Future Service Adaptive Access/Aggregation
Network Architecture

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Future Service Adaptive Access/Aggregation Network Architecture

Outline

- Motivation
- Requirement
- Overview
- Architecture
- Summary
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Motivation (1 of 2)

Carrier is replacing legacy networks with MPLS-TP network by merging service network

• ATM, SONET is reaching to end-of-life in backbone network
• MPLS-TP support various traffic

Providers deployed dedicated infrastructure for services in access networks because different requirement

• FTTH uses PON in a passive double star
• Leased line uses ATM with multi QoS in a single star
• Mobile backhaul uses optical media converter or PON
• Access is becoming large capacity like GE-PON, 10G-EPON
• Various services with different requirement is recently emerging
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Motivation (2 of 2)

High operation and equipment cost because vertical integration for various service

Dedicated equipment for each service
- A lot of equipment
- Increasingly complex operation
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Improvement of Network Characteristic

Change from man-to-man to machine-to-machine

- Business speed is becoming faster for value-added service
- Digital data is rapidly increasing

*Graph showing the increase in digital data from 2005 to 2011, with a chart indicating time and business speed improvements.*
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Data Size and Delay

Various application traffic from WEB to mission-critical task in access network is transmitted.
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Requirement for Access Network

Traffic Increase
- Large capacity (10G to 100G)
- Reliability and management cost

Diversification of service
- Unpredictable traffic demand
- Traffic mix

Collaboration with backbone NW
- Virtualization for cloud
- Deployment of service node
- Service collaboration

Power saving
- Network equipment
- PON: 10GE-PON
- Data center collaboration
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Requirement for Access Network

Current access network
- SDH, ATM, FTTH are provided by using dedicated equipment

Future access network
- Accommodate wide-range traffic from best-effort traffic to mission critical
- Need smooth and easy deployment of new service
- Support flexible OAM
- Collaborate with MPLS-TP in the backbone
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Requirement for Access Network

Future access network connecting with MPLS-TP in backbone networks

- Flexible service provisioning
- Scalability
- Redundancy
- Multi QoS support
  - Time synchronization, clock synchronization and low latency
- Long reach transmission

New requirement for access network

<table>
<thead>
<tr>
<th></th>
<th>Mobile backhaul</th>
<th>Micro-datacenter</th>
<th>M2M</th>
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<tbody>
<tr>
<td>Packet delay</td>
<td>--</td>
<td>very low</td>
<td>very low</td>
</tr>
<tr>
<td>Clock accuracy</td>
<td>0.05 ppm</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Time synchronization accuracy</td>
<td>1.5 ms</td>
<td>1.5 ms</td>
<td>1.0 ms</td>
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Future Access Network

Future access network aggregates various traffic by using feeder fiber.
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Service Adaptive Access Network

Unified Service Provisioning
- Configure programmable OLT/ONU based on service requirement

Unified OLT
- Aggregate various traffic in different topologies in the same hardware

Multiple QoS and OAM
- Collaborate with MPLS-TP
- Support time synchronization and clock distribution

Future Service Adaptive Access/Aggregation Network (SAAN)

OLT: Optical Line terminator
ONU: Optical Network Unit
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**1 Programable OLT/ONU**
- Create logical OLT/ONU based on service requirement
- Select MAC frame

**2 Service module**
- Configure service function based on service requirement
- Service module card

**3 Dynamic BW assignment**
- Dynamic BW assignment (DBA) for various topology
- Clock distribution, time synchronization

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**Programmable OLT**
- ADS
- PDS
- SS
- TDM
- Low latency
- Bandwidth guarantee
- DBA agent
- MAC control for DBA and MPCP

**MPLS-TP**
- Ethernet/MPLS-TP/FC/ATM
- Function module
  - OAM
  - Time sync
  - Protection
  - Power saving
  - Common

**Logical OLT**
- Multiplexer/parser

**Service module**
- Service adaptive control

**Dynamic BW assignment**
- Dynamic BW assignment (DBA) for various topology
- Clock distribution, time synchronization

**Optical Distribution Network**
- Programmable ONU
- PHY

**Multiplexer/parser**
- MAC control for DBA and MPCP

**MPCP**: multi-point control protocol

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**Operator**
- Service requirement
- Function module update

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**Kie University**
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DBA and MPCP

Although traditional DBA support only simple QoS for only PDS,
- SAAN DBA is responsible for time slot assignment for each logical ONU for PDS, ADS and SS
- SAAN DBA cooperates with service modules including time synchronization, protection, etc

SAAN MPCP support various MAC frames and network topology
- SAAN MPCP supports virtual multipoint-to-point traffic for multiple logical OLT and ONU
- SAAN OAM is needed in the domain of an L-OLT/L-ONU to work with MPLS-TP.
- MAC frames in the optical session is MPLT or Ether or others.

SAAN: Service adaptive access/aggregation network
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Application

- Configure logical OLT/ONU remotely, leading low deployment cost
- For bandwidth assignment, low latency DBA is selected
- low latency DBA performs in short cycle, so BW effectiveness is relative low
- Protection function is configured between service module cards

Micro data center: decentralized data center located near users for quick response
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Benefit & Challenges

Benefit

• As the virtual resources are reserved to the service requirement as necessary, it improves resource utilization
• Since the virtual resources are configured to the service deployment without installing additional equipment, it results in smooth service migration
• As logical OLT and ONU can be configured remotely, installation cost can be reduced

Challenges

• Programmable hardware for OLT/ONU
• Suitable MAC frame in the optical section
• Cost of programmable OLT/ONU
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Summary

- Future access network needs to accommodate various service from best-effort service to mission-critical service

- Future access network support MPLS-TP
  - DBA collaborate with MPLS-TP to guarantee QoS
  - MAC frame candidate: MPLS or Ether or GEM

- SAAN provides a flexible and scalable architecture independent of service
  - Unified service provisioning
  - Programmable OLT/ONU