# The anatomy of a centralized remedial action system: What can be done in 50 milliseconds?

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# A Large Western Utility:

- Service Area
  - 50,000 Square Miles
  - 5.3 Million Electric Meters
- Assets
  - 4,990 transmission and distribution circuits
  - 12,000 circuit miles of transmission lines
  - 111,500 circuit miles of distribution lines
  - 5,000 MW of generating capacity in nuclear, hydroelectric, and fossil-fuel power plants
  - 80 Transmission Substations
  - 850 Distribution Substations

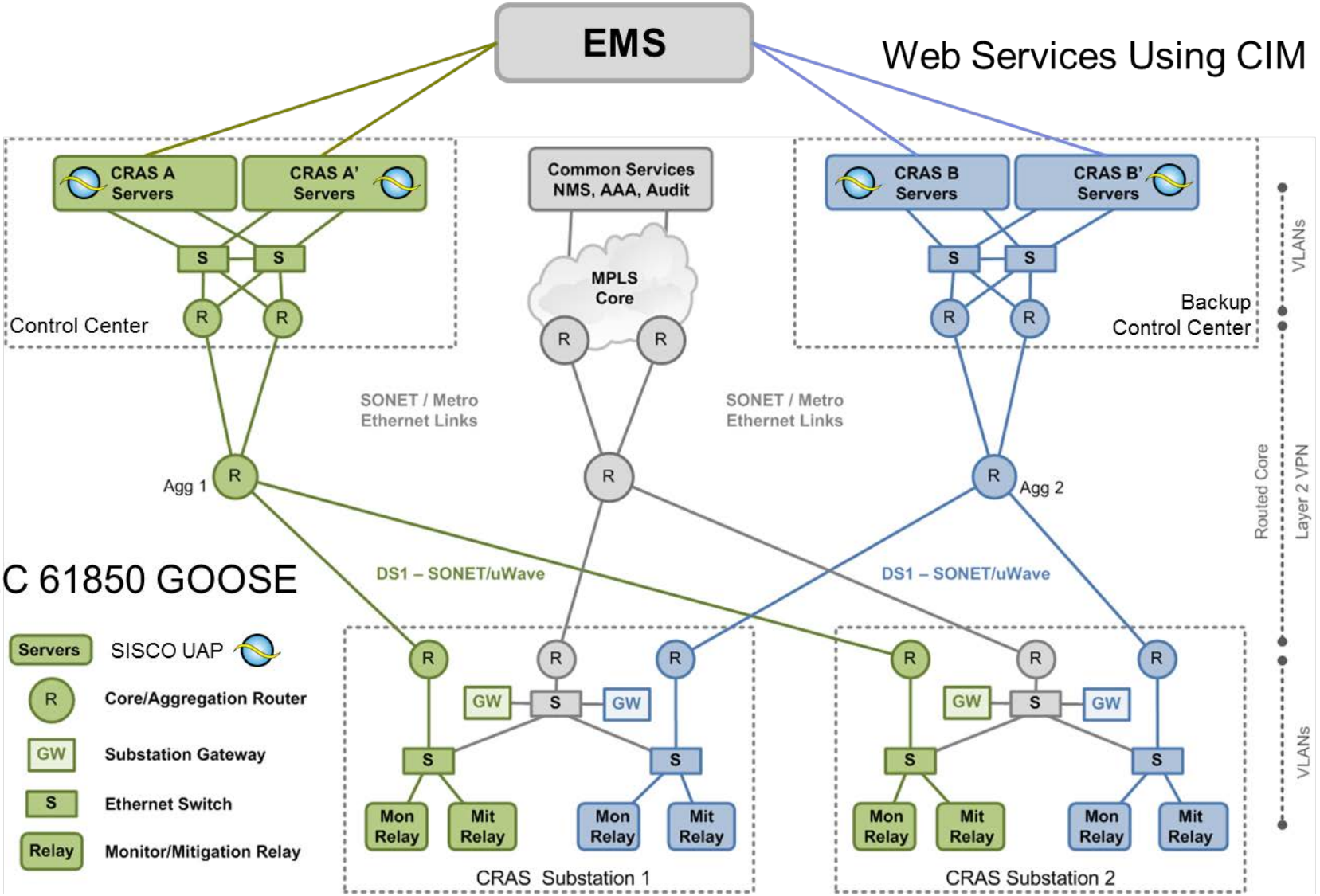
# Key Transmission Planning/Operational Issues

- Congested transmission corridors/ network
  - Ever increasing customer load growth
- Long lead time to build transmission
  - Transmission lagging generation and customer load growth
- Integration of new generators including renewables into the transmission network
  - Uncertainty on new generation siting/locations
  - Legislative/regulatory renewable targets mandate
- Increasing transmission voltage support requirements
- Extensive use of “Remedial Action Schemes (RAS)”

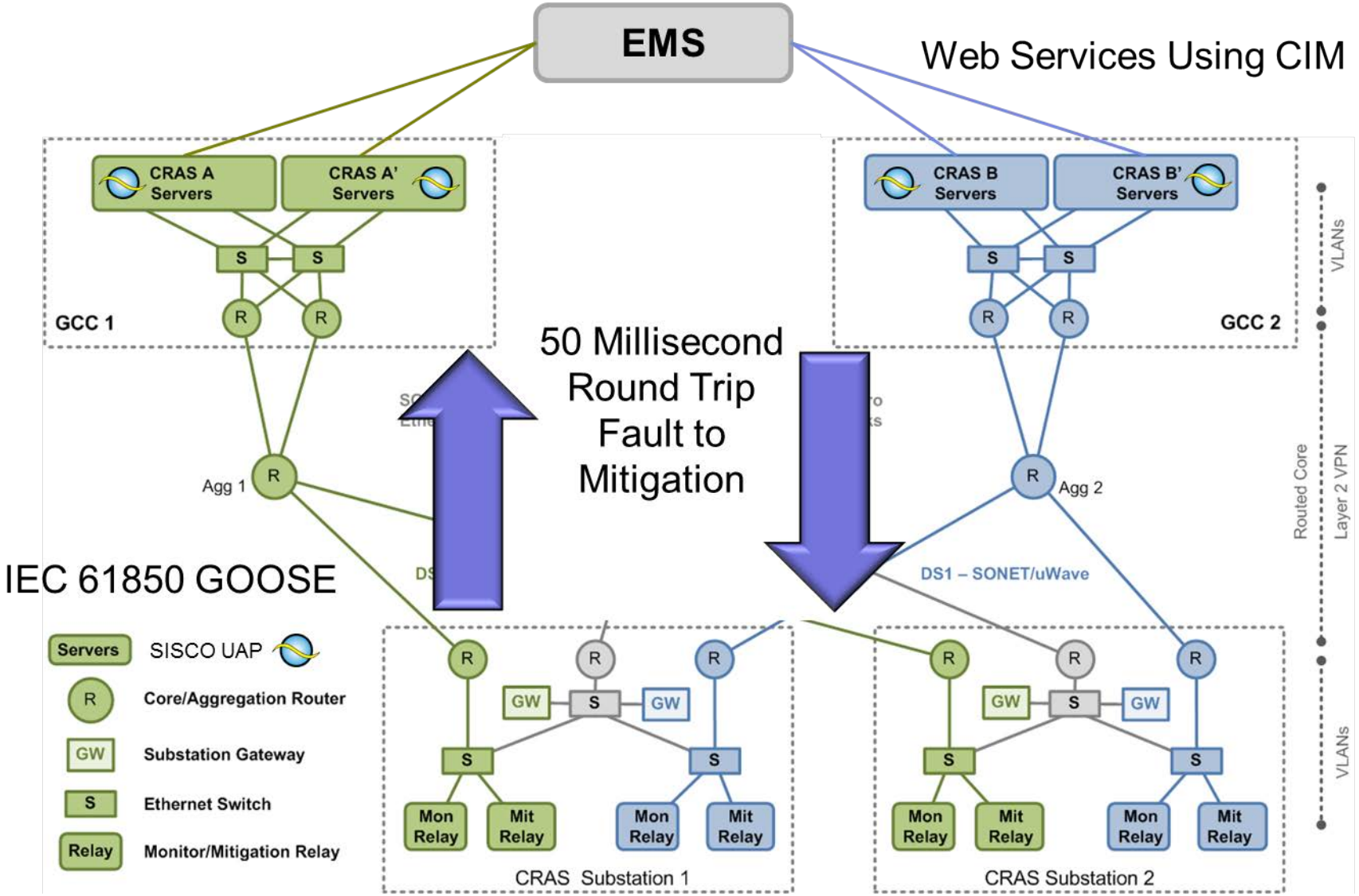
# Why RAS is Needed?

- Long lines separating load and generation need protection to prevent damage from generation tripping
- Increasing reserve margins to protect lines reduces available energy
- Maintaining system stability during anomalous conditions challenges operators to respond quickly to prevent cascade failure
- More transmission capacity in the same corridor is subject to the same contingencies and results in increasing reserve margins

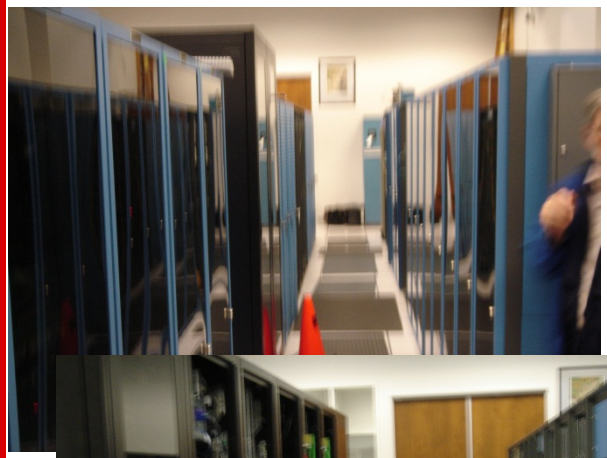
# C-RAS Architecture

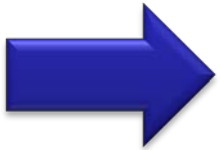


# C-RAS Architecture

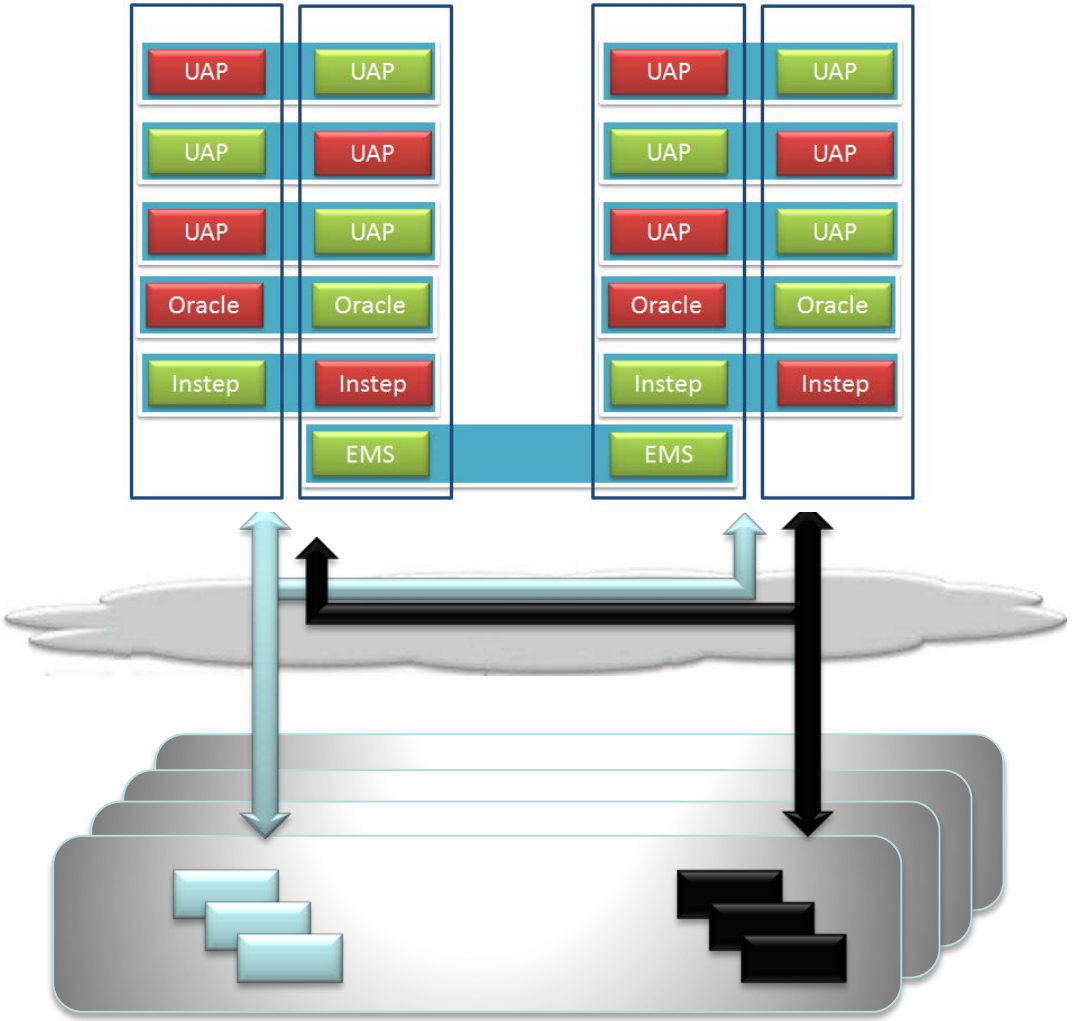


# Modern Technology Allows





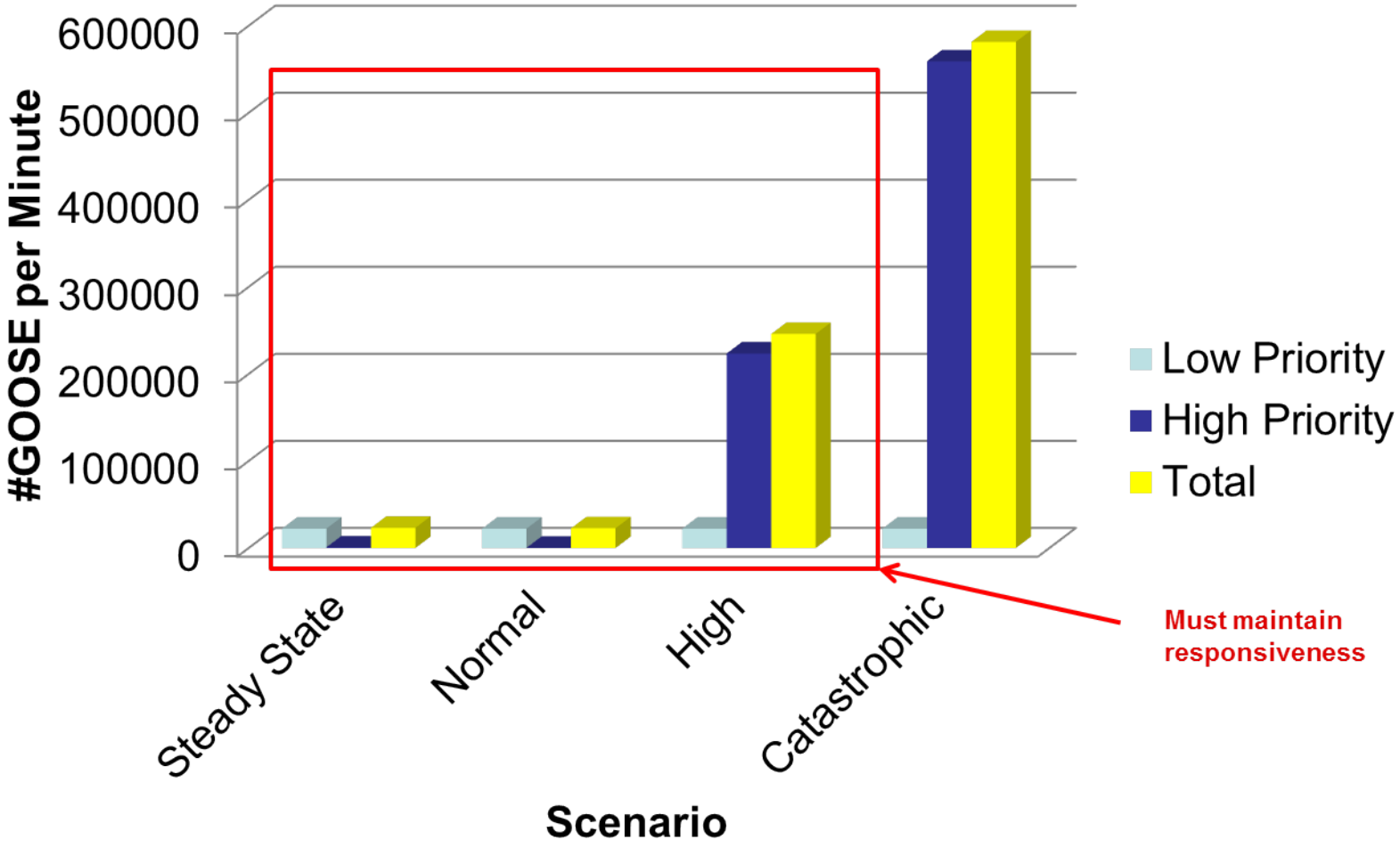
# A and B Control Centers



# System Sized/Tested

- 120 Substations
- 932 IEDs (466 on A and B each)
- 2 GOOSE Control Blocks per IED(high/low priority)
- 1864 GOOSE DataSets processed per UAP
- 43 different items/IED sent (80,152 per UAP)
- Each UAP processes both A and B system GOOSE messages
- Each UAP produces approximately 150K

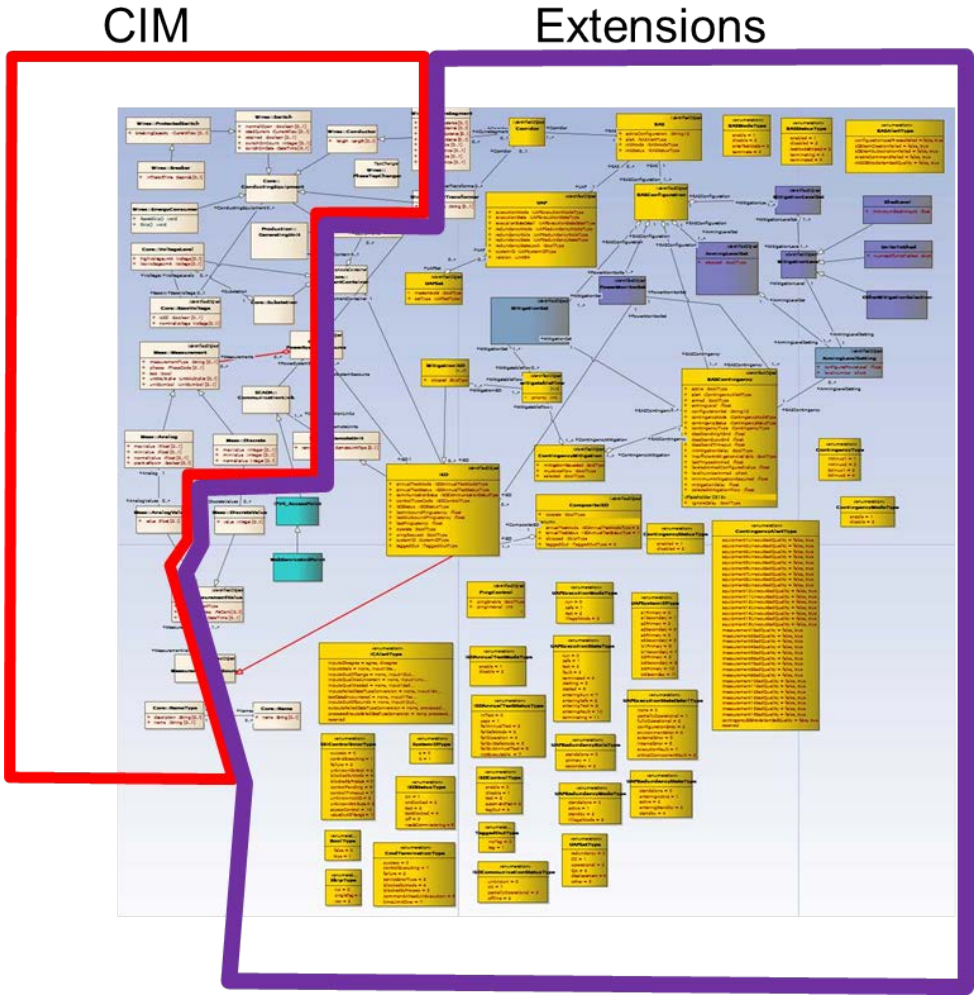
# GOOSE Processing Requirements



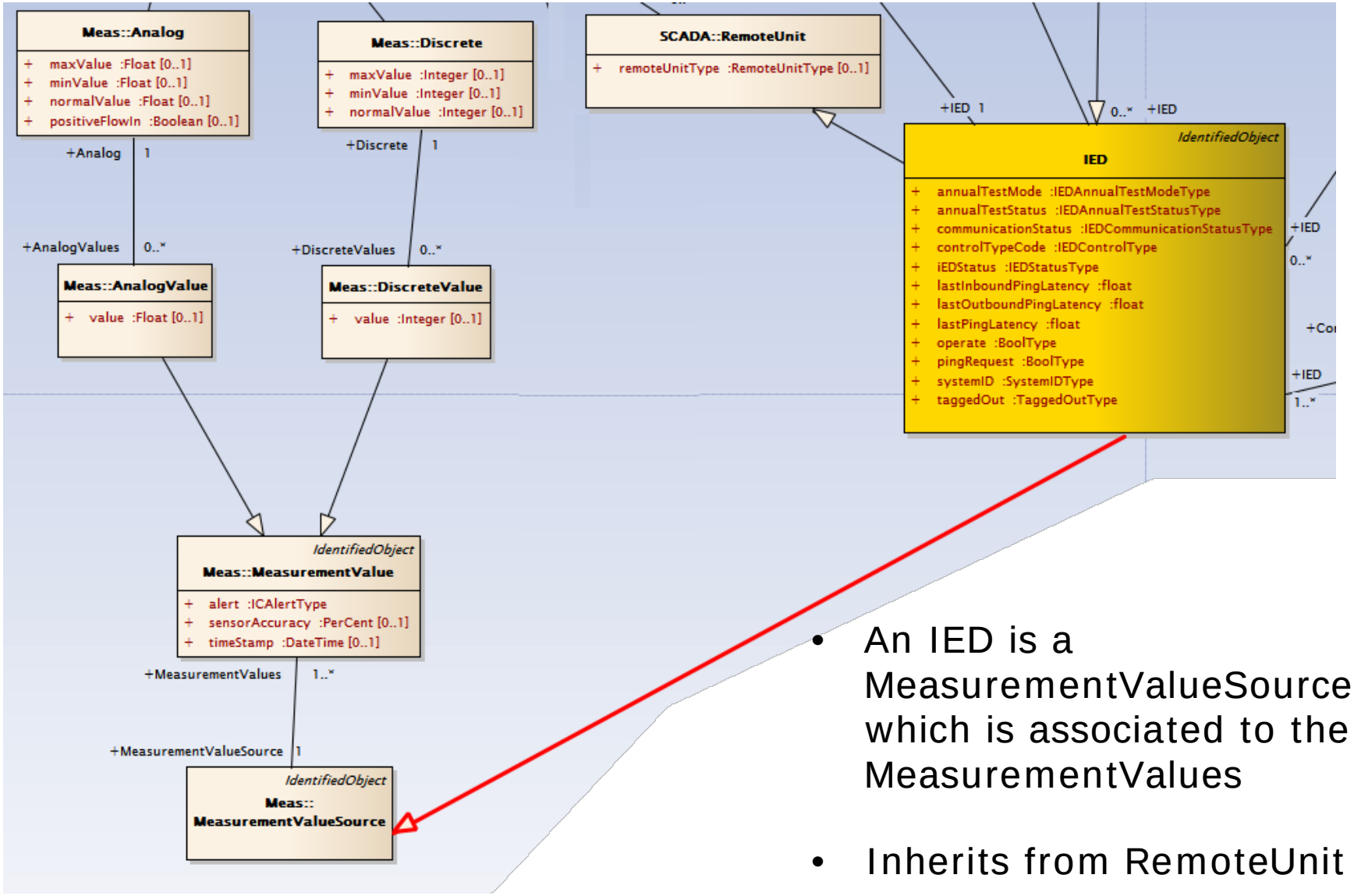
# EMS/61850 Harmonized Model

## Used to Configure EMS and UAP(s)

- IEC 61970-452 profile used for power system modeling
- Extensions for modeling of:
  - Contingencies
  - Mitigations
  - RAS Analytics
  - IEDs

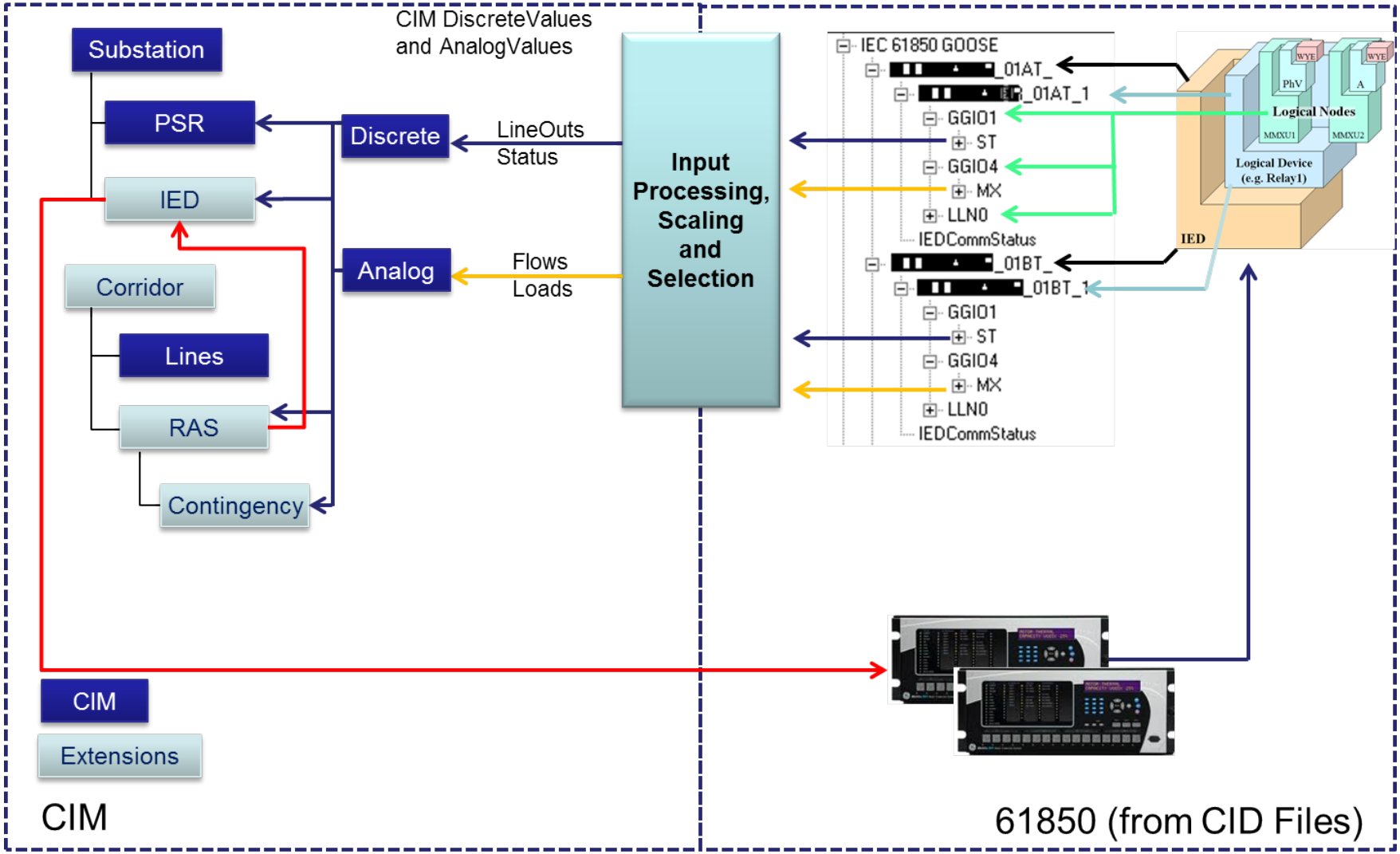


# CIM and 61850 Harmonization




- An IED is a MeasurementValueSource which is associated to the MeasurementValues
- Inherits from RemoteUnit

# General Information Flow



# EMS Processing

- 150K-200K per UAP pair (6 pairs)
- Not quite Big Data, but large volume of data
- Presents visualization challenges for operators
- Too much data to manually configure/layout displays (configuration and displays are automatic based upon harmonized CIM instance file)

# Thank You

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