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Change Proposal for Improved Text on the ATN Priority Architecture

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SUMMARY

Action 5/4 was agreed at the Rome meeting in order to provide definitive SARPs for the priority of the ISH PDU. During review of the current SARPs draft text in preparation for this action, a number of other problems were identified. These problems appeared to justify the preparation of new and more definitive text on the whole issue of priority. This proposal is the subject of this paper. Although, this is known to be a contentious area, it is not intended to change any of the agreed use of priority, the intention is simply to codify what has already been agreed in a definitive manner and one in which it is hoped will avoid future argument on this subject.

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1. Introduction

1.1 Scope

This paper provides proposed draft SARPs for an ATN Priority architecture, incorporating existing text on the Use of ATN Priority and new text on the priority of the ISH PDU.

1.2 References

1. ATN Draft SARPs Draft 3.0

2. Proposed ATN Priority Architecture

2.1 Identified Problems

1. Application Service Priority appears in table 2-2 but is not defined. It is not clear as to whether this is intended to refer to the priority provided to applications by the Transport Service, or to the service provided by the application protocol itself (and which is out-of-scope of these SARPs). The difference between the relative priority or importance of application messages and transport service priority is not brought out.

2. The use of priority in the transport layer to arbitrate between different users is only covered in a note. In fact, if service is not to be denied to a high priority (e.g. safety related) user by a lower priority user co-existing in the same End System, then actual SARPs are necessary to ensure pre-emption of low priority transport connections.

3. Note 4 is probably incorrect in its second part. The CLTP does not provide a mechanism to encode a transport priority. However, the TS user can still indicate a priority which is then translated into a network service priority. The semantic difference between transport connection priority and connectionless TSDU priority is lost on the reader as table 2-2 deals in transport protocols rather than services.

4. The mapping on to subnetwork priority is not covered here and only vaguely in 7.6.2.6, especially as regards subnetworks that provide less than 14 priority levels. The possibility of connectionless subnetworks that support priority is not discussed.

5. The need to establish high priority subnetwork connections first (i.e. to convey network management traffic) is not specified.

2.2 Notes on Proposed New Text

Appendix A provides the proposed text for the new section 2.6 of the draft SARPs. The following explanatory notes are provided to give an indication behind the reasons for some of the proposals:

1. Application Priority is addressed here because it is necessary to specify how priority in the ATN Internet relates to applications. The concept that is introduced here is that priority in the ATN Internet is used to distinguish the relative importance and urgency of different groups of application messages *while they are in transit*.

2. In the transport layer a requirement has been explicitly introduced to break a TC if a higher priority TC needs to be established and there are insufficient resources to do this. This seems to be the consequence of WG2's earlier deliberations on transport priority and how it applies to transport level resources, and appears necessary if higher priority applications are to be ensured network access. It is also intended to make clear the semantic difference between priority in connection and connectionless modes.

3. Default requirements have been introduced for mapping Internet to subnet priority. This seems to be appropriate as it provides a *pro forma* for other specifications, and makes clear the WG's intentions.

4. "application priority" has been removed from the table, as it is undefined and the purpose of it is not clear. Message Categories map on to transport data streams. Application priority may add a further dimension, but is outside of the scope of this specification.

Appendix A Proposed Replacement SARPs for section 2.6 “ATN Use of Priority”

2.6 ATN Use of Priority

Note 1. The purpose of priority is to signal the relative importance and/or precedence of data, such that when a decision has to be made as to which data to action first, or when contention for access to shared resources has to be resolved, the decision or outcome can be determined unambiguously and in line with user requirements both within and between applications.

Note 2. In the ATN, priority is signalled separately by the application in the transport layer and network layer, and in ATN subnetworks. In each case, the semantics and use of priority may differ. Figure 1 illustrates where priority is applied in the ATN, and where it is necessary to map the semantics and syntax of ATN priorities

2.6.1 Application Priority

Note 1. Priority in ATN Application Protocols is used to distinguish the relative importance and urgency of application messages within the context of that application alone.

For the purpose of

a) distinguishing the relative importance and urgency of messages exchanged by different ATN Applications, and

b) distinguishing the relative importance and urgency of messages of the same application during their transit through the ATN,

application messages shall be grouped into one or more categories listed in Table 2-1.

Note 2. An ATN Application may include messages from more than one category.

When a message is sent between ATN Application Entities, the message shall be sent using either:

a) a transport connection established using the Transport Connection Priority listed in Table 2-1 for the message’s message category, or

b) the connectionless transport service, signalling the Connectionless Transport Service Priority listed in Table 2-1 for the

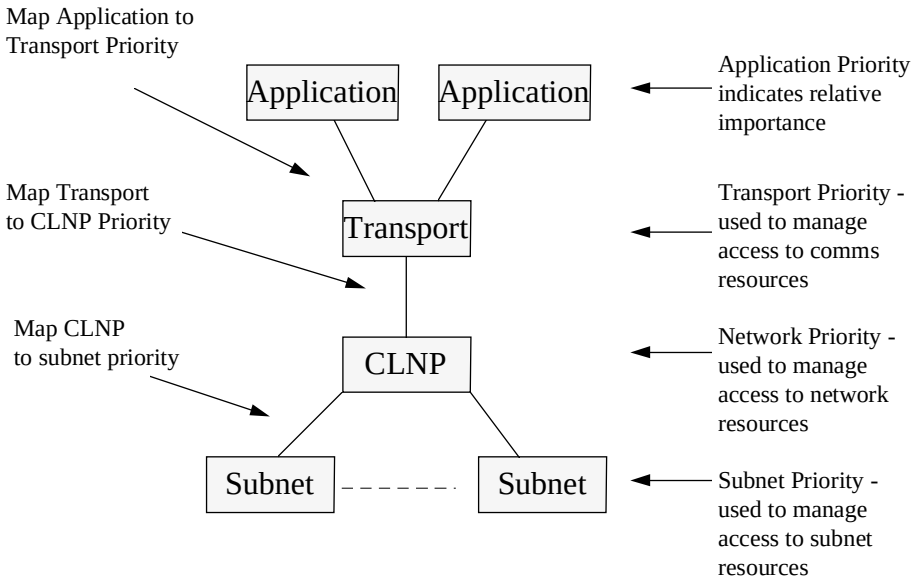

Figure 1 Use of Priority in the ATN

message's message category.

Note 3. The priority of an individual transport connection cannot be changed during the lifetime of the connection. Therefore, if an application exchanges messages belonging to more than one message category using the connection mode transport service, then a separate transport connection needs to be established for each message category.

2.6.2 Transport Connection Priority

Note 1. Transport priority is concerned with the relationship between transport connections and determines the relative importance of a transport connection with respect to (a) the order in which TCs are to have their QoS degraded, if necessary, and (b) the order in which TCs are to be broken in order to recover resources.

Note 2. The transport connection priority is specified by the transport user either explicitly or implicitly, when the transport connection is established.

When an ATN Transport Layer entity is unable to satisfy a request for a transport connection from either a local or remote TSAP, and which is due to insufficient local resources available to the transport layer entity, then it shall terminate a lower priority transport connection, if any, in order to permit the establishment of a new higher priority transport connection.

Note 3. Implementation may also use transport priority to arbitrate access to other resources (e.g. buffers). For example, this may be achieved by flow control applied to local users, by discarding received but unacknowledged TPDUs, by reducing credit windows, etc.

All TPDUs sent by an ATN Transport Layer Entity shall be transferred by the ATN Internet Layer, using the Network Protocol Priority that corresponds to the transport connection's priority according to Table 2-1.

2.6.3 Connectionless Transport Service Priority

Note 1. There are no procedures required of the ATN Connectionless Transport Entity in respect of priority, except for mapping the TSDU priority supplied by the service user (i.e. an ATN Application), to the corresponding Network Layer Priority, and vice versa.

All UD TPDUs sent by an ATN Transport Layer Entity shall be transferred by the ATN Internet Layer using the Network Protocol Priority that corresponds to the TSDU priority provided by the service user according to Table 2-1

2.6.4 ATN Internet Priority

Note 1. In the ATN Internet Layer, an NPDU of a higher priority is given preferred access to resources. During periods of higher network utilisation, higher priority NPDUs may therefore be expected to be more likely to reach their destination (i.e. are less likely to be discarded by a congested router) and to have a lower transit delay (i.e. be more likely to be selected for transmission from an outgoing queue) than are lower priority packets.

ATN Internet Entities shall maintain their queues of outgoing NPDUs in strict priority order, such that a higher priority NPDU in an outgoing queue will always be selected for transmission in preference to a lower priority NPDU.

Note 2. priority zero is the lowest priority.

During periods of congestion, or when any other need arises to discard NPDUs currently held by an ATN Internet Entity, lower priority NPDUs shall always be discarded before higher priority NPDUs.

Note 3. In addition to NPDUs containing user (i.e. transport layer) data, the Internet Layer also forwards routing information contained in CLNP Data PDUs (e.g. IDRP) and as distinct NPDUs (e.g. ES-IS). These must all be handled at the highest priority if changes to network topology are to be quickly actioned and the optimal service provided to users.

BISPDUs exchanged by IDRP shall be considered as Network/Systems Management category messages, and sent using CLNP priority 14.

ES-IS (ISO 9542) PDUs shall be implicitly assumed to have priority 14.

Note 4. The priority encoded in an ISH PDU conveys the priority of the sending system, and not the priority of the PDU.

2.6.5 ATN Subnetwork Priority

2.6.5.1 Connection Mode Subnetworks

Note 1. In a connection mode ATN subnetwork, priority is used to distinguish the relative importance of different data streams (i.e. the data on a subnetworks connection), with respect to gaining access to communications resources and to maintaining the requested Quality of Service.

Note 2. On some subnetworks (e.g. public data networks), not all data streams will be carrying ATN messages. Therefore, subnetwork priority is also used to distinguish ATN and non-ATN data streams.

Note 3. So as not to incur the overhead and cost of maintaining too many simultaneous subnetwork connections, NPDUs of a range of Network Layer priorities may be sent over the same subnetwork connection.

Note 4. The following does not apply to AMSS and Mode S Subnetworks, which have specified their own priority mapping schemes.

When an ATN connection mode subnetwork does not support prioritisation of subnetwork connections, then the ATN Internet Entity shall not attempt to specify a subnetwork connection priority, and NPDUs of any priority may be sent over the same subnetwork connection.

When an ATN connection mode subnetwork does support prioritisation of subnetwork connections, then unless the relationship between ATN Internet Priority and subnetwork priority is explicitly specified by the subnetwork specification, the following shall apply:

a) Subnetwork connections shall be established as either “High” or “Low” priority connections.

b) For the “Low” priority connection type, the priority to gain a connection, keep a connection and for data on the connection shall be the defaults for routine use of the subnetwork.

Message Categories	Corresponding Protocol Priority		
	Transport Layer Priority		Internet Layer Priority
	Transport Connection Priority	TSDU Priority	CLNP Priority
Network/Systems Management	0	0	14
Distress Communications	1	1	13
Urgent Communications	2	2	12
High Priority Flight Safety Messages	3	3	11
Normal Priority Flight Safety Messages	4	4	10
Meteorological Communications	5	5	9
Flight Regularity Communications	6	6	8
Aeronautical Information Service Messages	7	7	7
Network/Systems Administration	8	8	6
Aeronautical Administrative Messages	9	9	5
<unassigned>	10	10	4
Urgent Priority Administrative and U.N. Charter Communications	11	11	3
High Priority Administrative and State/Government Communications	12	12	2
Normal Priority Administrative	13	13	1
Low Priority Administrative	14	14	0

Table 2-1 Relationship of Communication priorities in the ATN

c) For the “High” priority connection type, the priority to gain a connection, keep a connection and for data on the connection shall be appropriate for urgent and network management data in the context of the subnetwork, In the absence of guidance from the subnetwork provider, the value decimal 8 shall be used for each of the three priorities.

d) “High” priority connections shall be used to convey NPDUs of priority five and above. “Low” priority connections shall be used to convey all other NPDUs.

When a subnetwork connection is established between two ATN Internet Entities and no subnetwork connection between these two entities exists over any subnetwork, then that subnetwork connection shall always be established at a priority suitable for conveying priority 14 NPDUs (i.e. Network/Systems Management).

Note 5. This is to ensure that routing information can be exchanged at the appropriate priority.

2.6.5.1 Connectionless Subnetworks

Note 1. The purpose of priority on a connectionless subnetwork is to provide higher priority NPDUs with preferred access to subnetwork resources.

Note 2. The relationship between NPDU priority and subnetwork priority is subnetwork specific.

When an NPDU is sent over a connectionless ATN Subnetwork which supports data prioritisation, the subnetwork priority assigned to the transmitted packet shall be that specified by the subnetwork provider as corresponding to the NPDU priority.

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