Graceful/Hitless restart of Routing Protocols

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Why does control plane restart?

- Due to control plane software upgrades
  - aka “planned restart”
- Due to control plane software bugs
  - aka “unplanned restart”

Both exist in the real life -> need a solution that handles both !!!
Impact of control plane restart - current situation

- Disrupt services by disrupting data path used by the services on the restarting node

- Control plane restart on PE is especially disruptive
  - As all the VPN sites that have connectivity just to that PE loose connectivity to other VPN sites
  - Disruption lasts as long as it takes for the PE to restart and to reacquire all the routing information
    - Both from other routers within the service provider network (both PEs and Ps) as well as from the directly connected CEs
Impact of control plane restart - current situation (cont.)

- Also disrupt services due to transient forwarding loops that could happen during routing convergence in response to control plane restart
  - Disruption happens twice: once when the control plane goes down, and once when the control plane comes back
  - Disruption involves multiple nodes, not just the node whose control plane restarts
    - The scope of the affected nodes is hard to predict (other than providing the worst case scenario)
  - Disruption lasts for as long as it takes routing to converge
    - The time it takes routing to converge is hard to predict
      - Because the scope of the nodes that have to converge is hard to predict (other than providing the worst case scenario)

⇒ The scope and the duration of the disruption is hard to predict (other than providing the worst case scenario)
Impact of control plane restart - current situation (cont.)

- Increases the load on the control plane
  - Involves multiple nodes, not just the node whose control plane restarts
    - The scope of the affected nodes is hard to predict (other than providing the worst case scenario)
  - Adversely impacts the scalability of the control plane
  - Adversely impacts the adaptability and convergence of the control plane

Bottom line: control plane restart adversely impacts service availability !!!
Graceful Restart - objectives:

- Improve service availability by minimize disruption of services (e.g., 2547 VPNs, L2 VPNs, VPLS, Internet, etc...) due to the control plane restarts.

- Restart could happen anywhere in the network that delivers the service:
  - Either at the edge (PE), or in the middle (P).

- Handle either planned (e.g., control plane software upgrade), or unplanned (control plane crash) restart.
Graceful Restart - How?

Separate control and data planes

If router’s control plane fails, data plane can keep forwarding packets

Neighbors hide failure from all others routers in the network

When router recovers, neighbors sync up without disturbing forwarding.

Other routers are never made aware of failure
Graceful Restart - How? (cont.)

- On the restarting node separate control component from forwarding component:
  - e.g., RE - control component (control plane)
  - e.g., PFE - forwarding component (forwarding state)

- On the restarting node preserve the forwarding state (forwarding component) across the restart of the control plane (control component)

- Localize the knowledge that the node’s control plane restarts to only the routing peers of the restarting node

- On the routing peers of the restarting node preserve routing information associated/received from the restarting node across the restart of the control plane of the restarting node

- Restarting node (re)learns its routing information from its routing peers
Graceful Restart - How? (cont.)

- Graceful restart mechanisms are protocol specific:
  - BGP – see draft-ietf-idr-restart-10.txt
  - ISIS – RFC 3847
  - OSPF – RFC 3623
  - LDP – RFC 3478
  - BGP/MPLS – see draft-ietf-mpls-bgp-mpls-restart-05.txt
  - RSVP – draft-ietf-mpls-generalized-rsvp-te-09.txt
  - RIP – already build in !!!

- No preservation of any of the protocol-related state across the restart on the restarting node
  - For all of the above protocols !!!
Graceful Restart – results:

- No disruption in the data path on the restarting node
  - Due to restarting node preserving its forwarding component

- No disruption in the data path on the routing peers of the restarting node
  - Due to the routing peers of the restarting node preserving routing information associated/received from the restarting node across the restart of the control plane of the restarting node
    - Implies that the routing peers don’t modify their forwarding state in response to the restart of the control plane of the restarting node

- No disruption of the data path elsewhere
  - Due to nodes other than the routing peers of the restarting node being unaware of the restart of the control plane of the restarting node
Graceful restart – results (cont.):

- No change in the traffic pattern
  - preserves steady state traffic pattern
  - no impact on jitter, latency, packet ordering, route optimality

- Improved control plane scalability
  - By limiting the scope of the nodes that are aware of the restart to only the routing peers of the restarting node

- Improved control plane convergence/adaptability
  - By limiting the scope of the nodes that are aware of the restart to only the routing peers of the restarting node
Thank You

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