Telephone Company Lease Line Elimination

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Lease Line Elimination

What's Happening?

Telephone Companies Eliminating Lease Line Services

AT&T in CA all less than 1.5Mbps by 2017
AT&T in CA all TDM by 2020
Support cut to 8-5, M-F

AT&T Single Channel Strategy Customer Communication (3/21/12)

Background Information

Single Channel Private Line Service, which consists of low-speed analog and digital service, has been part of AT&T's Private Line (PL) portfolio for approximately 50 years. The equipment and associated processes can not be supported in the long run without considerable investment and resources. The industry direction is to move to more advanced and higher speed services. Additionally, many manufacturers have stopped making the necessary equipment that supports low-speed PL. Many customers are already migrating to other solutions which consist of upgrading to a T1, AT&T VPN or wireless alternative.

AT&T has made a decision to exit from its Single Channel PL service portfolio and will be initiating the exit strategy in phases. These phases consist of grandfathering the service and then ultimately sunsetting (e.g. withdrawing) it in its entirety. It is recognized that this strategy will have an impact on customers and AT&T will proactively communicate the phases and offer potential alternatives as replacement options.

Impacted Services

The services impacted by the AT&T Single Channel Service strategy are identified below.

Interstate: Single Channel Services (speeds below 1.544 Mbps) consist of Voice Grade, DS0 and Fractional T1(FT1) IOC services as well as Voice Grade and DS0 Access Channels as described in the AT&T Bandwidth Services Service Guide located at http://new.serviceguide.att.com

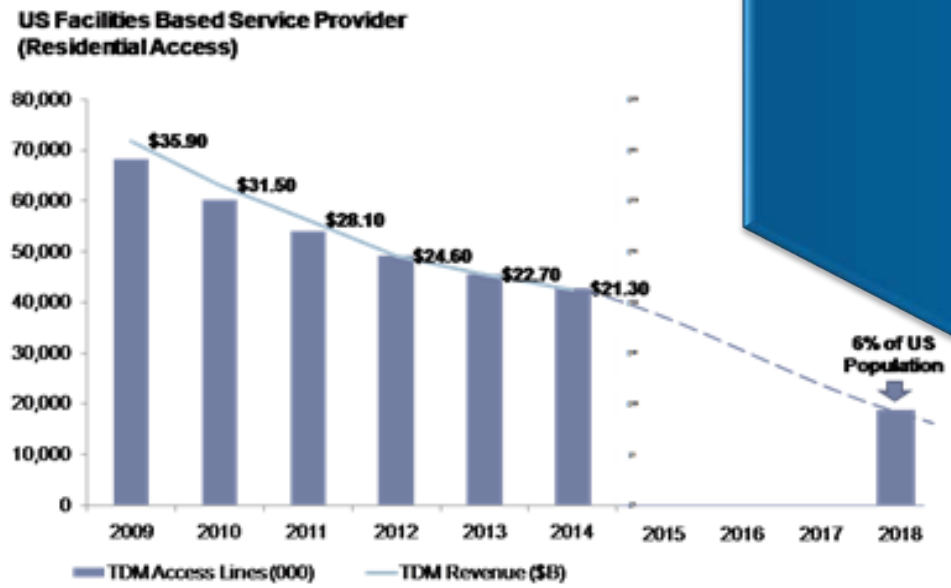
Private Line IOC consists of the following:
- *Voice Grade/Analog PL IOC*
- *DS0 IOC (9.6kbps, 56kbps and 64 kbps)*
- *FT1 IOC (128 kbps, 192kbps, 256 kbps, 320 kbps, 384, kbps, 448 kbps, 512kbps, 576 kbps, 640 kbps, 704, kbps, 768 kbps or 1.024 Mbps or 1.152 Mbps)*

Private Line Access Consist of the following:
- *Voice Grade/Analog LCS*
- *GDA (9.6kbps, 56 kbps, 64 kbps)*
- *DDLC 1&2 (2.4 kbps, 4.8kbps, 9.6kbps, 56 kbps, 64 kbps)*

Why's it Happening?

MONEY!

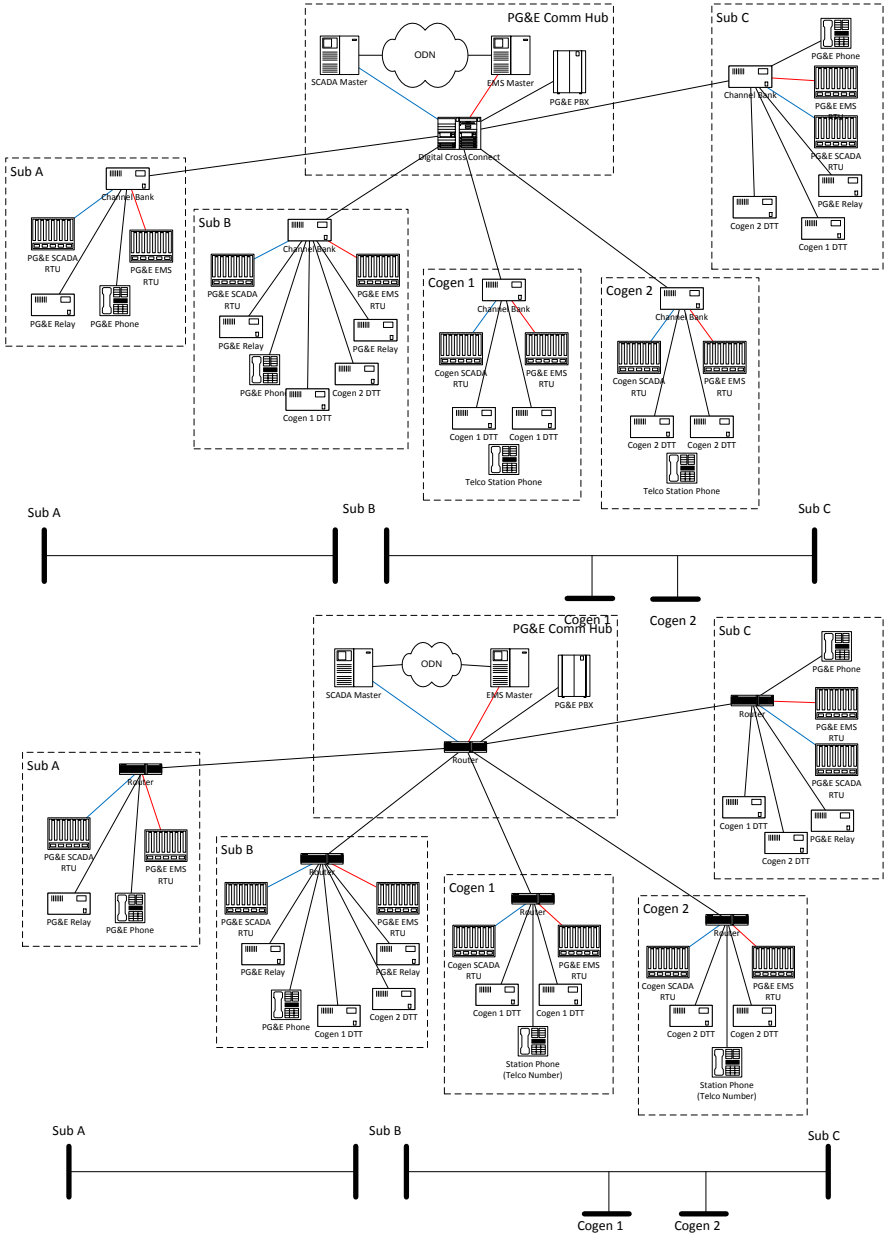
Conversion to Wireless
Reduction of "Land Lines"
Diminishing Work Force Expertise
FCC Rule Changes



Source: National Center for Health Statistics

What's Replacing Leased Lines

- Build Private TDM Communications
  - Self-Control
  - Reduced Lease Costs
  - Extremely High Bandwidth
  - Without Carrier Support Will Go Away Eventually
  - High Capital Expenditure
  - May Be too Much Work Before Sunset
- Convert Leases from DS0s to DS1s
  - They Will Be Around Longer
  - More Circuits Available on a T-1 Promotes Growth
  - Increased Lease Line Costs
  - Loss of "Class A" Functionality
  - They Are Still Going Away
- Convert to Ethernet
  - Long Term Support from Carriers
  - Economical
  - Extremely High Bandwidth
  - Are you sure that's going to work?



Teleprotection over Packet

Real Life Implementations

i-PCGRID Conference

March 27th, 2015

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Agenda

- Overview
- Requirements for delivering Teleprotection
- Challenges over a packet network
- Case Study 1 - Multiple Rings
- Case Study 2 - Multiple Carriers
- Learned Lessons
- Summary

Teleprotection Requirements

- Security
- Dependability
- Very strict delay
  - 10ms max for network or infrastructure
  - 250 Micro Sec Diff Delay Max
- Strict Delay Variation
  - Reduces Delay
- High Traffic Survivability
  - Network Switchover - is 50ms short enough?

Delivering Teleprotection

Minimize Delay
- Custom built low delay architecture
- Appropriate configuration

Maximize Traffic Survivability
- Zero-Loss or near Zero-Loss traffic resiliency

Diverse Interfaces
- Serial
- Audio-Tone
- C37.94
- G.703

NERC CIP compliant
- Security Hardening

Environment Compliance
- IEEE-1613

RFL

Solutions for an evolving world.

Technology For Delivering Teleprotection over Packet

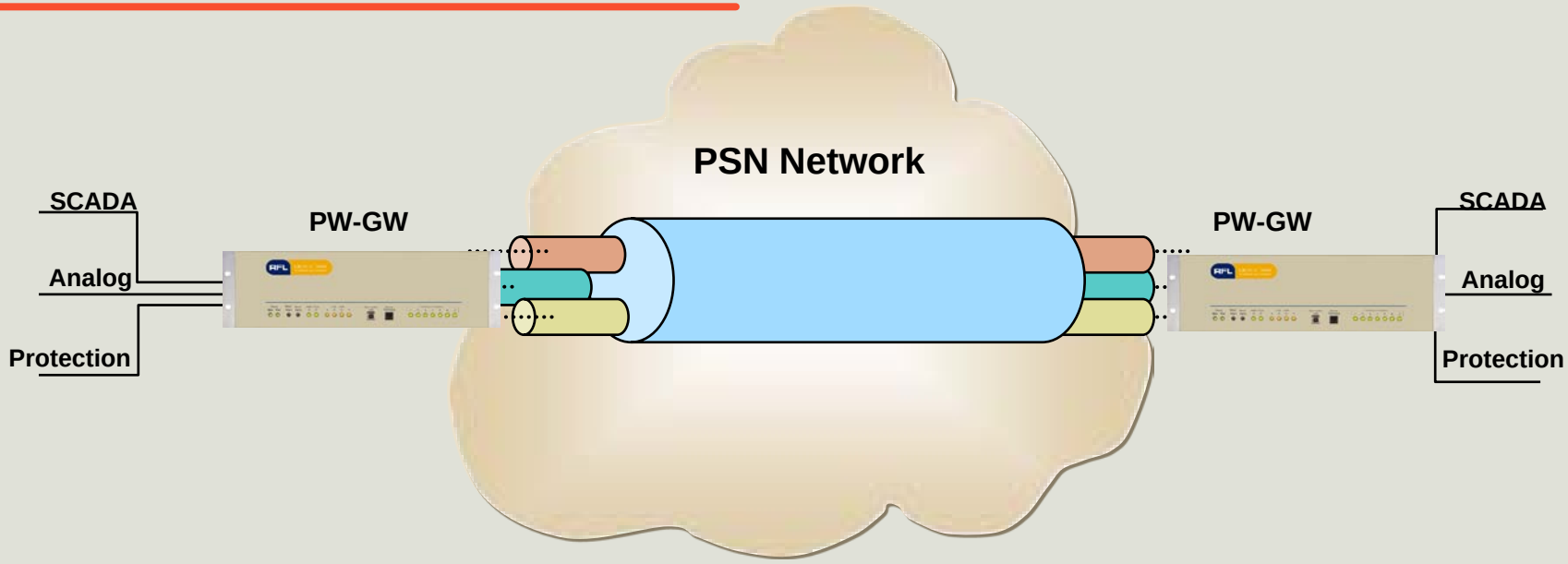
Strict Network Control
- Controlled Network Delay and switching
- Accurate QoS

Interworking Mechanism
- Pseudowire Trunking
- IEC-61850 Gateway

Accurate Timing Reconstruction
- PTP
- ACR
- IEEE-1588v2
- External: GPS
- Others: SYNC-E? SONET?

Pseudowires

What is Pseudowire (PW)?



- Pseudo = Simulated, Seemingly
- Emulation of a native service over a Packet Switched Network (PSN).
- The native services can be ATM, TDM, Frame Relay or ETH, while the PSN can be ETH, IP or MPLS.
- Supports voice, data and video
- Provides a transparent tunnel through the PSN
- Provides clock distribution and synchronization over PSN

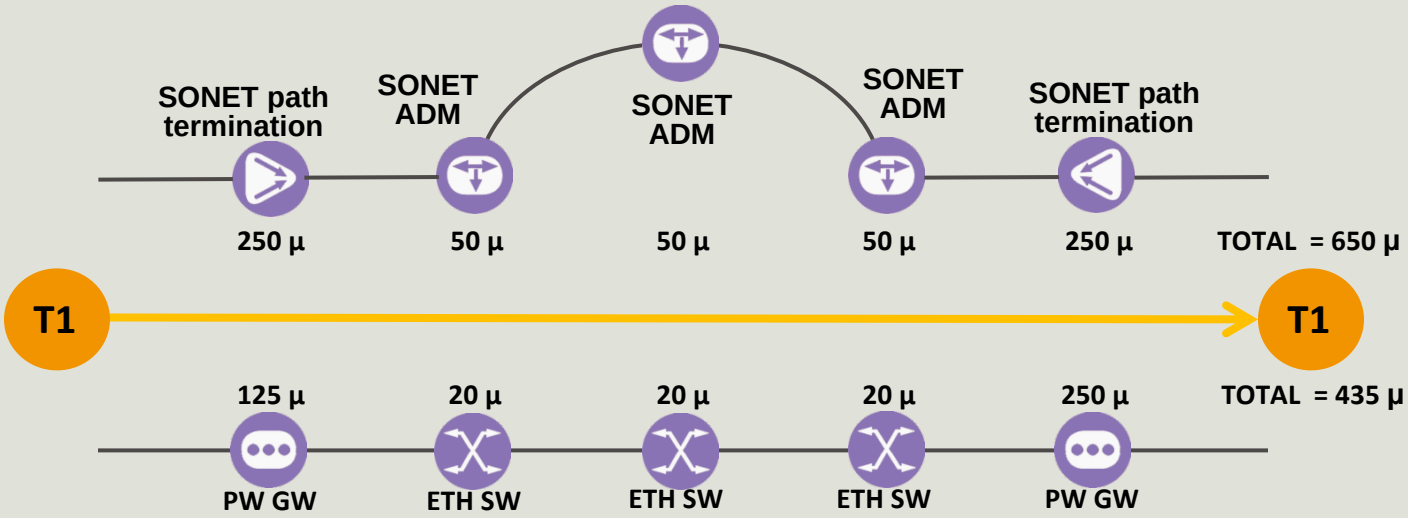
Delay in Pseudowire

During the conversion process
- Delay is added

Delay consists of:

- Device introduced delay (Vendor Specific)
- Packetization Delay (Vendor Dependent)
  - Waiting for the packet to fill up
- Jitter Buffer Delay (Vendor Dependent)
  - Compensation for network delay variation
- Transmission Delay

Packet or SONET/SDH - Debunking the Delay Myth



We compare the 1-way delay for transporting a single T1 in a VT15 to a single T1 in a SAToP TDM PW with fame padding over GbE
For the purposes of comparison, we assume the same number of network elements

The assumed SONET path consists of
- a path termination source (which adds 2 frame times)
- 3 SONET ADMs (we assume 50 µsec latency per ADM)
- a path termination sink (which adds 2 frame times)

for a total of 650 µsec plus fiber propagation

The assumed Ethernet path consists of
- a PW GW (which adds 1 frame delay)
- 3 Ethernet switches (each adds about 20 µsec delay pr switch)
- a PW GW with minimal jitter buffer (a frame time plus 125 µsec JB)

for a total of 435 µsec plus fiber propagation

We see that the TDM PW over Ethernet introduces less delay than the VT15 over SONET
This is because there are always 8000 SONET frames per second, while GbE switches transfer packets much faster

Case Studies

Case Study 1 - Multiple Rings

GULF POWER

Existing infrastructure was multiple T1 linear networks with no Ethernet access to substation

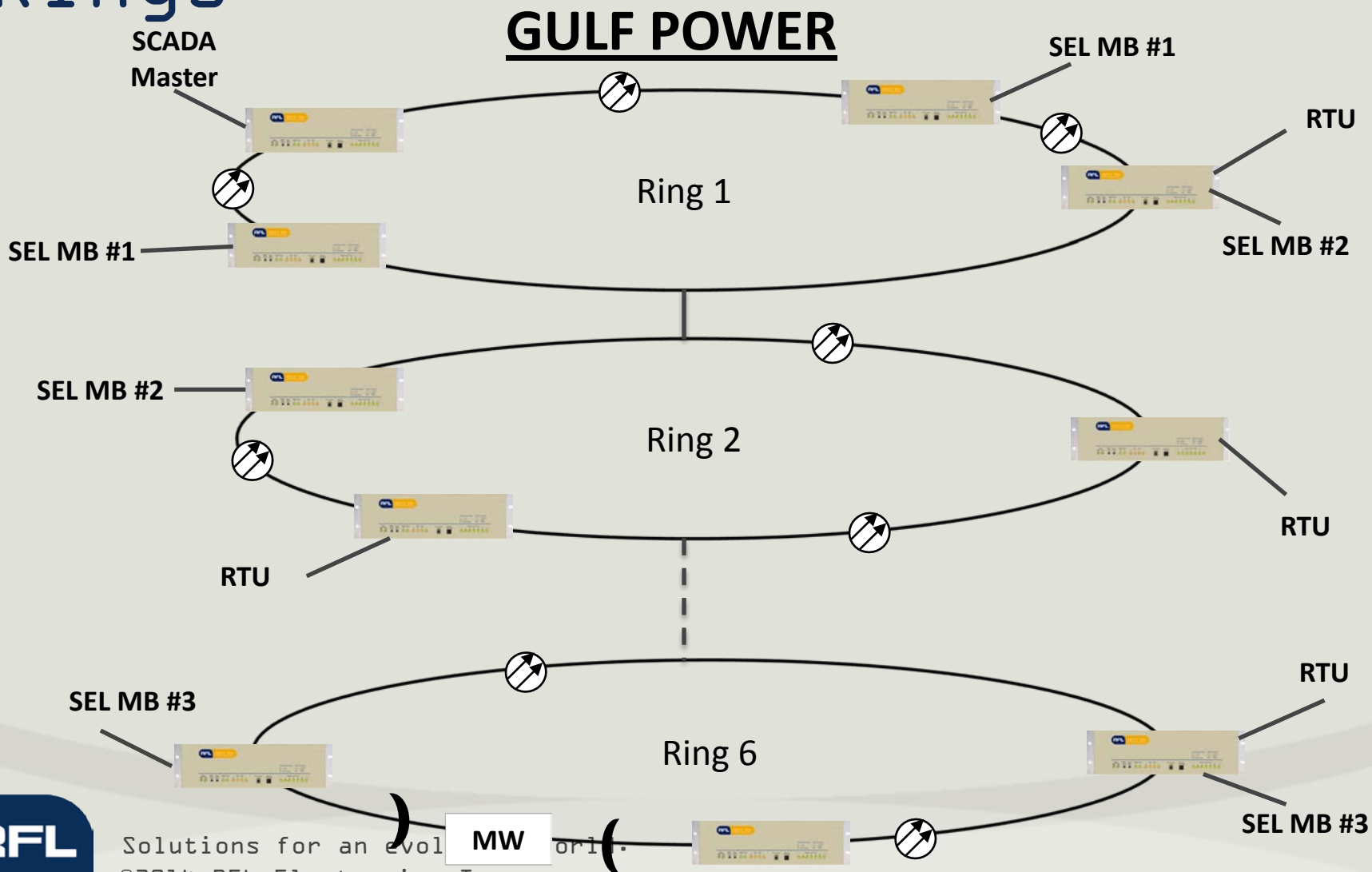
Transport & Network Requirements :

- SEL Mirrored Bits
- RS-232 & IP SCADA
- Corporate Ethernet Access
- eXmux Management Ethernet Access
- Resilient backup – Limited recovery period
- Easy to use

Highlights In Implementation

- Installed 6 rings
- Over 70 sites
- Clock distribution via ACR
- Zero Loss Resiliency
- Interconnected Ring Timing
- Traffic separation via layer 2
- Prioritization
  - Multiple networks on same physical infrastructure
  - Some services requiring very strict delay
- Close work with Teleprotection equipment provider

Case Study 1 - Multiple Rings



Case Study 2 - Multiple Carriers

North East US Transmission

Building a new infrastructure to replace obsolete carrier services

Transport & Network Requirements :

- Teleprotection
- RS-232 & IP SCADA
- Corporate Ethernet Access (Separate VLAN)
- eXmux Management Ethernet Access (Separate VLAN)
- Deliver traffic over a two packet networks
- Each network is different in delay and technology
- Cyber Security – needs to be prepared

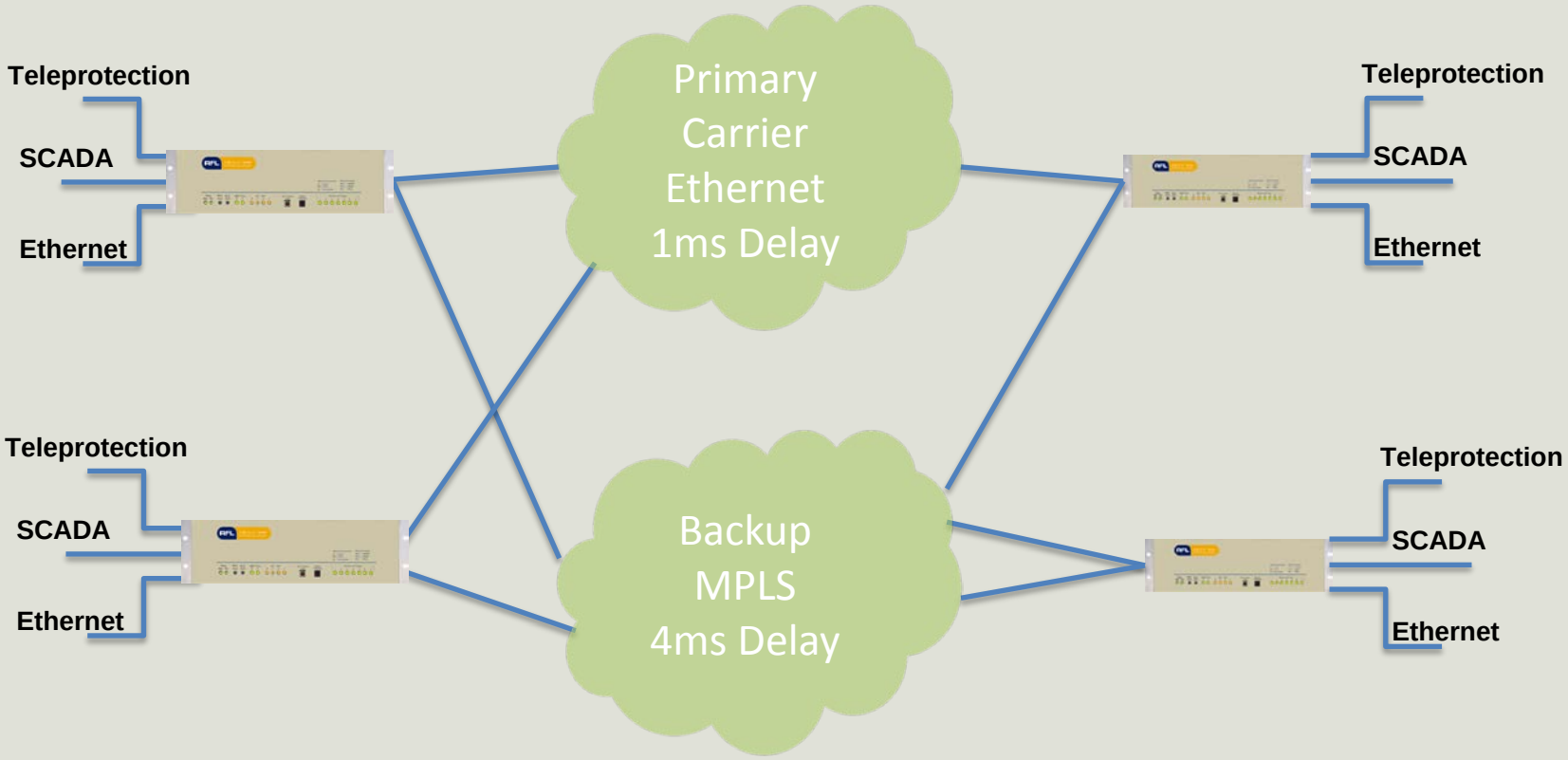
Case Study 2 - Multiple Carriers

North East US Transmission

Design Elements:

- Delay Optimization
  - No more than 2ms equipment and packetization delay
  - Compensation for variable delay (high delay variation)
- Automatic Switchover between primary/backup
- Zero-Loss on switchover
- Encryption of data
- Ease of Use management

Case Study 2 - Multiple Carriers



Lesson Learned

- Strict QoS Required
- Traffic Survivability - Highest available, ideally Zero-loss
- Adjustable Delay Variation (w compensation)
- Limit the size of rings
- Layer 2 and Layer 3 networks could be used
  - Flexibility in networking
- Close work with Teleprotection implementation
- Trial and re-trial

Summary

Delivering Teleprotection over packet is challenging

Success can be dependent on the implementation details of the technology

Diversity of architecture is critical

Protection Diversity means support diversity

Past experience is critical for a smooth migration

You can move forward with migration today

Thank You For Your Attention

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