• **PTN Overview and Technology Advantages**
  – Why & What is PTN?
  – PTN technology and its evolution
  – MPLS-TP OAM Overview and standard progress

• **MPLS-TP OAM in PTN**
  – Comprehensive and Hierarchical OAM in PTN
  – MPLS-TP OAM Options: GACH+Y.1731 vs. BFD Extension/LSP Ping
  – MPLS-TP OAM Implementation in PTN
  – Migration to Standard MPLS-TP OAM

• **PTN Key Application & Case-studies**
  – Key Applications
  – China Operators PTN Case Studies

• **Conclusion**
Mobile Data Growth Drivers

Key Catalysts

- Society
- Smart Phones
- Internet
- Key Catalysts

Network & Technology

- iPhone, Blackberry, and other smart phones driving the explosive growth in packet traffic
- Mobile carriers have implemented 3G and/or HSDPA to offer much higher data speeds
- HSPA+ and LTE to offer true broadband experience
Major Challenges for Service Providers

1. **How to deal with Packet Traffic Growth**: Rapid Growth in 3G Mobile and Broadband subscribers worldwide driving the demand for high-speed packet transport.

2. **How to improve revenue**: Despite the subscriber growth, ARPU is going down. Networks are too complex, difficult to scale, and expensive to maintain. Energy and Real-estate are another major challenges.

3. **How to offer New Services**: Current transport network infrastructure is not adequate to offer evolving mobile services such as LTE and advanced enterprise services (e.g., EPL, EVPL).
Transport Vendors
- Transport based technology
  - Telecom world
  - Connection-oriented, fully controlled by Carrier
- NG-SDH, T-MPLS, RPR
  - Metro aggregation

Router/Switch Vendors
- Router/Switch based technology
  - Internet world
  - Connectionless, loosely controlled, "peer-to-peer", "plug and play"
- IP/MPLS/VPLS
  - Metro core to Metro aggregation

Lack of 50ms switch over protection
No enough OAM
L2 devices have difficulty assuring hard QoS
Choices for Service Providers

1. **CONTINUE**
   - deploying SDH/SONET for transport
   - But...
     - Doesn’t scale for packet traffic
     - No support for statistical multiplexing – bandwidth inefficient
     - High CAPEX

2. **THINK**
   - Switch/Router for data Network
   - But...
     - Connection-less approach
     - High OPEX – complex operation
     - Difficult to troubleshoot – weak OAM
     - Doesn’t meet 3.5G/4G synchronization requirements

3. **DEPLOY**
   - Packet Transport Network
   - Low TCO
     - Connected Oriented
     - Statistical multiplexing; Powerful OAM functions
     - Meets mobile synchronization requirements
What is PTN?

Packet Network
- Statistical multiplexing, flexible transport containers
- Service aware
- Advanced QOS
- Scalable
- Cost effective (Ethernet based)

Transport Network
- Connection Oriented
- High clock accuracy
- Resilient (50ms switch-over)
- Comprehensive OAM
- Multi-service support
- Static or dynamic Provisioning

IP, Ethernet, MPLS

Best of both worlds

Note: PTN is sometimes also referred to as P-OTS or POTP

MSTP/MSPP (SDH/SONET)

Multi-service transport over Packet
- Statistical Multiplexing
- Connection Oriented
- Deterministic data plane
- Hard QoS
- Comprehensive OAM
- Network & equipment protection
PTN Technology Choices

T-MPLS

- A new formulation of MPLS, being standardized by ITU-T, and designed specifically for a connection-oriented packet transport network based on well-known and widely deployed IP/MPLS technology and standards.

\[ T\text{-MPLS} = \text{MPLS (PW/LSP)} + \text{OAM} - \text{L3 Complexity} \]

PBB-TE

- A subset of IEEE Provider Backbone Bridging (802.1ah) that turns Ethernet connectionless networking into a provisioned connection-oriented transport network primarily for point-to-point Ethernet virtual connections.

\[ \text{PBT} = \text{Ethernet (MAC/MAC)} + \text{OAM} - \text{L2 Complexity} \]

PBT and T-MPLS are major PTN technology choices base on different migration path.
PTN Standards Overview

IEEE

Focus on improvement and enhancement on Ethernet technology, such as: RPR, ERP, PBB, PBT

PBB/PBT/ RPR

PTN Standard organization

IETF

Focus on MPLS, PWE3 and VPLS etc, standard.
formed JWT with I-TUT, and promote the MPLS-TP

MPLS-TP

ITU

Focus on T-MPLS standard, formed JWT team with IETF for MPLS-TP in March 2008

UTS TN Product Line
Pre MPLS-TP

Ethernet

IP/POS

MPLS

T-MPLS

NG-SDH

SDH

ATM

WDM

OTN

UTS TN Product Line
Pre MPLS-TP

UTS TN Product Line
Pre MPLS-TP
### MPLS-TP Overview

<table>
<thead>
<tr>
<th><strong>MPLS-TP</strong></th>
<th><strong>Joint Working Team</strong></th>
</tr>
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</table>

#### Management Plane:
- Statically configure LSP and PW and manage via NMS
- OAM handling

#### Control Plane:
- **Optional**
- LSP, PW, and OAM not dependent upon control plane
- Static provisioning via NMS;
- *Dynamic Provisioning* (e.g., LSP: RSVP-TE, GMPLS, PW: RFC 4447) under study

#### Data Plane:
- Fully compatible with MPLS
- Forwarding based on LSP/PW Label
- Bi-directional path (LSP) for traffic and OAM
- OAM support via Associated Channel (PW ACH & GE ACH)
- MPLS based Protection mechanism
- Pseudo-wire encapsulation for all traffic types (Ethernet, ATM, SDH/SONET, and PDH)
- Transport hierarchy similar to SDH/SONET - nested PW and LSP
MPLS-TP OAM Overview

• OAM (Operation, Administration, and Maintenance) Basic Roles
  – Fault Detection & diagnostic: Continuity Check/Connectivity Verification (CC/CV), Loopback (LB)
  – Alarm and Alarm suppress: Generate alarm when fault happens but suppress large volume alarm through AIS/RDI (Alarm Correlation Suppression)
  – Performance monitor: packet loss ratio (LM), delay measurement (DM)
  – Maintenance tools: Link track (LT), Lock (LCK)
  – APS OAM: Linear and Ring APS

• MPLS-TP OAM with IETF and ITU-T
  – ITU-T and IETF in many technical aspects of the compromise, MPLS-TP OAM inherited the T-MPLS G.8114 part of the agreement, but the rest of codecs and protocols supplementary part, by the major inheritance from the IETF.
## MPLS-TP OAM Standard Progress Update (1)

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# MPLS-TP OAM Standard Progress Update (2)

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• Conclusion
Comprehensive & Hierarchical OAM in PTN

- Based on Ethernet, ITU-T, and MPLS-TP standards
- Multi-layer OAM support
  - **Client Layer**: ATM, SDH/SONET, and Ethernet
  - **MPLS-TP Layer**: PW and LSP (*using associated channel mechanism as shown below*)
  - **Network Uplink layer**: Ethernet and SDH/SONET

**LSP monitoring and alarming**
Generic Exception Label and Generic Associated Channel
Many options including Non IP BFD is an option encapsulation of Y.1731 pdu

![Ethernet Header Diagram](attachment:image.png)

0001 | Ver | Resv | Channel Type

**Pseudo-wire monitoring and alarming**
PW-Associated Channel

![Ethernet Header Diagram](attachment:image.png)

0001 | Ver | Resv | Channel Type
# MPLS-TP OAM Functions and Implementation

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<tr>
<th>Class</th>
<th>Type</th>
<th>Function</th>
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<td>CCM, LM, LMM, LMR</td>
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MPLS-TP Implementation in PTN

- **Pre-standard MPLS-TP OAM Implementation in PTN**
  - Send OAM packet between MEP/MIP in PTN network. Detect fault and performance through OAM packet exchanges, generate alarm and related process
  - Pre-standard MPLS-TP OAM mechanism is implemented in current PTN products like T-MPLS G.8114 or MPLS Y.1711
  - OAM packet is sent/received/handled by PTN equipment (normally using FPGA Hardware to handle OAM packet). The CV interval can be up to 3.3ms per OAM packet. Fault can be detected within 10ms when 3 packet missed (3*3.3ms=10ms) which trigger protection switch.

- **MPLS-TP OAM Option 1: GACH+ Y.1731**
  - Draft-Bhh-mpls-tp-oam-y.1731
  - Use RFC 5586 GACH package
  - OAM total solution and fulfill operator’s requirements
  - Support proactive/on-demand CC/CV, AIS, RDI, LB, LCK, TST, APS, LM, DM

- **MPLS-TP OAM Option 2: BFD/LSP Ping Extension**
  - 9 other Drafts
  - Use RFC 5586 GACH package
  - BFD extension supports proactive CC/CV/RDI, LSP Ping support on-demand CC/CV, new tools for other functions
## OAM Options: G.Ach+Y.1731 vs. BFD/LSP Ping Extension

### Y.1731 frame format:
- Use MPLS date plane (Label: 13)
- Use G.ACH
- Use **OpCode** to identify OAM type

### BFD extensions frame format:
- Use MPLS date plane (Label: 13)
- Use G.ACH
- Use **Channel Type** to identify OAM type

- **Y.1731** has better fault detection function but limited in L2 and below
- **BFD expansion** can support fault detection up to L3 and below

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**Tunnel label (13)**

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**End TLV**

**LSP label**

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<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

**End TLV**

**OAM PDU payload area (Y.1731)**
## GACH+Y.1731 and BFD Expansion

### Standard Progress

<table>
<thead>
<tr>
<th></th>
<th>Basic OAM requirements</th>
<th>GACH+Y.1731</th>
<th>BFD Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Continuity Check/Connectivity Verification (CC/CV)</td>
<td></td>
<td>IETF draft (draft-asm-mpls-tp-bfd-cc (close to complete) draft-ietf-mpls-tp-lsp-ping-bfd-procedures-00) (incomplete)</td>
</tr>
<tr>
<td>2</td>
<td>Connectivity Verification on demand (CV)</td>
<td></td>
<td>IETF draft (draft-nitinb-mpls-tp-lsp-ping-extensions) (incomplete)</td>
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<tr>
<td>3</td>
<td>Route Tracing</td>
<td></td>
<td>IETF draft (draft-flh-mpls-tp-oam-diagnostic-test) (incomplete)</td>
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<tr>
<td>4</td>
<td>Debug test</td>
<td>Testing</td>
<td>IETF draft (draft-boutros-mpls-tp-loopback) (incomplete)</td>
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<td></td>
<td></td>
<td>Loopback</td>
<td>IETF draft (draft-ietf-mpls-tp-fault) (close to complete)</td>
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<tr>
<td>5</td>
<td>Lock indicate</td>
<td></td>
<td>IETF draft (draft-asm-mpls-tp-bfd-cc-cv) (close to complete)</td>
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<tr>
<td>6</td>
<td>Lock</td>
<td></td>
<td>IETF draft (draft-he-mpls-tp-csf) (incomplete)</td>
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<tr>
<td>7</td>
<td>Alarm indication signal (AIS)</td>
<td></td>
<td>IETF draft (draft-frost-mpls-tp-loss-delay) (incomplete)</td>
</tr>
<tr>
<td>8</td>
<td>Remote Alarm Indication (RAI)</td>
<td></td>
<td></td>
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<tr>
<td>9</td>
<td>Client Signal Failure (CSF)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Packet loss measurement</td>
<td></td>
<td></td>
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<tr>
<td>11</td>
<td>Delay measurement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**G.Ach+Y.1731 OAM Packet Definition**

### OAM PDU payload area (Y.1731)

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Tunnel label (13)</td>
<td>TC</td>
<td>S</td>
<td>TTL</td>
</tr>
<tr>
<td>0001</td>
<td>0000</td>
<td>00000000</td>
<td>Channel Type (Y.1731 OAM)</td>
</tr>
<tr>
<td>MEL</td>
<td>Version</td>
<td>OpCode</td>
<td>Flags</td>
</tr>
<tr>
<td>OAM PDU payload area (Y.1731)</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### G.Ach MPLS-TP OAM Packet Format Definition

#### Opcode Definition

<table>
<thead>
<tr>
<th>Opcode</th>
<th>OAM PDU</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CCM PDU</td>
</tr>
<tr>
<td>2</td>
<td>LBR PDU</td>
</tr>
<tr>
<td>3</td>
<td>LBM PDU</td>
</tr>
<tr>
<td>4</td>
<td>LTR PDU</td>
</tr>
<tr>
<td>5</td>
<td>LTM PDU</td>
</tr>
<tr>
<td>43</td>
<td>FDI (AIS) PDU</td>
</tr>
<tr>
<td>35</td>
<td>LCK PDU</td>
</tr>
<tr>
<td>37</td>
<td>TST PDU</td>
</tr>
<tr>
<td>59</td>
<td>Linear APS PDU</td>
</tr>
<tr>
<td>40</td>
<td>Ring APS PDU</td>
</tr>
<tr>
<td>41</td>
<td>MCC PDU</td>
</tr>
<tr>
<td>44</td>
<td>SCC PDU</td>
</tr>
<tr>
<td>43</td>
<td>LMM PDU</td>
</tr>
<tr>
<td>42</td>
<td>LMR PDU</td>
</tr>
<tr>
<td>45</td>
<td>IDM PDU</td>
</tr>
<tr>
<td>47</td>
<td>DMM PDU</td>
</tr>
<tr>
<td>46</td>
<td>DMR PDU</td>
</tr>
<tr>
<td>52</td>
<td>CSF PDU</td>
</tr>
</tbody>
</table>

**OpCode Definition**

- **a.** Tunnel label: 16 bits, value = 13, GAL
- **b.** TC: 3 bits, traffic classification;
- **c.** S: 1 bit, Value = 1 means bottom of stack;
- **d.** TTL: 8 bit, Value = 1 or MEP to MEP hops + 1;
- **e.** Channel type identify it is an OAM packet;
- **f.** MEL: Maintenance entity level; configurable, default = “7”;
- **g.** Version: Identify OAM protocol version, set to 0
- **h.** OpCode define OAM PDU packet type (see right table)
- **i.** TLV offset: 8 bits, related to OAM PDU type, Value = 0 means TLV offset one byte;
- **j.** OAM PDU payload area: OAM PDU packet content;
- **k.** End TLV: 8 bit, identify end of OAM PDU packet
Select G.ach +Y.1731 as PTN OAM

- CMCC/China CCSA select G.ach +Y.1731 as PTN OAM standard
  - Treat draft-bhh-mpls-tp-oam-y.1731 as option of MPLS-TP OAM
  - Y.1731 Ethernet OAM: 0x8902
  - Select RFC5586 experimental Code Point 32767 (7FFF) as channel type
  - Alliance:
    - PTN vendor: Al-Lu, Huawei, ZTE, Fiberhome, UTStarcom;
    - Operators: China Mobile, China telecom, China Unicom, TI, CJK, telefonica etc.
  - Easy upgrade from existing PTN system to support this Mechanism
  - Better availability, Large volume PTN deployed in CMCC and most PTN equipment can upgrade to support it in short term

Option 1: GACH+Y.1731
- Mature, meet all the requirement at technical point of view
- Easy upgrade from existing PTN system to support this Mechanism
- Better availability, Large volume PTN deployed in CMCC and most PTN equipment can upgrade to support it in short term

Option 2: MPLS-TP & MPLS
- Not complete and not mature, can not meet short term requirements (at least another 2 years to be mature)
- Hard to upgrade from existing PTN system to support this mechanism, hardware upgrade might be necessary
- Consensus and might be final standard at last
- No equipment or vendor declare support it
Migration to MPLS-TP OAM

• MPLS-TP standards Progress
  – Standards still in development by the JWT from ITU-T and IETF.
  – MPLS-TP is based on PWE3 and LSP forwarding architecture which is within IETF MPLS standards. So there are minimal changes in the LSP and PW data-structure

• Upgrading to MPLS-TP OAM
  – More comprehensive OAM features to handle the end-to-end management of network than IP/MPLS.
  – MPLS-TP OAM standards are still under development, hence current installed equipment will have to be upgraded to support the new OAM formats and messages to comply with Standard

UTStarcom will ensure smooth migration to MPLS-TP OAM without any service disruption
When MPLS-TP OAM standards are finalized, TN series can be upgraded to work on dual OAM formats simultaneously (Dual-Mode): one mode supports the old format, and another one supports the new format that complies with the finalized MPLS-TP standards.

The whole upgrade process is divided into two steps:
1. upgrade each node to support dual OAM formats
2. activate the LSP to support new OAM format.
Contents

• PTN Overview and Technology Advantages
  – Why & What is PTN?
  – PTN technology and its evolution
  – MPLS-TP OAM Overview and standard progress

• MPLS-TP OAM in PTN
  – Comprehensive and Hierarchical OAM in PTN
  – MPLS-TP OAM Options: GACH+Y.1731 vs. BFD Extension/LSP Ping
  – MPLS-TP OAM Implementation in PTN
  – Migration to Standard MPLS-TP OAM

• PTN Key Application & Case-studies
  – Key Applications
  – China Operators PTN Case Studies

• Conclusion
# Mobile Backhaul using PTN

<table>
<thead>
<tr>
<th>Cell Site</th>
<th>Mobile Backhaul</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-bis E1/T1</td>
<td>2G BTS</td>
</tr>
<tr>
<td>AAL2/5 ATM IMA E1/T1</td>
<td>3G Node B (Copper)</td>
</tr>
<tr>
<td>IP MLPPP E1/T1</td>
<td>3G Node B (IMA/STM-1)</td>
</tr>
<tr>
<td>LTE UDP/IP Ethernet</td>
<td>Any traffic over MPLS-TP</td>
</tr>
</tbody>
</table>

- **2G BTS**: T1/E1 (Copper)
- **3G Node B**: ATM (Copper or Fiber)
- **3G NodeB or LTE eNodeB**: IP over Ethernet or MPLS

Migration to Unified Transport Network
SDH/MSTP Replacement

**Classic**

2G, 3G, HSDPA, LTE, ...

**Hybrid**

2G, 3G, HSDPA, LTE, ...

**Packet**

2G, 3G, HSDPA, Broadband Aggregation, Enterprise, LTE, ...

- **Packet (PTN)**
- **TDM (SDH)**
- **TDM (SDH/MSTP)**
Migrate to PTN at China Operators

China Operators’ PTN Market

China Mobile (CMCC)
2. Start PTN equipment and IOP test since Q4/2008;
3. Mobile backhaul by PTN field trial Q1/2009 and 1588v2 test in Q2/09

China Telecom (CTC)
1. Start CE (Carry Ethernet) test at Q4/2006 and switch PTN technology later
2. After PTN investigation and research, start large scale PTN test since Q3/2009
3. PTN field trail since Q1/2010; more than 3000 PTN nodes trial in the network

China Unicom (CUC)
1. Start CE (Carry Ethernet) test since 2008 and did a few trials.
2. Switch to PTN and start PTN test Q4/2009 and finished at Q1/2009
3. Start PTN field trial Q2/2010 and close to 2000 PTN nodes are running in the field.

Orientation has been confirmed that evolution is inevitable
Case Study – Mobile Operator China

Over 470 million subscribers – includes 2G and 3G (400,000+ base stations installed and growing)
Operates not only basic mobile voice services but also value-added services such as data, IP telephone and multimedia.
Start to deploy TD-SCDMA 3G network since 2008
Looking for IP RAN solution scalable to support future data service and at the same time support TDM and other legacy services such as ATM
Has deployed more than 100K PTN nodes network since 2009
Start MPLS-TP OAM IOP base on GAC+Y.7131
Current 2G/GSM Networks: TDM based BTS and BSC. E1 at BTS, STM-1 and E1 at BSC

Current 3G/TD-SCDMA Networks: ATM IMAE1 at Node B, Channelized STM-1 at RNC

Future 3G/TD-SCDMA Networks: FE at Node B, GE at RNC

Sync Requirement in current 3G/TD-SCDMA Networks
- Base stations need frequency sync: +/- 0.05ppm, and phase sync: +/- 3us
- For base stations, reference clock is distributed via GPS or PTN.
  - Time sync between NodeB and GPS/PTN: +/- 1.5us
**Requirement Highlights**

- **Requirements to PTN:**
  - Converged network to support multiple type of services: legacy E1, ATM and future FE
  - Common network for wireless and fixed line broadband service
  - Reliability, QOS, OAM, controllable and manageable
  - Performance including delay, jitter
  - Privacy
  - Inter-working with IP/MPLS and SDH/NGSDH
  - Distribute Frequency and time synchronization to Base stations

- **MPLS-TP PTN solution address these requirements by**
  - Multi-service support
  - Carries class design with hardware redundancy and OAM to support <50ms protection switching, fault detection and monitoring of tunnels
  - Use of network management systems to pre-configured CIR, EIR Bandwidth, control how tunnels are configured or provisioned
  - Provide frequency synchronization signal to BTS and Node B (+/- 0.05ppm) and time signal in the future
  - End to end QOS
## UTS PTN Value Proposition

<table>
<thead>
<tr>
<th>Competing Technology/Product</th>
<th>UTS PTN Advantages</th>
<th>TN Solution Set</th>
</tr>
</thead>
</table>
| MSTP, MSPP, SDH/SONET       | • Data friendly – statistical multiplexing, flexible transport containers, easy inter-working  
• Advanced QOS control & Multicast  
• Bandwidth Efficient & Scalable | TN703  
TN705  
TN725  
TN735 |
| Carrier Ethernet            | • Connection Oriented, end to end QoS  
• High clock accuracy  
• Resiliency on par with TDM network  
• Comprehensive OAM  
• Multi-service support  
• Powerful Network management for e2e service provisioning | |
| Other T-MPLS/MPLS-TP based PTN products, PBB-TE based products | • State-of-art pure-packet architecture  
• Competitive cost  
• Diverse set of interfaces (TDM, ATM, IP)  
• Compact platform  
• MPLS-TP (pre-standard) Compliant  
• Service oriented NMS | Converged Transport Solution |
Contents

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- **PTN Key Application & Case-studies**
  - Key Applications
  - China Operators PTN Case Studies

- **Conclusion**
PTN -- The Best choice of Metro Access & Aggregation (1)

Meet New Services’ Requirements

- Higher bandwidth: from E1/STM-1 to FE/GE; from dial in to xDSL to xPON; From nx64kbps to nx Mbps;
- Real time: real time application; clock sync; time sync
- Low delay and delay variance: Delay and Jitter sensitivity service
- Higher performance: advanced QoS, CIR/EIR, CBS/EBS
- Higher availability: 99.999% and higher
- Mobility: from fix to mobile
- Resilience: sub 50ms switch time
- …

<table>
<thead>
<tr>
<th>New Services Requirements</th>
<th>IPTV/Medium stream</th>
<th>VoIP</th>
<th>Enterprise VPN</th>
<th>Live TV Video Phone/ conference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Real-time</td>
<td>Real-time</td>
<td>Committed bandwidth</td>
<td>Real-time</td>
</tr>
<tr>
<td></td>
<td>High bandwidth</td>
<td>High performance</td>
<td>&lt;50ms Protection</td>
<td>Committed bandwidth</td>
</tr>
<tr>
<td></td>
<td>High performance</td>
<td>&lt;50ms Protection</td>
<td>Aggregation to core router</td>
<td>Protection</td>
</tr>
<tr>
<td></td>
<td>&lt;50ms protection</td>
<td>Aggregation to core router</td>
<td>Fixed route</td>
<td>P-t-P/MP-t-MP</td>
</tr>
<tr>
<td></td>
<td>Multicast supporting</td>
<td>Fixed route</td>
<td></td>
<td>Aggregation to video server</td>
</tr>
<tr>
<td></td>
<td>P-to-MP</td>
<td></td>
<td></td>
<td>Fixed route</td>
</tr>
<tr>
<td></td>
<td>Fixed route</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bandwidth • Jitter/latency • protection • Security
Meet Network Migration’s Requirements

- **Multi-services support**
  - Support ATM, TDM, Ethernet services in an unified access/aggregation network.
- **Topology free:**
  - Support any topology as the existing fiber network
- **Operation continuity:**
  - Utilize rich transport operation experience in past decade;
  - Centralized powerful network management system (NMS)
  - Simply training and quick knowledge transfer;
  - Continue to use the existing operation process and can change step by step;
- **Hierarchical OAM for quick fault isolation and trouble shooting**
- **High accuracy sync clock and time delivery**
- ……
PTN -- The Best choice of Metro Access & Aggregation (3)

Lower CAPEX and OPEX

- **Network and equipment simplify:**
  - Aggregated traffic (from access to core) dominate Metro access & aggregation network
  - Connection oriented and mainly permanent network connection circuit
  - No addressing and routing is required at most of time (fixed route)
  - No full Mesh network existing at Metro access & aggregation
- **Reduce the complexity of network operation**
  - Hierarchical network structure—Independent packet transport layer; Not peer IP/MPLS Network; avoid large scale of IP/MPLS domain
  - Manage and maintenance much more equipments per engineer simultaneously (hundreds vs. tens)
  - Lower transfer cost
  - Simpler IP address planning; Not touch customer’s IP planning
- **Smaller footprint**
- **Lower power consumption**
- ......
NetRing TN – Packet Transport Network
Product Portfolio

Switching Capacity

- 320/640 Gb/s
- 108/160 Gb/s
- 88 Gb/s
- 6.4/44 Gb/s
- <6.4 Gb/s

Chassis Size

- 1U
- 3U
- 7U
- 18U

TN 735*
- Under Developing
- Aggregation/Core Device

TN 725
- Aggregation Device
- Medium size

TN 705
- Edge/Aggregation device
- Compact

TN 703
- Edge Device
- 1U Entry Level Pizza box

TN 701*
- Under Developing
- CPE box

TN 705
- Under Developing
- Aggregation/Core Device

TN 703
- Edge Device
- 1U Entry Level Pizza box

TN 701*
- Under Developing
- CPE box

TN 725
- Aggregation Device
- Medium size

TN 735*
- Under Developing
- Aggregation/Core Device

TN 703
- Edge Device
- 1U Entry Level Pizza box

TN 701*
- Under Developing
- CPE box

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Thank you