Federal Aviation Administration

FTI-2 Transition Background

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1 OBJECTIVE OF THIS WHITE PAPER

This white paper is intended to provide background on the number and types of telecommunications requirements satisfied through the current FTI contract, the facilities that they connect, and the steps necessary to deploy new services into the National Airspace System (NAS). While this paper includes counts of services, service types, facilities, etc. these are based on a snapshot in time and the exact counts are subject to change due to the dynamic nature of the NAS.

2 FACILITIES

A description of telecommunications service requirements starts with the service endpoints. The service endpoints are generally at FAA facilities, though some are at other "customer" facilities. These include other government agencies and commercial companies.

2.1 Identification of Service Delivery Locations

Service delivery locations are identified through two main attributes:

- the Location Identifier (LID); and
- the Facility Code (FAC).

The Location Identifier is a string of up to four alphanumeric characters which generally describes the location. Some examples that are readily known by much of the public include airports such Chicago O'Hare (ORD), Newark (EWR), Los Angeles International (LAX), etc.

The facility code is a string of up to 5 characters that describes the type of facility that is involved. There are many different types of facilities. Some examples include: ATCT – Air Traffic Control Tower; TRACO – a shortened version of TRACON which is a Terminal Radar Approach Control Facility; and ARTCC – an Air Route Traffic Control Center.

2.2 Collocation

Facilities are often collocated. Some examples include ATCT and TRACON facilities that are located within the same building. In many cases, the TRACON will be on a lower level of the building that also includes the ATCT. The FAA has established a numeric identifier to determine a unique location. The Telsite Sequence Number is a number which identifies a location. Facilities that may be identified with different FACs which are collocated will have the same Telsite. There are even cases which facilities have different LIDs, but are collocated.

2.3 Types of Facilities

There are many types of facilities within the FAA. Additionally, there can be several common customer facilities. Figure 1 illustrates how facilities support the operations of the FAA and its customers.

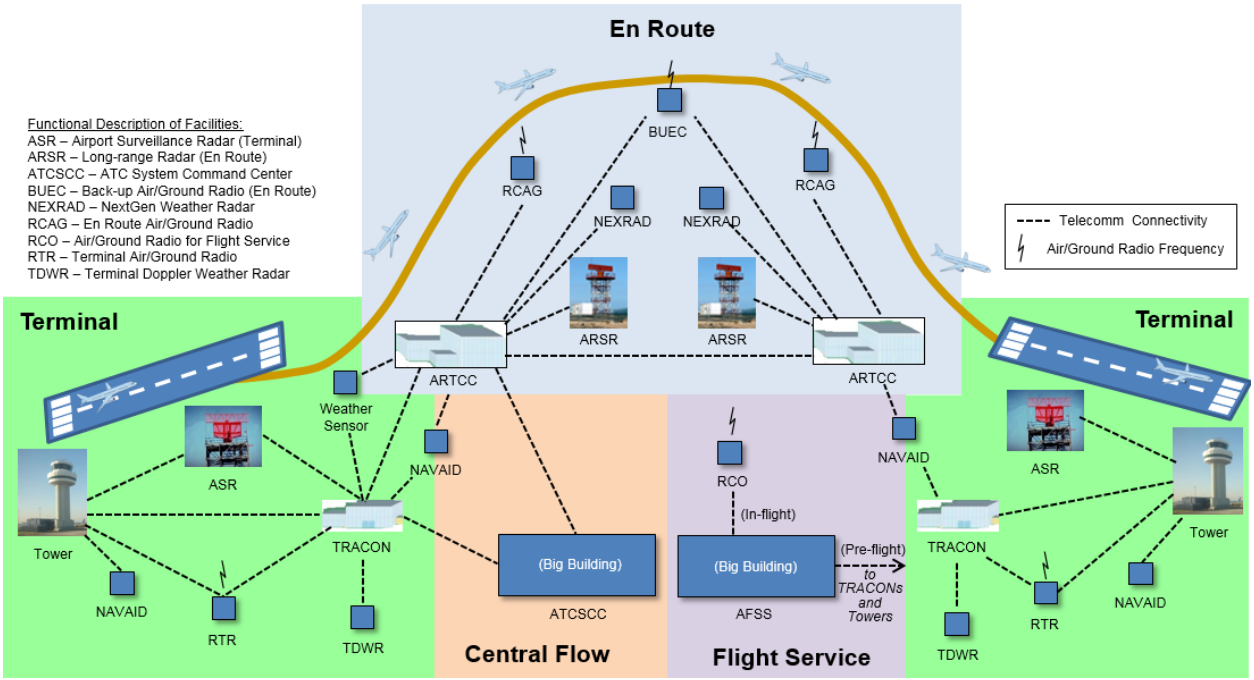

Figure 1: NAS Overview

A loose classification of some of the major facilities is as follows:

2.3.1 Command & Control

These facilities are directly involved with personnel, including air traffic controllers, involved in the control and safety of aircraft. Some of these facilities are:

- ARTCC: Air Route Traffic Control Center: Responsible for en route Air Traffic Control for all civil and military aviation
- TRACON: Terminal Radar Approach Control: responsible for Air Traffic Control for aircraft arriving into or departing from airports
- ATCT: Airport Traffic Control Tower: Provides ATC services to aircraft operating in the vicinity of an airport or airport movement areas.
- SCC: Systems Command Center: ATC central operations facility; integrates the several air traffic functions including Central Flow required to ensure the safety and effectiveness of air traffic in the National Airspace System (NAS).

2.3.2 Surveillance

These facilities are generally radar or radar associated.

- ARSR: Air Route Surveillance Radar: Provides ARTCCs with en route primary radar and secondary (beacon) radar surveillance of air traffic movements.
- ASR: Airport Surveillance Radar: Provides detection, display (azimuth and range), and control of detected aircraft, but not elevation.
- ATCBI: Air Traffic Control Beacon Interrogator: Stand-alone Secondary Surveillance Radar used in the en route or terminal environment.

2.3.3 Air / Ground Voice Communications

Air to Ground Communications with aircraft is accomplished through facilities that generally align with phase of flight for scheduled operations of aircraft.

- RCAG: Remote Communications Air/Ground Facility: Unmanned remote VHF/UHF transmitter and receiver facility; expands ARTCC air/ground voice communications coverage.
- BUEC: Back-Up Emergency Communications: Back up VHF/UHF air/ground communication equipment.
- RTR: Remote Transmitter/Receiver: Provides pilot to controller voice communications in the terminal area.
- RCO: Remote Communications Outlet: Peripheral air/ground radio communications facility providing radio link between AFSS and FSS specialists and pilots in their flight advisory areas.

2.3.4 Navigation

Navigational assistance to aircraft in flight is accomplished through different services that are provided by the FAA. Some of the facilities supporting these services are:

- VOR: VHF Omnidirectional Range: Provides 360-degree magnetic north oriented navigation signal.
- ILS: Instrument Landing System
- OM: Outer Marker: 75 MHz position identifier similar to IM/MM facility. Identifies the on path glide slope intercept point along the localizer course.
- IM: Inner Marker: Transmits a very narrow 75 MHz radiation pattern identifying the designated decision height point on the approach path.
- MM: Middle Marker: 75 MHz position identifier. Elliptical radiation pattern on the runway centerline axis identifying the decision height point along the localizer/glideslope approach path.

2.3.5 Weather

Weather information comes from FAA facilities as well as National Weather Service products and facilities. Some major weather facilities connected with FTI are as follows:

- ASOS: Automated Surface Observing Station: Same as an AWOS with additional weather sensors added.
- AWOS: Automated Weather Observing Station: Automated weather reporting system transmitted over radio or voice portion of a local NAVAID.
- TDWR: Terminal Doppler Weather Radar.
- WSFO: Weather Service Forecast Office: Prepares and disseminates forecasts.

2.3.6 Other Notable Facilities

The FAA has other non-ATC facilities that have extensive requirements for telecommunications connectivity. Two of these facilities are campus environments involving many buildings.

- OEX/ARCTR: The Mike Monroney Aeronautical Center: A centralized location for training academy, registry and records of all civil aircraft; airmen's licenses, ratings, and records; and certain automatic data processing services on a national and local level. Located in Oklahoma City, Oklahoma.

- ACY/WJHTC: The William J. Hughes Technical Center: Conducts aircraft fleet maintenance and test and evaluation activities supporting FAA approved research and development programs. Located at Atlantic City, New Jersey.

Other facilities that involve complex telecommunications requirements are:

- AFSS: Automated Flight Service Stations, these locations provided weather briefings and communicate with pilots, usually from general aviation. Two hub facilities concentrate communications with many RCO locations.
- NEMC: National Enterprise Management Centers are locations where the FAA has established its monitoring and control functions for NAS systems. The NEMCs are located in Atlanta and Salt Lake City adjacent to the ARTCCs in those cities. Some NAS-wide capabilities are located at the NEMC facilities to take advantage of the extensive build-out of infrastructure at those locations.

2.4 E911 Addresses

As part of the transition to FTI, the FAA was required to provide Enhanced 911-compliant addresses for the facilities. In some cases, directions to the facilities were provided, but an address was not available. A clean-up activity was undertaken and now most FAA facilities will have E911-compliant addresses, but there may be some exceptions.

3 REQUIREMENTS

Defining requirements for telecommunications services involves a number of attributes. One of the most important attributes involves the service endpoints as defined in Section 2.1 of this paper. Other attributes are described in the subsections below.

It is important to emphasize a point about vocabulary. The term “requirements” in this section refers to requirements for telecommunications services, not the specifications that the service must meet. There is an FAA Telecommunications Service Description (FTSD) document that is part of the FTI contract and describes the services required and the specifications for each of the services.

3.1 Service Classes

There are many different systems within the FAA that use a broad range of legacy interfaces and have different mission criticality. In an attempt to reduce the number of different types of services, the FAA defined the concept of “services classes.” A *service class* represents a unique combination of performance and interface requirements that the service must meet. The definition of a specific service class is based upon:

- The required reliability, maintainability, and availability (RMA) level
- The required latency level
- Whether modem compatibility is required, and if so, what type
- Whether compatibility with in-band signaling is required
- The Basic Security Level required
- The Voice Quality level required
- The physical interface

Currently, there are over 130 service classes established. Call setup and Call blocking are additional attributes that have been defined; however, based upon the current implementation of the services with connected systems, those parameters have not been applicable for the services ordered to date.

3.2 SVC / PDC Characterizations

The FAA uses a Service Code (SVC) and Program Designation Code (PDC) to identify the FAA function supported by the telecommunication service, i.e. the FAA mission supported by the service. There are over 260 SVC/PDC combinations that have been defined. The mission underlying each of the services is distilled into the major categories identified in Figure 2 below.

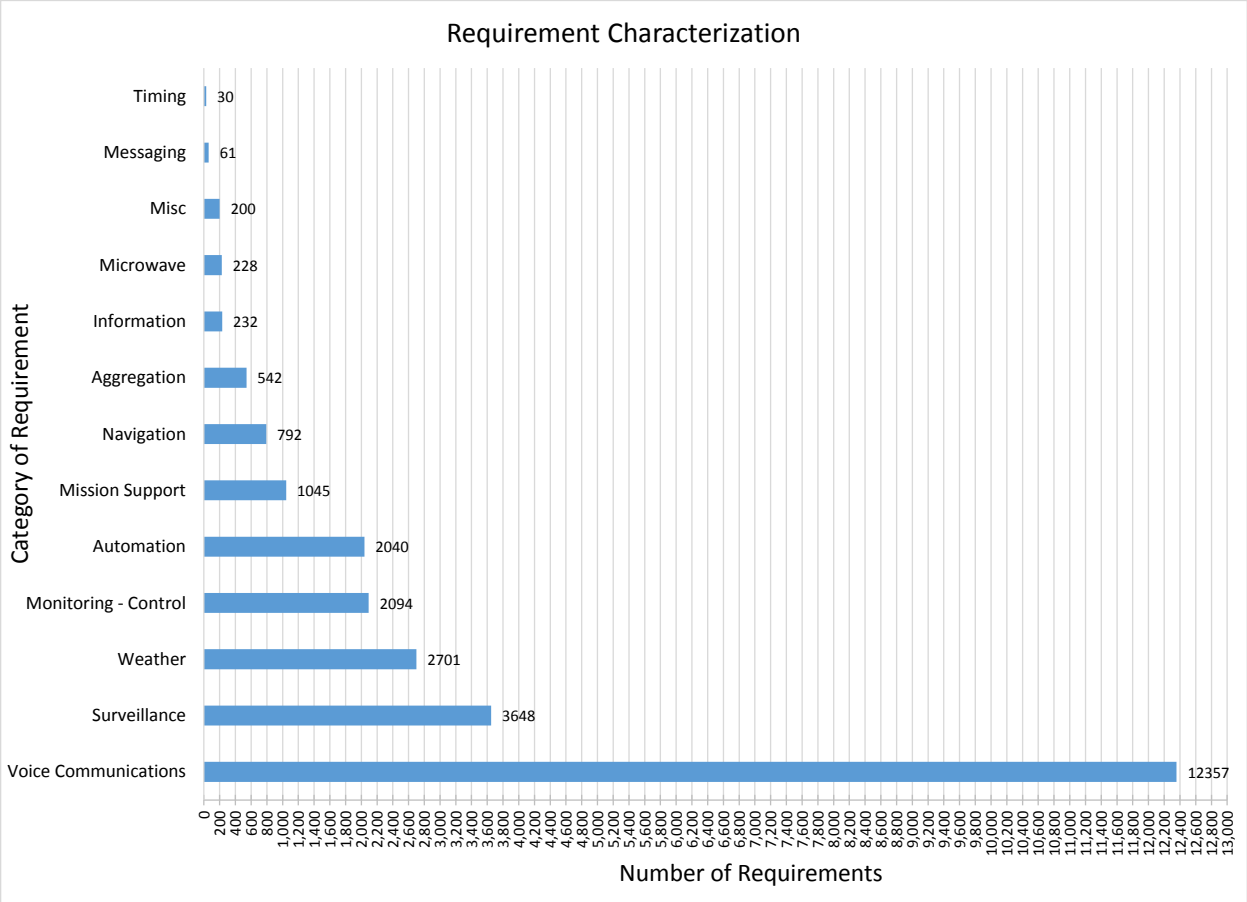

Figure 2: Requirement Counts by Category

3.3 Attributes

The main attributes used for the description of each service requirement are as follows:

Table 1: Service Requirement Attributes

Attribute	Description
Connectivity ID	Prior to establishing a Unique Service Identifier, requirements are labeled with a connectivity identification number
Connectivity Leg	Multipoint requirements will have the same connectivity id; however, the different drops of the multipoint will have different leg numbers
CSA-RCL-LDRCL	A legacy field from earlier tracking that provides some description of the requirement
From LID	From Location Identifier
From FAC	From Facility Code
To LID	To Location Identifier
To FAC	To Location Code
PDC	Program Designation Code (see description above)
SVC	Service Code (see description above)
Service Class	See Description above
Program Acronym	This field will generally describe the program that the requirement for service supports
Max Data Rate	The maximum data rate required for the service
From Interface Type	The interface at the "from" facility. This generally aligns with the "to" facility with one nontrivial exception.
To Interface Type	The interface at the "to" facility. Again, this generally aligns with the from interface type, except for asymmetric T1's. These are requirements for service that generally originate RCO locations as an analog (VG) interface and terminate at AFSS locations as a channel within a T1.
Avoidance	There are 5 avoidance fields within the requirements for service database. Some end systems will require high availability communications that result in multiple paths between locations, but the end systems perform the switching. In order to ensure high availability for the systems and avoid single points of failure, the connectivity ids of the other services are specified within the avoidance fields.
USI	Unique Service Identifier: this is a label for each requirement for service that is in-service, or that has been officially conveyed to the FTI provider as a requirement needing service.

There are several other attributes defined for a service requirement, but these may not always be populated.

3.4 Types

There are different high level types of requirements for service that are specified by the FAA. These are based upon the underlying mission being satisfied by the requirement.

- NAS requirements are those requirements for service that directly support the systems of the NAS, including those that provide Air Traffic Control services, navigation services, surveillance services, and weather services. The NAS Requirements fall into the following subcategories:
    - Point-to-Point: these are generally serial requirements that are either analog or digital
    - Point-to-Cloud: IP services are generally represented as a point to cloud, with any specific flows or connections being codified through supplemental information
    - Multipoint: The agency has two main forms of multipoint service. The first involves multipoint voice service that allows controllers to communicate regarding air traffic control. The second involves serial multipoint data service for radar.
- Mission Support requirements are those that support the mission of the agency, but are not directly supporting the NAS. They are also referred to as Administrative Services.

  - Most of the Mission Support requirements are for IP service; however, there are some ISDN PRI lines that are used for providing voice service.
- System Wide Information Management (SWIM) requirements fall into three different categories. These categories align with the NAS domain, the Mission Support domain, and a third domain, called the Research and Development (R&D) domain. Additional information is provided in a following section. SWIM service requirements involve Publishers and Subscribers. Additionally, a publisher of one service may be a subscriber of one or more other services.

4 SERVICES

This section provides a general description of how services are delivered to meet the underlying requirements for service.

4.1 Telecommunications

The ACT-IAC white paper titled *Current FTI Business Processes* provides an in-depth description of the lifecycle of a service and some of the internal interactions with FAA customers in the formulation of the requirement. For completeness and a broader context, some of the business processes are repeated here.

- FTI requirements are subject to configuration control. The statement of the service requirements and all pertinent attributes are entered into a database which is shared with the FTI Vendor. This database is called the Implementation Database (IDB).
- Once a service requirement has been deemed ready for quote, the FTI Program Office changes the state of the service requirement to RFQ. After this occurs, the FTI Vendor will generate a quote for service. The quote will identify the service slated to be provided to meet the specifications of the requirement for service. The appropriate CLINS will be added to the quote. The quote represents the cost for a period of 36months of service, though prices have been established for the life of the contract.
- Once a quote is submitted to the FAA in electronic form, the FTI Program office performs a due diligence step by reviewing and validating the quote.
- Ordering a service is represented by the acceptance of a quote.
- Upon receipt of an order, the FTI Vendor has a service delivery timeframe to meet. The delivery timeframe depends on the availability of FTI infrastructure at the facilities involved. If no current infrastructure or equipment exists at a site, the installation of equipment into an FAA site will be accepted prior to use. After acceptance of the installation of equipment, a service is formally accepted by the FAA prior to use.

Throughout this process, the requirements for services are tracked using an FAA defined Connectivity ID. Requirements have a lifecycle with different states. There are many different states that requirements can be in. The main states are as follows:

- BL: Baselined
- RFQ: Ready for Quote
- Q: quoted
- SO: Service has been ordered
- IS: In-service
- SD: Service has been deleted, the agency no longer needs the service
- SX: Service has been disconnected.

4.2 SWIM

System Wide Information Management (SWIM) services are provided through Enterprise messaging nodes. Each node represents an "enterprise services bus." Publishers and subscribers are connected to the bus. The establishment of SWIM services for a particular producer or consumer under the FTI contract is referred to as "on-boarding."

5 OTHER UNIQUE ASPECTS

There are other unique aspects to the requirements on FTI that are noteworthy. Two that are covered here involve the backbone network between telecommunications traffic centers and the boundary protection provided by FTI.

5.1 The Backbone

The vendor for the FAA has implemented a network backbone that connects FAA facilities that have the highest volume of telecommunications traffic. The backbone consists of leased waves and SONET access to the backbone. Of the 4479 sites served by FTI, only 65 are on the backbone. These sites access the backbone through SONET infrastructure. Some metropolitan areas have dual OC-48 (or higher) SONET rings, while others have more traditional dedicated access circuits directly between the service delivery location and a nearby local exchange carrier (LEC) facility.

The Figure 3 illustrates the topology of the backbone.

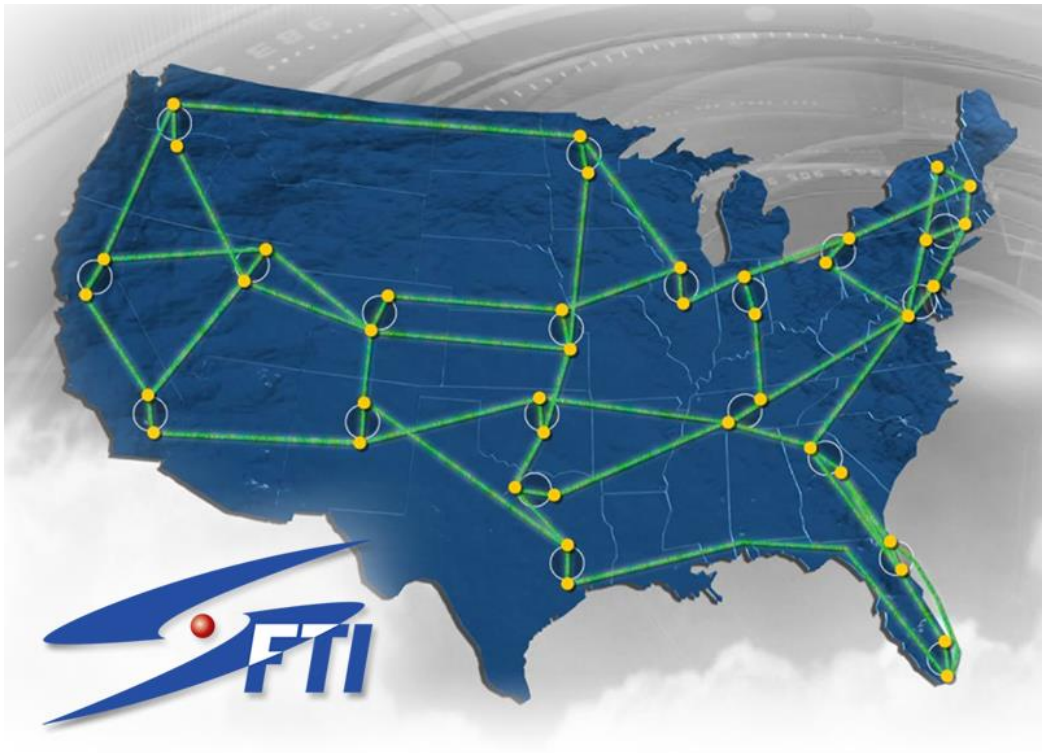

Figure 3: FTI Backbone

5.2 The NESG

The National Enterprise Services Gateway (NESG) provides a secure gateway to support data flows between NAS systems and non-NAS systems including external users. There are gateways that also allow external users to connect to the Mission Support network. For both domains, there multiple instances of these gateway for external users.

6 STATISTICS

6.1 Telecommunications Requirements

There are currently 25,195 FTI requirements. Of these, 1041 are for Mission Support administrative services. Figure 4 provides information about the distribution of different interfaces used by services.

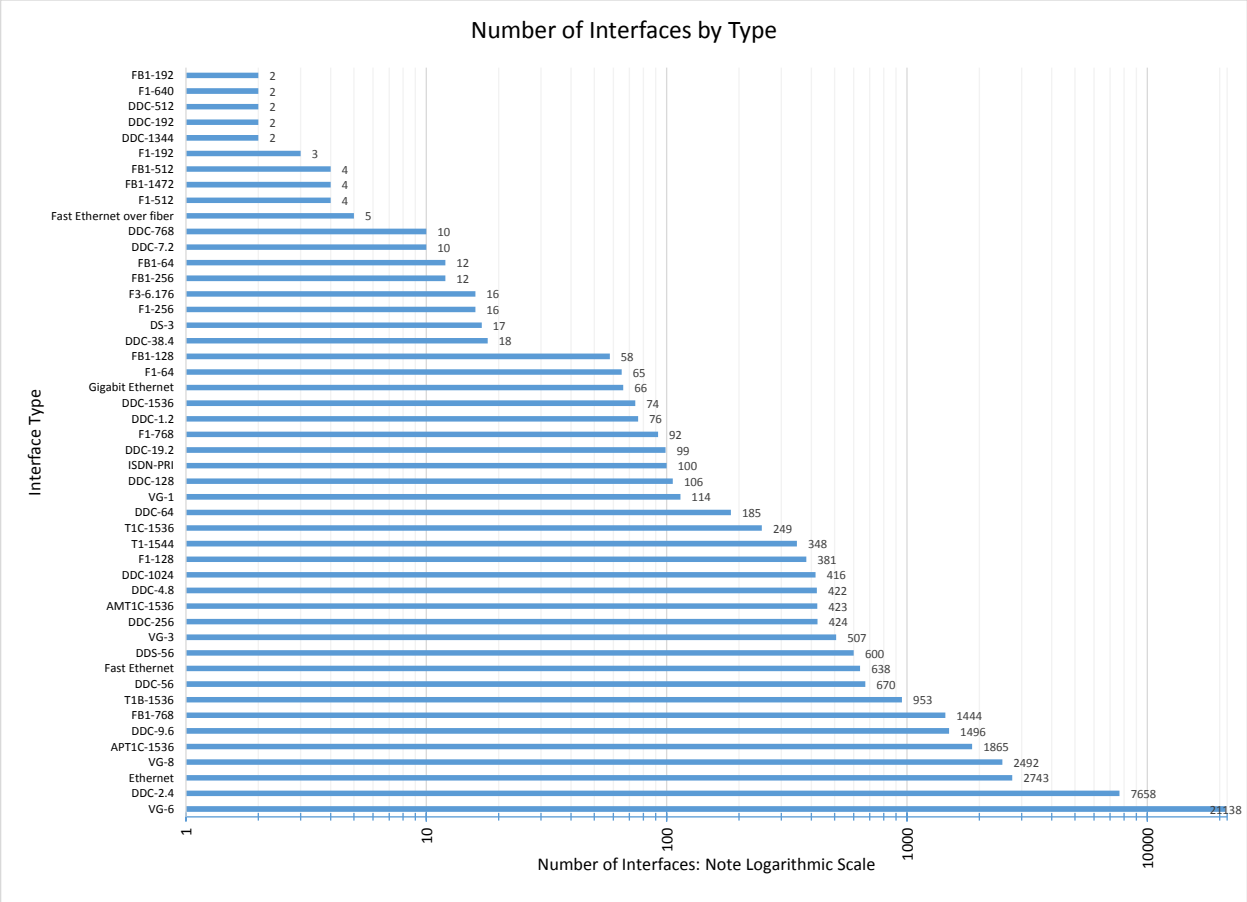

Figure 4: Number of Requirement Interfaces by Type (Logarithmic Scale)

Note: Interface Types starting with F denote fractional T1 interfaces which are channelized. The speed in kbps follows. Interface types starting with FB denote fractional bulk T1 interfaces which are not channelized. Again the speed in kbps follows. There are three main types of T1 interfaces defined: T1C denoting a channelized T1, T1B denoting an unchannelized T1, and T-1544 denotes a channelized T1 where the FAA populates the payload and framing bits. The Interface Types starting with A denote asymmetric T1s. This term denotes a service involving interfaces of dissimilar types. For an APT1C interface, one endpoint of the service is a channel within a T1. The other endpoint involves a VG interface. The AMT1C interface is similar, but it does involve a multipoint service rather than a point-to-point service.

Table 2 provides a distribution of the different reliability, maintainability, and availability levels used by services. While there are several attributes which describe an RMA level, the availability is included next to the RMA level below to provide a better appreciation of the service. All attributes included for an RMA level are defined within the FTSD.

Table 2: Service Requirements by RMA Level

RMA_CATEGORY – Availability	With Avoidance	Without Avoidance
RMA1 – 0.9999971	475	
RMA2 – 0.9999719	1339	3
RMA3 – 0.9998478	1136	2
RMA4 – 0.9979452	12588	8209
RMA5 – 0.9972603	1642	272
RMA6 – 0.9904215	988	
RMA7 – 0.997	263	109

Note: The totals in the above table will be greater than the requirement count provided earlier. The table above includes the different legs of multipoint services.

6.2 Facilities

There are a total of 4479 facilities served by FTI. Of these, 65 are on the backbone and the others are "off backbone." Most of these facilities are FAA facilities, though there are some locations which are not. Of the 4479 facilities, 1033 facilities are served by FTI Mission Support. Of these, 299 facilities only have Mission Support services. Figure 5 and Figure 6 provide information about the facilities served by FTI in terms of the number of sites with a specific number of services and bandwidth requirements.

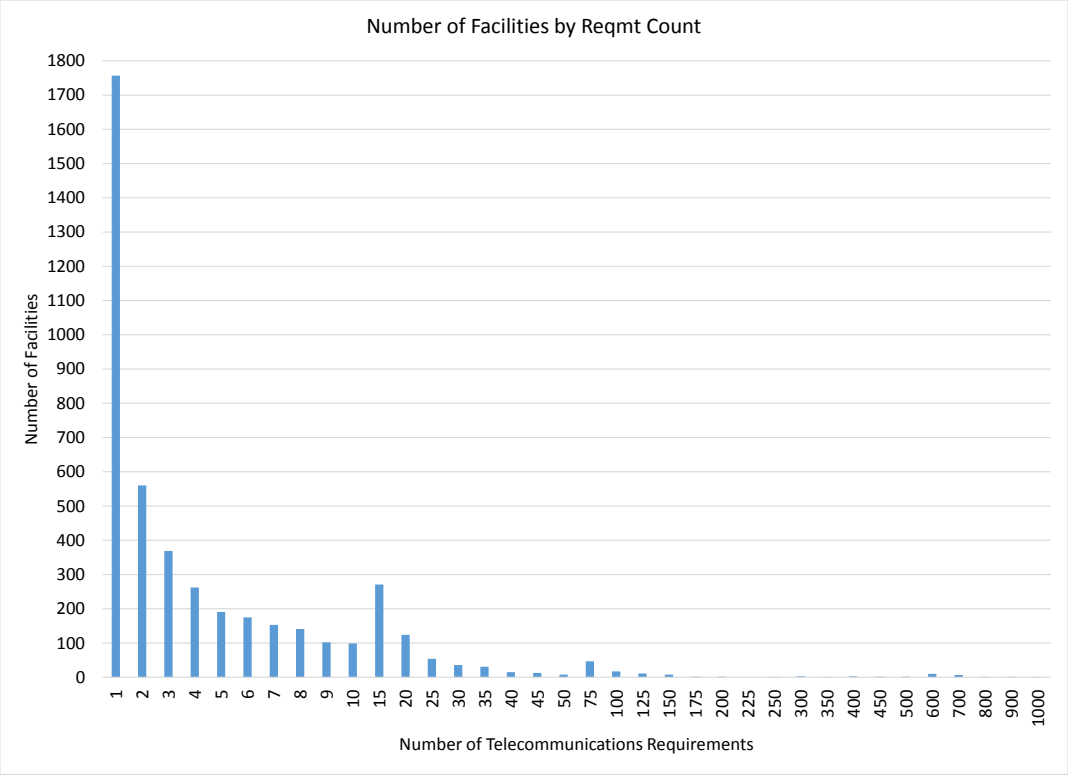

Figure 5: Distribution of Facilities by Service Requirement Count

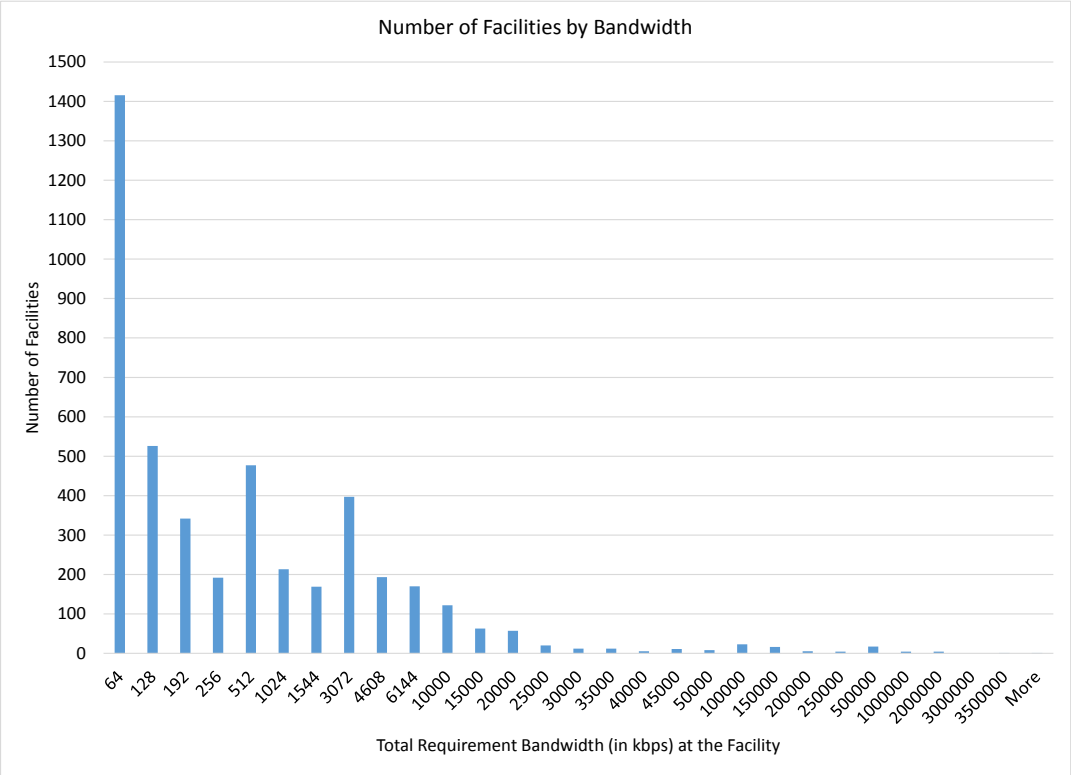

Figure 6: Distribution of Facilities by Service Requirement Bandwidth

6.3 SWIM

As described above, SWIM involves three different domains: NAS, Mission Support, and R&D. For the NAS domain, there are 13 different user programs that involve 94 different publishers and 209 different subscribers. Information about Mission Support SWIM services will be released at a future date.

7 DEPLOYING SYSTEMS AND SERVICES INTO THE NAS

There are several steps to deploying systems into the NAS. These steps also apply to telecommunications services. The FTI-2 Program office will have primary responsibility for ensuring the steps are completed; however, an FTI-2 provider will be required to support a number of the steps. Of key importance is an operational test and evaluation process. This testing process is typically conducted at the William J. Hughes Technical Center in Atlantic City, NJ. In terms of language, the process of deploying services into the NAS is often called Solution Implementation. A high-level flowchart of the activities is depicted in Figure 7. The following text from the AMS provides an overview of some of the key steps:

<u>Solution implementation</u> begins at the final investment decision when the Joint Resources Council approves and funds an investment program or segment, establishes the acquisition program baseline for variance tracking, and authorizes the service organization to proceed with implementation. Solution implementation ends when a new service or capability is commissioned into operational use at all sites.

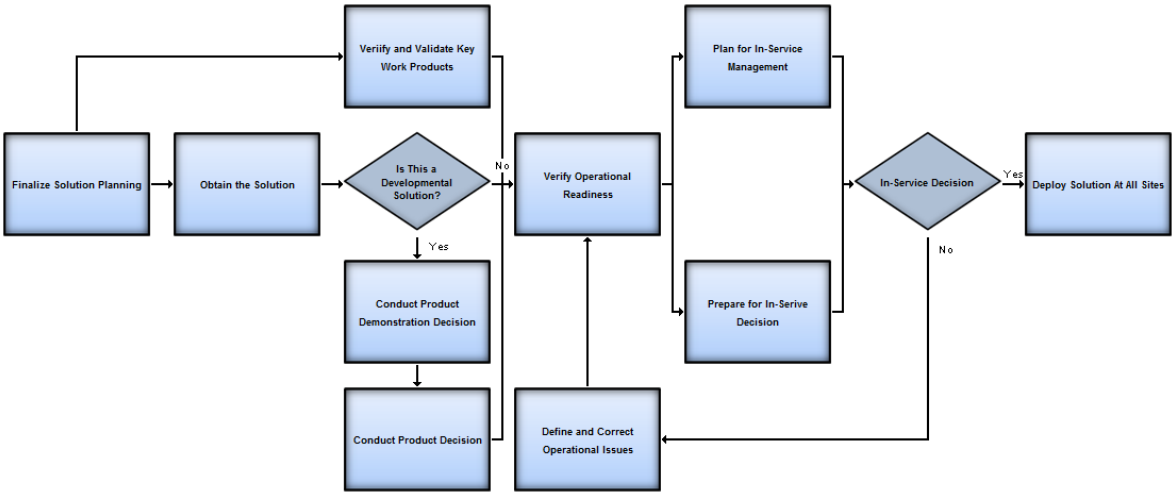

Figure 7: Solution Implementation Steps

Finalize Solution Planning. The program office reviews and updates program planning completed during final investment analysis (i.e., implementation strategy and planning document, work breakdown structure, ISR checklist). Key stakeholders participate in this activity to ensure planning is complete and realistic. For example, if new systems are to be installed or existing facilities modified, service organization planners work with service-area offices so people and resources will be available when needed.

Obtain the solution. The program office oversees and coordinates execution of tasks and activities necessary to achieve the benefits projected for the investment program within approved cost and schedule baselines. This includes such activities as contract award, contract administration, program management, resource management, risk management, systems engineering, logistics support, test and evaluation, and site acquisition and adaptation. It may involve developing operational procedures and standards; obtaining physical, personnel, and information security; modifying the physical infrastructure; and coordinating collateral action by the aviation industry.

Verify and Validate Key Work Products. The program office incrementally verifies and validates key work products and products of solution implementation, including the contract to obtain the capability, design documents, specifications, and actual product/product components. Verification and validation activity supports contract award, product demonstration decision, production decision, product acceptance, and the in-service decision.

Verify Operational Readiness. The program office manages all activities necessary to install the solution at a designated test site(s) and test it thoroughly to verify operational readiness. Operational readiness encompasses operational effectiveness and operational suitability. Operational effectiveness measures how well the solution satisfies mission need and operational requirements. Operational suitability measures how well a product can be integrated and employed for field use, considering such factors as compatibility, reliability, human performance factors, maintenance and logistics support, safety, and training. For designated programs (and FTI-2 may be so designated), operational readiness is also

assessed by an independent operational assessment. The solution will be installed at the William J. Hughes Technical Center before the in-service decision.

Prepare for In-Service Decision. The program office completes all activities necessary for the in-service decision. This includes resolution of all support issues identified by the operating service organization and integrated logistics management team; completion of management actions arising from the in-service review checklist and the independent operational assessment report; resolution of stakeholder issues; development of the in-service decision briefing and action plan; and concurrence of key stakeholders.

In-Service Decision Approved. The in-service decision authority reviews operational test results, the status of in-service checklist items, the independent operational assessment (designated programs only), the perspective of key stakeholders, and other information deemed relevant to the in-service decision. If the in-service request is approved, deployment of the solution may begin. If the request is not approved, the service organization must correct any deficiency and return for the in-service decision upon verification that all outstanding issues have been resolved.

Define and Correct Operational Issues. The service organization or program office takes whatever corrective action is necessary to resolve all remaining operational issues. This may involve a return to concept and requirements definition if correcting the issue involves a change to program requirements or to investment analysis if operational issues require a change to the acquisition program baseline.

Deploy the Solution at All Sites. The service organization or program office manages all activities necessary to deploy the solution at each site. This includes transportation and delivery of equipment, installation and checkout, contractor acceptance and inspection, integration, field familiarization, declaration of initial operational capability, joint acceptance and inspection, dual operations, declaration of operational readiness, and removal and disposal of obsolete equipment. Post implementation reviews are conducted at deployment sites to ensure user needs are satisfied, identify systemic problems that must be corrected, and determine whether cost, schedule, and benefits objectives are being achieved. The transition from solution implementation to in-service management extends over time, occurring at each site upon declaration of operational readiness or commissioning.

Implementation of telecommunications services within the FAA operating environment requires additional coordination factors. Some examples include:

- Deployment activities need to be pre-coordinated with the local site points-of-contact;
- FAA-provided escorts must be arranged for sites that are not permanently staffed;
- The equipment footprint and any changes to the equipment footprint that exceed the space allocation must be approved through a formal NAS Change Proposal; and
- Service releases, i.e. concurrence from the FAA to take a service offline, must be coordinated and obtained in advance if any deployment activities will (or have the potential to) disrupt services that are already in operation.

More information about the overall process can be found at fast.faa.gov and at sep.faa.gov.

8 REFERENCES

There are a number of publically available references which will assist in the understanding of the FAA's telecommunications infrastructure, and some of its high level plans.

The overall FAA infrastructure road maps can be found at: https://sep.faa.gov/products/ir/main

The communications roadmap will be of interest. It should be noted that these roadmaps are updated annually.

The current NAS requirements are contained here: https://sep.faa.gov/file/get/2718