Communications System Architecture Development
For
Air Traffic Management & Aviation Weather Information Dissemination

Research Task Order 24

Subtask 4.2, Identify of User Needs
Subtask 4.3, Communications System Functional Requirements
Subtask 4.4, Communications System Engineering Requirements

(Tasks 1, 2, 3)

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1 Introduction

The first three subtasks of RTO 24 are concerned with the collection and cataloging of user needs, functional system requirements, and engineering system requirements. The objective of Task 1 is to develop a comprehensive list of user needs derived from industry and government documentation. Task 2 is concerned with the creation of a comprehensive list of functional system requirements while Task 3 is focused on the generation of a complete list of system engineering requirements.

A relational database was created to serve as a repository for Tasks 1, 2 and 3 data. Each record in the list of requirements generated for these tasks has associated with it, a source document (shown in Attachment 3) as well as one or more functional capabilities (shown in Attachment 1) allowing for comparison and traceability between the user needs, functional requirements, and system requirements. Without the use of the functional capability and the source document, the ability to establish any sort of traceablity would be lost as the two types of requirements and the user needs are not directly related to each other. Instead, they are applicable to general activities in the NAS. These activities are captured in the list of functional requirements and, as a result, provide a means of comparison.

The lists resulting from the three tasks provide a large amount of information, but, as so many records exist for each of the three tasks, a reader would find it difficult to find specific information and, therefore, derive any real value from the work performed. To manage the output of the first three tasks and to create an index of records from which a user may quickly access any information necessary, the lists were incorporated into a relational database tool. This allows a user to create queries for specific information, and it creates a framework for any additional information that may be included in the future. The Task 1,2, and 3 database also has in it user forms which allow a user with no working knowledge of databases, to access specific information. From these forms, a user may query any number of fields and will receive information in an easy to understand format.

This document explains the outputs of Tasks 1, 2, and 3 in the context of the database displays. Field definitions are given, and user display screens are shown to ensure the reader is given the necessary information in context.

2 Identification of User Needs

The first subtask of TO 24 involved the collection of user needs from industry accepted documentation pertaining to ATM and AWIN data communications in the present, 2007, and 2015 state.

2.1 Task 1 Approach

The user needs presented for delivery were pulled from the source documentation required by NASA as well as from a collection of other document (shown in the appendices) to ensure adequate coverage of the diverse viewpoints of aviation's participants and leaders. The needs were then put into the database and were categorized by a number of parameters which allow for user defined sorts. Of particular importance are the functional capability, the ATM, and the AWIN parameters. The functional capability assignment of a user need allows it to be compared to the system engineering requirements, specific message characteristics, and link analyses carried out in later tasks, thereby allowing for a unified effort over the course of the entire task order. The ATM and AWIN fields provide the ability to sort the needs into those that are concerned with weather, air traffic management, or both. When using these three parameters as well as the others provided and discussed in more depth below, the database provides the ability to quickly reference multiple data sources for user needs relating to specific criteria.

2.2 User Needs Captured in the Database

The user needs view screen is shown below with field definitions following.

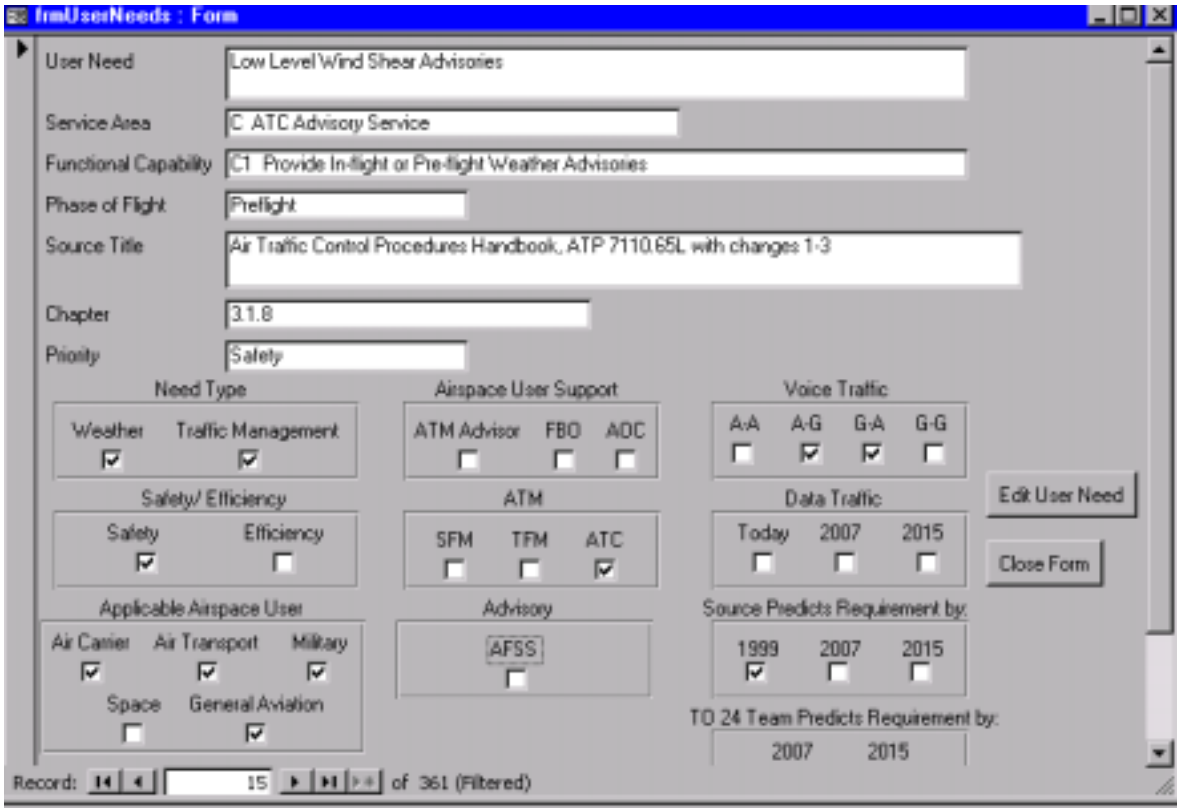

Figure 2.2-1. User Needs

User Need: This field shows the user need which all other fields on the form support.

Service Area: This field refers to the NAS services as defined in the NAS Architecture documentation. Attachment 2 has a complete description of each service.

Functional Capability: This field shows which functional capabilities affect the user need. The classification of needs allows their comparison with the outputs of the other TO24 Subtasks. The complete list of functional capabilities is shown in Attachment 1.

Phase of Flight: The phase of flight associated with the need. The options are preflight, arrival/ departure, enroute, and oceanic.

Source Title: Field displays the source document from which the user need was pulled. When documents are duplicative and contain the same user needs, the need is recorded only once with the document of higher precedence going into the source field. The other documents containing references to the user need, however, are mentioned in the "Comments" field.

Chapter: Field shows where in the source document the user need was found.

Priority: The relative level of importance assigned to the user need. Seven options exist for this field. From the highest to lowest priority they are: safety, regulatory, essential, important, relative, beneficial, and value added. Priority assignments for user needs other than those categorized as AWIN-related have been made subjectively. AWIN-related user needs were prioritized using techniques developed by MITRE, reviewed by industry, and then adopted by the FAA.

Need Type: This group allows the user to see whether the need is related to AWIN, ATM, or a combination of both activities.

Safety/ Efficiency: The need is shown here to be related to safety, efficiency, or both.

Applicable Airspace User: The user type to which the need applies. The type of user is defined primarily through the Federal Air Regulations under which the operations are conducted: general flight rules (FAR 91), certificated scheduled air carrier operations (FAR 121); certificated non-scheduled commercial operations (FAR 135), military operations, and space operations.

During the document review, it was found that specific user needs for military users were not included. Therefore, military requirements were assumed to be similar to those of other users.

Airspace User Support: Indicates which user support services are concerned with the need.

ATM: Fields show which ATM providers are affected by the specified user need. Strategic Flow Management (SFM), Tactical Traffic Management (TFM), and Air Traffic Control (ATCT, TRACON, ARTCC) are the possibilities.

Advisory: Determines whether the need pertains to services provided by Flight Service Station Specialists or others supporting the ATC function in an advisory capacity only.

Voice Traffic: These boxes show the flow of voice traffic that is affected by the need.

Data Traffic: These boxes indicate the year in which the source document says the necessary information flows concerning the need will occur via data instead of via voice.

Source Predicts Requirement by: A check in one of these fields indicates the source document says that the capabilities to service the user need specified will be available by the given year. When a document references data links, particularly those related to weather, the values for these fields was adjusted knowing that the FAA's data link program schedule has slipped. So, if the document were to say that a certain capability would be available by 2007, yet given FAA delays, such is known to be false. The 2015 field will be populated, and 2007 will be left blank.

TO 24 Team Predicts Requirement by: A check in one of these fields indicates that while the source document does not necessarily say that the capability to service the need will be available, the TO 24 team does feel the capability will be available by the given year.

Comments: This field contains additional information.

The electronic copy of the Task 1, 2, 3 Database is submitted as Attachment 5.

3 Communications System Functional Requirements

Task 2 identifies functional communications requirements associated with the user need identified in Task 1 and provides traceability back to them by way of the common mapping to functional capabilities. The task is divided into two separate subtasks which help to define "The Message" portion on the chart below showing the interactions between the three initial tasks of TO 24. The first subtask (Subtask 2.1) captures the characteristic data of a set of messages which are commonly used in aviation. The second (Subtask 2.2) involves the capture of message independent requirements relating to overall function, procedures, human factors, transition and security.

It is believed that the outputs from Task 2, used in conjunction with those of Tasks 1 and 3 provide all of the top-level requirements necessary for the development of the communications network architecture presented in later tasks.

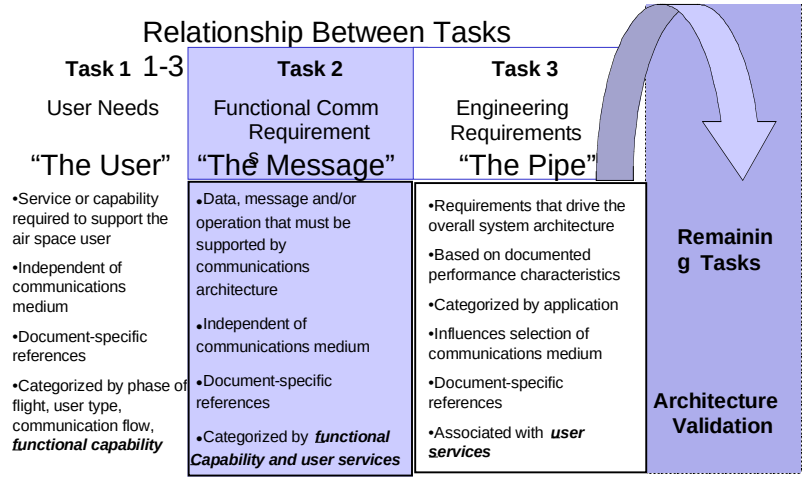

Figure 3-1. Task Relationships (Task 2)

3.1 Subtask 2.1: Message Characteristics

3.1.1 Subtask 2.1 Approach

This subtask serves as a collection point for all message requirements that are medium independent. These requirements bridge the gap between the user needs previously identified in Task 1 and the detailed system engineering requirements found in both Task 3 and discussed later in this document. The connection to the Task 1 output is through the functional capabilities providing a many-to-many relationship where all messages pertaining to a certain functional capability are related to all user needs pertaining to a functional capability. The link to the Task 3 output, however, is much tighter as each message is related to an engineering requirement in a one-to-one relationship. This means that each message can be shown in the database with not only its own characteristic data, but also with an associated system engineering requirement. This is better illustrated within the context of the database in the next section.

The reader of this document must remember that the primary focus of TO 24 is to establish traceability of functional requirements, specifically those pertaining to message traffic, back to user needs by way of the functional capabilities. Validation of these requirements is considered outside the scope of this task. However, validation by the user community is strongly recommended.

3.1.2 Message Characteristics in the Database

The Message Characteristics/ System Engineering Requirements view screen shot is shown below. Descriptions of those fields pertaining only to message characteristics (Subtask 1.1.1) and those fields pertaining to both message characteristics and to system engineering requirements are discussed in this section. Fields concerned only with engineering requirements are discussed in later sections.

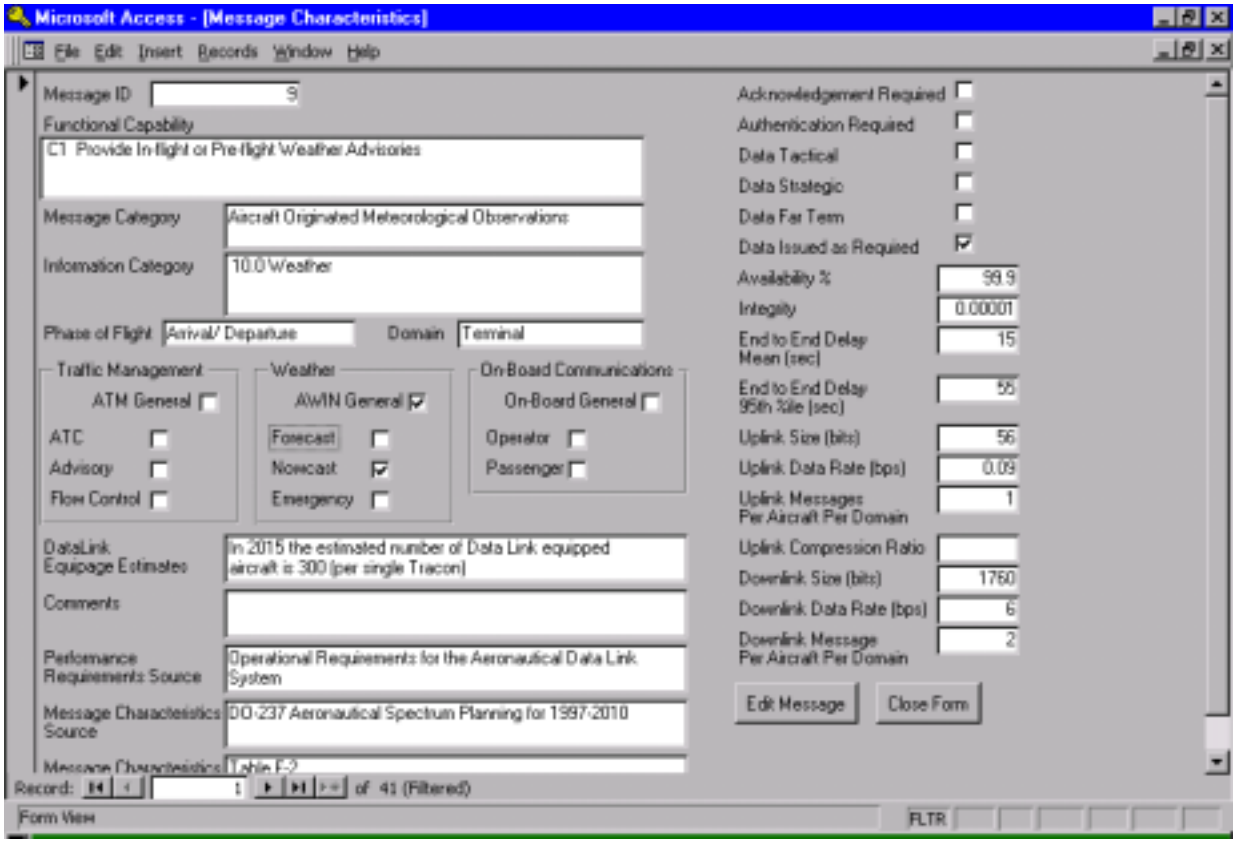

Figure 3.1-1. Message Characteristics Screen

Service Area: This field refers to the NAS services as defined in the NAS Architecture documentation. Attachment 2 has a complete description of each service.

Functional Capability: Functional capabilities, derived from the User Services definition used throughout the rest of TO-24, allow for a more granular classification of activities accomplished in the NAS. A complete list of functional capabilities and their associated user services can be found in Attachment 1.

Message Categories: Estimates of message traffic based on basic application areas as defined in the FAA Operational Requirements for the Aeronautical Datalink System source document. Note that in order to capture the projected weather products expected to be delivered under broadcast FIS, weather messages have been defined at a more detailed level.

Information Exchange Categories: Refers to eleven categories of traffic derived from NAS 4.0 and defined as part of TO-19 (AATT). An example of an information exchange is Category 1,

Aeronautical, which consists of PIREPS, NOTAMS, and charts. A complete list of information exchange categories can be found in Attachment 5.

Phase of Flight: Breakdown of NAS operational domains into the following segments: preflight, arrival/departure, en route domestic and en route oceanic.

Domain: Breakdown of flight profiles into the following segments: Airport, Terminal, En route, and En route Oceanic.

Traffic Management: Air Traffic Management (ATM) refers to all aspects of communication and control of aircraft in the NAS. It can be divided into specific Air Traffic Control (ATC), Advisory, and Flow control communications categories.

- ATC – control of aircraft movements though controlled airspace including terminal, enroute, and oceanic routes
- Advisory – general information provided by the air traffic control function to aircraft operating within a specific airspace
- Flow Control – predictive (strategic) and real-time (tactical) actions on the part of air traffic and the NAS users to facilitate smooth and even traffic flow through the NAS
- ATM General – message conforms to any one or more of the three ATM categories listed above.

Weather: Aeronautical Weather (AWIN) refers to all aspects of communication designed to provide NAS users with atmospheric data along their intended flight path. Data communication can be characterized temporally as forecast, current conditions (now-cast), or imminent danger to the aircraft (emergency).

- Forecast – generally refers to conditions predicted along the intended aircraft route
- Now-cast – current conditions being encountered immediately ahead of the aircraft or pilot reports of conditions being encountered at the time of transmission
- Emergency – dangerous conditions such as severe convective activity including severe lightning, icing, and windshear
- AWIN General – message conforms to any one or more of the three AWIN catogories listed above

Onboard Communication: Non-control information that relates to airline operations, administrative concerns, passenger communications, and passenger entertainment (e.g., broadcast TV, internet, etc.)

Data Link Equipage Estimates: Information provided by the defining source as to the predicted growth in a particular type of message traffic

Source of Message Characteristics: Industry or regulatory source document. In compiling the message characteristic data, only a subset of source documents was used as primary sources. The remainder of the source documents either did not address specific message requirements or restated the message characteristic data from the primary sources.

Acknowledgement Required: Indicator that either the current definition of the message or predicted use of the message will require active acknowledgement on the part of the message's recipient. Note that automatic acknowledgement inherent in the underlying transmission protocol are not included here.

Authentication Required: Indicator that some form of active authentication is to be employed in conjunction with a particular message type.

Data: The data fields provide a measure of the timeliness of the message. There is an indirect relationship between this field and both phase of flight and domain since the aircraft spends limited time in each phase of flight or domain.

- Tactical (0-15 minutes) – Messages needed for near-term decision making
- Strategic (15-60 minutes) – Messages, often predictive in nature, for strategic decision-making
- Far Term (60+ minutes) – Messages, often advisory in nature, relating to conditions or actions still quite far away
- Issue as Required – Data that is only sent when required

Average Uplink Message Size (bits): Message size (excluding error correction and protocol overhead).

Uplink Data Rate per Aircraft (bps): Bits per second measure of transmit time (excluding error correction and protocol overhead).

Uplink Message Frequency per Aircraft: Number of messages sent to an aircraft during its flight in a specific domain, i.e., number of messages uplinked in the terminal domain (terminal domain flight length is typically ten minutes).

Uplink Compression Ratio: The ratio of the uncompressed uplink message to the one that is actually sent. A value of 10 in this field would indicate a message is compressed to one tenth of its original size before being passed to the aircraft.

Average Downlink Message Size (bits): Message size (excluding error correction and protocol overhead).

Downlink Data Rate per Aircraft (bps): Bits per second measure of transmit time (excluding error correction and protocol overhead).

Downlink Message Frequency per Aircraft: Number of messages expected from each aircraft during its flight in a specific domain, i.e., number of messages downlinked in the terminal domain (terminal domain flight length is typically ten minutes).

3.2 Subtask 2.2, Functional Requirements

The second subtask (2.2) contains message independent functional communications requirements. These “shall” statements were found in industry-related documentation and address the current, planned and potential services projected for the 2007 to 2015 timeframe. As in Subtask 2.1, the data is traced back to functional capabilities to provide the traceability throughout TO 24. The view screen of for Subtask 2.2 data is shown below along with field definitions.

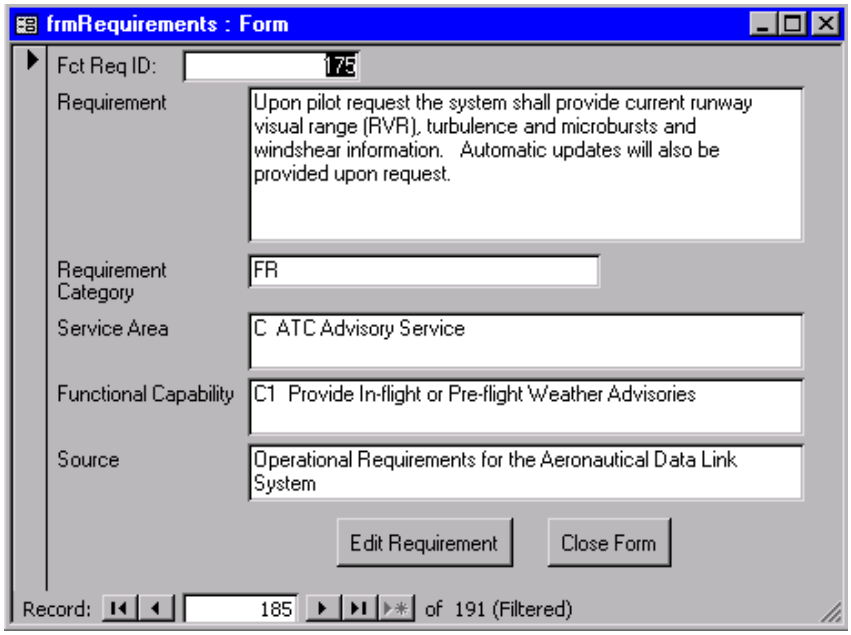

Figure 3.2-1. Requirements View Screen

FctReq ID: This field is used only for database management and has no bearing on the requirements presented within.

Requirement –Communications Requirement, specific "shall" statement

Requirement Category: The following classifications were used to capture these requirements:

FR:	Functional requirements capture requirements relating to the datalink system.
HFR:	Human factor requirements capture requirements that describe and specify the man-machine interface.
OPR:	Operational and procedural requirements capture requirements that govern the air-ground datalink.
SECR:	Security requirements are those requirements relating to the protection of data being communicated from malicious attack or from being divulged to unknown or unauthorized parties.
TRANSR:	Transition requirements are those requirements imposed due to the need to inter-operate seamlessly during the migration from existing communication infrastructure to a new infrastructure architecture.
COMR:	Communications requirements capture generic requirements relating to the communication media or mechanism to be employed across a particular link.
SLR:	System level requirements capture requirements that affect all communications regardless of transmission media or application including availability, integrity, reliability, and capacity requirements.

Service Area: This field refers to the NAS services as defined in the NAS Architecture documentation. Attachment 1 has a complete description of each service.

Functional Capability: Functional capabilities, derived from the User Services definition used throughout the rest of TO-24, allow for a more granular classification of activities accomplished

in today's air traffic environment. A complete list of functional capabilities and their associated user services can be found the attachments.

Source Document - Industry or regulatory source document from which the requirement was derived.

The electronic copy of the Task 1, 2, 3 Database is submitted as Attachment 5.

4 Communications System Engineering Requirements

Task 3 builds upon the work done in Tasks 1, 2, and 4. It serves as the collection point for "hard" system engineering requirements independent of the transmission medium and provides traceability back to user needs by way of a common mapping to functional capabilities. Its relationship with the two previous Tasks is shown in the following figure.

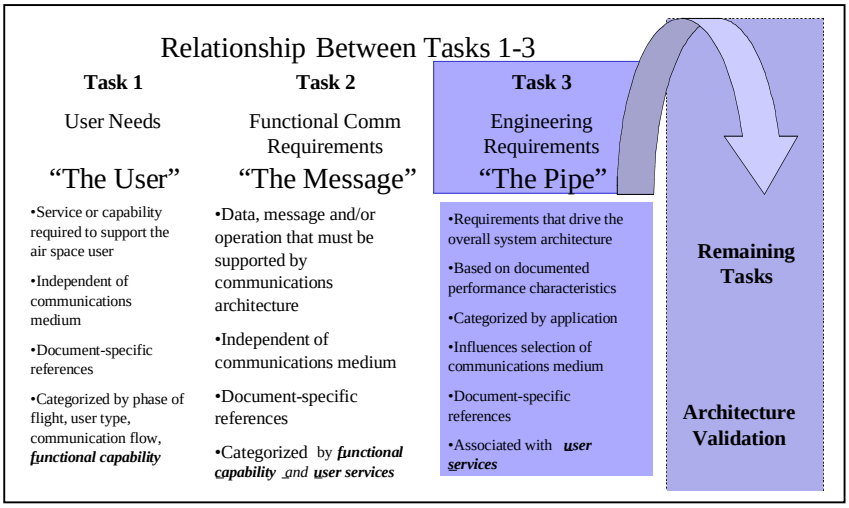

Figure 3.2-1. Task Relationships (Task 3)

Task 3 is divided into two primary subtasks. The first (Subtask 3.1) maps each potential communications link developed in Task 4 to a user service and functional capability. This information is contained in the "Link Analysis" in the database. The second (Subtask 3.2) involves the capture of system independent requirements concerning availability, reliability, and integrity as they relate to the message categories identified in Task 2. The Subtask 3.2 outputs are shown in the database under "Requirements".

It is believed that the outputs from Task 3, used in conjunction with those of Tasks 1 and 2 provide all of the system engineering requirements necessary for the development of the preferred architecture.

4.1 Sub-task 3.1: Development of Link Matrix

4.1.1 Subtask 3.1 Approach

As will be shown in further depth in Task 4, the basic Candidate System Architecture (CSA) Concept identifies six users/consumers of information. This is diagrammed in the following figure.

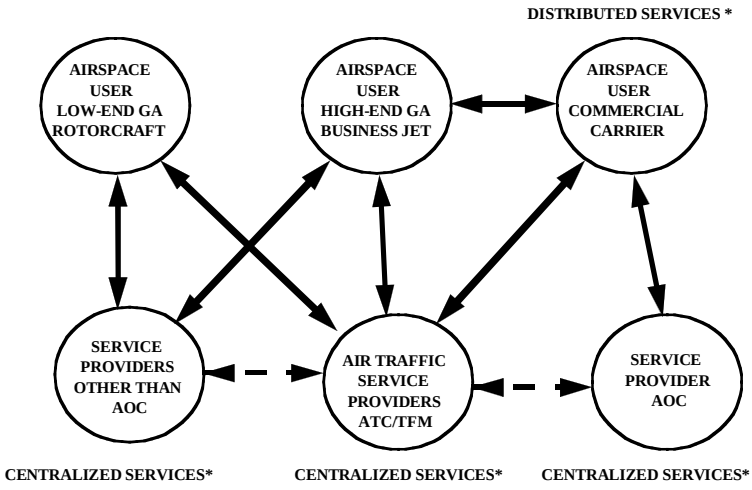

Figure 4.1-1. Basic CSA

At the Spring 1999 Quarterly review with NASA, it was agreed to modify this structure by using the FAR designations governing aircraft categories as the discriminator between airborne user classes. The new definition is as follows:

- Class 1: General Aviation Users required to follow Part 91 only.
- Class 2: Air Taxi and Commercial Users required to follow Parts 91 and 135.
- Class 3: Air Carrier Users required to follow Parts 91 and 121.

Adopting these definitions produces the following updated figure.

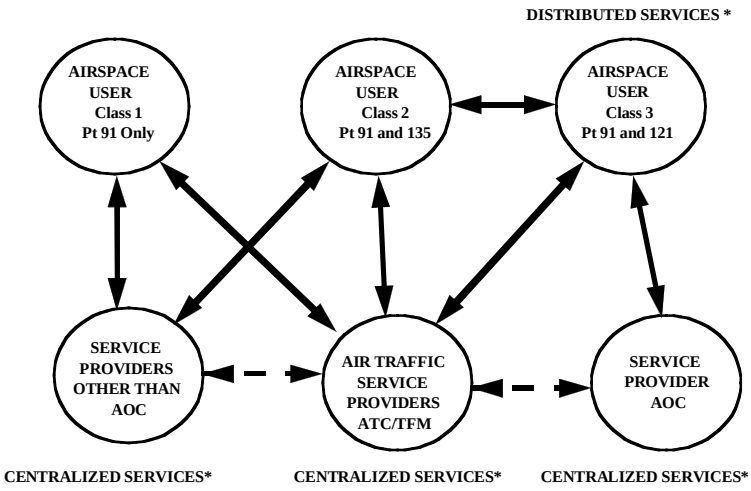

Figure 4.1-2. Basic CSA with FAR designations

Close examination of this figure indicates that there are thirty-six possible links in the system (includes the case where users are speaking with other users in the same class). These thirty-six links are as follows:

1. Class 1 to Class 1
2. Class 1 to Class 2
3. Class 1 to Class 3
4. Class 1 to Non-AOC Service Provider
5. Class 1 to ATS
6. Class 1 to AOC
7. Class 2 to Class 1
8. Class 2 to Class 2
9. Class 2 to Class 3
10. Class 2 to Non-AOC Service Provider
11. Class 2 to ATS
12. Class 2 to AOC
13. Class 3 to Class 1
14. Class 3 to Class 2
15. Class 3 to Class 3
16. Class 3 to Non-AOC Service Provider
17. Class 3 to ATS
18. Class 3 to AOC
19. Non-AOC Service Provider to Class 1
20. Non-AOC Service Provider to Class 2
21. Non-AOC Service Provider to Class 3
22. Non-AOC Service Provider to Non-AOC Service Provider
23. Non-AOC Service Provider to ATS
24. Non-AOC Service Provider to AOC
25. ATS to Class 1
26. ATS to Class 2
27. ATS to Class 3
28. ATS to Non-AOC Service Provider
29. ATS Provider to ATS
30. ATS to AOC
31. AOC to Class 1
32. AOC to Class 2
33. AOC to Class 3
34. AOC to Non-AOC Service Provider
35. AOC to ATS
36. AOC to AOC

Excluding direction of communications flow reduces the number of links to be considered to twenty-one. Removing the purely ground to ground links reduces the list to fifteen. These are:

1. Class 1 to/from Class 1
2. Class 1 to/from Class 2
3. Class 1 to/from Class 3
4. Class 1 to/from Non-AOC Service Provider
5. Class 1 to/from ATS
6. Class 1 to/from AOC
7. Class 2 to/from Class 2
8. Class 2 to/from Class 3
9. Class 2 to/from Non-AOC Service Provider
10. Class 2 to/from ATS
11. Class 2 to/from AOC
12. Class 3 to/from Class 3
13. Class 3 to/from Non-AOC Service Provider
14. Class 3 to/from ATS
15. Class 3 to/from AOC

Determination of whether a link is utilized for a specific service or functional capability was accomplished using the following criteria:

1. If the link is commonly used to provide that service, include it.
2. If NAS 4.0 projects use of that link in the future for the provision of that service, include it.
3. If no use of the link for provision of a service can be identified, exclude it.
4. If a corner condition is identified whereby the service could be provided, but it would be extremely rare or out of the ordinary, exclude it. In this case, a comment should be added to the comment field describing the circumstances where such use might occur.

In today's environment, a number of the links are uni-directional. However, in consideration of a 2015 end-state, it is likely that most links will provide bi-directional capability. This was the rationale for collapsing the links to bi-directional flow only.

4.1.2 Link Analysis in the Database

As with all other data groups in Tasks 1,2, and 3, the Link Analysis is accessed through three screens: query, view, and edit. The view screen is shown below to show the meanings of all fields in the link analysis. Field explanations then follow.

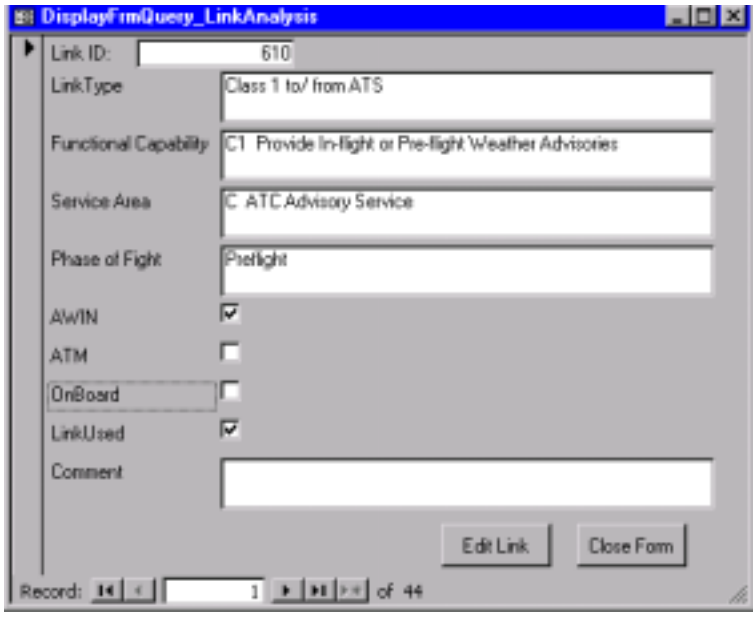

Figure 4.1-3. Link Analysis view screen

Link ID: This field shows the ID number assigned to the link shown. It is used for database management; its does not help to describe the communications link.

Link Type: This field shows the type of link. Its values can only be one of the 15 possible communications links described in the previous section. "Class 1 to/ from ATS" is the example shown here.

Functional Capability: This field shows which functional capabilities are supported by this communication link. The complete list of functional capabilities is shown in Attachment 1.

Service Area: This field shows which services areas are supported by this communications link. The complete list of service areas is shown in Attachment 2.

Phase of Flight: The field shows the applicable phase of flight for the link. The phases of flight in this study are preflight, arrival/departure, enroute, and oceanic.

AWIN: A checked box in this field shows that the link is used to communicate weather information.

ATM: A checked box here shows the link is used to communicate air traffic control instructions.

On Board: A box with a check shows that the link is used to provide on-board communications related to flight administration or passenger services.

Link Used: A checked box says that the link is used in the present architecture. A box without a check says that the link is not used.

Comment: The "Comment" field holds any extra information concerning the link not shown within the other fields.

4.2 Subtask 3.2: System Engineering Requirements

4.2.1 Subtask 3.2 Approach

The second portion of Task 3 serves as a collection point for all system engineering requirements that are medium independent. These requirements build on the message characteristics collected in Subtask 2.2 by providing overall availability, integrity, and delay values for each of the message types identified. Each system engineering requirement is tied directly to a single message type.

4.2.2 System Engineering Requirements in the Database

The system engineering requirements view screen is shown below along with field definitions. As most of the fields have already been discussed in previous sections, only the new fields which relate to the engineering requirements and have not been previously covered are discussed below.

Information Exchange Categories – Refers to eleven categories of traffic derived from NAS 4.0 and defined as part of TO-19 (AATT). An example of an information exchange is Category 1, Aeronautical, which consists of PIREPS, NOTAMS, and charts. A complete list of information exchange categories can be found in Attachment 5.

Phase of Flight – Breakdown of flight profiles into the following segments: preflight, arrival/departure, domestic, and oceanic

Domain – Breakdown of flight profiles into the following segments: Airport, Terminal, Enroute, and Enroute Oceanic

Performance Requirement Source: This field shows the source from which the performance requirement values come.

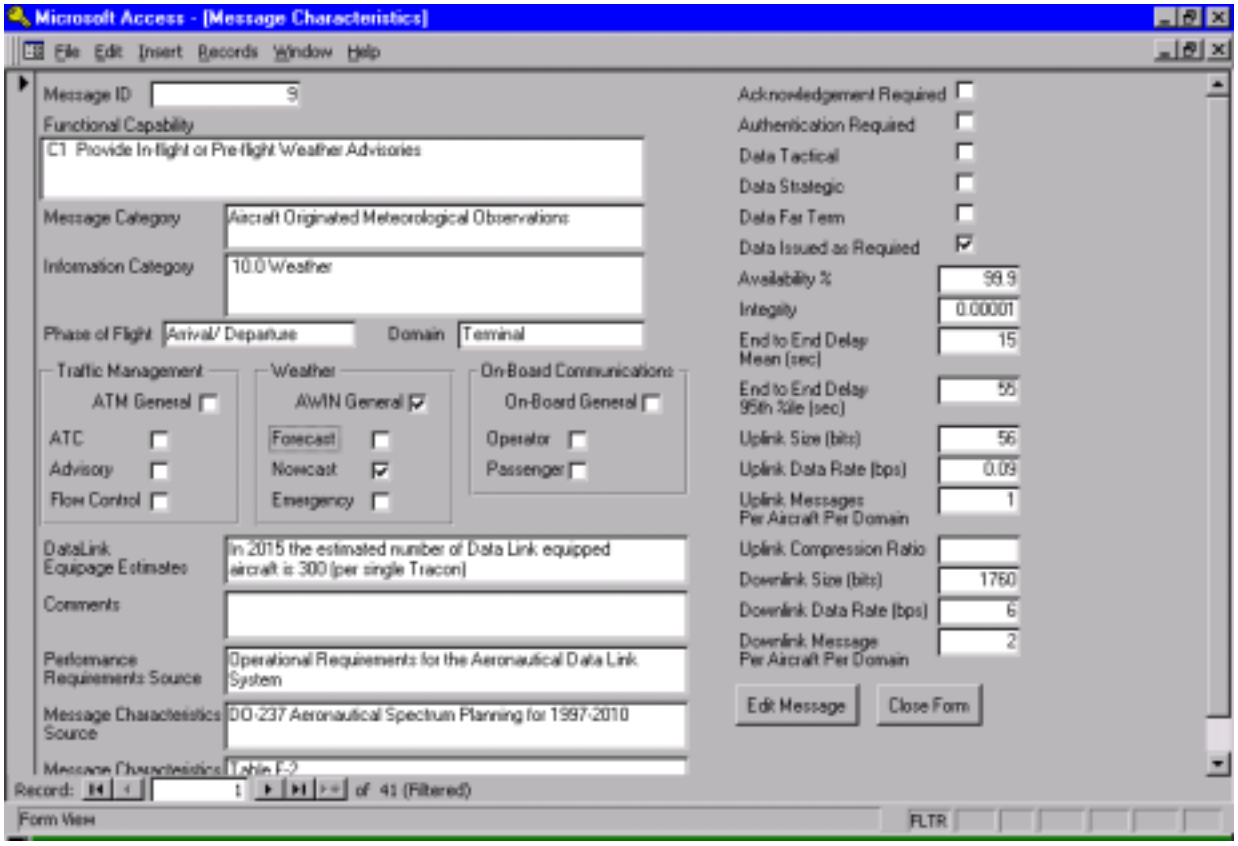

Figure 4.2-1. Message Characteristics/ System Engineering Requirements

Availability: The probability that the system, or a specific subsystem, is in an operable state and capable of performing its required functions to a specified level of performance during any and all required operating time.

Integrity: The absence of errors induced in a message by the system.

End-to-End Delay: Elapsed time between the initial presentation of speech or data to a channel for transmission and receipt of that speech or data at the receiver.

- Mean – Average measure of delay (seconds)
- 95% - Statistical measure indicative of the point at which 95% of messages can be expected to be received

The electronic copy of the Task 1, 2, and 3 Database is submitted as Attachment 5.

Attachment 1. Service/Functional Capabilities Matrix

All Subtasks in TO 24 are associated with a functional capability and user service to allow for traceability to each output of each subtask of the task order

USER SERVICES	FUNCTIONAL CAPABILITIES
Flight plan service	• File flight plans and amendments • Process flight plans and amendments • Provide information for flight plans
ATC separation assurance service	• Separate IFR aircraft • Avoid potential hazards and collisions • Maintain minimum distance from special use airspace (SUA) • Monitor flight progress
ATC advisory service	• Provide in-flight or pre-flight weather advisories • Provide in-flight or pre-flight traffic advisories • Provide in-flight NAS status advisories
Traffic management - Synchronization service	• Provide in-flight sequencing, spacing, and routing restrictions • Provide pre-flight runway, taxi sequence, and movement restrictions • Project aircraft in-flight position and identify potential conflicts • Process user preferences
Traffic management - strategic flow service	• Provide future NAS traffic projections • Collaborate with airspace users/user support on NAS projections and user preferences • Monitor NAS traffic status • Assess NAS traffic performance
Emergency and alerting Service	• Provide emergency assistance and alerts • Support search and rescue (SAR)
Navigation service	• Provide airborne navigation guidance • Provide surface navigation guidance
Airspace management service	• Manage design and use of NAS airspace • Manage use of SUA
Infrastructure/information management service	• Monitor and maintain NAS infrastructure • Manage radio spectrum for u.s. aviation community
On-board service Aircraft/airline operational services Passenger onboard services	• Schedule, dispatch, and manage aircraft flights • Monitor flight progress • Collaborate with ATM on NAS projections and user preferences • provide administrative flight information • Provide in-flight entertainment • Provide public communications

Attachment 2. User Service Definitions

Below are the definitions of Air Traffic user services from the latest draft FAA NAS Architecture document jointly developed by the FAA AT Requirements (ARS) and Systems Engineering and Architecture (ASD) organizations. For the purposes of AATT Task Order 24, a user service definition has been added for the Onboard services covering both passenger and aircraft/airline operational information.

Flight Planning Service

The flight planning service provides both flight plan support and flight plan data processing to support the safe and efficient use of the nation's airspace through the development and use of coordinated flight plans. This includes preparing and conducting pre-flight and in-flight briefings, filing flight plans and amendments, managing flight plan acceptance and evaluation, preparing flight planning broadcast messages, and maintaining flight-planning data archives. This service offers preparation to conduct a flight within the NAS and allows changes to flight profiles while operating within the NAS.

Flight Plan Support

Flight plan support provides NAS users essential weather and aeronautical information. Flight planning requires information such as expected route, altitude, time of flight, available navigation systems, available routes, special use airspace (SUA) restrictions, daily demand conditions and anticipated flight conditions including weather and sky conditions (e.g. volcanic ash, smoke, birds). There is an exchange of a variety of data to support flight planning including NAS operational and maintenance status, weather, FAA facility status, with numerous NAS users to include, fixed base operators, pilots and flight planners, airline operations centers, Department of Defense (DOD) operations offices, and inter alia. Planning and pre-flight briefings contain current and forecast weather including winds and temperatures, surface conditions, and any significant meteorological condition. Aeronautical information includes notices to airmen containing information concerning the establishment, condition, or change in any NAS component (facility, service, or procedure of, or hazard in the NAS) the timely knowledge of which is essential to flight.

Flight Plan Processing

Flight plan processing provides acceptance and processing of flight plan data from all users (e.g., general aviation, commercial, military, customs, law enforcement, etc.); validates the flight plans; notifies users of any problems; and processes amendments, cancellations and flight plan closures. NAS flight plan processing provides evaluation and feedback for both domestic and international flight plans. Flight plan amendments both pre-flight and in-flight are also processed including cancellations, and closures. The NAS disseminates flight plan information as necessary.

4.3 Air Traffic Control Separation Assurance Service

The separation assurance service ensures that aircraft maintain a safe distance from other aircraft, terrain, obstacles, and certain airspace not designated for routine air travel. Separation assurance involves the application of separation standards to ensure safety. Standards are defined for aircraft operating in different environments.

4.3.1 Aircraft to Aircraft Separation.

Aircraft to aircraft separation prevents collision between airborne aircraft. A variety of methodologies are employed to apply the defined separation standards. These methodologies include the use of visual and automated means.

4.3.2 Aircraft to Terrain/Obstacles Separation

NAS employs defined separation standards to prevent collision between aircraft, terrain, and obstacles. Methods used include published safety zones and processing of position and intent information.

4.3.3 Aircraft to Airspace Separation.

Aircraft are separated from special use airspace (SUA) such as prohibited, restricted, and warning areas. The SUA is designed to ensure safety for unique aircraft operations or to prohibit flight within a specified area. Separation standards ensure aircraft remain an appropriate minimum distance from the airspace. The standards are applied via methods including regulatory publications and specific control instructions.

4.3.4 Surface Separation

Surface separation accounts for activities such as vehicle movements on the airport movement area, taxiing aircraft, water vehicles, protection from designated critical zones, etc. Standards are employed to ensure safe operation on the surface.

4.4 Air Traffic Control Advisory Service

Air traffic control and other facilities provide advice and information to assist pilots in the safe conduct of flight and aircraft movement. These advisories include providing weather information, traffic, and NAS status information. These advisories and information may be directed to a specific location, broadcast to any user in an area, or provided to a specific user.

4.4.1 Weather Advisories

Weather advisories and information are available either automatically or on request through communication with ATC and other facilities. For example, pilots receive weather advisories from automated weather observing or other systems, ATC facilities, and aircraft operations centers (AOCs). Advisories provide hazardous weather and/or flight conditions at airports or along the route of flight.

4.4.2 Traffic Advisories

Traffic advisories are provided to alert aircraft to potential conflicts with others on the surface or in-flight. For example, traffic advisories are provided to aircraft or other flight objects that are in the proximity of hot air/gas balloons, missile launches or other potential hazards. Traffic advisories for aircraft on the surface include the number, type, position and intent of the ground traffic.

4.4.3 NAS Status Advisories

Information about NAS status that has changed or was not readily available during flight planning is provided to in-flight aircraft. This includes updates concerning the operational status of airspace, airports, navigational aids (NAVAIDs), in-flight or ground hazards, traffic management directives, and other information that is essential to the safety and efficiency of aircraft.

4.5 Traffic Management-Synchronization Service

Traffic synchronization supports expeditious flight for the large number of aircraft using the NAS during any given period of time. NAS processes operate to maximize efficiency and capacity in response to weather, NAS infrastructure, runway availability or other conditions. Traffic synchronization is the tactical portion of traffic management providing sequencing, spacing, and routing of aircraft. Traffic synchronization activities are accomplished while maintaining separation assurance and implementing strategic flow management directives. The traffic synchronization service provides tactical instructions to optimize operations while airborne and on the surface.

4.5.1 Airborne

Airborne synchronization involves sequencing of aircraft to maximize efficiency and capacity of the NAS through all phases of flight (arrival, departure, and cruise). Maximum efficiency, predictability and capacity are obtained through the application of processes, which reduce variability in application of the defined separation standards. These activities include prioritization including the input of user preferences.

4.5.2 Surface

The surface is managed by formulating taxi sequences and communicating instructions to pilots and vehicle operators for the safe and efficient flow of traffic on the airport surface. Surface synchronization involves processes intended to maximize surface efficiency, predictability and capacity. It includes activities such as runway assignment, taxi sequence and movement instructions.

4.6 Traffic Management-Strategic Flow Service

The strategic flow service provides for orderly flow of air traffic from a system perspective. NAS demand and capacity is analyzed and balanced to minimize delays, avoid congestion, and maximize overall NAS throughput, flexibility, and predictability. Actual and predicted demand is compared to the current and predicted capacity of the NAS airspace, airports and infrastructure to plan the overall NAS strategy. When necessary, traffic flow management (TFM) plans are developed collaboratively to optimize the flow of traffic while accommodating user requests and schedules, airspace, infrastructure, weather constraints, and other variables. The strategic flow services are comprised of long-term planning (more than one day in advance) and flight-day traffic management (current 24-hour period) and performance assessment.

4.6.1 Long-term Planning

Long term planning works to maximize efficiency by developing predictions of capacity and demand more than one day in advance. Inputs include capacity and demand models based on airport use data, airspace for special use schedules, airline flight schedules, infrastructure status,

and historical flight traffic demand information. It also includes activities designed for continual improvement in the predictive capabilities such as model validation, assessment of specific planned and executed strategies trend analysis and recommended changes.

4.6.2 Flight Day Management

Flight day traffic management optimizes NAS traffic flow for the current 24-hour period. Demand profiles are compared with projections of NAS capacity for the current day and identify periods and locations where predicted demand exceeds predicted capacity. Specific responses to maximize efficiency are developed and implemented through collaboration across the NAS.

4.6.3 Performance Assessment

Performance assessment provides institutional memory by archiving information to support post-flight analyses of NAS traffic flow. The effectiveness of NAS performance is analyzed to propose future improvements. Air traffic trends and activities are analyzed, problems identified and alternatives for improvement developed and evaluated. Long-term improvements to NAS performance include recommended changes to schedules, airspace design, ATC procedures, and the NAS infrastructure.

4.7 Emergency and Alerting Service

The emergency and alerting service monitors the NAS for distress or urgent situations, evaluates the nature of the distress, and provides an appropriate response to the emergency. Applicable situations include those that occur on the ground or in-flight. Emergency services include emergency assistance and alerting support.

4.7.1 Emergency Assistance

Emergency assistance provides direct support in the protection of individuals and property both in the air and on the ground. Examples of the wide variety of circumstances under which direct support is provided include location and navigation assistance for orientation, guidance to emergency airports, and generation of alternative courses of action.

4.7.2 Alerting Support

Alerting support provides indirect assistance for those events/circumstances in which the response is external to the system. For example, when information is received that an aircraft is overdue or missing, ELT signals are received, or search and rescue services may be required, alerting support provides the relevant information and coordinates with the appropriate international, military, federal, state, and local agencies. The appropriate organization(s) then provide direct response(s).

4.8 Navigation Service

The service provides navigational guidance to enable NAS users with suitable avionics to operate their aircraft safely and efficiently under different weather conditions. The service includes both ground and space-based networks of navigational aids for the NAS. These navigational aids broadcast electronic signals or provide guidance in accordance with international standards. The navigation service provides guidance during airborne operations (such as cruise, approach and landing), and during surface operations to appropriately equipped aircraft.

4.8.1 Airborne Guidance

NAS provides mechanisms and aids for point-in-space navigation through a variety of operating environments. These environments include structured routes, random routings and transitions. Guidance is provided for position determination in both vertical and lateral planes in all phases of flight. Additionally, visual aids provide guidance to aircraft transitioning to and from the surface.

4.8.2 Surface Guidance

NAS provides mechanisms and aids for maneuvering on the airport surface safely and efficiently. For example, references are provided to determine present position both electronic and/or visual.

4.9 Airspace Management Service

Airspace management service ensures the safe and efficient use of the national airspace resource. This includes the design, allocation, and stewardship of the airspace. Maximum safety and efficiency in the use of airspace results from coordinating airspace user needs and available capacity. Effective airspace management requires the seamless integration of airspace design and the management of airspace for special use.

4.9.1 Airspace Design

Airspace design provides maximum utilization of the national resource while ensuring safety to the public at large. This includes a cohesive plan for managing airspace changes, establishing and directing a financial plan to meet airspace priorities, establishing standards for modeling and analysis, and developing strategies to ensure environmental compatibility. Airspace planning and analysis considers, among other elements, the existing design, current and projected traffic usage, radio frequency congestion, effects of airport construction, proposed and existing surface structures, and environmental factors such as noise abatement and others. It provides the aviation community with the description, operational composition and status of airspace/airport components of the NAS.

4.9.2 Airspace for Special Use

Airspace for special use provides support to the national defense mission, fosters the development of commercial space enterprises, protects sensitive areas, and ensures the protection of other natural resources. Designation and management of special use airspace ensures optimal access,

4.10 Infrastructure/Information Management Service

Infrastructure management ensures a safe and efficient NAS through management and operation of the infrastructure and optimal use of resources. Infrastructure resources include systems such as radar, communication links, navigation aids and automation, while infrastructure management includes monitoring and maintenance of the NAS.

4.10.1 Monitoring and Maintenance

Monitoring and maintenance includes the activities necessary to monitor the NAS status, detect and isolate failures and outages, and perform corrective and preventive maintenance to ensure the operational readiness of the NAS. Maintaining, operating, and managing the infrastructure

requires a variety of planning, engineering, analysis, repair and maintenance functions. It also includes monitoring status, real time assessments and systems implementations in the NAS.

4.10.2 Spectrum Management

Spectrum management secures, protects, and manages the radio spectrum for the FAA and the U.S. aviation community. It is the focal point for management policy and plans, engineering, frequency assignment, radio interference resolution, radiation hazard, obstruction evaluation, electronic counter measures, and other national/international spectrum activities.

Government/agency support provides information and coordination services. Examples of the agencies and organizations supported include, military air defense operations, law enforcement, government land management, drug interdiction, state aviation, Customs, National Transportation Safety Board, and inter alia.

4.11 Aerospace Operational Control Service

Aerospace Operational Control Services are non-ATC, safety-related functions performed by AOC, FBO, Military or other aircraft operations support personnel that include the scheduling, dispatch and management of aircraft flights, monitoring of flight progress and collaboration on ATM and NAS projections and user preferences.

4.11.1 Onboard Services

Onboard services are either associated with the aircraft, airline, or passengers. In most cases it is potentially a two-way exchange. Since some of these services are driven more by market (Profit/Loss) considerations versus Air Traffic considerations, it is likely that the use of more advanced communications techniques may be justified and therefore provide additional alternative implementations beyond those provided by the NAS.

4.12 Aircraft/Airline Operational Onboard Services

These services potentially include information relative to the state, intent, and status of the aircraft. Typical examples include engine status, heading, speed, timing for gate departure/arrival, wheels up/down, etc. It also includes information relative to the airline operations such as, schedule changes, airport status, fuel estimates, gate availability/assignments, etc. This information is presently transmitted via ACARS and is used by the Airline for scheduling and dispatching aircraft.

4.12.1 Passenger Onboard Services

These services potentially include broadcast services for entertainment (e.g., sporting events or other television), information services such as Internet access, business services such as fax or e-mail, and voice or data passenger communications. Some of these services, such as passenger telephony, are likely to use communications links that can also be used for ATM or FIS.

Attachment 3. Tasks 1-3 Source Document List

Source_ID	Title	Author	Task 1	Task 2	Task 3
4	Aeronautical Digital Communication Architecture Utilizing LEO/ MEO Satellite Capability	AATT/ AWIN			
5	Aeronautical Satellite Communications for Automatic Dependent Surveillance	David H. Featherstone		S	
6	Aeronautical Information Manual	FAA	P	S	
7	Affordable, Flexible Communication Control Systems	Al Henry			
8	Air Traffic Management Concept Baseline Definition	Boeing Commercial Airplane Group		P	P
9	Air Traffic Service Plan, 1996-2005	FAA ATO-1		S	S
10	Air Traffic Weather Needs and Requirements, Order 7032.15	FAA	P	S	S
11	Air Traffic Weather Requirements Report	FAA/ Air Traffic Plans and Requirements Service	P	P	S
15	Aviation System Capacity Program, Advanced Air Transportation Technologies, ATM Concept Definition, Volume 1, Current and Future Operational Concepts for the National Airspace System	NASA Ames Research Center		S	S
16	Aviation System Capacity Program, Advanced Air Transportation Technologies, ATM Concept Definition, Volume 2, Coverage of Future National Airspace System Operational Requirements	NASA Ames Research Center		S	S
18	Avionics Transition Issues: User Motivations to Equip with Advanced Communication, Navigation, and Surveillance (CNS) Avionics	Rovinsky, Robert			
19	Aviation Weather (00-6A)	FAA	S	S	
20	Aviation Weather Services (00-45D)	FAA	P	S	
21	Aviation Weather Systems Plan	FAA NAS System Engineering Service		S	
22	Aviation Weather System: A Vision of the Future	FAA		S	
28	Comprehensive ATN Manual (CAMAL): Part I Introduction and Overview	Aeronautical Telecommunications Network (ATN)		S	
29	Comprehensive ATN Manual (CAMAL): Part II System Level Considerations	Aeronautical Telecommunication Network (ATN)		S	
30	Concept of Operations for the National Airspace System in 2005	FAA Traffic Services	S	S	
31	Concept of Operations for the National Airspace System in 2005, Addendum 1: Operational Tasks & Scenarios	FAA Traffic Services	P	S	
32	Concept of Operations in the National Airspace System in 2005 Version 1.0	FAA Office of Commercial Space Transportation		S	
33	Data Communications Requirements, Technology and Solutions for Aviation Weather Information Systems, Phase 1 Report	Lockheed Martin Aeronautical Systems, AWIN	S	P	P
34	Demonstrating an Improved Weather Awareness System for CDM	Falcone, Rich; Kevin Kollman; Bill Leber; John Moffatt; Lorraine Sandusky; Art Shantz; Mike Wambsganss; Jim Wetherly	S		
35	Evolutionary Operational Concept for Users of the National Airspace System, Draft V2.1	RTCA Select Committee on Free Flight Implementation	S	S	S
36	FAA Aviation Forecasts - Fiscal Years 1995-2006	FAA	S	S	S

Source_ID	Title	Author	Task 1	Task 2	Task 3
37	FAA Terminal Area Forecasts - Fiscal Years 1993-2005	FAA	S	S	S
38	FAR: Federal Aviation Regulations (including FAR Parts 71, 125, 129, 189)	FAA	P	S	S
39	Final Report of RTCA Task Force 3: Free Flight Implementation	RTCA	P	S	S
40	Free Flight Action Plan	RTCA	S	S	S
41	Free Flight Satellite Communication Study Final Report	Lockheed Martin Aeronautical Systems, AATT	S	S	S
42	Flight Management System - Air Traffic Management Next Generation (FANG) Operational Concept	DOT/FAA	P	S	S
43	Flight Management System - Air Traffic Management Next Generation (FANG) Required Capabilities	DOT/FAA	P	S	S
44	Future FAA Communications Plan (Fuchsia Book)	Telecommunications Network Planning and Engineering Division		S	S
45	Global MET Solutions	Cech, Petr			
46	Integrated Plan for Air Traffic Management Research and Technology Development, Version 2.0	FAA/ NASA Inter-agency Air Traffic Management Integrated Product Team			
48	Joint Government/ Industry Operational Concept for the Evolution of Free Flight	RTCA Select Committee on Free Flight Implementation	P	S	S
49	Milestone 1.0.0: Consolidate and Assess Operations Concepts for the Future NAS	NASA/ AATT			
50	Mobile Satellite Service (MSS) Study Final Report	Federal Systems Integration and Management Center; Stanford Communications		P	P
52	National Airspace System Architecture, Version 4.0	DOT/ FAA	P	P	
53	National Airspace System Stakeholder Needs	Boeing Commercial Airplane Group		P	
54	Next Generation AMHS for AFTN Communications	Misra, Ramesh			
58	Operational Requirements for the Aeronautical Data Link System	FAA/ AFS/ ATR/ AND/ ARD/ ASE	P	P	P
59	Operational Windshear Warning System for Hong Kong's New Airport	Mahoney, William P. and Bruce Donaldson			
61	Potential Benefits and Costs of Free Flight to General Aviation	Burgess, Malcolm A. and Stuart W. Law (Research Triange Institute)			
62	Proposed Aviation Weather System Architecture	FAA		S	S
65	SATCOM Links Speed Weather Forecasts	Asker, James R			S
74	Weather Related Federal Aviation Regulations: General Aviation, Air Carrier, Air Taxi, and Commercial Operations	Glover, Graham K. (MITRE)	S	S	
78	Airline Operational Control Overview	FMS-ATM Next Generation (FANG) Team for FAA	P	S	
79	DO-219 Minimum Operational Performance Standards for ATC Two-Way Data Link Communications	RTCA SC-169		S	S
80	DO-237 Aeronautical Spectrum Planning for 1997-2010	RTCA SC-185		S	P
81	DO-239 MASPS for Traffic Information Service Data Link Communications	RTCA SC-169		P	P
82	DO-238 Human Engineering Guidance for Data Link Systems	RTCA SC-169		S	P

Source_ID	Title	Author	Task 1	Task 2	Task 3
83	DO-136 Universal Air-Ground Digital Communication System Standards	SC-110 & SC-111		S	
84	DO-162 Report on Air-Ground Communications - Operational Considerations for 1980 and Beyond	RTCA SC-120			
85	DO-169 VHF Air-Ground Communication Technology and Spectrum Utilization	RTCA SC-140			S
86	DO-175 Minimum Operational Performance Standards for Ground-Based Automated Weather Observation Equipment	RTCA SC-143			S
87	DO-193 User Requirements for Future Communications, Navigation, and Surveillance Systems, Including Space Technology Applications	RTCA SC-155		S	
91	DO-209 Minimum Operational Performance Standards for Devices that Prevent Blocked Channels Used in Two-Way Radion Communications Due to Simultaneous Transmissions	RTCA SC-163		S	
92	DO-210C Minimum Operational Performance Standards for Aeronautical Mobile Satellite Services (AMSS)	RTCA SC-165		S	
94	DO-212 Minimum Operational Performance Standards for Airborne Automatic Dependent Surveillance (ADS) Equipment	RTCA SC-170		S	
95	DO-214 Audio Systems Characteristics and Minimum Operational Performance Standards for Aircraft Audio Systems and Equipment	RTCA SC-164		S	
96	DO-215A Guidance on Aeronautical Mobile Satellite Service (AMSS) End-to-End System Performance	RTCA SC-165		P	P
97	DO-218 Minimum Operational Performance Standards for Mode S Airborne Data Link Processor (Change 1)	RTCA SC-142		S	
98	DO-222 Guidelines on AMS(R)S Near Term Voice Implementation and Utilization	RTCA SC-165		S	S
99	DO-223 Minimum Operational Performance Standards for Context Management (CM) Equipment	RTCA SC-169		S	
100	DO-224 Signal-in-Space Minimum Aviation System Performance Standards (MASPS) for Advanced VHF Digital Data Communications Including Compatibility with Digital Voice Techniques	RTCA SC-172		S	S
101	DO-225 VHF Air-Ground Communications System Improvements Alternatives Study and Selection of Proposals for Future Action	RTCA SC-172		S	S
103	DO-231 Design Guidelines and Recommended Standards for the Implementation and Use of AMS(R)S Voice Services in a Data Link Environment	RTCA SC-165		S	S
104	DO-232 Operations Concept for Data Link Applications of Flight Information Services	RTCA SC-169		P	P
106	DO-237 Aeronautical Spectrum Planning for 1997-2010	RTCA SC-185		P	P
107	DO-240 Minimum Operational Performance Standards for Aeronautical Telecommunication Network (ATN) Avionics	RTCA SC-162		S	P

Source_ID	Title	Author	Task 1	Task 2	Task 3
108	DO-241 Operational Concepts and Information Elements Required to Improve Air Traffic Management (ATM) - Aeronautical Operational Control (AOC) Ground-Ground Information Exchange to Facilitate Collaborative Decision Making	RTCA SC-169	S	S	
109	DO-242 Minimum Aviation System Performance Standards for Automatic Dependent Surveillance Broadcast (ADS-B)	RTCA SC-186		S	P
110	DO-243 Guidance for Initial Implementation of Cockpit Display of Traffic Information	RTCA SC-186		S	
111	DO-244 Government/ Industry Guidelines and Concept for National Airspace Analysis and Redesign	RTCA SC-192		S	
112	DO-245 Minimum Aviation System Performance Standards for Local Area Augmentation System (LAAS)	RTCA SC-159		S	
113	DO-247 The Role of Global Navigation Satellite System (GNSS) in Supporting Airport Surface Operations	RTCA SC-159		S	
114	Operations Requirements for ATM Air/Ground Communications Services, OPR.ET1.ST05.1000-ORD-01-00	Eurocontrol		P	P
115	Inventory and Analysis of A/G Applications and Data Networks, Phase 1 Report, COM.ET2.ST15.1000-REP-xx-xx (Draft)	Eurocontrol		P	P
116	Aeronautical Safety Services Network Study	ARINC		S	
117	Code of Federal Regulations, 14 CFR Part 121	FAA	P	S	
118	Code of Federal Regulations, 14 CFR Part 129	FAA	P	S	
119	Code of Federal Regulations, 14 CFR Part 135	FAA	P	S	
120	Code of Federal Regulations, 14 CFR Part 91	FAA	P	S	
121	Air Traffic Control Procedures Handbook, ATP 7110.65L with Changes 1-3	DOT/ FAA	P		
122	Air Traffic Specialist Handbook, 7110.10M with changes 1-2	DOT/ FAA	P		
123	AATT Integrated Concept Volume 2	AATT	P	S	
124	FAA Air Traffic System Vision of the Future (1995-2015)		P	S	
125	FAA Flight 2000 Initial Program Plan		S		
126	AOPA Preliminary Assessment of General Aviation User Needs	RTCA SC-169, WG-3	P		
127	User Weather Requirements	FAA	P	S	
128	Digital A/G Communications System Operational Concept, FAA ASD-100	FAA	P	S	
129	FAR: Federal Aviation Regulations Part 125	FAA	P	S	S
130	FAR: Federal Aviation Regulations Part 189	FAA	P	S	S
131	FAR: Federal Aviation Regulations Part 25	FAA	P	S	S
132	FAR: Federal Aviation Regulations Part 23	FAA	P	S	S
133	Operations Concept for Data Link Applications of Flight Information Services	RTCA 081-96/ TMC 212			S
134	Initial/ Final Requirements Documents for En-Route Controller - Pilot Data Link Communications, Builds 1 and 1A	DOT/ FAA		S	S
135	Alternatives Analysis Report for Next Generation Air/ Ground System (NEXCOM)	DOT/ FAA		S	S
137	Requirements and Desirable Features of a Future VHF Air Ground Communications System	FAA		S	S

Attachment 4. List of Acronyms

AATT	Advanced Air Transportation Technology
A/A	Air to Air
ADS	Automatic Dependent Surveillance
ADS-B	Automatic Dependent Surveillance-Broadcast
AFSS	Automated Flight Service Station
A/G	Air to Ground
AIM	Aeronautical Information Manual
AIRMET	Airmen's Meteorological Information
AMSS	Aeronautical Mobile Satellite System
AOC	Airline Operational Control
ARTCC	Air Route Traffic Control Center
ATC	Air Traffic Control
ATC DSS	Air Traffic Control Decision Support Systems
ATCT	Air Traffic Control Tower
ATIS	Automated Terminal Information System
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services (organization in the FAA)
AWIN	Aviation Weather Information Services
BER	Bit Error Rate
CDM	Collaborative Decision Making
CDMA	Code Division Multiple Access
CDTI	Cockpit Display of Traffic Information
CNS	Communications, Navigation and Surveillance
CPDLC	Controller-Pilot Data Link Communications System
CSMA	Carrier Sense Multiple Access
CWA	Center Weather Advisory
D8PSK	Differential Eight-Level Phase Shift Keying
FAA	Federal Aviation Administration
FANS	Future Air Navigation System
FAR	Federal Air Regulations
FBO	Fixed Base Operator
FEDSIM	Federal Systems Integration and Management Center
FIS	Flight Information Services
FMS	Flight Management System
G/G	Ground-to-Ground
GA	General Aviation
GEO	Geostationary Earth Orbit
GPS	Global Positioning System
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ITWS	Integrated Terminal Weather System
IWF	Integrated Weather Forecast
KBPS	Kilobits Per Second

LEO	Low Earth Orbit
MBO	Military Base Operations
METAR	International standard code format for hourly surface weather observations
MDCRS	Meteorological Data Collection and Reporting System
MEO	Medium Earth Orbit
MOC	Mission Operational Control
MSS	Mobile Satellite Service
MTBF	Mean Time Between Failure
N/A	Not Applicable
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NAWIS	National Airspace Weather Information Service
NEXCOM	Next Generation A/G Communications System
NEXRAD	Next Generation Weather RADAR
NOTAM	Notice to Airman
NWS	National Weather Service
PIREP	Pilots Report
RCP	Required Communications Performance
RF	Radio Frequency
RTCA	RTCA, Inc. Before shortening its name to RTCA, the organization was named the Radio Technical Commission for Aeronautics.
SAR	Search and Rescue
SARP	Standards and Recommended Practices
SATCOM	Satellite Communications
SIGMET	Significant Meteorological Information
SPECI	Special Weather Report
SUA	Special Use Airspace
TAF	Terminal Aerodrome Forecast
TDWR	Terminal Doppler Weather RADAR
TIS	Traffic Information Services
TRACON	Terminal Radar Approach Control Facility
TWDL	Two-way Data Link
TWEB	Transcribed Weather Broadcast
VDL	VHF Digital Link
VFR	Visual Flight Rules
VHF	Very High Frequency
VOR	VHF Omni-Directional Range
WAAS	Wide Area Augmentation System
WARP	Weather and Radar Processor
Wx	Weather