International Civil Aviation Organization

THE SEVENTH MEETING OF AERONAUTICAL TELECOMMUNICATION NETWORK (ATN) TRANSITION TASK FORCE OF APANPIRG

Shanghai, China, 18-22 April 2005.

Agenda Item 7: **Review State's ATN Implementation/Operational activities and issues**

USE OF TCP/IP PROTOCOLS IN ASIA/PACIFIC REGION AERONAUTICAL TELECOMMUNICATION NETWORK

(Presented by the United States)

1. Introduction

1.1 This information paper describes the use of the Internet Protocol Stack (commonly referred to as the TCP/IP protocols) in the Asia/Pacific Aeronautical Telecommunication Network (ATN). The Asia/Pacific ATN will initially support ATS Message Handling Service (ATSMHS) and ATS Interfacility Data Communications (AIDC) and eventually will support ATN Air/Ground applications. The Asia/Pacific Regional ATN is based on ICAO standards for ATN Ground-Ground Routers. In accordance with the Asia/Pacific ATN Ground-Ground Router ICD, Ground-Ground Routers implement the standard ATN networking protocols, that is, they implement CLNP for packet forwarding and IDRP for dynamic routing. Asia/Pacific Ground/Ground Routers are by default interconnected using ISO/IEC 8208 (X.25) circuits on a point-to-point basis.

1.2 States may bilaterally decide to interconnect ATN Ground-Ground Routers using the TCP/IP protocol stack. However, in order to provide a common ATN inter-network, states must still provide ATN Ground-Ground Routers that meet the CLNP and IDRP provisions in the ATN Ground-Ground Router ICD and adhere to the Asia/Pacific IDRP Routing Policy and the Asia/Pacific Network Service Access Pont (NSAP) Addressing Plan.

1.3 This paper describes two common methods that may by used for ATN Router interconnectivity using TCP/IP. The first is to employ the IP SNDCF whereby CLNP packets are encapsulated in IP packets and the second is to employ the X.25 over Transport (XOT) protocol where CLNP packets are encapsulated in 8208 packets, which in turn are encapsulated in TCP packets, which are exchanged using IP. This paper concludes by noting that AFTN terminals and may be connected to AFTN via TCP/IP and that this is considered a local matter.

2. Asia/Pacific ATN ICS

2.1 The Asia/Pacific ATN is based on agreed-to International Civil Aviation Organization (ICAO) standards as specified in ICAO Doc 9705. The Asia/Pacific ATN uses the ATN Internet Communications Service (ICS), which is based on the OSI Connectionless Network Protocol (CLNP) and the OSI Inter-Domain Routing Protocol (IDRP). These protocols are implemented in ATN Ground-Ground Routers and they provide region-wide connectivity at the network level. The specific operating features and parameters for CLNP and IDRP are specified in the "Asia/Pacific ICD for

Ground-Ground ATN Routers for ISO/IEC 8208 Sub-Networks", generally referred to as the Ground-Ground Router ICD. The ISO/IEC 8208 standard is essentially the same as the CCITT X.25 standard, but additionally specifies operation for one router communicating with another router without intervening X.25 switches, that is for one Data Terminating Equipment (DTE) interfacing with another DTE. Connectivity in the region is provided with a minimum of routing overhead in accordance with the IDRP Routing Policy and the supporting NSAP Addressing Plan.

2.2 The common ATN ICS will initially be used to support ATS Message Handling System (AMHS) applications, followed by ATN Interfacility Data Communications (AIDC) applications, and eventually by Air-Ground Applications. Each of these applications will run directly over the ATN ICS protocols. Figure 1 depicts this generic environment.

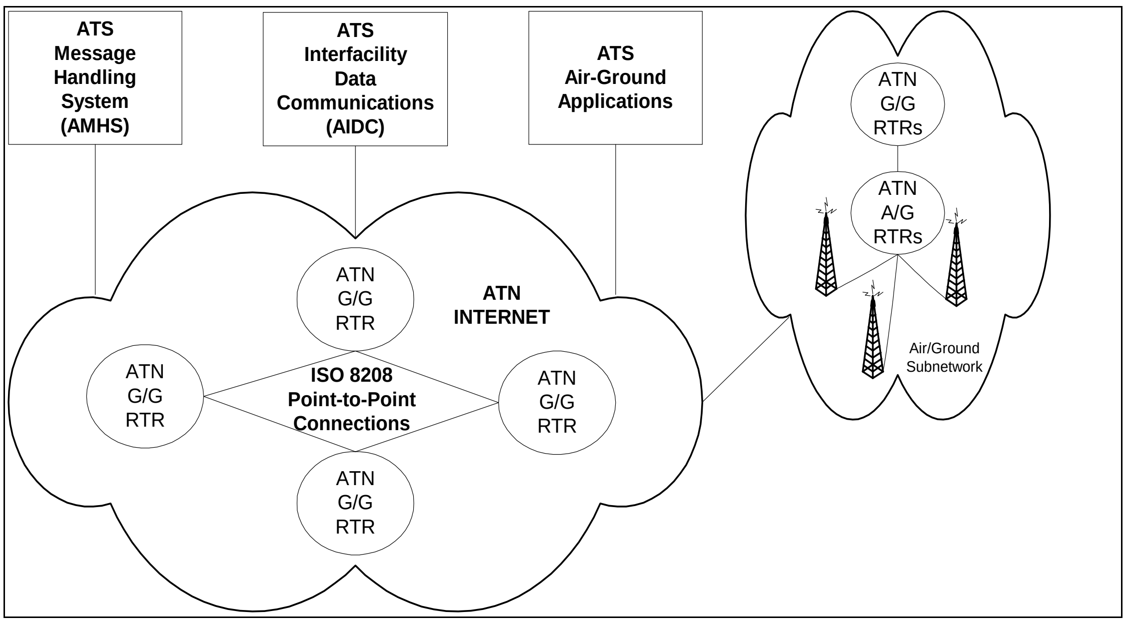

Figure 1. –ATN Internet Communication Service Environment

3. Asia/Pacific AMHS

3.1 The initial AMHS configuration (see Figure 2) is expected to be AFTN systems connected by AFTN/AMHS gateways, which operate over the ATN ICS. An AFTN/AMHS gateway has is an X.400 Access Unit with two main components. The Message Transfer and Control Unit (MTCU) provides the interface to AFTN by converting AFTN formatted messages to X.400 format. The Message Transfer Agent (MTA) performs static routing at the message level, that is, it selects the destination MTA by indexing a pre-configured table using the "Recipient Address" in an X.400 message. Once the destination MTA is determined the originating MTA looks up the network (i.e., NSAP) address and passes the message to the ATN Internet Communication Service. The ATN network however uses dynamic routing and adapts automatically to changes in connectivity, for example if an 8208 point-to-point connection fails. This is accomplished by the IDRP dynamic routing protocol operated among the ATN Ground/Ground Routers. It is this use of the ATN ICS that permits "direct MTA-to-MTA" routing in accordance with the Asia/Pac Regional AMHS MTA Routing Policy. In other words, an MTA does not have to be statically configured with MTA paths to the destination MTA. The underlying network provides this adaptive routing service. Note that this is a key difference from AFTN where AFTN switches must configured with a set of next-hop AFTN switches to reach a particular destination AFTN switch.

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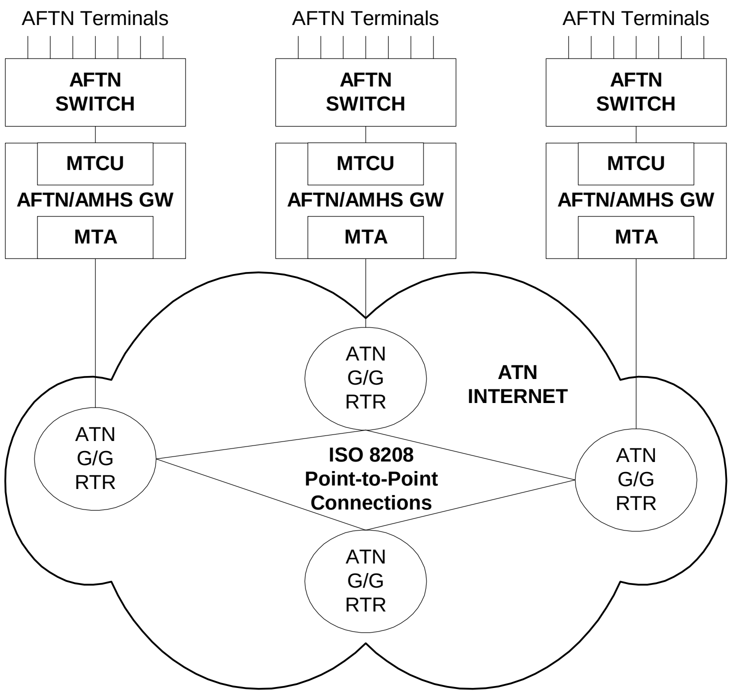

Figure 2. – AFTN/AMHS Gateways Using ATN Internet

4. Asia/Pacific ATN Ground-Ground Router Interconnectivity using TCP/IP

Rather than interconnect their ATN G/G Routers using 8208 point-to-point connections, states may choose to connect these routers using an IP sub-network. This configuration is depicted in Figure 3. Note that in this configuration the ATN Internet still consists of ATN Ground/Ground Routers and that these routers continue to operate CLNP and IDRP in accordance with the established Asia/Pacific Ground-Ground Router ICD, IDRP Routing Policy, and the NSAP Addressing Plan.

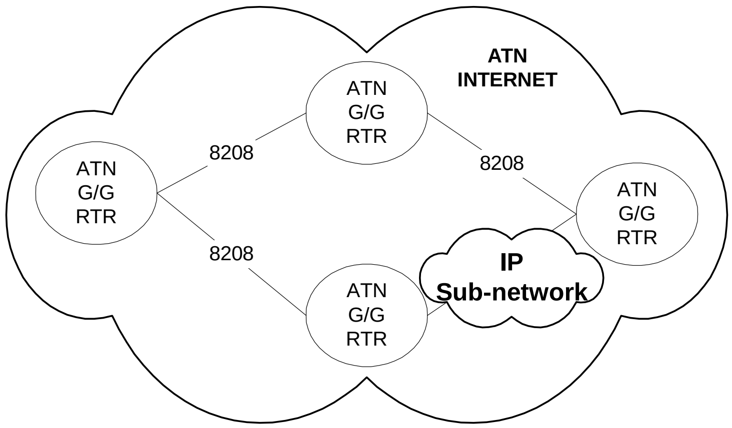

Figure 3. – Interconnection of ATN Routers via an IP Subnetwork

4.1 ATN Ground-Ground Router Interconnectivity using XOT

One way to interconnect ATN Ground-Ground Routers over an IP Sub-Network is continue to operate ISO/IEC 8208 out of the routers but to use IP routers within the sub-network configured to operate the X.25 over TCP/IP (XOT) in accordance with RFC 1613. In this case the IP routers will encapsulate the X.25 packets over a TCP/IP connection. The XOT configuration is depicted in Figure 4.

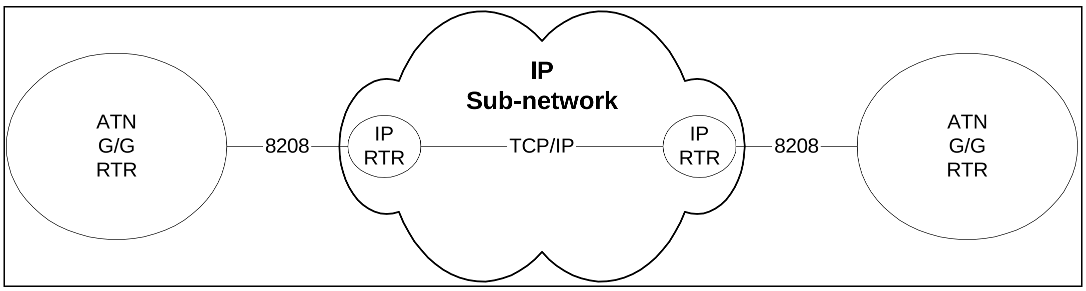

Figure 4. – Interconnection of ATN Routers using XOT

4.2 ATN Ground-Ground Router Interconnectivity using the IP SNDCF

An alternative way to interconnect ATN Ground-Ground Routers over an IP Sub-network is to implement the IP SNDCF in the router. In this case CLNP and IDRP packets are directly encapsulated within IP in accordance with a pending enhancement to Edition 3 of ICAO Doc 9705. The IP SNDCF configuration is depicted in Figure 5.

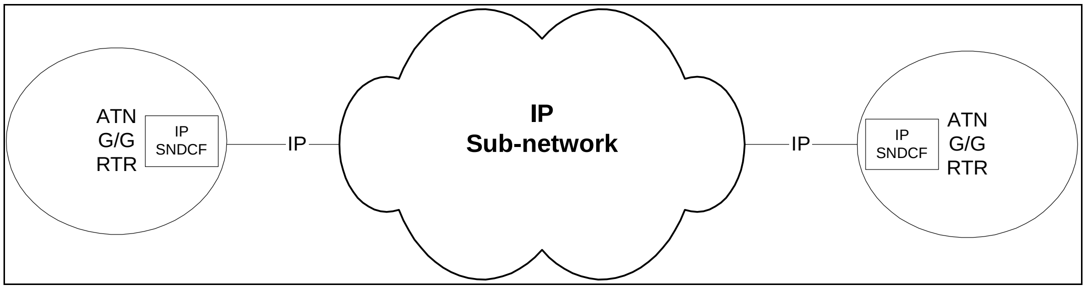

Figure 4. – Interconnection of ATN Routers using the IP SNDCF

5. AFTN Terminal Interconnectivity Options

One final application of TCP/IP in the initial AMHS environment would be to connect AFTN terminals to the AFTN switch. This could be as a replacement for X.25 or Asynch connections or to support terminals that are web-based. This connectivity is considered a local matter and is therefore not specified on a regional basis.

6. Conclusion

This information paper has described the Asia/Pacific ATN Internet consisting of ATN Ground-Ground Routers and its initial use by AFTN/AMHS Gateways and described the default interconnection of these outers by 8208 point-to-point circuits. It is noted that TCP/IP may be used to interconnect ATN Ground-Ground Routers by bilateral agreement between states/administrations; however the ATN Internet using CLNP and IDRP is still required in order to ensure regional interoperability. This paper described two common methods to use an IP sub-network: XOT and the IP SNDCF. This paper also notes that AFTN terminals may be connected to AFTN switches via TCP/IP.
