Tunnel Segment in Segment Routing

draft-li-spring-tunnel-segment-01

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IETF 95, Buenos Aires, Argentina

Background

- draft-ietf-spring-segment-routing-07 specifies the Segment Routing architecture. A packet can be steered through an ordered list of instructions, which are also called segments.
- Multiple types of segments:
  - IGP segment: node segment, adjacency segment, etc.
  - BGP Peering segment
  - LDP LSP segment
  - RSVP-TE LSP segment
  - BGP LSP segment

Binding Segment

- Mapping Server
  - A Remote-Binding SID S advertised by the mapping server M for remote prefix R attached to non-SR-capable node N signals the same information as if N had advertised S as a Prefix-SID.
- Tunnel Headend
  - The Remote-Binding SID allows to advertise the presence of a tunnel.

Introduction

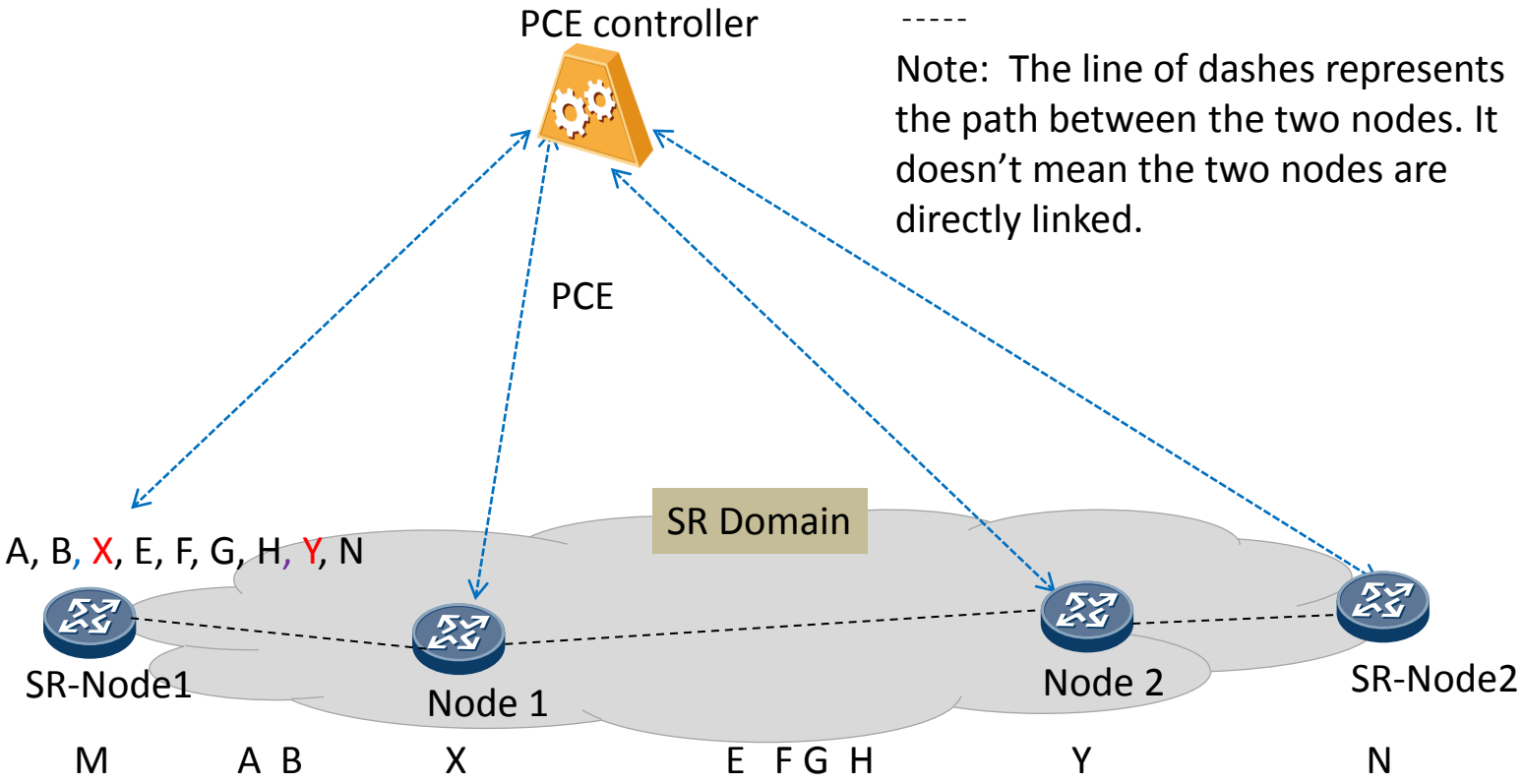
- draft-li-spring-tunnel-segment-01 introduces a new type of segment, Tunnel Segment, for the segment routing.
- Tunnel segment can be used to reduce SID stack depth of SR path, span the non-SR domain or provide differentiated services.
- The tunnel segment can be
  - MPLS RSVP-TE tunnel(with primary and secondary LSP)
  - SR-TE tunnel (with primary and secondary path)
  - IP Tunnel
- Forwarding mechanisms and requirements of control plane and data models for tunnel segments are also defined

Use Case 1: Reducing SID Stack Depth

- SR-TE path from SR-Node-1(ingress) to SR-Node-2(egress).

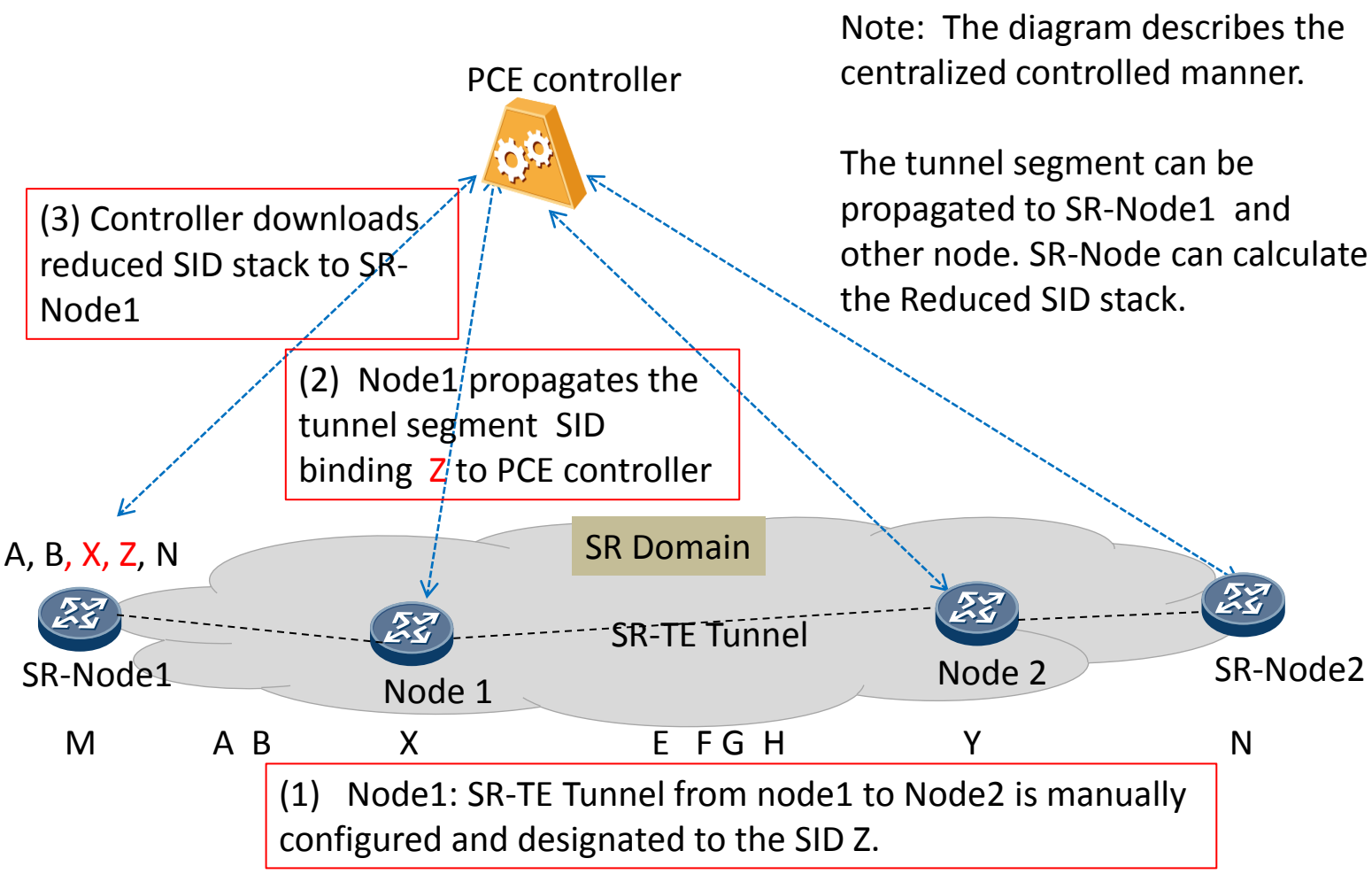
original SID stack: { A, B, X, E, F, G, H, Y, N}

- Too overwhelming for the path MSD(Maximum Segment ID Depth)



Use Case 1: Reducing SID Stack Depth

- The tunnel from Node 1 to Node 2 can be represented by a dedicated SID, saying Z.
- Reduced SID stack: {A, B, X, Z, N}.



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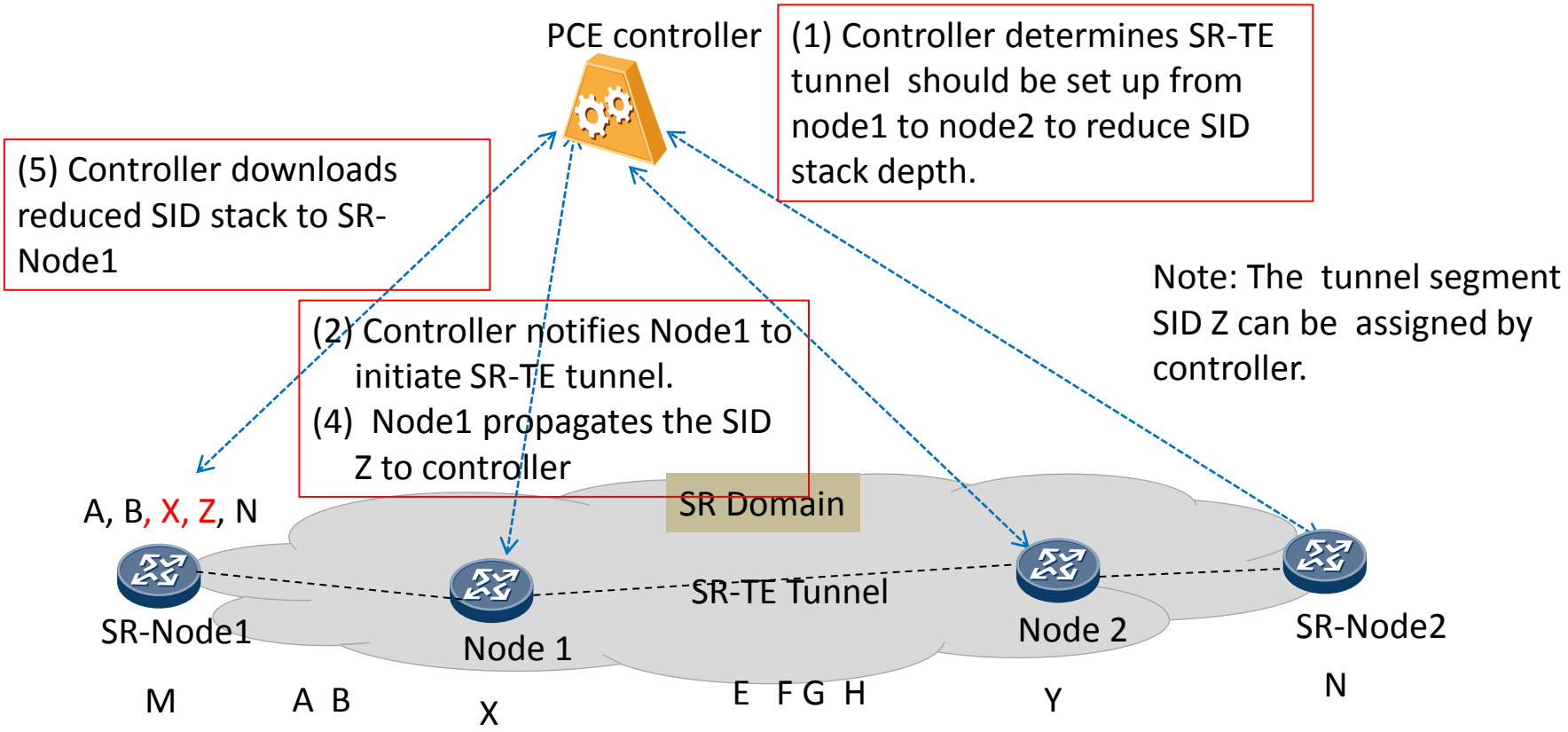
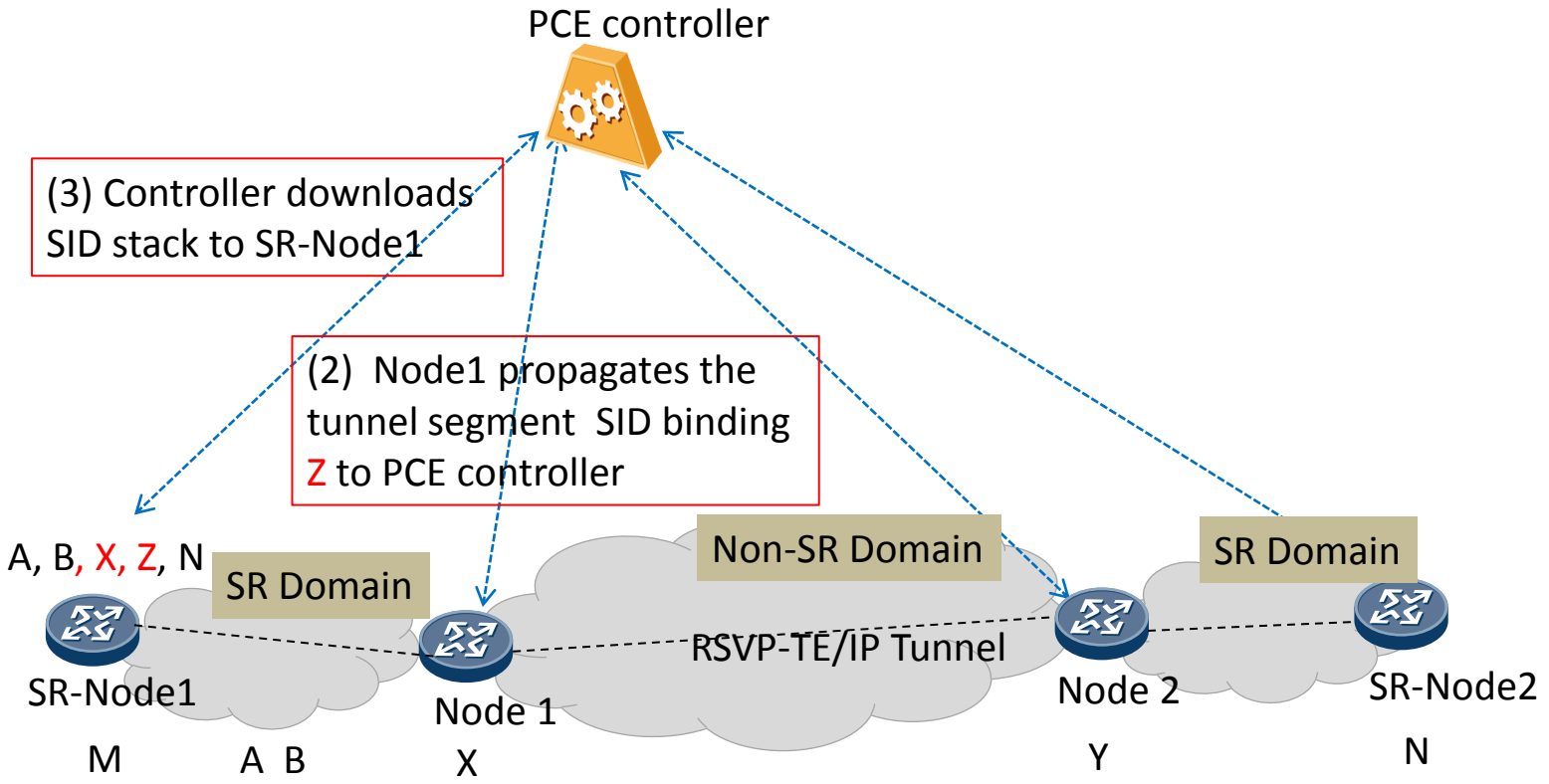


Use Case 2: Passing through Non-SR Domain

- Traffic from SR-Node 1 to SR-Node 2 has to pass through a traditional IP/MPLS network. A RSVP-TE tunnel or IP tunnel will be created between two border nodes. Allocating SID for the tunnel, saying Z.
- SID stack: {A, B, X, Z, N}.



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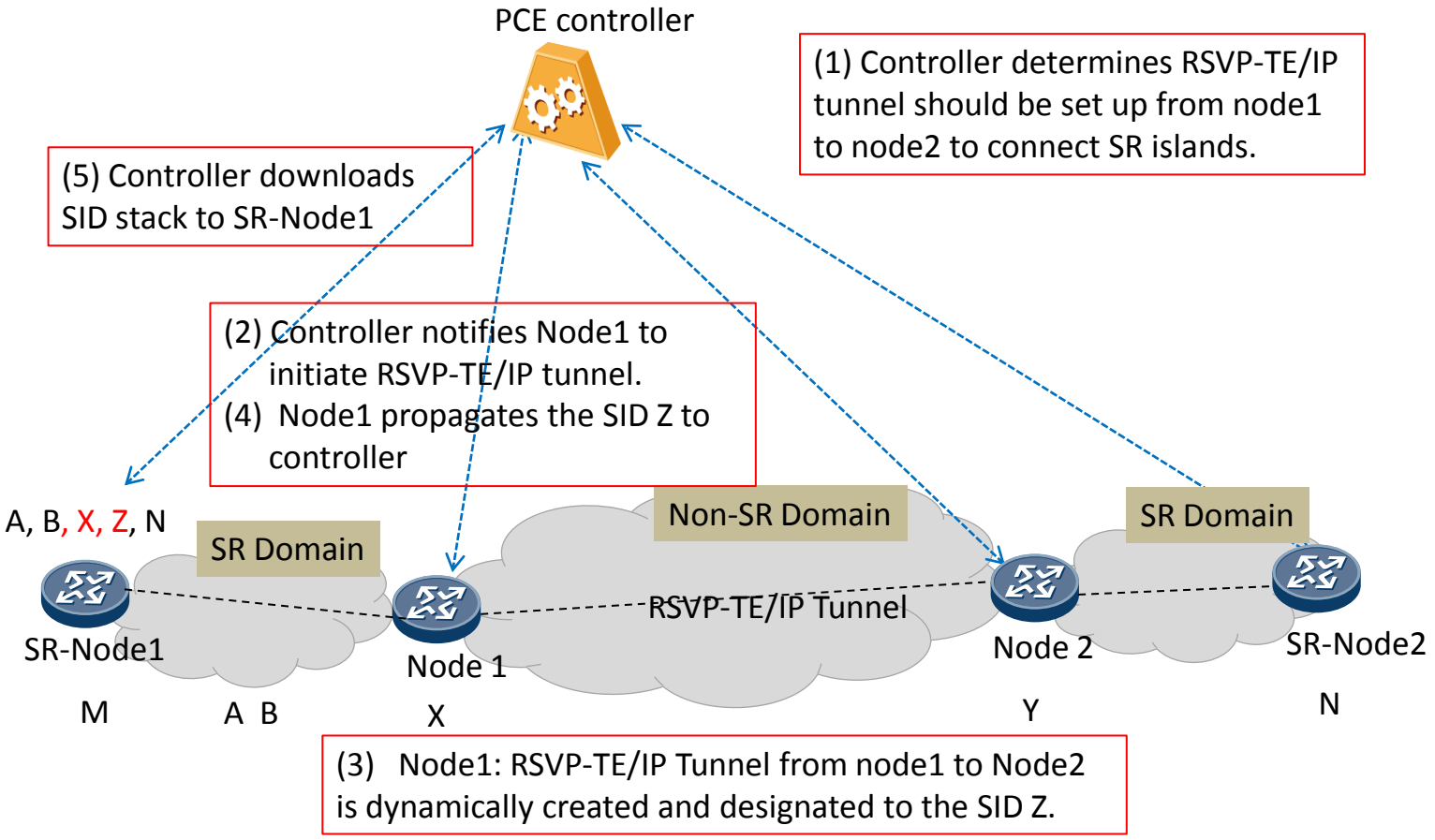
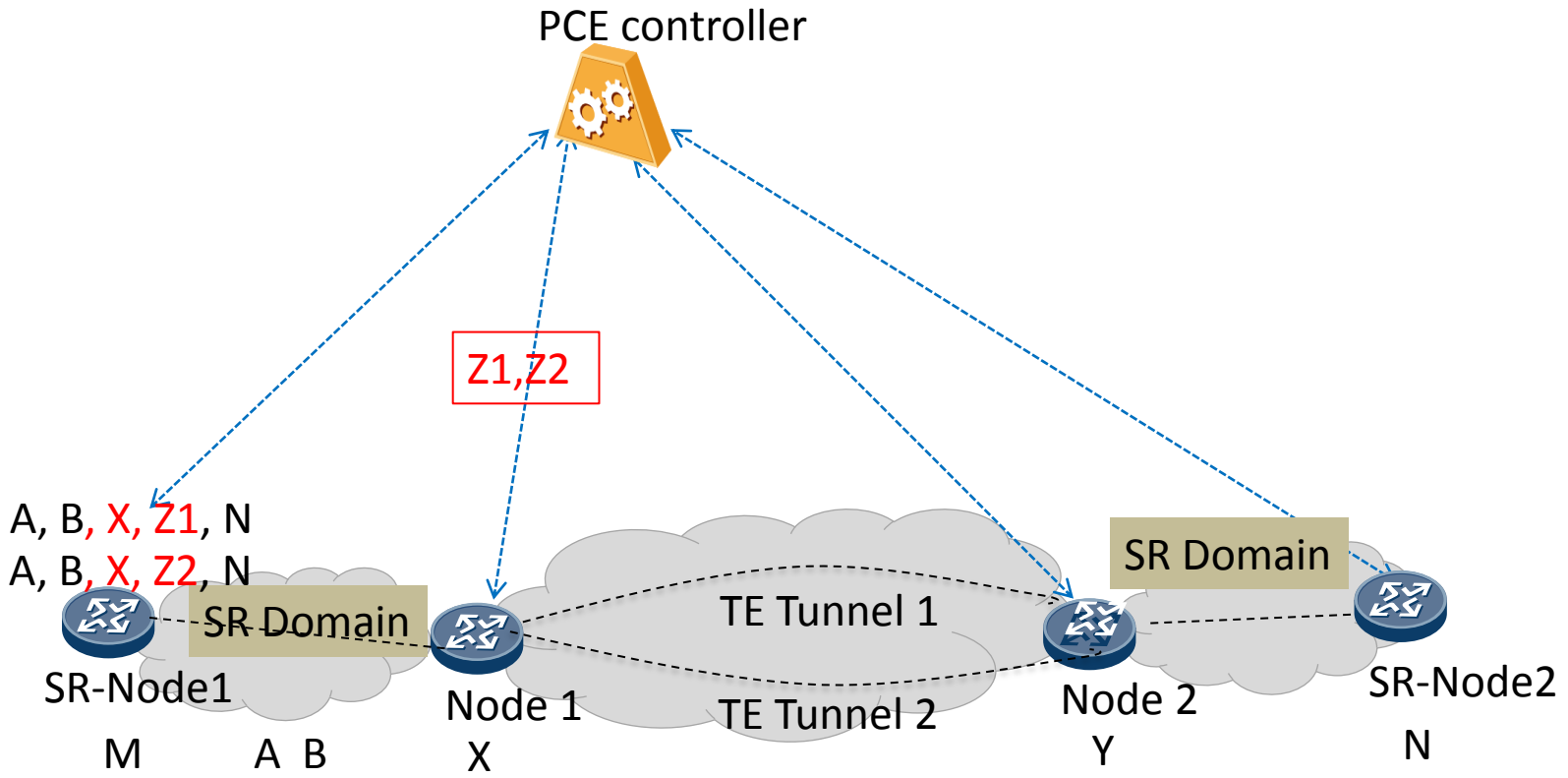


Use Case 3: Differentiated Services

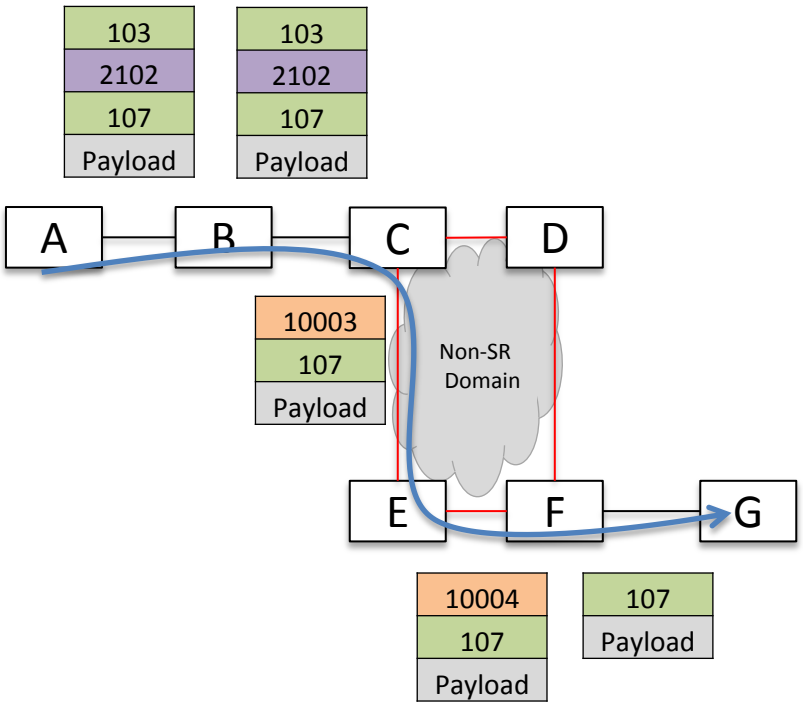
- Multiple tunnels between the same pair of border nodes to support different services. The tunnels maybe have the same path. Different SIDs have to be assigned per tunnel.
- SR path can choose different SIDs at ingress according to the service requirement when passing between gateway nodes.



Forwarding mechanism for Tunnel Segment

- Tunnel segment SID mapping to tunnel forwarding entry
- Forwarding diagram for tunnel segment in the use case of end-to-end SR path passing through non-SR domain

SR-TE Path from A to G



The SID of node segments and tunnel segments

Node Segment	SID
A	1
B	2
C	3
D	4
E	5
F	6
G	7

Tunnel Segment of C	SID
C-D-F	2001
C-E-F	2002

Note: SRGB: (100, 9100)

RSVP-TE Tunnel per-hop labels

C-D-F	D	F
	10001	10002

C-E-F	E	F
	10003	10004

Comparison with Adjacency Segment

	Tunnel Segment	Adjacency Segment (Tunnel as forwarding adjacency)
Need carrying tunnel IP address	X	√
Carrying more tunnel information such as bandwidth, explicit path which will be helpful for SR-capable nodes to know the detail of an explicit path that passes through non-SR networks.	√	X
Influencing the LSDB and the SPF computation.	X	√

Comparison with LSP Segment

	Tunnel Segment	LSP Segment
IGP extension	1)When LSP or path changes the tunnel segment needn't be advertised again. 2)Support tunnel type: • RSVP-TE tunnel with primary LSP and secondary LSP •Support SR-TE tunnel with primary LSP and secondary LSP •Support IP tunnel 3)Carry Information: Tunnel Identifier Tunnel Attribute	1)Support RSVP-TE LSP 2)Carry LSP Attributes such as Primary LSP ERO/ Secondary ERO with binding SID. 3)When LSP or path changes the new path will be advertised.
PCEP extension		1)Support RSVP-TE LSP / SR-TE path 2)May carry LSP identifier with binding SID.

Relationship to Binding Segment

Tunnel headend is typical application of binding segment. Just like LSP segment tunnel segment can be implemented by binding segment.

1)IGP

- IGP has SID/Label Binding TLV to carry SID/Label Binding sub-TLV and LSP attribute related sub TLV now.
- IGP can extend to carry tunnel related sub TLV which will be more stable and not frequently advertised because of the changed path.
  - Tunnel Identifier
  - Tunnel Attribute

2)PCEP

- PCEP extends to carry tunnel related Object and TLV.
  - Tunnel Identifier
  - Tunnel Attribute
- PCEP need to extend to carry SID binding Object or TLV.

Requirement of Control Plane

Description	Extension
IGP extensions SHOULD be introduced to advertise the binding relationship between a SID/label and the corresponding tunnel. Attributes of the tunnel MAY be carried optionally.	Based on SID/Label Binding TLV. Extend tunnel-related sub TLV.
BGP Link-State extension SHOULD be introduced to advertise the binding relationship between a label and the corresponding tunnel. Attributes of the tunnel MAY be carried optionally.	Refer to IGP extension
PCEP extensions SHOULD be introduced to advertise the binding relationship between a SID/label and the corresponding tunnel from a PCC to a PCE. Attributes of the tunnel MAY be carried optionally.	draft-li-pce-tunnel-segment-01. Based on Tunnel-related TLV add SR-TE and RSVP-TE tunnel type.
PCE SHOULD support initiated IP tunnel.	draft-chen-pce-pce-initiated-ip-tunnel-00. Tunnel-related TLV defined here.
PCE SHOULD support to allocate SID/label for the corresponding tunnel dynamically.	draft-li-pce-tunnel-segment-01. How PCE allocated is not defined.
PCEP extensions SHOULD be introduced to distribute the binding relationship between a SID/label and the corresponding tunnel from a PCE to a PCC. Attributes of the tunnel MAY be carried optionally.	draft-li-pce-tunnel-segment-01

Next Steps

- Solicit comments and cooperation.
- Revise the draft.