

A Scheme Based on Coexistence of NSIS and RSVP for Realization of End-to-End QoS Provisioning

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Abstract—Realization of end-to-end Quality of Service (QoS) provisioning in a scheme plays a very important role in improving stability and quality of communication. Although simple data switching is possible between heterogeneous networks supporting different QoS signalling, end-to-end QoS provisioning can not be completed due to different rules in executing resource reservation. In this paper, a dual-stack scheme is designed with the mapping of the signalling formats between Resource Reservation Protocol (RSVP) and Next Steps in Signalling (NSIS) protocols. In this approach, relationship between corresponding fields of the two protocols is defined according to their signalling formats. The detailed mapping specification of the two signalling includes Common Header, Message Formats, Object Formats, etc. Based on this scheme, end-to-end resource reservation for QoS provisioning can be realized in heterogeneous networks, by recognizing signalling formats between different protocols.

Keywords—NSIS, RSVP, Resources Reservation, QoS Provisioning, Dual-Stack scheme, End-to-End QoS

I. INTRODUCTION

In recent years, there are many problems remaining unresolved when different kinds of wireless networks are integrated together seamlessly, such as mobility management, Quality-of Service (QoS), and AAA et al. How to provide end-to-end QoS provisioning for heterogeneous wireless networks is a key problem that need to be resolved immediately. In general, integrated QoS provisioning scheme is based on end-to-end situation. With the extension of application domain of networks and the appearance of new businesses, in heterogeneous wireless networks environment, the total process of transmission between the receiver and the sender for an operation may involve various network areas and types, such as access network, core network, and IP backbone network, et al. Different QoS schemes are required by different networks. Therefore, it is necessary to design effective end-to-end QoS provisioning scheme for negotiation of QoS demands and realization of end-to-end QoS provisioning, when data flows are transmitted and maintained in heterogeneous networks based on different QoS schemes.

RSVP [1] and NSIS (Next Steps in Signalling) [2] are two typical end-to-end QoS signalling. Initially, RSVP has been designed to be used by a host to request specific QoS services

from a network. Service is requested for a specific flow of group of flows. It is used also by routers to deliver QoS requests to all nodes along the path(s) and to create and maintain state resource reservations so to match the host request for specific flows. In addition, RSVP is known to have some practical constraints in deployment such as scalability and security problems. Accordingly, the Internet Engineering Task Force (IETF) proposed a new IP signalling protocol suite, called Next Steps in Signalling (NSIS). Up to now, IETF have proposed many solutions to guarantee end-to-end QoS that is based on RSVP or NSIS. However, the coexistence of RSVP and NSIS has not been considered, and end-to-end QoS provisioning can not be realized in heterogeneous networks, resulting in obstacles in the development of QoS of networks.

Based on the RSVP and NSIS solutions proposed by IETF, a Dual-Stack scheme is proposed here to guarantee end-to-end Quality-of Service (QoS) in next-generation heterogeneous networks. In this scheme, signalling interaction is considered between NSIS and RSVP. Through communication, they can recognize signalling [3] from each other, and therefore resource reservation [4] of the total path can be completed. The rest of this work is organized as follows. Section 2 describes the related works on the recent solution using two QoS signalling. Section 3 describes in detail the Dual-Stack solution for QoS mechanism in heterogeneous network applications. Section 4 analyses the detailed signalling. Conclusions are finally drawn in Section 5

II. BACKGROUND AND RELATED WORK

This study proposes a Dual-Stack scheme supporting for end-to-end Quality-of Service (QoS) in next-generation heterogeneous networks. The referred QoS schemes are described as follows.

A. Rsvp

When the receiver and the sender both support RSVP protocol, but the middle routers support NSIS, in order to actualize the communication between the two different protocols, RSVP defines the tunnel scheme [1]. For networks that can not support RSVP protocol, RSVP can establish tunnel automatically. The tunnel requires the routers, whether

they support RSVP or not, to forward path information by local routing table. When path information passes a network that does not support RSVP, it carries an IP address, which is the IP address of the last router supporting RSVP. Reservation messages are forwarded to an upstream router with RSVP capability, to realize the network communication. However, the path can not achieve resource reservation, and therefore relevant QoS can not be completed either.

B. Nsis

When two NSIS peer entities communicate, some routers on the data path may support NSIS, while others support RSVP. In this case, the transmission of NSIS signalling is not influenced, because the routers supporting RSVP only have a function of forwarding signalings. However, signalling interacting between the two kinds of routers can not be performed. Therefore, the end-to-end QoS provisioning can not be realized either.

C. Nsis and Rsvp Interworking

In heterogeneous networks, it is necessary to use the RSVP and the NSIS QoS protocols simultaneously. When the receiver and the sender support the two protocols respectively, and the middle routers also support different protocols, the end-to-end QoS provisioning can not be realized.

In a word, for the three situations above, only the end-to-end communication is realized. The routers that do not support RSVP or NSIS can not perform reservation, and hence the end-to-end QoS provisioning can not be achieved. In order to accomplish the coexistence of RSVP and NSIS, a Dual-Stack scheme is proposed.

III. A DUAL-STACK SCHEME

A. Dual-Stack scheme

The Dual-Stack is a protocol stack that can employ RSVP and NSIS simultaneously in a system. The main methodology of the scheme is to install two protocol stacks for network codes, the RSVP protocol stack and the NSIS protocol stack. In this way, the Dual-Stack code can communicate with NSIS and RSVP codes, and finally realize end-to-end reservation. The Dual-Stack structure is shown in Figure 1. The dual-stack host (or router) can not only communicate with the routers supporting RSVP, but also communicate with the routers supporting NSIS. The routers of Dual-Stack are called RSVP/NSIS, indicating that they have two QoS signalling protocols: RSVP protocol and NSIS protocol. The hosts with Dual-Stack employ NSIS protocol when they communicate with NSIS host, but when they communicate with RSVP host, the RSVP protocol is employed.

B. Deployment of The Dual-Stack

In this work, the mapping between the two QoS signalings is achieved by the definition of the two signalling formats, to realize the function of the Dual-Stack and enable the coexistence of RSVP and NSIS. The details of the mapping are described as follows.

1) RSVP Signalling Format

RSVP signalling consists of 5 parts, including protocol object, source address, source port, receiving address, and receiving port. The protocol object means signalling head.

• Common Header

The common header [5] is shown in Table 1

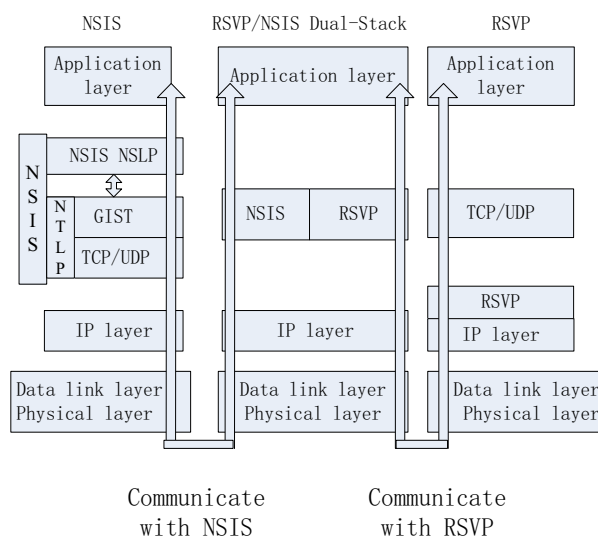


Figure 1. Dual-Stack Structure

TABLE 1. COMMON HEADER OF RSVP

Vers	Flags	Msg Type	RSVP Checksum
Send-TTL		(Reserves)	RSVP Length

The fields in the common header are as follows:

Vers: 4 bits, protocol version number

Flags: 4 bits, No flag bits are defined yet

Msg Type: 8 bits

1=Path; 2=Resv; 3=PathErr; 4=ResvErr; 5=PathTear; 6=ResvTear; 7=ResvConf

RSVP Checksum: 16 bits

Send-TTL: 8 bits, The IP TTL value with which the message was sent.

RSVP Length: 16 bits, the total length of this RSVP message in bytes, including the common header and the variable-length objects that follow.

• Object Formats

Every object consists of one or more 32-bit words with a one-word header, the format of which is shown in Table 2.

TABLE 2. OBJECT HEADER OF RSVP

Length(Byte)	Class-Num	C-Type
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Length: A 16-bit field containing the total object length in bytes. Must always be a multiple of 4, and at least 4.

Class-Num: Identifies the object class, an RSVP implementation must recognize the following classes:

1=Null; 2=Session; 3=Session-group; 4=RSVP-hop; 5=Integrity; 6=Time-Value; 7=Error-spec; 8=type; 9=FLOWSPEC; 10=FILTER-SPEC; 11=SENDER-TEMPLATE; 12=SENDER-TSPEC; 13=ADSPEC; 14=POLICY-DATA; 15=CONFIRM; 16=Scope; 30=DIAGNOSTIC; 31=ROUTE; 32=DIAG-RESPONSE.

C-Type: indicate concrete signalling with Class-Num.

2) NSIS Signalling

The IETF NSIS protocol suite consists of the NSIS Transport Layer Protocol (NTLP) and the NSIS Signalling Layer Protocol (NSLP) layers as shown in Fig.2. The NSLP layer is placed above the NTLP layer and comprises of signalling applications, such as the QoS-NSLP, NSLP for metering and the NSLP for NAT/firewall traversal (NatFW-NSLP). The NSIS protocol suite enables signalling applications to install, modify or remove control state in a network. This control state is related to the data flow that the application wants to deliver. Here NTLP signalling format is defined as a combination of source address, source port, receiving address, and receiving ports, while the design of the QoS NSLP is conceptually similar to RSVP.

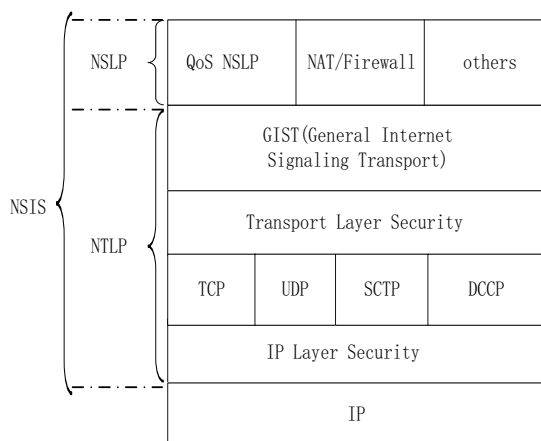


Figure 2. NSIS framework

• Common Header

Similarly, the common signalling header [6] contains a field of 32-bit, which consists of 3 parts. The structure of the header is shown in Table 3.

TABLE 3. COMMON HEADER OF NSLP

Message type	Message flags	Generic flags
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QoS NSLP uses four messages for QoS signalling:

RESERVE: handles QoS reservation state. (creat, refresh, modify, and remove)

QUERY: requires information of the data path such as path characteristics, receiver-initiated reservations, or support of certain QoS models.

RESPONSE: provides information as the result of a previous QoS NSLP message.

NOTIFY: delivers information to a QoS NSLP node without preliminary request.

The fields in the common header are as follows:

Msg Type: 8 bits

1=RESERVE; 2=QUERY; 3=RESPONSE; 4=NOTIFY.

Message-specific flags: 8 bits

These flags are defined as part of the specification of individual messages, and, thus, are different with each message type.

Generic flags: 16 bits

Generic flags have the same meaning for all message types.

• Object Formats

The QoS NSLP uses a Type-Length-Value(TLV) object format. Every object consists of one or more 32-bit words with a one-word header. For convenience the standard object header is shown in Table 4.

TABLE 4. OBJECT HEADER OF NSLP

Length(Byte)	Class-Num	C-Type
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Length: The format is the same as the RSVP.

Class-Num: We have define 9 different signalling.

1=NULL; 2=Session; 3=NSIS-HOP; 4=Time-Value; 5=SENDER-RSV; 6=RECEIVER-RSV; 7=QoS-Desir; 8=QoS-Avail; 9= QoS-Rsrv.

C-Type: The format is the same as the RSVP.

3) The mapping of the two signalling

Through the definition of the two signalling formats, we can recognize the relation between them.

For the mapping from RSVP to NSIS, the relation between the common headers of the two signalling is shown in Table 5. The message types that are not listed in the table will be discarded. The mapping between the object formats is described in Table 6. The numbers in this table represent the Class-Num of objects shown in Table 2 and Table 4.

Thus, the mapping relationship is obtained by defining the signalling formats. Through the mapping between RSVP and NSLP, the two signalling can communicate with each other freely and realize the end-to-end QoS provisioning.

TABLE 5. THE MAPPING OF THE MSG TYPE OF THE COMMON HEADER

RSVP	Resv	Path	PathErr
NSLP	RESERVE	QUERY	RESPONSE
RSVP	ResvErr	PathTear	ResvTear

NSLP	RESPONSE	RESPONSE	RESPONSE
RSVP	ResvConf		
NSIS	RESPONSE		

TABLE 6. THE MAPPING OF THE OBJECT TYPES

RSVP	1	2	4	6
NSIS	1	2	3	4
RSVP			9	9
NSIS	5	6	7	8
RSVP	9			
NSIS	9			

IV. ANALYSIS OF SIGNALLING

In paper, we considered the mapping of RSVP to NSIS. In this case, RSVP and NSIS are all based on the receiver to realize resource reservation. The detailed signalling are shown in Fig.3.

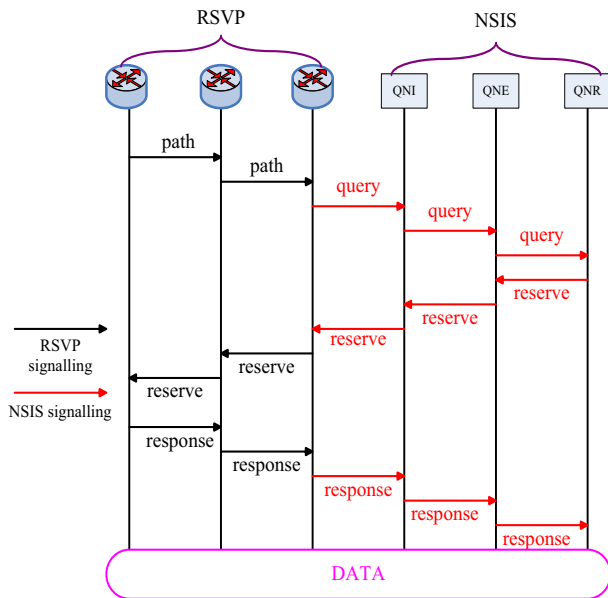


Figure 3. RSVP-NSIS signalling

V. CONCLUSIONS

In this study, we firstly analysed RSVP and NSIS signalling individually. Aiming at resolving the problems in communication between the two protocols in heterogeneous networks, we proposed a Dual-Stack scheme. The mapping between the two QoS signalling is achieved by the definition of the two signalling formats. Based on this scheme, RSVP and NSIS can recognize signalling from each other. Therefore, communication between them can be completed, and the end-to-end resource reservation is realized. This scheme guarantees QoS provisioning successfully, and provides a foundation to the next generation heterogeneous networks.

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