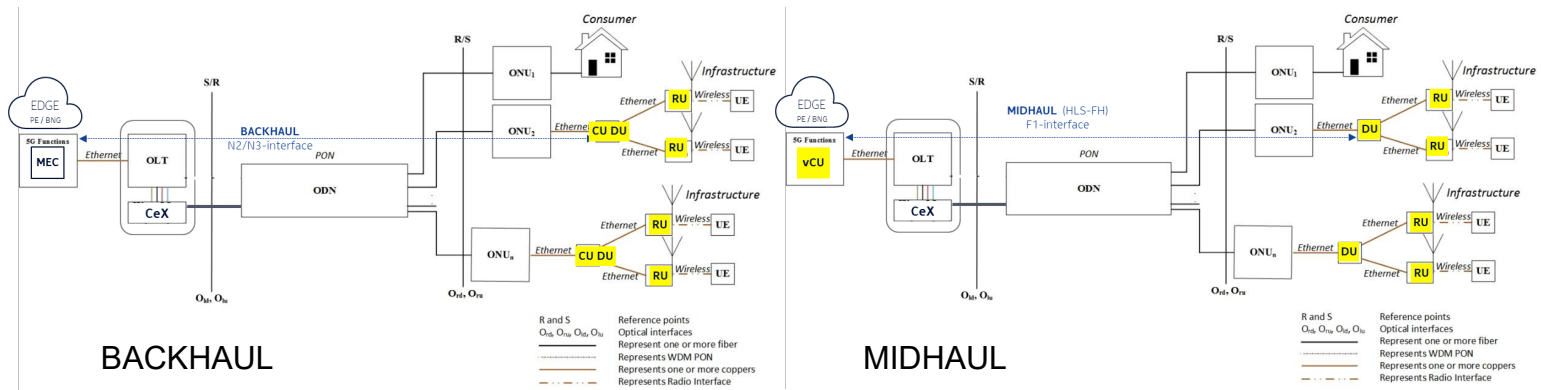


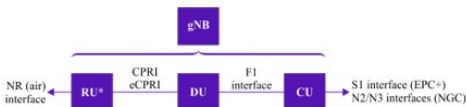
# G Suppl. 75 5G small cell backhaul/midhaul over TDM-PON

- This Supplement 75 to the ITU-T G-series Recommendations first enumerates the various requirements arising from IMT-2020/5G small cell systems, concentrating on the backhaul and radio access point (RAP) midhaul portions of the network.
- Application 5G NT small cell (SC) scenarios and related requirements are suggested as guidance.
- These 5G SC requirements are compared and confirmed with capabilities of the current and future time-division multiplexing-passive optical network (TDM-PON), such as 10-gigabit-capable symmetrical passive optical network (XGS-PON) defined in Recommendation [ITU-T G.9807.1] and towards higher speed PON such as 50G TDM-PON defined in the ITU-T G.9804.x series.



## REVIEW OF 5G SMALL CELL SYSTEMS

The Supplement starts with an overview of the 5G new radio (NR) small cell applications and their typical deployment scenarios with Small Cell (SC) using a distributed baseband (Backhaul BH) or High Layer Split (HLS) base-station in cloud architecture ("Midhaul" MH).



## REQUIREMENTS OF SMALL-CELL BACKHAUL AND RADIO ACCESS POINT MIDHAUL TRANSPORT

The 5G SC BH and MH interfaces are defined in 3GPP N2 (user plane) and N3 (control plane) specification for BH as well as the F1 specification for MH. The supplement analysis the requirements in these 7 domains:

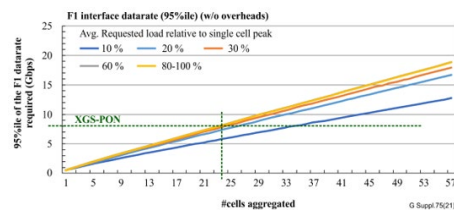
1. Capacity
2. Latency
3. Time and frequency synchronization
4. High availability
5. Security
6. Service slicing
7. Management of Transport

## COMPARISON BETWEEN BACKHAUL AND PON CAPABILITIES

This Supplement is cross-referencing these 7 domains in a converged wireline-wireless transport using the ITU-T defined TDM-PON from 10Gbps (XGS-PON [ITU-T G.9807.1] and towards higher speed PON defined in the ITU-T G.9804.x series. The analysis in this supplement confirms that TDM-PON can be used for 5G SC backhaul and midhaul:

## Capacity

BH and MH dimensioning is based on NGMN Alliance peak and average spectral efficiency match the TDM-PON capacity.



## Latency

Transport delays BH & MH associated to application latencies in the 5G This is possible TODAY on both ISR and LSR releases. (eMBB) or massive Machine-Type-Communication (mMTC) are configurable over both downstream and upstream TDM-PON. 5G URLLC applications require fronthaul transport and a reference is made to ITU-T G Suppl. 71 on Coordinated Dynamic Bandwidth Assignment (CO-DBA).

## Time synchronization

For 5G BH and MH the 3GPP requirements for Time Alignment Error (TAE) can only be met with full timing support and each node has to be the boundary clock (T-BC) class A or B. The Time Distribution function (clause C.13.2 of G.9807.1) allow TDM-PON to perform as a T-BC class B.

	Based on Class A T-BC		Based on Class B T-BC		Based on Class C T-BC	
	Single T-BC	Pair of media converters	Single T-BC	Pair of media converters	Single T-BC	Pair of media converters
cTE (ns)	≤50	±100	±20	±40	±10	±20
dTE, MTIE (ns)	40	60	40	60	10	15
dTE, TDEV (ns)	4	6	4	6	2	3
dTE <sub>95%</sub> (peak-to-peak, ns)	70	70	70	70	For further study	For further study
maxTE (ns)	100	160	70	100	30	45

## High availability

The high availability requirements for 5G services can be met with TDM-PON as a reference is made to ITU-T G Suppl. 51 for details.

## Security

TDM-PON is considered an untrusted transport node. BH and MH IPsec tunnels can be transported over TDM-PON. Additional encryption of PON is providing additional level (hop-by-hop) of security an MIC.

## Service slicing

The slicing solutions in TDM-PON are under study at ITU-T SG15 Question 2 and shall deliver the (transport) sub-slice functionality required by 5G NR service slicing.

## Management of Transport

TDM-PON management shall include an SDN control function to the BH and MH transport node management system per [BBF OB-BAA].

## SUGGESTED APPLICATION SCENARIOS AND OTHER TOPICS

The supplement includes reference to technologies that will further drive the 5G SC adaptation:

- ✓ 5G SC for indoor coverage replacement of DIS
- ✓ 3G and 4G SC evolution to 5G
- ✓ Integrated access and backhaul (IAB) 5G SC
- ✓ 4G+5G dual-mode small cell
- ✓ Developing the 5G SC in mmWave (FR2 spectrum)

