IMT-2020/5G related standardization in ITU-T SG15

ITU/TSB

Hiroshi OTA

SG15 mandate

SG15 is responsible for the development of **standards** on**:**

- **optical transport network**
- **access network**
- **home network and power utility network infrastructures**
- **equipment**
- **systems**
- **maintenance**
- **optical fibres and cables and their related installation**
- **management**
- **instrumentation and measurement techniques**
- **control plane technologies**
- **test**

to enable the evolution toward intelligent transport networks, including the support of smart-grid applications.

WP1 – Broadband Access

G.FAST — Broadband access up to 2 Gbps

G.mgfast — Next generation G.fast targeting 5-10 Gbps

DTA — G.fast dynamic time assignment (DTA) downstream/upstream bit-rates responsive to customer traffic

Continue collaboration with broadband forum

G.RoF — Radio over fiber for mobile fronthaul

NG-PON2 — Next generation of converged fiber access going to higher speeds

Visible Light Communication for home networking

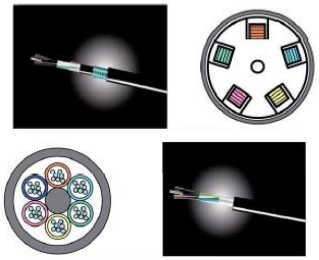
Powerline communication (PLC) for smart grid and home networking

G.Hn — G.hn home networking over indoor phone, power, and coax wires >2 Gbps

WP2 – Optical Technologies

Optical Network Infrastructure

Disaster Management issues



Optical Fibre Technologies and Cables for easy and environmentally friendly outside plants

Multichannel bi-directional DWDM applications targeted at lower cost optical solutions for applications including mobile fronthaul and backhaul

100G and future higher-rate coherent multi-vendor interoperable interfaces

200G
400G

Short-reach (OTN client) 200G and 400G interfaces reusing components developed for Ethernet applications

WP3 – Optical Transport Networks

Transport and synchronization supporting 5G mobile fronthaul and backhaul

Synchronization of packet networks and future OTN networks, e.g., beyond 100G

Architecture and other Transport SDN Aspects

Network survivability (protection and restoration)

New “B100G” OTN interfaces, including the use of coherent G.698.2 interfaces under development

Management aspects of control and transport planes

Equipment & management specifications for OTN, Ethernet and MPLS-TP

Core Information model enhancement for management of synchronization and optical media

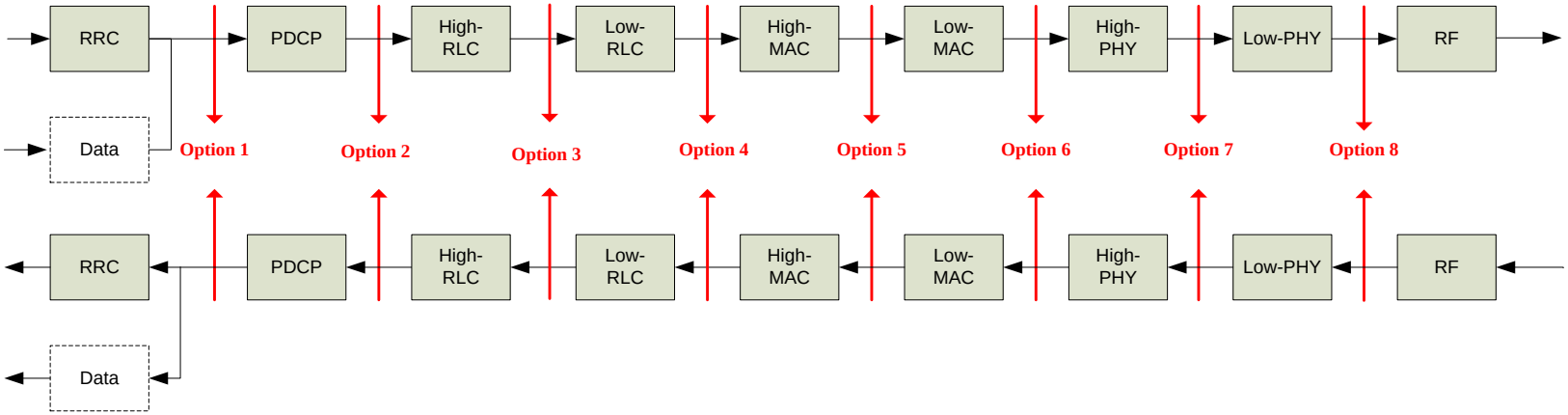
Transport network support of IMT-2020/5G

GSTR-TN5G: Transport network support of IMT-2020/5G (Published in Feb. 2018)

- A reference model of IMT-2020/5G network and a set of deployment scenarios.
- Requirements on transport networks in order to support IMT-2020/5G networks
- Interfaces between IMT-2020/5G entities and transport networks
- Aspects of transport network support include network slicing (data plane and control plane), synchronization, and Control/Management.

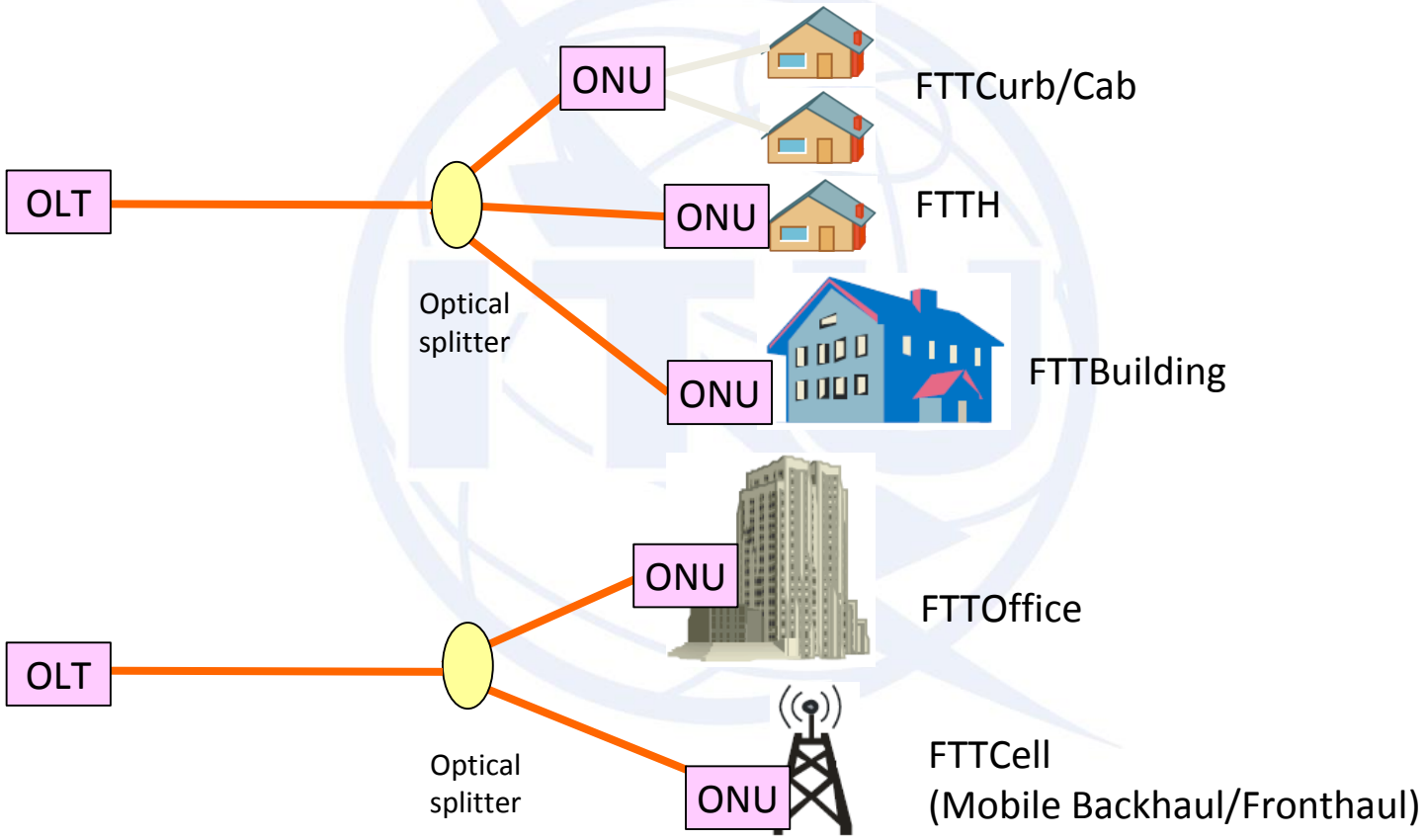
Fronthaul

- Conventionally, the fronthaul link is between RF and the remaining L1/L2/L3 functions (Option 8 split point)
- Option 8 centralizes high layer functions but requires stringent latency and high bandwidth
- It is critical to consider tradeoffs between throughput, latency, and functional centralization.



Signal processing chain of 4G and 5G wireless base stations and optional split points
source: 3GPP TR 38.801, "Technical Specification Group Radio Access Network; Study on new radio access technology: Radio access architecture and interfaces", March 2017

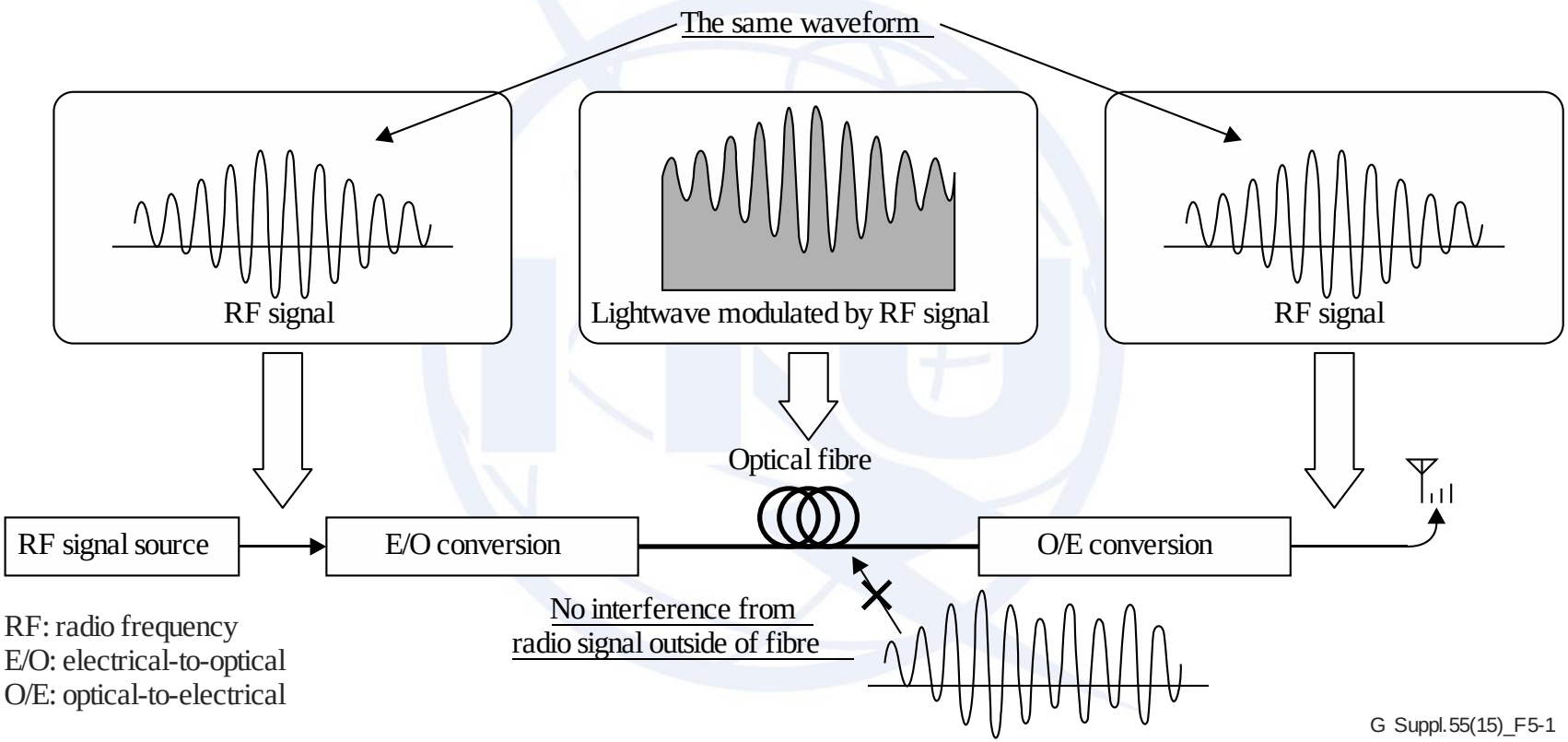
Fronthaul by PON



Standards and supplements on PON

- Related Recommendations include:
  - G.9807 series (XGS PON) – G.9807.1 (10G symmetric PON), G.9807.2 (reach extension)
  - G.989 series (NGPON2) - 40-Gigabit-capable passive optical networks (G.989 (Definitions), G.989.1 (General requirements), G.989.2 (Physical layer), G.989.3 (TC layer))
- Ongoing work:
  - G.sup.5GP: 5G wireless fronthaul requirements in a PON context
    - Requirements for 5G wireless fronthaul in the setting of optical access networks
    - Practical passive optical network solutions

Radio over fiber (analog RoF) for 5G fronthaul



Radio over fibre (RoF) - standards

- In-force Supplement
  - G Suppl. 55: Radio-over-fibre (RoF) technologies and their applications
- Recommendation under development
  - G.RoF: Radio over Fiber systems

CPRI over OTN for 5G fronthaul

- G Suppl. 56: OTN transport of CPRI signals
  - Describes alternatives for mapping and multiplexing CPRI client signals into the optical transport network (OTN)
  - Shows examples but does not specify standard methods
  - Relates to G.872 (OTN architecture), G.709(.x) series (OTN interfaces), G.798 (OTN equipment) and G.959.1 (OTN physical layer interfaces)

Optical transport network (OTN) beyond 100 Gbit/s

- ITU-T G.709: Interfaces for the optical transport network
- ITU-T G.709.1: Flexible OTN short-reach interface
- ITU-T G.709.2: OTU4 long-reach interface (under approval process)
- ITU-T G.709.3: Flexible OTN long-reach interface
- G.Sup.5gotn: Application of OTN to 5G transport (new work item)
  - Describes how to use the current OTN standards for this application
  - Plan to approve it at October 2018 SG15 meeting
- G.ctn5g: Characteristics of transport networks to support IMT-2020/5G (new work item)
  - Follow-up to GSTR-TN5G: it goes down to the lower level of details
  - It will be an area of focus at the October 2018 SG15 meeting

Wavelength division multiplex (WDM) technologies

- ITU-T G.695: Optical interfaces for coarse wavelength division multiplexing applications (under approval process)
- ITU-T G.698.4: Multichannel bi-directional DWDM applications with port agnostic single-channel optical interfaces
- ITU-T G.959.1: Optical transport networks physical layer interfaces (under approval process)

Frequency synchronization for 5G

- Requirements on performance and management of the frequency synchronization are defined in the ITU-T G.826x series
- ITU-T G.8265 describes the architecture and requirements for packet-based frequency distribution in telecom networks
- ITU-T G.8261 provides the network architecture and requirements related to physical layer-based frequency synchronization
- ITU-T G.8262.1 is being developed to define enhanced performance requirements of the physical layer clock, and this clock can be used in supporting a more accurate time synchronization
- ITU-T G.8265.1 defines the Precision Time Protocol telecom profile for frequency synchronization

Time synchronization for 5G

- Requirements on performance and management of time synchronization are defined in the ITU-T G.827x series
- General time synchronization architecture is defined in ITU-T G.8275
- Time synchronization requirements and network reference models have been defined by ITU-T G.8271 and ITU-T G.8271.1
- Requirements on performance and management of time synchronization are defined in the ITU-T G.827x series
- General time synchronization architecture is defined in ITU-T G.8275
- ITU-T G.8273.x series of recommendation defines clocks to be used for time synchronization; A new generation of more accurate clocks is being defined addressing the needs of future networks (e.g., Ethernet-based fronthaul)
- ITU-T G.8275.1 defines the Precision Time Protocol telecom profile for phase/time synchronization with full timing support from the network; G.8275.2 defines Precision Time Protocol Telecom Profile for time/phase synchronization with partial timing support from the network
- Time synchronization requirements and network reference models have been defined by ITU-T G.8271 and ITU-T G.8271.1; New synchronization solutions and network reference models are being developed to allow the distribution of timing with increased accuracy and reliability

Management & Control of Transport Network supporting IMT-2020/5G

- GSTR-TN5G (2/2018) focuses on the requirements on transport networks in order to support IMT-2020/5G networks.
  - Transport network technologies are those that are in the scope of SG15, including Photonic, OTN, Carrier Ethernet, MPLS-TP and PON, etc.
- Q14/15 is responsible to develop the specifications for the management & control of transport network resources, encompassing MCC* requirements, protocol-neutral Information Models (IM) and protocol-specific solutions (Data Model – DM) for common transport functionality, and transport technology-specific functionality (e.g., OTN, Carrier Ethernet, MPLS-TP, Photonic).
  - Common: ITU-T G.7710 (Requirements), ITU-T G.7711 (Core IM)
  - OTN: ITU-T G.874 (Requirements), ITU-T G.874.1 (Base IM)
  - Carrier Ethernet: ITU-T G.8051 (Requirements), ITU-T G.8052 (Base IM), ITU-T G.8052.1 (OAM IM & DM), ITU-T G.8052.2 (Resilience IM & DM)
  - MPLS-TP: ITU-T G.8151 (Requirements), ITU-T G.8152 (Base IM)
  - Photonic: G.media-mgmt (Requirements and Base IM)
- These IM & DM specifications can be used to derive the specific MCC interfaces, such as
  - Between transport NEs and SDN controllers, between SDN controllers of adjacent layers, between SDN controllers and Applications, and between SDN controller and administrative role

* *MCC – Management-Control Continuum: The concept whereby management and control functions are considered to be a continuum is known as the management-control continuum (MCC)*

ITU-T Study Group 15 meetings

- Geneva, 8-19 October 2018
- Geneva, May-July 2019 (exact dates to be determined)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