Requirements placed on the ATN Communication Service by Air/Ground Applications

1. Scope and Purpose

This flimsy presents a summary of the air/ground user application requirements derived from discussions held during the March 1995 meetings of ATNP Working Groups 1, 2, and 3. The intent of this flimsy is to present those requirements along with associated technical implications, in order to allow Working Group 1 to ratify this requirement set for use by Working Groups 2 and 3. This ratification is urgently needed, in order to support the continued and timely progress of Working Groups 2 and 3 in their development of SARPs and Guidance Material to meet these user requirements.

In the context of this flimsy, the term "ATN Communication Service" includes all services provided by the ATN architecture, including those of the upper layers.

2. Application Requirements

2.1 General Design Requirements

1. Transit Delay shall be specified as a design parameter, for each application.
2. Residual Error Rate shall be specified as a design parameter, for each application. **All ATN applications will have the same value.**
3. Service Loss Reporting shall be specified as a design parameter, for each application. **All ATN applications will have the same value.**
4. Availability shall be specified as a design parameter, for each application.
5. Service Restoration Time shall be specified as a design parameter, for each application.

2.2 Message Sequencing

Sequentially ordered message delivery capability is required (e.g., where succeeding message delivery is dependent upon the successful delivery of preceding messages).

2.3 Communication Service Termination

1. The communications service shall provide an orderly termination of service upon indication by the application (e.g. if messages have been passed to the communications service and then a termination of service is requested, the preceding messages are to be delivered as per normal operations before the service is terminated). It is noted that the ATN Upper Layer Architecture will provide this service.
2. Upon failure of orderly termination an indication shall be provided to the application. It is noted that the ATN Upper Layer Architecture will provide this service.

2.4 Priority

1. Applications shall use priority in a manner consistent with ICAO ANNEX 10 and ITU radio regulations.
2. There shall be a one-to-one relationship between application specified priority and any communication service priorities (e.g. transport layer, network layer, etc.).
3. Note that for the CNS/ATM-1 package, application specified priority will not necessarily invoke processing within the transport service entity (e.g. will not result in the reordering of transport entity queues), but will be used internally by the network layer to reorder transmission queues. Transport priority is only of significance between the end-users of the transport service; thus, there

is no requirement in Package 1 that transport priority be used by the transport protocol layer for internal processing purposes or for internal resource allocation (connection and buffer management) purposes although this is not precluded

2.5 Routing Policy

1. Applications shall be able to set routing policies based on a) QOS requests, and on b) Traffic Type identification.
2. QOS policies shall be applied on a "best effort" basis. In the terminology of the Working Group 2 experts, this means that "Weak QOS" is required. Traffic Type policies shall be applied on a "must be enforced" basis. In the terminology of the Working Group 2 experts, this means that "Strong Traffic Typing" is required.
3. Policy information must be indicated by the application to the communication service and will be conveyed on end-to-end basis in the CLNP NPDU header.
4. Airlines have a further requirement that, for any air/ground subnetwork that supports multiple simultaneous router-to-router connections (e.g. as is possible via the Satellite data link), a mechanism must be defined whereby the correct ground-based air/ground router is selected based on local aircraft policy decisions.

2.5.1 QOS Policy

Applications shall be able to specify that message traffic be routed to achieve one of the following QOS policies:

1. Minimal Transit Delay.
2. Minimal Cost.
3. No Policy on QOS (i.e. "don't care").

2.5.2 Traffic Type Policy

Applications shall be able to specify that message traffic be routed to achieve one of the following Traffic Type policies:

1. ATN Operational Communications
   - a) Air Traffic Service Communications (ATSC)
     - i) No Traffic Type Policy Preference.
     - ii) Traffic only follows route(s) (to be determined) for ATSC.
     - iii) Route Traffic using an ordered preference of Mode S first, then VHF Data Link, then Satellite, then HF Data Link.
   - b) Aeronautical Operational Control (AOC)
     - i) No Traffic Type Policy Preference.
     - ii) Route Traffic only via Gatelink.
     - iii) Route Traffic only via VHF Data Link.
     - iv) Route Traffic only via Satellite Data Link.
     - v) Route Traffic only via HF Data Link.
     - vi) Route Traffic only via Mode S Data Link.
     - vii) Route Traffic using an ordered preference of Gatelink first, then VHF Data Link.
     - viii) Route Traffic using an ordered preference of Gatelink first, then VHF Data Link, then Satellite.
     - ix) Route Traffic using an ordered preference of Gatelink first, then VHF Data Link, then HF Data Link, then Satellite Data Link.
2. ATN Administrative Communications
3. General Communications
4. ATN Systems Management Communications

Note1: Airlines have a requirement that the mechanism defined for support of ATN policy routing be capable of allowing the inclusion of up to 20 traffic types for AOC traffic.

Note2: The definition of further traffic types for ATSC is not precluded.

2.6 Message Duplication

A message delivered to the communications service shall not be delivered more than once to its peer entity.

2.7 QOS Monitoring

No QOS monitoring is required to be provided in the CNS/ATM-1 package. Inclusion of this capability in future CNS/ATM packages is not precluded.

3. Implications of Requirements

3.1 General Design

The noted requirements regarding general network design pose no particular implications.

3.2 Message Sequencing

Working Group 3 ad hoc discussions lead to the requirement of connection oriented transport only, in the CNS/ATM-1 package time frame. IATA requirements for per message policy enforcement require functionality best supported by a connectionless transport service.

Note1: Implementation of per message policy enforcement in a connection oriented environment will require extensive non-standard modifications to the ISO connection oriented transport protocol.

Note2: In CNS/ATM-1 Package, which offers only the Connection Oriented Transport Service (COTS), Airlines will set up multiple application associations and transport connections as necessary.

3.3 Communication Service Termination

Orderly service termination is not provided by the transport layer. This function must be provided as part of the upper layer architecture or application design. There are no transport layer implications of this requirement in package 1.

3.4 Priority

Priority in the transport layer affects transport operations only. Network priority, while related to transport priority for consistency, only affects the operation of the network components (e.g., CLNP routers and end-systems). Further, network and transport priority are semantically independent. Package 1 intermediate systems will be required to forward data consistent with CLNP priority. Every NPDU associated with a given transport connection must have the same priority.

3.5 Routing Policy

Routing policy, as stated above, requires weak QoS and strong traffic type routing.

3.5.1 QOS Policy

End-to-end QoS decisions require that ground IDRP routers exchange route information including QoS. Thus, IDRP route information exchange including QoS poses certain risks to ongoing validation efforts given current validation and operational implementation schedules.

3.5.2 Traffic Type Policy

End-to-end policy enforcement requires that all ground IDRP routers receive route information including traffic type, make routing decisions, and populate local FIBs accordingly. This requires that IDRP update PDUs contain traffic type route information. Without this traffic type information, there is no guarantee of end-to-end policy enforcement and ultimate air/ground subnetwork choice based upon stated traffic type.

If suitable network design provisions are not available, then traffic typing must be conveyed in the CLNP NPDU and acted upon by every router in the communications path to facilitate end-to-end

traffic selection and policy enforcement. To communicate traffic type on an end-to-end basis, ground IDRP decisions must be made on this information and knowledge of this information must be conveyed amongst IDRP ground routers. For this reason, guaranteed end-to-end policy decisions may not be feasible in the package 1 time frame.

Note: If traffic type processing is only performed by the "air/ground" routers (routers directly connected to an air/ground subnetwork), there is no guarantee that routers one hop or more removed from a ground based air/ground router will make the correct decision to enable proper subnetwork selection by a ground router directly attached to an air/ground subnetwork. For example, if router A can choose between two forwarding destinations, router B and router C, and router B supports VHF access only and router C supports satellite access only and both are in contact with the aircraft, router A may choose to forward the packet to router B even if the local policy on router B states satellite preference. Thus, without complete ground knowledge of policy, end to end decisions cannot be made and without end to end decisions packets may be forwarded to routers implementing strong policy (i.e., traffic may be dropped) or packets may be forwarded to routers implementing weak policy but only having access to a less preferred subnetwork. The same scenario applies to the aircraft; however, it is assumed that package 1 aircraft consist of one BIS only which in turn has access to available air/ground subnetworks.

3.6 Message Duplication

No implication exists given the use of ISO connection oriented transport protocol.

3.7 QOS Monitoring

QoS "rankings" are only known by the routers on an a priori basis in the CNS/ATM-1 package architecture.

4. Proposal

It is proposed that Working Group 1 review the requirements presented in Section 2 above, and consider the implications presented in Section 3. Following this discussion, Working Group 1 is requested to endorse the appropriate set of requirements.

This endorsed set of requirements will be used by Working Groups 2 and 3 to prepare draft ATN SARPs and Guidance Material for CNS/ATM-1 package.