

Chapter 9

Understanding the Structure of RSVP

Considering that Resource Reservation Protocol (RSVP)-signaled label-switched paths (LSPs) are primarily established using RSVP Path and Resv messages, it is useful to understand the structure of RSVP when you examine a problem with an LSP. This chapter discusses the following topics:

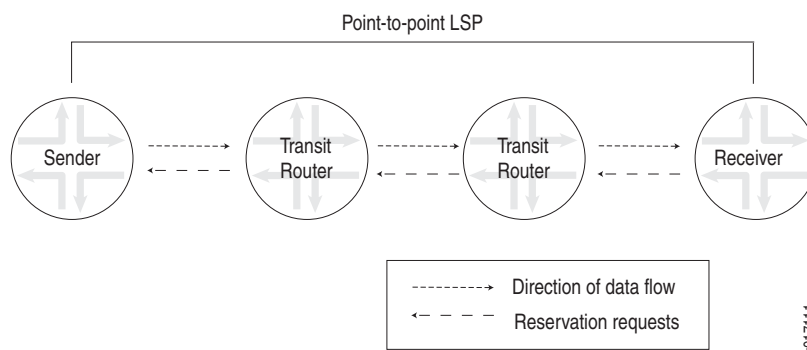
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RSVP Overview

The RSVP protocol is used by routers to deliver quality-of-service (QoS) requests to all nodes along data flow path(s) and to establish and maintain state for the requested service. RSVP requests generally result in resource reservations in each node along the data path. RSVP has the following attributes:

- Makes resource reservations for unidirectional data flows.
- Allows the receiver of a data flow to initiate and maintain the resource reservation used for that flow, as shown in Figure 6.
- Maintains a soft state in routers and hosts, providing graceful support for dynamic membership changes and automatic adaptation to routing changes.
- Depends upon present and future routing protocols, but is not a routing protocol itself.
- Provides several reservation models or styles to fit a variety of applications.
- Supports both IPv4 and IPv6. Note, you can configure the JUNOS software to tunnel IPv6 over an MPLS-based IPv4 network. For more information, see the *JUNOS MPLS Applications Configuration Guide*.

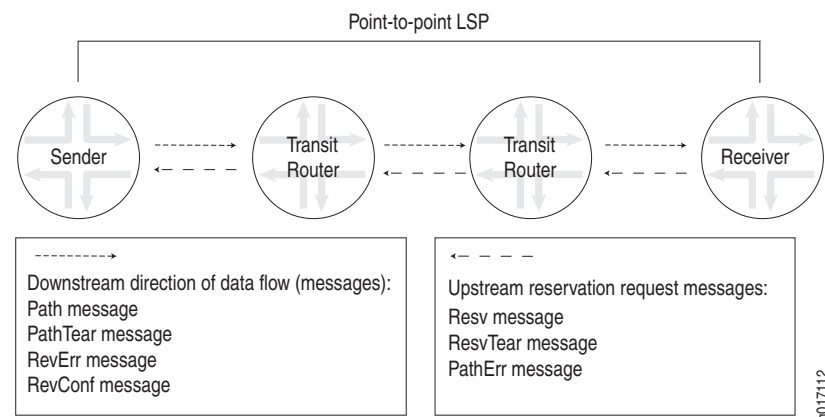
Figure 6: RSVP Reservation Request and Data Flow



RSVP Session Overview

RSVP creates independent sessions to handle each data flow. It is important to note that each session is simplex, even though bidirectional messages (Path and Resv) create the simplex session. A session is identified by a combination of the destination address, an optional destination port, and a protocol. Within a session, there can be one or more senders. Each sender is identified by a combination of its source address and source port. Figure 7 shows a simplified overview of an RSVP point-to-point session. For information on point-to-multipoint LSPs, see the *JUNOS MPLS Applications Configuration Guide*.

Figure 7: RSVP Session



A typical RSVP session involves the following sequence of events:

- A potential sender (ingress router) starts sending RSVP Path messages to the session address (egress router).
- The receiver receives the Path messages.
- The receiver sends appropriate Resv messages toward the sender. These messages carry a flow descriptor, which is used by routers along the path to make reservations in their link-layer media.
- The sender receives the Resv message, then starts sending application data.

RSVP Message Structure

RSVP was extended by various Requests for Comments (RFCs) to function as a signaling protocol to create Multiprotocol Label Switching (MPLS) LSPs. The signaling occurs with RSVP messages which are encapsulated directly with IP datagrams using a protocol ID of 46. Each RSVP message uses a common header followed by various objects, as shown in Figure 8.

Figure 8: RSVP Common Header

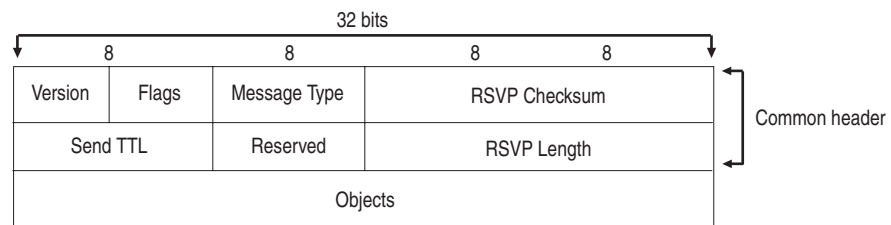


Table 13 lists and describes the fields in the RSVP common header.

Table 13: Fields in the RSVP Common Header

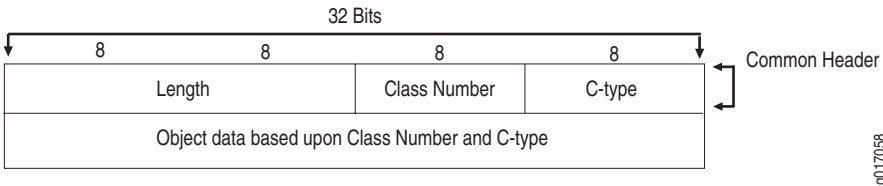
Field Name	Defined	Description
Version	4 bit	JUNOS software supports RSVP version 1.
Flags	4 bits 0x01 to 0x08 0x01: Refresh overhead reduction 0x02 to 0x08: Reserved	Used to signal support for protocol extensions to neighboring RSVP routers.
Message Type	1 Path (RFC 2205) 2 Resv (RFC 2205) 3 PathErr (RFC 2205) 4 ResvErr (RFC 2205) 5 PathTear (RFC 2205) 6 ResvTear (RFC 2205) 7 ResvConf (RFC 2205) 12 Bundle (RFC 2961) 13 Ack (RFC 2961) 15 SRefresh (RFC 2961) 20 Hello (RFC 3209) 25 Integrity Challenge (RFC 3097) 26 Integrity Response (RFC 3097)	Displays the number for the type of RSVP message encoded in the packet. For a detailed description of some message types, see “Examining RSVP Log Messages” on page 123 and “Examining RSVP Error Messages” on page 143.
RSVP Checksum	16 bits	Displays a standard IP checksum for the entire RSVP message. When the checksum is computed, the local router assumes that this field contains zeros.
Send TTL	8 bits	Derived from the IP packet time to live (TTL). If the IP TTL value does not match the value in the Send TTL field, the previous node does not support RSVP.

Field Name	Defined	Description
Reserved	8 bits	This field is no used and must be set to 0x00.
RSVP Length	16 bits	Displays the entire RSVP packet, including any optional objects that are attached to the message.
Objects	Variable	This variable-length field contains one or more RSVP objects. For a more detailed description of objects, see “RSVP Objects Structure” on page 109.

RSVP Objects Structure

RSVP objects carry the information that comprises the contents of RSVP messages. Different combinations of objects define the information necessary for RSVP to signal LSPs. Each object is represented by a fixed-length header and a variable-length data field, as shown in Figure 9.

Figure 9: RSVP Object Header



The maximum object content length is 65,528 bytes. The **Class-Num** and **C-Type** fields may be used together as a 16-bit number to define a unique type for each object. Table 14 lists and describes the fields in the RSVP object header.

Table 14: Fields in the RSVP Object Header

Field Name	Defined	Description
Length	16 bits	Contains the total object length and must always be a multiple of 4.
Class-Num	The values of this field are defined in Appendix A, RFC 2205, <i>Resource ReSerVation Protocol (RSVP), Version 1, Functional Specification</i> .	Identifies the object class; for example, Session. For more information about object classes, see Table 15

Field Name	Defined	Description
C-Type	For a breakdown of the C-Type associated with each RSVP object, see Appendix A, RFC 2205.	Coded with values that are unique to each class number (Class-Num); for example, C-Type 1.
Object Data	The Class-Num and C-Type may be used to define a unique object. C-Type is the object type and is used to accommodate different Internet address families, such as those corresponding to IPv4 and IPv6 [44]. Currently, C-Type 1 is assigned to IPv4 and C-Type 2 is used for IPv6. The structure and format of the objects may change from one family to another.	Contains the data identified by the Class-Num and C-Type fields. For more information on object data, see Table 15.

The setup and maintenance of an RSVP session requires information that is encoded in multiple objects used in the various RSVP message types. Table 15 lists and describes some RSVP objects, the messages in which they are used, and the RFC to which you can refer for further information. The objects are listed in alphabetical order.

Table 15: RSVP Objects

Object Name	RSVP Message	RFC	Description
Adspec	Path	2205	Carries a summary of available services, delay and bandwidth estimates, and operating parameters used by specific QoS control services. The summary is computed as the Adspec passes each hop. The JUNOS software uses the Adspec field for maximum transmission unit (MTU) negotiation.
Detour	Path		Used in one-to-one backup to identify detour LSPs. For more information on the Detour object, see Internet draft <i>draft-ietf-mpls-rsvp-lsp-fastreroute-03.txt</i> , <i>Fast Reroute Extensions to RSVP-TE for LSP Tunnels</i> .
Error	PathErr, ResvErr, ResvConf	2205	Specifies an error in a PathErr or ResvErr message, or a confirmation in a ResvConf message.
Explicit route	Path	3209	Specifies a strict or loose path in the network topology.
FastReroute	Path		Used to control the backup for a protected LSP. The fast reroute object specifies the setup and hold priorities, the session attribute filters, and the bandwidth to be used for protection. It also allows a specific local protection technique to be requested. For more information on the fast reroute object, see Internet draft <i>draft-ietf-mpls-rsvp-lsp-fastreroute-03.txt</i> , <i>Fast Reroute Extensions to RSVP-TE for LSP Tunnels</i> .
Filter	Resv ResvTear ResvErr		Defines the source of the session.

Object Name	RSVP Message	RFC	Description
FilterSpec	Resv	2205, 3209	Defines a subset of session data packets that should receive the desired QoS specified by a flow specification object.
FlowSpec	Resv	2205, 2210	Defines a desired QoS.
Hello	Hello	3209	Can be a request or a reply. Every request should generate a reply.
Hop	Path, Resv	2205	Carries the IP address of the RSVP-capable node that sent the message, and a logical outgoing interface.
Integrity	All message types	2205, 2747, 3097	Carries cryptographic data to authenticate the originating node and verify the contents of an RSVP message.
Label	Resv	3209	Contains the label value (for example, 100624) that is mapped to the LSP identified by the session value.
LabelRequest	Path	3209	Indicates, to the next downstream node, that a label assignment is requested.
Null			Has a class number of zero, and its C-Type is ignored. Its length must be at least 4, but can be any multiple of 4. A NULL object may appear anywhere in a sequence of objects, and its contents will be ignored by the receiver.
Policy data	Path, Resv, PathErr, ResvErr	2205	Carries information that allows a local policy module to decide whether an associated reservation is administratively permitted. The use of policy data objects is not fully specified at this time.
Properties		Juniper only	Specifies a Juniper Networks proprietary object used to carry information about the LSP.
RecRoute	Path, Resv	3209	Indicates the list of addresses that this Path message has transited.
RestartCap	Hello	3473	Indicates the sender node's graceful restart capability.
ResvConf	Resv, ResvConf	2205	Response to confirm a reservation request.
Scope	Resv, ResvErr, ResvTear	2205	Carries an explicit list of sender hosts towards which the information in the message is forwarded.
Sender	Path	2205, 3209	Contains a sender IP address and perhaps some additional demultiplexing information to identify a sender.
Session	All message types	2205, 3209	Contains the IP destination address (DestAddress), the IP protocol ID, and some form of generalized destination port, to define a specific session for the other objects that follow.

Object Name	RSVP Message	RFC	Description
SessionAttribute	Path	3209	Indicates a variety of parameters including setup priority, hold priority, flags, name length, and session name.
SrcRoute	Path		Contains the list of addresses in the Explicit Route Object (ERO).
Style	Resv	2205, 3209	Defines the reservation style, plus style-specific information that is not in flow specification or filter specification objects.
Time	Path, Resv	2205	Contains the value for the refresh period used by the creator of the message.
Tspec	Path	2205	Defines the traffic characteristics of a sender's data flow.