Automated Connection Provisioning and Restoration Framework in All Optical Network using Distributed Objects

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Abstract. OXC (Optical Cross-Connect) system is on indispensable network element to realize the all-optical mesh networks by supporting the increase of link channels and expansion of an OTN (optical transport network) capacity at low expense. This paper describes an architecture of APRS(Automated Connection Provisioning and Restoration Subsystem), which can be applicable various network topology. Since APRS manages network connections and optical circuits for transparent OXC that can be classified by survivability class level, it provides an efficient mechanism for optical connection management. APRS coordinates with SMS(Service Management System) or network services, etc, VPN(Virtual Private Network), VLAN(Virtual Local Area Network), and QoS(Quality of Service), so it can support optical level CoS(Class of Service). And APRS supports an automated connection provisioning that can provide PC(Permanent Connection), SPC(Soft Permanent Connection), and SC(Switched Connection) and supports a dynamic restoration mechanism according to the policy and survivability class level. APRS consists of distributed objects, then it can be applied in not only the layered-centralized network connection management without control plane but also the distributed network connection management with control plane.

I. Introduction

In a traditional all optical transport network, operators make efforts to manage network connections. When creating a new connection, operators should calculate point-to-point optical light path, assign a wavelength corresponding with the calculated path, and control units of each NE(Network Element). The larger network capacity and the greater number of NEs is, the more difficult and the more complex role of operator is. This paper proposes an architecture of APRS(Automated Connection Provisioning and Restoration Subsystem) implementing ASON (Automatic Switched Optical Network) [1] for operators to manage easily network connections and optical circuits.

II. APRS Architecture

APRS supports an automated connection provisioning that can provide Permanent Connection, Soft Permanent Connection, and Switched Connection and supports a dynamic restoration mechanism according to the policy and survivability class level with distributed objects. A role of APRS is calculating path, managing and gathering network resource information and states, and managing path.

![APRS Architecture Without Control Plane](image_url)

Figure 1. APRS Architecture Without Control Plane

APRS can be deployed actively for the layered-centralized network connection management without control plane, while it can be deployed passively for the distributed network connection management with control plane. To change traditional deployed OTN to ASON, each NE needs a control plane implementing a extended routing mechanism for OTN and signaling protocols, UNI(User Network Interface), NNI(Network Node Interface), RSVP-TE(Protocol

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Management System

- Policy Manager
- State Analyzer
- RWA
- Connection Manager
- N/W Resource Manager
- CM
- Signaling Req Handler
- FCP

OXC node
Reservation Protocol – traffic engineering, LMP (Link Management Protocol) and so on, that requests to make efforts. An active architecture of APRS, shown in Figure 1, is able to provide automatic network connection management to support for operator to manage easily without deploying a control plane and specifying detail call setup parameters.

On the other hand, with deploying RWA on a control plane and passive APRS on a management plane, the distributed network connection management can be implemented. Passive APRS, shown in figure 2, just gets and saves connection information like as LSP which is created and deleted by signaling protocols.

An architecture of APRS is composed six components, which are described below:

PoM (Policy Manager): PoM manages constraints, for example, survivability class level (1+1, 1:1, and 1:N protection, pre-reserved restoration, restoration), policy (node inclusion/exclusion, propagation delay, Wavelength convertibility, connection bandwidth), service (VPN, QoS) and so on.

RWA (Routing and Wavelength Assignment): RWA selects a path depending on topology and calculates a path using logical and physical constraints provided by PoM.

SRH (Signaling Req Handler): SRH plays a passive and active role according to the existing or not-existing of control plane. When SRH is passive, it just passes to CoM connection information provisioned by signaling protocol. When it is active, it supports UNI (User Network Interface) signaling emulation to client requests for call control.

NRM (Network Resource Manager): NRM gathers and maintains network resource information and states. It works with CM (Configuration Management) and extracts resource information to affect connections. NRM updates information whenever connection is created, deleted or modified. And it also can work with a database system.

SA (State Analyzer): SA coordinates with PM (Performance Manager) and FM (Fault Manager). It analyzes fault and performance factors, and extracts a fault origin and new constraint, which are sent to CoM.

CoM (Connection Manager): CoM plays a passive and active role too. The former just saves, updates, and inserts connection information and states passed by SRH. The latter provisions a path requested by SRH. CoM finds constraints, managed by PoM, corresponding with the request, and lets RWA calculate a path with constraints. After calculating path, CoM controls units of each NE to provision of connection. And CoM requests NRM to save change of resource information and states, and reports completing connection provisioning to SRH, which returns a create complete response to the UNI client.

When SA reports faults, CoM triggers restoration action according to the survivability class level. A working path of protection survivability level exchanges to a pre-provisioned protection path. APRS supports revertive restoration mechanism, so when fault is corrected, working path is switched back. While working path of restoration survivability level is recalculated using current resource and provisioned.

III. Conclusion

In this paper, we propose APRS designed based on distributed objects and composed six components: Policy Manager, State Analyzer, Connection Manager, Signaling Request Handler, N/W Resource Manager, and RWA. We apply an active APRS for the layered-centralized network connection management and a passive APRS for the distributed network connection management.

IV. Reference

[1]ITU-T draft recommendation G.8080, Architecture for the automatically Switched Optical Networks (ASON)