Selective Customer TCN Snooping across a Provider Domain

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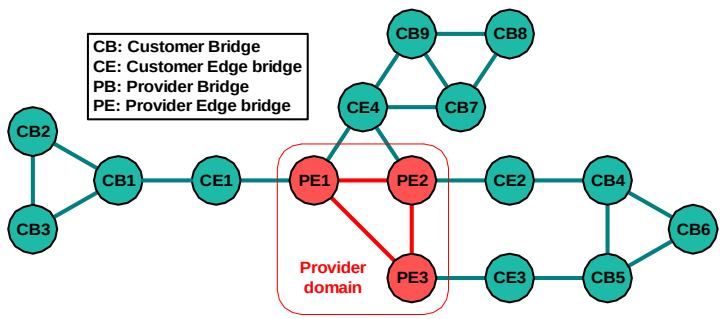
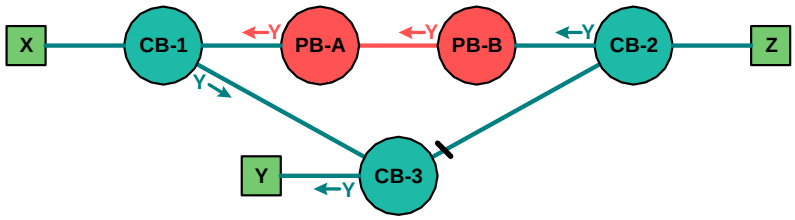
Provider/Customer domain interaction



- Provider control plane is separated from Customer control plane and they both run R/STP
- Provider bridges:
  - Never process Customer BPDUs but may trigger some actions in Provider domain
  - Transparently transport them: wire-like service
  - dual homing, back doors allowed
- It is assumed that R/STP runs across C-VLANs for Spanning Tree (ST) and provider domain is stable

Case for Unlearning

- Norman Finn's *Provider Bridge "Unlearn" Signaling:*
  http://www.ieee802.org/1/files/public/docs2003/unlearn-signaling.pdf

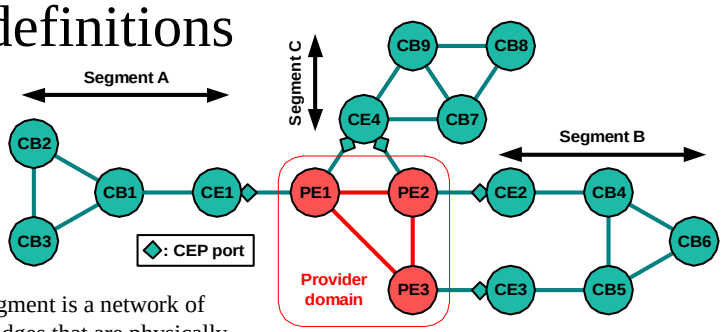


- Need for Provider bridges to act upon Customer TCN-BPDUs
- However frequent unlearning and learning is very expensive in provider domain
  - Need to reduce broadcast storms

Goals

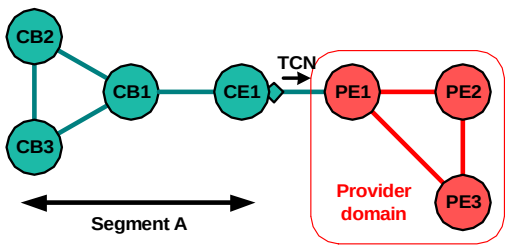
- Examine cases where/when to trigger unlearning in Provider domain based on the Customer-VLAN (C-VLANs) Topology Change Notifications (TCNs)
- Ways to minimize unnecessary flushing of MAC addresses in Provider bridges
- Assess the impact of the proposed solution

A few definitions



- A VLAN Segment is a network of Customer bridges that are physically connected
- A C-VLAN is a collection of one or more physically separated VLAN Segments that are logically connected through a Provider domain
- Single-homed Segment has only one Customer Edge bridge (CE) connected to a single Provider Edge bridge (PE) (e.g., Segment A)
- A dual (multi)-homed C-VLAN Segment has one or more CEs connected to two or more distinct PEs (e.g., Segments B & C)
- The port on a CE connected to a CE-PE link is referred to as a "CEP port".
- The state of a CEP port is with respect to the C-VLAN ST

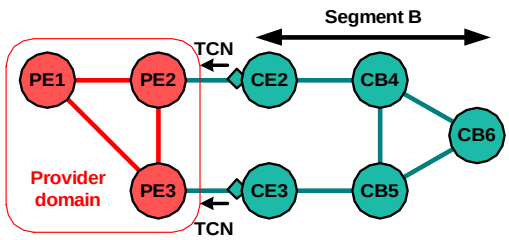
Single-homed Segment



- The CEP port of CE1 is in the Forwarding State
- C-VLAN Segment A reconfigures somewhere inside
- Segment A generates a TCN
- Provider bridges **need not**:
  - Act upon this TCN as the segment is single-homed
  - Flush learned MAC addresses of the C-VLAN Segment

Dual-homed C-VLAN Segment (I)

(with the possibility of both CEP ports in the Forwarding State)

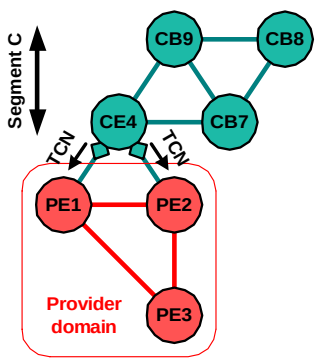


- The CEP ports of CE2 & CE3 are in the Forwarding State
  - Similar case when two CEP ports of two CEs connected to a PE
- C-VLAN Segment B reconfigures
- Segment B generates TCNs (no change in CEP ports' Port States)
- Provider bridges **need to**:
  - Act upon these TCNs as Segment B is dual-homed
  - Flush relevant C-VLAN MAC addresses

Dual-homed C-VLAN segment (II)

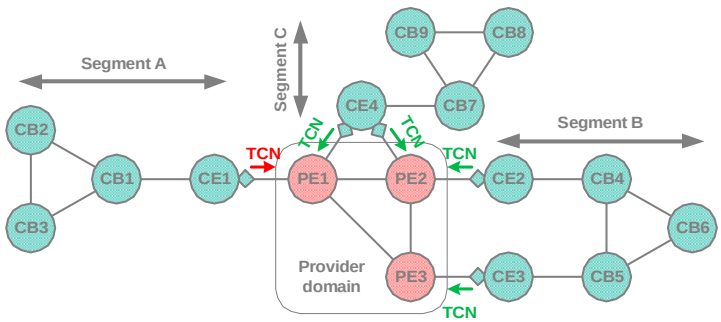
(with/out the possibility of both CEP ports in the Forwarding State)

- Same case as in the previous slide
- Both CEP ports on CE4 are in the Forwarding State
- Segment C reconfigures (no change in CEP ports' Port States)
- Segment C generates TCNs
- Provider domain needs to:
  - Trigger unlearning of Segment C MAC addresses upon these TCNs as Segment C is dual-homed (both CEP ports are in the Forwarding State)
  - Flush relevant C-VLAN MAC addresses



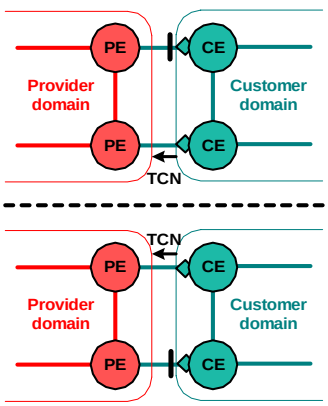
Which TCN to snoop?

- Single homing:
  - Provider bridges **need not snoop** on C-VLAN TCNs and **do not trigger** unlearning
- Dual homing:
  - Provider bridges **need to snoop** on C-VLAN TCNs and **trigger** unlearning



A solution for reduction in unlearning for dual-homed segments

- If the CEP ports in a dual-homed Segment are prevented from being in the Forwarding State simultaneously, a dual-homing case degenerates to a simple single-homing case
- In this case, we need to trigger unlearning in the Provider domain only if a blocked CEP port transits to the Forwarding State
- Thus, by blocking one of the CEP ports in a dual-homed Segment, we avoid the triggering of unlearning in Provider domain as in the case of a single-homed Segment
- This restriction can be realized either manually or automatically



Solution realization

- The CEs can be preconfigured to set/unset a “Snoop” bit in the TCNs to indicate to PEs that they need to be snooped for unlearning
- Thus, CEs can convey the differentiation of TCNs due to **a)** change in their CEP port’s Port State (transiting to Forwarding State) and **b)** a TCN originated somewhere in the C-VLAN Segment not involving CEP ports in C-VLAN RSTP through a “non-intrusive” Snoop bit (no change in the state machine of Customer domain’s RSTP)
  - CEs set the Snoop bit to 0 if any of their CEP ports’ Port State transits to the Forwarding State
  - CEs set the Snoop bit to 1 in TCNs if there is no change in any of their CEP ports’ Port State
- PEs trigger unlearning of the given C-VLAN if the Snoop bit is set to 0
- Default value for Snoop bit is 0
- Bit 8 in RST BPDUs’ “Flags” byte goes unused: is it reusable for this purpose?

Advantages of the Snoop bit approach

- Avoid coordination/signaling between PEs in the case where PEs have to be configured to know which CE-PE links are dual-homed and which are not
- The Snoop bit approach is much faster when compared to the signaling approach for coordination between PEs
- Provider bridges can be totally agnostic to customer’s topology and can avoid large book-keeping tables as the number of C-VLANs increases (scalable)
- Localization of interaction: limited to CEs and PEs

Advantages of the Snoop bit approach (contd.)

- Non-intrusive:
  - No change in the state machine of the Customer RSTP (just an add-on)
- Co-existence with Snoop bit-unaware bridges (default value 0)
  - As a result improvement in terms of unlearning (/broadcast storms) without any harm/change to C-VLANs
- Service differentiation

Summary

- TCNs from a single-homed Segment need not be snooped
- A dual-homed segment can be transformed into a single-homed Segment by restricting that only one of the CEP ports can be in the Forwarding State at any given time
  - This facilitates snooping on TCNs only if a previously-blocked CEP port transits to the Forwarding State
  - Eliminates unlearning due to TCNs generated by the R/STP that does not involve a transition of a CEP port to the Forwarding State
  - This reduces greatly unlearning in Provider domain
- A Snoop bit is proposed in the Customer TCNs across CE-PE links
- Set/unset by CEs in the TCNs
- PEs decide whether to trigger unlearning or not in the Provider domain based on the Snoop bit in the TCNs received from CEs

Thank you!