Optical transport networks: why they matter and the importance of standardized solutions

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Why you should care about optical networks

- Can you imagine your life without your smartphone? Probably not, it has become your new sensory organ
- But, as any sensory organ, it needs a nervous system to connect it
- Optical networks are the nervous system that the digital society, industry and economy rely upon.
- Optical fiber networks are deployed in telecommunication systems worldwide.
- They are continuously being pushed by new bandwidth-demanding services including 5G and high-speed Internet access.

Optical networks & 5G: a marriage of convenience

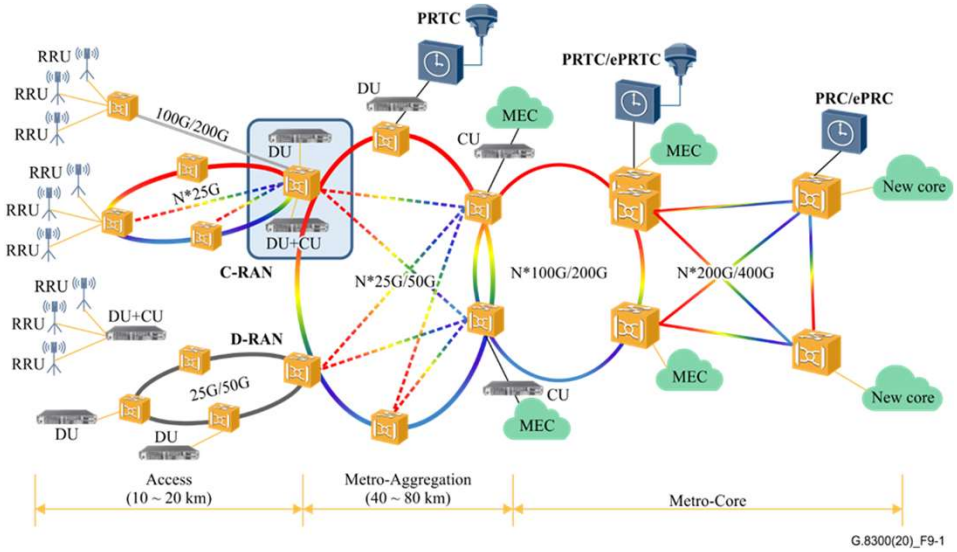
5G led to the introduction of a new "mobile transport network" segment, with its own peculiarities

- Short distances, as in access networks
- High capacity and multiple topologies, as in WANs
- New advanced features, such as self-configurable components and low latency transmission and switching.

What does it imply for optical components?

- Potential product volumes are high, as in datacom
- Target cost is low, as in access
- Required features are demanding, as in WAN

Example of mobile transport network topology, from ITU-T Recommendation G.8300



5G requires new optical components: the high volumes make the business opportunity appealing but initial investments and risks are big too

- Standardization is the key to mitigate the risks in introducing the required new technologies

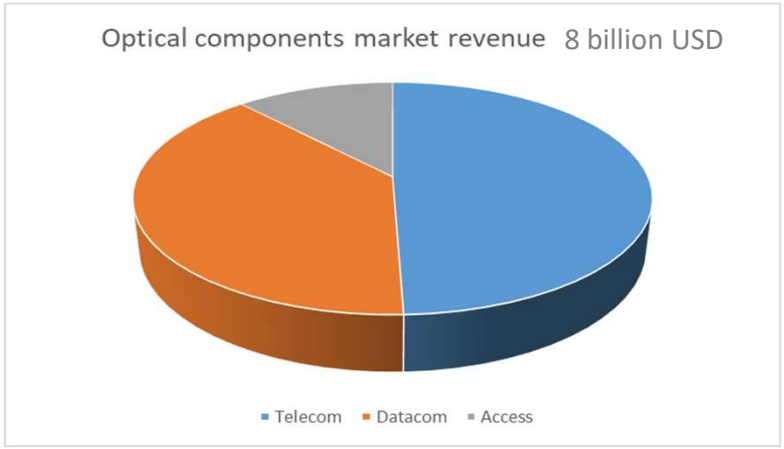
What is an optical fiber

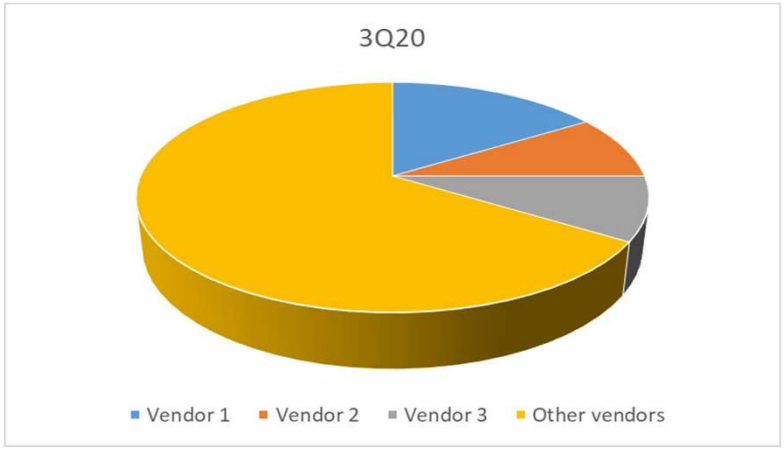
- Optical fiber is a guided propagation medium (in essence, a glass wire) that supports the transmission of light pulses that carry information
- Pros: low attenuation (=higher distance, lower power consumption), immunity to electromagnetic interference, broadband capacity
- Optical fiber is ubiquitous: it connects offices, industries, homes, data centers, …
- We should speak about optical fiber**s**: the design of an optical fiber is a delicate trade-off of many performance aspects
- …and here come ITU-T expertise! (Q5/15 especially)
- Single Mode Standard Fiber, standardized in ITU-T Recommendation G.652, is by far the most deployed type of optical fiber worldwide, supporting several generations of optical transmission systems in many different applications (e.g., access, metro and long-haul networks).

The role of ITU-T Question 6/15

- Q6/15 gathers experts in optical technologies and systems from industry, operators, governments and academia.
- Q6/15 is responsible for the “standardization of optical components, subsystems and systems for optical transport networks”
- Its scope encompasses all technologies needed to transmit, amplify and switch (at the physical layer) optical signals in communications networks that use optical fiber as propagation medium
- Q6/15 defines specifications for physical layer components and interfaces of single and multi-wavelength transmission systems
- These specifications enable multi-vendor interoperable systems, fostering an open market based on standardized components producible in large volumes.

The optical components market





Telecom= wide area networks (WAN), including amplifiers and ROADM
Datacom= components for data centers, enterprise, and LANs
Access= FTTx and CATV

- The optical components market is a healthy but fragmented market, where competition fosters innovation but also poses profitability challenges

Industrial impact of Q6/15 work

- All relevant players (operators, system vendors, and optical modules vendors benefit from participating in Q6 work.
- Operators contribute by creating a common and shared view of the features that the optical networks require to enable new services, like the one required by 5G and, in future, 6G.
- Then, systems and subsystem vendors can develop technical specification accordingly.
- Unavoidable compromises are compensated for by the resulting bigger and less fragmented market, where healthy competition can take place.
- Multi-vendor interoperable specifications make it easier, and lower risk, for operators to plan the evolution of their optical networks
- Moreover, vendors can make their R&D more efficient in presence of a more sustainable supply chains

Examples of specifications developed by Q6 1/2

- High speed optical transmission systems for WDM metro systems
  - WDM= wavelength division multiplexing, i.e., using different “colours” for different signals
  - Metro systems = distance of some hundreds of kilometers
  - 100G optical interfaces specified in G.698.2
  - Work in progress about 400G and 800G optical interfaces
- Optical interfaces for 5G fronthaul and backhaul networks
  - 25G DWDM systems specified in G.698.1
  - Adding automation features (transmitter frequency self tuning): G.698.4
- New WDM systems in O band (Draft Recommendations G.owdm and G.owdm2)
  - O band is around 1310 nm, C band (where traditional WDM system works) is around 1550 nm
  - O band systems offer lower cost and are mainly used for optical interconnects over short distances (100m-1 km) and fixed fiber access
  - The aim of these new system is to expand the capacity of optical fiber systems, exploiting the huge optical fiber bandwidth as efficiently as possible

Examples of specifications developed by Q6 1/2

- Increasing the distance transparently to the signal format
  - Optical amplifiers: G.662, G.661, G.665
- Switching optical signals at the physical layer
  - Reconfigurable optical add drop multiplexers: G.672
- Making optical networks smarter
  - Optical performance monitoring: G.697
- The frequencies to use
  - G.694.1 and G.644.2

- …and don’t miss G.Sup39 an excellent tutorial about optical networks!

Questions?