Network Support for Systems Moving to IP

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Utilities, Transportation and Migration

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Agenda

- Migration challenges
- The hybrid approach
- Migration steps
- Technology enablers
- Sample application

Packet is the Way to Go

- Ethernet transport and IP/Packet-based networks gradually gain traction for higher throughput and lower OpEx
- Upgrades to Smart Grid foster transformation
- Combination of Ethernet capabilities (IEC 61850) with legacy voice and RTU support required at substations
- Video surveillance is bandwidth demanding
- Infrastructure wholesale services require network scalability

Next Generation Migration Challenges

Manage migration economically

- Avoid CapEx hikes
- Continue using legacy installed-base
- Ensure service quality for mission critical apps (e.g., Teleprotection)
- Avoid over-burdening network operations and management
- Maintain smooth operation of current networks
- Replace discontinued vendor products

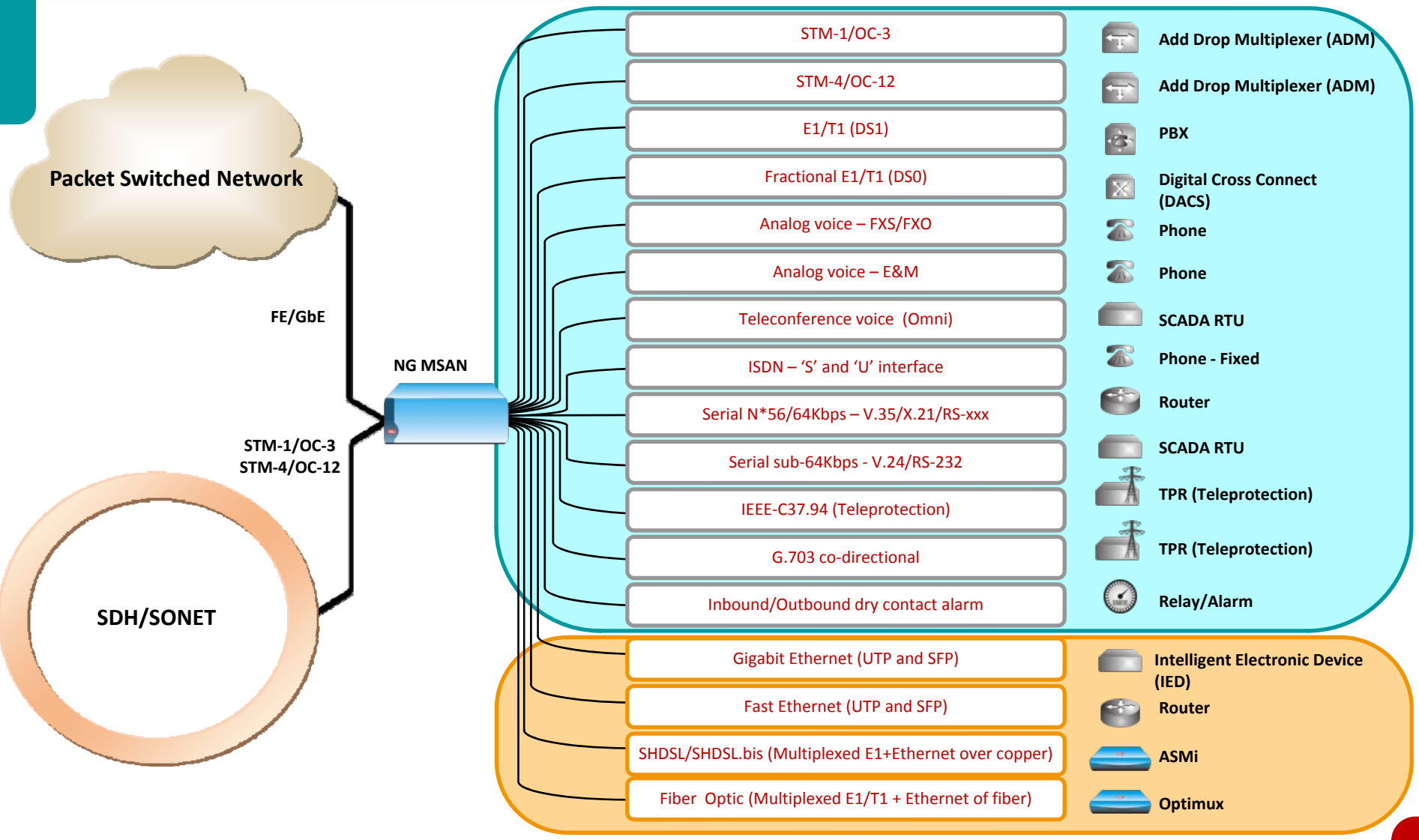
Smart Communications over Packet

- Service assurance for mission critical apps in a PSN environment:
  - Low end-to-end delay
  - High Availability
  - SDH/SONET-level resiliency
  - Differentiated quality of service
  - Lower OpEx using OAM

The Hybrid Approach

- Hybrid SDH/SONET and PSN access for seamless migration
- Extensive support for legacy services and interfaces
- Future proof Ethernet capabilities
- Enhanced connectivity for any topology
- System solutions: CPE, grooming and aggregation with unified management
- Pure transport over any media for service extension

A Hybrid Solution – NG MSAN



5 Steps for Smooth Migration

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1. Add new services

- Add Ethernet/IP services to existing and new locations

2. Utilize existing infrastructure

- Use existing SONET/SDH network to transport Ethernet/IP services

3. Set up a packet switched network

- Build a carrier grade packet network with smart provisioning and monitoring tools

4. Hybrid approach

- Continue using SONET/SDH for legacy TDM and mission critical services; transport non critical Ethernet/IP traffic over the PSN

5. Complete migration

- Fully migrate all services, including legacy TDM and mission critical apps over the PSN

Migration Technology Enablers

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TDM Support

- Continued support for legacy TDM and industry specific interfaces

Next Generation SONET/SDH

- Utilize existing SONET/SDH infrastructure to transport Ethernet services in an efficient and optimized way

Pseudowire

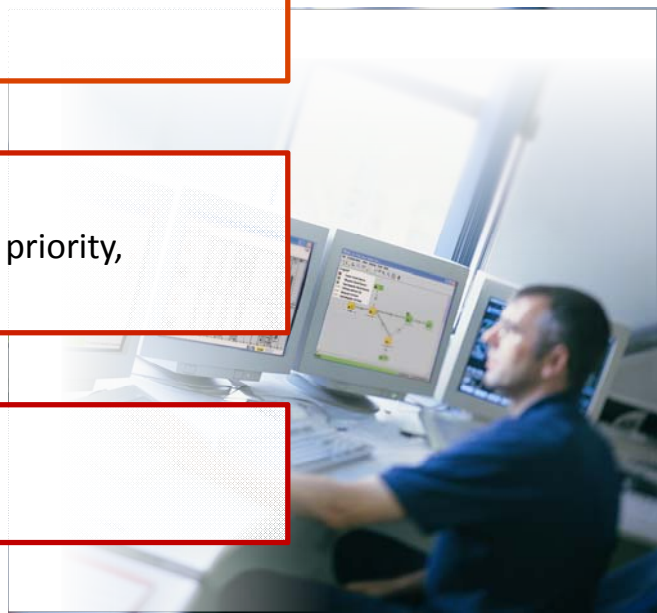
- Transport existing TDM services over packet switched networks

Carrier Ethernet

- Provision and monitor critical services using an Ethernet network, assuring priority, availability and minimal delay

Timing Over Packet

- Transport accurate clock signal over an asynchronous network



Migration Technology Enablers

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TDM Support | Next Generation SONET/SDH | Pseudowire | Carrier Ethernet | Timing Over Packet

- STM-1/OC-3
- STM-4/OC-12
- E1/T1 (DS1)
- Fractional E1/T1 (DS0)
- Analog voice – FXS/FXO
- Analog voice – E&M
- Teleconference voice (Omni)
- ISDN – 'S' and 'U' interface
- Serial N*56/64Kbps – V.35/X.21/RS-xxx
- Serial sub-64Kbps - V.24/RS-232
- IEEE-C37.94 (Teleprotection)
- G.703 co-directional
- Inbound/Outbound dry contact alarm

Migration Technology Enablers

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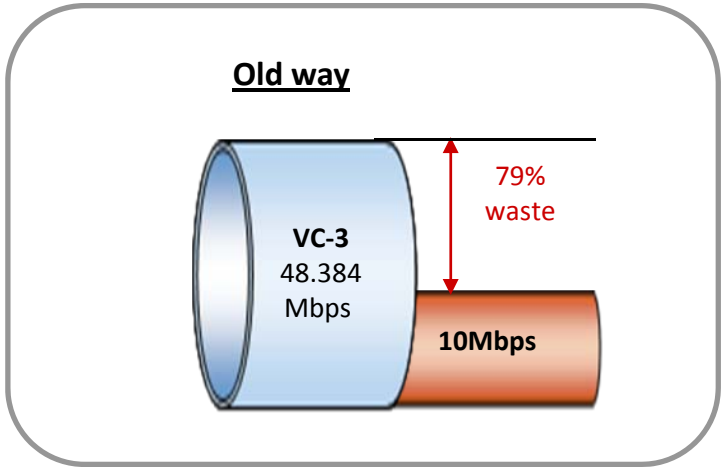
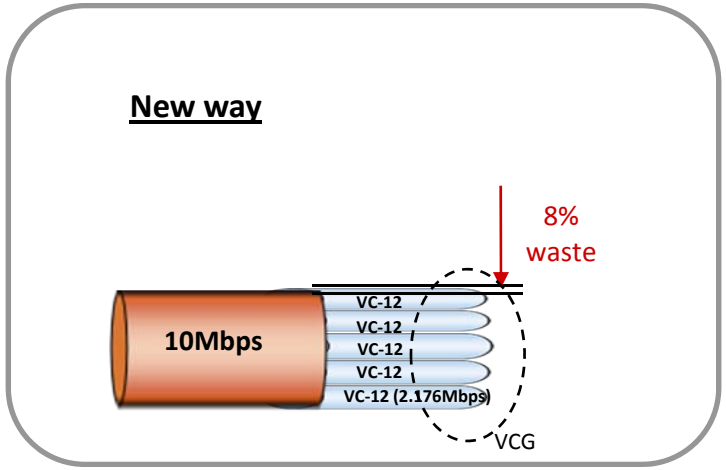
TDM Support | Next Generation SONET/SDH | Pseudowire | Carrier Ethernet | Timing Over Packet

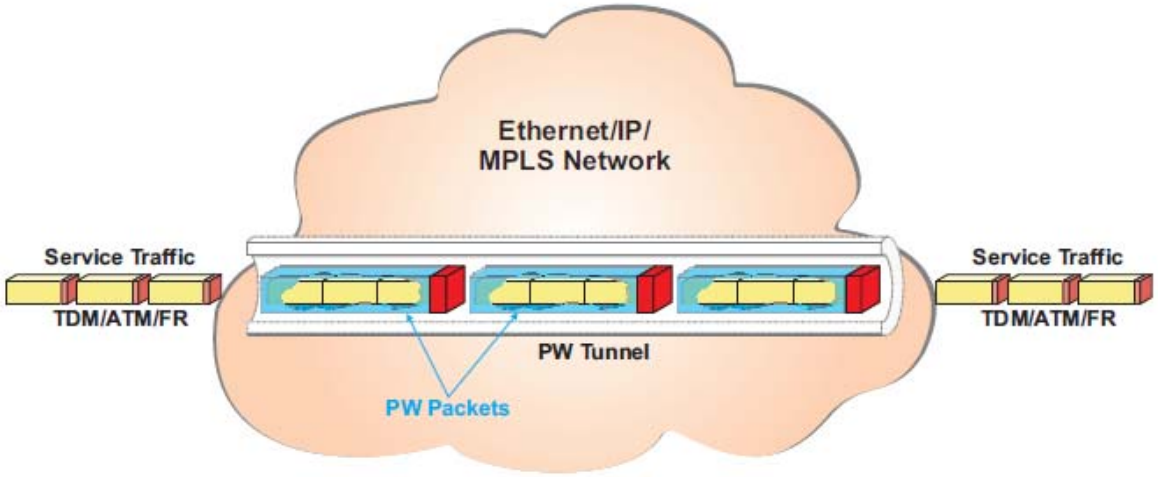
- VCAT – Virtual Concatenation – An inverse-multiplexing technique that allows granular increments of bandwidth in single VC-x units
- VCG – A set of x containers known as a Virtual Container Group (VCG)
- LCAS – Line Capacity Adjustment Scheme – enables dynamic allocation of bandwidth
- GFP – Generic Framing Procedure – A simple technique to connect Ethernet LANs and to provide LAN extensions over SDH/SONET





Migration Technology Enablers

- The synchronous bit stream is segmented
- Headers are added to each segment to form the packet
- Packets are forwarded to destination over the PSN network
- At destination, the original bit stream is reconstructed by removing headers, concatenating frames and regenerating clock



Migration Technology Enablers

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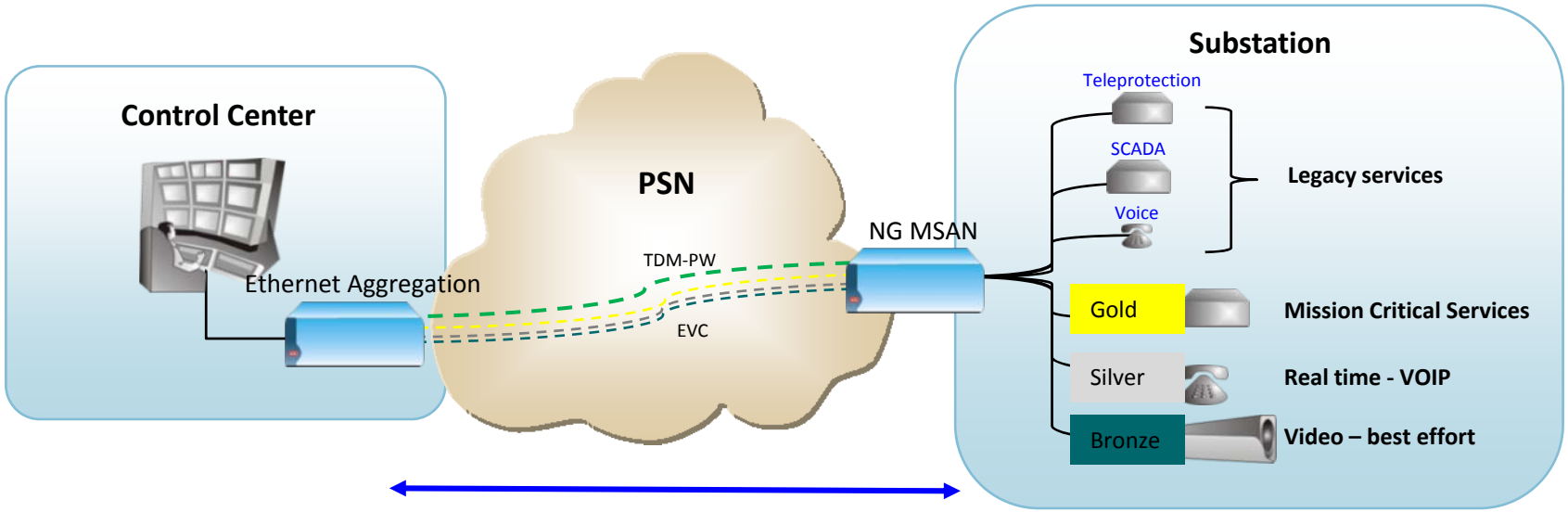
TDM Support | Next Generation SONET/SDH | Pseudowire | **Carrier Ethernet** | Timing Over Packet

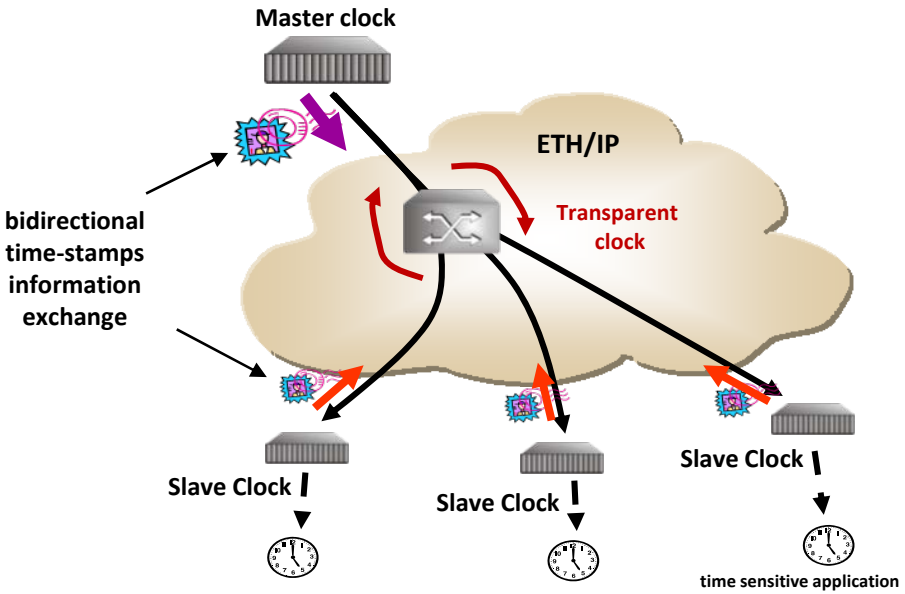
- Traffic management: For service classification, policing and shaping
- Ethernet OAM (Operation Administration and Maintenance): Provide the basic tools for carriers to monitor, diagnose and troubleshoot first-mile Ethernet access links
- Performance Monitoring (ITU-T Y.1731): Answers the need to meet user expectations for SLA accountability



End-to-end service control, SLA monitoring and diagnostics and accurate timing

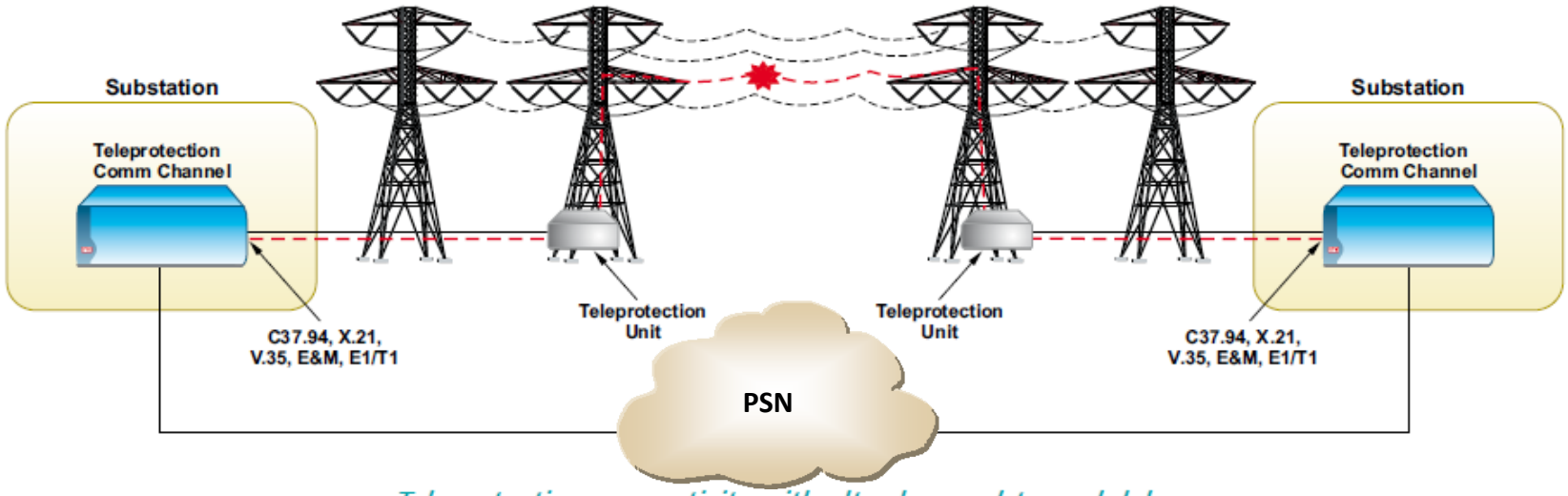
Migration Technology Enablers

- ToP is an alternative for GPS clock in each location
- Based on SYNC-E and IEEE 1588v2
- Provides accurate clock source for:
  - Sequence of events and fault recording
  - Process bus interconnecting RTUs
  - Phasor Measurement Units (PMUs)



Sample Application: Teleprotection Connectivity over PSN

- Deliver Teleprotection signals with mission-critical accuracy over a packet switched network
- Ensure low end-to-end propagation delay, minimal jitter and robust protection
- Maintain performance levels (dependability and security) over PSN with hard QoS, Ethernet OAM and performance monitoring



Teleprotection connectivity with ultra-low end-to-end delay

Summary

- Utility networks require extensive support for legacy services and interfaces
- Packet technologies gain traction both for services and networks
- Utilities face economical and technological challenges
- Hybrid TDM-Ethernet approach ensures minimal capital and operational expenses
- There are numerous technology enablers that ease the migration process

Thank You For Your Attention

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