



*EPCC 2011, Altea, Spain*

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# Integrated Substation Data for Control Center Applications

Mladen Kezunovic, Ph.D., P.E.

*Department of Electrical and Computer Engineering*

*Texas A&M University*

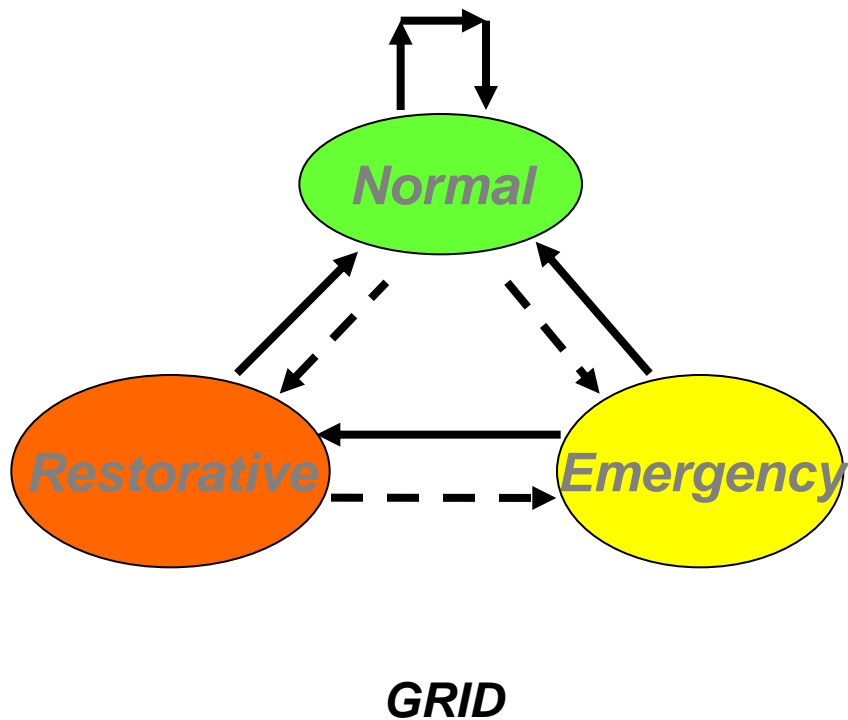
*kezunov@ece.tamu.edu*



Existing EMS paradigm  
New EMS paradigm  
Data management  
Model management  
New applications  
Q/A

# OUTLINE

# Existing Paradigm



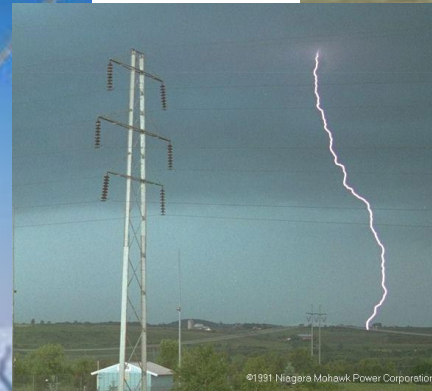
## Emergency

- SCADA Data
- N-1 contingency
- Protective relaying
- SIPS and islanding
- No operator action
- Market suspended
- Blackouts occur



# Emergencies

- *N-m*



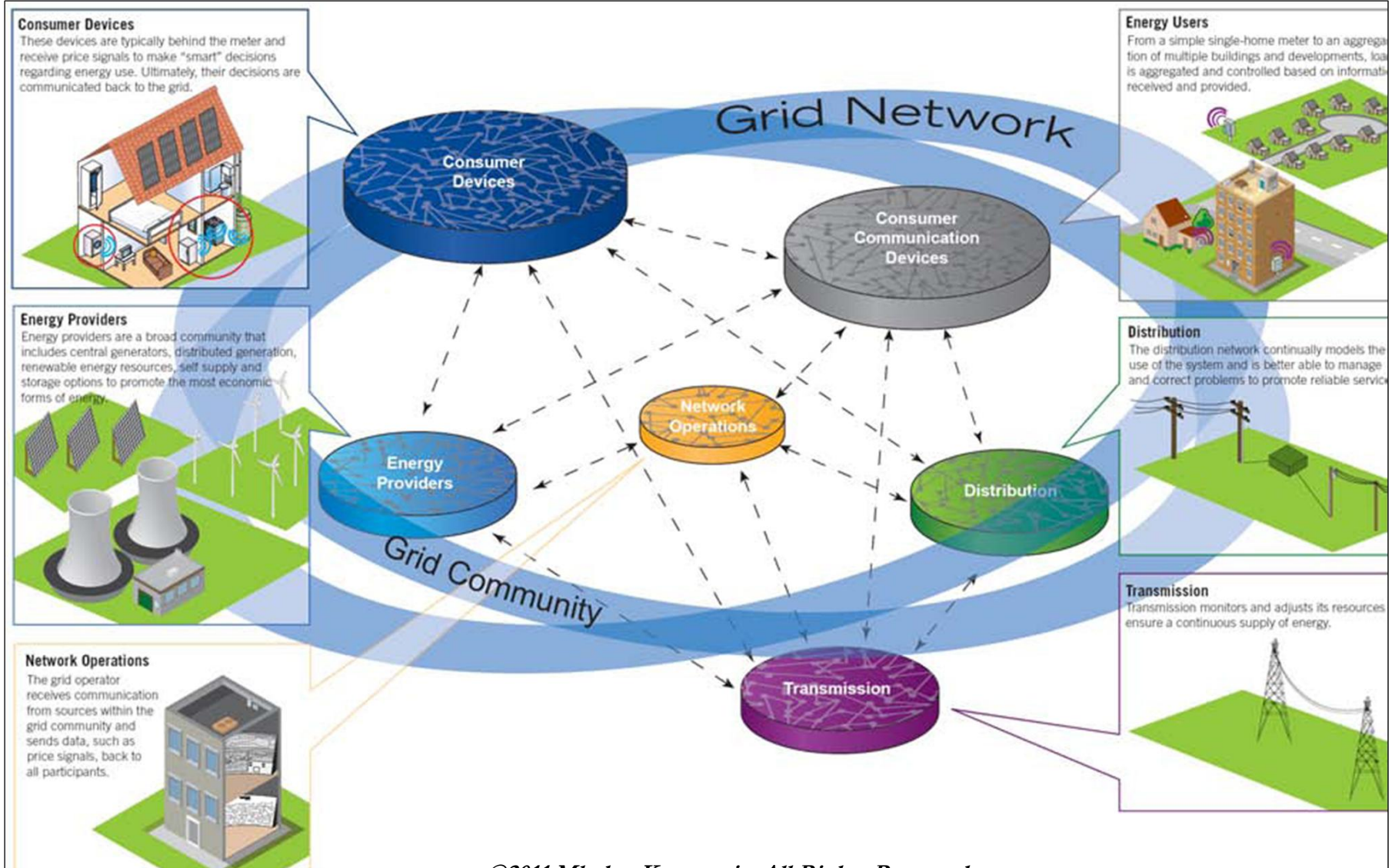
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- *Cascading events*
- *Types of faults*
  - *Temporary*
  - *Permanent*



# New Paradigm



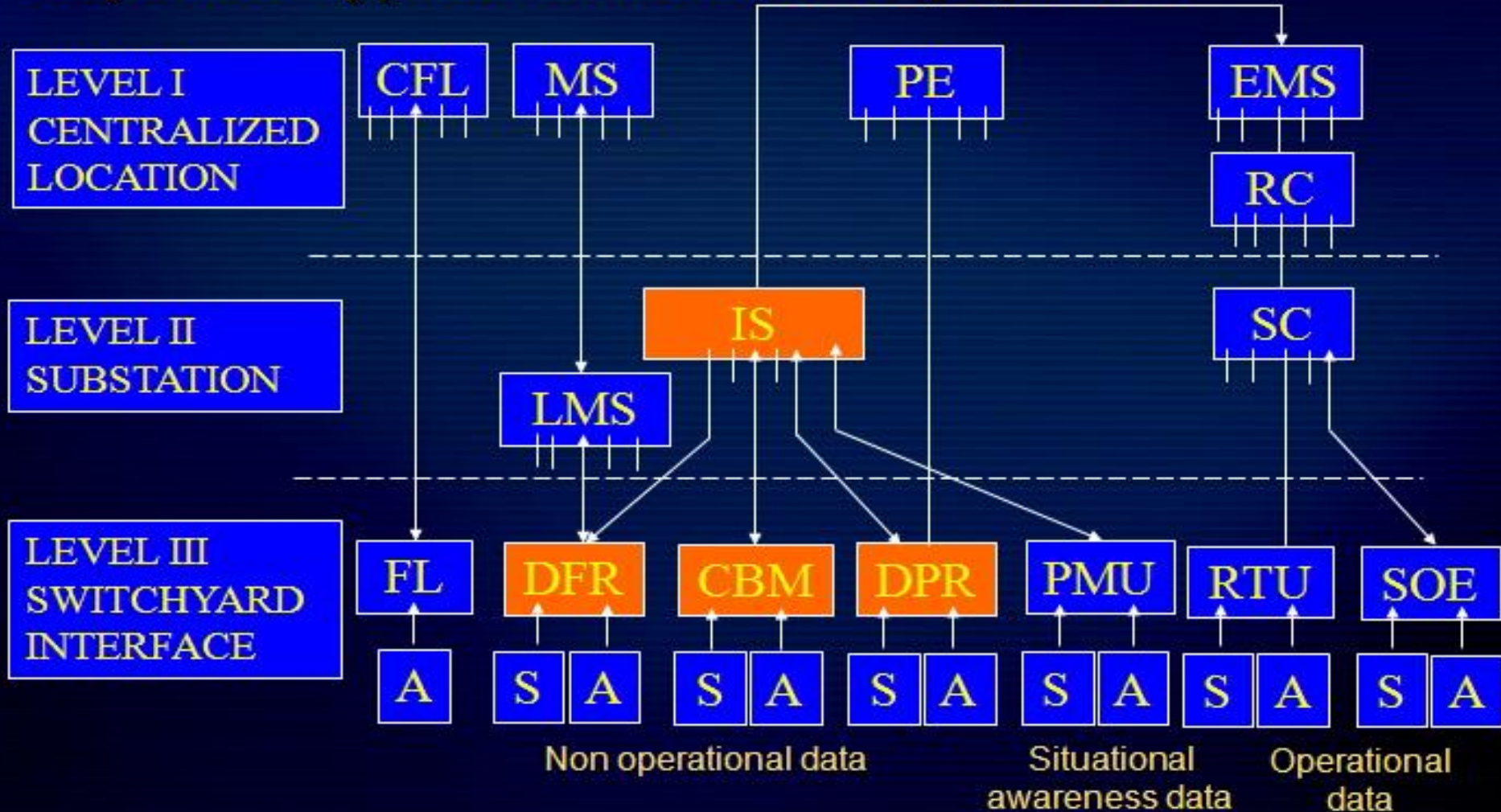




# Data Management

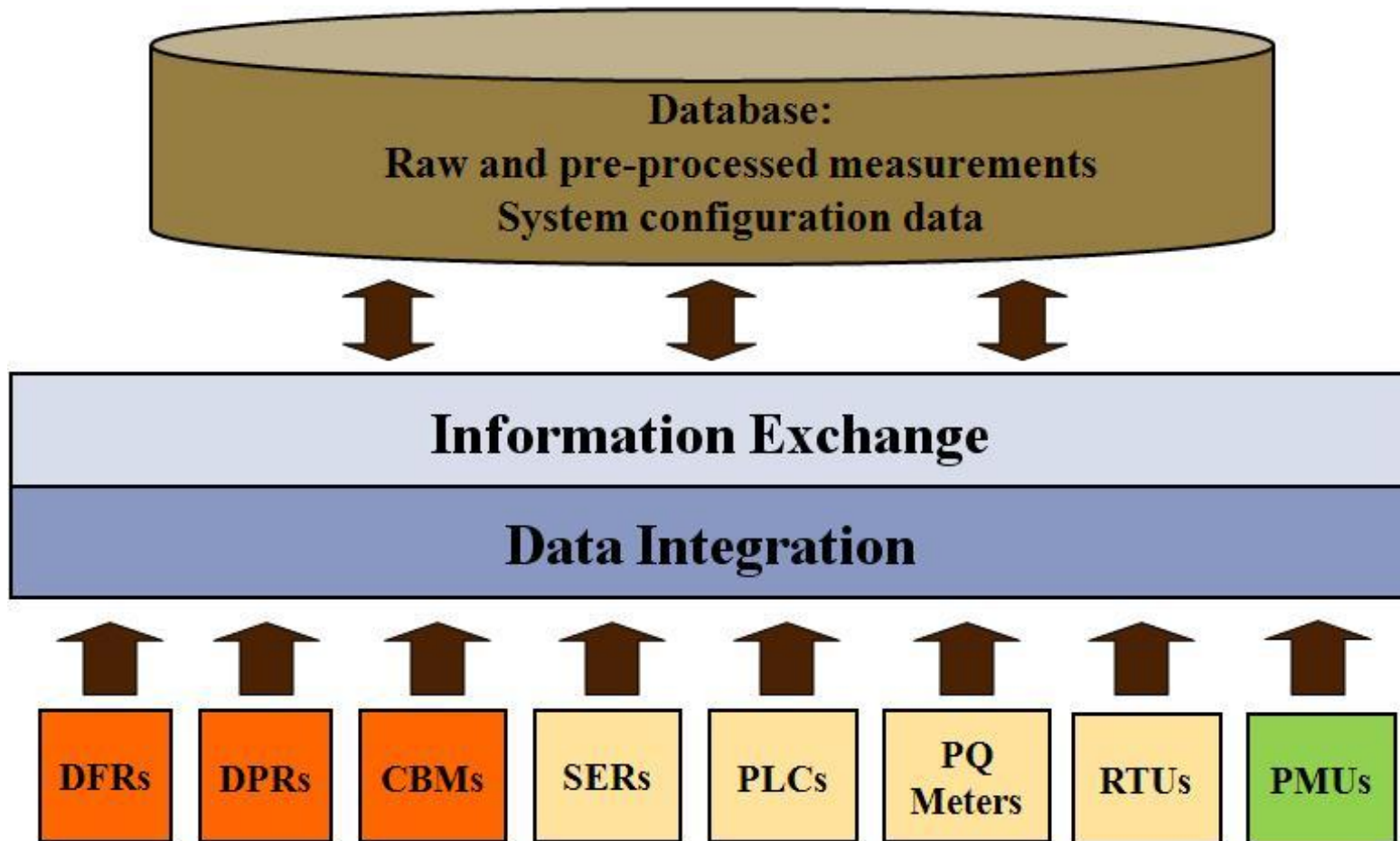


## Layout of typical substation equipment



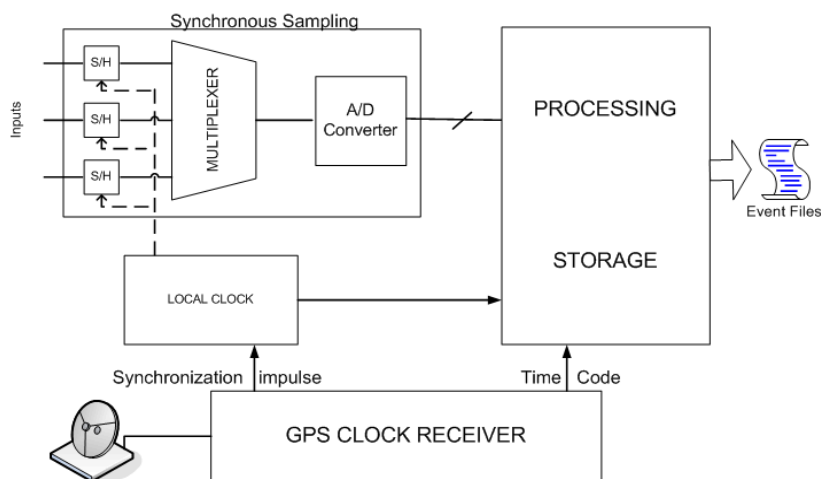


# Data Integration





# Time synchronization

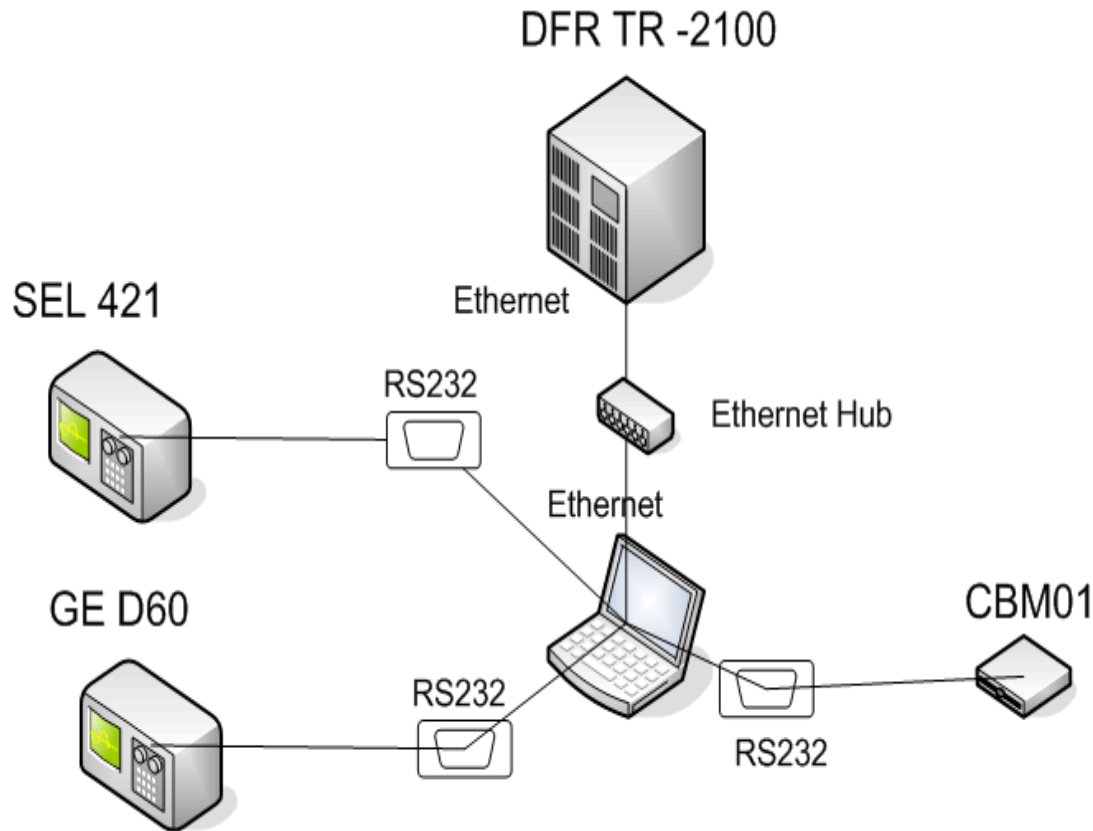


- Absolute time reference (time stamp)
- Relative time reference (samples, phasors/angles)
- Time scales ns, ms, s
- Synchronized sampling vs. scanning
- Synchronization per substation
- System-wide synchronization.



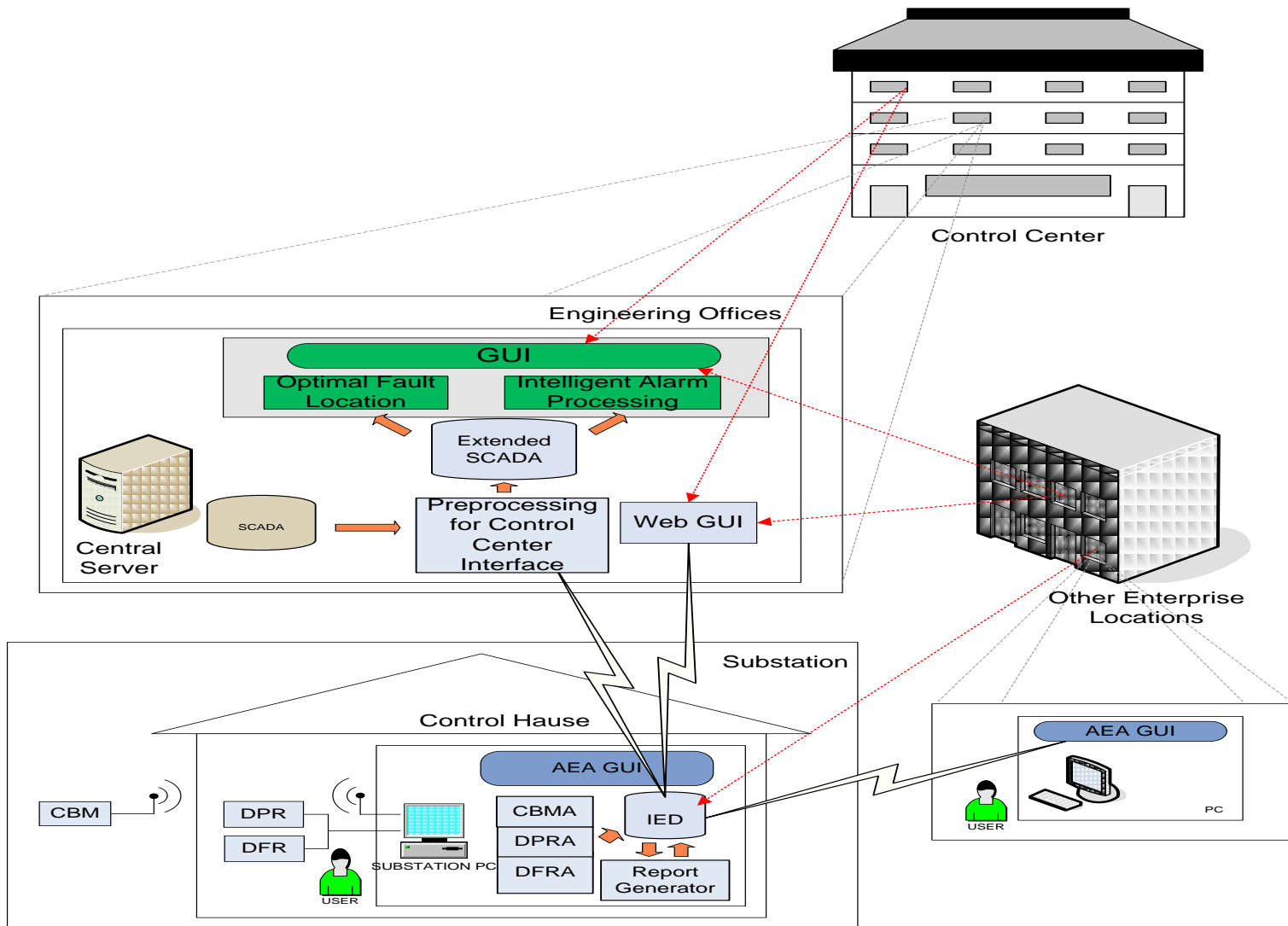
# Time synchronization

## IED GPS and data exchange wiring





# Information Extraction





# Information Sharing

Engineer



Comprehensive Report

Dispatcher

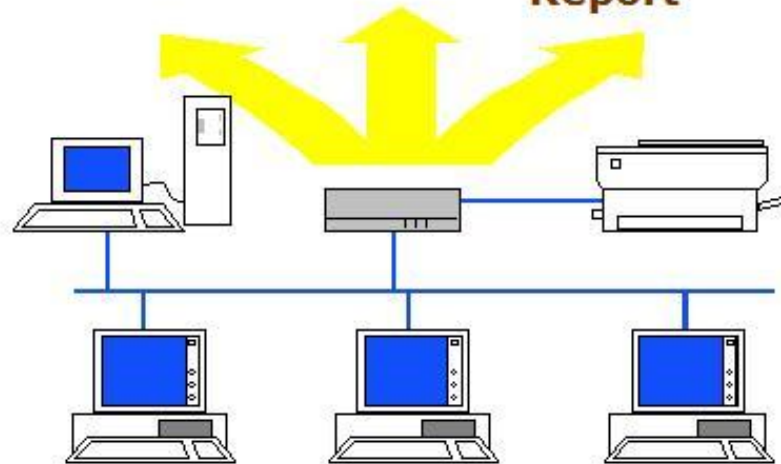


Brief Report

Technician



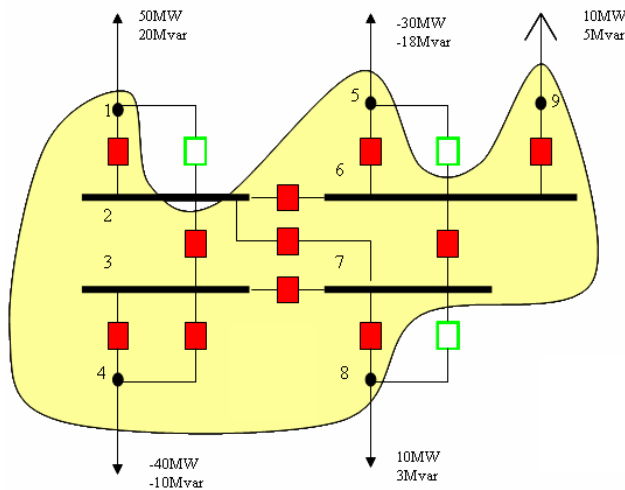
Summary Report





# Two-Model Paradigm

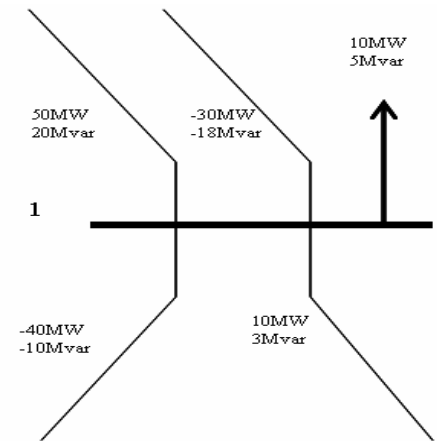
## Operations Model



Physical System



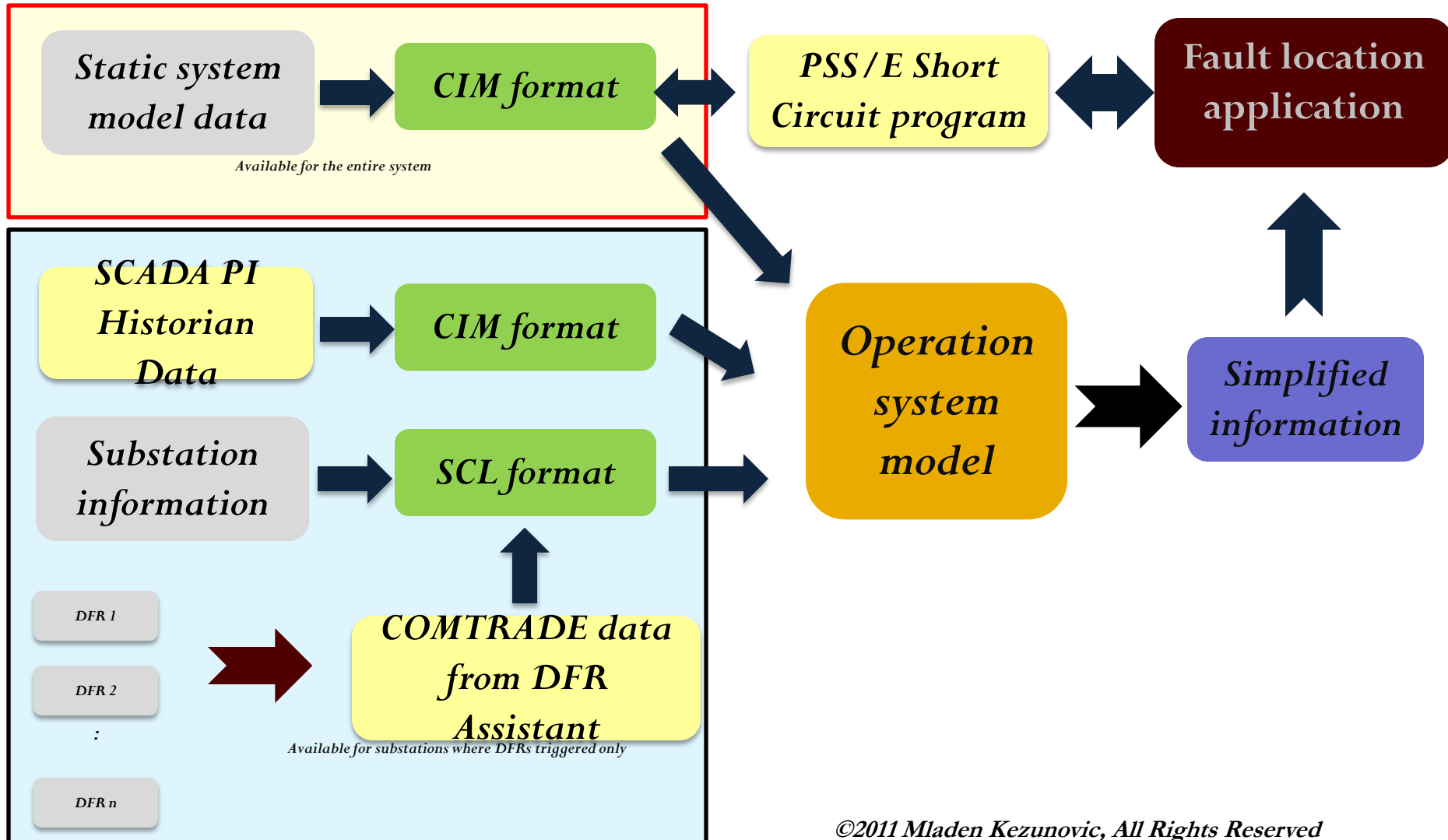
## Planning Model



- During the 60s and 70s, the power industry decided to adopt different power system **models** for real-time operations and planning.
- This **two-model paradigm** continues **today**

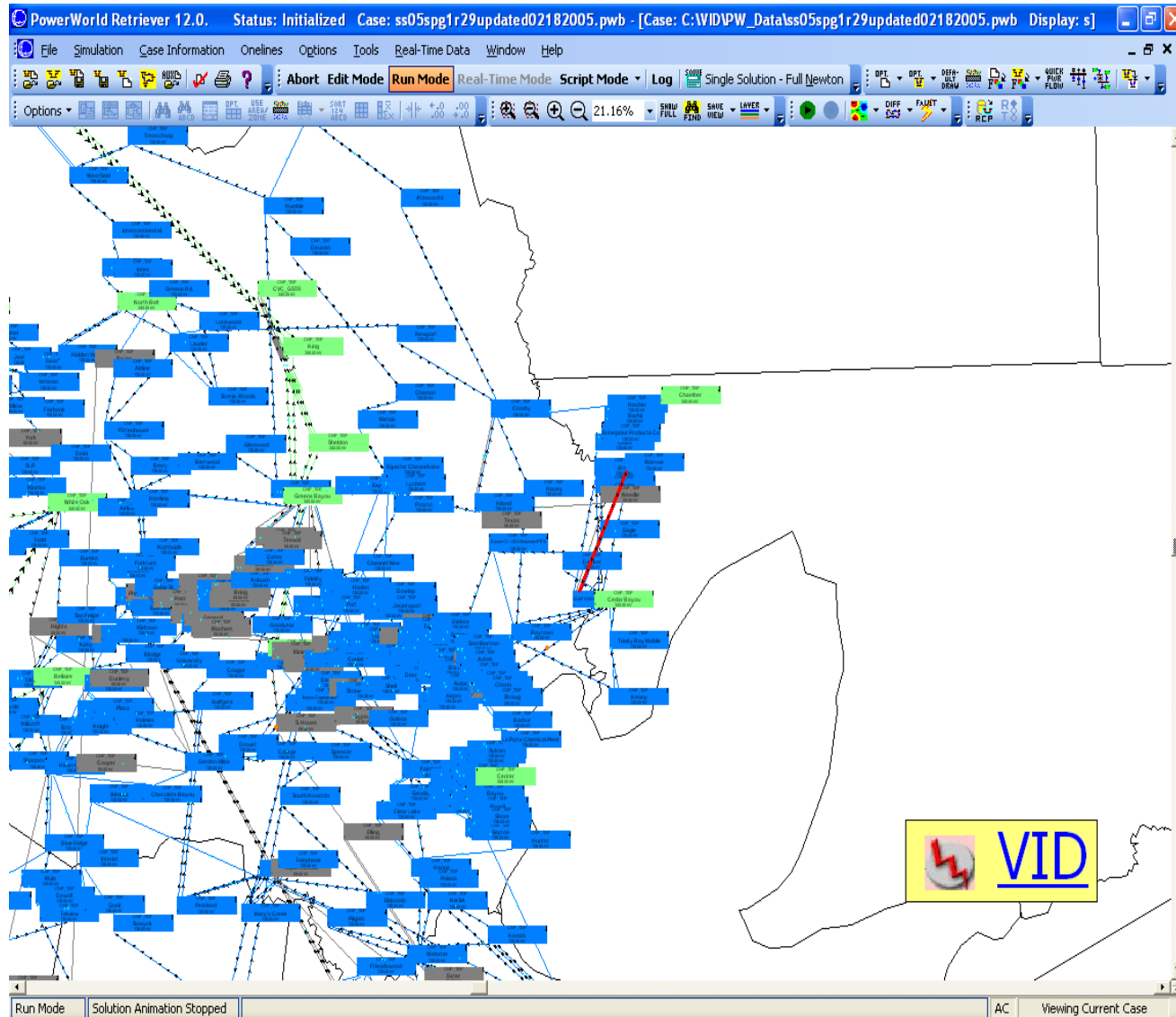


# Matching of data and models



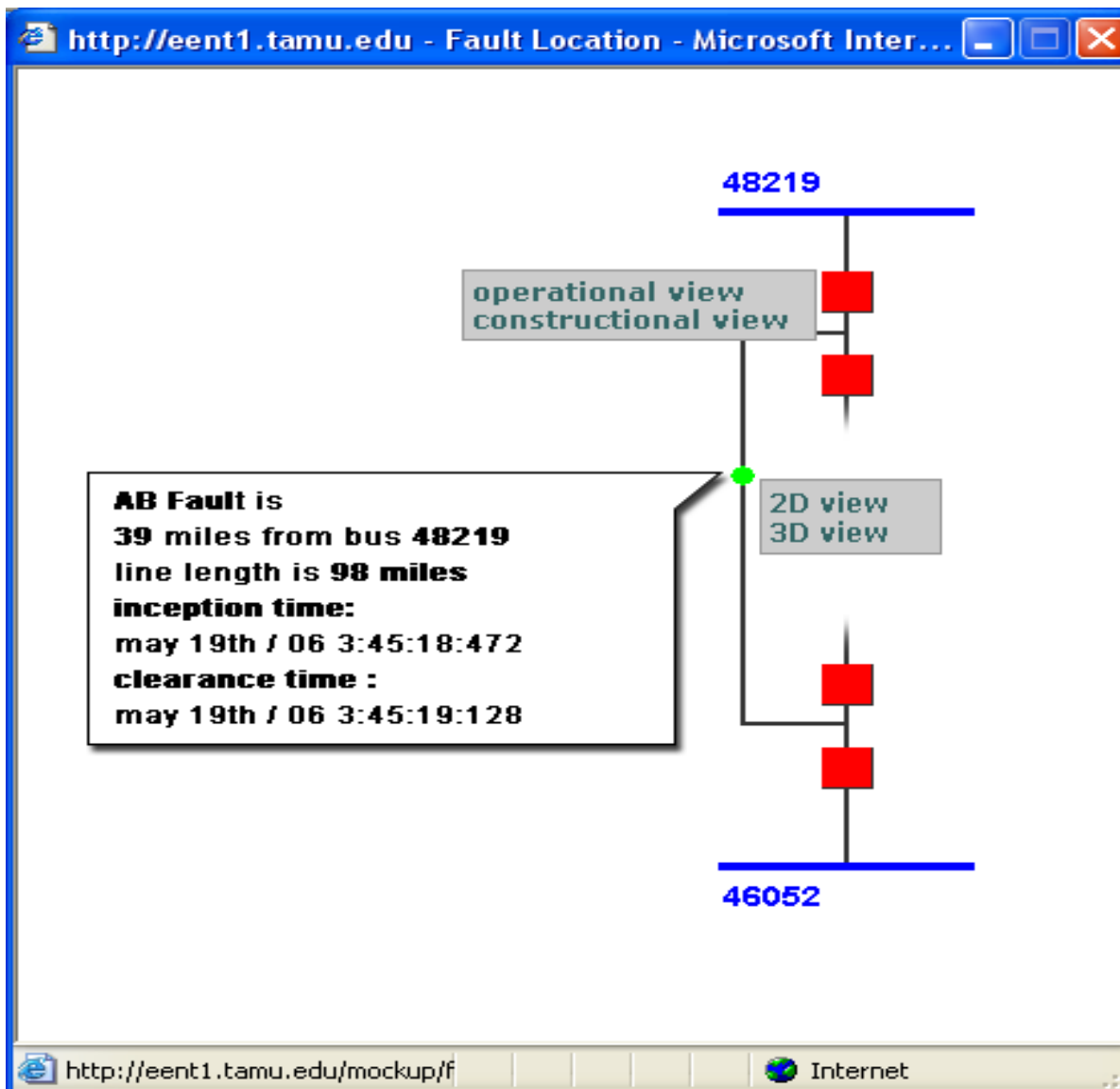


# Visualization





# Visualization





# Visualization

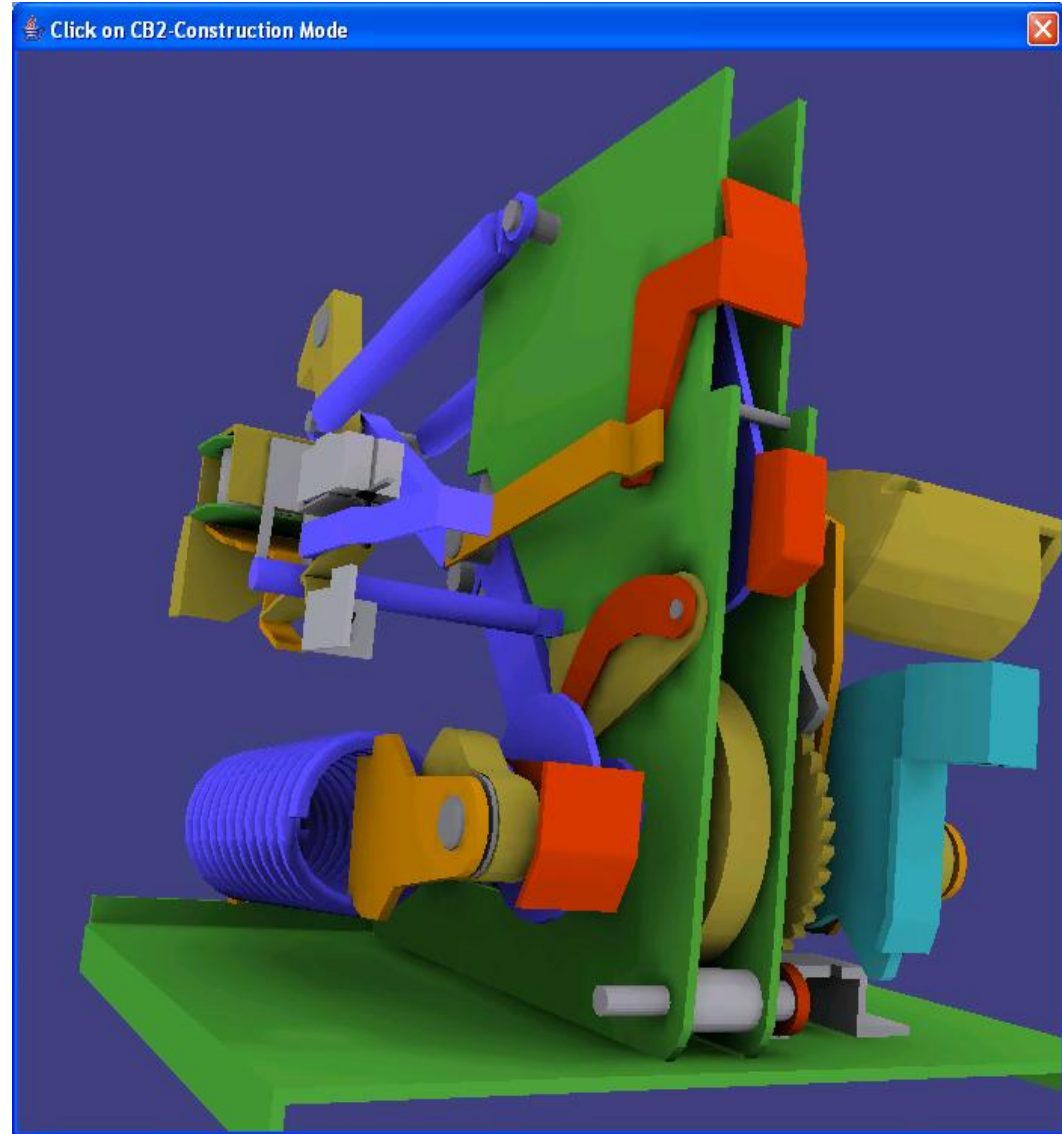
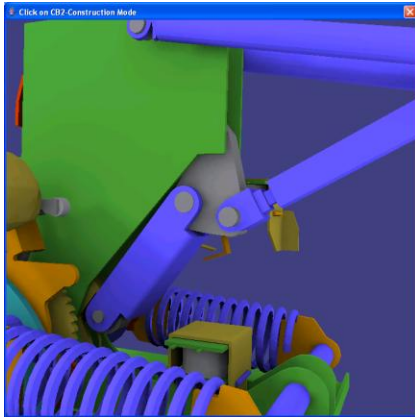


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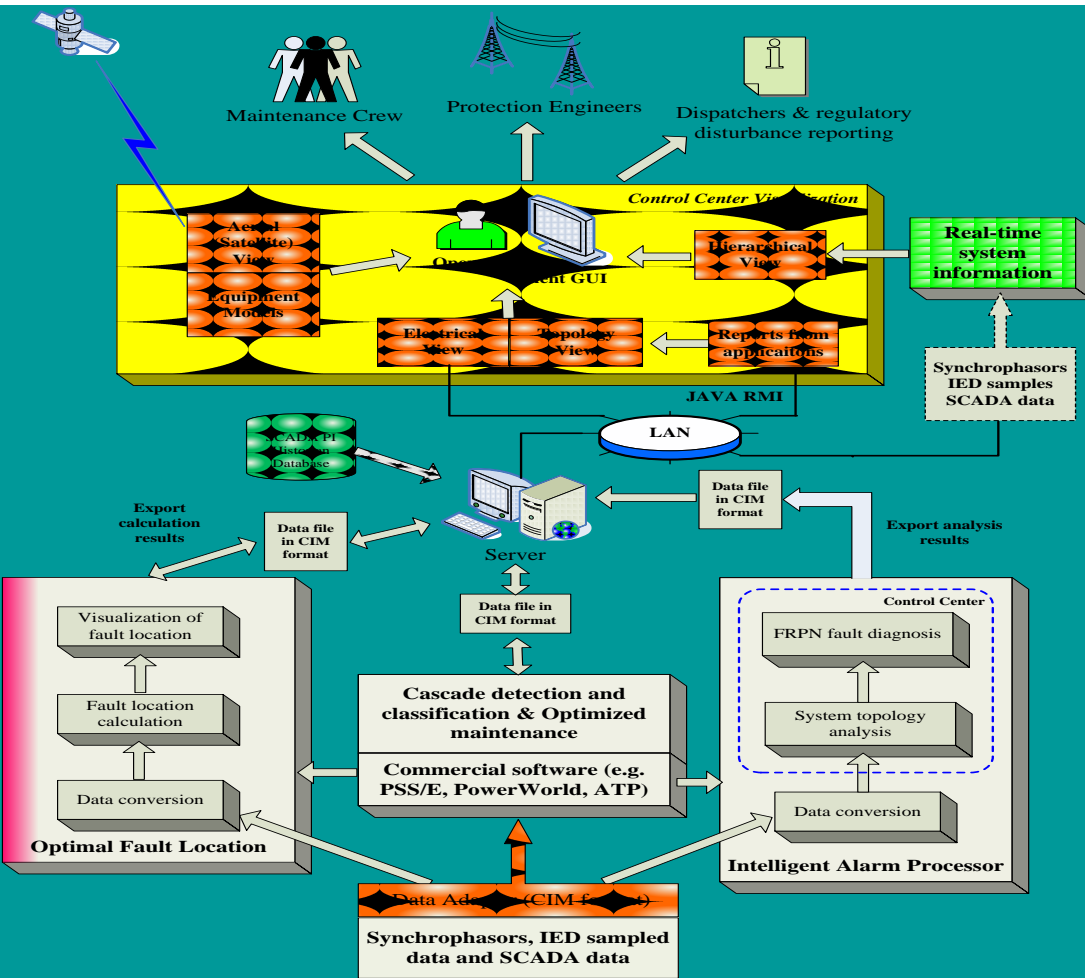


# Visualization





# New Applications



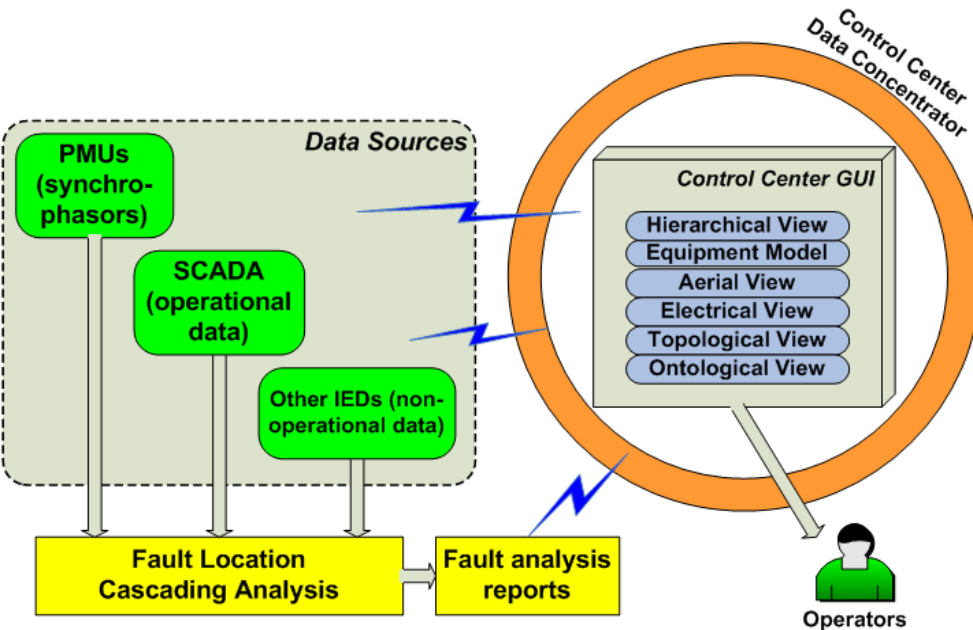
Distributed processing  
Centralized coordination

**Data:**  
High resolution at source  
**Information:**  
High context at destination

# ARCHITECTURE



# New Applications



Enhanced view of the system:  
data integration

Improved handling of  
emergencies:  
Economic Alarm Processor

# OPERATIONS



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# Questions?