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C-RAS Architecture and UAP Product Overview

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Why C-RAS?

- 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.
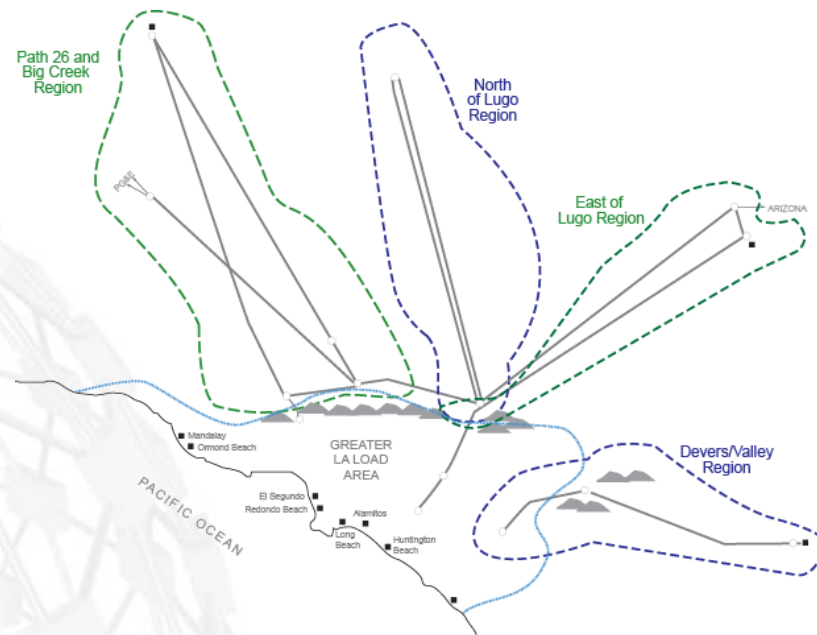
Individual Remedial Action Schemes and Special Protection Systems (RAS/SPS)

- Protects lines from damage during anomalous conditions.

- Individual RAS are available using traditional approaches involving hardwired devices within local areas.
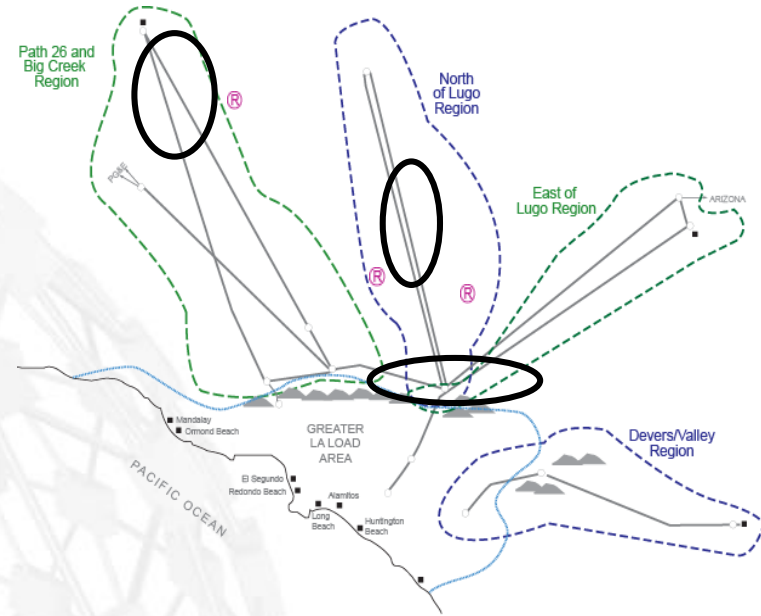
Multiple Individual RAS

- Deploying multiple individual RAS practical because little interaction between RAS.

- Difficult to maintain and update as number of RAS increases.
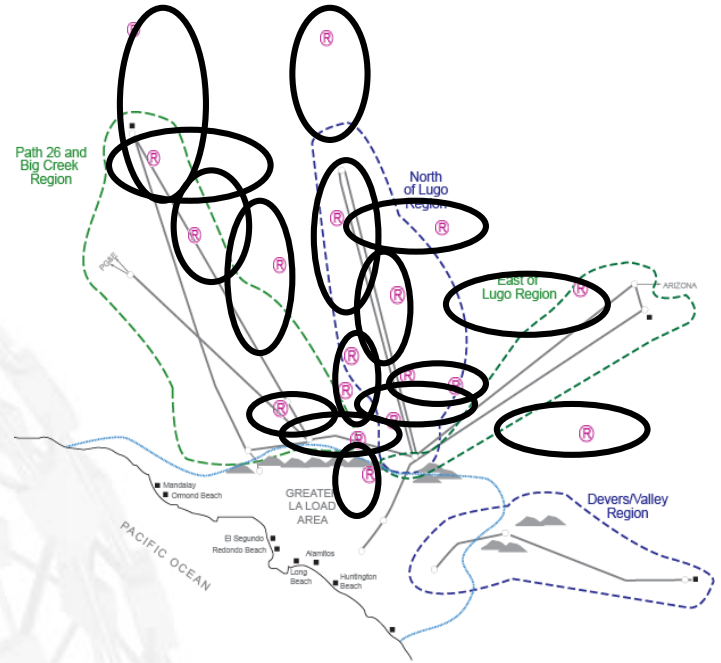
Integration of Multiple Individual RAS into a Distributed RAS

- Addressing system stability requires integration of multiple RAS over a wide area.

- Information sharing and interactions between individual RAS using traditional techniques increases complexity and cost beyond what is practical.

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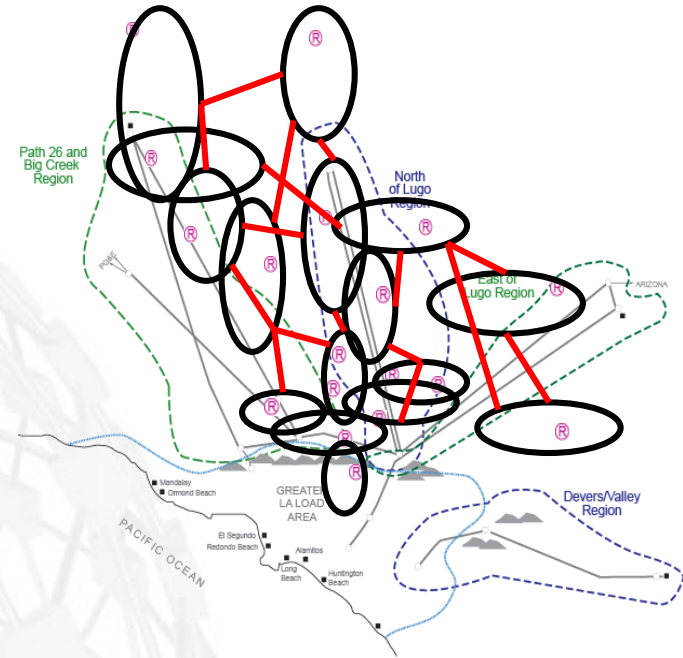
Centralized Remedial Action Systems (C-RAS)

- Centralized control reduces complexity of information sharing making implementation feasible.

- Centralization of control requires a network architecture to support very reliable high speed communications of events and controls

Distributed
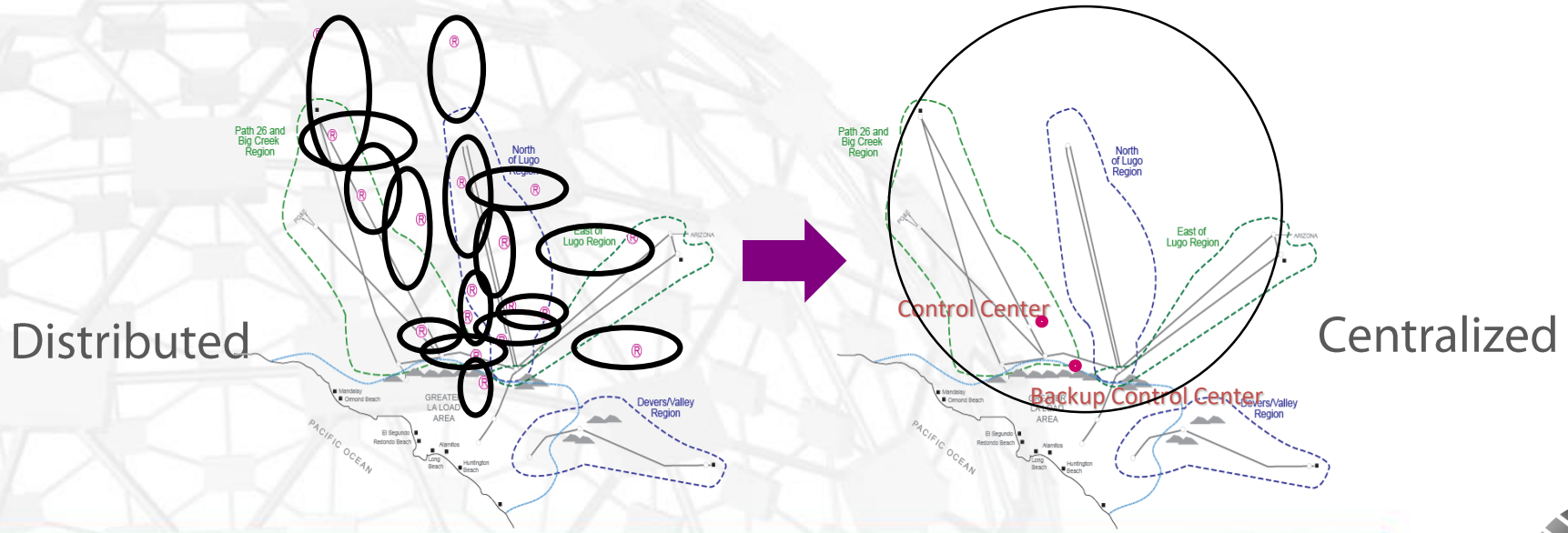
Centralized

Unified Analytic Platform (UAP)

The UAP was specifically designed to meet the requirements of implementing Special Protection Systems for wide area protection applications based on a Centralized Remedial Action Systems (C-RAS) architecture

Redundancy & Resiliency

EMS & Historian Integration

Testability

UNIFIED ANALYTIC PLATFORM

Real-Time Data Stream Analytics

Hi-Speed Control Analytics

Field Device Integration & Input Conditioning

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C-RAS Controller Requirements

- High Performance and Low Latency:
  - Analytic and control processing
  - Communications in and out
  - External system interfaces
- Traceability for all communications and control actions
- Controllability
  - Enabling/disabling analytics based on contingencies determined by EMS
  - Modifying control actions based on system conditions (e.g. load shed levels)
- GOOSE Input conditioning
  - Eliminating bad data from analytic processing

- Testability
  - Simulation of data and monitoring of test actions
  - Playback of previously encountered scenarios
- Repeatability
  - Control actions must be consistent and predictable under minor variations
- Redundancy and Resiliency for all components
  - Dual Redundant controllers
  - Trip Redundant control centers
  - Simple voting mechanism in mitigation substations

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UAP Components

- GOOSE/R-GOOSE Interface and Input Conditioner
- EMS Interface
  - Commands (arm/disarm) and data from EMS
  - Sends C-RAS data for operator displays
- Historian Interface
- Scenario Player
  - Plays back previously recorded data
- GOOSE Blaster
  - Enables complex GOOSE sequences to be simulated
- Monitor
  - Monitors data exchange between components
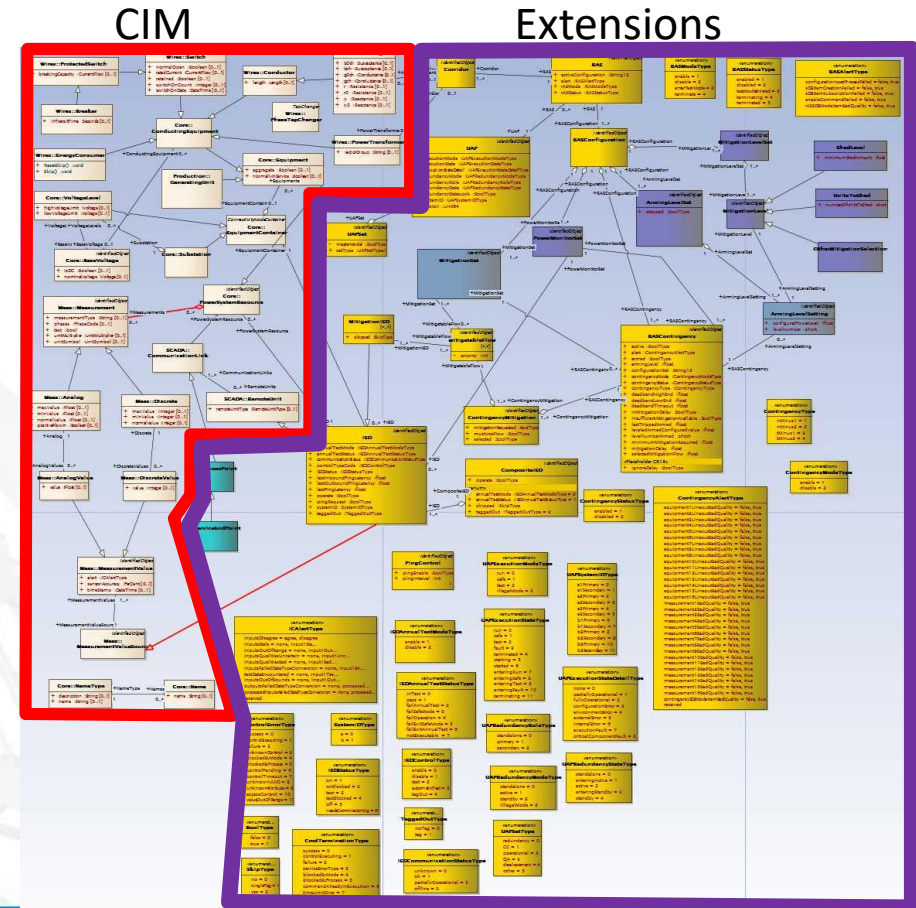- Analytics
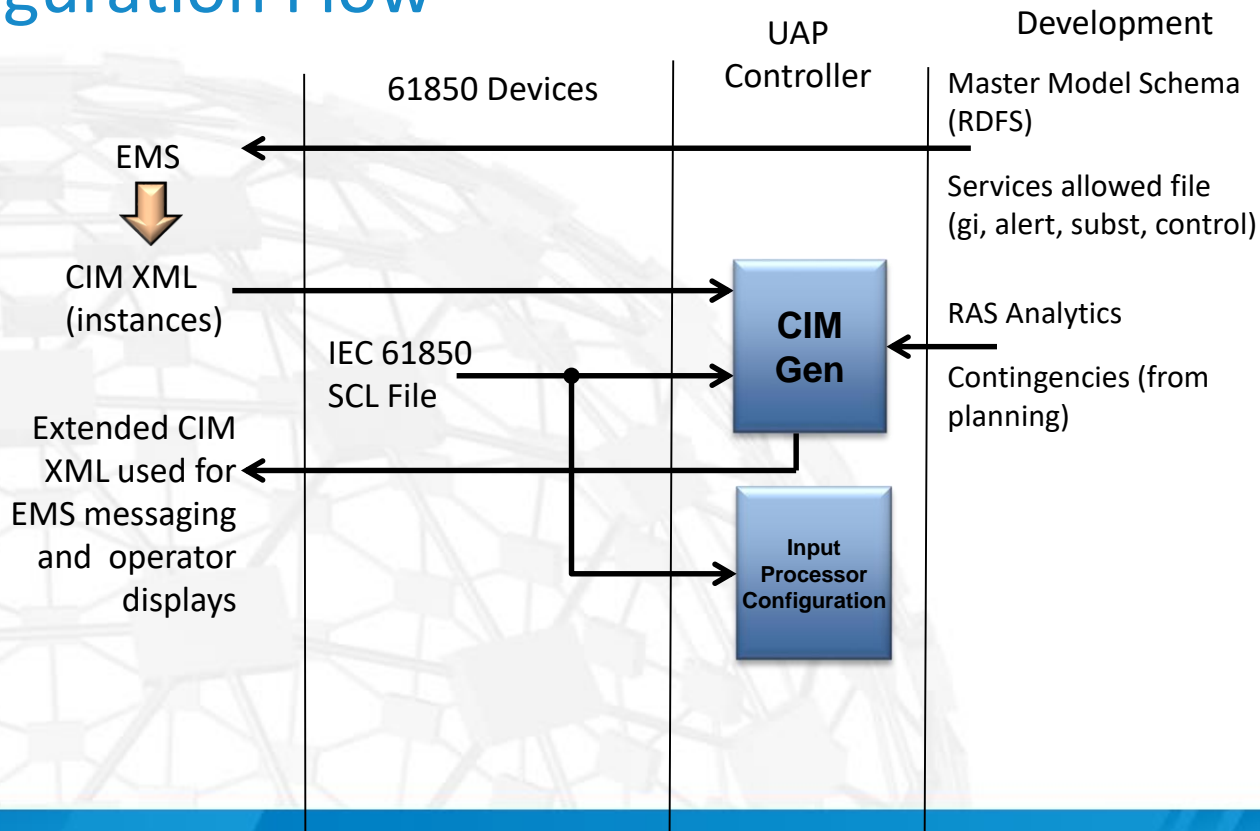

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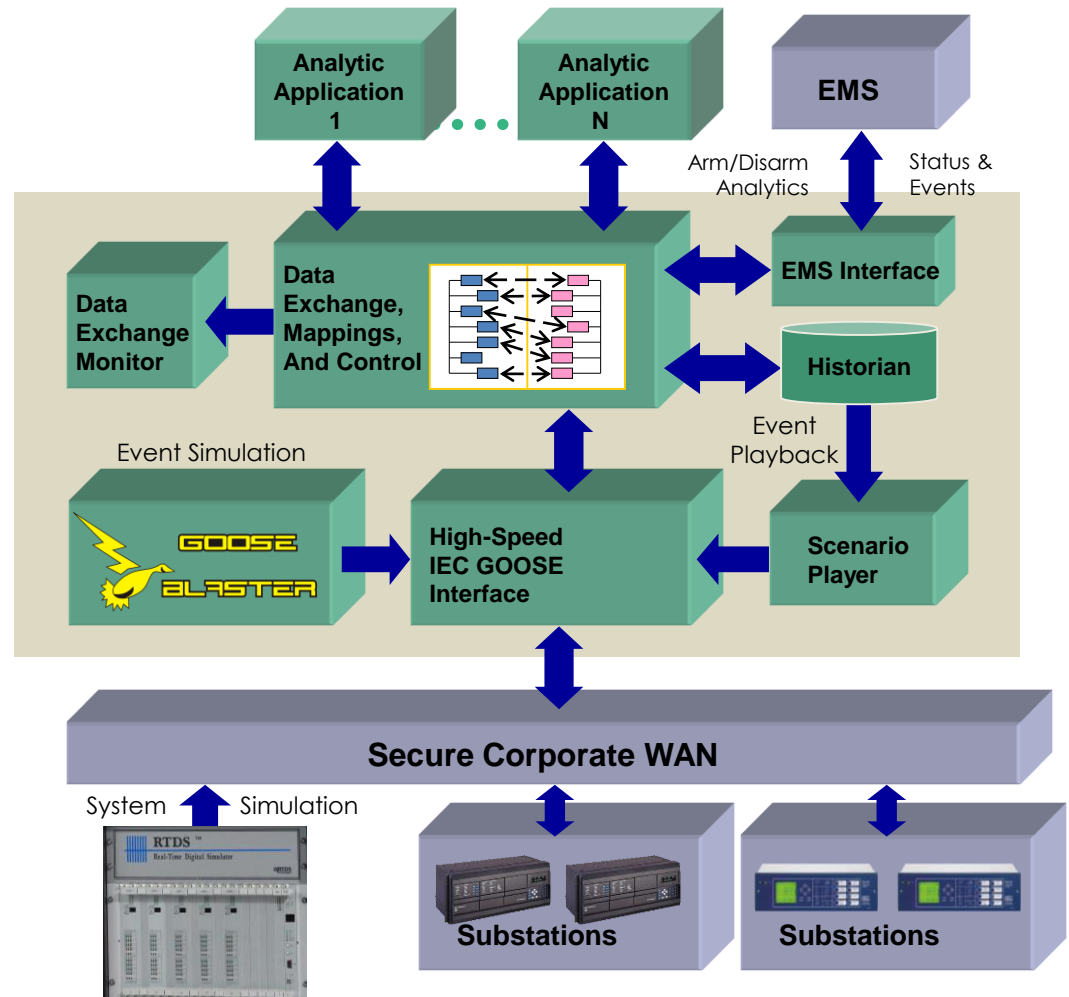
UAP Data Modeling

- Management of system configuration and interaction between systems requires a common data model for data exchange
  - Without common data model each system's understanding of the power system relationships of data could be different.
  - Performing critical control operations on the power system requires absolute certainty of the operations…ambiguity is not allowed

- CIM is used for high-level power system models
  - Existing EMS mapping with CIM already established
  - CIM power system model (IEC 61970-301 and -452 (CPSM))

- IEC 61850 is used for IED modeling
  - Measurement and status naming
  - Configured IED Description (CID) files for GOOSE subscriptions

- Extensions to integrate these models into a "Master Model" used by the C-RAS central controllers

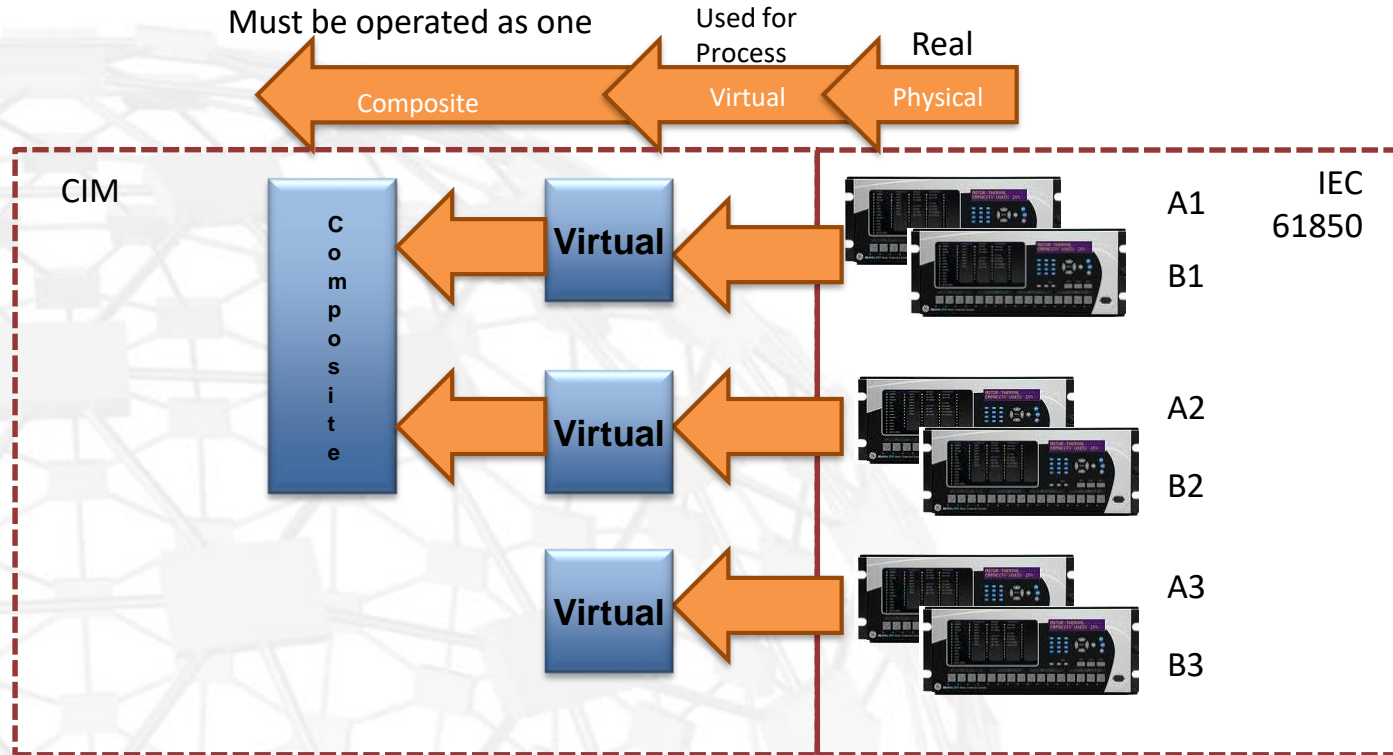SISCO
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UAP Use of CIM

- IEC 61970-452 profile used for power system modeling

- Extensions for modeling of:
  - Contingencies
  - Mitigations
  - RAS Analytics
  - IEDs

CIM   Extensions

Configuration Flow

UAP Controller

Development

61850 Devices

Master Model Schema (RDFS)

Services allowed file (gi, alert, subst, control)

EMS

CIM XML (instances)

IEC 61850 SCL File

CIM Gen

RAS Analytics

Contingencies (from planning)

Extended CIM XML used for EMS messaging and operator displays

Input Processor Configuration

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IED are Virtualized and Composited

RAS and Contingencies

Commands and data from EMS via Web Service Interface

Process data from Input Conditioner

Contingency1 – (n-1)

Contingency1 – (n-2)

Contingency2 – (n-1)

Contingency2 – (n-2)

Logic & Monitoring

Outputs

From Planning Systems

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Unified Analytic Platform (UAP)

- Off-the-shelf components delivered as part of a complete solution
- Built and maintained on-site using customer configuration mgmt.
- Some components are available separately as stand-alone products:
  - GOOSE Blaster
  - R-GOOSE Gateway

GOOSE Blaster

- Simulates GOOSE and R-GOOSE messaging

- Capable of supporting large scale simulations of many devices including
  - Critical state changes
  - Out of sequence and missing message scenarios
  - Good/bad quality/timestamps
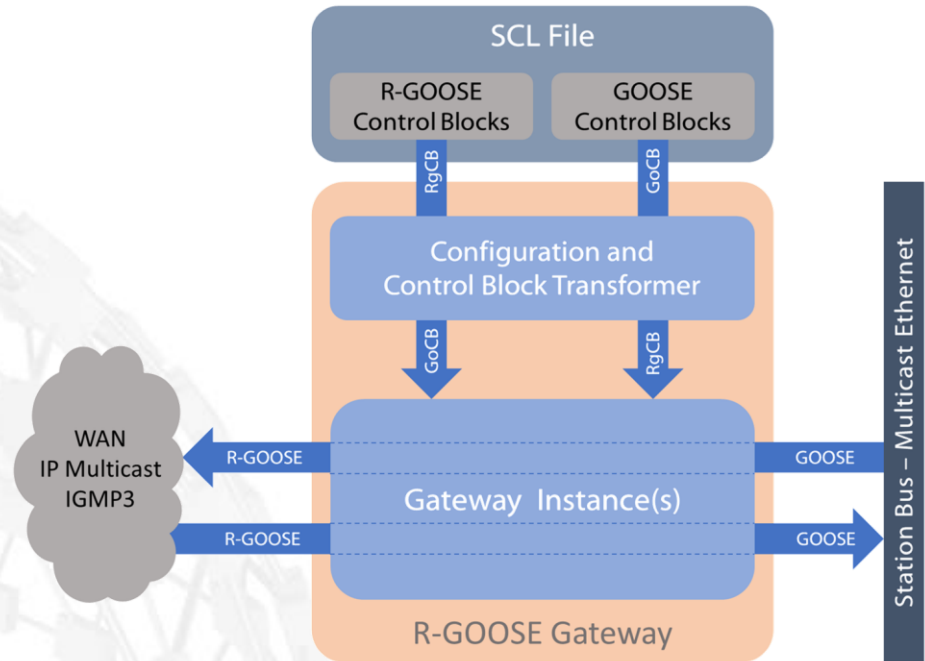 - Many realistic and anomalous conditions can be simulated
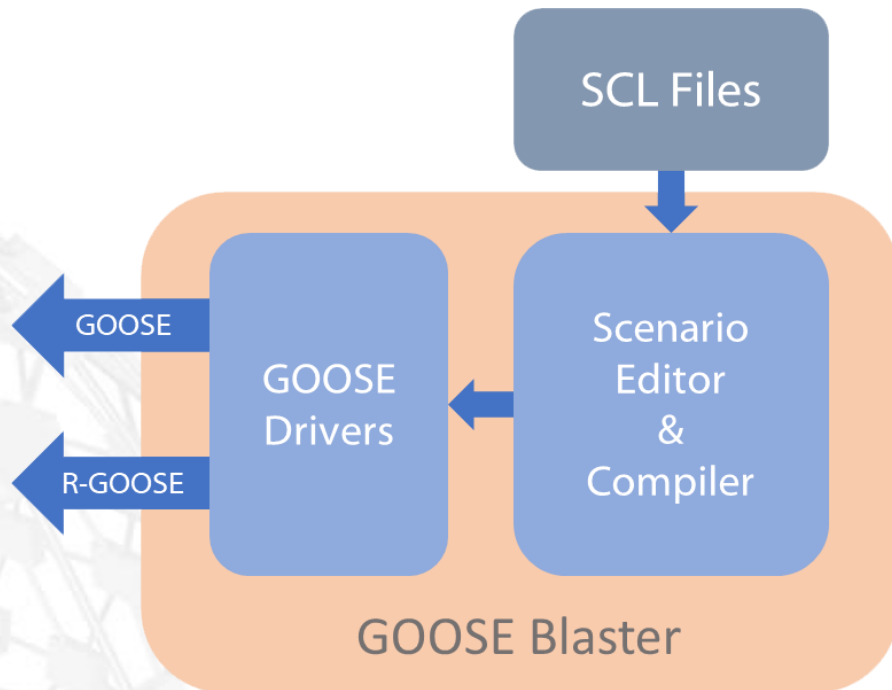
GOOSE Blaster Scenario Editor

R-GOOSE Gateway

- Translates Ethernet Multicast GOOSE messaging to/from IP Multicast GOOSE (R-GOOSE) with minimal latency

- Configures with SCL and autogenerates the necessary GoCB and RgCBs needed on either end of the gateway

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Thank You

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