

# Preferred Path Routing (PPR) in IGPs

**draft-chunduri-lsr-isis-preferred-path-routing-01**  
**draft-chunduri-lsr-ospf-preferred-path-routing-01**

Uma Chunduri, Richard Li [Huawei USA]

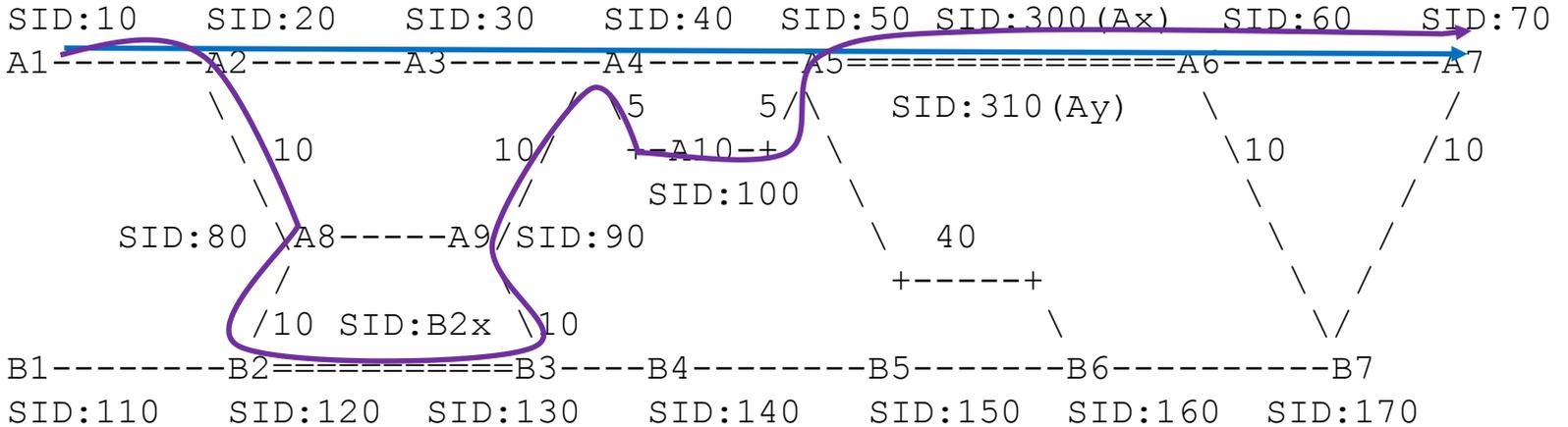
Russ White [LinkedIn]

Jeff Tantsura [Nuage Networks]

Luis M. Contreras [Telefonica]

Yingzhen Qu [Huawei USA]

# SR Network



## SR Path:

- All nodes: A1 to A7 and B1 to B7 (In the above Picture uses SR-MPLS)
- Shortest Path from A1 to A7: A2-A3-A4-A5-A6-A7 ( —————> )
- SR-PATH-1: From A1 to A7 - A2-A8-B2-B2x-A9-A10-Ax-A7( —————> )
- The above SR path uses both node and adjacency SIDS a stack of 8 labels.

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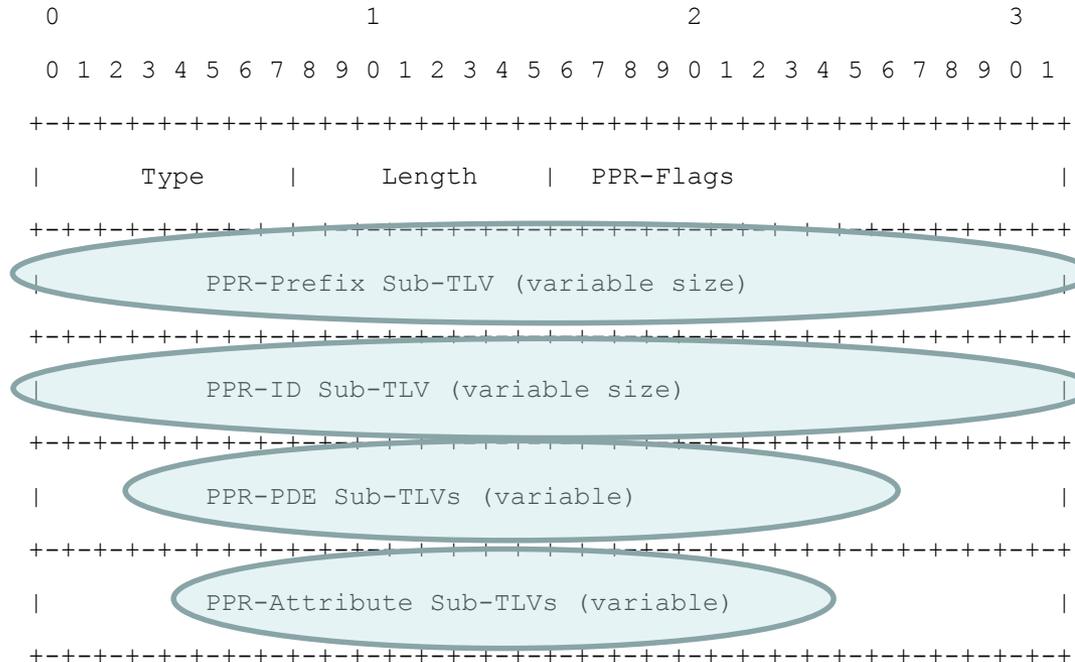
- This number can be higher based on MSD Capabilities of intermediate nodes and ELI/EL pair or because of Service Labels
- If this were to use for IPv6 data plane – RFC8200 IPv6 Encap. + SRH with 8 SRv6 SIDs

# Deployment Scenarios & Issues

## Issues:

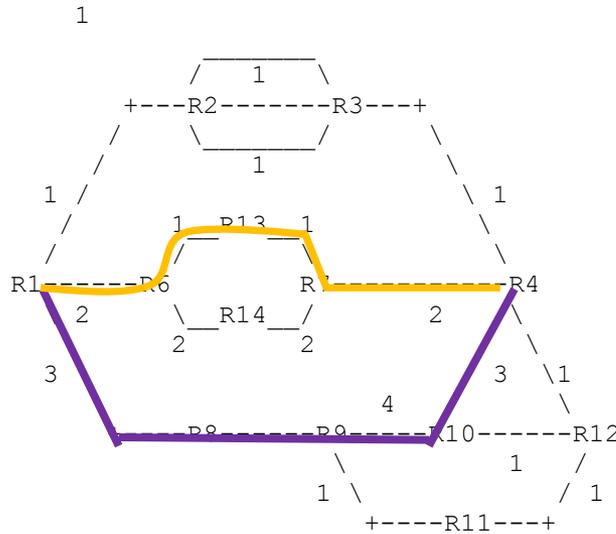
- **Hardware capabilities:** Not all nodes can push/read label stack needed.
  - MSD only helps to mitigate, if there is an alternate NSP, which meets the operator requirements
- **Line Rate:** Potential performance issues with increased size of SRH with IPv6 SIDs
- **MTU:** Potential MTU/Fragmentation issues with large SID stack (SR-MPLS, SRH)
- **Header Tax:** NW/Path overhead relative to actual application data, especially for small payload packets (mIOT and uRLLC in 5G or in various fixed scenarios).

# PPR TLV (IS-IS)



- New top level MT aware TLV with control plane prefix
- Data plane identifier (PPR-ID) with data plane type (e.g. MPLS, SRH, IPv6 etc..)
- Path Description Element Sub-TLV (ordered path info of underlying data plane)
- PPR Attribute Sub TLVs –path attributes including but not limited traffic accounting

# Computation



- **Strict PPR:** R1-R8-R9-R10-R4 for a prefix from R4
- After R9 receives the path, after SPF computation it check if R9 is itself on the path
- For E.g.: @R9: Without the above PPR, for R4's FEC, R9 would have set the NH to R11, but it changes to R10.
- Same applies to all the nodes in the path (R1, R8 etc..).
- **Loose PPR:** R1-R6-R7-R4 for a reachable prefix of R4 with 'L' bit set.
- Control plane processing is same Strict PPR. Various data plane differences in the document.

## In Summary:

- Change the next hop from actual shortest path NH to the NH of the immediate segment as described in the PPR TLV.
- Data-plane: IGP programs the received PPR-ID to the corresponding NH calculated as above (based on the data plane type)
- Existing protections/IP-FRR works as is; per new NH (but more can be done).



## Relation To Binding SID

- Not related
  - Earlier version of SR draft has EROs
- IS-IS Binding SID advertises the SID on behalf of one or \*more\* nodes in the network

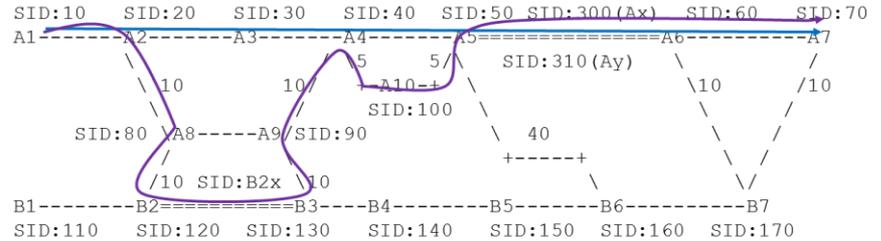
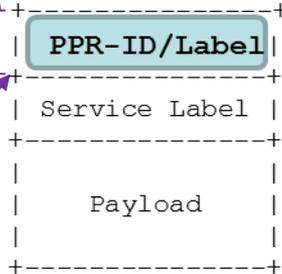
## Traffic Accounting

- Traffic Accounting Statistics through PPR with PPR-ID
  - **OPT1:** Offline Provisioning and collecting from the nodes as needed based on the operator
    - PPR-ID representing the PPR simplifies this operation for Operators
  - **OPT2:** Dynamically enable stats for certain PPRs through optional PPR Attribute Sub-TLVs( traffic accounting with fine granularity for some PPRs as needed automatically). No need for additional labels and MSD/RLD compatability issues.

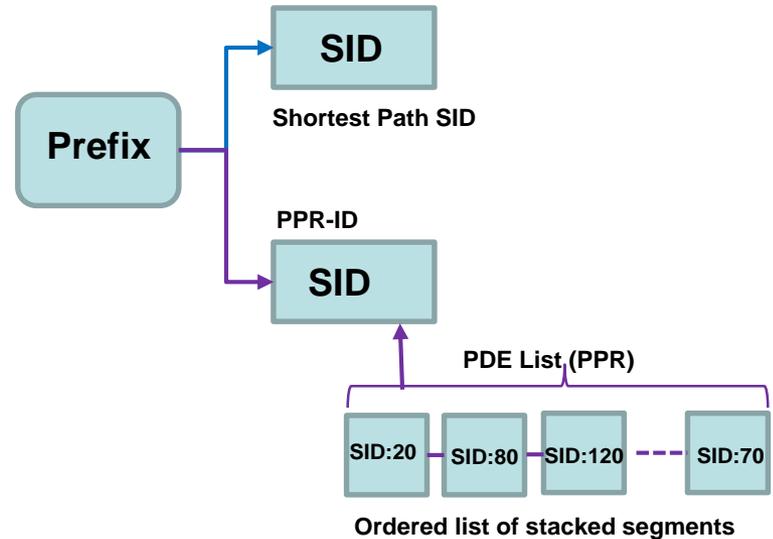


# Data plane with PPR-ID (SR-MPLS)

### 8 Node NSP with RLD = 6



### Summary:

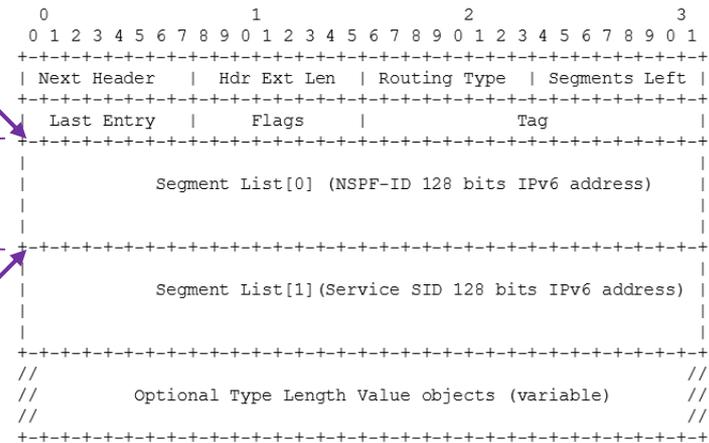
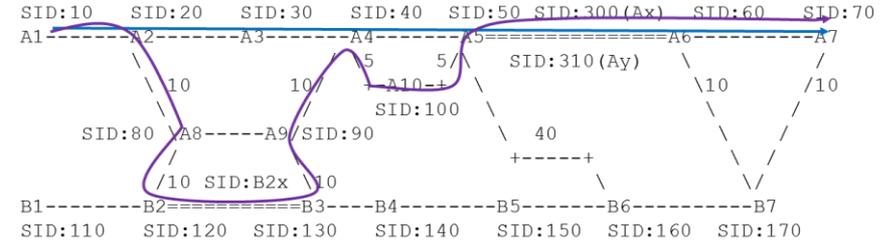
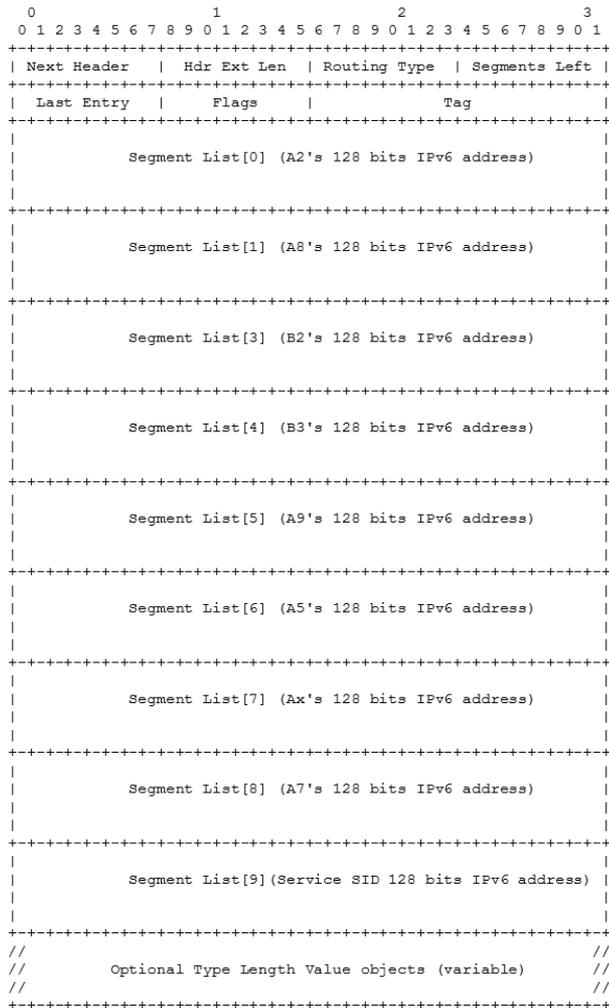


- This can be seen as equivalent of single shortest path SID (LDP equivalent); i.e., PPR is represented with one label as in the DP
- Though Service Label is shown as one, it can be more in most deployments/various scenarios



# Data plane with PPR-ID (with SRH)

## SRH with 8 Segment PPR





## Yang Data Model

- Yang data model for Preferred Path Routing

<https://tools.ietf.org/html/draft-qct-lsr-ppr-yang-00>



# Scaling & Other Aspects

## ▪ Scalability

- In a network with  $N$  nodes and with  $O(N^2)$  total unidirectional paths with  $(k)$  multiple such path only small set are preferred paths based on the deployment (for high value traffic Detnet, 5G Slices)
  - However to address the scaling of preferred paths a TREE structure can be used and details are in [I-D.draft-ce-ppr-graph-00].
  - Each PPR Tree uses one label/SID and defines paths from any set of nodes to one destination, thus reduces the number of entries needed from SRGB at each node (more details in the draft).
  - In other word, PPR Tree identifiers are destination identifiers and with this scaling simplifies to linear in  $N$  i.e.,  $O(k*N)$ .
- ## ▪ Support for native IP data planes (IPv4 and IPv6) with only control plane upgrades
- Needs respective IP encapsulation with destination IP as PPR-ID
  - Needed for slow migration and backward compatibility, More details in the draft



DMM WG is responding to 3GPP Study item for optimized 5G user plane

- 3GPP Study Item [http://www.3gpp.org/ftp/tsg\\_ct/WG4\\_protocollars\\_ex-CN4/TSGCT4\\_82\\_Gothenburg/Docs/C4-181380.zip](http://www.3gpp.org/ftp/tsg_ct/WG4_protocollars_ex-CN4/TSGCT4_82_Gothenburg/Docs/C4-181380.zip)
  - 3GPP Scenarios, Requirements, Solution Comparison <https://www.ietf.org/id/draft-bogineni-dmm-optimized-mobile-user-plane-01.txt> (SRv6, LISP, ILA)
- ✓ **This work helps most of the proposals to reduce the transport overhead on N9 interface.**

## Status & Next Steps

- Concept Presented at IETF101; lot of offline feedback and updates
- Comments?
- Request WG Adoption

Thank you!