

# 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

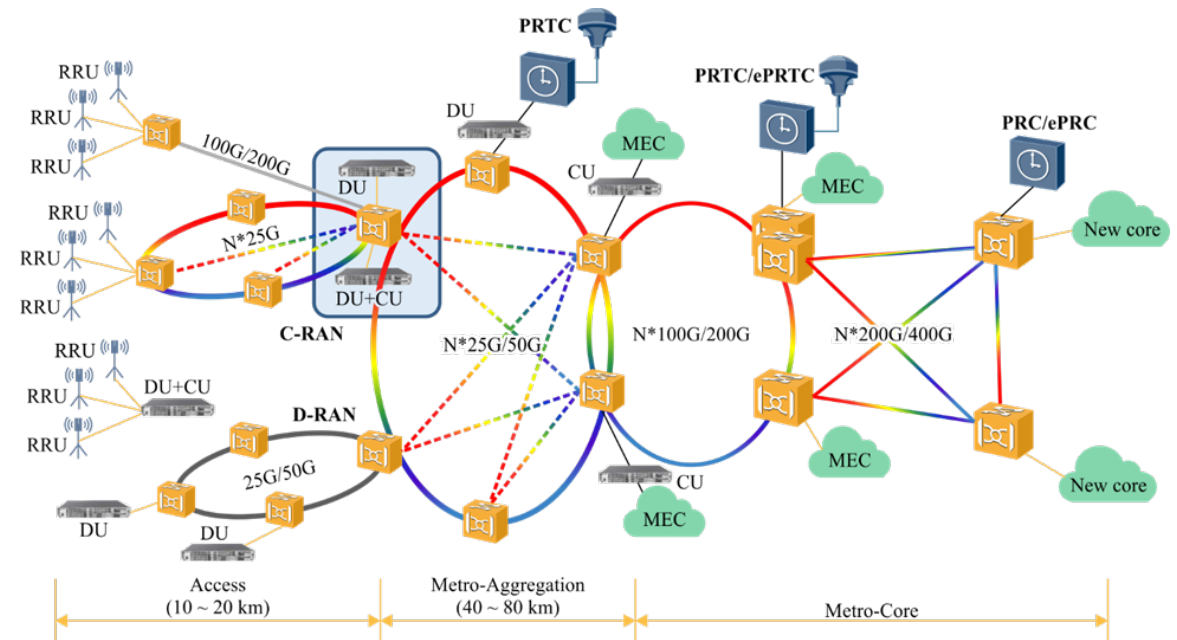
**5G led to the introduction of a new “mobile transport network” segment, with its own peculiarities**

- 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



G.8300(20)\_F9-1

**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

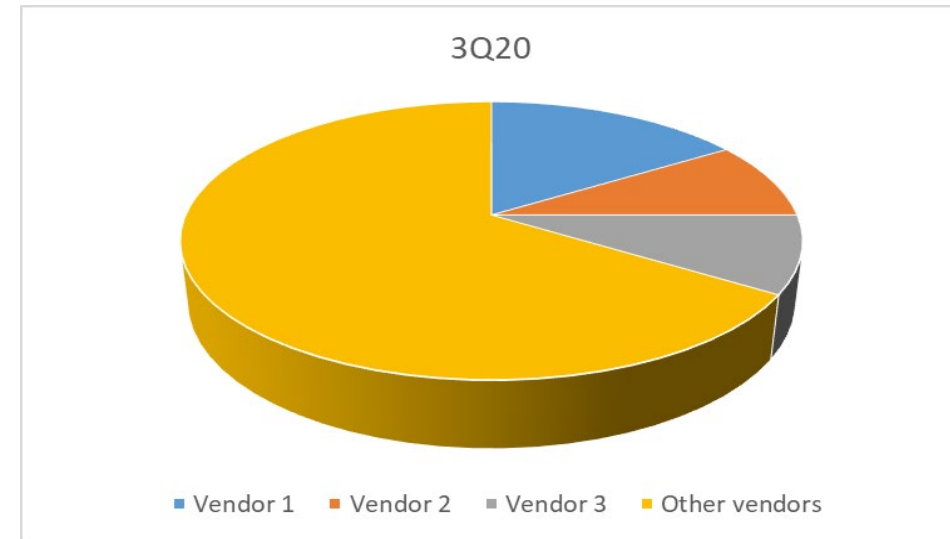
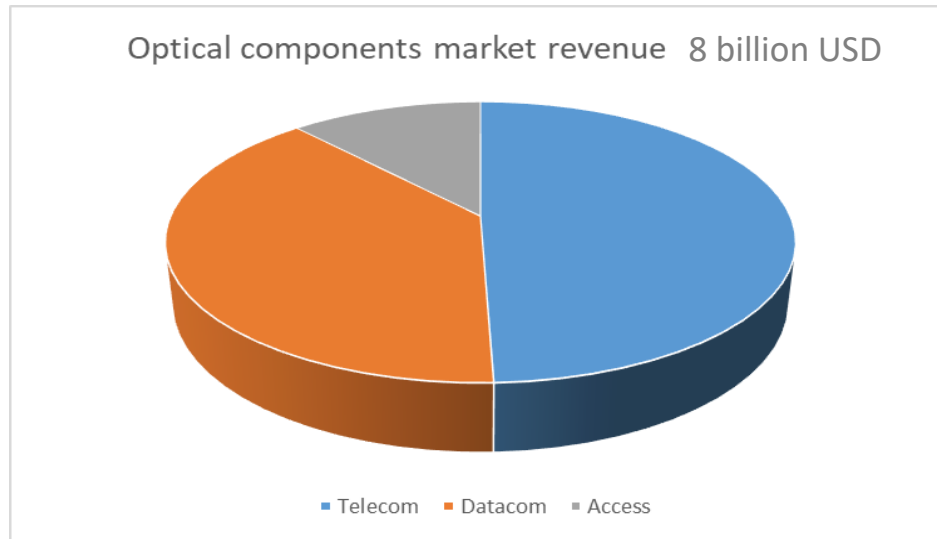
# What is an optical fiber

- 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 fibers: 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?