MPLS-TP

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Introduction

As data traffic started dominating telecom networks, there was a need for transport data networks, as opposed to transport TDM networks. Traditional transport technologies like SONET, SDH and recently developed OTN were geared towards voice traffic. There was a need for a technology that retained the best features of transport technologies but was packet switched in nature.

MPLS-TP (Multi Protocol Label Switching – Transport Profile) is an effort by IEEE & ITU-T to have a technology that meets all the requirements of transport networks but is packet switched in nature.

Connection Oriented Transport

One of the major motivations for developing MPLS-TP was the need for the circuits in Packet Transport Networks. Traditionally packet transport switches each packet independently. However with connection oriented transport a 'connection' is first setup between the end points and then all the traffic for that connection follows only that path through the network. This makes the Packet Transport Network very similar to the TDM networks and simplifies management and migration of the transport network.

The concept of Label Switched Paths or LSPs from MPLS technology is already tried and tested and successful in the internetworking world. It made sense to adapt it for use in Packet Transport Networks. However there was a need to simplify the working of MPLS to make it more suitable for use in the Packet Transport World.

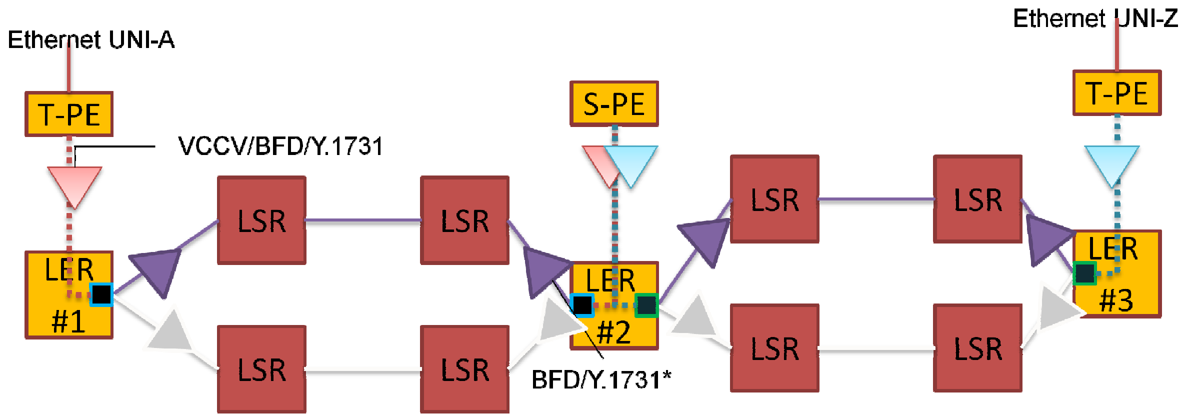
With this in mind, some features were removed from the traditional MPLS, since it was felt that these were not needed in Transport World and would simply the network. The features from MPLS that are not supported by MPLS-TP are:

a) MPLS Control Plane: MPLS-TP does not require LDP or any other control plane protocol to set up the circuits. Instead a user provisioned model is followed. The user can provision a circuit from a centralized Network Management System in a way similar to TDM networks.
b) Penultimate Hop Popping (PHP) : PHP is used by MPLS Edge Routers to reduce the load of two label lookups. However this causes problems with QoS and was disabled in MPLS-TP
c) LSP Merge: Merging two LSPs (going to the same destination) reduces the number of labels being used in the network. However it makes it impossible to differentiate between traffic common from two different sources before the merging happened. To simplify things in transport networks, LSP merge was also disabled.
d) Equal Cost Multi Path : In traditional IP/MPLS networks different packets between a source-destination pair can take different paths. This is especially true when multiple equal cost paths exist. However this is in conflict with the concept of a circuit where all the traffic should follow the same path. Hence ECMP is disabled.

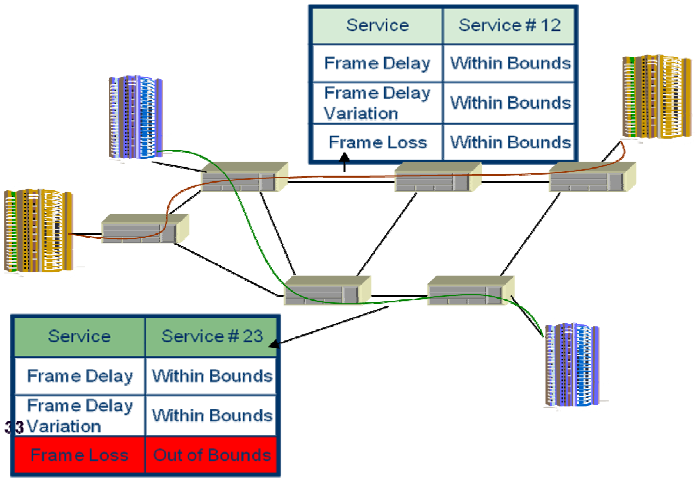
The introduction of circuits is key to adding a lot of functionality to transport networks. These are explored below:

OAM

Operations Administration and Maintenance has always been important for transport networks and one of the mail reasons for the success of SONET/SDH. Recent developments have brought this functionality to Packet Transport as well. Standards like IEEE 802.1ag, ITU-T Y.1731, Bidirectional Forwarding Detection (BFD), and LSP-Ping, LSP Traceroute enable OAM features on Packet Transport.

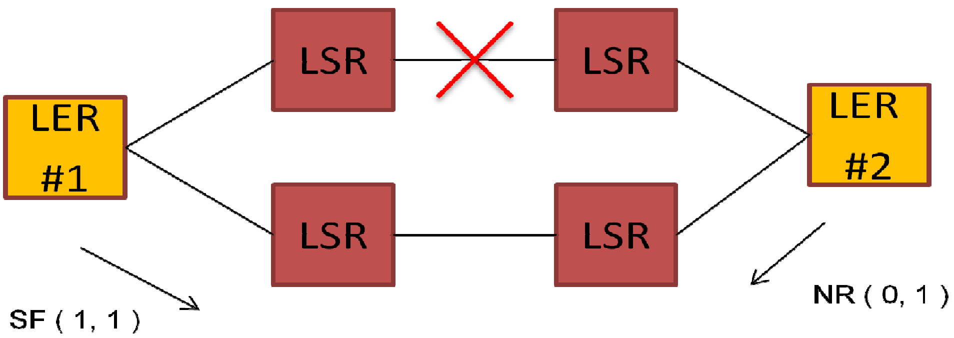


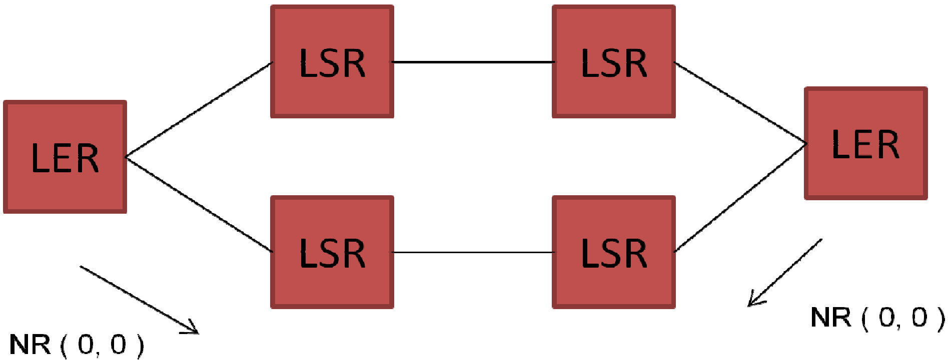
Alarms can be raised on certain events/failures, loopbacks can be used to localize faults and end-to-end connection parameters like throughput, packet loss, latency, latency variation (jitter) can be measured and continually reported. The OAM can be applied across multiple layers across the network. For eg, an End-to-End connection can be monitored, and also for a particular network operator or a particular subnet.



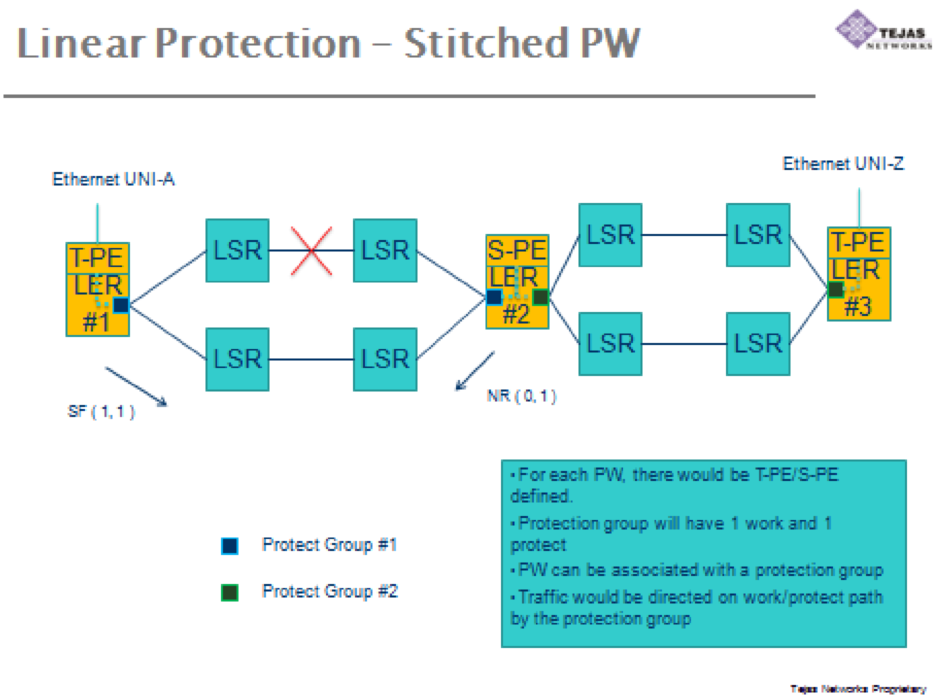
Linear Protection

Traditional SDH has offered end-to-end Path protection and that too within 50ms. The same was required from Packet Transport. Once Packet Transport had the concept of Connections or Circuits and there was OAM on those circuits (with alarms in case of failures) it became possible to detect faults and switch the traffic from work to protect path quickly. These protect paths would be pre-provisioned and kept ready, just like in SDH. This functionality has been standardized by ITU-T G.8031 standard.





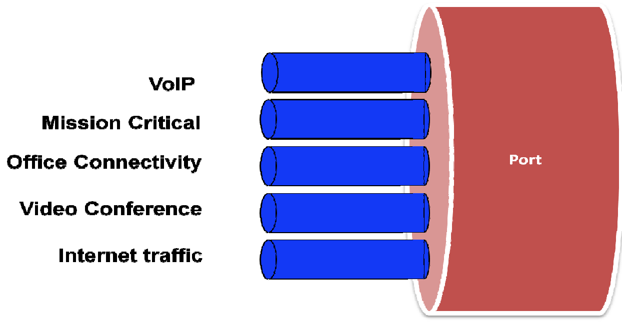
It is possible to define the protection as revertive or non-revertive and for the user to give forced switch or manual switch command. It is also possible to provide Linear Protection in a stitched pseudowire, where as shown below, as long as any path (work or protect) on Protection Group 1 is up, and any path (work or protect) on Protection Group 2 is up, the destination will be reachable.



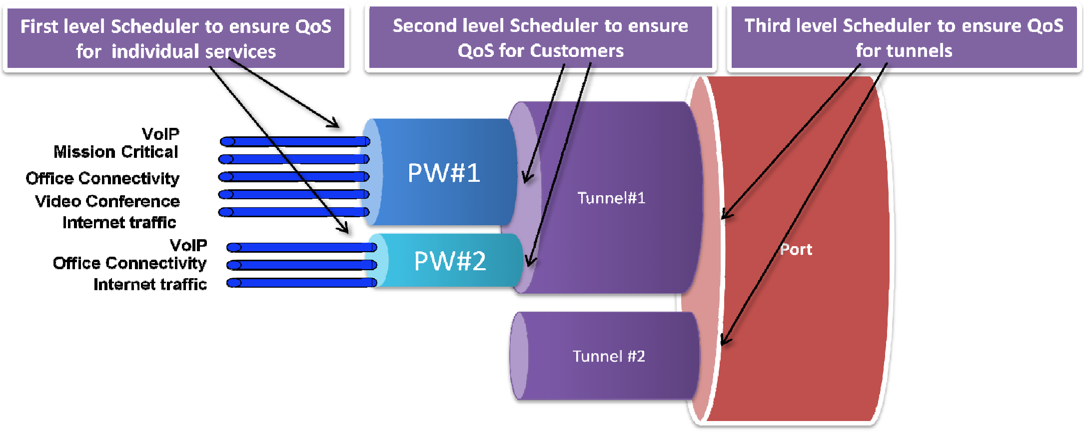
Quality of Service

In a packet switched network since all the packets share the same infrastructure, Quality of Service and prioritization are very important. A high priority or delay critical packet should not be held up in a queue by low priority or non-premium traffic. Hence all packet switched networks need QoS mechanisms.

MPLS & MPLS-TP label has a 3 bit Traffic Class (formerly called EXP bits). These can support 8 classes of service per LSP. At the LERs the IP or TCP header fields can be used to mark the TC bits or it can be statically provisioned by the service provider. With QoS, both a flat QoS and a hierarchical QoS model can be supported as shown below. Hierarchical QoS can ensure fairness of service between different services, between different customers and across different tunnels.



Flat QoS. All the traffic will be prioritized based on PCP/IP DSCP field



Hierarchical QoS: 3 Levels of QoS

- First level scheduler ensures that each CoS within a service gets the promised bandwidth.
- Second level scheduler ensures that service (pseudo-wire) gets the required priority within a tunnel
- Third level scheduler ensures that each tunnel get the requisite priority within the egress port

Scalability

MPLS-TP follows a label similar to MPLS. The label has 20 bits for label value which allows for 1 million unique labels. In addition, label stacking allows multiple levels of hierarchy to be created. There's no limit on the number of levels that can be stacked. This makes MPLS-TP, just like MPLS highly scalable. One limitation of MPLS was that the entire database of network topology had to be present on each router. Since each router had limited memory and processing power, they could handle only a particular network size. In MPLS-TP by moving all this intelligence to a central NMS, we not only increase the scalability of the network, since high capacity multi-processor servers can be deployed to do this processing, but the individual nodes become simpler and cheaper.

Summary

MPLS-TP combines the best of both worlds TDM and Packet. It inherits the scalable connection oriented packet networks approach from MPLS and leverages the scalability of MPLS technology. It incorporates the best of TDM transport networks features like OAM, 50ms protection and provisioned model, and is the ideal technology to build packet transport networks of the future.

To find out more about the Tejas Solutions and how Tejas Networks can help you build the optimal network for your needs, visit us at www.tejasnetworks.com.