CLIN No: 0012B (Software Maintenance)
Data Item No: Q034
Data Item Title: Installation Test Description
Data Item Description: No. 68
Contract Ref: C1-8
Frequency: One
Date of Submission: 30 DP test
No. of Hard Copies (Draft/Final): 0/10
No. of Magnetic Copies (Draft/Final): 0/1
Magnetic Format: Text - Word Perfect 5.1, Graphics - Designer 3.0
Remarks: Appropriate tests from the Test Description baselined in BC 2.

CLIN No: 0012B (Software Maintenance)
Data Item No: Q035
Data Item Title: Installation Test Report
Data Item Description: No. 69
Contract Ref: C1-8
Frequency: One
Date of Submission: 30 DA test
No. of Hard Copies (Draft/Final): 0/9
No. of Magnetic Copies (Draft/Final): 0/0
Magnetic Format: Text - Word Perfect 5.1, Graphics - Designer 3.0
Remarks:

CLIN No: 0012B (Software Maintenance)
Data Item No: Q036
Data Item Title: Version Description Document
Data Item Description: No. 48
Contract Ref: C1-1
Frequency: One
Date of Submission: 30 DP STB FCA
No. of Hard Copies (Draft/Final): 0/4
No. of Magnetic Copies (Draft/Final): 0/1
Magnetic Format: Delivered software in prime item usable format,
Text - Word Perfect 5.1, Graphics - Designer 3.0
Remarks: Deliver source and object code for NCOTS and object code
for COTS software. If Version Description Document was baselined in BC 2,
submit as ECN.

CLIN No: 0012B (Software Maintenance)
Data Item No: Q037
Data Item Title: Software Product Specification
Data Item Description: No. 55
Contract Ref: C1-1
Frequency: One/R
Date of Submission: Draft 30 DP STB FCA, ARINC comments by 15 DA FCA,
final 30 DAAR
No. of Hard Copies (Draft/Final): 2/3
No. of Magnetic Copies (Draft/Final): 0/1
Magnetic Format: Text - Word Perfect 5.1, Graphics - Designer 3.0
Remarks: If Software Product Specification was baselined in BC 2,
submit as ECN.

CLIN No: 0012B (Software Maintenance)
Data Item No: Q038
Data Item Title: Functional Configuration Audit Plan
Data Item Description: No. 71
Contract Ref: C1-2
Frequency: One/R
Date of Submission: Draft 90 DP STB FCA, 30 days for AR, final 30 DAAR
No. of Hard Copies (Draft/Final): 2/2
No. of Magnetic Copies (Draft/Final): 0/1
Magnetic Format: Text - Word Perfect 5.1, Graphics - Designer 3.0
Remarks: Submit as ECN to Functional Configuration Audit Plan baselined in BC 2.

CLIN No: 0012B (Software Maintenance)
Data Item No: Q039
Data Item Title: Physical Configuration Audit Plan
Data Item Description: No. 71
Contract Ref: C1-2
Frequency: One/R
Date of Submission: Draft 90 DP STB PCA, 30 days for AR, final 30 DAAR
No. of Hard Copies (Draft/Final): 2/2
No. of Magnetic Copies (Draft/Final): 0/1
Magnetic Format: Text - Word Perfect 5.1, Graphics - Designer 3.0
Remarks: Submit as ECN to Physical Configuration Audit Plan baselined in BC 2.

CLIN No: 0012B (Software Maintenance)
Data Item No: Q040
Data Item Title: System Problem/Change Report
Data Item Description: No. 31
Contract Ref: C1-2
Frequency: As Req
Date of Submission: As Req
No. of Hard Copies (Draft/Final): 0/8
No. of Magnetic Copies (Draft/Final): 0/0
Magnetic Format: Text - Word Perfect 5.1, Graphics - Designer 3.0
Remarks:

D3
DATA ITEM DESCRIPTION LIST

This section contains the following data item descriptions:

1. Maintenance Support Plan
2. Hardware Development Plan
3. Software Development Plan
4. Engineering Change Notice
5. Configuration Management Plan
6. Configuration Status Accounting Report
7. System Requirements Review Agenda
8. System Requirements Review Minutes
9. System Design Review Agenda
10. System Design Review Minutes
11. Master Installation Plan
12. Site Installation Specification
13. Site Drawings
14. Master Test Plan
15. Software Unit Development Folder
16. Test Plan
17. ADNS II Network Design
18. ADNS II Availability Model
19. ADNS II Availability Model Documentation
20. ADNS II Availability Prediction Report
21. Disaster Recovery Plan
22. Interface Requirements Specification
23. Software Specifications Review Agenda
24. Software Specifications Review Minutes
25. System Reliability Test Plan
26. System Reliability Test Report
27. System Maintainability Test Plan
28. System Maintainability Test Report
29. Electromagnetic Interference Test Report
30. International Certification
31. System Problem/Change Report
32. Installation Test Plan
33. Installation Test Report
34. Student Material
35. Maintenance Activity Report
36. Quality Management Plan
37. Software Design Document
38. Program Status Review Agenda
39. Program Status Review Minutes
40. Software Requirements Specification
41. Training Plan
42. Software Operator Manual
43. Software User Manual
44. Software Programmer Manual
45. Equipment Operations and Maintenance Manual
46. License
47. Program Management Plan
48. Version Description Document
49. Project Status Report
50. Technical Interchange Meetings Agenda
51. Technical Interchange Meetings Minutes
52. System/Segment Design Document
53. Engineering Change Proposal
54. System/Segment Specification
55. Software Product Specification
56. Preliminary Design Review Agenda
57. Preliminary Design Review Minutes
58. Critical Design Review Agenda
59. Critical Design Review Minutes
60. Site Survey Report
61. Firmware Support Manual
62. Intentionally Left Blank
63. Intentionally Left Blank
64. Intentionally Left Blank
65. STB Test Readiness Review Agenda
66. STB Test Readiness Review Minutes
67. Test Plan
68. Test Description
69. Test Report
70. Interface Design Document
71. FCA/PCA Plan
72. Environmental Verification Report

D4
DATA ITEM DESCRIPTIONS

DID 01: Maintenance Support Plan

Purpose

The Maintenance Support Plan describes the Seller's program for performing hardware and software maintenance through the life of the contract. In addition, it describes his program for providing hardware and software upgrades.

Application/Interrelationship

This DID provides the format and preparation instructions for the Maintenance Support Plan.

Format

The Maintenance Support Plan may be in the Seller format. At a minimum, it shall include:

1. **Maintenance Organization**
    a. **Organization chart**
    b. **Subcontractors**
2. **Maintenance Support Locations**
    a. **Location including address:**
        (1) **Local maintenance offices**
        (3) **Regional support sites**
        (4) **Central support site**
    b. **Identification of sites supported by:**
        (1) **Local maintenance offices**
        (3) **Regional support sites**
        (4) **Central support site**
3. **Response Time Procedures**
4. **Trouble Call Procedures**
    a. **Process**
    b. **Documentation**
    c. **Reporting**
5. **Maintenance Escalation**
    a. **Procedures**
    b. **Documentation**
6. **On Call Logistics Support**
    a. **Procedures**
    b. **Documentation**
7. **Spare Parts**
    a. **Spare parts list which indicates all spares recommended by the manufacturer and additional spares needed to meet the system's availability requirements**

b. Location of spare parts identified by equipment item and quantity

(1) At ARINC site
(2) At local maintenance office
(3) At regional support sites
(4) At central support site

c. Local maintenance office restocking procedures

d. Provisions made with suppliers to ensure that needed spares will be expedited to the repair site.

8. Hardware and Software Upgrade Procedures

a. ARINC notification and approval process
b. Seller testing
c. Problem resolution
d. System Test Bed (STB) testing
e. Installation
f. Documentation

9. Preventive Maintenance

a. General process
b. Schedule by equipment type
c. Rescheduling procedures
d. Reporting procedures

10. Remedial Maintenance

a. General process
b. Scheduling procedures
c. Reporting procedures

11. Maintenance Reviews

a. Schedule
b. Location
c. Attendees

12. Procedures for equipment removal and storage

13. Technical Assistance Procedures

14. Reports

a. Contact points
b. Maintenance activity report
c. Maintenance review minutes
d. Parts usage report

DID 02: Hardware Development Plan

Purpose

The hardware development plan documents the procedures to be used in modifying an existing or developing a new hardware item.

Application/Interrelationship

This DID contains the format and content preparation instructions for the hardware development plan.

Format

The hardware development plan will be in Seller format. It shall be submitted in hard copy and magnetic media. The hard copy shall be submitted on 8.5 x 11-inch white paper while the magnetic media copy shall be submitted in WordPerfect 5.1 format.

At a minimum, the hardware development plan shall include:

1. **Project resources and organization.**

2. **Design methodology.**

3. **Design analysis procedures to be used if more than one design is considered.**

4. **Development activities, schedule, and associated milestones.**

5. **Risk management. A description of the procedures that will be used for managing areas of risk. The following procedures shall be described:**

   a. **Identification of the areas of risk to successful project completion.**
   b. **Identification of the constituent risk factors that contribute to the potential occurrence of each risk.**
   c. **Documentation of procedures for monitoring the risk factors and for reducing the potential occurrence of each risk.**
   d. **Identification of contingency procedures for each area of risk (as appropriate).**

6. **Developmental testing provisions including test models and evaluation tools.**

7. **Procedures for preparing and conducting reviews.**

8. **Corrective action process to be implemented.**

9. **Plan for coordinating design and data management efforts with ARINC.**

10. **Documentation to be developed.**

11. **Configuration management activities including:**

    a. **Resources**
    b. **Internal hardware configuration items used**

c. Configuration control
d. Configuration status accounting
e. Other unique procedures tailored for the effort

12. Quality management including:

a. Resources
b. Quality activities

13. List of applicable documents.

DID 03: Software Development Plan

Purpose

The Software Development Plan (SDP) is a management document that describes the activities necessary for the management, design, testing, quality assurance, and configuration management of software.

Application/Interrelationship

The SDP is a plan for developing the software system defined by the System/Segment Design Document (SSDD). The SDP expands upon the information in the Program Management Plan (PMP). It also describes the methods for software requirements definition and software design. The requirements definition information is used in the Software Requirements Specification (SRS) and the design information is used in the Software Design Document (SDD). The SDP is produced for all program personnel.

Format

The Software Development Plan shall follow the format specified in the *ARINC Documentation Standard.*

DID 04: Engineering Change Notice

Purpose

The Engineering Change Notice (ECN) provides documentation on manufacturer's hardware and software changes.

Application/Interrelationship

Format

The Engineering Change Notice shall follow the format specified in the *Configuration Management Standard.*

DID 05: Configuration Management Plan

Purpose

The Configuration Management Plan (CMP) is a management document that identifies the organization that performs Configuration Management (CM) activities. It is typically produced during the system design phase, and its intended audience is all project personnel. The CMP describes the organizational structure, personnel resources, processes and control, configuration (change) control, configuration reporting, and auditing.

Application/Interrelationship

The CMP is related to the Project Management Plan (PMP) and the Software Development Plan (SDP).

Format

The Configuration Management Plan shall follow the format specified in the *ARINC Documentation Standard.*

The Configuration Management Plan shall follow the format specified in the ARINC Documentation Standard with the addition of a Transition Plan included as Appendix A.

The Transition Plan shall contain, but need not be limited to, the following information:

Bill of Materials Identifying Deliverable Items
Method of Delivery
Special Handling Instructions
Seller Responsibilities and Point of Contact

DID 06: Configuration Status Accounting Report

Purpose

The Configuration Status Accounting (CSA) Report shall provide accurate records of the status of all configuration items.

Application/Interrelationship

Format

The Configuration Status Accounting (CSA) Report shall be prepared by the Seller and include, but need not be limited to, the following:

Status of Purpose and Approved Changes
Status of All Problem Reports
Current Status of the Configuration and Documentation
CCB Review Decisions

DID 07: System Requirements Review Agenda

Purpose

The System Requirements Review (SRR) shall be conducted to evaluate the Seller's implementation of ADNS II requirements. The System Segment Specification (SSS) shall be presented for review. In addition, the Seller shall present plans for project management, development of NCOTS software, site installation, training logistics, and maintenance.

Application/Interrelationship

Format

The SRR agenda shall be prepared by the Seller and include, but need not be limited to, the following:

Schedule - Time and Location of Meeting
Seller Participants
Meeting Objectives
Items To Be Covered

DID 08: System Requirements Review Minutes

Purpose

The System Requirements Review (SRR) minutes are prepared by the Seller to document the significant events, results, and action items.

Application/Interrelationship

Format

The format of the SRR minutes shall be determined by the Seller and contain, but need not be limited to, the following information:

Introduction - Statement relating to the purpose and/or objective of the review meeting.

Administrative Data

- **Date/Time/Location**
- **Attendees**

Material Reviewed - A description and/or listing of all documentation and other material reviewed during the meeting.

Revision Required - Specific statements relating to all changes and/or additions required to the documents reviewed.

Baseline Changes - A description of all changes to the established baselines required as a result of the meeting. This shall include a description, the justification, and responsible organization for each required change.

Action Item List - An action item list of problem areas not resolved during the meeting, to include the statement of the problem, action item descripton, responsible organization, resolution date, and closure procedure.

Agenda - Copy of the approved agenda, revised to reflect actual meeting conduct.

Presentation Material - A copy of all presentation material used at the review meeting, revised to reflect any required corrections.

DID 09: System Design Review Agenda

Purpose

The System Design Review (SDR) shall be conducted to evaluate the Seller's design of the ADNS II system. The System/Segment Design Document (SSDD) shall be presented for review. In addition, the Seller shall present the ADNS II network design for review.

Application/Interrelationship

Format

The SDR agenda shall follow the same format as DID 7 System Requirements Review (SRR) Agenda.

DID 10: System Design Review Minutes

Purpose

The System Design Review (SDR) minutes are prepared by the Seller to document the significant events, results, and action items.

Application/Interrelationship

Format

The SDR minutes shall follow the same format as DID 8 System Requirements Review (SRR) Minutes.

DID 11: Master Installation Plan

Purpose

The Master Installation Plan shall provide the narrative, graphic, and material requirements overview necessary to install the equipment at each site.

Application/Interrelationship

Format

The Master Installation Plan shall be prepared in the Seller's format.

The Master Installation Plan shall contain the following information:

1. **Scope and purpose of the installation plan, applicable documents, drawings and reference manuals, and definitions.**

2. **A work breakdown structure to the third tier of a typical installation, from the initial site survey through the completion of system acceptance testing.**

3. **A sample floor plan layout of a typical site, including cabinet placement and intercabinet cabling.**

4. **Environmental factors necessary, general power and receptacle requirements.**

5. **The procedures the Seller will follow to obtain international certifications of the ADNSII equipment in London, England; Tokyo, Japan; and Winnipeg, Canada.**

DID 12: Site Installation Specification

Purpose

The Site Installation Specification includes detailed information for specific ADNS II sites that will provide detailed installation instructions, drawings, lists of materials, and other requirements necessary to install an ADNS II site. A Site Installation Specification shall be completed for each installation at each site.

Application/Interrelationship

The Site Installation Specification shall supplement the Master Installation Plan and shall be submitted as an appendix of the Master Installation Plan.

Format

The Site Installation Specification shall be in the Seller's format.

The Site Installation Specification shall contain the following:

1. **Environmental conditions necessary.**

2. **Receptacles, circuit breakers, and power requirements necessary for the site.**

3. **All equipment dimensions, sizes, weights, and clearances.**

4. **A detailed listing of the equipment to be installed which will include the equipment part numbers, model numbers, and quantities.**

5. **A detailed listing of the equipment that will be used to support the installation, including the equipment part numbers, model numbers, and quantities.**

6. **A narrative describing the schedule and sequence of events that will take place to complete the installation. The start date and the stop date shall be included.**

7. **Interfaces and demarcation points necessary for the installation and operation of the equipment to be installed.**

8. **Manpower requirements grouped by installation event, including titles and man-hours necessary for the completion of the event.**

9. **Site drawings including the proposed floor plan layout, equipment block diagrams, signal and control cabling layout, and system interconnectivity. These will be used during the installation and redlined as changes occur.**

10. **Any other technical or general information necessary for preparation of the sites and planning for the installations.**

DID 13: Site Drawings

Purpose

The site drawings document the physical layout/configuration of a site after equipment has been installed.

Application/Interrelationship

This DID contains the format and content preparation instructions for the site drawings.

Format

Site drawings shall be prepared in both hard copy and magnetic format. They shall accurately portray all of the equipment within the room(s) where the Seller installs equipment. The drawing shall depict the configuration which exists at the completion of the equipment installation. The hard copy drawing size will be C or larger. The magnetic copy shall be provided in the ".DRW" format generated by Designer 3.0.

The drawings shall depict all of the equipment to the chassis level and indicate all telephone line, power and data cable, and jumper connections. In addition, all cabling within the facility shall be depicted.

The Seller shall provide a list of all drawings within the delivered drawing package. At a minimum, each drawing shall contain:

1. **ARINC drawing configuration identification number**
2. **Revision number**
3. **Date**
4. **Originator**

DID 14: Master Test Plan

Purpose

The Master Test Plan (MTP) defines the approach, objectives, scope, and planning factors for the overall system testing effort. The MTP shall relate all system-level requirements to specific tests.

Application/Interrelationship

The MTP is produced during the system design phase. It identifies the system-level testing that is to be executed.

Format

Sections 1 and 2 of the MTP shall be in the standard format given for test documents in the ARINC Documentation Standard. The remainder of the document shall be in a format defined by the Seller and approved by ARINC and shall provide the information listed below.

1. **Organizational Responsibilities and Management. This data defines the test management approach to provide for continuity of test effort and to arrange for the applicaton of appropriate skills and experience to the test program.**

2. **Identification and Traceability Matrix. This listing identifies all system-level tests to be executed. The matrix relates all system-level requirements to identified tests.**

3. **Objectives. The expression of test objectives establishes a unified set of objectives for the entire test program in order to eliminate redundant testing and conduct an ordered progression through each testing phase.**

4. **Support Requirements. This data identifies all significant technical and logistical support required to conduct each of the tests.**

5. **Methods and Planning Factors. This data describes test terminology, test coordination, basic testing methodology, identification of constraints, test concurrency requirements, data collection and reduction requirements, analysis and evaluation techniques, and presentation of results.**

6. **Schedule and Milestones. This data describes the test activity (documentation development, test execution) schedule and identifies the major milestones associated with testing.**

DID 15: Software Unit Development Folder

Purpose

The Software Unit Development Folder (SUDF) includes all current and historical requirements and design data related to the software unit under development.

Application/Interrelationship

Format

The SUDF shall be prepared by the Seller and include, but need not be limited to, the following for each program unit:

1. **Performance and functional requirements**
2. **Design data**
3. **Current source and object codes**
4. **Unit Test Plans/Procedures**
5. **Unit Test Results**
6. **Schedule and status**
7. **Change log**

It is recommended that the SUDF be maintained for units that fit the suggested criteria:

1. **Lowest level of logical CSCI breakdown**
2. **Performs a well defined function**
3. **Composed of routines or subprograms**
4. **Satisfaction of requirements is traceable**
5. **Lowest level of informal testing**

DID 16: Test Plan

Purpose

This plan describes the methods to be used by the Seller to demonstrate that the system/subsystems of the Pilot Network meet all Environmental and Electromagnetic Interference requirements as stated in the Contract.

Application/Interrelationship

The Environmental and the Electromagnetic Test Plans are two separate plans. ARINC may exercise the option of omitting the actual testing if the Seller can provide acceptable documentation, as determined by ARINC, verifying that these requirements have already been satisfactorily demonstrated in previous tests.

Format

Scope: The Test Plan shall outline the techniques, procedures, and equipment used for verifying that each subsystem HWCI is capable of performing in accordance with the requirements as stated in the Contract. The plan is made up of a series of individual "tests" and will identify and describe in detail all test activities conducted by the Seller for testing. The information provided shall be to the level of detail necessary to show adequacy of test methods and test limits. Specific methods, control settings, test equipment used, data collected, and expected results for performance measurement shall be included for each test.

Format: The Test Plan shall be completed in an ARINC-approved Seller format. It shall consist of an overall test approach, of testing, and individual test descriptions to include description of test equipment used.

The test descriptions shall address, at a minimum, the following items when applicable:

1. **Methods to be used to select critical circuits to be monitored for the compliance to the degradation criteria and/or safety margin.**

2. **Procedures for developing methods for monitoring/evaluating failure/degradation criteria for each subsystem and equipment.**

3. **Test conditions and operating modes/procedures for all electronic and electrical equipment installed in or associated with the system and the sequence of operation during tests, including all switch activations.**

4. **Means of simulating and testing electroexplosive subsystems and devices.**

5. **Electrical power voltage limits and methods for monitoring AC and DC power buses to assure that voltages are within proper limits.**

6. **Methods and procedures for data readouts and analysis.**

7. **Test locations and descriptions of arrangements for simulating operational performance in cases where actual operation is**

impractical.

8. Adjustments and setting of variable controls such as audio gains, video gains, sensitivities, squelch settings, etc.

9. Details concerning frequency ranges, channels, and combinations to be specifically tested such as image frequencies, intermediate frequencies, local oscillator, and transmitter fundamental and harmonically related frequencies. Include results of computer aided analyses and laboratory testing used to make frequency selections.

10. Means of simulating signal inputs.

11. Calibration schedules and descriptions of unique EMC instrumentation for measuring electrical and video outputs of equipment and subsystems to be monitored during the testing, including applicable safety margins.

12. Personnel required (ARINC, Seller, and subcontractors).

13. Methods of measuring and demonstrating bonding and grounding requirements.

14. Description and RF profile of test site.

15. Considerations and regulations regarding the operation of test sample and measuring equipment in open areas.

DID 17: ADNS II Network Design

Purpose

This is a report that documents the Seller's design for the ADNS II network.

Application/Interrelationship

This DID contains the format and content preparation instructions for the ADNS II network design report.

Format

The report shall be provided in two parts: a magnetic copy of the network design data and a written analysis of the design. The magnetic modeling data shall be in the format specified below, whereas the written analysis shall be in Seller format and shall contain the following information.

1. **Modeling Data. Provide a text file (on magnetic media) detailing all input parameters used in the design. The file will be input to the ARINC Network Simulation Model (ANSM). ARINC will provide Seller with the required ANSM File Format by SRR.**

2. **Analysis. The ADNS II network design analysis shall include the following:**

   a. **An executive summary.**

   b. **A clear and well-labeled diagram of the network topology showing the location of all network equipment inclusive of TDMs, concentrators, packet switches, PGP and SFS, and connectivity among the equipment (i.e., trunk capacities), and the clustering criteria and algorithm used.**

   c. **An implementation sequence for incrementally fielding the network. The analysis shall address network capability limitations imposed by deviating from the recommended implementation sequence. In particular, the impact on throughput and availability shall be addressed.**

   d. **A description of optimization strategies used in developing the design.**

   e. **The levels of priorities implemented by the network equipment to achieve the stated quality of service, and the scheduling algorithm used to serve the multiple priority queues.**

   f. **The backbone input traffic matrix indicating the peak traffic flow in terms of number of messages from each priority class and the average message lengths or message length distribution assumed for each class of traffic. Backbone input traffic matrix is the source-to-sink traffic that flows between any pair of the backbone packet switches. These data should include the traffic component due to protocol and signaling overhead.**

g. The mechanism used to route the traffic. This shall include the criteria used to select the outgoing port and alternative routing criteria such as shortest hop distance, minimum delay path, round robin, table drive, etc. In the case of static routing, a routing table indicating the explicit route taken through the network for each source/destination pairs shall be provided.

h. The processing time within each network component. This should exclude queuing and transmission delays.

i. The engineered (targeted) line utilization assumed and the actual utilization figures on each backbone trunk.

j. The mean and maximum delays through each network component in the network under the assumed traffic condition.

k. The percentage of resource utilization in each network component.

l. The calculated source-to-sink mean and worse case delays for each traffic class through:

   (1) The backbone network (i.e., excluding concentrators)

   (2) The entire network (i.e, including the local access delays through concentrators and the user lines)

m. The amount of time the protection of a high priority message adds to the message transit time through the network. Indicate the minimum and average values in the design for protecting a high priority message.

n. The procedure for handling the periodic transmission of heavy bulk data (e.g., weather forecasts).

o. An assessment of the proposed network reliability and performance in terms of changes in traffic (growth) and failures of single links or nodes in the network.

p. A complete and detailed description of the internal processing for Seller-provided network components. The descriptions shall include diagrams specific to the internal architecture illustrating the packet flow through the modules of a network component that requires packet processing. Modules may include items such as communications boards, CPUs, buses, etc. Chip level illustrations are not required. However, the diagrams shall clearly depict the data flow through each module and whether packets for multiple virtual circuits are processed in a parallel or serial mode. The packet throughput for each module shall be provided, excluding the queuing delays.

q. For each network component:

   (1) Describe the queuing mechanisms used at each input and output link/trunk.

(2) Specify the maximum number of modules through which a packet may be processed before exiting.

(3) Specify the maximum number of ports and the different combinations of port speeds supported.

r. Identify any limitations on the number of virtual circuits that can be simultaneously in progress for a network component that is limited by either that network component and/or any other network component.

s. Provide the call processing time or the call set-up capacity (calls per second) supported by each network component.

DID 18: ADNS II Availability Model

Purpose

The ADNS II availability model will be used to assess the system availability provided by the Seller's design for the ADNS II network. The model shall be computer-based and support the conduct of sensitivity analysis.

Application/Interrelationship

This DID contains format and content preparation instructions for the ADNS II availability model.

Format

The model shall be provided in Seller format on a magnetic media. Although not required, it is desired that the model be capable of being used on a personal computer using the MS-DOS operating system.

The model shall accurately represent the ADNS II system architecture. It shall predict network, site, and network control station (equipment level) availability for critical air safety, essential, and routine services as described in Section C2 (System Specification), Paragraph 4.10 of the contract. The model shall contain a sensitivity analysis feature which will permit examining the effect of changing components at a site.

DID 19: ADNS II Availability Model Documentation

Purpose

A computer-based availability model will be used to assess the ADNS II system availability. The documentation shall describe the procedures for using the model. It shall describe the steps for executing the model's software, the expected output, and the measures to be taken if error messages appear.

Application/Interrelationship

This DID contains format and content preparation instructions for the ADNS II availability model user manual.

Format

The user manual shall be prepared according to the following format.

1.0 Scope

1.1 Identification. Contains the approved project number, title, and abbreviation for the ADNS II availability model.

1.2 System Overview. Briefly states the purpose of the model.

1.3 Document Overview. Summarizes the purpose and content of the user manual.

1.4 Terms and Acronyms. Lists (or includes in an Appendix) the terms, definitions, and acronyms used in the manual.

2.0 Applicable Documents. Provides references to documents applicable to the manual. References contain the document number, title, revision level, and issue date.

2.1 ARINC Documents. Lists by title, number, revision level, and issue date the ARINC-produced documents that were used in the preparation of this manual.

2.2 Non-ARINC Documents. Lists by title, number, revision level, and issue date the non-ARINC documents that were used in the preparation of this manual.

3.0 Execution Procedures. Presents the information and instructions the user needs to interact with the model. This section describes the step-by-step procedures for executing the model's software. It also identifies the options available to the user. The procedures include the following information.

3.1 Initialization. Describes the initialization procedures necessary to execute the model; describes all initialization options available to the user.

3.2 User Input. Describes the user input to the model

(including the range of values).

3.3 System Input. Describes the system input to the model that may occur while the software is in use and may affect the model's interface with the user (including the range of values).

3.4 Termination. Describes how to terminate the model's operation and how the user can determine whether normal termination has occurred.

3.5 Restart. Describes the procedure for restarting the model.

3.6 Output. Describes the expected output of the model, including error messages.

4.0 Error Messages. Identifies the error message output of the model, the meaning of each error message, and the action that should be taken when error messages appear.

DID 20: ADNS II Availability Prediction Report

Purpose

A computer-based model will be used to predict the availability of the ADNS II system. This report documents the availability predictions.

Application/Interrelationship

This DID contains format and content preparation instructions for the ADNS II availability predictions.

Format

The ADNS II availability prediction report shall contain all the information used to calculate the ADNS II availability. Predictions shall be made for network, site, and network control system (equipment level) availability for critical air safety, essential, and routine services as described in Section C2 (System Specification), Paragraph 4.10 of the contract.

The report format is determined by the Seller. At a minimum, the report shall include:

1. **Predictions of network, site, and network control system availability for critical air safety, essential, and routine services.**

2. **Sensitivity analysis results.**

3. **Assumptions that apply to the predictions.**

4. **Sources and validity of failure rate data.**

5. **Failure rate data used.**

6. **Sources and validity of maintainability data.**

7. **Maintainability data used.**

DID 21: Disaster Recovery Plan

Purpose

The Disaster Recovery Plan will define the functions and procedures necessary to restore an ADNS II node or subsystem in the event that the node has been destroyed or is severely impaired.

Application/Interrelationship

Format

The Disaster Recovery Plan will be developed that will provide for backup as described in the Contract, Section C2-6, 3.1.4. This plan will include the following:

1. **Scope and purpose of the disaster recovery plan.**

2. **Applicable documents, reference manuals, and drawings.**

3. **Personnel requirements.**

4. **Equipment requirements.**

5. **Software requirements.**

6. **A chronological sequence of the procedures and organizational responsibilities necessary to implement the disaster recovery plan for each geographical site, including any hardware and software reconfiguration necessary, personnel necessary, and auxiliary equipment.**

7. **Procedures, personnel, equipment, equipment/circuit configurations, and software necessary to maintain the configuration files, databases, and procedures to keep the disaster plan current with the evolving ADNS II network.**

DID 22: Interface Requirements Specification

Purpose

The Interface Requirements Specification (IRS) is a requirements document that specifies the requirements for an interface between two or more Computer Software Configuration Items (CSCIs), Hardware Configuration Items (HWCIs), or critical items.

Application/Interrelationship

The IRS specifies the interface. It is used as the basis for the design for utilizing the interface. Detailed design information for the interfaces defined by the IRS is provided in the Interface Design Document (IDD). The IRS traces back to the Software Requirements Specification (SRS). The IRS is produced for software engineers and test engineers.

Format

The Interface Requirements Specification shall follow the format specified in the *ARINC Documentation Standard.*

DID 23: Software Specifications Review Agenda

Purpose

The Software Specifications Review (SSR) shall be conducted to evaluate the proposed software requirements for NCOTS CSCIs. The Software Requirements Specification (SRS) and Interface Requirements Specification (IRS) shall be presented for review. In addition, the Seller shall present the STB Test Plan to demonstrate adequate test coverage for system requirements.

Application/Interrelationship

Format

The SSR agenda shall follow the same format as DID 7 System Requirements Review (SRR) Agenda.

DID 24: Software Specifications Review Minutes

Purpose

The Software Specifications Review (SSR) minutes are prepared by the Seller to document the significant events, results, and action items.

Application/Interrelationship

Format

The SSR minutes shall follow the same format as DID 8 System Requirements Review (SRR) Minutes.

DID 25: System Reliability Test Plan

Purpose

This plan describes the Seller's reliability testing of all operational equipment comprising the subsystems of the network. It delineates required reliability tests, their purpose and schedule. The Seller will comply with all requirements outlined in the Contract. This document will be used by ARINC for review, evaluation, and approval of the Seller's reliability test program.

Application/Interrelationship

The System Reliability Test Plan is a separate test plan under the Master Test Plan. Formal test procedures shall be prepared for each "test" conducted under the System Reliability Test Plan.

Format

Scope: The System Reliability Test Plan is made up of a series of individual "tests" and will identify and describe in detail all test activities conducted by the Seller for reliability testing. The information provided shall be to the level of detail necessary to show adequacy of test methods and test limits. Specific methods and expected results for performance measurement shall be included for each test.

Format: The System Reliability Test Plan shall consist of an overall test approach, schedule of testing, individual test descriptions and the Reliability Test Log. The will be prepared in the format described in the ARINC Documentation Standard (D50355-002-01) or in a suitable, alternate Seller format subject to ARINC approval.

Contents: The System Reliability Test Plan shall contain a complete listing of all tests to be conducted and a master test schedule. In addition the following items are to be included when applicable for each individual test description:

1. **Title Page: The title page shall include the title of the specific test and the paragraph number of the corresponding specification, when applicable.**

2. **Objective: Describe the objectives and requirements of each test, including any secondary objectives, in terms of anticipated results. The objective shall be stated in such a manner that the test clearly demonstrates that the requirements of the system specification are met or not met.**

3. **Description of Test Item: Describe the test item in terms of the system specification. Include, where applicable, a description of all subsystems having a direct bearing on the purpose of the test.**

4. **Definition and Criteria to Determine Success/Failure of Test: Clearly describe in detail the criteria to be used to measure the success/failure of the test conducted and the conditions under which this success must be achieved. These conditions may include, but not be limited to, range of input value, amount of input data required, and types of specific critical values or occurrences. This criteria may be stated in terms of tolerant limits.**

5. Approach: Describe the test approach to the detail necessary to establish a baseline for each test. This may include the following items:

   5.1 Location, schedule, and number of times the test is run.

   5.2 Test conditions both environmental and operational. This should also include test ground rules and procedures and interface boundaries.

   5.3 Test items, configuration, description, and quantity to be included in the test.

   5.4 Test facilities and equipment used as support equipment for the test.

   5.5 Detailed assignment of specific responsibilities for the Seller/Subcontractors and ARINC personnel involved in the tests.

   5.6 Method of recording all test activities to include, but not be limited to, test conditions, equipment and software parameters, and test results.

   5.7 Indicate specific data to be collected and the methods used for data reduction and analysis.

6. Reliability Test Log: The Seller is required to maintain a Reliability Log. This shall be done in accordance with the requirements as described in the Contract.

7. List of interim test reports to be issued.

DID 26: System Reliability Test Report

Purpose

These reports are a formal record of the results of the Seller's reliability tests and will be used by ARINC to evaluate the degree to which the reliability requirements in the Contract have been met.

Application/Interrelationship

The System Reliability Test Report is a separate test report under the Master Test Plan.

Format

Scope: The System Reliability Test Report will describe the overall test approach and will identify and describe in detail all test activities, with their corresponding results, conducted by the Seller.

Format: The System Reliability Test Report will consist of a Summary Test Report, the Test Schedule, the Test Matrix, the Reliability Test Log and Detailed Test Results. The Summary Report will briefly describe the test results stating which tests were performed and the results of each test. The Test Matrix will cross-reference the test results with the Contract specification requirements. The Reliability Test Log will be prepared in accordance with the Contract. The Detailed Test Results will provide a detailed analysis of the test results. The Report will be prepared in the format described in the ARINC Documentation Standard (D50355-002-01) or in a suitable, alternate Seller format subject to ARINC approval.

Content: The System Reliability Test Report shall contain the above-mentioned items in addition to the following items for each individual test, when applicable:

1. **Title Page: The title page shall include the title of the specific test, the paragraph number of the corresponding system specification, and cross-references to the System Reliability Test Plan, when applicable.**

2. **Objective: A description of the objectives and requirements of each test, including any secondary objectives, in terms of anticipated results. The objective will be stated in such a manner that the results of the test clearly demonstrates that the requirements of the system specification have been met or not met.**

3. **Description of Test Item: A description of the test item in terms of the system specification. Include, where applicable, a description of all subsystems having a direct bearing on the purpose of the test.**

4. **Definition and Criteria to Determine Success/Failure of Test: A description in detail of the criteria used to measure the success/failure of the test conducted and the conditions under which success can or cannot be achieved. These conditions may include, but are not limited to, range of input values, amount of input data required, and types of specific critical values or occurrences. This criteria may be stated in terms of**

tolerant limits.

5. Test Procedures: Describe the test approach used to establish a baseline for each test. This should include the following items if applicable:

   5.1 Date, location, and number of times the test was run.

   5.2 Test conditions, both environmental and operational. This should also include test ground rules and procedures and interface boundaries.

   5.3 Test items, configuration, description, and quantity included in the test. If there was a deviation from the original plan, this should be noted as well as to the reason for the deviation.

   5.4 Test facilities and equipment used as support equipment for the test. Include the manufacturer, model (and number if applicable), calibration status, and serial number of all test equipment.

   5.5 Detailed assignment of specific responsibilities for the Seller/Subcontractors and ARINC personnel involved in the tests.

   5.6 Method used for recording all test activities to include, but not be limited to, test conditions, equipment and software parameters, and test results.

6. Detailed Test Results: At a minimum the following information should be provided on the results of each individual test unless not applicable:

   6.1 Indicate the specific data collected and the methods used for data reduction and analysis.

   6.2 Indicate the confidence level of the data collected.

   6.2 List the results of the individual tests based on the data collected during the test.

   6.3 For each step of a test procedure where a discrepancy occurred, identify the procedure step number, the expected response, the actual response, the significance of the discrepancy and the impact of the discrepancy on the validity of preceding or following steps of the test procedure.

   6.4 Include any amplifying information (for example, core dumps, record registers, display diagrams).

   6.5 If individual trouble reports were prepared these may be referenced in the test report in lieu of repeating the information. In this case the trouble report should be included in the appendix.

   6.6 Results of retesting in cases where the equipment failed the original test. Should include a discussion of corrective action taken, procedures repeated or modified, parameters

used, and any information pertinent to the functional analysis of the equipment.

7. Test evaluation: An overall analysis of the functional performance of each piece of equipment tested shall be provided. This analysis shall describe the functional capability as it was demonstrated in the test. If applicable, this section shall include an assessment of the manner in which the test environment is different from the operational environment and its anticipated effect on the functional capability. A general statement shall be provided for each operational deficiency of the impact on the system design performance, if the deficiency is corrected.

8. Reliability Test Log: The log shall be maintained in accordance with the requirements in the Contract and included as an appendix in the report.

9. Interim Test Report(s): ARINC reserves the right to request Interim Test Reports prior to receipt of the Final Test Report. These reports may or may not include all of the above information. Format and content will be decided by ARINC at the time of the request.

10. Test Certification: The test report shall contain a statement certifying that the test results in this report are, in fact, authentic, accurate, current, and in accordance with related requirements and test plans.

DID 27: System Maintainability Test Plan

Purpose

This plan describes the Seller's corrective and preventive maintenance tests and fault isolation on the following end items: Native NCS(s), PGP, SFS, network information processing system, and NIS/Router. The plan provides details and procedures for evaluating the above-mentioned End Items with respect to the maintainability requirements as outlined in the Contract. This document will be used by ARINC for review, evaluation, and approval of the Seller's Maintainability Test program.

Application/Interrelationship

The System Maintainability Test Plan is a separate test plan under the Master Test Plan. The Seller shall perform all tests in accordance with MIL-STD-471 except when modified by the Contract.

Format

Scope: The System Maintainability Test Plan will consist of a series of proposed demonstrable LRU and non-LRU fault-isolation tasks in addition to corrective and preventive maintenance tasks for both the System and the above End Items. These tasks will be grouped into a series of test descriptions for the End Items to be performed by the Seller. These tasks are grouped into three general categories - Corrective, Preventive, and Software Maintenance. A description of each of these tasks will be included in the test plan along with the expected results for each task.

Format: The System Maintainability Test Plan shall consist of an overall test approach, individual test descriptions for the end item stated above, and the Maintainability Test Log. It will be prepared in the format described in the ARINC Documentation Standard (D50355-002-01) or in a suitable alternate Seller format subject to ARINC approval.

Contents: The System Maintainability Test Plan shall contain a complete listing of all tasks proposed. In addition, the following items are to be included when applicable for system level and each individual End Item test description:

1. **Title Page: The title page shall include the name of the specific equipment (End Item), and if applicable, paragraph numbers of the system specification, and a cross-reference to the System Maintainability Test Plan.**

2. **Description of Equipment (End Item): Describe the equipment to be tested. Include, where applicable, a description of all subsystems having a direct bearing on the purpose of the test.**

3. **Objective: Briefly describe the objectives and requirements of each task, including any secondary objectives, in terms of anticipated results. The objective shall be stated in such a manner that the test clearly demonstrates that the requirements of the system specification are met or not met.**

4. **Definition and Criteria to Determine Success/Failure of Test: Clearly describe in detail the criteria to be used to measure the success/failure and the conditions under which this success must be achieved. This criteria may be stated in terms of tolerant**

limits or levels.

5. Approach: Describe the test approach to the detail necessary to establish a baseline for each task, when appropriate. This may include the following items:

   5.1 Location, schedule, and number of times the test or task is run.

   5.2 Test conditions, both environmental and operational. This should also include test ground rules and procedures and interface boundaries.

   5.3 Test items, configuration, description, and quantity to be included in the test.

   5.4 Test facilities and equipment used as support equipment for the test. Include the manufacturer, model (and number if applicable), calibration status, and serial number of all equipment tested.

   5.5 Detailed assignment of specific responsibilities for the Seller/Subcontractors and ARINC personnel involved in the tests.

   5.6 Method of recording all test activities to include, but not be limited to, test conditions, equipment and software parameters, and test results.

   5.7 Indicate any data to be collected and the method used for data analysis.

6. Maintainability Test Log: The Seller is required to maintain a Maintainability Log. This shall be done in accordance with the requirements as described in the Contract and should be included as an appendix.

7. List of interim test reports to be issued.

DID 28: System Maintainability Test Report

Purpose

These reports are a formal record of the results of the Seller's maintainability tests and will be used by ARINC to evaluate the degree to which the maintainability requirements in the Contract have been met.

Application/Interrelationship

The System Maintainability Test Report is a separate test report under the Master Test Plan. The Seller shall perform all tests in accordance with MIL-STD-471 except when modified by the Contract.

Format

Scope: The System Maintainability Test Report will describe the overall test approach and will identify and describe in detail all test activities, with their corresponding results, conducted by the Seller.

Format: The System Maintainability Test Report shall consist of a Summary Test Report, the Test Schedule, the Test Matrix, the Maintainability Test Log, and Detailed Test Results. The Summary Report will briefly describe the test results stating which tests were performed and the results of each test. The Test Matrix will cross-reference the test results with the Contract specification requirements. The Maintainability Test Log will be prepared in accordance with the Contract. The Detailed Test Results will provide a detailed analysis of the test results. It will be prepared in the format described in the ARINC Documentation Standard (D50355-002-01) or in a suitable alternate Seller format subject to ARINC approval.

Contents: The System Maintainability Test Report shall contain all of the above mentioned items in addition to the following items for each individual test, when applicable:

1. **Title Page: The title page shall include the name of the system (if system level), specific equipment (End Item), paragraph numbers of the system specification, and cross-reference to the System Maintainability Test Plan, when applicable.**

2. **Description of Equipment (End Item): Describe the equipment. Include, where applicable, a description of all subsystems having a direct bearing on the purpose of the test.**

3. **Objective: Briefly describe the objectives and requirements of each task, including any secondary objectives, in terms of anticipated results. The objective shall be stated in such a manner that the test clearly demonstrates that the requirements of the system specification are met or not met.**

4. **Definition and Criteria to Determine Success/Failure of Test: Clearly describe in detail the criteria to be used to measure the success/failure and the conditions under which this success must be achieved. This criteria may be stated in terms of tolerant limits or levels.**

5. Approach: Describe the test approach used to establish a baseline for each task when appropriate. This should include the following items if applicable:

   5.1 Date, location, and number of times the test was run.

   5.2 Test conditions both environmental and operational. This should also include test ground rules and procedures and interface boundaries.

   5.3 Test items, configuration, description, and quantity to be included in the test.

   5.4 Test facilities and equipment used as support equipment for the test. Include the manufacturer, model (and number if applicable), calibration status, and serial number of all test equipment.

   5.5 Detailed assignment of specific responsibilities for the Seller/Subcontractors and ARINC personnel involved in the tests.

   5.6 Method used for recording all test activities to include but not be limited to, test conditions, equipment and software parameters and test results.

6. Detailed Test Results: At a minimum the following information should be provided on the results of each individual test unless not applicable:

   6.1 Indicate specific data collected and the methods used for data reduction and analysis.

   6.2 Indicate the confidence level of the data collected.

   6.3 List the results of the individual tests based on the data collected during the test.

7. Maintainability Test Log: The Seller is required to maintain a Maintainability Log. This shall be done in accordance with the requirements as described in the Contract.

8. Interim Test Report(s): ARINC reserves the right to request Interim Test Reports prior to receipt of the Final Test Report. These reports may or may not include all of the above information. Format and content will be decided by ARINC at the time of request.

9. Test Certification: The test report shall contain a statement certifying that the test results in this report are, in fact, authentic, accurate, and in accordance with related requirements and test plans.

DID 29: Electromagnetic Interference Test Report

Purpose

Test Reports document the results of tests. They are used to identify and evaluate discrepancies between expected and actual test results.

Application/Interrelationship

Format

The Test Report shall be prepared in Seller-specified format.

The Test Report shall contain the following:

a. Identification of the specific test.

b. The purpose of the test.

c. The specific test objective, including reference to applicable requirements and specifications.

d. Reference to the applicable Test Plan and Test Procedure.

e. Description of the test article, including test configuration.

f. A list of all test equipment, including manufacturer, model, calibration status, and serial number.

g. A description of the criteria used for evaluation of each test, including the range of data and parameter values tested.

h. A summary of test results, stating which tests were performed and the results of each test. A matrix shall be provided comparing test results with specification requirements.

i. Detailed Test Results. List the results of the test based on the data collected during the test. For each step of a test procedure where a discrepancy occurred, identify the procedure step number, the expected response, the actual response, the significance of the discrepancy, and the impact of the discrepancy on the validity of preceding or following steps of the test procedure. If individual trouble reports are prepared, these may be referenced in the test report in lieu of repeating the information. In this case, a copy of the trouble reports shall be included as an appendix.

j. Test Evaluation. An overall analysis of the functional performance of the article tested shall be provided. This analysis shall describe the functional capability as it was demonstrated in the test. If applicable, this section shall include an assessment of the manner in which the test environment is different from the operational environment and its effect on the functional capability. A general statement shall be provided for each operational deficiency of the impact on system design performance, if the deficiency is corrected. This section shall contain a statement for determining whether or not the article passed the individual tests or inspections satisfactorily.

The test report shall contain a certification that the test results are authentic, accurate, current, and in accordance with related requirements and test plans.

DID 30: International Certification

Purpose

The Seller shall provide certifications for equipment proposed for use in a foreign country.

Application/Interrelationship

This DID contains instructions for delivering international certifications.

Format

International certification shall be in Seller format. It shall include as a minimum the following data:

1. **Name of the country that has certified the equipment for use.**
2. **Date when the certification was granted.**
3. **Facsimile of equipment certification.**
4. **Description of the equipment that has been certified.**
5. **Restrictions on the use of the equipment.**

DID 31: System Problem/Change Report

Purpose

The System Problem/Change Report (SPCR) form provides a standard method of reporting product problems and/or proposing product changes by those who develop, test, use, maintain, or control ARINC products.

Application/Interrelationship

The SPCR is used to track problems or changes from identification through analysis, testing, resolution, and delivery of solutions. The SPCR is produced for configuration management personnel.

Format

The System Problem/Change Report shall follow the format specified in the *Configuration Management Standard.*

DID 32: Installation Test Plan

Purpose

The Installation Test plan provides a basis for testing the physical and functional aspects of the installation to ensure technical compliance with the Equipment Performance Specification prior to cutover.

Application/Interrelationship

This data item description contains the format and content preparation instructions for data product generated by the specific and discrete task requirement for this data included in the contact.

This data item description is related to the Installation Test Report.

Format

General. The Installation Test Plan shall contain the overall plan and procedures the Seller intends to use in accomplishing physical inspections and functional testing of the ADNS II System. This plan may be provided in Seller format on 8 1/2" x 11" bond paper and suitably bound in a durable cover. The standards the Seller intends to use for installation shall also be included in this plan. The physical inspections shall be based on these standards and shall include recommended inspection procedures to be used to conduct a physical inspection and audit of the ADNS II System. The test plan consists of all applicable precutover installation tests.

Introduction. The test plan shall include an introduction which contains the following:

a. Location and size of the ADNS II equipment, including all other Seller-provided equipment.

b. Floor plan for each site covering all equipment provided by Seller or which is being interfaced. The floor plan shall be labeled with equipment identification markings to show location of equipment components.

c. Description of the overall installation test program.

d. Flowchart of consecutively numbered events to identify installation and testing activities and their interrelationships from the beginning of installation through job completion for each installation location. A brief description of each numbered event shall also be provided.

e. Indicate the scope of what is to be tested and to what extent in terms of subsystem and system diagnostics and subsystem integration(readiness) tests. Describe any special test, such as a computer checkout, site adaptation, interfaces, adjustment and alignment checks, etc.

f. Roles and responsibilities of all major participants, including ARINC, Seller, subcontractors, etc.

g. Milestones and scheduling to identify the phases of installation.

h. Security guidelines.

i. The reports required to flag problem areas, method of transmission, frequency, and addresses. Procedures for emergency reporting of problems or waivers.

Test Documentation. The test plan shall include test documentation for all tests to be accomplished. The test documentation shall consist of a master test list, test validation sheets, and test procedures. The master test list shall consist of a tailored test list for each installation site developed from the applicable subsystem and system diagnostics and subsystem integration (readiness) tests cross-referenced with the applicable test procedure for each test. The individual test validation sheets shall be used to record the results of the tests and record witnesses signatures. They shall be followed by the test procedures to be utilized for that particular test. All test validation sheets and test procedures used shall be incorporated as a separate section to this plan.

Master Test List. The master test list shall list all tests to be performed in the order they are to be accomplished as outlined in the flowchart of installation. Separate lists for each site shall be provided. This list shall include the following:

a. Building location where testing is to be accomplished.

b. ADNS II Specification reference.

c. Test title.

d. Documentation location within this plan.

e. Equipment designator.

Test Validation Sheets. The test validation sheets shall be used to document individual test accomplishment and shall include the following:

a. Item number.

b. Test title.

c. Equipment location.

d. Reference of the test procedures to be used.

e. Results obtained to include required measurements and a space for actual measurements and annotations.

f. Pass/Fail block for each piece of equipment tested.

g. Remarks.

h. ARINC and Seller witness initials block for each separate testable requirement.

i. ARINC and Seller signature block and date.

Test Procedures. The test procedures shall be detailed step-by-step to include observations, parameters, expected test results, and equipment or personnel safety warnings and hazards. Procedures shall be provided for all installation tests to be accomplished.

Installation Tests. This section shall contain instructions for ensuring that the installation is properly completed. The test shall include the following:

a. Physical inspection to:

(1) Determine the completeness of the installation.

(2) Check the condition of the equipment.

(3) Verify the specified placement of the equipment.

(4) Ensure that the installation meets required safety standards.

b. Mechanical and electrical preliminary measurements to verify the proper mounting of equipment and to confirm the adequacy and stability of the voltage, frequency, and other characteristics of the primary power.

c. Preliminary equipment alignments and adjustments made upon confirmation of compliance with the installation specifications and before the shakedown and operational tests.

d. System and subsystem diagnostics.

Readiness Tests. This section shall include procedures for performing the tests required to demonstrate that all equipment is performing within the prescribed specifications as defined during subsystem integration testing.

Installation Test Documentation. Appropriate test documentation shall be prepared and maintained throughout the installation testing period. These records shall include failure and unsatisfactory reports, listings of parts and components replaced during each phase of installation testing, operational test log with chronological listing of significant events, all equipment and facility reactions, meter readings, etc., obtained during installation test, and copies of all recorded or photographed test data.

DID 33: Installation Test Report

Purpose

Test Reports document the results of tests. They are used to identify and evaluate discrepancies between expected and actual test results.

Application/Interrelationship

The test report shall contain a certification that the test results are authentic, accurate, current, and in accordance with related requirements and test plans.

Format

The Test Report shall be prepared in Seller-specified format.

The Test Report shall contain the following:

a. Identification of the specific test.

b. The purpose of the test.

c. The specific test objective, including reference to applicable requirements and specifications.

d. Reference to the applicable Test Plan and Test Procedure.

e. Description of the test article, including test configuration.

f. A list of all test equipment, including manufacturer, model, calibration status, and serial number.

g. A description of the criteria used for evaluation of each test, including the range of data and parameter values tested.

h. A summary of test results, stating which tests were performed and the results of each test. A matrix shall be provided comparing test results with specification requirements.

i. Detailed Test Results. List the results of the test based on the data collected during the test. For each step of a test procedure where a discrepancy occurred, identify the procedure step number, the expected response, the actual response, the significance of the discrepancy, and the impact of the discrepancy on the validity of preceding or following steps of the test procedure. Amplifying information (for example, core dumps, record registers, display diagrams) should be included if applicable. If individual trouble reports are prepared, these may be referenced in the test report in lieu of repeating the information. In this case, a copy of the trouble reports shall be included as an appendix.

j. Test Evaluation. An overall analysis of the functional performance of the article tested shall be provided. This analysis shall describe the functional capability as it was demonstrated in the test. A statement shall be provided for each operational deficiency of the impact on system design performance, if the deficiency is corrected. This section shall contain a statement for determining whether or not the article

passed the individual tests or inspections satisfactorily.

DID 34: Student Material

Purpose

The Student Material Data Item describes the material to be provided to students to effect or to supplement their training.

Student Material comprises all items the student would require to augment their training for ADNS II. These items could include, but are not limited to, technical manuals and operational procedures, maintenance procedures, parts lists, installation and checkout procedures, schematics, block diagrams, logic diagrams, software flowcharts, pdl and program listings, visual aids, drawings, charts, handouts, response items, hands-on exercises, texts, workbooks, copies of presentation slides or overheads, supplemental reading material, study questions, tests, handbooks, reference cards, instructional media materials, and disks/diskettes.

Application/Interrelationship

Refer to DID 41, Training Plan, for related information.

Format

1. For COTS training, the format of the Student Material may comprise the Seller's standard COTS training materials. The material should, however, provide comprehensive coverage of all required knowledge.

2. For NCOTS or custom developed training, the student material shall be organized for the best convenience of and utilization by the student. All NCOTS or custom developed training material is subject to review and approval by ARINC.

   a. Loose handouts shall be organized into a loose-leaf binder. Additional handouts shall be three hole-punched to allow integration into the binder. Pages shall be numbered for easy reference. Course identification and number shall be printed on each handout. A glossary of terms and acronyms shall be provided.

   b. All student materials shall be designed with human factors considerations, i.e., in an easily assimilated format. The material provided should contain all facts and information presented so as to limit the amount of note-taking required of the student. Graphical representations of concepts should be provided, whenever possible, to facilitate the student's understanding of concepts.

   c. The Seller shall perform any correction/revision of course materials required by ARINC prior to acceptance of the materials.

   d. A table of contents shall be provided at the beginning of each applicable item of student material. Additionally, a syllabus or outline of covered material shall be provided at the beginning of any appropriate supplied material.

   e. All supplied material shall be technically accurate and free of error. In addition all hard copy material should be printed, not hand-written, legible, and of a size print that is easily read.

DID 35: Maintenance Activity Report

Purpose

The Maintenance Activity Report (MAR) documents the activities associated with remedial and preventive maintenance activates. The report will be provided to the ARINC System Management Office (SMO).

Application/Interrelationship

This DID provides the format and preparation instructions for the MAR.

Format

The MAR shall be provided in both a hard copy and magnetic media. The complete MAR shall be submitted on magnetic media in Word Perfect 5.1 format. Selected information shall be submitted in dBase III format.

The MAR shall contain the following information:

1. **Remedial Maintenance. A detailed chronological report of the activities that occurred. Include problem analysis and corrective action taken.**

   a. **Chronology for remedial maintenance activity:**

      (1) **Trouble report received**
      (2) **On-site arrival**
      (3) **Site departure**
      (4) **Problem resolved**

   b. **Names, titles, and organizations of all personnel involved in the activity.**

   c. **Location, equipment type, model, serial number, and other information needed to identify the system and subsystem which was repaired.**

   d. **Trouble symptoms reported.**

   e. **List of replaced or repaired parts with part number, revision level, and serial number.**

   f. **Follow-up action required.**

   g. **Remarks section for other applicable information.**

2. **Preventive Maintenance. A detailed chronological report of the activities that occurred.**

   a. **Chronology for preventive maintenance activity:**

      (1) **On-site arrival**
      (2) **Site departure**
      (3) **Activity completed**

   b. **Names, titles, and organizations of all personnel involved in the activity.**

c. Location, equipment type, model, serial number, and other information needed to identify the system and subsystem which was repaired.

d. Reason for maintenance call.

e. List of replaced or repaired parts with part number, revision level, and serial number.

f. Follow-up action required.

g. Remarks section for other applicable information.

3. Data Base Report. A dBase III compatible data file with the following fields:

a. Remedial maintenance - date of trouble call
b. Remedial maintenance - time trouble call received
c. Remedial maintenance - site location
d. Remedial maintenance - time arrival on-site
e. Remedial maintenance - time departed site
f. Remedial maintenance - time problem resolved
g. Remedial maintenance - name, title, and organization of each person involved
h. Remedial maintenance - trouble symptom reported
i. Remedial maintenance - problem analysis
j. Remedial maintenance - corrective action taken
k. Remedial maintenance - equipment name
l. Remedial maintenance - equipment model number
m. Remedial maintenance - equipment serial number
n. Remedial maintenance - part number of item replaced
o. Remedial maintenance - serial number of part replaced
p. Remedial maintenance - revision number of part replaced
q. Remedial maintenance - follow-up action required
r. Remedial maintenance - remarks
s. Preventive maintenance - site location
t. Preventive maintenance - time arrival on-site
u. Preventive maintenance - time departed site
v. Preventive maintenance - time activity completed
w. Preventive maintenance - name, title, and organization of each person involved
x. Preventive maintenance - reason for maintenance call
y. Preventive maintenance - equipment name
z. Preventive maintenance - equipment model number
aa. Preventive maintenance - equipment serial number
ab. Preventive maintenance - part number of item replaced
ac. Preventive maintenance - serial number of part replaced
ad. Preventive maintenance - revision number of part replaced
ae. Preventive maintenance - follow-up action required
af. Preventive maintenance - remarks

DID 36: Quality Management Plan

Purpose

The Quality Management Plan (QMP) is a management document based on the Program Management Plan (PMP), that defines the Quality Management (QM) role and responsibilities for a specific program. This information includes identification of QM resources, activities, and processes that are to be implemented for the identified program.

Application/Interrelationship

As a subsidiary plan to the PMP, the QMP is identified in the PMP as an appendix. The QMP is the plan used to manage QM activities for a program. The QMP is produced for QM and other program personnel desiring an understanding of QM's role in the program.

Format

The Quality Management Plan shall follow the format specified in the *ARINC Documentation Standard*.

DID 37: Software Design Document

Purpose

The Software Design Document (SDD) is a design document that describes the complete design of a Computer Software Configuration Item (CSCI). A CSCI is made up of Computer Software Components (CSCs). CSCs may be further subdivided as needed; it is not the intent of this document to dictate design methodology or a decomposition format.

Application/Interrelationship

The SDD is produced as a response to the requirements that are specified in the System/Segment Specification (SSS), allocated in the System/Segment Design Document (SSDD), and expanded upon in the System Requirements Specification (SRS). The SDD is the definitive system document and is produced for all program personnel who need to know the design and inner workings of the subsystem.

Format

The Software Design Document shall follow the format specified in the *ARINC Documentation Standard.*

DID 38: Program Status Review Agenda

Purpose

The Program Status Review Agenda shall define the Seller effort toward achieving contract objectives. It identifies accomplishments to date and difficulties encountered and compares the status achieved to planned goals and the resources expended. It is used by ARINC to monitor and evaluate Seller performance. At ARINC's option, the Program Status Review may include a Project Status Review. The Project Status Review shall also follow the format presented below.

Application/Interrelationship

Format

The Program Status Review agenda shall be prepared by the Seller and include, but need not be limited to, the following:

Schedule - Time and Location of Meeting

Seller Participants

Summary - A brief statement of the overall project status, covering the technical activities and development, objectives of efforts, summary results of efforts, identifications of major problems/deficiencies with impact, and recommended solutions.

Milestones/Task Status - The status of each milestone/task as defined in the Seller-prepared ADNS II PMP :

- **Status of each milestone/task**
- **Updated schedule**
- **Test information**
- **Problem areas**
- **Information that may affect schedule**

Future Plans - Summary of future plans, recommendations, and proposals.

DID 39: Program Status Review Minutes

Purpose

The Program Status Review minutes are prepared by the Seller to document the significant events, results, and action items of all reviews.

Application/Interrelationship

Format

The format of the minutes shall be determined by the Seller and contain, but need not be limited to, the following information:

Introduction - Statement relating to the purpose and/or objective of the review meeting.

Administrative Data

- **Date/Time/Location**
- **Attendees**

Material Reviewed - A description and/or listing of all documentation and other material reviewed during the meeting.

Action Item List - An action item list of problem areas not resolved during the meeting to include the statement of the problem, action item descripton, responsible organization, resolution date, and closure procedure.

Agenda - Copy of the approved agenda, revised to reflect actual meeting conduct.

Presentation Material - A copy of all presentation material used at the review meeting, revised to reflect any required corrections.

DID 40: Software Requirements Specification

Purpose

The Software Requirements Specification (SRS) is a requirements document that defines the complete requirements (e.g., functional, performance, qualification, etc.) of a given Computer Software Configuration Item (CSCI). This is accomplished by expanding the allocated system requirements into a set of detailed engineering requirements.

Application/Interrelationship

The SRS is the basis for development and all testing of a given CSCI. As such, the Software Design Document (SDD), and the Software Test Plan (SWTP) are derived from the SRS. The SRS is produced for development, testing, and quality assurance personnel.

Format

The Software Requirements Specification shall follow the format specified in the *ARINC Documentation Standard.*

DID 41: Training Plan

Purpose

The Training Plan Data Item describes the approach, structure, and objectives of the training program. It shall define the target audience, course definitions, course sequencing, and class environments. It shall specify the methodology for assuring that all necessary training is provided.

Application/Interrelationship

Refer to DID 34, Student Materials, for related information and further guidance.

Format

The Training Plan shall include a training schedule that coincides with the fielding of the corresponding equipment. The Training Plan is subject to ARINC review and approval.

The Seller shall provide a course flow diagram depicting the relationships between courses for the entire curriculum, and the relationships between each course and its lower level lessons and facts. The format of this diagram is left to the Seller's discretion.

The Training Plan shall include, in addition to items delineated below, practice or activites and participation pertinent to objectives, sufficient detail to communicate instructional intent, and identification of handouts and reference material.

The Seller's proposed training plan shall include, but not be limited to, the following sections:

- **Title Page/Cover Sheet**
- **Table of Contents**
- **Identification**
- **Overview**
- **Terms and Acronyms**
- **Courses**
  - **Schedule of Courses and Their Duration**
  - **Course Flow Description**
  - **Course Flow Diagram**
  - **Proposed Locations**
  - **Course Interdependencies**
  - **Course Descriptions**
    - **Recommended Target Audience and Class Size**
    - **Hierarchical Course objectives**
    - **Prerequisites**
    - **Syllabus or Outline of Course Content**
    - **Required Materials/Equipment**
    - **Required Environment**

DID 42: Software Operator Manual

Purpose

The Software Operator Manual (SOM) is a user and maintenance document that provides information and detailed procedures for initiating, operating, monitoring, and shutting down a computer system. A SOM provides information for identifying and isolating a malfunctioning component in a computer system.

Application/Interrelationship

The SOM contains the procedures for using system functions. These functions are described in the Software Design Document (SDD). The SOM is produced for operations personnel.

Format

The Software Operator Manual shall follow the format specified in the *ARINC Documentation Standard.*

DID 43: Software User Manual

Purpose

The Software User Manual (SUM) is a user and maintenance document that describes the steps for executing software, expected output, and user messages to be taken if error messages appear. The information in the SUM is directed to the functional user of the CSCI rather than the operator of the computer system.

Application/Interrelationship

The SUM dictates how to execute software functions rather than how to operate the system. These functions and their formats are defined in the Software Requirements Specification (SRS) and the Software Design Document (SDD). The SUM is produced for the functional user of the CSCI.

Format

The Software User Manual shall follow the format specified in the *ARINC Documentation Standard.*

DID 44: Software Programmer Manual

Purpose

The Software Programmer Manual (SPM) is a user and maintenance document that provides information that a programmer needs to understand about the instruction-set architecture of the special host and target computers. It provides information that may be used to interpret, examine, troubleshoot, or modify existing software on the host and target computers.

Application/Interrelationship

The SPM is a stand-alone document. The SPM is produced for software developers and maintenance engineers.

Format

The Software Programmer Manual shall follow the format specified in the *ARINC Documentation Standard.*

DID 45: Equipment Operations and Maintenance Manual

Purpose

This is a Seller's standard manual used for the operation, maintenance, and logistical support of commercial equipment.

Application/Interrelationship

This DID contains the format and content preparation instructions for the manual. It is applicable to the acquisition of all equipment.

Format

The manual shall be in Seller format and shall contain the procedures necessary to properly operate, maintain, and support the equipment. If any of the chapters listed below are not part of the Seller's manual, those chapters shall be provided as supplementary material in the same format as the existing manual.

1. **Description. This chapter shall include:**

   a. **A full page composite illustration of the equipment.**
   b. **An illustration calling out the major assemblies with their nomenclature.**
   c. **A basic description of the type of equipment and its purpose.**
   d. **A functional block diagram.**
   e. **Tables listing equipment supplied and equipment required, but not supplied.**
   f. **Tables of technical, environmental, and physical characteristics.**
   g. **A description of the software for the equipment that will include the purpose, routines, and functions of the software program.**

2. **Installation. This chapter shall include:**

   a. **Information on the proper location of units, interconnection, and initial preoperational procedures.**
   b. **Details of cables and grounding requirements and cable fabrications, if applicable.**
   c. **Illustrations of interconnections and their respective functions.**
   d. **Power requirements.**

3. **Operation. This chapter shall include:**

   a. **Step-by-step procedures for turning on, operating, and turning off the equipment.**
   b. **Meter calibration readings and/or results expected from properly adjusted and operating equipment.**
   c. **Tables and illustrations calling out all operational controls and indicators, and their functions. All references to switches, controls, and indicators throughout the manual shall follow the designations on the panels and name plates.**
   d. **Maintenance procedures which may normally be performed by the operator.**

4. Principles of Operation. This chapter shall include:

   a. A complete functional description of the equipment based on a block diagram.
   b. A complete explanation of the mechanical features using block diagrams or cutaway drawings.
   c. Major assemblies broken into individual circuits.
   d. Brief description of complex and unusual circuits.

5. Preventive/Corrective Maintenance. This chapter shall include:

   a. A schedule of detailed maintenance and adjustment checks.
   b. List of recommended test equipment.
   c. Lubrication schedule, if applicable.
   d. Troubleshooting information to enable a technician to locate trouble and to make repairs or adjustments to the equipment.
   e. An outline of disassembly and reassembly procedures.
   f. Details of special test procedures and expected results.
   g. Complete adjustment and maintenance information for electromechanical devices.
   h. Oscilloscope waveforms illustrated with peak voltage, duration, repetition rate, and control positions.
   i. A complete listing of diagnostic programs and where to use them.
   j. A flowchart and listing of diagnostics.
   k. Complete identifying numbers for all firmware and software.

6. Software. This chapter shall include:

   a. A description of all firmware/software supplied.
   b. Instructions for using the routines and programs.

7. Parts List. This chapter shall contain a tabulation of all electrical/mechanical components and repairable/replaceable commercial or Seller components in the equipment. All parts shall be sufficiently described to reorder/replace. The parts list shall contain:

   a. Clear and legible illustrations shall be provided to identify component parts and parts' relationships. Illustrations shall contain sufficient information to easily correlate component parts with other parts list data. Part numbers and part names may be shown on illustrations.
   b. Nomenclature and complete description of the part (including hardware, firmware, and software).
   c. Original equipment manufacturer (OEM) with full company name, address, and telephone number.
   d. OEM part numbers.
   e. Quantity per item listed.
   f. Seller part number, if any.

8. Drawings. All drawings and lettering in the manual shall be legible, uncluttered, and capable of being read without magnification. The drawings shall include, as applicable:

   a. Schematic diagrams of individual major assemblies, printed wiring boards, and the complete equipment.
   b. Logic diagrams.
   c. Interconnection diagrams.
   d. Cabling diagrams.
   e. Wiring diagrams.
   f. Illustrations that identify and call out circuit components on printed circuit cards and chassis.

DID 46: License

Purpose

The Seller shall provide the licenses needed to operate the equipment and software delivered under this contract.

Application/Interrelationship

This DID contains instructions for delivering licenses.

Format

Licenses shall be in Seller format as provided by the originator. It shall include as a minimum the following data:

1. **Date of issue for license.**
2. **Description of the item licensed.**
3. **An indication that ARINC is the holder of the license.**
4. **The duration of the license.**
5. **Restrictions on the use and/or modification of the licensed item.**
6. **Includes requirements of DID 30 International Certifications as applicable.**

DID 47: Program Management Plan

Purpose

The Program Management Plan (PMP) is a management document that defines the methodology, schedules, work breakdown structures, etc., required to manage the program. The PMP is a dynamic management document that is modified as the program matures.

Application/Interrelationship

The PMP is prepared by the program manager after the operational needs in the Statement of Operational Need (SON) have been internally reviewed. The appendices to the PMP contain the more detailed plans associated with the program, such as the Software Development Plan (SDP), the Configuration Management Plan (CMP), and the Quality Management Plan (QMP). The PMP is produced for all functional departments who have an interest in the program, including the functional end-users.

Format

The Program Management Plan shall follow the format specified in the *ARINC Documentation Standard.*

Seller shall develop its Schedule and Milestones to the activity and task levels for Block Changes 1 and 2. All activities, deliverables (draft and final), and ARINC review times shall be presented graphically and in tabular form and shall allow for reading at one day increments.

DID 48: Version Description Document

Purpose

The Version Description Document (VDD) is a user and maintenance document that identifies and describes a version of a CSCI or a collection of CSCIs. The term version may be applied to the initial release of a CSCI, to a subsequent release of a CSCI, or to one of multiple forms of a CSCI released at the same time (CSCI released to different sites).

Application/Interrelationship

The VDD is used to track and control versions of software released to the field. The VDD is produced for technical personnel who need detailed information about the system.

Format

The Version Description Document shall follow the format specified in the *ARINC Documentation Standard.*

DID 49: Project Status Report

Purpose

The Project Status Report documents the status of Seller effort toward achieving contract objectives. It identifies accomplishments to date and difficulties encountered and compares the status achieved to planned goals and the resources expended. It is used by ARINC to monitor and evaluate Seller performance.

Application/Interrelationship

This data item description (DID) contains the format and content preparation instructions for the data product generated by the specific and discrete task requirement as delineated in the contract.

Format

Summary - The summary shall include a brief statement of the overall project status, covering the accomplished technical activities and development, objectives of efforts, summary results of efforts, identification of major problems/deficiencies with impact, and recommended solutions.

Body of Report - The Status Report shall contain the following items, where applicable:

Milestone/Task Status - The status of each milestone/task is defined by the statement of work or contract, as applicable:

1. **A statement as to whether or not the project/task is on schedule: if not, the effort planned to meet the schedule shall be indicated. Include an overall status of each milestone, task, or unit of work. Include updated schedule sheets, milestone charts, or task synopsis sheets identifying phase of task and percentage of completion of each task, technical instruction, or order.**

2. **A comparison of achieved end-product performance capabilities projected against contract baseline values, requirements, or allocations.**

3. **Effort expended on each task to date and a brief description of technical developments and accomplishments.**

4. **Key dates in any testing program and a description of tests performed and significant test results. If applicable, a description of the amount and type of downtime on the equipment or system under test.**

5. **A list of all designs completed and a brief description of each item. For designs in process, provide estimated dates for design and drawing completion.**

6. **A narrative of outstanding problems existing as of the previous status report and their resolution status.**

7. **New problem areas encountered or anticipated, their effect on the overall work effort/project, and steps being taken to remedy problem situations.**

8. Significant results of conferences, trips, or directives from the Contracting Officer's representatives.

9. Any other information which may cause significant changes in the project schedule.

Future Plans - Summary of future plans, recommendations and proposals both for the next reporting period and for any long-term plans.

Itemized Man-Hours and Costs - Itemized man-hour and cost expenditure incurred for the reporting period by category and task, total contractual expenditures, and funds remaining as of the reporting date.

Contract Deliveries Status - The status of each deliverable end item, including data deliveries, as required by the contract. Provide item and contract identification, shipping/transmittal data, acceptance status, security classification, and scheduled due date information.

Report Preparer - Name of person(s) preparing report and telephone number(s).

Appendices - Appendices, where applicable, for tables, references, charts, or other descriptive material. Each appendix shall be identified and referenced in the appropriate area of the report.

DID 50: Technical Interchange Meetings Agenda

Purpose

The purpose of the technical interchange meetings (TIMs) is to allow for the exchange of technical information.

Application/Interrelationship

Format

The Technical Interchange Meeting Agenda shall be prepared by the contractor and include but need not be limited to the following:

Schedule - Time and Location of Meeting

Seller Participants

Summary - A brief statement of the overall project status covering the technical activities and development, objectives of efforts, summary results of efforts, identifications of major problems/deficiencies with impact, and recommended solutions.

Milestones/Task Status - The status of each milestone/task as defined in the Seller-prepared ADNS II PMP:

- **Status of each milestone/task**
- **Updated schedule**
- **Test information**
- **Problem areas**
- **Information that may affect schedule**

Meeting Objectives

Items to be Covered

DID 51: Technical Interchange Meetings Minutes

Purpose

The TIM review minutes are prepared by the Seller to document the significant events, results, and action items.

Application/Interrelationship

Format

The TIM minutes shall follow the same format as DID 39 Program Status Review Minutes.

DID 52: System/Segment Design Document

Purpose

The System/Segment Design Document (SSDD) is a design document that describes the design of a system or segment and its organizational and support environments. The SSDD describes the organization of a system or segment in terms of Hardware Configuration Items (HWCIs), Computer Software Configuration Items (CSCIs), and manual operations.

Application/Interrelationship

The SSDD traces back to requirements contained in the System/Segment Specification (SSS). The SSDD is produced for engineers involved in software requirements analysis.

Format

The System/Segment Design Document shall follow the format specified in the *ARINC Documentation Standard*.

DID 53: Engineering Change Proposal

Purpose

An Engineering Change Proposal (ECP) describes a proposed alteration in the configuration of a configuration item after formal establishment of its configuration identification.

Application/Interrelationship

Format

The Engineering Change Proposal shall follow the format specified in the *Configuration Management Standard.*

DID 54: System/Segment Specification

Purpose

The System/Segment Specification (SSS) is a requirements document that establishes the performance, design, development, and testing requirements of an ARINC-defined system. Upon approval, the SSS becomes the functional baseline.

Application/Interrelationship

The SSS derives its requirements from the Statement of Operational Need (SON). The SSS is produced for engineers involved in system design.

Format

The System/Segment Specification shall follow the format specified in the *ARINC Documentation Standard.*

DID 55: Software Product Specification

Purpose

The Software Product Specification (SPS) is a user and maintenance document that consists of the Software Design Document (SDD) and the source code listings for a CSCI. The SPS establishes the baseline for the CSCI.

Application/Interrelationship

The SPS is related to nearly all documents in a program's documentation suite. The SPS defines the product and is produced for technical personnel who need information about the system.

Format

The Software Product Specification shall follow the format specified in the *ARINC Documentation Standard.*

DID 56: Preliminary Design Review Agenda

Purpose

The Preliminary Design Review (PDR) shall be conducted for all configuration items to (1) evaluate the progress, technical adequacy, and risk resolution (on a technical, cost, and schedule basis) of the selected design approach, (2) demonstrate that the proposed design begins to detail the design of each software requirement documented in the SRS. The Interface Design Document (IDD) and preliminary Software Design Document (SDD) shall be presented for review. In addition, the contractor shall present the System Test Description (STD) to adequately demonstrate that the test cases are sufficient to complete the system test objective.

Application/Interrelationship

Format

The PDR agenda shall follow the same format as DID 7 System Requirements Review (SRR) Agenda.

DID 57: Preliminary Design Review Minutes

Purpose

The Preliminary Design Review (PDR) minutes are prepared by the Seller to document the significant events, results, and action items.

Application/Interrelationship

Format

The PDR minutes shall follow the same format as DID 8 System Requirements Review (SRR) Minutes.

DID 58: Critical Design Review Agenda

Purpose

The Critical Design Review (CDR) shall be conducted for each configuration item when detail design is essentially complete. The purpose of the review is to (1) determine that the detail design of the configuration item satisfies performance and engineering requirements, (2) establish detail design compatibility among the configuration items, and (3) assess configuration item risk areas. The contractor shall present the detailed Software Design Document (SDD), as well as preliminary hardware and software manuals.

Application/Interrelationship

Format

The CDR agenda shall follow the same format as DID 7 System Requirements Review (SRR) Agenda.

DID 59: Critical Design Review Minutes

Purpose

The Critical Design Review (CDR) minutes are prepared by the Seller to document the significant events, results, and action items.

Application/Interrelationship

Format

The CDR minutes shall follow the same format as DID 8 System Requirements Review (SRR) Minutes.

DID 60: Site Survey Report

Purpose

The Site Survey Report will be used to report on the readiness of the ARINC ADNS II site for the ADNS II installation, on any problem areas, and on corrective action necessary for the ADNS II installation.

Application/Interrelationship

Format

The site survey may be in the Seller's format. The site survey report shall contain the following:

1. **Name of the site and the date the site was visited.**

2. **Names of the site survey team and the ARINC personnel contacted.**

3. **A summary of the meetings and discussions held concerning the site survey.**

4. **Any potential problems that have been identified that will affect the ADNS II installation at that site.**

5. **Any corrective actions necessary and the reasons those actions are necessary.**

DID 61: Firmware Support Manual

Purpose

The Firmware Support Manual (FSM) is a user and maintenance document that provides the information necessary to generate and load software or data into the firmware components of a system. It is equally applicable to the Read Only Memory (ROM), Programmable ROM (PROM), Erasable PROM (EPROM), and other firmware devices. This document may be derived from associated hardware documentation.

Application/Interrelationship

The FSM is used to describe the firmware components of a system. Since firmware is hardware-resident software, this document defines the loading of software items defined by the Software Design Document (SDD) to a hardware device. It also describes in greater detail the required support environment outlined in the Software Development Plan (SDP). The FSM is produced for hardware development personnel and maintenance personnel.

Format

The Firmware Support Manual shall follow the format specified in the *ARINC Documentation Standard.*

DID 62: Intentionally Left Blank

Purpose

Application/Interrelationship

Format

DID 63: Intentionally Left Blank

Purpose

Application/Interrelationship

Format

DID 64: Intentionally Left Blank

Purpose

Application/Interrelationship

Format

DID 65: STB Test Readiness Review Agenda

Purpose

The STB Test Readiness Review (TRR) Agenda is the listing of resources required to be in place in order for STB testing to commence.

Application/Interrelationship

An STB TRR is conducted each time additional functionality is added to the STB. The agenda is used to conduct the TRR.

Format

The STB TRR Agenda shall be produced in an ARINC-approved Seller-developed format. The Agenda contains, as a minimum, the following items:

1. **Status of personnel (ARINC, Seller, and subcontractor) required to conduct the test**
2. **Status of problem reports resulting from prior tests**
3. **Factory Test Reports**
4. **Software Configuration Status**
5. **Hardware Configuration Status**
6. **Test Equipment Status**
7. **STB Test Plan and Description**
8. **Operations Procedures, Maintenance Procedures, Users Manuals**

DID 66: STB Test Readiness Review Minutes

Purpose

The STB Test Readiness Review (TRR) Minutes are prepared by the Seller to document significant events, results, and outstanding action items resulting from the TRR.

Application/Interrelationship

Format

The STB Readiness Review Minutes shall follow the same format as DID 8, System Requirements Review (SRR) Minutes.

DID 67: Test Plan

Purpose

Test Plans identify the hardware and software test environment, data recording methods, and test execution criteria required to formally qualify an entity of a system.

Application/Interrelationship

A system entity is defined as a CSCI, an HWCI, any aggregation of CIs, or the entire system. Test Plans are applicable to the test activities listed below.

- Subsystem (COTS), for each COTS CI
- Design Qualification, for each Non-COTS CI
- Subsystem Integration, for each block change in which new functionality is incorporated into the system
- Pilot Network, for each block change in which new functionality is incorporated into the system
- Interoperability, for each network interfaced with ADNS II
- Network Acceptance, for each block change in which additional functionality is incorporated into the system

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Format

The preferred format for Test Plans is given in the ARINC Documentation Standards. Alternative formats must be approved by ARINC.

DID 68: Test Description

Purpose

Test Descriptions identify the test cases, test preparation, and test procedure activities necessary to perform qualification testing on a system entity.

Application/Interrelationship

A system entity is defined as a CSCI, an HWCI, any aggregation of CIs, or the entire system. Test Plans are applicable to the test activities listed below.

- Subsystem (COTS), for each COTS CI
- Design Qualification, for each Non-COTS CI
- Subsystem Integration, for each block change in which new functionality is incorporated into the system
- Pilot Network, for each block change in which new functionality is incorporated into the system
- Interoperability, for each network interfaced with ADNS II
- Network Acceptance, for each block change in which additional functionality is incorporated into the system

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Format

The preferred format for Test Descriptions is given in the ARINC Documentation Standards. Alternative formats must be approved by ARINC.

DID 69: Test Report

Purpose

Test Reports document the formal tests performed on system entities.

Application/Interrelationship

A system entity is defined as a CSCI, an HWCI, any aggregation of CIs, or the entire system. Test Reports are applicable to the test activities listed below.

- Subsystem (COTS), for each COTS CI
- Design Qualification, for each Non-COTS CI
- Subsystem Integration, for each block change in which new functionality is incorporated into the system
- Pilot Network, for each block change in which new functionality is incorporated into the system
- Interoperability, for each network interfaced with ADNS II
- Network Acceptance, for each block change in which additional functionality is incorporated into the system

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Format

The preferred format for Test Reports is given in the ARINC Documentation Standards. Alternative formats must be approved by ARINC.

DID 70: Interface Design Document

Purpose

The Interface Design Document (IDD) further defines interfaces specified in the Interface Requirements Specification (IRS). Message descriptions and communication protocol descriptions are added, control structures used for accessing the interface are defined, and data elements are defined in greater detail.

Application/Interrelationship

The IDD completes the description of an interface defined by an IRS. The IDD is produced for software development engineers and test engineers.

Format

The Interface Design Document shall follow the format specified in the *ARINC Documentation Standard*.

DID 71: FCA/PCA Plan

Purpose

The Functional Configuration Audit/Physical Configuration Audit (FCA/PCA) plan is to organize and describe the configuration audit(s) to be conducted. It is to serve as a commonly agreed-upon document between the Seller and ARINC as to the activities and responsibilities concerning the functional and physical configuration audits.

Application/Interrelationship

The plan is to provide management (Seller and ARINC) with a common document to describe in detail all activities required to perform configuration audits for the items under contract.

Format

Preparation of the plan shall be closely coordinated with the procuring activity. It shall be prepared in accordance with, but need not be limited to, the following:

a. Schedules (time and place) of all audits.
b. Persons participating (Seller and ARINC) and extent of participation.
c. Identification of the configuration items to be audited.
d. Description and extent of the physical and functional audits to be performed.
e. Planned procedures for FCA/PCA to be performed.
f. Description of Seller's audit support such as personnel, equipment, facilities, etc.
g. Audit reports.

DID 72: Environmental Verification Report

Purpose

This report documents testing that demonstrates that the equipment meets the environmental requirements of the contract.

Application/Interrelationship

This DID provides the format and preparation instructions for the Environmental Verification Report.

Format

The Environmental Verification Report may be in the Seller format. At a minimum, it shall include:

1. Description of Tests

a. Organization conducting the tests
b. Date of tests

2. Test Results

D5
CONTRACT DELIVERY SCHEDULE

Seller shall conduct Block Change 1 of the ADNS II contract in accordance with the following schedule of deliverables. This schedule is based on the deliverable due dates set forth in Section D2, Contract Deliverables Requirements List. Seller shall complete Block Change 2 within 400 days of issuance of delivery order.

Data Item Number	*Block Change 1 (CLIN 0009)*	*Submittal Date (DADO)*
M001	Program Management Plan (DID 47)	Draft 60 Final 120
M002	Software Development Plan (DID 3)	Draft 75 Final 135
M003	Hardware Development Plan (DID 2)	Draft 75 Final 135
M004	Configuration Management Plan (DID 5)	Draft 75 Final 135
M005	Quality Management Plan (DID 36)	Draft 75 Final 135
M006	Training Plan (DID 41)	Draft 90 Final 150
M007	Master Installation Plan (DID 11)	Draft 195 Final 255
M008	Master Test Plan (DID 14)	Draft 225 Final 285
M009	Disaster Recovery Plan (DID 21)	Draft 135 Final 195
M010	Maintenance Support Plan (DID 1)	Draft 90 Final 150
M011	Program Status Review Agenda (DID 38)	75, 165, 255
M012	Program Status Review Minutes (DID 39)	100, 190, 280
M013	Technical Interchange Meeting Agenda (DID 50)	Monthly and as required
M014	Technical Interchange Meeting Minutes (DID 51)	5 DA meeting
M015	Configuration Status Accounting Report (DID 6)	180, then Monthly
M016	System/Segment Specification (DID 54)	Draft 70 Final 150
M017	System Requirements Review Agenda (DID 7)	105
M018	System Requirements Review Minutes (DID 8)	130

Data Item Number	*Block Change 1 (CLIN 0009)*	*Submittal Date (DADO)*
M019	System/Segment Design Document (DID 52)	Draft 120 Final 200
M020	ADNS II Network Design (DID 17)	Draft 135 Final 200
M021	ADNS II Availability Model (DID 18)	135
M022	ADNS II Availability Model Documentation (DID 19)	Draft 135 Final 200
M023	ADNS II Availability Prediction Report (DID 20)	135
M024	System Design Review Agenda (DID 9)	150
M025	System Design Review Minutes (DID 10)	180
M026	Interface Requirements Specification (DID 22)	Draft 225 Final 275
M027	Software Requirements Specification (DID 40)	Draft 225 Final 275
M028	Software Specifications Review Agenda (DID 23)	225
M029	Software Specifications Review Minutes (DID 24)	255
M030	Engineering Change Proposal (DID 53)	As Required
M031	Engineering Change Notice (DID 4)	As Required
M032	Project Status Report (DID 49)	Monthly

Data Item Number	*Block Change 2 (CLIN 0010)*	*Submittal Date DADO*
N001	Program Status Review Agenda (DID 38)	75, 165, 255, 345, 435
N002	Program Status Review Minutes (DID 39)	100, 190, 280, 370, 460
N003	Technical Interchange Meeting Agenda (DID 50)	Monthly and as Required
N004	Technical Interchange Meeting Minutes (DID 51)	30 DA review
N005	Configuration Status Accounting Report (DID 6)	Monthly
N006	Interface Design Document (DID 70)	Draft 45 Final 110
N007	Software Design Document (DID 37)	Preliminary 45 Draft 140 Final 205
N008	Software Operator Manual (DID 42)	Preliminary 140 Draft 385 Final 485
N009	Software User Manual (DID 43)	Preliminary 140 Draft 385 Final 485
N010	Software Programmer Manual (DID 44)	Preliminary 140 Draft 385 Final 485
N011	Firmware Support Manual (DID 61)	Preliminary 140 Draft 385 Final 485
N012	Critical Design Review Agenda (DID 58)	140
N013	Critical Design Review Minutes (DID 59)	170
N014	Subsystem (COTS) Test Plan (DID 67)	Draft 85 Final 145
N015	Subsystem (COTS) Test Report (DID 69)	220
N016	Software Unit Development Folder (DID 15)	270
N017	Subsystem Design (Non-COTS) Test Plan (DID 67)	Draft 190 Final 250
N018	Subsystem Design (Non-COTS) Test Description (DID 68)	250
N019	Subsystem Design (Non-COTS) Test Report (DID 69)	340
N020	Subsystem Integration Test Plan (DID 67)	Draft 220 Final 280
N021	Subsystem Integration Test Description (DID 68)	280
N022	Subsystem Integration Test Report (DID 69)	370

Data Item Number	*Block Change 2 (CLIN 0010)*	*Submittal Date DADO*
N023	Environmental Verification Test Plan (DID 16)	160
N024	Environmental Verification Test Report (DID 72)	225
N025	Electromagnetic Interference Test Plan (DID 16)	160
N026	Electromagnetic Interference Test Report (DID 29)	225
N027	System Reliability Test Plan (DID 25)	Draft 250 Final 310
N028	System Reliability Test Report (DID 26)	385
N029	Maintainability Test Plan (DID 27)	Draft 220 Final 260
N030	Maintainability Test Report (DID 28)	355
N031	Interoperability Test Plan (DID 67)	Draft 295 Final 355
N032	Interoperability Test Description (DID 68)	355
N033	Interoperability Test Report (DID 69)	445
N034	Student Material (DID 34)	At course
N035	Pilot Network Test Plan (DID 67)	Draft 220 Final 280
N036	Pilot Network Test Description (DID 68)	310
N037	Pilot Network Test Report (DID 69)	415
N037A1	NMI Installation Spec.	30
N037A2	NMI Site Survey Rept.	10 DA site survey
N037A3	NMI Install. Test Plan	Draft 90 DP test, Final 30 DP test
N037A4	NMI Install. Test Descr.	30 DP test
N037A5	NMI Install. Test Rept.	30 DA test
N037A6	NMI Site Drawings	30 DA install. test
N037A7	NMI Licenses	with equip. delivery
N037A8	NMI Equip. Oper. & Maint. Manuals	Draft 30 DA equip. deliv., Final 30 DAAR
N037A9	NMI Maint. Activity Rept.	2 DA maint. activity
N037B1	NIPS Installation Spec.	30

Data Item Number	*Block Change 2 (CLIN 0010)*	*Submittal Date DADO*
N037B2	NIPS Site Survey Rept.	10 DA site survey
N037B3	NIPS Install. Test Plan	Draft 90 DP test, Final 30 DP test
N037B4	NIPS Install. Test. Descr.	30 DP test
N037B5	NIPS Install. Test Rept.	30 DA test
N037B6	NIPS Site Drawings	30 DA install. test
N037B7	NIPS Licenses	with equip. delivery
N037B8	NIPS Equip. Oper. & Maint. Manuals	Draft 30 DA equip. deliv., Final 30 DAAR
N037B9	NIPS Maint. Activity Rept.	2 DA maint. activity
N037C1	X.25/SLC GW Install. Spec.	30
N037C2	X.25/SLC GW Site Survey	10 DA site survey
N037C3	X.25/SLC GW Install. Test Plan	Draft 90 DP test, Final 30 DP test
N037C4	X.25/SLC GW Install. Test Descr.	30 DP test
N037C5	X.25/SLC GW Install. Test Rept.	30 DA test
N037C6	X.25/SLC GW Site Drawings	30 DA install. test
N037C7	X.25/SLC GW Licenses	with equip. delivery
N037C8	X.25/SLC GW Equip. Oper. & Maint. Manuals	Draft 30 DA equip deliv., Final 30 DAAR
N037C9	X.25/SLC GW Maint. Activity Rept.	2 DA maint. activity
N037D1	ATSS Install. Spec.	30
N037D2	ATSS Site Survey Rept.	10 DA site survey
N037D3	ATSS Install. Test Plan	Draft 90 DP test, Final 30 DP test
N037D4	ATSS Install. Test Descr.	30 DP test

Data Item Number	*Block Change 2 (CLIN 0010)*	*Submittal Date DADO*
N037D5	ATSS Install. Test Rept.	30 DA test
N037D6	ATSS Site Drawings	30 DA install. test
N037D7	ATSS Licenses	with equip. delivery
N037D8	ATSS Equip. Oper. & Maint. Manuals	Draft 30 DA equip. deliv. Final 30 DAAR
N037D9	ATSS Maint. Activity Rept.	2 DA maint. activity
N037E1	TMG Installation Spec.	30
N037E2	TMG Site Survey Rept.	10 DA site survey
N037E3	TMG Install. Test Plan	Draft 90 DP test, Final 30 DP test
N037E4	TMG Install. Test Descr.	30 DP tet
N037E5	TMG Install. Test Rept.	30 DA test
N037E6	TMG Site Drawings	30 DA install. test
N037E7	TMG Licenses	with equip. delivery
N037E8	TMG Equip. Oper. & Maint. Manuals	Draft 30 DA equip. deliv., Final 30 DAAR
N037E9	TMG Maint. Activity Rept.	2 DA maint. activity
N038	STB Test Readiness Review Agenda (DID 65)	420
N039	STB Test Readiness Review Minutes (DID 66)	445
N040	Network Acceptance Test Plan (DID 67)	Draft 615 Final 675
N041	Network Acceptance Test Description (DID 68)	410
N042	Network Acceptance Test Report (DID 69)	470
N043	Version Description Document (DID 48)	405
N044	Software Product Specification (DID 55)	Draft 405 Final 485
N045	Functional Configuration Audit Plan (DID 71)	Draft 345 Final 405
N046	Physical Configuration Audit Plan (DID 71)	Draft 385 Final 445
N047	System Problem/Change Report (DID 31)	As Required

Data Item Number	*Block Change 2 (CLIN 0010)*	*Submittal Date DADO*
N048	Engineering Change Proposal (DID 53)	As Required
N049	Engineering Change Notice (DID 4)	As Required
N050	Preliminary Design Review Agenda (DID 56)	45
N051	Preliminary Design Review Minutes (DID 57)	80
N052	Project Status Report (DID 49)	Monthly

SECTION E
Inspection, Acceptance, and Payment

1 Acceptance

The acceptance criteria described in this section identifies those items which must be satisfactorily completed, ~~in the judgment of the ARINC CTOR,~~ before any invoice may be submitted and before any payment will be made. An authorized ARINC official shall "sign-off" and acknowledge acceptance of all deliverables when such products meet the agreed upon acceptance tests as per §C.

If ARINC uses any of the products before acceptance, as defined herein, delays acceptance more than a reasonable time after Digital offers the products for acceptance, or does not make available requested materials, then such products shall be considered accepted by ARINC.

If the products do not meet the acceptance criteria as set forth in the Statement of Work when they are offered by Digital for ARINC acceptance, ARINC will give Digital detailed notification of the non-conformance. Digital then has thirty (30) days after receiving the notice to correct the non-conformance. The time Digital has to make corrections can be extended by agreement.

CLINs and CDRLs identified in this section include all subordinate CLINs or CDRLs (e.g., CLIN 0009 includes CLINs 0009A, 0009B; CDRL M means CDRLs M001, M002).

1.1 Developmental Items

1.1.1 Block Change 1

Acceptance criteria: completion of the Block Change 1 work described in Section C, including CLINs 0009 and CDRLs M.

1.1.2 Block Change 2

Acceptance criteria: completion of the Block Change 2 work described in Section C, including CLINs 0010, CDRLs N, and satisfactory completion of the Factory Tests and System Test Bed Test (STB) in accordance with §C1-8.

1.1.3 PGP With PARS

Acceptance criteria: completion of the Block Change 4 PGP work described in Section C, including CLINs 0005, CDRLs E, CDRLs F, and satisfactory completion of the Factory Tests and System Test Bed Test (STB) in accordance with §C1-8.

1.1.4 PGP Without PARS

Acceptance criteria: completion of the Block Change 4 PGP work described in §C2 without the PARS protocol support specified in §C2-4, including CLINs 0005, CDRLs E, CDRLs F, and satisfactory completion of the Factory Tests and System Test Bed Test (STB) in accordance with §C1-8.

1.1.5 SFS

Acceptance criteria: completion of the Block Change 4 SFS work described in §C, including CLINs 0007, CDRLs J, CDRLs K, and satisfactory completion of the Factory Tests and System Test Bed Test (STB) in accordance with §C1-8.

1.1.6 Router

Acceptance criteria: completion of the Block Change 4 Router work described in Section C, including CLINs 0006, CDRLs G, CDRLs H, and satisfactory completion of the Factory Tests and System Test Bed Test (STB) in accordance with §C1-8.

1.2 Indefinite Delivery, Indefinite Quantity Items

1.2.1 Products

Acceptance criteria: completion of the Field Tests in accordance with §C1-8.

2 Payment for Developmental Items

Invoices may be rendered by seller no earlier than the date of acceptance. Payment shall be made within 30 days of receipt of a valid invoice. Buyer need not pay for unsatisfactory items rejected under this agreement. Payments shall not constitute acceptance of any item by buyer.

All payments for developmental items, except for Block Change 1, will be subject to a 20% holdback pending one (1) year of satisfactory performance and availability.

3 Payment for Indefinite Delivery, Indefinite Quantity Items

3.1 Payment for Products

Invoices may be rendered by seller no earlier than the date of acceptance. Payment shall be made within 30 days of receipt of a valid invoice. Buyer need not pay for unsatisfactory products rejected under this agreement. Payments shall not constitute acceptance of any products by buyer.

3.2 Payment for Maintenance Support

Invoices for maintenance support shall be submitted for monthly increments of support. Invoices may be rendered by seller at the end of each month for which maintenance support is provided. Payment shall be made within 30 days of receipt of a valid invoice.

4 Invoices

Invoices must include the contract number and delivery order number. Invoices shall be sent in triplicate to:

Aeronautical Radio, Inc.
Attn: Accounts Payable, M.S. 6–3078
2551 Riva Road
Annapolis, MD 21401

SECTION F
Contract Requirements and Clauses

1 Superseding Effect

This Contract supersedes all written or oral agreements, if any, and constitutes the entire agreement between the parties hereto with respect to this Contract.

2 Scope of Work

This is a Firm Fixed Price type Contract, with Option elements and Indefinite Delivery, Indefinite Quantity elements, to develop, deliver, install, and maintain specified equipment and software for ADNS II. Subject to the terms and conditions hereafter provided, the Buyer engages the Seller, on a delivery order basis, for the products and services described in Sections C and D herein. Contract requirements will be provided and funded as delivery orders are issued.

3 Term

The order period under which the Buyer may issue delivery orders for the items described in Section D shall commence upon issuance of a delivery order for Block Change 1, and terminate ten (10) years after acceptance of the work and products for Block Change 2 or Block Change 4, whichever is later. The Contract is renewable by the issuance of a modification to this Contract at any time prior to the termination date. Pricing shall be subject to the time limitations stated in Section B.

4 Products and Services To Be Delivered

The products and services to be purchased under this Contract are set forth in Sections B, C, and D attached hereto. Equipment delivered under this Contract shall conform to the specifications contained in Sections C and D.

5 Pricing

There is no guarantee of any minimum amount to be paid under this Contract. Buyer is under no obligation to purchase any quantities of product and **should Buyer fail to purchase any quantities, Buyer shall have no liability of any kind nor incur any penalties or retroactive price increases.** Buyer's liability and responsibility extends only to those items properly ordered and received under the terms and conditions of this Contract.

Pricing of products and services are set forth in Section B. Unit pricing is firm for the term of this Contract.

Seller shall not increase prices specified herein during the term of the Contract except as specifically authorized herein. **For products** (not services) **ARINC shall receive the lower of the following prices:**

a) Pricing as set forth in Section B; or

b) The then current MLP as discounted based on the cumulative volume over the previous five (5) years in the following table:

Table 48. Volume Discount Schedule

Discount Level	Aggregate Dollar Value (In Thousands)			Category A Discount Percentage
A	$ 0	but less than	$ 500	0
B	500	but less than	1,000	5
C	1,000	but less than	1,500	7
D	1,500	but less than	2,500	9
E	2,500	but less than	4,000	12
F	4,000	but less than	6,000	14
G	6,000	but less than	10,000	16
H	10,000	but less than	15,000	17
I	15,000	but less than	25,000	18
J	25,000	but less than	40,000	18.5
K	40,000	but less than	65,000	19
L	65,000	but less than	100,000	19.5
M	100,000	but less than	150,000	20
N	150,000	but less than	200,000	20.5
P	200,000	and above		21

6 Delivery Orders

Delivery orders shall be issued against this Contract for work and products provided hereunder. Each delivery order issued shall specify the work or products and quantity to be delivered, the unit price, extended price, and shipping instructions.

Seller shall accept or reject each delivery order issued under this agreement by written notification to Buyer within seven (7) calendar days of Seller's receipt of each delivery order. Seller may reject a delivery order only if it does not comply with this agreement.

If within seven (7) days after Seller's receipt of a delivery order Buyer does not receive written notice from Seller rejecting the delivery order and specifying the reasons for such rejection, the delivery order shall be deemed accepted by Seller. Work shall not be performed, nor products delivered until authorized by a delivery order.

7 Product Delivery Schedule

Delivery orders for the developmental items listed in Section B, paragraph 2, shall, unless otherwise agreed to in writing, have a delivery lead time as specified in Section D.

Delivery orders for the Indefinite Delivery, Indefinite Quantity Items listed in Section B, paragraph 3, shall, unless otherwise agreed, have a delivery lead time of thirty (30) days after receipt of Buyer's order. Seller shall delivery products at such times and to the location as requested by Buyer.

At no charge, Buyer may at any time, with at least fifteen (15) days prior written notice to Seller, reschedule and postpone for up to ninety (90) days the delivery of any products scheduled for shipment.

8 Change Control

8.1 Specifications

The specification provided in Sections B, C, and D will be the baseline against which all product changes, product advancements, and field change orders will be evaluated for approval/acceptance by the Buyer.

8.2 Changes

Seller shall notify Buyer in writing of any contemplated changes in the product model, at least ninety (90) days prior to the date that the change is effective. Such notice will be directed to the individual specified in this agreement for notices and correspondence.

In the event of a dispute of classifications of a change, Seller shall not incorporate subject change into equipment until such time as the classification is mutually resolved. Seller shall continue to ship equipment against Buyer's delivery orders at the prevailing change/revision level, i.e., less incorporation of change under dispute.

Seller agrees to provide the change part and/or change kit required to effect the proposed change, at no charge to the Buyer, for testing purposes.

8.3 Class 1 Changes

A Class 1 Change is one that affects the form, fit, and function of equipment or parts. This definition includes interchangeability, maintainability, reliability, interface, appearance, and the specified performance operation of the item.

Buyer approval, in writing, is required before incorporation of a Class 1 Change in shipments to Buyer. Seller shall notify Buyer in writing ninety (90) days prior to instituting any Class 1 Changes. Buyer may accept or reject such changes and shall respond within 90 calendar days after receipt of information concerning a proposed change from Seller.

8.4 Class 2 Changes

Class 2 Changes are those changes which do not fit into the definition of a Class 1 Change.

Providing that compliance with the requirements of this agreement, including delivery schedule, is not affected, Seller shall have the right to make Class 2 Changes, provided Seller notifies Buyer in writing of any changes in accordance with paragraph 8.2.

9 Transportation

Transportation costs for all deliveries within the Continental United States (CONUS) are included in the prices in Section B. For shipments outside the CONUS (OCONUS), Buyer agrees to pay the incremental transportation costs providing that the Seller agrees to prepay transportation costs and invoice Buyer referencing purchase order and delivery order number and attaching a copy of the freight bill.

For OCONUS shipments, Buyer may, by written notice, specify to Seller a specific carrier or carriers or a means of transportation or routing, and Seller will comply with Buyer's written directions.

All items delivered under the agreement shall be F.O.B. Buyer destination subject to the acceptance criteria in Section E.

A notice of shipment, listing the products to be delivered, shall be provided to the Contract Technical Office Representative (CTOR) at the time of shipment from Seller's facilities.

10 Packaging

Seller shall be responsible for preservation, packaging, and packing of all items to be delivered under the terms of this agreement. The responsibility will be carried out in such manner that adequate protection is provided against corrosion, deterioration, and physical damage during shipment and handling from the source of supply to the ultimate destination and until final installation.

Seller shall provide with the equipment, as specified in each delivery order, a complete list of contents, including serial numbers and the top assembly number for each item of equipment delivered.

11 Directions, Notices, and Correspondence

Buyer's CTOR for all work performed under this Contract and the person to whom Seller should submit any technical reports that may be required hereunder, shall be David P. Harding, Director, Data Network Services. Contractual direction shall be provided by Buyer's Mr. J. Panagopulos, Director, Purchasing-Contracts (301) 266-4341.

All notices and correspondence shall be sent by either party to the other in all matters dealing with this Contract to the following addresses:

To the Buyer:

Aeronautical Radio, Inc.
2551 Riva Road
Annapolis, MD 21401
Attention: J. Panagopulos
Director
Purchasing-Contracts
Phone: (301) 266-4341

Copy to the Buyer:

Aeronautical Radio, Inc.
2551 Riva Road
Annapolis, MD 21401
Attention: David P. Harding

To the Seller:

Digital Equipment Corporation
8400 Corporate Drive
MEL2-15
Landover, MD 20785
Attention: Kierin Bustamante

or any other address providing that prior written notice is given to the other party.

12 Rights to Intellectual Property

12.1 Title and Assumption of Risk

Digital represents and warrants that it has sufficient rights to convey the necessary title, license and use rights to all intellectual property, including without limitation, software, hardware, firmware, system design information and documentation to be delivered under this Contract.

12.2 Grant and Warranty

If performance under this Contract requires the use of any proprietary programs (including source code, commented source code and maintenance design and design documentation therefor) of Digital or of Digital's suppliers, then Digital shall specifically identify such proprietary programs to ARINC, and shall grant to ARINC a software license for such programs as set forth below:

12.3 Support, Maintenance, and Upgrades

1. Product support, maintenance and upgrades shall be in accordance with Section C1-7. Seller will employ all reasonable efforts promptly to correct any Material Defect in the Licensed Software. For purposes of this Contract, Material Defect shall mean the material failure of the Licensed Software, as reasonably determined by Buyer or discovered by Seller: (i) to conform to the specifications set forth in Section C; or (ii) to operate in an uninterrupted or error free manner on the hardware delivered and configured in accordance with this Contract and on foreseeable replacement computer configurations. Seller will provide copies of the corrected Licensed Software, together with the required Documentation, to Buyer promptly upon the correction of the software.

2. Seller will employ all reasonable efforts to correct any material defect in the hardware delivered under this Contract. For purposes hereof, a Material Defect shall mean the material failure of the hardware, as reasonably determined by Buyer or discovered by Seller: (i) to conform to the specifications set forth in Section C; or (ii) to operate in an uninterrupted or error free manner.

3. For ten years following Buyer's acceptance of the Licensed Software and the hardware, Seller agrees to use its best efforts to support, maintain, and upgrade said software and hardware, for a reasonable charge and within a reasonable time schedule, to accommodate such additional hardware, software and capabilities as Buyer may, in its reasonable commercial discretion, request. Seller shall maintain a reasonable stock of spares for the hardware for at least ten years following Buyer's acceptance of the Licensed Software and the hardware. At the conclusion of said ten-year period, Seller shall either (a) provide Buyer, in writing, with all information and rights necessary to permit Buyer to continue to support, maintain, and upgrade the Licensed Software and hardware, and shall provide Buyer an opportunity to purchase (or cause a third party to purchase) any remaining spares and to use same as needed to support the hardware, or (b) extend the support, maintenance, and upgrade terms and conditions of this Contract.

4. If Seller corrects a defect in, or improves, any program element used in the Licensed Software, and if Buyer has issued the appropriate orders for maintenance as listed in Section B, Seller agrees to provide said improved or corrected code to Buyer at no additional charge, whether or not the correction or improvement was first made pursuant to this Contract.

5. Seller acknowledges that if Seller as a debtor-in-possession or a trustee in bankruptcy in a case under the Bankruptcy Code rejects this Contract or any agreement supplementary hereto, Buyer may elect to retain its rights under this Contract or any agreement supplementary hereto as provided in Section 365(n) of the Bankruptcy Code. Upon written request of Buyer to Seller or the Bankruptcy Trustee, Seller or such Bankruptcy Trustee shall not interfere with the rights of Buyer as provided in this Contract or any agreement supplementary hereto to obtain the source code and hardware documentation from the Bankruptcy Trustee or from a third party Escrow Agent, and

shall, if requested, cause a copy of the source code and hardware documentation to be available to Buyer.

6. The requirements of this ¶12.3 shall apply to software and hardware provided by the Seller under this Contract, regardless of its source.

7. Buyer may inspect the contents of all escrow deposits at any reasonable time for the sole purpose of ensuring that adequate documentation has been deposited.

12.3.1 Source Code Escrow

1. Upon payment of the Block Change 2 price, Seller shall deposit two complete machine readable copies (on two separate diskettes) and one human readable printout (on paper) of the source code for the Licensed Software (the "Source Code"), and full documentation for the Source Code (including commented source code) (collectively, the "Deposit") with an Escrow Agent ("Escrow Agent") within 120 days of acceptance of the deliverable of the software to Buyer. The Escrow Agent shall be selected and identified by the Seller, subject to the approval of the Buyer, prior to Buyer's acceptance of the Licensed Software and the hardware. Seller shall annually upgrade, modify, and correct the Deposit. Escrow Agent shall hold the Deposit in Escrow pursuant to the terms of this ¶12.3.1 and shall release the Deposit only pursuant to the terms of subparagraphs (2), (3), or (4) of this ¶12.3.1. The Escrow Agreement shall contain, *inter alia*, the following provision:

   "Seller and Buyer acknowledge that this Escrow Agreement is an "agreement supplementary to" the License Agreement as provided in Section 365(n) of Title 11, United States Code (the "Bankruptcy Code"). Seller acknowledges that if Seller as a debtor-in-possession or if a trustee in bankruptcy in a case under the Bankruptcy Code rejects the License Agreement or this Escrow Agreement, Buyer may elect to retain its rights under the License Agreement and this Escrow Agreement as provided in Section 365(n) of the Bankruptcy Code. Upon written request of Buyer to Seller or the Bankruptcy Trustee, Seller or such Bankruptcy Trustee shall not interfere with the rights of Buyer as provided in the License Agreement and this Escrow Agreement to obtain the source code from the Bankruptcy Trustee or from the Escrow Agent, and shall, if requested, cause a copy of the source code to be available to Buyer."

2. Escrow Agent shall release the Deposit to Buyer or Seller as directed in a notice bearing the original signatures of authorized officers of both Buyer and Seller.

3. Upon: (i) the dissolution, winding up or cessation of Seller or its business; (ii) an assignment by Seller of substantially all of its assets for the benefit of creditors; (iii) the filing of any petition or application or the commencement of any proceeding by or against Seller under any law relating to bankruptcy, insolvency, or the relief of debtors; (iv) any transfer by Seller to any third party of substantially all of Seller's assets; or (v) Seller's abandonment of support of the Licensed Software, or any portion thereof, as a current product, Buyer may deliver to Seller and Escrow Agent a notice of Buyer's right of access to the Deposit (the "Cessation Notice"). Escrow Agent shall release the Deposit to Buyer ten (10) business days following receipt of a Cessation Notice unless the parties agree to the contrary, or such release is enjoined by a court of competent jurisdiction. Buyer's exercise of the right of access to the Deposit shall be subject to Buyer's payment of the Source Code Withdrawal Fee in Section B.

4. Upon release of the Deposit to Buyer, Buyer shall have a perpetual, non-exclusive, non-transferrable, worldwide license to use the Source Code and the remainder of the Deposit solely for the purpose of supporting, maintaining, upgrading and using the Licensed Software for uses contemplated by this Contract. Buyer may hire an independent contractor to perform such work, provided the contractor agrees to be bound by the restrictions of this subparagraph. If the release occurred pursuant to subparagraph (4), Buyer shall maintain the Source Code as a trade secret and will not disclose or release the Deposit to any third party (other than Buyer's authorized independent contractor).

5. Escrow arbitration and release of the Deposit shall be in addition to, and not in lieu of any other remedy of the parties.

12.4 Standard Software License Terms

12.4.1 Software Execution

1. ARINC may execute the Software on the Licensed Processor including any processor upgrades obtained from Digital for ADNS II and may load, copy, or transmit the Software, in whole or in part, only as necessary for execution on the Licensed Processor, except that ARINC may execute the Software (except diagnostic Software) on another single processor or equipment configuration on a temporary basis during a malfunction or other temporary reasonable circumstances which prevents execution of the Software on the Licensed Processor, and may load, transmit, or copy the Software as necessary for such temporary execution.
2. ARINC may make archival copies of the Software as provided in the Copyright Law of the United States.
3. ARINC agrees to reproduce Digital's copyright and all other legal notices, including but not limited to other proprietary notices and notices mandated by governmental entities, on all complete or partial copies or transmissions of the Software.
4. The Licensed Processor is the processor or equipment configuration ordered with the Software License, or if the Software License is ordered separately, is the processor or equipment configuration on which the Software is first executed pursuant to the license grant.

12.4.2 Modification and Merger

ARINC may (1) modify the Software (in machine readable form only), or (2) merge modified Software or unmodified Software into other Software, to form adaptations intended solely for the execution by ARINC on the Licensed Processor. Any part of the Software included in such adaptions will continue to be subject to these Terms and Conditions.

12.4.3 Access to Software

ARINC may make the Software available to its employees and agents to the extend needed to exercise its License hereunder.

12.4.4 Personal, Non-exclusive Licenses

ARINC's License is personal and non-exclusive, and may not be transferred without Digital's express consent, except to wholly-owned subsidiaries or as otherwise provided in Digital's Software License Transfer policy stated in the Price List in effect at the time of the transfer.

12.4.5 Record Maintenance

ARINC shall maintain records which identify (1) the Licensed Processor on which the Software is executed, and (2) the corresponding Software License granted by Digital which authorizes such execution. Upon request, ARINC shall make records available to Digital within a reasonable period of time.

12.4.6 License, Limitation, Reverse Engineering

COTS Software is proprietary to Digital. Digital transfers no title to or ownership of any COTS Software to ARINC or any third party. Except as explicitly set forth in these Terms and Conditions, ARINC shall not execute, use, copy, or modify the COTS Software nor disclose any part of the COTS Software. ARINC shall not decompile, or reverse assemble the COTS Software or analyze or otherwise examine the COTS Software, including any hardware or firmware implementation of the COTS Software for the purpose of reverse engineering.

12.4.7 License Termination

ARINC's License shall continue unless terminated based upon ARINC's knowing, willful or persistent breach of any obligation or requirement in this Contract specifically as such breach may relate to usage exceeding the scope of the ADNS II program, reverse-engineering, relicense, remarketing or misappropriation of Digital software. ARINC will be given written notice and the opportunity to cure any breach at least thirty (30) days prior to license termination hereunder by Digital.

Termination, whether by Digital or by ARINC, shall apply to all versions of the Software Licensed for execution on the Licensed Processor.

Before any termination by ARINC becomes effective, and in the event of any termination by Digital, ARINC shall (1) return to Digital any License certificate or PAK furnished by Digital, (2) destroy all copies of all versions of the Software in ARINC's possession, (3) remove all portions of all versions of the Software for any adaptations made ARINC and destroy such portions, and (4) certify in writing that all copies, including all those included in ARINC's adaptations, have been destroyed.

12.4.8 New Versions

All Software updates, whether described as updates, new releases, new versions, modifications, or corrections may only be executed on a processor that is validly licensed for a previous version of the Software. Any such updates, new releases, and/or new versions shall be subject to these Terms and Conditions.

13 Data Rights

1. Digital grants to ARINC all right, title, and ownership, of any software first developed by Digital in connection with this Contract. Digital and/or its subcontractors shall retain a perpetual, non-exclusive, unlimited rights, royalty-free/no-cost license to use software and related documentation first developed hereunder for any and all purposes, including but not limited to the rights to use, copy, modify, and transfer as Digital may desire. However, Digital shall not sell or otherwise deliver any such software or attendant design documentation to anyone other than ARINC for a period of two (2) years after acceptance of said software by ARINC. In accordance with the above,Digital shall transfer source code and attendant documentation to ARINC for software first developed hereunder.
2. The right, title, and ownership to any and all customization, enhancement, or modification to standard Digital or third-party commercial off the shelf (COTS) shall remain with the owner(s) of the original software COTS product; however, ARINC shall have a non-exclusive, unlimited rights, royalty-free/no-cost license to use or transfer such customization, enhancement, or modification for any purpose as ARINC may desire. COTS Products
3. All Digital COTS products shall be licensed in accordance with Section 12.4, Standard Software License Terms.
4. ARINC shall be deemed to have been granted exclusive rights to:
    a. data derived from demonstrations and tests, and
    b. data derived from design and engineering on this Contract.
5. Digital agrees and shall hereby grant to ARINC a royalty-free, non-exclusive and irrevocable (limited) license to reproduce all commercial manuals and supplemental material that may contain copyrighted information provided such reproduction and use is specifically limited to the ADNS II program (as defined in this Contract) only.
6. Digital shall furnish appropriate copyright releases giving ARINC permission to reproduce and use the submitted copyright material for use under the ADNS II program (as defined in this Contract) only. When Digital uses a manual that covers a third party vendor's components or portions

thereof, and the vendor's manual contains copyrighted material, Digital shall be responsible for obtaining a copyright release from the vendor for manuals specific to the ADNS II program (as defined in this Contract) and furnishing the release to ARINC.

ACE

7. ~~Third party~~ software shall be licensed in accordance with the accompanying standard third party software license. All other third party software shall be licensed as described herein for Digital developed software or as otherwise approved by ARINC.

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14 Insurance

The Seller shall procure and maintain unemployment compensation insurance and the following insurance with respect to this Contract:

1. Workmen's compensation insurance in accordance with statutory requirements in any state in which the work is performed.
2. Comprehensive general liability insurance providing operation liability, owners and Contractual protective liability insurance. The policy shall provide a combined single limit of liability or personnel injury (including death) and property damage for not less than $1,000,000 for each occurrence.
3. Automobile liability insurance covering liability for personal injury (including death) and damage to property involving the use of company automobiles and self propelled equipment.
4. All insurance required pursuant to the provisions of this article shall be in force and remain in force throughout the Contract period. Seller shall furnish ARINC with proof of insurance prior to Contract award.

15 Conceptual and Developmental Design Drawings

Conceptual and developmental design drawings specific to ADNS II shall be considered the exclusive property of ARINC, and be turned over to ARINC upon request by ARINC. The Seller shall maintain strict control over such drawings, and maintain proper revision labels and approvals in accordance with good engineering practices.

16 Indemnification

Digital shall defend and indemnify ARINC against, and hold ARINC harmless from, all claims, damages, costs, and expenses, including reasonable attorney's fees, within the limitations of liability under this Agreement, on account of property damage, personal injury, or death which may be sustained by Digital, its agents or employees while on ARINC's premises arising out of, or i connection with, the performance of this Agreement to the extend that such damage, injury, death is caused by the negligence of Digital. Digital shall retain sole control of the defense of any such claim. Neither this indemnity nor the provisions of the agreement set forth herein in any way limit liability for personal injury caused by the negligence of Digital.

ARINC shall defend and indemnify Digital against, and hold Digital harmless from, all claims, damages, costs, and expenses, including reasonable attorney's fees, within the same limitations of liability as provided herein for Digital, on account of property damage, personal injury, or death which may be sustained by ARINC, its agents or employees while on Digital's premises arising out of, or in connection with, the performance of this Agreement to the extent that such damage, injury, or death is caused by the negligence of ARINC. ARINC shall retain sole control of the defense of any such claim. Neither this indemnity not the provisions of the agreement set forth herein in any way limit liability for personal injury caused by the negligence of ARINC.

16.1 Patents and Copyrights

Digital shall defend, at its expense, any claim (including any suit) brought against ARINC alleging that any products or deliverables furnished hereunder infringe a United States patent, copyright, or mask work right, and shall pay all costs and damages finally awarded, provided that ARINC gives Digital prompt written notice of such claim, and information, reasonable assistance and sole authority to defend or settle the claim. Digital may obtain for ARINC the right to continue using the products or deliverables, replace or modify the products or deliverables so they become non-infringing.

Notwithstanding the above, Digital shall not have any liability for a claim alleging that the system infringes a U. S. patent or copyright if the alleged infringement was developed based on information furnished by ARINC or if the alleged infringement is the result of a modification made by ARINC.

Digital disclaims all other liability for violation, misappropriation or infringement of intellectual property rights, and further disclaims any liability for incidental or consequential damages.

17 Warranty

Digital expressly warrants that all deliverables covered by this contract shall be of good quality and workmanship and shall conform to the specifications set forth in Section C for a period of one (1) year after acceptance of such deliverables.

17.1 Hardware Warranty

Seller shall warrant all hardware conforms with the specifications set forth in the Contract as expanded by Seller for a period of not less than one (1) year after acceptance. Warranty to include replacement of defective parts, assemblies, components, etc., at no cost to ARINC. When warranty repairs are completed, the network shall perform to specifications as described in §C2.

17.2 Software Warranty

Seller shall warrant all software conforms with the specifications set forth in the Contract as expanded by Seller for a period of not less than one (1) year after acceptance. As a minimum, the warranty shall include functionality, conformability, and ability to operate hardware as called for in §C. At no cost to ARINC, Seller shall correct, or cause to be corrected, any deficiencies in network functionality or performance resulting from any Seller provided software incorporated into the network.

17.3 Warranty Limitation

The warranties provided herein are limited warranties and do not apply to:

1. conditions resulting from improper use of the hardware or software or operation of the hardware or software products outside the specified environmental conditions, or
2. conditions resulting from improper causes external to the hardware or software after delivery, or
3. conditions resulting from modifications to hardware or software other than modifications made by Digital.

Except for the express warranties state above, Digital disclaims all warranties, including all implied warranties of merchantability and fitness for a particular purpose, and the stated express warranties are in lieu of all obligations or liabilities on the part of Digital arising out of or in connection with the performance of this project effort.

18 Order of Precedence

The following Order of Precedence shall govern in the event of conflict between the documents of this agreement:

1. Section C—Statement of Work
2. Section D—Deliverables
3. Section B—Pricing
4. Section F—Contract Requirements and Clauses and ARINC Standard Terms and Conditions
5. Section E—Inspection, Acceptance, and Payment
6. Section H—Appendix
7. Section A—General
8. Section G—Agreements/Proposal

19 Standard Terms and Conditions

19.1 Uniform Commercial Code

What does this mean?

Issues not covered under the terms of this Contract shall be governed by the State of Maryland Uniform Commercial Code where applicable.

19.2 Delivery

The Seller agrees to deliver the items described pursuant to a Delivery Order in the quantity, within the time, and at the price(s) specified therein. Any failure by the Seller to comply with the foregoing shall entitle Buyer, in addition to any other rights or remedies at law or in equity, to cancel the Delivery Order for items listed in Section B3 and be relieved of all liability for any undelivered or non-conforming items.

B1(3)2

19.3 Warranty

conform to the requirements set forth in Section C

The Seller expressly warrants that all materials and work covered by this Contract: (a) shall be of good quality and workmanship and free from defects, latent or patent; (b) shall conform to the drawings, designs, specifications, descriptions, and samples furnished to or specified by Buyer; and (c) shall ~~be fit for the purpose intended by Buyer~~ for a period of twelve (12) months after acceptance. No materials may be substituted in lieu of those specified and no modification may be made in the drawings, designs, specifications, descriptions, or samples furnished or specified by Buyer without Buyer's prior written consent. In the event the materials or work does not conform to the warranty, the Seller shall promptly, and at its own expense (including transportation costs), repair or replace the defective item.

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19.4 Acceptance/Title

Items purchased hereunder are subject to inspection and acceptance after receipt by Buyer as set forth in Section E. **Title and risk of loss or damage to deliverable items shall remain with Seller until Buyer accepts such items.** Items not in conformity with the requirement of this Contract may, at Buyer's option, be returned to the Seller for repair, replacement, credit, or refund as Buyer may direct, or Buyer may retain the nonconforming items and shall be entitled to an equitable adjustment in the price. Buyer shall be reimbursed for all expenses of handling, inspection, and return of nonconforming items. The

Seller expressly assumes all risk of loss or damage to items returned by Buyer while same are in transit and risk of loss or damage due to improper packing by Buyer shall likewise be assumed by the Seller unless the Seller shall promptly upon receipt of such items (1) notify Buyer of the damage, (2) cause prompt inspection by the carrier, and (3) furnish Buyer with a copy of the carrier's inspection report.

19.5 Taxes

The prices herein stated do not include federal, state and local sales, and use taxes imposed on the Seller or to be collected by the Seller on items furnished hereunder. The Seller shall set forth all applicable taxes as separate line items on invoices to be paid by Buyer, unless Buyer shall furnish the Seller with tax exemption certificates.

19.6 Performance of Work Not Assignable

The Seller shall not assign, in whole or in part, the work to be done hereunder without the prior written consent of Buyer, but this provision shall not restrict the Seller in the procurement of component parts or materials. If the Seller is not a manufacturer, it agrees to require compliance with all provisions of this Contract by its manufacturer as if such manufacturer were the Seller hereunder.

19.7 Compliance With Laws

Seller warrants that the items purchased under this Contract shall be produced in compliance with all applicable Federal, State and local laws, ordinances and regulations, including specifically, but without limitation, the requirements of OSHA, Hazardous Materials Transportation Act, Toxic Substances Control Act, Consumer Products Safety Act, Federal and State regulations regarding the handicapped, Federal and State local rules, laws, and regulations on Equal Opportunity Employment, affirmative action and socially and economically disadvantaged small business concerns. The Seller also agrees, if requested by Buyer, to furnish Buyer with satisfactory evidence of compliance with any such laws, ordinances, or regulations.

19.8 Publicity

The Seller shall not, without first obtaining the express written consent of Buyer, in any manner disclose, advertise, or publish the fact that Seller has contracted to furnish Buyer the items herein ordered. Such consent shall not be unreasonably withheld by Buyer.

19.9 Applicable Law and Arbitration

Is this need to say Bundy?

Any controversy or claim arising out of or relating to this Agreement or the breach thereof, shall be settled by arbitration in accordance with the Commercial Rules of the American Arbitration Association. Judgment upon the award rendered by the arbitrators may be entered in any court having jurisdiction thereof. Both parties have the right of full judicial appeal of the arbitrators decision. This Agreement will be governed by the laws of the State of Maryland. Pending the resolution of any dispute, the Seller shall proceed as directed by ARINC in writing.

19.10 Termination for Convenience

Without limiting any other right Buyer has to cancel or terminate any Delivery Order, it is agreed that Buyer shall have the right to terminate the Delivery Order in whole or in part for Buyer's convenience at any time prior to Buyer acceptance of the item or items to be terminated. Such termination for convenience shall be effected by means of a written or telegraphic notice or oral notice confirmed in

writing expressly stating that the termination is for the convenience of Buyer. Upon such a termination for Buyer's convenience, Buyer shall reimburse the Seller for those actual and reasonable costs properly allocable to the Delivery Order, provided that such reimbursement shall not exceed the applicable price of the item or items terminated. In calculating the reimbursement to Digital for work performed up to the date of termination for convenience by ARINC, the clause at FAR 52.249-2 Termination for Convenience shall be used as the initial for calculation of costs payable to Digital. Final calculation of termination costs shall be negotiated by the parties.

19.11 Changes

Buyer may at any time, by written notice, make changes in the specifications, designs or drawings, samples or other description to which the contract products are to conform, in methods of shipment and packaging, or time and place of delivery. If any such change causes an increase or decrease in the cost of, or the time required for, the performance of any part of the work under this Contract, an equitable adjustment shall be made in the price or delivery schedule, or both, and this Contract shall be modified in writing accordingly. Any claim by Seller for any such adjustment must be made in writing within thirty (30) days of the receipt of any such change. Nothing in this clause shall excuse the Seller from proceeding without delay to perform this Contract as changed. The authorized Purchasing personnel shall be the only individuals empowered to make any adjustments or modifications to the price or delivery schedule. Buyer shall not be responsible for any action undertaken by Seller which may result in any increase in the price or extension in the time for delivery of the items for hereunder which have not been approved in advance by Buyer. If Digital is prevented from installing equipment by causes due to an ARINC act or omission, then Digital reserves the right to seek an equitable adjustment in Contract price and/or schedule.

was this done?

19.12 Notice of Delay

Whenever any actual or potential event, including labor disputes, delays, or threats, delay the timely performance of a Delivery Order, Seller shall give immediate notice thereof to Buyer.

19.13 Information Disclosed

Unless expressly marked and legended in accordance with the Non-Disclosure Agreement set forth in Section G, no information disclosed by either party to the other in the performance or in connection with this Contract shall be deemed to be confidential or proprietary.

19.14 Remedies

The rights and remedies provided Buyer herein shall be cumulative and in addition to any other rights and remedies provided by law or equity. A waiver of a breach of any provision hereof shall not constitute a waiver or breach of any other provisions.

see 24

incorporate w/ 24

19.15 Effect of Invalidity

The invalidity in whole or in part of any provision hereof shall not affect the validity of any other provision.

20 Termination for Default

Did ARINC default?

If either party fails to perform its material obligations under this Contract or fails to make progress in performing such material obligations, the other party has the right to terminate this Agreement. This Agreement may not be terminated orally.

21 Proposal Material and Data

The data included with the Digital ADNS II proposal shall be considered Digital proprietary and use of such by ARINC shall be for evaluation purposes only, and shall be in accordance with the Non-Disclosure Agreement executed by the parties on 9 August 1990. To the extent that drawings and other data or proposal information submitted by Digital with the RFP are marked confidential or proprietary, that information shall be considered Digital proprietary, used for proposal evaluation purposes only, and handled in accordance with the Non-Disclosure Agreement executed by the parties. However, ARINC is granted a license to use, modify, and copy such proposal material for internal purposes after acceptance and payment for Block Change 1.

22 Technology Substitution

Subject to ARINC's acceptance testing and approval, Digital reserves the right to substitute technology of equivalent or greater functionality for products and services offered hereunder.

23 Customer Responsibilities

ARINC shall give timely responses to reasonable questions and reasonable requests for materials which arise during the project effort. The project shall be based on the information provided by ARINC which is incorporated into the Contract. ARINC is responsible for the accuracy and completeness of all information given. If the information is incorrect or incomplete, or ARINC requests a change, Digital shall continue work and may agree with ARINC on the appropriate changes and determine an equitable and mutually agreeable adjustment.

24 Limitation of Liability

Increase risk at 19.14

see 19.14

Digital's entire liability and Purchaser's remedies are set forth in this paragraph. These remedies are Purchaser's exclusive remedies and are in lieu of any other remedy at law or in equity.

In all situations involving performance or non-performance of Equipment and Software furnished hereunder, ARINC's remedy is:

- repair or replacement by Digital (at Digital's option) of defective Equipment if notified by ARINC of the defect within the warranty period, or
- remedy, by Digital in the manner specified in the Software Product Description (SPD), of a non-conformance of Software to the applicable SPD during the stated warranty period.

If Digital fails to perform its warranty or service responsibilities, or if ARINC has any other claim related to Products or Services purchased or licensed from Digital, ARINC shall be entitled to recover only direct damages and only up to the limits set forth herein.

Digital's liability to ARINC for any cause whatsoever shall be limited to the lesser of five million dollars $5,000,000 or the purchase price paid to Digital for the products and services that are the subject of ARINC's claim. This limitation will apply regardless of the form of action, whether contract or tort,

including without limitation negligence. The foregoing limitation does not apply to damages resulting from personal injury caused by Digital's negligence.

In no event will Digital be liable for any damages resulting from loss of data or use, lost profits or any incidental or consequential damages.

Any action against Digital must be brought within two (2) years after the cause of action is known or should have been known to ARINC.

25 Service Limitations

A waiver of liability by Digital or its employees or other restrictions will not be imposed as a requirement for access to ARINC's site where service is performed. Digital may suspend the delivery of services if Digital reasonably believes that conditions at or in transit to or from ARINC's site represent a safety or health hazard to any Digital employee.

26 Personnel

If ARINC directly contracts with or hires a Digital employee engaged in providing services to ARINC under this Agreement within one (1) year after the completion of Block Change 2 or 4, whichever is later, Digital will have the option of negotiating a change in the cost and/or time to deliver or invoking the Cancellation clause and being released from all obligations under this Agreement.

27 Patent License

For Equipment which has a UNIBUS or Q-BUS interconnection bus, Digital grants to Purchaser a non-transferable license under U.S. Patent 3,815,099, effective on Digital's acceptance of Purchaser's order for the Equipment to manufacture, but not to have manufactured, up to ten Devices (as defined below) for connection to the Equipment through the bus and to use, or to the extent that Purchaser is authorized by Digital to resell the Equipment under a written agreement and any applicable addendum thereto, to sell a system containing the Equipment and the manufactured Devices. The term "Device" means a memory or peripheral unit adapted to be directly connected to the bus, or an interface for a memory or peripheral unit enabling it to be connected in such a way that the connected memory or peripheral unit is covered by one or more claims of Patent 3,815,099.

28 Training and Maintenance Material

Diagnostic Software, Documentation, Equipment, training or educational material, or other material used by Digital in the performance of installation, warranty, or services may be furnished with Products or stored at ARINC's facility. Digital grants no title or license to such material, and it remains the exclusive property of Digital. ARINC agrees to properly secure such material and not use it in any manner or make it available to third parties without Digital's consent.

29 Export

ARINC hereby acknowledges that it will not export any Digital Products, Distributed Software or technical data (e.g. any technical information relating to Products or Distributed Software, written or otherwise), or any product incorporating Products, Distributed Software, or Digital technical data, without first obtaining required U.S. Government export licenses. ARINC further acknowledges that it is knowledgeable about U.S. Government export licensing requirements or that it will become so prior to engaging in any export transaction involving Products, Distributed Software, or Digital technical data.

Service Eligibility: U.S. export regulations require that non-U.S. citizens (excluding Canadians) who are enrolled or receive training courses or materials classified as "restricted" sign a Statement of Assurance or, if a citizen of a restricted country identified in the Statement of Assurance, possess a valid U.S. export license. The regulations prohibit training of any persons listed on the Commerce Department's "Table of Denial Orders."

It is ARINC's responsibility to comply with these U.S. export regulations by obtaining the Statement of Assurance or the U.S. export license when required, and by ensuring that no person listed on the Commerce Department's "Table of Denial Orders" is enrolled in the course.

Digital will identify restricted courses to which these regulations apply and will provide Statement of Assurance forms on the opening day of the classes.

30 Product Restrictions

Digital Products are manufactured for standard commercial uses and are not intended to be sold or licensed for use in critical safety systems in nuclear facilities.

31 Force Majeur

Digital is not responsible for delay or failure to perform its obligations due to causes beyond its reasonable control. Installation, warranty, and Services to be performed at ARINC's facility may not be performed if Digital reasonably believes conditions at ARINC's facility represent a safety or health hazard to any Digital employee.

SECTION G
Agreements/Proposal

1 Seller's Proposal

The Seller's proposal dated February 15, 1991, is incorporated into this Contract in its entirety but is subject to and subordinate to all other specifications and requirements of this Contract.

2 Disclosure Agreement

Whereas, the parties will conduct discussions or otherwise transfer information relating to ADNS II and;

Whereas, in the furtherance of these discussions, it may be necessary or desirable for ~~ARINC~~ to disclose to the ~~Seller~~ certain confidential and proprietary business and technical information, and

Therefore, in consideration of the mutual promises herein set forth, the parties hereto agree as follows:

- For the purpose of this Agreement, *Confidential Information* shall mean information received by ~~the Seller from ARINC~~ directly or indirectly.
- For a period of three (3) years from the date of receipt, all Confidential Information shall be maintained in confidence with the same degree of care as the ~~Seller~~ normally uses in the protection of its own confidential and proprietary information of like kinds, but in no case with any less degree than reasonable care. The ~~Seller~~ further agrees not to use any Confidential Information received from ~~ARINC~~ except for the purposes contemplated by this Agreement.
- The restrictions herein shall not apply with respect to Confidential Information which:
  - Is or becomes a part of the public domain without breach of this Agreement
  - Is already in the possession of the ~~Seller~~ without restriction prior to any disclosure hereunder
  - Is or has been lawfully disclosed to a party by a third party without an obligation of confidentiality
  - Is independently developed by a party without access to or use of the Confidential Information
  - Is disclosed by judicial action or government regulations, provided the ~~Seller~~ notifies ~~ARINC~~ prior to such disclosure and cooperates with ~~ARINC~~ in the event ~~ARINC~~ elects to legally contest and avoid such disclosure
  - At the end of the period of confidentiality as stated above
- Except as expressly herein provided, no rights, licenses, or relationships whatsoever are to be inferred or implied by the furnishings of Confidential Information specified above or pursuant to this Agreement.
- All tangible information, including drawings, specifications, and other information submitted hereunder, by the Seller to ARINC shall remain the property of ARINC.
- Seller shall not publish or use any advertising, sales promotion, press releases, or publicity matters relating to this Agreement without the prior written approval of ARINC, for which approval shall not be unreasonably withheld.

SECTION H
Attachments

H1
LIST OF ATTACHMENTS

The following specifications are provided as attachments.

- X.25 Specification
- X.32 Specification
- SLC Specification
- ALC PARS/IPARS Specification

H2
X.25 SPECIFICATION

1 Introduction

This specification defines the functional and performance requirements for the X.25 protocol elements to be implemented in the applicable ADNS II Network elements.

2 Detailed Requirements

2.1 X.25 Implementations

All implementations of X.25 shall be in conformance with the "ANNEX A, X.25 PROFILE for Air Transport Industry Packet Subnetworks," International Air Transport Association IATA [IATA #1].

2.2 Aeronautical Telecommunications Network Requirements

All implementations of all intermediate and end systems provided by Seller shall be compliant with the ATN standards as specified in Aeronautical Telecommunications Network: Proposed Standards and Recommended Practices (SARPs) and Guidance Material for Internetworking AND the ATN component of the Aviation Coordinating Committee for Telecommunications Services (ACCTS) OSI Profiles as inclusive of the ISO 8473 and ISO 8348 AD 2 profiles. ATN addressing specifications are contained in the SARPs and ACCTS #3 with the SARPs having precedence over ACCTS #3 in the event of conflict.

3 Subnetwork System Configuration and Control

This section specifies the configuration, operational control status, reports, and alarms of X.25.

3.1 Configuration

Each link defined in the X.25 interface shall be defined as a line by network configuration. The line may be an independent connection or it may be part of a multilink connection (i.e., rotary).

The required configuration parameters, the default setting, and the range of values are shown in §H2-2.

The required subscription time selectable facilities shall be as specified in IATA #1.

3.2 Operational Controls

Network control information shall be used to manage network performance and subscriber access. This information includes network activity alarms, link statistics, and call accounting data. On-line modification is required to provide the ability to meet the dynamically changing performance and access requirements. Network Control specifications are detailed in Section §C2-2.

3.2.1 Call Accounting (Billing)

Call accounting requirements are specified in §C2 and in the NIPS specification §C2-5.

3.2.2 Alarms

Table 49 shows alarms specific to X.25 that shall be incorporated into the alarm database and reported by the Alarm Reporting Service as detailed in §C2 and the NCS §C2-2. The table also provides reasons for the alarms. Alarm specifications listed in this section are to be considered supplemental to the requirements listed in §C2 and the NCS §C2-2.

Table 49. Alarms Specific to X.25

X.25 LINE ALARMS	REASONS
Line Disconnect received	User closed the line
Line reconnected	User re-opened the line
Line failure (1)	Physical line error detected
Line restoral	Physical line restoral
Line RNR received	User not ready to receive traffic on line
Line RR received	User ready to receive traffic on line
Line RNR Transmitted	ADNS PS not ready to receive traffic on line due to throttling
Line RR Transmitted	ADNS PS ready to receive traffic on line
Restart Received (2)	User initiates restart of line
Restart Confirmation Transmitted	ADNS PS completes user-initiated restart
Restart Transmitted (2)	ADNS PS initiates restart of line
Restart Confirmation received	User indicates restart completed
Reset Received (2,3)	User indicates reset of logical channel
Reset Confirmation Transmitted (3)	ADNS PS completes user-initiated reset
Reset Transmitted (2,3)	ADNS PS initiates reset of logical channel
Reset Confirmation Received (3)	User indicates reset complete
Channel RNR received (3)	User not ready to receive traffic on logical channel
Channel RR received (3)	User ready to receive traffic on logical channel
Channel RNR Transmitted (3)	ADNS PS not ready to receive traffic on logical channel
Channel RR Transmitted(3)	ADNS PS ready to receive traffic on logical channel

1. A diagnostic code shall be included as part of the alarm data field. Applicable diagnostic codes shall be reflected in Seller's design and operational documentation.
2. The diagnostic code used in this packet shall be included as part of the alarm data field. Diagnostic codes are described in CCITT Annex C.
3. The logical channel on which the control packet was received or transmitted shall be included as part of the alarm data field. The errors listed in Table 50 shall generate alarms indicating the LCN, called address, calling address, interface identifier, diagnostic description, and diagnostic code.

3.2.3 Line Monitoring System

The Native NCS shall have the capability to monitor the performance and activity lines for each of the X.25 DCE/DTE interfaces. A trace of frames and/or packets shall be performed and statistics shall be collected. Performance specifications listed in this section are to be considered supplemental to the requirements listed in §C2 and the NCS §C2-2.

Table 50. Errors That Generate Specific Alarms

Diagnostic	Code
No additional information	0
Invalid P(S)	1
Invalid P(R)	2
Packet type invalid	16 to
For state r1-d3	29
Packet not allowed	32
Unidentifiable packet	33
Call on one-way logical channel	34
Invalid packet type on PVC	35
Packet on unassigned logical channel	36
Reject not subscribed to	37
Packet too short	38
Packet too long	39
Invalid GFI	40
Restart or registration packet incorrect	41
Packet type not compatible with facility	42
Unauthorized interrupt confirmation	43
Unauthorized interrupt	44
Unauthorized reject	45
Time expired	48
For incoming call	49
For clear indication	50
For reset indication	51
For restart indication	52
For call deflection	53
Call set-up, call clearing or registration problem	64
Facility/registration code not allowed	65
Facility parameter not allowed	66
Invalid called DTE address	67
Invalid calling DTE address	68
Invalid facility/registration length	69
Incoming call barred	70
No logical channel available	71
Call collision	72
Duplicate facility requested	73
Nonzero address length	74
Nonzero facility length	75
Facility not provided when expected	76
Invalid CCITT-specified facility	77
Maximum number of call redirection or call deflection exceeded	78
Miscellaneous	80
Improper cause code from DTE	81
Nonaligned octet	82
Inconsistent Q bit setting	83
NUI problem	84
International problem	112
Remote network problem	113
International protocol problem	114
International link out of order	115
International link busy	116
Transit network facility problem	117
Remote network facility problem	118
International routing problem	119
Temporary routing problem	120
Unknown called DNIC	121
Maintenance action	122

The following trace shall be collected for each X.25 PVC and SVC line.

- Trace of packet selected by type or Logical Channel Number
- Trace of frames selected by type or line
- Trace of on-line activity interactively selected by line number on the native NCS. The trace shall be easily controlled on the native NCS and printable on an on-line printer supporting the X-ON/X-OFF protocol. The trace shall include the following:
  - Packet or frames with or without the user data field
  - Frame type and sequence number
  - Packet type and sequence number
  - D, M, and Q bit values
  - Line and logical channel number
  - Frame address
  - P/F bit

The Native NCS shall interact with administrative management to collect, display, and archive cumulative performance traffic statistics. Upon request, at predetermined time intervals, and/or at the end of each day, the following cumulative information shall be reported for each SVC and PVC:

- LCN versus number of received data packets
- LCN versus number of sent data packets
- LCN versus number of incoming calls
- LCN versus number of outgoing calls
- LCN versus number of reset packets sent
- LCN versus number of error packets
- LCN versus number of reset packets received
- LCN versus number of invalid NS and NR counts
- LCN versus number of received packets by size
- Number of restart packets sent
- Number of restart packets received
- Number of times up/down on all LCNs
- Line number versus frame window size exceeded counts
- Line number versus aborted frame counts
- Line number versus idle channel counts
- Line number versus maximum link byte size
- Line number versus timer expiration counts
- Line number versus byte transfer counts
- Line number versus number of up/down lines

Table 51. ADNS II X.25 Trace Support

Item	*DTE/DCE Feature*	*C: Conformant P: Planned N: Nonconformant NA: Not Applicable*	*Comments*
Trace of packet selected by Logical Channel Number	DTE	C	
Trace of frames selected by line	DTE	C	[8]
On-line trace of packet or frames with or without the user data field	DTE	C	[8]
On-line trace of frame type and sequence number	DTE	C	
On-line trace of packet type and sequence number	DTE	C	
On-line trace of D, M, and Q bit values	DTE	C	
On-line trace of line and logical channel number	DTE	C	
On-line trace of frame address	DTE	C	
On-line trace of P/F bit	DTE	C	

[8] DTE tracing of packet or Frame Type requires NCOTS development.

SECTION H2-1
PERFORMANCE CHARACTERISTICS

Performance specifications for ADNS II Network are detailed in §C2.

SECTION H2-2
CONFIGURATION PARAMETERS AND RANGES

CONFIGURABLE PARAMETER	DEFAULT	RANGE
LINK LEVEL Line Speed	9600 bits per second	2.4, 4.8, 9.6, 19.2, 48, 56, 64 kbps, T1
Retransmission Timer T1	5 sec	1 to 63 sec increment of 100ms
Response Timer T2	50 milliseconds	1 to 9s increment of 50 ms
Poll Timer T3	6 sec	1 to 63 sec increment of 1s
Frame retry counter N2	3	0 to 7 increment of 1
Frame sequencing	Basic	B- Basic, E- Extended
Maximum # of outstanding I frames K	7	1 to 7 Modulo 8 or 1 to 127 Modulo 128

PARAMETER	DEFAULT	RANGE
PACKET LEVEL		
DCE or DTE	DCE	DCE or DTE
Packet sequencing	Basic	Basic, Extended
Maximum # outstanding packets	2	2 to 7 Basic 2 to 127 Extended
Maximum input packet data size	128 octets	64, 128, 256, 512, 1024, 2048, 4096 octets
Maximum output packet data size	128 octets	64, 128, 256, 512, 1024, 2048, 4096 octets
Addressing format	CCITT X.121 (1988)	
Address per interface per hunt group	up to 10	up to 20
D bit use	No	Yes or No. Valid for DTE config. only
VC FACILITIES	255	1 to 2047. LCN 0
Closed User Group	up to 10	up to 256
Throughput class negotiation	Subscribed line speed	2400, 4800, 9600, 19200, 56000, 64000 bps. Negotiable to values lower than subscribed line speed.
Fast Select	up to 128 octets	

SECTION H2-3
SUBSCRIPTION TIME PACKET LAYER OPTIONAL USER FACILITIES SELECTION

Subscription time parameters shall be as specified in the X.25 profile [IATA #1].

On-Line Facility Registration, Call Deflection Subscription, and Call Deflection Selection shall be available within 15 months of Contract award.

SECTION H2-4
CCITT ANNEX A

3.2.4 Logical Channel Assignments

The logical channel assignments required for an X.25 circuit shall be as specified in CCITT X.25 (1988) ANNEX A [CCITT #3].

SECTION H2-5
CCITT ANNEX B

3.2.5 Packet Layer DTE/DCE Interface State Diagram

The state diagram shall be as specified in CCITT X.25 (1988) ANNEX B [CCITT #3].

SECTION H2-6
CCITT ANNEX C

3.2.6 Actions Taken By The DCE On Receipt Of Packets In A Given State Of The Packet Layer DTE/DCE Interface As Perceived By The DCE

The restart and registration procedures, call set-up and clearing procedures, and data transfer (flow control and reset) on an assigned logical channel procedures, shall be as specified in CCITT X.25 (1988) ANNEX C [CCITT #3].

SECTION H2-7
CCITT ANNEX D

3.2.7 Packet Layer DCE Timeouts And DTE Time Limits

ADNS PS DCE timeouts and DTE time limits shall be as specified in CCITT X.25 (1988) ANNEX D [CCITT #3].

SECTION H2-8
CCITT ANNEX E

3.2.8 Coding Of X.25 Network-Generated Diagnostic Fields In Clear, Reset And Restart Indication, Registration Confirmation, And Diagnostic Packets

Coding of X.25 network-generated diagnostic fields in clear, reset and restart indication, registration confirmation, and diagnostic packets shall be as specified in CCITT X.25 (1988) ANNEX E [CCITT #3].

SECTION H2-9
CCITT ANNEX F

3.2.9 Applicability Of The On-Line Facility Registration Facility To Other Facilities

The ADNS PS applicability of the on-line facility registration facility to other facilities shall be as specified in CCITT X.25 (1988) ANNEX F [CCITT #3].

SECTION H2-10
CCITT ANNEX G

3.2.10 CCITT-Specific DTE Facilities To Support The OSI Network Service

3.2.10.1 Introduction: CCITT-Specific DTE Facilities To Support The OSI Network Service shall be as specified in the X.25 profile [IATA #1].

SECTION H2-11
COMPATIBILITY LIMITATIONS WITH X.25-1984

For DTEs needing to operate with the CCITT 1984 (Red Book) version of recommendation X.25, the following 1988 capabilities are not used:

1. Expanded capabilities for the following optional user facilities:

   - NUI-related facilities
   - RPOA-related facilities
   - Call redirection and deflection-related facilities

   For 1984 operation, call deflection was not defined and NUI and RPOA facilities were not explicitly separated into subscription and negotiation facilities.

2. Nondefined facilities:

   - Priority
   - Protection

3. The coding of the following facility was modified:

   - Called and calling address extension

   In the 1984 version, only BCD encoding was permitted.

4. The largest throughput class for the 1984 version was 48 Kbps. The largest throughput class for the 1988 version is 64 Kbps.

SECTION H2-12
PRIORITY ASSIGNMENT ON SVC

Priority assignment on SVC shall be as specified in C2, the System Specification.

H3
X.32 SPECIFICATION

1 Scope

This document specifies the requirements for Dial-up X.25 access to the ADNS II network using the X.32 protocol.

1.1 System Overview

The ADNS II packet switched network will operate according to *CCITT Recommendation X.25* as detailed in §H2, Dial-up X.25 allows the user to send and receive data via a dial-up capability across the local Public Switched Telephone Network (PSTN). The PSTN is involved in:

1. The establishment of the switched path
2. Providing a transmission medium
3. Providing a PSTN number for purposes of identification and addressing.

On the Data Terminal Equipment (DTE) side of the connection, several, possibly different, devices (terminals, CPUs, etc.) shall be supported, given that each device is a packet-mode DTE. Dial-up X.25 shall provide all the functionality of a dedicated X.25 connection over the PSTN from the DTE to the DCE.

At the destination end of the X.25 connection (i.e., Receiver DTE), the data may be transmitted via any acceptable convention, possibly via another Dial-up X.25 connection.

Following call-setup, the use of Dial-up X.25 vs. conventional X.25 is transparent to both the sending and receiving devices until the initiation of disconnect procedures.

1.2 General Requirements

All implementations of X.32 on the ADNS II network shall be in accordance with the ACCTS X.32 profile [ACCTS #4].

The user DTEs supported shall all communicate in SVC packet-mode.

The DCE connection shall support billing statistics functions and network management functions. Flow control, speed control, link establishment and disconnection, and DTE identification (all to be discussed in later sections) shall be provided.

The maximum user port data rate shall be 9.6KBPS. Dial-up X.25 shall allow both automatic and manual control of transmission speed. Requirements are defined in greater detail below.

2 Applicable Documents

For a list of applicable documents, please turn to §A2.

3 Detailed Interface Requirements

The following sections describe the requirements of the individual protocol layers of Dial-up X.25.

3.1 Physical Layer

The physical layer shall provide the electrical, mechanical, functional and procedural characteristics for the interface between the user DTE and the ADNS II network.

For establishment, maintenance, and disestablishment of a switched access path between a DTE and the ADNS II network via a PSTN, the physical layer interface of the protocol and its host machine shall conform to the details given in the following sections.

3.1.1 Electrical Characteristics

The network equipment interfaces shall use the electrical characteristics defined in EIA-530, as a standard interface configuration. Support for the RS-232-C, RS-232-D, and EIA 530 interfaces shall be provided. EIA 530 may be supported via a connecting cable per EIA 530 specification "INTERCONNECTING EIA-530 WITH EIA-449," pg. 34, [EIA #2].

3.1.2 Equipment Connector Configurations

All external communication circuits shall attach to the network equipment using cables and connectors. The connectors shall be 25 pin (DP-25) as defined in EIA-530 for a DTE as well as defined for RS232C, D support.

3.1.3 Clocking

Synchronous interfaces shall support internal and external (modem) clock.

3.1.4 Data Rates

Dial-up X.25 shall support a collection of the following full- duplex data rates for connection between the DTE and the DCE:

1. 1200 bit/s
2. 2400 bit/s, with fallback to 1200 bit/s
3. 9600 bit/s, with fallback to 4800 bit/s
4. 14000 bits/s, with fallback to 9600 bits/s

3.1.5 Modem Characteristics

The following full-duplex, V-series modem standards shall be supported:

1. V.22 for 1200 bit/s
2. V.22 bis for 2400/1200 bit/s
3. V.32 for 14000/9600/4800 bit/s
4. V.32 bis for 14000/9600/4800 bit/s

3.1.6 Full Duplex Operational Procedures

Dial-up X.25 shall operate in Full Duplex mode, as described in the *CCITT X.32 Specification*, Section 4.3.2. Of notable importance, circuits 106 and 109 may enter the OFF condition due to momentary transmission failures of modem retraining. Higher layers should delay for several seconds before considering the interface to be non-operational.

3.1.7 Origination Procedures

The automatic origination procedures defined in the *CCITT Recommendation V.25*, Section 3 shall be supported.

3.1.8 Answering Procedures

The automatic answering procedure defined in the *CCITT Recommendation V.25 bis* shall be supported.

3.1.9 Disconnecting Procedures

The disconnection procedures specified in *CCITT Recommendation V.24* shall be supported.

3.1.10 Data Compression

The data compression standards as specified in *CCITT Recommendation V.42 bis* shall be supported for V.32 bis modems.

3.1.11 Test Loops

The definitions of test loops and the principles of maintenance testing using the test loops are provided in *CCITT Recommendation V.54*. The descriptions and procedures associated with the test loops vary among the modem Recommendations detailed in ¶3.1.5.

3.2 Data Link Layer

The Data Link Layer is responsible for establishment, maintenance, and release of data link connections. It will detect and correct errors on the physical link, provide sequenced delivery and flow control.

The following sections specify the data link layer procedures for switched access data interchange between the DTE and the DCE.

3.2.1 Compatibility with the ISO Balanced Classes of Procedure

The switched access link layer procedures shall use the principles and terminology of the High-level Data Link Control (HDLC) principles specified by the International Organization for Standardization (ISO).

The DCE's operation shall achieve compatibility with the ISO's balanced class of procedures by using the LAPB procedure described in §H2.

3.2.2 Underlying Transmission Facility

The underlying transmission facility shall be duplex.

3.2.3 Link Layer Address Assignment

In accordance with the specifications in Section 2.4.2 of *Recommendation X.25*, the link layer address assignment depends on the roles of the equipment as DTE and DCE such that the DCE transmits to the DTE the address A in command frames and the address B in response frames. The DTE shall perform the opposite addressing (i.e. DTE transmits to the DCE the address B in command frames and the address A in response frames).

3.2.4 Use of Exchange Identification (XID) Frames

XID Frames shall be supported as defined in *ISO Recommendations 8885* and *8885/DAD 1*.

3.2.5 Packet Layer

The Packet Layer provides the means to establish, maintain and terminate network connections between open systems. It will provide independence from routing and relay considerations associated with the establishment and operation of a given network connection. The network layer provides network addresses and connections, connections endpoint identifiers, service data unit transfers, error notification, sequencing, flow control, reset and release.

Dial-up X.25 shall support the procedures and standards defined in §H2.

4 Network Management

☞ Note: Network Management functions and managed object interface specifications are detailed in §C2-2. All Alarm processing, command, control and configuration, etc., shall interface with the native ADNS II NCS responsible for the device that is providing the X.32 functions.

4.1 Alarms & Events

There is a requirement for diagnostic data collected by the system to be reported to allow timely fault isolation and repair.

Alarms shall be generated which notify the network management facility of modem and physical medium failures, security violations, software failures, protocol anomalies, and performance faults.

4.2 User Configuration Options

The network management facility shall have the ability to control the following configurable items:

- User Security Tables
- Line Speeds
- Port Availability
- Address Tables
- Alarm Thresholds
- X.25 Parameters and Facilities as Applicable

4.3 Performance Statistics Required

Dial-up X.25 shall provide the following statistics:

- Memory Overflow
- Real-time Node Status
- Number of bytes received
- Number of bytes transmitted
- Number of supervisory packets received
- Number of supervisory packets transmitted
- Total number of active virtual circuits
- Number of free logical channels
- Number of reset packets received
- Number of reset packets transmitted
- Number of interrupt packets received
- Number of interrupt packets transmitted
- Total number of data packets transmitted
- Number of rejected frames
- Number of RNR frames received
- Number of RNR frames transmitted
- Number of FCS errors
- Number of user packets received
- Number of user packets transmitted
- Number of information frames received
- Number of information frames transmitted

4.4 Security

Dial-up X.25 shall provide security for a particular session through a choice of the Dial-Back facility or one-way authentication. One-way authentication shall be implemented through identification by means of:

- A link level XID procedure
- A packet level registration procedure
- The network user identification (NUI) facility in call set-up packets
- The address field in call set-up packets

4.5 Accounting

Not Applicable.

5 Performance Requirements

Performance data shall meet or exceed that specified in §C2.

5.1 Throughput

Throughput of Dial-up X.25 shall be consistent with throughput detailed in §C2.

H4
SLC SPECIFICATION

1 Introduction

This functional specification outlines the requirements and the discipline necessary to employ the synchronous link procedures as described in the ATA/IATA ICM. This section is designed to supplement the ICM, not replace it. §H4-1 contains a correlation table mapping ICM requirements to this section. ICM features that are not supported or extended are annotated therein.

The Synchronous Link Control protocol specification is in revision. Complete specification details will be provided to Seller by the System Requirements Review (SRR).

1.1 General Requirements

Transmission involves the use of two types of blocks, control and data, to accomplish link initialization, message exchange, traffic acknowledgment, flow control, and error detection and correction. Bit transmission is synchronous and serial, employing any one of three different code sets: 5-bit padded, 6-bit padded, or ATA/IATA 7-bit, and binary control fields in both control and data blocks. Characters are transmitted with the low order bit first and the parity bit last. This specification depicts a character as eight bits, marked *B1* through *B7* and *P*, where *B1* is the low-order bit (least significant) and *B7* is the high-order bit (most significant). The *P* bit denotes parity (that is, P 7 6 5 4 3 2 1).

The circuit procedure is full-duplex and employs two-way simultaneous transmission. Control blocks are interleaved with data blocks to maximize utilization of the circuit. Control blocks have transmission precedence over data blocks.

Block error detection is accomplished by means of character and block parity checks. Character parity is odd and block parity is even. Both control and data blocks require the use of a block check character, which is the modulo two sum taken on each of the seven levels of the code. The block check character parity is odd.

The link procedures use a number of configurable timers and counters. The ranges for the timer and counter settings are described in ¶5 of this section. While minimum operator intervention is desirable, a full set of manual link controls are required to provide supervisory control. They are described in ¶5 of this section.

In general, messages adhere to the formats described in the ICM. This specification describes the link procedures when transmitting and receiving messages employing different code sets and block enveloping options.

1.2 Terms and Acronyms

For a list of acronyms, please turn to §A1 ¶2.

2 Applicable Documents

For a list of applicable documents, please turn to §A2.

3 Requirements

This section describes the SLC procedure requirements as a series of software levels. The levels are identified as: circuit, block, link, and message. Conceptually, each level communicates to the other immediate level via a set of primitives indicating the service required. Figure 13 shows the separate levels.

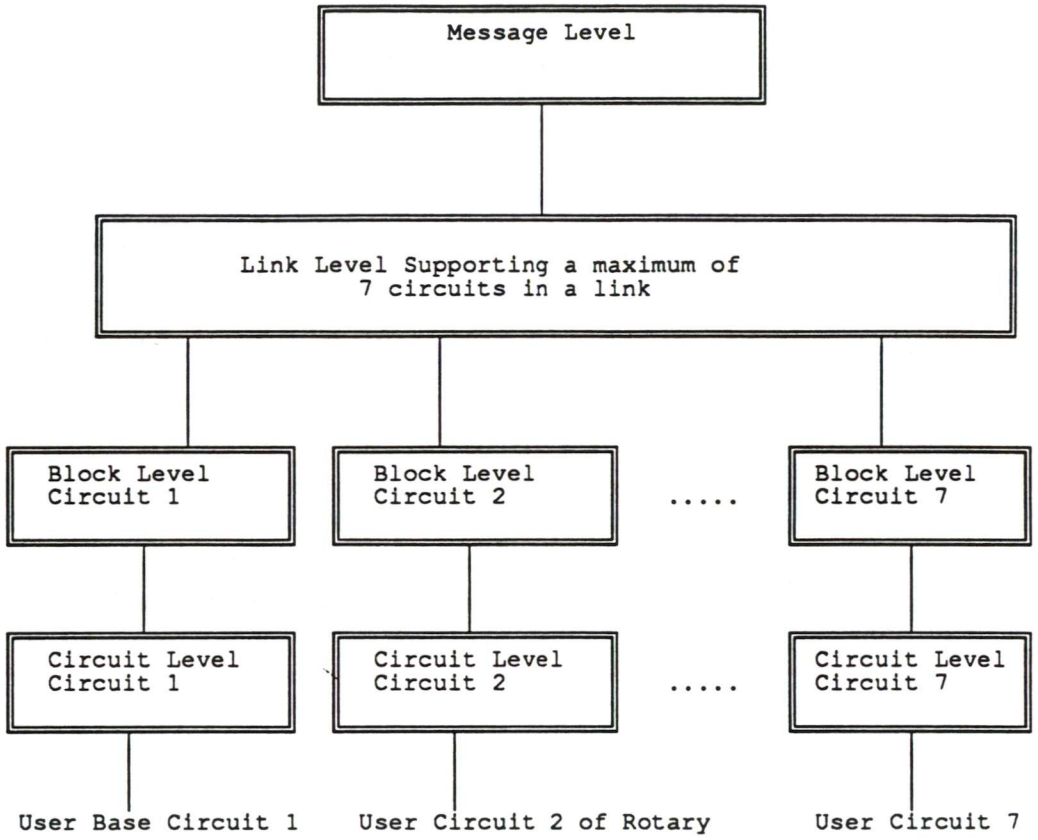


Figure 13. SLC Levels

The ADNS application level is above the SLC message level and is responsible for the routing, protection, and validation of traffic.

Figure 14 shows the valid configurations of the SLC envelope. Each configuration is decomposed to indicate the portions of the envelope that are processed by the various levels (circuit, block, link, and message). Definitions for the specific characters of the envelope are provided in the level that is responsible for processing the characters.

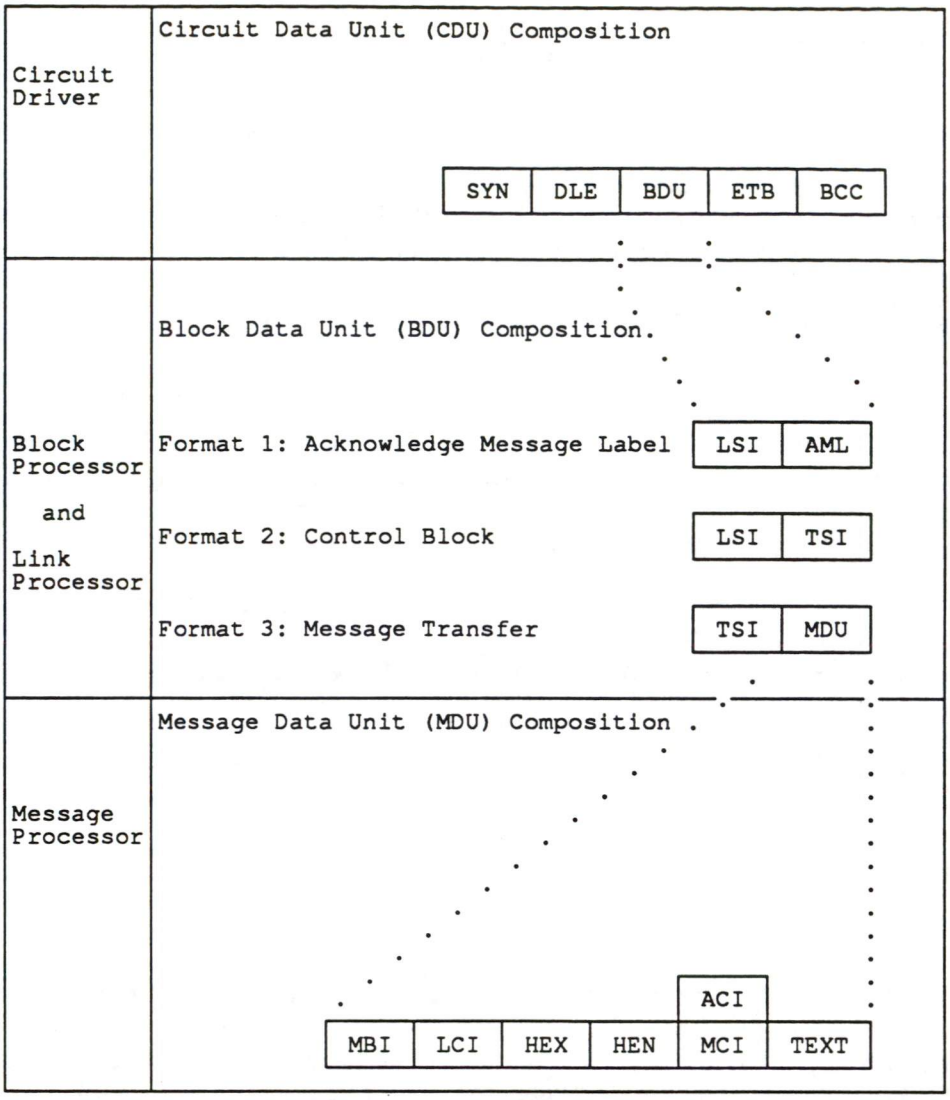


Figure 14. Envelope Decomposition/Processing Assignments

3.1 Circuit Level

The circuit level of SLC defines the electrical interface and the interface to the block level, indicating that a block has been transmitted or received. An SLC channel is associated with a circuit.

3.1.1 Electrical Interface

The data set interface conforms to the electrical signal requirements of §C2.

3.1.2 Circuit Data Unit

Figure 15 shows the portion of the SLC envelope for which the circuit level has responsibility. The BDU is defined in ¶3.2.1. The entity comprising the BDU and the envelope controlled by the circuit driver is referred to as the CDU.

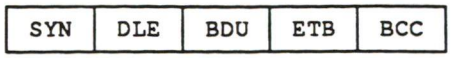


Figure 15. Circuit Data Unit Composition

3.1.2.1 Synchronization Character: A defined number of synchronization characters (**SYN**) begin the block. Provision will be made to define the number of synchronization characters used to begin an information or link control block on a link-by-link basis. The ICM identifies this value as *N1*. The composition of the synchronization character is as follows:

```
Binary composition of synchronization character:

          P 7 6 5 4 3 2 1
     SYN  0 0 0 1 0 1 1 0
```

3.1.2.2 Data Link Escape Character: The first character to follow the last synchronization character is Data-Link-Escape (**DLE**). This is a restricted character and must not be found elsewhere in the block through **ETB**. The composition of **DLE** is as follows:

```
Binary composition of DLE character:

          P 7 6 5 4 3 2 1
     DLE  0 0 0 1 0 0 0 0
```

3.1.2.3 Block Data Unit Entity: The BDU is the information entity that is passed on the interface between the circuit level and the block level.

3.1.2.4 End of Transmission Block Character: The End of Transmission Block (**ETB**) character immediately follows the last character of the information portion and is the first character of the ending block envelope. Its composition is as follows:

```
Binary composition of ETB

          P 7 6 5 4 3 2 1
     ETB  1 0 0 1 0 1 1 1
```

3.1.2.5 Block Check Character: The Block Check Character (**BCC**) follows the **ETB** character and is the last character of the ending block envelope. This character represents the horizontal even parity of each of the seven levels of the code throughout the block from **DLE** through **ETB**, inclusively. Odd character parity for the **BCC** character is then added. An information block received with a parity error will be negatively acknowledged and discarded (see ¶3.2.4.1.1.2.2).

3.2 Block Level

The block processor is responsible for processing primitives from the link and message levels and from the circuit level via the circuit driver. Processes within this level generate primitives for the circuit level or the link and message levels.

SLC does not require each data block to be explicitly acknowledged. An acknowledgment for a particular information block, defined by a TSN, explicitly acknowledges the data block represented by that TSN and implicitly acknowledges all unacknowledged data blocks with TSNs that are logically less than the acknowledged TSN.

The block processor is responsible for initialization of the circuit protocol. It maintains five circuit states to control initialization and recovery of a circuit. Figure 16 is a diagram of the block processor circuit states. The *closed* state is the state assigned during software initialization. The block processor leaves the closed state by receiving an open command and can reenter it only by receiving a close command from any of the other states. The block processor action upon receiving an open command is to move to the *initialization* state. A block processor in this state sends **ENQ** control blocks at [T4] intervals. The

block processor leaves the initialization state when it receives a valid **ENQ** and enters the *recover* state. A block processor in this state awaits a valid **ACK**, RXT, or SXT control block while continuing to send **ENQ**s every [T4] seconds. When a valid acknowledging control block is received, the block processor moves to the *normal* state. This is the only state in which data exchange is allowed. Protocol conditions that are detected in the normal state may cause transitions to the *down* or *recover* states. All circuit input is ignored while the block processor is in the down state. A [T7] timer runs to expiration in this state, causing the resetting of all TSN handling variables and reentry into the initialization state. When the recover state has been entered from the normal state a valid acknowledging control block is solicited by sending up to [N7] **ENQ**s at [T4] intervals. If the solicited block is not received by this time the circuit enters the down state. Figure 17 recaps the circuit activity during initialization and recovery.

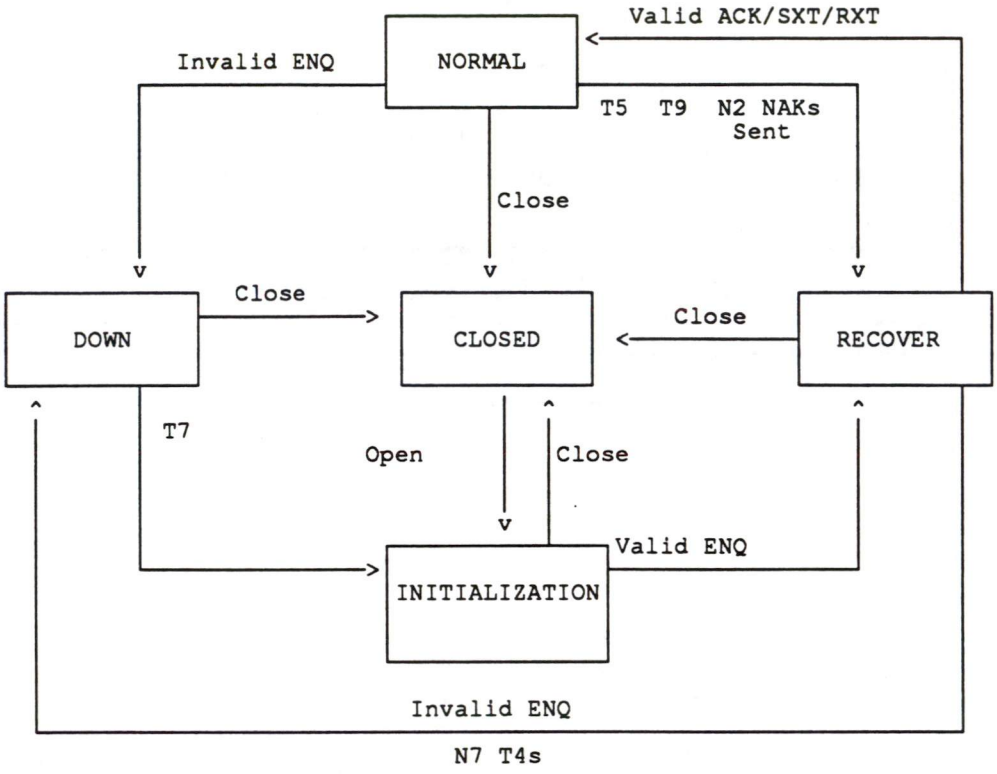


Figure 16. Block Processor State Diagram

3.2.1 Block Data Unit

Figure 18 shows the portion of the SLC envelope for which the block level has responsibility and identifies the three formats of the envelope. MDU is defined in ¶3.4.1. Each of these formats constitutes the BDU.

3.2.1.1 Link Status Identifier: The Link Status Identifier (**LSI**) character identifies the type of control block. It is structured as follows:

P	7	6	5	4	3	2	1
	0	Control Block Type					

Bit 7 is equal to 0.

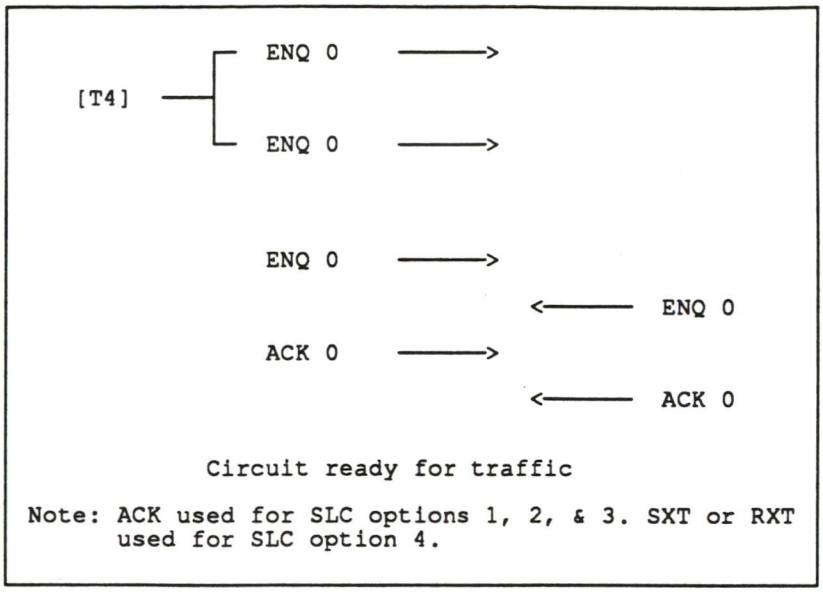


Figure 17. Circuit Initialization/Recovery

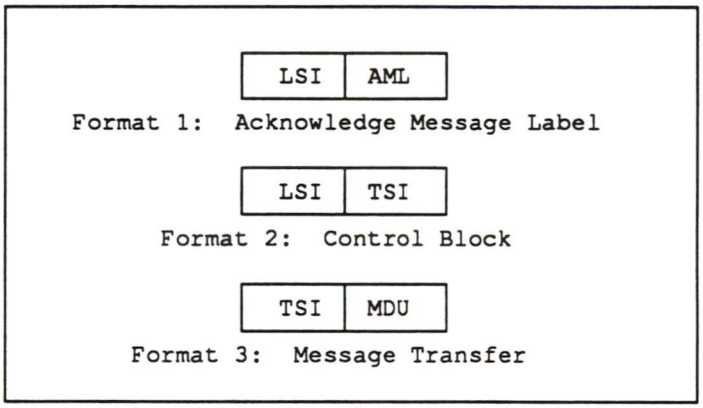


Figure 18. Block Data Unit Compositions

Bits 6, 5, 4, 3, 2, 1 are structured as follows:

Structure	6	5	4	3	2	1	
Positive Acknowledgment	1	0	0	0	0	1	ACK
Negative Acknowledgment	1	0	0	0	1	0	NAK (IVB)
Negative Acknowledgment	1	0	0	0	1	1	NAK (OTS)
Enquiry	1	0	0	1	0	0	ENQ
Acknowledge Message Label	1	0	1	1	1	1	AML is next Character
Stop Sending All	1	1	0	0	0	0	SXT All Circuits
Resume Sending All	1	1	1	0	0	0	RXT All Circuits
Stop Sending Indicated	1	1	0	0	0	1	SXT Circuit 1
	1	1	0	1	1	1	SXT Circuit 7
Resume Sending Indicated	1	1	1	0	0	1	RXT Circuit 1
	1	1	1	1	1	1	RXT Circuit 7

The description of the control blocks is given in the block level process ¶3.2.4.

3.2.1.2 Transmission Sequence Identifier: The Transmission Sequence Identifier (TSI) character immediately follows the DLE character in the information block envelope and contains binary field information as follows:

```
P   7  6    5 4 3 2 1
    1  *      TSN
```

Bit 7 is a constant and equal to 1.

Bit 6 * high or low precedence indicator 0 = high, 1 = low. High is associated with Type A conversational messages and low is associated with Type B conventional messages as defined in the ICM.

Bits 5 through 1 make up the transmission block serial number (TSN) and provide 31 combinations less value 00000, which is not used in information block envelopes. As each information block is transmitted over a circuit of a link, the field increases by 1. Upon reaching the value 11111, the field returns to 1. The field is used for positive or negative information block acknowledgment.

3.2.1.3 Acknowledge Message Label: Control blocks having an LSI that designate an acknowledge message label structure contain a second character called an Acknowledge Message Label (AML). No TSI exists in an AML control block. The AML character contains three fields as follows:

```
P   7  6  5   4  3  2  1
    label    0  0  0  *
```

Bits 7 through 5 define the message label to be acknowledged. Message label 1 is not used in the AML. Valid message labels are 0 and 2 through 7.

Bits 4 through 2 are 000.

Bit 1 * high or low precedence indicator 0 = high, 1 = low. High is associated with Type A conversational messages and low is associated with Type B conventional messages as defined in the ICM.

3.2.2 Block Level Timers

The block processor controls seven timers:

- *No information blocks received* [T1]
- *No block transmitted* [T2]
- *Expected block not received* [T3]
- ENQ *repetition* [T4]
- *No* ACK *received* [T5]
- *Circuit down* [T7]
- *No block received* [T9]

3.2.2.1 No Information Blocks Received [T1]: The *no information blocks received* [T1] timer is used to force transmission of an ACK. It is started after the reception of a valid data block and stopped when the circuit enters a *recover*, *down*, or *closed* state. When [T1] expires, an ACK is transmitted for the last protected data block.

3.2.2.2 No Block Transmitted [T2]: The *no block transmitted* [T2] timer is used to force transmission of the current control block during extended periods of idle circuit conditions. The current control block is either an ACK, SXT, or RXT. T2 is started:

- After transmission of an **ACK**, SXT, or RXT control block in the *normal* state, or
- After transmission of a data block.

T2 is stopped when the circuit enters a *recover*, *down*, or *closed* state. When [T2] expires, the action depends on the state of [T1]. If [T1] is not running, the current control block is transmitted for the last protected data block; if [T1] is active, only [T2] is restarted.

3.2.2.3 Expected Block Not Received [T3]: The *expected block not received* [T3] timer is used to protect against lost **NAK** control blocks. It is started when a **NAK** has been transmitted, and stopped when a data block is correctly received, or when the circuit enters a *recover*, *down*, or *closed* state. When [T3] expires, a **NAK** transmission process (see ¶3.2.4.1.1.2) is executed.

3.2.2.4 ENQ Repetition [T4]: The **ENQ** *repetition* [T4] timer represents the interval between successive **ENQ**s transmitted when the circuit is in an *initialization* or *recover* state. It is started when an **ENQ** is sent, and stopped when the circuit enters a *normal*, *down*, or *closed* state. When [T4] expires, an **ENQ** transmission process (see ¶3.2.4.1.1.3) is executed.

3.2.2.5 No ACK Received [T5]: The *no* **ACK** *received* [T5] timer is used to continue processing of a transmitted data block if an **ACK** is not received for it. It is started at the end of the transmission of a data block. [T5] is stopped at the beginning of a data block transmission when any one of the following circumstatnces occurs:

- An **ACK** for the last block transmitted is received,
- Any valid **NAK** is received, or
- The circuit enters a *recover*, *down*, or *closed* state.

When [T5] expires, the circuit transitions to the *recover* state and an **ENQ** is sent.

3.2.2.6 Circuit Down [T7]: The *circuit down* [T7] timer is used to force the distant end to declare the circuit down. This is accomplished by ignoring all input received from the distant end. [T7] is started when the *down* state is entered, and stopped when the *closed* state is entered. When [T7] expires, the circuit transitions to the *initialization* state and an **ENQ** is sent.

3.2.2.7 No Block Received [T9]: The *no block received* [T9] timer is used to provide circuit assurance by forcing transmission of a control block from the distant end. It is started upon reception of a good block, a data block with a parity error, or reception of a valid control block with either a **BCC** or parity error. [T9] is stopped when the circuit enters the *recover*, *down*, or *closed* state. When [T9] expires, the circuit transitions to the *recover* state and an **ENQ** is sent.

3.2.3 Block Level Counters

The block processor uses six counters to control block processing activities on a circuit: [N], [N2], [N3], [N4], [N7], and [N8].

3.2.3.1 Outstanding Transmitted Blocks Before ACK [N]: The *outstanding transmitted blocks before* **ACK** [N] counter is used to determine when the block processor will stop sending blocks and wait for outstanding blocks to be acknowledged.

3.2.3.2 NAKs Transmitted Before Circuit Recovery [N2]: The number of **NAK***s transmitted before declaring circuit recovery* counter [N2] defines the point at which the block processor stops sending **NAK**s and starts circuit recovery procedures. A tally is incremented each time a **NAK** is sent and cleared each time a valid data block is received. If the incremented tally matches [N2], the circuit transitions to the *recover* state and an **ENQ** is sent.

3.2.3.3 Outstanding Received Blocks Before ACK [N3]: The number of *outstanding received blocks before an* **ACK** *is transmitted* counter [N3] defines the point that an **ACK** control block must be sent for received blocks. The logical difference between the last protected data block's transmission sequence number (TSN), and last TSN sent in a control block is calculated each time a message is protected.

3.2.3.4 Block Retransmission Before Circuit Recovery [N4]: The number of *retransmissions of a block* counter [N4] defines the point when the retransmission process is abandoned and the recovery state is entered. When the retransmit process is invoked, a tally is incremented and compared to [N4]. The tally is cleared when the retransmitted data block is acknowledged.

3.2.3.5 ENQs Transmitted Before Declaring Circuit Down [N7]: The number of **ENQ***s transmitted before declaring the circuit down* counter [N7] defines the point in the *recover* state when **ENQ** transmission is discontinued, and the *down* state is entered. A tally is incremented when transitioning from the *normal* state to the *recover* state, and upon [T4] expiration in the *recover* state. The tally is cleared on a transition out of the *recover* state.

3.2.3.6 Received Error Data Block Alarm Trigger [N8]: The number of consecutively *received error data blocks* before generating an alarm [N8] indicating circuit problems.

3.2.4 Block Level Process

The processes of the block processor are activated through the block primitives and through timer expirations.

3.2.4.1 Block Request To Transmit: The block processor accepts data blocks from the link-level processor, and controls the presentation of these blocks to the circuit level. Additionally, the link-level processor may direct the block processor to send an **AML**. If the protocol requires that a control block be sent, the data block or **AML** request must be held up pending transmission of the control block.

All transmitted blocks are returned to the block processor by the circuit level. [T2] is started at this point. For control blocks, no further processing is required. For data blocks, [T5] is restarted. Transmitted data blocks are maintained in an acknowledgment-pending list until acknowledgment is received. Data blocks that require retransmission as a result of the receipt of a **NAK** or **ENQ** are given precedence over transmission of nontransmitted blocks. The block processor maintains a retransmit list for this purpose.

3.2.4.1.1 Control Block Transmission: The transmission sequence identifier (**TSI**) is used in control blocks to indicate the last correctly received protected data block **TSI** on this circuit. The TSN 02 in the **TSI** has special meaning in control blocks. It informs the other end of the circuit to reset the data block **TSI** numbering to 1. This is used for circuit recovery and to initialize the circuit following a processor restart. A TSN is considered logical if it is in the inclusive window of the last data block sent and the last data block acknowledged. TSNs outside this window are illogical.

3.2.4.1.1.1 ACK Transmission: An **ACK** is transmitted when:

- The *no information blocks received* timer [T1] expires.
- The *no block transmitted* timer [T2] expires and the circuit is not sending SXTs or RXTs.
- The window defined by [N3] is met.
- An **ENQ** control block is received with a logical TSN (SLC options 1, 2 and 3).

3.2.4.1.1.2 NAK Transmission: Two types of **NAK** control blocks may be transmitted in response to reception of a data block as defined in the following paragraphs. Received control blocks containing errors are not negatively acknowledged, they are ignored and discarded as if they had not been received. Regardless of the **NAK** type transmitted the action taken is as follows.

A circuit timer [T3] is provided to repeat the NAK if the expected data block has not been retransmitted and correctly received within the defined time interval. A circuit counter [N2] is provided to set a maximum number of consecutive NAKs to be transmitted before the circuit recovery procedures are invoked. The TSI contained in the NAK control block indicates the last correctly received and protected (if necessary) data block, not the TSI of the block in error. The block in error and all subsequent data blocks are discarded until a block with the expected TSI is received. The circuit receiving the NAK will retransmit the blocks bearing TSIs next in sequence from the TSI in the NAK control block, as soon as possible.

3.2.4.1.1.2.1 NAK Out Of Sequence Transmission: A negative acknowledgment out-of-sequence (NAK OTS) control block is sent when a limited or full protection data block contains a TSI that is not one greater than the previous correctly received data block TSI. The TSI next in sequence after 31 is 1; 0 is not used in data block TSIs.

3.2.4.1.1.2.2 NAK Invalid Block Transmission: A negative acknowledgment Invalid Block (NAK IVB) control block is sent when a limited or full protection data block is received with one of the following errors:

- Character parity error
- BCC error
- Excessive characters (including a data block interrupted by noise if identifiable as a data block)
- Block envelope format errors

3.2.4.1.1.3 ENQ Transmission: The ENQ control block is used to recover from circuit faults and to establish the circuit after the processor or circuit has been *down* or *closed*. An ENQ is sent when:

- The *no* ACK *received* timer [T5] expires
- The *circuit down* timer [T7] expires
- The *no blocks received* timer [T9] expires
- The ENQ repetition process is executed
- The circuit transitions out of the *closed* state

The ENQ *repetition* timer [T4] is started when an ENQ is transmitted. All incoming data and control blocks are discarded until the block processor receives the ACK, RXT, or SXT it expects in response to the transmitted ENQ. The one exception is an incoming ENQ. While in the ENQ transmission mode, no other control or data blocks will be transmitted except for the proper response to an ENQ.

The circuit counter [N7] is used to count the number of consecutive ENQs transmitted with no response. When [N7] ENQs have been transmitted, the circuit will be declared down and all transmit and receive activity will be inhibited for an interval of time equal to [T7] seconds. This is to ensure that the distant end detects the circuit being *down*. At the expiration of this [T7] interval, the circuit will again start sending ENQs at [T4] intervals and will continue to do so until a positive acknowledgment is received. In this case, [N7] is not used.

A positive acknowledgment in response to an ENQ is an ACK, a resume (RXT), or stop sending (SXT) with a logical TSN. After receipt of the positive acknowledgment (except SXT), the circuit is marked *up*, and the data transmission may commence. Unacknowledged data blocks will be retransmitted in accordance with the TSI in the positive acknowledgment. When SXT is received as a positive acknowledgment, data transmission may not be resumed. However, the circuit is *up* and positive acknowledgments are sent in response to incoming error-free data blocks.

The link is initialized upon initiation of a new link, or following a processor or link failure (all circuits declared *down*). The link is initialized circuit-by-circuit using the ENQ control block as follows:

An ENQ is sent with a TSI of 0 to signal the distant end to reset the output TSI count, ensuring that the first data block transmitted will have a TSI of 1. The link will be monitored for a positive acknowledgment or

an **ENQ**. The **ENQ** 0 is sent at [T4] intervals. If an **ENQ** is received, an **ACK** with **TSI** 0 will be sent. When a positive acknowledgment is received a RXT for this circuit with a **TSI** of 0 will be sent. If the acknowledgment was not an SXT, data transmission begins with a **TSI** one greater in sequence than the **TSI** in the positive acknowledgment, and the circuit is declared *up*. In this case, a **TSI** that was previously considered illogical (out of range) will now be accepted, and all unacknowledged traffic will be retransmitted with LCI B6 coded 12 to indicate a PDM. Partially acknowledged multiblock messages interrupted by a down circuit or processor failure will be retransmitted from the beginning of the message. Transmission attempt counters for blocks and messages will be maintained and acted upon as previously described through the circuit recovery and initialization process.

An alarm will be sent upon detection of the loss of modem carrier, loss of data-set ready, loss of modem clear-to-send signal, or hardware malfunction in the circuit terminating area of the processor. An **ENQ** will be sent if the expected response is not received upon expiration of the following timers and counters: [T9], [T4], [T5], and [N2], or following a processor restart.

3.2.4.1.1.4 SXT Transmission: The block processor will transmit an SXT to indicate that the processor is unable to accept data blocks of certain priority levels. SXTs will only be sent on the circuit for which they are marked. SXTs will be sent every [T2] seconds until the processor is able to accept data blocks at a lower priority level. Three levels of throttling are supported. The processor may be in unthrottled, low precedence throttling (options 1, 2, and 3 only), or high and low precedence throttling conditions. The three throttling levels are controlled by commands from the network control system and by resource conditions. The control blocks transmitted are:

- SXT *low* during low priority throttling (options 1, 2, and 3 only)
- SXT *high* during high and low priority throttling
- RXT/**ACK** when no throttling exists

3.2.4.1.1.4.1 SXT Low Transmission: The stop-low option will be provided on a link-by-link basis as follows in conjunction with a 1 value for B6 in the **TSI** field (see ¶3.2.1.2). This option will provide for a phased traffic reduction under heavy system load to accept higher priority traffic while stopping lower priority traffic. Two levels of system thresholds will be defined so that when the first level is detected on those links employing the stop-low option, an SXT *low* individual circuit control block will be sent; whereas on those links that do not employ this option, an SXT *high* will be sent. Data blocks received while transmitting the SXT *low* will be acknowledged with an **ACK** at the defined frequency and the SXT *low* will be sent at [T2] intervals during idle input as long as the ARINC network is running with the first threshold met.

If system conditions continue to deteriorate and the second threshold is reached, the stop-low option links will commence sending SXT *high* control blocks until recovery to the first system threshold range is achieved, at which time SXT *low* blocks will again be sent. This will allow high-priority traffic to be received. When no system thresholds exist, the RXT is sent, indicating that all traffic may be sent. There is no RXT *low*. Receipt of an RXT will remove all transmission constraints.

Links employing the stop-low option do not send **ACK**s at [T2] intervals during idle. Instead, these links send **ACK**s according to the following thresholds: SXT *low* this-circuit, SXT *high*, or RXT *all*-traffic-this-circuit. All data blocks successfully received are positively acknowledged with an **ACK** at the link-defined frequency.

Links that do not employ the stop-low option send RXTs at [T2] intervals until the first data is successfully received. They then send **ACK**s at [T2] intervals during idle.

A circuit sending stops (SXTs) will continue to send data as well, if no stops have been received. A circuit that has been stopped from sending by receipt of an SXT will acknowledge data normally with **ACK**s and **NAK**s.

The SXT *low* control block will have **TSI** B6 equal to 12 and the SXT *high* control block will have **TSI** B6 equal to 02. This bit is not interrogated on links that do not employ the stop-low option, and in this case

TSI B6 equals 0. An operator-imposed SXT *high* will have precedence and will override the sending of stop-low SXTs.

3.2.4.1.1.4.2 SXT High Transmission: When a processor throttling situation or native NCS command is signaled, requiring the transmission of an SXT *high*, the block processor checks if all received blocks can be acknowledged. If the message processor has not indicated that all received blocks may be acknowledged, the block processor delays transmission of the SXT *high* until all blocks can be acknowledged. All data blocks received during this period are discarded.

If the processor is throttling, an envelope option 4 link sends SXT *high* control blocks in response to a received ENQ.

3.2.4.1.1.4.3 SXT All Transmission: SXT *all* will not be transmitted.

3.2.4.1.1.5 RXT Transmission: A resume sending indicated circuit control block is sent at T2 intervals on stop-low option links and on others until the first data is successfully received. It is sent after receiving a positive acknowledgment to an enquiry. It is also sent when the operator removes manually imposed SXTs when no system thresholds exist. The manually imposed RXT will not override any system resource related SXTs. The TSI in the RXT control block indicates the TSN of the last correctly received data block and may be used for block acknowledgment purposes.

RXTs will only be sent on the circuit for which they are marked.

If throttling is off, an envelope option 4 link sends RXT control blocks in response to a received ENQ.

3.2.4.1.1.5.1 RXT All Transmission: RXT *all* control blocks will not be transmitted.

3.2.4.1.2 AML Transmission Request: Upon indication from the link level an AML block (Format 1) is built and passed to the circuit level.

3.2.4.1.3 Data Block Transmission: Data blocks can be transmitted only when all of the following conditions are true:

- The circuit recovery process is complete; that is, the circuit state has transitioned from recovery to normal
- No control blocks need to be transmitted
- No SXT *high* has been received

Data block transmission precedence is handled by the message level for new blocks. When the circuit is available for data block transmission the block processor uses message level envelope information and text to format a data block. The block's TSN is generated and the data block is passed to the circuit level for transmission. The TSN is not reused until it has been acknowledged and cleared.

If the logical difference between the last sent TSN and the last acknowledged TSN matches (N], the block processor cannot send any further data blocks until an ACK that updates the window [N] is received.

3.2.4.1.3.1 Transmission Precedence Of Information Blocks: Two precedence levels exist for the transmission of information blocks: high level and low level. The high level is used for conversational messages, while the low level is used for conventional messages. Blocks set to the high level have the highest transmission priority after control blocks and will be sent at the earliest opportunity. They will be sent at the nearest block boundary. If a multiblock, low-precedence message is in progress, the high-precedence message will be sent immediately following the completion of a low-precedence block before allowing the remainder of the low-precedence message to be sent. All high-precedence messages will be sent from queue before transmitting low-precedence messages.

The following is the priority processing for the transmission of information blocks:

1. Retransmission of previously negatively acknowledged blocks

2. High precedence

3. Low precedence

3.2.4.2 Block Indication Of Receipt: Blocks received from the circuit level may be **AMLs**, control blocks, or data blocks. If the first character of the BDU is equal to (2F) hexadecimal, an **AML** is indicated. If bit 7 of that character is zero, a control block is indicated; If bit 7 equals one a data block is indicated.

3.2.4.2.1 Control Block Receipt: Control blocks not having exactly two characters are discarded. The **LSI** character is validated using the values in ¶3.2.1.1 and invalid blocks are discarded.

Upon receipt of a control block the TSN is validated and blocks with invalid TSNs are discarded except for **ENQs**. A valid TSN is one that is greater than or equal to the TSN in the last received valid control block and less than or equal to the TSN of the last transmitted data block. A feature known as loopback detection is available on links configured as Option 4. This capability is implemented within the TSI field of control blocks and is described in ¶3.2.4.2.1.6.

3.2.4.2.1.1 ACK Receipt: If the TSN of the **ACK** control block now equals the TSN of the last sent information block then all blocks that are outstanding are implicitly acknowledged and the *no* **ACK** *received* timer [T5] is stopped. If the **ACK** is in reply to an **ENQ** (exclusive of option 4) the retransmit procedure is invoked.

3.2.4.2.1.2 NAK Receipt: Negative acknowledgments for invalid data blocks (**NAK**-IVB) and for out-of-sequence data blocks (**NAK**-OTS) are handled identically. Separate **LSIs** are used only to assist in circuit troubleshooting. Acknowledged blocks are returned to the message processor and the retransmit procedure is invoked.

3.2.4.2.1.3 ENQ Receipt: An **ENQ** control block is accepted regardless of the TSN if the circuit is in the normal, initialization or recover states.

An **ENQ** with a valid TSN causes an **ACK** control block (option 1, 2, and 3) or an RXT or SXT control block (option 4) to be transmitted, and may initiate the return of acknowledged blocks to the message processor. A valid **ENQ** received in the initialization state causes a transition to the recover state.

If the circuit is in the normal state, then an **ENQ** with an invalid TSN indicates a protocol failure and forces the circuit to enter the down state.

If the circuit is in the initialization state, then an **ENQ** with an invalid TSN is considered valid. The TSN contained in the **ENQ** is then used as the basis for the next information block to send.

3.2.4.2.1.4 SXT Receipt: Stop sending control blocks request the block processor to hold transmission of data blocks. For nonoption 4, the SXT control block also indicates the specified precedence level(s). SXTs received on a circuit other than the one indicated in the control block are directed to the associated circuit. After receipt of a valid SXT the block processor informs the link processor of any acknowledged blocks and that the circuit is throttled.

3.2.4.2.1.4.1 SXT Low Receipt: Low precedence SXTs require no special handling by the block processor. These are treated as **ACKs**. An indication of stop-low is passed to the link level. The circuit receiving the stop-low will cease sending low-priority traffic (QP, Q/, and those messages with no priority indicator, QD) and continue sending high-priority conventional (QU, QS, QX) and conversational traffic.

If the message level had previously received a SXT *high* indication then it could resume sending high-priority traffic.

3.2.4.2.1.4.2 SXT High Receipt: SXTs indicating high precedence on nonoption 4 or any SXT on option 4 cause the block processor to stop [T5]. SXT *high* indication is passed to the link level.

3.2.4.2.1.4.3 SXT All Receipt: Receipt of SXT *all* control block is handled specially by the link level (see ¶3.2.4.1.1.4.3). SXT *all* indication is generated for the link processor.

3.2.4.2.1.5 RXT Receipt: This control block may be received over any circuit of the link. ARINC, however, will only transmit the control block on the circuit being regulated.

Received RXT control blocks cue the block processor to restart transmission of data blocks for all precedence levels. If the RXT is received on a throttled circuit the link processor is informed that the throttling has been relieved. Otherwise, the RXT is treated as an **ACK**.

3.2.4.2.1.5.1 RXT All Receipt: Receipt of RXT *all* control block is handled specially by the link level (see ¶3.2.4.1.1.5.1). RXT *all* indication is generated for the link processor.

3.2.4.2.1.6 Loopback Detection: Loopback Detection is the ability to identify that a circuit has entered a modem loopback condition. This capability is only required on links configured as Option 4. It is accomplished through the setting of bit 6 in the TSI field of all transmitted control blocks to indicate a loopback condition. If a control block is received with bit 6 of the TSI field indicating loopback, the link shall stop transmitting data blocks and enter a hold data state until the loopback condition clears.

3.2.4.2.2 AML Receipt: When an **AML** is received it is passed to the link level for processing. An indication is generated for the link processor.

3.2.4.2.3 Data Block Receipt: Data block reception is allowed only while the circuit is in the normal state. Data blocks received while the circuit is not in the normal state are discarded.

A block received that has an error recognized by the circuit level is discarded. In this case, if [T3] is not currently started for the circuit, the block is negatively acknowledged as invalid block (**NAK**-IVB).

When no block error condition was detected by the circuit level, the TSN is checked. A block having a TSN that is not logically one greater than the data block received is discarded. If [T3] is not currently started for the circuit, the block is negatively acknowledged as out of sequence (**NAK**-OTS).

Correctly received, in-sequence blocks are passed to the link processor for further disposition. [T1] and [T9] are restarted.

3.3 Link Level

An SLC link consists of one to seven circuits. The link level uses all of the circuits in the link for the transmission of data blocks. Each of the circuits has a block level and a circuit level associated with it. The message level interfaces with the link level to determine the circuit for message transmission. Data block, acknowledgment and **AML** indications are passed directly through from the block processor to the message processor.

3.3.1 Multicircuit Links

Links consisting of more than one circuit are called multicircuit links. Multicircuit links allows the link level to provide load sharing between the circuits. A multicircuit link may share the load between circuits on a block or a message basis. One circuit of the group is marked as the baseline. Messages are always routed to the baseline, transmission is based on the shortest queue in the group.

3.3.1.1 Block-scatter Links: Block scatter is an option used to load level the multicircuit link on a block basis. Block scatter allows the individual blocks of a multiblock message to be transmitted over different circuits within the multicircuit link. The link level determines the best circuit for transmission based on availability and passes the block to the corresponding block level. The link level receiving the *scattered* blocks passes the blocks to the message level which is responsible for the resequencing of the blocks. The **AML** may be transmitted on any circuit of the link.

3.3.1.2 Nonblock-scatter Links: Multicircuit links not employing the block-scatter option are required to transmit an entire multiblock message on the same circuit. The choice of which circuit to use is made by the link level based on the current load of all circuits in the multicircuit link.

3.3.2 Link Level Flow Control

The flow of data blocks may be controlled at the link level by use of the SXT and RXT control blocks. These control blocks have the different effects based on circuit availability and block-scatter option.

3.3.2.1 SXT High Received: When SXT *high* indication is received from the block processor the link processor checks for any available circuits in the link. If none are available then the message processor is informed with a SXT *high* indication. If a circuit is available and the link is block-scatter option then subsequent MDUs are transmitted on the remaining circuits. Nonblock-scatter option links require SXT indication to be passed to the message processor.

3.3.2.2 SXT Low Received: When SXT *low* indication is received from the block processor the link processor checks for any available circuits in the link. If none are available to send low precedence traffic the message processor is informed with a SXT *low* indication. If a circuit is available then subsequent high precedence MDUs will be sent on the circuit receiving the SXT *low* while both high and low precedence MDUs will be sent on the other available circuits.

3.3.2.3 RXT Received: When RXT indication is received from the block processor the link processor checks if the link was previously declared unavailable or declared available for high precedence traffic only. If either case is true the message processor is informed with a RXT indication. The circuit is marked as available for all traffic.

3.3.2.4 SXT All: The SXT *all* control block may be received on any of the circuits in a link. The TSI field in the SXT *all* control block will be ignored. Receipt of the SXT *all* will cause all circuits in the link to be placed on automatic hold. SXT *high* indication is passed to the message processor for each circuit in the link.

3.3.2.5 RXT All: The RXT *all* control block may be received on any of the circuits in a link. The TSI field in the RXT *all* control block will be ignored. Receipt of the RXT *all* will cause the automatic hold to be removed from all circuits in the link. RXT indication is passed to the message processor for each circuit in the link. The transmission of data blocks will begin with a TSI of one greater than the last known positive or negative acknowledgment on each circuit. Data blocks of messages that were previously transmitted, but not acknowledged, will be retransmitted with LCI B6 equal to 1 to indicate PDM.

3.4 Message Level

The message level is responsible for processing primitives from from each block processor in the link. Processes within this layer generate primitives for the block processor. The message level interface to the link level provides for the sequencing of incoming blocks and the selection of a circuit for transmitted blocks.

3.4.1 Message Data Unit

The entity comprising TEXT and the envelope controlled by the message processor is referred to as the Message Data Unit (MDU). *TEXT* is a segment of data from the message being transferred. SLC supports five MDUs. These MDUs are collected into groups of one to two MDUs, each group defining a separate SLC option. There are four separate options supported. The following paragraphs define all of the MDU fields. ¶3.5 defines the grouping of these fields.

3.4.1.1 Message Block Identifier: The Message Block Identifier (**MBI**) character is the first character of the MDU. It contains binary field information indicating whether the ensuing message is contained in single or multiple blocks. It also contains block chaining information to enable a receiving center to correctly assemble a message as follows:

```
P        7 6 5  4 3 2 1
      Message  Block Chaining
        Label  Number
```

Bits 7 through 5 constitute the message label, providing three bits from which eight message labels can be assigned. The label 0012 is used exclusively for messages that are contained within a single block and may be reused without positive or negative acknowledgment of the message. The labels 000 and 010 through 111 are used for multiblock messages. They may not be reused until the message bearing one of the seven labels has been positively acknowledged by the connecting center or negatively acknowledged, which will cause the message to be removed from the link and directed to the system intercept as an undeliverable message. In the latter case, sufficient time should lapse before reuse of the label to allow the connecting center to discard a partially received multiblock message. This will avert the possibility of splicing two messages together.

In a block chaining number, four bits provide 16 combinations, of which the combination 1111 has two uses. It is always used in conjunction with message label 001 (single block). In conjunction with the labels 000 and 010 through 111, it indicates the sixteenth and the last possible block of the message bearing that label. Combinations 0000 through 1110 represent the first through fifteenth blocks of a given message to allow the correct assembly of the message at a receiving center. When a complete message is contained within one block, the **MBI** character of that block shall be 1F (hexidecimal). On a link of one to seven circuits employing both high and low precedence traffic, seven multiblock message labels per type are defined. For example, it is possible that message label 010 may be active simultaneously for high and low precedence. When MDU indication is received from the link/block level it must be accompanied by a precedence indicator. Within each precedence, message labels are not reused (duplicated) until properly acknowledged.

An optional feature is available that employs a multiblock message label in a message that is coded normally as a single block message. This feature permits the use of an **MBI** character composed of a multiblock message label (000 or 010 through 111) with a block chaining number of 0000 in a single block message instead of the standard single block message label (0001) with block chaining number (1111).

If a link is configured with this optional feature, all single block messages transmitted and received using this option shall be handled as multiblock messages. Additionally, if a single block message is received using the standard single block message **MBI** character, it shall be processed according to the single block message procedure.

The standard single block message **MBI** character will not be used in messages transmitted on a link configured with this optional feature.

3.4.1.2 Link Characteristics Identifier: The Link Characteristics Identifier (**LCI**) character immediately follows the **MBI** character in the envelope and contains binary field information as follows:

```
P          7  6  5  4  3 2 1
           1  P  A  H    P L
              D  C  L    r a
              M  I  D    o s
                        t t
                        e
                        c B
                        t l
                        i o
                        o c
                        n k
```

Bit 7 is always equal to 1.

Bit 6 is the possible duplicate message indicator. For example, if B6 is equal to 0 (normal case), this message is not a possible duplicate. If B6 is equal to 1, this message may have been previously sent successfully. If a message is received with B6 equal to 1, it will be retained throughout the ARINC system when in transit from link-to-link. It is not necessary to edit text for PDM characters and set or reset LCI B6 in agreement. LCI B6 will be set by a link that retransmits a message due to lack of a positive or negative acknowledgment.

Bit 5 is the ACI presence/absence indicator. If B5 equals 0, no ACI character is present in the envelope or information portion of the block. If B5 equals 1, an ACI character is present (see ¶3.5 for ACI placement when present.)

Bit 4 indicates the presence or absence of high-level designators in the envelope. Bit 4 equals 0 absent, B4 equals 1 present. If B4 equals 1, four additional characters are in the envelope (see ¶3.4.1.3 and ¶3.4.1.4).

Bits 3 and 2 are the protection level as follows:

3	2	
0	0	Full
1	0	Limited
0	1	None
1	1	End-to-End

Links employing option 4 do not use LCI B3 and B2 for protection. B2 is coded 1 always. B3 equals 1 for conversational format and B2 equals 0 for conventional format. When other options are used, and a conventional formatted message is received with other than full protection indicated, an invalid protection specified alarm is generated and the protection is changed to full.

Bit 1 is the last or not last block indicator. 0 equals not last block of a message. LCI B1 equals 0 on the first and intermediate blocks of a multiblock message. LCI B1 equals 1 on all single block messages and on the last block of a multiblock message.

Links employing the single block message using a multiblock label have the last block indicator set in the first block of a multiblock label. This indicates the entire message is contained in the first block.

3.4.1.3 High Level Exit Center: This field consists of two characters and uniquely identifies a HEX (that is, the center ultimately responsible for the final delivery of the message to a terminal or computer application). Provision will be made on a link basis to regard or ignore the HEX field on a conventional block when received. If the field is to be ignored, routing will use the addresses contained in the conventional message format in the information portion of the block or blocks. If the field is to be regarded, routing will use the HEX and ignore the addresses contained in the conventional message format in the information portion of the block or blocks, unless the HEX is that of the high level center, in which case the conventional addresses apply. Provision will be made, on a circuit-by-circuit basis, to insert a constant *dummy* HEX into the envelope of conventional blocks whose options require it.

3.4.1.4 High Level Entry Center: This field consists of two characters and uniquely identifies a HEN (that is, a message originated from a terminal or computer application associated with this center). Provision will be made on a circuit-by-circuit basis to insert a constant *dummy* HEN into the envelope of conventional blocks on those links whose block format options require it. The HEN is always present on conversational blocks, and its integrity will be maintained from link to link as received. The two characters of the HEX or HEN are also called high level designators (HLDs). Blocks received with undefined HLDs will be handled as follows:

- Conversational/conventional blocks with full protection will be directed to system intercept with an appropriate reason for intercept and the circuit of origin.
- Conversational/conventional blocks with other than full protection will be rejected to the HEN if an enquiry. If a response, the message will be discarded.

3.4.1.5 Message Characteristics Indicator: The Message Characteristics Indicator (MCI) character immediately follows the HEN field in those formats that require it. Its composition is as follows:

```
Binary Composition of MCI

   P          7    6  5    4      3  2  1
              1    Format  I/R    Code R/N
                                  Set
```

Bit 7 is always equal to 1.

Bit 6 and 5 contain the message format contained in block(s) as follows:

6	5	
0	0	Conventional
0	1	Conversational
1	0	Reserved
1	1	Network Control Block *

* Network control blocks are not supported.

Bit 4 is the inquiry/response indication. B4 equals 0 response. B4 equals 12 inquiry.

Bits 3 and 2 contain the code set of the message as follows:

3	2	
0	0	ATA/IATA 5-bit code padded to 7-bits
0	1	6-bit character set padded to 7-bits
1	0	ATA/IATA 7-bit code
1	1	Reserved

Bit 1 is the rejected/normal indication. Bit 1 equals 0 normal status; B1 equals 1 rejected message. This field is currently not examined in conventional blocks. This bit is set by a link unable to forward an enquiry message (MCI B4 equals 1). The HEX and HEN fields are reversed in the envelope, making the original HEN a HEX and the original HEX a HEN; the message is then routed back to the center of origin, if possible. Once an enquiry has been rejected, it is not subject to a second rejection. If a rejected enquiry message cannot be returned to the center of origin, it is discarded. Response messages (MCI B4 equals 0) are not subject to the rejection process. If they are unable to be forwarded they are discarded. The conditions that cause the rejection or discarding of conversational blocks are:

- The link to which the block is directed is down, or
- The block has been sent N4 times over a link without a positive acknowledgment.

3.4.1.6 Additional Characteristics Indicator: The Additional Characteristics Indicator (ACI) is an optional character subject to bilateral agreement. Its presence or absence is indicated by LCI bit 5. The ACI is required on links employing option 4. On links employing option 3, the ACI may also be present in the format shown in ¶3.5, but the code set indicated in the ACI will be the same as the code set in the MCI. See the ICM for the ACI composition on nonoption 4 links.

The composition of the option 4 ACI is as follows:

```
Composition of option 4 ACI

        P   7  6  5  4  3  2  1
            1  1  0  1    Code
                          Set
```

Bit 7 is always equal to 1.

Bit 6 is reserved for future application and is equal to 1.

Bit 5 indicates the presence of additional ACI characters and is equal to 0, indicating that no additional ACI characters are present.

Bit 4 is reserved for future application and is equal to 1.

Bits 3, 2, 1 are used to indicate the code set of the information portion of the block as follows:

```
3   2   1
0   0   0     ATA/IATA 5-bit code padded to 7-bits
0   1   0     6-bit character set padded to 7-bits
1   0   0     ATA/IATA 7-bit code
```

Option 4 links carry three different code sets by use of the code set field. Less capable code sets are padded up to eight bits including odd parity.

3.4.2 Message Level Timers

The message processor controls two timers; **AML** [T6] and *message complete* [T8].

3.4.2.1 AML [T6]: The **AML** [T6] timer monitors the acknowledgment of a transmitted multiblock message. When the last block of a multiblock message has been confirmed, the timer is started. When an **AML** indication is received for the message, the timer is stopped. If [T6] expires, message retransmission is attempted.

3.4.2.2 Message Complete [T8]: The *message complete* [T8] timer monitors the reception of all blocks of a multiblock message. The timer is started when the first block of a multiblock message has been correctly received, and restarted when any subsequent block of the message is received (except for the last block). It is stopped when all blocks of the message have been received. If [T8] expires, all blocks of the message are discarded, and the message label is made available for use.

3.4.3 Message Counters

The message processor uses one counter: the *retransmit of multiblock message* counter [N5].

3.4.3.1 Retransmit Multiblock Message Counter [N5]: The message processor uses the assigned value of [N5] to determine whether, following an unsuccessful attempt to deliver a multiblock message, the message should be retransmitted or returned to the applications interface as undeliverable.

3.4.4 Message Level Process

The processes of the message processor are activated through the message primitives from the block level via the link level, the application level and timer expirations.

3.4.4.1 Message Block Receipt Indication: Blocks passed to the message processor by block processors via the link level are validated for correct message information fields in the envelope. Violations of this validation include:

1. A block with the same BCN has already been received for this message label.
2. The received block has the last block indicator set and has a BCN lower than that in another already received block for this message label.
3. The received block has a BCN higher than a previously received block that had the last block indicator set.

If the block fails the validation, a block response is given to the block processor with status indicating invalid. Valid blocks are reassembled into complete messages and these are passed to an application that handles message routing and protection. Messages requiring protection will receive it through this interface and the message processor will be notified when the message protection is complete.

Messages received with message labels 0 and 2-7 must be reassembled from received blocks as described in ¶3.4.4.5. When a block is received with a message label other than 1 the BCN is examined and the block is placed in the proper sequence in the text block chain. If the message is incomplete the *message complete* timer [T8] is started. If the message is complete, [T8] is stopped and the message is sent to an application for routing and protection.

When protection is complete for a full-protection multiblock message, the link processor is informed so that the **AML** block may be sent. When protection is completed for a single block message the link processor is informed so that the **ACK** control block can be sent.

3.4.4.2 Message Block Transmit Request: The application level provides the message processor with messages to be transmitted. These messages are assigned a message label and broken down into MDUs as described in the message blocking ¶3.4.4.5. An MDU is given to the link level to select a circuit from among the available circuits for the link and to transmit the MDU. Higher precedence MDUs may be interspersed with lower precedence MDUs being passed to the link level.

The link level returns MDUs for which the message level had generated transmit requests. Status returned by the link level is used to determine the next process for the block. ¶3.4.4.3 and ¶3.4.4.4 define the process for blocks returned with undeliverable and possible duplicate status' respectively. When the link level indicates acknowledgment of a single block message the message is marked as successfully transmitted. When all blocks of a multiblock message have been confirmed by the link level as acknowledged, the **AML** timer [T6] is started unless the **AML** has already been received. In this case, the message is marked as successfully transmitted.

When an **AML** is returned from the link level it is considered valid if all data blocks for the associated label/precedence have been transmitted. Invalid **AML**s are discarded.

If all the blocks have been acknowledged the message is marked as transmitted successfully and [T6] is stopped. If all the blocks have not been acknowledged the message is marked as **AML** received and the message will be marked as transmitted successfully when the last block is acknowledged.

3.4.4.3 Undeliverable Messages: Block processors may return undelivered blocks with a status indicating the target SLC refused to accept this block.

If the block is a single-block conventional message, the message is directed to system intercept with an intercept header indicating undeliverable status.

If the message is single-block conversational and an inquiry, it will be rejected to the originating HEN. If it is a rejected inquiry or a response, it will be discarded.

For a multiblock message block, [T6], if started, is stopped. In this case, or when [T6] had expired, the [N5] tally is incremented. If the tally has not yet reached [N5], an attempt is made to retransmit the message on a different circuit (block processor returned undeliverable block) or on the same circuit ([T6] expired) using the same message label. When the tally matches [N5], the message will be treated as discussed previously for a single block message.

3.4.4.4 Possible Duplicate Messages: When a block processor informs the message processor of a circuit-down condition any completely transmitted but unacknowledged messages are marked as PDM. Blocks built from text of these messages after the circuit recovery will have the PDM bit set in the **LCI**.

If the Acknowledge Message Label [T6] timer expires, the message is marked as PDM before retransmission. A processor failure will cause all messages that had been transmitted but not acknowledged to be retransmitted with the PDM bit set in the **LCI**.

3.4.4.5 Message Blocking: Messages are divided into blocks for transmission over a link. Present circuits use 240 or 250 characters as a maximum size for the information portion of a data block. Other maximums are possible through bilateral agreement; therefore, provision is made for varying the maximum size of the information portion of a data block on a link-by-link basis. Some links use different block sizes for conversational and conventional traffic.

If a message contains less than the maximum number of characters established for the link, it is sent without padding to the maximum size.

No more than one message is contained in a single block. Messages in excess of the maximum size of a block are sent in up to 16 blocks of the maximum size, with each block having a message label and block chaining number to tie the blocks together. Single-block messages or the last block of a multiblock message will contain a variable length of characters up to the maximum established for the link. Messages received by a link may be multiblock and may contain less than the established maximum of characters in the individual blocks. Provision will be made to handle this situation. ARINC will always block to a given link's established maximum to the extent possible in the transmit direction. Example: On a link configured for 250 maximum block size, a 300-character message will be sent as one 250-character block and one 50-character block (information portion). That same link may receive a 300-character message as two 150-character blocks (information portion) or any combination of blocks up to a maximum of 16 and characters that total 300.

3.4.4.6 SXT High Indication Received: The link processor indicates to the message processor when a SXT *high* has been received and if there are other available circuits in the link. If no other circuits are available the message processor returns all messages that have not been acknowledged to the application level. Multiblock messages that have been acknowledged but no AML received are also returned to the application level with the PDM indicator set. No other messages are attempted to be transmitted until RXT or SXT *low* indication is received.

If other circuits are available the message processor resubmits MDUs for all messages that have any MDUs unacknowledged.

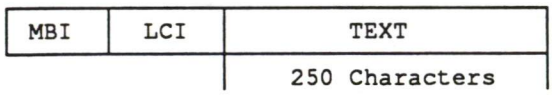
3.4.4.7 SXT Low Indication Received: The link processor indicates to the message processor when a SXT *low* has been received and there are no other available circuits in the link or all other available circuits are also receiving SXT *low*. All messages in progress will continue to be transmitted. Any new requests to the application level will be for high precedence messages only. This continues until either RXT or SXT *high* is received.

3.4.4.8 RXT Indication Received: The link processor indicates to the message processor when a RXT has been received after either SXT *high* or SXT *low* indication had been previously received. The message processor will resume sending all traffic upon receipt.

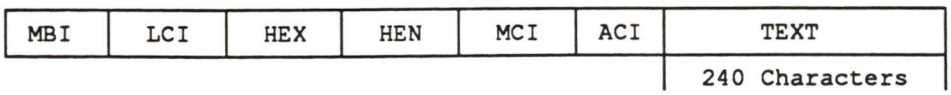
3.5 Information Block Composition

The following paragraphs define the five MDUs SLC supports and the grouping of these MDUs into the four supported SLC options.

3.5.1 Conventional Block With No Network Operation Contemplated



3.5.2 Conventional Block With Network Operation Contemplated And Message Characteristics Indicator



3.5.3 Conventional Block With Network Operation Contemplated Excluding Message Characteristics Indicator

MBI	LCI	HEX	HEN	ACI	TEXT
					240 Characters

3.5.4 Conversational Block Network Operation Implied

MBI	LCI	HEX	HEN	MCI	ACI	TCI	Addrs.	TEXT
						240 Characters		

3.5.5 Conversational Block Network Operation Implied Excluding Message Characteristics Indicator

MBI	LCI	HEX	HEN	ACI	TCID	TEXT
					240	Characters

3.5.6 Enveloping Options And Handling

The preceding block formats represent the various options of the ICM Synchronous Link Procedures; however, not all links require, nor are able to support, the many features available. It is, therefore, necessary to establish block format options on a link basis as follows:

Option 1 ¶3.5.1 Blocks Only

Option 2 ¶3.5.1 and ¶3.5.4 Blocks Only

Option 3 ¶3.5.2 and ¶3.5.4 Blocks Only

Option 4 ¶3.5.3 and ¶3.5.5 Blocks Only (P-1024 Option)

Provisions have been made to allow a link to change options as user requirements change. A link operating with one of the four options will transmit and receive only the permitted formats as shown above.

Messages transiting links with differing block options will have the required envelope elements generated or removed, as necessary.

4 Message Information

This paragraph describes the message elements required for conventional and conversational messages. It is included in this section as user information only. Specifications for ICM message processing are detailed in Section §C2-4.

The absence of any of the message elements in a message will have no effect on the operation of the protocol. Those elements marked with an asterisk, if missing or improperly formatted, will result in interception of the message. The ARINC network performs code conversion to and from 5-bit or 6-bit padded as required so that all messages are processed internally in the 7-bit code set. When using the 5-bit or 6-bit padded code sets over a 7-bit code link, the provisions of Section 6.3.2 of the ICM apply.

4.1 Conventional Message

Conventional traffic is considered to be store-and-forward traffic using standard seven- or eight-character addressing conventions. If high level addressing (HEX/HEN) is used in conjunction with conventional traffic, the high level addressing will take precedence over the seven- or eight-character addressing unless the high level exit designator (HEX) is that of the center receiving the message. The envelope formats used for these messages can be those shown in ¶3.5.1, ¶3.5.2 or ¶3.5.3. This traffic is of low precedence (bit 6 of the TSI) and while transit time is important, it is increased because this traffic is marked for full protection and is protected by block acknowledgment. This does not preclude, however, the receipt of a conventional message requiring other than full protection. Full protection messages must be written to safe storage media before the acknowledgment is sent. Blocks of a multiblock conventional message are acknowledged before they have been written to safe storage. The acknowledgment of the message (AML), however, will not be sent until all blocks of the message have been correctly reassembled and written to safe storage.

4.1.1 Format

4.1.1.1 Start Of Address*: The original SOA sequence as received and validated by the network entry point will be removed in its entirety. The network exit point will place the applicable SOA sequence on the output message based on the code set used, as follows:

ATA/IATA 5-bits padded to 7-bits	CR LF
6-bits character padded to 7-bits	LF CR LF
ATA/IATA 7-bits	CR LF SOH

4.1.1.2 Priority Indicator: In addition to their block precedence, conventional messages may contain priority indicators that affect their transmission order. The priority indicator is optional and when found is located immediately following the SOA element in the message.

If present, the priority indicator consists of two characters followed by a space. If absent, the first character of the first address immediately follows the SOA element of the message. The precedence is as follows:

Priority Indicators	Conventional Message Level
QU, QS, QX	First (Urgent)
QP	Second (Normal with higher priority for local delivery)
Q/, or NONE	Third (Normal)
QD	Fourth (Deferred)

Q/ is defined as all priorities not specifically defined elsewhere (e.g., QK).

Once transmission of a given priority conventional message has begun, it will be allowed to complete without interruption from a higher priority conventional message. First-in-first-out (FIFO) will be maintained within high precedence messages and within the prioritization of low precedence messages. Messages in the lower levels of low precedence messages will not be sent until all messages in a higher level have been transmitted.

4.1.1.3 Addressee Indicators*: Only those addresses that cause routing to this particular link will be retained in the message as received; those that do not will be removed in their entirety. Surviving addresses shall be spaced seven per line for eight character addresses or eight per line for seven character addresses as in the ICM.

4.1.1.4 End Of Address*: EOA follows the last address indicator. Must consist of carriage return, line feed followed by a period (.).

4.1.1.5 Message Origin*: A seven or eight character routing indicator indicating the station that originated the message.

4.1.1.6 Supplemental Addressing: A seven or eight character routing indicator indicating a station having message servicing responsibilities other than the originator of the message.

4.1.1.7 Start Of Text*: The network entry point will validate the STX sequence used on received messages. The network exit point will ensure that the proper STX sequence is used on output messages, based on the code set assigned to the link, as follows:

```
ATA/IATA 5-bits padded to 7-bits       CR LF
6-bits character padded to 7-bits      CR LF
  followed by the binary combination 0000  0010 (02)
ATA/IATA 7-bits                        CR LF STX
```

4.1.1.8 Text Section: This part of the block is to be code-translated consistent with its arrival and exit points. It is variable in length to the established link maximum. ARINC does not support the extension of maximum message length as defined in ICM Section 5.4.2.11. The maximum message length supported for universal interchange is 3840 characters. Note that option 2 links have one maximum for conversational blocks and another for conventional blocks. The TCI character and TCID character(s) have their integrity maintained when transiting links with differing code sets (that is, they are sent as received without translation). The character length of 7 data bits is maintained in all code sets. A single information block shall contain a single complete message or part of a message.

The alignment function following the text section is mandatory but currently ARINC message editing does not examine for its presence. However, future implementations will examine for the mandatory alignment function between the text section and the end of text section and messages received without the mandatory elements will be automatically rejected back to the sender with an intercept header indicating the reason for intercept.

4.1.1.9 End Of Text: The ETX section as received is normally removed from all messages. This process, called input ender stripping, searches backwards from the end-of-message until the end-of-text is found or until the search reaches a predefined number of characters. If the end-of-text is found, it and all following characters are removed. If the end-of-text is not found within the predefined number of characters searched, then no characters are removed. In either case, the appropriate output message ender (OME) will be appended to the outgoing message, based on bilateral agreement with the recipient.

4.1.1.10 Ending: The following output message enders (OMEs) are supported on a circuit-by-circuit basis: None, semicolon (;), and ETX EOT. For the code sets listed below the associated OME is normally applied.

```
ATA/IATA 5-bits padded to 7-bits       ;
6-bits character padded to 7-bits      None
ATA/IATA 7-bits                        ETX EOT
```

4.1.2 Code Set Translation

Conventional messages received on SLC links option 2 or 3 base the translation requirements on the code set specified in the MCI character of the first block received. Option 4 links use the ACI character of the first block received to determine the code set to use. Option 1 links do not have the MCI or ACI character, therefore data received is assumed to be in the code set configured for the link. Data is always translated to the code set defined for the link when transmitted, with the ACI or MCI characters coded appropriately.

DLE, ETB, or **SYN** may not be used in the text. It is also vital that no other code combinations assigned to communications control characters be used for other purposes.

4.2 Conversational Message

Conversational traffic is enquiry/response traffic. High level addressing in conjunction with terminal addresses is used for routing. While protection on a link basis is provided, transit time is of primary importance. Due to this consideration and the fact that loss of this traffic is protected by either terminal operator reentry or application timeout, this class of traffic is not written to safe storage. This does not preclude, however, the receipt of a conversational message requiring full protection. The envelope formats used for these messages can be those shown in ¶3.5.4 or ¶3.5.5. This traffic is of high precedence (bit 6 of the TSI) and receives limited protection. Single block conversational messages are protected via block acknowledgment.

The block may be acknowledged as soon as it is correctly received in memory. Multiblock conversational messages are also protected by block acknowledgment. In order to ensure rapid transit time, a correctly received block of a multiblock message will be transmitted immediately if the high level address indicates the message is destined for another center. Upon receipt of the last block of a multiblock conversational message, the receiving center will transmit an acknowledge message label control block (AML) even though that center served as a transit center and did not reassemble the message. This serves to satisfy the link protocol. If any or all of the blocks are lost in transit, operator reentry or application timeout will protect the message. If a center receives an enquiry message and is unable to forward it due to an outage at the destination link, a service message will be returned to the originator.

4.2.1 Format

4.2.1.1 Terminal Characteristics Indicator: The *terminal characteristics indicator* (TCI) character is the first character of the information portion of a nonoption 4 conversational block and is described as follows:

```
Binary Composition of TCI

        P    7  6  5  4  3  2  1
             1  0  0   Terminal
                       Address
                       Character
                       Count
```

Bit 7 is always equal to 1.

Bits 6, 5 are reserved and are equal to 00.

Bits 4, 3, 2, 1 are the number of characters in the origin terminal address that immediately follows this character; 0 to 15 characters are possible.

Special problems arise when exchanging conversational blocks over option 4 and nonoption 4 links. The TCI and the terminal address that follows are retained throughout the ARINC network as received. If code translation is required, extreme care will be exercised to ensure that the characters originally sent are preserved. These two fields are present on both enquiry and response messages and represent the terminal of origin or computer application of the enquiry. The response to the enquiry preserves the original field from the enquiry.

4.2.1.2 TCI Identifier: The TCID represents the terminal address. On option 4 links the TCID consists of three characters, on nonoption 4 links the TCI defines the number of TCID characters. The TCID is used in conversational blocks and must be retained as follows when exchanged between option 4 and nonoption 4 links. The option 4 ACI-TCID terminal address fields will become a MCI-TCI-TCID terminal address on the nonoption 4. In the reverse direction, the MCI-TCI-TCID terminal address will become an ACI-TCID terminal address. No code translation is done on the TCID.

4.2.1.3 Text Section: The text section is free format.

4.2.1.4 Ending: No ending sequence is defined for conversational messages.

4.2.2 Conversational Service Message Formats (Rejected Inquiry Messages)

A service message is returned to the originator when SLC cannot transmit a conversational inquiry message to the user. The format of the service message is based on the envelope option employed on the link attempting to return the message.

4.2.2.1 Format Employed On SLC Options 1, 2, And 3: The entire enquiry message as received with the original HEX, HEN fields reversed and with the reject bit set in MCI (B1=12) will be returned to the originator when necessary to reject.

4.2.2.2 Format Employed On SLC Option 4: Inquiries received from option 4 links require a canned message text to be inserted in place of original text when necessary to reject. The original HEX, HEN fields are reversed and the original TCID terminal address characters are preserved to effect routing back to the originator. The MCI and TCI fields do not exist in option 4 block formats and, if present, will be removed. The ACI field will be generated if it is not present.

☞ Note: Any conversational message received from an option 4 link is assumed to be an inquiry message currently, because inquiries and responses have identical block envelopes in option 4 formats.

```
                                E
                                0  E
                                M  T
C1 C2 = SYSTEM - UNAVAILABLE = C  B
```

Characters are contiguous. The equals sign (=) means space.

The characters C1, C2, and EOMC are necessary to satisfy 6-bit terminal protocol. The ETB satisfies the P-1024 protocol.

```
                     ASCII
                         E
                         T
     SYSTEM UNAVAILABLE  B
```

4.2.3 Code Set Translation

Data internal to the ARINC network is in the 7-Bit code set.

Data received or transmitted on links not employing this code set must be translated. Conversational messages received on SLC links option 2 or 3, base translation requirements on the code set specified in the MCI character of the first block received. Option 4 links use the ACI character of the first block received to determine the code set to use. The message is always translated to the code set defined for the link when transmitted, with the ACI or MCI characters coded appropriately.

DLE, ETB, or SYN may not be used in the text. It is also vital that no other code combinations assigned to communications control characters be used for other purposes. As described above, the TCI and TCID characters are not translated into link defined code sets, but are transmitted as received.

4.3 Message Protection

☞ Note: Protection specifications for the ADNS II network are detailed in Section §C2-4. The following is offered for informational purposes.

The protection level information is found in the data block envelope and is retained as received and forwarded. Option 4 does not code the LCI B3 and B2 to indicate the protection level. Therefore,

conventional and *conversational* messages received from an option 4 link will be forwarded with protection coded *full* and *limited*, respectively. If a conventional message arrives from a nonsynchronous link source where protection level has no meaning and is bound for a synchronous link, it will be sent coded *full protection*. If the message is a conversational message, it will be sent coded as *limited protection*.

One of four levels of protection will be provided for a message transiting synchronous links: full protection, limited protection, no protection, or end-to-end protection. Each level of protection is discussed in the following paragraphs.

4.3.1 Full Protection

A single-block, fully-protected message will not be positively acknowledged until it is written successfully to a safe storage media (e.g., disk, drum, etc.). A multiblock message is not written to disk until the entire message is received. After the successful write to disk, the acknowledge message label (AML) is sent, indicating that the message is fully protected. A message will be retained until it has been positively acknowledged once or negatively acknowledged a number of times. Only then will all link reference to the message as well as the memory and safe storage media occupied by the message in the link's queue be released.

4.3.2 Limited Protection

A message will not be positively acknowledged until it is correctly received in memory. A message will be retained in memory until it has been positively acknowledged once or negatively acknowledged a number of times. Only then will all link reference to the message, and the memory occupied by the message, be released.

4.3.3 No Protection

If a message is received with the protection bits set to indicate no protection, the message will be afforded limited protection throughout the ARINC network.

4.3.4 End-To-End Protection

If a message is received with the protection bits set to indicate end-to-end protection, the message will be afforded limited protection throughout the ARINC network. Network acknowledge message label control blocks are not supported and will be discarded upon receipt.

5 Network System Configuration And Control

This Paragraph describes the configuration, operational control, status, reports, and alarms used in the ARINC network supporting synchronous links.

5.1 Configuration

5.1.1 ATA/IATA SLC Link Configuration Parameters

A series of network system configuration screens are provided and maintained to define ATA/IATA SLC link parameters in the ARINC network.

The following data elements are subject to bilateral agreement between ARINC and the user at subscription time, and may be changed thereafter by further coordination between the parties:

- The value of the various circuit and message timers (see Table 52).
- The value of the various circuit and message counters (see Table 53).
- The number of circuits forming the link.
- The data transmission rate of each circuit.
- Whether the transmission of a multiblock message over more than one circuit of a multicircuit link is allowed, (e.g., block- scatter option).
- The character code set to be used for transmissions on the link.
- Whether high-level designators will be used for addressing Type B messages.
- The specific SLC envelope link option to be used.
- Whether a multiblock label is to be used for single block message.
- The maximum block size of a Type A information block.
- The maximum block size of a Type B information block.
- The input message ender stripping option to be used by ARINC.
- The output message ender character sequence to be used by ARINC.
- The network congestion indication stop option to be used by ARINC.

Table 52. Channel And Message Timers

Description	*Timer Number*	*ATA/IATA Equivalent*	*Range*	*Suggested Value*
Maximum time period for nonexchange of protected information blocks before a positive acknowledgment is required	T1	T1	1-63 secs.	1
Maximum time period for nonexchange of protected information blocks between positive acknowledgment or resume sending link control blocks	T2	T2	1-63 secs.	15
Time period after which a negative acknowledgment is repeated if the expected block has not been received	T3	T3	1-63 secs.	5
Time interval between successive enquiry link control blocks	T4	T4	1-63 secs.	5
Maximum time interval awaiting acknowledgment of protected information blocks	T5	T5	1-63 secs.	5
Acknowledge message label (AML) timer	T6	T6	1-63 secs.	10
Circuit Down Timer	T7	-	1-63 secs.	20
Multiblock message timer	T8	T8	1-63 secs.	8
No block received timer	T9	T9	1-63 secs.	31

5.2 Operational Control

The native NCS for the device providing the SLC functions performs all functions necessary for the real-time operational control and management of the ARINC network. Specifications for the ADNS II native Network NCSs are defined in Section §C2-2.

Table 53. Channel And Message Counters

Description	Timer Number	ATA/IATA Equivalent	Range	Suggested Value
Number of outstanding transmitted blocks	N	-	1-31	4
Number of SYN characters preceding each	N1	N1	2-12	4
Number of NAK responses transmitted	N2	N2	1-12	3
Number of outstanding received information blocks	N3	-	1-16	2
Message block retransmit counter (determines when to stop attempting to transmit a message block)	N4	-	1-16	3 for Type A/B mixed 5 for Type B only
Number of message retransmit counters (determines when to intercept a transmit message)	N5	N3	1-16	1 for Type A/B mixed 2 for Type B only
Number of consecutive ENQ transmitted	N7	N5	1-16	3
Number of BCC errors to trigger alarm	N8	-	1-63	10

5.2.1 Link Level Commands

While synchronous links require minimum intervention in normal operation, a full set of manually imposed online controls are provided to the native NCS. The following operations may be performed by an individual SLC station. Commands directed to a SLC station effect all circuits of the SLC link.

5.2.1.1 Close/Open Link Commands: When the *close* command is executed: transmission of both information and control blocks is suspended immediately; RTS on the circuit(s) of the link(s) is dropped; all received blocks are discarded; all timers for the circuit(s) of the link(s) are stopped; and any message in progress but still undelivered is requeued for output on the link(s) ahead of any message already queued.

When the *open* command is executed, transmission of information blocks may be resumed after circuit recovery procedures are completed for the effected link(s).

5.2.1.2 Hold/Release Link Commands: When the *implement hold* command is executed, transmission of information blocks is suspended after all blocks of the current message in progress on all circuits of the link(s), if any, has been transmitted. The manual hold will have precedence over automatic holds and restorals, while imposed traffic may be received normally with appropriate control blocks sent in response. When the *remove hold* command is executed, transmission of information blocks is resumed unless there is another exception condition preventing normal operation (e.g., automatic hold).

5.2.1.3 Skip/Poll Link Commands: When the *skip* command is executed, all received information blocks received over all circuits of the specified link(s) are discarded. This control will have precedence over SXT *low*. Traffic may be sent along with SXTs if conditions permit. Circuit recovery will have precedence over all manually imposed conditions. When continuity is restored, the manually imposed condition, in effect, will again be resumed. When the *poll* command is executed, all received blocks are accepted unless there are other exception conditions in effect (e.g., node traffic congestion). Output is unaffected by either the *skip* or *poll* commands.

When the *skip regulate* command is executed, SXT *low* is transmitted every [T2] seconds. There is no other affect on the circuit(s) of the link(s).

5.2.1.4 Alternate Route Command: When the *alternate route* command is issued to the SLC link, all messages currently queued and messages subsequently destined for that link are diverted to the alternate station. This command will stay in effect until canceled. This command can only be issued to the link, individual circuits of a link are all effected.

5.2.1.5 Queue Extension Command: When the *queue extension* command is issued to the SLC link, all messages currently queued and messages subsequently destined for that link are diverted to the native NCS. Canceling of this command causes the currently delivered traffic to queued for output on the SLC link. Once the *queue extension recall* command is issued the messages diverted to the native NCS are requeued to the original SLC link.

5.2.2 Circuit Level Commands

While synchronous links require minimum intervention in normal operation, a full set of manually imposed online controls are provided to the native Network Control Station (NCS). The following operations may be performed by all circuits at a node or by an individual SLC circuit. Commands directed to a SLC circuit effect only that circuit of the SLC link.

5.2.2.1 Open/Close Circuit Commands: When the *close* command is executed, transmission of both information and control blocks is suspended immediately, RTS on the circuit(s) is dropped, all received blocks are discarded, all timers for the circuit(s) are stopped, and any message in progress but still undelivered is requeued for output on the link ahead of any message already queued.

When the *open* command is executed, transmission of information blocks may be resumed after circuit recovery procedures are completed for the effected circuit(s).

5.2.2.2 Hold/Release Circuit Commands: When the *implement hold* command is executed, transmission of information blocks is suspended after all blocks of the current message in progress on the specified circuit(s), if any, has been transmitted. The manual hold will have precedence over automatic holds and restorals, while imposed traffic may be received normally with appropriate control blocks sent in response. When the *remove hold* command is executed, transmission of information blocks is resumed unless there is another exception condition preventing normal operation (e.g., automatic hold).

5.2.2.3 Skip/Poll Circuit Commands: When the *skip* command is executed, all received information blocks are discarded. This control will have precedence over SXT *low*. Traffic may be sent along with SXTs if conditions permit. Circuit recovery will have precedence over all manually imposed conditions and, when continuity is restored, the manually imposed condition in effect, if any, will again be resumed. When the *poll* command is executed, all received blocks are accepted unless there are other exception conditions in effect (e.g., node traffic congestion). Output is unaffected by either the *skip* or *poll* commands.

When the *skip regulate* command is executed, SXT *low* is transmitted every [T2] seconds. There is no other affect on the circuit.

5.3 Link Status And Reporting

The ARINC network uses alarms and user exception status reporting to maintain link and circuit status. An alarm shall be automatically generated by the serving device to the native NCS immediately upon detection of a fault condition on any SLC circuit or link. Alarm handling specifications for the ADNS II Network are defined in §C2-2.

The alarms associated with the SLC protocol are listed in Table 54. Each alarm shall contain the following data elements:

- Alarm number
- Data time group
- PGP and/or other appropriate device identification
- Link and circuit identification

Alarm severity levels are defined in §C2-2. For purposes of this paragraph the following are defined.

Level 1: A detected fault that has significant impact on the operation of the SLC link.

Level 2: A detected fault that has significant impact on the operation of the circuit.

Level 3: A detected fault that degrades service performance or other advisory regarding diminished capacity.

Table 54. SLC Alarm Descriptions

Alarm Number	*Severity Criteria*	*Description*
TBD	2	Data Set Not Ready
	2	Data Set Not Ready Restoral
	2	No Carrier Detected
	2	No Carrier Detected Restoral
	2	No Clear To Send
	2	No Clear To Send Restoral
	1	Link Failure
	1	Link Failure Restoral
	2	Circuit Failure
	2	Circuit Failure Restoral
	3	Excessive BCC Errors
	3	Excessive BCC Error Restoral
	2	Stop Sending All Circuits Received
	2	Resume Sending All Circuits Received
	2	Stop Sending High Received
	2	Resume Sending Received
	3	Stop Sending Low Received
	2	Stop Sending Low Transmitted
	2	Resume Sending Transmitted after SXT low
	2	Stop Sending High Transmitted
	2	Resume Sending Transmitted after SXT high
	3	Invalid Protection Specified
	3	Enquiry/Response Sent to Invalid HEX Address

6 Code Tables And Character Sets

6.1 ATA/IATA 7-Bit Code (Based On CCITT Alphabet No. 5)

The ATA/IATA 7-Bit Code, which is based on CCITT Alphabet No. 5, is depicted in Table 55.

Because the set of characters provided by either the 5-bit or 6-bit code sets padded to 7-bits is less than that available for the 7-bit code set, it should be understood that no complete conversion can be performed.

For conversion from 7-bit to 5-bit padded to 7-bit, lower-case alphabetical characters (a to z) are translated to upper-case alphabetical characters (A to Z). Other conversions are as follows:

```
NUL (00) to SP  (44)
 *  (2A) to *   (5B)
    (40) to     (5F)
BEL (07) to '   (6B)
 !  (21) to !   (6D)
```

Characters that do not have a corresponding ATA/IATA 5-bit code representation are converted to a 5-bit space (44).

Characters that do not have a corresponding 6-bit code representation are converted to a 6-bit NOP (7D).

6.2 Padded 6-Bit

The padded 6-Bit code table is used with odd parity added when employing envelope option 4 as defined in ¶3.5. This code table is depicted in Table 56.

6.3 ATA/IATA 5-Bit Code Padded To 7-Bits

The ATA/IATA 5-Bit code padded to 7-Bits code table may be used with odd parity added when employing envelope options 3 or 4 as defined in ¶3.5. This code table is depicted in Table 57.

7 Statistics

This section details the statistics that will be collected for the ATA/IATA Synchronous Link Control protocol implementation. The following statistics shall be collected and reported for each remote station:

- Number of messages per day sent and received by priority and type
- Average number of blocks per message sent and received per day
- Number of messages/blocks sent and received in the peak hour
- Number of NAKs by hour and peak hour
- Number of reply-requests by hour and peak hour

Table 55. 7 Bit Code Table

BITS b7					0	0	0	0	1	1	1	1
b6					0	0	1	1	0	0	1	1
b5					0	1	0	1	0	1	0	1
b4	b3	b2	b1	ROW \ COLUMN	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	A	LF	SUB	*	:	J	Z	j	z
1	0	1	1	B	VT	ESC	+	;	K	[	k	{
1	1	0	0	C	FF	FS	,	<	L	\	l	|
1	1	0	1	D	CR	GS	-	=	M	]	m	}
1	1	1	0	E	SO	RS	.	>	N	^	n	~
1	1	1	1	F	SI	US	/	?	O	_	o	DEL

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Table 56. 6 Bit Padded Code Table

				B7	0	0	0	0	1	1	1	1
				B6	0	0	1	1	0	0	1	1
B4	B3	B2	B1	B5	0	1	0	1	0	1	0	1
					0	1	2	3	4	5	6	7
0	0	0	0	0					SYNC 1	EOMPB	SYNC 2	BK SPACE
0	0	0	1	1					RGA	EOMC	SEGID	SPACE
0	0	1	0	2					TIC_2	EOMU	TIC_1	TAB
0	0	1	1	3					GA	EOMI	C/R OUT	C/R
0	1	0	0	4					G	E	F	D
0	1	0	1	5					X	V	W	U
0	1	1	0	6					P	N	O	M
0	1	1	1	7					7	5	6	4
1	0	0	0	8					.	I	?	H
1	0	0	1	9					,	Z	-	Y
1	0	1	0	A					#	R	LIGHTS	Q
1	0	1	1	B					*	9	0	8
1	1	0	0	C					C	A	B	
1	1	0	1	D					T	/	S	NOP
1	1	1	0	E					L	J	K	
1	1	1	1	F					3	1	2	NULL

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Table 57. 5 Bit Padded Code Table

B4	B3	B2	B1	B7 / B6 / B5	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
					0	1	2	3	4	5	6	7
0	0	0	0	0	INV	INV	INV	INV	INV	T	INV	8
0	0	0	1	1	INV	INV	INV	INV	E	Z	3	+
0	0	1	0	2	INV	INV	INV	INV	LF	L	LF	)
0	0	1	1	3	INV	INV	INV	INV	A	W	_	2
0	1	0	0	4	INV	INV	INV	INV	SP	H	SP	#
0	1	0	1	5	INV	INV	INV	INV	S	Y	'	6
0	1	1	0	6	INV	INV	INV	INV	I	P	8	0
0	1	1	1	7	INV	INV	INV	INV	U	Q	7	1
1	0	0	0	8	INV	INV	INV	INV	CR	O	CR	9
1	0	0	1	9	INV	INV	INV	INV	D	B	$	?
1	0	1	0	A	INV	INV	INV	INV	R	G	4	&
1	0	1	1	B	INV	INV	INV	INV	J	*	'	*
1	1	0	0	C	INV	INV	INV	INV	N	M	,	.
1	1	0	1	D	INV	INV	INV	INV	F	X	!	/
1	1	1	0	E	INV	INV	INV	INV	C	V	:	;
1	1	1	1	F	INV	INV	INV	INV	K	@	(	@

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SECTION H4-1
ICM CORRELATION TABLE

ICM Paragraph	*Internal Paragraph(s)*
5.3	¶1
5.3.1.1	¶1.1
5.3.1.2 a	¶3.2.4.1.3.1
5.3.1.2 b	¶1.1
5.3.1.2 c	¶1.1
5.3.1.2 d	¶3.4.4.3
5.3.1.2 e	¶3.2.4.1.1
5.3.2.1	¶3
5.3.2.2	¶3.4.4.3
5.3.2.3	¶3.4.4.3
5.3.2.4	¶3.4.4.3, ¶1.1
5.3.2.5	¶3
5.3.2.6	¶3.4.1.2
5.3.2.7	¶4
5.3.3	¶3
5.3.4.1 a	¶3.4.1.6
5.3.4.1 b	¶4.1
5.3.4.1 c	¶3.1.2.5
5.3.4.1 d	¶3.1.2.2
5.3.4.1 e	¶3.1.2.4
5.3.4.1 f	¶3.4.1.2
5.3.4.1 g	¶3.2.1.1
5.3.4.1 h	¶3.4.1.1
5.3.4.1 i	¶3.2.1.2
5.3.4.2 a	¶3.4.1.6
5.3.4.2 b	¶3.2.1.3
5.3.4.2 c	¶3.1.2.5
5.3.4.2 d	¶3.1.2.2

ICM Paragraph	*Internal Paragraph(s)*
5.3.4.2 e	¶3.1.2.4
5.3.4.2 f	¶3.4.1.2
5.3.4.2 g	¶3.2.1.1
5.3.4.2 h	¶3.4.1.1
5.3.4.2 i	¶3.2.1.2
5.3.5.1	¶1.1
5.3.5.2	¶4.3, ¶4.3.1, ¶4.3.2, ¶4.3.3, ¶4.3.4
5.3.5.2.1	¶4.3.1
5.3.5.2.2	¶4.3.2
5.3.5.2.3	¶4.3.3
5.3.5.3.1	¶4.3.1
5.3.5.3.2	¶4.3.1
5.3.6.1.1	¶3.4.4.3, ¶3.2.4.1.3.1, ¶3.3.1.2
5.3.6.1.2 a	¶3.4.1.1
5.3.6.1.2 b	¶3.4.1.2
5.3.6.1.2 c	¶3.4.1.6
5.3.6.1.3	¶4.3.1
5.3.6.1.3 a	¶3.4.2, ¶3.4.1.1, ¶3.4.4.2
5.3.6.1.3 b	¶3.4.2.2
5.3.6.1.3 c	¶3.4.1.1
5.3.6.1.3 d	¶3.4.1.1
5.3.6.1.4	¶3.4.1.2
5.3.6.2.1	¶3.1.2.1
5.3.6.2.2	¶1.1
5.3.6.2.3	¶3.2.4.1.1, ¶3.2.1.2
5.3.6.2.4	¶3.2.4.1.3
5.3.6.2.5	¶3.2.4.1.3.1
5.3.6.2.6	¶3.2.4.1.1, ¶3.2
5.3.6.2.7	¶3.2.2.1, ¶3.2.2.2, ¶3.2.4.1.1.3
5.3.6.2.8 a	¶3.2.4.1.1.2.2
5.3.6.2.8 b	¶3.2.4.1.1.2.1

ICM Paragraph	*Internal Paragraph(s)*
5.3.6.2.8 c	See exception A below
5.3.6.2.9	¶3.2.4.1.1.2
5.3.6.2.10	¶3.2.4.2.1.2, ¶3.2.4.1.1.2
5.3.6.2.11	¶3.2.2.3, ¶3.2.3.2
5.3.6.2.12	¶3.2.4.1.1.4, ¶3.2.4.1.1
5.3.6.2.13	¶3.2.4.1.1.5
5.3.6.2.14	¶3.3.2.1, ¶3.2.4.1.1
5.3.6.2.15	¶3.2.4.1.1.3
5.3.6.2.16 a	¶3.2
5.3.6.2.16 b	¶3.2
5.3.6.2.16 c	¶3.2.4.1.1.3
5.3.6.2.16 d	¶3.2.4.1.1.3
5.3.6.2.16 e	¶3.2
5.3.6.2.17	¶3.2.4.2.1.3, ¶3.2.4.1.1.1, ¶3.2.4.1.1.3
5.3.6.2.18	¶3.2.4.1.1.3
5.3.6.2.19	¶3.2
5.3.7	¶5.1, ¶5.2
5.4.2.1	¶6
5.4.2.2	NA
5.4.2.3	NA
5.4.2.4	NA
5.4.2.5	NA
5.4.2.6	NA
5.4.2.7	NA
5.4.2.8	¶3.2.4.1.1.5
5.4.2.9	NA
5.4.2.10	NA
5.4.2.11	NA

Exception A — A NAK is sent for incorrectly received blocks regardless of their protection level.

NA — Not Applicable. These ICM sections are optional procedures that ARINC does not support.

H5
ALC PARS/IPARS SPECIFICATION

1 Scope

This functional specification describes the requirements to support the PARS family of protocols. Included in this family are the following protocols:

PARS	Programmed Airline Reservation protocol
IPARS	IBM version of PARS
IBM 1006	IPARS
SIRCCO	SITA Satellite Processor Version of 1006
P1024B	SITA version of 1006
Uniscope	Univac polled character protocol
P1024C	SITA version of Uniscope
Alphascope	Variation of Uniscope; uses a slight variation of the Uniscope addressing scheme

Two logical groupings emerge from this family of protocols: the IPARS group, which consists of PARS/IPARS, IBM 1006, P1024B, and SIRCCO; and the Alphascope group, which consists of Alphascope, Uniscope, and P1024C.

In this section, PARS refers to the entire PARS family of protocols, which is the union of the two groups described above.

PARS protocols share a common philosophy but have some differences in message format and addressing specifics. The two groups mentioned above differ in that the IPARS group uses Interchange Addresses (IAs) and Terminal Addresses (TAs), while the Alphascope group uses Remote IDs (RIDs), Station IDs (SIDs), and Device IDs (DIDs).

The only difference between Alphascope and Uniscope is in the level of addressing. The Alphascope stations are addressed at the lowest level (i.e., DID). Uniscope stations can be addressed at the second level (i.e., SID). An Alphascope TCU can be addressed at the SID level. Any Alphascope-compatible device (e.g., Uniscope) is supported by this system. The ALC PARS/IPARS protocol specification is in revision. Complete specification details will be specified by the System Requirements Review.

1.1 General Requirements

The system being described supports RC/TCU/Terminal connections through ADNS II. The protocols and available documentation are shown in Table 58 (refer to ¶2 for details on the documentation).

This specification defines the communications procedures necessary to implement the PARS protocols. The implementation of PARS in an ARINC PAD incorporates two functions: RC emulation and TCU emulation. RC emulation (RCE) is the process of providing an interface to one or more TCUs on a dedicated line to the ARINC network. TCU emulation (TCE) is the process of providing an interface of one RC to the ARINC network. This section defines the TCE and RCE functionality for Alphascope. It then defines the TCE and RCE functionality for IPARS.

Table 58. Protocol Groups/Documentation Matrix

GROUP	INCLUDES	DOCUMENTATION
Alphascope	Alphascope Uniscope P1024C	
RC		SITA P1024C (Uniscope) ARINC FS Alpha S00602-022-01
TCU/TERM		SITA P1024C (Uniscope) ARINC FS Alpha S00602-027-01
IPARS	P1024B, IBM 1006, SIRCCO	
RC		SITA P1024B PZ 7130.1
TCU/TERM		ARINC FS SE-81005 SITA P1024B PZ 7130.1

1.2 Acronyms

For a list of acronyms, please turn to §A1 ¶2.

Refer to the Alphascope and IPARS glossaries (see §H5-1 and §H5-2, respectively).

2 Applicable Documents

2.1 ARINC Documents

Functional Area Specification for the ARINC Transaction Terminal Service (ATTS) Using the Alphascope Communications Protocol,
ARINC Document Number S00602-022-01, May 4, 1987.

Functional Area Specification for the ARINC Reservation Computer Interface Using the Alphascope Communications Protocol,
ARINC Document Number S00602-027-01, Preliminary Draft, June 22, 1987.

Functional Specification PARS/IPARS Terminal Control Procedures,
ARINC Document Number SE-81005, June 3, 1981, revised November 17, 1981.

2.2 Non-ARINC Documents

Communication Control Procedure For Connecting IPARS Agent Set Control Unit Equipment to a SITA S.P.,
SITA Document No. PZ 7130.1, third edition Rev. 0, November 12, 1973.

Communication Control Procedure Specification,
SITA Document No. 100/LP-SD-001 P1024C, April 2, 1983.

3 Alphascope Detailed Interface Requirements

This section discusses the partition of Alphascope into the various protocol layers. This partitioning is based on the following:

- The function level. Example: checking character parity, which is a low-level function, is done in the lower layers.
- The amount of message framing in place. Example: raw messages, which include the SYN characters and a BCC, are handled at the link layer.

A glossary of Alphascope terminology is included as §H5-1.

3.1 Alphascope Physical Layer

The Alphascope physical layer is composed of an electrical interface and equipment configuration.

3.1.1 Electrical Interfaces

ADNS and customer equipment operate in two-way alternate mode using a full-duplex line. Flow control is done through the CCITT V.24/EIA RS-232C and RS-232D "clear to send" lead at the customer equipment. The data set is able to operate at 2400, 4800, 7200, or 9600 bps.

Each line is four-wire full-duplex, with transmission in bit-serial synchronous mode. The data bits are transmitted in least-to-most-significant order, followed by a parity bit.

3.1.2 Equipment Configurations

The possible equipment configurations are the same for the Alphascope and Uniscope protocols.

To connect customer RCs and TCUs through ADNS without modifications to the RC/TCU software, an RCE and a TCE are needed. The RCE will appear to the customer TCUs as an ordinary RC. Similarly, the customer RC will be connected to an ADNS TCE which, as far as the customer TCU is concerned, is just an ordinary TCU.

No special treatment is necessary for the ADNS RCE or TCE. For example, the TCE may be part of a multidrop connection to the customer RC.

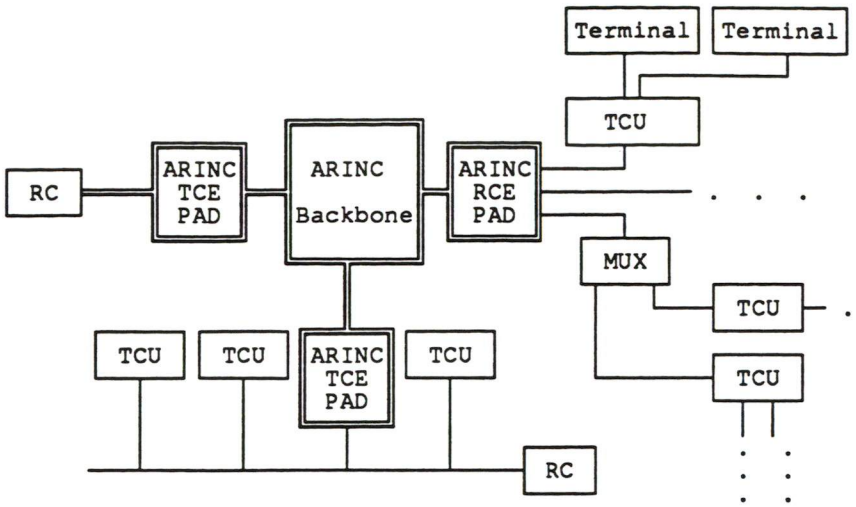
It is possible for the TCE to serve as a TCU concentrator by having a single TCE represent several TCUs that are connected to ADNS remotely. In particular, if the customer equipment consists of several TCUs connected to a single RC, only one RCE and TCE are required for that customer. The RCE will handle the multidrop line just as the customer's RC did, and the several customer TCUs will all be handled by the single TCE. This means that the single TCE will respond to more than one address (RID or RID/SID), but it will always respond as if it were the single TCU being addressed.

The equipment configuration depends on whether the ARINC TCE is on a line with other (customer) TCUs. Both possibilities are illustrated in Figure 19.

3.1.2.1 Point-to-Point Connections: RCE operation of a TCU circuit is independent of the physical configuration of that circuit. It is dependent solely on the number and identities of TCUs connected to the circuit (directly or through multiplexers).

Single Terminal Control Unit

A unique TCU is connected directly to the RCE. The only limitation on the number of terminals connected to the TCU is inherent in the protocol. Uniscope terminals are addressed by SID. Since there are 31 specific SIDS, Uniscope installations can have 31 terminals connected to a TCU at most. On the other hand, Alphascope terminals are addressed by DID. Therefore, an Alphascope TCU can support 94 terminals, since there are 94 specific DIDs.



Double lines are used for ARINC equipment and connections, and single lines are used for customer equipment and connections.

Each RCE has an associated TCE to which it delivers all messages from the RCE's TCUs.

Figure 19. Hypothetical Alphascope-ARINC Connections

Multiplexed Terminal Control Units

The maximum number of TCUs to be connected to the multiplexer is limited to 16, which is the number of TCUs allowed per circuit. The limit of 16 TCUs per circuit holds whether the TCUs are multiplexed or not.

3.1.2.2 Multipoint: A multipoint circuit consists of a circuit with more than one circuit termination to which TCUs are connected. Each termination connection is either a single TCU or a multiplexer connection to several TCUs.

3.1.3 Link Layer

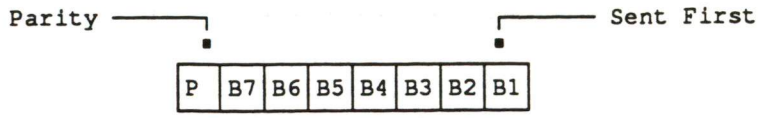
The link layer of Alphascope does the following:

- Detects and reports line transitions
- Checks for proper message framing and validates characters

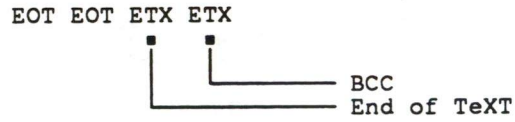
3.1.3.1 Line Transitions: Both the TCE and the RCE detect and report occurrences of line failures and restorals.

3.1.3.2 Message Framing and Character Validation: Messages from the Alphascope group begin with an SOH character preceded by RCE N9 SYNchronization (SYN) characters for output or 2 SYN for input. The value of N9 is configurable. Messages end with an ETX followed by a block check character (BCC). The high-order bit of each character is used for odd-parity.

The character structure follows the ANS X3.16-1966 standard. The bit sequencing follows ANS X3.15-1966, 7 bit ASCII plus character parity bit. The sequencing is from least significant bit (Bit-1) to most significant (Bit-7) with parity appended.



A BCC is appended to all messages transmitted. The BCC is the exclusive-or of the 7 bit ASCII with odd parity. The BCC starts after the SOH and ends with an End of TeXt (ETX). It does not include any interspersed SYN characters. A no-traffic message from an Alphascope has no SOH. Therefore, the complete no-traffic (including the BCC) message is as follows:



The link layer validates an incoming message by checking that the--

- Character parity is correct
- BCC is correct
- (RCE) RID/SID matches the most recent poll
- (TCE) DID is valid for the TCU
- Length of the message is less than or equal to RCE N4, which is the configured maximum message length

To carry out these checks, the TCE recognizes the device connections it is emulating and the RCE knows which TCUs are supported by its corresponding RCs.

A basic element of the RID/SID/DID check is a range check. The range of values is as follows:

RID	hex 20 through 4F
SID	hex 50 through 6F
DID	hex 20 through 7E

Hex 20 is a general RID recognized by all devices on a line. The other 47 RIDs are specific. Hex 50 is a general SID; the other 31 are specific. Hex 70 is a general DID; the other 94 are specific.

Each TCU supported has a unique RID or SID regardless of the number of RCEs. All devices on a line have a unique SID-DID pair that consists of a specific SID and a specific DID.

Each device under a single TCU has the same RID or SID value as the TCU. However, it has a unique SID/DID pair.

3.1.4 Network Layer

The Alphascope protocols contain no Network Layer functionality.

3.1.5 Transport Layer

The Transport Layer of Alphascope manages the exchange of control and data messages between the RC and the TCU. At the RC interface, the TCE manages the exchanges; at the TCU interface, the RCE manages the exchanges.

3.1.5.1 TCU Emulation Functions: TCU emulation consists of control and data message exchanges between the RC interface and the RC.

3.1.5.1.1 Control Message From An RC: The TCU emulation function processes the Poll control message sent by an RC. The format of a poll message is as follows:

RID	SID	DID	control chars	ETX

The "control chars" field defines four types of poll messages as follows:

Status	This poll message solicits any non-text message that a device has to send. Status can be used to monitor print device status after a print command has been issued.
Traffic	This poll message solicits from the device any message a station has to send, including text messages. Traffic will be used as the input message poll request.
Selection	This poll message is used to select a non-CRT display peripheral (printer) and to return its status.
Retransmission	This poll message requests the device to resend its last response. It is used for error recovery.

Except for the retransmission request, an acknowledgment may be included with poll messages. The control characters representing each poll type are given in Table 59.

Table 59. Poll Message Control Characters

Poll Function	ASCII Characters
Status	ENQ
Status with Acknowledgment	ENQ DLE 1
Traffic	none
Traffic with Acknowledgment	DLE 1
Selection	none
Selection with Acknowledgment	DLE 1
Retransmission	DLE NAK

3.1.5.1.2 Data Message From An RC: The TCU emulation function accepts one message format from an RC.

It is as follows:

RID	SID	DID	STX	data	ETX

The data portion of text messages is generated by the RC and may consist of command information or actual text or both.

3.1.5.1.3 Control Message To An RC or TCU: The TCU emulation function processes control messages in response to a poll. A specific RID/SID/DID value is always expected on messages from Alphascope devices. The control messages are Reply Request, No Traffic, and Acknowledgment.

The format of a Reply Request message is as follows:

RID	SID	DID	DLE	?	ETX

This message is used for error recovery. It is sent by a device that is owed an acknowledgment but which did not receive one in the good poll message just received.

The format of a No Traffic message is as follows:

EOT	EOT	ETX

This message indicates that the device has no other appropriate response to send. It is the only response that does not require an acknowledgment.

There are two types of acknowledgment responses that an Alphascope device may generate. The format of the first is as follows:

RID	SID	DID	DLE	1	ETX

This response indicates that the previous message was received without error.

The format of the second type of acknowledgment response is as follows:

RID	SID	DID	DLE	?	ETX

This is the "busy" or wait before transmit (WABT) response. It indicates that the previous message from the system was received without error but that the peripheral operation was not complete when this poll arrived.

3.1.5.1.4 Data Message To An RC: The TCU emulation function accepts messages from terminals (connected to the network via the RCE function) for delivery to the RC. There are four valid text responses from an Alphascope: Text Traffic, Program Attention Key Code Traffic, Peripheral Status Traffic, and Station Status Traffic.

Text Traffic may appear in two formats as follows:

RID	SID	DID	STX	data	ETX

and

RID	SID	DID	STX	data	ETB	ETX

The first format is used for all text messages that are complete or that are completed within a text block of 4096 characters. The second format is used to indicate that more text is to come. It indicates that greater than 4096 characters of data are in the input message.

The Program Attention Key Code Traffic format is as follows:

RID	SID	DID	keycode	ETX

The key code is a single ASCII character the meaning of which is defined by the RC. This type of traffic response will be treated exactly like a complete text traffic response.

The Peripheral Status Traffic format is as follows:

RID	SID	DID	status	ETX

The peripheral status consists of two-character values. The expected status sequences are shown in Table 60.

Table 60. Printer Status Control Sequences

Status Description	ASCII Value
Device Ready	DLE >
Unable to Proceed	DLE <

The Station Status Traffic format is as follows:

RID	SID	DID	station status	ETX

The station status response consists of two-character sequences.

3.1.5.2 RC Emulation Functions: RCE emulation consists of control and data message exchanges between the TCU interface and other TCUs.

3.1.5.2.1 Control Message From A TCU: The RC emulation function accepts messages from a TCU in the forms described in ¶3.1.5.1.3.

3.1.5.2.2 Data Message From A TCU: The RC emulation function accepts messages from a TCU in the forms described in ¶3.1.5.1.4.

3.1.5.2.3 Control Message To A TCU: The RC emulation function delivers messages to an identified TCU in the forms described in ¶3.1.5.1.1.

3.1.5.2.4 Data Message To A TCU: The RC emulation function delivers messages to an identified TCU in the forms described in ¶3.1.5.1.2.

3.1.6 Session Layer

The Alphascope protocol suite contains no Session Layer functionality.

3.1.7 Applications Layer

The Alphascope protocol suite contains no Application Layer functionality.

4 Alphascope Network Management

The following sections address the various network management items used to control the PARS system. All functions will be managed by the ADNS II native NCS for the device providing the PARS/IPARS function. Detailed requirements on the native NCS functions are specified in §C2-2.

4.1 Alphascope Hardware Configuration

This section describes the hardware parameters needed to define the characteristics of the RCE and the TCE.

4.1.1 Reservation Computer Emulator

Parameter	*Description*	*Range*	*Default*
Line mnemonic	A character ID by which the RCE is known to the network.	Alphanumeric	None
Data rate	Baud rate of the line	2400, 4800, 7200, 9600	None

4.1.2 Terminal Control Unit Emulator

Parameter	*Description*	*Range*	*Default*
Line mnemonic	A character ID by which the TCE is known to the network.	Alphanumeric	None
Data rate	Baud rate of the line	2400, 4800, 7200, 9600	None

4.2 Alphascope Protocol Configuration

This section describes the protocol parameters needed to define the characteristics of the RCE and the TCE.

4.2.1 Reservation Computer Emulator

Parameter	*Description*	*Range*	*Default*
Remote Identifier (RID) list	TCU IDs in the range hex '20' through hex '4F'. The RCE uses these values for TCU polling.	hex '20' through hex '4F'	None
Slow poll rate (N1)	The rate, in poll cycles, at which each TCU is polled if it is in the down state.	1 - 255	50
Error responses to DOWN state (N2)	Whenever an abnormal response or no response condition is detected, the TCU error log procedure is executed. If the TCU is up, an error count variable is incremented. If this count equals N2, the TCU is declared down and is polled at the N1 rate.	1 - 7	3
Good responses to UP state (N3)	Whenever a correct message sequence is executed, the TCU correct response log procedure is executed. If the TCU is down, a good count variable is incremented. If this count equals N3, the TCU is declared up and will be polled at the N8 rate.	1 - 7	1
Maximum input characters (N4)	The maximum number of input (from TCU to RC) characters allowed in a block.	1 - 3840	3840
Maximum output characters (N5)	The maximum number of output (from RC to TCU) characters allowed in a block.	1 - 3840	3840
Output message attempts before discarding (N6)	If an error occurs during output of a message to the RC, the message is retransmitted N6 times before being discarded.	1 - 7	3
Consecutive no-response-to-polls before error (N7)	If an error occurs during an input poll cycle, the TCU is polled N7 times before the TCU error log procedure is executed. Polling then continues with the next TCU in the cycle.	1 - 7	2
Normal poll weight (N8)	The rate, in poll cycles, at which the TCU is polled if it is in the up state.	1 - 7	1
Number of synchronization characters (N9)	Used to define the beginning of an output message.	4 - 7	4
Poll pause timer (T1)	After each complete polling cycle, the length of time that the RCE waits before a new polling cycle.	1 - 7	1

Parameter	Description	Range	Default
No-response timeout (T2)	When the T2 timer expires, there is a poll or acknowledgment response error. In either case, a general poll without acknowledgment to the TCU is generated.	1 - 7	2
HEX of RC	The High-level EXit code used in routing input messages to the TCE.	<00><00> - <7E><7E> excluding 16 & 17	None

4.2.2 Terminal Control Unit Emulator

Parameter	Description	Range	Default
Poll pause timer (T1)	This timer is started at the end of each TCU poll cycle. Upon expiration, the poll cycle will resume.	1 - 60	10
Input message length (N1)	The maximum number of characters allowed in input messages.	1 - 3840	3840
Output message length (N2)	The maximum number of characters allowed in output messages.	1 - 3840	3840
Count of sync characters (N3)	Used to define the beginning of an output message.	4 - 7	4
Message delivery attempts (N4)	If N4 consecutive erroneous messages are sent to the RC, an alarm is generated and a no-traffic response is delivered to the RC.	1 - 7	3
Input error threshold (N5)	This counter is the number of erroneous input messages received before generating an alarm. When this number is reached, the input error counter is reset.	1 - 63	10

4.3 Alphascope Alarms

The following alarms are sent to network control to report abnormal conditions and responses to those conditions.

4.3.1 Electrical Interface

The following line error conditions cause alarms to be generated:

- No data set ready
- No data set restoral
- No carrier detected
- No carrier detected restoral
- No clear to send

- No clear to send restoral

4.3.2 Protocol

The following protocol conditions cause alarms to be generated:

- TCU declared down
- TCU restoral
- TCU poll timeout
- TCU poll timeout restoral
- Line declared down
- Line restoral
- Line poll timeout
- Line poll timeout restoral
- Input error threshold count exceeded
- Message discarded due to excessive retransmission attempts
- RID/SID/DID received from RC is invalid
- RID/SID/DID received from TCU is invalid
- Unable to output to device RID/SID/DID
- Unable to output restoral

4.4 Alphascope Commands

The following tactical commands are used to control the processing of messages through the RCEs and the TCEs.

4.4.1 Open/Close

The capability to open and close both lines and stations is required. If a line is closed, Request To Send (RTS) to the modem is kept off, input on the line is ignored, and all output messages to the line are discarded. If a TCU is open, normal processing occurs. If a TCU is closed, it is not polled, all input from it is ignored, and all output messages to the TCU are discarded. A closed status overrides all other line/station statuses (poll/skip, hold, up/down.)

4.4.2 Skip/Poll

The capability to place lines or stations in poll or skip mode is required. If a line is in poll mode, all TCUs are polled at rates dependent on their individual up/down statuses. If a line is in skip mode, no TCUs are polled. If a TCU is in poll mode, it is polled at a rate dependent on its up/down status. If a TCU station is in skip mode, it is not polled.

4.4.3 Hold/Release Hold

The capability to place lines or stations in the hold or release condition is required. If a TCU is on hold, no messages are sent to it. Messages queued for it are discarded. Putting the line on hold is equivalent to putting each of the line's TCUs on hold.

4.5 Alphascope Displays and Reports

The following sections describe the Alphascope displays and reports.

4.5.1 Queues

RCE and TCE message line queue lengths can be displayed on demand.

4.5.2 Statistics

The following TCU statistics are collected and sent to the network control monitor. They can be displayed on demand. The statistics are as follows:

- Timeouts in input mode
- Timeouts in output mode
- Messages in
- Messages out
- Reply requests received

4.5.3 Reports

Reports may be generated that give detailed information on configuration parameters and performance statistics. The configuration parameters reported include the following:

- Line mnemonic
- Station mnemonic
- Timer and counter values
- Baud rate
- DID list

The performance statistics reported include the following:

- Input and output message counts
- Input error counts
- Messages retransmitted

5 Alphascope Performance Requirements

The network equipment throughput delay shall be in accordance with that specified in §C2.

6 IPARS Detailed Interface Requirements

This section discusses the partitioning of IPARS into the various protocol layers. This partitioning is based on the following:

- The function level. Example: checking character parity.
- The amount of message framing in place. Example: raw messages, which include the SYN characters and a BCC, are handled at the link layer.

A glossary of IPARS terminology is included as §H5-2.

6.1 IPARS Physical Layer

The IPARS Physical Layer implements the electrical and equipment configuration components of IPARS.

6.1.1 Electrical Interfaces

Transmission is in bit serial synchronous mode. Character synchronization is established through the use of the two SYNC characters S1 and S2. The idle condition should be continuous mark polarity (i.e., permanent zero-TCU side and permanent one- network side).

All transmissions are carried out by using six-bit characters of the BCD code (no parity). The order of bit transmission is from "B" bit to "1" bit in terms of the BCD nomenclature (see Table 61). The speed of transmission over a circuit may be 1200, 2400, 3600, or 4800 bps. In addition, the network shall support different agent set circuits that operated at different transmission speeds. Each circuit is four-wire, and is operated in full-duplex mode.

The network modem interface complies with the CCITT V.24 and the EIA RS-232C and RS-232D recommendations. The customer equipment, however, has the binary states inverted.

The carrier is permanently ON on the network transmit channel. The network incoming channel carrier is not permanently ON (except for a point-to-point TCU configuration in which it may be permanently ON). The network modem acquires synchronization within 50 milliseconds of Request to Send being raised by any transmitting TCU modem.

The customer equipment receives and generates bit patterns for communication control as shown in Table 62.

The 6-bit BCD character code used by the customer equipment is shown in Table 62.

Table 61. IPARS Communication/Control Characters (Customer)

		BINARY						HEX
		B	A	8	4	2	1	
Communications Control Characters	S1	1	1	1	1	1	1	3F
	S2	1	1	1	1	1	0	3E
	EOMi	0	0	1	1	0	1	0D
	EOMc	0	1	1	1	0	1	1D
	EOMu	1	0	1	1	0	1	2D
	EOMpb	1	1	1	1	0	1	3D
Command Characters	GA	0	0	1	1	1	1	0F
	RS	1	1	1	1	1	0	3E
	NIA	1	1	0	1	1	1	37

Because the binary states are inverted, ADNS recognizes and generates the bit pattern for communication control characters and command characters as shown in Table 62.

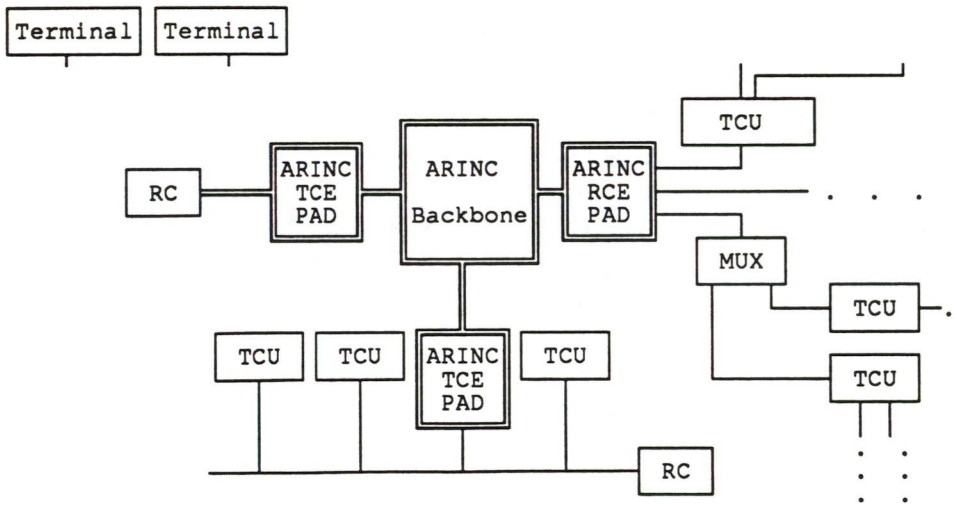
Table 62. IPARS Communication/Control Characters (ADNS)

		BINARY						HEX
		B	A	8	4	2	1	
Communications Control Characters	S1	0	0	0	0	0	0	00
	S2	0	0	0	0	0	1	01
	EOMi	1	1	0	0	1	0	32
	EOMc	1	0	0	0	1	0	22
	EOMu	0	1	0	0	1	0	12
	EOMpb	0	0	0	0	1	0	02
Command Characters	GA	1	1	0	0	0	0	30
	RS	0	0	0	0	0	1	01
	NIA	0	0	1	0	0	0	08

6.1.2 Equipment Configurations

It is possible for the TCE to serve as a TCU concentrator by having a single TCE represent several TCUs that are remotely connected to ADNS. In particular, if the customer equipment consists of several TCUs connected to a single RC, only one RCE and one TCE are required for that customer. The RCE will handle the multidrop line just as the customer's RC did, and the several customer TCUs will all be handled by the single TCE. This means that the single TCE will respond to more than one IA address, but it will always respond as if it were the single TCU being addressed.

The equipment configuration depends on whether the ARINC TCE is on a line with other (customer) TCUs. Both possibilities are illustrated in Figure 20.



Double lines are used for ARINC equipment and connections; single lines are used for customer equipment and connections.

Each RCE has an associated TCE to which it delivers all messages from the RCE's TCUs.

Figure 20. Hypothetical IPARS Customer ARINC Connections

6.1.2.1 Point-to-Point Connections: RCE operation of a TCU circuit is independent of the physical configuration of that circuit. It is dependent solely on the number and identities of TCUs connected to the circuit (directly or through multiplexers).

Single Terminal Control Unit
: A unique TCU is connected directly to the RCE. The only limitation on the number of terminals connected to the TCU is inherent in the protocol.

Multiplexed Terminal Control Units
: The maximum number of TCUs to be connected to the multiplexer is limited to 16, which is the number of TCUs allowed per circuit. The limit of 16 TCUs per circuit holds whether the TCUs are multiplexed or not.

6.1.2.2 Multipoint: A multipoint circuit consists of a circuit with more than one circuit termination to which TCUs are connected. Each termination connection is either a single TCU or a multiplexer connection to several TCUs.

6.1.3 Link Layer

The link layer of IPARS does the following:

- Detects and reports line transitions
- Carries out code translation
- Checks for proper message framing and validates characters
- Conducts the appropriate polling method

6.1.3.1 Line Transition Detection: The TCE detects and reports line failures and restorals. The RCE detects and reports line failures and restorals.

6.1.3.2 Code Translation: The code sets seen at the customer equipment are different, although both are based on BCD codes. ADNS emulators (RCE/TCE) make the required mappings. The code sets supported are shown in Tables 63 and 64. The communication codes are shown in Tables 61 and 62.

6.1.3.3 Message Framing and Character Validation: Messages from the IPARS group begin with two synchronization characters, denoted S1 and S2. The values of S1 and S2 are given in Tables 61 and 62. Beyond this, the format depends on the nature of the message. The character code employed is the six-bit BCD code without parity.

The Cyclic Check Character (CCC) is generated starting with the first bit (B) of the first non-synchronized character and ending with the last bit (1) of the last character of the message (EOM). The CCC is generated by dividing the message (viewed as a polynomial) by the generation polynomial $x^6 + x^5 + 1$.

It is possible for the customer to inhibit the CCC check.

6.1.3.4 Polling Techniques: Two polling techniques are supported: *hub polling* and *direct polling*.

6.1.3.4.1 Hub Polling: The RC initiates polling scans by sending a "GO AHEAD" (GA) message to the most remote TCU. Each interchange (TCU), except the most remote, monitors the input and output circuit and when an interchange recognizes a GA message addressed to it, it sends all complete data messages to the RC and follows with a GA addressed to the next interchange on the circuit. The next interchange behaves in the same manner. The last interchange in the sequence polls the RC, which reinitiates the sequence by polling the remote interchange again.

The format of the Go-Ahead message is as follows:

Table 63. IPARS BCD Code Set (At Customer Equipment)

				B6 B5	0 0	0 1	1 0	1 1
B4	B3	B2	B1	Hex	0	1	2	3
0	0	0	0	0	NUL		▪	S
0	0	0	1	1	1	/	J	A
0	0	1	0	2	2	S	K	B
0	0	1	1	3	3	T	L	C
0	1	0	0	4	4	U	M	D
0	1	0	1	5	5	V	N	E
0	1	1	0	6	6	W	O	F
0	1	1	1	7	7	X	P	G**
1	0	0	0	8	8	Y	Q	H
1	0	0	1	9	9	Z	R	I
1	0	1	0	A	0	-	:	?
1	0	1	1	B	*	▪	<	.
1	1	0	0	C		SPACE	+	%
1	1	0	1	D	EOMi	EOMc	EOMu	EOMpb
1	1	1	0	E	=		)	S2*
1	1	1	1	F	GA	)	(	S1

* May also be command character "RS"
** May also be command character "NIA"

S1	S2	GA	IA	EOMc	CCC

The values for the control characters are given in Tables 61 and 62.

6.1.3.4.2 Direct Polling: In the direct polling technique, all polling is done by the RC. The RC polls each interchange by sending a poll message over the output data circuit. As each interchange is polled, it sends all available output data messages to the RC and follows with a GA message addressed to the RC. The RC then polls the next interchange.

The ARINC equipment can accumulate traffic from many TCUs to be delivered since each TCU has a unique IA.

Single IA Polling — The RC sees the TCE as a single TCU. In this case, a specific IA is given to the TCE and when the TCE is polled, the messages, if any, coming from the TCUs are sent to the RC.

Multiple IA Polling — The RC sees the TCE as several TCUs. In this case, the TCE accumulates the messages coming from the TCEs (via RCEs), keeping them separated by IA. When the RC asks for messages from a TCU, the TCE sends only the data received from the corresponding TCU.

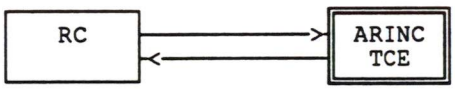
If the RC is using direct polling, the TCE simulates the TCU mechanism and sends all the messages from the polled TCU followed by a GA. If the RC is using hub polling, the TCE sends all or part of the messages for the IA indicated in the POLL command and then sends the GA message. After the end of transmission for this output, the TCE simulates the hub polling by sending messages corresponding to another TCU, then the GA message and so on.

Table 64. IPARS BCD Code Set (At ADNS Equipment)

				B7 B6 B5	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
B4	B3	B2	B1	Hex	0	1	2	3	4	5	6	7
0	0	0	0	0	S1			GA		■		%
0	0	0	1	1	S2*				)	■		SPACE
0	0	1	0	2	EOMpb	EOMu	EOMc	EOMi	(	■	)	+
0	0	1	1	3						■	=	
0	1	0	0	4					G	E	F	D –
0	1	0	1	5					X	V	W	U
0	1	1	0	6					P	N	O	M
0	1	1	1	7					7	5	6	4
1	0	0	0	8	NIA				.	I	?	H
1	0	0	1	9					■	Z	-	Y
1	0	1	0	A					<	R	:	Q
1	0	1	1	B					*	9	0	8
1	1	0	0	C					C	A	B	S
1	1	0	1	D					T	/	S	
1	1	1	0	E					L	J	K	■
1	1	1	1	F					3	1	2	NUL

* May also be command character "RS"

If this is not a multidrop line, the connection is simply point-to-point as follows:



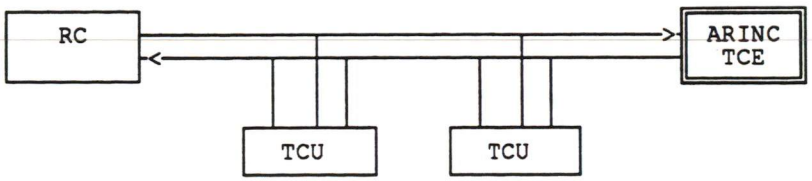
The point-to-point connection will use either a direct poll or hub technique.

If there are other TCUs controlled by the RC, the TCE supports the following three contingencies:

1. The RC uses direct polling.

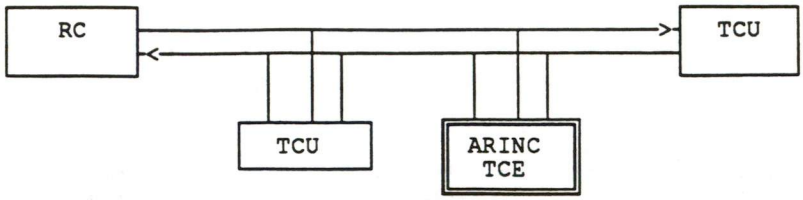
   For this case, the RC does not need to be cognizant of other TCUs on the line. When the TCE is polled, it responds.

2. The RC uses hub polling and the TCE is the most remote TCU on the line.



   The TCE sees polls from the RC. When all data is sent to the RC, the TCE generates a GA to the next TCU (if there are no other TCUs on the line, this GA is directed to the RC).

3. The RC uses hub polling and the TCE is not the most remote TCU on the line.



The TCE monitors the output line so that when a GA from a more remote TCU arrives for the TCE, it is detected and the TCE can respond. To accomplish this, the TCE knows the polling technique employed by the RC. For hub polling, the TCE needs to know the IA address of the adjacent TCU closer to the RC so that ARINC can send the appropriate GA.

6.1.4 Network Layer

The IPARS protocols contain no Network Layer functionality.

6.1.5 Transport Layer

The Transport Layer of IPARS manages the exchange of control and data messages between the RC and the TCU. At the RC interface, the TCE manages the exchanges; at the TCU interface, the RCE manages the exchanges.

6.1.5.1 TCU Emulation Functions: TCU emulation consists of control and data message exchanges between the RC interface and the RC.

6.1.5.1.1 Control Message From An RC: The TCU emulation function processes two control messages sent by an RC: Poll and Reset.

The objective of the Poll message is to solicit traffic from terminals connected to the TCU and identified by the IA. The Poll format is as follows:

GA	IA	EOMc

The objective of the Reset message is to force the interchange and all terminals to perform a reset function. This function includes clearing all messages stored in the interchange, clearing the screen, and placing the cursor in the top left-most position on the screen. The Reset format is as follows:

IA	RS	EOMc

6.1.5.1.2 Data Message From An RC: The TCU emulation function accepts two data message types sent by an RC: a Normal message and a Resend Indicator message.

A Normal message has the following format:

IA	TA	CMD	LA	TEXT	EOM

A Resend Indicator message has the following format:

IA	TA	C1	C2	EOMc

6.1.5.1.3 Control Message To An RC or TCU: The TCU emulation function processes one control message for an RC or a TCU: the Go Ahead message.

The Go Ahead message has the following format:

GA	NIA

The Go Ahead message is received from an adjacent TCU in the hub polling configuration. The Go Ahead message is transmitted by the TCE after one or several input data messages to indicate the end of an input sequence.

6.1.5.1.4 Data Message To An RC: The TCU emulation function accepts messages from terminals (which are connected to the network via the RCE function) for delivery to the RC. IPARS output data messages consist of the following elements:

IA	TA	TEXT	EOM

6.1.5.2 RC Emulation Functions: RCE emulation consists of control and data message exchanges between the TCU interface and other TCUs.

6.1.5.2.1 Control Message From A TCU: The RC emulation function accepts messages from a TCU in the forms described in ¶6.1.5.1.3.

6.1.5.2.2 Data Message From A TCU: The RC emulation function accepts messages from a TCU in the forms described in ¶6.1.5.1.4.

6.1.5.2.3 Control Message To A TCU: The RC emulation function delivers messages to an identified TCU in the forms described in ¶6.1.5.1.1.

6.1.5.2.4 Data Message To A TCU: The RC emulation function delivers messages to an identified TCU in the forms described in ¶6.1.5.1.2.

6.1.6 Session Layer

The IPARS protocol suite contains no Session Layer functionality.

6.1.7 Applications Layer

The IPARS protocol suite contains no Application Layer functionality.

7 IPARS Network Management

The following sections address the various network management items used to control the PARS system. All functions will be managed by the ADNS II native NCS for the PARS/IPARS device. Detailed requirements on the native NCS functions are specified in §C2-2.

7.1 IPARS Hardware Configuration

This section describes the hardware parameters needed to define the characteristics of the RCE and the TCE.

7.1.1 Reservation Computer Emulator

Parameter	*Description*	*Range*	*Default*
Line mnemonic	A character ID by which the RCE is known to the network.	Alphanumeric	None

Parameter	Description	Range	Default
Data rate	Baud rate of the line	2400, 4800, 7800, 9600	None
Incoming channel carrier status	Modem carrier	On, Off	On

7.1.2 Terminal Control Unit Emulator

Parameter	Description	Range	Default
Line mnemonic	A character ID by which the TCE line is known to the network.	Alphanumeric	None
Data rate	Baud rate of the line	2400, 4800, 7200, 9600	None
New sync positive potential (S1)	The TCE applies a positive potential to the new SYNC lead of the monitor modem after reception of the last bit of IA character of any GA command on the monitor.	0.1ms - 4ms	2ms
RTS on after receipt of GA (S2)	If the GA command is addressed to the TCE, the TCE raises RTS ON after a time S2 from a new SYNC request.	22ms <= S2 (must be a multiple of 22 ms.)	22ms
Time to maintain positive potential to new sync (S3)	The TCE maintains positive potential to the new SYNC lead for S3 ms.	1ms - 10ms	5ms

7.2 IPARS Protocol Configuration

This section describes the protocol parameters needed to define the characteristics of the RCE and the TCE.

7.2.1 Reservation Computer Emulator

Parameter	Description	Range	Default
Resend message option	Yes or no. If yes is selected, input data correction is allowed. The RCE, upon reception of a data message with an incorrect CCC, discards the input message and sends a resend indicator message to request repetition.	N, Y	Y
IA list	IA values.	hex '20' through hex '4F'	None
TCU declared down (N1)	If the RCE receives N1 successive abnormal responses from a TCU, the TCU is declared DOWN.	1 - 30	3

Parameter	Description	Range	Default
TCU declared up (N2)	If the RCE receives N2 successive expected responses from the TCU, the TCU is declared UP.	1 - 30	3
Number of poll cycles between polling of a downed TCU (N3)	The RCE will poll a TCU that is down once every N3 poll cycles.	1 - 50	5
Maximum message length from TCU (N4)	The maximum input message length allowed from a TCU.	1 - 3840	3840
TCU timeout counter (N5)	After N5 consecutive timeouts, an alarm will be generated.	1 - 50	5
Data CCC error counter (N6)	Number of consecutive CCC errors encountered on input messages.	1 - 50	
Timeout delay between poll and response (T1)	This timer, defined in seconds, starts after the RCE transmits the last character (CCC) of a control message. A time-out occurs if the RCE has not detected an input sequence before T1 expires.	0.1s - 1s	.5s
Input segment timer (T2)	This timer, defined in seconds, starts after the RCE receives the first character of an input sequence. A time-out occurs if the RCE has not detected a Go Ahead message before T2 expires.	1s - 10s	2s
Poll pause timer (T3)	After each complete polling cycle, the length of time that the RCE waits before a new polling cycle.	0 - 32	0

7.2.2 Terminal Control Unit Emulator

Parameter	Description	Range	Default
Line mnemonic	6-character ID by which the RC is known to ADNS.	Alphanumeric	None
Type of polling mode	Single IA or Multiple IA -- In the single IA polling mode, all messages collected from the TCUs are sent to the RC when the TCE is polled. In the multiple IA polling mode, the RC requests messages from one TCU and the TCE sends only the messages from that TCU.	S, M	M

Parameter	*Description*	*Range*	*Default*
Type of simulation	If the multiple IA mode is chosen, enter hub or direct polling. In direct polling, the RC completes a polling sequence with each TCU before proceeding to the next TCU.	D, H	D
Go Ahead (GA) response with idle character	Yes or no. If yes, output messages (GA) are in the format GA NIA IDL. Otherwise, output messages will be in the format GA NIA.	N, Y	N
Initial next interchange address (NIA)	The interchange address (IA) sent in the GA. If single IA polling is used, or if multiple IA polling is used with the direct polling technique, only one NIA value is maintained by the RCE. If multiple IA polling is used with the hub polling technique, the RCE maintains two NIA addresses in memory for each IA in the IA list: the initial NIA, NIAi, and the NIA that is modified if the change NIA command is sent, NIAc.	hex '20' through hex '4F'	None
Check of CCC inhibited	Yes or no. If yes, the CCC character is not checked by the receiving processor and the transmission error protection is not used.	N, Y	N
IA of the TCE if the single IA polling mode is chosen	When the single IA polling technique is used, this is the IA of the TCE that the RC will poll to retrieve TCU messages.	hex '20' through hex '4F'	None
IA list maximum length (N7)	47 or 48, depending on the polling mode (single IA or multiple IA).	47, 48	48
Number of IAs in the IA list (N8)	Number of IAs in the IA list	1 - N7	None
IA list	IA values in the range hex '20' through hex '4F'.	hex '20' through hex '4F'	None
Maximum number of messages sent by the TCE to the RC between 2 poll messages (N2)	This is the maximum number of consecutive messages sent to the RC during any one polling cycle.	1 - 100	10
Number of consecutive poll commands correctly received to declare the output circuit to the RC available (N3)	When the TCE receives N3 consecutive poll commands, the circuit is available for output to the RC.	3 - 15	3

Parameter	Description	Range	Default
Number of consecutive T3 timeouts to declare the output circuit to the RC unavailable (N4)	Each time the polling timeout timer expires, the polling timeout counter is increased by one. When this value reaches N4, the TCE is declared not polled.	1 - 5	3
Maximum input/output message length (N5)	The maximum number of characters allowed in input and output messages for a given IA.	1 - 3840	3840
Minimum number of segments incorrectly received among N9 received segments (N6)	If more than N6 segments are received incorrectly, after receiving N9 total segments and with the "Check of CCC inhibited" off, the TCE generates an alarm stating the number of incorrectly received segments.	10 - N9	10
Number of received segments involving the checkpoint (N9)	If the "Check of CCC inhibited" option is off, the TCE maintains two counters. The first contains the number of incorrectly received data segments, and the second contains the total number of received data segments, starting with the reception of the first incorrectly received data segment. When the second counter reaches the value N9, the TCE generates an alarm stating the value of the first counter if this value is >= N6. Both counters are then reset.	10 - 50	10
Maximum number of messages in each output queue on a per IA basis (N10)	In multiple IA polling mode, messages received from the TCUs are put into unique queues corresponding to the TCU's IA. A maximum of N10 messages are kept on the TCU's queue.	1 - 30	30
Polling timeout timer (T3)	This time is set after transmission of a GA or after the timer expires. It is reset on reception of a poll command. If the polling timeout timer expires, the polling timeout counter is incremented by one, except when the TCE is in the initialization state. When the polling timeout timer reaches the value N4, the TCE is declared not polled.	1 - 10	4
Time delay between successive GA responses in multiple IA polling/hub technique (T4)	Time to wait, after sending the last bit of a GA response, before sending the next GA response.	1 - 32	2

Parameter	Description	Range	Default
Segmented message timer (T5)	Upon receipt of a message segment, the segmented message timer is started. When the timer expires, the segmented message is considered complete.	1 - 10	4

7.3 IPARS Alarms

The following alarms are sent to network control to report abnormal conditions and responses to those conditions.

7.3.1 Electrical Interface

The following line error conditions cause alarms to be generated:

- No data set ready
- No data set restoral
- No carrier detected
- No carrier detected restoral
- No clear to send
- No clear to send restoral

7.3.2 Protocol

The following protocol conditions cause alarms to be generated:

- TCE isolated from ADNS
- TCE isolated restoral
- TCE not polled
- TCE polled
- Segment error; generated if N9 consecutive data segments are received

7.4 IPARS Commands

The following tactical commands are used to control the processing of messages through the RCEs and the TCEs.

7.4.1 Open/Close

The capability to open and close both lines and stations is required. If a line is closed, RTS to the modem is kept off, input on the line is ignored, and all output messages to the line are discarded. If a TCU is open, normal processing occurs. If a TCU is closed, it is not polled, all input from it is ignored, and all output messages to the TCU are discarded. A closed status overrides all other line/station statuses (poll/skip, hold, up/down.)

7.4.2 Skip/Poll

The capability to place lines or stations in poll or skip mode is required. If a line is in poll mode, all TCUs are polled at rates dependent on their individual up/down statuses. If a line is in skip mode, no TCUs are polled. If a TCU is in poll mode, it is polled at a rate dependent on its up/down status. If a TCU station is in skip mode, it is not polled.

7.4.3 Hold/Release Hold

The capability to place lines or stations in a hold or release condition is required. If a TCU is on hold, no messages are sent to it. Messages queued for it are discarded. Putting the line on hold is equivalent to putting each of the line's TCUs on hold.

7.5 IPARS Displays and Reports

The following sections describe the IPARS displays and reports.

7.5.1 Queues

All RCE and TCE message line queue lengths can be displayed on demand.

7.5.2 Statistics

The following TCU statistics are collected and sent to the network control monitor. They can be displayed on demand. Statistics are collected on the following:

- Circuit availability
- Transit time
- Response time
- CCC errors for each RC circuit
- Timeouts
- Number of data messages sent to the RC from the TCE
- Number of data messages received at the TCE from the RC
- Number of data segments sent to the RC from the TCE
- Number of data segments received at the TCE from the RC
- Number of data characters sent to the RC from the TCE
- Number of data characters received at the TCE from the RC

7.5.3 Reports

Reports may be generated that provide detailed information on configuration parameters and performance statistics. The configuration parameters reported include the following:

- Line mnemonic
- Station mnemonic
- Timer and counter values
- Baud rate

- DID list

The performance statistics reported include the following:

- Input and output message counts
- Input error counts
- Messages retransmitted

8 IPARS Performance Requirements

The network equipment throughput delay shall be in accordance with that specified in §C2.

SECTION H5-1
ALPHASCOPE TRANSPORT LAYER GLOSSARY

CHAPTER	
DID	Device IDentification
DLE NAK	Retransmission
DLE 1	Traffic with acknowledgment or selection with acknowledgement
DLE ?	Wait Before Transmit (WABT) response to poll
ENQ	Status ENQuiry
ENQ DLE 1	Status ENQuiry with acknowledgment (DLE 1)
EOT EOT	No traffic response to poll
ETB	End of Text Block: indicates that greater than 4096 characters are in a message.
ETX	End of TeXt
RID	Remote IDentification
SID	Station IDentification
STX	Start of TeXt

SECTION H5-2
IPARS TRANSPORT LAYER GLOSSARY

C1	Character 1: Character code denoting the message command.
C2	Character 2: Used in conjunction with C1 character code denoting the message command.
CMD	CoMmanD: Character code denoting the type of write command: either "Write Line Address" or "Erase/Write Line Address." • *Write Line Address* indicates that the output message must be displayed on the line specified by the Line Address character (LA) following this command. • *Erase/Write Line Address* operates in the same way as the Write Line Address, except that the addressed line and all higher numbered lines are erased when the output data message is displayed.
EOM	End Of Message: End of Message
EOMc	End Of Message: End of Message Complete
GA	Go Ahead: Character code denoting the type of control message.
IA	Interchange Address: Address of the TCU to which the output control message is sent.
LA	Line Address: Control character indicating where the message must be displayed. The control character may be a no-op, a new line character, or a specific line address.
NIA	Next Interchange Address
TA	Terminal Address: Address of device (i.e., screen or printer) to which the output message is sent.
TEXT	TEXT: May contain control characters and characters to be displayed or printed.