ATNP/WG2 Review of the conformance of AMCP recommended VDL Design Guidelines to the ATN manual requirements for mobile subnetworks

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Abstract

This document is the outcome of the action item WG2-24 , from the first WG2 meeting, which aimed at reviewing the AMCP assumptions regarding the requirements placed on VDL subnetwork service

This working paper identifies the requirements placed by the ATN on mobile subnetwork and compares them with the requirements assumed by AMCP for the development of the VDL SARPs. It presents the ATNP/WG2 view on the capability of the Draft VDL SARPs to support the CNS/ATM1 package.

WG2 members are invited to review and comment this paper before its being forwarded to the ATNP secretary

1. SCOPE AND PURPOSE

In April, 1994, the AMCP drafted a list of requirements, design guidelines and desirable features for the VDL ([1]) expecting that the ATNP and other ICAO bodies would offer their comments (Recommendation 8/1 of the ACMP/3 report). Action WG2-24 of the ATNP-WG2/1 meeting held in October, 1994 was assigned to complete this effort and to create a checklist of ATN subnetwork requirements and to forward the resulting Information paper the ATNP secretary for the information of the ANC.

The intent of this draft working paper is to present the list of requirements and recommendations on mobile subnetwork services used to implement the ATN.(as postulated by the ATN Manual) along with their associated technical implications when imposed to the VDL Air/ground subnetwork. The ATNP decided a phased implementation of the ATN , starting with the CNS/ATM package 1 implementation.

The following evaluation is the analysis of the capability of the VDL , as specified in [1] , to support the CNS/ATM1 ATN requirements.

The result of this review is proposed to be the base of ATNP/WG2 comments of the AMCP VDL Digital Guidelines. The resulting Information paper will be forwarded to ATNP secretary as ATNP input to the forthcoming ANC meeting.

2. REFERENCES

i *Requirements and Desirable Features for a Future ATS Air-Ground Communications System, VHF digital Link (VDL) Design Guidelines and Summary of VDL Mode 2 Performance Characteristics,* ATNP/1-WP59 (a.k.a. ATNP-WG1/WP19 and ATNP-WG2/WP49), AMCP, 22 April 1994.

ii *ATN Manual,* version 2.0, 19 November 1993

iii ATNP/WG1 meeting report, March 21-24, 1995 in Toulouse, WG1 Flimsy 3

iv Draft VDL SARPs, version 1.0 - 22 April 1994

3. REQUIREMENTS FRAMEWORK

The following lists indicate the features that an air/ground mobile subnetwork *must,* (ie required) or *should* offer (ie recommended)...

3.1 Subnetwork Requirements from ATN Manual

Chapter 10 and Appendix 10 of the ATN manual place the following requirements on Air/ground mobile subnetworks :

1. Provide a connection-mode service

A10.3.2.3 An ATN mobile subnetwork shall provide a connection-mode service between SNPAs, with a well-defined start and end to a connection, and with reliable, sequenced SNSDU transfer over that connection.

Note 1.— A mobile subnetwork implementing ISO 8208 to provide a connection-mode service between SNPAs meets this requirement; however, where appropriate, an alternative protocol providing the same service may be used.

2. Byte & Code independence

Chapter 10 b. Data must be transferred through ATN Subnetworks in a byte and code independent manner, due to the bit-oriented nature of the ISO OSI protocol architecture.

3. Determination of Subnetwork QOS

Chapter 10 c. Subnetwork QOS must either be constant and known, or must be capable of being determined on a dynamic basis, in order to support the internetwork routing decision process

Note: Within the framework of CNS/ATM1 package the internetwork routing decision process can be based on a priori knowledge of the subnetwork QOS . (WG1/WG2 decision, ATNP March 21-24 1995 meeting)

4. Independence from subnetwork node topology relationship

Chapter 10 d. An ATN subnetwork must provide a mechanism for uniquely and unambiguously identifying each ATN router attached to that subnetwork. This is to provide for unconstrained router-to-subnetwork-node topology relationships.

5. Internal subnetwork routing

Chapter 10 e. Routing between specified SNPA addresses on a local subnetwork is assumed to be carried out by mechanisms internal to the subnetwork, based solely on the subnetwork addressing information given to the SN-Service provider when the SN-Service is invoked.

3.2 Recommendations from ATN manual applicable to subnetworks

Chapter 10 and Appendix 10 of the ATN Manual place the following recommendations on air/ground mobile subnetworks and associated systems :

1. Subnetwork priority,

A10.3.2.1 When priority is implemented within that subnetwork, an ATN subnetwork shall provide a SNAcP mechanism for invocation of subnetwork priority

The semantic of subnetwork priority is defined in section 5.8.3 of the ATN manual the subnetwork priority is used to provide resource management during times of network congestion .

2. Invocation of the Subnetwork Quality of Service

10.3.2.2 It is recommended that Mobile ATN Subnetworks provide a mechanism for invocation of subnetwork QOS. Subnetwork QOS parameters include transit delay, protection against unauthorized access, cost determination and residual error probability

A10.3.2.2 and A10.3.2.3 *ATN subnetworks may allocate subnetwork resources on a per user or per subnetwork connection basis in order to make available a different QOS* . When QOS is available on a per subnetwork connection basis, the SNAcP shall provide mechanisms for selecting a specific QOS when the subnetwork connection is established

3. Connectivity Status Indication,

.A10.3.2.4 If a mobile subnetwork provides subnetwork connectivity information, the subnetwork shall convey this information to connected subnetwork service users (i.e., connected

ATN routers), in order to initiate operation of the internetwork routing protocols as specified in Appendix 6 of the ATN manual .

Chapter 10 10.3.2.4 It is desirable for the IS-SME (intermediate system management entity) to be notified as soon as possible by the SN-SME (subnetwork management entity) when communication is possible with a newly attached BIS and for an immediate decision to be made as regards bringing up the link

4. Segmentation /reassembly mechanism

Chapter 10 - 10.3.2.5 It is recommended that ATN subnetworks ensure efficient utilization of their own resources through implementation of an internal segmentation/reassembly mechanism

This recommendation is established to avoid the need to segment the ISO 8473 PDUs when they are transmitted over air/ground subnetworks, with the view that this function is more efficiently performed within subnetwork protocols. However if this capability is not present within a Mobile ATN Subnetwork, ISO 8473 can support segmentation of NPDUs for transit over subnetworks with small maximum SNSDU sizes.

A10.3.2.5 *An ATN subnetwork should provide a mechanism that allows the conveyance of large SNSDUs greater than the subnetwork's internal packet size between subnetwork points of attachment.*

5. Recommendation for ISO-8208 subnetwork

A10.6.4.3.2 section 3. Fast Select shall be used if available

3.3 Quantitative operational requirements

The ATN manual does not specify quantitative requirements for desired minimal subnetwork quality of service , as it is not possible to assign specific quantitative values in the framework of CNS /ATM1 package . Operational requirement supported will therefore be handled as network design issues tempered with the actual expected capabilities of the air/ground subnetworks.

4. IMPLICATIONS OF THE REQUIREMENTS FRAMEWORK TO THE DRAFT VDL SARPS

The review of the associated technical implications on the set of assumed requirements developped by AMCP for the VDL SARPs lead to the following conformance analysis :

4.1 Conformance to ATN subnetwork requirements

1. Provide a connection-mode service

The VDL subnetwork is designed to implement an ISO-8208 communication service over VHF DATA link . This requirement is supported by VDL, see ref. [1] paragraph 3.2

2. Byte & Code independence,
supported by VDL, see ref. [1] paragraph 3.2

3. Determination of the subnetwork QOS

The VDL minimal QOS is a constant value , depending of the subnetwork design and therefore defined as a subnetwork design parameter. See ref. [1] paragraph 4.7. Quality of service, paragraph 5.4 Congestion control, paragraph 5.5. Availability, paragraph 5.6. System recovery

4. Independence from subnetwork node topology relationship

The VDL addressing plan allows the unique and unambiguous identification of each ATN router attached to the subnetwork, see ref. [1] paragraph 3.5 on Addressing

5. Internal subnetwork routing

The VDL addressing plan and routing provision ensure that routing between two specified SNPA addresses is carried out by mechanisms internal to the subnetwork, see ref [1] paragraph 4.2 Connection oriented mode .

In addition the VDL architecture supports simultaneous connectivity between an airborne router and at least two ground routers , or two connections via different subnetwork paths to the same ground router, thus allowing subnetwork handover to be performed in a transparent fashion for the subnetwork user. See [1] - paragraph 3.1, General provision].

4.2 Conformance to ATN Recommendations

1. Subnetwork priority

There is no VDL prioritisation mechanism available to Internet Users, see [1] paragraph 4.6, Priority.

This limitation exists also in other subnetworks that ATN is planning to use in the framework of the CNS/ATM1 package implementation. Many Connection oriented service WANs offering an ISO_8208 SNAcP (eg. PSPDN) may offer end to end transport of the optional facility accomodating the "Priority" without having implemented associated ressources management or any other pre-emption mechanism. For these reasons the subnetwork priority is only recommended and the VDL limitation is acceptable within the framework of the CNS/ATM1 package

2. Subnetwork Quality of Service,

Transit delay/throughput: The maximum, minimum and average transit delay times as well as the available troughput is a VDL design parameter, and is constant for all subnetwork users .See [1] - paragraph 5.2 - Result of simulations..

Residual Error Probability: The maximum Residual Error Rate (RER) is a VDL design parameter, and is constant for all subnetwork users .See [1] paragraph 5.3.

Protection against unauthorized access: there is no technical provision for this QOS parameter within the VDL subnetwork.

Economic Cost : there is no technical provision for this QOS parameter within the VDL subnetwork.

This is consistent with the approach proposed by ATNP/WG2 , and endorsed by ATNP/WG1 for the CNS/ATM1 package [3] , which does not mandate dynamic determination of transit delay/throughput or RER , neither specifies mechanism for the protection against unauthorised access. There is a WG2/WG1 agreement that subnetworks transit delay, throughput , RER and economic cost are known on an a-priori basis.

3. Connectivity Status Indication,

The VDL is able to report to the user subnetwork connectivity establishment or connectivity breaches as soon as as recommended in the ATN Manual. See ref. [1] paragraph 3.3. VDL subnetwork and interface provision to the router (IS-SME)

Connectivity establishment reporting is limited to the airborne side . Only the aircraft SNPA can initiate the subnetwork connection establishment .However this is consistent with the ATN routing initiation mechanism specified for the CNS/ATM1 package, which is also initiated by the aircraft.

Termination of connectivity is reported on both the airborne subnetwork service user and on the ground subnetwork service users as soon as it occurs.

4. Segmentation /reassembly mechanism,

Depending on the size of the CLNP NPDU the VDL subnetwork may further fragment the NPDU at the VDL origin DTE(SNDCF)/DCE interface, transmit it accross the subnetwork using the M bit mechanism, and reassemble the VDL fragments for delivery to the destination DTE(SNDCF). [1] paragraph 4.5, Segmentation of data units

5. Recommendation for ISO-8208 subnetwork

The VDL supports the Fast Select facility [4 - paragraph 4.6.1. Supported facilities] and provide the required capability, for the purpose of subnetwork connection maintenance service [4 - paragraph 4.6.3.4.2. Explicit subnetwork connection maintenance & paragraph 4.6.3.3. Intermediate system identification]

4.1.3 Conformance to ATN quatitative requirements

As the requirements are not expressed yet by the ATN community , further liaisons with AMCP will be necessary during the validation time frame of the CNS/ATM1 package.

5. Conclusions

The ATNP reviewed the VHF Digital Link (VDL) Design guidelines against the ATN manual requirements for mobile subnetworks and against the ATN operating concept anticipated within ATNP. The VDL design guidelines as specified in [1] are conformant to the ATN manual subnetwork requirements and the resulting VDL SARPs deliver a mobile subnetwork service acceptable for the support of CNS/ATM1 package.

Possible further requirements will be introduced as enhancements to be supported for further CNS/ATM packages.