Timestamp Format

Richard Tse

Nov 24, 2015

Background

- The current draft of 1904.3 defines the timestamp as follows:
  - The timestamp is 32 bits in size and in units of nanoseconds
  - The timestamp field is encoded as a 32 bit sliding window capable of representing ~2 seconds worth of time
  - This implies the timestamp field is capable of encoding a presentation time maximum ~1 second in the future

- The time-of-day for an RoE system will be distributed using IEEE 1588 and GNSS:
  - IEEE 1588 would be used alone or as a backup for GNSS
  - IEEE 1588 uses a timestamp[79:0] and time counter that has:
    - 48-bits of integer seconds
    - 32-bits of nanoseconds (of which only bits [29:0] are used to count up to 999,999,999ns before rollover)
    - Up to 16-bits of fractional nanoseconds
  - GNSS uses 1pps events:
    - Gives the year, day, hour, minute, and second that corresponds to the 1pps

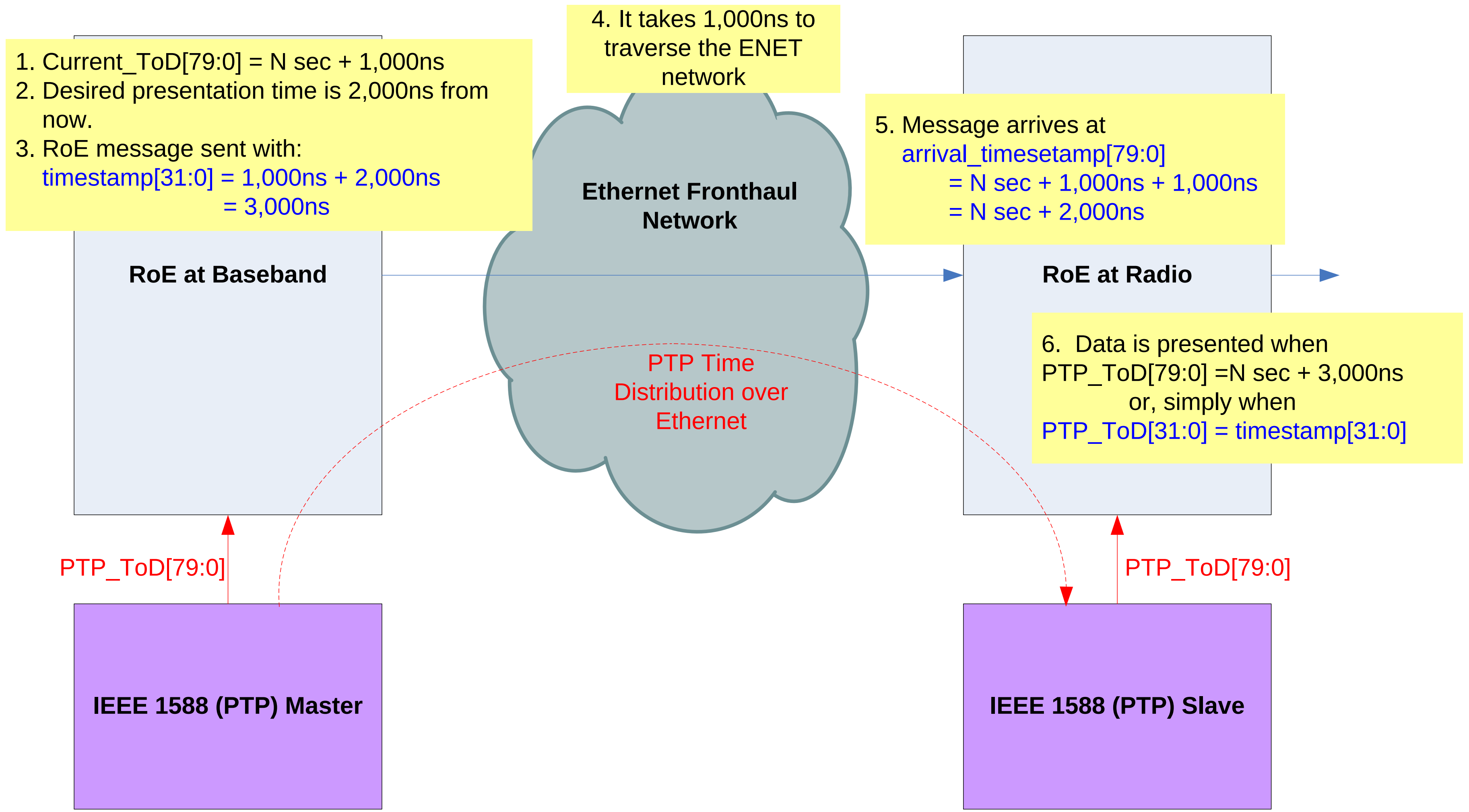
Description of Proposal

- Define our timestamp so it can be used with a IEEE 1588/GNSS time counter without conversion:
  - Option 1: simplest
    - Limits the presentation time to 1 second in the future
    - Timestamp[31:30] = ‘b00
    - Timestamp[29:0] counts from 0 to 999,999,999ns
  - Option 2: best resolution
    - Limits the presentation time to 1 second in the future
    - Timestamp[31:2] counts from 0 to 999,999,999ns
    - Timestamp[1:0] counts in steps of 0.25ns
  - Option 3: allow a later presentation time
    - Limits the presentation time to 2 seconds in the future
    - Timestamp[31] counts from 0 to 1 seconds
    - Timestamp[30:1] counts from 0 to 999,999,999ns
    - Timestamp[0] counts in steps of 0.5ns

Benefits of Proposal

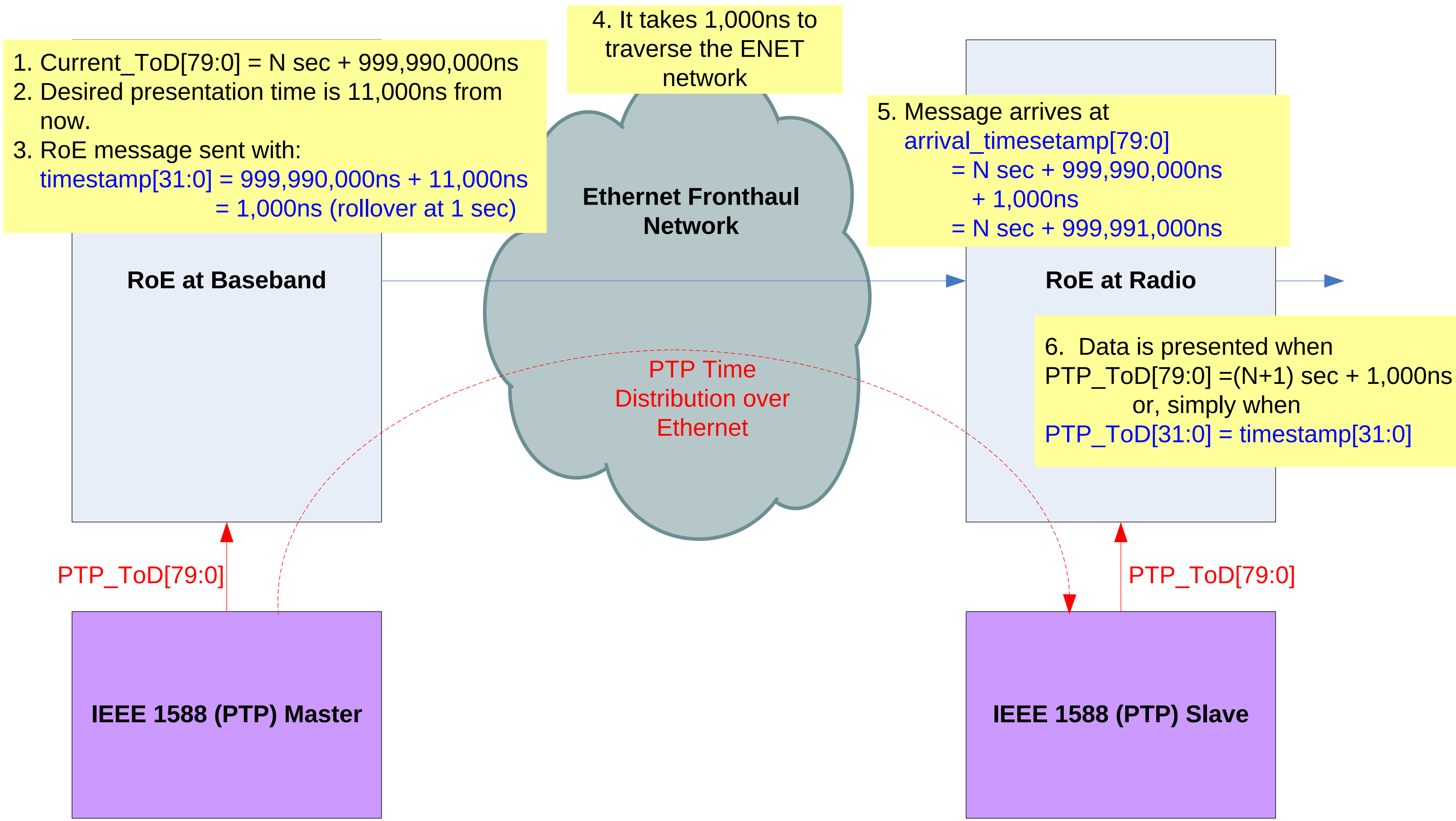
- Directly compatible with time-counters used by existing time synch protocols:
  - IEEE 1588 and GNSS equipment use time counters with 1 second time boundaries, not binary nanosecond time boundaries
- Determining the presentation time is simple (option 1 example shown below):
  - If timestamp[31:0] > arrival_timestamp[31:0]
    - Presentation_time = arrival_timestamp[79:32] seconds + timestamp[31:0] nanoseconds
  - Else (rollover case)
    - Presentation_time = (arrival_timestamp[79:32] + 1) sec + timestamp[31:0] nanoseconds
- Future timestamp formats could be accommodated by using new PKT_TYPEs
  - Not likely to be needed for a long time

Example #1: no rollover



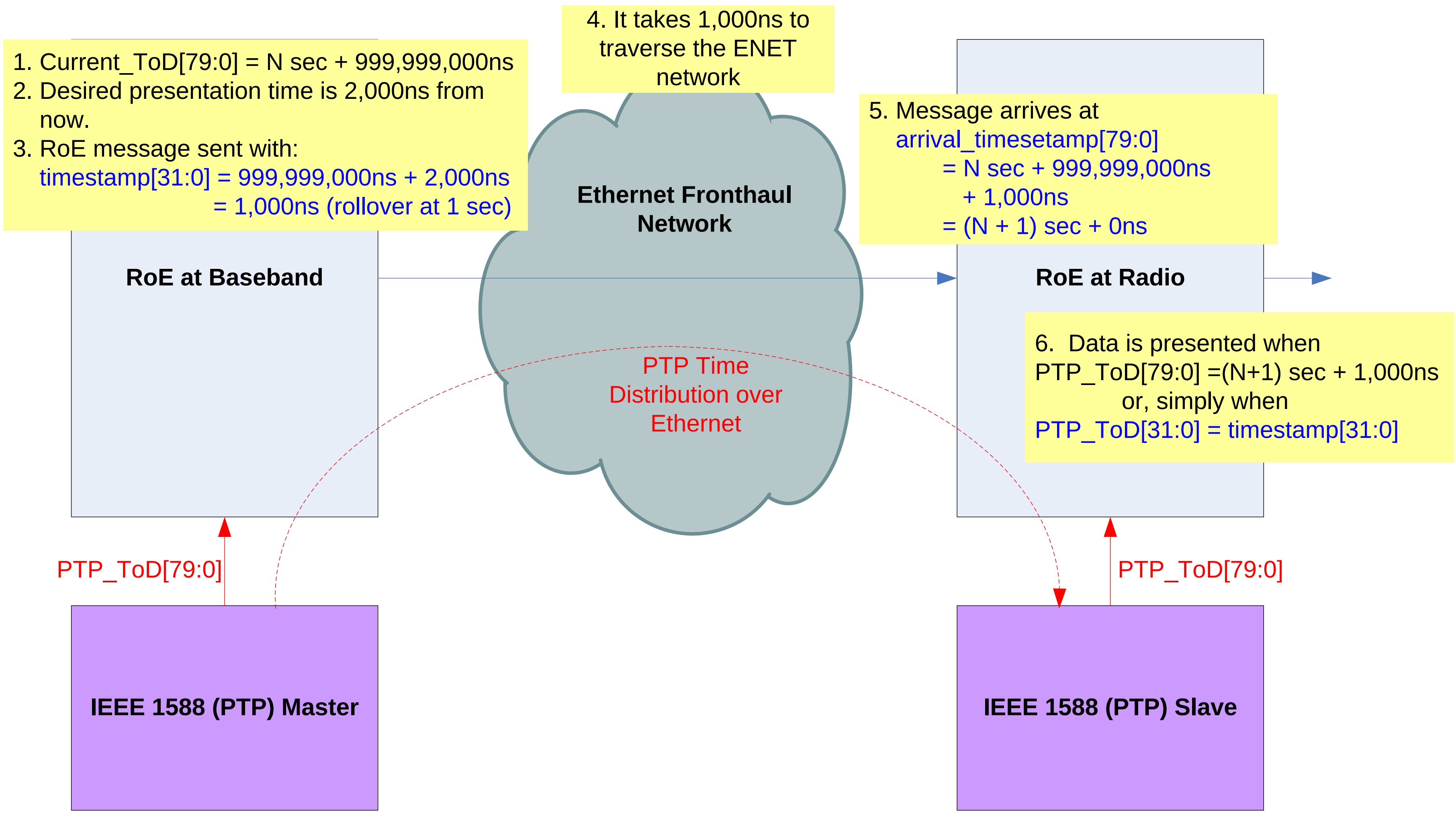
Example #2: rollover case A

timestamp rolls over, arrival time does not



Example #3: rollover case B

timestamp and arrival time both roll over



Proposal

- Redefine the timestamp as follows (for option 1):
  - The timestamp expresses the absolute time for presentation, relative to a defined reference plane, at the receiving endpoint of the RoE packet.
  - The timestamp is 32 bits in size and in units of nanoseconds. (unchanged from original definition)
  - The timestamp value ranges from 0ns to 999,999,999ns (0x0 to 0x3B9A C9FF) and is thus capable of expressing a presentation time of up to 1 second in the future.
  - Both the sending and receiving endpoints of the RoE packet must account for rollover of this field after 999,999,999ns.
  - Both endpoints shall share the same understanding of the Time of Day (ToD). (unchanged from original definition)
- Change Annex B to show how to derive the absolute presentation time from the timestamp, as shown on slide 4.