ICON® Deterministic Packet Transport

Guarantee fast and dependable operation for power protection and mission-critical applications.

- ICON Ethernet packet transport provides deterministic and minimal data communications latency.

- Minimal propagation delay with a 13 µs jitter buffer size ensures no packet delay variation.

- Restoration of communications traffic within 5 ms minimizes network-wide service disruptions.
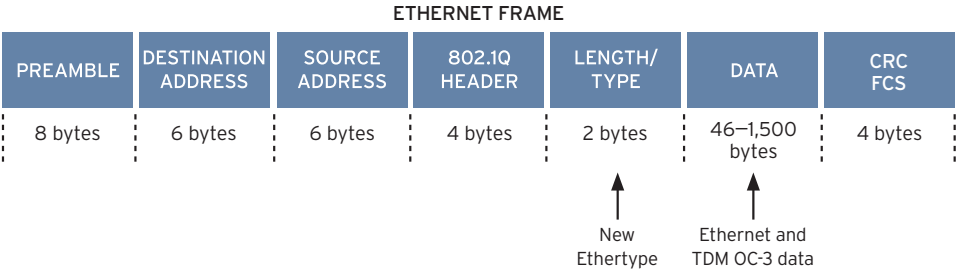
SEL

TDM and Ethernet—Get the Best of Both Technologies

Teleprotection is a mission-critical service that requires low-latency deterministic communication, which is very difficult to achieve with Ethernet. Time-division multiplexing (TDM) can guarantee the low latency and determinism required for relay teleprotection. Deterministic packet transport technology in the SEL ICON Integrated Communications Optical Network combines TDM and Ethernet to maintain low-latency deterministic communication for teleprotection while capitalizing on the flexibility of Ethernet for other applications, with no tradeoff in performance.
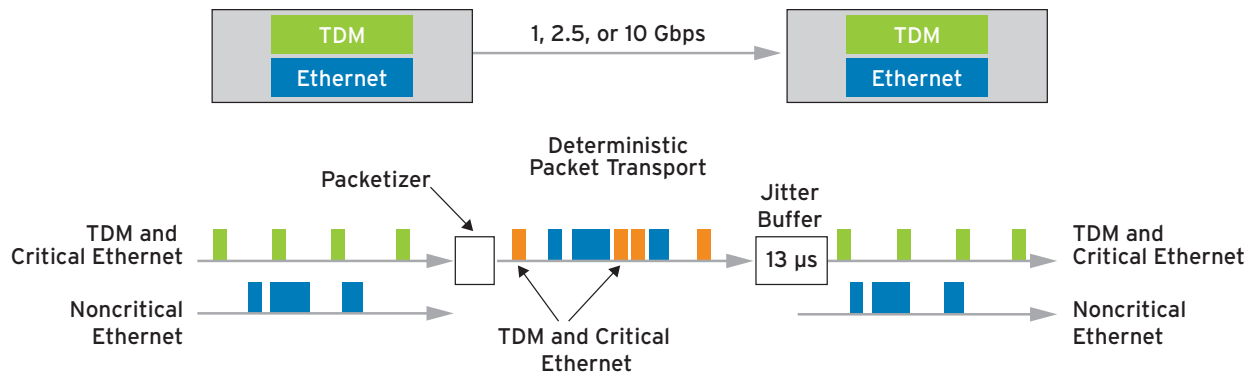
Deterministic Packet Transport Concept

ICON deterministic packet transport provides the innovative approach of delivering mission-critical traffic with low and deterministic latency over an Ethernet transport network. The concept is to preserve the performance characteristics of TDM, which are presently available in the ICON synchronous optical network (SONET) platform, with no performance degradation when converting to Ethernet as a transport protocol.

The ICON deterministic packet transport solution uses a standard Ethernet frame with a new Ethertype that packetizes a SONET's payload into regularly spaced, fixed-length packets. To ensure that the packet is not buffered longer than the time required for a maximum-length standard Ethernet packet, ICON will always egress the deterministic packet as the next Ethernet frame.

ETHERNET FRAME

PREAMBLE	DESTINATION ADDRESS	SOURCE ADDRESS	802.1Q HEADER	LENGTH/ TYPE	DATA	CRC FCS
8 bytes	6 bytes	6 bytes	4 bytes	2 bytes	46–1,500 bytes	4 bytes

New Ethertype

Ethernet and TDM OC-3 data

Packetizing at SONET STS-1 line rates, versus circuit emulation on DS0 or DS1 rates, allows for less packetizing overhead and smaller jitter buffers, decreasing latency between nodes. For example, OC-3 TDM bandwidth sampled at 90,000 packets/second can be transmitted at a regular interval (~11 μs for 1 Gbps line rate) with a hard-coded highest priority. If the largest Ethernet packet size of 1,536 bytes has started to egress the fiber port just prior to the OC-3 TDM bandwidth egress, the most it would have to wait is ~11 μs. With a 13 μs jitter buffer on the ingress far end, the OC-3 can be realigned for jitter-free Ethernet transport.
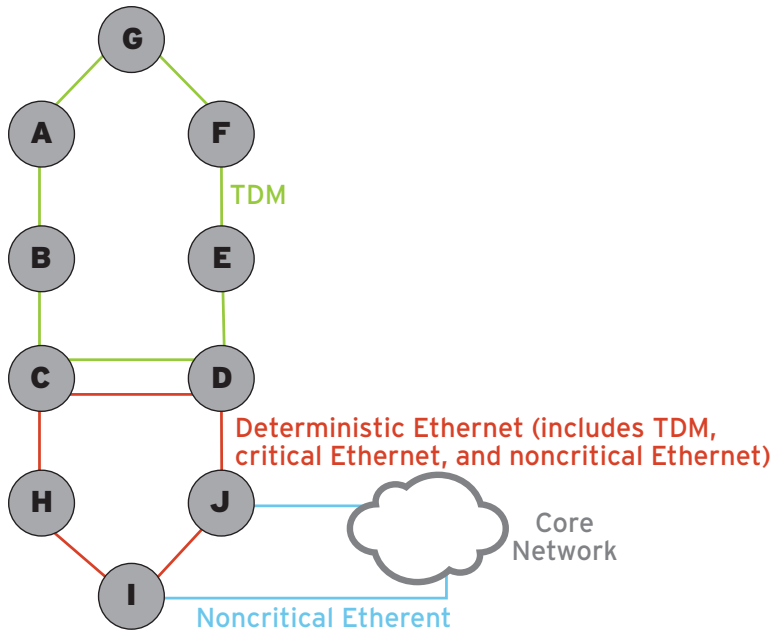

ICON deterministic packet transport is intended for mission-critical operational technology (OT) systems, including power utility and industrial control system applications. The performance of the OT wide-area network (WAN) is crucial to fault-clearing times and the restoration of circuits used in communications-assisted protective-relaying schemes. The ICON is purpose-built for dependable communications for mission-critical data in substation-hardened environments, and its deterministic packet transport implementation offers the best solution to preserve that performance when using Ethernet as the transport technology.
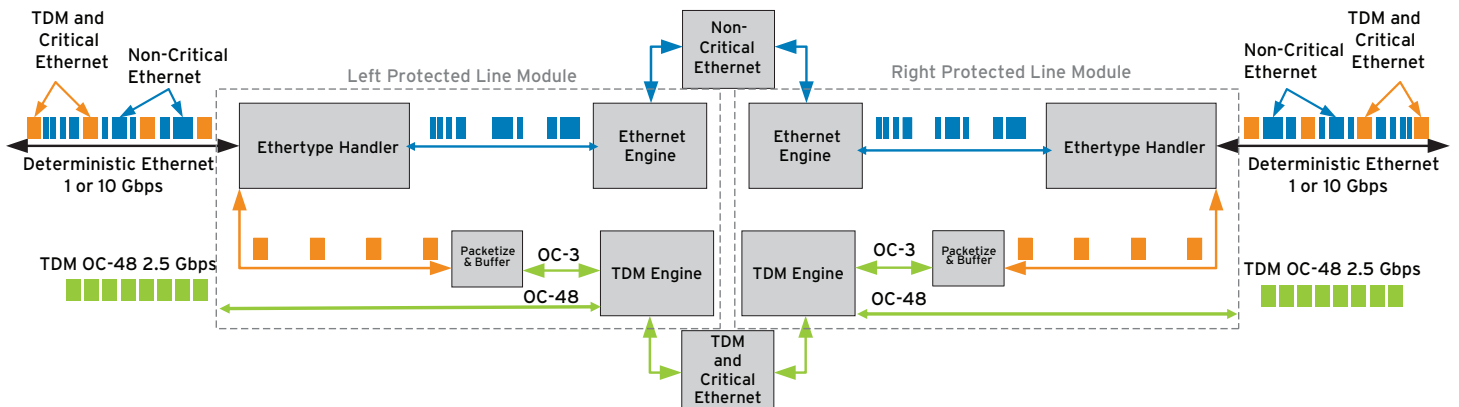
Flexible Interoperation With Packet Core Network

The SEL ICON is designed to provide low-latency services for substation and OT applications. With ICON, TDM and TDM-encapsulated services can be provisioned across substation facilities while allowing native Ethernet services to transit through core network infrastructure. By complying with Ethernet standards for the ICON's transport technology, Ethernet services can be passed into core network infrastructure, enabling the ICON to interoperate with Multiprotocol Label Switching (MPLS) or Carrier Ethernet-based core networks.

TDM

Deterministic Ethernet (includes TDM, critical Ethernet, and noncritical Ethernet)

Core Network

Noncritical Etherent

Features

- In-service conversion of ICON SONET infrastructure to Ethernet
- No reprovisioning of existing TDM services
- Deterministic TDM performance
- Interoperability with other Ethernet networks

Performance

- <1 ms equipment propagation delay
- <5 ms ring restoration time
- <1 μs time distribution
- No need to compromise protective-relaying performance