



Transforming the world of energy using open standards

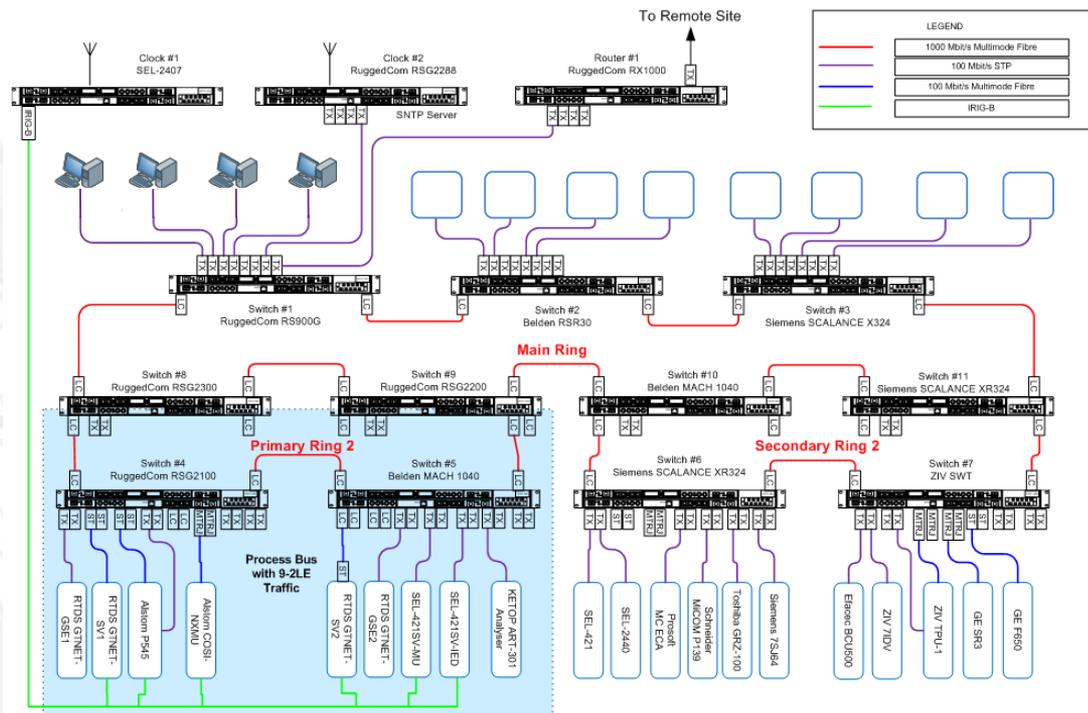
Challenges and Solutions for GOOSE Traffic Monitoring

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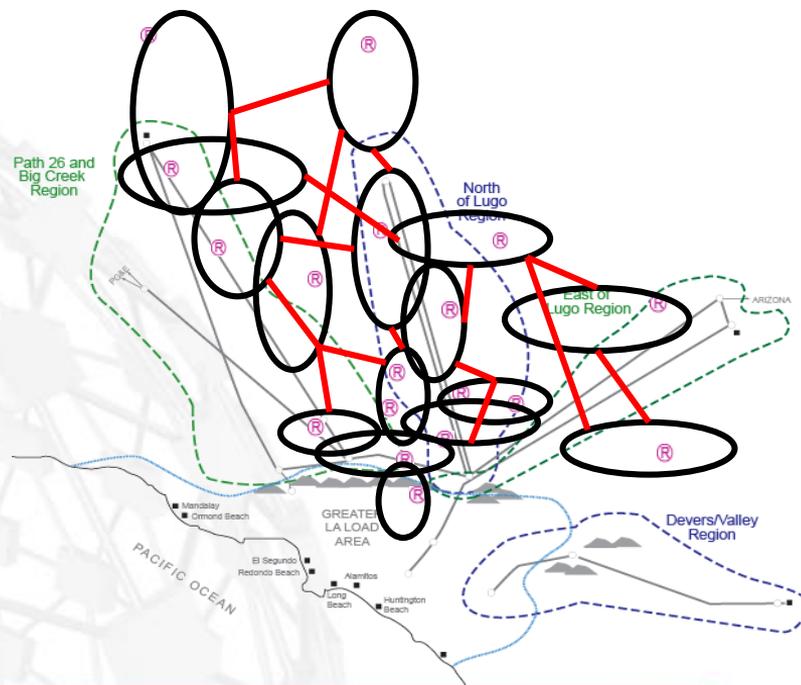
GOOSE on Station Bus

- IEC 61850 GOOSE Messaging uses multicast technology for station level time-critical protection and automation messaging
- Each device is typically publishing multiple GOOSE control blocks and subscribing to multiple GOOSE control blocks from other devices in the substation
- Large substations can have many hundreds of publish-subscribe relationships between devices



New Applications of GOOSE: Wide Area Protection with Routable GOOSE (R-GOOSE)

- R-GOOSE uses IP Multicast services letting the routers determine the paths
- Publish/subscribe relationship are harder to determine
- Physical access to communicating peers is not available



The Challenge of GOOSE

- With messages being transmitted as fast as 4-10 ms per message it can be very difficult for the substation engineer to debug these systems using traditional network monitoring or by monitoring a single device
- Looking at messages does not indicate if the devices that should be processing those messages are, in fact, processing those messages
- With R-GOOSE moving from device to device is not practical



The GOOSE Monitor Solution

- The GOOSE Monitor is designed to provide an intuitive visualization of the real-time GOOSE messaging occurring on station bus that enables the engineer to quickly identify what is working and what is not working
- Allows the engineer to cut through the complexity and focus their attention on where the problems are



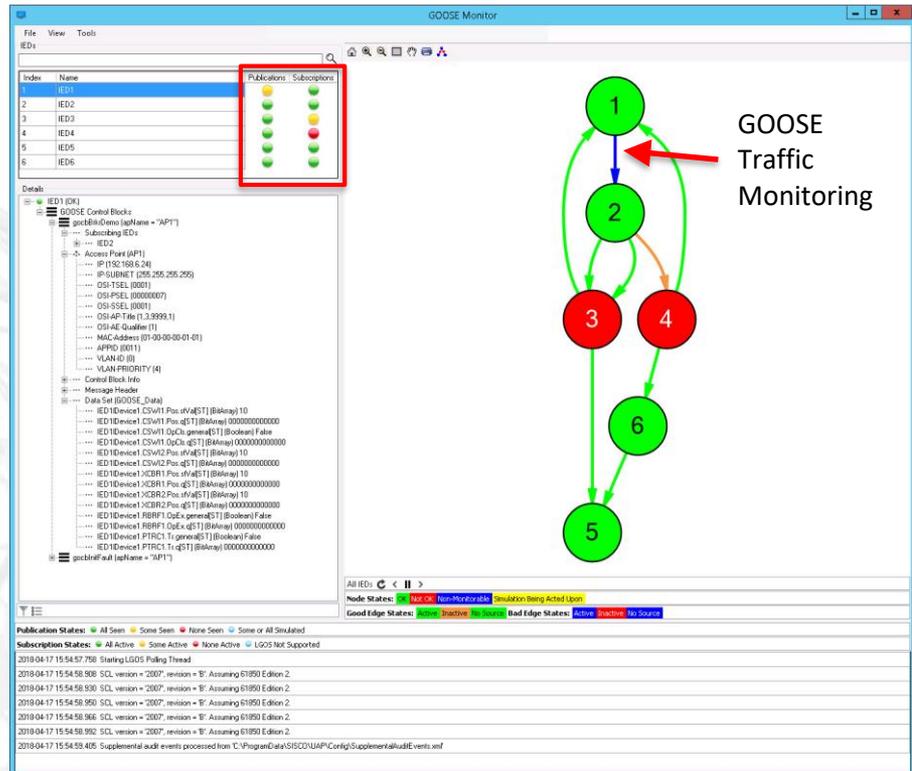
GOOSE Monitor Provides Answers

- Are GOOSE messages being published as expected?
- Are GOOSE messages being received by the IEDs as expected?
- What data is being published in each GOOSE message?
- Is the flow of GOOSE messages as expected?
- Are their simulated GOOSE messages on the network?



GOOSE Monitor Visualization

- GOOSE configuration is automatically generated from SCD file:
 - Graph diagram
 - LGOS subscriptions
 - Addressing, etc.
- Pub/Sub colors (user configurable) represent GOOSE traffic (Pub) and LGOS state (Sub)
- Node colors (devices) state of GOOSE subscriptions via LGOS
- Edge colors (arrows) represent GOOSE messaging/traffic state



GOOSE Monitor – Device 2 a Problem?

- What is going on with Device 2?
- Click on Device 2 and details are brought up.
- Right click on Device 2 to enable “Beep Mode”
- Beep Mode displays an isolated view of the selected device.

The screenshot displays the GOOSE Monitor interface. On the left, a table lists IEDs (IED1 to IED6) with status indicators. The 'Details' pane shows the configuration for IED2, including GOOSE Control Blocks, Subscribing IEDs, and various parameters like S1 (True/False) and SmG1. On the right, a network diagram shows six nodes (1-6) connected by green arrows. Node 2 is highlighted with a red circle and a 'Beep Mode' tooltip. At the bottom, a log window shows the following entries:

```
2018-04-17 15:54:57.758: Starting LGDS Polling Thread.
2018-04-17 15:54:58.908: SCL_version = '2007', revision = 'S'. Assuming 61890 Edition 2.
2018-04-17 15:54:58.930: SCL_version = '2007', revision = 'S'. Assuming 61890 Edition 2.
2018-04-17 15:54:58.950: SCL_version = '2007', revision = 'S'. Assuming 61890 Edition 2.
2018-04-17 15:54:58.966: SCL_version = '2007', revision = 'S'. Assuming 61890 Edition 2.
2018-04-17 15:54:58.992: SCL_version = '2007', revision = 'S'. Assuming 61890 Edition 2.
2018-04-17 15:54:59.405: Supplemental audit events processed from 'C:\ProgramData\SISCO\UAP\Config\SupplementalAuditEvents.xml'
```

GOOSE Monitor – Beep Mode

- Displays an isolated view involving only the selected device
- Enables the engineer to focus on the more likely causes for problems
- Details screen show the state of the LGOS subscriptions in subscribed devices
- Edge color shows Device 4 is likely missing messages from Device 2

The screenshot displays the GOOSE Monitor interface. On the left, a table lists IEDs (IED1 to IED6) with columns for Index, Name, Publishers, and Subscribers. IED2 is selected. Below the table, the 'Details' pane shows the configuration for IED2, including 'GOOSE Control Blocks' and 'Subscribing IEDs'. Two 'LGOS Reference' entries are highlighted with red boxes, indicating subscriptions to IED3 and IED4. On the right, a network diagram shows four nodes (1, 2, 3, 4) connected by edges. Node 1 is green, Node 2 is green, Node 3 is red, and Node 4 is red. Edges are color-coded: green for good, orange for bad. A red arrow points to the orange edge between Node 2 and Node 4. At the bottom, a log shows 'Good Edge States' and 'Bad Edge States' for the selected IED.

Index	Name	Publishers	Subscribers
1	IED1	●●●	●●●
2	IED2	●●●	●●●
3	IED3	●●●	●●●
4	IED4	●●●	●●●
5	IED5	●●●	●●●
6	IED6	●●●	●●●

GOOSE Monitor – Beep Mode to Device 4

- Beep Mode allows the engineer to follow the publisher and subscriber relationships through the system to track down root causes of problems

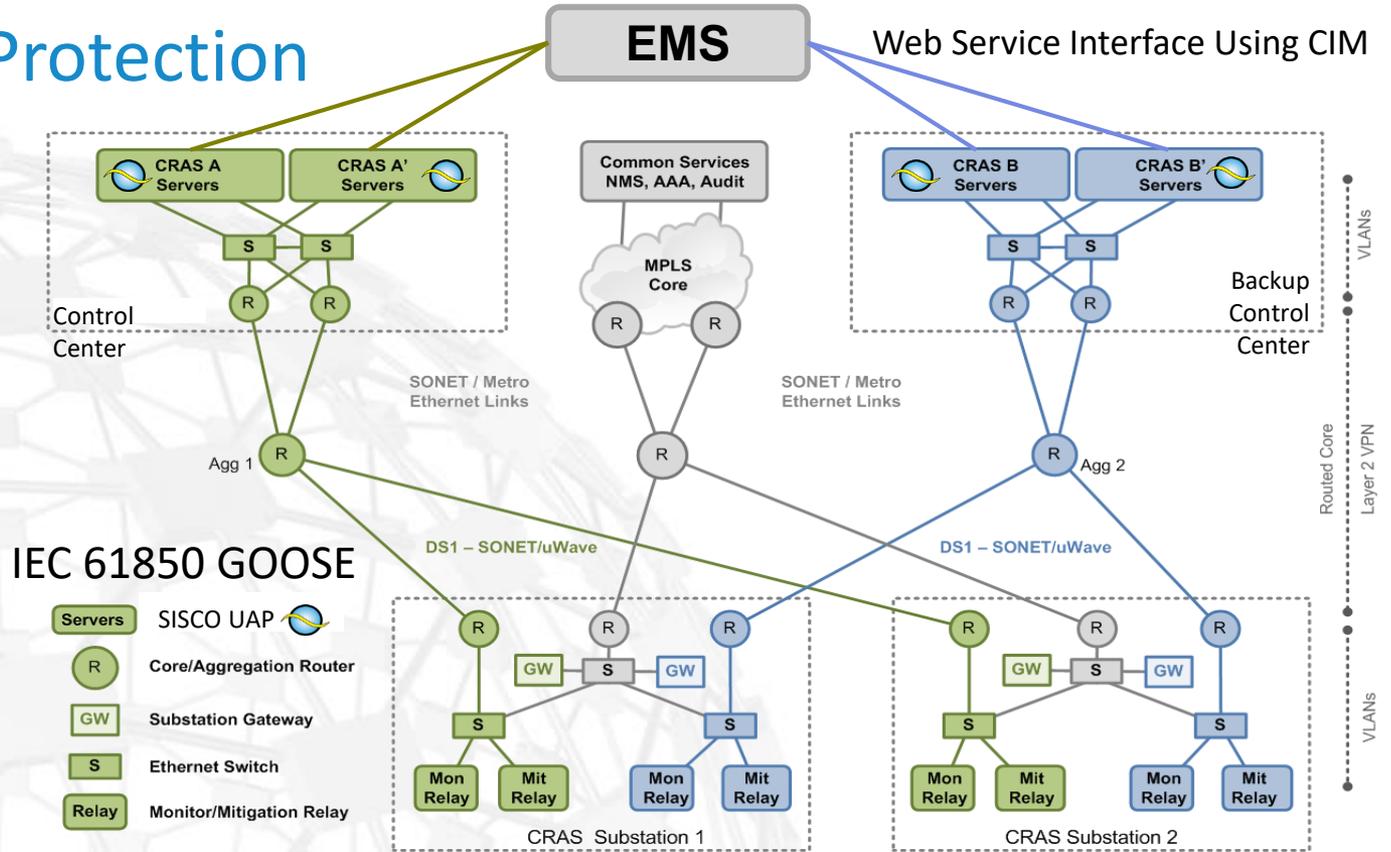
The screenshot displays the GOOSE Monitor interface. On the left, a table lists IEDs (IED1 to IED6) with columns for Name, Publishers, and Subscribers. IED4 is highlighted in blue. Below the table, the 'Details' pane shows a tree view of IED4's configuration, including 'GOOSE Control Blocks' and 'Data Set (GOOSE_Data)'. On the right, a network diagram shows six nodes (1-6) connected in a vertical chain. Node 1 is green, node 2 is green, node 4 is red, and node 6 is green. Arrows indicate connections: a blue arrow from 1 to 2, an orange arrow from 2 to 4, and a green arrow from 4 to 6. At the bottom, there are status indicators for 'Publication States', 'Subscription States', and 'Mode States', along with a log of events.

GOOSE Monitor

- An essential tool to facilitate quicker identification of the cause of problems in a complex GOOSE pub/sub network
- Provides an intuitive and simplified view of network relationships and GOOSE traffic status to help the engineer focus on what is important



Wide Area Protection using Centralized Remedial Action Systems C-RAS



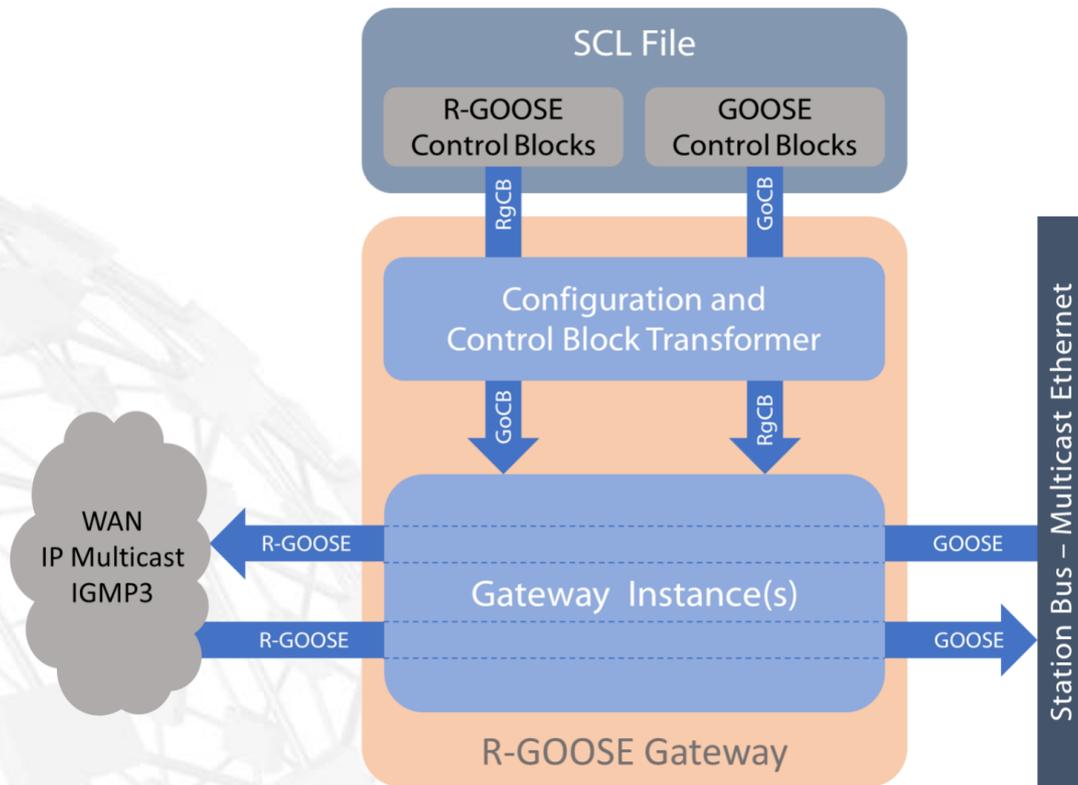
Migration and Integration of Wide Area and Local Protection

- Requires integrating wide area communications with devices designed for local operation
- Protocols used over wide area networks are customized for routers as compared to local communications
- A simple transparent means to go to/from these 2 worlds help with integration and allows migration of existing systems



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
- Supports execution of multiple gateway instances and multiple network interfaces





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Thank You

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