CABLE ACCESS
TRANSPORT ARCHITECTURE

APPLICATION NOTE

In this paper, a brief introduction on the evolution of cable access network scenarios is provided with focus on transport architecture.

CableLabs has recently announced the release of DOCSIS 4.0 specification with the target to provide 10G access capabilities via cable access.

Main characteristics of DOCSIS 4.0:

- Downstream capacity: 10Gb/s
- Upstream capacity: 6Gb/s

Compared to DOCSIS v.3.1, the bandwidth is almost doubled. This has implications for the 'backhauling' architecture that needs to provide the required bandwidth.

Hereafter some network scenarios as defined by CableLabs with focus on optical transport capabilities needed.

REMOTE PHY ARCHITECTURE AND ITS EVOLUTION

Remote PHY Architecture is described in [1].

Main components of a Remote PHY Architecture:

- CCAP (Converged Cable Access Platform) Core
- RPD (Remote PHY Device)

The RPD component has a network interface on one side and an RF interface on the other. The RPD provides Layer 1 PHY conversion, Layer 2 MAC conversion, and Layer 3 pseudowire support. The RPD RF output may be RF combined with other overlay services such as analog or digital video services.

The CCAP Core contains everything a traditional CMTS does, except for functions performed in the RPD. The CCAP Core contains the downstream MAC, the upstream MAC, and all the initialization and operational DOCSIS related software.

The reference network scenario is the following:

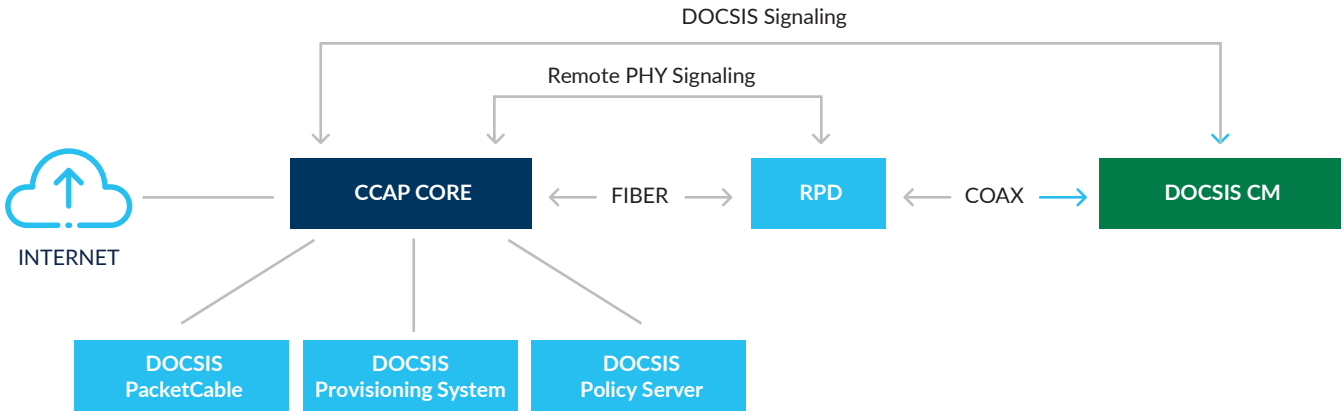

Figure 1 Remote PHY architecture (CableLabs)

Evolving the capacity over the access COAX cable via DOCSIS 4.0, requires the network between CCAP Core and RPD to evolve accordingly. Introduction of WDM technology allows to cope with existing and future requirements in terms of bandwidth. In this way:

- CCAP CORE sends traffic to all RPD multiplexing different wavelengths over the same physical fiber infrastructure.
- Each RPD filters its own wavelength (and uses the same for transmission).

Wavelengths can be initially 10Gb/s evolving to 100Gb/s in future.

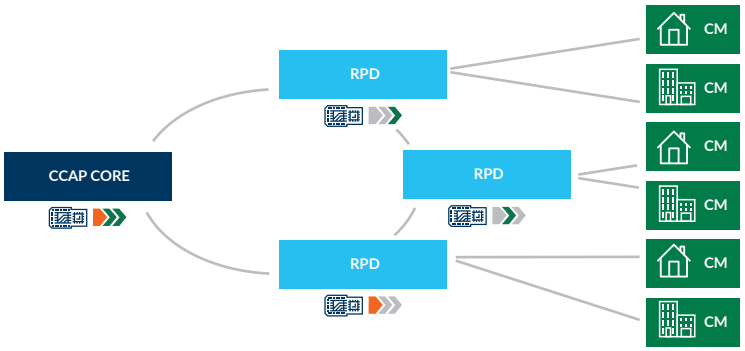

Figure 2 Remote PHY evolution with WDM Access

10G ACCESS AND EVOLUTION

A convergent single network able to host different kinds of services has been defined by CableLabs as a combination of technologies that will deliver symmetric multi-gigabit Internet speeds with the promise to be 10 times faster than today's networks and 100 times faster than what most consumers currently experience, with lower latencies, enhanced security and greater reliability [2].

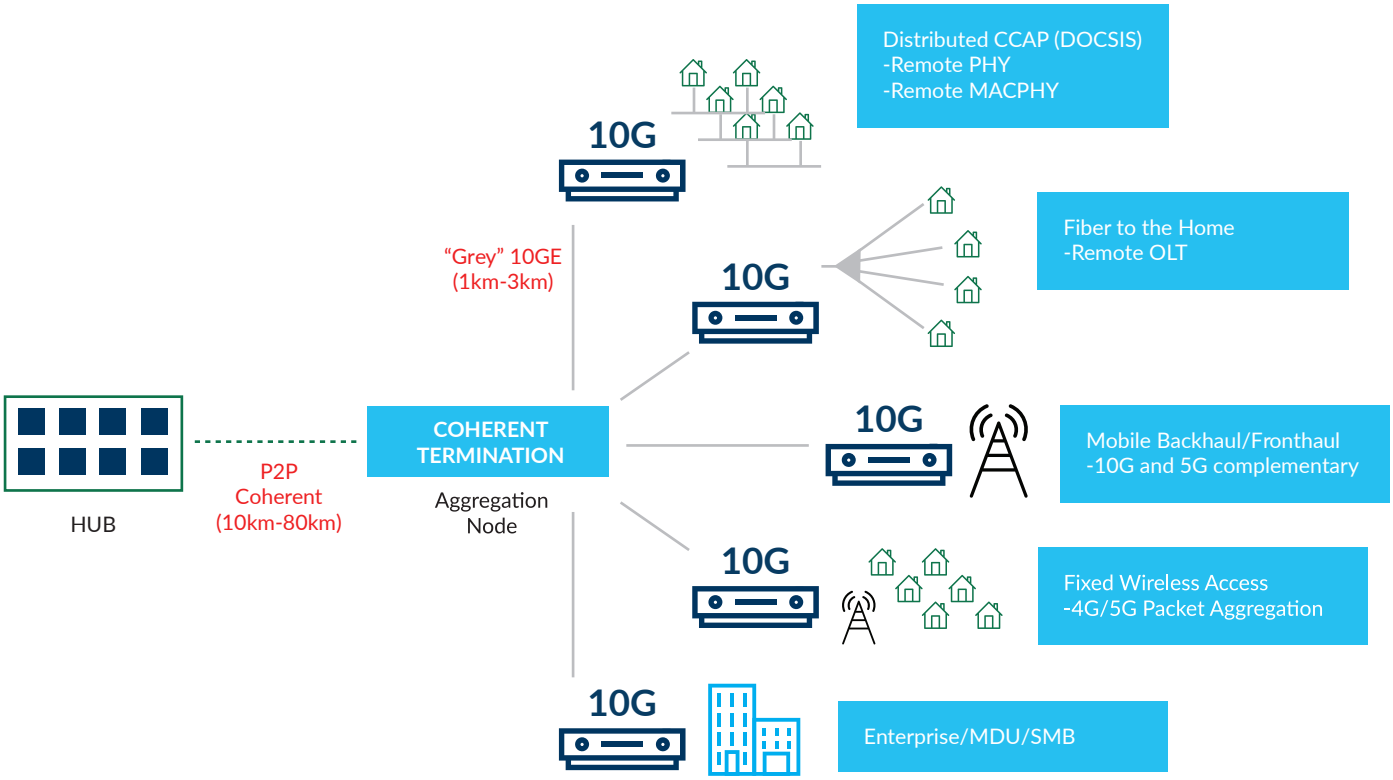

Figure 3 10G CableLabs architecture (from CableLabs website)

Technologies enabling 10G architecture:

- DOCSIS 4.0
- Coherent Optics
- 10G/25G/50G PON

In this architecture, the Aggregation Node is located in the connection between the metro and access network. Utilizing coherent termination, this architecture is set to evolve with the introduction of WDM in the connection between the HUB and the Aggregation Node (instead of the P2P link).

This allows the HUB to distribute many wavelengths (one for each Aggregation Node) that are dropped/inserted by aggregation nodes that then delivers 10Gb/s point-to-point to each 10G access node.

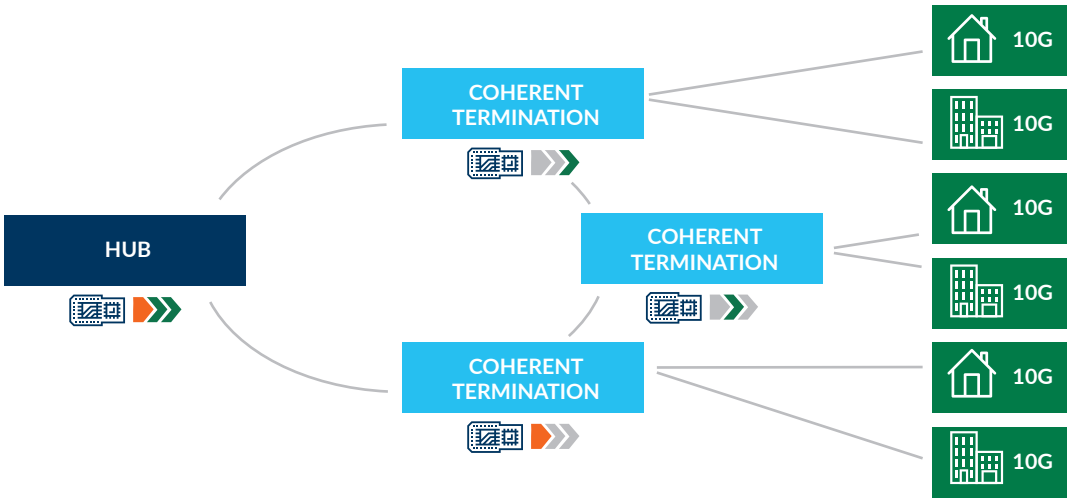

Figure 4 10G access evolution

OPTICAL COMMUNICATION MODULE LINK EXTENDER

A Technical Paper prepared for SCTE/ISBE introduces the DWDM Access for Remote PHY Networks Integrated Optical Communications Module (OCML) [3].

OCML (Optical Communications Module Link Extender) is a concept for cost effectively transporting a mix of DWDM 10GbE, GPON and 10GEPON wavelengths over the same fiber to a typical Hybrid Fiber Coax node serving area.

This is possible because the wavelengths used for GPON, 10GPON and for traditional C-band WDM do not overlap:

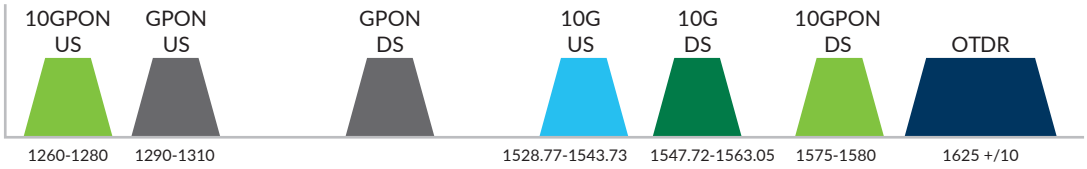

Figure 5 Wavelengths used for OCML services

Some key requirements for OCML include:

- 5 to 60 Km fiber rings
- 10G DWDM - transport up to 20 X 10G bi-directional wavelengths
- GPON/10EGPON transport over 20Km

The OCML has been defined with the vision that it could support future requirements for 100GEPON and 100G Coherent.

Two components are introduced:

- Headend node: located in the central office, it is the node that performs the multiplexing of different signals and services over the same fiber.
- Outside plant: it is the remote node mostly passive that separates the traffic coming from the headend node into the services towards the access (PON, P2P)

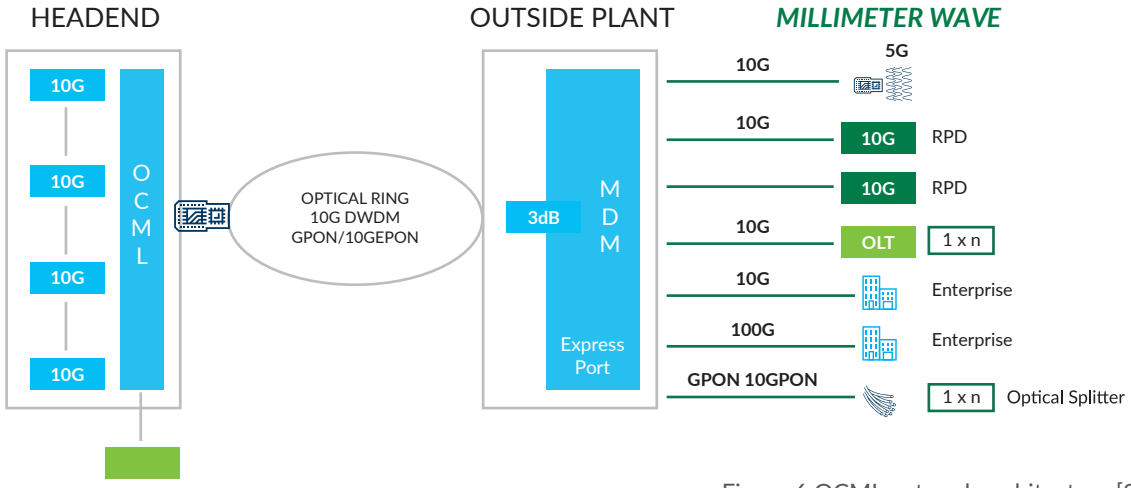

Figure 6 OCML network architecture [3]

The main building blocks of OCML terminal are the following:

- Passive filter with the capability to mix wavelengths used for PON access with traditional C-band wavelengths
- Optical Booster and Pre-amplifier to satisfy the requirements defined for OCML
- Couplers/splitters and optical switch to provide optical protection

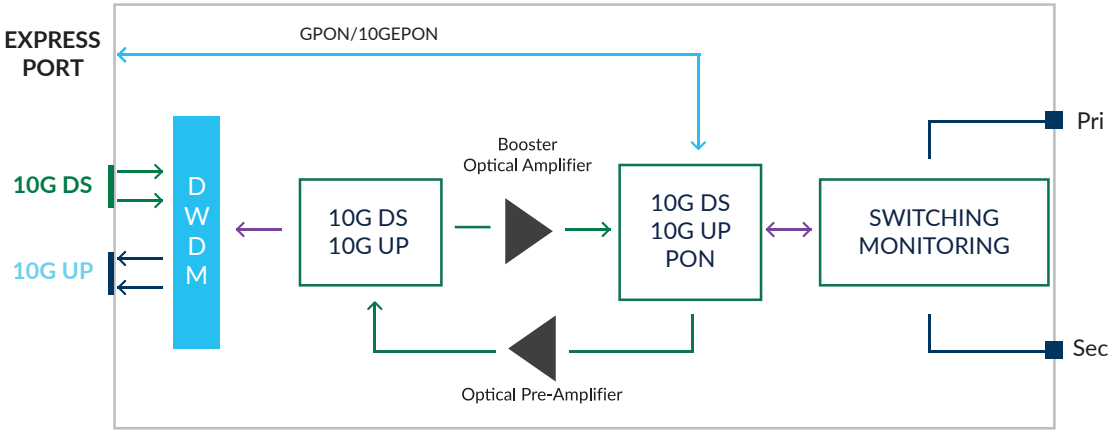

Figure 7 OCML Building blocks [3]

ABOUT JABIL PHOTONICS

Jabil Photonics is a business unit within Jabil with extensive photonics expertise and a comprehensive portfolio of optical products, including optical components, passive and active fiber optical components, EDFA amplifiers and complex optical modules. With Jabil's reputation as a leading global EMS provider in conjunction with the company's growing focus and investment in the photonics space, Jabil Photonics provides an unparalleled set of solutions and capabilities for the photonics industry including market-proven advanced photonics packaging services (APPS) to support silicon photonics technologies and an in-house developed 100G/200G CFP2 Coherent pluggable (DCO).

In addition to product offerings and manufacturing services, Jabil Photonics has a strong focus on R&D and provides value-add services including HW and SW design, testing and verification.

Jabil Photonics offers its expertise for the main optical building blocks for cable network evolution, in both subsystems and customized design, which can be integrated in products or utilized as stand-alone systems:

Figure 8 Jabil Photonics Portfolio

References

[1] Data-Over-Cable Service Interface Specifications DCA - MHAv2 - Remote PHY Specification - CM-SP-R-PHY-I14-200323

[2] CableLabs - 10G: The Next Great Leap in Broadband

[3] DWDM Access for Remote PHY Networks Integrated Optical Communications Module (OCML) - A Technical Paper prepared for SCTE/ISBE.