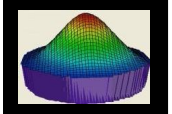
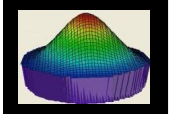


Where this technology is applied in India together with our partner EIP

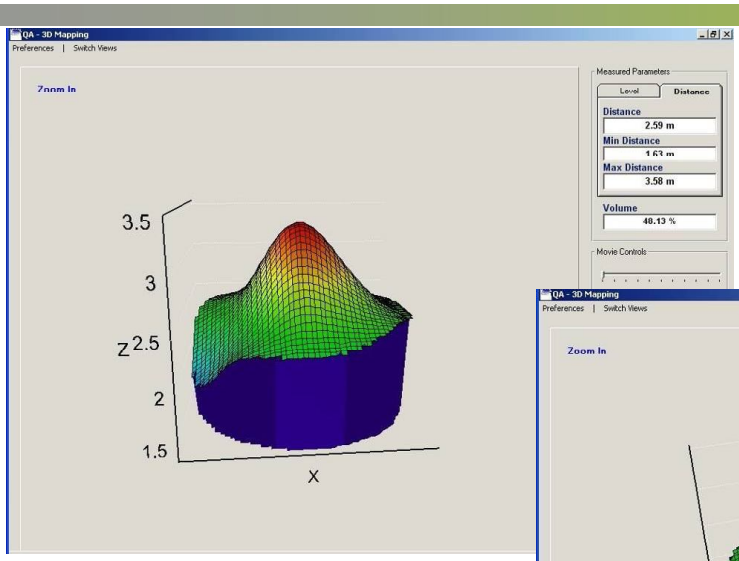
	Project/Customer	Application	Remarks
8)	**Tata power**	**Coal Bunker**	**Replaced with Radar**
9)	**Penden Cement Bhutan**	**Cement Silo**	**Replaced with Radar**
10)	**Maducon Project**	**Coal bunker**	**Replaced with Radar**
11)	**Tata Steel**	**Iron Ore**	**Replaced with radar**
12)	**And many more**		

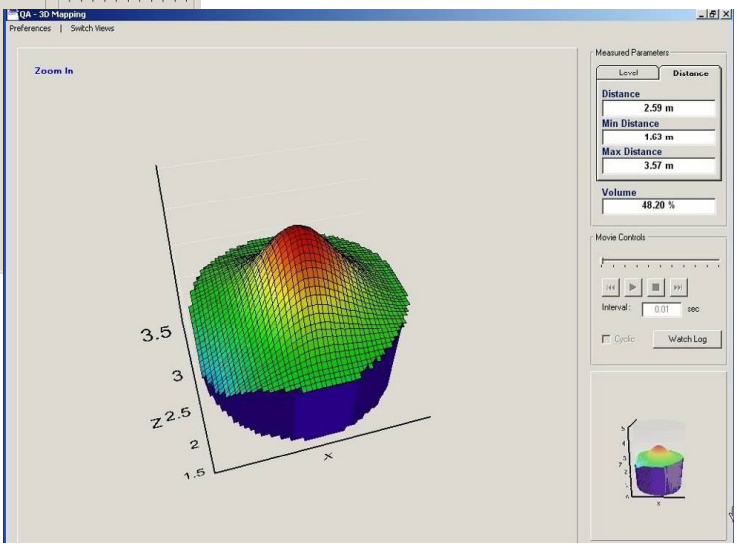
Revolutionizing the market and replacing existing technologies

ISA Delhi Section



3D surface mapping





Thank You!

Integration Considerations For large Scale

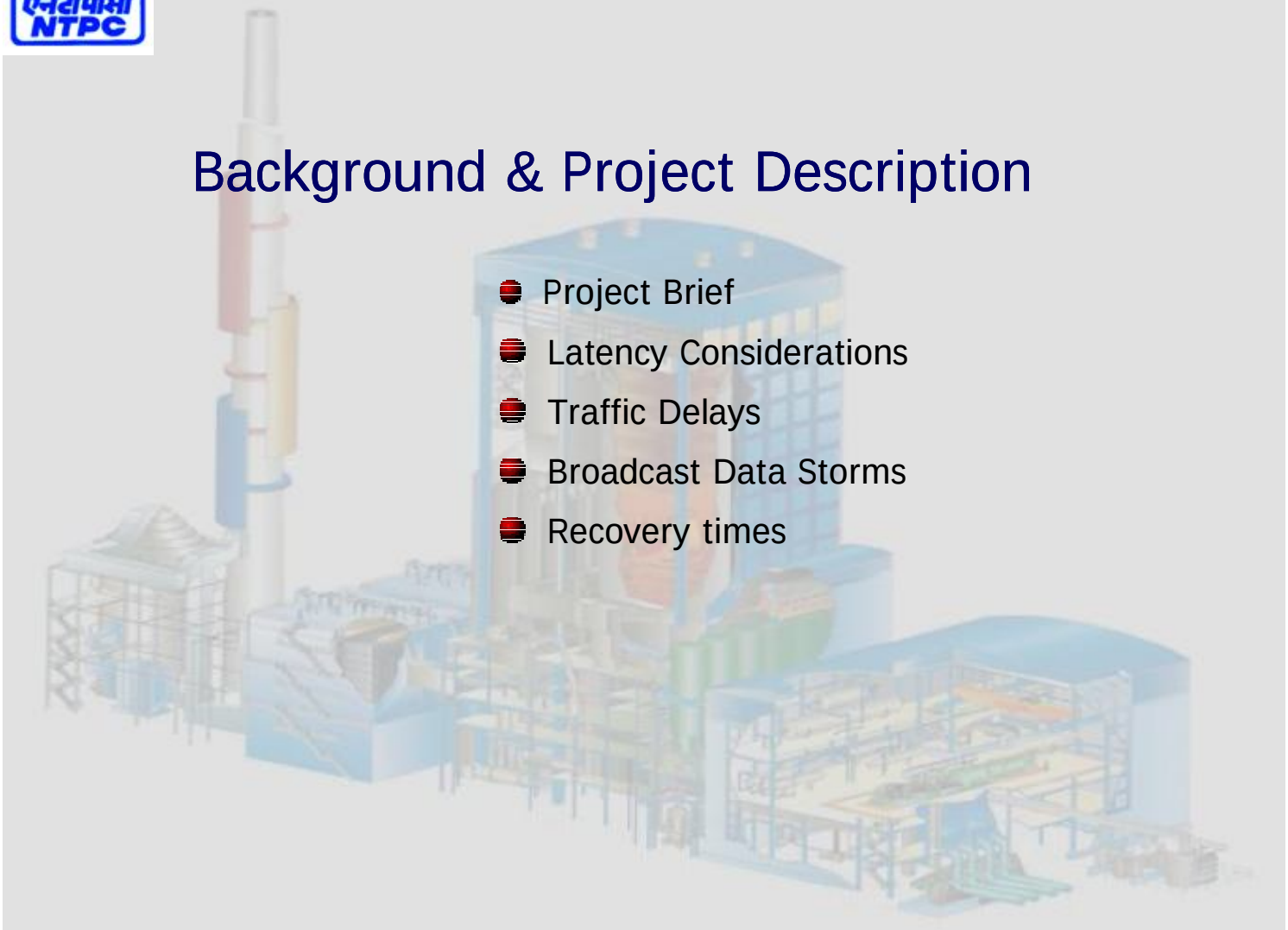
IEC 61850 Systems

……***A new approach for a Power Utility***

Presentation Overview

- Introduction
- Background & Project Description
- Band Width Usage Simulation
- Bandwidth Management Strategies
  - Data sets
  - Buffered Reports
  - Un Buffered Reports
  - Multicast Traffic
  - Proper Configuration of IED Capability Description
- Other Network Considerations
- Recommendations

Background & Project Description



- Project Brief
- Latency Considerations
- Traffic Delays
- Broadcast Data Storms
- Recovery times

Introduction

Since its inception IEC 61850 has been demonstrating a world wide acceptance. The paper is the Case study on Design and Implementation of IEC 61850 Substation automation system solution to integrate about 600 IED devices. Indira Gandhi Super Thermal Power Project (3 X 500 MW) is being Constructed at Jhajjhar, Haryana near Delhi. The first unit of the Project is expected to be commissioned by Oct 2010.

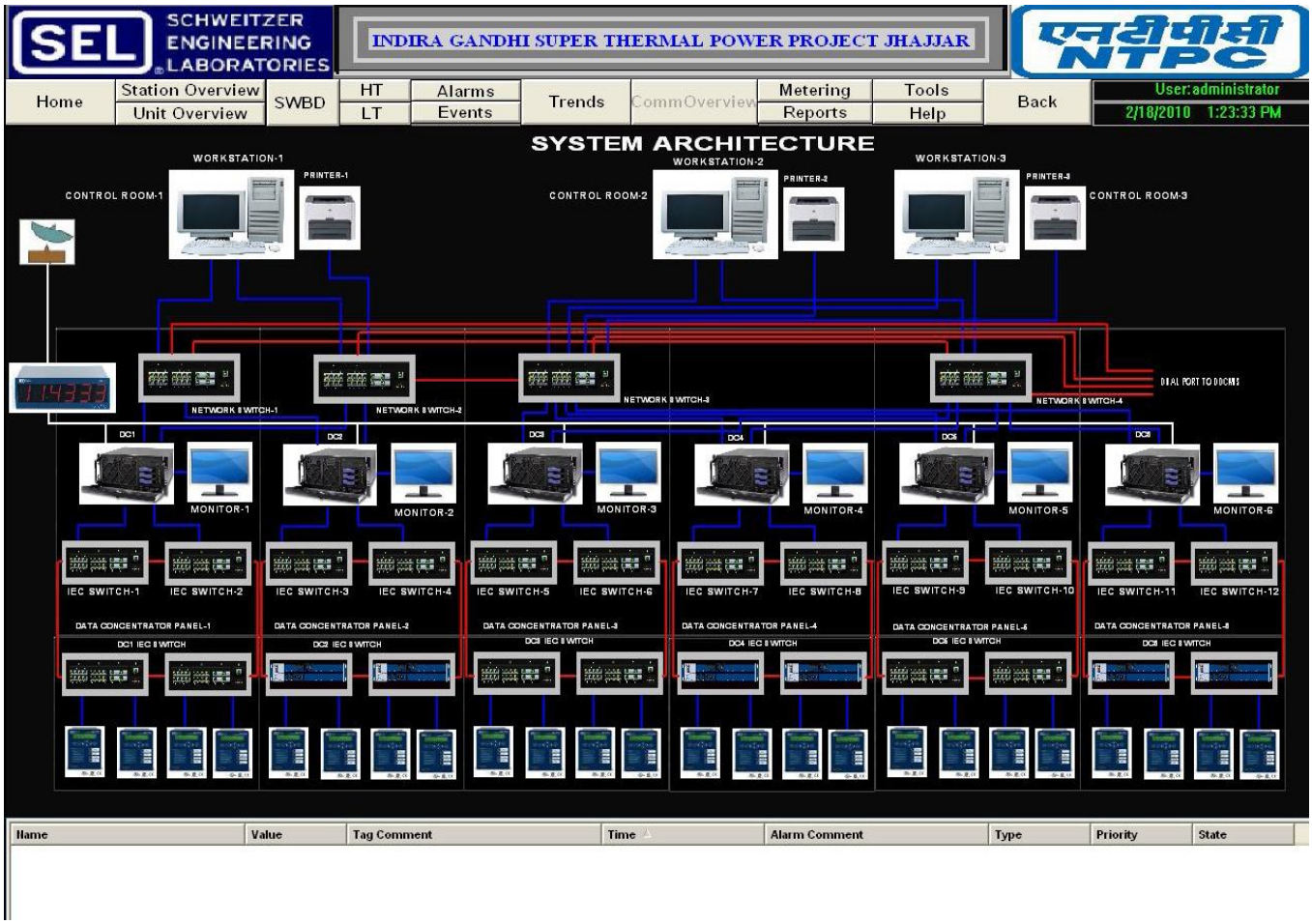
Brief about the Project

- All the 11 KV ,3.3 KV Systems and LT (MV and LT Switchgears) have Communicable Numerical Relays on IEC 61850.
- The Breaker control is Performed from the DCS system
- Modern IEDs & Numerical Relays being used for typical protection functions can also capture all feeder data, records, events and monitor the equipment and also keep record of Energy Consumption.
- Such a real time data of the Complete Auxiliary System of the Power Utility is captured and displayed on HMI to help monitor the system from remote locations and send data in soft to Plant DCS systems. Typically the various feeders are divided into Modular Basis
  - ***Incomers, Ties & Bus couplers : DC,DE &DD***
  - ***Transformer feeders : DBF/DB***
  - ***Motor Feeders : DAF/DA***
  - ***LV Feeders : DAET/DAE***

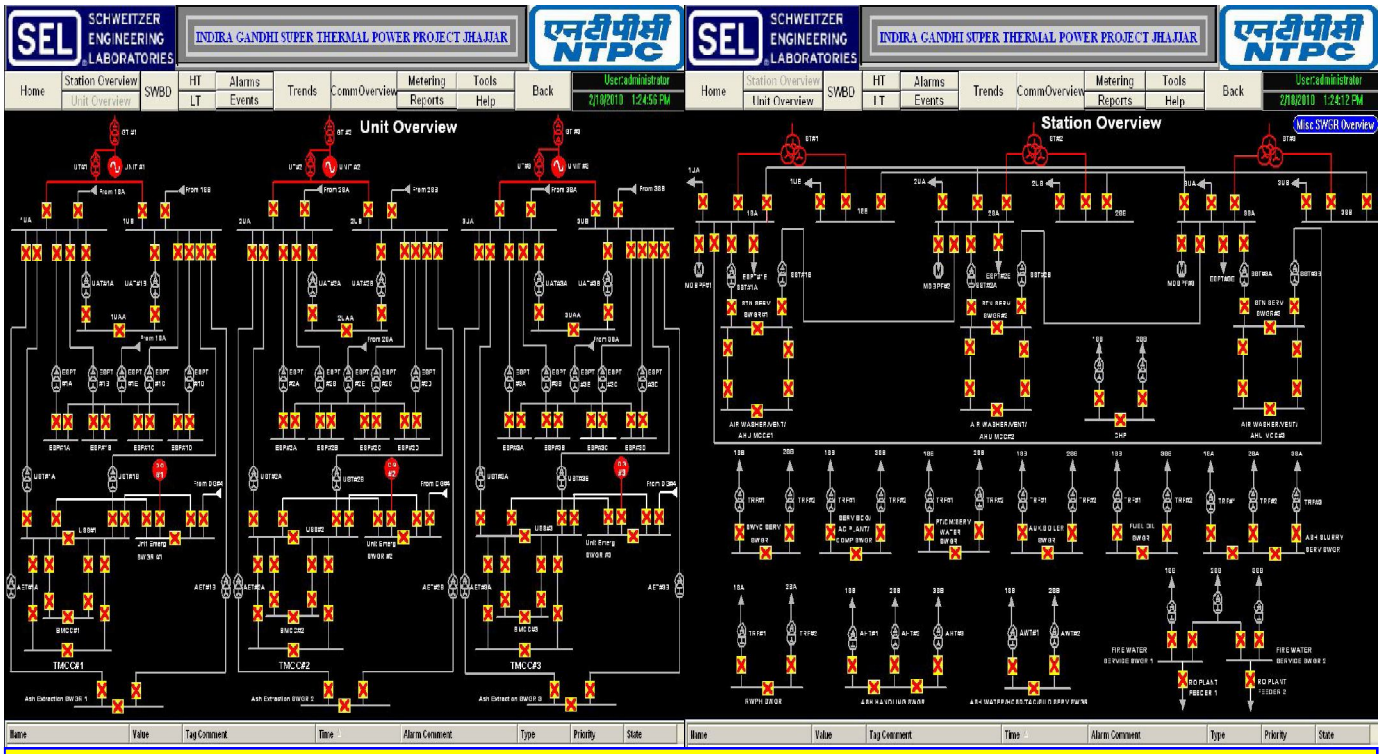
The Concept

- Each of the feeder types has a standardized configuration with respect to control schematic, data points and signals and other relay configurations. Typical signal Matrix is developed for type of Module As the No's of IED are large (say around 600). Such a Modular Concept helped in building the application for SAS faster and with accuracy
- The data from the IEDs is sent to the Data Concentrator system and then further to HMI system
- Data is also configured to be sent to the Plant DCS system on OPC
- The network system is also monitored with online real time status. Any Breakage/split in the network is immediately alarmed
- The SAS Consists of around 500000 data points generated by 600 IED's . The IEDS are distributed in 13 (Thirteen) 11 KV , 6 No's (Six) of 3.3 KV and 415 V LV Switchboards using 104 No's of Ethernet Switches on IEC 61850.

System Configuration For MV and LV Switchgear SCADA System (on IEC 61850)

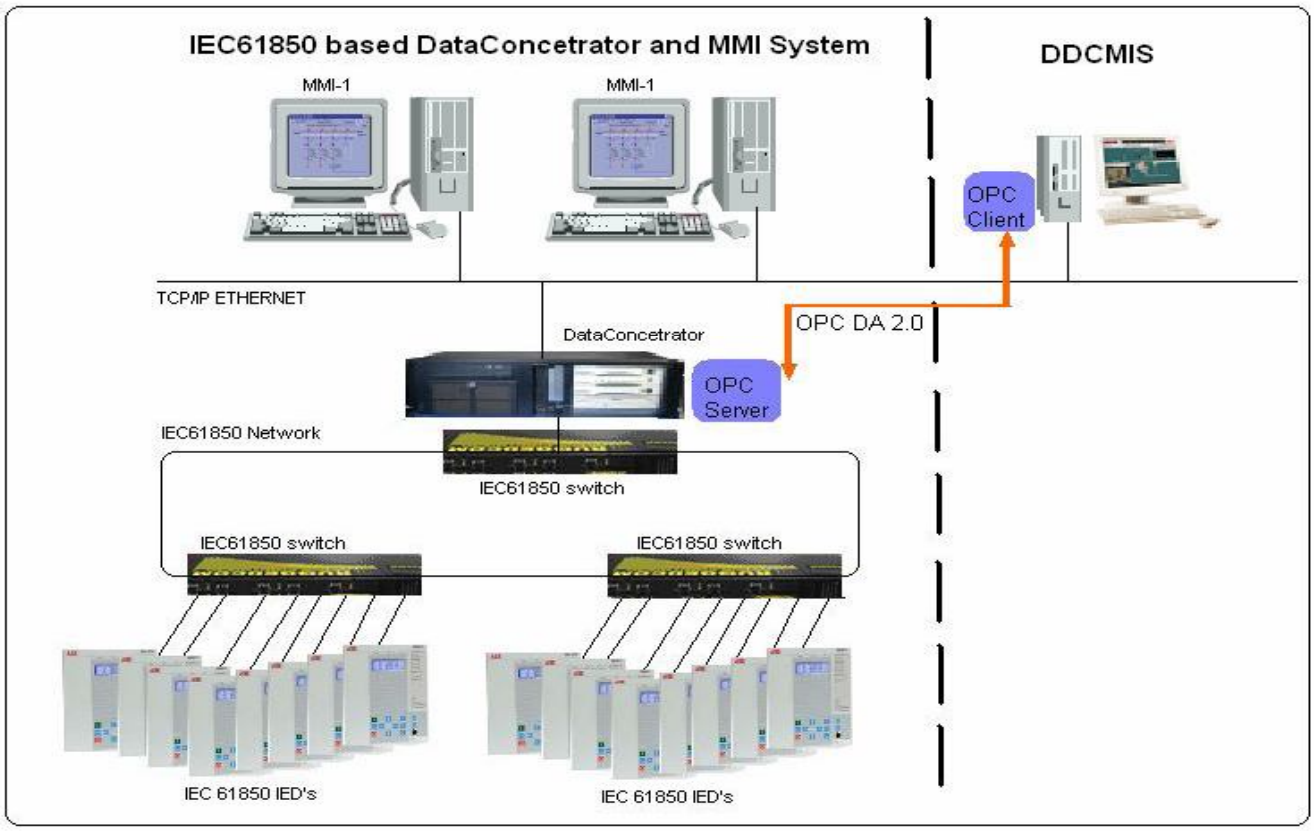


Dynamic Online Display systems of Auxiliary Power Supply System



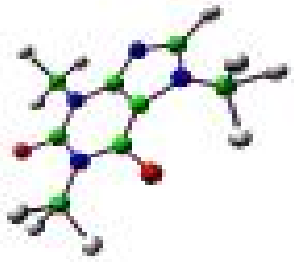
600 IEDS communicating for **Online Power Supply System Display**

OPC Data Access



Latency Considerations

- Media
- Ethernet Switch Latency
- Traffic Delays
- Broadcast Data Storms
- Recovery Times



Latency Considerations

- Media
  - Category 5e (CAT 5e) or Category 6 (CAT 6) cables, designed to support 100 to 1 Gbps
  - Fiber-optic cables (single mode or multimode), with a typical bandwidth of 1 Gbps (10 Gbps is now commercially available).
- Ethernet Switch Latency
  - Modern substation switches have fast switching capabilities. A 16-port switch operating at 100 Mbps per port needs to support a switching capacity of 1.6 Gbps
  - Substation Managed Ethernet switches use “store and forward.” to ensure only only good packets are transmitted
  - Other switching technologies such as “cut through,” impose minimal frame latency, but they enable bad frames to propagate into the network, thus adding traffic

Latency Considerations ....Traffic Delays

- SAS network architectures typically require all switch ports to send data to one uplink port
- At Peak activity, when an event triggers information reports and GOOSE messages from the IEDs, the likelihood of multiple users contending for the same Network port increases.
- Switches with priority queues help to reduce high-priority message delays due to traffic
- A GOOSE frame propagating through 10 switches of a 100 Mbps LAN with an event trigger burst of 12 GOOSE frames canintroduce delays of more than 2 milliseconds.

Latency Considerations ....Traffic Delays

	Frame Duration at 100 Mbps	Frame Duration at 1 Gbps
64 octets (minimum allowed)	7 µs	0.7 µs
300 octets (compact GOOSE frame)	25 µs	2.5 µs
800 octets (large GOOSE frame)	64 µs	64 µs
1,530 octets (maximum)	124 µs	12.4 µs

Latency Considerations...Broadcast Data Storms

- An failed IED communications interface corrupts the network
- Broadcast Data storm occurs if an Ethernet network interface fails and continuously broadcasts messages, corrupting communication with any recipient of the data.
- Switches and routers prevent a broadcast data storm from influencing communication on other segments of the network, but no data are retrieved from the failed segments

TABLE II
ELAPSED TIME FOR AN IEEE 802.3 FRAME TO TRAVERSE THE PHYSICAL MEDIUM [1]

Medium	Time to Traverse a Link
CAT 5e and CAT 6 cables	0.55 μs per 100 m
Glass fiber optics	0.49 μs per 100 m
Wireless	0.33 μs per 100 m

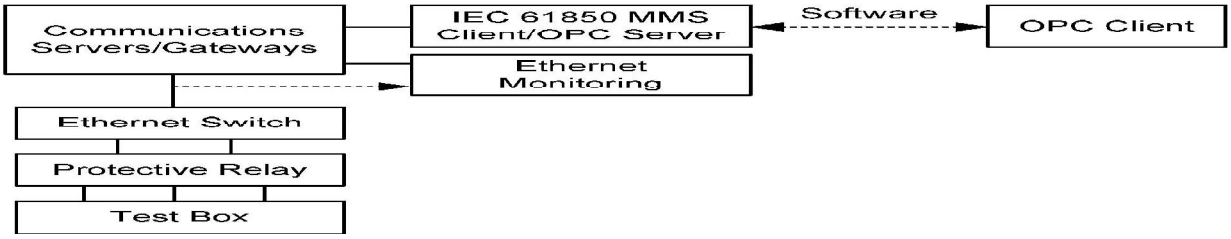
Recovery Times

- **Rapid Spanning Tree protocol (RSTP)** provides a way to interconnect managed switches in a ring configuration
- Managed industrial Ethernet switches running RSTP send inquiry packets actively seeking information from neighboring switches, providing fast network healing times
- Typical RSTP reconfiguration times are approximately 5milliseconds per switch.
- Other protocols, such as Parallel Redundancy Protocol (PRP) or High-Availability Seamless Ring (HSR), provide specialized redundancy methods but require specific implementations in IEDs and specialized network devices to connect to standard Ethernet networks

Band Width Usage Simulation

- Test Set up
- IEC 61850 MMS Client configuration
- Goose Traffic Simulation

Test Setup and Simulation



(Untitled) - Ethereal

File Edit View Go Capture Analyze Statistics Help

Filter: mms — Add Expression... Clear Apply

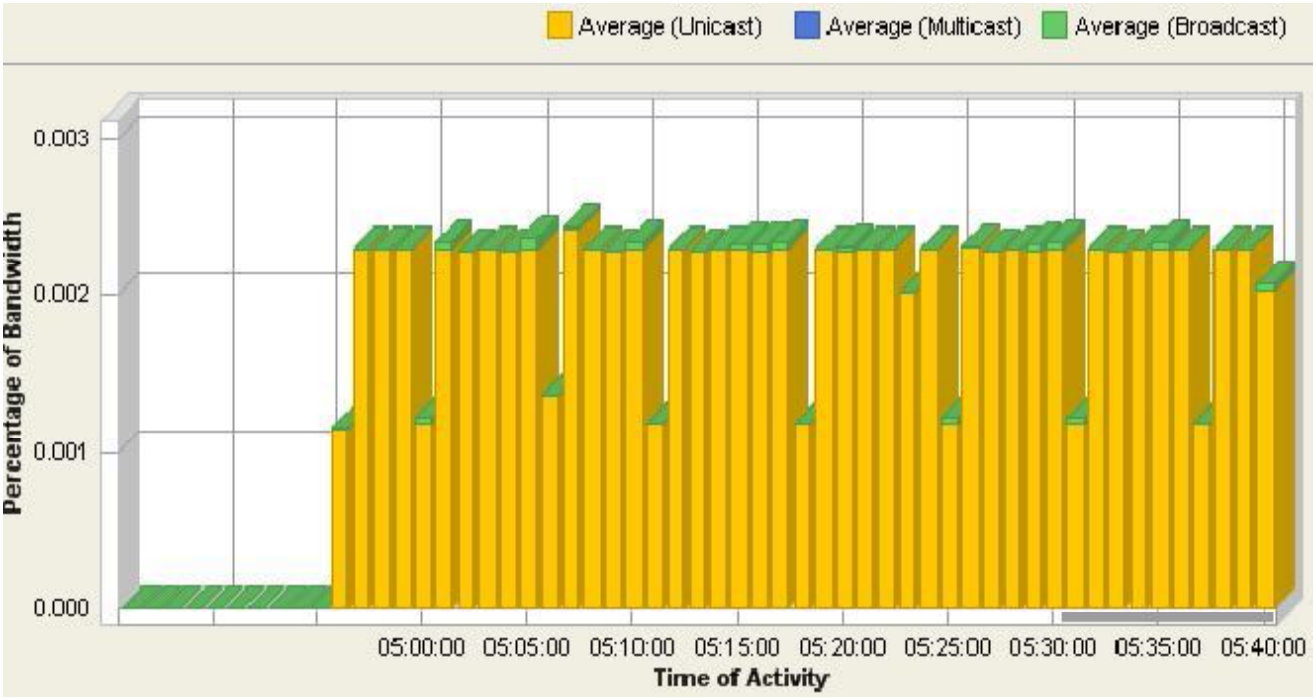
No.	Time	Source	Destination	Protocol	Info
6	2.125259	10.42.50.31	10.42.50.42	MMS	Unconfirmed
35	14.892338	10.42.50.31	10.42.50.42	MMS	Conf Response: Read (InvokeID: 10)
66	33.902199	10.42.50.31	10.42.50.42	MMS	Unconfirmed
88	43.341926	10.42.50.31	10.42.50.42	MMS	Conf Response: Read (InvokeID: 11)
130	64.562400	10.42.50.31	10.42.50.42	MMS	Unconfirmed
144	73.916710	10.42.50.31	10.42.50.42	MMS	Conf Response: Read (InvokeID: 12)
154	79.520375	10.42.50.31	10.42.50.42	MMS	Unconfirmed
163	82.243696	10.42.50.31	10.42.50.42	MMS	Unconfirmed
189	95.359308	10.42.50.31	10.42.50.42	MMS	Unconfirmed
206	104.070823	10.42.50.31	10.42.50.42	MMS	Conf Response: Read (InvokeID: 13)
255	127.149469	10.42.50.31	10.42.50.42	MMS	Unconfirmed
269	133.290449	10.42.50.31	10.42.50.42	MMS	Conf Response: Read (InvokeID: 14)

- Reports sent periodically every 30 seconds.
- OPC read commands set for update rate of 30 seconds.
- Reports generated by data change.

IEC 61850 MMS Client Configuration

- In IEC 61850 MMS Data transfer is optimized by the use of report by exception
- In this mode of operation, the integral polling period can be increased to several seconds (30 seconds was used during testing to refresh data points).

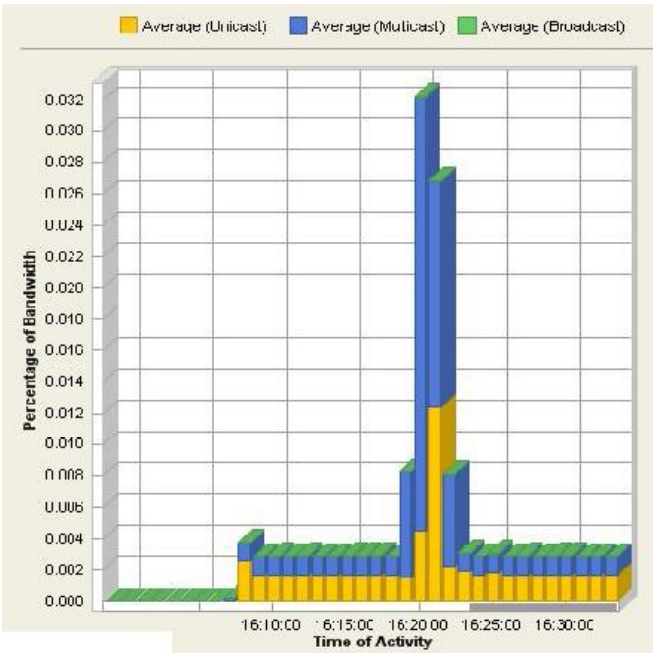
Simulation of % of Bandwidth Used



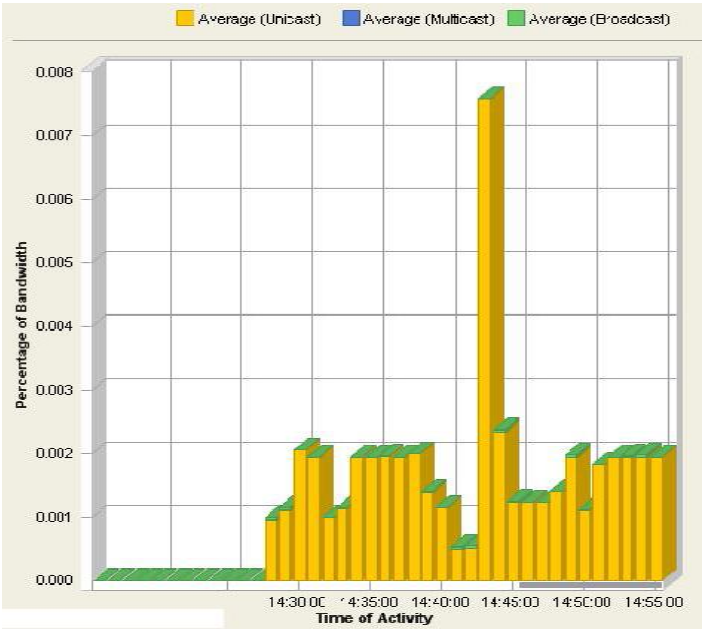
When GOOSE is enabled with a time-to-live (TTL) of 1 second, the expected result is an increase of bandwidth use, as shown above

During the Test, Circuit breaker Changes Generated an Increase in GOOSE Publishing.

Traffic Simulation on a Electrical Fault



Increase in % of bandwidth used under heavy reporting condition with Goose messages.

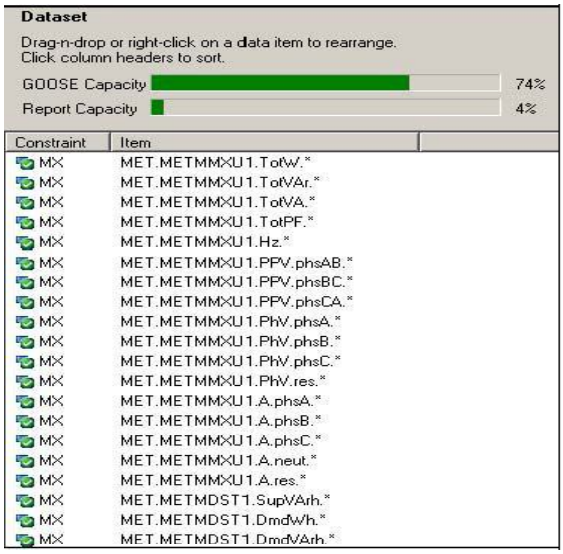


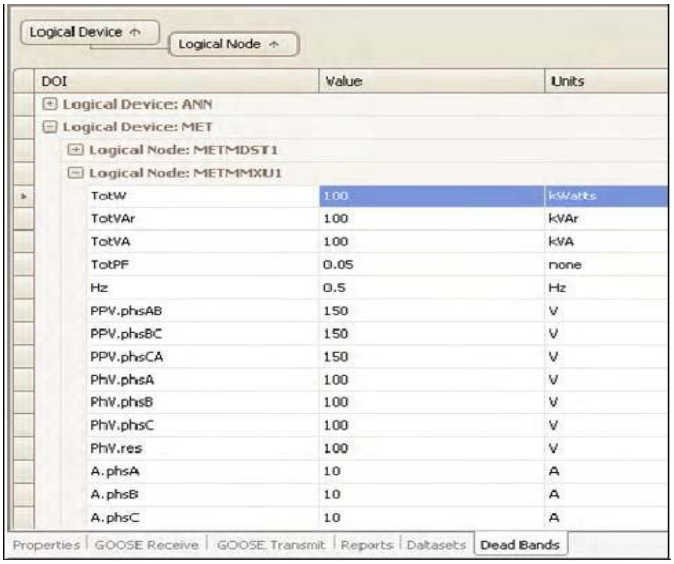
Peak increase in the percentage of bandwidth used under heavy Reporting conditions with No Goose messages

BANDWIDTH MANAGEMENT STRATEGIES

- Data Sets
- Buffered Reports
- UnBuffered Reports
- Multicast Traffic
- Proper Configuration of IED Capability Description (ICD) Files

Data Sets ... Customization of Data





In the IGSTPP, there are three data sets: one analog metering data set linked to an Unbuffered report and two discrete status data sets linked to buffered reports. The optimization of the data sets is shown above. Correct dead-band settings help to effectively manage the use of the network bandwidth.

Buffered Reports & Unbuffered Reports

Internal events are triggered by

- ✓Data change or update
- ✓Quality change

Buffering the events (to a practical limit) for transmission prevents the loss of data values due to transport flow control constraints or loss of connection

The Immediate sending of reports on a "best efforts" basis generate Unbuffered reports. The Network does not provide any Guarantee that the data are delivered. If no association exists or if the transport data flow is not fast enough to support the report, events are lost.

Multicast Traffic

- GOOSE works with a dynamic repetition of multicast messages communicating on Ethernet Layer. If the data within the GOOSE frame do not change, the repetition period becomes longer (1 second or more), lowering the network load.
- Ethernet switches do not prevent the unrestricted dissemination of these messages.
- With a large Number of devices publishing multicast traffic there is a serious impact on the network.
- Some devices do not have multicast filters, so GOOSE messages interrupt normal processes on these devices

Multicast Filters or Virtual local-area Networks (VLANs), are necessary to control and restrict the dissemination of GOOSE Messages

IED Capability Description (ICD) Files

- Vendors provide default ICD files with their products. This factory default capability file can have settings that require configuration.
- During the Design phase Integrators need to modify the configuration in order to subscribe to
  - Relay GOOSE messages
  - Optimize Data sets & change dead bands
  - Unnecessary GOOSE messages that introduce Multicast Traffic and are not used by IEDs on the network must be removed

Relay should be Configured for Optimal Network Performance.

OTHER NETWORK CONSIDERATIONS

- Selection of Network Topologies
- Fault Trees