RSVP
Resource Reservation Control Protocol

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OVERVIEW

Overview

RSVP (Resource Reservation Protocol) is a resource reservation setup protocol for the Internet.

The RSVP protocol is used by hosts and routers:

- **Hosts**: to obtain specific qualities of service from the network for particular application data streams or flows.
- **Routers**: to deliver quality-of-service (QoS) requests to all nodes along the path of the flows and to establish and maintain state to provide the requested service.

Overview

- Some applications require reliable delivery of data but do not impose any requirements for the timeliness of delivery.
- But applications such as videoconferencing, IP telephony, NetRadio require the opposite: Data delivery must be timely but not necessarily reliable.
- RSVP support divergent performance requirements of differing application types.

QUALITY OF SERVICE
(QoS)

Quality of Service

- A lot of different kind of applications in Internet and each one needs different properties to run.
- For example, distributed multimedia applications need to communicate in real-time and are sensitive to the quality of service they receive from the network.
- These application requirements of multimedia systems have to be transferred to the communication services and operating system.

Quality of Service

Definition of QoS:

"A set of quality requirements on the collective behavior of one or more objects".

Three basic levels of end-to-end QoS that can be provided across a heterogeneous network:

- ***Best Effort***
- ***Differentiated service (DiffServ)***
- ***Integrated service (IntServ)***

Quality of Service

Best Effort

This model deliver data to the destination as soon as possible, but with no commitment as to bandwidth or latency. For this reason the "best effort" model is inadequate for applications requiring timeless. The FIFO queues are the best characterization of this service.

Quality of Service

Differentiated service (DiffServ)

Is traffic that requires timeliness of delivery and that varies its rate accordingly. It means that some traffic is treated better than the rest, but not a fast and guarantee. For instance, MPEG-II video averages about 3 to 7 Mbps, depending on the amount of change in a picture. As an example, 3 Mbps might be a picture of a painted wall, although 7 Mbps would be required for a picture of waves on the ocean.

This service is as well referred as *Controlled delay service*.

Quality of Service

Integrated service (IntServ)

This service requires a guaranteed transmission rate from its source to its destination. The objective of IntServ is to have only one IP network which has best-effort service and flows with a QoS. This is provided through QoS tools RSVP and CBWFQ. It is called as well *Guaranteed bit-rate service*

SYSTEM OVERVIEW

System Overview

DATA FLOW : sequence of datagrams that have the same source, destination and the QoS.

Two basic elements in RSVP: *Sources* and *Destinations*.

All of them run RSVP daemons that participate in RSVP protocol and exchange RSVP messages on behalf of their hosts.

They exchange basically two types of messages:

- PATH
- RESV

System Overview

• RSVP source sends a PATH message.

• It travels through the network to the destination.

• If the destination wants to make a reservation for the particular RSVP flow, it responds with a RESV message and it traverses the reverse path back to the sender.

• Otherwise, a RESV ERROR message is sent back to the receiver.

System Overview

An end-to-end reservation is successfully established when the RESV message reaches the sender and is successfully processed by the RSVP daemon on the sender and in all the other nodes in the middle.

A **multicast** reservation session can also be made:

The sender sends the PATH messages to a multicast group address. The path messages travels through the network to all the members of the multicast group.

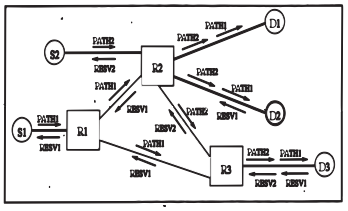
System Overview

When PATH messages reach the receivers, each receiver independently decides if it wants to request a reservation for the session.

Let's see an example...

System Overview

Example:



RSVP is not a Routring Protocol

RSVP is a protocol to negotiate a quality of service for an specific application.

It uses the routing table in routers to determine routes to the appropriate destinations.

So it was designed to interoperate with existing unicast and multicast IP routing protocols.

Data Flows

A **SESSION** in RSVP is defined to be a data flow with a particular destination and transport-layer protocol

It is defined by 3-tuple:

- *Destination address*: Destination IP address of the packages (unicast or multicast).
- *Protocol ID*: Is the identifier ID of the IP protocol.
- *Destination port (optional)*: UDP/TCP destination port field.

Traffic Control

When an RSVP request goes throw a host or a router, it passes between the *admission protocol* who determines if the node has enough resources to supply the requested QoS and the *policy control* to know if the user has administrative permission to make the reservation.

The traffic control has basically two components:

- **Packet classifier**: Determines the QoS for each packet.
- **Packet scheduler**: Achieves the promised QoS.

Traffic Control

If the packet succeed the admission protocol and the policy control then the parameters are set in the *packet classifier*.

After that it goes to the *packet scheduler* which obtains the desired QoS.

If in any control it does not succeed then the RSVP program returns an error to the application process that originated the request.

Reservation Styles

When a receiver sends a RESV message, the message tells how the reservation has to be treated in relationship to the sender, this set of options are called *reservation styles*.

If we have different senders for the same RSVP session, then we have two modes:

- *Distinct Reservation*: creates a different reservation for each upstream sender.
- *Shared Reservation*: creates a shared reservation for specified senders.

Reservation Styles

But we have another option that controls the set of senders. With this option there are also two options:

- *Explicit*: select a list of the senders.
- *Wildcard*: selects all the senders for the session.

Reservation Styles

Sender Selection	Reservation	
	Distinct	Shared
Explicit	*Fixed-Filter Style* (FF)	*Shared-Explicid Style* (SE)
Wildcard	(none defined)	*Wildcard-Filter Style* (WF)

Reservation Styles

- The *Wildcard-Filter* (WF) style creates a single reservation shared by all flows from all upstream senders.
- The *Shared-Explicit* style (SE) creates a single reservation shared by selected upstream senders, so is the same than the Wildcard-Filter but with not all the senders.
- The *Fixed-Filter* creates a distinct reservation for data packets from a particular sender.

RSVP MESSAGES

RSVP Messages

PATH messages store information in each node along the way.

This information includes the IP address of each previous hop in the traffic path which will be used to forward the subsequent RESV messge.

The RSVP receiver sends the RESV message upstream to the sender, which creates a *reservation state* in each node along the traffic path, following the same way than the previous PATH message.

RSVP Messages

An RSVP message consist on two parts :

- Heading
- Object

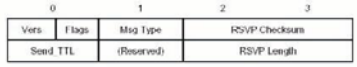
Heading contains the type of message.

With it each node can recognize if the message is a PATH, RESV or an Error message.

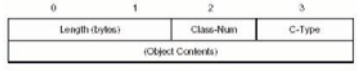
Object contains the reservation style and the quality of service.

RSVP Messages

Heading :



Object :



PATH Messages

- It is sent by the host which wants to make a QoS reservation.
- It travels along the network using the way given by the routing protocols.
- It keep the 'path state' which will be followed by the RESV messages to find the sender.
- It contains the IP address of the previous node, to allow the RESV messages to find the same way back to the sender.

PATH Messages

PATH messages include:

- **Sender Template**
- **Sender Tspec**
- **Adspec**

PATH Messages

- **Sender Template**: describes the format of the data traffic that the sender will send.

  It contains a parameter which identifies the sender's flow from other flows that share the same session on the same link, this parameter is called Filter Spec (filter specification).

PATH Messages

- **Sender TSpec**: descrives the traffic flow that the sender wants to generate.
- **Adspec**: collects information from the intermediate network elements.

PATH Messages

When a node receive a PATH message, it modifies the Adspec with resource information and sends it to the next downstream hop.

Adspec allows receivers to choose a QoS control service and determine the right reservation parameters.

While the PATH message goes toward the receiver, the nodes in the middle include some information in the Adspec object such as delay and bandwidth estimates and various parameters used by specific QoS control services.

PATH Messages

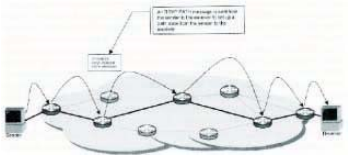
The information in the Adspec is updated each time the PATH message passes through a node.

At each node the Adspec is processed by the traffic-control module. Then it updates the Adspec identifying the services specified in the Adspec and calling each process to update it.

If there is any QoS specified in the Adspec that the node doesn't support, then a flag is set to report this to the receiver.

PATH Messages

Example of Path state:



RESV Messages

A RESV message contains information about the reservation style:

- **Flowspec**
- **Filterspec**

This pair is called a *Flow descriptor*.

RESV Messages

• **Flowspec**: specifies the desired QoS.

It is used to set the parameters in the packet scheduler of each node.

• **Filterspec**: defines the set of data packets to receive the QoS defined by the flowspec.

It is used to set parameters in the packet classifier.

RESV Messages

To get the appropriate QoS between a sender and a receiver, is necessary to communicate some information to the nodes between them.

• **Receiver Tspec:** Describes the traffic flow to which the resource reservation should apply.

• **Receiver Rspec:** Required to invoke the desired QoS.

This information is contained in the *Flowspec* and carried in the RESV messages.

RESV Messages

In each node an RSVP reservation request take two actions:

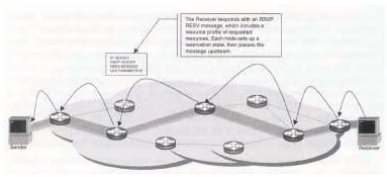
1. Make a reservation on the link.

The RSVP process passes the request to the admission and policy control modules.

If there is some fail in some of them then the process sends an error message to the receiver(s). But if it passes both tests then the packet classifier is setup and it select that data packets defined by the *Filterspec* and interact with the link-layer to find the QoS defined by the *Flowspec*.

2. Forward the request upstream.

RESV Messages



Soft Session

The *soft state* is the maintenance of the reservation state along a particular traffic path, which is maintained by RESV messages.

Necessary because Internet is a dynamic network, some routers can stop working or others can appear.

To keep the soft state is necessary to refresh each node after some specific time.

When a path changes, the next PATH message will start the 'path state' in the new way, and the next RESV message will set up the new soft state.

Teardown Messages

Used to remove the path or the reservation state.

It is not necessary to remove the last reservation, but it is recommended for all the end nodes to send a teardown message when an application finnish.

•**Path Tear**: it goes through all receivers removing the *'path state'*.

•**Resv Tear**: it goes through all senders removing the 'reservation state'.

It can be generated by an application in an end-node or by a router as a result of a timeout.

Error Messages

Two types of error messages:

- **PathErr**: it is generated when there is an error sending a PATH message.

The PathErr is sent to the sender with the type of the error and the IP address of the node who has detected the error.

- **ResvErr**: it is generated when there is an error sending a RESV message.

The ResvErr is directed to the flow receiver who requested the reservation.

Merging

In multicast traffic.

RESV message carries the *Flowspec* which specifies the desired QoS.

Different RSVP receivers which each one send their RESV message.

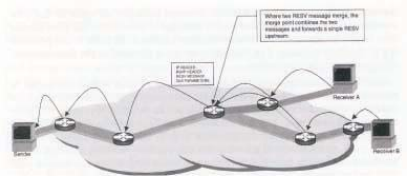
One of the routers in the middle of the way will receive different RESV messages.

It will have to send to the same RSVP sender. So it has to merge the Flowspecs.

Merging

The largest Flowspec from all the merged Flowspecs is used to define the single merged Flowspec.

Different reservation styles cannot be merged because they are incompatible.



RSVP IN WIRELESS MOBILE NETWORKS

Problems of RSVP

When there are end-nodes that change their position during the data communication, then appear a lot of problems.

When a mobile node (MN) moves to another place, the path from the sender to the receiver has to be reestablish.

This MN is discovered only after the soft state time out is expired in the network elements such as a router.

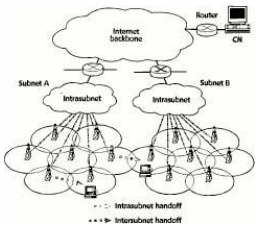
There is a large delay for the applications and the possibility to lose a lot of packets encrease a lot.

Mobility

Micromobility: happens when a mobile node moves to another area but in it is still in the same subnet, then it means that it has the same IP address, so it does not have to notify its home agent (HA).

Macromobility: mobility between different subnets. When macromobility occurs, it means that the mobile node is connected to a different base station that is connected to another router.

Mobility

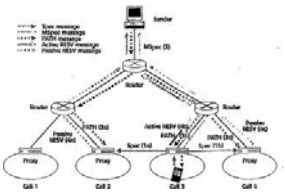


Mobile RSVP (MRSVP)

From the point of view of the receiver:

- Inform the places that it is going to visit in the future.
- Establish a path with sufficient resources to guarantee the quality of service in case he will move.
- When the mobile node gets to one attachment then the path becomes active and the others become passive.

Mobile RSVP (MRSVP)



Mobile RSVP (MRSVP)

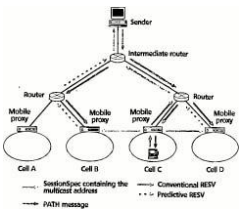
Problems:

- It has to reserve so many resources that maybe will never use.
- The mobile node has to wait a lot until all the attachments are available.

Mobility Support based on IP Multicast

- RSVP messages are delivered to a mobile node using IP multicast routing.
- When the mobile node changes its position, the multicast tree is expanded dynamically. A new branch is formed in the multicast tree.
- When a host leaves from a multicast group a branch in the multicast tree is pruned.
- Once this braches are formed the path messages are forwarded to the mobile proxies along the multicast tree.

Mobility Support based on IP Multicast



Mobility Support based on IP Multicast

Problem:

• Inefficient due to resource reservation in advance.

Simply QoS Signaling Protocol

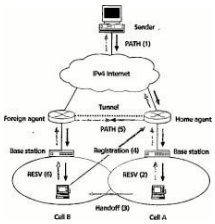
Mixes between RSVP tunneling and Mobile IPv4.

When a mobile node moves to another area it informs to its home agent and when it knows it takes two actions:

- Creates a tunnel along the foreign agent.
- Encapsulates PATH messages to the foreign agent through the tunnel to the mobile node new location.

When the foreign agent receives the RESV message, it sends through the tunnel to the home agent and it forwards it to the sender.

Simply QoS Signaling Protocol



Simply QoS Signaling Protocol

Problem:

If the distance between the new location of the mobile node is so big, then there are problems with the registration between the mobile node and the home agent.

Mobile IPv6 & RSVP Integration Model

• Combination between RSVP and IPv6.

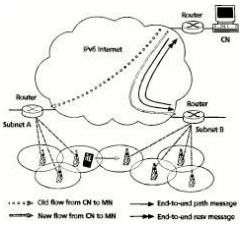
• The resources between the sender and the receiver are established using IPv6 without going through a home agent.

• When the mobile node moves to another area, an RSVP signaling process is invoked and reservation resources are established along the new path.

• The mobile node sends an update to the sender.

• The sender sends a PATH message to the new location and the receiver replies with a new RESV message.

Mobile IPv6 & RSVP Integration Model



Mobile IPv6 & RSVP Integration Model

Problem:

• The main problem of this extension is the reservation delays because of this end-to-end RSVP renegotiation.

Mobility support based on flow transparency

When a mobile node changes its position, the address is changed, so the routers in the middle between the sender and the receiver have to update their data.

There are some of them that are in the new path.

Only that ones that were in the old path have to update their data.

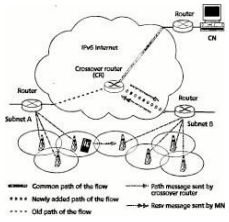
The same with the ones that belong to the new flow path.

Mobility support based on flow transparency

When the mobile node is acting as a receiver, the crossover router (CR) sends the PATH message to the mobile receiver because it still has the information from the last RSVP message exchange.

Then the mobile node has to send the new information to the crossover router.

Mobility support based on flow transparency



Mobility support based on flow transparency

Problem:

• There are more messages traveling in the network, so limits the RSVP negotiation process.

SUMMARY

Summary

• RSVP makes resource reservations for unicast and multicast applications.

• RSVP sessions are simplex. Thus, a bidirectional exchange of data between a pair of machines actually constitutes two separate RSVP simplex session.

• RSVP is receiver-oriented. The receiver of a data flow initiates and maintains the resource reservation used for that flow.

• RSVP maintains soft state in routers and hosts, providing graceful support for dynamic membership changes and automatic adaptation to routing changes.

Summary

• RSVP is not a routing protocol but depends upon present and future routing protocols.

• RSVP transports and maintains traffic control and policy control parameters that are opaque to RSVP.

• RSVP provides several reservation models or styles to fit a variety of applications.

• RSVP provides transparent operation through routers that do not support it.

• RSVP supports both IPv4 and IPv6.

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The End

Thanks everybody.

See you soon...