Abstraction and Control of Transport Networks (ACTN) BoF

Charter Discussion

Network scoping

Transport networks are defined as network infrastructure that provides connectivity and bandwidth for customer services. They are characterized by their ability to support server layer provisioning and traffic engineering for client layer services, such that resource guarantees may be provided to their customers. **Transport networks here refer to a set of different type of connection-oriented networks**, which include Connection-Oriented **Circuit Switched** (CO-CS) networks and Connection-Oriented **Packet Switched** (CO-PS) networks. This implies that at least the following transport networks are in scope: Layer 1 (L1) and Layer 0 (L0) optical networks (e.g., OTN, ODU, OCh/WSON), MPLS-TP, MPLS-TE, as well as other emerging network technologies with connection-oriented behavior.

Transport networks have a variety of mechanisms to:

- Facilitate **separation of data plane and control plane**,

- Allow for **distributed signaling or centralized models** (e.g., NMS-based or centralized signaling) for path setup and protection, and

- Provide **traffic engineering** mechanism via centralized path computation.

Multi domain and need for abstraction

These represent key technologies for enabling flexible and dynamic networking, and efficient control and recovery of resources. **Although these technologies provide significant benefits within a single domain control boundary**, **they do not meet the growing need for transport network virtualization in multi-domain transport networks**. More and more network operators are building and operating on multi-domain transport networks. These domains (collections of links and nodes) may be each of a **different technology, administrative zones, or vendor-specific islands**. **Establishment of end-to-end connections spanning multiple domains is a perpetual problem** for operators because of both operational concerns (control plane and management plane) and interoperability issues (control plane and data plane). Due to these issues, new services that require connections that traverse multiple domains need significant planning and often manual operations to interface different vendor equipment and technology.

The aim of Abstraction and Control of Transport Networks (ACTN) is to facilitate a centralized virtual network operation: **the creation of a virtualized environment allowing operators to view and control multi-subnet, multi-technology, multi-vendor domain networks**. This will enable rapid service deployment of new dynamic and elastic services, and will improve overall network operations and scaling of existing services. Discussion with operators has also highlighted a **need for operation of virtual networks based on the abstraction of underlying technology and vendor domains**. Abstraction of transport networks also allows operators to consolidate their network services into multi-tenant virtual transport networks.

Controllers, hierarchy and architecture

Multi-domain network coordination function in ACTN is built on a control hierarchy where a multi-domain coordinator interacts with the control mechanism for each domain (e.g., EMS/NMS, GMPLS/PCE control plane, SDN controller) to represent abstraction of network resources and to provide control functions for virtual networks. These control functions enable various services/clients/applications to create and manage their own virtual networks that share the common transport network resources.

The **ACTN working group will develop the architectural description for transport network abstraction and control** that facilitates seamless **vertical service coordination** across multi-tenant customers (primarily internal service organizations with respect to a network operator), the control of virtual and physical network domains, as well as a **horizontal E2E service coordination across multi-domain networks**. It will identify key building components and the corresponding interfaces among these components. Key components can be future building block or legacy components existing today.

Use cases have been documented for ACTN in consultation with network operators and based on a preliminary architecture shown in <draft-ceccarelli-actn-framework-03.txt>. This architecture shows **three control components**: **the Customer Network Controller (CNC)** responsible for servicing requests from applications (such as OSS/NMS), **the Virtual Network Controller (VNC)** responsible for realizing customer networks out of physical network resources, and the **Physical Network Controller (PNC)** responsible for control and provisioning in physical networks. The architecture shows the **need for interfaces** between these components. Some of the realization of these interfaces is expected to involve protocols while some will utilize data models.

To do list (1/2)

The ACTN working group will **complete the architectural description and will develop the requirements for these interfaces** before moving on to **choose and extend existing protocols and data models, or to develop new protocols and data models**. A preference will be given to using existing protocols and data models.

The working group will work on the following items:

1. **Complete the architecture** that describes the basic building blocks to enable transport network vitalization to support use cases.
2. **Complete the specification of operator-driven use cases** to address the following initial items:
   - o Control and operation of virtual networks for core transport **Packet Optical Integration (POI).** (e.g., MPLS-TP, OTN/WSON)
   - o Control and operation of virtual networks for **mobile backhaul multi- technology transport** (e.g., MPLS-TP and MPLS/OTN)
   - o **Data Center Operator's interconnection with optical transport network infrastructure providers** to support dynamic virtual circuit services.
   - o **Multi-tenant support** to allow virtual network information query, virtual network negotiation, creation/deletion and modification.
   - o **Synchronization of network resources view across control of physical and virtual networks**.
   - o **Dynamic service control and monitoring across all entities**.

(*) Initial work within the working group will be limited to a single operator administrative domain with an exception for the Data Center operation use case.

To do list (2/2)

3. **Evaluate Information models / data models** to support the use cases.

4. **Develop requirements to support APIs/protocols, encoding languages, and data models including issues of security, privacy and trust mechanisms that provide control and abstraction across domain boundaries** (and therefore across trust boundaries).

5. **Evaluate existing IETF and other protocols, encoding languages and data models to fulfill the requirements**.

6. **Develop protocol extensions**.

The working group will determine if new protocol or extensions to existing protocols are necessary. If the working group determines they are necessary, then it will develop new protocols within the working group; on the other hand, any extensions to existing protocols would be done with interactions with other working groups where possible.

Where the need for data models is identified, the working group will first examine data models already developed by other working groups.