IEEE PES meeting

DMS Evolution

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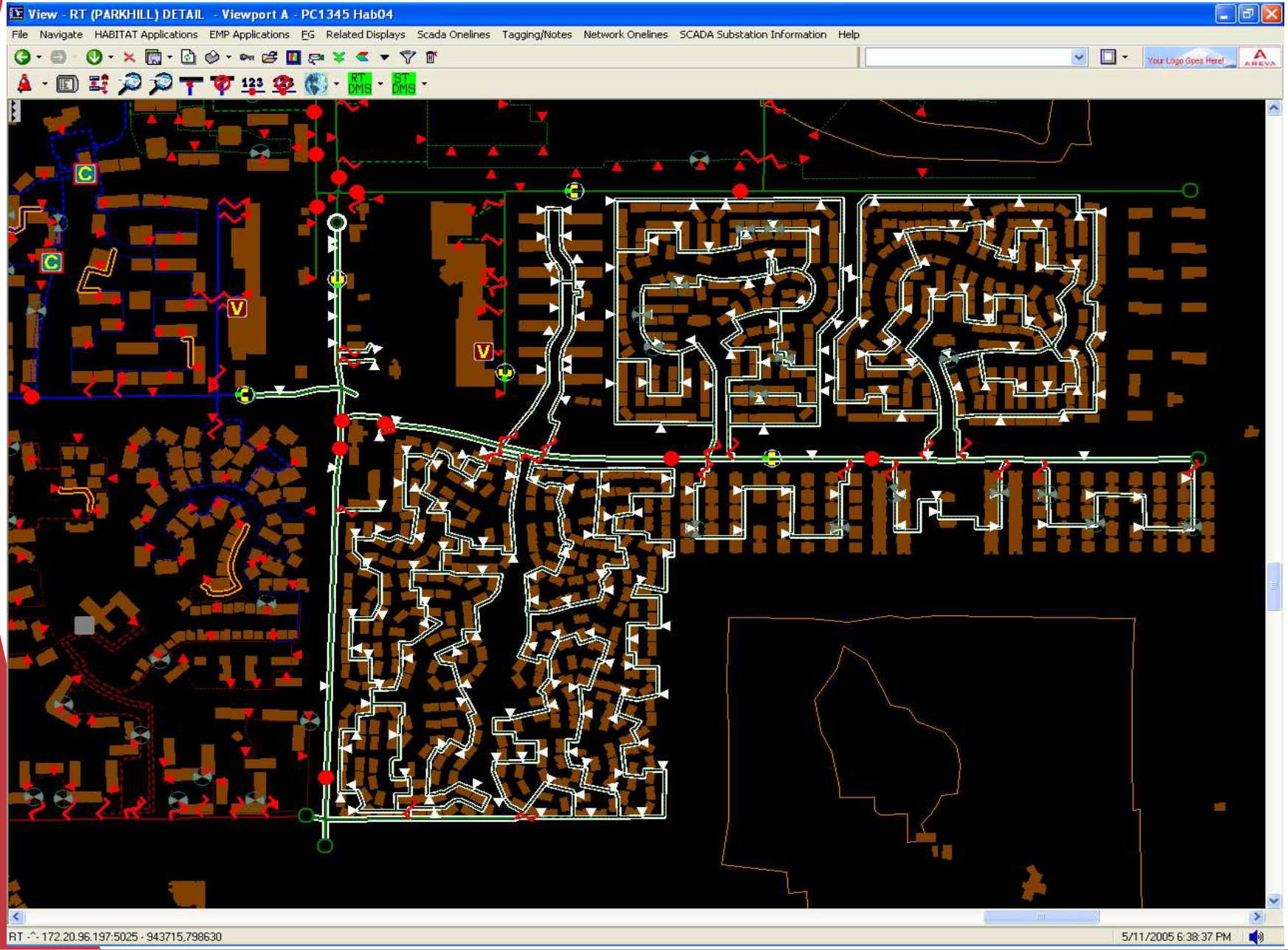
DMS Evolution

- Quick overview of a DMS
- Changing Times
- Design Impacts

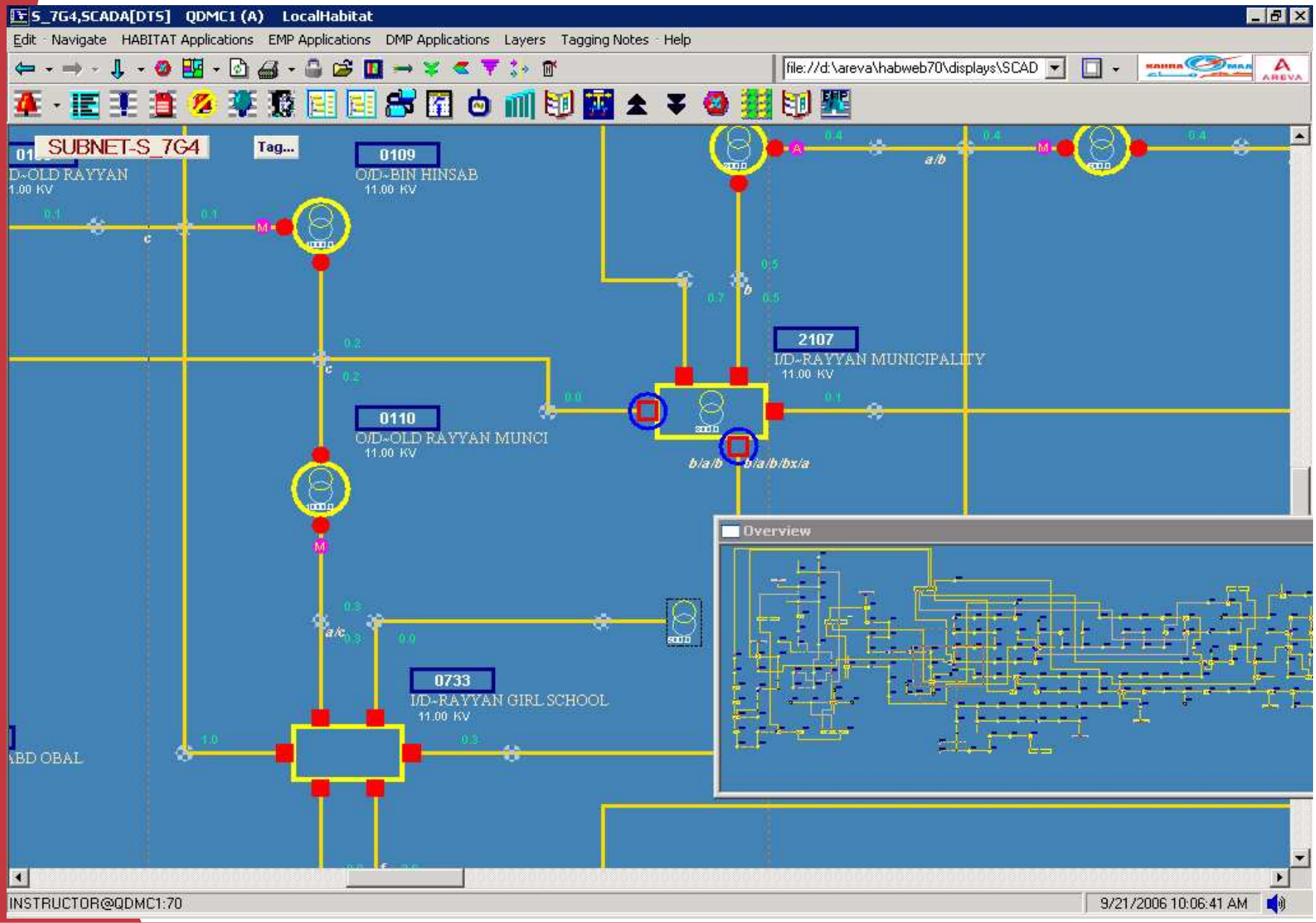
DMS: What is it ?

DMS: What is used to be (and still is sometimes)

What it is now (geo display)



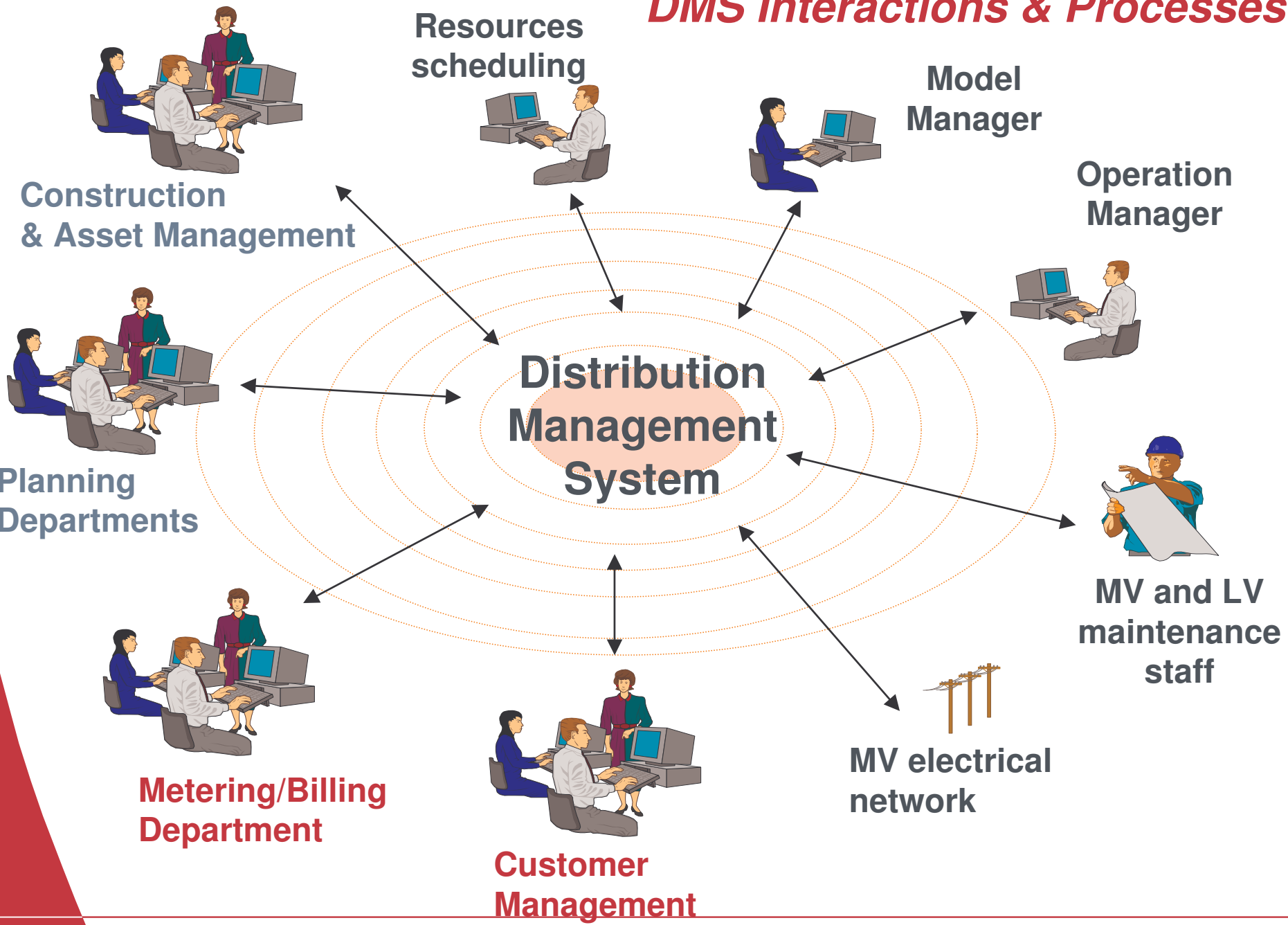
What it is now (schematic display)



DMS in simple terms

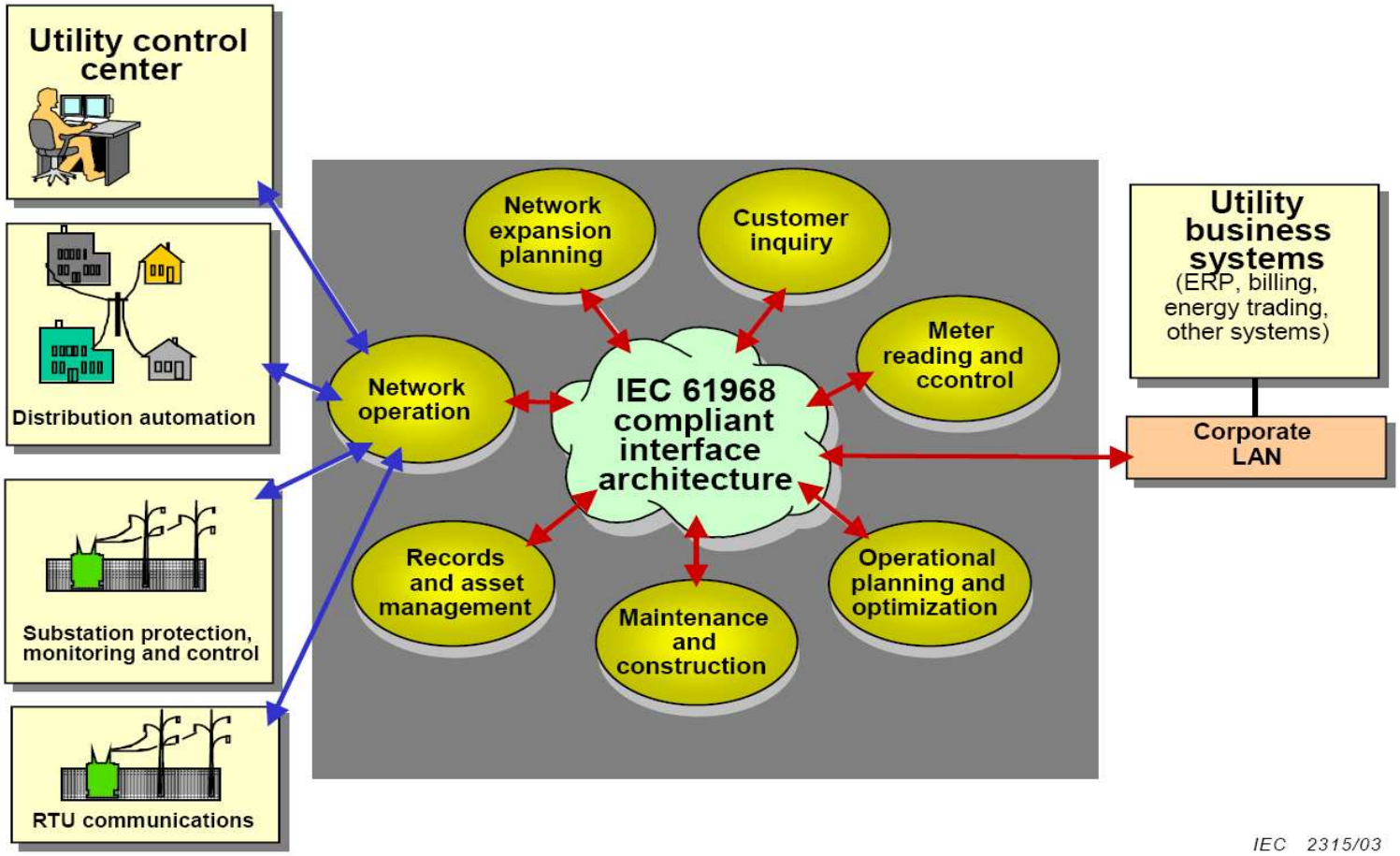
- **Distribution Management System overview:**
  - A (very large) database and User Interface to manage the states of the MV network
  - A strong process for data/display model updates
  - A tool to operate the MV network
  - Works/Outage Management related Applications to manage customers situations and field activities
  - Load flow related Applications to help/automate decisions
  - Reporting facilities
- **Deal/Interface with the 3 pillars of the Distribution**
  - Operations
  - Assets
  - Customers

DMS Interactions & Processes

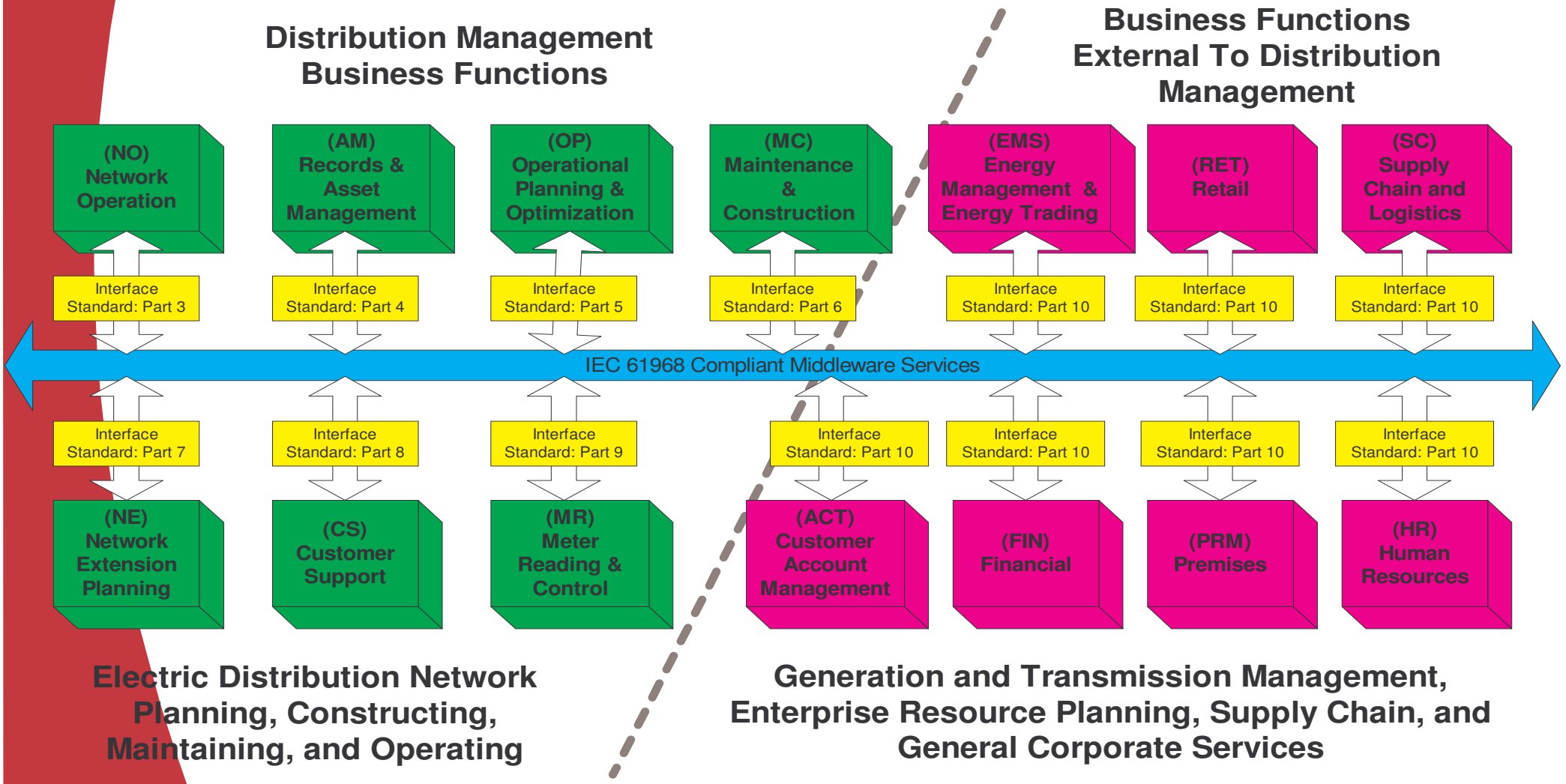


IEC 61968:

Standardization of interfaces is on its way



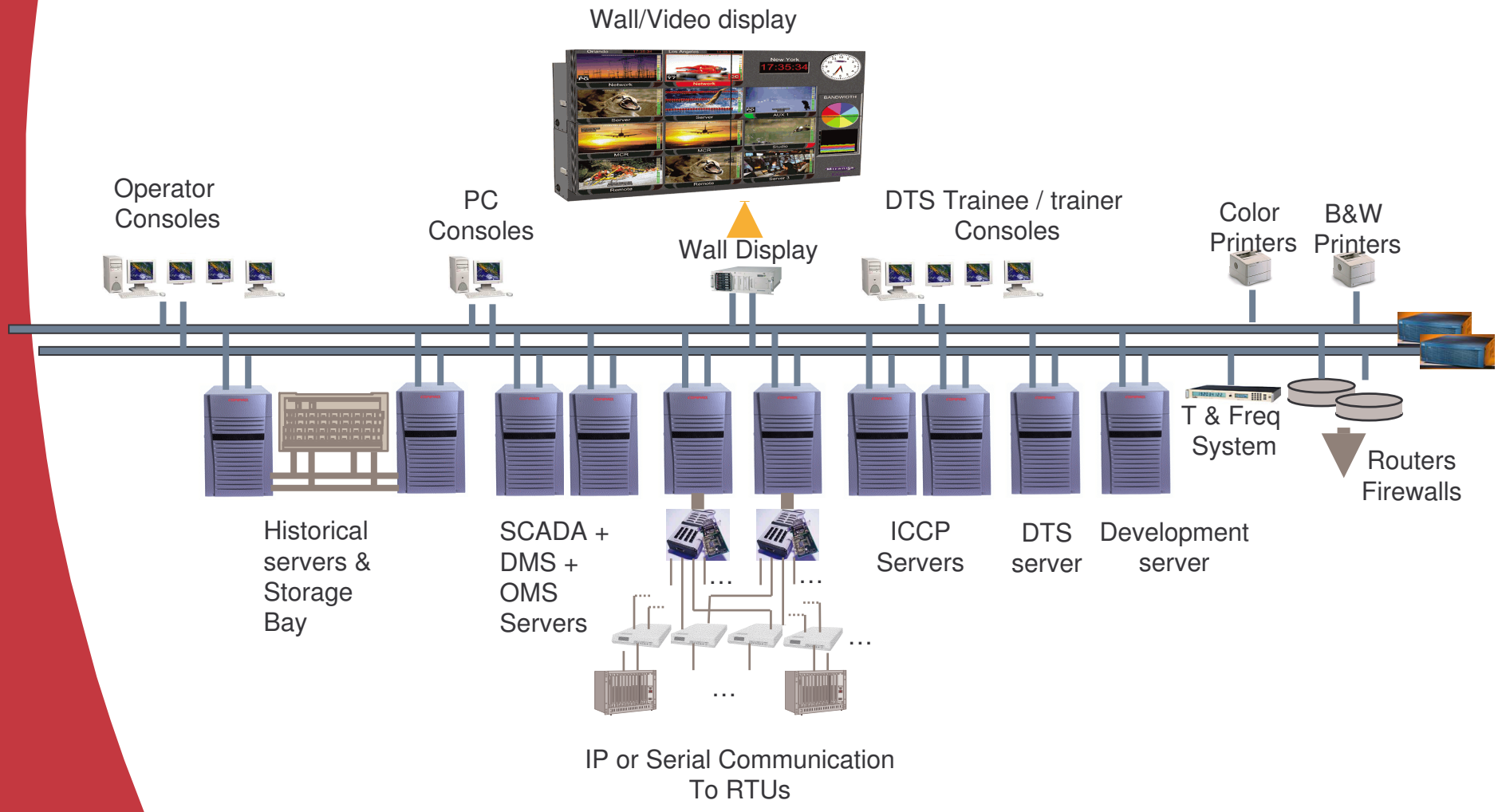
IEC 61968 Interface Reference Model (WG14)



DMS: Applications

- **Modeling**
  - Graphical Modeler
  - GIS import
- **Network Operations**
  - SCADA
  - Topology
  - Feeder coloring, Mesh detection
  - Temporary Modifications
  - Volt Var Control
- **Historical Information System**
  - Performance Indexes
- **Training Simulator (DTS)**
- **Network Analysis**
  - Load Forecast
  - State Estimation / Real Time Loadflow
  - Short Circuit Analysis
  - Power flow
  - Optimal Switching
  - Optimal Volt Var Management
  - Real Time and Study mode
- **Outage & Customer Management:**
  - Trouble Call & Outage Management
  - Work Orders Management
  - Crew Management
  - Network Reconfiguration (Fault Detection Isolation & Restoration)

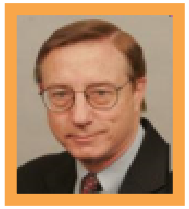
EMS/DMS Control Centers: Typical HW configuration



DMS: Changing Times

the Smart Grid Revolution

"Running today's digital society through yesterday's grid is like running the Internet through an old telephone switchboard"

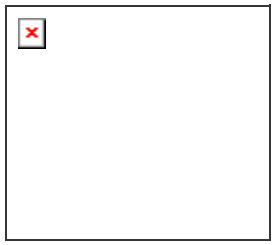


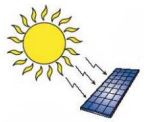
energy future COALITION

Reid Detchon

Smart Grid: Key Impacts on DMS

- Distributed Generation (MV, LV)





- Automated Meter Management and AMI

- Demand Response (policies, events/signals)

- HAN devices, Energy Box

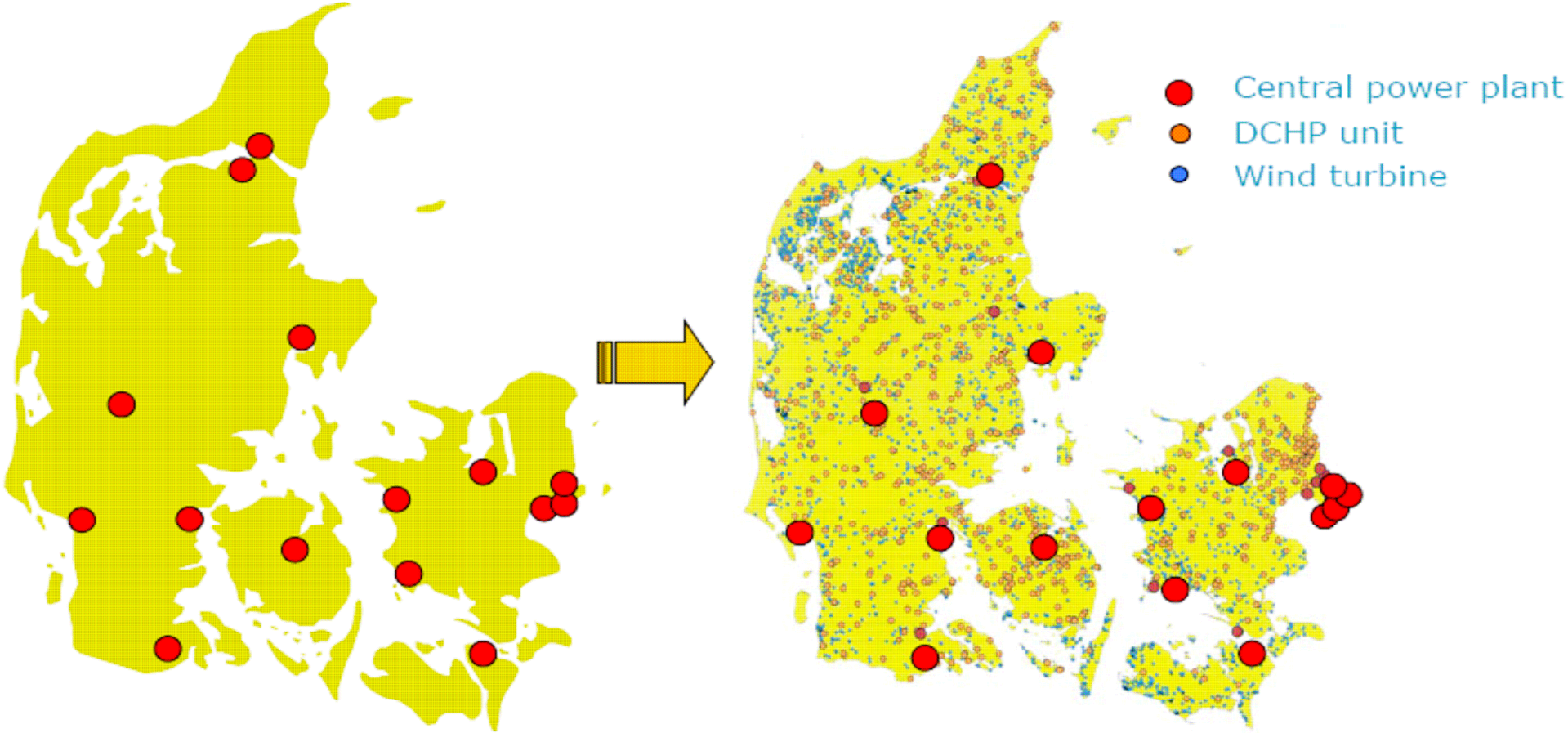
- Plugin Hybrid Electric Vehicles

Distributed Generation:

Development from the late 1980s to present

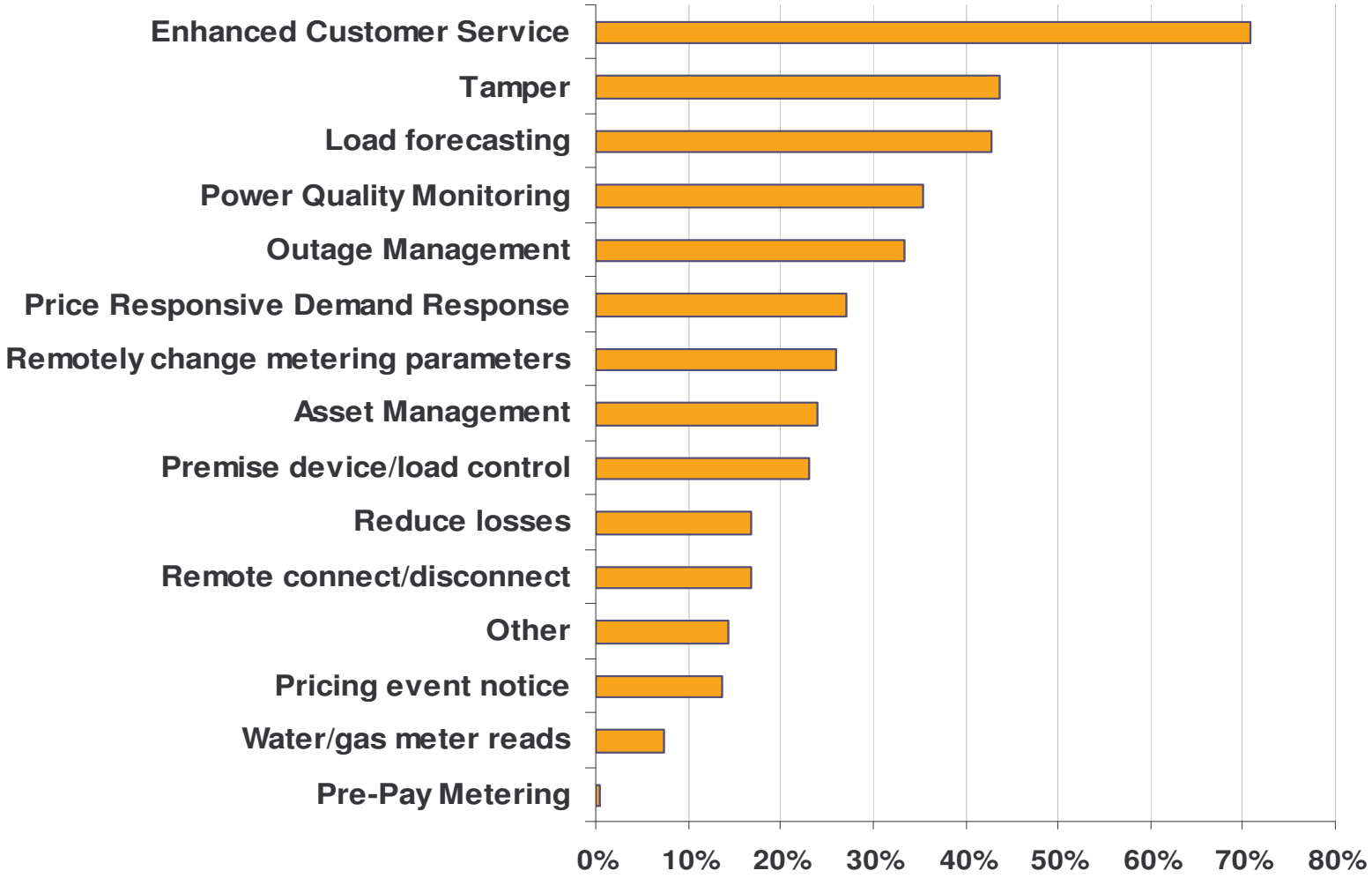
Primary generation

Local generation



Denmark's DG is 43% of installed capacity

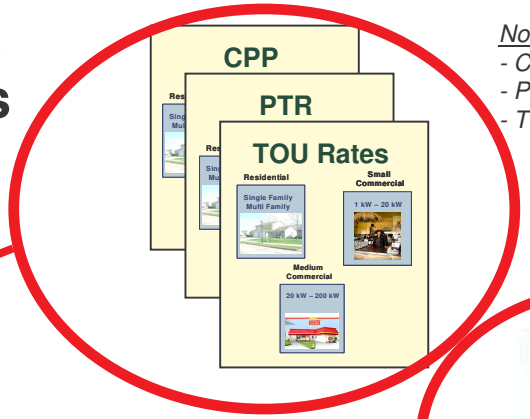
Uses of AMI



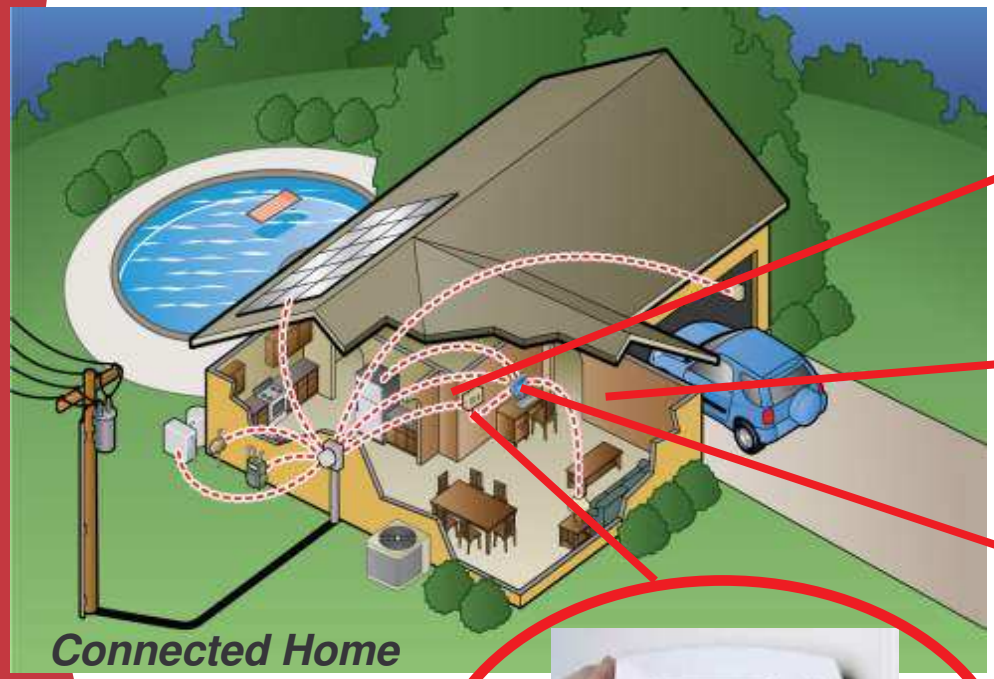
» *Source: FERC Survey*

End-User perspective: New consumption modes …

Rates & Rebates



Notes:
- *CPP: Critical Peak Pricing*
- *PTR: Peak Time Rebate*
- *TOU: Time of Use*



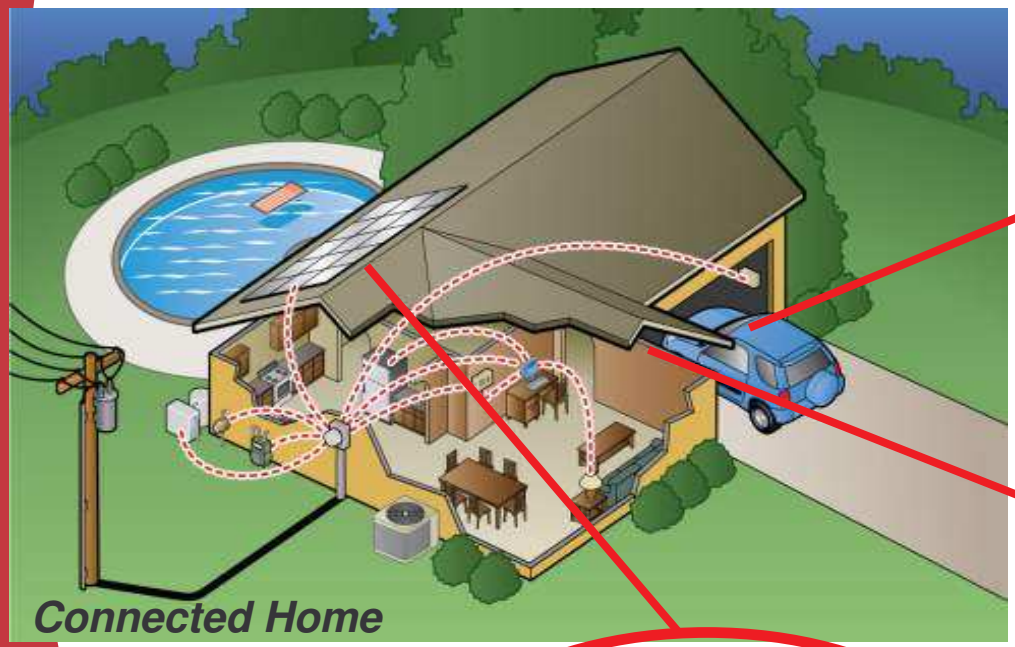
Smart appliances

Smart thermostats

Energy box

Source: Southern California Edison (modified)

… plus Generation and Storage



Plug-in Electric Vehicles

Distributed Generation

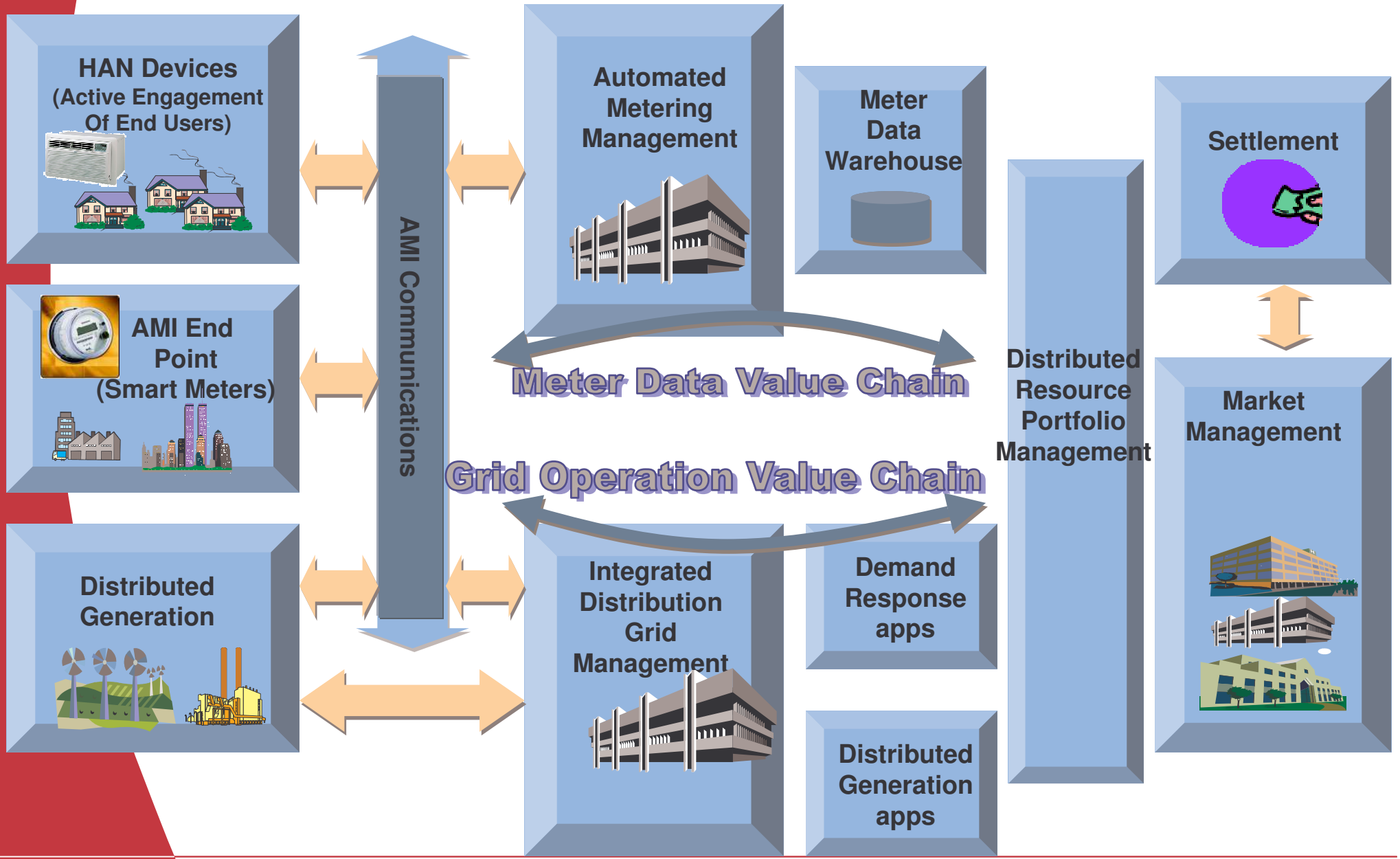
(Residential)

Customer Home Energy Storage

Source: Southern California Edison (modified)

Smart Distribution – Combining Value Chains

Business and Physical – Metering and Operation



DMS: Design Impacts

Critical DMS Capabilities (today)

- Modeling
  - Size
  - Version control
  - Incremental changes
  - Intuitive Graphical modeling
  - Interactions with other repositories (GIS, AM, CIS, EMS, …)
  - Management of Incomplete and Inaccurate Models
  - Fast and flexible On-lining
- Large scale Operation and Telemetry (Millions points)
  - 1000's, 10K, 100K RTUs ?
  - Millions MV Loads
  - Model LV Customers
  - Fast growing models
- Network Analysis robustness
  - Is Critical to Feeder/Substation Reconfiguration (planned or unplanned Outages)
  - Is Critical where feeders are strongly loaded (high growth rates)
- Work Management effectiveness
  - Model accurately work and safety processes
  - Synchronize with Modeling activities
- Deployment Management
  - Underestimation of Data/Model Management issues
  - Business Process adaptation
  - Resistance to Change

New Issues and Requirements for DMS (1)

- **Distributed Generation**
  - Bidirectional flows
  - Unpredictability
  - Instability
  - Modeling in MV and in LV (residential)
  - Various aggregations levels
  - Portfolio Management, optimisation
  - Behaviour during Outages
  - Operation of Microgrids requires multi-islands Loadflow + Freq calculations at MV level
- **Demand Response**
  - Variability of Load Models
  - Modeling in MV and in LV (residential)
  - Various aggregation levels
  - Manage Event/Signals - Interfaces (MDM, Settlement, CSP, …)
  - Cold Load pickup after Outage
  - Portfolio Management, optimisation

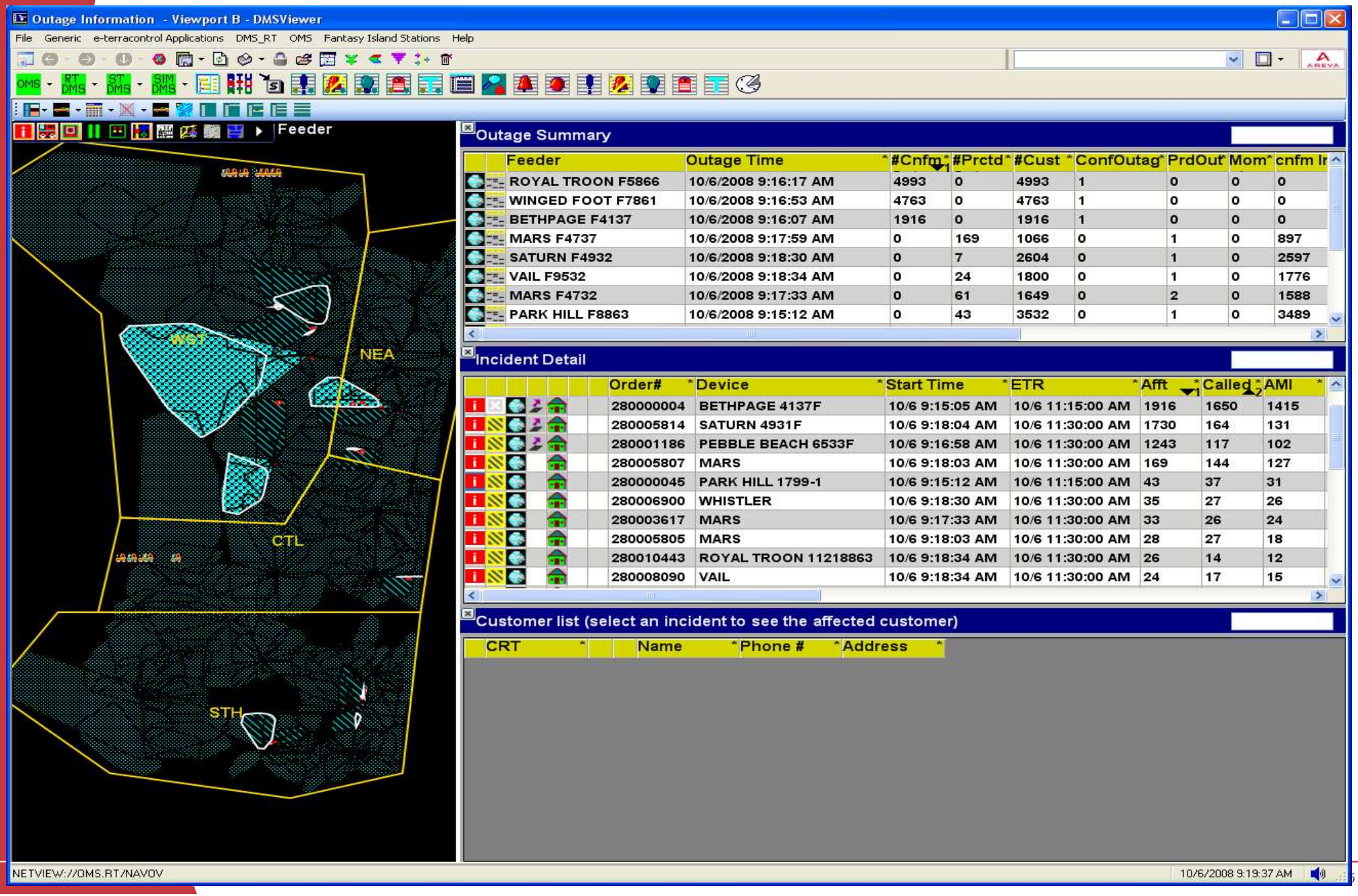
New Requirements for DMS (2)

- Interoperation with AMI
  - OMS and Work Management
  - DG
  - Signals/Events from DR
  - Interface with Metering
  - Customer modeling
  - load data at LV level
  - Load model
  - Voltages monitor, LV phases balance
- HAN devices / Energy Box
  - Load Forecast
  - Load Model
- MVDC:
  - Control and Optimisation
- PHEV:
  - Load model: might become very complex

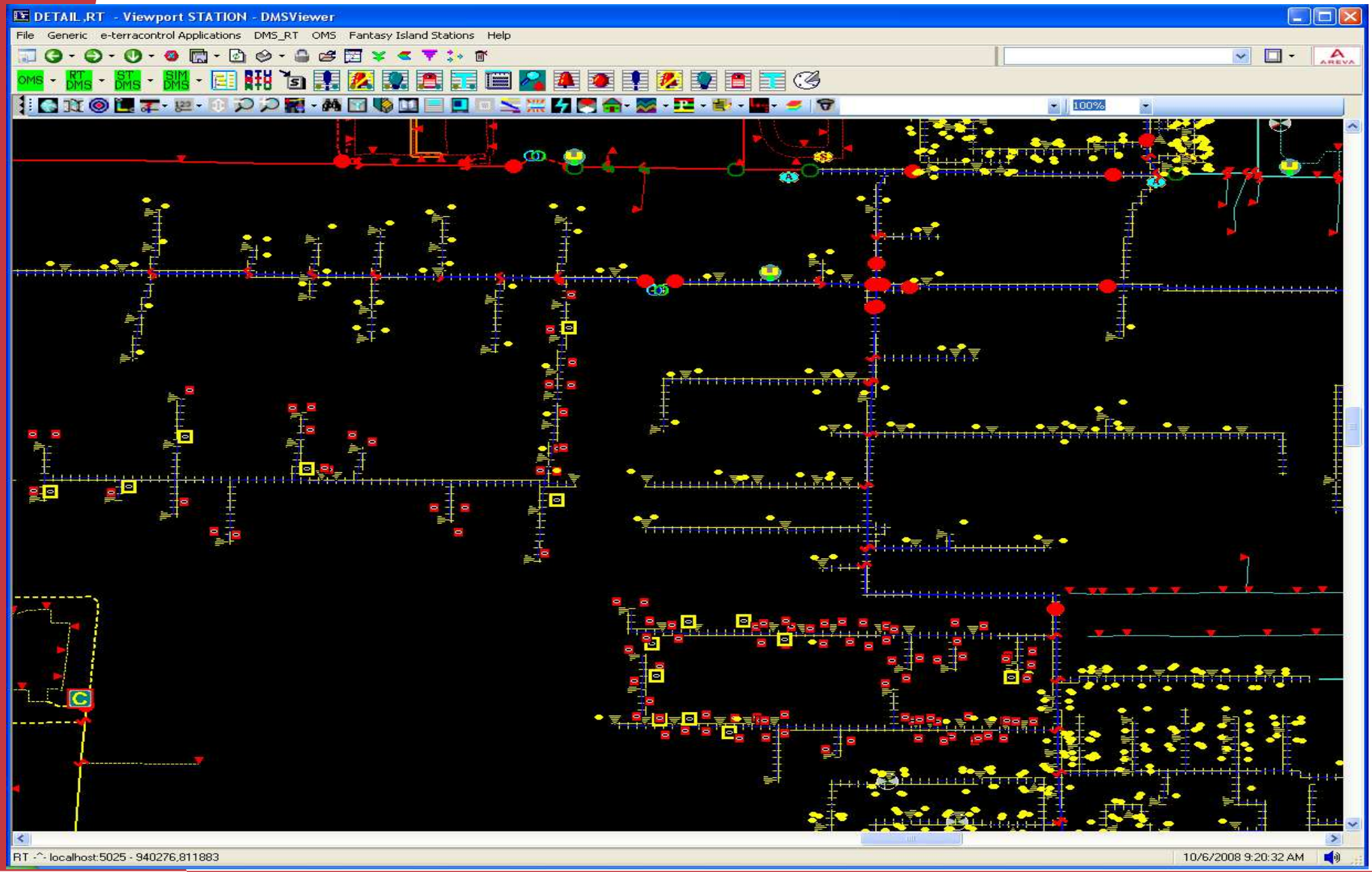
Summary: exciting time for DMS applications

- Load Forecast: Integrate with multiple engines (Wind, Solar, DR, ..)
- DG application (MV and LV units/portfolios)
- DR application (MV and LV loads/portfolios)
- EMS-like applications down to MV levels
  - Generation forecast, scheduling, monitoring and balancing (and dispatch ?)
  - Look ahead loadflow and security analysis
  - Training Simulator (eg: micro-grid operation/restoration)
- Load flow calculations
  - Simple one way algorithms will be phased out
  - Extend to LV => another order of magnitude for model size increase
  - multi-islands Loadflow + Freq calculations at MV level
  - Very complex, non static Load Models (DR)
- Micro grid operation tools
- Reconfiguration (DG and Micro grid options)
- Closer coordination with Customer model (complex load groups, portfolios for DR, connectivity model)
- Extended Interfaces:
  - AMI Interface (OMS, load model, DG, DR)
  - MDM Interface (DR)
  - Business/Enterprise Interface (eg: DR Events to Settlement)
- MVDC management (optimisation, reconfiguration strategies, …)

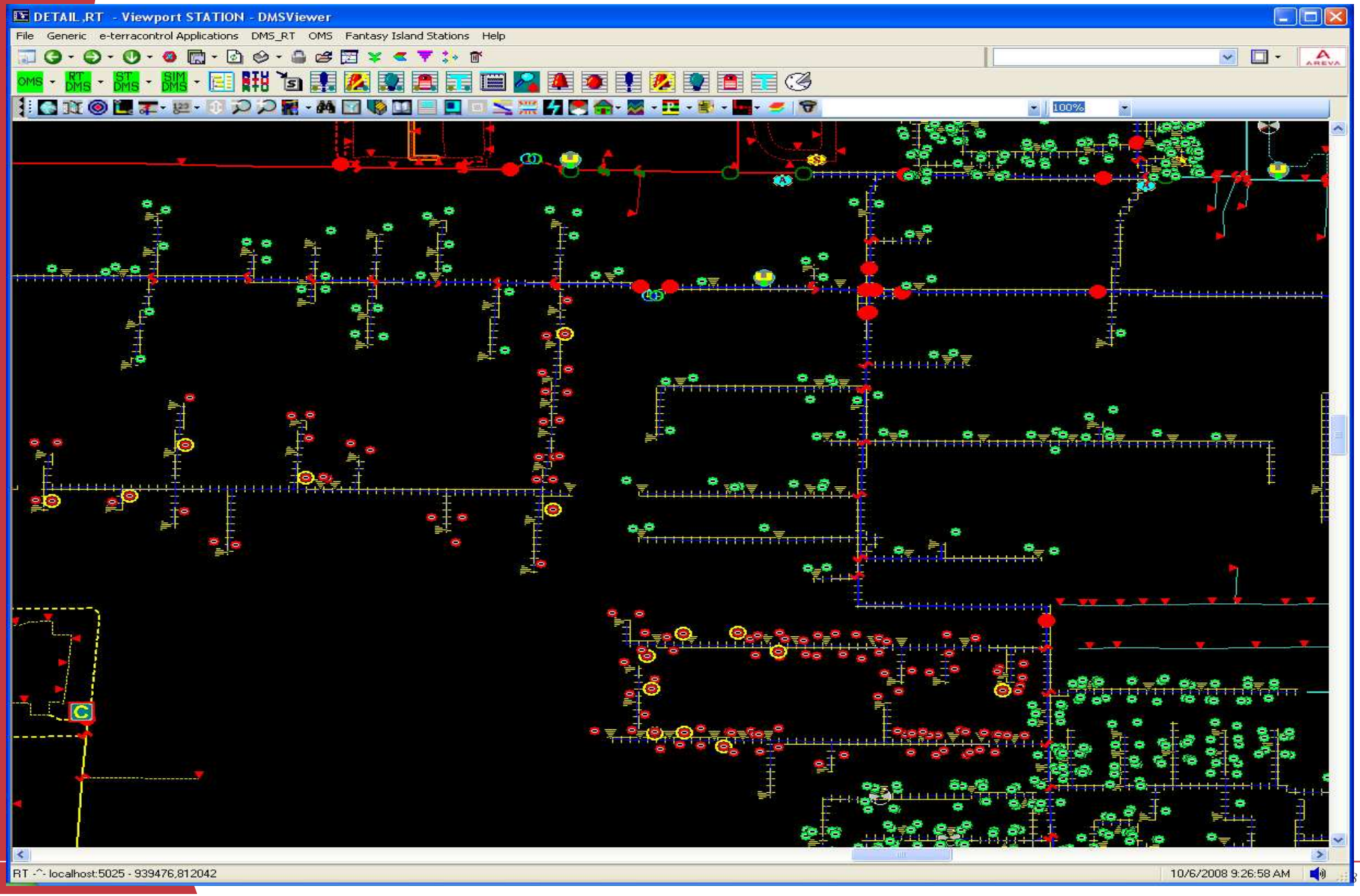
AMI Integrated OMS Incident Summary



AMI-Integrated Predicted Feeder Level Outage – Southern Company



AMI Integrated Smart Meter Responses to Feeder-wide Ping



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Thank You !

Questions ?