# A Split Reservation Protocol for Mobile Hosts in Wireless Networks

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# **A Split Reservation Protocol for Mobile Hosts in Wireless Networks**

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Abstract

We discuss the problem of resource reservation, such as bandwidth, for delay sensitive application in wireless networking environment. As multimedia application is becomi ng a critical role of the current mobile network, the resource reservation become very important to support the real-time service.

In this paper, we propose and evaluate a new resource reservation protocol, called Split Reservation Protocol, in wireless ne twork. The simulation results show that our proposed protocol outperforms an existing protocol called MRSVP in terms of network overhead.

## 1. Introduction

In mobile computing environments, one of the most important issues is how to support the guaranteed quality of different types of services. As real-time traffics are on the increase in wireless networks, a certain quality of services (QoS) must be guaranteed [2,4,5,6,7,12] to support them. When a mobile host moves from one location to another, the delivery delay of a packet is affected. A mobile host initiates a session with a certain QoS guarantee by reserving link bandwidth along the path from the sender to its current location. The QoS guarantee is valid only in that location; therefore, when the mobile host moves else where, the QoS guarantee is not valid in the new location.

To provide QoS to a mobile host, it is necessary to make resource reservation from all locations where the mobile host may visit [5,6,7,10,12]. However, this decreases the utilization of the network resource. In this paper we propose a Split Reservation Protocol, which reserves the resource in a current location and in advance only in a next predicted location for the flow of the mobile host to improve the utilization of the network resource. Our reservation protocol supports Reservation which reserves the resource from the current location of a mobile host and Advance reservation which reserves the resource from a next predicted location. The main idea behind our reservation protocol is to split the network into a wired part and a wireless part and efficiently use limited resource in the wireless part by reducing the number of control signals required to maintain the reservation state.

The reminder of this paper is organized as follows: we review previous published work and then in Section 3 we describe the protocol for resource reservation and predictive advance reservation adequate for wireless mobile networks. Then, in Section 4 we provide simulation experiments and evaluate the performance of proposed protocols for resource reservation in wireless mobile networks. Finally, we conclude our paper with a review of our results and a brief discussion of future work in Section 5.

## 2. Previous Work

To provide real-time services over mobile computing environments, predictive advance resource reservation to support smooth handoff have been proposed [10, 11].

To provision QoS in Integrated Services Packet Networks (ISPNs), a number of resource reservation setup protocols have been proposed. RSVP has attracted significant attention in recent times because of its desirable attributes [8,9].

The currently proposed reservation protocol in the Internet, RSVP, is not adequate to make such reservations for mobile hosts. Talukdar [10] has proposed a new reservation protocol, MRSVP, for supporting Integrated Services in mobile networks.

### 2.1 RSVP

RSVP [8,9] is a unidirectional receiver oriented Internet Control Protocol which is used to request Quality of Service from the network and to establish and maintain state to ensure that the request service is provided [8]. AS The RSVP reservation message propagates from the receiver to the sender, resources are reserved at intermediate nodes along the data path.

RSVP employs the concept of "*soft states*" in which resources are reserved only for a predefined interval of time. Periodic refresh messages are required to maintain the state and guarantee that resources remain in reserve. If a refresh message is not sent after a predefined interval of time, the "state" becomes stale and reserved resources are reclaimed for other applications.

A *Path* message carries the *Sender Tspec* which defines the traffic characteristics of the data flow that the sender will generate. On receiving a path message from a source, a receiver sends a *Resv* message. This Resv message contains the *flowspec* the receiver is willing to handle.

### 2.2 MRSVP

MRSVP requires *proxy agents* to make reservations along the paths from the locations in the mobility specification of the sender to the locations in the mobility specification of the receiver. In this protocol, the sender or the receiver or both, may be a mobile host and a mobile host may be a receiver and a sender simultaneously. The proxy agent at the current location of a mobile host is called the *local proxy agent*. The proxy agents at the other locations in the mobility specification of a given mobile host are called *remote proxy agents*. The agent of a mobile host acts as a normal router for the mobile host and an active reservation is setup from/to the sender/receiver to/from the mobile host via its local proxy agent. It is assumed that the mobile host knows the subnets where it is likely to visit.

In MRSVP, there are two types of *Path* messages as well as two types of *Resv* messages. These are:

- Active Path: Carries a Sender_Tspec for active reserv.
- Passive Path: Carries a Sender_Tspec for passive reservation.
- Active Resv: Carries a Flow spec for active reserv.
- Passive Resv: Carries a Flow spec of only passive reservation.

A sender host periodically sends active Path messages to flow destination. In addition, if the sender is mobile, its proxy agents will send passive Path messages. After the routes of active and passive reservations are set up, the mobile host and the proxy agents will start receiving the Path messages. On receiving a Path message the mobile host will send a Resv message for active reservation. If a proxy agent receives Path messages, it will make a passive reservation on the downstream link to which the mobile host will attach when it arrives in its subnet, and then send a Resv message to make a passive reservation. Resv messages for active reservations are converted to Resv messages for passive reservation when they are forwarded towards nodes which contain only proxy agents of the mobile senders and no active sender.

## 3. Split Reservation Protocol

In mobile computing environments, a resource reservation protocol, MRSVP [10], is proposed for mobile hosts in an ISPN, which is an extension of the reservation protocol RSVP. The main feature of this protocol is the concept of active and passive reservation which is used to provide user mobility.

Both RSVP and MRSVP employ the notion of soft reservation states, which are signaling messages associated with state maintenance that increase bandwidth consumption on the wireless segments of the network. Periodically, two protocols require refresh messages to maintain the reservation state. An important attribute of mobile environments is a limited bandwidth, and hence low network utilization.

A new reservation protocol in wireless networks is essential to improve the utilization of wireless networks. Therefore, we separate the reservation protocol in wireless networks from wired networks. To support user mobility, we propose this new reservation algorithm in wireless networks, and recommend that additional function be relegated to RSVP in wired networks.

### 3.1 Features of Split Reservation Protocol

We propose two main classes of reservations, namely

- *Reservations*: allocate resource in the current cell
- *Advance reservations*: reserve resource in the next predicted cell

A Mobility Agent is an entity that acts as a proxy for a mobile receiver under our split reservation protocol. It will typically reside on a base station. A mobility agent on the wired network can generate refresh messages on behalf of mobile hosts. To do so, the mobility agent intercepts messages from its mobile host at first message transmission and then it sends those messages periodically on behalf of the mobile host. It forwards messages to its mobile host only once: refresh messages are not generated in the wireless network, which increases the utilization of wireless network resources. Accordingly, reservations are maintained by transmitting refresh messages in wired networks and by one explicit transmission in wireless networks.

To make advance reservations, the set of locations to which the mobile hosts may visit in future needs to be specified. We define it as Mobility Profile and each mobile host has own mobility profile.

In a split reservation protocol, we present four additional messages. These are:

- *AdvPath: Advance Path message*
- *AdvResv*: Advance Reservation Message
- *MInfo*: Mobility Information for Advance Reservation Msg.
- *FInfo: Flow Information of a Mobile Host Message*

### 3.2 Reservation Setup

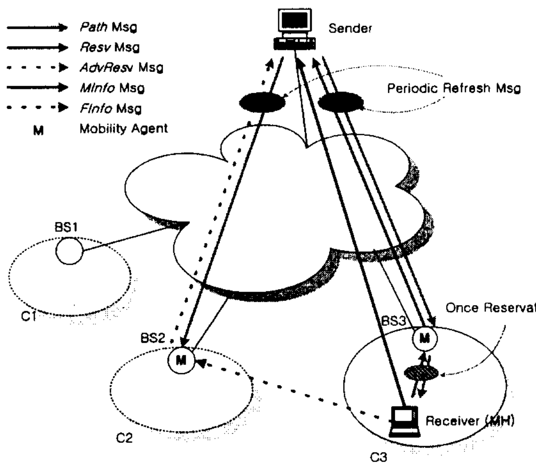
To initiate the reservation setup process, the sender must be informed of the destination address of the flow. A mobile host sends a MInfo message to a sender that generates Path messages. If a sender is a mobile host, it sends a FInfo message to its remote mobility agent that generates AdvPath messages.

When a receiver is a mobile host (Figure 1), a sender periodically sends Path messages to a mobile receiver. On receiving a Path message the mobile host will send a Resv message for reservation. If a mobility agent receives the Resv message from the mobile host, it sends Resv messages periodically on behalf of the mobile host. Whenever a mobility agent in the next predicted cell receives a Path message from the sender, it sends an AdvResv message.

When a sender is a mobile host, a mobile sender transmits a Path message for reservation and its mobility agent in the next cell of the mobility profile sends an AdvPath message for advance reservation to a receiver. After that, its mobility agent periodically sends the Path message on behalf of the mobile host. If a receiver gets the Path message or the AdvPath message, it sends a Resv message for reservation and an AdvResv message for advance reservation.

### 3.3 Managing Reservation State

When a mobile host moves to a next predicted location within its mobility profile and then registers with a new base station, the mobility agent (base station) changes an advance reservation into a reservation state and will not send any further AdvPath or AdvResv messages. When the mobile host de-registers with an old base station, it removes the reservation for the flow of the mobile host.




- BS: Base Station
- C: Cell
- MH: Mobile Host

[Figure 1] Reservation Route – Receiver is a Mobile host

## 4. Simulation Result

We measured the values of the network overhead by varying the mean mobility rate and the number of flows while keeping all other parameters fixed. To compare the performance of our Split Reservation Protocol (Split-RP) with that of the MRSVP, we have to define the time interval to transmit refresh messages in RSVP. The fresh time R is chosen locally by each node and the current suggested default for R is 30 seconds. We used only one type of service class for real-time traffic and the parameters associated with the flows and host mobility:

- *Mean Mobility Rate ($\lambda_a$): moves/second (Poisson Distribution)*
- *Fresh time R: 30 seconds*

Figure 2 shows the message transmission times with mobility rates while fixing the number of flows at 100 and Figure 3 shows them with the number of flows while fixing the mean mobility rate at 0.005 moves/second. As the mobility rate and the number of flows increase, the network overhead also increases. The two Figures show a wide difference in message transmission times between Split-RP and MRSVP in wireless networks. The Split-RP transmits the reservation message when the mobile host moves to another cell. But MRSVP transmits the reservation message periodically and also at the handoff time, which increases the network overhead. Therefore, as the number of mobile flows increases, the difference of the network overhead between two protocols also increases.

## 5. Conclusion

In this paper, we have proposed a new reservation protocol for wireless mobile networks to support QoS to mobile hosts. The basic idea of the proposed reservation protocol is to split the network into a wired part and a wireless part. Through simulations, we find that the network overhead of Split Reservation Protocol is low by reducing the number of control signals required to maintain the reservation state. We are also performing more simulations to support various QoS in wireless mobile networks.

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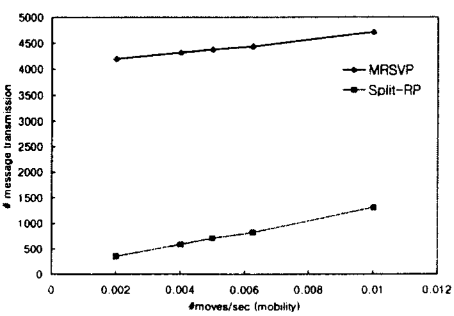
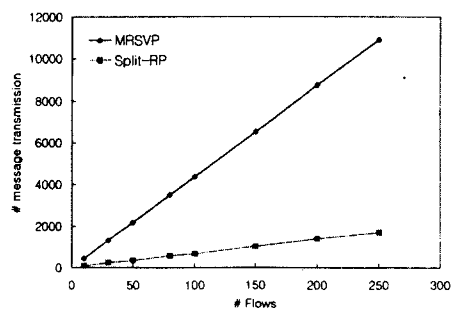



[Figure 2] Network overhead with Mobility




[Figure 3] Network overhead with Flows