Design and Implementation of NNI Interworking Protocol of OBP Satellite B-ISDN

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Abstract: It is essential to develop the internetworking strategies between the OBP satellite B-ISDN and the terrestrial B-ISDN for the economical and efficient implementation of the future network infrastructure. We have considered the implementation issues of the emerging B-ISDN, especially interworking strategies of the terrestrial B-ISDN with the OBP satellite B-ISDN.

We proposed interworking model between terrestrial B-ISDN and OBP satellite B-ISDN NNI signaling protocol, and describes the design and verification of the interworking protocol. For the verification, interworking protocol is modeled by Predicate/Action Net derived from Petri Net and the designed model is analyzed by reachability tree.

Using Unix socket, the verified interworking protocol is implemented in two workstations and implemented interworking protocol is tested by local test method which is outstanding in error detection and recommended by ISO.

1. Introduction

It have been rapidly developed satellite communication in the 21 century's high tech information. So, it bring about problems which lack of satellite orbit and gives out frequency resource by increment of satellite universally. To support this, an OBP satellite system is need.

In this paper, we have outlined the next generation of satellite communication; NNI interworking protocol of OBP satellite B-ISDN, which offers multimedia service and applies frequency reuse method for multi-spot beam. The NNI interworking protocol of OBP satellite B-ISDN is also analyzed and implemented.

2. Design of B-ISDN Signaling Message

In this section, we have considered as follow below.

- Definition of signaling message
- NNI interworking strategies of the terrestrial B-ISDN with the OBP satellite B-ISDN

2.1 B-ISUP Protocol Message

Message defined network node is shown in Table 1.

Table 1. B-ISUP Protocol Message

Message	Description
ACM	Address complete message
ANM	Answer message
CPM	Call progress message
IAM	Initial address message
IAA	Initial address acknowledgement message
IAR	Initial address reject message
REL	Resume message
RLC	Release Complete message
SAM	Subsequent address message

2.2 Define of Satellite B-ISUP Signaling Message

For processing interworking protocol of the terrestrial B-ISDN with the satellite B-ISDN, we define satellite B-ISUP signaling message in table 2.

Table 2. Define of Satellite B-ISUP Signaling Message

S-BISUP	Description
Back In Service	Message to notify available circuit state
Out Of Service	Message to notify disable service
Release	Message to notify protocol conversion and release circuit
Setup	Message to request to connect the satellite circuti
Setup Acknowledge	Message to notify setup acknowledge
Update	Message for update parameter

2.3 Design of internetworking signaling protocol

(1) Establishment and Release process of point-to-multipoint basic call

Figure 1 indicates OBP satellite B-ISDN call setup processes. Point-to-multipoint process is equal to point-to-point call setup process. Based on this call setup process, add the party then point-to-multipoint call setup process is finished. In many parties of point-to-multipoint connection, message includes end point reference for knowing that the parties are related to the call message, and bandwidth established has the ability that can be simplex information transmission.

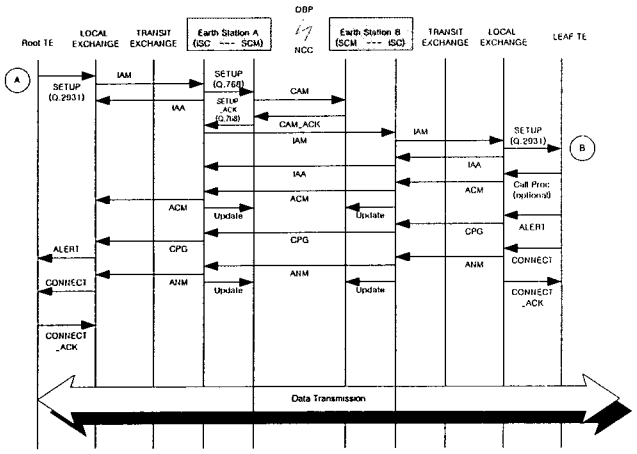

Figure 1. Establishment of point-to-multipoint basic call

Local exchange received RELEASE message at point-to-multipoint call proceed call release process by transmitted RELEASE message to independent party in the all current party. And this independent release process equal to point-to-point basic call setup process.

(2) Add Party process and Drop Party process

After the point-to-multipoint basic call setup, it can try the add party process by only root. It is processed by add party process start with switched and transmitted the ADD_PARTY message. Reference value of end point in the ADD_PARTY message assigned positive number except zero. And call reference uses first value of call connection. Received local exchange's transmission process is equal to call setup message's. Figure 2 indicates this process.

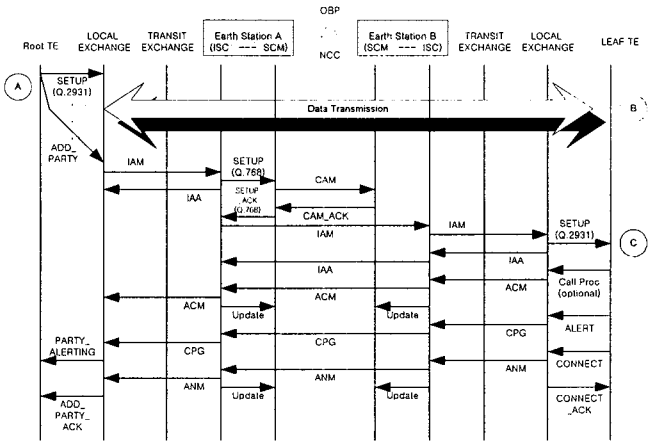

Figure 2. Add Party process of point-to-multipoint

Some parties can be dropped by call-owner's requirement or party located end point itself's requirement.

3.Verification of NNI Interworking Protocol

3.1 Architecture of NNI Interworking Process

NNI interworking protocol handles signaling of establishment and disconnect of call and bearer connection using communication service that presented from terrestrial and OBP satellite B-ISDN user part. Architecture of NNI interworking protocol is shown in Figure 3.

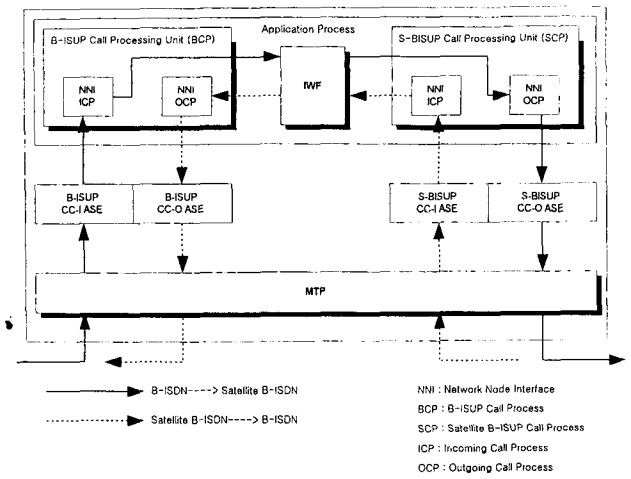

Figure 3. Architecture of NNI interworking protocol

3.2 State Transiton of NNI Interworking Protocol

The state transition steps for establishment and disconnect of call/connection must be designed by required each processing unit. They are shown in Figure 4 and Figure 5.

(1) Request of call/connection from Terrestrial B-ISDN side

B-ISUP Call Processing unit is selected from call control process of trunk switching system for continuous call processing. NNI outgoing call processing unit receives IAM message, and then sends B_Setup_req primitive to B-ISUP protocol processing unit. State transition diagram of outgoing terrestrial B-ISUP is shown in Figure 4.

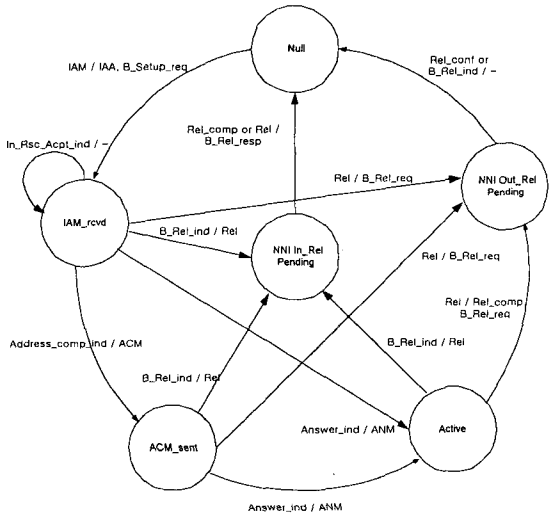

Figure 4. State transition diagram of outgoing terrestrial B-ISUP

Satellite B-ISUP Call Processing unit is selected from call control process of trunk switching system. Satellite B-ISUP Call Processing unit receives setup message, and then sends S-BISUP_Setup_req primitive to S-BISUP protocol processing unit. State transition diagram of outgoing satellite B-ISUP is shown in Figure 5.

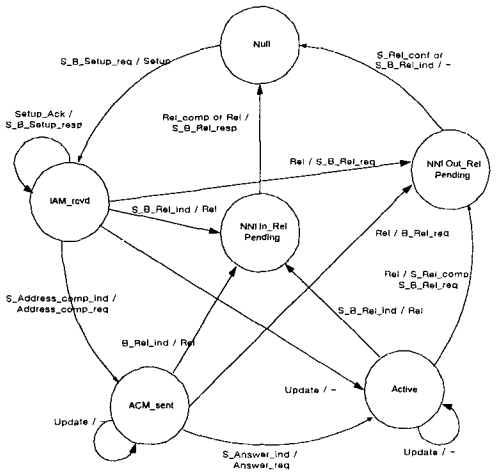

Figure 5. State transition diagram of outgoing satellite B-ISUP

3.3 Modeling of B-ISUP/S-BISUP Protocol

The connection between outgoing B-ISUP Call Processing and Satellite B-ISUP Call Processing is modeled by Petri Net as shown in Figure 6.

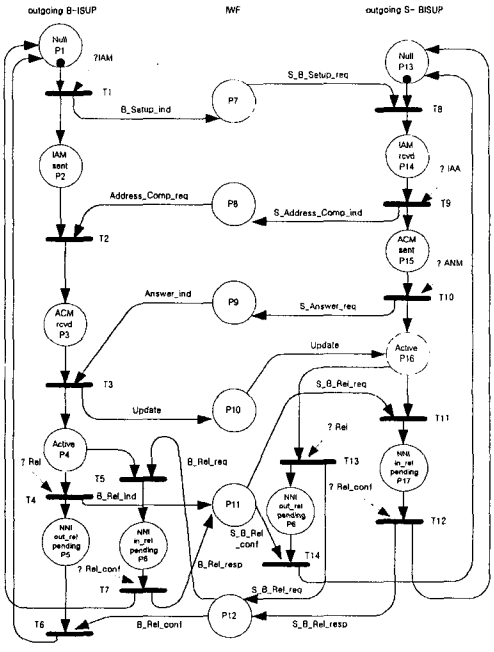

Figure 6. Verification of NNI Interworking Protocol

3.4 Verification of NNI Interworking Protocol

The reachability tree that presents case of connection between outgoing terrestrial B-ISUP Call Processing unit and satellite B-ISUP Call Processing unit is shown in Figure 7.

A node of reachability tree presents a token's place at each module. This tree shows that all states are reachable from initial state without deadlock. Also, this tree is boundness because all places do not have more than two tokens.

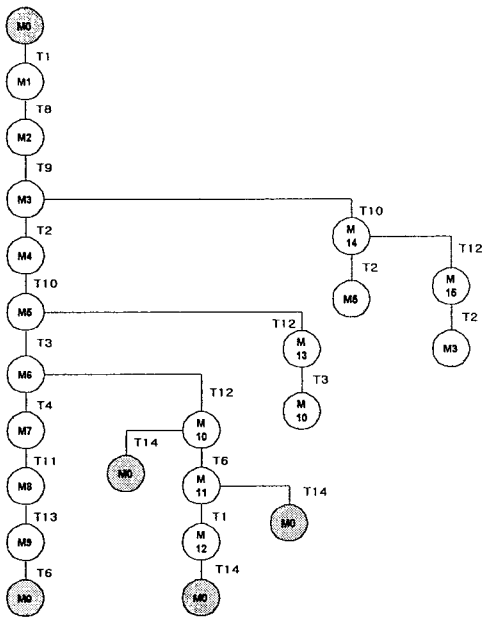

Figure 7. Reachability tree that require Call Setup at Outgoing Processing unit

4 Implementation of NNI Interworking Protocol of OBP Satellite B-ISDN

To implement interwoking protocol between two hybrid networks, it has used Q.2931, Q.2763, Q.768 corresponding to B-ISDN's UNI, NNI and S-BISUP NNI protocols respectively.

Using UNIX socket, the verified interworking protocol is implemented in two workstations and implemented interworking protocol is tested by local test method which is outstanding in error detection and recommended by ISO. Test system architecture is shown in Figure 8. Test is processed by test scenario and that results are successful.

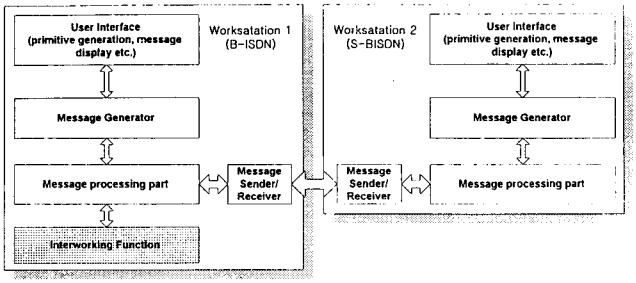

Figure 8. Test system architecture

5 Conclusion

Future satellite communications networks providing broadband multimedia and mobile services for personal, residential, and private business applications need to be interconnected to and interwork with terrestrial broadband networks and multimedia service provisioning systems to facilitate service access and end-to-end communications.

This paper describes a design and implementation of interworking protocol between B-ISUP of terrestrial B-ISDN and S-BISUP of OBP satellite B-ISDN.

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