

Information and Control of Dispersed Generation

The Next Generation EMS Design

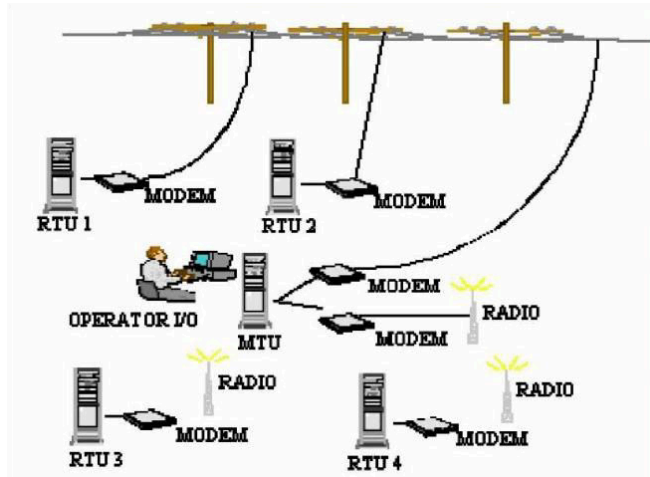
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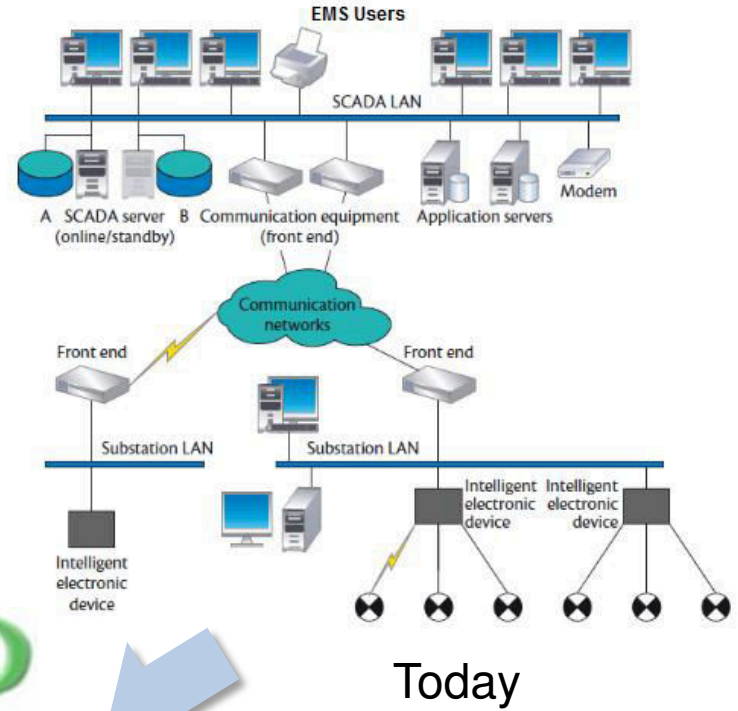
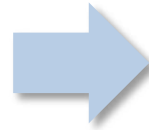


- Introduction
- The Impact of Field Data
- Matching Data and Models
- Implementation stages
- Conclusions





Yesterday



Today



Tomorrow



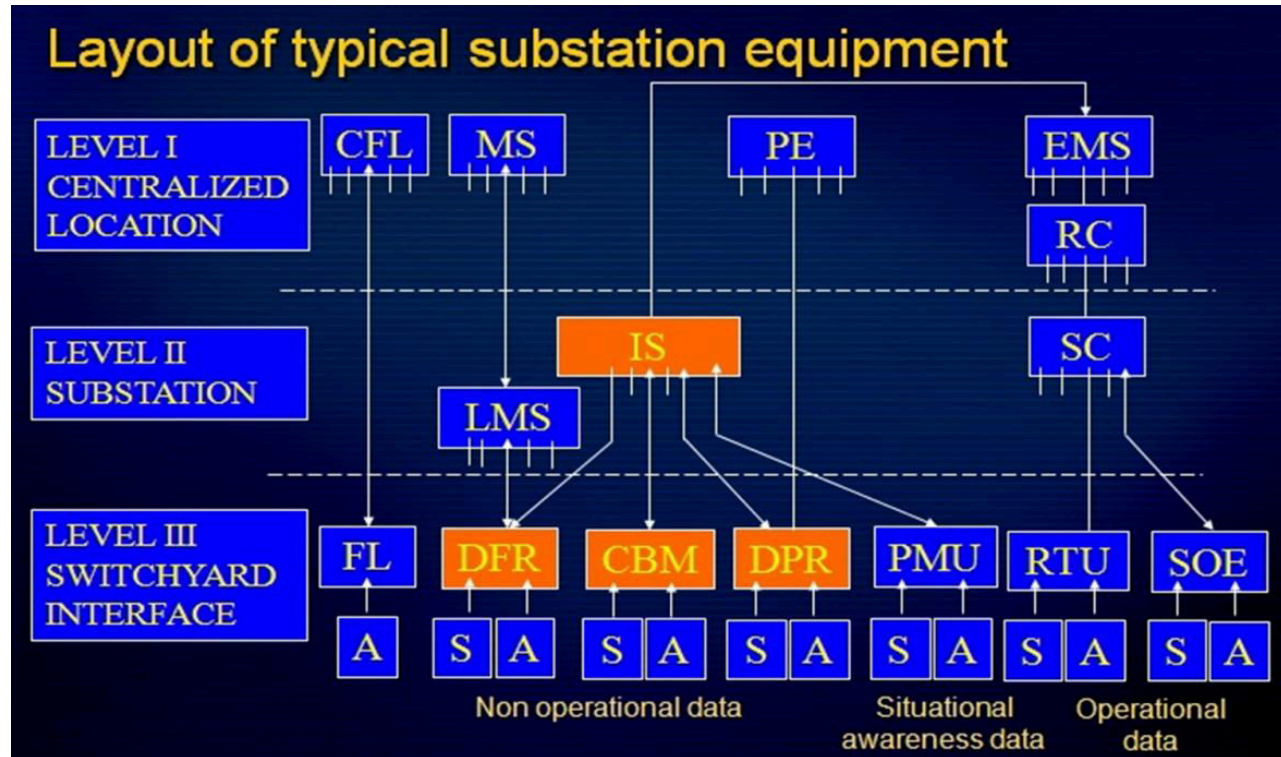
- Categories of field data

Source	Type of Data	Operating Mode	Reporting Frequency	Synchronization between devices
RTUs	Status RMS value	Report	Every several seconds	No
PMUs	Phasor	Report	Up to 60 times per second	Yes
ERDs	RMS /DFT /samples	Upon-request	Upon Request	No

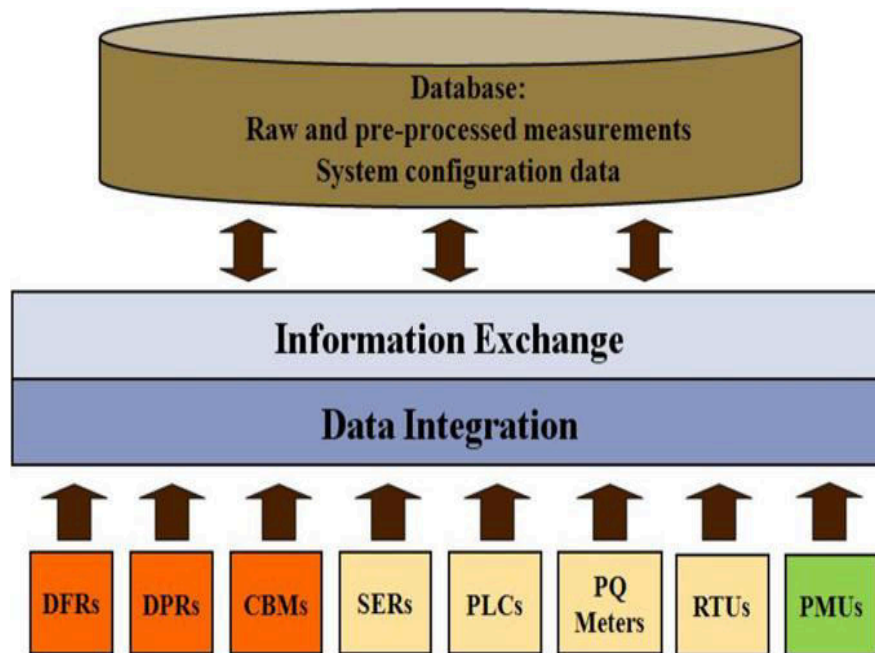
* RTUs: Remote Terminal Units

* PMUs: Phasor Measurement Units

* ERDs: Event Reporting Devices



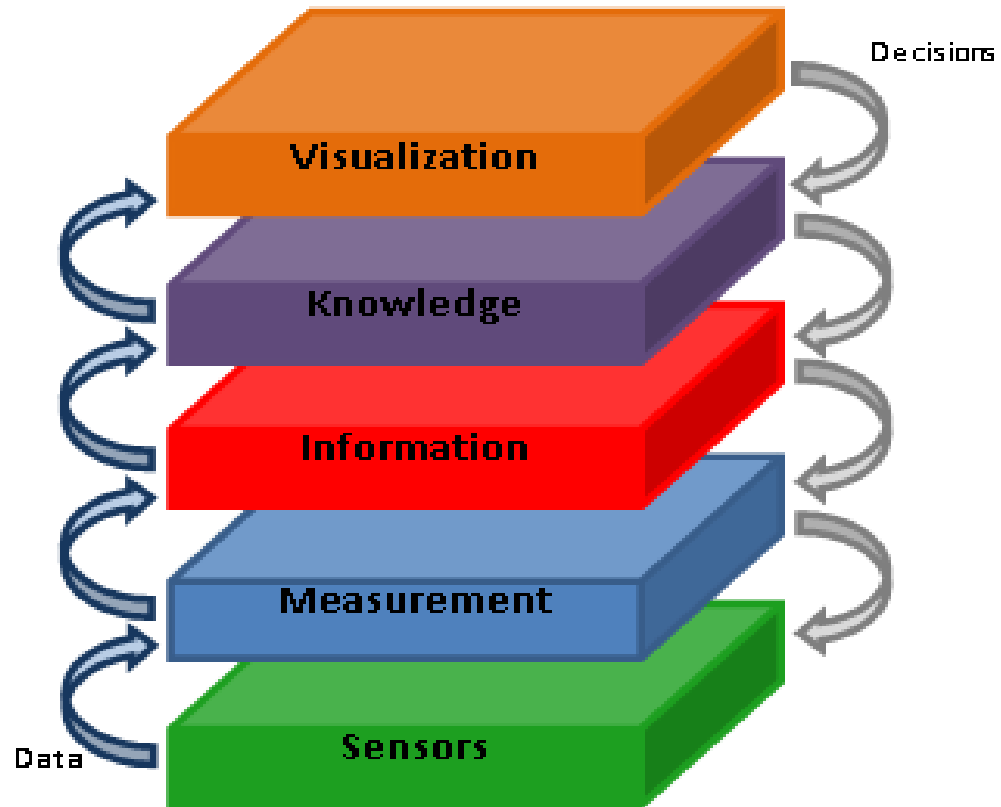
Layout of IED infrastructure for calculating fault location, recording, and tracking voltage and current phasors



Integration of IED Data through Software Solution

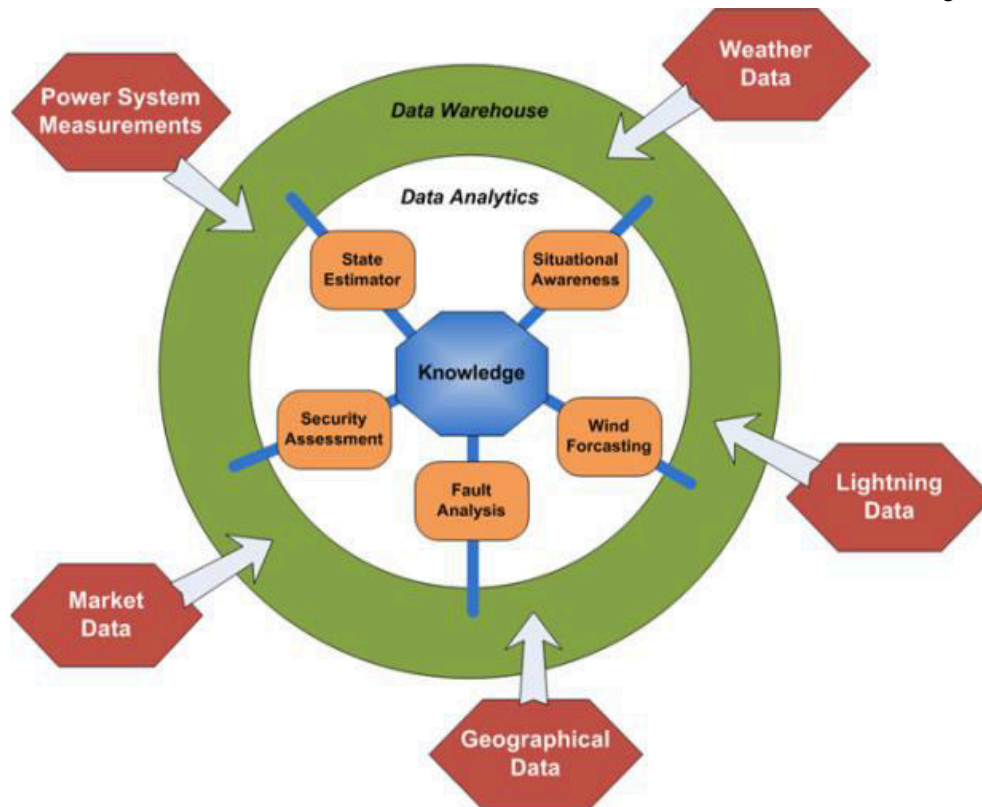
- **Application examples**

- Topology Processor and State Estimation
- Risk-based Circuit Breaker Monitoring
- Detection and Classification of Cascades



Data Analytics

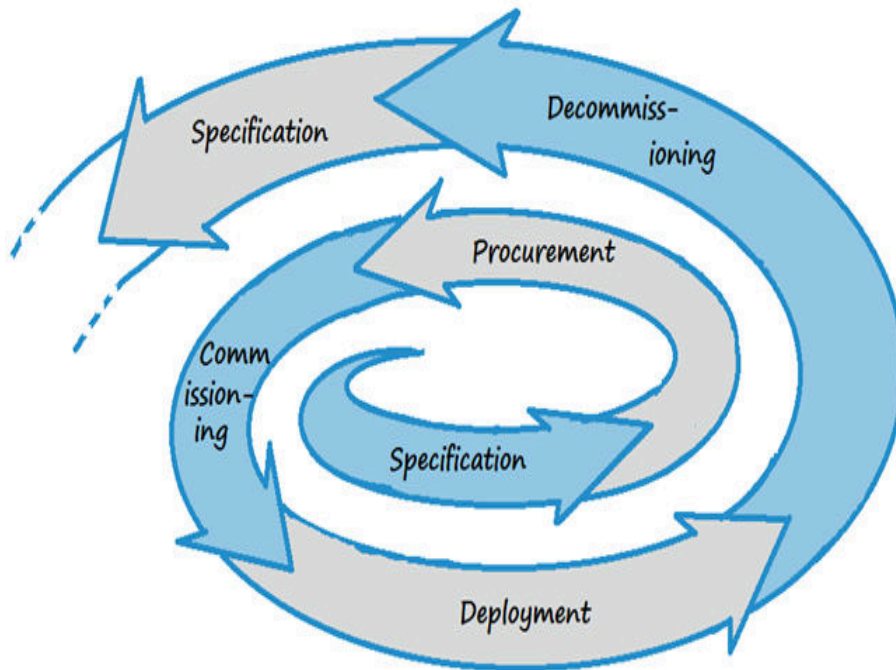




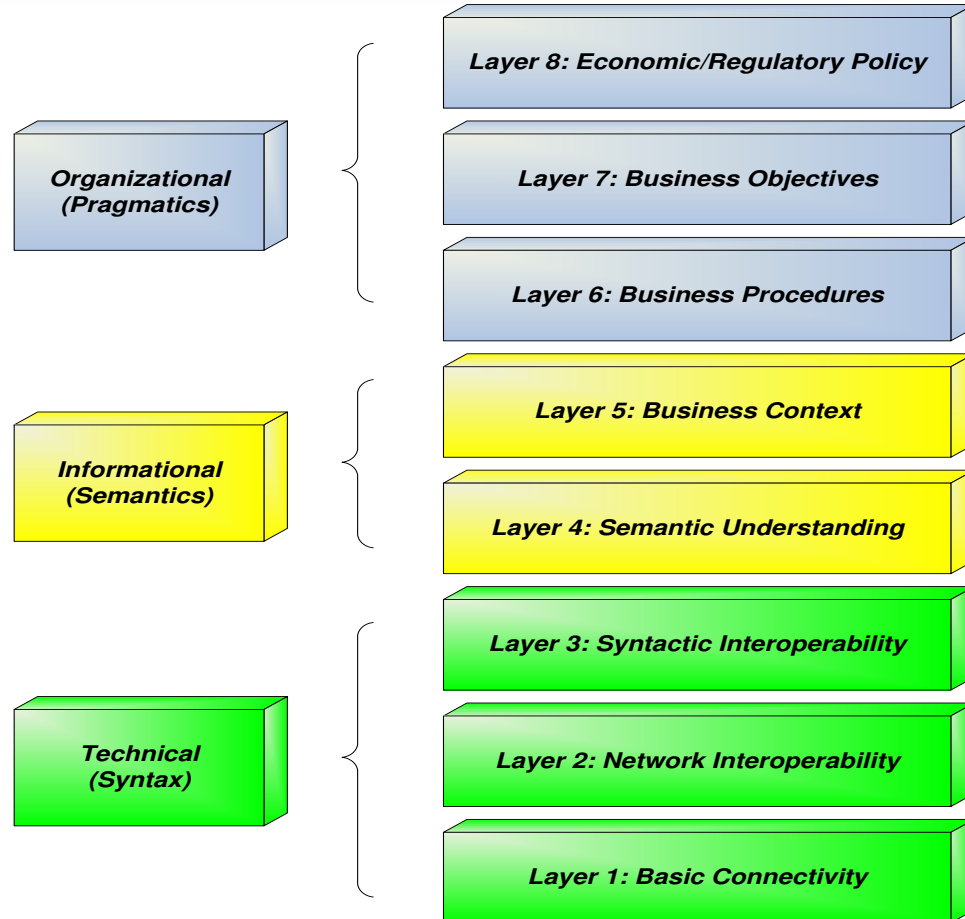
- **Use of knowledge**
 - Analysis of Fault Clearing Sequences
 - Fault Classification and Location
 - Intelligent Alarm Processor

Diverse data used for new data analytics





- **The “spiral” Deployment**
 - Have an interoperable design that conforms to the interoperability standards
 - allows major design upgrades to be done at any time
 - the system life-cycle never ends but gets prolonged as the updates are made



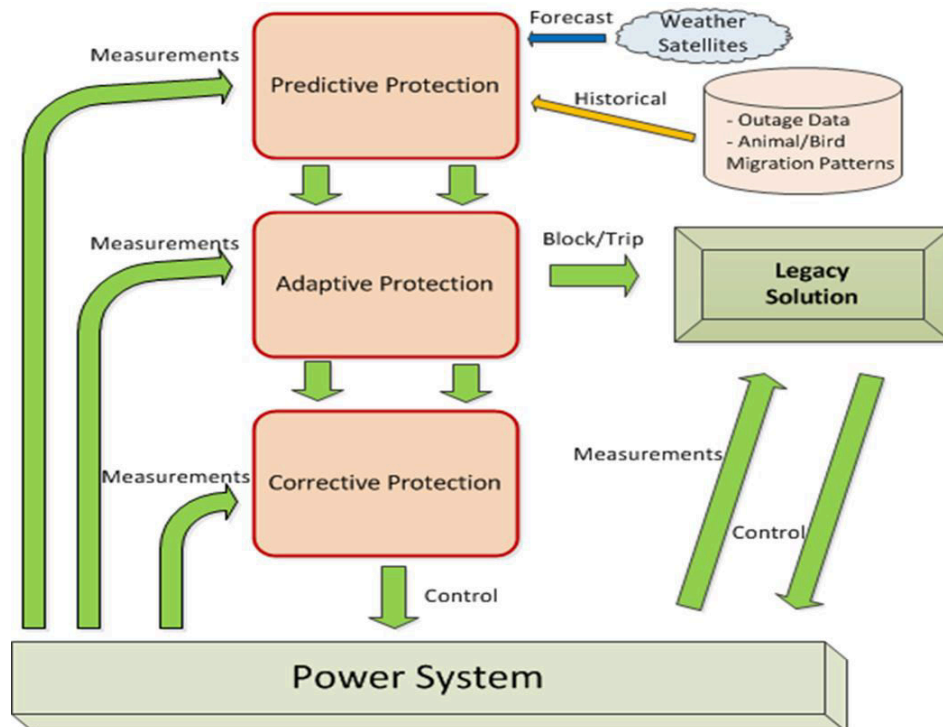
Interoperability Concern in Spiral Deployment: GWAC interoperability stack



- A need for new design with integration of field data, introduction of new data-analytics based decision-making tools, and flexible implementation architecture
- Integration of field data to improving the ability of operators to closely monitor power system operating states
- Extraction of knowledge based on matching between data and models
- Seamless transition from legacy solutions to new designs through use of interoperability standards



- *How should renewable energy controls be managed in the new EMS proposed*
 - Improvement of existing functions
 - Existing EMS infrastructure should be enhanced with synchrophasor measurements available from wind farms
 - Existing State Estimator functionality should be enhanced to cover variability in wind resources for better assessment of system state
 - Addition of new functions
 - New functionalities in adaptive hierarchical protection should be added to better control wind generator connection
 - New wind estimation techniques based on variety of different measurements should be deployed for better operational planning



- **The Hierarchically Coordinated Protection**
 - Assures ride-through for faults in the system
 - Provides improved anti-islanding protection
 - Detects faults on generators despite low fault current contributions