


Tim Frost

A close-up, high-contrast photograph of an owl's face, showing its large, yellowish-green eye and dark feathers. The owl is looking towards the right of the frame.

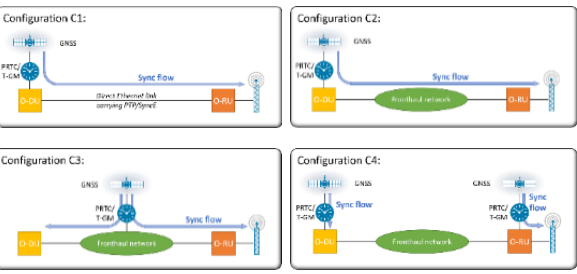
Challenges in Synchronization Testing for ORAN Fronthaul

WSTS, May 2022

O-RAN Technical Specifications for Synchronization

 O-RAN.WG4.CUS.0-v07.00
Technical Specification

O-RAN Fronthaul Working Group
Control, User and Synchronization Plane Specification



Configuration C1: O-DU (with PRTC/T-CU) to O-RU via Sync flow (over Ethernet link carrying PDSync).

Configuration C2: O-DU (with PRTC/T-CU) to O-RU via Sync flow (through fronthaul network).

Configuration C3: O-DU (with PRTC/T-CU) to O-RU via Sync flow (through fronthaul network).

Configuration C4: O-DU (with PRTC/T-CU) to O-RU via Sync flow (through fronthaul network), and O-RU to O-RU via Sync flow.

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O-RAN Fronthaul Working Group – Control, User and Synchronization Plane Specification

O-RAN Technical Specifications for Synchronization

O-RAN
O-RAN.WG4.CUS.0-v07.00
Technical Specification

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O-RAN Fronthaul Working Group – Control, User and Synchronization Plane Specification

O-RAN
O-RAN.WG4.CONF.0-v04.00
Technical Specification

O-RAN Fronthaul Working Group
Conformance Test Specification

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O-RAN Technical Specifications for Synchronization



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 Control, User and Synchronization Plane Specification

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 Conformance Test Specification

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O-RAN Fronthaul Working Group – Conformance Test Specification

O-RAN
 O-RAN.WG9.XTRP-TST-v01.01
 Technical Specification

O-RAN Open Xhaul Transport Working Group 9
 Xhaul Transport Testing

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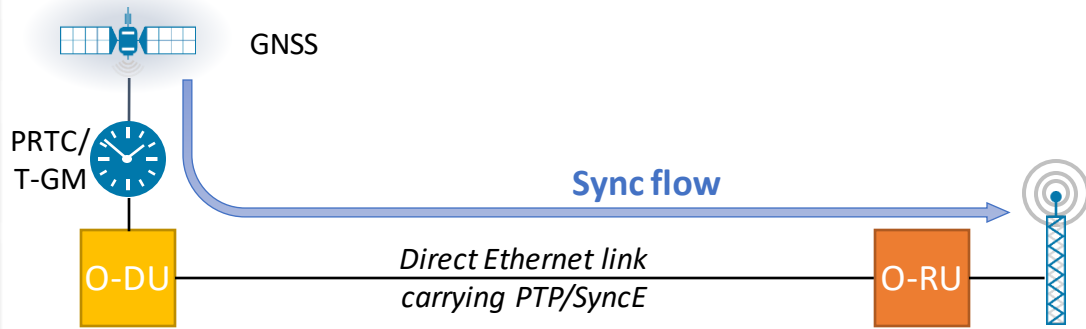
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O-RAN Open Xhaul Transport Working Group 9 – Xhaul Transport Testing

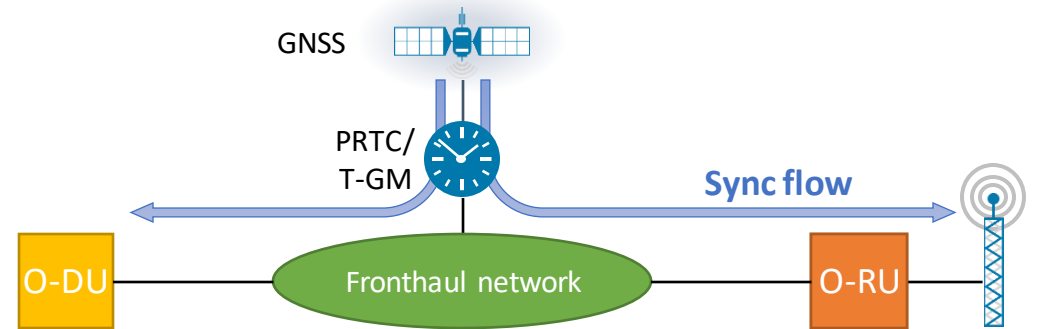
Control, User and Sync Plane Specification

ORAN LLS* Sync Architectures

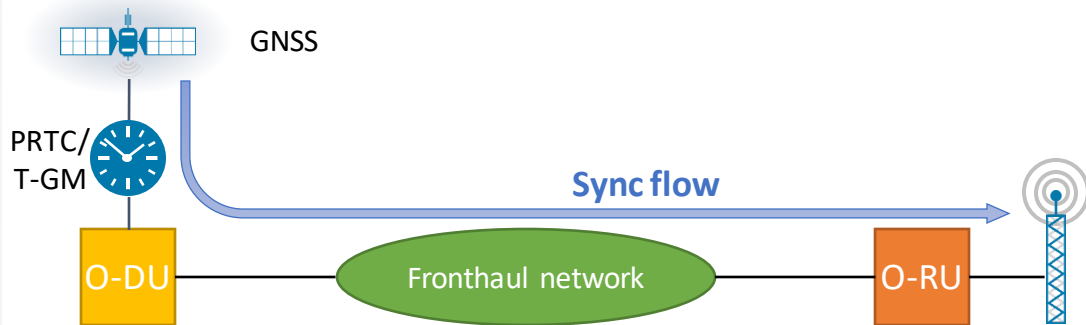
Configuration C1:



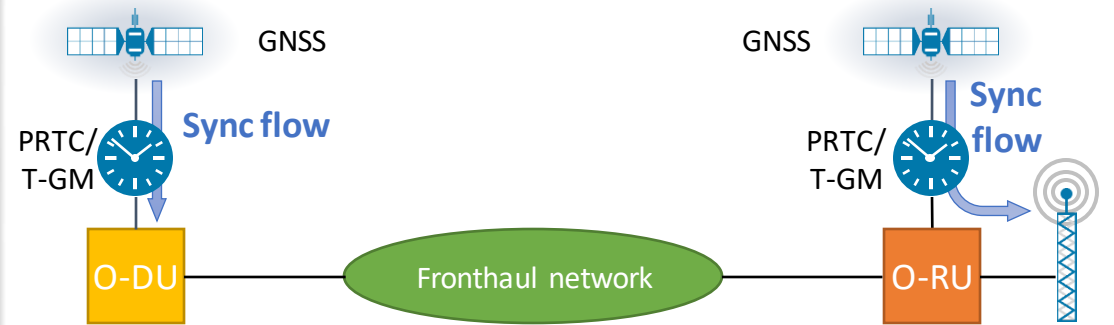
Configuration C3:



Configuration C2:

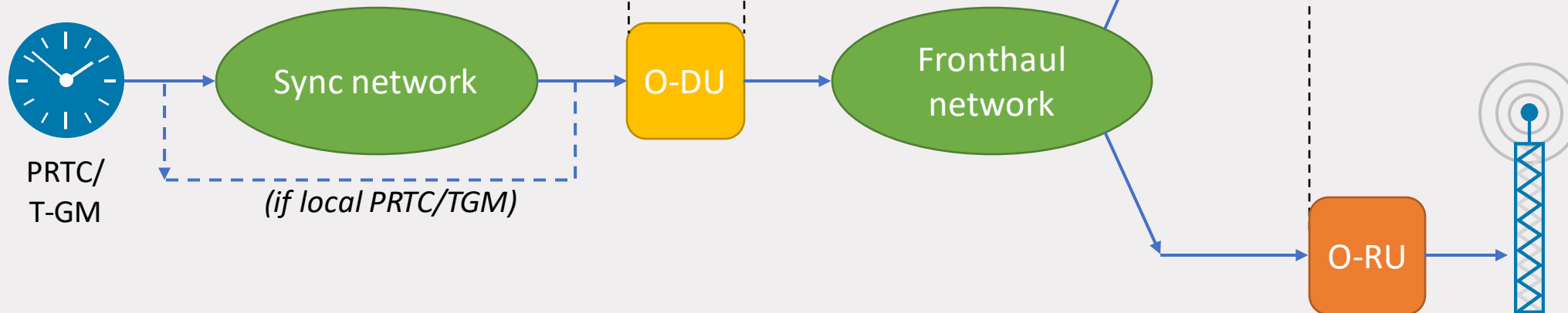
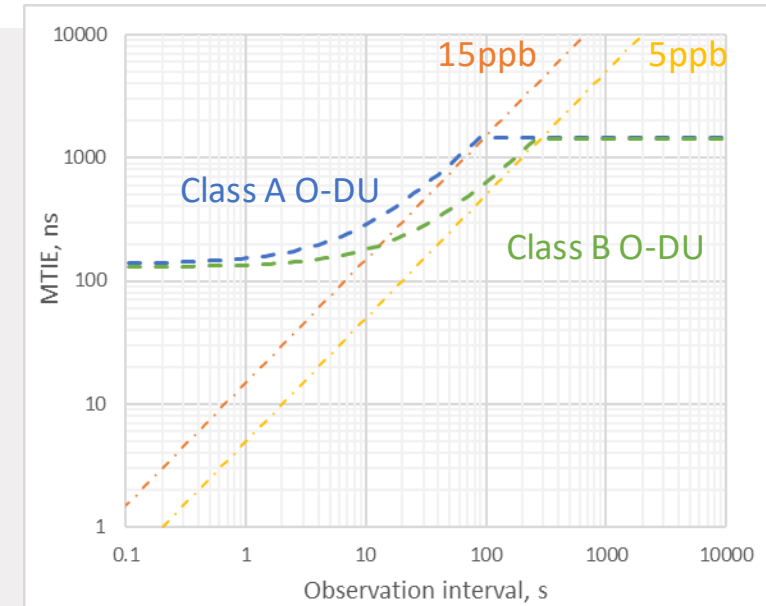
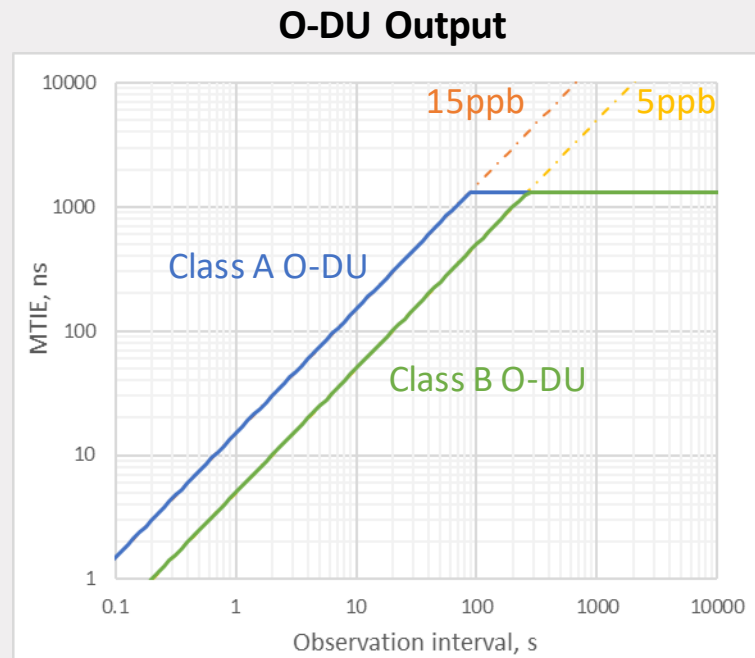
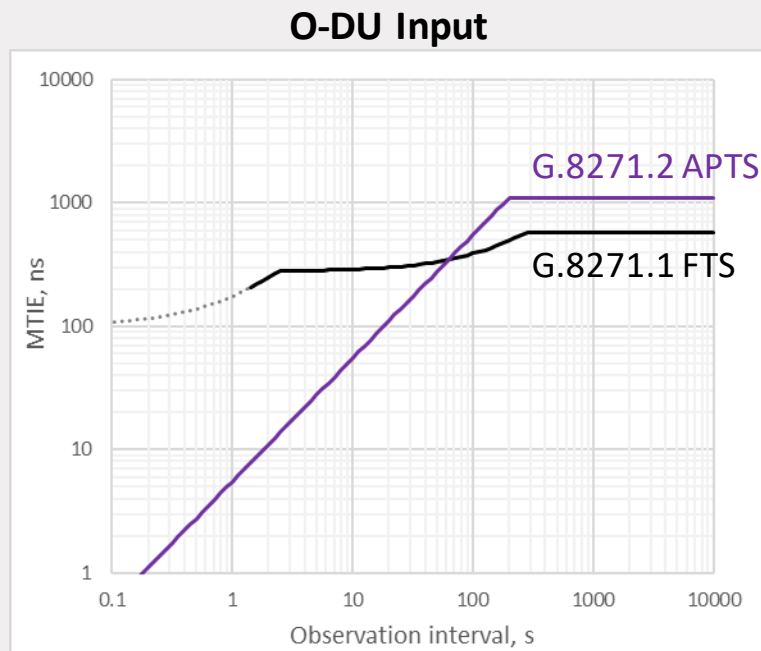


Configuration C4:



*LLS: "Lower Layer Split" – in effect, fronthaul

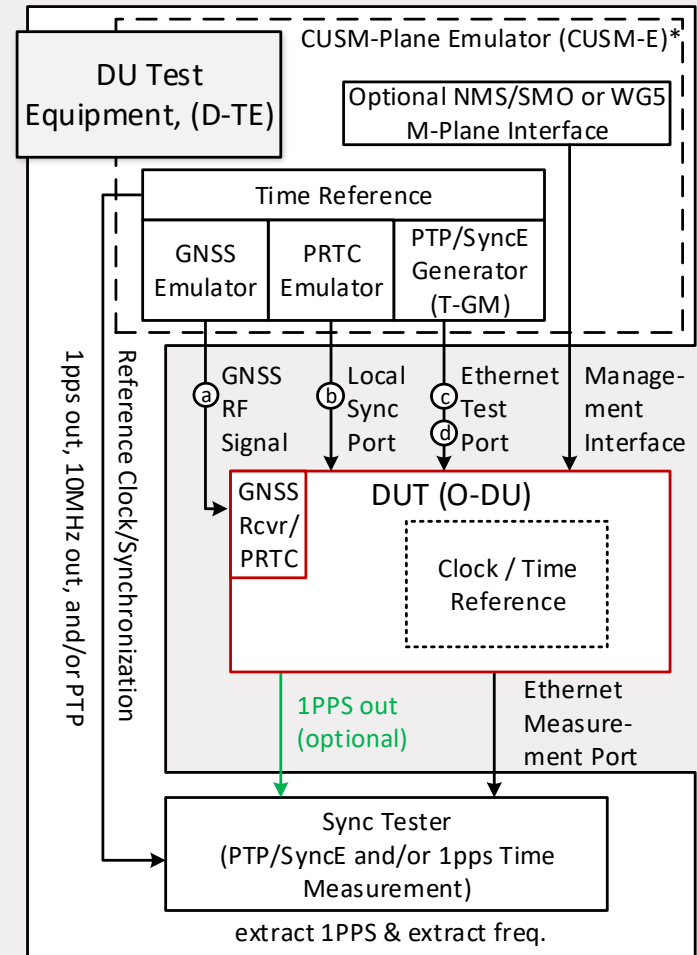
LLS-C2 Fronthaul Input/Output Limits



Conformance Test Specification: O-DU Performance

O-DU Test Configuration (from ORAN-WG4.CONF)

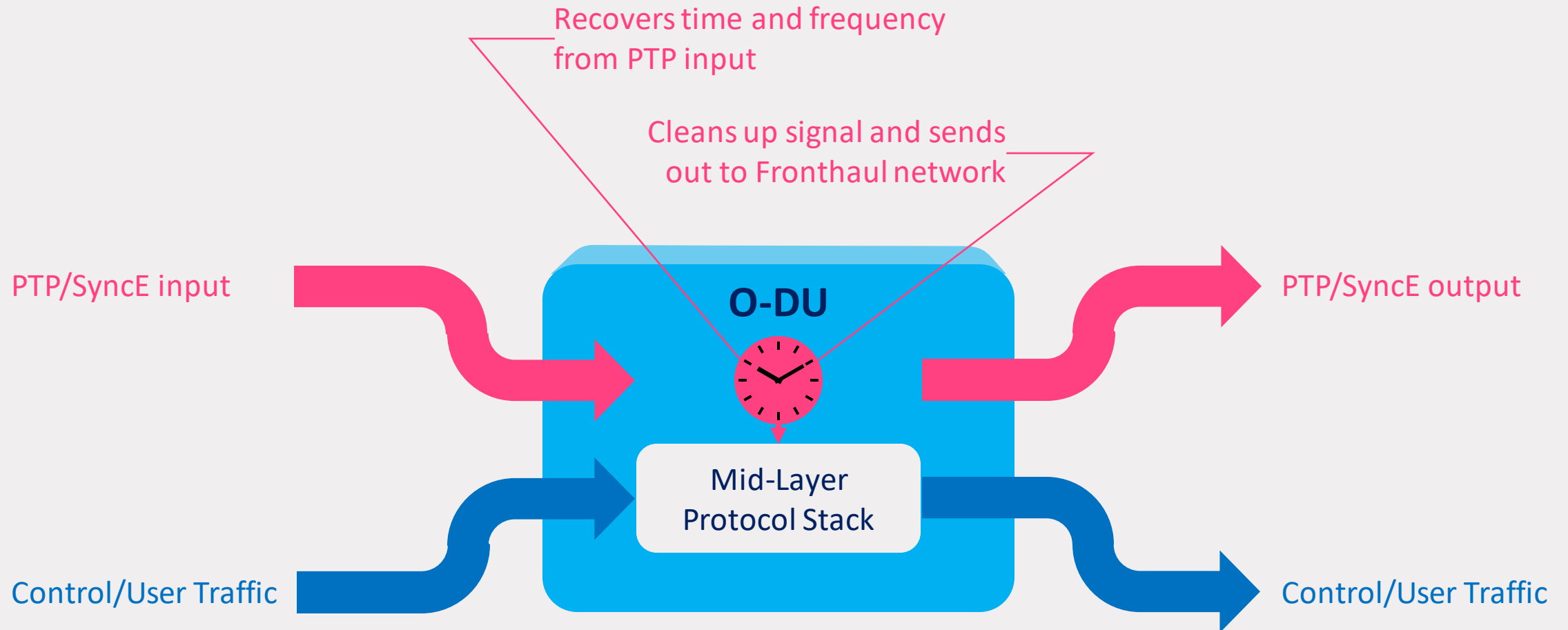
- Requires a CUSM-plane emulator, but
 - M-plane is optional
 - Remainder is the timing reference and measurement
- Sync-plane emulation:
 - Capable of testing S-Plane performance under stress with various noise profiles
 - S-Plane signals traceable to master time reference



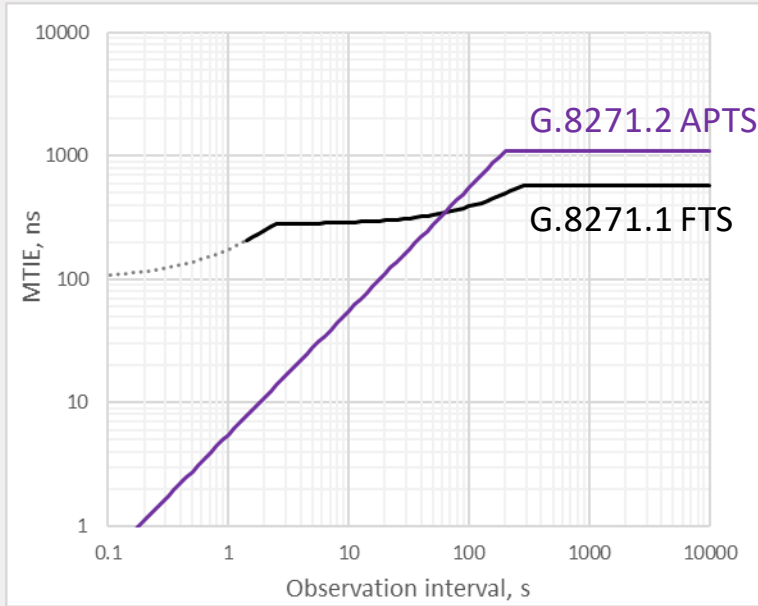
* For O-DU S-Plane testing the CUSM emulator need not implement WG4 C-Plane or U-Plane Protocols.

- (a) Embedded PRTC GNSS radio interface.
- (b) Local PRTC using Local Sync Port (for example ITU-T G.8271 Annex A)
- (c) Local PRTC using PTP and PLFS
- (d) Remote PRTC using PTP and PLFS

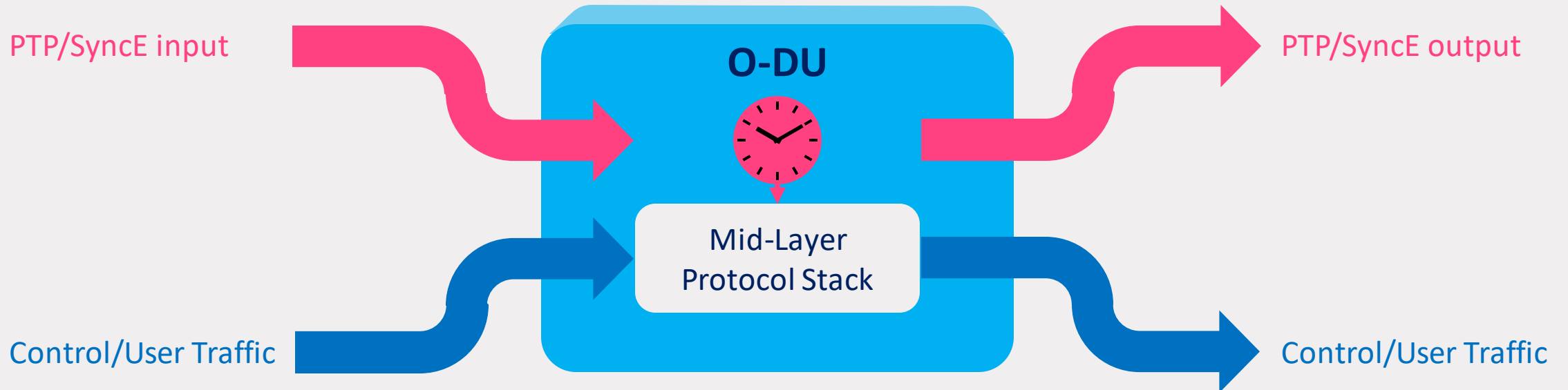
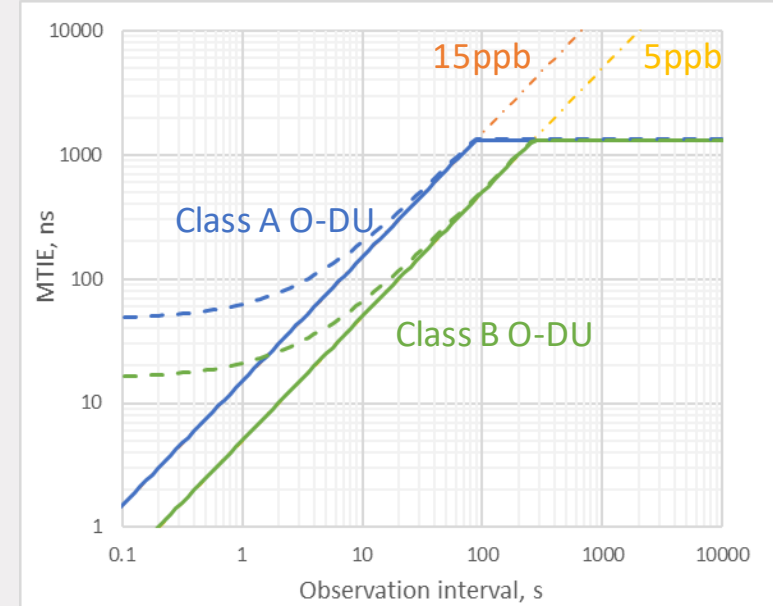
O-DU Synchronization Function



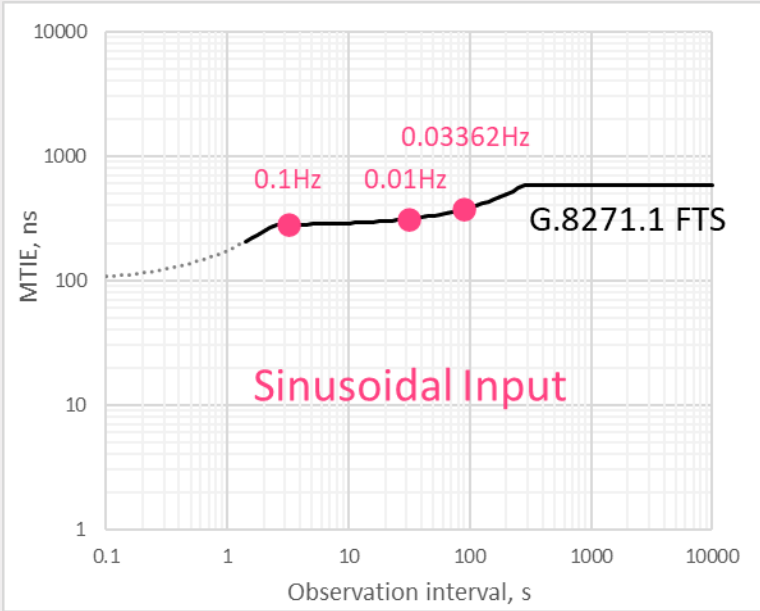
O-DU Synchronization Testing



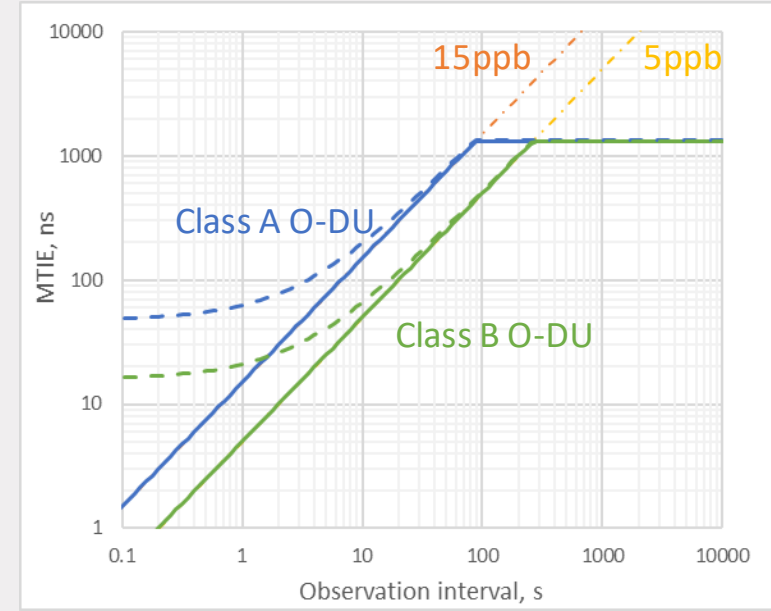
CUS Annex H,
Figures H.2.3 and H.2.4



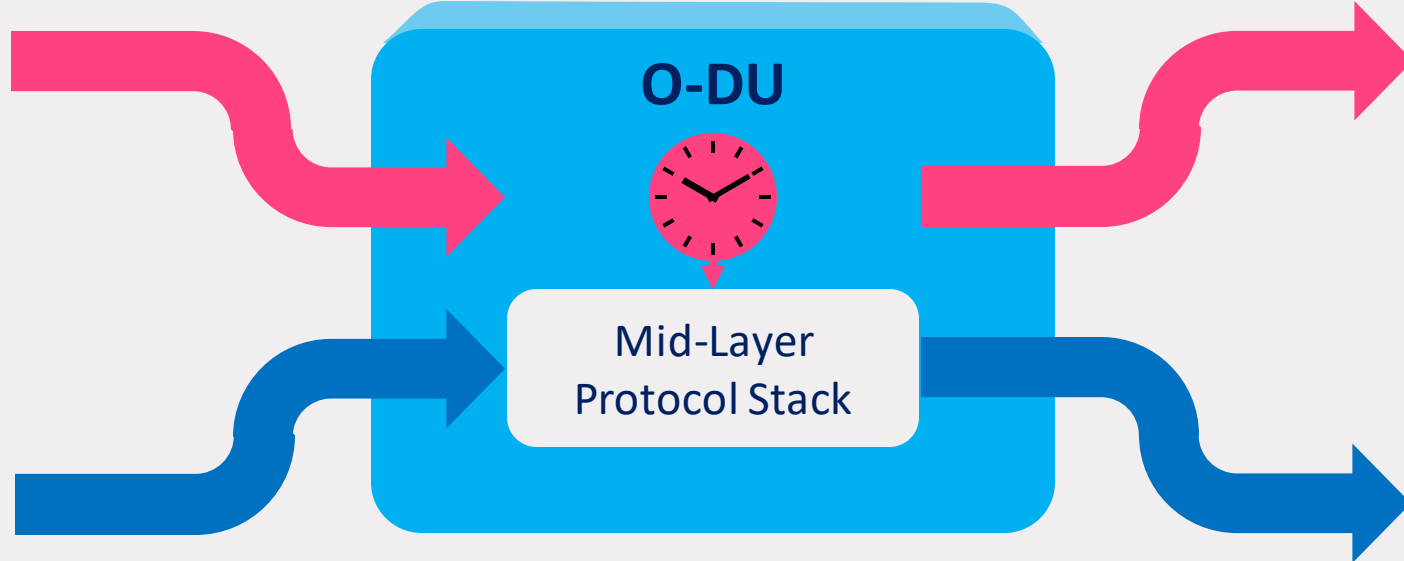
O-DU Sync Testing: CONF clause 3.3.8



CUS Annex H, Figures H.2.3 and H.2.4



PTP/SyncE input

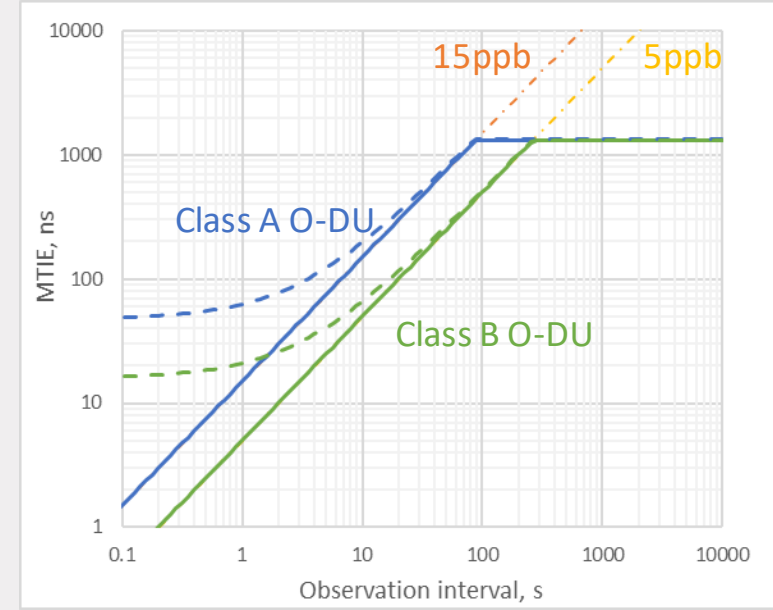
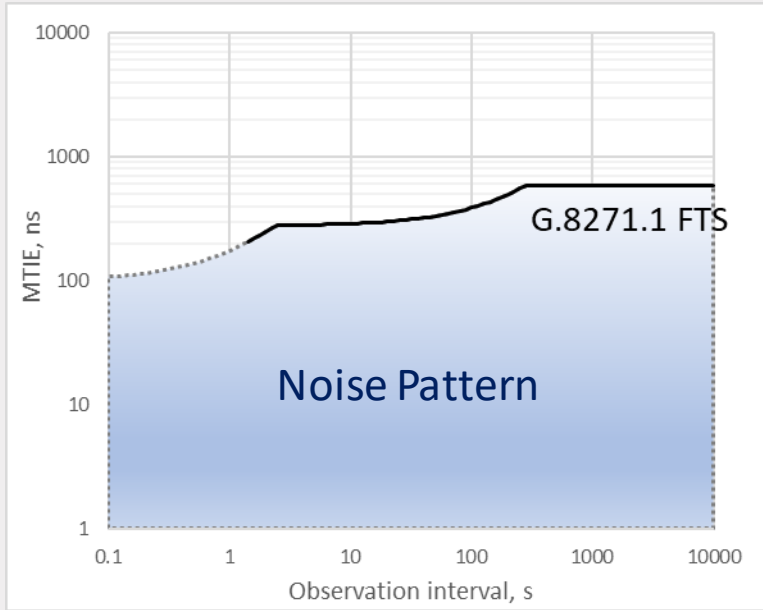


PTP/SyncE output

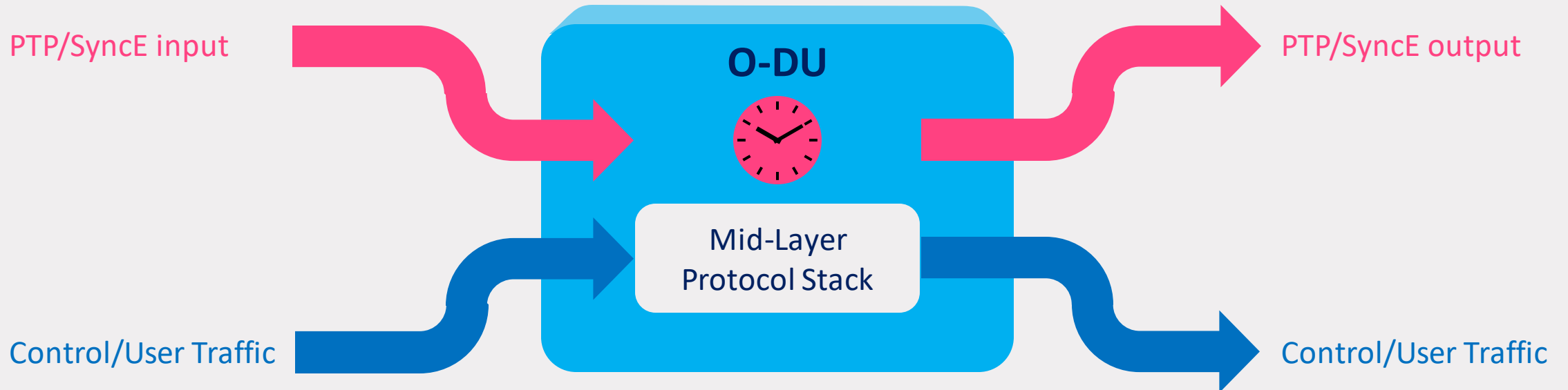
Control/User Traffic

Control/User Traffic

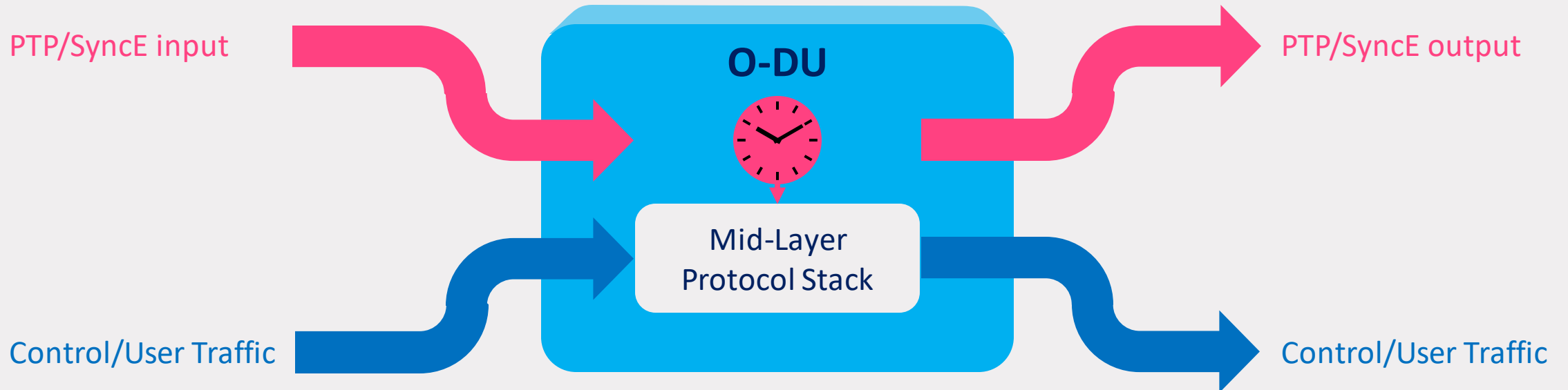
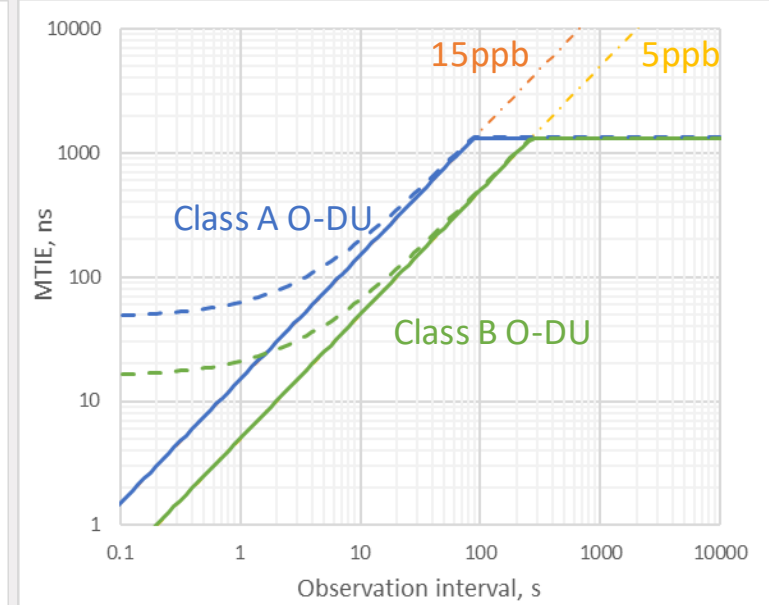
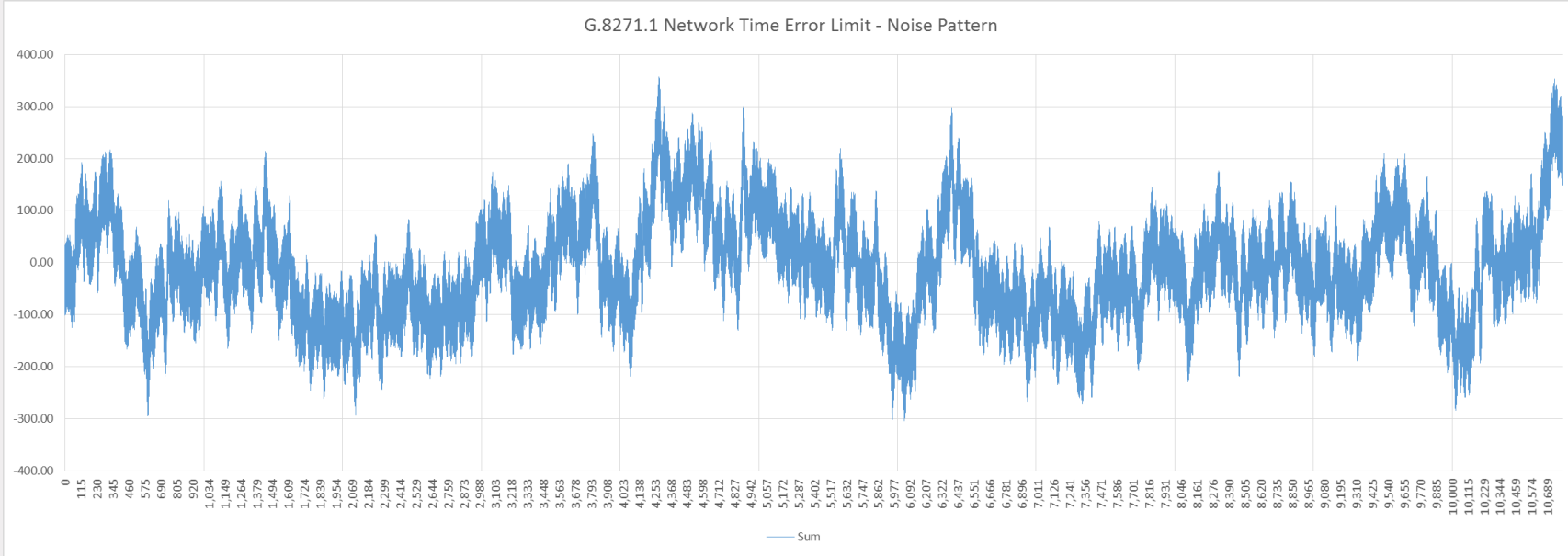
O-DU Sync Testing: ITU-T Method (G.8273.2 App. IX)



CUS Annex H, Figures H.2.3 and H.2.4



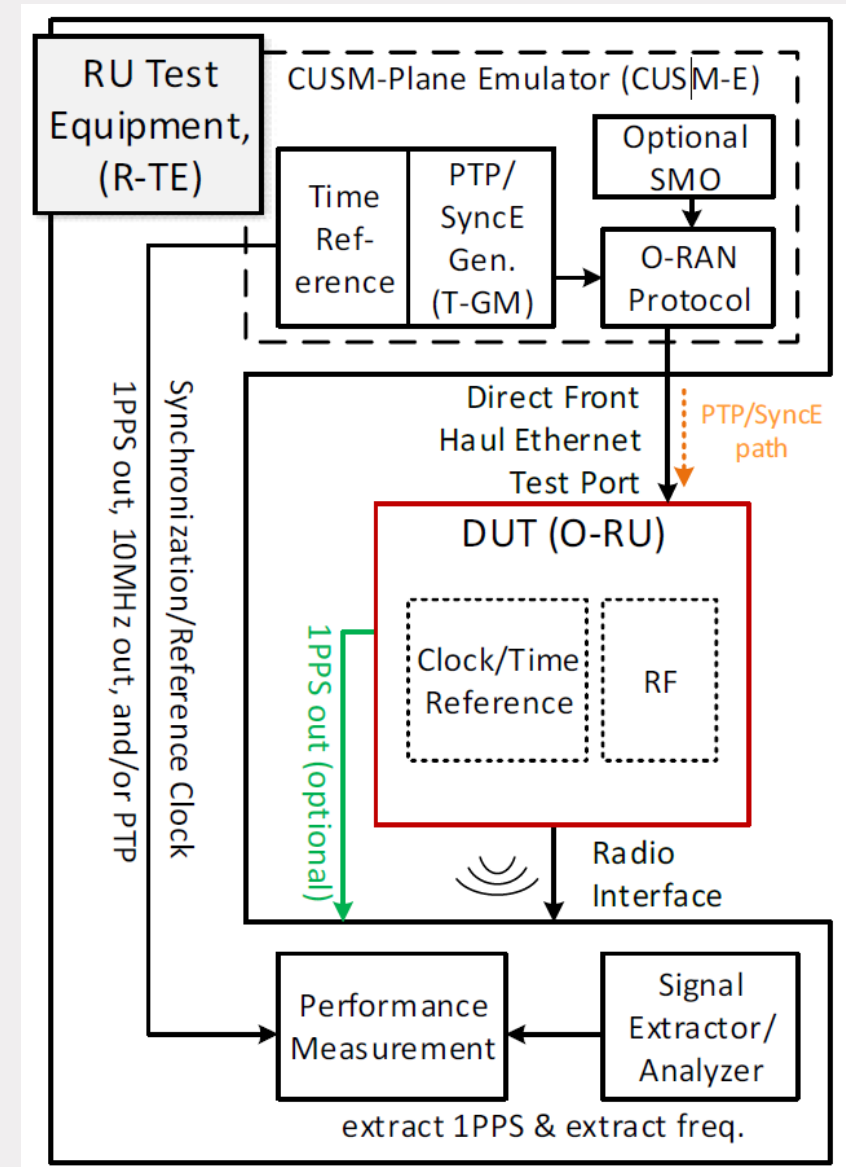
O-DU Sync Testing: ITU-T Method (G.8273.2 App. IX)



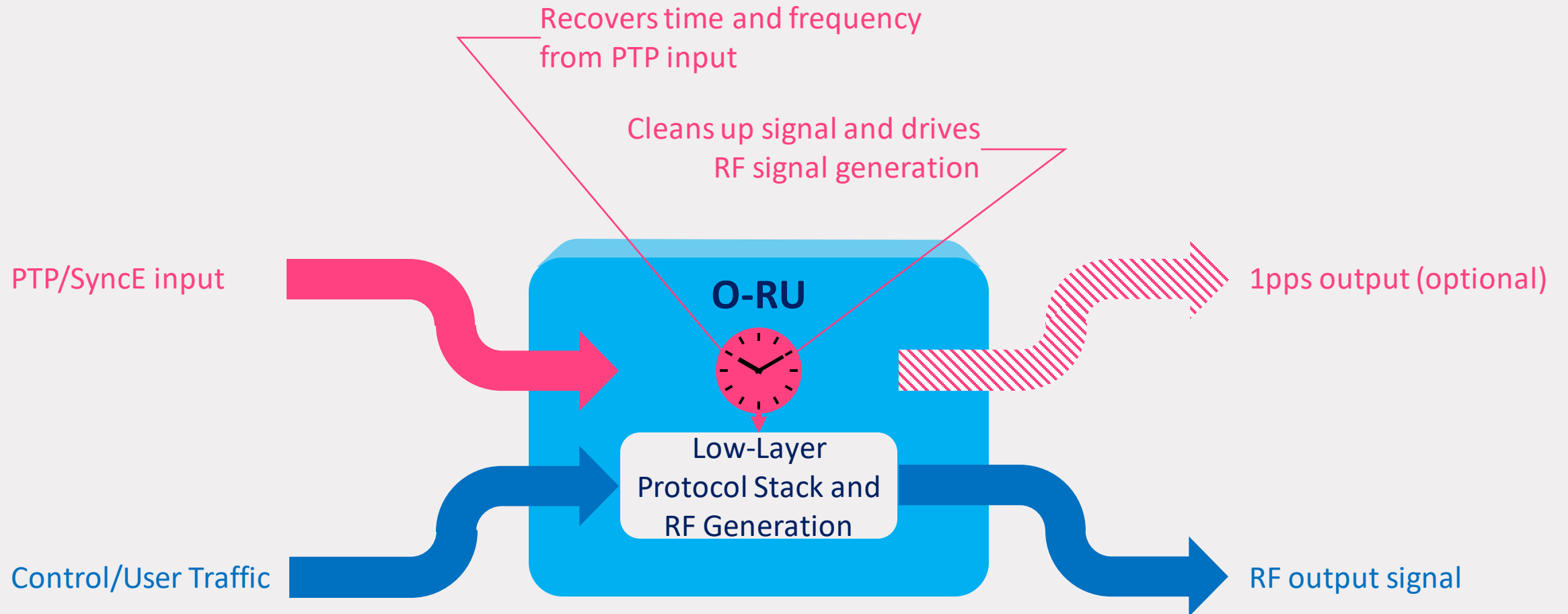
Conformance Test Specification: O-RU Performance

O-RU Test Configuration (from ORAN-WG4.CONF)

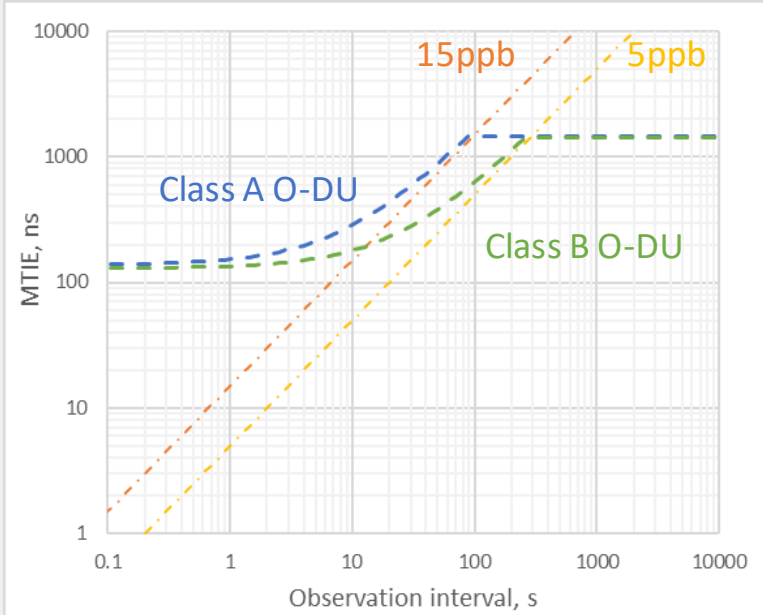
- Requires a CUSM-plane emulator, but
 - M-plane is optional
 - Limited C/U emulation required
 - Remainder is the timing reference and measurement
- Sync-plane emulation:
 - Capable of testing S-Plane performance under stress with various noise profiles
 - S-Plane signals traceable to master time reference
- Measurement either on RF output, or optional 1pps output



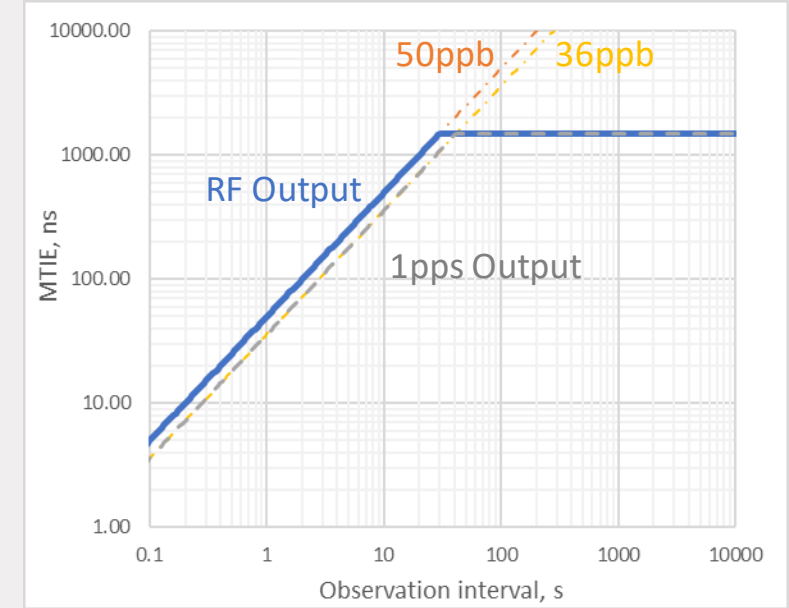
O-RU Synchronization Function



O-RU Synchronization Testing (LLS-C2)

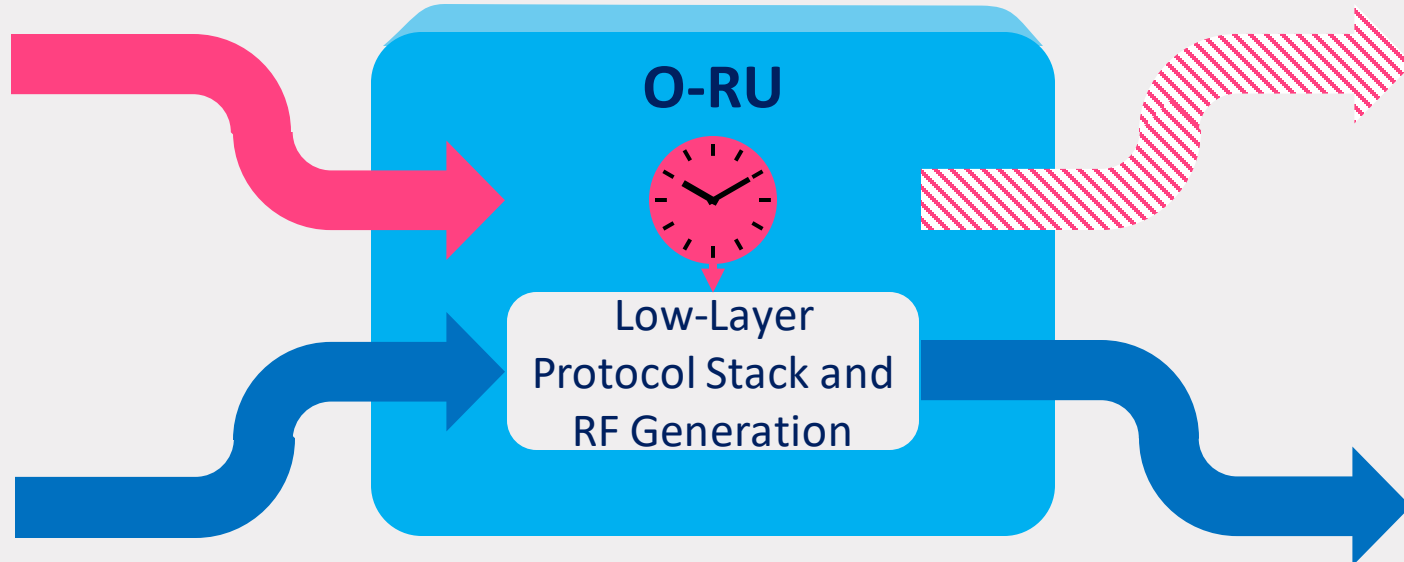


CUS Annex H, Figure H.2.5



PTP/SyncE input

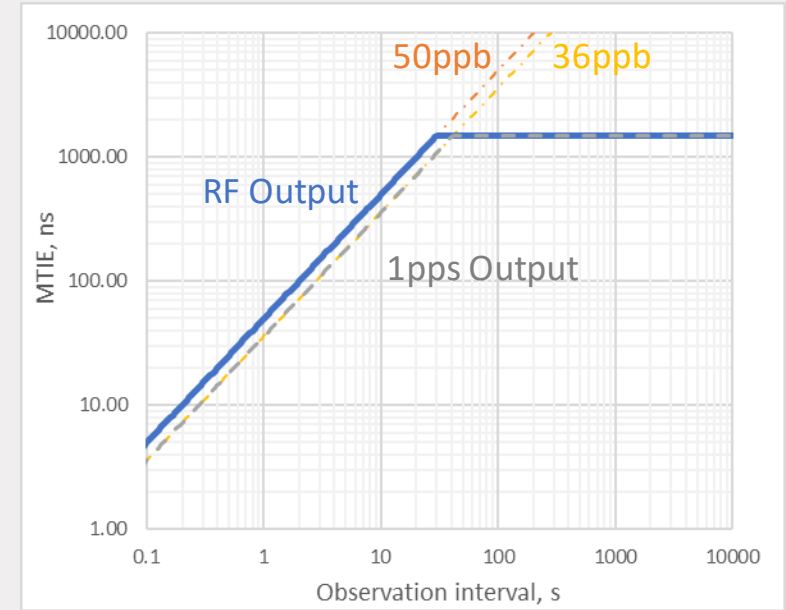
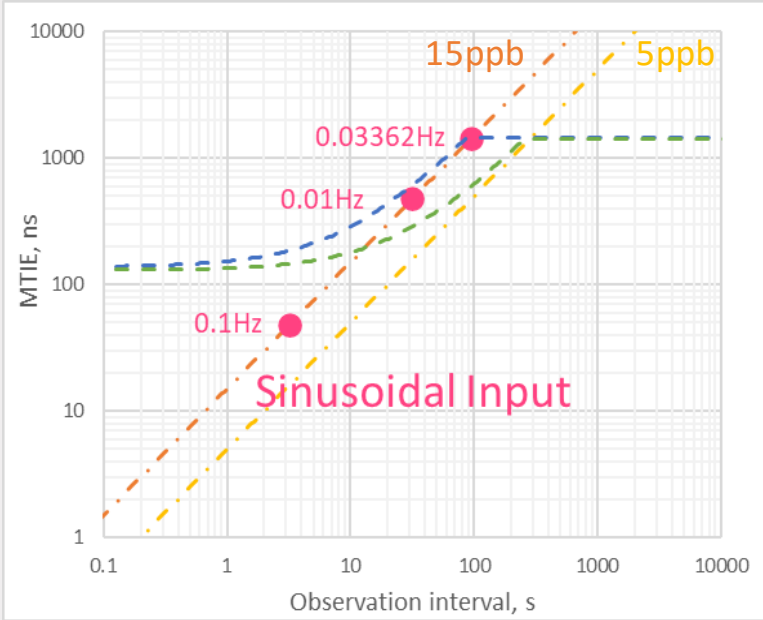
Control/User Traffic



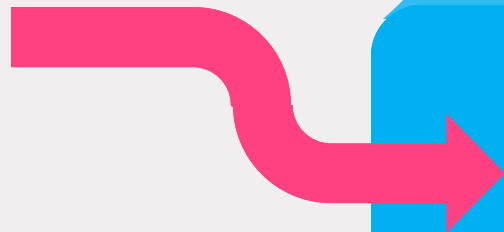
1pps output (optional)

RF output signal

O-RU Sync Testing: CONF clause 3.3.3 (LLS-C1 only)



PTP/SyncE input



O-RU



Low-Layer Protocol Stack and RF Generation



1pps output (optional)

Control/User Traffic

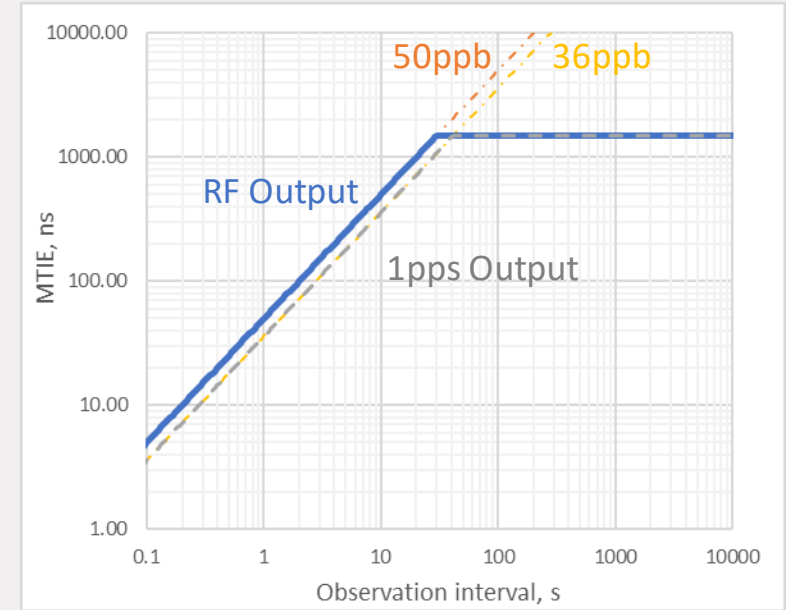
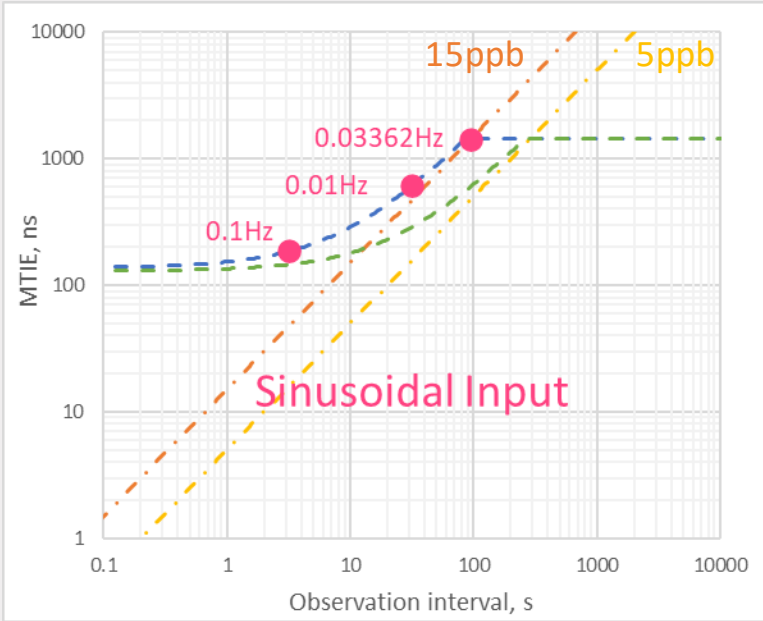


Low-Layer Protocol Stack and RF Generation

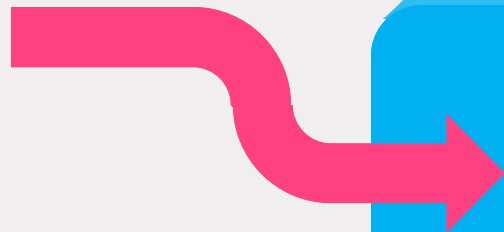


RF output signal

O-RU Sync Testing: CONF clause 3.3.3 modified for LLS-C2



PTP/SyncE input



O-RU



Low-Layer Protocol Stack and RF Generation



1pps output (optional)

Control/User Traffic



Low-Layer Protocol Stack and RF Generation



RF output signal

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**Insight and
Innovation**