CNS

Computer Networks & Software, Inc.

AI Requirements Definition Document

to

NASA's Glenn Research Center

for the

Airborne Internet Development

Under the

Small Aircraft Transportation System Project

October 10, 2001

Version 1.0

7405 Alban Station Court, Suite B-201, Springfield, VA 22150-2318

Airborne Internet Requirements Definition

Table of Contents

List of Figures

Figure **Page**

List of Tables

Table **Page**

1. GENERAL

1.1. Background

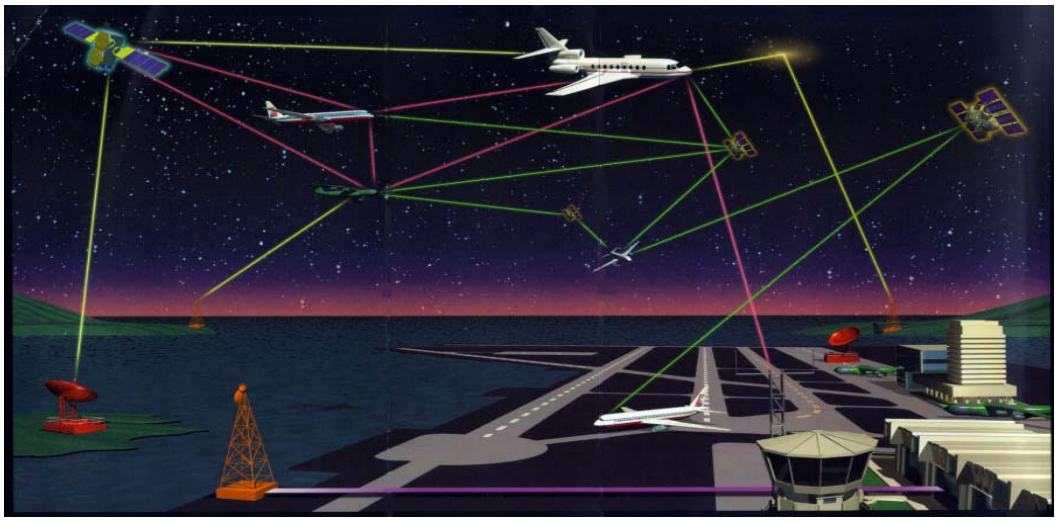
The National Aeronautics and Space Administration (NASA), in partnership with the Federal Aviation Administration (FAA) and State and local aviation development organizations, has initiated a research and development program focused on maturing Small Aircraft Transportation System (SATS) enabling technologies. The program will initially focus on intermodal transportation systems engineering to develop an overall design for SATS that is complimentary to existing air and ground transportation systems. The bulk of the program will focus on developing digital airspace infrastructure and vehicle technologies that enable the SATS concept.

Air traffic congestion at "Hub and Spoke" airports in the commercial passenger aircraft transportation system is approaching a critical juncture in the next few years. Rural areas and communities not close to the major airports find economic development hindered by lack of easy air access to their community. Air travel capacity, safety, accessibility, and the expense of personal time are major concerns. Further, advancements in personal transportation stopped in about 1950 at an average speed of about 60 mph with the completion of the Interstate Highway System. The information age has stimulated greater human interactivity, yet ground travel suffers from gridlock, air travel suffers from hublock, and travelers suffer from inefficient use of time.

NASA is taking leadership in developing technologies for the SATS that could play a major role in helping to relieve large airport congestion and provide reliable, convenient, safe environmentally compatible air transportation service to rural and outlining communities, as well as revolutionizing the national transportation system. The Advanced General Aviation Transport Experiments (AGATE) and General Aviation Propulsion (GAP) programs have taken a quantum step in this process through the development of affordable, easy to use, environmentally friendly aircraft and propulsion systems. This investment is already benefiting the flying public through much more affordable, informative and readable avionics systems and will soon cause a revolution in small aircraft with the introduction of a whole new class of aircraft - safe, comfortable, affordable small jet aircraft. To bring the SATS vision to its full potential of a personal transportation alternative, however, will require major technology enhancements to the National Air Space (NAS) system, and another order of magnitude advancement in affordability, performance and environment impact for aircraft systems.

The initial 5-year objective (FY01-05), SATSLAB, will address the President and Congress' charge to NASA and the FAA to "prove that SATS works". SATSLAB is focused on demonstrating technologies to enable the use of existing small community and neighborhood airports, without requiring control towers, radar, and more land use for added runway protection zones. The key to such a system is a robust extremely reliable automated communications system. Such a system must be capable of passing large amounts of data between aircraft and various ground systems as well as between neighboring aircraft in a reliable fashion.

To this end, NASA Glenn Research Center, through its partnership with NASA Langley Research Center, is pursuing a key enabling technology area: *Airborne Internet*. (Figure 1)



Graphic Courtesy of Rockwell Collins

Figure 1. Airborne Internet - a key enabling technology to realize the SATS vision

The Airborne Internet will leverage open standards and protocols for a client-server network system architecture (Figure 2) that are in development in the telecommunications industry for increased bandwidth for mobile applications. SATS research will leverage the developments in NASA and FAA Airspace System Capacity (ASC) research on Distributed Air Ground (DAG) collaborative decision-making. SATS research will focus on defining the functional allocations between clients and servers for all navigation, communications, and surveillance information necessary for aircraft operations including sequencing, separation, and conflict resolution.

Continued growth in air travel across all segments of aviation in the National Air Space (NAS) system is placing severe demands of the already constrained system and the underlying Communication-Navigation-Surveillance (CNS) infrastructure. Current NAS operations are primarily conducted via analog voice communications, radar surveillance, and ground-based navigation aides. Although a number of efforts are underway to modernize the NAS, the majority of these efforts are targeting the commercial air transport segment operating under the traditional hub-and-spoke model.

To meet the forecasted need, the consolidation and integration of communication, navigation, and surveillance technologies, systems, and services will have been initiated through a client-server internet-like model. A demonstration of integrated services via satellite-terrestrial hybrid communications architecture will benchmark the capability, efficiency, and safety of a digital

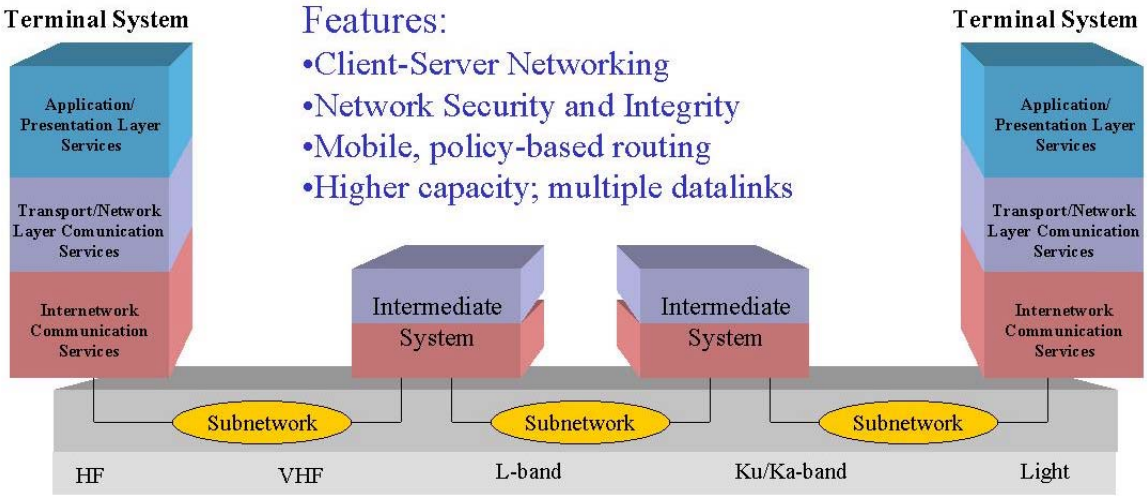


Figure 2. Airborne Internet Architecture

airspace infrastructure. This infrastructure development will be the maturing of the Airborne Internet to enable the full SATS vision**.**

For public stakeholders in the states and airport communities, the SATS experiments and the data collected will be designed to demonstrate that SATS capabilities significantly increase affordable access to virtually all communities, including rural and remote areas. For the FAA, the SATS demonstration will illustrate airborne technology-based approaches for increasing NAS capacity, for lower costs for NAS expansion, and for greater NAS throughput. In addition, the SATS demonstration will show that the distributed nature of SATS augments air carrier hub and spoke operations by accessing untapped NAS capacity. Finally, for industry customers, the experiments will illustrate the role of human-aiding automation in creating single-crew mission safety and reliability comparable with two-crew operations. These results of the five-year proof of concept Program will establish the basis for decisions by industry, the FAA, NASA, and the state and community decision-makers.

Although SATSLAB will integrate key enabling technology areas to “prove that SATS works”, technology advancements for architectures, vehicles, and procedures will be limited. These initial advancements will need to be further developed while other technology elements for a complete SATS validation will need to be pursued and addressed in follow-on innovative transportation vehicle programs. As a result the CNS infrastructure needed to support the SATSLAB flight demonstrations will be built largely on commercially available systems having limited bandwidth and coverage.

1.1.1. SATS Key Word Definitions

The following definitions help define the focus of the SATS Program.

- Small: The technologies targeted for development are aimed at smaller aircraft used for personal and business transportation missions within the infrastructure of smaller airports throughout the nation. These missions include travel by individuals, families, or groups of business associates. Consequently, the aircraft are of similar size to typical automobiles and vans used for non-commercial ground transportation – two to eight seats. They may be used for on demand, unscheduled air-taxi transportation of these same user types. Various forms of shared ownership and usage will likely be a most common means of use. While the aircraft are not specifically designed for air carrier use, the targeted technologies would provide benefits to commuter and major air carrier operations in the hub-and-spoke system as well. For FAA regulatory purposes, SATS technologies are targeted toward aircraft with a maximum take off weight (MTOW) less than 12,500 pounds (i.e., FAA small aircraft category).

- Aircraft: The strategy for development of airborne technologies focuses initially on fixed-wing airplane applications. However, the technologies created are also applicable to operational improvements for vertical take-off and landing aircraft. These technologies would enable near all-weather operations by new generations of such aircraft at virtually any landing facility in the nation. Near all-weather means operational reliability in instrument meteorological conditions except those classified as severe or hazardous (i.e., severe icing, severe turbulence, thunder storm activity, etc).

- Transportation: The technology investments are selected and prioritized for the purpose of transportation of people, goods, and services. Even so, the technologies would likely have favorable effects on safety, cost, and accessibility in recreational or other non-transportation commercial uses. The aircraft will have the altitude and speed performance, as well as the weather avoidance and toleration systems, to enable safe and reliable operations with high availability (similar to or better than today's air carrier reliability).

- System: In addition to technologies for the aircraft, SATS strategies are conceived to affect the nature of aviation operational capabilities for airports, airspace, and air traffic and commercial services. The SATS vision encompasses inter-modal connectivity between public and private, air and ground modes of travel. In concept, the SATS vision integrates the use of smaller landing facilities with the interstate highway system, intra-city rail transit systems, and hub-and-spoke airports. The strategy focuses on airborne technologies that expand the use of airports with excess capacity (those without precision instrument approaches) as well as underutilized, unmanaged airspace for transportation use (such as the low-altitude, non-radar airspace below 6,000 feet and the enroute structure below 18,000 feet).

1.1.2. SATS Objective

The objective of the program is to conduct an integrated flight demonstration of four new operating capabilities that are currently not possible today. These operating capabilities are:

- Higher Volume Operations at Non-Towered/Non-Radar Airports. Simultaneous operations by multiple aircraft in non-radar airspace at and around small non-towered airports in near all-weather conditions through the use of vehicle-to-vehicle collaborative sequencing and self separation algorithms and automated air traffic management systems. Meeting this objective has the potential to safely expand the capacity of the NAS.

- Lower Landing Minimums at Minimally Equipped Landing Facilities. Precision approach and landing guidance, through the use of graphical flight path guidance and artificial vision, to any touchdown zone at any landing facility while avoiding land acquisition and approach lighting costs, as well as ground-based precision guidance systems such as an Instrumented Landing System (ILS). Meeting this objective has the potential to safely reduce the cost to increase accessibility to small airports.

- Increase Single Crew Safety & Mission Reliability to Two-Crew Levels. Increased safety and mission completion through the use of human-centered automation, intuitive and easy to follow flight path guidance superimposed on a depiction of the outside world, software enabled flight controls, and onboard flight planning/management systems. Meeting this objective has the potential to safely increase the throughput of the NAS.

- En Route Procedures & Systems for Integrated Fleet Operations. Integration of SATS equipped aircraft into the higher en route air traffic flows and controlled terminal airspace through the use of automated air traffic management systems designed to facilitate operations at non-towered airports and in non-radar airspace. Meeting this objective has the potential to safely reduce the need for ground holds.

1.2. Purpose

This report describes the communications, navigation, and surveillance requirements that architecture and components of the Airborne Internet (AI) will have to support.

1.3. Report Organization

This report is organized into 10 sections supported by three appendixes:

- Section 1 provides an introduction and overview.

- Section 2 contains a summary of the tasks performed to define the requirements for the AI.

- Section 3 defines the operational services that will be available to SATS users.

- Section 4 defines objects that can be used to describe the information exchange between a SATS aircraft and other entities.

- Section 5 presents reference models that can be used to portray the information exchange between entities.

- Section 6 identifies the entities that support the operational services.
- Section 7 identifies the information exchange objects that support the operation services.
- Section 8 contains the parameters associated with each of the information exchange objects.
- Section 9 describes the communications load model.
- Section 10 analyzes the results of the modeling activity and develops the bandwidth requirements needed by the AI.
- Appendix A contains an acronym reference listing.
- Appendix B contains the year 2005 parameters for the information exchange objects.
- Appendix C contains the year 2025 parameters for the information exchange objects.

2. TASK METHODOLOGY

Figure 3 presents the overall task plan and relationships for the activities associated with the definition of the Airborne Internet. In FY 2001 there are basically five major task flows indicted in the figure:

- NAS Infrastructure Assessment
- AI Requirements
- Technology Evaluation
- AI Architecture Development
- AI Architecture Evaluation (Testbed)

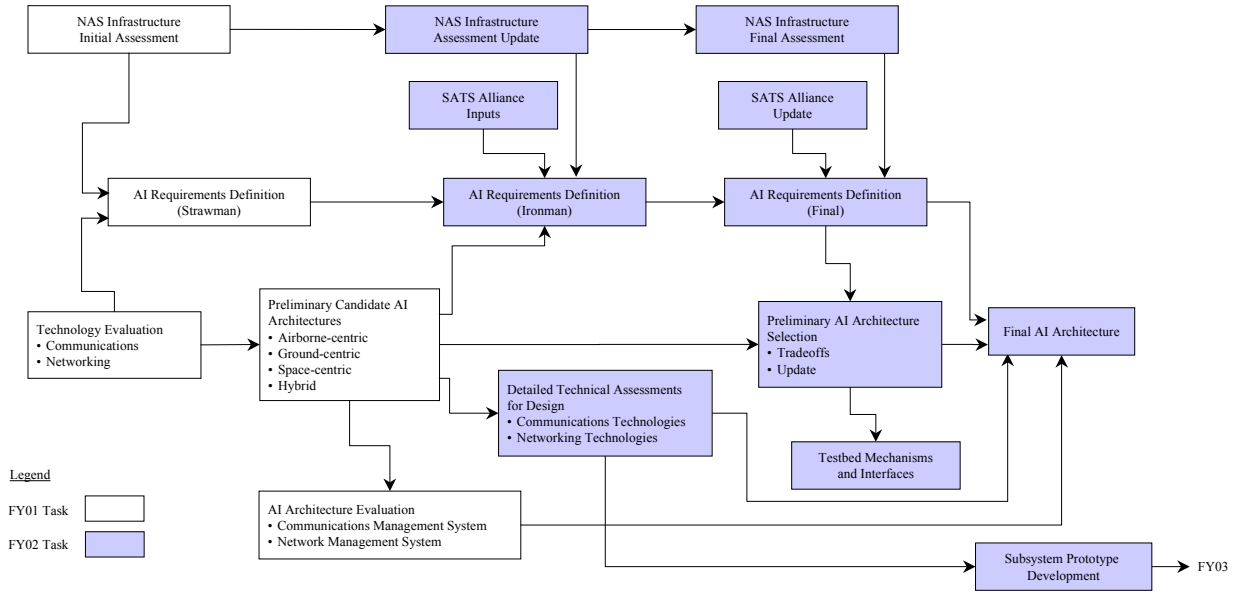


Figure 3. Task Flow Diagram

AI Requirements Definition Process

The process of defining the AI requirements (Figure 4) started with the development of a set of operational concepts for the SATS aircraft. The operational concepts describe the SATS operational environment in three timeframes: proof of concept (2005), transition (2025), and mature (2050). (The SATS Operational Concepts, Version 1.6 of 10 Oct 01 is a standalone document.) Next, sets of operational services were defined based upon the forecasted concepts. The first set described the services that would support a SATS pilot and passengers in the proof

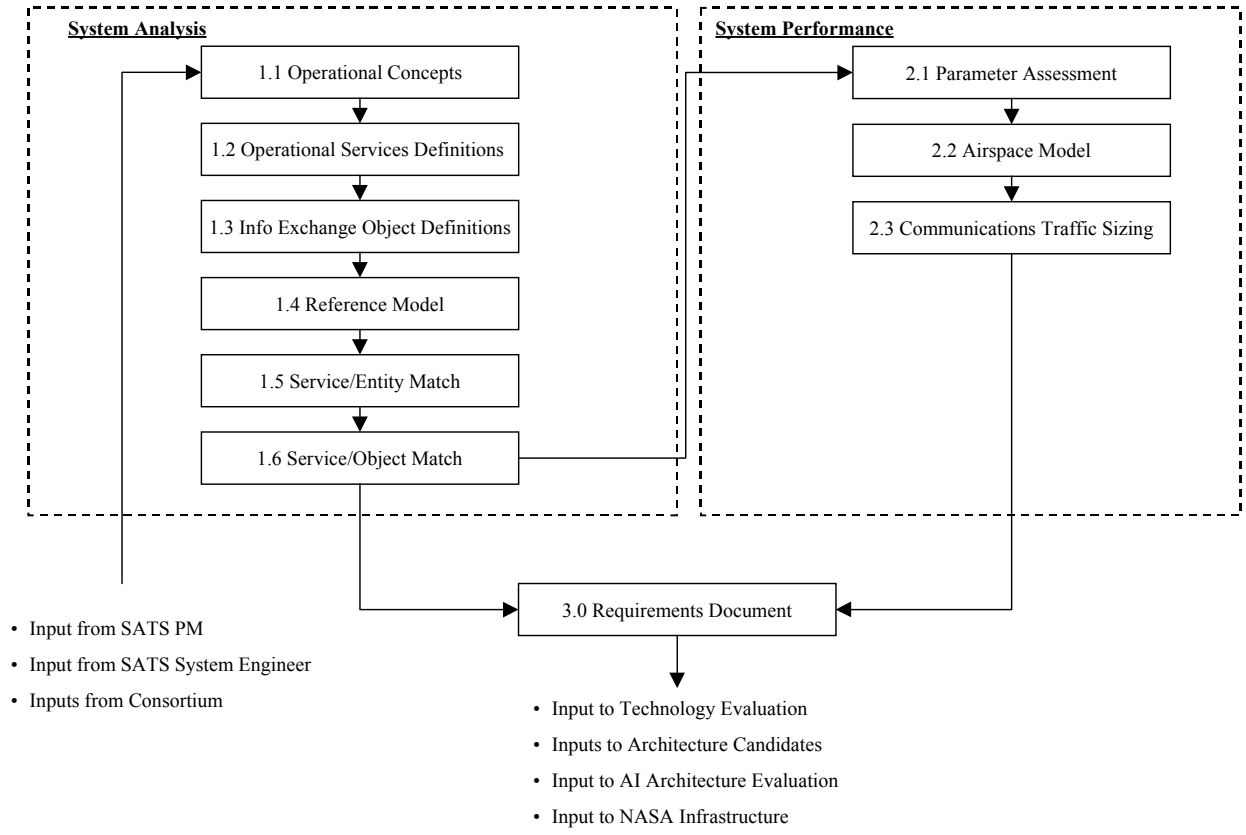


Figure 4. AI Requirements Workflow Diagram

of concept timeframe (2005). A second set expanded upon the first to indicate the services that would be available in 2025. (Note: The mature timeframe was described in the operation concepts document to support the SATS vision. It is too far in the future to use in defining the requirements for the AI. Thus, the analysis herein is limited to the 2005 and 2025 timeframes.)

The services available to a SATS user require that information be exchanged between the user (pilot, aircraft, and passengers) and the external entities (other aircraft and ground based systems). A set of information exchange objects was defined to support this exchange. Likewise, reference models were developed to show the entities with which a SATS user would communicate.

A matrix was developed to match the operational services with the entities with which a SATS aircraft would communicate in using the services. A second set of matrices matched operational services with the information objects that would be exchanged in providing the services.

Next was the development of the parameters that are associated with the transmission of each of the information exchange objects. The objects and their parameters were used in developing the data communications load associated with a typical 2-hour flight by a SATS aircraft. The results from modeling the communications requirements of a single SATS aircraft were analyzed and

adjusted to describe the communications load to be supported by the AI for all aircraft within a 50 mile radius of a SATS airfield.

3. OPERATIONAL SERVICES DEFINITIONS

The operational services that will be available to a SATS pilot/aircraft and its passengers in 2005 are shown in Table 1. The services are defined by the functional capabilities that the service provides. The first seven services are associated with the pilot. The eighth service (Public Information Exchange) is associated with the passengers.

Table 1. SATS Operational Services in 2005

Ref #	SATS User Services	Functional Capability
1	Flight Service	File flight plans and amendments. Process flight plans and amendments. Provide information for flight plans. Obtain in-flight or pre-flight weather and NAS status (NOTAMs) advisories. (*Near real time and forecast, tactical and strategic*) Obtain in-flight or pre-flight traffic advisories. (*Existing tactical and strategic*) Obtain in-flight NAS status advisories – current and scheduled.
2	Air Traffic Service	Provide separation of aircraft during ground operations. Provide separation of in-flight IFR aircraft. Avoid potential hazards and collisions. Maintain minimum distance from Special Use Airspace (SUA). Monitor flight progress. Enable in-flight sequencing, spacing, and flow management for SATS aircraft. Obtain pre-flight runway, taxi sequence, and movement restrictions. Project aircraft in-flight position and identify potential conflicts. Provide data to support managing use of SUA.
3	Emergency and Alerting Service	Provide emergency assistance and alerts. *(For downed or troubled aircraft)* Support search and rescue.
4	Self-Separation and Sequencing Service	Provide data to ensure proper separation to avoid potential hazards and collisions. Provide data to support VFR and IFR traffic separation. Provide data to monitor flight progress. Provide self-separation in NAS.
5	Navigation Service	Provide airborne navigation guidance.

Ref #	SATS User Services	Functional Capability
6	Pilot/Aircraft Information Service	Provide information concerning the flight. Enable separation of in-flight IFR aircraft. Enable in-flight sequencing and spacing for SATS aircraft. Provide aircraft in-flight position and identify potential conflicts.
7	Aircraft and Travel Service	Provide information about airport services. Notification to owner/operator about change in aircraft availability. Notification to owner/operator about aircraft maintenance issues. Provide other travel related information.
8	Public Information Exchange Service	Provide in-flight entertainment Provide public communications including email and web browsing.

The operational services that will be available to a SATS user in 2025 are shown in Table 2. They expand upon those that were available in 2005. The new functions are bolded.

Table 2. SATS Operational Services in 2025

Ref #	SATS User Services	Functional Capability
1	Flight Service	File flight plans and amendments. Process flight plans and amendments. Provide information for flight plans. Obtain in-flight or pre-flight weather and NAS status (NOTAMs) advisories. (*Near real time and forecast, tactical and strategic*) Obtain in-flight or pre-flight traffic advisories. (*Existing **and planned** tactical and strategic*) Obtain in-flight NAS status advisories – current and scheduled.

Ref #	SATS User Services	Functional Capability
2	Air Traffic Service	Provide separation of aircraft during ground operations. Provide separation of in-flight IFR aircraft. Avoid potential hazards and collisions. Maintain minimum distance from Special Use Airspace (SUA). Monitor flight progress. Enable in-flight sequencing, spacing, and flow management for SATS aircraft. Obtain pre-flight runway, taxi sequence, and movement restrictions. Project aircraft in-flight position and identify potential conflicts. Provide data to support managing use of SUA.
3	Emergency and Alerting Service	Provide emergency assistance and alerts. *(For downed or troubled aircraft)* Support search and rescue. **Provide information from SATS aircraft that is in trouble; e.g., location, persons on-board, fuel remaining, and problem. (Voice would be the primary means, but this information could be sent automatically by the SATS FMS.)**
4	Self-Separation and Sequencing Service	Provide data to ensure proper separation to avoid potential hazards and collisions. Provide data to support VFR and IFR traffic separation. Provide data to monitor flight progress. Provide self-separation in NAS.
5	Navigation Service	Provide airborne navigation guidance. **Provide surface navigation guidance.** **Provide position foundation for distributed surveillance (ADS-B, ADS-A, TIS-B, etc.).**
6	Pilot/Aircraft Information Service	Provide information concerning the flight. Enable separation of in-flight IFR aircraft. Enable in-flight sequencing and spacing for SATS aircraft. Provide aircraft in-flight position and identify potential conflicts.
7	Aircraft and Travel Service	Provide information about airport services. Notification to owner/operator about change in aircraft availability. Notification to owner/operator about aircraft maintenance issues. Provide other travel related information. **Provide information for surface transportation.**
8	Public Information Exchange Service	Provide in-flight entertainment Provide public communications including email and web browsing.

4. INFORMATION EXCHANGE OBJECT DEFINITION

The services available to a SATS user require that information be exchanged between the user (pilot, aircraft, and passengers) and the external entities (other aircraft and ground based systems). The objects that can be used to model the information exchange between entities is shown in Table 3. The intent is that there not be overlapping functions performed by the objects.

Table 3. Information Exchange Objects

Ref #	SATS Information Exchange Object	Description of Process/Data
1	Flight Planning and Use (FPU)	Submission and processing of original or revised flight plans.
2	Weather (WX)	Collection and exchange of weather data both forecast and current (FIS-B like)
3	Airspace Situation (AS)	Information to enable a common situational awareness (ADS-B /TIS-B like).
4	Maneuver & Control (MC)	Near real time exchange of data to direct or implement the maneuvering of an aircraft (CPDLC like).
5	Navigation Information (NAV)	Information to provide airborne and surface navigation guidance.
6	Aviation System Information (ASI)	Information regarding the current status, use or readiness of the system entities.
7	Pilot/Aircraft Information Exchange (PAE)	Pilot-to-pilot or aircraft-to-aircraft exchange of flight information.
8	Aircraft & Travel (AT)	Exchange of aircraft status and other travel related information.
9	Public Information Exchanges (PIE)	Passengers use of email and other Internet-based services.

5. REFERENCE MODELS

An understanding of the information (data) exchange environment required that reference models be developed. The SATS reference model for 2005 is shown in Figure 5 while the model for 2025 is shown in Figure 6.

The SATS aircraft is at the center of the model universe. Each of the entities is shown in a rectangle and the interface between them identified with a letter. The entities are:

- Airport represents the Fixed Base Operator (FBO).
- Aircraft 2 is one or more SATS equipped aircraft.
- ATM Sys represents the FAA's Air Traffic Management System.

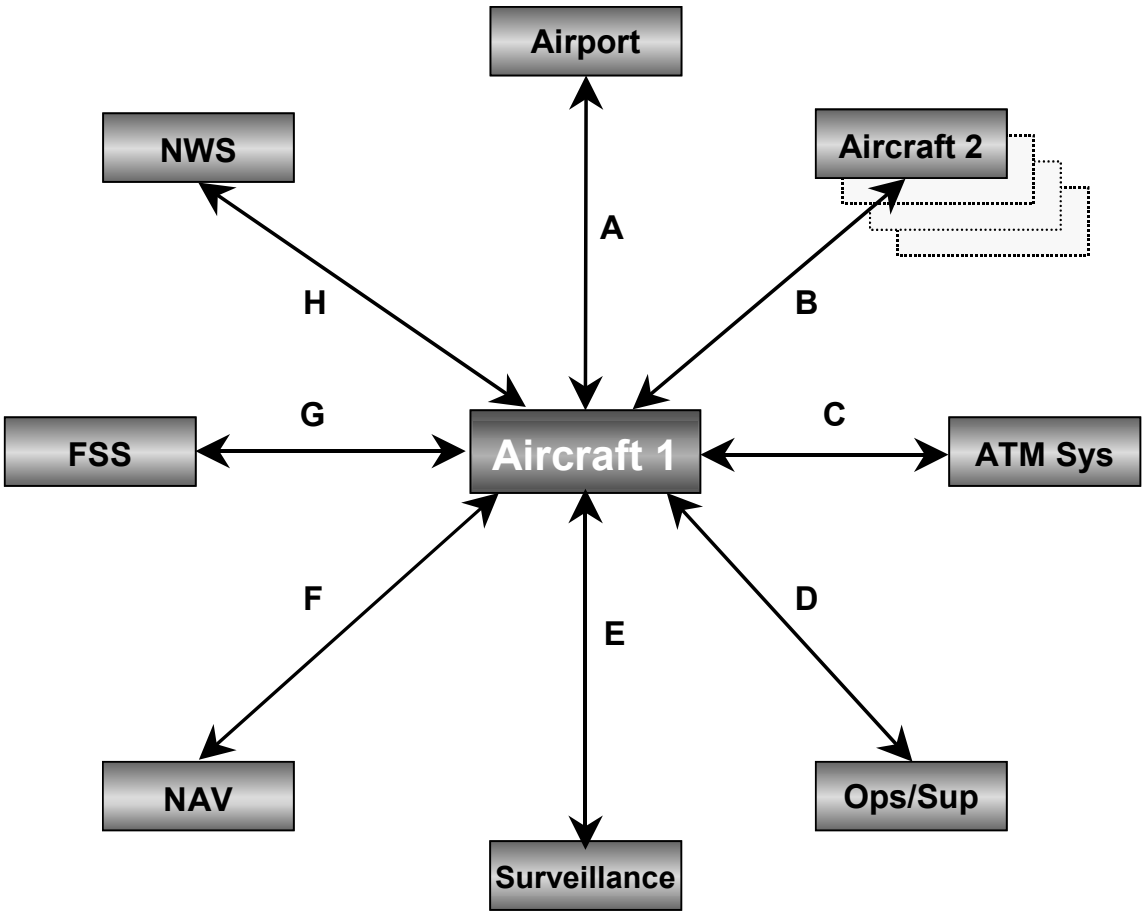


Figure 5. SATS Reference Model - 2005

- Ops/Sup stands for the operators/owners of SATS aircraft (e.g., aircraft rental agencies, flying clubs, etc.) plus other suppliers that would be involved with the SATS aircraft. It also represents suppliers associated with the SATS "doorstep to destination" concept such as rental car agencies.

- Surveillance is the ground-based system that broadcasts positional data for all aircraft within a specified region.

- NAV represents the system that is broadcasting navigation information in reference to a location. The only NAV system considered viable to use the AI as its transport mechanism is the Local Area Augmentation System (LAAS).

- FSS represents the Flight Service Stations. Many of them provide services (weather, and NOTAMs) through their web sites. The FSS supports pilot recorded flight plans via telephone, and is anticipated that they would support flight plans filed by email in 2005. These sites could be accessed if a SATS gateway into the Internet is available.

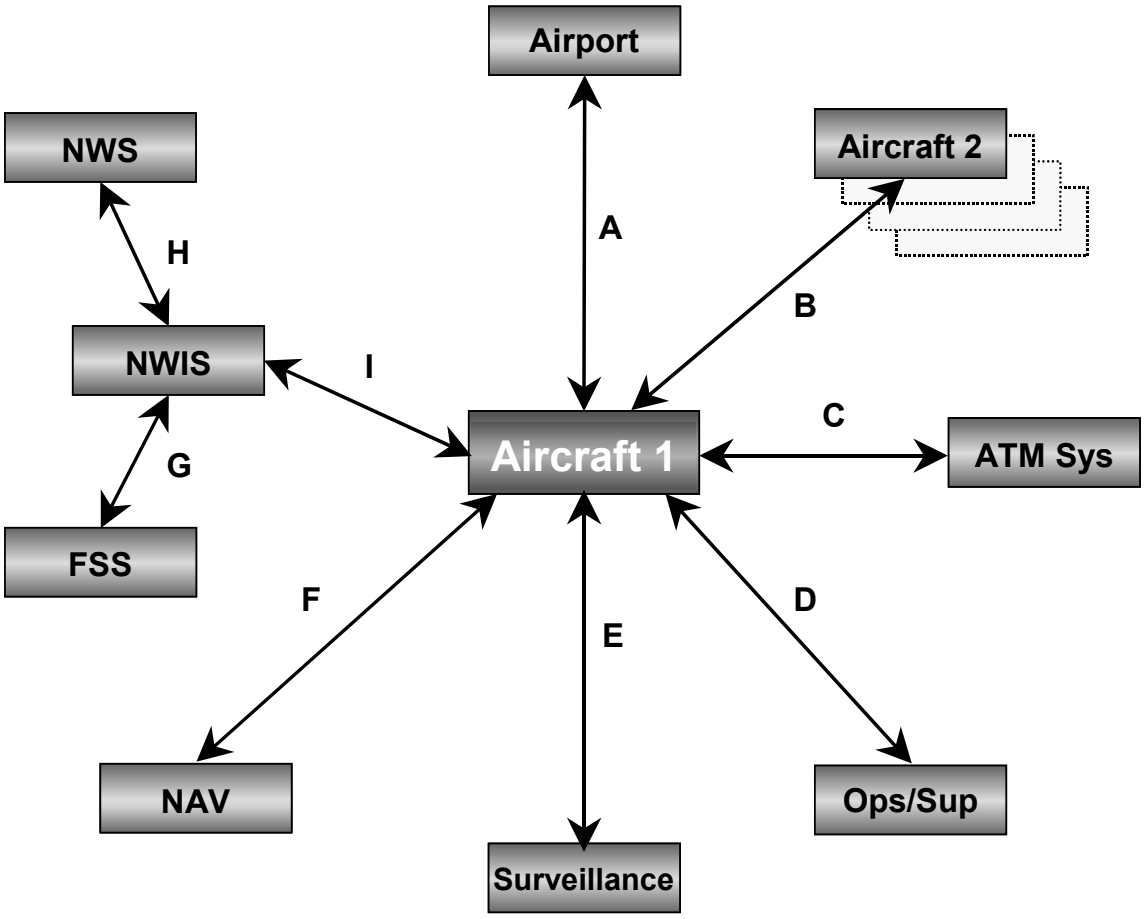


Figure 6. SATS Reference Model - 2025

- NWS is the National Weather Service. It too provides weather data including graphical NEXRAD reports via its web site.

- NWIS. As the FAA's infrastructure evolves, safe and secure access to the FSS and NWS will be available through the NAS-Wide Information System (NWIS). This change is reflected in the 2025 reference model.

6. OPERATIONAL SERVICES/ENTITY MATCH

Providing operational services to the SATS user involves all of the entities shown in the reference models. Insight into communications requirements can be achieved by matching the operational services with the entities that will support those services. Tables 4 - 11 show the matching of operational services with the entities that support them. The tables show the purpose of the service, functions that are involved, and the entities that support those services. The purposes and functions that are added in 2025 are bolded.

Table 4. Service/Entity Matrix - Flight Service

State	Purpose	Functions	A/C 1	A/C 2	A/P	ATM Sys	Ops/ Sup	Surv	NAV	NWIS	FSS	NWS
2005	Provide a lost comm separation plan. Provide SAR information.	File flight plans and amendments. Process flight plans and amendments. Provide information for flight plans. Obtain in-flight or pre-flight weather and NAS status (NOTAMs) advisories. (*Near real time and forecast, tactical and strategic*) Obtain in-flight or pre-flight traffic advisories. (*Existing tactical and strategic*) Obtain in-flight NAS status advisories – current and scheduled.	X			X					X	X
2025	Provide a lost comm separation plan. Provide SAR information. **Provide intent information for better air traffic management**.	File flight plans and amendments. Process flight plans and amendments. Provide information for flight plans. Obtain in-flight or pre-flight weather and NAS status (NOTAMs) advisories. (*Near real time and forecast, tactical and strategic*) Obtain in-flight or pre-flight traffic advisories. (*Existing **and planned** tactical and strategic*) Obtain in-flight NAS status advisories – current and scheduled.	X			X	X			X	X	X

Table 5. Service/Entity Matrix - Air Traffic Service

State	Purpose	Functions	A/C 1	A/C 2	A/P	ATM Sys	Ops/ Sup	Surv	NAV	NWIS	FSS	NWS
2005	Provide safe separation between aircraft during surface operations. Provide safe separation between aircraft and airspace.	Provide separation of aircraft during ground operations. Provide separation of in-flight IFR aircraft. Avoid potential hazards and collisions. Maintain minimum distance from Special Use Airspace (SUA). Monitor flight progress. Enable in-flight sequencing, spacing, and flow management for SATS aircraft. Obtain pre-flight runway, taxi sequence, and movement restrictions. Project aircraft in-flight position and identify potential conflicts. Provide data to support managing use of SUA.	X			X		X				

State	Purpose	Functions	A/C 1	A/C 2	A/P	ATM Sys	Ops/ Sup	Surv	NAV	NWIS	FSS	NWS
2025	Provide safe separation between aircraft during surface operations. Provide safe separation between aircraft and airspace.	Provide separation of aircraft during ground operations. Provide separation of in-flight IFR aircraft. Avoid potential hazards and collisions. Maintain minimum distance from Special Use Airspace (SUA). Monitor flight progress. Enable in-flight sequencing, spacing, and flow management for SATS aircraft. Obtain pre-flight runway, taxi sequence, and movement restrictions. Project aircraft in-flight position and identify potential conflicts. Provide data to support managing use of SUA.	X			X		X				

Table 6. Service/Entity Matrix - Emergency and Alerting Service

State	Purpose	Functions	A/C 1	A/C 2	A/P	ATM Sys	Ops/ Sup	Surv	NAV	NWIS	FSS	NWS
2005	Minimize loss of life due to aircraft accidents and incidents.	Provide emergency assistance and alerts. *(For downed or troubled aircraft)* Support search and rescue.	X	X		X					X	X
2025	Minimize loss of life due to aircraft accidents and incidents.	Provide emergency assistance and alerts. *(For downed or troubled aircraft)* Support search and rescue. **Provide information from SATS aircraft that is in trouble; e.g., location, persons on-board, fuel remaining, and problem. (Voice would be the primary means, but this information could be sent automatically by the SATS FMS.)**	X	X		X				X	X	X

Table 7. Service/Entity Matrix - Self-Separation and Sequencing Service

State	Purpose	Functions	A/C 1	A/C 2	A/P	ATM Sys	Ops/ Sup	Surv	NAV	NWIS	FSS	NWS
2005	Provide data for tracking aircraft on the ground. Provide data for tracking aircraft enroute Support safe separation between participating traffic and airspace.	Provide data to ensure proper separation to avoid potential hazards and collisions. Provide data to support VFR and IFR traffic separation. Provide data to monitor flight progress. Provide self-separation in NAS.	X	X				X				
2025	Provide data for tracking aircraft on the ground. Provide data for tracking an aircraft enroute Support safe separation between participating traffic and airspace.	Provide data to ensure proper separation to avoid potential hazards and collisions. Provide data to support VFR and IFR traffic separation. Provide data to monitor flight progress. Provide self-separation in NAS.	X	X				X				

Table 8. Service/Entity Matrix - Navigation Service

State	Purpose	Functions	A/C 1	A/C 2	A/P	ATM Sys	Ops/ Sup	Surv	NAV	NWIS	FSS	NWS
2005	Enable aircraft to arrive at the planned destination via a predictable, planned, cleared route of flight.	Provide airborne navigation guidance.	X						X			
2025	Enable aircraft to arrive at the planned destination via a predictable, planned, cleared route of flight. **Enable aviation ground vehicles to move about the airport surface in periods of reduced visibility.**	Provide airborne navigation guidance. **Provide surface navigation guidance.** **Provide position foundation for distributed surveillance (ADS-B, ADS-A, TIS-B, etc.).**	X					X	X			

Table 9. Service/Entity Matrix - Pilot/Aircraft Information Service

State	Purpose	Functions	A/C 1	A/C 2	A/P	ATM Sys	Ops/ Sup	Surv	NAV	NWIS	FSS	NWS
2005	Enable pilot-to-pilot or aircraft-to-aircraft exchange of flight information.	Provide information concerning the flight. Enable self-separation of in-flight IFR aircraft. Enable in-flight sequencing and spacing for SATS aircraft. Provide aircraft in-flight position and identify potential conflicts.	X	X								
2025	Enable pilot-to-pilot and aircraft-to-aircraft exchange of fight information.	Provide information concerning the flight. Enable self-separation of in-flight IFR aircraft. Enable in-flight sequencing and spacing for SATS aircraft. Provide aircraft in-flight position and identify potential conflicts.	X	X								

Table 10. Service/Entity Matrix - Aircraft and Travel Service

State	Purpose	Functions	A/C 1	A/C 2	A/P	ATM Sys	Ops/ Sup	Surv	NAV	NWIS	FSS	NWS
2005	Enable pilot exchange of non-flight information.	Provide information about airport services. Notification to owner/operator about change in aircraft availability. Notification to owner/operator about aircraft maintenance issues. Provide other travel-related information.	X		X		X					
2025	Enable pilot exchange of non-flight information. **Provide additional "doorstep-to-destination" traveler information**.	Provide information about airport services. Notification to owner/operator about change in aircraft availability. Notification to owner/operator about aircraft maintenance issues. Provide other travel-related information. **Provide information for surface transportation.**	X		X		X					

Table 11. Service/Entity Matrix - Public Information Exchange Service

State	Purpose	Functions	A/C 1	A/C 2	A/P	ATM Sys	Ops/ Sup	Surv	NAV	NWIS	FSS	NWS
2005	Provide passenger business, entertainment, and personal services.	Provide in-flight entertainment Provide public communications including email and web browsing.	X				X					
2025	Provide passenger business, entertainment, and personal services.	Provide in-flight entertainment Provide public communications including email and web browsing.	X				X					

7. OPERATIONAL SERVICES/INFORMATION EXCHANGE OBJECT MATCH

Additional insight into the communications requirements associated with SATS operational services can be gained by matching the services with the information exchange objects that are involved. This matching is shown in Tables 12 - 19. Again, the purposes and functions that are introduced in 2025 are bolded.

Table 12. Service/Object Matrix - Flight Service

State	Purpose	Functions	FPU	WX	AS	MC	NAV	ASI	PAE	AT	PIE
2005	Provide a lost comm separation plan. Provide SAR information.	File flight plans and amendments. Process flight plans and amendments. Provide information for flight plans. Obtain in-flight or pre-flight weather and NAS status (NOTAMs) advisories. (*Near real time and forecast, tactical and strategic*) Obtain in-flight or pre-flight traffic advisories. (*Existing tactical and strategic*) Obtain in-flight NAS status advisories – current and scheduled.	X	X	X			X			
2025	Provide a lost comm separation plan. Provide SAR information. **Provide intent information for better air traffic management**.	File flight plans and amendments. Process flight plans and amendments. Provide information for flight plans. Obtain in-flight or pre-flight weather and NAS status (NOTAMs) advisories. (*Near real time and forecast, tactical and strategic*) Obtain in-flight or pre-flight traffic advisories. (*Existing **and planned** tactical and strategic*) Obtain in-flight NAS status advisories – current and scheduled.	X	X	X			X			

Table 13. Service/Object Matrix - Air Traffic Service

State	Purpose	Functions	FPU	WX	AS	MC	NAV	ASI	PAE	AT	PIE
2005	Provide safe separation between SATS aircraft during surface operations. Provide safe separation between SATS aircraft and airspace.	Provide separation of aircraft during ground operations. Provide separation of in-flight IFR aircraft. Avoid potential hazards and collisions. Maintain minimum distance from Special Use Airspace (SUA). Monitor flight progress. Enable in-flight sequencing, spacing, and flow management for SATS aircraft. Obtain pre-flight runway, taxi sequence, and movement restrictions. Project aircraft in-flight position and identify potential conflicts. Provide data to support managing use of SUA.			X	X		X			

State	Purpose	Functions	FPU	WX	AS	MC	NAV	ASI	PAE	AT	PIE
2025	Provide safe separation between aircraft during surface operations. Provide safe separation between aircraft and airspace.	Provide separation of aircraft during ground operations. Provide separation of in-flight IFR aircraft. Avoid potential hazards and collisions. Maintain minimum distance from Special Use Airspace (SUA). Monitor flight progress. Enable in-flight sequencing, spacing, and flow management for SATS aircraft. Obtain pre-flight runway, taxi sequence, and movement restrictions. Project aircraft in-flight position and identify potential conflicts. Provide data to support managing use of SUA.			X	X		X			

Table 14. Service/Object Matrix - Emergency and Alerting Service

State	Purpose	Functions	FPU	WX	AS	MC	NAV	ASI	PAE	AT	PIE
2005	Minimize loss of life due to aircraft accidents and incidents.	Provide emergency assistance and alerts. *(For downed or troubled aircraft)* Support search and rescue.	X	X	X	X					
2025	Minimize loss of life due to aircraft accidents and incidents.	Provide emergency assistance and alerts. *(For downed or troubled aircraft)* Support search and rescue. **Provide information from SATS aircraft that is in trouble; e.g., location, persons on-board, fuel remaining, and problem. (Voice would be the primary means, but this information could be sent automatically by the SATS FMS.)**	X	X	X	X					

Table 15. Service/Object Matrix - Self-Separation and Sequencing Service

State	Purpose	Functions	FPU	WX	AS	MC	NAV	ASI	PAE	AT	PIE
2005	Provide data for tracking aircraft on the ground. Provide data for tracking an aircraft enroute Support safe separation between participating traffic and airspace.	Provide data to ensure proper separation to avoid potential hazards and collisions. Provide data to support VFR and IFR traffic separation. Provide data to monitor flight progress. Provide self-separation in NAS.			X				X		
2025	Provide data for tracking aircraft on the ground. Provide data for tracking an aircraft enroute Support safe separation between participating traffic and airspace.	Provide data to ensure proper separation to avoid potential hazards and collisions. Provide data to support VFR and IFR traffic separation. Provide data to monitor flight progress. Provide self-separation in NAS.			X				X		

Table 16. Service/Object Matrix - Navigation Service

State	Purpose	Functions	FPU	WX	AS	MC	NAV	ASI	PAE	AT	PIE
2005	Enable aircraft to arrive at the planned destination via a predictable, planned, cleared route of flight.	Provide airborne navigation guidance.					X				
2025	Enable aircraft to arrive at the planned destination via a predictable, planned, cleared route of flight. **Enable aviation ground vehicles to move about the airport surface in periods of reduced visibility.**	Provide airborne navigation guidance. **Provide surface navigation guidance.** **Provide position foundation for distributed surveillance (ADS-B, ADS-A, TIS-B, etc.).**					X				

Table 17. Service/Object Matrix - Pilot/Aircraft Information Service

State	Purpose	Functions	FPU	WX	AS	MC	NAV	ASI	PAE	AT	PIE
2005	Enable pilot-to-pilot or aircraft-to-aircraft exchange of flight information.	Provide information concerning the flight. Enable self-separation of in-flight IFR aircraft. Enable in-flight sequencing and spacing for SATS aircraft. Provide aircraft in-flight position and identify potential conflicts.		X	X				X		
2025	Enable pilot-to-pilot or aircraft-to-aircraft exchange of flight information.	Provide information concerning the flight. Enable self-separation of in-flight IFR aircraft. Enable in-flight sequencing and spacing for SATS aircraft. Provide aircraft in-flight position and identify potential conflicts.		X	X				X		

Table 18. Service/Object Matrix - Aircraft and Travel Service

State	Purpose	Functions	FPU	WX	AS	MC	NAV	ASI	PAE	AT	PIE
2005	Enable pilot exchange of non-flight information.	Provide information about airport services. Notification to owner/operator about change in aircraft availability. Notification to owner/operator about aircraft maintenance issues. Provide other travel-related information.								X	
2025	Enable pilot exchange of non-flight information. **Provide additional "doorstep-to-destination" traveler information**.	Provide information about airport services. Notification to owner/operator about change in aircraft availability. Notification to owner/operator about aircraft maintenance issues. Provide other travel-related information. **Provide information for surface transportation.**								X	

Table 19. Service/Object Matrix - Public Information Exchange Service

State	Purpose	Functions	FPU	WX	AS	MC	NAV	ASI	PAE	AT	PIE
2005	Provide passenger business, entertainment, and personal services.	Provide in-flight entertainment Provide public communications including voice and slow speed data.									X
2025	Provide passenger business, entertainment, and personal services.	Provide in-flight entertainment Provide public communications including email and web browsing.									X

8. PARAMETER ASSESSMENT

There is a set of parameters that describe the communication requirements for each information exchange object. The parameters used in this analysis are:

- Type: General location of the communications source and sink. The options are: air-to-ground (A/G), air-to-air (A/A), and ground-to-air (G/A)

- Integrity (Error Rate): The integrity level indicates the need for error free data transfer. This is also an estimate of the trust placed in the accuracy of the received data. The options are high, medium, and low. High integrity would be equal to an undetected error rate of less than 1 error in 10 gigabits of data. Low integrity would indicate 1 undetected error or less in 100 kilobits. Medium integrity is obviously in the middle.

- Information Unit Size (Min, Max, Avg): This is the size of the data portion of the message. It does not include the overhead associated with a specific protocol.

- Frequency of Occurrence: How often the object is transmitted during a flight.

- Acceptable Delay: Acceptable delay between the time that the object is transmitted until the time that it is received by the recipient.

- Authentication: Whether confirmation is required to ensure that the true sender and receiver are connected. Authentication may be passwords or certificate style (e.g., PKI) mechanisms. The options are yes and no.

- Priority: Level of priority assigned to transmitting one object ahead of another. Objects ranked as high will be processed before those ranked as medium, which in turn are processed before those ranked as low.

- Retransmission Required: Need to retransmit a message if it fails to reach the recipient. The options are yes and no.

- Suitable for Addressed Communications: Whether the object is suitable for transmission via addressed communications. This generally means that the message will be retransmitted up to a set number of times (determined by the protocol) if an acknowledgment is not received.

- Suitable for Broadcast: Whether a broadcast transmission mechanism can be used to send the object. The implication is that the risk of the object being lost is acceptable. This is generally the case if the data is perishable and new data is transmitted soon thereafter.

- Suitable for Multicast: This is similar to broadcast except that a multicast transmission mechanism is used.

One of the key components in determining the communications load that the AI must support is the size of the information exchange objects. Table 20 shows the minimum, maximum, and average message size for each object. The sizes were estimated based upon an understanding of the data protocols used in existing and planned system. The average value was used in the modeling activities that are described later.

Table 20. Information Object Parameters Size

Ref #	SATS Information Exchange Object	Description of Process/Data	Data Object Size (Kb) (Min, Max, Avg)
1	Flight Planning and Use (FPU)	Submission and processing of original or revised flight plans.	1, 5, 2
2	Weather (WX)	Collection and exchange of weather data both forecast and current (FIS-B like)	Aircraft Request: 0.2, 1, 0.5 Ground Response: 0.5,500, 250 Aircraft Broadcast: 0.2, 0.5, 0.4
3	Airspace Situation (AS)	Information to enable a common situational awareness (ADS-B /TIS-B like).	Addressed: 0.2, 1, 0.3 Broadcast (2005): 0.2, 13, 4 Broadcast (2025): 0.2, 13, 11
4	Maneuver & Control (MC)	Near real time exchange of data to maneuver aircraft (CPDLC like).	0.2, 10, 0.4
5	Navigation Information (NAV)	Information to provide airborne and surface navigation guidance.	1, 1.8, 1.4
6	Aviation System Information (ASI)	Information regarding the current status, use, or readiness of the system entities.	0.2, 1.2, 0.3
7	Pilot/Aircraft Information Exchange (PAE)	Pilot-to-pilot or aircraft-to-aircraft exchange of flight information.	0.2, 1, 0.4
8	Aircraft & Travel (AT)	Exchange of aircraft status and other travel related information.	0.5, 4, 1.6
9	Public Information Exchanges (PIE)	Passengers/crew use of email and other Internet-based services.	Request: 1, 5, 1 Response: 1, 5,000, 50

The information exchange objects and their parameters associated with each operational service are shown in Appendix B (2005) and Appendix C (2025). Summaries of the parameters used in the 2005 modeling activities are shown in Tables 21 and 22. Table 21 groups the objects by operational service, while Table 22 groups them by interface. Likewise, the objects for used in the 2025 modeling effort are shown in Tables 23 and 24. The interface letter is used to indicate the entity with which the SATS aircraft is communicating.

The 2025 reference model shows the NWIS between the SATS aircraft and the FSS and NWS. Interface I and the NWIS were treated as transparent in Appendixes B and C. If an object was destined to go to the FSS (or the NWIS got the data from the FSS), only the FSS was shown to eliminate double entries.

Table 21. Information Exchange Object Parameters by Service - 2005

Ref #	Service	I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
						Min	Max	Avg				
1	Flight											
		C	ATM Sys	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		C	ATM Sys	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
		G	FSS	WX	G/A	0.5	500.0	250.0	5 min	2 min	Yes	No
		H	NWS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
		H	NWS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes
		H	NWS	WX	A/G	0.2	0.5	0.4	15 sec	2 min	No	Yes
		C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
		E	Surv	AS	G/A	0.2	13.0	4.0	5 sec	5 sec	No	Yes
		C	ATM Sys	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
		C	ATM Sys	ASI	G/A	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
		G	FSS	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
		G	FSS	ASI	G/A	0.5	1.2	0.3	1 p/flt	3 min	Yes	No
2	Air Traffic											
		C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
		E	Surv	AS	G/A	0.2	13.0	4.0	5 sec	5 sec	No	Yes
		C	ATM Sys	MC	A/G	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
		C	ATM Sys	MC	G/A	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
		C	ATM Sys	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
		C	ATM Sys	ASI	G/A	0.2	1.2	0.3	1 p/flt	2 min	Yes	No

Ref #	Service	I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
						Min	Max	Avg				
3	Emergency & Alert											
		C	ATM Sys	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		C	ATM Sys	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
		G	FSS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes
		H	NWS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
		H	NWS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes
		B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
		C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		C	ATM Sys	MC	A/G	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
		C	ATM Sys	MC	G/A	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
4	Self-Separation & Sequencing											
		B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
		E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
		E	Surv	AS	G/A	0.2	13.0	4.0	5 sec	5 sec	No	Yes
		B	Aircraft	PAE	A/A	0.2	1.0	0.4	5 sec	5 sec	Yes	No
5	Navigation											
		F	NAV	NAV	G/A	1.0	1.8	1.4	2 p/sec	1/2 sec	No	Yes
6	Pilot/Aircraft Information											
		B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
		B	Aircraft	PAE	A/A	0.2	1.0	0.4	5 sec	5 sec	Yes	No
7	Aircraft & Travel											
		A	Airport	AT	A/G	0.5	4.0	1.6	1 p/flt	2 min	Yes	No
		A	Airport	AT	G/A	0.5	4.0	1.6	1 p/flt	2 min	Yes	No
		D	Ops/Sup	AT	A/G	0.5	4.0	1.6	1-2 p/flt	2 min	Yes	No
		D	Ops/Sup	AT	G/A	0.5	4.0	1.6	1-2 p/flt	2 min	Yes	No

Ref #	Service	I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
						Min	Max	Avg				
8	Public Information Exchange											
		D	Ops/Sup	PIE	A/G	1.0	5.0	1.0	1-2 p/flt	2 min	Yes	No
		D	Ops/Sup	PIE	G/A	1.0	5,000.0	50.0	1-2 p/flt	2 min	Yes	No

Table 22. Information Object Parameters by Interface - 2005

I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
				Min	Max	Avg				
A	Airport	AT	A/G	0.5	4.0	1.6	1 p/flt	2 min	Yes	No
A	Airport	AT	G/A	0.5	4.0	1.6	1 p/flt	2 min	Yes	No
B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
B	Aircraft	PAE	A/A	0.2	1.0	0.4	5 sec	5 sec	Yes	No
B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
B	Aircraft	PAE	A/A	0.2	1.0	0.4	5 sec	5 sec	Yes	No
C	ATM Sys	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
C	ATM Sys	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
C	ATM Sys	ASI	G/A	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	MC	A/G	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
C	ATM Sys	MC	G/A	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
C	ATM Sys	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
C	ATM Sys	ASI	G/A	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
C	ATM Sys	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
C	ATM Sys	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	MC	A/G	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
C	ATM Sys	MC	G/A	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No

I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
				Min	Max	Avg				
D	Ops/Sup	AT	A/G	0.5	4.0	1.6	1-2 p/flt	2 min	Yes	No
D	Ops/Sup	AT	G/A	0.5	4.0	1.6	1-2 p/flt	2 min	Yes	No
D	Ops/Sup	PIE	A/G	1.0	5.0	1.0	1-2 p/flt	2 min	Yes	No
D	Ops/Sup	PIE	G/A	1.0	5,000.0	50.0	1-2 p/flt	2 min	Yes	No
E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
E	Surv	AS	G/A	0.2	13.0	4.0	5 sec	5 sec	No	Yes
E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
E	Surv	AS	G/A	0.2	13.0	4.0	5 sec	5 sec	No	Yes
E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
E	Surv	AS	G/A	0.2	13.0	4.0	5 sec	5 sec	No	Yes
F	NAV	NAV	G/A	1.0	1.8	1.4	2 p/sec	1/2 sec	No	Yes
G	FSS	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
G	FSS	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
G	FSS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
G	FSS	WX	G/A	0.5	500.0	250.0	5 min	2 min	Yes	No
G	FSS	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
G	FSS	ASI	G/A	0.5	1.2	0.3	1 p/flt	3 min	Yes	No
G	FSS	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
G	FSS	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
G	FSS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
G	FSS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes
H	NWS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
H	NWS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes
H	NWS	WX	A/G	0.2	0.5	0.4	15 sec	2 min	No	Yes
H	NWS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No

I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
				Min	Max	Avg				
H	NWS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes

Table 23. Information Object Parameters by Service - 2025

Ref #	Service	I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
						Min	Max	Avg				
1	Flight											
		C	ATM Sys	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		C	ATM Sys	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		D	Ops/Sup	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		D	Ops/Sup	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
		G	FSS	WX	G/A	0.5	500.0	250.0	5 min	2 min	Yes	No
		H	NWS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
		H	NWS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes
		H	NWS	WX	A/G	0.2	0.5	0.4	15 sec	2 min	No	Yes
		C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
		E	Surv	AS	G/A	0.2	13.0	11.0	5 sec	5 sec	No	Yes
		C	ATM Sys	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
		C	ATM Sys	ASI	G/A	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
		G	FSS	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
		G	FSS	ASI	G/A	0.5	1.2	0.3	1 p/flt	3 min	Yes	No
2	Air Traffic											
		C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
		E	Surv	AS	G/A	0.2	13.0	11.0	5 sec	5 sec	No	Yes
		C	ATM Sys	MC	A/G	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
		C	ATM Sys	MC	G/A	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No

Ref #	Service	I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
						Min	Max	Avg				
		C	ATM Sys	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
		C	ATM Sys	ASI	G/A	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
3	Emergency & Alert											
		C	ATM Sys	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		C	ATM Sys	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
		G	FSS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
		G	FSS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes
		H	NWS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
		H	NWS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes
		B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
		C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
		C	ATM Sys	MC	A/G	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
		C	ATM Sys	MC	G/A	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
4	Self-Separation & Sequencing											
		B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
		E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
		E	Surv	AS	G/A	0.2	13.0	11.0	5 sec	5 sec	No	Yes
		B	Aircraft	PAE	A/A	0.2	1.0	0.4	5 sec	5 sec	Yes	No
5	Navigation											
		F	NAV	NAV	G/A	1.0	1.8	1.4	2 p/sec	1/2 sec	No	Yes
		E	Surv	AS	G/A	0.2	13.0	11.0	5 sec	5 sec	No	Yes
6	Pilot/Aircraft Information											
		B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
		B	Aircraft	PAE	A/A	0.2	1.0	0.4	5 sec	5 sec	Yes	No
7	Aircraft & Travel											
		A	Airport	AT	A/G	0.5	4.0	1.6	1 p/flt	2 min	Yes	No
		A	Airport	AT	G/A	0.5	4.0	1.6	1 p/flt	2 min	Yes	No

Ref #	Service	I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
						Min	Max	Avg				
		D	Ops/Sup	AT	A/G	0.5	4.0	1.6	1-2 p/flt	2 min	Yes	No
		D	Ops/Sup	AT	G/A	0.5	4.0	1.6	1-2 p/flt	2 min	Yes	No
8	Public Information Exchange											
		D	Ops/Sup	PIE	A/G	1.0	5.0	1.0	1-2 p/flt	2 min	Yes	No
		D	Ops/Sup	PIE	G/A	1.0	5,000.0	50.0	1-2 p/flt	2 min	Yes	No

Table 24. Information Object Parameters by Interface - 2025

I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
				Min	Max	Avg				
A	Airport	AT	A/G	0.5	4.0	1.6	1 p/flt	2 min	Yes	No
A	Airport	AT	G/A	0.5	4.0	1.6	1 p/flt	2 min	Yes	No
B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
B	Aircraft	PAE	A/A	0.2	1.0	0.4	5 sec	5 sec	Yes	No
B	Aircraft	AS	A/A	0.2	1.0	0.3	5 sec	5 sec	No	Yes
B	Aircraft	PAE	A/A	0.2	1.0	0.4	5 sec	5 sec	Yes	No
C	ATM Sys	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
C	ATM Sys	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
C	ATM Sys	ASI	G/A	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	MC	A/G	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
C	ATM Sys	MC	G/A	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
C	ATM Sys	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
C	ATM Sys	ASI	G/A	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
C	ATM Sys	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
C	ATM Sys	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
C	ATM Sys	AS	A/G	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	AS	G/A	0.2	1.0	0.3	8-10 p/flt	5 sec	Yes	No
C	ATM Sys	MC	A/G	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No
C	ATM Sys	MC	G/A	0.2	10.0	0.4	20 p/flt	15 sec	Yes	No

I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
				Min	Max	Avg				
D	Ops/Sup	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
D	Ops/Sup	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
D	Ops/Sup	AT	A/G	0.5	4.0	1.6	1-2 p/flt	2 min	Yes	No
D	Ops/Sup	AT	G/A	0.5	4.0	1.6	1-2 p/flt	2 min	Yes	No
D	Ops/Sup	PIE	A/G	1.0	5.0	1.0	1-2 p/flt	2 min	Yes	No
D	Ops/Sup	PIE	G/A	1.0	5,000.0	50.0	1-2 p/flt	2 min	Yes	No
E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
E	Surv	AS	G/A	0.2	13.0	11.0	5 sec	5 sec	No	Yes
E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
E	Surv	AS	G/A	0.2	13.0	11.0	5 sec	5 sec	No	Yes
E	Surv	AS	A/G	0.2	1.0	0.3	5 sec	5 sec	Yes	Yes
E	Surv	AS	G/A	0.2	13.0	11.0	5 sec	5 sec	No	Yes
E	Surv	AS	G/A	0.2	13.0	11.0	5 sec	5 sec	No	Yes
F	NAV	NAV	G/A	1.0	1.8	1.4	2 p/sec	1/2 sec	No	Yes
G	FSS	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
G	FSS	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
G	FSS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
G	FSS	WX	G/A	0.5	500.0	250.0	5 min	2 min	Yes	No
G	FSS	ASI	A/G	0.2	1.2	0.3	1 p/flt	2 min	Yes	No
G	FSS	ASI	G/A	0.5	1.2	0.3	1 p/flt	3 min	Yes	No
G	FSS	FPU	A/G	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
G	FSS	FPU	G/A	1.0	5.0	2.0	1-2 p/flt	2 min	Yes	No
G	FSS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
G	FSS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes
H	NWS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No

I/F	Entity	Object	Type	Size (Kb)			Frequency	Delay	Addressed	Broadcast
				Min	Max	Avg				
H	NWS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes
H	NWS	WX	A/G	0.2	0.5	0.4	15 sec	2 min	No	Yes
H	NWS	WX	A/G	0.2	1.0	0.5	1-2 p/flt	2 min	Yes	No
H	NWS	WX	G/A	0.5	500.0	250.0	5 min	2 min	No	Yes

9. AIRCRAFT COMMUNICATIONS LOAD MODEL

The operational services/information exchange object matrix shows all of the objects associated with each service. Since the same object supports multiple services, the matrix cannot be used directly to gain insight into the communications load experienced by a SATS aircraft in flight. A spreadsheet model was created to gain insight into the communications load experienced by a single SATS aircraft. The model was based upon a two hour flight with the following segments: departure - 30 minutes, en route - 70 minutes, and arrival - 20 minutes.

Two models were created. The 2005 model was based upon 100 aircraft being within a 50 mile radius of a SATS airfield. The 2025 model assumed 250 aircraft. The number of aircraft in the area is significant because it is the basis for the size of the airspace situation (AS) message. The AS broadcast (analogous to TIS-B) contains data generated by the ground-based surveillance system. More aircraft in the area results in a larger message.

The FPU, MC, ASI, AT and PAE objects were assumed to be transmitted via addressed messages. The AS, WX and NAV objects used a broadcast transmission scheme. Protocol overhead was added to each message that was transmitted.

The messages associated with the objects were grouped into either a human and system message category. A human message is one that has to be processed by a person. Processing can be preparing the message, reading it, or just acknowledging it. A system message is one that is generated or processed by systems on board the aircraft.

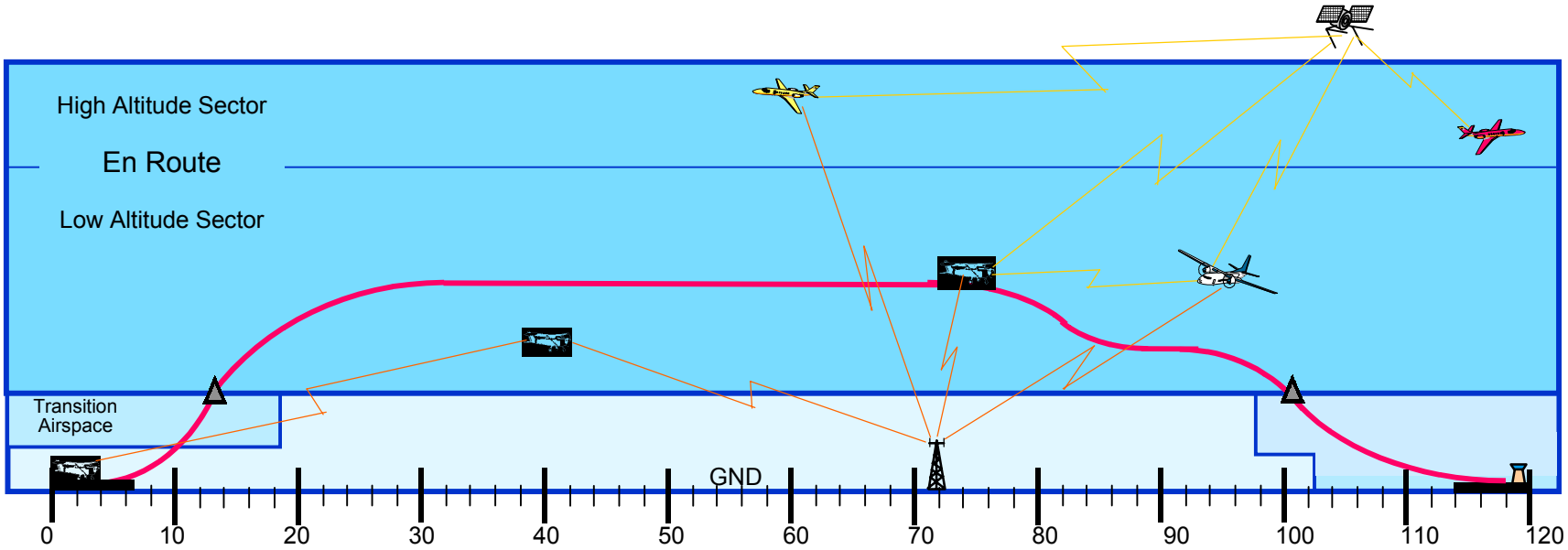
A review of the objects indicates that some of them can fall into both categories. For this analysis, they were included in the category that seemed most appropriate. The FPU, MC, ASI and AT objects were associated with human messages, while PAE, AS, WX and NAV objects were considered system messages.

A graphical depiction of the 2005 flight profile and model results are shown in Figure 7, while Figure 8 shows the communications load by time throughout the flight. It is clear from looking at Figure 8 that the vast majority of the communications load is attributed to system messages. There is a constant load of about 820 bps that can be attributed to surveillance data broadcasts. There is a 2 minute spike every 5 minutes of about 2.1 Kbps associated with a new graphical weather report. Then, there is about a 2.8 Kbps spike at the beginning and end of the flight due to the reception of LAAS data. (Since one of the SATS goals is a Category 3 landing, LAAS reports are needed every ½ second.)

As shown in the table at the bottom of Figure 7, the average communications load attributed to system message is almost 300 times that of human messages (171.8 Kb/min vs. 0.6 Kb/min). The average communications load attributed to a single SATS aircraft is 172 Kb/min.

Figures 9 and 10 portray a similar situation for 2025. The most significant difference is the increase in the size of the load associated with surveillance data (2.2 Kbps). This is because of the increase in aircraft density (100 to 250) within a 50 mile radius of a SATS airfield. The ratio

of system to human message load increases to over 400 (255.8 Kb/min vs. 0.6 Kb/min). The average communications load attributed to a single SATS aircraft also increases. It is 256 Kb/min.



Airborne Internet Air/Ground Messages

	Human	System	Total
Total Load (Kb)	70	20,611	20,681
Average Message Size (Kb)	1.3	2.7	2.0
Average Load/Minute (Kb/min)	0.6	171.8	172.3
Total # Messages	55	7,671	7,726
Average # Messages/Minute	0.5	63.9	64.4

Figure 7. Typical Flight Profile - 2005

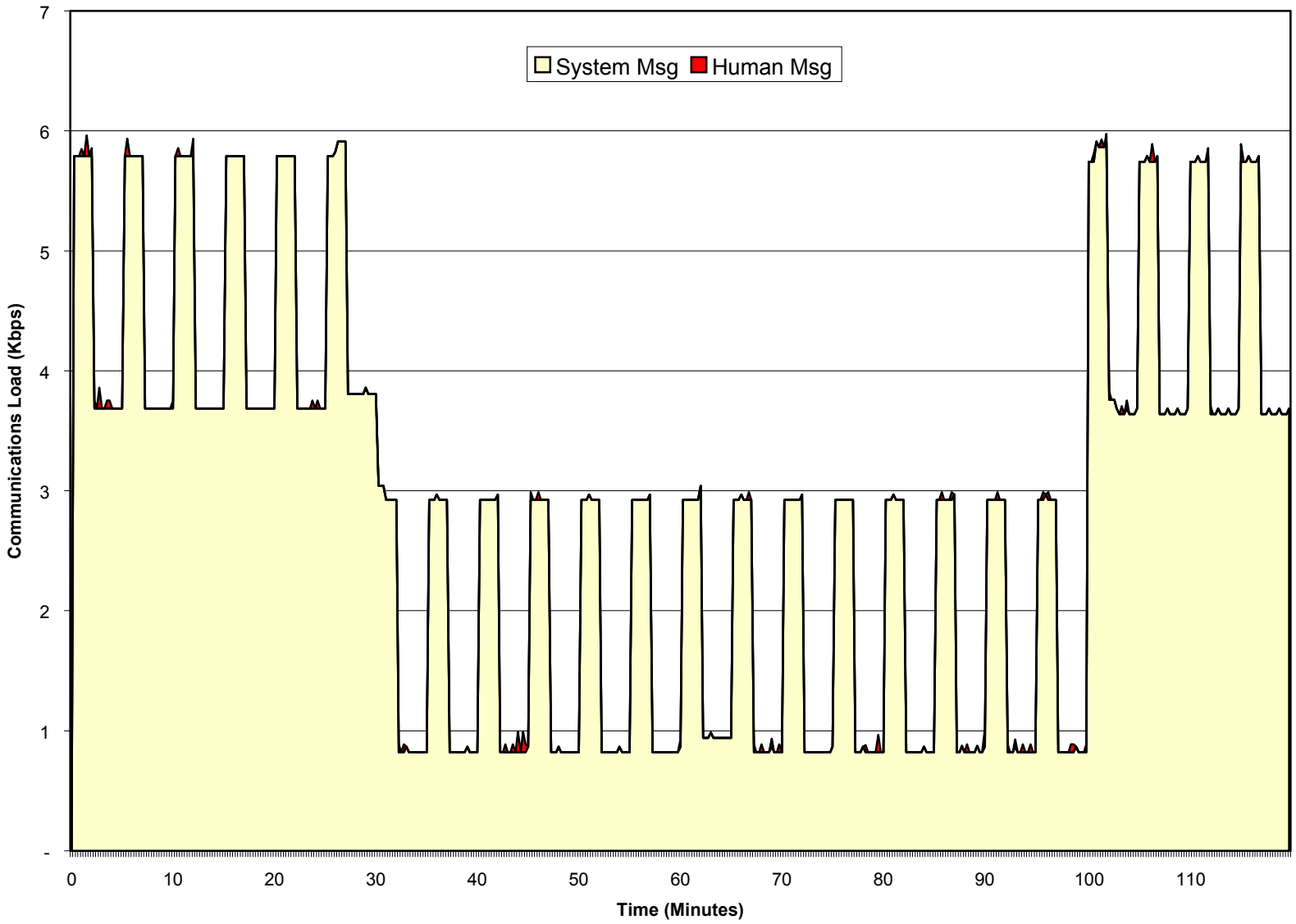
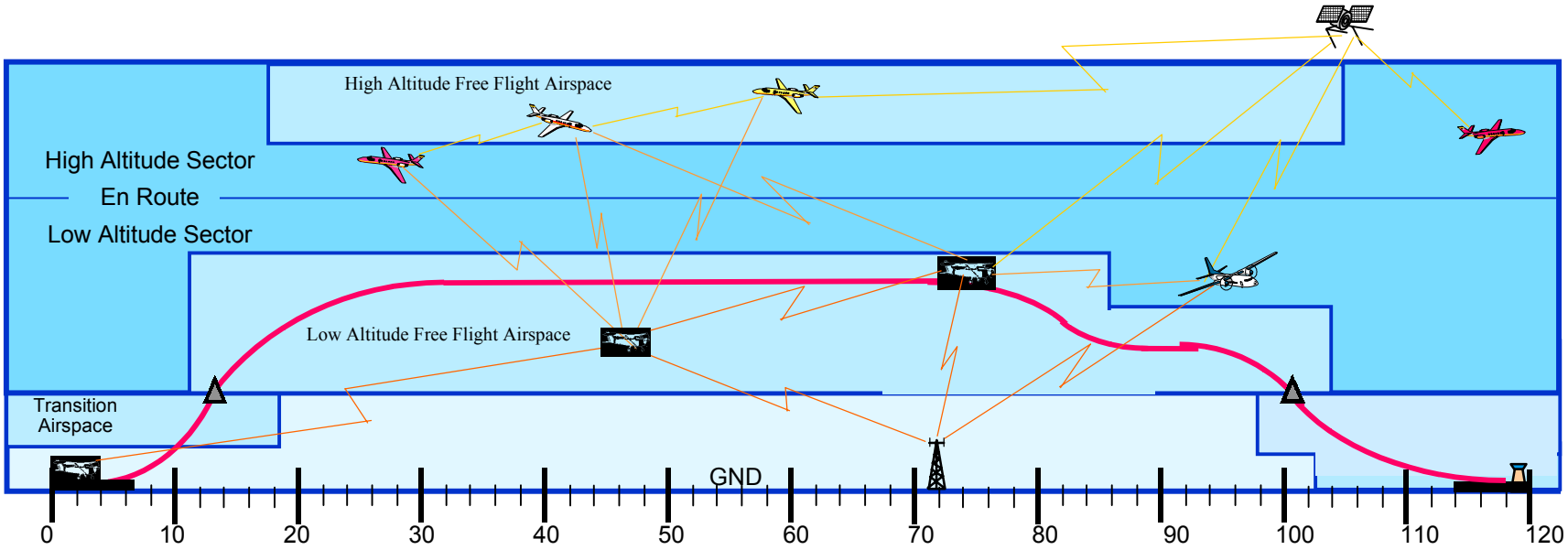


Figure 8. Communication Load Distribution - 2005



Airborne Internet Air/Ground Messages

	Human	System	Total
Total Load (Kb)	**70**	**30,691**	**30,761**
Average Message Size (Kb)	**1.3**	**4.0**	**4.0**
Average Load/Minute (Kb/min)	**0.6**	**255.8**	**256.3**
Total # Messages	**55**	**7,671**	**7,726**
Average # Messages/Minute	**0.5**	**63.9**	**64.4**

Figure 9. Typical Flight Profile - 2025

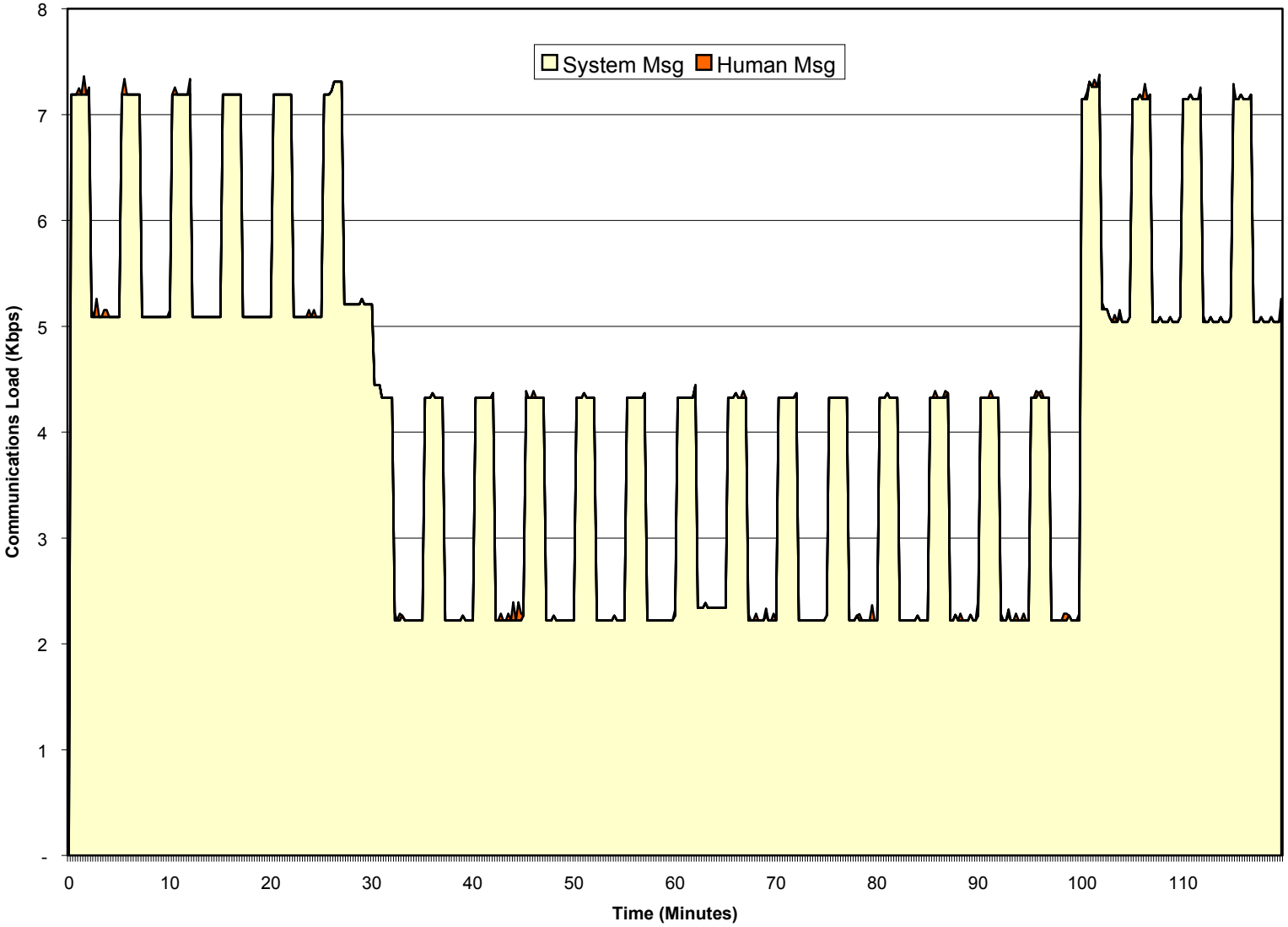


Figure 10. Communication Load Distribution - 2025

10. AIRBORNE INTERNET BANDWIDTH REQUIREMENTS

The modeling activities yielded the communications load attributed to a single SATS aircraft. One goal of the AI effort is to reduce the number of transmission mediums needed to support the SATS aircraft. Achieving this goal should reduce the number of radios and antennas needed aboard the aircraft.

If a minimum (or ideally one) radio is to support the SATS aircraft, the bandwidth must be sufficient to support all of the aircraft that are using it. There are two areas where the single aircraft model results have to be adjusted. Although SATS aircraft #1 will only use the LAAS during departure and arrival, other aircraft in the vicinity will be using it while aircraft #1 is in the en route segment of its flight. Thus, the bandwidth must accommodate the continuous use of the LAAS.

A second adjustment is associated with weather data that is transmitted by the aircraft. (The parameters used in the model were based upon the TAMDAR system.) The bandwidth must accommodate multiple aircraft transmitting weather data. The assumption used was that 25% of the aircraft would transmit weather data from its sensor.

Finally, the bandwidth must accommodate addressed communications from each aircraft in the area. Thus, the single aircraft requirement is multiplied by the number of aircraft in the region.

The resulting bandwidth requirements are shown in Tables 25 and 26. The tables also show the communications load requirements by addressed and broadcast transmission scheme. The AI bandwidth requirement is 6.9 Kbps in 2005 and 11.8 in 2025.

Table 25. Analysis - 2005

All Messages	FPU	MC	ASI	AT	PAE	AS	WX	NAV	Total
Message Load - Flight (Kb)	1,300	4,000	360	1,320	7,200	5,904	8,913	20,304	49,301
Average Message Load (Kbps)	0.18	0.56	0.05	0.18	1.00	0.82	1.24	2.82	6.85
Addressed Messages	FPU	MC	ASI	AT	PAE	AS	WX	NAV	Total
Message Load - Flight (Kb)	1,300	4,000	360	1,320	7,200				14,180
Average Message Load (Kbps)	0.18	0.56	0.05	0.18	1.00				1.97
Broadcast Messages	FPU	MC	ASI	AT	PAE	AS	WX	NAV	Total
Message Load - Flight (Kb)						5,904	8,913	20,304	35,121
Average Message Load (Kbps)						0.82	1.24	2.82	4.88

Table 26. Analysis - 2025

All Messages	FPU	MC	ASI	AT	PAE	AS	WX	NAV	Total
Message Load - Flight (Kb)	3,250	10,000	900	3,300	18,000	15,984	13,192	20,304	84,930
Average Message Load (Kbps)	0.45	1.39	0.13	0.46	2.50	2.22	1.83	2.82	11.80
Addressed Messages	FPU	MC	ASI	AT	PAE	AS	WX	NAV	Total
Message Load - Flight (Kb)	3,250	10,000	900	3,300	18,000				35,450
Average Message Load (Kbps)	0.45	1.39	0.13	0.46	2.50				4.92
Broadcast Messages	FPU	MC	ASI	AT	PAE	AS	WX	NAV	Total
Message Load - Flight (Kb)						15,984	13,192	20,304	49,480
Average Message Load (Kbps)						2.22	1.83	2.82	6.87

Appendix A: Acronyms

Acronym	Meaning
A/A	Air-to-Air
A/C	Aircraft
A/G	Air-to-Ground
A/P	Airport
ADS-A	Automatic Dependent Surveillance - Addressed
ADS-B	Automatic Dependent Surveillance – Broadcast
AGATE	Advanced General Aviation Transport Experiments
AI	Airborne Internet
ATC	Air Traffic Control
ASC	Airspace System Capacity
AS	Airspace Situation
ASI	Aviation System Information
AT	Aircraft & Travel
ATM	Air Traffic Management
ATM Sys	Air Traffic Management System
Avg	Average
bps	Bit per Second
CDM	Collaborative Decision Making
CNS	Communications, Navigation, and Surveillance
CNS	Computer Networks & Software, Inc.
CPDLC	Controller Pilot Data Link Communications
DAG-TM	Distributed Air Ground Traffic Management
FAA	Federal Aviation Administration
FBO	Fixed Base Operator
FMS	Flight Management System
FPU	Flight Planning and Use
FSS	Flight Service Station
G/A	Ground-to-Air
GA	General Aviation
GAP	General Aviation Propulsion
GPS	Global Positioning System
GRC	Glenn Research Center
HF	High Frequency
IE	Information Exchange

Acronym	Meaning
IFR	Instrument Flight Rules
ILS	Instrumented Landing System
IP	Internet Protocol
Kb	Kilobits
Kb/min	Kilobits per minute
Kbps	Kilobits per second
LAAS	Local Area Augmentation System
Max	Maximum
MC	Maneuver & Control
Min	Minimum
min	minute
Msg	Message
MTOW	Maximum Take Off Weight
NAS	National Airspace System
NASA	National Aeronautics & Space Administration
NAV	Navigation Information
NAVAID	Navigational Aid
NEXRAD	Next Generation Weather Radar
NOTAM	Notice to Airmen
NWIS	NAS-Wide Information System
NWS	National Weather Service
Ops/Sup	Operator/Supplier
PAE	Pilot/Aircraft Information Exchange
p/flt	per flight
PKI	Public Key Infrastructure
PIE	Public Information Exchange
SAR	Search and Rescue
SATCOM	Satellite Communications
SATS	Small Aircraft Transportation System
SUA	Special Use Airspace
Surv	Surveillance
TCP/IP	Transport Control Protocol/Internet Protocol
TIS	Traffic Information Service

Appendix A: Acronyms

Acronym	Meaning
TIS-B	Traffic Information Service – Broadcast
VFR	Visual Flight Rules
VHF	Very High Frequency
WAAS	Wide Area Augmentation System
WX	Weather

1. Flight Service - 2005

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) G	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) G	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) G	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.5 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) G	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 500 Kb, 250 Kb Frequency of Occurrence: Every 5 minutes Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) H	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.5 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) H	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 500 Kb, 250 Kb Frequency of Occurrence: Every 5 minutes Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) H	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 0.5 Kb, 0.4 Kb Frequency of Occurrence: 15 seconds Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: Yes Suitable for Broadcast: Yes Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 13 Kb, 4 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) G	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) G	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

2. Air Traffic Service - 2005

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: Yes Suitable for Broadcast: Yes Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 13 Kb, 4 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Maneuver & Control (MC) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 10 Kb, 0.4 Kb Frequency of Occurrence: 20 times per flight Acceptable Delay: 15 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Maneuver & Control (MC) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 10 Kb, 0.4 Kb Frequency of Occurrence: 20 times per flight Acceptable Delay: 15 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

3. Emergency and Alerting Service - 2005

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) G	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) G	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) G	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.5 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) G	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 500 Kb, 250 Kb Frequency of Occurrence: Every 5 minutes Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) H	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.5 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) H	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 500 Kb, 250 Kb Frequency of Occurrence: Every 5 minutes Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) B	Type: A/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Maneuver & Control (MC) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 10 Kb, 0.4 Kb Frequency of Occurrence: 20 times per flight Acceptable Delay: 15 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Maneuver & Control (MC) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 10 Kb, 0.4 Kb Frequency of Occurrence: 20 times per flight Acceptable Delay: 15 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

4. Self-Separation and Sequencing Service - 2005

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) B	Type: A/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: Yes Suitable for Broadcast: Yes Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 13 Kb, 4 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Pilot/Aircraft Information Exchange (PAE) Applicable Interface: (Entity-to-Entity) B	Type: A/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.4 Kb Frequency of Occurrence: Every 5 seconds for 10 minutes of a flight Acceptable Delay: 5 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

5. Navigation Service - 2005

Information Exchange – (IE Object) Navigation Information (NAV) Applicable Interface: (Entity-to-Entity) F	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 1 Kb, 1.8 Kb, 1.4 Kb Frequency of Occurrence: Two times per second for 15 minutes Acceptable Delay: 1/2 second Authentication: Yes Priority: High Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

6. Pilot/Aircraft Information Service - 2005

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) B	Type: A/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Pilot/Aircraft Information Exchange (PAE) Applicable Interface: (Entity-to-Entity) B	Type: A/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.4 Kb Frequency of Occurrence: Every 5 seconds for 10 minutes of a flight Acceptable Delay: 5 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

7. Aircraft and Travel Service - 2005

Information Exchange – (IE Object) Aircraft & Travel (AT) Applicable Interface: (Entity-to-Entity) A	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 4 Kb, 1.6 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aircraft & Travel (AT) Applicable Interface: (Entity-to-Entity) A	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 4 Kb, 1.6 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aircraft & Travel (AT) Applicable Interface: (Entity-to-Entity) D	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 4 Kb, 1.6 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aircraft & Travel (AT) Applicable Interface: (Entity-to-Entity) D	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 4 Kb, 1.6 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

8. Public Information Exchange Service - 2005

Information Exchange – (IE Object) Public Information Exchange (PIE) Applicable Interface: (Entity-to-Entity) D	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 1 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: No Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Public Information Exchange (PIE) Applicable Interface: (Entity-to-Entity) D	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5,000 Kb, 50 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: No Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

1. Flight Service - 2025

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) D	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) D	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) G	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) G	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) G	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.5 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) G	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 500 Kb, 250 Kb Frequency of Occurrence: Every 5 minutes Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) H	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.5 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) H	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 500 Kb, 250 Kb Frequency of Occurrence: Every 5 minutes Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) H	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 0.5 Kb, 0.4 Kb Frequency of Occurrence: 15 seconds Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: Yes Suitable for Broadcast: Yes Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 13 Kb, 11 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) G	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) G	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

2. Air Traffic Service - 2025

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: Yes Suitable for Broadcast: Yes Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 13 Kb, 11 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Maneuver & Control (MC) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 10 Kb, 0.4 Kb Frequency of Occurrence: 20 times per flight Acceptable Delay: 15 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Maneuver & Control (MC) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 10 Kb, 0.4 Kb Frequency of Occurrence: 20 times per flight Acceptable Delay: 15 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aviation System Information (ASI) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1.2 Kb, 0.3 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

3. Emergency and Alerting Service - 2025

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) G	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Flight Planning & Use (FPU) Applicable Interface: (Entity-to-Entity) G	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 2 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) G	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.5 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) G	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 500 Kb, 250 Kb Frequency of Occurrence: Every 5 minutes Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) H	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.5 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Weather (WX) Applicable Interface: (Entity-to-Entity) H	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 500 Kb, 250 Kb Frequency of Occurrence: Every 5 minutes Acceptable Delay: 2 minutes Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) B	Type: A/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 8 – 10 times per flight Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Maneuver & Control (MC) Applicable Interface: (Entity-to-Entity) C	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 10 Kb, 0.4 Kb Frequency of Occurrence: 20 times per flight Acceptable Delay: 15 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Maneuver & Control (MC) Applicable Interface: (Entity-to-Entity) C	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 10 Kb, 0.4 Kb Frequency of Occurrence: 20 times per flight Acceptable Delay: 15 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

4. Self-Separation and Sequencing Service - 2025

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) B	Type: A/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: A/G Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: Yes Suitable for Broadcast: Yes Suitable for Multicast: No

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 13 Kb, 11 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Pilot/Aircraft Information Exchange (PAE) Applicable Interface: (Entity-to-Entity) B	Type: A/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.4 Kb Frequency of Occurrence: Every 5 seconds for 10 minutes of a flight Acceptable Delay: 5 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

5. Navigation Service - 2025

Information Exchange – (IE Object) Navigation Information (NAV) Applicable Interface: (Entity-to-Entity) F	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 1 Kb, 1.8 Kb, 1.4 Kb Frequency of Occurrence: Two times per second for 15 minutes Acceptable Delay: 1/2 second Authentication: Yes Priority: High Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) E	Type: G/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 13 Kb, 11 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

6. Pilot/Aircraft Information Service - 2025

Information Exchange – (IE Object) Airspace Situation (AS) Applicable Interface: (Entity-to-Entity) B	Type: A/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.3 Kb Frequency of Occurrence: 5 seconds Acceptable Delay: 5 seconds Authentication: No Priority: Medium Retransmission Required: No Suitable for Addressed Communications: No Suitable for Broadcast: Yes Suitable for Multicast: Yes

Information Exchange – (IE Object) Pilot/Aircraft Information Exchange (PAE) Applicable Interface: (Entity-to-Entity) B	Type: A/A Integrity (Error Rate): High Information Unit Size (Min, Max, Avg): 0.2 Kb, 1 Kb, 0.4 Kb Frequency of Occurrence: Every 5 seconds for 10 minutes of a flight Acceptable Delay: 5 seconds Authentication: No Priority: High Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

7. Aircraft and Travel Service - 2025

Information Exchange – (IE Object) Aircraft & Travel (AT) Applicable Interface: (Entity-to-Entity) A	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 4 Kb, 1.6 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aircraft & Travel (AT) Applicable Interface: (Entity-to-Entity) A	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 4 Kb, 1.6 Kb Frequency of Occurrence: Once per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aircraft & Travel (AT) Applicable Interface: (Entity-to-Entity) D	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 4 Kb, 1.6 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Aircraft & Travel (AT) Applicable Interface: (Entity-to-Entity) D	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 0.5 Kb, 4 Kb, 1.6 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: Yes Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

8. Public Information Exchange Service - 2025

Information Exchange – (IE Object) Public Information Exchange (PIE) Applicable Interface: (Entity-to-Entity) D	Type: A/G Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5 Kb, 1 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: No Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No

Information Exchange – (IE Object) Public Information Exchange (PIE) Applicable Interface: (Entity-to-Entity) D	Type: G/A Integrity (Error Rate): Medium Information Unit Size (Min, Max, Avg): 1 Kb, 5,000 Kb, 50 Kb Frequency of Occurrence: 1-2 times per flight Acceptable Delay: 2 minutes Authentication: No Priority: Low Retransmission Required: No Suitable for Addressed Communications: Yes Suitable for Broadcast: No Suitable for Multicast: No