

# MT>1 support over Bundled Links

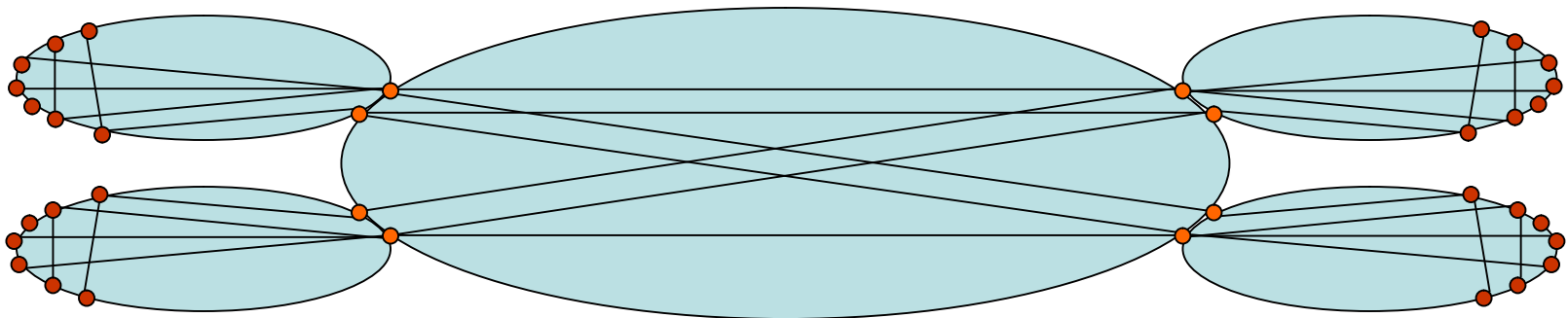
draft-sadler-ccamp-rsvp-mt-bundled-links-00

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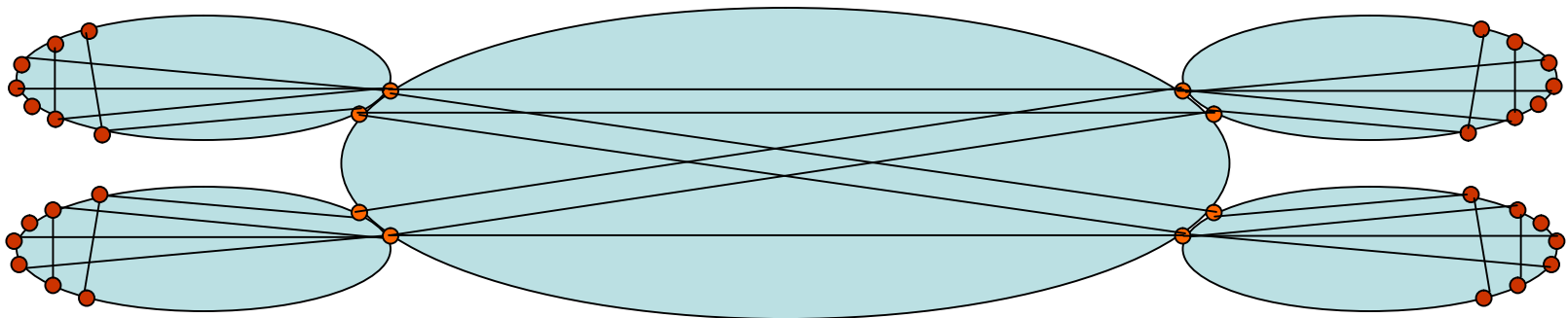
# Motivation

- In Multi-domain TE networks, core border routers end up with multiple LSPs between them
- Scaling the number of LSPs between borders is a key issue
  - As number of LSPs increase between borders, number of RSVP-TE SESSIONS handled by intermediate routers grows
- Minimizing RSVP sessions is desirable
  - Reduces memory/CPU requirements on intermediate routers



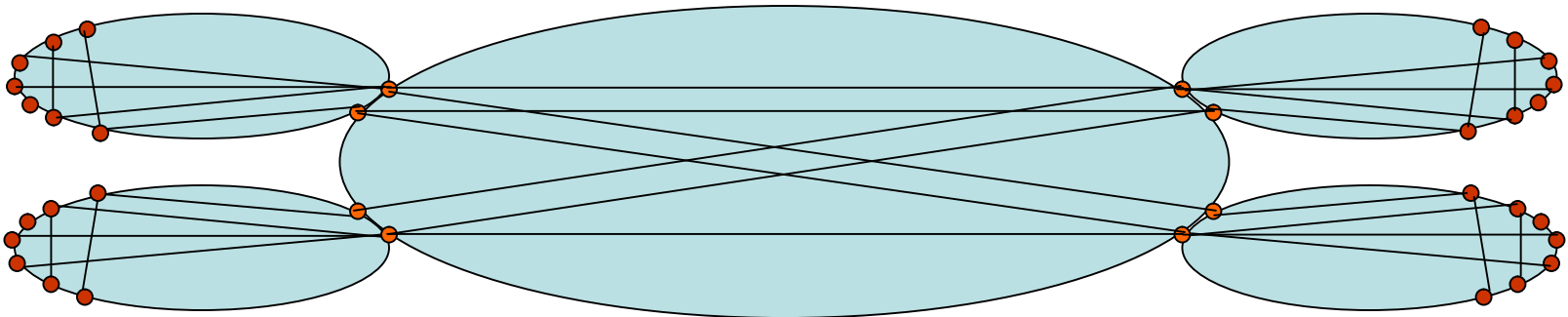
# Motivation

- Nesting provides a way for end-to-end sessions to be separated from edge-to-edge sessions
  - Allows multiple end-to-end LSPs with common traffic behaviors to be put into one edge-to-edge LSP through core domain.
  - End-to-end SESSION details remain intact
    - Endpoints, specific TE-bandwidth allocation, etc.
  - Traffic demands from nested LSPs accounted for in outer LSP TSPEC.



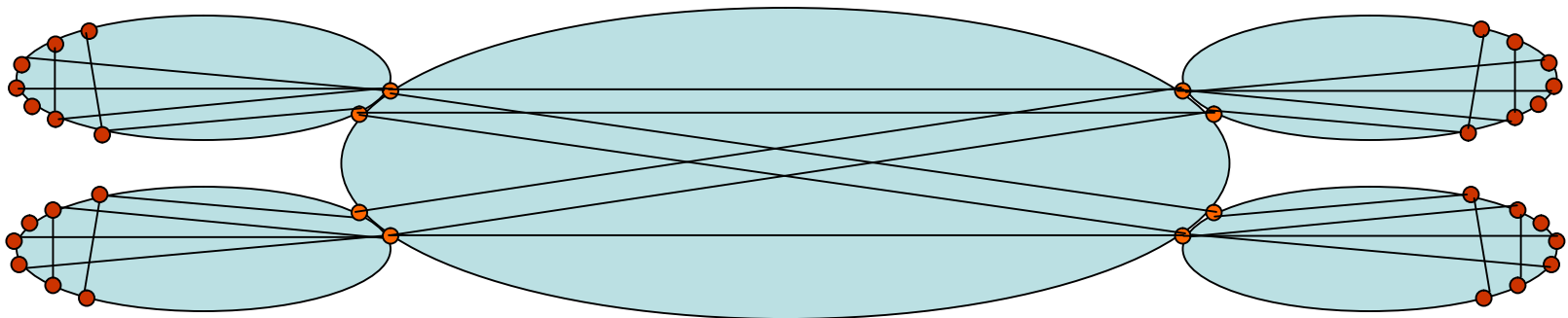
# Motivation

- Reserving total LSP bandwidth similar but different for Packet & TDM:
  - For Packet, accounting for total bandwidth is done by increasing edge-to-edge bandwidth requested in IntServ TSPEC
    - Label object contains single label
  - For TDM, accounting for total bandwidth is done by increasing MT in SONET/SDH or OTN TSPEC
    - Label object contains Label List detailing timeslots used.



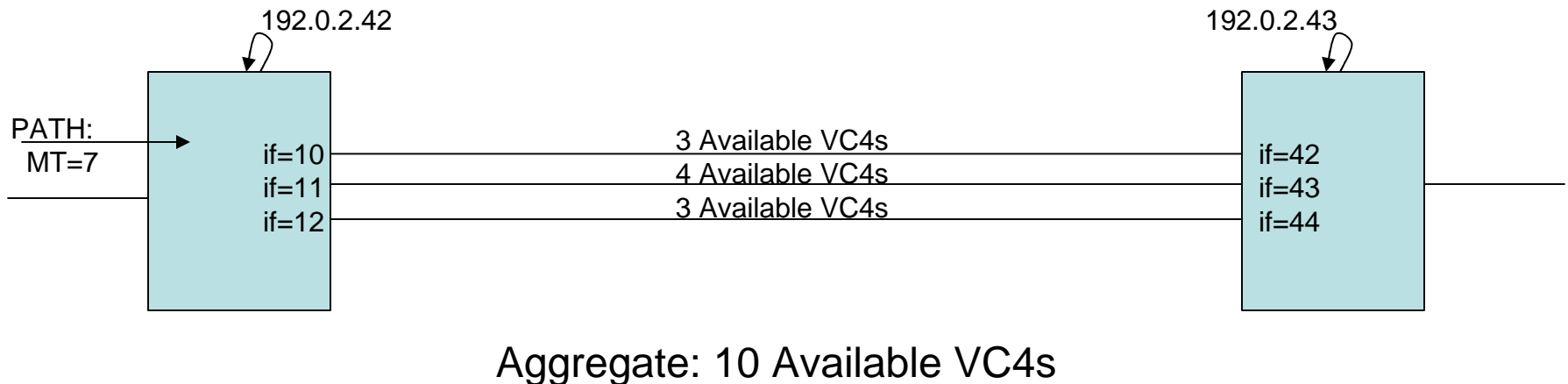
# Motivation

- Intermediate switches need to have mechanisms to provide adequate bandwidth for nested LSPs
  - In Packet world, this can be provided by inverse mux functions operating at a lower layer (e.g. LAG or ML-PPP)
  - In TDM world, there is no equivalent. However, link bundling provides similar routing scalability.



# Motivation

- Problem:
  - Use of MT over Bundled Links doesn't work when MT value is greater than the number of timeslots available on one link
    - Bundle advertises adequate capacity is available
    - Problem comes from lack of information in RSVP\_HOP object
      - RSVP\_HOP object limited to describing one downstream link (and optionally one upstream link)
  - Need RSVP\_HOP information that corresponds to label list entries



# Proposed Extension

- Allow RSVP\_HOP object to contain IF\_ID TLVs for more than one downstream and one upstream link
- Problem - Link Bundling RFC 4201:
  - Deprecating Component Link TLVs made TLV position in RSVP\_HOP object important. Text states:

*“Except in the special case noted below, for a bidirectional LSP, only one or two TLVs SHOULD be used in an IF\_ID RSVP\_HOP object or IF\_ID TLV. The first TLV always indicates the component link identifier of the downstream data channel on which label allocation must be done. When present, the second TLV always indicates the component link identifier of the upstream data channel on which label allocation must be done. When only one TLV is present, it indicates the component link identifier for both downstream and upstream data channels.”*
  - Need method for multiple TLVs that is backward compatible

# Method

- IF\_ID TLVs in RSVP\_HOP object maintain a pattern similar to existing RSVP\_HOP usage:
  - Interleave Downstream/Upstream link information
  - If only one set of Downstream/Upstream link TLVs is provided, all labels in the LABEL object apply to the downstream link and all labels in the UPSTREAM\_LABEL object apply to the upstream link
- IF\_ID TLVs in RSVP\_HOP object allow for additional links to be specified:
  - If two or more sets of Downstream/Upstream links are provided, the order of downstream links relates to the order of the labels in the LABEL object and the order of upstream links relates to the labels in the UPSTREAM\_LABEL object.
  - Resulting BNF:  
IF\_ID\_TLVs ::= <TLV\_IFs>+  
TLV\_IFs ::= <Downstream\_IF> [ <Upstream\_IF> ]
- Upstream\_IF is mandatory for Bidirectional LSPs when more than one TLV\_IF is provided
  - even when Upstream\_IF is the same as the Downstream\_IF



# Example Encodings

- 1 x Unidirectional VC4 LSP  
TSPEC: MT=1  
RSVP\_HOP TLV: {C000022A:0x0000000a}  
LABEL: {0x00010100}
- 1 x Bidirectional VC4 LSP  
TSPEC: MT=1  
RSVP\_HOP TLV: {C000022A:0x0000000a}  
UPSTREAM\_LABEL: {0x00010100}  
LABEL: {0x00010100}
- 2 x Unidirectional VC4 LSP  
TSPEC: MT=2  
RSVP\_HOP TLVs: {C000022A:0x0000000a} {C000022A:0x0000000b}  
LABEL: {0x00010100}, {0x00010100}
- 2 x Bidirectional VC4 LSP  
TSPEC: MT=2  
RSVP\_HOP TLVs: {C000022A:0x0000000a} {C000022A:0x0000000a},  
{C000022A:0x0000000b} {C000022A:0x0000000b}  
UPSTREAM\_LABEL: {0x00010100}, {0x00010100}  
LABEL: {0x00010100}, {0x00010100}

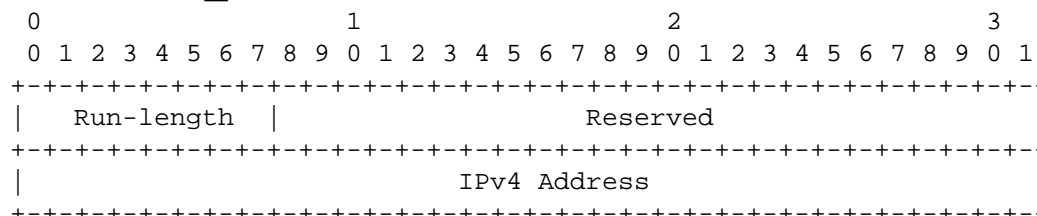
# Additional Method

- When MT is large, the RSVP\_HOP object may become large due to lots of repeated information
- Use of Run Length Encoded TLVs (RLE TLVs) would reduce the size of the RSVP\_HOP object
  - Each RLE TLV replaces multiple IFs from Downstream or Upstream sequence
  - Maintains Upstream/Downstream interleave
    - One RLE TLV does NOT contain information for both Upstream and Downstream IFs

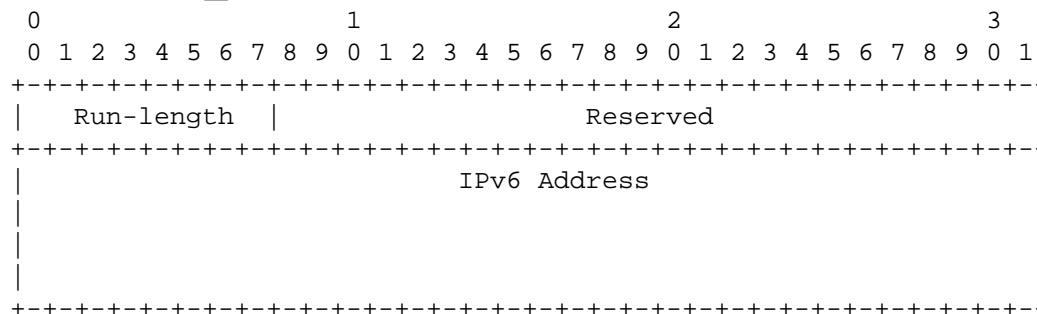
# RLE IF\_ID TLVs

- New RLE IF\_ID TLV formats would be:

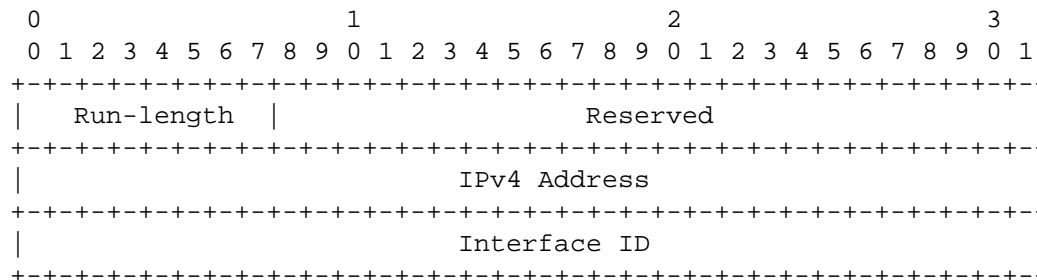
- IPv4 RLE IF\_ID TLV



- IPv6 RLE IF\_ID TLV



- Unnumbered RLE IF\_ID TLV



# Example

## RLE IF\_ID TLV Usage

- 10 x Unidirectional LSP  
TSPEC: MT=2  
RSVP\_HOP TLVs: {5, C000022A:0x0000000a}, {5, C000022A:0x0000000b}  
LABEL: {0x00010100}, {0x00010200}, {0x00010300},  
{0x00020100}, {0x00020200}, {0x00010100},  
{0x00010200}, {0x00010300}, {0x00020100},  
{0x00020200}
- 10 x Bidirectional LSP  
TSPEC: MT=2  
RSVP\_HOP TLVs: {6, C000022A:0x0000000a} {5, C000022A:0x0000000a},  
{4, C000022A:0x0000000b} {5, C000022A:0x0000000b}  
UPSTREAM\_LABEL: {0x00010100}, {0x00010200}, {0x00010300},  
{0x00020100}, {0x00020200}, {0x00020300},  
{0x00010100}, {0x00010200}, {0x00010300},  
{0x00020100}  
LABEL: {0x00010100}, {0x00010200}, {0x00010300},  
{0x00020100}, {0x00020200}, {0x00010100},  
{0x00010200}, {0x00010300}, {0x00020100},  
{0x00020200}

NOTE: While SDH/OTN have requirements that Bidirectional LSPs use the same I/F for upstream & downstream, this example has been provided to show the flexibility of the RLE TLV encoding. Specific technology rules still apply.

# Additional Work Required

- Need to determine how to handle encoding in ERO/RRO.

# Summary & Proposal

- Scalability of RSVP-TE sessions is important in multi-domain networks
  - Nesting and LAG provides mechanism for Packet
  - Nesting and Bundling is a start of a mechanism for SDH/OTN
- Adding a mechanism for MT>1 to be used with bundled links will further progress scalability
  - Draft provides two encodings for RSVP\_HOP object
- Work still remains – ERO, RRO
- Looking for co-authors
- Request: WG Draft?