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Internet SARPs Modifications to Mitigate Mobile Subnetwork Connectivity

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Summary

The ICAO ADS Panel developed the operational requirements for the ATS data link applications concurrent with the ATNP WG2 development of the ICS SARPs (i.e., Sub-Volume V of Dc0 9705). The ADSP has defined very stringent requirements for service availability and continuity of service that probably cannot be satisfied by early (i.e., Package 1) implementations due in part to lack of real-time reporting of mobile subnetwork connection status. This working paper proposes to modify Sub-Volume V to utilize the selective acknowledgment mechanisms of the transport protocol.

1 BACKGROUND

The ICAO ADS Panel developed the operational requirements for the ATS data link applications concurrent with the ATNP WG2 development of the ICS SARPs (i.e., Sub-Volume V of Dc0 9705). The ADSP has defined very stringent requirements for service availability and continuity of service that probably cannot be satisfied by early (i.e., Package 1) implementations due in part to lack of real-time reporting of mobile subnetwork connection status; and due in part in to the potential loss of TPDUs.

2 DISCUSSION

The ICAO ADS Panel has produced an ICAO Manual of ATS Data Link Applications. In this document the operational requirements for the initial data link applications are defined. The manual defines very stringent requirements for continuity of service and service availability for the CPDLC and ADS (contract) applications. The manual specifies that availability may be achieved through provisions of alternate communications routing. Although not explicitly stated, this technique could also be applicable to the requirement for continuity of service.

In order for the ATN to offer an end-to-end service that satisfies the above referenced operational requirements, each BIS must have near real-time knowledge of the loss of connectivity over a given subnetwork. The consequence of not having such knowledge could be the forwarding of packets to a subnetwork that will discard the packets because it cannot provide the required connectivity.

A packet forwarded according to out-of-date connectivity information would be “lost” since it would be discarded. The packet(s) would contain one or more TPDUs that would not be received or acknowledged by the destination end-system. At some point the appropriate connectivity information would become available and packets would again be received by the end-system. However, the transport entity would not be able to deliver the received TPDUs since they would be out-of-sequence (due to the lost TPDUs). For the correctly received TPDUs, the delay in delivery would be related to the sender’s retransmission time since only upon a timeout would the TPDUs be resent. The time period for which a receiver would wait would be equal to the retransmission timer plus the transit delay. This can result in a service interruption of several minutes due to a change in subnetwork connectivity.

An optional mechanism in the transport protocol can be used to minimize the waiting period and force retransmission. The mechanism “selective acknowledgment” allows a receiving transport entity to acknowledge out-of-sequence TPDUs. This information can be used by the sending transport entity to generate retransmissions. Selective acknowledgment was added to the transport protocol to handle the cases where occasional loss of TPDUs could occur over long delay networks. The procedures allow a receiving transport entity to acknowledge out-of-sequence TPDUs to avoid retransmissions of already received data. These procedures, with additional algorithms, can be used within the ATN to limit the problems encountered when connectivity information is out-of-date.

The use of selective acknowledgment is currently an optional feature within Doc 9705. Additional procedures for its use and the conditions under which it should be used need to be added.

The following procedures could be used to enhance mobile operation:

1. both sending and receiving transport entities negotiate the use of selective acknowledgment

2. on receiving an out-of-sequence TPDU, the transport entity shall wait for the next TPDU. If the second received TPDU is not the missing TPDU, the transport entity should send a selective acknowledgment with the two TPDUs.

3. on receiving a selective acknowledgment, the sending transport entity should immediately resend all missing TPDUs.

3 RECOMMENDATIONS

The working group is invited to consider the above material and to develop enhancements to Doc 9705 Sub-Volume V to utilize transport protocol selective acknowledgment mechanisms in support of the availability requirements of the ADS Panel Manual.

Specifically it is proposed that the transport protocol selective acknowledgment mechanisms be made mandatory for systems operating over mobile subnetworks. The use of selective acknowledgment should be described according to the procedures outlined above.