MPLS+SDN
+NFVWORLD
→PARIS2017

The critical role of Maximum SID Depth (MSD) hardware limitations in Segment Routing ecosystem and how to work around those

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Vocabulary

- MSD – Maximum SID Depth
  - Generic concept defining number of SID's, HW/SW are capable of imposing on a given node
  - Applicable to both, SR-MPLS (labels) and SRv6 (SRH's) data planes
    - Focus of this presentation is SR-MPLS data plane

- SR-MPLS
  - SID instantiated as an MPLS label, context set by the label value
  - Path (LSP) is usually computed by a centralized entity, commonly known as PCE/SDNc
  - PCEP with SR extensions is a commonly used protocol to communicate the path to the ingress
  - MPLS label stack defines at the **ingress** the path a packet will take thru the network
  - Other actions could be defined and applied as packet traverses the network:
    - Apply a service
    - Treat a packet in a special way
    - Set context
    - …

Short SR-MPLS recap – SID types

- Prefix SID
  - Uses SR Global Block (SRGB), must be unique within the routing domain
  - SRGB(‘s) is advertised by an IGP
  - Prefix-SID can be configured as an absolute value or an index

- Node SID
  - Node SID is a prefix SID with ‘N’ (node) bit set, it is associated with a host prefix (/32 or /128) that identifies the node, more than 1 Node SID’s per node can be configured (think router-id)

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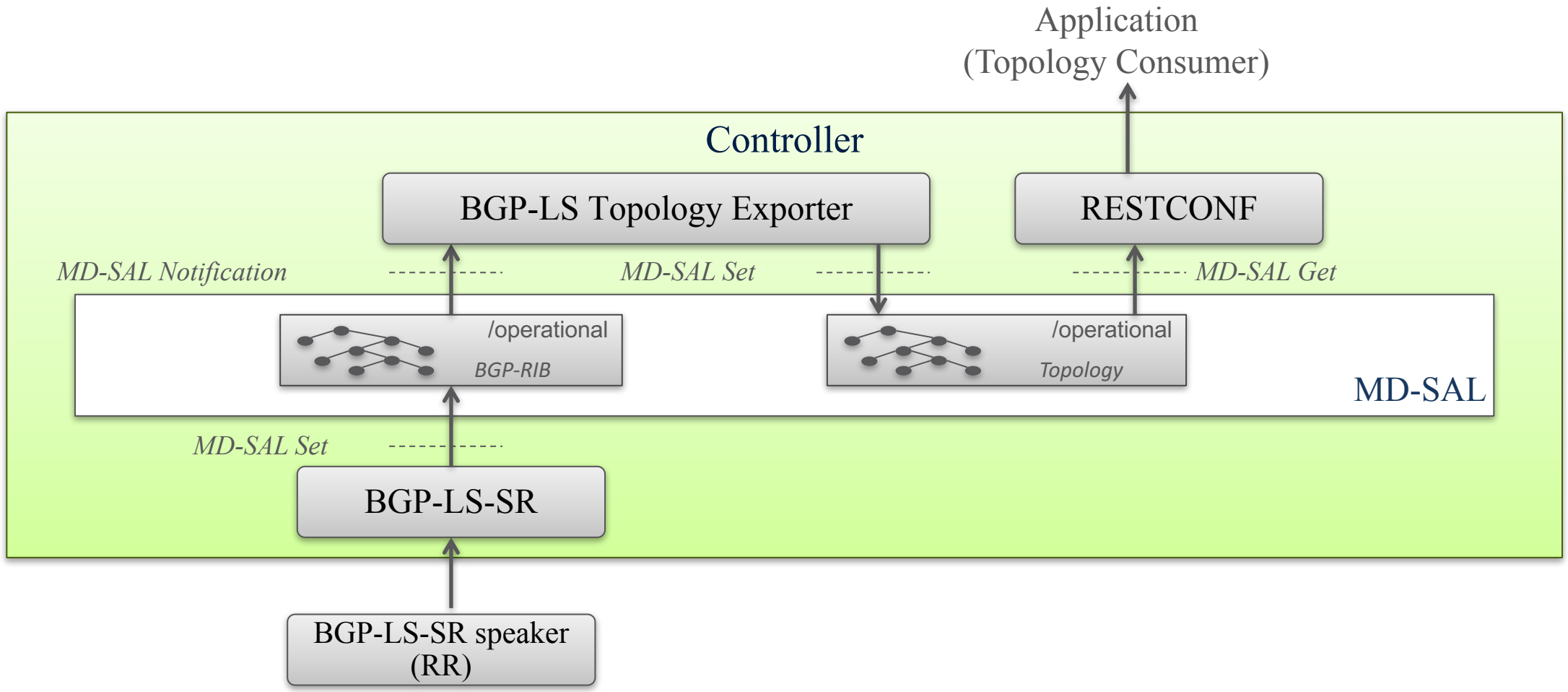
Short SR-MPLS recap – SID types

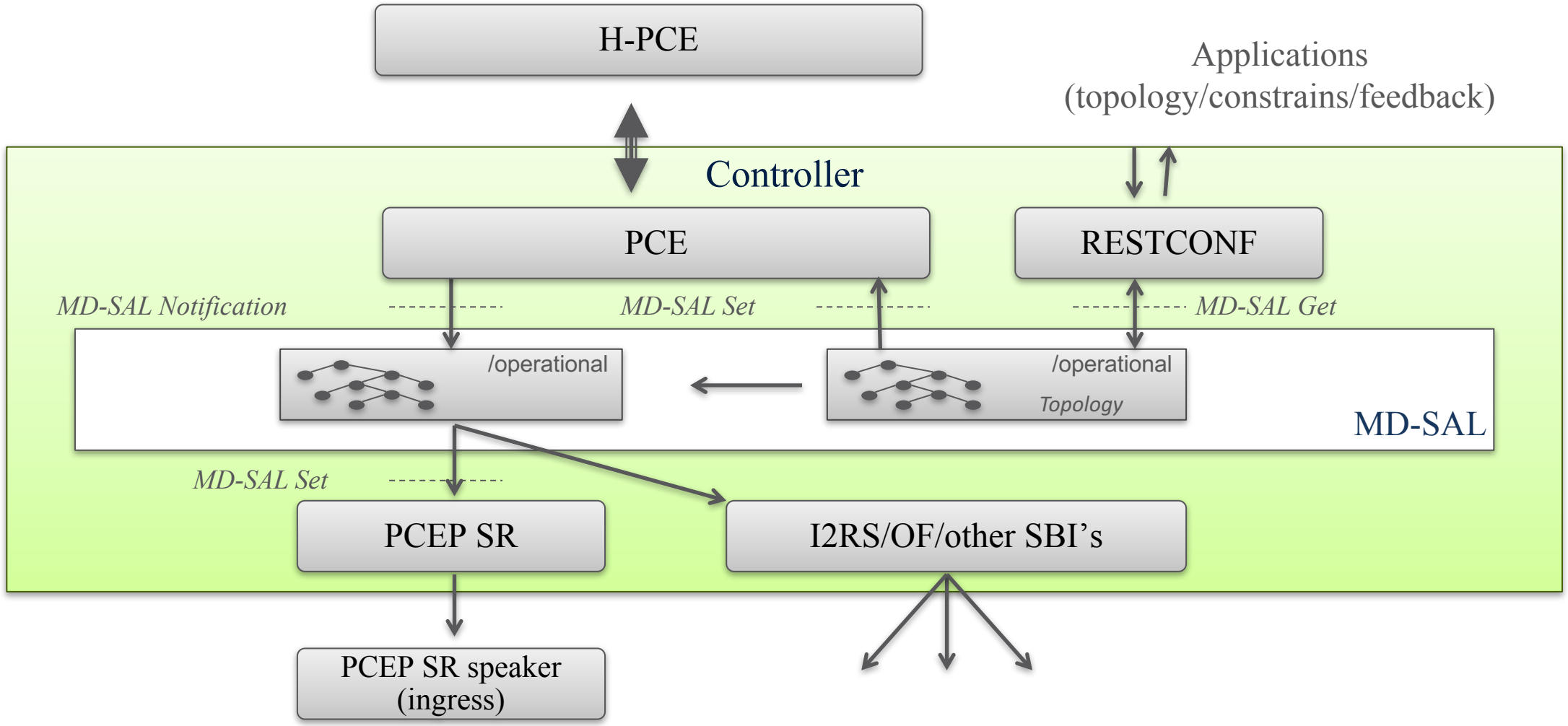
- Adjacency SID
  - Locally significant in most implementations– can be made globally significant thru ‘L’ flag
  - Identifies unidirectional adjacency
  - In most implementations automatically allocated for each adjacency
  - Always encoded as an absolute (not indexed) value

- Binding SID
  - Can be originated by any SR capable device in a SR domain
  - Can be used to instantiate a new label stack at the SID originating node (anchor), hence splitting end2end path into number of sub-paths

SR in SDN world – topology acquisition



SR in SDN world – SID stack provisioning



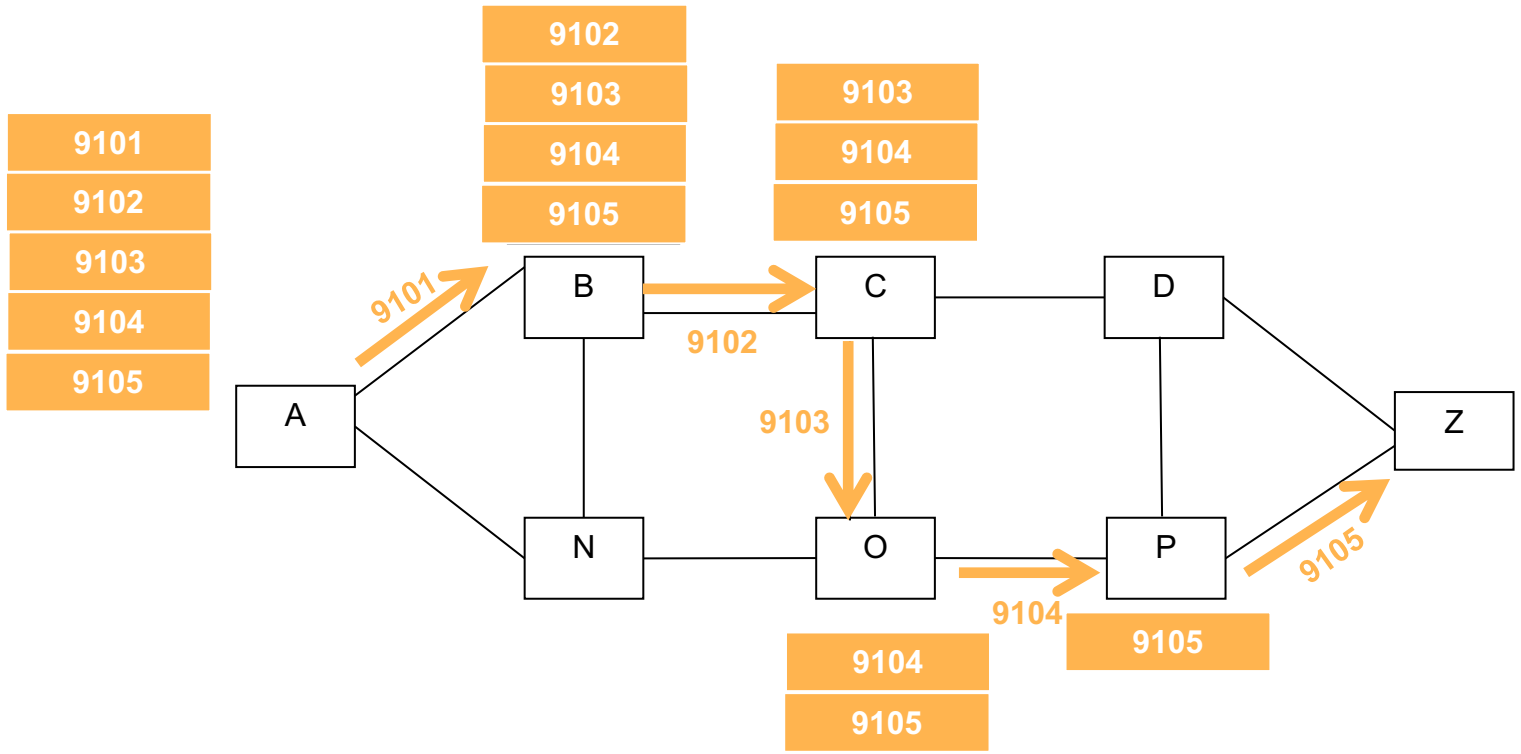
What's the problem?

- MSD supported by different HW/SW differs widely :
  - Linux (kernel 4.10): 2 SID's
  - Low end merchant silicon: 3-5 SID's
  - High end merchant silicon: 4-7 SID's
  - Proprietary silicon: 4-10+ SID's

- If SID stack > MSD at ingress node
  - Best case:
    - Service can't be provided
  - Worse case:
    - Packet will get dropped somewhere in the network

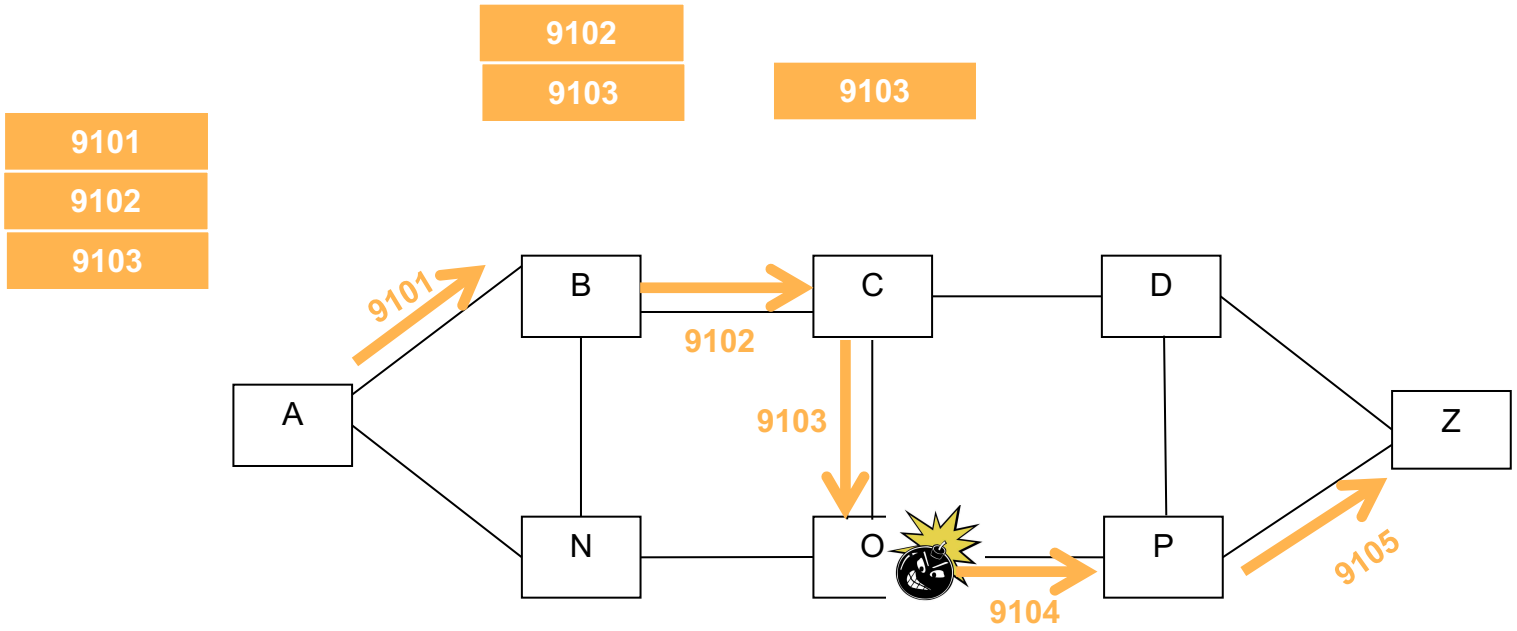
A path with Adjacency SID's (strict encoding)
MSD =>5

› Source routing along an explicit labeled path



A path with Adjacency SID's (strict encoding)
MSD == 3

› Source routing along an explicit labeled path



Possible solutions:
Control plane is the right place to start!

- SID stack compression
  - Efficient path computation algorithms
    - Compressed SID stack that meets MSD limitations
- SID stack expansion
  - Instantiate a new SID stack at the node, within ingress's MSD limits
    - Signaled thru Binding SID

Possible solutions:
SID stack compression

- SR-LEA
  - SR paths Label Encoding Algorithm
- SR-LEA-A
  - SR paths Label Encoding Algorithm with global Adj-SID's

Label Encoding Algorithm for MPLS Segment Routing

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http://ieeexplore.ieee.org/document/7778603/

Possible solutions:
SID stack compression

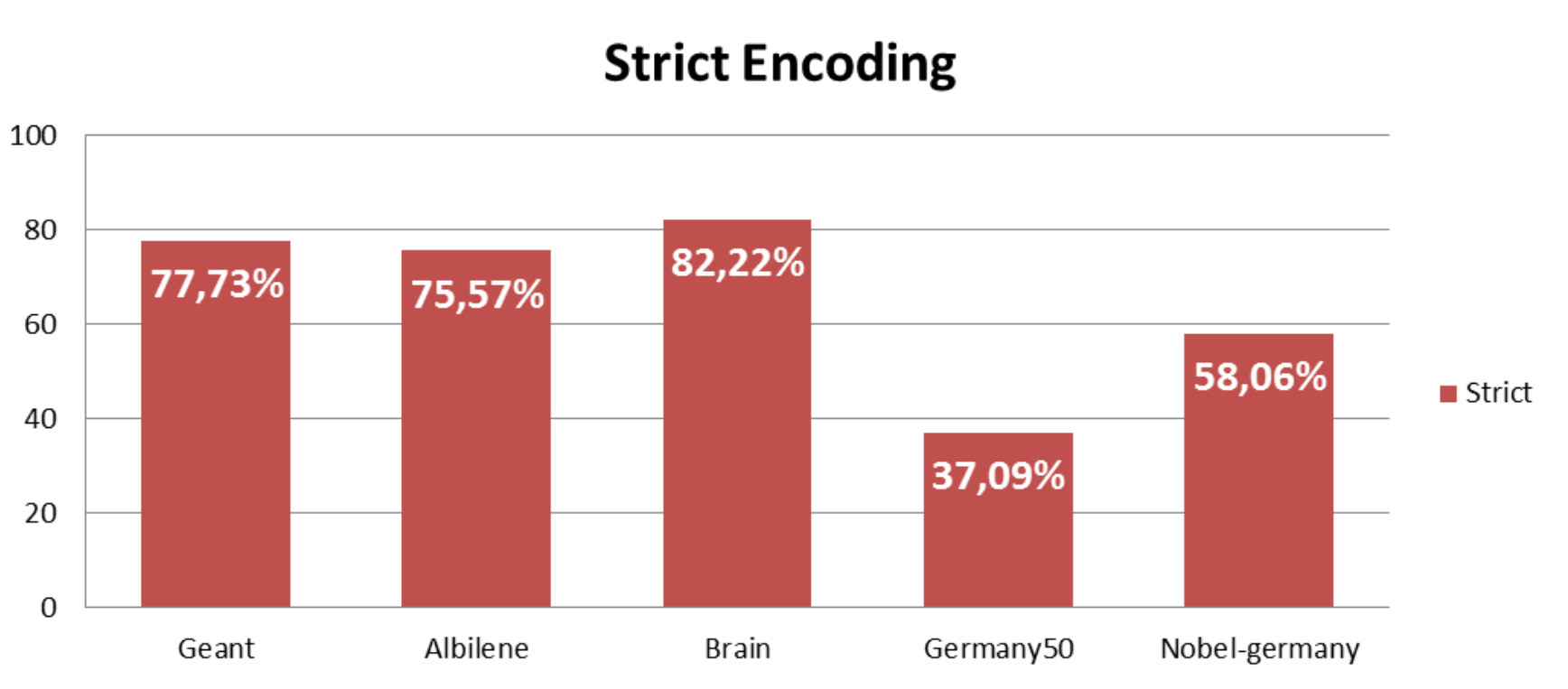
- Analysis based on topologies available from Network Design Library
  - The result is the optimal set of paths to satisfy the demand matrix
    - V: the number of nodes
    - E: the number of links
    - D: number of demands in the demand matrix

Topology	V	E	D
Geant	22	36	431
Albilene	12	18	131
Brain	161	166	9045
Germany50	50	80	1270
Nobel-germany	17	26	248

Possible solutions:
SID stack compression

› Analysis based on topologies available from Network Design Library

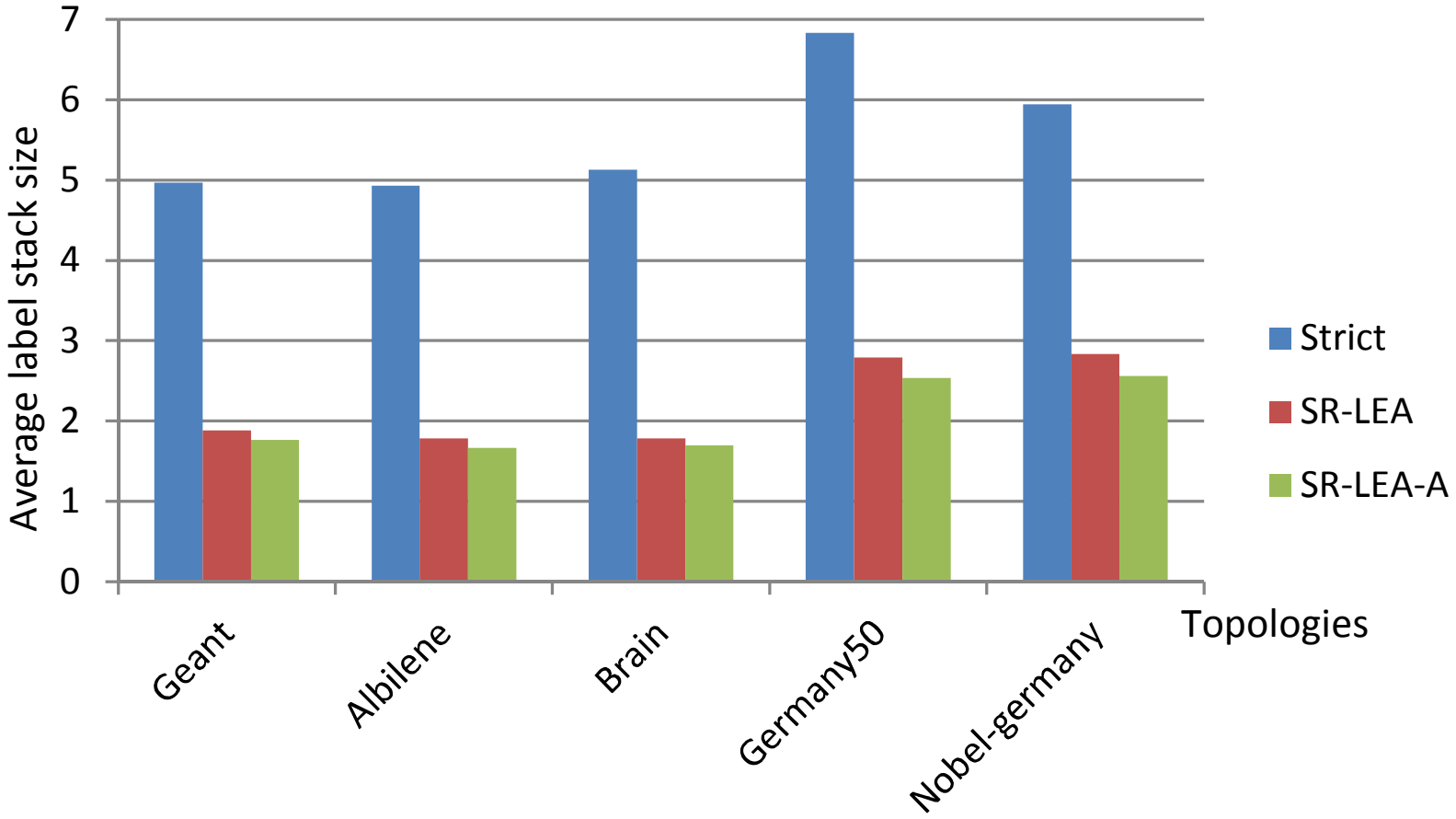
› % of usable paths satisfying service requests with MSD == 5



Possible solutions:
SID stack compression

› Analysis based on topologies available from Network Design Library

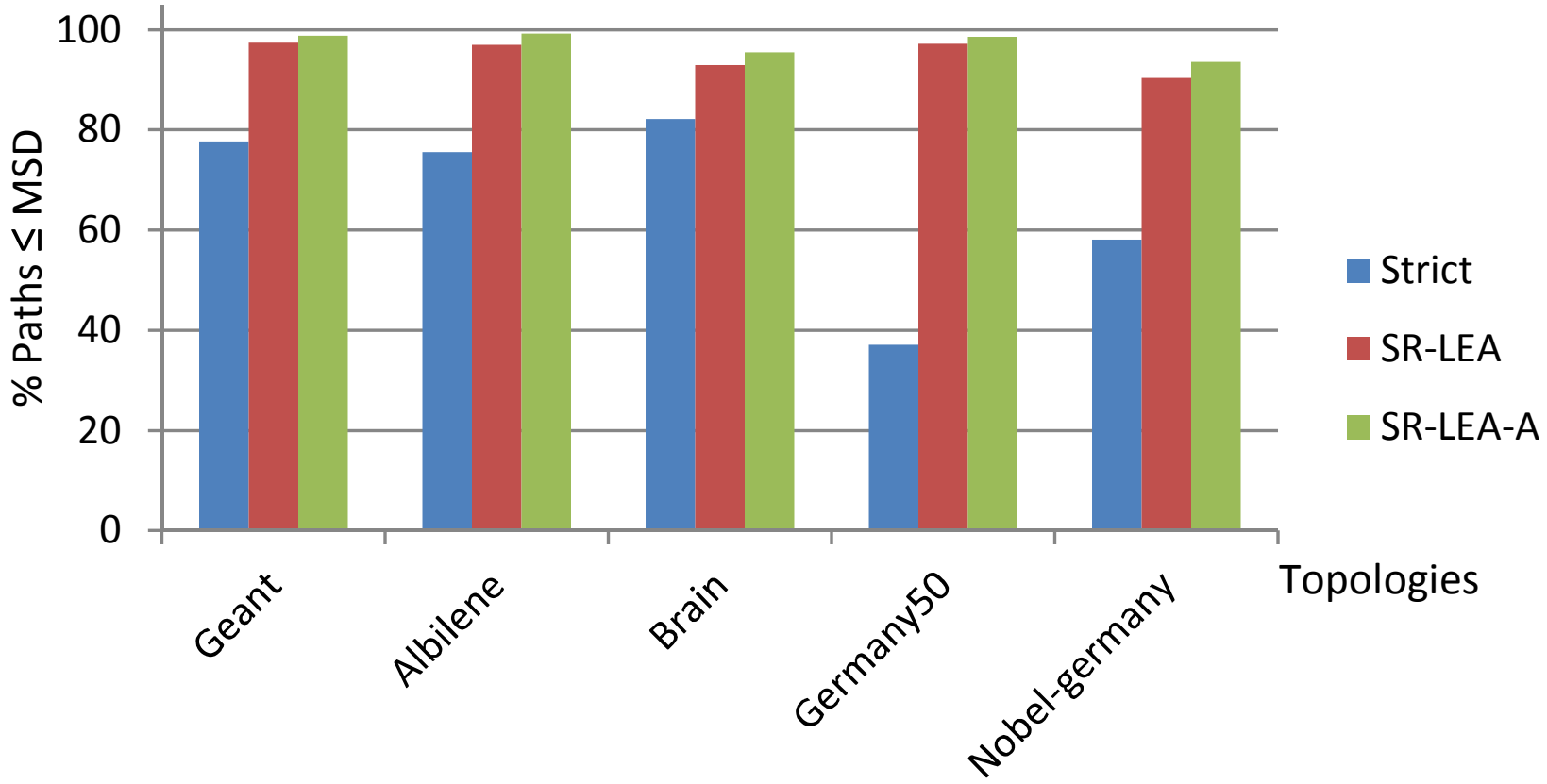
› Average SID stack satisfying service requests



Possible solutions:
SID stack compression

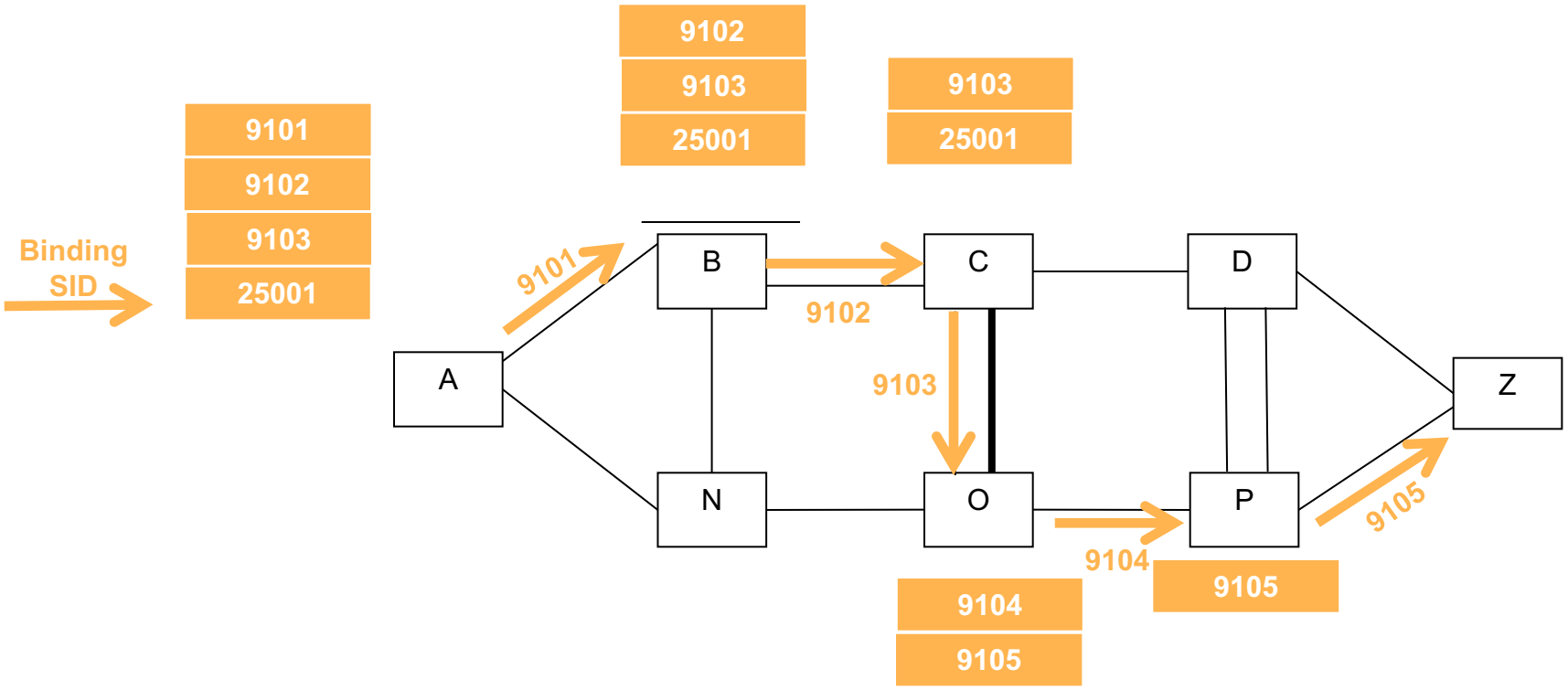
› Analysis based on topologies available from Network Design Library

› % of usable paths satisfying service requests with and without compression



Possible solutions:
SID stack expansion, MSD == 3

- Node O (anchor for Binding SID 25001) expands 25001 into new SID stack {9104,9105}



Signaling

- MSD
  - OSPF
    - draft-ietf-ospf-segment-routing-msd
  - ISIS
    - draft-ietf-isis-segment-routing-msd
  - BGP-LS
    - draft-tantsura-idr-bgp-ls-segment-routing-msd

- PCEP
  - Binding SID setup
    - draft-sivabalan-pce-binding-label-sid

Conclusions

- HW limitations are impairing service agility
  - TTM for a new ASIC is around 2 years
- Innovation in SW provides tangible results
  - Work in IETF ensures - the solution is technically sound and can interoperate
- Get your vendors to implement it ☺

Questions

Thank you!