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      Packet Optical Integration (POI) Use Cases for Abstraction and Control
                     of Transport Networks (ACTN)
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Abstract

   This document describes the Abstraction and Control of Transport
   Networks (ACTN) use cases related to Packet and Optical Integration
   (POI), that may be potentially deployed in various transport networks
   and apply to different applications.

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1. Introduction

The transport networks are in an unique position to embrace the
concepts of software defined networking (SDN) because of the existing
separation in control and forwarding plane via GMPLS/ASON. The path
computation element (PCE) [RFC4655] and its stateful extension
[STATEFUL-PCE] can further provide a central control over the
resources. Abstraction and Control of Transport Network (ACTN) is
focused on building over the existing blocks by adding
programmability, access and control over abstract virtual topologies.
[ACTN-FWK] provides detailed information regarding this work.

It is preferable to coordinate network resource control and
utilization rather than controlling and optimizing resources at each
network layer (packet and optical transport network) independently.
This facilitates network efficiency and network automation.

This document explores the Packet and Optical Integration (POI) use
cases of ACTN to help provide programmable network services like
access to abstract topology and control over the resources.
Increasingly there is a need for packet and optical transport
networks to work together to provide accelerated services. Transport
networks can provide useful information to the packet network
allowing it to make intelligent decisions and control its allocated
resources. In this POI use-case, we regard packet networks as a

consumer to transport networks. It is interesting to note that the
Packet networks themselves may have their ultimate clients to
support. The use case described in this document are primarily
concerned with 'packet network as a consumer' in a single trusted
domain.

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
document are to be interpreted as described in [RFC2119].

2. Terminology

The following terminology is used in this document.

ACTN: Abstraction and Control of Transport Networks.

PCE: Path Computation Element. An entity (component, application,
   or network node) that is capable of computing a network path or
   route based on a network graph and applying computational
   constraints.

POI: Packet and Optical Integration

VNTM: Virtual Network Topology Manager

3. Packet Optical Integration

Connections (or tunnels) formed across the optical transport network,
can be used as virtual TE links in the packet network. The
relationship is reduced to determining which tunnels to set up, how
to trigger them, how to route them, and what capacity to assign them.
As the demands in the packet network vary, these tunnels may need to
be modified.

An entity in packet network (maybe a Path Computation Element (PCE),
Virtual Network Topology Manager (VNTM) [RFC5623], Controller etc..)
should be aware of the abstract topology of the transport network.
The topology may consist of established tunnels in transport network
or ones that can be created on demand. The level of abstraction is
dependent on various management, security and policy considerations.
This abstract topology information in the packet network can be
utilized in various cases, as detailed in the following sections.

3.1. Traffic Planning, Monitoring and Automatic Network Adjustments

   Currently there is a schism between network planning for packet and
   optical transport networks. Sometimes these networks are
   administered, operated and planned independently even when they are a
   part of a single trusted domain. Any change in traffic requirements
   requires long business process to make changes in the network. In
   dynamic networks this is no longer acceptable.

   A unified Packet+Optical traffic planning tool can be developed which
   uses the traffic demand matrix to plan the optical transport network.
   Further based on traffic demand changes, historical data, traffic
   prediction and monitoring, changes should be made to the optical
   transport network. An access to abstract topology of the optical
   transport network based on established and potential (on-demand)
   tunnels in transport network can provide mechanism to handle this.

   Further optical bypass may be established automatically to offload
   the continuous changing traffic to transport network allowing
   streamlined business process between packet and optical transport
   networks.

3.1.1. Automated Congestion Management

   Congestion management and synergized network optimization for packet
   and transport networks can eliminate the need for overbooking of
   transport networks as dumb pipes. Application could be written that
   provide automated congestion management and network optimization.
   Automated congestion management recognizes prolonged congestion in
   the network and works with the controllers to add bandwidth at a
   transport layer, to alleviate the congestion, or make changes in the
   packet layer to reroute traffic around the congestion.

   For such applications there is a clear need for an abstract network
   topology of optical transport layer, further there is also a need for
   a synergy of cost and SLA across optical and packet networks.

3.2. Protection and Restoration Synergy

   The protection and restoration are usually handled individually in
   Packet and optical layer. There is a need for synergy and optimized
   handling of protection of resources across layers. A lot more
   resources in the optical transport network are booked for backup then
   actually required since there is a lack of coordination between
   packet and optical layers. The access to abstract graph of transport
   network with information pertaining to backup path information can
   help the packet network to handle protection, shared risk, fault
   restoration in an optimized way. Informing the packet network about

   both working and protection path which are either already
   established, or potential path can be useful.

   A significant improvements in overall network availability that can
   be achieved by using optical transport shared-risk link group (SRLG)
   information to guide packet network decisions; for example, to avoid
   or minimize common SRLGs for the main (working) path and the loop
   free alternative or traffic engineered fast reroute (LFA/TE FRR)
   back-up path. Shared risk information need to be synergized between
   the packet and optical. A mechanism to provide abstracted SRLG
   information can help the packet network consider this information
   while handling protection and restoration.

3.3. Service Awareness

   In certain networks like financial information network (stock/
   commodity trading) and enterprises using cloud based applications,
   Latency (delay), Latency-Variation (jitter), Packet Loss and
   Bandwidth Utilization are associated with the SLA. These SLAs must
   be synergized across packet and optical transport networks. Network
   optimization evaluates network resource usage at all layers and
   recommends or executes service path changes while ensuring SLA
   compliance. It thus makes more effective use of the network, and
   relieves current or potential congestion.

   The main economic benefits of ACTN arise from its ability to maintain
   the SLA of the services at reduced overall network cost considering
   both packet and optical transport network. Operational benefits of
   the ACTN also stem from greater flexibility in handling dynamic
   traffic such as demand uncertainty or variations over time, or
   optimization based on cost or latency, or improved handling of
   catastrophic failures.

3.4. Coordination between Multiple Network Domains

   In some deployments, optical transport network may further be divided
   into multiple domains, an abstracted topology comprising of multiple
   optical domains MAY be provided to the packet network. A Seamless
   aggregation and orchestration across multiple optical transport
   domains will be a great help in such deployments.

   Another interesting deployment involves multiple packet network
   domains. There exist scenarios where the topology provided to the
   packet network domains may be different based on the initial demand
   matrix as well as, management, security and policy considerations.

   The ACTN framework as described in [ACTN-FWK] should support the
   aggregation and orchestration across network domains and layers.

4. Security Considerations

   TBD.

5. IANA Considerations

   None, this is an informational document.

6. Acknowledgments

   TBD.

7. References

7.1. Normative References

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[Appendix A](). Contributor Addresses

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