5G ACCESS TRANSPORT ARCHITECTURE

APPLICATION NOTE

SUMMARY

In this paper, a brief introduction of the 5G architecture is provided, but the focus is to address the transport architecture options for the 5G access network and how it has evolved from the previous 4G architecture. In particular, we identify the optical building blocks needed in each case.

OVERVIEW OF 5G TRANSPORT ARCHITECTURE

3GPP has specified several functional split options for 5G transport: fronthaul, midhaul, backhaul (as defined in [1]) as well as different combinations of functions, as illustrated in the following figure:

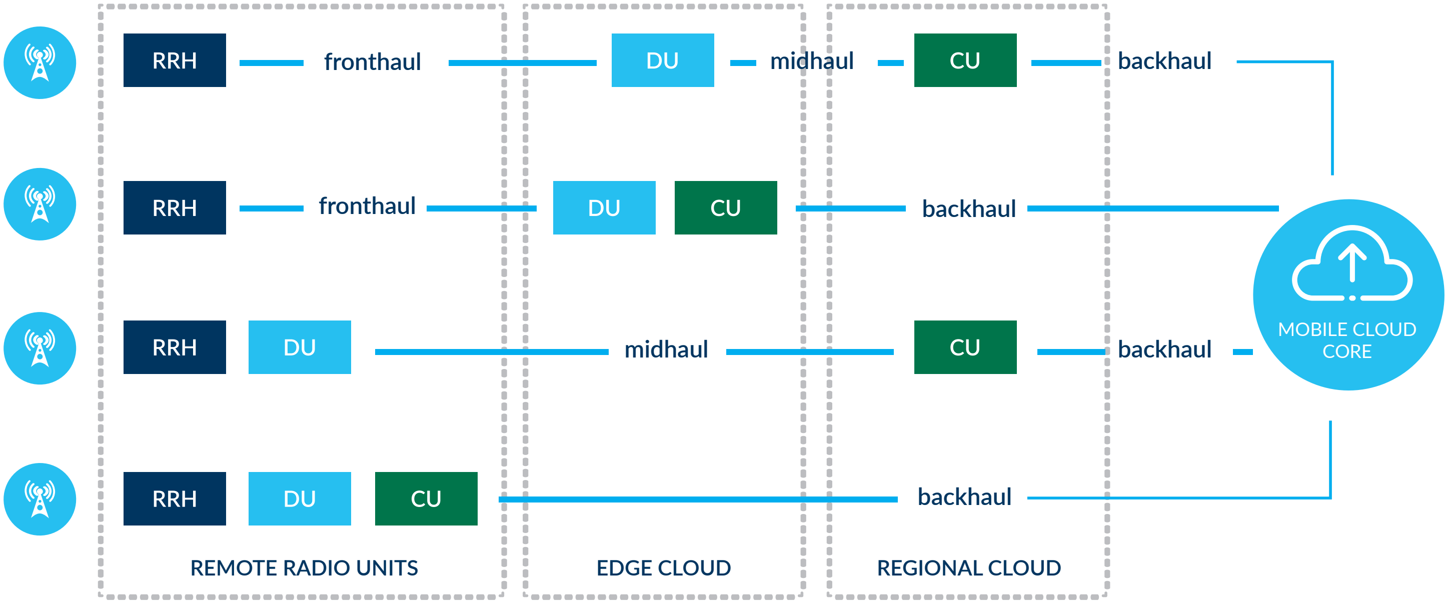

Figure 1 Different options for 5G transport

Typically, a single network can host different options at the same time depending on geography, amount of traffic, legacy network presence, etc. For this reason, the 5G transport network needs to be ready to transport any type of 5G traffic (fronthaul, midhaul, backhaul) at the same time. This presents important implications around bandwidth and latency requirements for the access network as described in [1].

5G ACCESS ARCHITECTURE

The 4G access network was primarily based on backhaul architecture (fronthaul was defined but not largely deployed), where the cell site gateway, typically a Layer 2/3 device, was connected directly to each base station and the traffic forwarded via fiber to the next level of L2/L3 aggregation

Topology was point-to-point or ring and the capacity was typically 1Gb/s with evolution to 10Gb/s.

Microwave connections were utilized to reach remote base stations not connected via fibers.

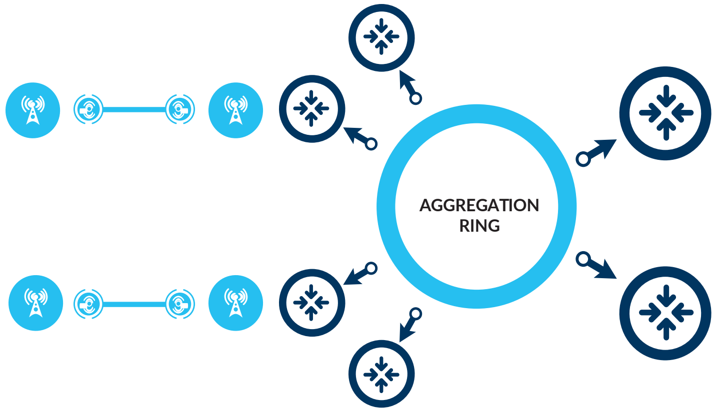

Figure 2 architecture of 4G access ring

The evolution from 4G to 5G architecture needs to consider the following elements:

- Increasing bandwidth from each RRH or CU/DU (typically 10Gb/s or 25Gb/s)
- Stringent latency requirements and requirements for the nodes to pass-through traffic at the lowest possible transport layer
- Coexistence with 4G architecture to allow sharing of a single infrastructure for the current and the previous network technology.

The consequence of this is that the access rings for 4G which were typically based on 'dark fiber' are migrating to WDM technology with two objectives: to increase the bandwidth and reduce the latency in the pass-through nodes:

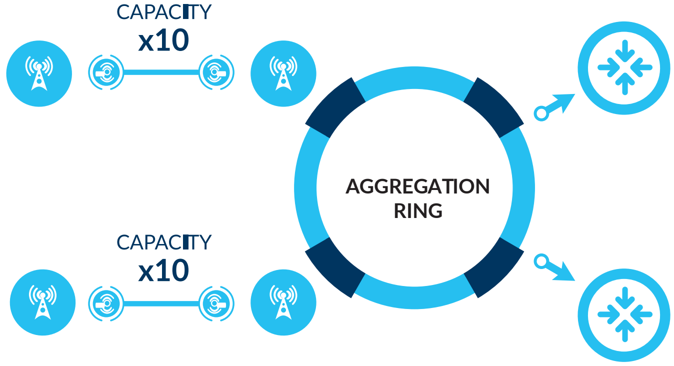

Figure 3 architecture of 5G access ring

In each access node, there can be still the Cell Site Gateway (with higher capacity and maybe with decentralized MEC functions), but logically this remote Cell Site Gateway will be connected (via dedicated wavelength) to the higher level L2/L3 node in the central office (or datacenter). This will minimize the accumulated latency in the network avoiding pass-through at the packet level:

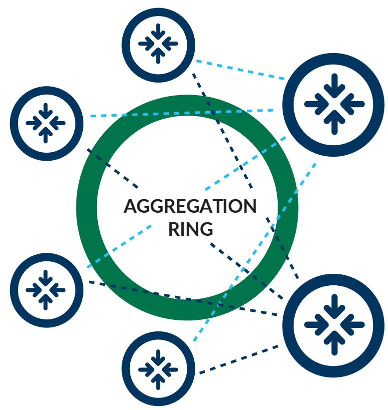

Figure 4 Logical connectivity between CSG and High level L2/L3 node

This architecture requires the following main WDM building blocks:

- Passive filters to add/drop the specific wavelengths in the access nodes and to terminate all the wavelengths in the hub node (ROADM architecture is a potential option but is currently too expensive for the target TCO of the 5G network)
- Amplification to exceed the pure passive network optical power budget
- Optical Transceivers (colored) hosted in all the network elements of the network both in the remote nodes and in the hub

In the case of fronthauling, it is possible to dedicate a transparent WDM wavelength from the Remote Radio Head (RRH) up to the hub node where centralized functions are located. This way, it will be possible for the same access architecture to support both backhaul/midhaul traffic and fronthaul and meet the bandwidth and latency requirements for each.

5G ACCESS VIA PON NETWORK

Operators that have heavily invested in PON infrastructure, now have a rich capillarity and the ability to connect RRH via fibers, and require a solution where PON and 5G access coexist on the same fiber.

PON architecture imposes some constraints on the access architecture:

- Usage of 'single fiber' (the usage of different wavelengths for Upstream and Downstream directions)
- Design of specific filters to accommodate wavelengths used for 5G access together with PON upstream and downstream signals
- Amplification needed for satisfying the power budget of a PON network
- Specific pluggable for RRH in order to interwork with PON network
- Another potential requirement is the coexistence between CWDM and DWDM over the same network.

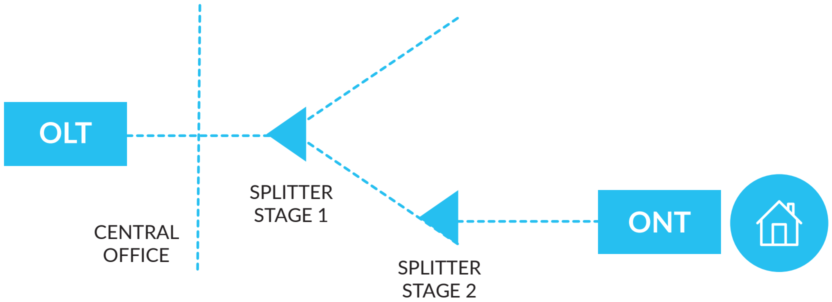

Figure 5 High level PON access architecture

A PON network can be then adapted for 5G by overlaying the PON network with a WDM network and introducing additional filters to add/drop the PON specific wavelengths from the others dedicated to 5G transport.

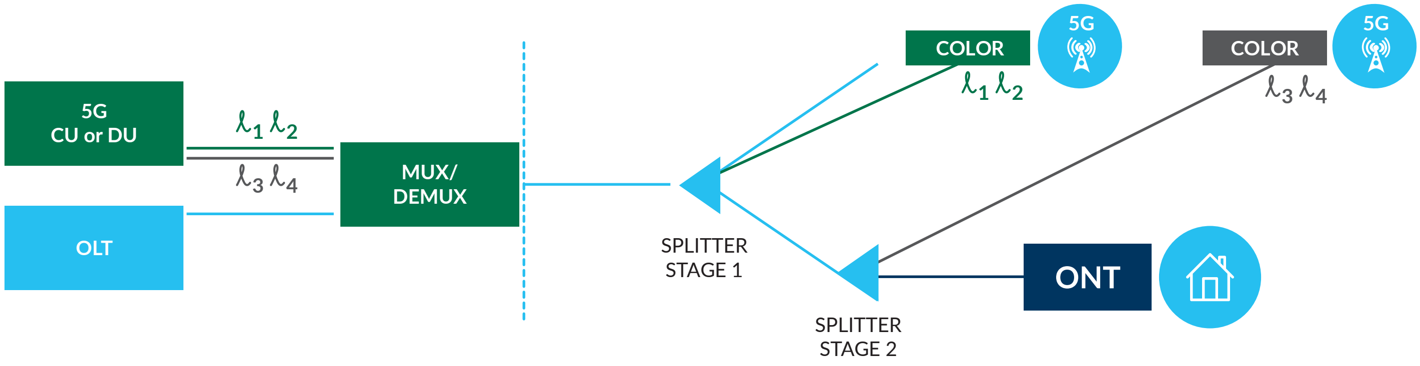

Figure 6 Overlay of 5G to PON network

Key elements of 5G access overlay with PON architecture:

- Passive filters with the capability to insert/extract specific PON wavelengths with WDM wavelengths
- Amplifiers to satisfy the optical power budget of the PON access network overlaid with the WDM network
- Colored WDM transceivers for 10G and 25G

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 7 Jabil Photonics Portfolio

References

[1] ITU-T G.Sup67 - Application of optical transport network recommendations to 5G transport

