UNLEASH THE POWER OF LIMITLESS CONNECTIVITY
Wireline Access Network

Lessons from Operating Tens of Thousands of Remote PHY Devices

Jorge Salinger
VP, Access Architecture
Comcast
The need for more network capacity to keep up with growing demands continues to drive the need for better spectral efficiency and node segmentation.

Better spectral efficiency requires, amongst other things:

- Higher DS MER performance. Analog intensity modulated links and distance between the transmitter and node become limiting factors; moving to digital links is required.
- Moving the entire PHY to the node further helps solve this objective. Both remote PHY and remote MAC-PHY move the PHY layer, implementing DAA.
- Node segmentation involves adding additional equipment into service provider facilities, which reduces available space and increases power requirements.
- Moving the PHY layer out of the facility reduces power requirements and allows for CCAP platforms to become denser.
- The migration to Remote PHY reduce, and even eliminates, the need for headend equipment and all modulation equipment.
Benefits of DAA

- DAA nodes use SFP+ transceivers which allow the use of standard ITU channel DWDM mux / demux equipment
  - This allows for greater efficiency of outside plant fiber utilization vs. CWDM channels used for analog transmission today
  - Commercial services and other Ethernet links can share the same fiber more easily
  - Having Ethernet at the node location allows options like offering PON or Ethernet services from a deep network location
- Digital Ethernet links are more reliable than analog AM links
  - Analog AM links require maintenance to maintain light level as the resulting RF signal level is directly related
  - Ethernet links have a large range of receive power and light level is not directly related to performance
- Moving the PHY to the field paves the way for full duplex (FDX) DOCSIS
  - FDX operation requires the PHY to be located at the node location
Distributed Architecture Implementation

- Multivendor platform – simpler and quicker to implement than a single platform solution
- Core components use GCP and engine components do not
- All RPD functions except DOCSIS and 55-2 OOB are configured by the principal GCP core
- Leverages existing legacy video platform by keeping it simple. Video engine does simple encapsulation of MPEG with DEPI header with static PW.
- OOB implemented as separate components; both require processing in the RPD and in the headend, and interface with existing legacy HW/SW
1. RPHY Base Implementation

- Develop RPD
- Implement Interfaces
- Separate PHY
- Timing
  - Control plane
  - Data plane

Core

RPD
Lessons from Operating 10s of Thousands of Remote PHY Devices

1. RPHY Base Implementation

- Separate PHY
- Develop RPD
- Implement Interfaces
- Timing Control plane
- Data plane

2. Core-RPD Interoperability

- Address non-vendor-specific interaction
- No exact match of CCAP, node and encryption footprint
- Need one vendor’s R-PHY node/RPD with another vendor’s core
Lessons from Operating 10s of Thousands of Remote PHY Devices

1. RPHY Base Implementation

- Implement Interfaces
- Separate PHY
- Develop RPD
- Timing
- Control plane
- Data plane

2. Core-RPD Interoperability

- Same Interfaces
- CMTS Core 1
- RPD 1
- CMTS Core 2
- RPD 2
- vCMTS
- RPD 3

- Address non-vendor-specific interaction
- No exact match of CCAP, node and encryption footprint
- Need one vendor’s R-PHY node/RPD with another vendor’s core

3. Use Cases

- New Plant
- Node Split
- Shelf

- Features for each case
- Spectrum difference DS and US
- Capacity and performance differences
- Different device architecture
Lessons from Operating 10s of Thousands of Remote PHY Devices

1. RPHY Base Implementation
- Implement Interfaces
- Develop RPD
- Separate PHY

2. Core-RPD Interoperability
- Same Interfaces
- CMTS Core 1
- CMTS Core 2
- vCMTS
- RPD 1
- RPD 2
- RPD 3

- Address non-vendor-specific interaction
- No exact match of CCAP, Node and Encryption footprint
- Need one vendor’s R-PHY node/RPD with another vendor’s Core

3. Use Cases
- New Plant
- Node Split
- Shelf

- Features for each case
- Spectrum difference DS and US
- Capacity and performance differences
- Different device architecture

4. Generations

<table>
<thead>
<tr>
<th>Year</th>
<th>Generation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Progress</td>
<td>Gen 1</td>
<td>Current silicon (1x1, 1x2)</td>
</tr>
<tr>
<td>2021</td>
<td>Gen 2</td>
<td>Designed to support scaling (2x2, 2x4)</td>
</tr>
<tr>
<td>2023</td>
<td>Gen 3</td>
<td>Designed to support FDX</td>
</tr>
</tbody>
</table>

- Optimize components & power
Lessons from Operating 10s of Thousands of Remote PHY Devices

- Use of modern monitoring systems is critical, such as moving to streaming telemetry
  - Currently available open-source tools make monitoring much easier
  - More scalable telemetry makes data acquisition easier and troubleshooting faster
  - Moving to steaming telemetry from the RPD
- Plant powering can become very impactful
  - Previously normal maintenance procedures did not cause perceptible outages
  - Very short power interruptions now cause five to 10 minute outages
  - New node components help mitigate problems
- Scaling to thousands of RPDs requires smooth provisioning process and approaches
  - Multiple information sources brought into a single configuration
  - Smart back-end and field tools are required to prevent and/or identify errors
- Software and hardware management tools become essential
  - Software upgrades for RPDs is much closer to CPE upgrades than CMTS upgrades
  - Keeping track of hardware versions and use cases is paramount for configuration
Thank You!

Jorge Salinger
VP, Access Architecture
Comcast
jorge_salinger@cable.comcast.com