

Risks and Challenges

Risk and Challenges Associated with Unique Requirements and Marketplace

Networks & Telecommunications Community of Interest

Federal Aviation Administration (FAA) Telecommunications Infrastructure (FTI)-2

Transition and Implementation Working Group

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SYNOPSIS

This Paper is organized to examine transition risks and challenges from a number of vantage points. Some of these vantage points consider the same challenges. The outline/topic organization considers and organizes the challenge review by FAA facility type, FTI service area (meaning the services under the FTI contract), technologies that are available or that need to be researched, planned/discussed, the potential FTI-2 acquisition strategies that are being discussed by the acquisition working group, and the marketplace supportability of the unique FAA requirements.

Finally, this white paper considers challenges that have a dependency on the other FTI-2 working groups (Acquisition, Technology) and the recommendations/direction that these groups make.

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1. Purpose, Introduction, Organization and Summary Recommendations

1.1 Purpose

As the FAA plans the migration from FTI to FTI-2, they have identified the need to better understand the unique marketplace transition and implementation risks (challenges) and costs expected to occur during contract transition. This future transition will be more complex than the previous Leased Inter-facility National Airspace (NAS) Communications System (LINCS) to FTI transition because:

- The FAA has expanded the number, magnitude and scope of services within FTI and
- The FAA is facing a rapidly approaching replacement of Time Division Multiplexing (TDM) infrastructure that underlies the majority (~90%) of FAA air traffic control systems. This replacement, driven by the commercial carriers will begin retirement of TDM-based services as early as 2020.

The FAA should also plan for a contract transition with expanded FTI services (over those provided under LINCS) and broad commercial carrier driven technology modernization from TDM to Internet Protocol (IP). The purpose of this paper is to provide insight into marketplace challenges and mitigation efforts that the FAA can consider and undertake in advance of the FTI-2 procurement to positively mitigate the transition and implementation cost, schedule and risk challenges. The response considers quality, value, safety, and resource issues that are implicit within this discussion response.

1.2 Introduction

“The FAA currently obtains a majority of the telecommunications services it requires through the FAA Telecommunications Infrastructure (FTI) contract that expires at the end of September 2017. While the FAA has announced its intent to award a single source contract extension to the current FTI service provider (Harris Corporation) to extend FTI services through 2022 (if all options are exercised), the FAA has also initiated planning for a follow-on program, referred to as “FTI-2,” that could result in one or more competitive awards as early as 2020.”

The FAA has also articulated that it may need a subsequent phase out contract after the single sourced bridge.

1.3 Organization

This Paper is organized to look at transition risks (challenges) from a number of vantage points. Some of these vantage points consider the same challenges. The outline/topic organization considers and organizes the challenge review by FAA facility type; FTI service area (meaning the services under the FTI contract); technologies that are available or that need to be researched, planned/discussed; the potential FTI-2 acquisition strategies that are being discussed by the acquisition working group; and the marketplace supportability of the unique FAA requirements.

Finally, this white paper considers challenges that have a dependency on the other FTI-2 working groups (Acquisition, Technology) and the recommendations/direction that these groups make. A review and possible update of the challenge topics should occur as this white paper is reviewed by ACT-IAC and the FAA/Industry Working Group leads to ensure that the challenges identified within this paper include items that are being introduced by these other working group papers.

1.4 Summary Recommendations

The FAA should take steps now to reduce the FTI-2 transition challenges, while maintaining safety and quality levels. Specific recommendations include:

- Develop/document existing FTI inventory and provide these to offerors to minimize transitions risks and costs
- Begin research engineering for TDM to Internet Protocol (IP) solutions well before the FTI-2 procurement. These solutions will require significant validation across the various FAA facility and systems to ensure suitability across the FAA
- Develop an FTI-2 target architecture in advance of the FTI-2 award
- Develop and provide offerors with new IP circuit ordering and validation test procedures that will be used as the FAA migrates from TDM to IP solutions to guide the offerors compliance with FAA-developed standards. These procedures should be provided to offerors no later than (NLT) the Draft Screening Information Request (DSIR) release so that offeror migration plans provide efficient low risk plans for the FAA. The purpose (value) in providing these procedures is that it minimizes the likelihood (risk) of cost and schedule increases and delays associated with new FAA defined IP-based Test and Acceptance procedures that cannot be reasonably assumed by offerors.

- Advance FTI-2 acquisition and modernization strategies that drive innovation/competition/efficiency across the different NAS, Mission and Administrative Systems performance requirements without impacting safety or quality of service.

2. FTI-Overview

1.5 Current Operating Environment

“The FAA obtains approximately 25,000 telecommunications services under the existing FTI contract to support a broad spectrum of the agency’s requirements ranging from critical air traffic control operations to routine administrative functions. These include voice services, synchronous and asynchronous data services, Internet Protocol (IP) network services, and “enterprise messaging services.” FTI services are provided over a dedicated optical backbone infrastructure and interexchange carrier (IXC) private line services as well as dedicated microwave and satellite resources.”

1.6 Challenges

“The FAA faces a range of challenges in the planning for the FTI-2 program. First is the magnitude of the service inventory and the number of sites affected. Transitioning 25,000+ services can take an extended period of time during which the FAA will incur parallel operating costs with the legacy FTI network and the new FTI-2 network. The optimal transition strategy will likely depend on the proposed network architecture of the FTI-2 service provider which will not be known until contract award.

The transition is complicated by the fact that commercial service offerings do not meet the FAA’s unique performance and security requirements. To meet those requirements, the FAA’s service provider typically must deploy customer premise equipment (CPE) that provides automatic protection switching and is specifically configured to meet the FAA’s service requirements. When transitioning from FTI to FTI-2, the FAA will have to plan for the space and power requirements to support the deployment of new CPE and the parallel operation of two separate infrastructures until the legacy FTI CPE can be removed....

The FAA’s dependence on services based on time division multiplexing (TDM) technology presents another challenge. Some commercial telecommunications carriers

have announced their intent to phase-out TDM-based services by as early as 2020. Currently, the majority (~90%) of the FAA's systems supporting air traffic control operations require TDM-based services to support their required system-to-system interfaces. While that percentage is expected to drop over the next 5-10 years, the FAA does not control where the TDM-based services will be phased-out first or the pace at which it will occur. This complicates the FAA's decision-making process when it comes to the potential need to invest in TDM-to-IP conversion devices to continue to support the communications interfaces of the FAA's legacy systems.

With the phase-out of TDM-based services, there is also the possibility that commercial telecommunications carriers may discontinue wireline infrastructure in remote locations. This presents a challenge for the FAA in that current generation wireless services have not proven capable of meeting the FAA's requirements for service availability, latency, and timing. In addition, the information security implications of commercial wireless service have yet to be determined."

3. Transition and Implementation Challenges and Cost Impacts by Facility Type

The challenges outlined in the Table 3-1 Facility Challenges, apply across all types of FAA facilities. Some challenges are heightened based upon the facility mission and operation. However, facility function (Air Traffic Control, Navigation, Surveillance, Communication, etc.) is less significant than the locality staffing and operations model. The FAA's focus should be on these items and the transition activities at these facilities. The most significant facility challenges are grouped as follows:

1. Staffed vs Unstaffed Facilities (e.g., Command and Control, Surveillance, Communications, Navigation, Weather, Other facilities)
2. Remote vs Non-Remote (e.g., Command and Control, Surveillance, Communications, Navigation, Weather, Other facilities)
3. 24X7 Operations vs Facilities that lack staff during shifts and weekends.
4. Other Stakeholders (Department of Defense (DOD), International locations, and partners)
5. FTI provider facilities (Operations Centers)

Table 3-1: Facility Challenges

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
3.1	FTI provides customer premise equipment which adapts to carrier equipment	There is potential for mismatch between the new provider and on-site legacy FAA infrastructure if a new carrier uses different equipment than the incumbent. New Services being installed may not match exactly the legacy service. Equipment will need to be upgraded to replace equipment that is not compatible or end of life	Identify customer premise equipment at FTI service sites. FAA or industry providers identify mismatch with legacy equipment and consider in transition mitigation plan. This could be a significant cost impact for new services being installed. Additionally compatibility with legacy systems may be impacted, especially if the new service is IP-based rather than TDM based.
3.2	Durations/cost for on-site wiring	Site delays	Pre-fabricated solution Minimize on-site wiring
3.3	Existing FTI infrastructure at 4,000+ nodes owned by FTI contractor/ carriers	Buy-out or replacement costs	The FAA should have replacement costs estimated and allocated in the budget.
3.4	Existing FTI infrastructure at 4,000+ nodes owned by FTI	FAA facility space constraints- limited physical space, power, Telco HVAC for	The FAA should begin planning for target space at facilities for new FTI-2 equipment. Assume same space footprint as required by FTI. Utilize a transitional location; In some instances this may require a temporary staging location that is not adjacent to existing

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
	contractor/ carriers	implementations and parallel operations	FTI infrastructure and it may involve more than one move within each installation location.
3.6	Existing FTI infrastructure at 4,000+ nodes owned by FTI contractor/ carriers	Time/effort to install equipment	The FAA should research options to reduce cost and time for installation and configuration changes. Example: standard hardware solution using “Whitebox” Network Function Virtualization (NFV) allowing remote software configurations to minimize the number of repeat transition trips.
3.7	FTI-2 contractor will have their own customer premise equipment	Managing facility cutover costs and time.	Transition planning to reduce risks of FTI to FTI-2 cutover. Candidate mitigations could include validating cutover procedures in a test/trial environment, flexible for supporting site differences.
3.8	Personnel Clearances	<ul style="list-style-type: none"> Enhanced procedures since Chicago fire event Enhanced personnel screening More stringent access of people getting around a facility It takes time to get people cleared for unescorted privileges 	The FAA should anticipate that large numbers of the FTI staff will migrate to the FTI-2 contract. The FAA should consider steps to minimize a surge of “re-badge” efforts at the end of a contract period that could be disruptive to on-going operations. Tactics for consideration include working with the security office for interim transfer from FTI to FTI-2, with any associated background investigation that may be deemed necessary

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
		<ul style="list-style-type: none"> Airports also have their own badge requirements 	
3.9	Working hour limitations at staffed Facilities.	Implementation/ Transition work takes more time and has cost implications.	Transitions needs to be done at night or other low peak Air Traffic Control (ATC) traffic situations considering time of year for weather (e.g., Alaska), holidays, sporting events, maintenance limitations. FAA supports coordination with other acquisitions to avoid deployment risks.
3.10	NAS disruption avoidance	Transition activities that disrupt NAS-transition time of day/year work period restrictions.	Transitions need to be done at night or other low peak ATC traffic situations considering time of year for weather (e.g., Alaska), holidays, sporting events, maintenance limitations. FAA supports coordination with other acquisitions to avoid deployment risks.
3.11	NAS disruption avoidance	Transition activities that disrupt NAS-Transition time of day/year work period restrictions.	Develop/consider well planned fall back procedures as an additional risk mitigation
3.12	Testing/ Validation of Critical services: (e.g. voice communications are the FAA’s most critical service)	Critical role of Voice Communications in service delivery must be clear in terms of establishment, verification and duration required to support reliability	The FAA needs to define and incorporate how testing of new services/equipment interfaces, will be performed as well as the expected time that will be required to maintain any existing FTI services as backup until validation of new service and its sustained reliability is met. These expectations should be considered in

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
			the FAA’s parallel operations budget and planning effort.
3.13	International Coordination	Coordination of infrastructure takes longer to establish with international partners at deployed infrastructure locations in Mexico, Canada, and with other Air Navigation Service Providers (ANSPs).	FAA International Office should be engaged to provide coordination as an enabler of technology discussions that fall under International Traffic in Arms Regulations (ITAR), and coordination/approval for international technology change requests and travel. The FAA should identify these international locations that will require additional coordination as well as take steps to reduce the coordination complexity at these locations
3.14	Unstaffed, remote facilities, and FAA and industry operated facilities may present unique logistical challenges for transition activities.	Time and cost of delays in access and approvals of remote sites during inspections, installation and testing.	FAA should support short-notice access of contractor personnel to unstaffed facilities (e.g., remote or off-hours access) to provide greatest flexibility in schedule priorities and adjustments to (e.g., weather, staffing travel).
3.15	Maintain ability for disaster recovery as a facility contingency during transitions	Plan and responsiveness to loss of services, power, etc.	The FAA should develop/prepare or update Continuity Of Operations Procedure (COOP) plans for disaster recovery of FTI-2 as part of site or system acceptance plans.

4. Transition and Implementation Challenge and Cost Impacts across the Services Provided by FTI

Table 4-1: Challenges across FTI Services

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
4.1	Inconsistent protocols may exist across FAA systems	<p>1. FAA has not phased out all legacy interfaces.</p> <p>2. FAA has not mandated connectivity protocols across programs.</p> <p>3. Schedule lacks planning for phase-out of legacy systems & protocols.</p>	<p>The FAA should perform research and validation of engineered technology solutions for legacy connectivity. These should consider</p> <p>a) deployment options,</p> <p>b) mandating connectivity protocols to support phase-in, and</p> <p>c) Developing a baseline implementation schedule for planning migration and connectivity of legacy protocols/systems.</p>
4.2	Lack of clarity (by FTI program) on pace of FAA system modernization and other programs' ability/ timeline/ dependency to migrate from TDM to IP	Lack of insight to system modernization plans can yield risky or expensive solutions.	<p>The FAA should create an inventory of TDM dependent systems, analyze the TDM dependencies as well as prioritize engineering solutions that will support continuity of these systems in an efficient safe operation. Further the FAA should, prototype and test validation approaches to support cutover of services. Approaches need to handle variability in pace and priorities of modernization to avoid delays to transition activities.</p>

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
4.3	FAA TDM Test procedures may not be adequate for IP architecture	Unlike existing TDM routing, IP routing may no longer be deterministic in an IP path, which may not support current FAA test/validation practices for circuit readiness.	The FAA should prioritize the development of validation and testing procedures across FAA systems in advance of transition phases so that transition activities are not delayed.
4.4	Unique ATC services must be maintained/replicated	Current connection capabilities between facilities (e.g., point-point voice circuits) and their service reliability should remain as new capabilities are implemented on FTI-2.	<p>a) Approach/solutions need to be validated & tested in FAA labs (Tech center) far in advance of transition & implementation. Today this effort is done with FTI contractor (Harris).</p> <p>b) Consider monitoring availability of legacy systems during phase-out transition, or until completion of FTI-2 service area implementation.</p> <p>The FAA should anticipate, plan, budget for an FTI-2 Testbed specifically for this type of testing</p>
4.5	Obsolescence: Local Service and Cost of Service	As carriers move to incorporating new technologies for non FAA communication services, the lower volume on legacy technologies used by	Identify and assess local service provider's technology and service change plans against any to be developed for FAA service milestones goals, or implementation schedules. Consider the high-reliability service requirements of current service

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
		the FAA raises uncertainties in the costs of maintaining the use of legacy systems. Local service providers may not be able to support legacy services (it may not be profitable/ sustainable) and/or the costs for these services may be increasing shortly, years before the sun-setting of the technologies.	providers and costs of maintaining that same level of reliability under lower volume of legacy services plans. Continue to identify and test alternate access technologies. The FAA should consider cost risks of increased carrier charges necessary to maintain existing Reliability, Maintainability, Availability (RMA) requirements associated with continued support of legacy TDM services during or at initiation of transition due to market conditions
4.6	Obsolescence: Qualified local staffing	Qualified, local staff may not be available for an extended period of time to support legacy equipment (people are no longer being trained on TDM). Existing available workforces to support legacy infrastructure will diminish	The FAA should: a) Assess timelines for phase-out of legacy technologies against a baseline implementation schedule for planning migration and connectivity of legacy protocols/systems. b) Identify gaps that can be addressed with training. c) Identify feasibility of relying on remote personnel support. d) Identify potential contractors who will support “legacy” technology repair and maintenance.

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
4.7	Obsolescence: Equipment	Availability of maintaining existing equipment becomes harder (carriers not able to readily get replacement parts).	Assess carriers’ interest and ability to support depot parts. Assess repair and parts replacement trends. Consider obsolescence into transition phase-out priorities.
4.8	Parallel Operations	LINCS to FTI required parallel operations	The FAA should plan and budget for at least ~5 year of parallel operations <u>regardless of a provider change</u> from FTI to FTI-2

5. Transition and Implementation Challenges and Cost Impacts of New Marketplace Technologies

The FTI-2 Technology Working Group is reviewing a number of technologies: Software Defined Networks (SDN), TDM to IP migration solutions, “Whitebox” Network Function Virtualization, etc. The FAA should prioritize its transition readiness to implement these marketplace driven technologies

Table 5-1: New marketplace technology challenges

	Challenge Areas	Cost/Risk Item	Mitigation of Risk/Cost/Schedule
5.1	FTI provides customer premise equipment which adapts to carrier equipment	There is a potential for mismatch between the carrier and the on-site legacy FAA infrastructure. New Services being	The FAA should: 1) Document the physical plant and the current network structure (cable plant to the external connectivity requirements,

	Challenge Areas	Cost/Risk Item	Mitigation of Risk/Cost/Schedule
		<p>installed may not match exactly the legacy service. Equipment will need to be upgraded to replace equipment that is either not compatible or end of life</p>	<p>port security, routing and transport concerns).Use open standards in network support, design and architecture, where possible, to allow for generic skill and management tool sets</p> <p>2) Research the modifications necessary to bridge the gap (hardware and/or software) and then develop strategies, standards and plans for verifying interoperability (physical to application layers)</p> <p>3) Identify a sponsor / stakeholder group for sharing interoperability issues / information through resolution</p> <p>4) Begin these efforts now including the TDM to IP solution identification via FTI and/or other engineering contract tasks. (Delaying this activity only increases cost/risk for FTI-2)</p>
5.2	The historic pace of TDM to IP migration on FTI is	While new technologies might	The FAA should research technology/deployment

	Challenge Areas	Cost/Risk Item	Mitigation of Risk/Cost/Schedule
	very slow with only a small number of systems migrated from serial to IP across FTI's 15 year history	yield cost efficiencies the effort to validate any new technologies in the FAA's unique environment will not diminish over time. At the very least this effort is constant yet the cost will increase over time because of inflation and more likely because of increased carrier costs to support legacy services.	options to deal with a wide range of FAA TDM systems to see which implementation approach will work best. Expediting National Airspace Voice System (NVS) would have a likely very positive impact on lowering legacy TDM equipment dependencies and cost The FAA should begin TDM to IP solution identification via FTI and/or other engineering contract task (delaying this activity only increases cost/risk for FTI-2)
5.3	During the LINCS to FTI migration NAS technology upgrades such as replacing TDM were deferred. Telecommunications carriers are planning to sun-set these technologies	Service transition of TDM and end-system analog circuits, such as those used for Navigation Aids and remote maintenance, is becoming more complex and costly. Some transitions may involve carrier changes, technology changes, or both.	The FAA should begin to research and demonstrate technology options with Strength, Weaknesses, Opportunity, Tactics (SWOT) analysis, to determine migration strategy and schedule (e.g., TDMoIP until final migration) Leverage hardware-agnostic / industry standards (e.g., SDN) that increase interoperability

	Challenge Areas	Cost/Risk Item	Mitigation of Risk/Cost/Schedule
5.4	Procedures for establishing/validating a TDM circuit may not work for the effort required to establish an IP circuit	Ordering, planning, engineering, and/or validation of IP services are different and may cause delays in any part of the transition	The FAA should define and optimize these new FAA processes, procedures and publish these processes as part of the Request for Proposal (RFP) to minimize FAA migration risks that may be unknown to industry.
5.5	FTI-2 contract/contractor will have their own customer premise equipment that may or may not initially support all FTI and FTI-2 functions.	FAA will need to plan for technology upgrades, not just any potential provider change. This makes the FTI to FTI-2 transition more complex than the previous transition	Investigate providing certain equipment as Government Furnished Equipment (GFE), particularly in cases where additional equipment during cutover cannot be easily accommodated
5.6	Qualified staff at rural locations	Rural locations <u>may</u> have an issue for having carrier and/or FAA staff with the required skills.	Develop, publish and update a plan of the expected/needed staff/technical skills required by FAA and FTI /FTI-2 Service Provider/carriers
5.7	Inconsistent technology adoption pace across and within carriers	Pace of technology adoption varies across carriers and across rural vs metro locations (limits “one	The FAA should develop validation approaches and have them in-place and tested by time of cutover so

	Challenge Areas	Cost/Risk Item	Mitigation of Risk/Cost/Schedule
		size fits all” solutions) within a single carrier	that transition activities are not delayed. The FAA should research technology that can support multiple types of end points (i.e., remain hardware / software agnostic (e.g., TDMoIP)) and begin TDM to IP solution identification now via FTI and/or other engineering contract tasks (delaying this activity only increases cost/risk for FTI-2)
5.8	Carrier retirement of legacy Technology	Carriers are retiring unprofitable, difficult to maintain services, particularly internationally and in areas of low demand (rural locations). Carriers continue providing TDM support after the 2020-2025 time period however these services may come at an FAA premium over the	The FAA should define standards and requirements rather than dictating the technology The FAA should also leverage technology that increases interoperability (e.g., Software Defined Networking (SDN))

	Challenge Areas	Cost/Risk Item	Mitigation of Risk/Cost/Schedule
		costs of these services today.	
5.9	TDM to IP Technology readiness	Engineered solutions to support TDM to IP conversion may not be ready, in place, and tested by time of cutover	The FAA should prioritize, research, test, and validate these engineered solutions now well in advance of FTI-2. Developing these efforts now under multiple contract vehicles may increase the number of personnel and firms with experience developing solutions for the unique FAA requirements. This will enhance competition for the FTI-2 procurement by broadening the number of firms capable of delivering solutions to FAA. Conversion could be a significant cost impact for new services being installed. Additionally compatibility with legacy systems may be impacted, especially if the new service is IP-based rather than TDM based.

6. Transition and Implementation Risk and Cost Impacts of the FTI-2 Acquisition Scope Approach

The FAA is reviewing multiple acquisition scenarios for FTI-2.

Influencing the decision to alter FTI-2 in a significant or insignificant way are the following items:

- FTI-2 like the previous transition from LINCOS will take ~5 years to safely and fully transition
- The FTI scope of voice and data services is broader and has grown over those services provided under LINCOS
- FTI has also grown to deliver additional services (e.g. Enterprise messaging, and security)
- FTI governance is more complex than the government model that existed under LINCOS
- A migration to any IP system introduces IP security risks that are significantly different than those faced in the current environment.
- A single FTI-2 contract may impose more stringent reliability and quality of service than required to meet mission or administrative services, creating inefficiencies.
- Finally the FAA is facing a significant marketplace driven technology change that the current FTI contract has not significantly faced. These technology changes in turn will likely drive the carriers pricing to maintain legacy TDM services.

The FAA should prioritize activities that reduce these cost and risks (challenges) on FTI-2. It is highly recommended that the FAA start on the recommendations now, well in advance of the FTI-2 contract to minimize the risk cost and complexity that the FAA will face with FTI-2.

Table 6-1: Acquisition Approach Challenges

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
6.1	FTI Transition took 5+ years to fully transition. FTI-2 includes transitioning 25k FTI services	The LINCOS to FTI transition while generally facility centric-resulted in multiple trips to some locations; There were also instances where circuit capacity needed to be increased within two years of the	The FAA should verify existing conditions and research the use technologies such as “Whitebox” Network Functions Virtualization (NFV) standard Hardware

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
	in 4,000+ locations	<p>transition resulting from poor site inventory.</p> <p>ARTCC transitions were system based. Approaches for systems needs to consider efficient parallel operations across highly connected localized facilities (Center, TRACON, Tower)</p>	<p>(HW) solution allowing remote Software (SW) configurations to minimize an occurrence of repeat trips during the transition period</p> <p>The FAA should also consider the transition sequencing for highly interconnected facilities in a local area (ARTCC, TRACON, Tower)</p> <p>The FAA should begin TDM to IP solution identification soon via FTI and/or other engineering contract tasks (delaying this activity only increases cost/risk for FTI-2)</p>
6.2	FTI-2 is more complex than LINCS-to FTI Transition	FTI-2 will have a comparable of number of sites, but more end points to be supported and more data/voice services. Inadequate inventory (lesson learned from LINCS to FTI) caused an increase (unplanned transition workloads)	The FAA should adequately develop, update and maintain an inventory plan that will be an output deliverable from the current FTI provider (via FAA) to FTI-2 offerors
6.3	FTI-2 is more complex than	FTI-2 must contend technology change from TDM to IP	The FAA should begin the technology assessment and identification of

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
	LINCS-to FTI Transition		replacement technology in advance of FTI-2 procurement to minimize migration risks.
6.4	FTI-2 is more complex than LINCS-to FTI Transition	FTI-2 has additional services and approval/coordination complexities (e.g. LINCS to FTI did not have to contend with certain current FTI services such as: NAS Enterprise Security Gateway (NESG); Data messaging Nodes (NEMS) (SWIM), etc.)	<p>The FAA should evaluate the risk reduction benefits, and potential increase in competition by separation of these components from the basic FTI-2 communications infrastructure, while also considering the benefits of continuing to include these services as part of the FTI-2 acquisition.</p> <p>Separation of certain services can provide the FAA with a broader set of firms who bring innovative approaches, increased FAA domain experience and enhanced competition for FTI-2, while also making FTI-2 less complex (less risk).</p> <p>Certain core voice, data, services may/may not be good candidates for any</p>

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
			separation as it may only increase risks and offer too little competitive enhancement for the FAA
6.5	FTI-2 is more complex than LINC3 to FTI Transition	Today’s FAA governance requires more internal oversight and approvals as compared to the FTI transition from LINC3 need examples	<p>The FAA should document and publish its FAA approval matrix including the time and effort it takes to achieve these milestones; The FAA should provide the Matrix as part of solicitation to maximize validity of cost and schedule proposals from offerors.</p> <p>Examples of "more internal oversight and approvals" occur in the tight scrutiny within the more complex integration which has evolved. Each Network Operations Center (NOC) has its configuration management processes, including at pre-coordination, testing, piloting, and production steps. Mission systems have become more complex with their own</p>

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
			interfaces and life cycle processes, including En Route Automation Modernization (ERAM) and System Wide Information Management (SWIM).
6.6	The FAA provides premise equipment which adapts to FTI carrier/provider equipment.	There is a potential for mismatch between the FTI-2 carrier and on-site legacy FAA infrastructure	See inventory plan creation recommendation above to minimize the occurrence of mismatches
6.7	Parallel operations will require parallel operating costs for FTI and FTI-2 network	LINCS to FTI spanned 5+ years	<p>The FAA should plan/budget for a similar transition period.- Technology may hasten transition, while FTI is more complex (has more services) than previous effort.</p> <p>The FAA focus should be on activities that minimize cost/schedule/risk of a more complex FTI environment.</p> <p>Prioritizing these activities and performing these</p>

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
			efforts in advance of FTI-2 should be top FAA Leadership priority to minimize these challenges These challenges are not simply an FTI-2 program challenge, these challenges affect the majority of FAA NAS, Mission and administrative systems.
6.8	FTI-2 Transition Complexity	Given FTI-2 is broader in scope/complexity than FTI the transition may take longer given a similar set of resources	The FAA should adequately plan/budget for 5+ years of Parallel Operations, regardless of a service provider change.
6.9	FTI Transition-Out Plan	Inadequate transition planning will cause inconsistent bid assumptions by the FTI-2 offerors. Lack of a transition-out plan that covers transition activities from FTI to FTI-2 Contract (with well-coordinated plans for any transitions) will cause post award challenges as Transition-In and Transition Out Plans may not sync from an incoming and outgoing service provider.	The FAA should specify Transition-Out Plan requirements as part of the FTI Bridge Contract to minimize risk, cost, and best plan for contract transition, regardless of a service provider change. Transition-Out Plan(s) to include inventory plans should be developed, and maintained and provided as a required deliverable from FTI contractor to the

	Challenge Areas	Cost/Challenge Item	Mitigation of Risk/Cost/Schedule
			FTI-2 offerors via the FAA Draft SIR or market survey step.
6.10	There will be a period of time when services across systems' multi-point voice drops will be on two different networks	No single visibility location for all networks if/when they are with two contracts (FTI and FTI-2)	<p>Evaluate approaches to deal with this scenario:</p> <p>Such as a neutral NOC</p> <p>Mimic approach used from LINCIS to FTI where the FAA installed FAA-owned analog bridge</p> <p>And/or Waive/modify SLAs during period (who is responsible)</p> <p>Plan for two different monitoring approaches</p>

7. Transition and Implementation Risks and Cost Impacts of Marketplace Supportability of FAA Requirements

Table 7-1: Marketplace supportability of FAA requirements challenges

	Challenge Areas	Cost/Risk Item	Mitigation of Risk/Cost/Schedule
7.1	Contract changes may dictate new service during a cutover at time of FTI bridge extension or phase out	Carriers may use new contract period to define new rate structures (i.e. increase prices associated with new services) particularly for TDM services that carriers seek to retire	Expedite the recommendation activities to minimize the duration of any increased TDM service rates stemming from the carriers desire to retire legacy TDM infrastructure
7.2	Transition from one carrier to another could require “disconnect and reinstall” effort	Multiple service disruptions, added expense for disconnect/reinstall effort	Requires close coordination with all parties to minimize parallel operations costs
7.3	Obsolescence:	Availability of maintaining existing equipment becomes harder (carriers not able to readily get replacement parts).	Assess carriers’ interest and ability to support depot parts. Assess repair and parts replacement trends. Consider obsolescence into transition phase-out priorities.

	Challenge Areas	Cost/Risk Item	Mitigation of Risk/Cost/Schedule
7.4	Obsolescence:	Qualified, local staff may not be available for an extended period of time to support legacy equipment (people are no longer being trained on TDM). Existing available workforces will diminish	The FAA Assess timelines for phase-out of legacy technologies against a baseline implementation schedule for planning migration and connectivity of legacy protocols/systems.
7.5	Obsolescence:	Availability of maintaining existing equipment becomes harder (carriers not able to readily get replacement parts).	Assess carriers’ interest and ability to support depot parts. Assess repair and parts replacement trends. Consider obsolescence into transition phase-out priorities.
7.6	Contract and/or provider changes may dictate new service customer	Transition from one carrier to another could/will require “disconnect and reinstall” Moving from one contract to another may also force that same migration as carriers establish a new service for a new contract.	Develop a strategy to re-use as much physical infrastructure as possible while still providing technology transformation according to FAA’s requirements. Re-use of physical infrastructure may limit expensive site visits.
7.7	Carrier technology adoption/ sustainability plan	Lack of FAA visibility into large and rural carriers timelines for adoption and sustainment of legacy services	FAA needs visibility into carrier modernization

	Challenge Areas	Cost/Risk Item	Mitigation of Risk/Cost/Schedule
			plans – specifically for last-mile solutions.

Additional areas of FAA focus should include:

- a. Performance requirements based upon the level of service (NAS, Mission, Administrative)
- b. Information Technology (IT) Cyber Security and physical security at remote unmanned sites – Transition to new technologies represents remote connectivity and data entry into the NAS that requires Cyber Security considerations, and possibly different security issues for protecting systems and data at sites that are difficult to secure
- c. Redundancy and back-up of critical infrastructure – Consideration of the approach to sustainment of critical infrastructure including handling data storage at sites, network/connectivity capabilities, hardware and software redundancy. Enable a support a resilient infrastructure and system of operations for handling localized, regionalized, or system/subsystem interruptions and recovery, whether by error/accident or deliberate hostile act.
- d. The number of Layer-3 service classes required to meet the needs of FTI-2, then determine the cost/benefit/risk to FAA if the number exceeds current or planned industry offerings. Non-standard implementations may increase one-time and ongoing costs, complexity, and time to delivery of services.
- e. Visibility/control/access by FAA into commercial virtual routing

8. Summary/Recommendations

The FTI-to-FTI-2 transition is more complex than the LINCIS to FTI transition, which lasted 5+ years. This increase in complexity is driven by several factors: the number of services has increased on FTI over the contract period, the FTI scope has been expanded by the FAA to support enhanced security and enterprise messaging efforts, and the internal FAA approval environment has evolved since the FTI transition, requiring more complex governance and approvals before a service can be accepted. Finally, the FTI to FTI-2 cutover must deal with a telecommunications carrier marketplace that has already initiated the phase out of TDM-based services that support ~90% of the FAA Air Traffic Control systems. While the FAA anticipates the exercise of a 5 year

contract extension and has acknowledged the potential for an additional phase-out contract, these FTI extensions may not adequately cover the increased transition complexity and expected durations required to safely transition the FTI contract.

The FAA can anticipate a longer FTI-2 transition period or the FAA can look to tackle these challenges in advance of the FTI-2 transition. A focus on these challenges in advance of the FTI-2 contract can positively reduce transition costs and risks by avoiding any increase in carrier charges that are expected if they continue to support TDM services beyond their desired life. The cost of legacy TDM services is expected to increase as the carriers seek to charge more to support legacy wired services, particularly for remote areas.

The FAA should take steps, well before the FTI-2 migration, to reduce the FTI-2 transition challenges, while maintaining safety and quality levels.

Deferring these efforts to the FTI-2 program will increase costs because of these technology and systems-driven items. Additional summary recommendations to reduce risk/challenges/cost for a very complex FTI-2 transition and implementation are as follows:

- Develop/document existing FTI inventory and provide these to offerors to minimize transitions risks The FAA needs to develop thorough inventories of the existing FTI environment to avoid repeating previous challenges on the LINCS to FTI transition. This inventory should be a deliverable of the existing FTI effort and prepared as part of the planned 5-year contract extension. The information would be provided to FTI-2 offerors.
- The FAA should begin the planning and research engineering efforts well before the FTI-2 procurement that will minimize the duration and complexity of the FTI-2 Transition. These efforts would include the research and validation of engineered solutions that will support legacy FAA systems that will likely need an IP to TDM conversion solution to support their quality and safety performance.
- The FAA should develop and provide offerors with new IP circuit ordering and validation test procedures that will be used as the FAA migrates from TDM to IP solutions. This ensures that the awardee conforms to FAA requirements for numbering and address management. These procedures should be provided to offerors NLT than the DSIR release so that offeror migration plans provide the FAA with efficient low risk plans.

The purpose (value) in providing these procedures is that it minimizes the likelihood (risk) of cost and schedule increases and delays associated with new FAA defined IP-based Test and Acceptance procedures that cannot be reasonably assumed by offerors. FAA-driven test and

acceptance efforts that are undefined in the SIR/DSIR puts risk on the FAA vs the Offeror. These risks may include safety concerns if the FAA attempted to shift the risk to the offeror. The new test and acceptance procedures will include different steps than are used today under FTI. Failure to define/provide the tested procedures and the expected impact to test and acceptance durations will cause offerors to estimate the durations and effort involved for this work. Accepted estimates will cause cost and schedule increases if/when the actual time for testing and acceptance is greater than the time estimated by offerors, and/or the time it takes to perform these functions today. The FAA should not simply provide the time that it takes today based upon historical FTI practice because it does not reflect the new IP-based test procedures that would be required within the FAA. The risk and impact is foreseeable and one that can be mitigated to avoid extended delays and costs during the transition period.

- The FAA should develop strategies that drive innovation/competition/efficiency without impacting safety
- The FAA should evaluate whether expanded FTI services such as enterprise messaging should be part of FTI-2 or moved to separate procurements (decoupled from the FTI-2 telecommunications infrastructure acquisition) to minimize the FTI-2 transition complexity and risk.
- The FAA may benefit from increased competition and potentially lower overall risk if they can obtain solutions to these challenges in an incremental fashion. Developing incremental solutions can broaden the competitive marketplace by allowing access to more firms who have demonstrated their respective ability to deliver services that use the FTI-2 infrastructure.

9. Authors & Affiliations

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