UCAIug IOP Results Report

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UCA IOP Group Meeting

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UCA International Users Group

IEC 61850 users group

Topics

- Areas of Testing
  - Network Infrastructure
  - Substation Configuration Language
  - Sampled Values
  - GOOSE (Generic Object Oriented Substation Event)
  - Client/Server
  - Time Synchronization - SNTP (added at site)

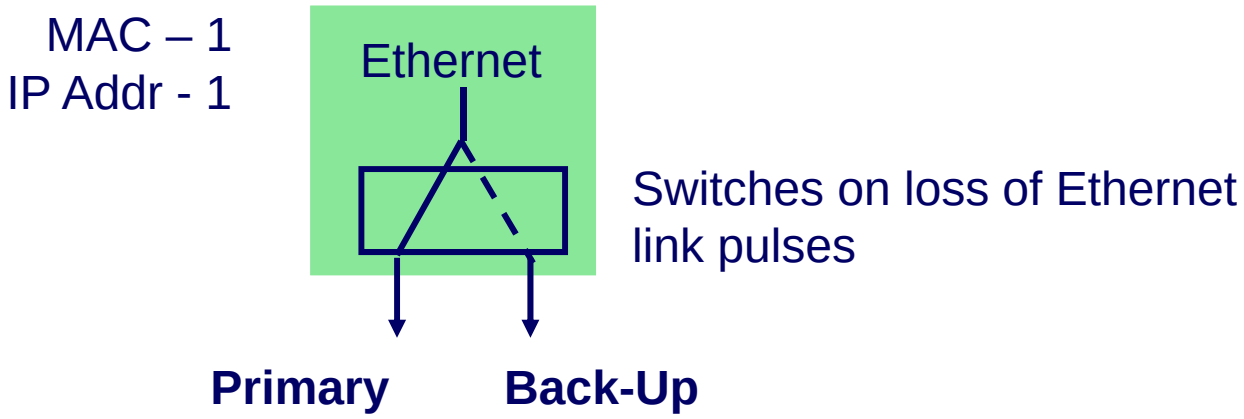
IEC 61850-90-4
Network Engineering Guidelines

- Test Approach
  - Multiple switch vendor's equipment
  - Primary purpose to test Rapid Spanning Tree Protocol (RSTP) in the following topologies:
    - Single Ring
    - Main Ring with 2 Sub-Rings
  - Other topologies:
    - Main Ring with Mesh
    - Single Ring with Integrated Switches

Redundant Ethernet

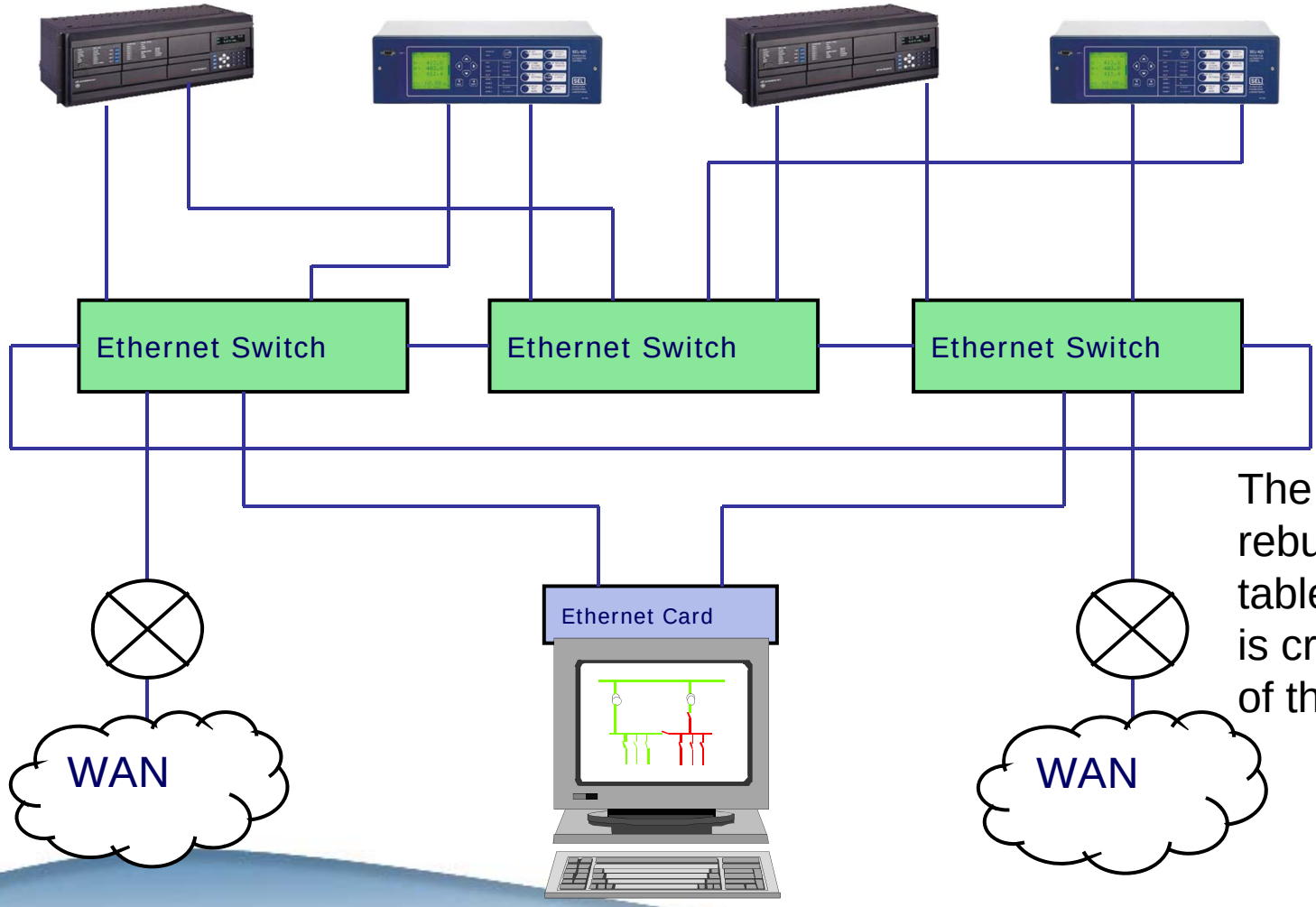
Redundant Port: 2 independent Ethernet ports with 2 different addresses

Redundant Media: 1 Ethernet port with switched media



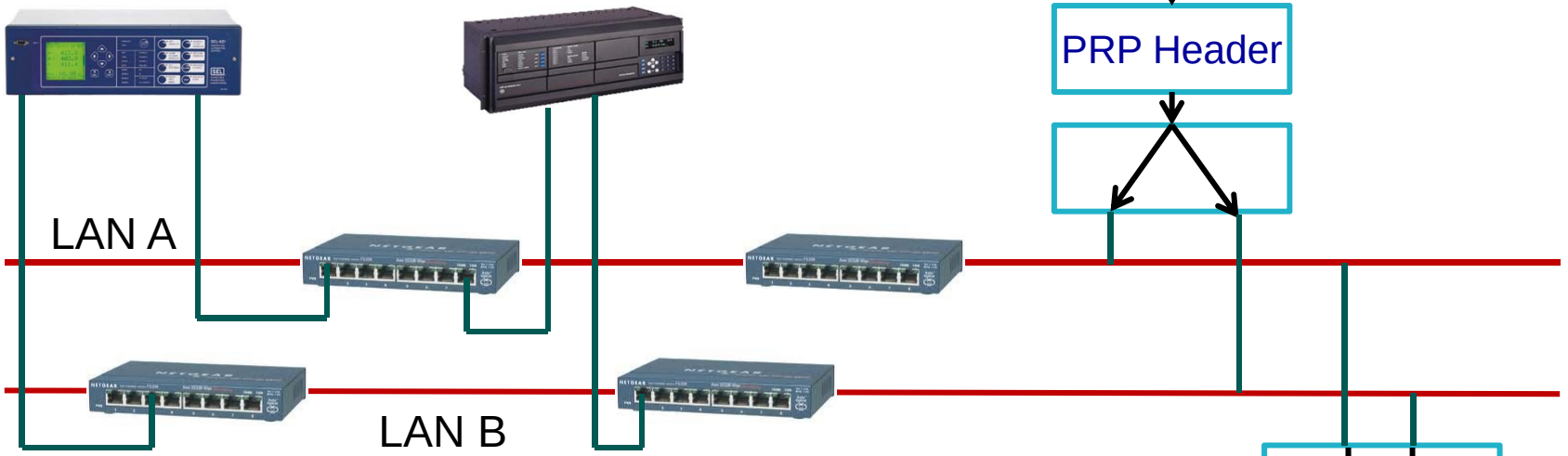
Redundant Media is Common - Easy to Configure for Redundancy

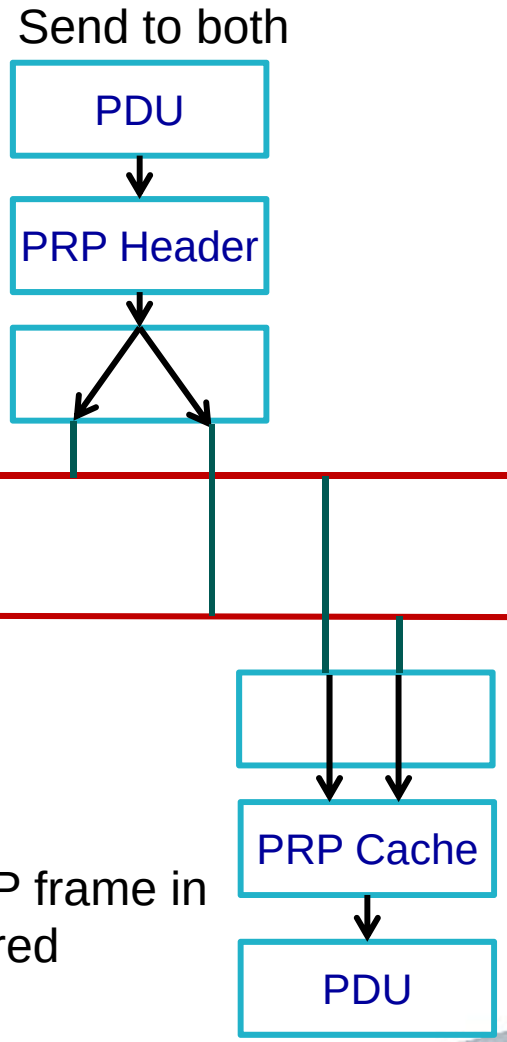
Redundant Network Configuration



The time to rebuild MAC tables after failure is critical feature of the switches

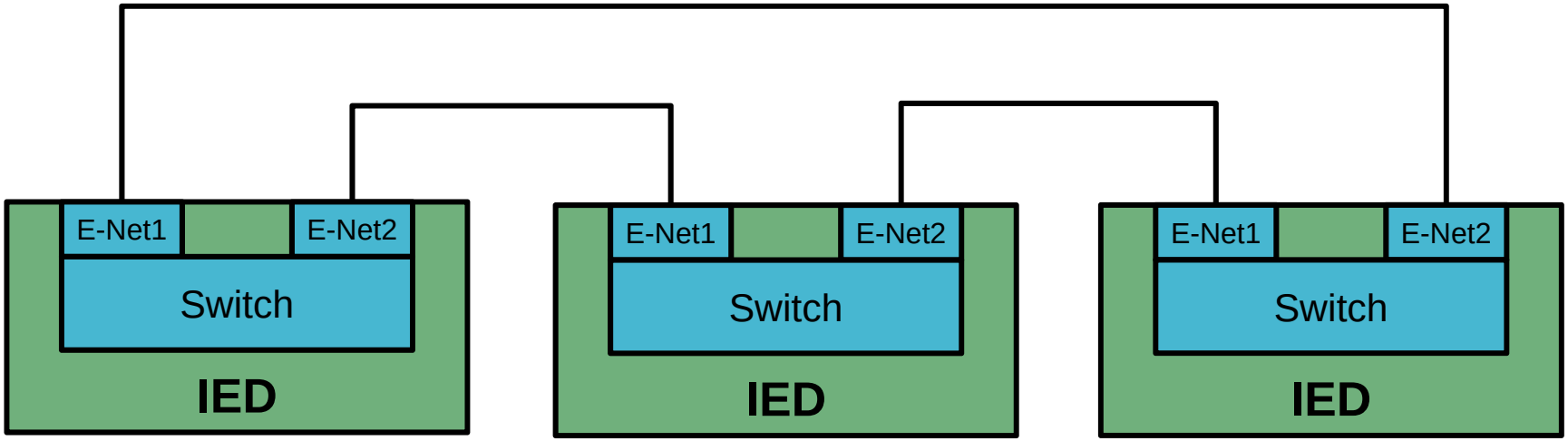
Parallel Redundancy Protocol (PRP)





First PRP frame in is delivered

Emerging Approach
Embedded Switching



HSR – High-Speed Redundancy Ethernet uses this kind of approach to avoid the delay of rebuilding the MAC tables on a failure

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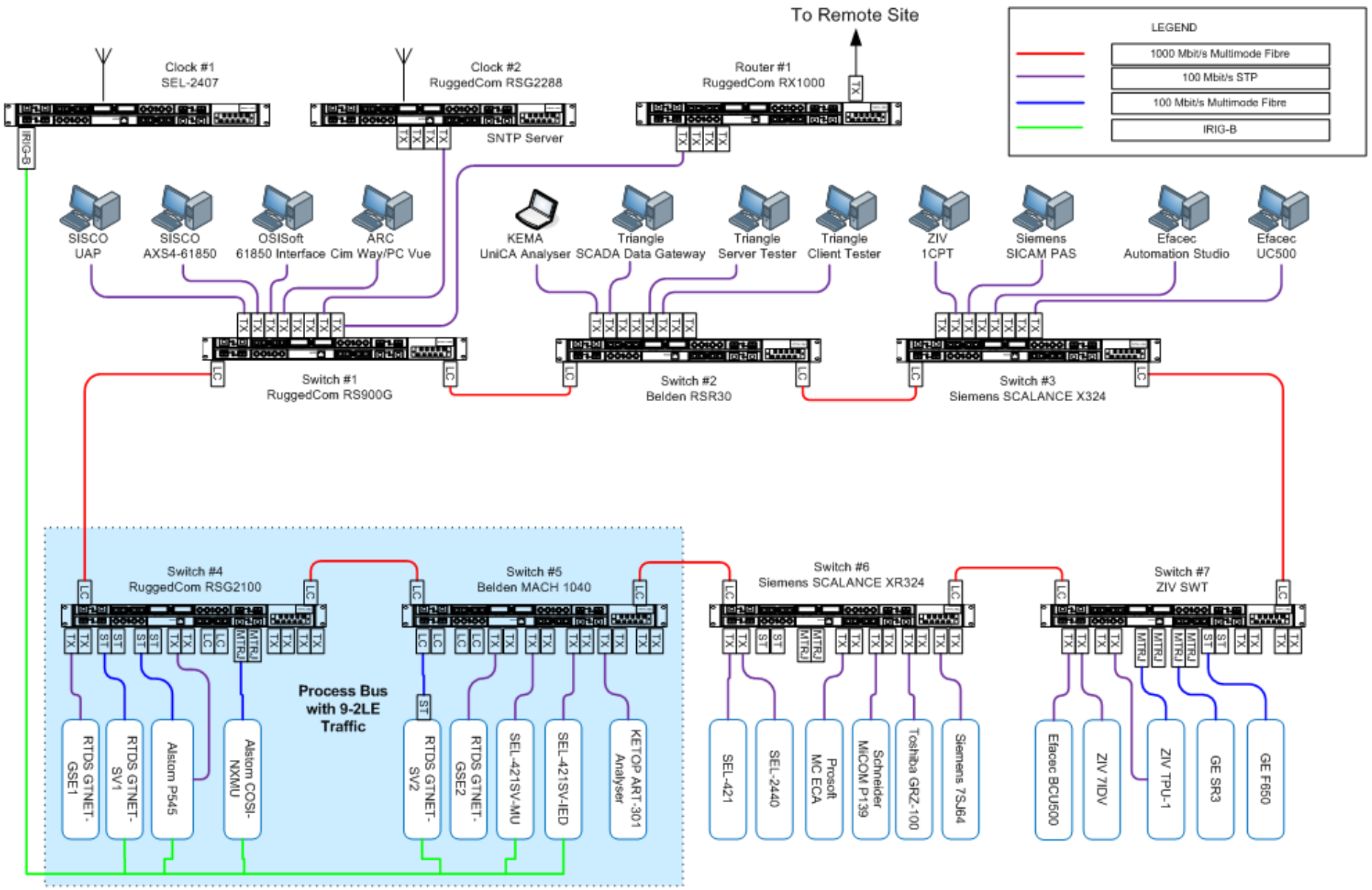
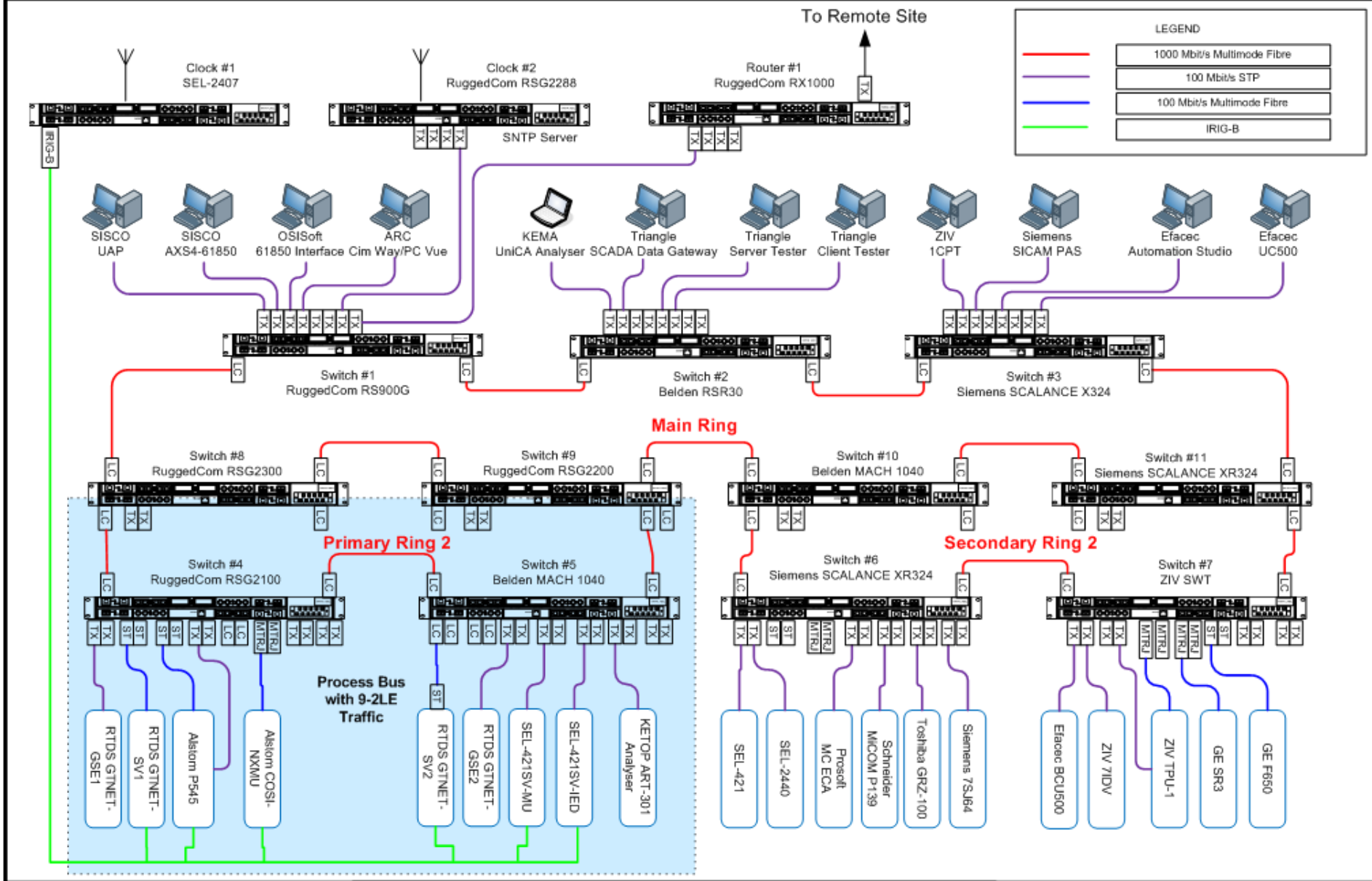
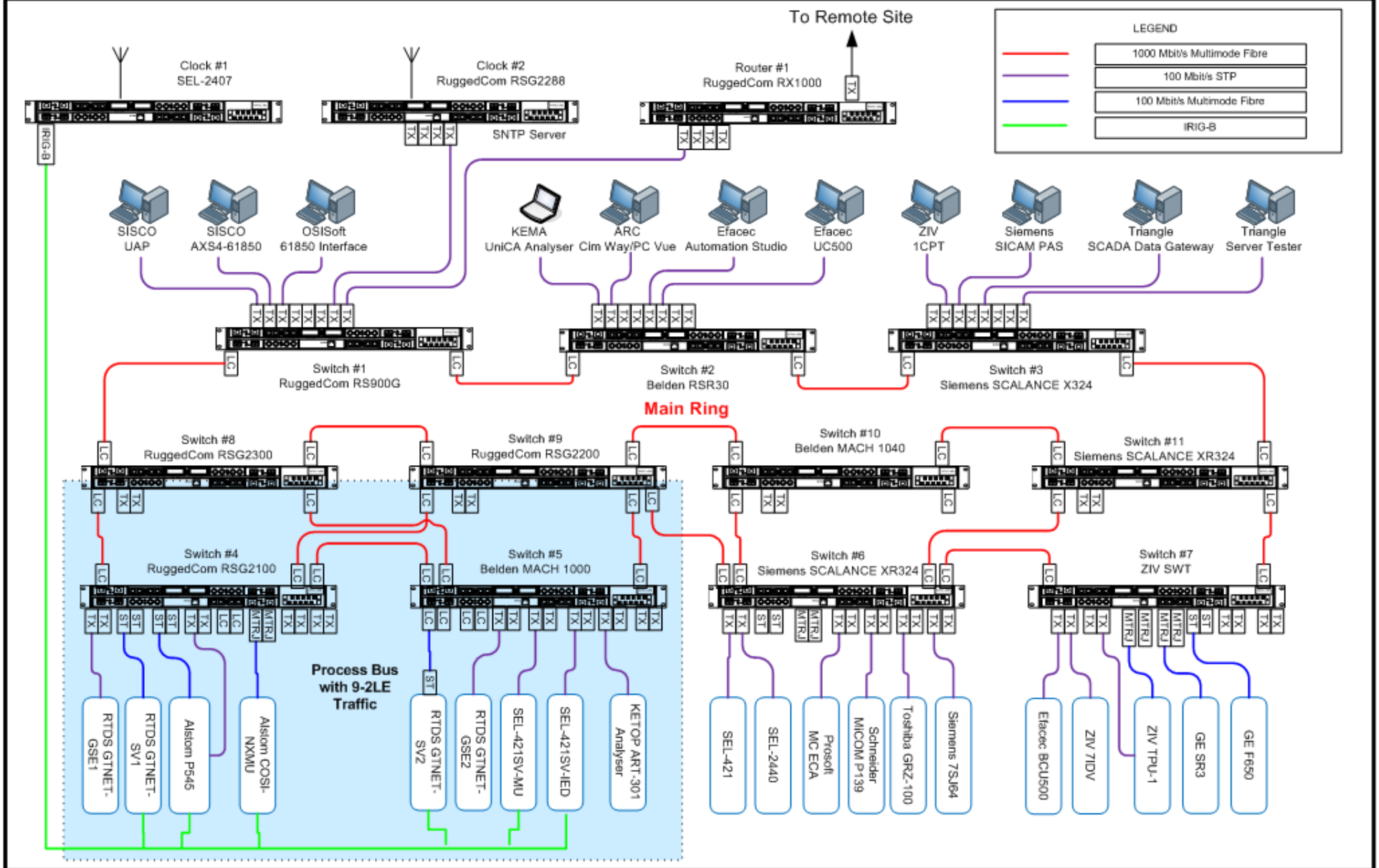
Topology 1 – Single Ring



Topology 2 – Main Ring with Two Subrings



Topology 3 – Main Ring with Mesh



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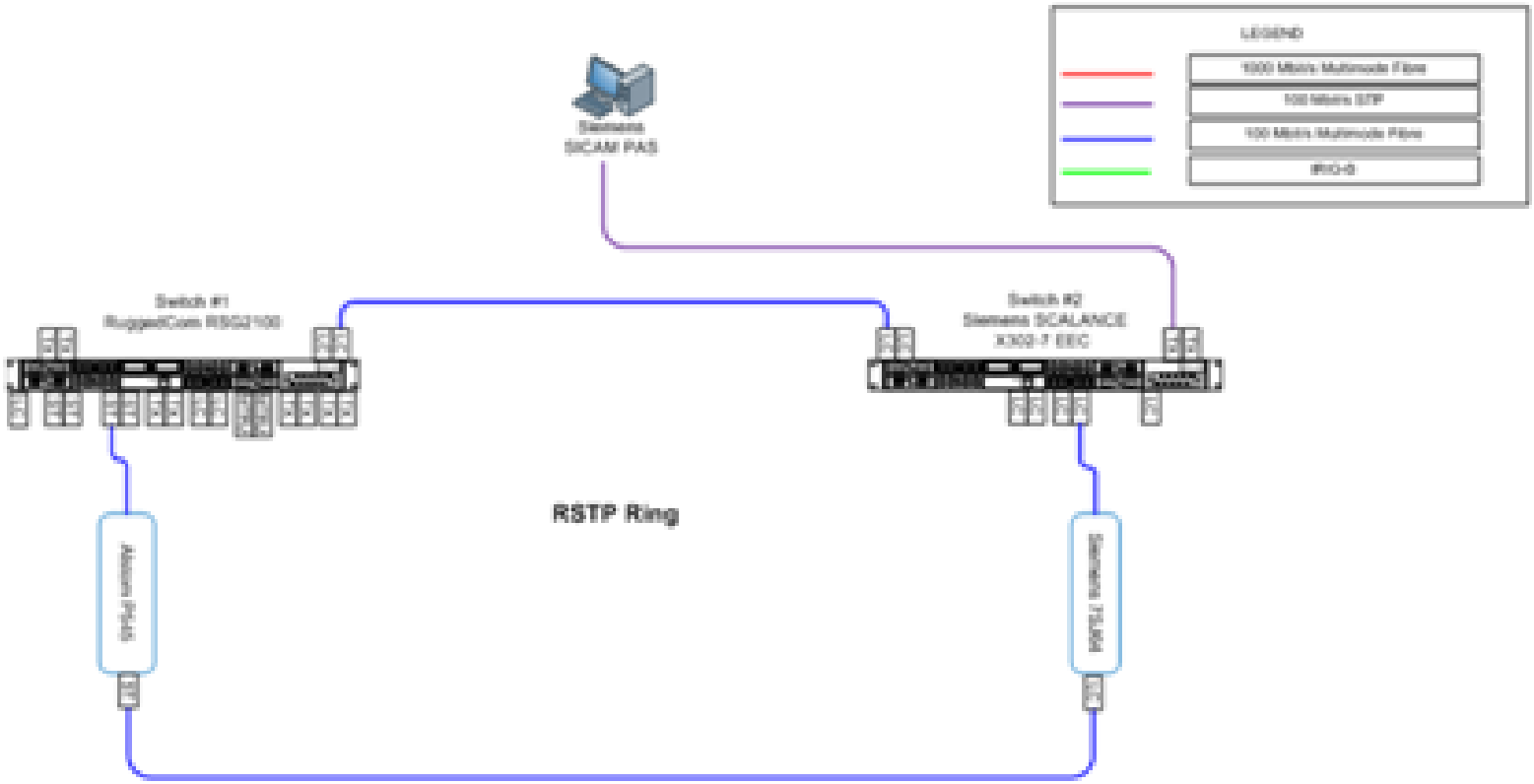
Topology 4 – Ring of IEDs with Integrated Switch



Network Infrastructure Participants

- Hirschmann
- RuggedCom
- Siemens
- Schweitzer Engineering Laboratories*
- ZIV

* - unmanaged switch did not participate in RSTP testing.

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Infrastructure IOP Results

- Not all switches interoperated properly.
- Found that all hands are not as quick as others.
- Fiber 1G uplink cables “preferred” over copper.
- Auto-negotiation turned off has a major impact on RSTP performance (can impact recovery by almost 6 seconds).
- In a highly meshed “network” a root bridge failure can cause the network to take up to 20 seconds to recover.

Infrastructure Lessons Learned

- IOP Host IT staffs need to be more involved prior to the IOP.
- Network infrastructure should have been staged prior to IED being plugged in.
- The best laid plans sometimes take too long to configure.
  - The full network infrastructure never got fully configured to support the IED/61850 testing as was originally intended.
  - Need to investigate how to streamline configuration (maybe an SCL like configuration file for switches).

SCL – IEC 61850-6

- Test Approach:
  - Exchange of SCL for IED Configuration
    - primarily Configured IED Description (CID)
  - Exchange of SCL to create Substation Configuration Description(s) for exchange.

Every participant had to participate either as a IED exchange or System exchange.

The exception to the rule: Switches are not considered IEDs (yet?).

SCL IOP Results

- No “complete” SCL validating tool exist, XML validation is not SCL validation
- Not able to properly interpret the XSD without reading -6.
- A good percentage of problems have been addressed in ED.2
- There has not been a validated release of the ED.1 XSD + Technical Issues (TISSUE) fixes.

SCL Lessons Learned

- Clarifications/user guide may be useful
- SCL allowed the IOP to come together rather quickly.

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IEC 61850-9-2
Sample Values (SV) Process Bus

- Test Approach:
  - Validate UCA Users Group Usage guide for 9-2LE
  - Merging Units and Simulators provided by:
    - Alstom Grid
    - RTDS Technologies
    - Schweitzer Engineering Laboratories (SEL)
  - Subscribers provided by:
    - KETOP
    - Alstom Grid
    - Schweitzer Engineering Laboratories

SV IOP Results

- Question of SampleSync values (an additional value was added in V3 of UCA 61850-9-2LE but V3 was never published).
- SCL example in the standard is not correct.

GOOSE – IEC 61850-8-1

- Test Approach:
  - Validate FCD (Functionally Constrained Data – complex structure) and FCDA (Functionally Constrained Data Attribute – singel value) exchange.
  - Validate detection of communication loss and Time Allowed to Live (TAL) processing
  - “Test” bit behavior.

GOOSE Participants

- Publishers And Subscribers
  - Alstom Grid
  - Efacec
  - GE
  - Prosoft-Systems
  - RTDS Technologies
  - Schneider Electric

Siemens

Schweitzer Engineering Laboratories

SISCO

Toshiba

Triangle Microworks

ZIV

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GOOSE IOP Results

- Many issues clarified in ED.2
- Need to forward a Tissue regarding a transition indication from Test to Non-Test.
- Need to come up with a recommendation in regards to how to handle a mismatched configuration.
- May need to come up with best implementation guidance regarding IEC 61850-7-3 information to be supported so that “common” datatype transformations are readily available.
- Determined that leaf FCDA exchange is the least common denominator that enables interoperability.

Client Server – IEC 61850-8-1

- Test Approach:
  - Validate FCD and FCDA exchange.
  - Validate typical control and reporting patterns
  - Transfer and interoperability of transient disturbance files (COMTRADE).

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Client/Server Participants

- Clients
  - ARC Informatique
  - Efacec
  - OSIsoft
  - Prosoft-Systems
  - Siemens
  - SISCO
  - Triangle Microworks
  - ZIV

Servers

- Alstom Grid
- Efacec
- GE
- Prosoft-Systems
- Schneider Electric
- Siemens
- Schweitzer Engineering Laboratories
- Toshiba
- Triangle Microworks
- ZIV

Client/Server IOP Results

- Determined “how” to solve the issue of COMTRADE file location and naming. Will need to add specific guidance in IEC 61850 8-1.
- Need to come up with better test methodologies for purging report buffers.
- Should recommend that FCD be preferred for reporting members.

SNTP – IEC 61850-8-1

- Test Approach:
  - Make sure that SNTP time synchronization worked.
  - SNTP source: RuggedCom
  - SNTP Clients:
    - Alstom Grid
    - Efacec
    - GE
    - Prosoft-Systems
    - Schneider Electric
    - Siemens
    - SISCO
    - Toshiba
    - ZIV

Results: It worked.

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Issues that span technological groups

- Use of VLANs: Network Infrastructure and IEC 61850-8-1
  - IEC 61850-8-1 default configuration with VLAN 0 vs the way substations should be implemented.
  - IEEE 802.1q and its impact on VLAN usage and text in IEC 61850-8-1.

Impacts: IEC 61850-90-4, IEC 61850-8-1, and IEC 61850-9-2.

More…

- Need IEC 61850-90-4 to be explicit about the impact of not using VLANs and Multicast Filtering.

General Comments

- Major benefits for the 61850 suite of standards.
- Allowed vendors to improve their products.
- Utilities/witnesses observed that 61850 is interoperable.
- Encountered issues were typically fringe conditions.
  - A high percentage of the executed tests had no issues (on previous slides).
  - Most issues were resolved during IOP through system engineering.
- Recommend implementation of ED.1 + Tissues.
- Detailed test result document(s) will be produced.
- Current IOP focused on IEDs. More concentration on system engineering tooling recommended in the future.

It was a WIN:WIN

A Big Thank You goes out to our witnesses

- EDF – France
- Endesa Distribucion - Spain
- EnerNex - USA
- KEMA – Netherlands
- Ketop Laboratories – China
- Prosoft-Systems - Russia
- Red Electrica de Espana - Spain
- Mikronika - Russia

And to the host: EDF

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Additional Information

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