Question 3.6: At the remote site level, for example at the substations, where multiple services exist, discuss the techniques used to segment, isolate and apply service differentiation in a multi-service packet-switched network. A challenging example is the case of protection relays – discuss the approaches that can be used in designing a packet-switched network to securely segregate the two services (SCADA and relay management), both of which are applicable to protection relays – you may choose to submit your contribution to include this challenging example, or you may choose to contribute other example cases if desired.

Service isolation and differentiation in a multiservice MPLS-TP packet-switched network.

There is a growing need for a packet-switched transport network for the Operational Telecom (OT) to address end of life PDH and SDH products along with the growing demand for higher bandwidth capacity to support Ethernet services like IoT, CCTV, IEC61850, GOOSE and R-GOOSE.
Migrating from a Time Division Multiplexed (TDM) network to a packet -switched network comes with many challenges. A typical OT network requires the network equipment to support multiple services like teleprotection, with current differential protection as its most critical service, voice and SCADA alongside the emerging ethernet applications. It is vital that the packet-switched network is as reliable as the TDM network to assure the delivery of the most critical applications.

MPLS-TP is a protocol defined by the International Telecommunication Union (ITU-T) and Internet Engineering Task Force (IETF) to address the needs and requirements of an operational telecom network. The standard is designed to support all mandatory OT features. It is secure, reliable, deterministic, easy to use with good monitoring and especially strong traffic engineering capabilities.

These strong traffic engineering capabilities are required to isolate all the different applications on the packet - switched network. In MPLST-TP, service segregation is addressed by making use of a service described in RFC 5454. This service can be point to point, point to multipoint or multipoint to multipoint. For a client layer network service transported by the MPLS-TP a Pseudo Wire can be used for the adaptation. (RFC 5921)

Pseudo Wire Emulation Edge-To-Edge (PWE3) described in RFC 3916 emulates the essential attributes of the services transported over the network. It assures the application's PDU timing and order on the network. A pseudo wire is an unshared link from the application's perspective that isolates, and transparently transports the application over the network, Edge-to-Edge.

In the specific case of the utilities for example, all applications such as current differential protection, SCADA, voice and Ethernet, can be segregated in MPLST-TP by pseudo wires for both Ethernet and Circuit Emulated Services.

Clean service segregation is only one part of the puzzle. Service differentiation to provide Quality of Service (QoS) is essential for secure and reliable transport of these services over a packet-switched network. Preventing overprovisioning of the network by assigning a dedicated bandwidth to each individual service running over the network, not only assures the delivery of the most critical services but assures delivery of all the services. Congestion in one service will never impact the other.

Furthermore, the most critical applications, like current differential protection, are delay sensitive. It is essential to transport these services with an absolute priority to assure a constant delay. Assigning a strict priority to all services, with the highest priority assigned to the most critical services guarantees the delivery of these services without any impact on the delay.
Adding to the above, enhanced delay optimization like co-routed bidirectional paths defined in the MPLS-TP standard, jitter buffer equalization, clock drift prevention and a 1+1 protection switching are all required to guarantee the delivery of the most critical services in the power industry with the most optimal constant delay.

To conclude, the MPLS-TP standard provides secure segregation of services on a packet-switched network. The applications can be isolated and transported in a dedicated service via the Edge-to-Edge pseudo wire emulation. The services are transported securely over the network thanks to service differentiation with a 100% QoS achieved by the dedicated bandwidth assignment for each individual service and a strict priority assigned to each application. This assures the delivery of all applications and guarantees a constant delay for delay sensitive applications, meeting the stringent requirements of the power industry.