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Problems with ITU-T G.8271.2 and G.8275.2 Partial Timing Support (PTS) in NGFI

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IEEE 1914
Next Generation Fronthaul Interfaces
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Problems with ITU-T G.8271.2 and G.8275.2 Partial Timing Support (PTS) in NGFI			
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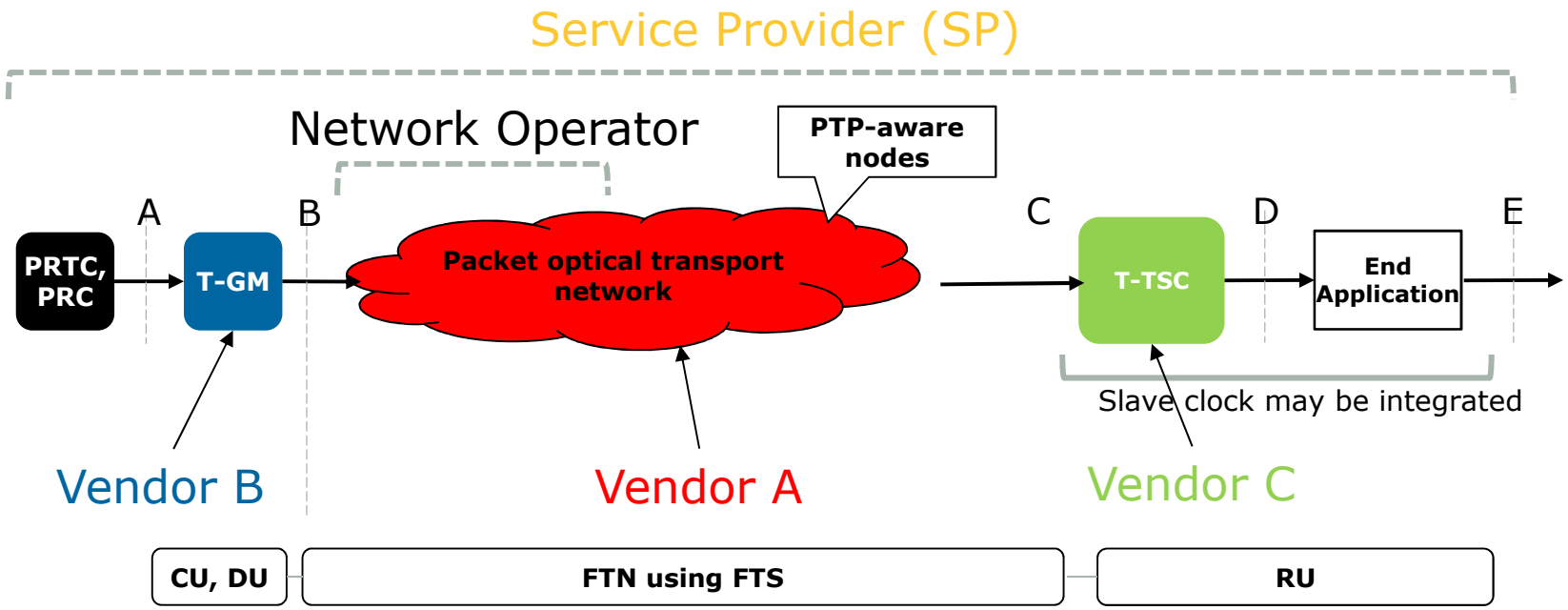
PTS requirements in IEEE P1914.1

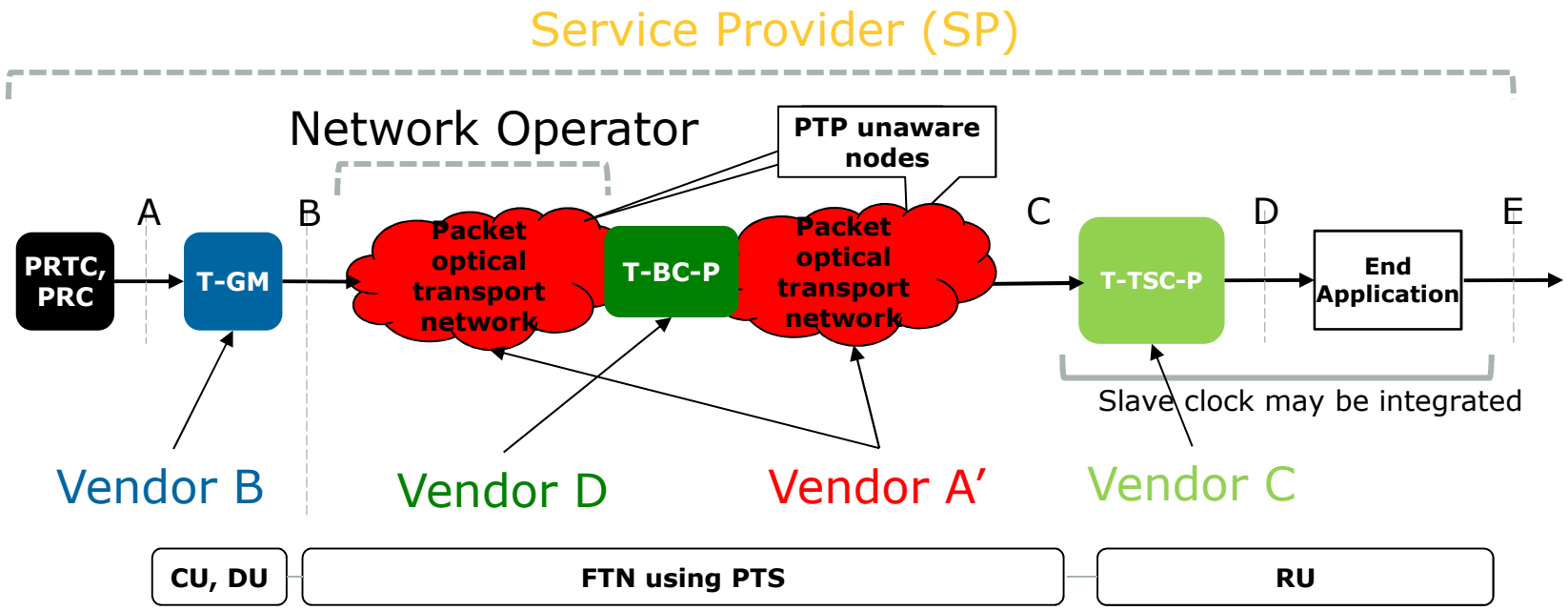
- IEEE P1914.1/D3.0 includes the following requirements in section 8.5.2 and 9.3.1:
  - In section 8.5.2 (NGFI Requirements):
    - *One of the following PTP profiles shall be used for NGFI network time distribution, with the optional exceptions that are listed henceforth:*
      - ***a) ITU-T G.8275.1 PTP Telecom Profile*** *for Phase/Time Synchronization with Full Timing Support from the Network.*
      - ***b) ITU-T G.8275.2 PTP Telecom Profile*** *for Phase/Time Synchronization with Partial Timing Support from the Network.*
  - In section 9.3.1 (FTN Requirement):
    - *For packet-based time distribution, an FTN shall support at least one of the following PTP profiles, with the optional exceptions that are listed henceforth:*
      - ***a) ITU-T G.8275.1 PTP Telecom Profile*** *for Phase/Time Synchronization with Full Timing Support from the Network.*
      - ***b) ITU-T G.8275.2 PTP Telecom Profile*** *for Phase/Time Synchronization with Partial Timing Support from the Network.*

Clear Domain of Responsibilities with FTS



- Vendor A can commit to the Service Provider (SP) that the timing requirements *at the transport network boundaries* will be met if
  - transport network supports ITU-T G.8275.1 & G.8271.1 FTS,
  - filtering bandwidth of the end application (RU)'s T-TSC meets the XRAN CUS specification.

Blurred Domains of Responsibilities with PTS



- Which vendor has responsibility – and contractual obligation – to commit to the Service Provider that the timing application requirements will be met?
- Will the SP assume the risks?

** The use of the T-BC-P and its impact on the performance budget is for further study*

Vacuum of responsibility with PTS

- If PTS is accepted by the SP, two options

1. Vendor D and A' test and agree to co-share responsibility for meeting the requirements towards the SP.
2. Vendor D of dedicated PTS equipment has to bear the full responsibility for meeting the requirements.
   - Vendor D does not know about the possible sources of asymmetries in the transport network (new high-speed PAM-4 based optical pluggable interfaces with on-board DSP, optical path restoration, wavelength difference, OTN mapping, etc) and cannot measure/compensate them
   - Vendor D cannot speak on behalf of Vendor A'
   - What happens in case of issues? – Vendor D will instruct the SP to turn to the Vendor A' for troubleshooting/correction, who cannot be held responsible if he/she never committed in the first place

Vacuum of responsibility with PTS

- PTS is dependent on the filtering algorithm in the RAN implementation of vendor C.
- The basic input conditions for the RU with PTS in FTN are unknown, making it impossible to define and implement a suitable filtering algorithm in the RU.
  - The PDV profile of a PTP-unaware node is not and will never be defined nor standardized (each network and traffic is different).
  - Hence the noise accumulation rules for a chain of PTP-unaware nodes is not defined. In contrast, FTS has well defined noise model and node specification in ITU-T G.8273.2 (cTE, dTE) and formula to calculate the accumulated noise of a FTS T-BC clock chain at network limit (RU input) in ITU-T G.8271.1
- While it may be possible for the RAN Vendor C to implement the right filtering after cooperation between parties, Vendor D alone cannot commit to the SP it will work.

Vacuum of responsibility with PTS

- PTS performance depends on traffic load/pattern and engineering rules.
- With PTS, who defines that the network is "well controlled" and that this is good enough with ALL possible traffic loads/patterns in networks today and in the future?
- Many knobs could potentially have an impact: traffic burst, priority of user/mgt/control plane packets vs. PTP packets under RAN vendor C's control, PTP-unaware switch design and PDV behavior with different traffic under control of the switch vendor A' – are not under control of the same party.
- What happens in case of issue? Vendor A' or D could claim traffic pattern was not envisioned. Debugging and trying to figure out which traffic pattern is endless. Switch vendor A', T-BC-P Vendor D and RAN vendor C will blame each other.

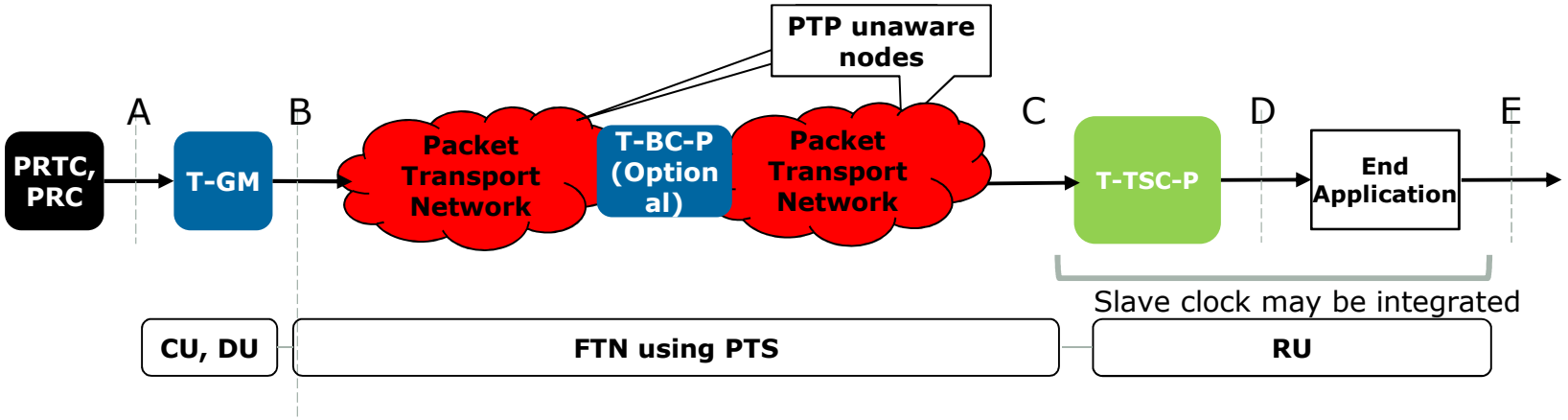
Conclusion on Responsibilities

- With PTS, the burden of meeting the requirements and successful operation falls completely on the SP/network operator and Vendor D has to take full responsibility for deployment, operation, support, including contractual penalties for downtime.
- The risks shall be highlighted in IEEE P1914.1.
- A standard shall be truthful to the SP and not serve specific vendor business interest.

Other Operational Concerns: UDP/IP Encapsulation in PTS

- According ITU-T G.8275.2, PTP clocks in a PTS network must support Annex D and Annex E of IEEE 1588-2008 in terms of encapsulation of PTP messages, i.e. UDP/IPv4 and UDP/IPv6
- Only unicast mode is used for PTP messages in PTS
- Thus supporting PTS in NGFI/FTN implies support of L3 functionality, IP address management, additional configuration for addressing, etc., on each FTN and RU nodes. This is contrary to
  - the requirement to make NGFI agnostic from the packet networking protocol (should allow both L2 and L3 networks)
  - Industry's expectation to keep fronthaul as simple as possible leveraging ubiquitous Ethernet technology. As example, IEEE Std 802.1CM™-2018 is an Ethernet bridged network

PTS usage consideration



- PTS' original intention is to avoid all of network elements to be PTP-aware, in order to save the network investment and shorten the construction cycle
- But if IEEE1914.1 requires FTN NE to support PTS profile, it is going against to the original intention of PTS. It implies every FTN elements needs to implement PTS function. Given that, what is the difference to full timing support which can provide better and determinative time performance?

Suggestion for IEEE 1914.1

- Suggest to make FTS mandatory and PTS optional
  - Consistent with other SDOs
- Add note regarding the use of PTS: PTS using non T-BC switches may also be allowed following ITU-T G.8271.2 and G.8275.2. Performance aspects and budgets associated with this mode requires further investigation (same note as in xRAN CUS specification)

Reference xRAN-FH.CUS.0 v2.0

9.2.4.2.2 Partial Timing Support

Support of Partial Timing Support using ITU-T G.8275.2 Telecom Profile is currently considered as permissible but requires additional considerations:

- Partial Timing Support allows switches with no T-BC orT-TC, hence there is no guarantee of synchronization performance based on ITU-T standard specification sch as G.8273.2. As a result, the system operator must ensure the network components will have adequate performance to meet frequency and phase error budgets to allow an accurate detection of frequency accuracy and phase for proper network operation. Such budgets are and implications on performance require further investigation.
- RUs (and lls-CU as T-TSC from fronthaul in configuration C3) must support L3 (UDP/IP) which is considered "optional" in this version of the CUS-Plane specification.
- RUs (and lls-CU as T-TSC from fronthaul in configuration C3) must support unicast communication with the GM.
- For configurations C1 and C2, the lss-CU must implement G.8275.2 PTP master function.

Note finally that Partial Timing Support is not finalized in the ITU, which has considered this timing method only for relatively coarse timing accuracy (1.5 µsec).

END