RoE Use Cases

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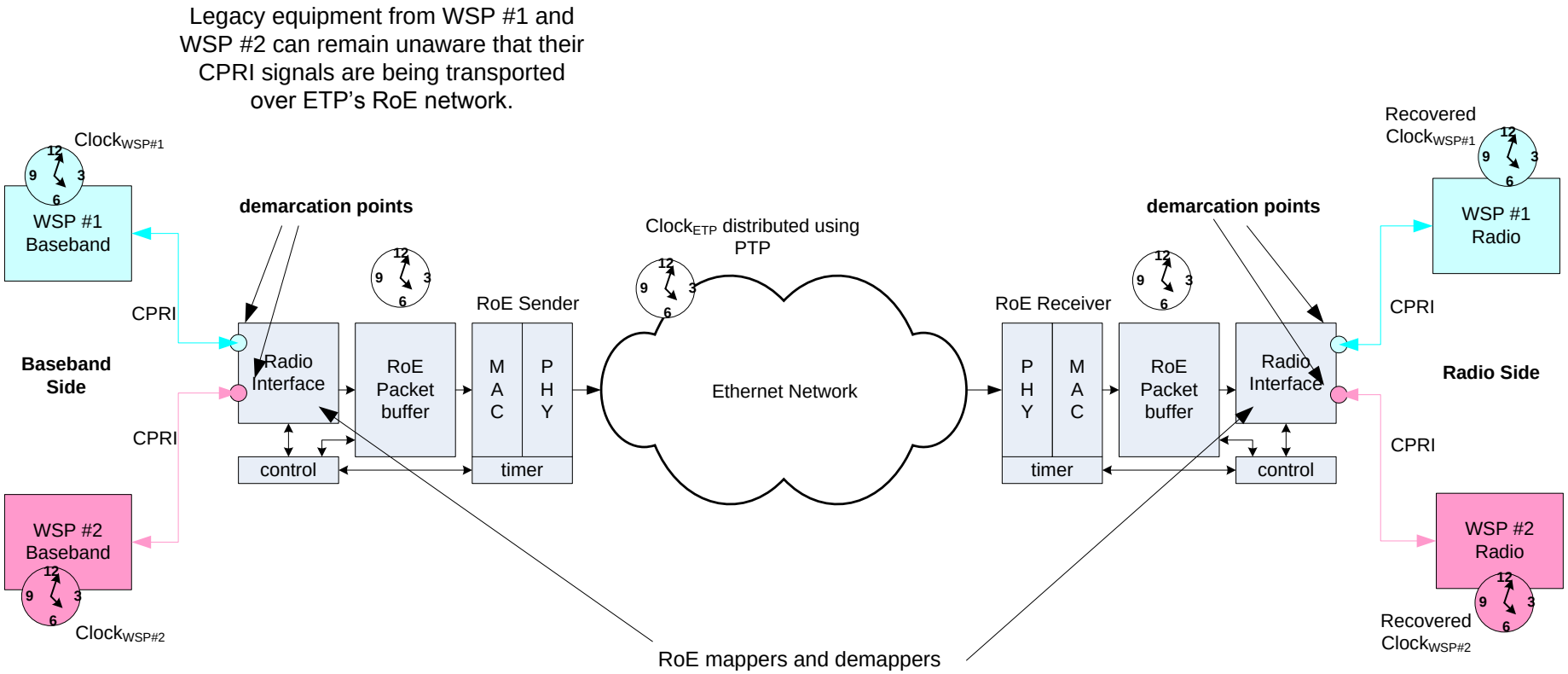
Introduction

- There were questions at the Apr 5, 2016 IEEE 1904.3 meeting on RoE use cases, especially wrt whether or not timing could be shared between the Ethernet Transport Provider (ETP) and Wireless Service Provider (WSP) entities
- Some examples of how RoE could be used are shown in this presentation
  - Example cases are shown in a chronologically advancing order
- Note:
  - Wireline and Wireless carriers usually operate as independent corporate entities, even if they belong to the same company
  - There is no guarantee they share the same clock

Case #1: Legacy CPRI clients

- Case#1 Summary:
  - WSP does not upgrade any equipment but just buys a service to transport its CPRIs
  - A new ETP fronthaul service is developed with the transport of legacy CPRI clients as part of its business and equipment plan

Case #1: Legacy CPRI clients



Case #1: Legacy CPRI clients

- Demarcation Points between the WSP and the ETP
  - The point where the CPRI signal arrives at the ETP (for both the radio side and the baseband side)
  - The point where the CPRI signal departs the ETP (for both the radio side and the baseband side)

- Ethernet Mapping and Demapping Functions
  - These functions are done by the ETP at the demarcation points

Case #1: Legacy CPRI clients

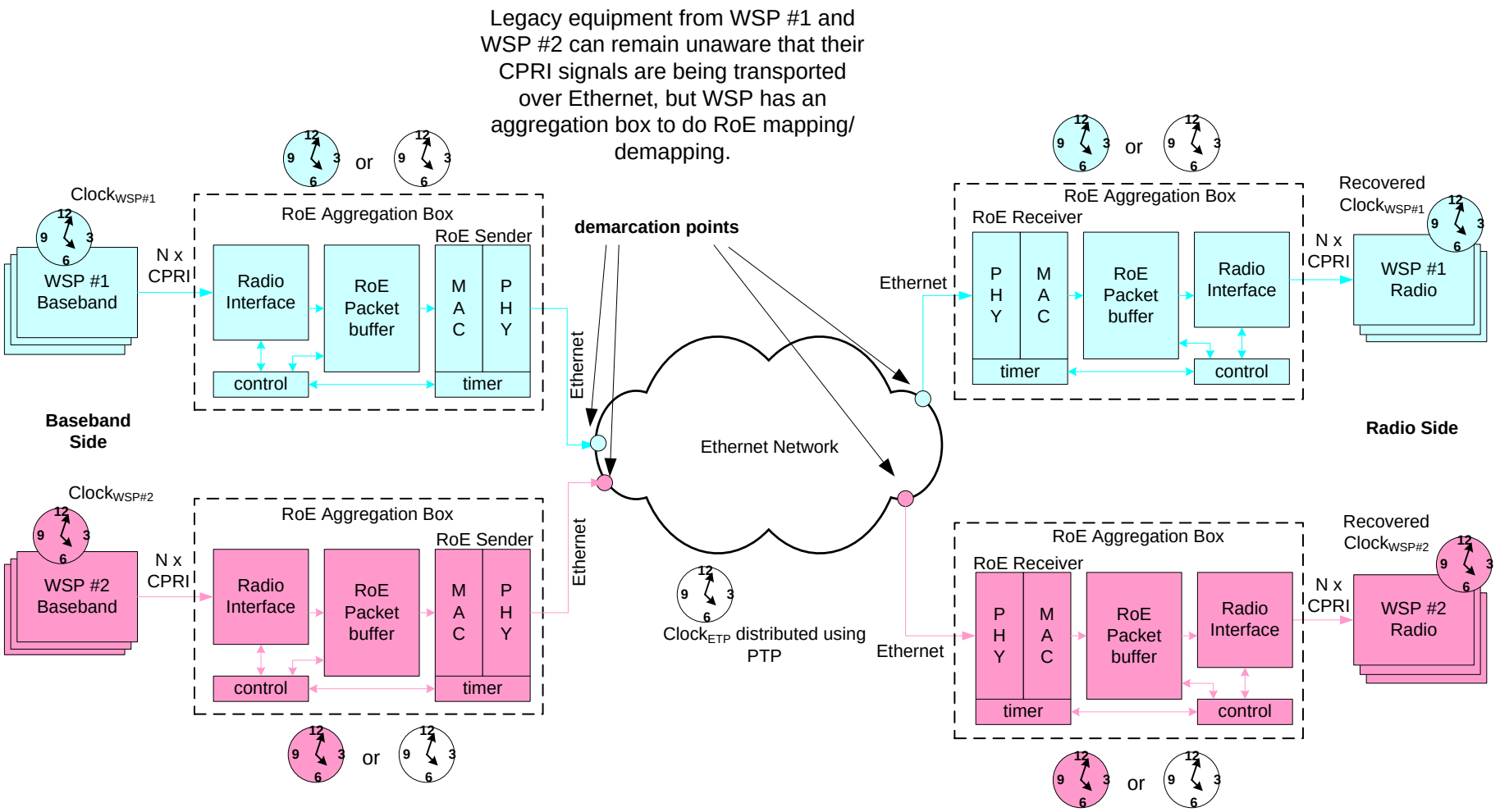
- Timing
  - CPRI from each WSP runs with its own original pre-RoE clock, which is likely asynchronous to the ETP's clock
  - CPRI's original latency measurement mechanism uses its own local ToD, unrelated to the Ethernet ToD, and requires a symmetric uplink and downlink

- Service Level Agreements
  - ETP guarantees its uplink and downlink have latency ≤ *X* μs for CPRI signals
  - ETP guarantees its uplink and downlink delays are symmetric to within *Y* ns for CPRI signals
  - ETP guarantees that the delivered CPRI signal meets the CPRI RMS frequency offset requirements

Case #2: CPRI clients with Intermediate Aggregation Point

- Case#2 Summary:
  - Legacy radios are reused
  - WSP supplies an RoE aggregation box that maps and aggregates its CPRI signals into Ethernet
  - ETP receives Ethernet containing RoE mapped CPRIs from WSP

Case #2: CPRI clients with Intermediate Aggregation Point



Case #2: CPRI clients with Intermediate Aggregation Point

- Demarcation Points between the WSP and the ETP
  - The Ethernet connecting points at the boundary of the ETP
- Ethernet Mapping and Demapping Functions
  - These functions are done by the WSP in its aggregation boxes

Case #2: CPRI clients with Intermediate Aggregation Point

- Timing
  - CPRI from each WSP runs with its own original pre-RoE clock, which is likely asynchronous to the ETP's clock
  - Aggregation boxes can get the RoE timing from ETP

    or

    aggregation boxes can use the WSP's own clock and tunnel its own PTP timing through the ETP network (i.e. ETP network acts as a PTP transparent clock to WSP's PTP)

Note: use of TCs is not yet standardized by ITU

- Service Level Agreements
  - ETP guarantees its uplink and downlink have latency ≤ X ns
    - ETP does not need to guarantee symmetry because demapping buffer for presentation time belongs to WSP
  - ETP guarantees performance of PTP and SyncE timing services

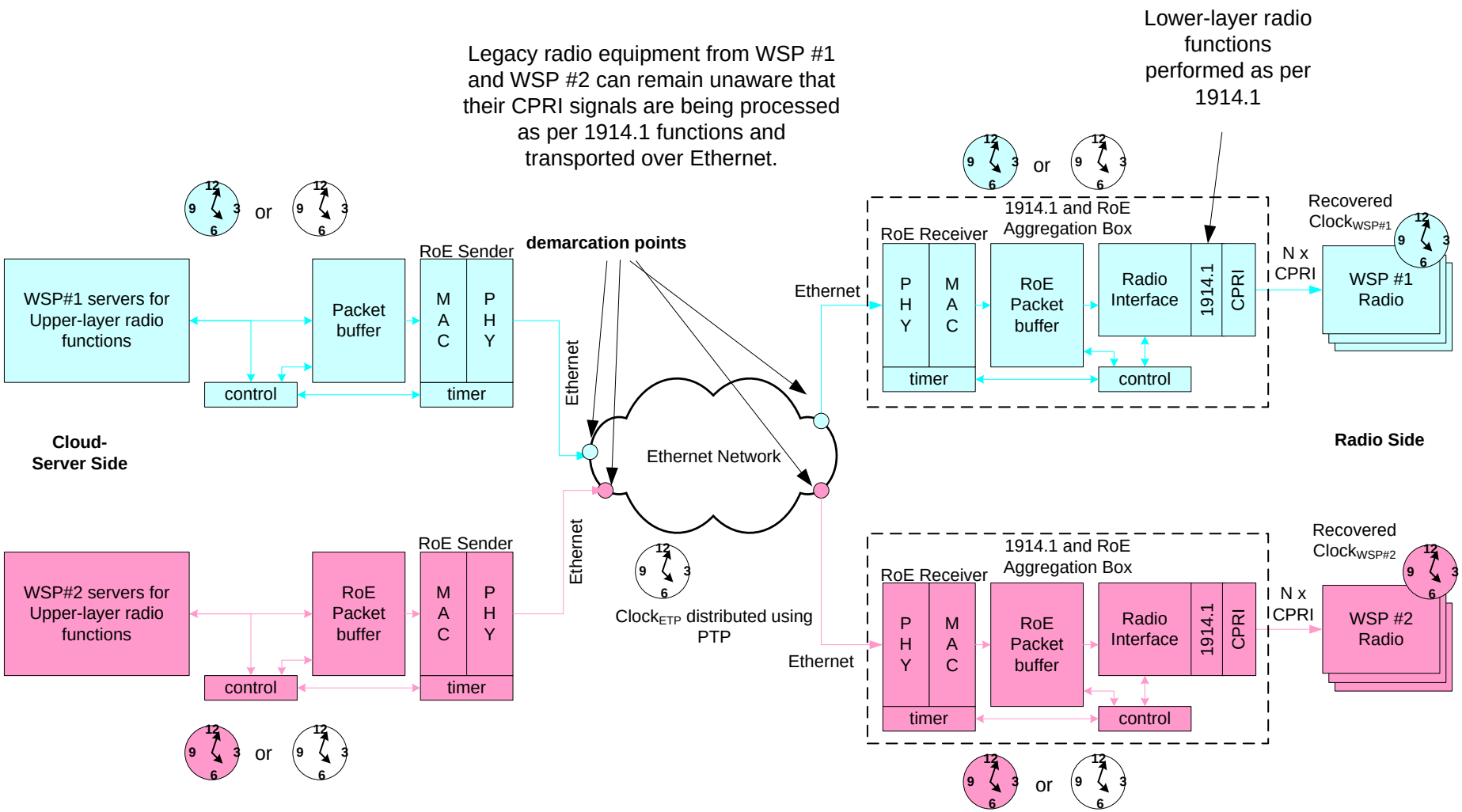
    or

    ETP guarantees PTP TC residence time measurement accuracy to ±Z ns

Case #3: CPRI with IEEE 1914.1 functions and Intermediate Aggregation Point

- Case#3 Summary:
  - Legacy radios with CPRI are reused
  - Centralized side uses servers to process the upper-layer radio functions, as defined by IEEE 1914.1
  - WSP supplies an RoE aggregation box that performs the lower-layer radio functions, as defined by IEEE 1914.1, maps and aggregates the partly-processed radio data into Ethernet
  - ETP receives Ethernet from WSP

Case #3: CPRI with IEEE 1914.1 functions and Intermediate Aggregation Point



Case #3: CPRI with IEEE 1914.1 functions and Intermediate Aggregation Point

- Demarcation Points
  - The Ethernet connecting points at the boundary of the ETP
- Ethernet Mapping and Demapping Functions
  - Mapping and demapping is for the partly-processed (as defined by IEEE 1914.1) radio data and is done by the WSP in its aggregation boxes
  - The servers can directly generate/receive RoE frames with the partly-processed radio data

Case #3: CPRI with IEEE 1914.1 functions and Intermediate Aggregation Point

- Timing
  - The WSP could use the ETP's PTP and SyncE timing references

    or

    WSP could have its own clock and tunnel its own PTP timing through the ETP network (i.e. ETP network acts as a PTP transparent clock to WSP's PTP)
- Service Level Agreements
  - ETP guarantees its uplink and downlink have latency ≤ X ns
    - ETP does not need to guarantee symmetry because demapping presentation to radios is done by WSP
  - ETP guarantees performance of PTP and SyncE timing services

    or

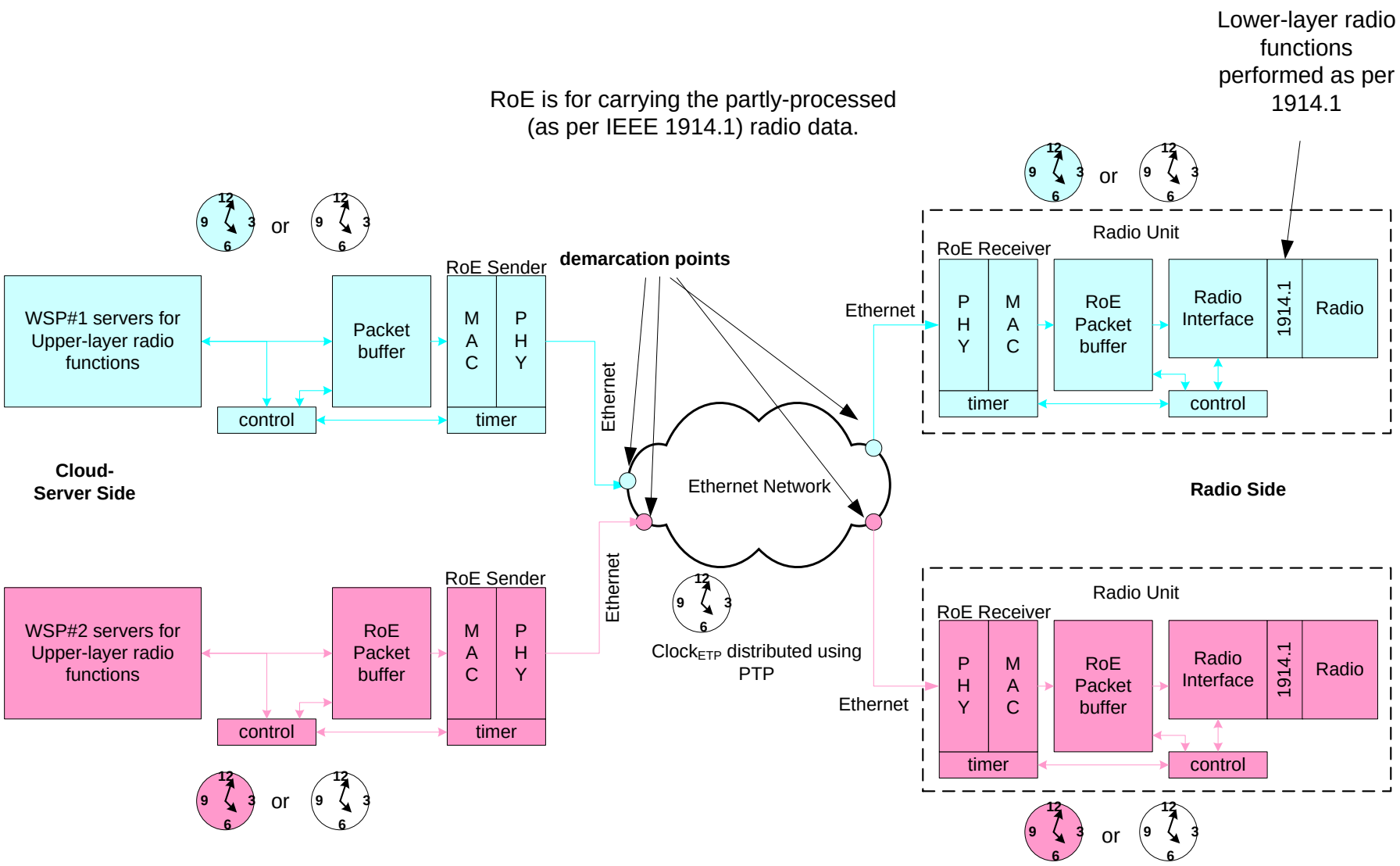
    ETP guarantees PTP TC residence time measurement accuracy to ±Z ns

Note: use of TCs is not yet standardized by ITU

Case #4: All new equipment with IEEE 1914.1 functions

- Case#4 Summary:
  - Radios do lower-layer radio processing (as defined by IEEE 1914.1) internally and connect to external world using Ethernet
  - Centralized servers process the upper-layer radio functions directly to/from Ethernet
  - ETP receives Ethernet from WSP

Case #4: All new equipment with IEEE 1914.1 functions



Case #4: All new equipment with IEEE 1914.1 functions

- Demarcation Points
  - The Ethernet connecting points at the boundary of the ETP
- Ethernet Mapping and Demapping Functions
  - Mapping and demapping is for the partly-processed (as defined by IEEE 1914.1) radio data and is done by the radio units
  - The servers can directly generate/receive RoE frames with the partly-processed radio data

Case #4: All new equipment with IEEE 1914.1 functions

- Timing
  - The WSP could use the ETP's PTP and SyncE timing references

    or

    WSP could have its own clock and tunnel its own PTP timing through the ETP network (i.e. ETP network acts as a PTP transparent clock to WSP's PTP)
- Service Level Agreements
  - ETP guarantees its uplink and downlink have latency ≤ X ns
    - ETP does not need to guarantee symmetry because demapping presentation to radios is done by WSP
  - ETP guarantees performance of PTP and SyncE timing services

    or

    ETP guarantees PTP TC residence time measurement accuracy to ±Z ns

Note: use of TCs is not yet standardized by ITU

Summary

- Some scenarios in which RoE could be used are shown
- For all cases:
  - ETP must always be able to guarantee its uplink and downlink latencies are below a specified max value
  - The WSP would use the ETP's PTP and SyncE timing as its own for RoE timestamping

    or

    WSP could conceptually tunnel its own PTP timing through the ETP network, but TC operation is not currently supported in telecom networks.
- What other scenarios are possible and likely?