Preferred Path Loop-Free Alternate (pLFA)
IETF 105
draft-bryant-rtgwg-plfa-00

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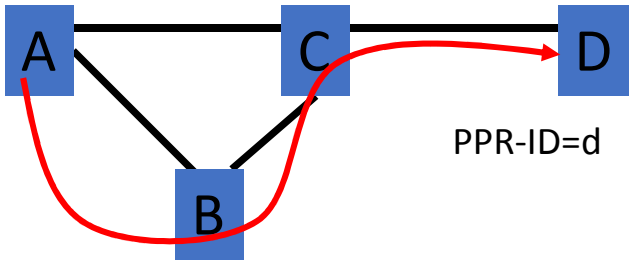
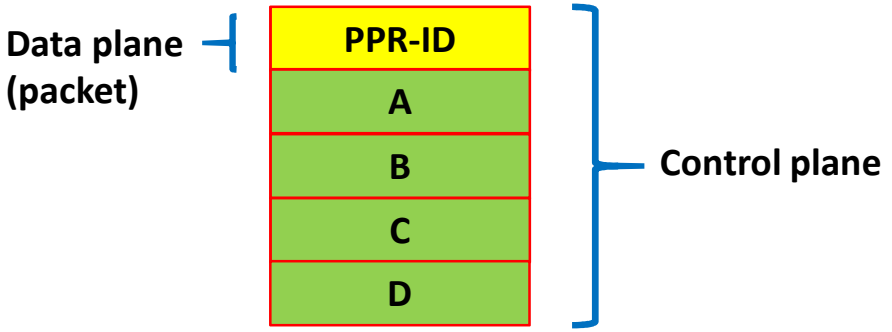
PPR Overview

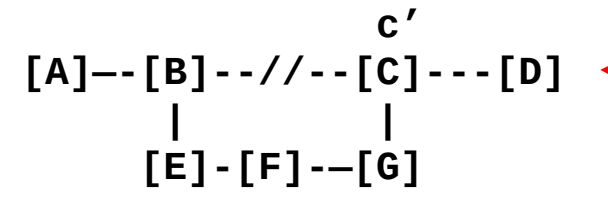
- PPR provides a method of injecting paths into link-state IGPs.
- In the data plane the packet is mapped to its intended path by the PPR-ID.
- PPR-ID is a *single* identifier in the packet.
- The format of the PPR-ID is data-plane specific (IPv6 addr, IPv4 addr, MPLS label, MAC Addr).
- PPR Interop at IETF Hackathon July 2019



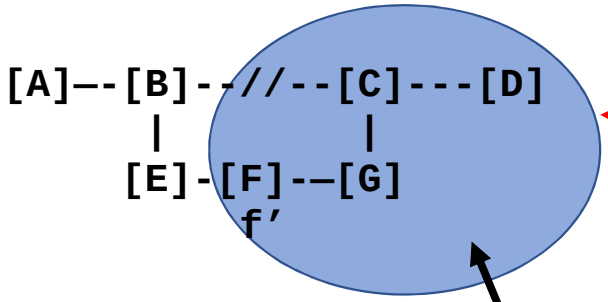


See draft-chunduri-lsr-isis-preferred-path-routing for encoding detail

Simple Link Repair



- PPR-ID=c'
- Path from B = E->F->G->C
- Note this can be an arbitrary policy derived path
- PLR=B
- B encaps packet to c' next hop = E via link B->E

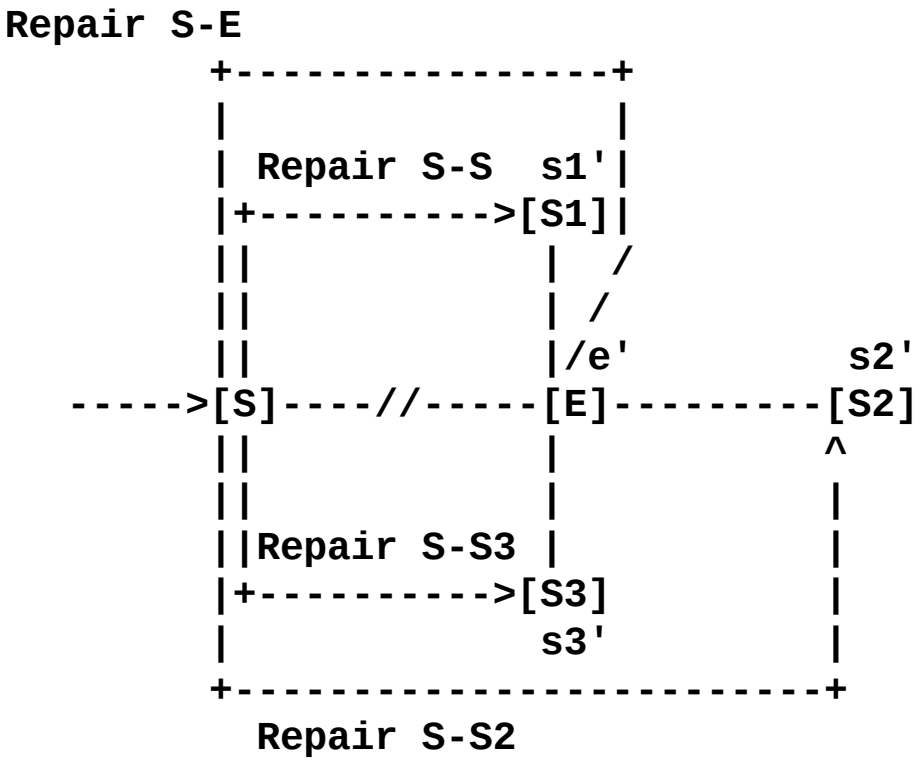


- Could release in Q –space
- PPR-ID=f'
- Path from B = E->F
- PLR=B
- B encaps packet to f' next hop = E via link B->E

Q-space WRT B->C failure

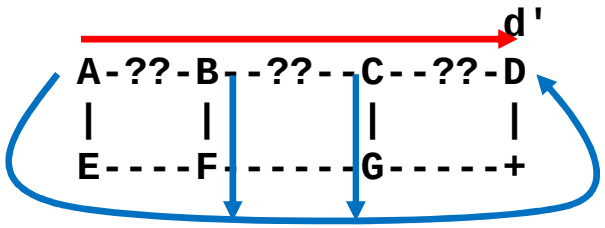
- After repair, if base network:
  - IP, SRv6 or MACinMAC - Simple
  - MPLS classic – usual next hop label problem
  - MPLS-SR – label correction easy

Node Repair



- Treat as k-1 separate failures repairing to each next-next hop.
- Also repair to E in case it was only a link failure.
- Each of the k repair paths for PLR (S) can follow required policy of the traffic type being repaired.
- Can have multiple repairs if required by policy

Traffic Engineered Repair



- Primary path is A->B->C->D and is traffic engineered
- Backup path is A->E->F->G->D and is also traffic engineered
- TE connectors provided from B and C to TE repair path.
- If A->B, or B->C or C->D fails single TE path can be used for repair

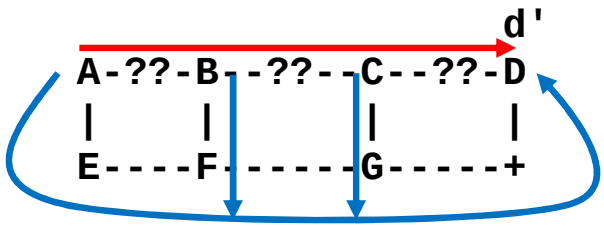
- Need TE backup paths because:
- Critical SLA traffic must use FRR with same SLA as primary: (5G uRLLC or mIOT slices)
- High b/w traffic carried on TE paths must not saturate best effort shortest-path-LFA-path/shortest-path-post-convergent-LFA-path.

PPR Graphs

- Described in draft-ce-lsr-ppr-graph
- TLVs describe graph as a series of lists of paths
- Any node may be a source
- A source node is annotated with the S bit
- In pLFA there is one destination which has the D bit set.
- The destination has a PPR-ID associated with it.

Simple Repair Graph

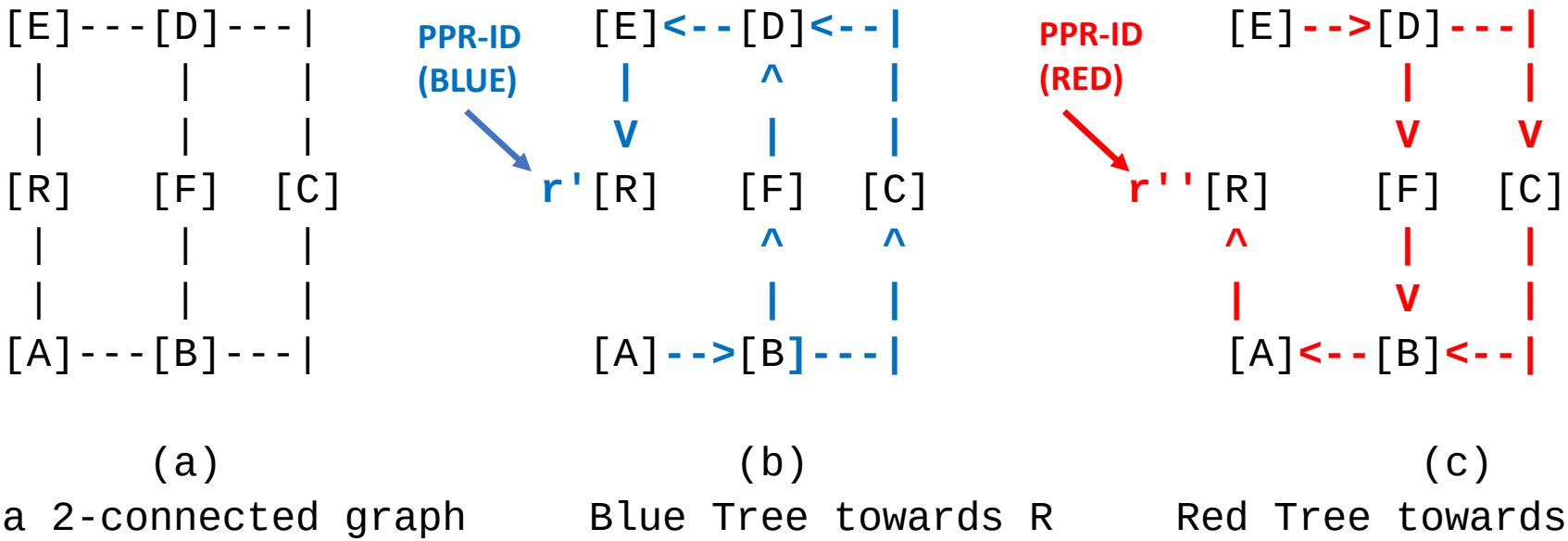
- We have seen this topology before
- The key difference is that the repair is described in a single graph



- Graph:
  - PPR-ID=d’
  - A(s)->E->F->G->D(d bit)
  - B(s)->F
  - C(s)->G

- Primary path is A->B->C->D
- Backup path is A->E->F->G->D + B->F + C->G
- If A->B, or B->C or C->D fails single pLFA path can be used for repair

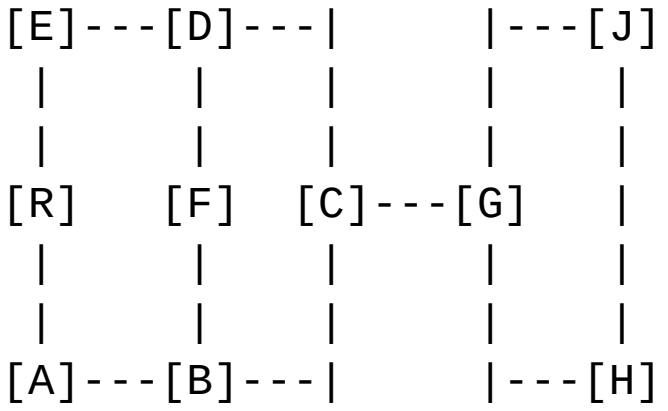
A 2-Connected Network

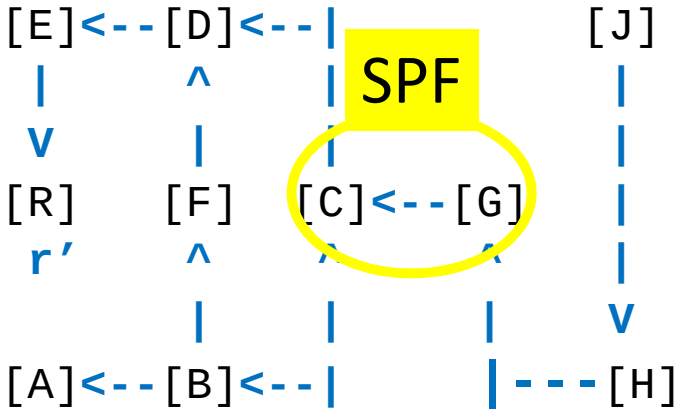


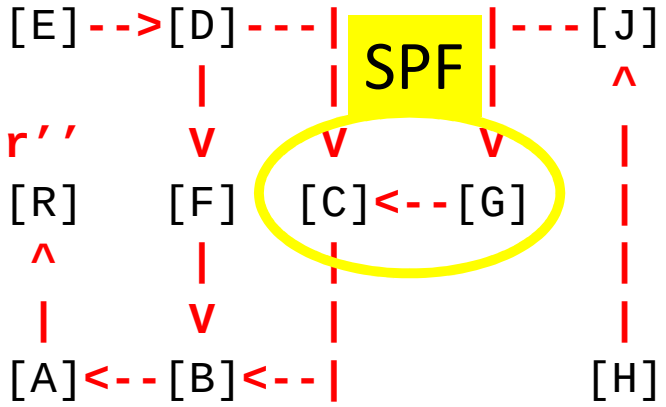
Example from RFC 7812. Path defined by PPR rather than from MRT algorithm.
Note we can define the paths through policy and have multiple repair paths each with its own PPR-ID(colour).

Multiple Disjoint Graphs (2)

- From RFC 7812 (Fig 2)
- Single Point of failure inevitable with this topology
- No restriction to a single repair topology/policy







Centralized and Decentralized Approaches

- pLFA can support both centralized and decentralized computation of the repair path.
- Any node can inject the PPR path either:
  - For itself as the PLR calculating its own repair paths
  - On behalf of an SDN controller managing the repair paths
- Multiple nodes can inject the repair for redundancy and the duplicate will be eliminated by the IGP flooding process.
- With centralized computation *any* algorithm can be used to compute *any* path or graph - e.g. bespoke dis-joint path or lossless or low path.
- pLFA is independent of any other FRR approach and may be run concurrently with it.

Multiple Data Planes

- pLFA is applicable to multiple data-planes:
  - MPLS
  - MPLS-SR
  - IPv6
  - SRv6
  - IPv4
  - Ethernet

- Indeed with any data plane in which the topology is known to an entity capable of computing the repair paths
- It requires no additional data plane services beyond encapsulating and decapsulating the packet at the PLR and the Repair Target.

Advantages

- Supports any data plane type.
- The control protocol is just the IGP in use.
- Any repair can be constructed with a single level of packet encapsulation with no need for midpoint identifiers.
- The repair can be constructed to conform to any required policy.
  - Post convergence path
  - TE path
  - Policy of the repaired traffic
- Consistency and loop checking is easy.

.. and in the next episode

- There is a lot to add in the next instalment
- There is some IPR, which we will declare as soon as we can.
- Finally:

Questions?