ToP Demarcation – An Innovative Approach for Synchronization Performance Monitoring in Packet Networks

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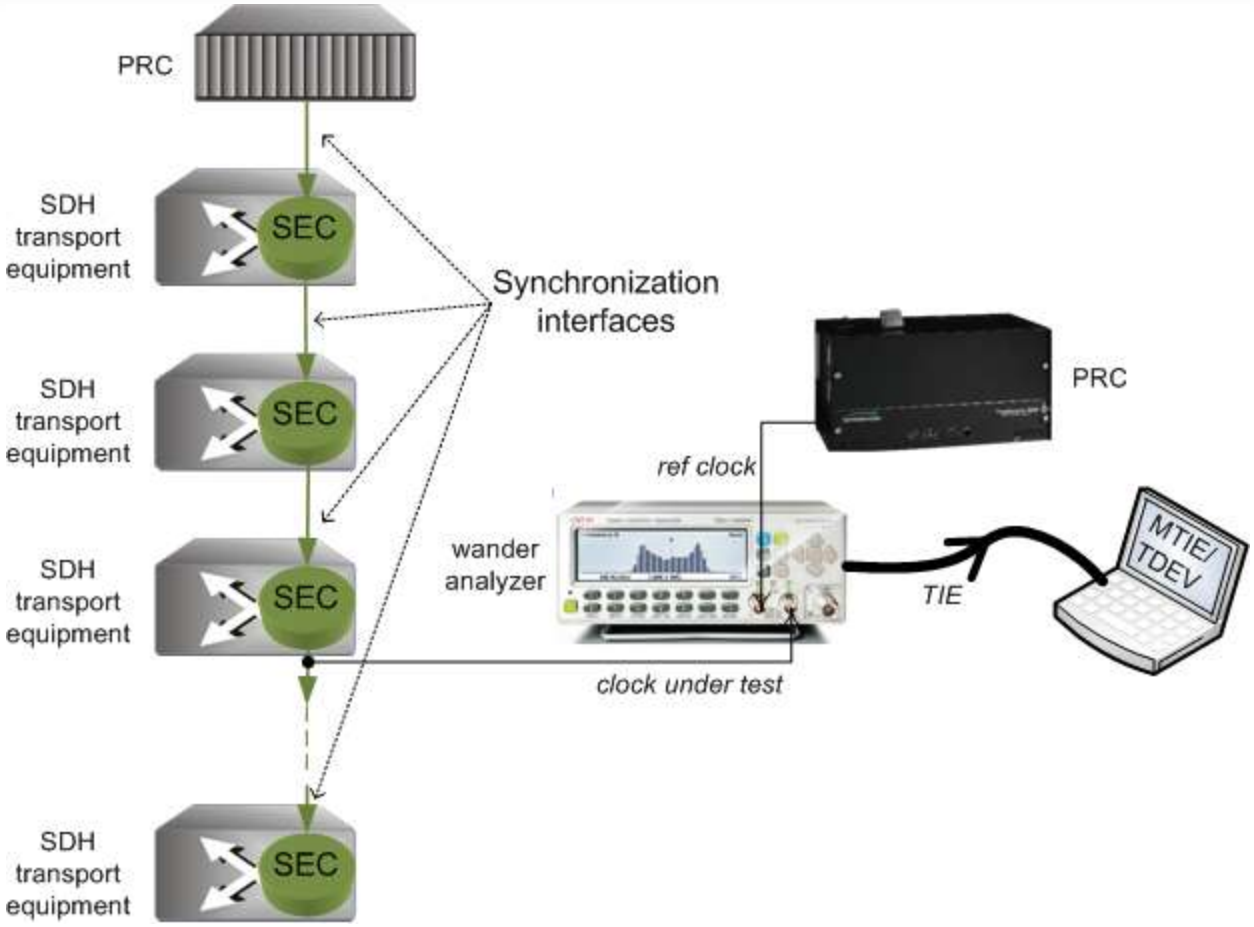
Telecom IEEE 1588v2 status today

- IEEE 1588v2 (PTP) is gradually becoming the technology of choice for frequency and time distribution over packet networks
- A huge effort is currently taking place in order to improve clock recovery algorithms, at one end, and define sync performance related metrics, at the other
- These efforts need to be supplemented with

adequate mechanisms to monitor on-going sync service performance

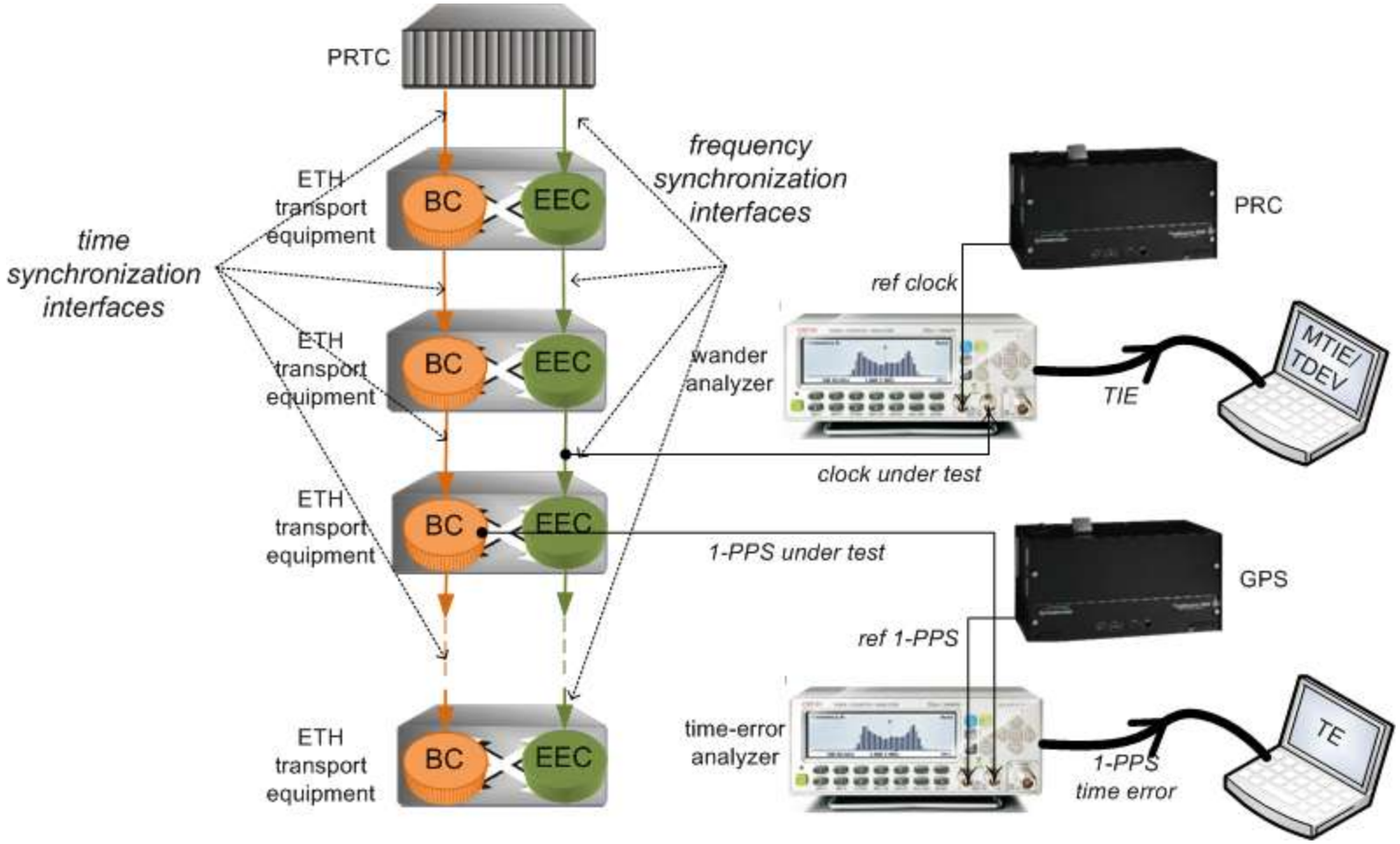
THIS PRESENTATION WILL DISCUSS SUCH MECHANISMS

Legacy sync performance monitoring



Measurable signal (phase error) is easily mapped to meaningful performance metrics (MTIE/TDEV)

Performance monitoring of time-profile based IEEE 1588v2



Hop-by-hop ➔ Measurable signal (phase or time error) is easily mapped to meaningful performance metrics (MTIE/TDEV or TE)

PTP performance monitoring today (frequency profile)

- Most deployments are frequency E2E distribution in nature (G.8265.1 based)
- Performance monitoring is mostly based on master-slave connectivity and status

Creates a problem when:

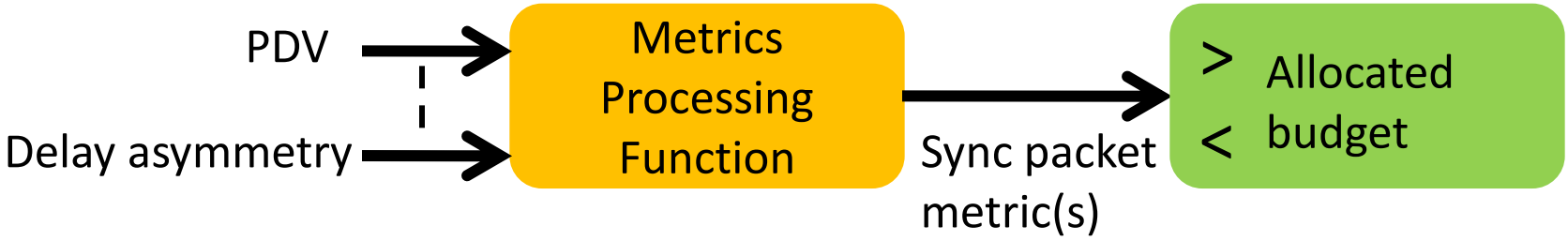
1. PTP is a service provided by a network provider to a customer → **HOW CAN WE TELL WHETHER THE SYNC SERVICES COMING FROM THE PROVIDER'S SIDE MEET THE REQUIRED PERFORMANCE LIMITS?**

2. Customer PTP traffic is traversing a provider's network infrastructure → **HOW CAN WE TELL WHETHER THE**

PDV metrics to facilitate PTP performance monitoring

- A close set of good PDV metrics is a must in order to measure performance budgets

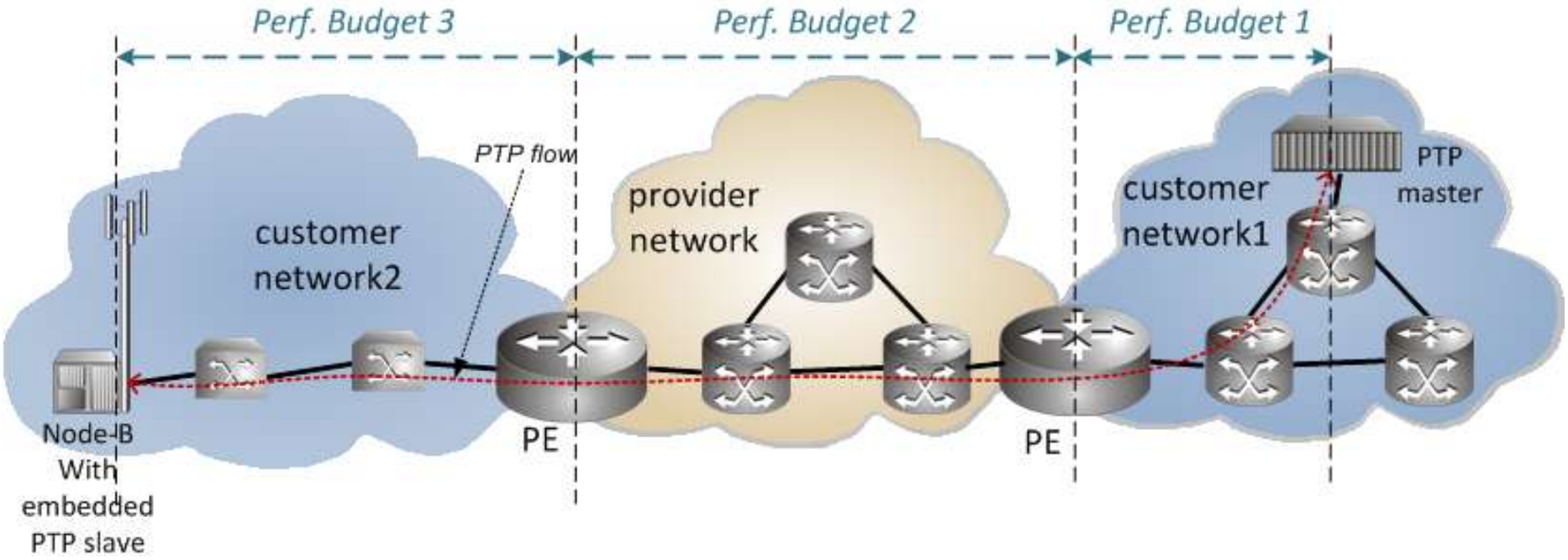
- Mapping between packet network measurable attributes (especially PDV) and legacy performance metrics (MTIE/TDEV)



The work on metrics is currently progressing in ITU-T Q13/SG15

Performance budgets

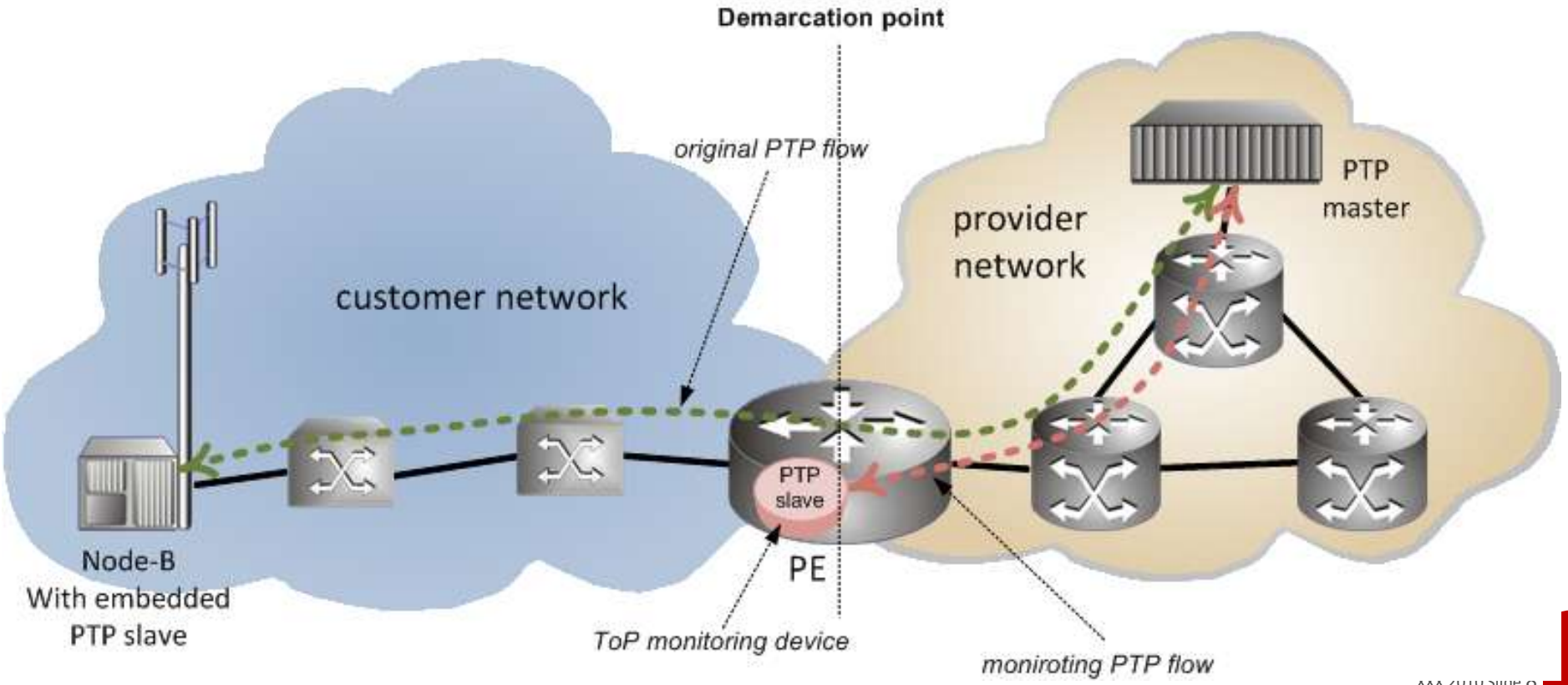
Once metrics are defined performance budgets needs to be allocated over the distribution path…



But, even if we had the metrics and performance budgets, we still need to accurately extract packet network measurable parameters to feed to them…

One solution: intermediate PTP slave device

The intermediate PTP slave is only used to extract packet network measurable parameters to calculate budget conformance



Problems with the intermediate slave approach

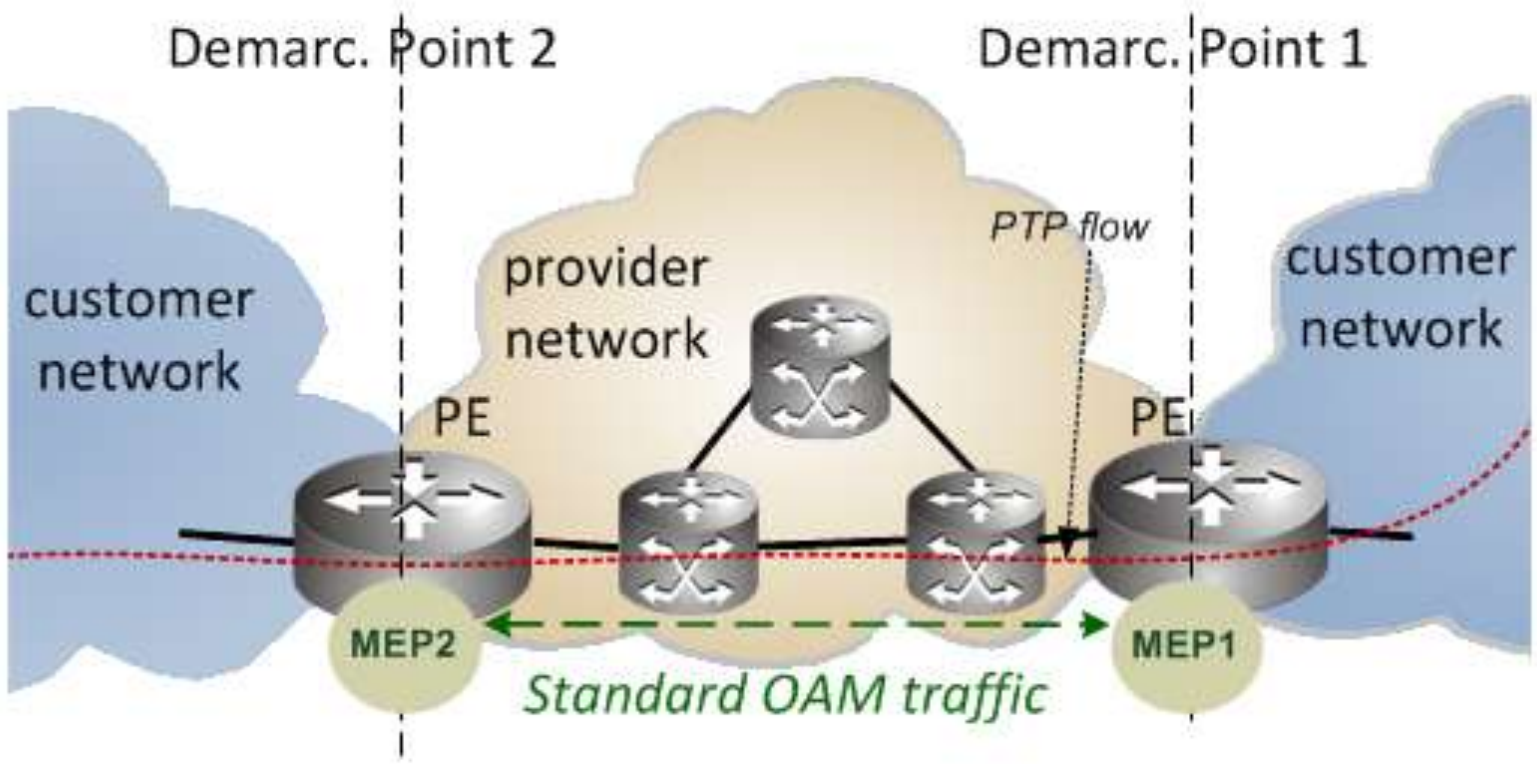
- Additional bandwidth demand → an additional PTP flow for each new monitoring slave function

- Demands full IEEE 1588 implementation that must also be fully interoperable with the GM → additional cost and management issues

- Monitoring a different IEEE 1588 flow than the original one → possibly on a different network path with different packet delay attributes

Second solution: standard OAM techniques

- Using standard OAM traffic (e.g. Y.1731) to extract sync relevant network measurable parameters



Problems with standard OAM techniques

- Measurements are performed on synthetic OAM packets rather than the original PTP flow → measurement is less reliable and accurate

- The measurements do not include the GM, thus, not reflecting the true PTP service degradation from the GM to the demarcation point

- Does not take any TC or BC node, located between the GM and the demarcation point, into account

ToP Demarcation (ToPD) set of requirements

- Allows operators and transport providers know whether the existing conditions over their network allow meeting E2E sync goals
- Continuously monitor network delay attributes, over the original PTP flow, without adding additional traffic or consuming additional resources
- Easily identify and isolate sync distribution problems by simultaneous monitoring at several network locations
- Measure the true synchronization quality at any given location in the network without requiring additional PTP bandwidth

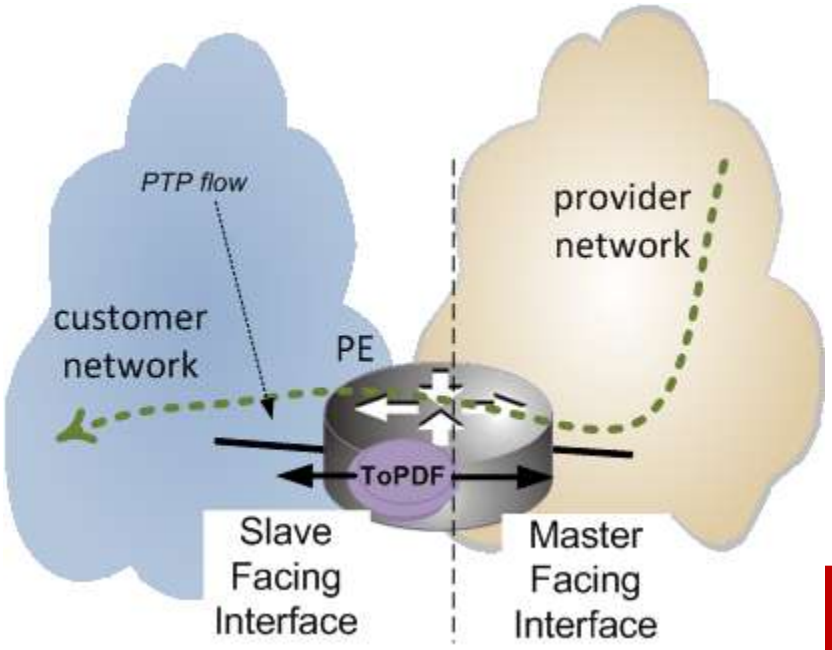
ToP Demarcation Function (ToPDF)

- Completely passive device located at the demarcation point (e.g. PE router between networks)
- Doesn't introduce additional delay asymmetry
- Accurately timestamp incoming/outgoing PTP messages of a selected PTP flow (selected master-slave pair)
- Can extract relevant information from incoming/outgoing PTP messages (e.g. timestamps)
- Gathered information can be used

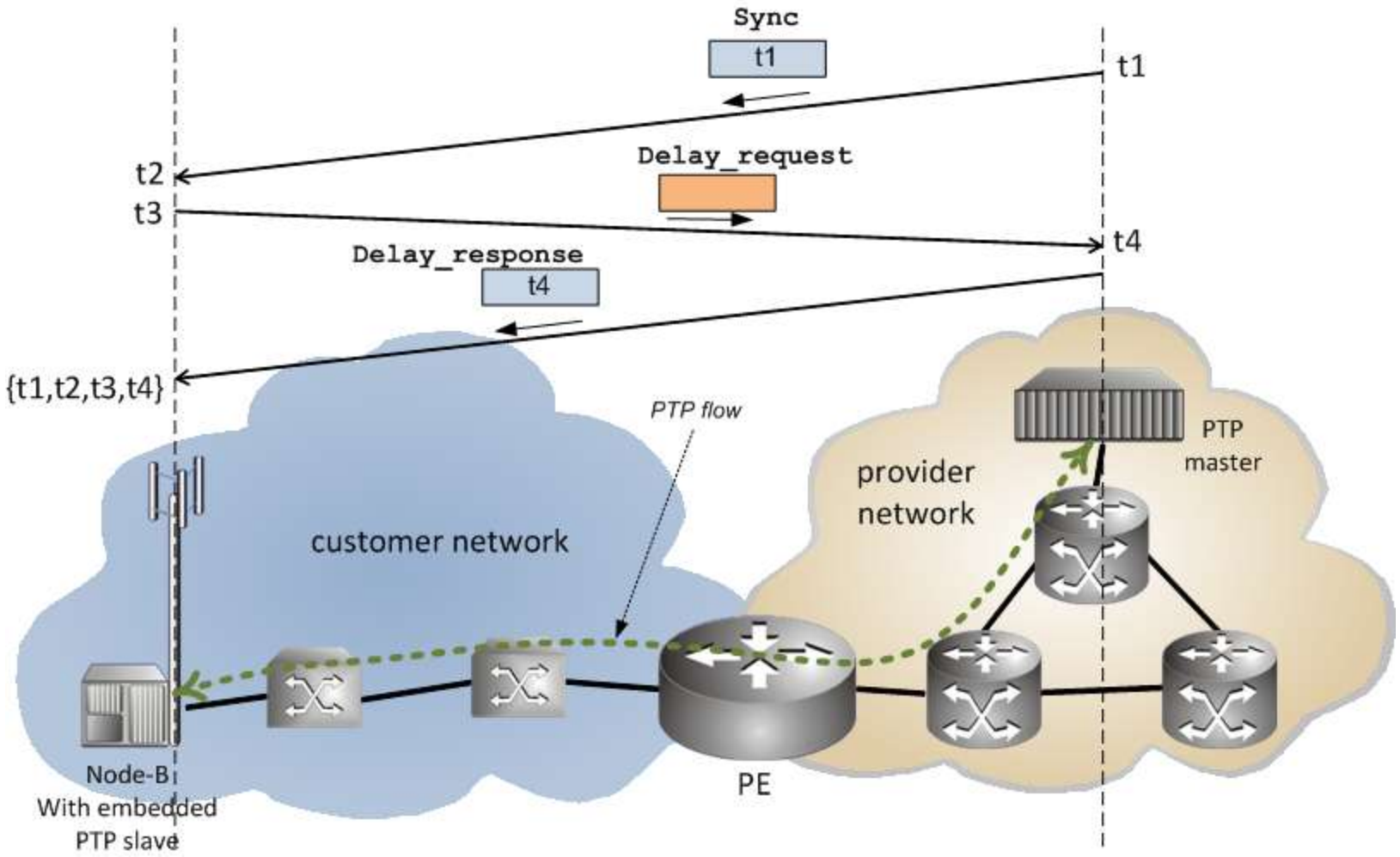
for:

(a) Calculating performance metrics

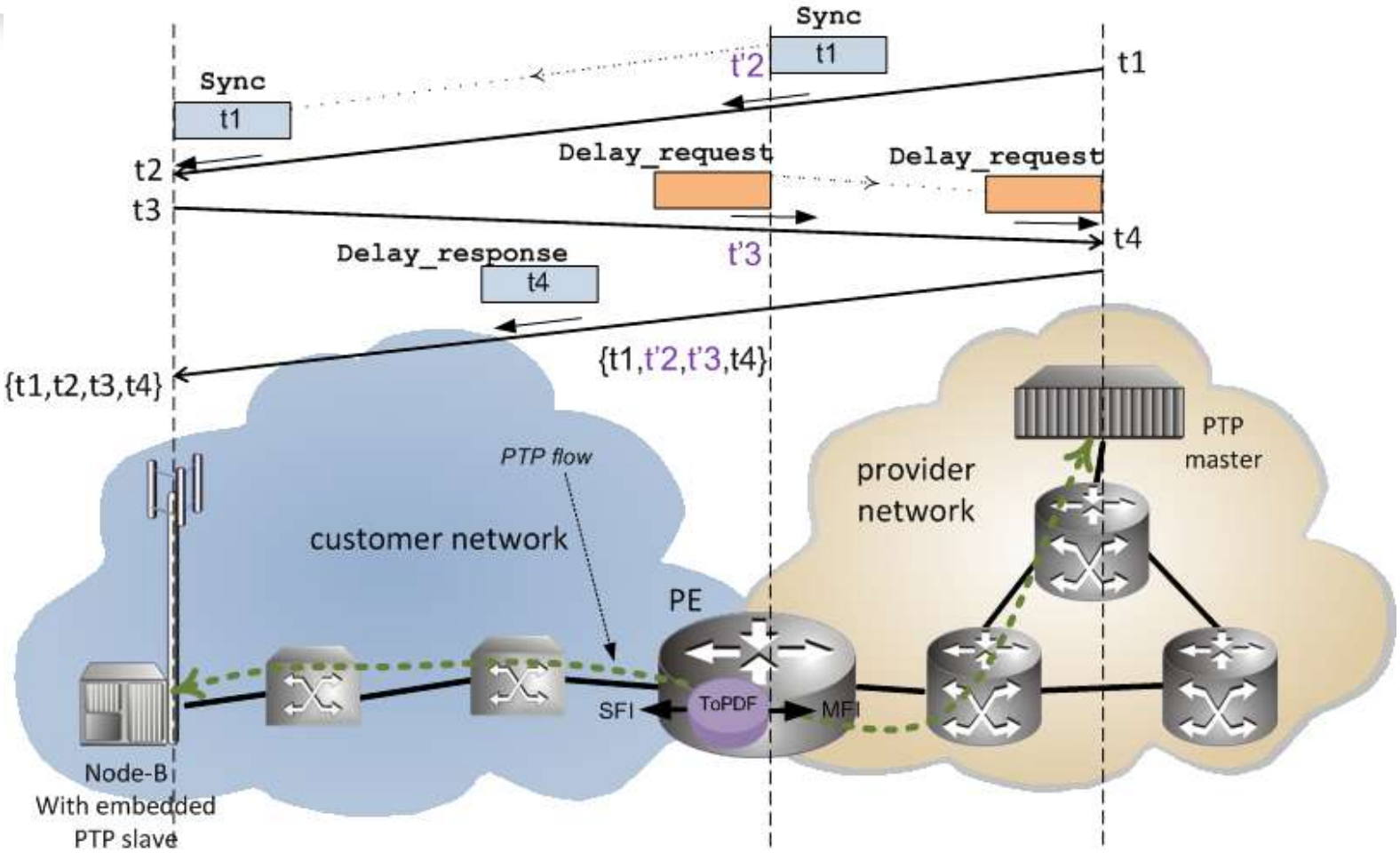
(b) Recovering a clock



Standard IEEE 1588v2 Transaction (one step)

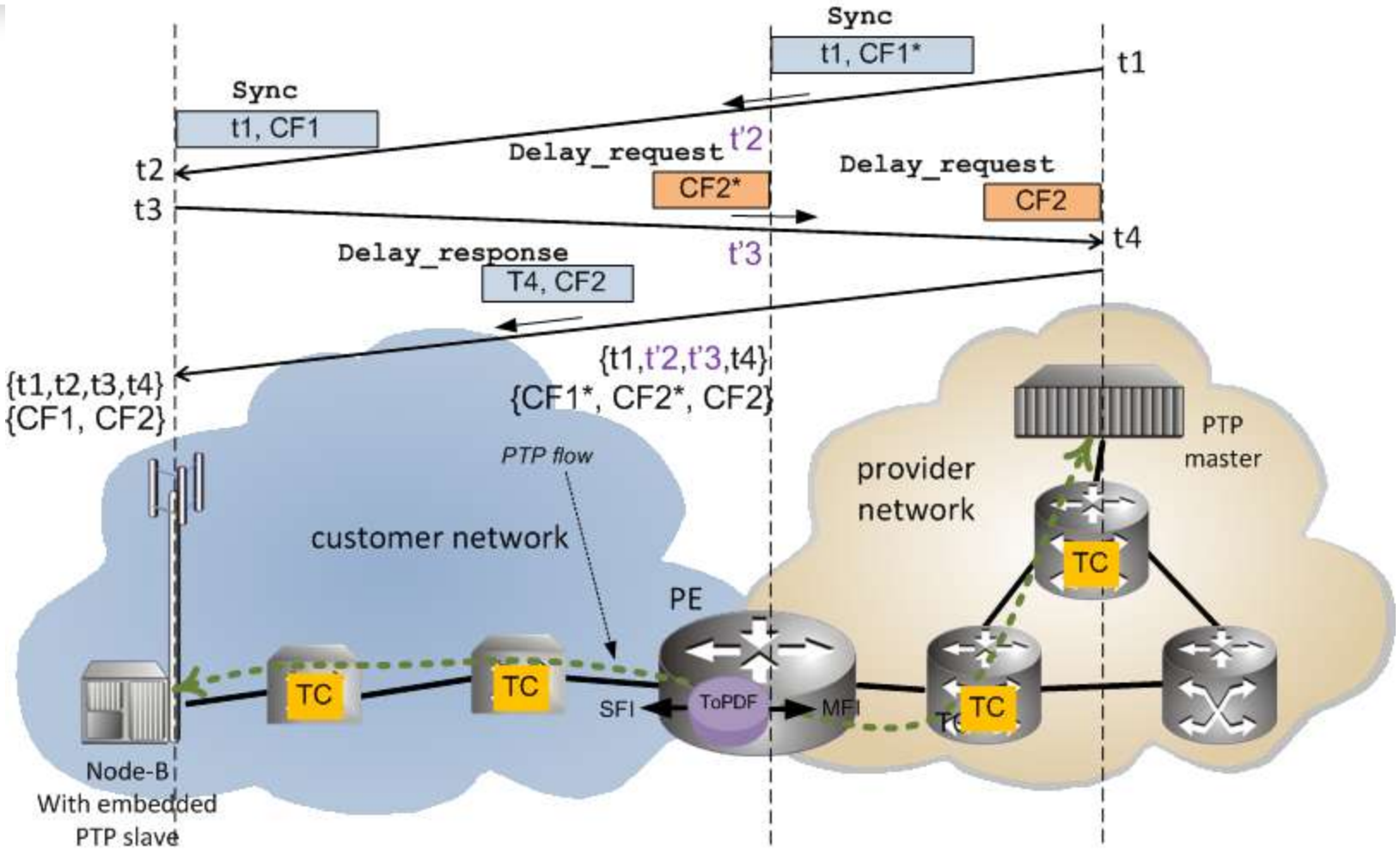


Introducing an Intermediate ToPD Function



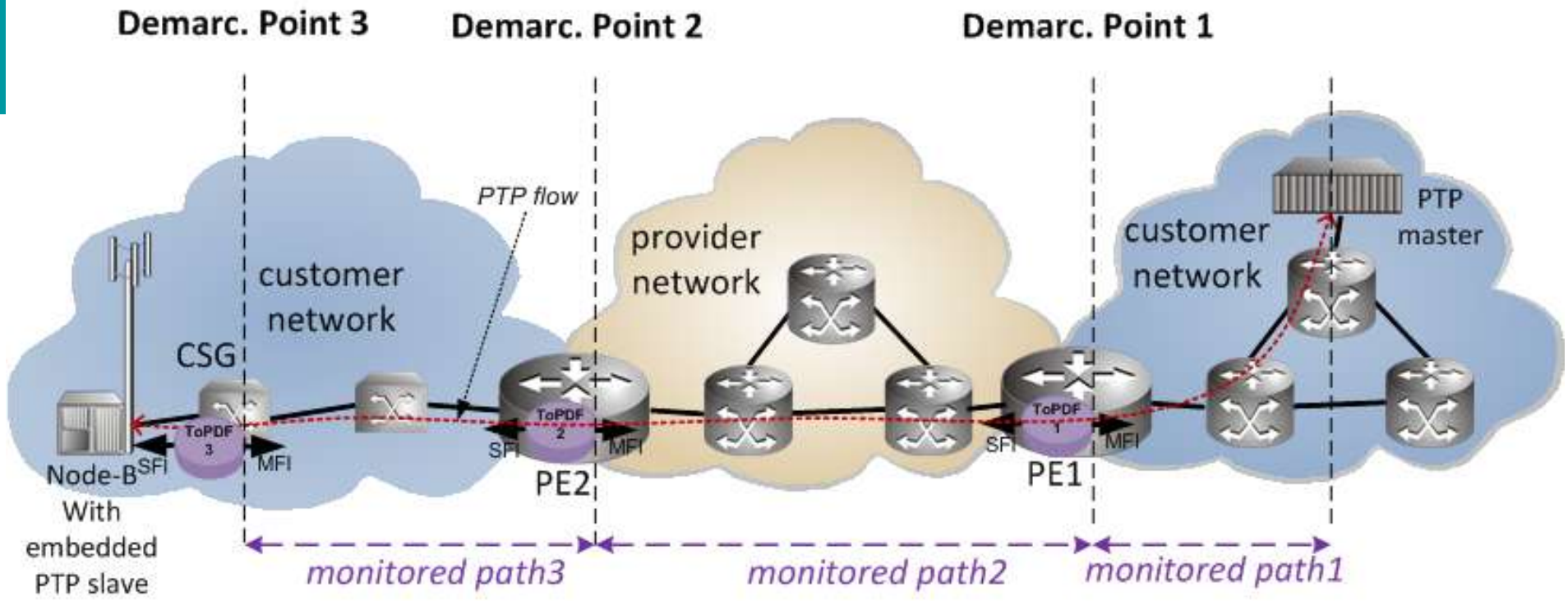
- Upon the completion of the master-slave transaction the ToPDF has all the required information regarding the PTP flow over the provider's network
- This information can be used either for computing the service metrics and/or performing actual clock recovery (monitored by an external measurement device)

ToPDF with Transparent Clocks



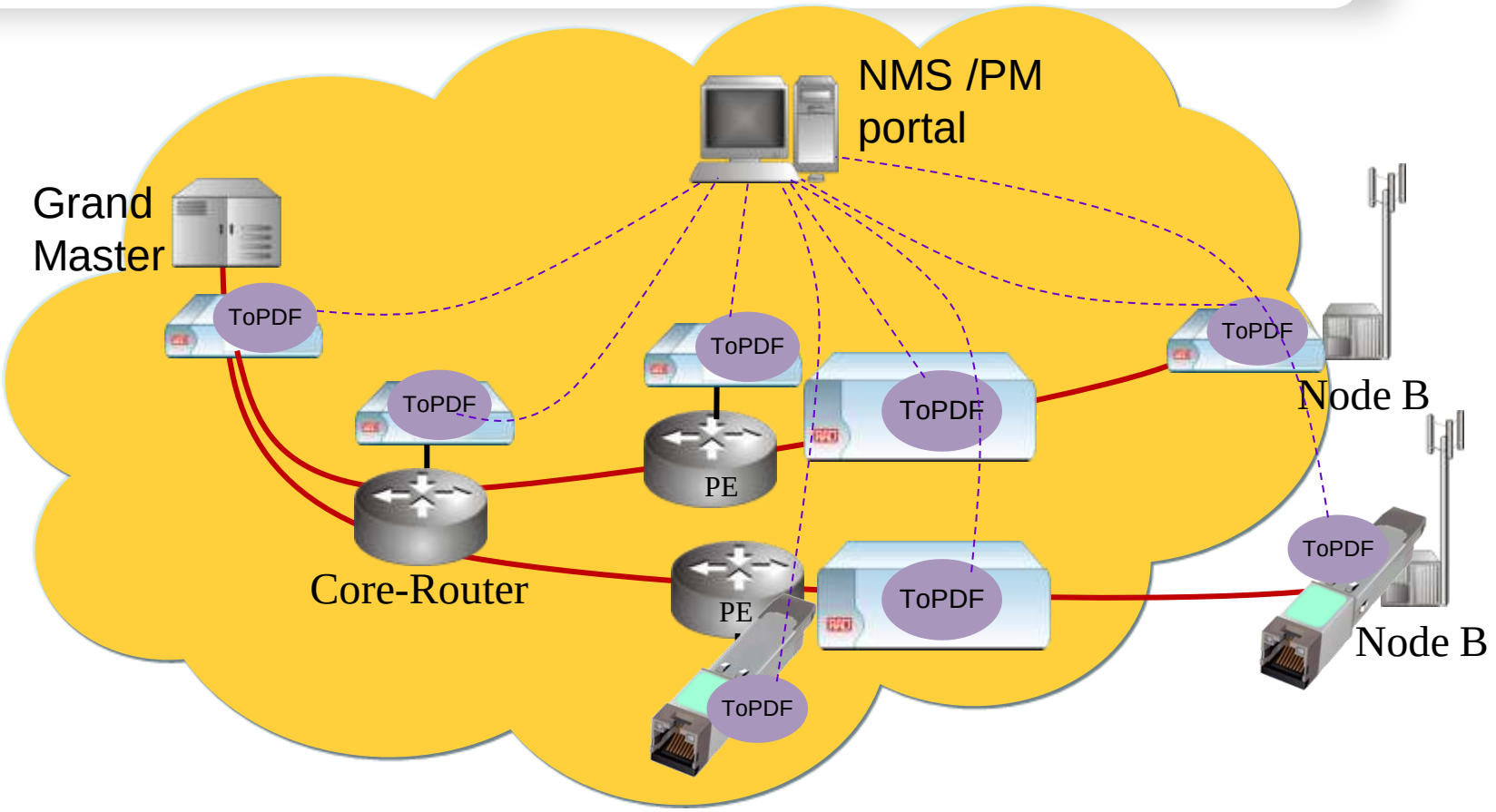
In addition to the timestamps information {t1,t2*,t3*,t4}, the ToPDF has all the required correction field information: {CF1*, CF2-CF2*}

Multiple demarcation points



- ToPDF1: GM ←→ PE1 network performance
- ToPDF2 – ToPDF1: PE1 ←→ PE2 network performance
- ToPDF3 – ToPDF2: PE2 ←→ CSG network performance

ToPDF management and data collection



- The NMS/PM server is collecting real-time data from all the ToPDFs installed in the network
- The data gathered from the ToPDFs is synchronized (based on PTP flow and packet SN) and analyzed

ToPD Realization

- Integrated inside large aggregation switches/routers

- Embedded inside an NDD box

- A dedicated ‘smart’ SFP

Summary

- Synchronization performance monitoring is a key element in PTP frequency and time distribution
- Metrics and performance allocation budgets are under study in the ITU-T, but…
- Methods to accurately measure sync-related packet network attributes are required
- RAD's ToP Demarcation approach offers effective low-cost solution to this problem

Thank You For Your Attention

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