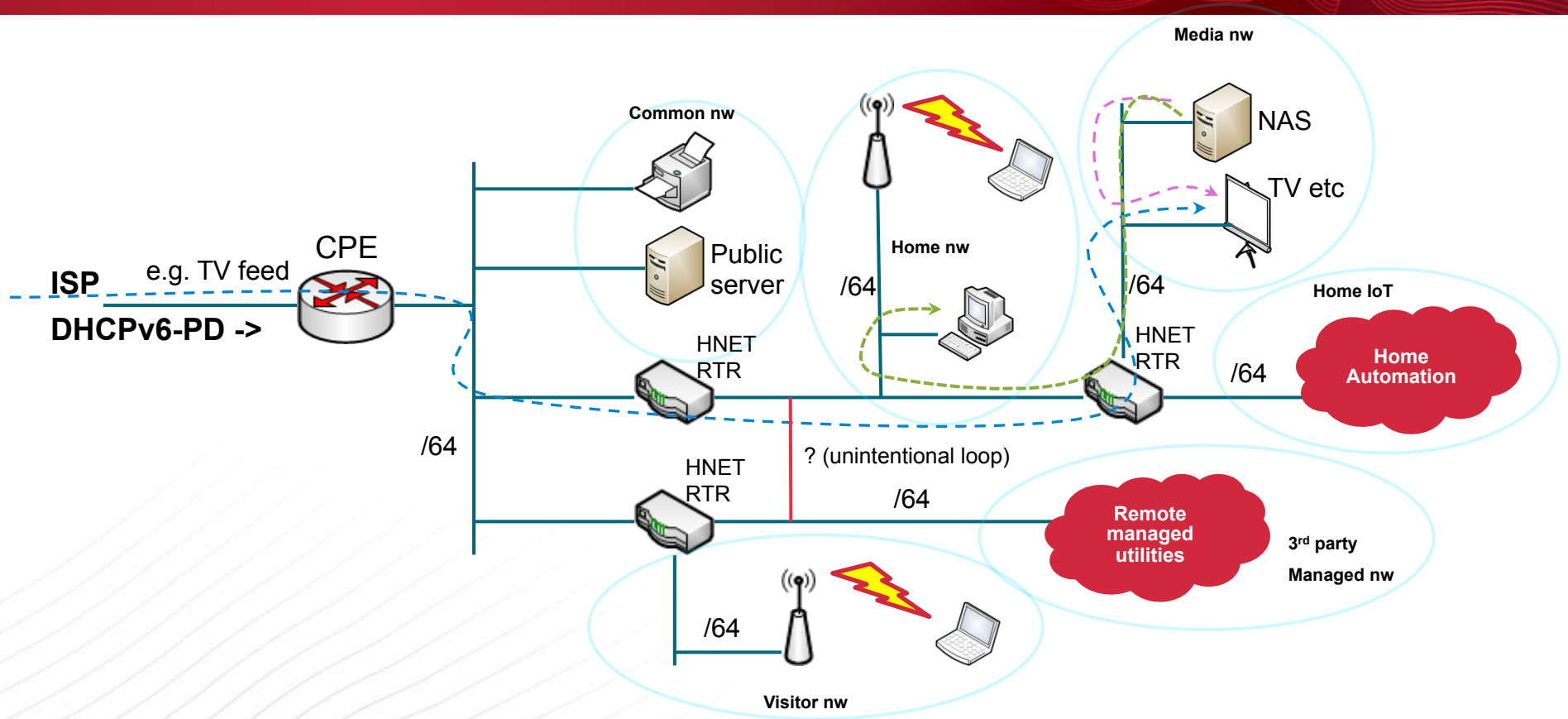# LAYER 3 TSN – DRAFT 3.1

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REMEMBER THE "HOMENET" ARCHITECTURE ?


- **L3 routers are connected by multiple L2 segments not managed by L3.**

- **The challenge:**
  - How to manage path selection & reservation between L3 devices?
  - How to manage path selection & reservation across L2/L3 boundaries?

- **Clear separation of "independent" but <u>cooperating</u> layers:**
  - Layer 3 topology and (non-)adjacent layer 2 topologies are handled separately.

- **Role separation for layer 3 router:**
  - "L3 PCE + L2 PCE" or "L3 PCC + L2 PCE".
  - One router is an elected or preconfigured g0d-box.

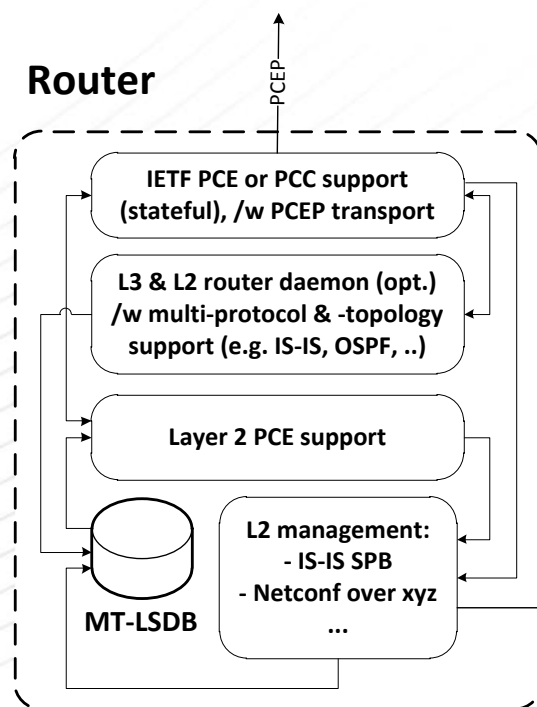- **One L2 PCE per Layer 2 topology.**

BROADCOM.
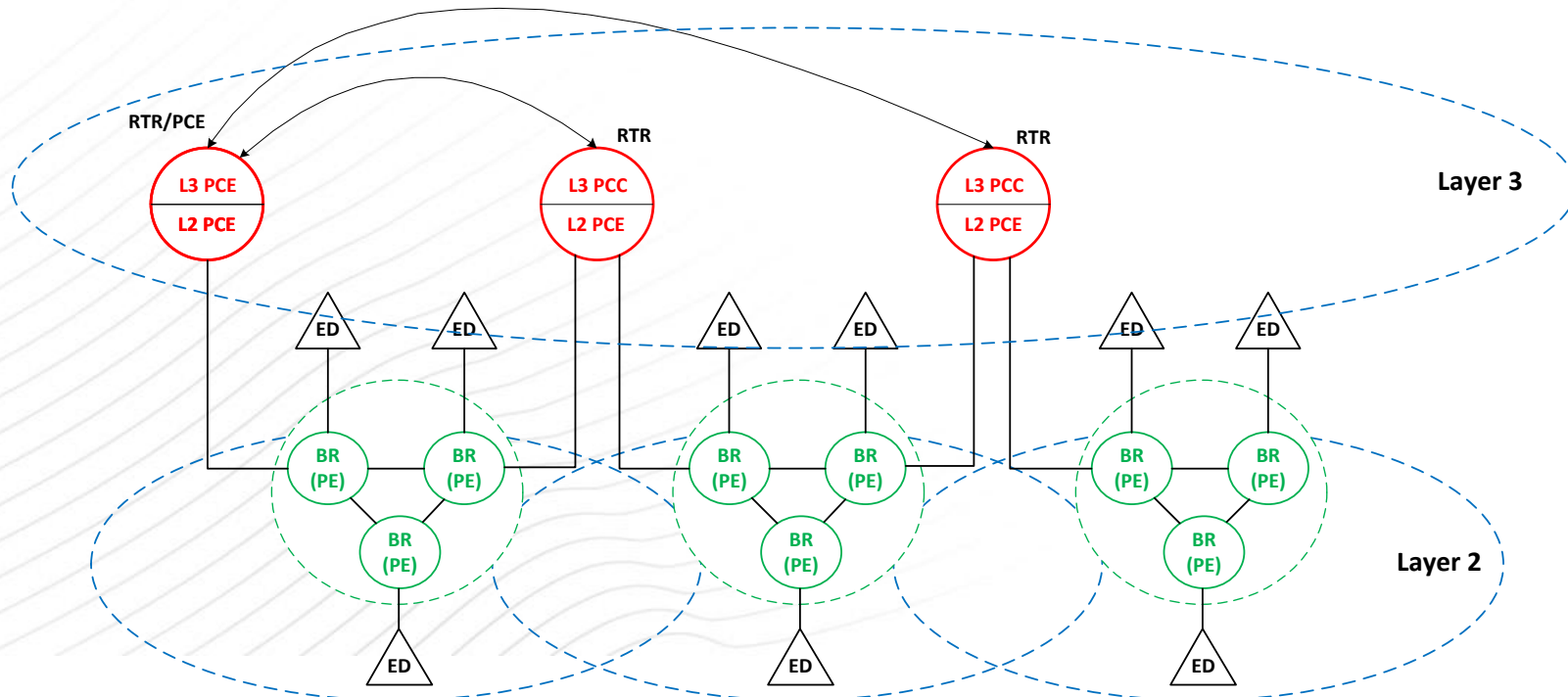
- **PCEs for both layer 3 and layer 2 purposes:**
  - They have different topology view..
  - An L3 PCE knows L2 circuits (logical paths) to the next L3 hop(s) and an L2 PCE knows its own network links/hops.

- **Layer 2 could use any standard link-state protocol (e.g. IS-IS or equivalent) for path management.**

- **Layer 2 circuits computed based on Layer 3 path requests.**

Router

PCEP

```
IETF PCE or PCC support
(stateful), /w PCEP transport

L3 & L2 router daemon (opt.)
/w multi-protocol & -topology
support (e.g. IS-IS, OSPF, ..)

Layer 2 PCE support

L2 management:
- IS-IS SPB
- Netconf over xyz
...

MT-LSDB
```

XYZ

Assumption: A PE (switch or bridge):
- Does not necessarily feature an IP stack.
- Allow remote management of FIB.

PEs are managed by an L2 PCE..
PEs do not have any access to L3 information
PEs do not perform any local path computation.

L2 PCE (AS A PART OF THE ROUTER)

- **It must know the layer 2 topology it manages:**
  - Either it learns it dynamically or it is pre-configured.

- **It must manage the switch/bridge (PE) QoS & reservations:**
  - The PCE must be informed of the any PE locally originated configurations, initial configuration and obviously its own configuration commands.

- **Service the L3 PCE for a path computation and selection:**
  - L3 circuit establishment request is serviced by L2 PCE computation and path selection.
  - L2 PCE provides an aggregated summary of L2 information.

- **Layer 2 path management and reservation:**
  - Independent of the protocol solutions at the L3!
  - Could use .1Qca (/w ECTs) or other adequate protocol such as Netconf over SSH, etc.

L3 PCE / PCC (AS A PART OF THE ROUTER)

- **Layer 3 routers have a dual role:**
  - Either an L3 PCE Client (PCC) or a g0d-box (PCE).
  - Based on the IETF PCE architecture and model.

- **PCE must know the layer 3 topology:**
  - Either PCE learns it dynamically (e.g., IS-IS, HNCP, OSPF) or it is pre-configured.
  - Layer 2 topology knowledge is not relevant beyond "circuits".

- **PCE must know both layer 3 and layer 2 QoS & reservations:**
  - Reporting from other L3 PCCs /w L2 summaries or.. L3 PCE just knows..

- **Layer 3 "circuit" management and reservation:**
  - Independent of the protocol solutions at the L2!
  - Proposal to use IETF "PCE initiated LSP model" (with modification) to push the layer 3 path to other L3 routers that then take care of the layer 2 path.

- **No path reservation protocol like RSVP-TE in this proposal..**

PE (SWITCH/BRIDGE)

- **Simple device.. hopefully..**
  - Remote management of FIB must be possible.
  - PE should accomodate static FIBs.
  - Proper security must be in place..

- **Unaware what happens at layer 3 circuit computation and most likely also on layer 2 path computation:**
  - However, it may needs to report its own capabilities & status to L2 PCE..

PROTOCOL CONSIDERATIONS

- **Layer 3 – IETF protocols could & should be reused but unfortunately not possible without being extended:**
  - PCE architecture – [RFC4655].
  - Stateful PCE – [draft-ietf-pce-stateful-pce].
  - PCE initiated LSP + delegation – [draft-ietf-pce-pce-initiated]
    - Apply to this specific context tbd. (since we have no MPLS here..)
  - PCEP – [RFC5440]
    - Capability indication tbd.
    - Adding the listener/talker models tbd.
    - Dynamic reporting tbd.
  - PCE discovery – e.g. [RFC5088, 5089] for IS-IS & OSPF.
  - Possibly Netconf over HTTP or SSH – e.g. [RFC5539, 6242].

- **Layer 2:**
  - Minimal changes.. .1Qca + ECT sound promising (for .1aq capable PEs).

- **Data model:**
  - For exchanging specs and etc..
  - Could be YANG.. At the same time transportation over PCEP should also be considered!

ADDITIONAL THOUGHTS..

- **The illustrated solution approach is for layer 3 traffic. If layer 2 (or non-IP) transmission is needed, then layer 2 frames need to be tunneled over layer 3 network:**
  - PseudoWire could fit in there..
  - Would require MPLS support..
  - PCE initiated LSP model would allow the use of segment routing -> no LSP setup signaling/reservation.

SUMMARY

- **A comprehensive L3 and L2 PCE model with a clear layer separation is a must:**
  - We cannot let homenets and equivalent run ahead without putting enough considerations on L2.
  - L2 TSN alone without a comprehensive L3 solution is at risk to achieve limited adoption only.

- **Allows plumbing together arbitrary layer 3 networks with support for path management & reservation at layer 2 as well.**

- **Aims to maximize protocol & prior work reuse.**

QUESTIONS & COMMENTS ?

- **Thank you..**