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SRv6 Network Programming

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Introduction

“SRv6 network programming” refers to the capability for an application to encode any complex program as a set of individual functions distributed through the SRv6 network.

Introduction (2)

- This draft is the "key" SRv6 document that describes SRv6 network programming concepts, its various functions, and their use cases:
  - Local-SID Functions, Transit Behavior
  - Control Plane
  - Counters, Security
  - Use case illustrations
- Status:
  - Larger community support (from vendors and operators)
  - Multiple interoperable implementations
    - Open Software Projects: http://www.segment-routing.net/open-software/ (VPP 17.04 and Linux Kernel 4.10)

Local SID

- An SRv6 local SID has a specific instruction bound to it.
- An SRv6-capable node N maintains a table containing all the local SRv6 segments explicitly instantiated at node N.
  - N is the parent node for these SIDs.
- A local SID of N could be routed to N but it does not have to be. Most often, it is routed to N via a shorter-mask prefix.

Local SID (2)

- SRv6 local SID is represented as LOC:FUNCT
  - LOC is the L most significant bits
  - FUNCT is the (128-L) least significant bits.
  - L is called the locator length and is flexible:
    - no assumption on size/length
- Most often the LOC part of the SID is routable and leads to the node which owns that SID.
- The FUNCT part of the SID is an opaque identification of a local function bound to the SID. Hence the name SRv6 "Local" SID.
  - LOC:FUNCT:ARGS if function requires argument(s)

Local SID Functions

- This draft defines a set of well-known functions that can be associated with a local SID.
  - For each function, packet processing algorithm is also documented at a high level

Local SID Functions (2)

Name	Forwarding	Use case
End *	Lookup	Prefix SID
End.X *	L3 Xconnect	Adj SID
End.T *	Lookup in table T	Multi-table operation in the core
End.DT6	Decap and IPv6 table T lookup	IPv6 L3VPN - Per-VRF
End.DT4	Decap and IPv4 table T lookup	IPv4 L3VPN - Per-VRF
End.DX6	Decap and IPv6 Xconn	IPv6 L3VPN - Per-CE
End.DX4	Decap and IPv4 Xconn	IPv4 L3VPN - Per-CE
End.DX2	Decap and L2 Xconn	L2VPN

*: With variants

Local SID Functions (3)

Name	Forwarding	Use case
End.B6	SRv6 policy	Binding SID
End.B6.Encaps	SRv6 policy (with encap)	Binding SID
End.BM	SR-MPLS policy	Binding SID
End.S	Search of a target (Locally forward or END behavior)	ICN
End.AS	Remove Outer IPv6 header and SRH, forward to target interface	Service chaining through SR-unaware App
End.AM	Update Outer IPv6 header DA with LAST SID and forward to target interface	Service chaining through SR-unaware App (with masquerade)

SRH Pop

- "SRH Pop" refers to removal (pop) of the "top" SRH in a received SRv6 packet at an endpoint.
- We define SRH popping for the following functions:
  - End, End.X, and End.T
- Flavors:
  - Two variants:
    - **Ultimate Segment Pop** (USP) : SRH Popped at last segment
    - **Penultimate Segment Pop** (PSP): SRH Popped at penultimate segment
  - For each of the above End functions, these variants can be enabled or disabled either individually or together.

Transit Behaviors

- Transit node: A node that receives an IPv6/SRv6 packet whose DA is neither local address nor local SID

Name	Behavior
T	Pure Transit
T.Insert	Insert an SRv6 policy
T.Encaps	Encap an SRv6 policy
T.Encaps.L2	Encap an SRv6 policy on L2 frame

Control Plane

- The following table summarizes which SID and transit capabilities would be signaled in which signaling protocol

Name	IGP	BGP-IP/VPN	BGP-LS
End	X		X
End.X	X		X
End.T	X		X
End.DT6		X	X
End.DT4		X	X
End.DX6		X	X
End.DX4		X	X
End.DX2		X	X
End.B6			X
End.B6.Encaps			X
End.BM			X
End.S			X
End.AS			X
End.AM			X
T			X
T.Insert			X
T.Encaps			X
T.Encaps.L2			X

Counters and Security

- Counters:
  - Local SID - Matched and processed correctly/incorrectly
  - SR policy – Steered into and processed correctly/incorrectly
- Security:
  - "How a domain of trust can operate SRv6-based services for internal traffic while preventing any external traffic from accessing these internal SRv6-based services."
  - Some mechanisms:
    - ACL on the external interface to drop any traffic with SA or DA in the internal SID space
    - ACL to prevent access to local SIDs from outside the operator's infrastructure
    - An SRv6 router MUST only implement the End behavior on a local IPv6 address if that address has been explicitly enabled as a segment (local SID)
    - Support Unicast-RPF on source address on external interface

Use Case Illustrations

- Basic Security
- SR-L3VPN
- SR-L2VPN-VPWS
- SRTE for Underlay SLAs
  - Policy @ ingress PE
  - Policy @ mid
- End-to-end SRTE policy
- TI-LFA
- SRTE for Service Chaining

Draft: Next Steps

- Seeking WG input and feedback
- Comments and suggestions are welcomed !!!