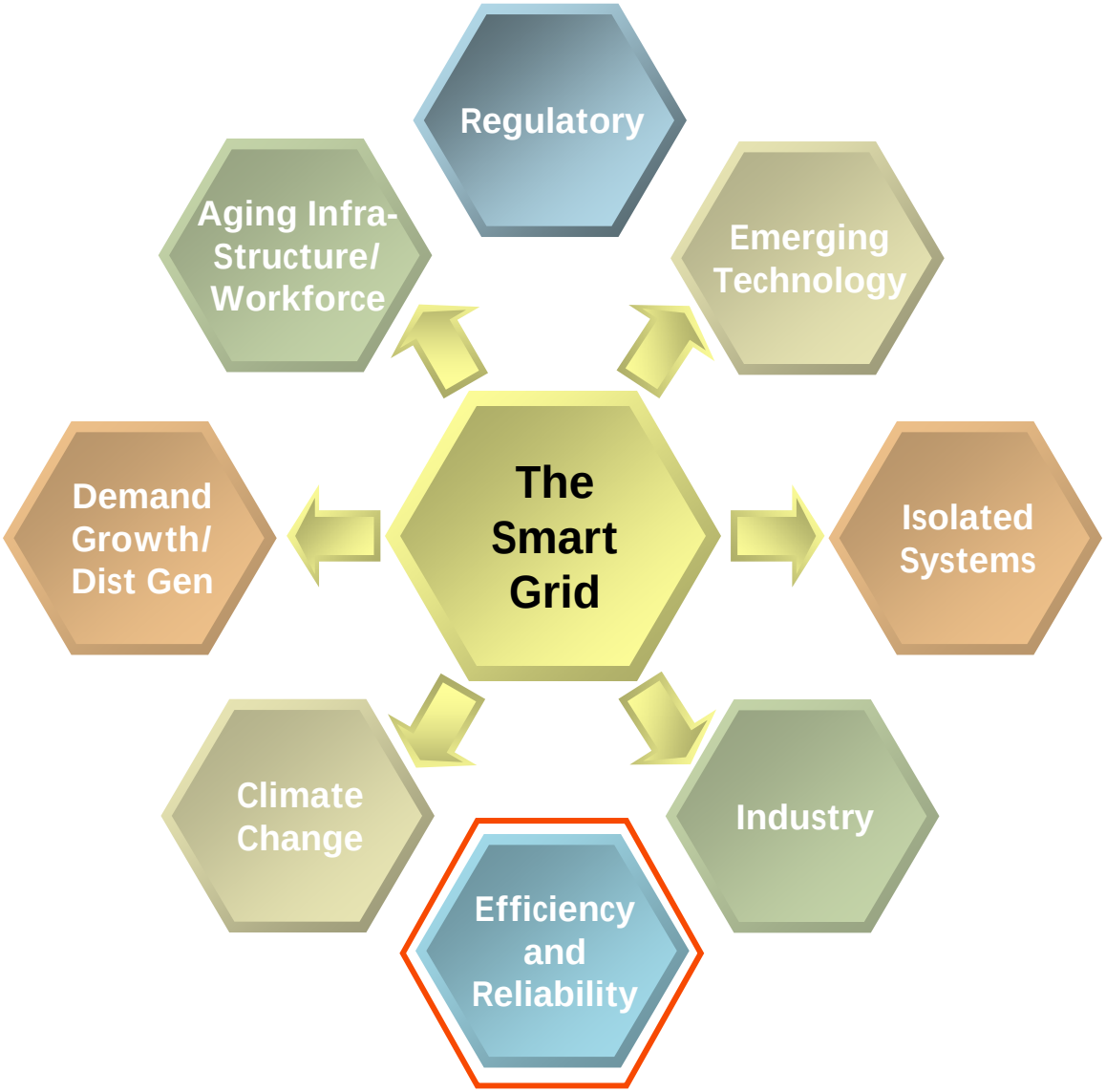
DMS, AMI and the Smart Grid

1. Smart Grid Drivers and Concepts
2. DMS, AMI, and Business Value
3. DMS in Smart Grid – DG implementation
4. Usage of AMI in DMS
5. Integration: Key to Smart Grid Success

Key Smart Grid Market Drivers



Key Smart Grid Technology Drivers

Network Management:
OMS, SCADA, GIS

Smart Metering:
AMR, AMI, remote measurement, remote control, remote indication

Customer Information System:
Billing, pricing and reporting, connection to ERP

Demand Side Management
Direct load control, household load management, industrial load management

Network Optimization:
EMS, DMS, Network Planning, Asset Management

Smart Grids Technology Drivers

Advanced power electronics:
Flexible Alternating Current Systems (FACTS devices)

New materials:
Semiconductor-based power electronics, nano-science

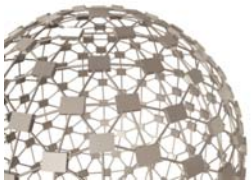
High Temperature Superconductors:
HTS generators, transformers, and cables

Distributed energy resources:
Distributed energy generation and combined heat and power systems

Electricity storage & VPP:
Virtual generation, electric vehicles, hybrid-, mini-, micro power plants

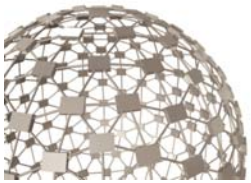
Principal Characteristics of the Smart Grid

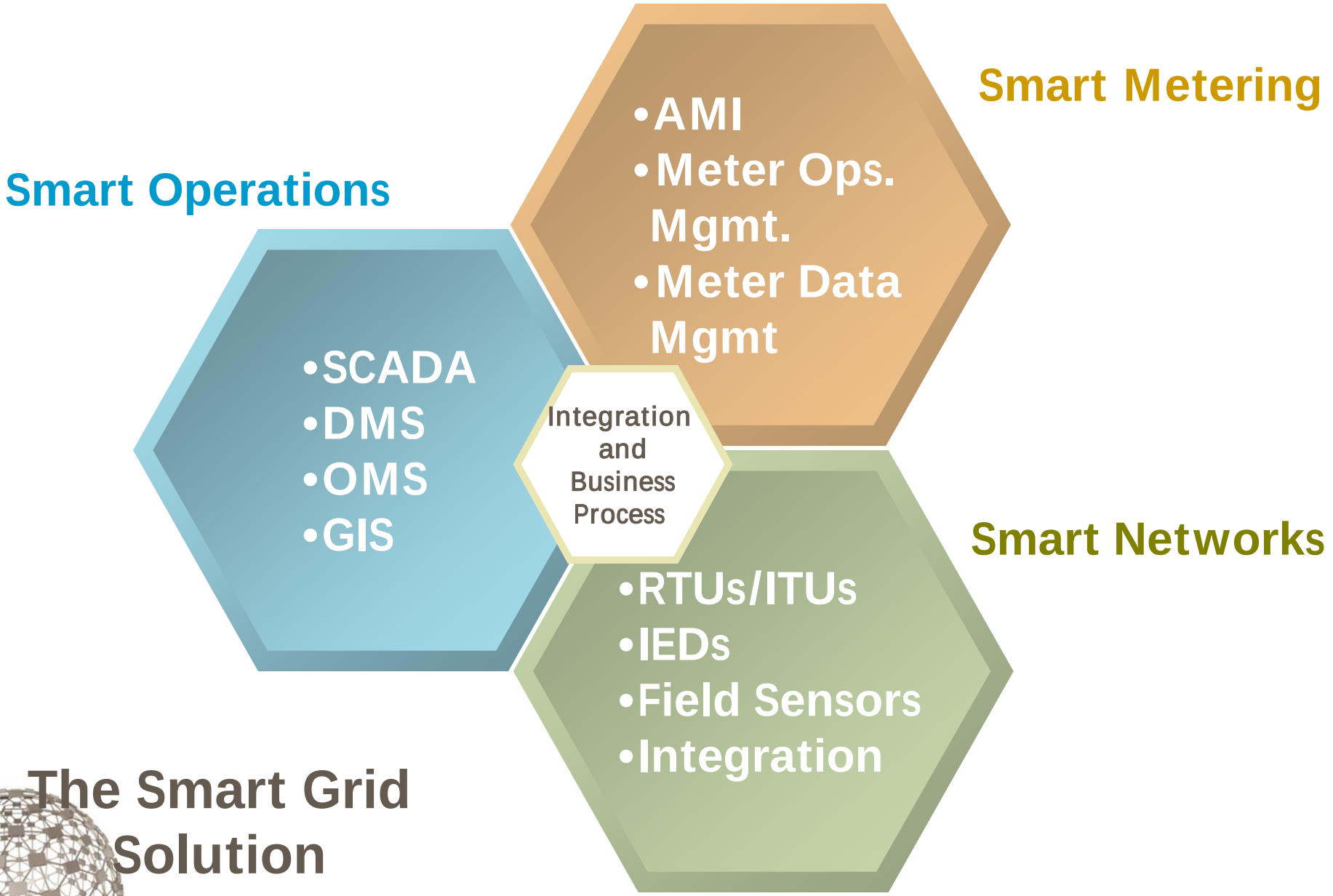
1. Optimizes performance and resource using
2. Better insight in distribution network
3. Education of staff/what if analysis
4. Operates efficiently/decreasing costs/postponement of investment
5. Self-healing and adaptive
6. Provides high quality power
7. Resists disturbances, natural and man-made
8. Interactive with consumers and markets



The Challenge

- To transform the current utility grid into one that distributes electricity more efficiently and securely, while meeting the demands of a changing society in a sustainable way
  - Through logical, systematic steps
  - Taking advantage of the best resources available
  - Recognizing that time is not on our side

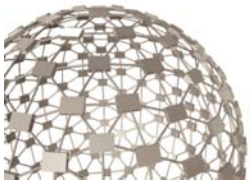




The Smart Grid Solution

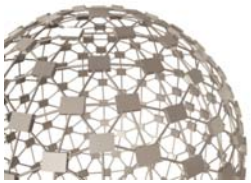
AMI/DMS/OMS core of system distribution management

- Complete insight into MV and LV state
- Radical improvement of distribution state estimation results
- More precise determination of energy losses and commercial losses
- Energy balance calculation
- Improving Fault management
- Shorter outage time and removing violations in network (voltage, current)
- Improving power system quality and customer satisfaction
- Providing load management and emergency load shedding

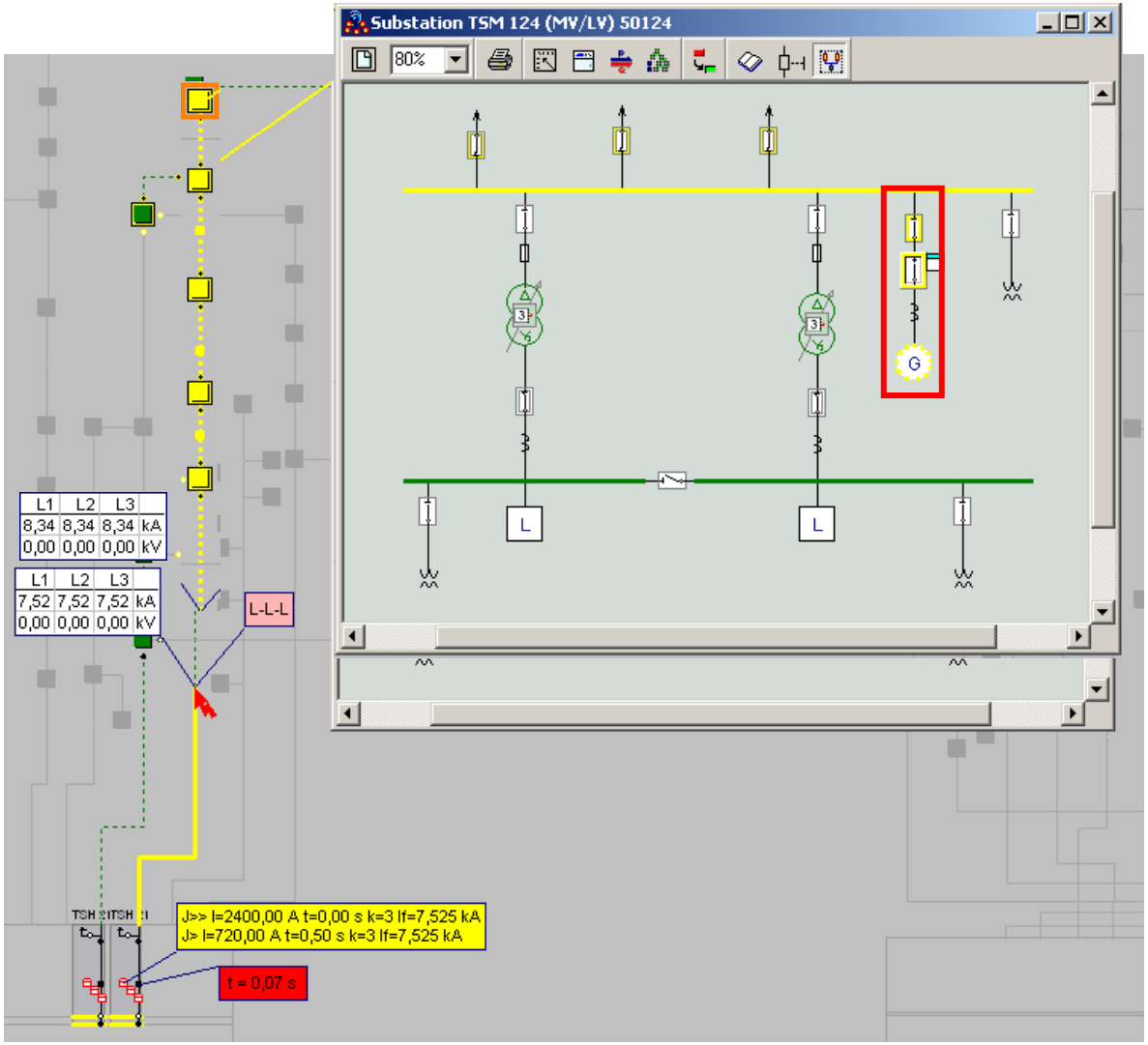


Short circuit and impact of DG to circuit breakers

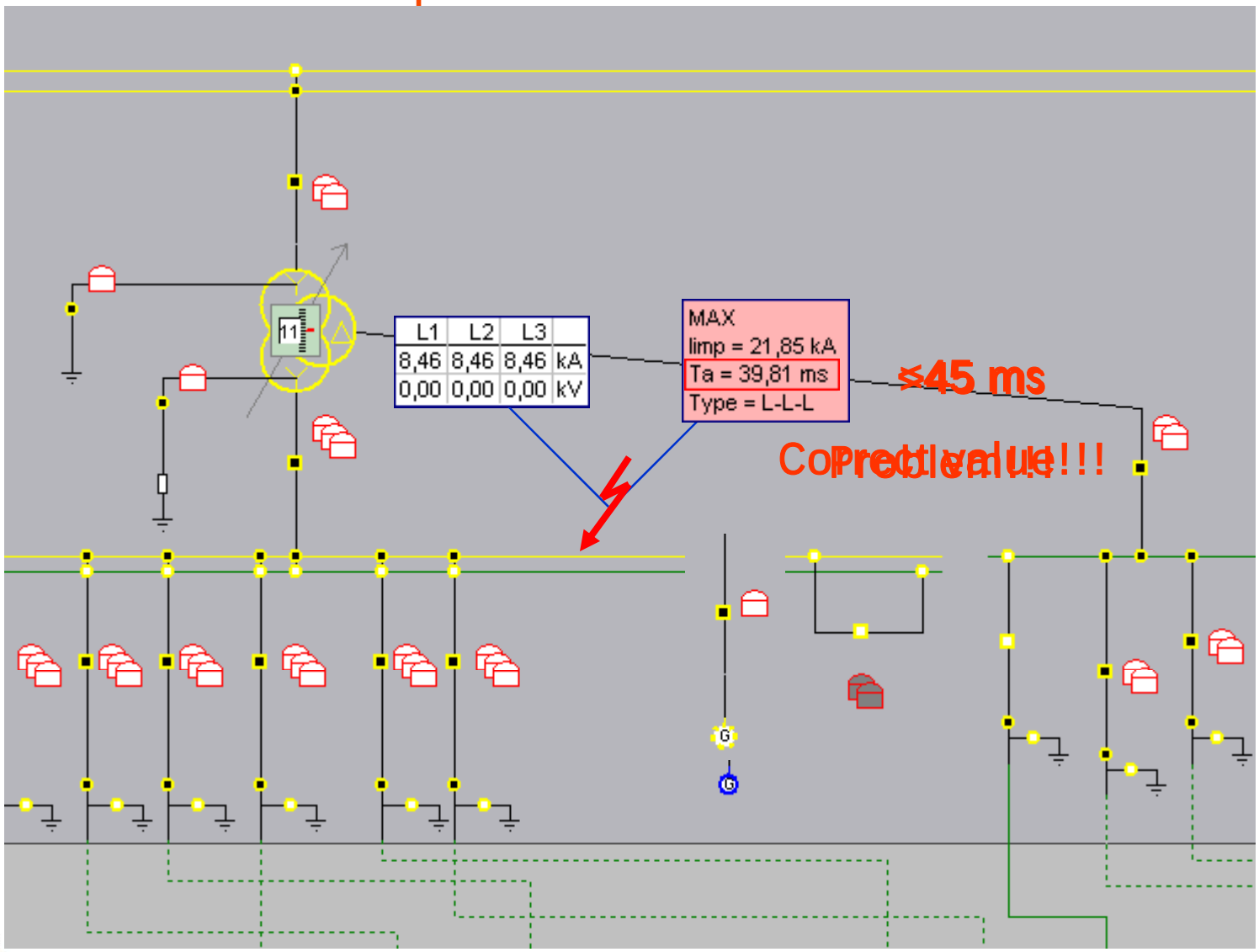
- Increasing short circuit current on fault location
- DC caused by DG has time constant greater then usual for circuit breaker (45 ms according IEC 56 – this value can be overreached; consequence is unsafe operation of circuit breaker).
- Short circuit current does not decrease along the feeder with DGs



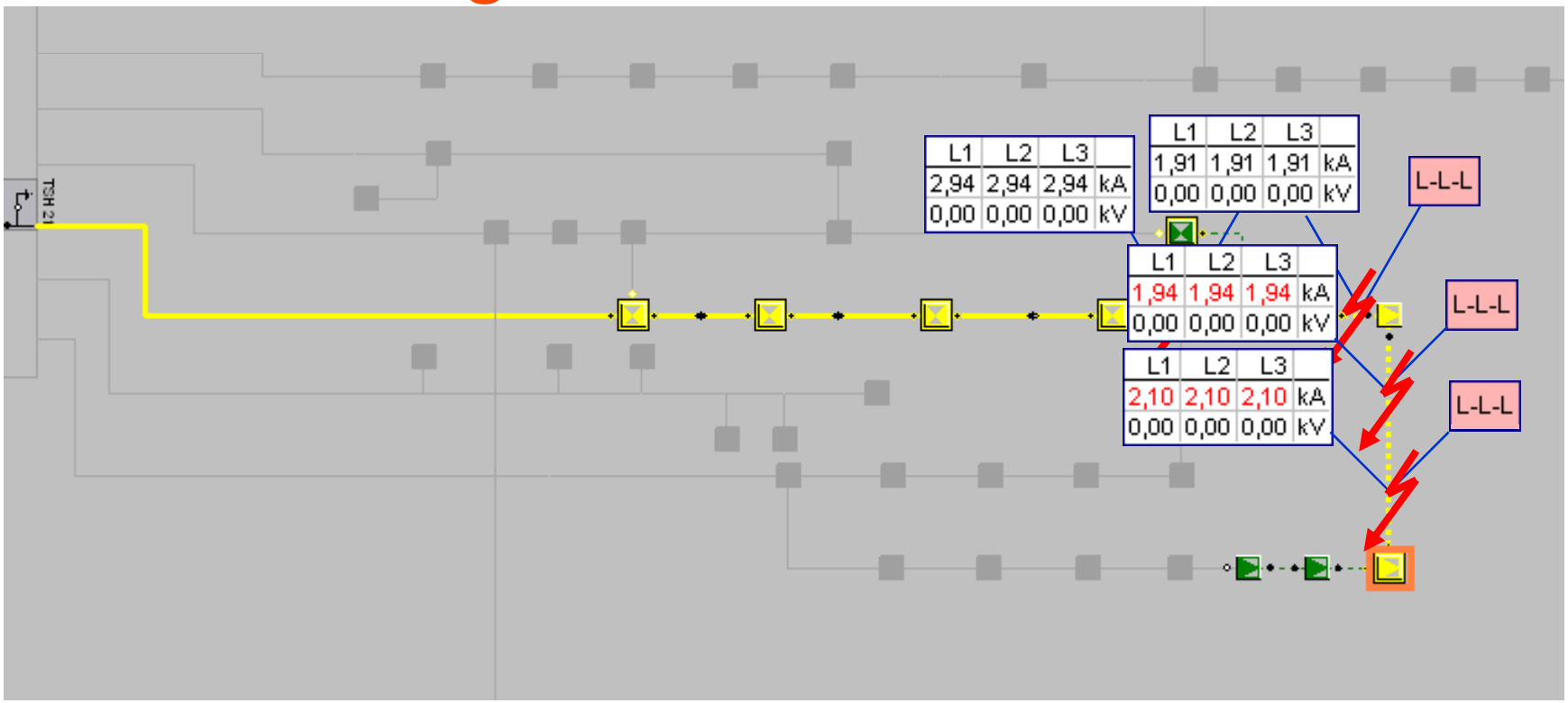
Increasing short circuit current on fault location



Impact of DG to circuit breaker

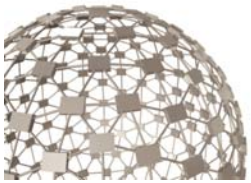


Decreasing/increasing short circuit current along the feeder with DGs

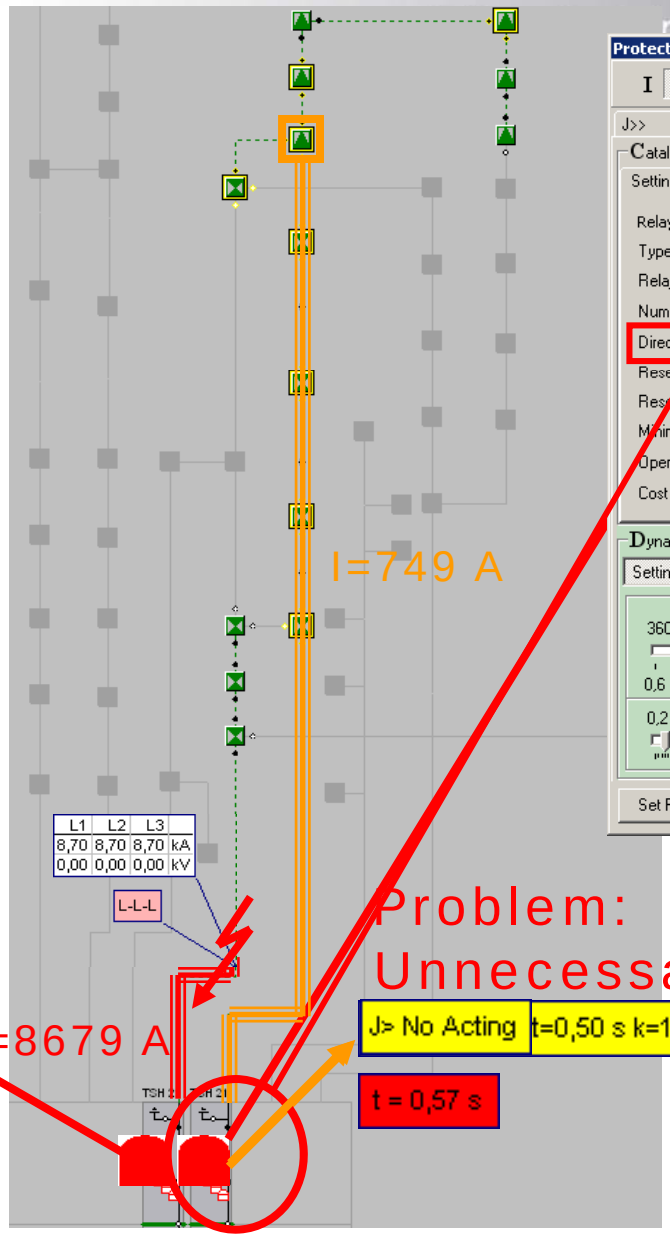


Settings of relay protection and tuning of selectivity with multiple DGs

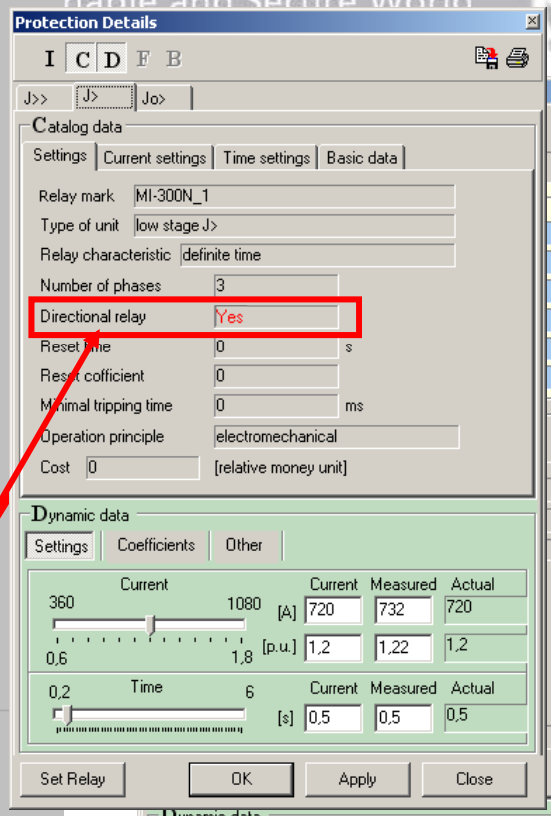
- Selectivity problem
- More complex relay protection settings
- More complex relay solutions are required – like directional relays



TELVENT DMS



J>> I=2400,00 A t=0,00 s k=3 If=8,697 kA
J> I=732,00 A t=0,50 s k=3 If=8,697 kA

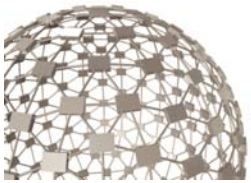


Problem:
Unnecessary relay tripping

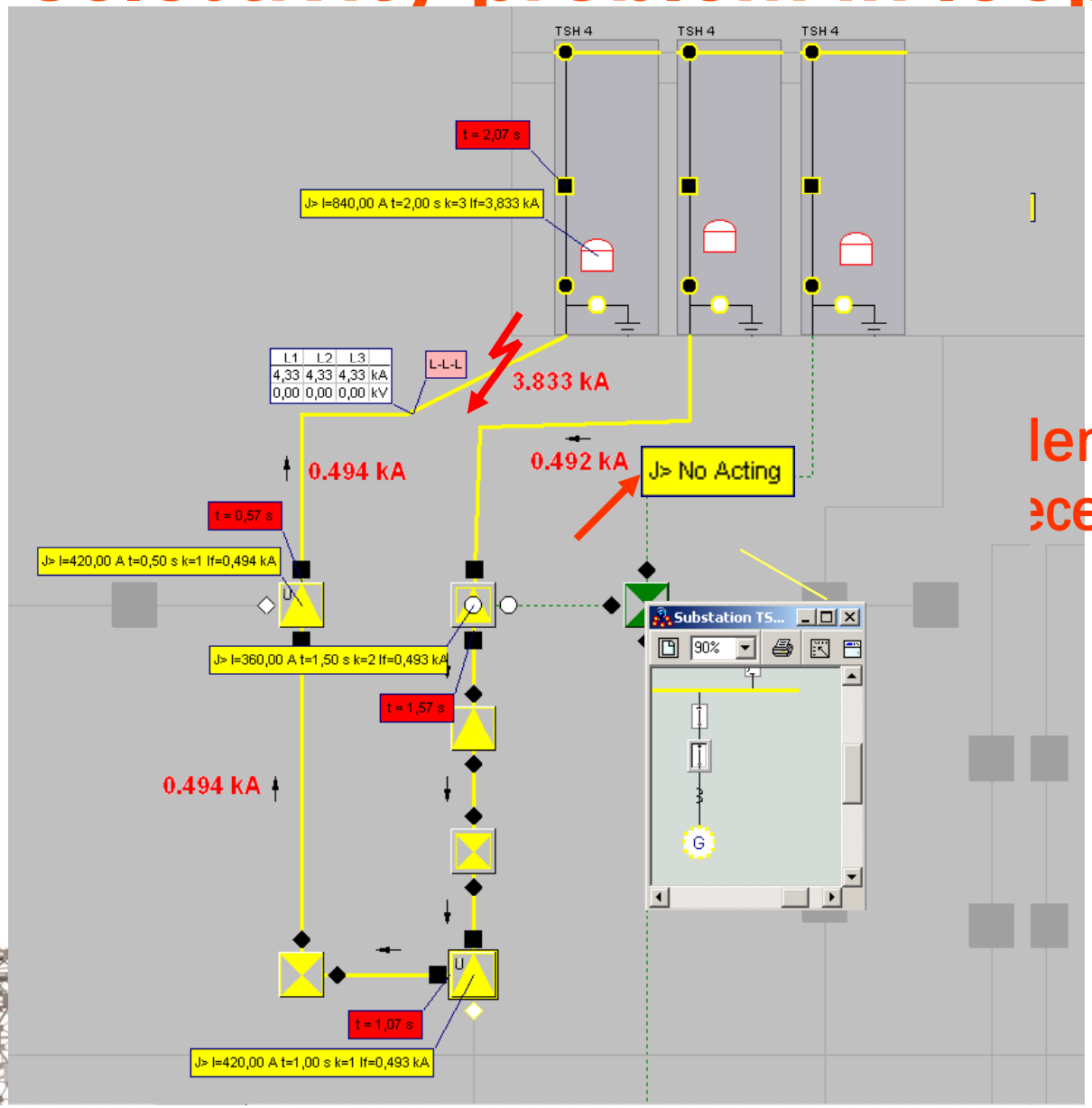
Solution ???

DGs operation in loop

- Selectivity problem
- Solution cannot be achieved by existing protection
- Sometimes additional separate line for DGs is required



Selectivity problem in loop with DGs



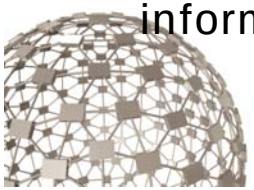
lem:

ecessary relay tripping

Solution ???

Integration - Key to Smart Grid Success: AMI integration (requirements)

- Have information of individual consumers (id, rated power, actual power, in service) in DMS
- Have the ability to import individual consumers information (id, rated power, actual power, in service) from an external system (typically CIS)
- Have the ability to build the Load curve associated to a bus bar (LV or MV) based on the customers connected to the bus bar and their individual data imported from an external system (typically CIS)
- Have the ability to periodically update the customers associated to each load curve and their rated power (typically AMI/MDM)
- Have the ability to adjust the load curves based on the values that are received from AMI or retrieved from an MDM
- Have the ability to update the actual value of power associated to a load curve based on the values received from AMI
- Have the ability to improve fault management based on real-time information received from SCADA, OMS and AMI

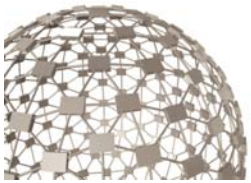


Detect outages in non “visible” parts of the network (Fault Location)

- The system should detect outages in the network based on the difference of power in the current state and the previous state. This may happen when the system is tuned and the confidence in the measurements and estimation is high.
- As part of this detection, when a realtime measurement change on the head of a feeder is greater than what is expected according to the aggregate load profile (considering a predefined treshold), that feeder should be highlighted as suspicious to have an outage.
- When the system receives a list of customers affected coming from an external system (OMS/AMI) it should estimate the part of the network without energy based on the realtime meassured current, the load profiles and the customers confirmed to be affected.

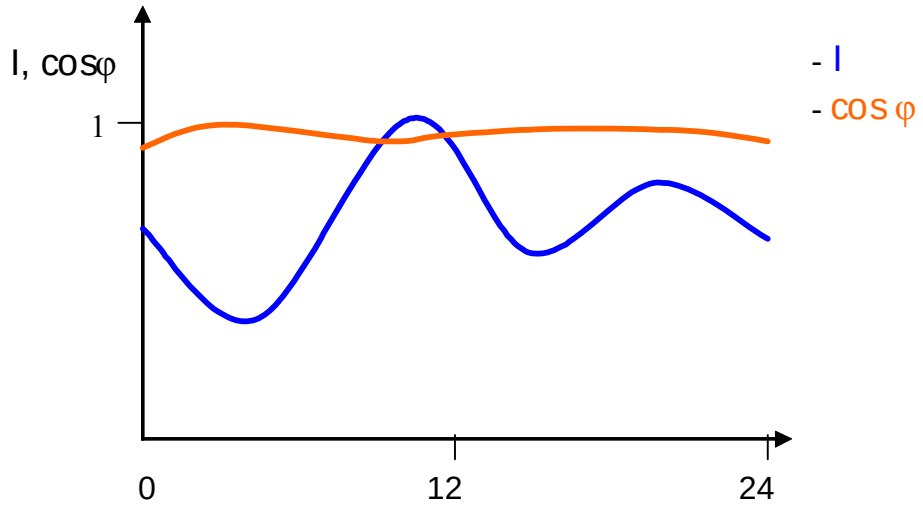
Usage of Automatic Metering Infrastructure (AMI) in DMS

- Update of consumer load profiles
- Value of consumer load peak
- Addition measurement in network depth
- Improving fault management
- Load management (selective turn off some consumption – A/C, water heater, …)

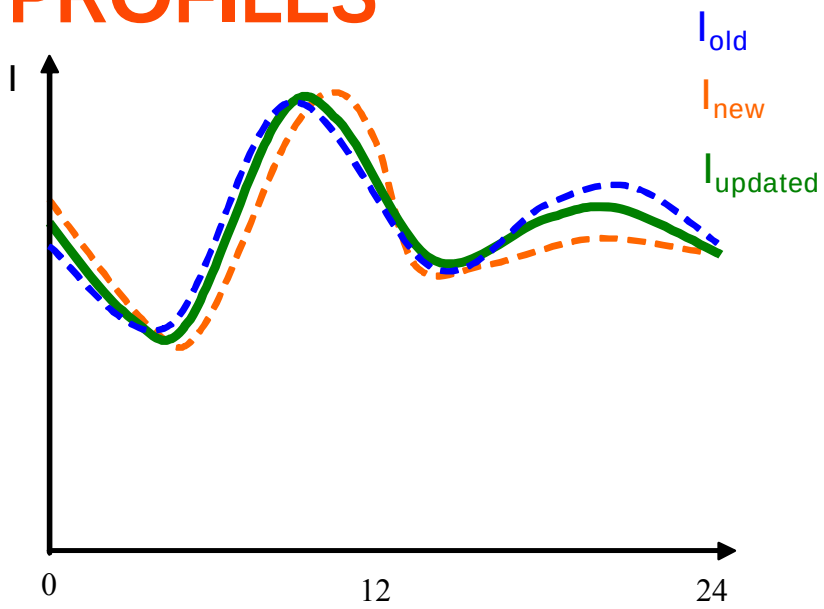


UPDATE OF CONSUMER LOAD PROFILES:

Each typical consumer type is described by appropriate load profiles in relative units



UPDATING LOAD PROFILES



$$I_{updated}=(1-\alpha)I_{old}+\alpha I_{new}$$

Update is provided by AMI placed on LV side of MV/LV transformers.

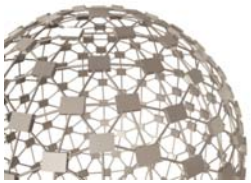
α is typically 5-15%

VALUE OF CONSUMER LOAD PEAK

- Product of consumer load peak and profile gives value of consumption

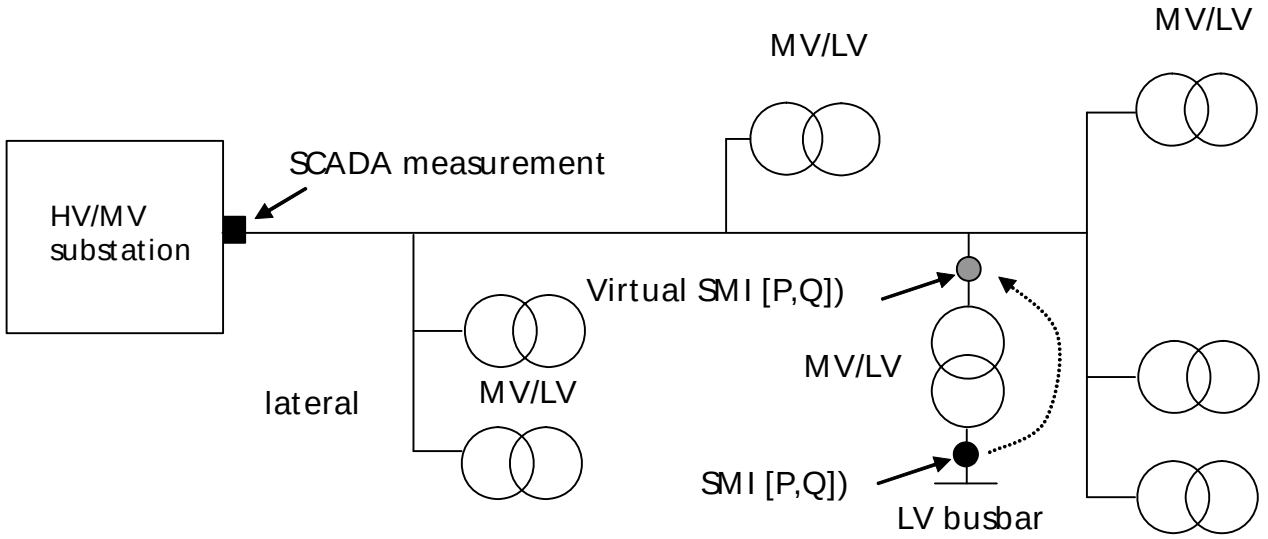
- This value defines distribution of load along feeder and it is used in network state estimation

- Generally distribution of load along feeder can be done by:
  - rated power of MV/LV transformer
  - peak loads (better; AMI provides this value)
  - sold energy (the best; AMI provides this value)



ADDITIONAL MEASUREMENT I TNE NETWORK DEPTH

If AMI provides measurement on LV side of MV/LV transformer periodically (every e.g. 1 or 2 hours), this value can be recalculated and added on MV side where it can be taken in the State Estimation procedure; this will improve network state estimation quality



IMPROVING FAULT MANAGEMENT

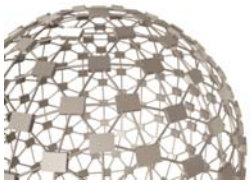
Sudden drop of feeder load – may be caused by two ways:

• simply decreasing consumption without fault (significant consumer is turned off)

• more often it means fault; this means that a part of feeder is without energy

How can we check which of these two cases has happened?

Let us consider the situation on the following slide:

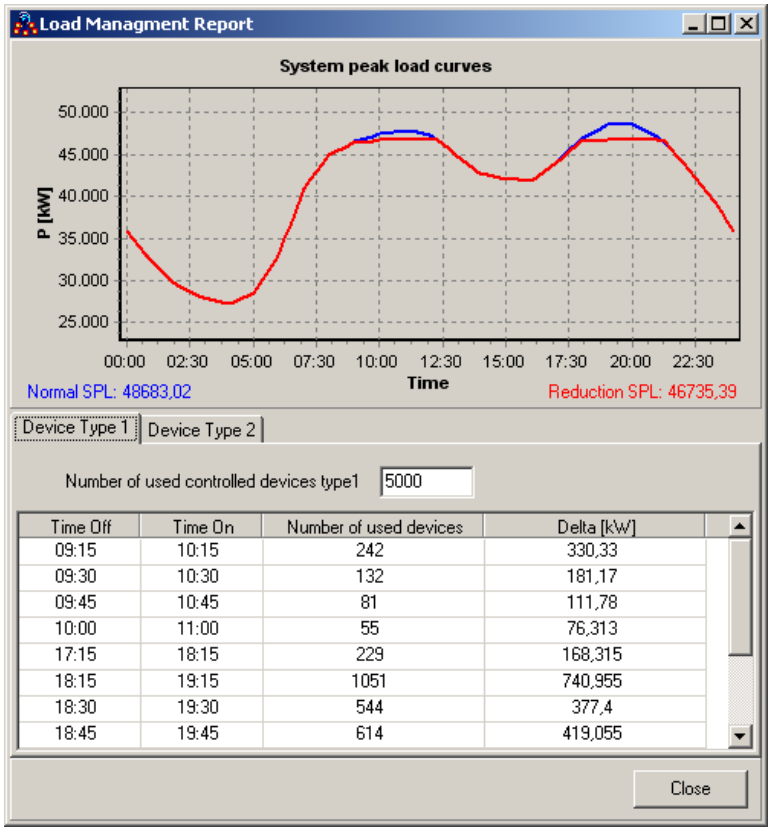


LOAD MANAGEMENT

Reduction of peak load practically without consumer disturbance

•Load management function gives schedule and number of consumers which should be turned off

•AMI can be infrastructure for accomplishment of load management



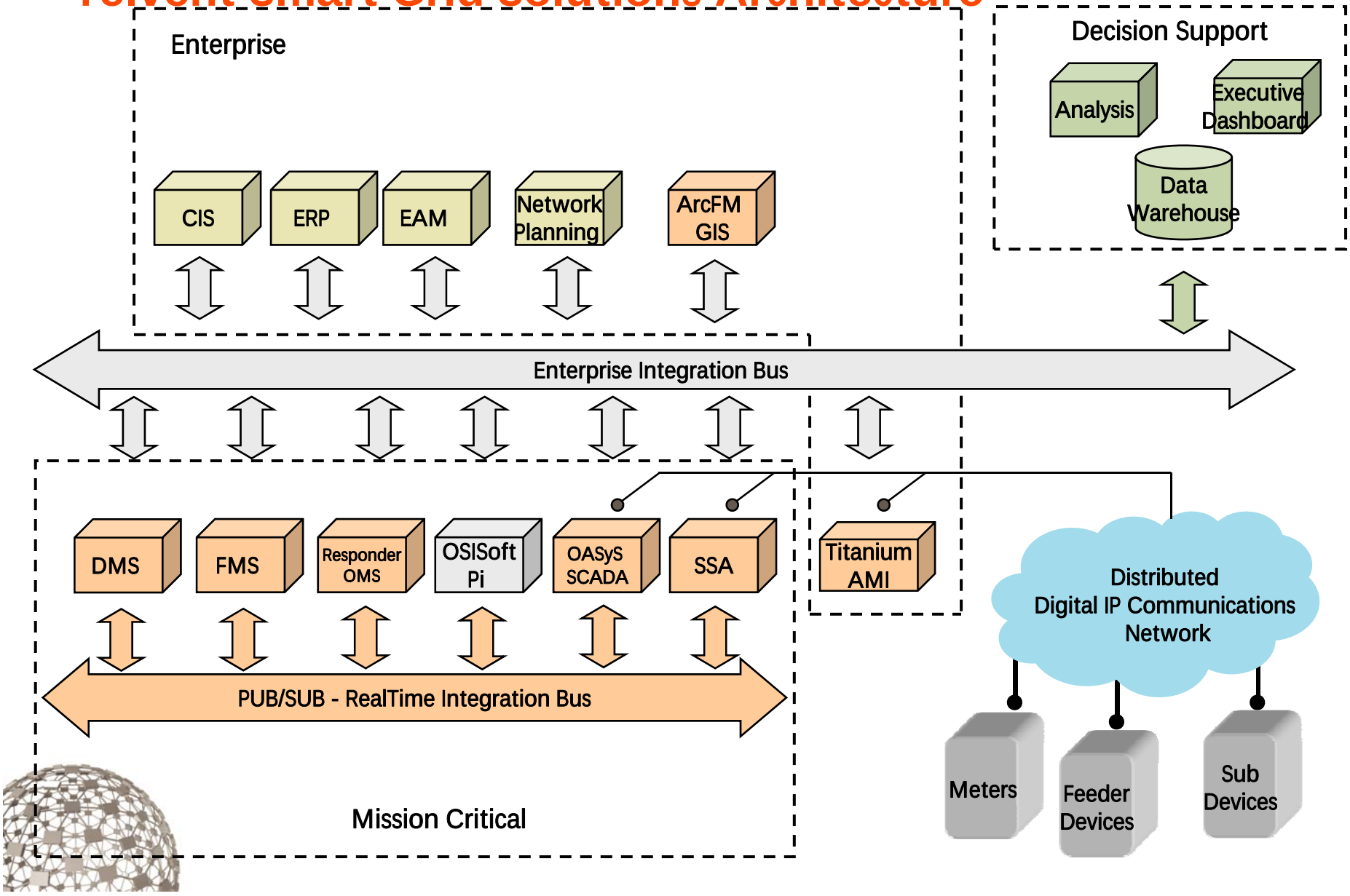
The Power of Integration

Integrated

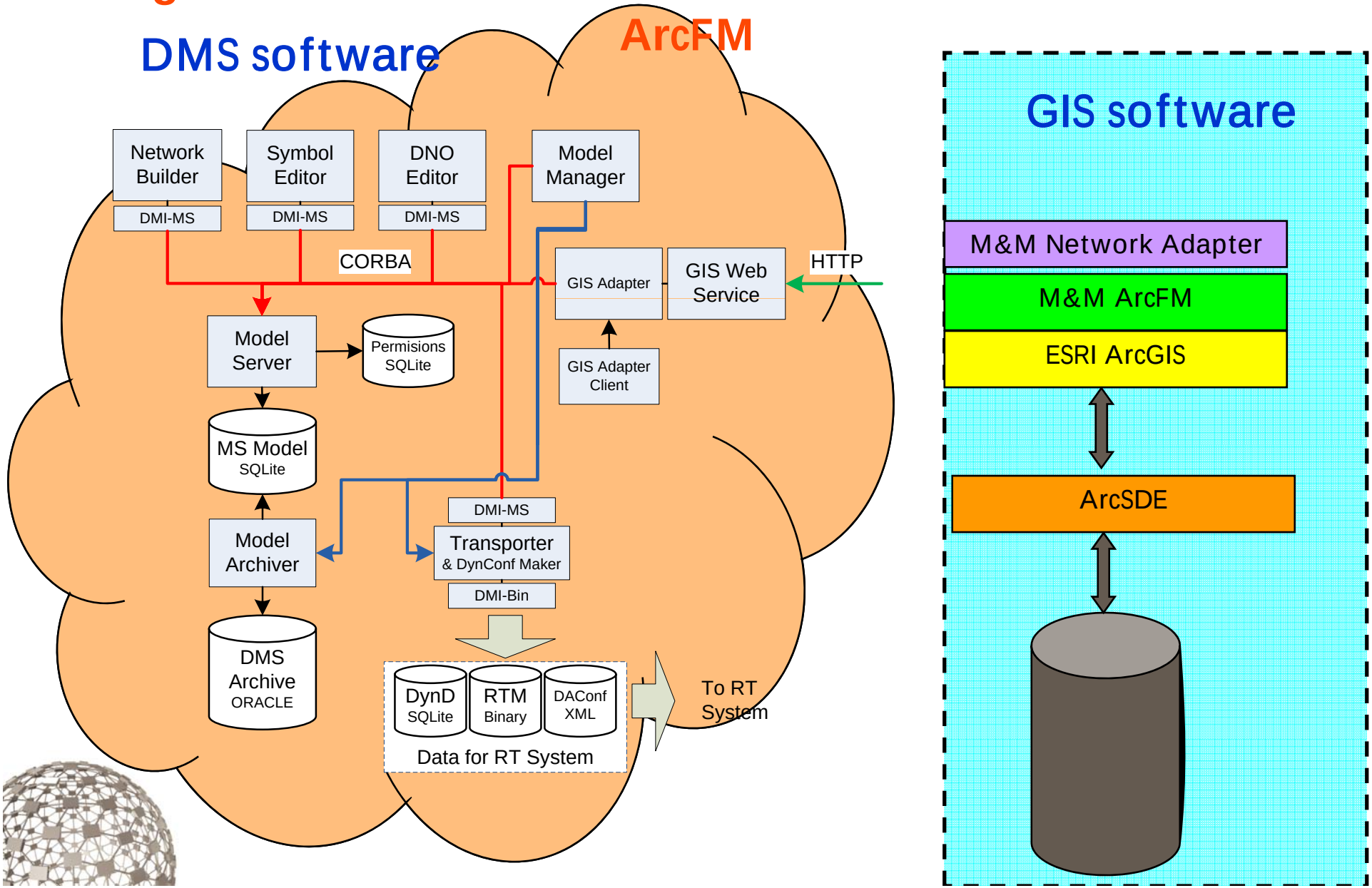
The Telvent Smart Grid Solution

- ✓ Enables optimal asset and load management decisions in RealTime
- ✓ Improves customer service and reliability by cross-cutting data access, accuracy, and enhanced network security
- ✓ Combines AMI, SCADA, OMS, DMS, and enterprise information in a seamless and secure way to provide operations personnel and executives with a more comprehensive view of the network

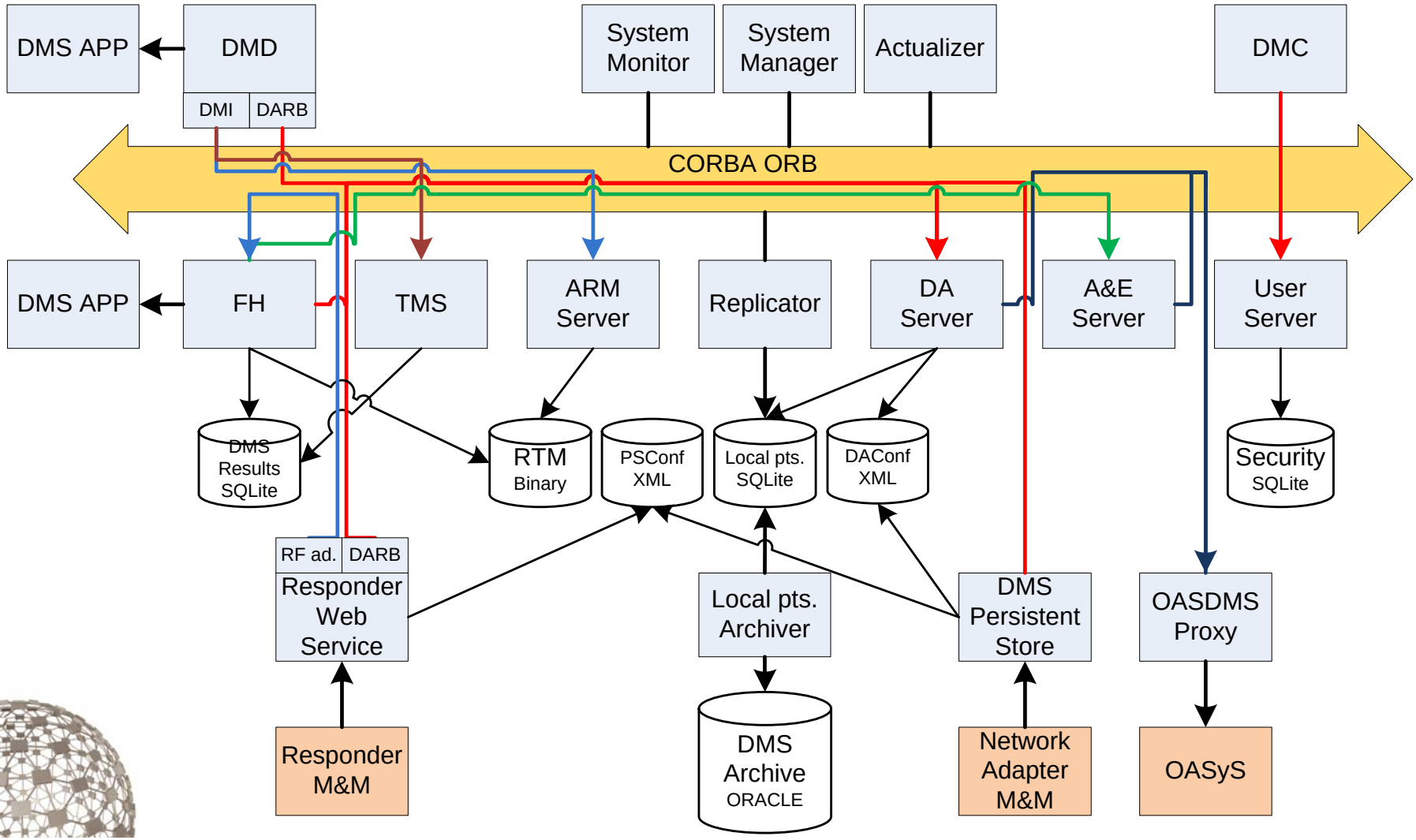
Telvent Smart Grid Solutions Architecture



Integration between DMS software and GIS Miner&Miner



Integration between DMS software and OASys SCADA, Miner&Miner ArcFM and Responder



Enel
L'ENERGIA CHE TI ASCOLTA.

ENEL – Power Industry of Italy

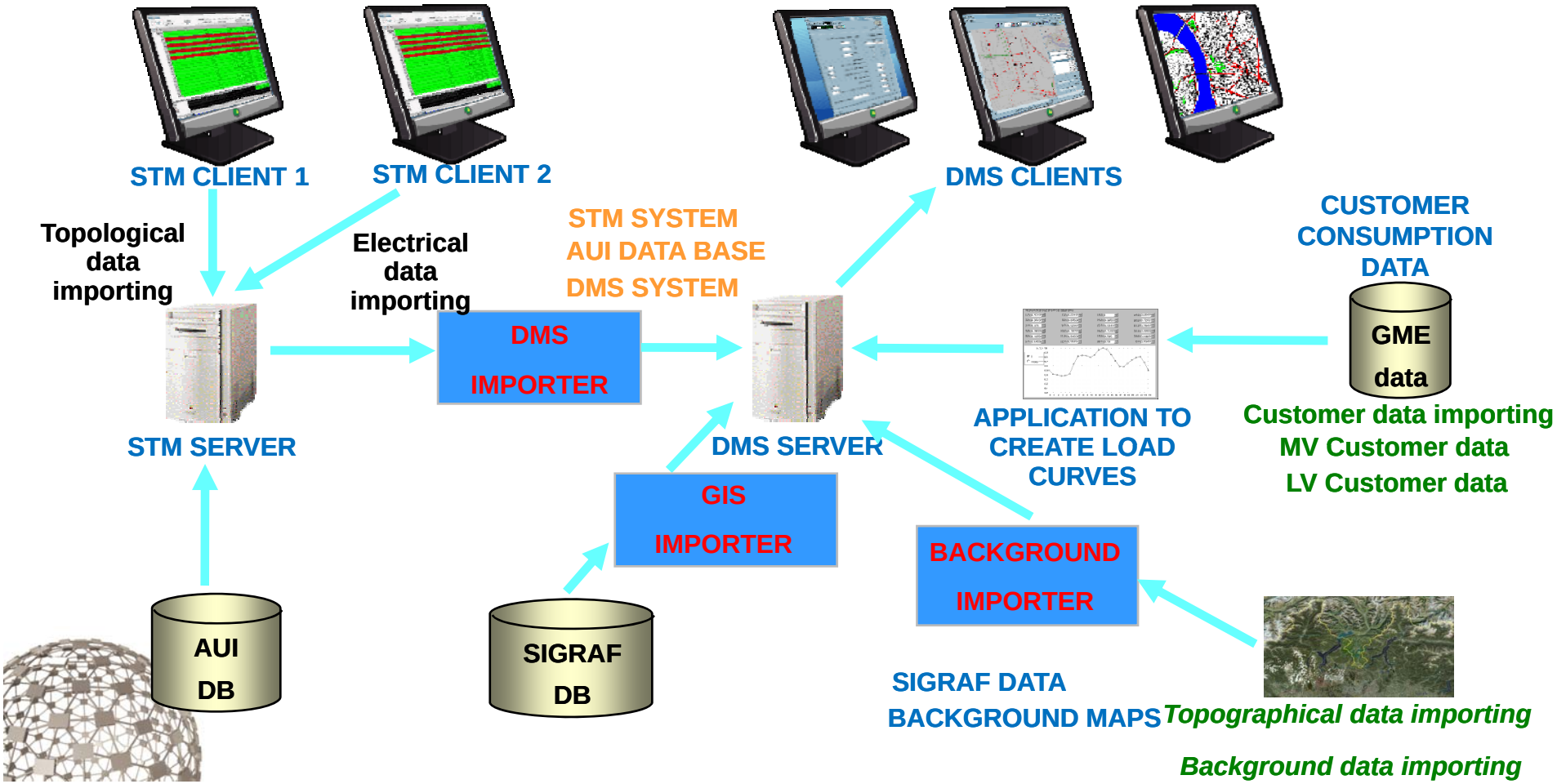
Installations and Maintenance supported by Telvent DMS

- Completed pilot project Milano
- 7 years cooperation
- 50 mil. consumers

Installation of DMS Software in all 28 control centres in ITALY

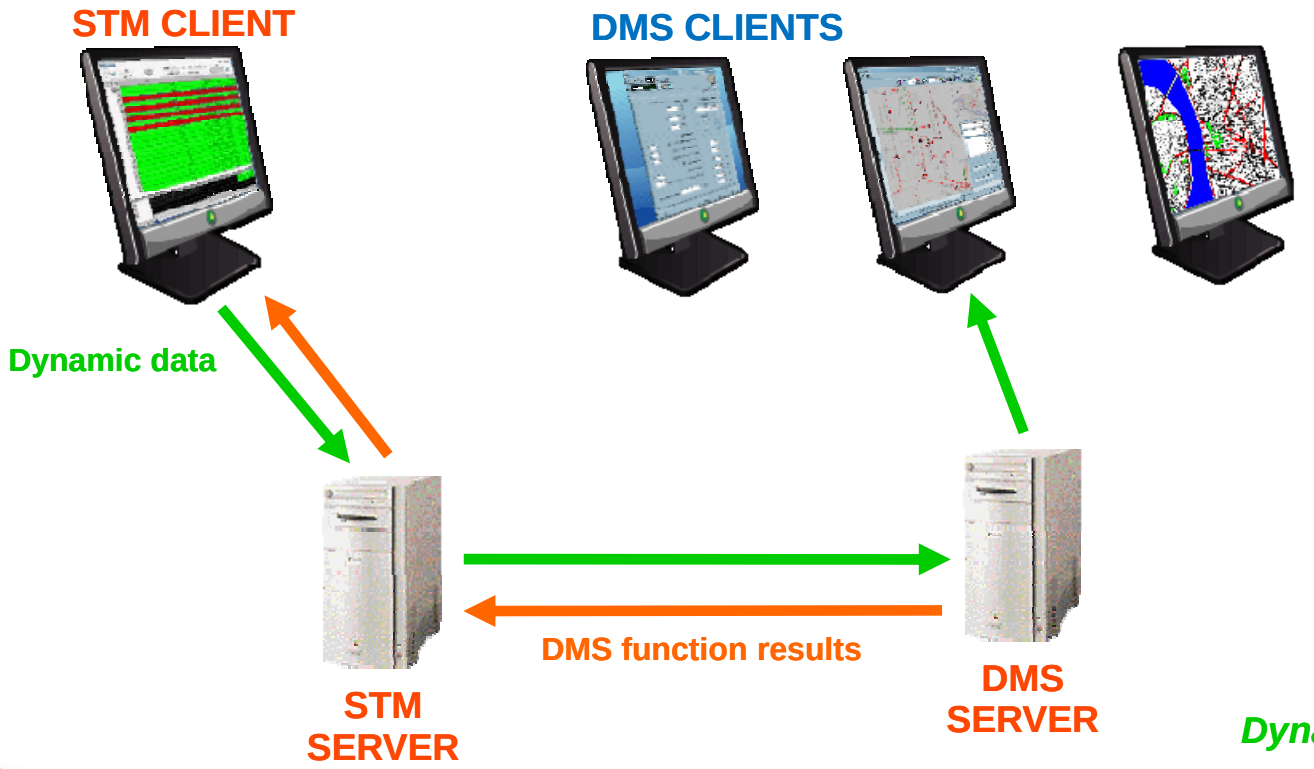
ENEL – Case Study Integration

Distribution Management – Import process



ENEL – Case Study Integration

Distribution Management – Operation process



Dynamic data exchange

DMS results data exporting

Conclusions

- DMS and Smart Grid integrations are necessary for:
  - Estimation and calculation of C/B from investments into the Smart Grids
  - Network design with settings of Smart Grid facilities (equipment number and location)
  - Settings and coordination of Smart Grid facilities (how to set them in order to achieve the best and expected effect)
  - Redesign of distribution network with Smart Grid facilities (change of topology, relay protection etc)
- DMS is a decision making online tool on top of Smart Grid.