Scalable BGP FRR Protection Against Edge Node Failure

draft-bashandy-bgp-edge-node-frr-02

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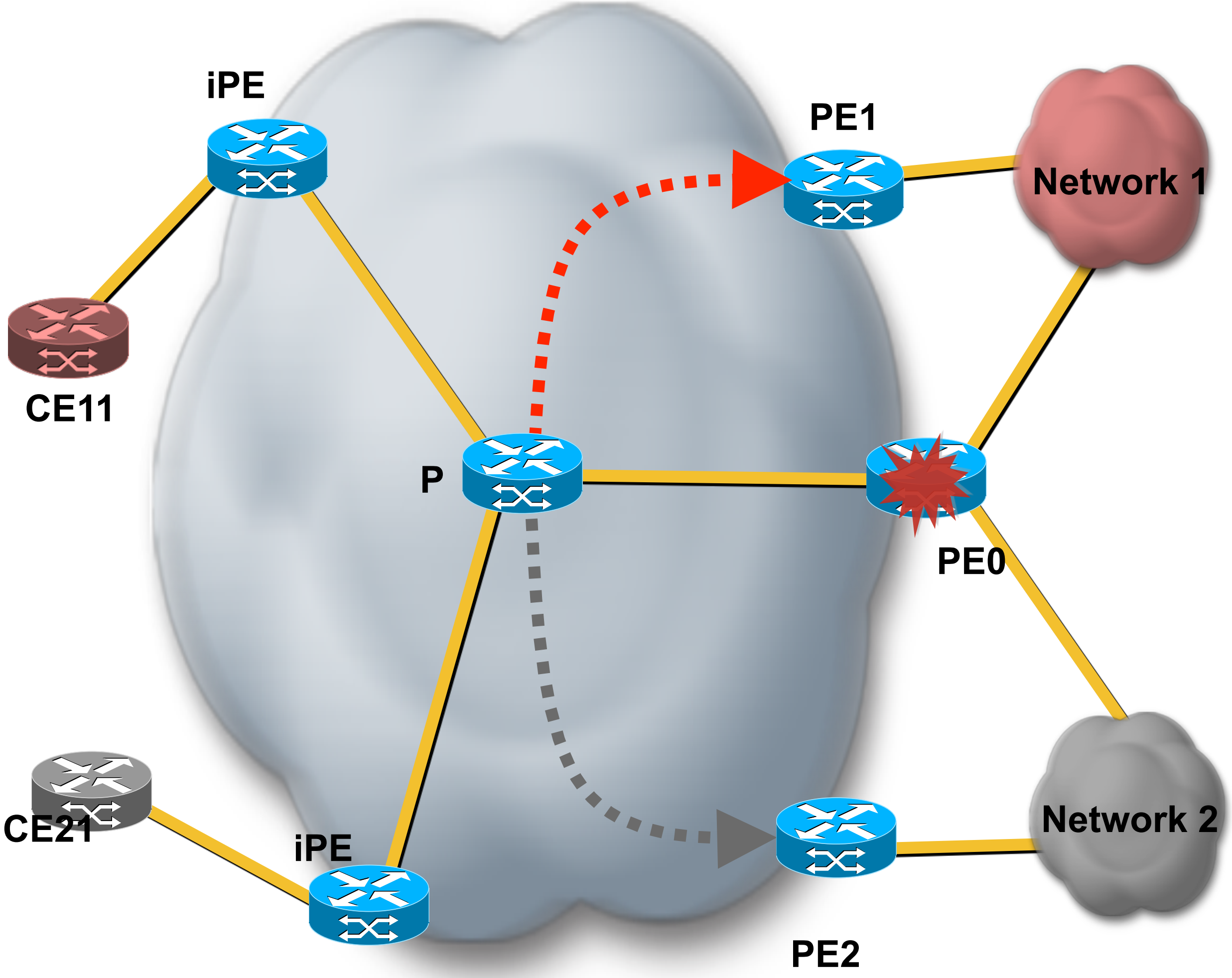
Agenda

- Problem and requirement
- Proposed Solution

Problem



- PE0 is primary for both **Red** and **Gray**.
- PE0 *fails* !!
- P router redirects traffic to the ***correct*** repair PE
  - PE1 for **Red**
  - PE2 for **Gray**
- Correct ***BGP label*** must exist for correct forwarding on repair PE

What we are trying to Achieve

- Packet must be forwarded to correct repair PE on primary PE failure
- Correct BGP label must be pushed when repairing
- Core remains BGP free
- Minimal provisioning
- Loop-free during repair

Control Plane Steps

1. Choose the repair PE
2. Assign and Advertise the next-hop for protected prefixes
3. Inform repairing core routers about primary to repair path mapping
4. Programming the forwarding plane on the repairing routers

Control Plane (1): Choosing repair PE

- Each PE that has an external path to a prefix P/m also chooses a repair PE
  - Any other PE that advertises an external path to P/m
  - The other PE MAY also advertises a ***repair label (rL)***
    - Optional non-transitive as in `draft-bashandy-idr-bgp-repair-label`
    - Same semantics as `draft-bashandy-idr-bgp-repair-label`
      - Either send the packet out or drop it
    - MUST Be Per-CE or Per-VRF
      - To keep the core ***BGP-free***
      - Needed for ***good*** attribute packing

Control Plane (2): Next-hop for P/m

- A PE now has a repair PE and possibly repair label for a protected prefix
- ***Group*** prefixes as follows:
  - Prefixes without repair labels
    - Two prefixes belong to the same group Gi if they share the same repair PE
  - Prefixes with repair label
    - Two prefixes belong to the same group Gi if they share the same repair PE and repair label
- Assign each a group ***Gi*** a separate protected next-hop ***pNHi***
  - Can be assign from a range
  - pNHi must be unique within a core: must not collide with other next-hops
- Advertising the pNHi to iBGP peers
  - May be the next-hop attribute of BGP: Good for backward compatibility
  - Can be optional non-transitive attribute: Less churn but requires ingress PEs to understand it

Control Plane (3): Informing Core Routers

- Egress PE needs to inform core routers about repair info: pNH, rNH, and rL
  - pNH s advertised into IGP
  - rNH is an IP address for the repair PE→ it is advertised into IGP as usual
  - What is left is mapping of ***pNH*** to ***rNH*** and ***rL***
- If there is <u>no</u> repair label ***rL***
  - Advertise the pair *(pNH,rNH)* to repairing routers (e.g. through optional LDP or ISIS TLV)
  - The <u>semantics</u> of *(pNH,rNH)* is

    *If the next-hop pNH becomes unreachable, then traffic tunneled to the next-hop pNH SHOULD be immediately **<u>re-tunneled</u>** to **rNH**, **without <u>waiting</u> for IGP or BGP to <u>re-converge</u>**, because **rNH** can reach protected prefixes reachable via pNH.*
- If there is a repair label ***rL***
  - Advertise the quadruple *(pNH,rNH, rL, Push)* to repairing routers (e.g. through optional LDP or ISIS TLV)
  - The <u>semantics</u> the quadruple *(pNH,rNH, rL,Push)* is

    1. If the next-hop ***pNH*** becomes unreachable, then traffic tunneled to the next-hop ***pNH*** SHOULD be immediately ***<u>re-tunneled</u>*** to ***rNH*** , ***without <u>waiting</u> for IGP or BGP to <u>re-converge</u>***, because ***rNH*** can reach protected prefixes reachable via ***pNH***.
    2. If the ***Push*** flag is <u>cleared</u>, the label underneath the tunnel encapsulation PE MUST be <u>swapped</u> with the label ***rL*** before re-tunneling to the repair PE, *<u>irrespective</u>* of the value of the label below the tunnel encapsulation.
    3. If the ***Push*** flag is set, then the label ***rL*** MUST be pushed on the packet before re-tunneling to the repair PE*.

Control Plane (4): FIB in Core routers

- Assume pNH matches the IGP router pR
- Thus the FIB entry for pR is programmed as follows
  - Primary path: Next hop router on the path towards pNH
  - Repair path when the candidate repair router receives the pair *(pNH,rNH)*
    - Next-router on the path towards rNH
  - Repair path when the candidate repair router receives the quadruple *(pNH,rNH,rL,Push)*
    - Primary path: Next router on the path towards pNH
    - Repair path:
      - Next router towards rNH but with additional semantics
      - If the "***Push***" flag is cleared
        - » Pop label in the packet right under the tunnel header (irrespective of the value of that label)
      - EndIf
      - Push the underlying repair label ***rL***

Forwarding Plane on Repairing Router on Failure

- The repairing P router detects that pNH is no longer reachable

1. Decapsulate the tunnel header to expose the tunneled packet
2. If the underlying repair label ***rL*** is programmed in the forwarding plane
   1. If the "***Push***" flag is set

      Push the underlying repair label ***rL***
   2. Else

      Swap the label under the tunnel encapsulation (irrespective of the value of that label) with the underlying repair label ***rL***
3. Tunnel the packet towards rNH

Q & A