FAA Telecommunications Infrastructure 2

(FTI-2)

Program Objectives

White Paper

September 25, 2017

Federal Aviation Administration
800 Independence Avenue
Washington, D.C. 20591

TABLE OF CONTENTS

1.0 Introduction **1**

2.0 Challenges **2**

3.0 Current Operating Environment **3**

3.1 System Overview 3

3.2 Description of Current Services 4

4.0 FTI-2 program Objectives **6**

5.0 Summary **8**

6.0 Reference **8**

LIST OF FIGURES

Figure 1 – National Airspace System (NAS) 1

Figure 2 - FTI Telecommunications Services 2

Figure 3 - FTI Telecommunications Interfaces 3

Figure 4 - FTI Scope 5

1.0 Introduction

As articulated in *The Future of the NAS* [1], the Federal Aviation Administration (FAA) is evolving towards the seamless integration of National Airspace System (NAS) data, systems and people. FAA emerging systems and the associated operational concepts will rely on the distribution of information to accomplish this – providing resiliency and decision making that is driven by improved access to information [1]. A challenge to this evolution is the FAA's extensive inventory of point-to-point communication services used by FAA legacy systems that provide core Air Traffic Control (ATC) functions (e.g., Air-to-Ground (A/G) and Ground-to-Ground (G/G) voice; surveillance; and monitoring and control)). Figure 1 – National Airspace System (NAS) provides a high-level overview of the NAS.

Figure 1 – National Airspace System (NAS)

Currently, the FAA primarily relies on the FAA Telecommunications Infrastructure (FTI) contract for communications services to satisfy the needs of the FAA's portfolio of systems. FTI is comprised of three separate network environments (also referred to as "domains"): NAS Operations, Mission Support, and Research and Development (R&D). The FTI contract was awarded in 2002 with a five-year base period and 10 one-year options. In 2013, the FAA announced its intent to extend the contract on a single source basis for five more years (FY2018-FY2022).

Before the end of the FTI contract, the FAA intends to conduct a competitive solicitation resulting in one or more awards of service-based contracts to meet the FAA's needs for communications services. The follow-on program is referred to as "FTI-2." This document presents the FTI-2 program objectives.

2.0 Challenges

There are several telecommunications challenges facing the FAA:

- Transition to FTI-2: The FAA's requirements for telecommunications services to support the NAS are continual and not bound by the contractual end dates. With a new contract, there will be new operational solutions and the need to transition current FTI services to that new solution. With a current inventory of over 26,000 telecommunications services, transition may require multiple years to plan, install, test, and put into operation. Figure 2 - FTI Telecommunications Services shows a summary of the services currently provided under FTI by the functional use.

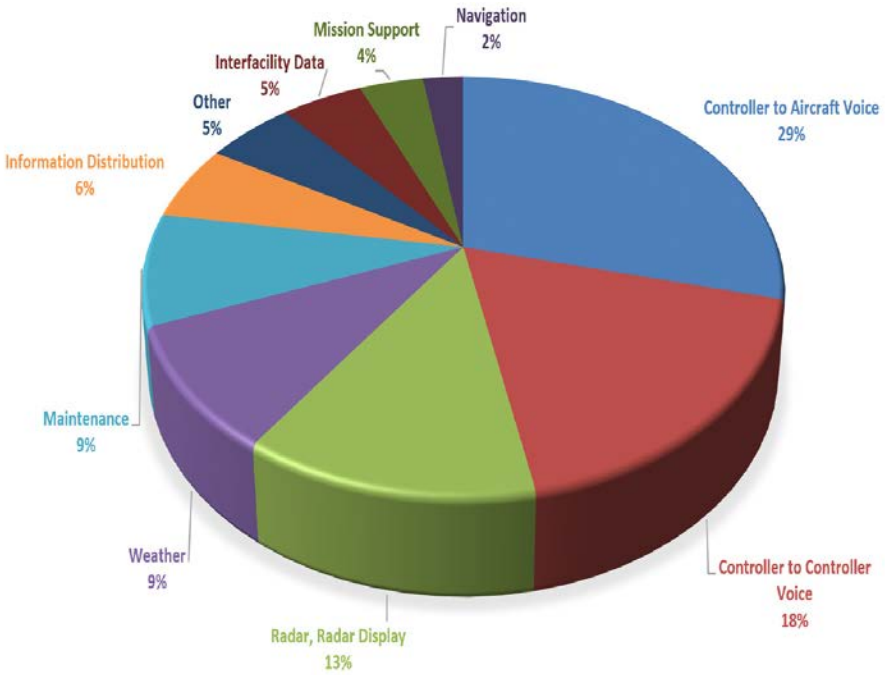

Figure 2 - FTI Telecommunications Services

- Time Division Multiplexing (TDM) to Internet Protocol (IP) industry transition: In the commercial marketplace, telecommunications carriers are moving away from TDM-based technologies. This has a significant impact on the FAA because approximately 90 percent of the communications services used by NAS operational systems (87percent of the total FTI services) are TDM-based. Additionally, the phase out of TDM-based services will also pose challenges for the FAA with respect to the reliability and cost effectiveness of these services over time. Figure 3 - FTI Telecommunications Interfaces shows the distribution of telecommunications interfaces currently in use under FTI.

- NAS Unique Requirements: The NAS has many requirements that are not widely available from the telecommunications industry. Examples include TDM interfaces like EIA-232 services, high availability services, and high availability radar over IP multicast.

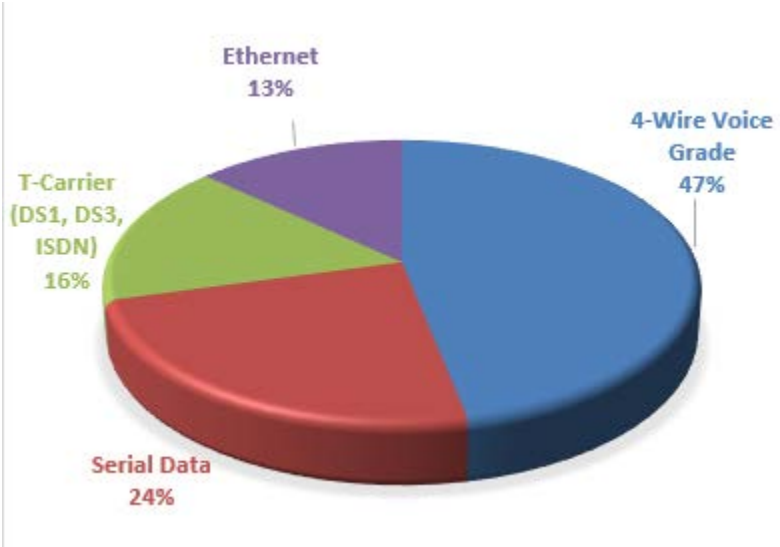

Figure 3 - FTI Telecommunications Interfaces

- New Technology: As new telecommunications technologies enter the marketplace and FAA infrastructure is continuously modernized, the FTI-2 contractor will need to provide services to accommodate the hybrid environment.
- Investment Profile: The FAA will need to establish a minimum investment profile that allows the FTI-2 contractor to design, test, establish network assets and transition services safely and efficiently.
- Remote Site Access: With over 3000 locations, FTI-2 will need the ability to obtain modern, high availability network communications in remote/rural locations.

3.0 Current Operating Environment

3.1 System Overview

As noted in the preceding sections, FTI is a service-based contract. The FTI contractor is responsible for the design, provisioning, integration, operation, and maintenance of the FTI system. To support the FAA's communications service needs, the FTI system encompasses all required requirements including:

(i) Physical layer transport and access transmission resources such as fiber, copper, microwave, satellite, etc. and physical layer transmit/receive equipment;

(ii) Data Link Layer traffic flow and control resources such as multiplexers, switches and bridges;

(iii) Network Layer IP networking and security resources, such as routers, firewalls, Boundary Protection Gateways, and Intrusion Detection Systems; and

(iv) Infrastructure, network and service monitoring and control resources as necessary.

The mission of the FAA Air Traffic Organization (ATO) is to provide the safest, most efficient aerospace system in the world through the NAS. Due to the critical nature of the NAS, the required performance levels for FTI services are difficult to provide using basic commercial service offerings. The FAA's requirements for high availability and survivability (i.e., protection from network-wide failures) are due to the potential impacts of service interruptions that may range from the safety of the flying public to costly airline delays. Operational drivers include:

- ***High availability for critical NAS services:*** NAS systems require telecommunications services with an availability that ranges between 0.999997 to 0.997. The highest availability services support NAS critical services. Approximately 90 percent of the services require 0.997 availability or less.
- ***Performance:*** Although most NAS services do not have stringent performance requirements, the most latency-sensitive services have performance requirements as low as 50 milliseconds.
- ***NAS Sites:*** NAS facilities requiring telecommunications services can range from 21 large Air Route Traffic Control Centers (ARTCCs) in major metropolitan areas supporting hundreds of services each to many (3,000 plus) small unmanned facilities in remote and rural locations supporting as few as a single service.
- ***Diversity:*** High availability service requirements typically require various forms of diversity in the access path design.
- ***Survivable Network Infrastructure:*** The telecommunications infrastructure must be protected against system-wide failures including those caused by rare or common-mode events.
- ***Legacy interfaces:*** Many of the dedicated telecommunications services in the NAS rely on low-speed serial data or analog voice interfaces. These interfaces are present at many NAS sites that provide navigation, surveillance, air/ground voice and other critical services.

3.2 Description of Current Services

The FTI contract provides network infrastructure, access and transport, and security mechanisms (including boundary protection) to meet the FAA's requirements for communication services. Primarily through the use of dedicated Customer Premise Equipment (CPE) and access and transport services, FTI

supports the transfer of voice, data, and video information among NAS and external users as depicted in Figure 4 - FTI Scope.

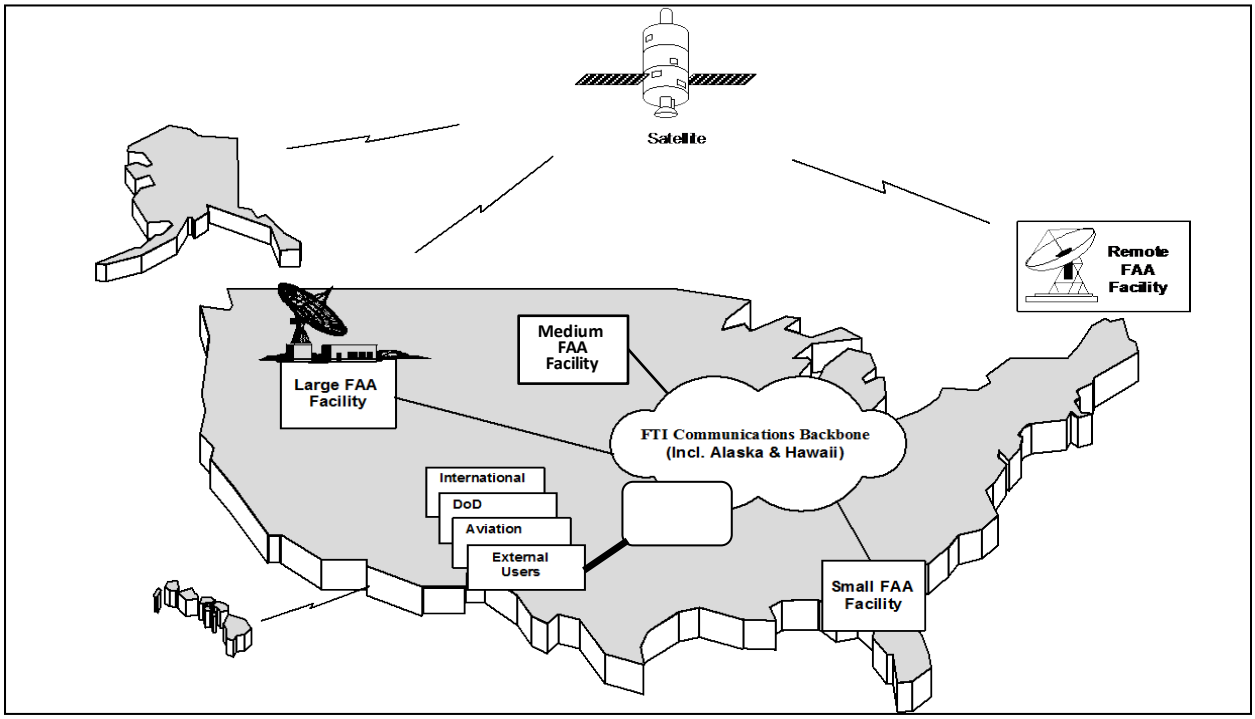

Figure 4 - FTI Scope

The services provided by the FTI contract may be broadly categorized as follows:

Operational IP (OPIP) Network

Systems that require the use of IP for NAS operations use the FTI NAS Operational IP (OPIP) Network. OPIP services can be provisioned at any NAS facility including remote unmanned facilities. Each OPIP service provides connectivity from a site to the NAS private Wide Area Network (WAN). Security services include boundary protection are implemented via an extranet security gateway.

Mission Support IP Network

The FTIMS network provides IP telecommunications services primarily to support FAA's non-NAS systems such as payroll and email. The MS network is located at approximately 1100 FAA facilities and non-government sites throughout the United States of America and select international locations.

Enterprise Security

FTI's boundary protection infrastructure includes multiple extranet security gateways, Internet Access Points (IAPs), and a dedicated boundary protection transmission network for inter-gateway interactions.

Point-to-Point and Multipoint Services

There are approximately 21,000 plus point-to-point and multipoint services in the NAS inventory. These services form the most critical component of NAS communications. High availability may be required for these services (up to 0.9999971). The following list provides a brief description of these services:

- ***Voice Communications:***
    a. ***Full period point-to-point voice:*** used for pilot-to-controller and controller-to-controller communications. These are typically four-wire analog voice grade channels. (~11,000 services).
    b. ***Multipoint voice circuits:*** used for controller-to-controller communications. (~2,100 legs).
- ***Surveillance (Radar, Sensor):*** Typically 2.4 kilobytes per second (kbps) or 9.6 kbps EIA-232 channels. Newer sensors may be 56 kbps EIA-530, DDS-56, or Fractional T1. (~1500 services).
- ***Weather:*** Typically, 2.4 kbps or 9.6 kbps EIA-232 channels. Some weather radars use T1 service. (~1800 services).
- ***Flight Data distribution:*** Typically, 2.4 kbps or 9.6 kbps EIA-232 channels. (~700 services).
- ***Automation:*** Used for handoff between Enroute and Terminal Airspaces. These are typically 2.4 kbps or 9.6 kbps EIA-232 channels. (~350 services).
- ***Remote Monitoring and Maintenance:*** Monitoring and control of FAA ATC systems typically at unmanned sites. These are typically 2.4 kbps EIA-232 (~1780 services) and 4-wire analog voice grade (~300 services).

SOA Messaging Infrastructure

The FAA's enterprise messaging infrastructure provides the basis for information exchange between systems based on the principles of a Service Oriented Architecture (SOA). The FAA uses SOA as a means of organizing Information Technology (IT) assets, policies, practices, and frameworks that enable application functionality to be provided and consumed as services. Enterprise messaging services are implemented as part of the FTI infrastructure to support the FAA NextGen-enabling System Wide Information Management (SWIM) program. The FAA's use of SOA is geared toward providing a common platform to exchange information among different NAS systems.

4.0 FTI-2 Program Objectives

The FAA expects that the FTI-2 program will comprise one or more service-based contracts in which the contractor will be responsible for the design, provisioning, integration, operation, and maintenance of the FTI-2 network, services, and operational support systems. The FTI-2 system will encompass all required system resources to support FAA-defined telecommunications and information management service needs terminated at stipulated Service Delivery Points (SDPs) within FAA facilities and required field locations.

Most of the current services described in Section 3.2 are also expected to be ordered under FTI-2, although the combination of services is expected to change over time. For example, although it is

expected that FTI-2 will need to support the TDM interfaces for NAS legacy systems, the proportion of TDM interfaces is expected to decline over the contract period of performance.

The FAA envisions that FTI-2 will support the following specific objectives:

Maintain the high levels of availability, survivability, security, and performance that are required for NAS mission critical applications.

Even with the penetration of existing and new technology like Multi-Protocol Label Switching (MPLS), Long Term Evolution (LTE) wireless, Very Small Aperture Terminal (VSAT) satellite, Software Defined Network (SDN), and Network Function Virtualization (NFV), the FAA cannot suffer degradations in the performance of its networks. The basic function and criticality of the NAS must not be impacted. This requires FTI-2 to carefully plan the implementation of new technology. Additional considerations are as follows:

- Survivability of new technology that centralizes control of network infrastructure should be investigated and robust implementation of these technologies suggested. Examples might include dual/diverse backbone architectures and robust/redundant SDN architectures.
- New technology that can improve performance and availability should be explored. For example, utilization of VSAT and LTE architectures where it is anticipated that diverse wireline infrastructure may not be supported as industry moves away from legacy technology.
- New models should be considered for utilizing technology to reduce the number of outages that require a time-consuming site dispatch for resolution.

Provide dynamic service provisioning capabilities, flexibility, and seamless user experience related to specifying and ordering services.

Several recent changes in telecommunications technology, like SDN, NFV, Carrier Ethernet/Wireless Carrier Ethernet, may make it feasible to support a flexible service ordering paradigm under FTI-2 including:

- *Dynamic Provisioning* – The FTI-2 Service Management function includes the capability to support the provisioning of new services and upgrading existing services within minutes (in certain situations).
- *Dynamic Reconfiguration* – The FTI-2 Service Management function will be capable of dynamically reconfiguring services in the event of the loss of an individual service or the catastrophic loss of an entire facility. Depending on the scope of the event, these actions may be completed within minutes or hours. This capability will directly benefit FAA initiatives to support contingency operations and improve NAS resiliency.
- *Remote Configuration Management* – The FTI-2 Service Management function will be capable of remotely implementing new versions of virtualized functions.

Provide insight and visibility into the network service configuration and operations.

The introduction of newer telecommunications technologies such as SDN and NFV may support a considerably more flexible and resilient architecture under FTI-2. This could potentially provide the FAA

with visibility into individual critical service flows as they traverse the network, with features like end-to-end testing of performance parameters, visualization of service flows and situational awareness of service flow outages. An example of an operation feature would be the implementation of a possible reconstitution of a NAS radar service that goes to the primary ARTCC. When the primary ARTCC fails, the Network Operations Control Center (NOCC) enables the reconstitution playbook which uses SDN to automatically send instructions to the network equipment rerouting the radar date to the secondary ARTCC.

Evolve to future technologies that may benefit both NAS and Administrative users.

As new technologies are developed in the telecommunications industry, the FTI-2 program is expected to investigate their viability and their potential benefits to the FAA. Examples may include 5G LTE, Low Earth Orbit (LEO) Satellite, and Internet-of-Things (IoT) protocols for deployment to sensors (like security cameras at remote facilities).

Manage transition and lifecycle costs for both National Airspace System (NAS) and FAA administrative communications.

Efficiencies related to technological advancements may provide cost savings opportunities for the FAA both during the transition and during the life cycle of the FTI-2 contract. Some examples of technologies that may offer opportunities include:

- *Access Options (e.g., Carrier Ethernet, LTE or VSAT);*
- *SDN; and*
- *NVF/White Box Technology.*

5.0 Summary

The FTI-2 program will help the FAA migrate toward an information-driven approach that is needed to support the FAA NextGen concept. The following objectives are key to that migration and the success of the FTI-2 program:

- Maintain the high levels of availability, survivability, security, and performance that are required for many NAS mission critical applications.
- Provide dynamic service provisioning capabilities, flexibility, and seamless user experience related to specifying and ordering services.
- Provide insight and visibility into the network service configuration and operations.
- Evolve to future technologies that may benefit both NAS and Administrative users.
- Manage initial and lifecycle costs for both NAS and FAA administrative communications needs during the life of the contract.

6.0 References

[1] "The Future of the NAS," Federal Aviation Administration, *www.faa.gov/nextgen/media/futureOfTheNAS.pdf*, Accessed 30 August 2017