

A photograph of a large industrial factory interior. In the foreground, a large orange robotic arm is visible, partially obscured by a dark blue semi-transparent overlay. The background shows a complex network of orange steel beams and various industrial machinery. The lighting is bright, typical of a large manufacturing facility.

MPLS-SR PATH IDENTIFIERS

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PROBLEM SPACE

An interface is running hot

- We want to know which flows contribute how much to the traffic on an interface
- So we want to count packets per path on an interface

But MPLS-SR (like LDP) is a path-merging paradigm

- As traffic moves toward a destination, only the downstream path is visible
- The source of the traffic and any path distinguisher has been discarded

HIGH-LEVEL SOLUTION

Insert an “SR Path Identifier” into each MPLS-SR packet

Count packets per interface based on that value

Value must be

- globally unique
- Be possible to find in the packet header
- Transparent to legacy implementations

THE PATH IDENTIFIER LABELS (MODEL A)

The presence of the path identifier in the label stack is indicated by a special purpose label

- The SR Path Indicator (SPI)

SR Path Indicator		TC	S	TTL
C	Path Identifier	TC	S	TTL
Node Identifier		TC	S	TTL

The SPI is followed by two Label Stack Entries

- The label field in the first carries a C-flag and a path identifier
 - If C-flag is zero a node identifier label stack entry is also present (model A)
 - The path identifier value is assigned by the head end of SR Path
 - It is unique within the scope of the node identifier
 - $15 < p < 2^{19} - 1$ (must not appear to be a special-purpose label)
- The label field in the second encodes a node identifier
 - This is a globally unique Node SID assigned for MPLS-SR
 - It identifies the router at the head end of the SR Path
 - It gives the scope of uniqueness for the path identifier
 - $15 < n < 2^{20} - 1$ (must not appear to be a special-purpose label)

THE PATH IDENTIFIER LABELS (MODEL B)

The presence of the path identifier in the label stack is indicated by a special purpose label

- The SR Path Indicator (SPI)

SR Path Indicator		TC	S	TTL
C	Path Identifier	TC	S	TTL

The SPI is followed by 1 Label Stack Entry

- The label field in the first carries a C-flag and a path identifier
 - If C-flag is one a node identifier label stack entry is not present (model B)
 - The path identifier value is network unique
 - $15 < p < 2^{19} - 1$ (must not appear to be a special-purpose label)
 - May be assigned by the controller
 - Controller may assign blocks of identifiers to head end nodes to allow the head end to assign the identifiers

Note that this approach conserves label stack resources

- I.e., only needs two labels

PLACEMENT IN THE LABEL STACK

Ideally, place the Path label at the bottom of the stack

- Stops it getting in the way of normal packet processing
- Means it is in the packet right up to the final hop

Just as the entropy label, the path identifier needs to be accessible

- Entropy label must be in the hash
- Path label must be visible to count the packets

So may need appear further up the stack

Any node finding the SPI at the top of the stack must strip it (and the node and path labels)

- Means that such nodes **MUST** know about SPIs
- So will need to advertise support

SUB SR-PATHS and Traffic accounting

To overcome the RLDC limitation of the hardware

- Sub-paths are created in the network and assigned with Binding-SIDs
- Binding-SIDs used in the Label stack from Head-end

Traffic accounting to be done for end-to-end SR-Paths and separate accounting for Sub-paths is not supported

- The Label stack may have multiple SR-Path-Stats label
- The SR-Path-Identifier should be same in one label stack.

FORWARDING PLANE PROCEDURES

- When a packet arrives with the top label from SR label blocks, statistics lookup procedures are performed
- Lookup the SR-Path-Indicator label
- Get SR-Path-Identifier and if C bit is set get the SR Node ID
- Dynamically create counters corresponding to SR-Path-Identifier
- Account traffic on per interface basis

SR-Path-Identifier and Binding-SID

	Binding SIDs	SR-Path-Identifier
Scope	Global or local scope and derived from SRLB or SRGB	Global or local scope. Need not be derived from SRGB/SRLB
Purpose	Traffic steering into SR-Path	Traffic statistics accounting
Action	Popped off and replaced by label /label stack	Popped off if appears on top of stack
Size	20 bit	19 bit additional 1 leftmost bit indicates scope

In spite of the differences, it is possible for an operator to allocate an SR-Path-identifier and use it also as a binding-SID for the policy.

Questions