UNITED STATES COPYRIGHT OFFICE

PROVISIONAL INFORMATION TECHNOLOGY MODERNIZATION PLAN AND COST ANALYSIS

FEBRUARY 29, 2016

Table of Contents

Executive Summary

The United States Copyright Office is pleased to deliver this Provisional Information Technology Modernization Plan, dated February 29, 2016 (the "IT Plan") to the House of Representatives, as required by the Consolidated Appropriations Act of 2016 (the "Act"). The House Report accompanying the Act requires the Register of Copyrights to deliver "a detailed plan on necessary IT upgrades, with a cost estimate, that are required for a 21st century copyright organization" no later than June 18, 2016, and to seek public comments regarding a funding strategy and a time frame for completion.[1] As the House Report further explains:

> The Committee fully understands the importance of the Copyright Office as it relates to creativity and commercial artistic activity not only within the United States but also on a world-wide basis. In order to serve the copyright owners and the copyright community in the 21st century, a robust modern information technology (IT) operation will be necessary.[2]

The IT Plan must be read alongside the U.S. Copyright Office Strategic Plan (2016-2020), *Positioning the United States Copyright Office for the Future*, published on December 1, 2015 (the "Strategic Plan"). The Strategic Plan addresses the national copyright system's IT, data, and infrastructure needs as they relate to the Copyright Office's business, regulatory, and legal responsibilities.[3] As described in the Strategic Plan, modernization of the Copyright Office is a comprehensive undertaking requiring work to proceed on multiple fronts in tandem, including updates to Office staffing, funding, IT systems, and administrative practice, as well as potential changes to the copyright laws of the United States. The major regulatory changes necessary to effectively examine, register, protect, document, and license copyright interests and information in the digital age cannot be accomplished in the current technology state, however.

The IT Plan heeds the Strategic Plan's call for the Copyright Office of the twenty-first century to be lean, nimble, results-driven, and future-focused, and translates those themes into a comprehensive modernization plan that can meet the needs of the Office's customers. For example, the Copyright Office is currently unable to offer the ability to register works through mobile devices or apps, or to connect via an API to search public data in real time. Rather, the registration system is tied to a proprietary product, a federally-owned data center, and dated and costly underlying architecture which, even if updated, could not permit the kind of flexibility needed for the national copyright system to stay current. The recordation system remains paper-based.

Meanwhile, the industries at the core of our digital economy—from video game developers to mobile device manufacturers, from movie studios to internet streaming companies, from music creators to online music services—depend upon rapidly changing and innovative technology. The challenge today is ensuring that the Copyright Office can meet the future needs of these essential industries. It is clear that making incremental improvements will not be enough. We must shift the approach entirely, and the IT Plan therefore provides a flexible platform that others can build upon for the effortless protection and licensing of copyrighted works.

---

[1] H.R. REP. NO. 114-110, at 17 (2015).

[2] *Id.*

[3] *See* U.S. COPYRIGHT OFFICE, STRATEGIC PLAN 2016-2020: POSITIONING THE UNITED STATES COPYRIGHT OFFICE FOR THE Future (2015) ("Strategic Plan"), http://copyright.gov/reports/strategic-plan/sp2016-2020.html.

As documented in the following pages, the Copyright Office projects that the modernization effort will cost in the range of $165 million over a five-year implementation timeframe. Thereafter, operating costs would require an increase in the base budget of approximately $25 million. The dollar amount of costs that would be funded by fees is unknown at this time. In accordance with the House directive, the Register is seeking public comments as to both the funding strategy and implementation timeline.[4] The Office has published a Notice of Inquiry on these matters, timed with the release of the IT Plan, and will report back to Congress with a summary and recommendations as soon as possible.

Among other main points, the IT Plan reduces costly infrastructure by embracing well-established alternatives. For example, it does not require investment in a sizeable physical plant or data center. Rather, it embraces well-established alternatives, including cloud services and mobile technologies that are prevalent in the consumer and business markets. It prioritizes data integrity and security controls, and decreases risk by spreading operations among multiple partners or vendors. The Copyright Office would be responsible for phasing out legacy systems, and would assume a clean-slate, mission-critical strategy for moving forward. To this end, the IT Plan makes several key assumptions, including: (1) modernization must be managed from within the Copyright Office, utilizing individuals who work alongside of, and are fully accountable to, the Office's legal and business experts; and (2) modernization requires, and will receive, singular attention and around-the-clock dedication.

With respect to the Strategic Plan, the IT Plan ties most directly to Goal 5, which states that a robust, responsive, and highly secure enterprise architecture will form the backbone of a modern Copyright Office. These government systems should inspire confidence and encourage participation in day-to-day services and transactions. Custom search tools should yield quick, authoritative results. In short, modern technology should support all aspects of the Copyright Office's mission and adapt to evolving needs. The IT Plan incorporates the underlying themes of the Strategic Plan, namely, that the twenty-first century Copyright Office must be lean, nimble, results-driven, and future-focused.[5]

Both the Strategic Plan and the IT Plan draw on four years of Copyright Office deliberations regarding current and future services. This groundwork was carried out by staff at all levels, and involved a number of internal committees, public meetings and public reports. These significant efforts include a completely revised Compendium of Copyright Office practices, published on December 22, 2014,[6] a major report that informs the legal parameters of transforming and automating the copyright recordation system, published on January 7, 2015,[7] and a report recommending technological upgrades to the registration and recordation functions, published on February 18, 2015.[8] The Strategic Plan not only sets a path for copyright administration in the twenty-first century, but also provides a flexible basis for supporting such further statutory duties, databases, and regulatory programs that Congress may choose to assign to the Office going forward.

In the last few years, the Copyright Office also has worked with Congress to address gaps in the copyright law and to advise on changes that may be necessary to ensure a balanced and effective copyright regime in the modern age. The House Judiciary Committee, in particular, has conducted more

---

[4] H.R. REP. NO. 114-110, at 17 (2015).

[5] *See* Strategic Plan at 7.

[6] *See* U.S. COPYRIGHT OFFICE, COMPENDIUM OF U.S. COPYRIGHT OFFICE PRACTICES (3d ed. 2014).

[7] *See* U.S. COPYRIGHT OFFICE, TRANSFORMING DOCUMENT RECORDATION AT THE UNITED STATES COPYRIGHT OFFICE (Jan. 2015).

[8] *See* U.S. COPYRIGHT OFFICE, REPORT AND RECOMMENDATIONS OF THE TECHNICAL UPGRADES SPECIAL PROJECT TEAM (Feb. 2015).

than twenty hearings on the state of copyright law since 2013, including a hearing devoted to the current and future functions and resources of the U.S. Copyright Office.[9] In support of this work, the Office has undertaken sixteen policy and technical studies for the benefit of House of Representatives and the Senate, delivering ten completed policy and technical reports, which have built on the significant policy work of previous Registers over the past few decades.[10] Every study undertaken by the Office has incorporated opportunities for public notice and comment.

The Register's Office also has prioritized the organizational structure of the Copyright Office during the last few years to ensure that the Office's current statutory responsibilities and related operations are supervised by sufficiently qualified experts. For example, the Office now has senior leaders overseeing technology planning, copyright recordation, and public information, and has deputies assisting with the significant supervisory workload in the Office's registration, legal, and policy offices.[11] These senior leaders will be working with their respective staffs in the years ahead to further build, reorganize, or refine their respective departments and to align activities to modernization objectives.[12]

As requested by the House of Representatives, the IT Plan is comprehensive and exhaustive. It presents a fully-mapped out future-state IT enterprise and a detailed cost analysis for a modern IT environment for the national copyright system. In preparing it, the Copyright Office employed and incorporated federal government best practices, as identified by OMB, GAO, and other authorities. For example, the IT Plan integrates IT security into enterprise architecture processes, presents five-year lifecycle costs of implementation, and provides a cost basis of estimate report to provide for proper documentation of the cost estimate.[13]

Together, the Strategic Plan and the IT Plan provide a modernization approach that integrates enterprise architectures, cloud services, security controls, staffing requirements, and other operational authorities that will transform copyright administration in the United States. As explained further in the overview, customers will be able to transact with the Copyright Office easily, quickly, and from anywhere at any time, using any number of consumer platforms to secure copyrights and access data, including licensing or public domain information. Systems will yield quick, authoritative results, encouraging participation, partnerships, and commerce. As copyright law and copyright businesses evolve, so too will copyright administration.

Finally, in presenting the Strategic Plan and the IT Plan, the Copyright Office is mindful that Congress continues to deliberate on a number of legal and policy matters relating to copyright administration and the copyright law. As such, the business and IT improvements anticipated in the Strategic Plan and IT Plan are not the entirety of modernization discussions. As noted in the Senate Appropriation Committee's 2016 Report:

---

[9] *See U.S. Copyright Office: Its Functions and Resources: Hearing Before the H. Comm. on the Judiciary*, 114th Cong. (2015); Strategic Plan at 53–54; *Congressional Hearings on the Review of the Copyright Law*, U.S. COPYRIGHT OFFICE, http://copyright.gov/laws/hearings; *see also Improving Customer Service for the Copyright Community: Ensuring the Copyright Office and the Library of Congress Are Able to Meet the Demands of the Digital Age*: *Hearing Before the H. Comm. on Administration,* 114th Cong. (2015).

[10] *See Policy Reports*, U.S. COPYRIGHT OFFICE, http://copyright.gov/policy/policy-reports.html; *Active Policy Studies*, COPYRIGHT.GOV http://copyright.gov/policy/.

[11] *See* Strategic Plan at 47.

[12] *See USCO Leadership*, U.S. COPYRIGHT OFFICE, http://copyright.gov/about/leadership/; *Organization of the U.S. Copyright Office*, U.S. COPYRIGHT OFFICE (2015), http://copyright.gov/docs/c-711.pdf.

[13] *See e.g.*, *Best Practices and Leading Practices in Information Technology Management*, U.S. GOV'T ACCOUNTABILITY OFFICE, http://www.gao.gov/key_issues/leading_practices_information_technology_ management/issue_summary; Computer Security Resource Center, *Federal Information Security management Act (FISMA) Implementation Project*, NAT'L INST. OF STANDARDS AND TECH., http://csrc.nist.gov/groups/SMA/fisma/index.html; OFFICE OF MGMT & BUDGET, GUIDANCE ON EXHIBITS 53 AND 300 – INFORMATION TECHNOLOGY AND E-GOVERNMENT (2012), https://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/fy14_guidance_on_exhibits_53_and_300.pdf.

> The Committee finds that it is necessary to ensure that effective, efficient, and secure systems are in place at the Copyright Office to support the needs of all copyright-related industries. The Committee notes that, in addition to ongoing technological and process improvements, modernization of the Copyright Office could include proposed alternatives to its current structure and location within the Library of Congress. The Committee encourages an open dialogue to consider all options that allow for a thriving and efficient Copyright Office in the modern economy.[14]

The Copyright Office appreciates the complexity of these Congressional discussions and is pleased to provide this provisional IT Plan as requested and ahead of schedule. The IT Plan is flexible in that it may be implemented according to a variety of governance protocols, approvals and controls between the Copyright Office and larger Library of Congress. In envisioning a robust modern IT operation needed for a twenty-first copyright organization,[15] it does, however, necessarily depart from the status quo in which the Copyright Office manages software applications and the Library of Congress manages underlying IT systems. Rather, the Copyright Office would have maximum responsibility for operations relating to the national copyright system and the services that the Office provides.

In providing this IT Plan, the Copyright Office appreciates the support of Deloitte Consulting, LLP, which provided expert consulting services on the modernization plan and associated costs, and Gartner, Inc., which provided independent review and validation of the cost analysis and methodology. In the months ahead, the Copyright Office looks forward to refining these goals with Congress, the Library, the GAO, and the public.

All Copyright Office reports, testimony, rulemakings and public inquiries related to information technology or modernization are available at www.copyright.gov. Information about appropriations, IT spending, and budget justifications can be found online.[16]

Maria A. Pallante
United States Register of Copyrights

[14] S. REP. NO. 114-64, at 40 (2015).

[15] H.R. REP. NO. 114-110, at 17 (2015).

[16] *See Budgets*, LIB. OF CONGRESS, https://www.loc.gov/about/reports-and-budgets/congressional-budget-justifications/.

1.0 Overview and Business Case

This IT Plan, when implemented, would change a number of existing paradigms. Copyright Registration would move away from a large proprietary software product managed by the Copyright Office to a model that enables third parties to build a variety of products on an open source technology platform that can seamlessly interoperate with Copyright Office systems. The IT Plan would markedly minimize data center and other infrastructure needs and, instead, utilize a variety of cloud strategies. These cloud strategies would permit the USCO to implement examination and documentation practices that are tailored to the variety and complexity of copyrighted works in the digital age. Copyright owners will have an array of registration options to choose from, and be able to employ them from mobile devices as well as business-to-business interfaces. For example, a musician recording a song on a smartphone will be able to seamlessly send her song and the associated data to the Copyright Office for examination and registration. On the back end, users of copyright data, including licensing or public domain information, will have simple access to timely and authoritative data that can be used to build new businesses or analyze global trends.

The Copyright Recordation system would move from a paper-based intake system to an automated system where recording parties may enter their own information, using metadata standards established or adopted by the USCO. For example, a party could record a change in copyright ownership immediately at the time of contracting. As appropriate or required, the USCO would exercise quality review consistent with the requirements of the Copyright Act, *i.e*., to ensure priority filing and authoritative information. Digital search capabilities will provide users with dynamic access to the Office's recordation data. Moreover, the USCO will integrate Registration and Recordation data and databases that are currently siloed into a comprehensive System of Records, to provide a more seamless chain of title from registration to licenses to transfers and the public domain. Meanwhile, the IT Plan prioritizes strong IT security standards, and will protect the integrity of and access to nonpublic data and materials.

Collectively, these changes will engender more participation in national copyright administration. The planned comprehensive IT modernization will benefit all USCO systems, including the administration of statutory licenses, public information services, expert impartial assistance to Congress, the courts, and executive branch agencies on questions of copyright law and policy, and its back-office operations. By addressing the services and needs of the national copyright system in an integrated fashion, the USCO will efficiently prioritize its work and leverage synergies across various divisions and statutory duties.

In developing the Provisional Information Technology Modernization Plan ("IT Plan"), the United States Copyright Office ("USCO") undertook a holistic review, including a comparison of the USCO's objectives for a vision of the future state to a defensible cost estimate. All of these considerations themselves have a number of variables. The overall issues that frame this modernization plan are shown below in Figure 1.0.

Figure 1.0: USCO IT Plan Overview

1.1 Overview of Future State

The USCO's current information technology ("IT") operating model is essentially a shared services arrangement whereby the Copyright Technology Office manages USCO systems at the application layer (for example, the online copyright registration system) and the Library of Congress ("LoC") provides IT infrastructure and network support (for example, servers, storage, and database administration). The USCO applications are hosted at the LoC's Madison Building Data Center, which is controlled and managed by LoC staff. This structure places the USCO in a unique position to take advantage of "As a Service" IT technologies, such as cloud service delivery models, and the proposed architecture incorporates these technologies where reasonable. Core drivers enabling the USCO to consider cloud delivery models are shown below in Figure 1.1-1.

Core drivers enabling USCO to consider cloud delivery models:

Figure 1.1-1: Drivers Enabling USCO to Consider Cloud Delivery Models

Combined, these drivers position the USCO to take advantage of technologies that enable IT delivery of capabilities and services in a timely, scalable, and iterative manner, supporting the USCO's vision of becoming a twenty-first century model for government.

The USCO administers several mission-critical services, including the national copyright registration and recordation systems, an online database of records of copyright ownership, and copyright.gov. Within the USCO, staff use a variety of systems to accomplish their work. Under this IT Plan, all mission-critical services and systems will be re-platformed and designed to achieve user-centric computing for both external and internal users.

The proposed architecture makes use of cloud-enabled and cloud-provided services that give the USCO scalability, flexibility, and Operational Expense ("OPEX")-focused spending. Hosting key mission systems and services outside of the Madison Data Center will require tighter governance and Service Level Agreements ("SLAs") with vendors to ensure adequate service delivery and security.

Key characteristics of this architecture include:

- **Platform as a Service ("PaaS")- Based Mission Services** – The USCO will develop, operate, and maintain multiple mission-critical services with a limited transition period. Using a PaaS solution to build mission-critical applications will enable the USCO to meet the following objectives:
  - Prioritize limited resources on highest value-add activities
  - Adapt to changing needs using platform-enabled scaling
  - Reduce application management and operation complexity through standardization
  - Secure IT environment (via a Federal Risk and Authorization Management Program ("FedRAMP")-compliant cloud provider[17])
  - Lower upfront costs and expected Capital Expenses ("CAPEX")
- **Minimal Infrastructure Owned and Operated by the USCO** – The USCO will own and host a small, core subset of infrastructure to enable future state operations, including:
  - User authentication and directory services capabilities
  - Back-office infrastructure such as printers and voice hardware

[17] Applications from FedRAMP-compliant providers will still need to receive a valid Authorization to Operate (ATO) that specifically authorizes the use of the application for the USCO.

- Core networking equipment (with built-in redundancy)
- Remote user access points
- Infrastructure needed to enable off-line, off-site backups of critical enterprise data
- Power backup

- **USCO IT Focused on High Value-Add Activities** – The USCO IT will focus on high value-add activities like management, strategy, architecture, and engineering. This provides flexibility to procure support from service providers. The USCO IT will maintain responsibility for the following:
  - Cybersecurity (including operating model and standards/requirements)
  - Disaster Recovery ("DR") including data integrity, Recovery Time Objectives ("RTOs"), Recovery Point Objectives ("RPOs")
  - Enterprise data (including data model and data governance)
  - Strategy, enterprise architecture, solution engineering, and project delivery
  - Mission-critical application development support
- **Non-Core Mission Services Sourced Rather than Built** – The USCO will need to transition its IT operating model to be focused on governance, architecture, solution engineering, and vendor management. The USCO will source IT and non-IT shared services, such as:
  - IT Service Management ("ITSM") support (*e.g.*, service desks)
  - IT operations support (*e.g.*, server patching, archive storage environment maintenance)

Finally, given the importance of security to USCO operations, the future state will adopt FedRAMP's standardized approach to security assessment, authorization, and continuous monitoring for cloud products and services. The security provided by FedRAMP compliant solutions will serve as a baseline that can be augmented as needed.

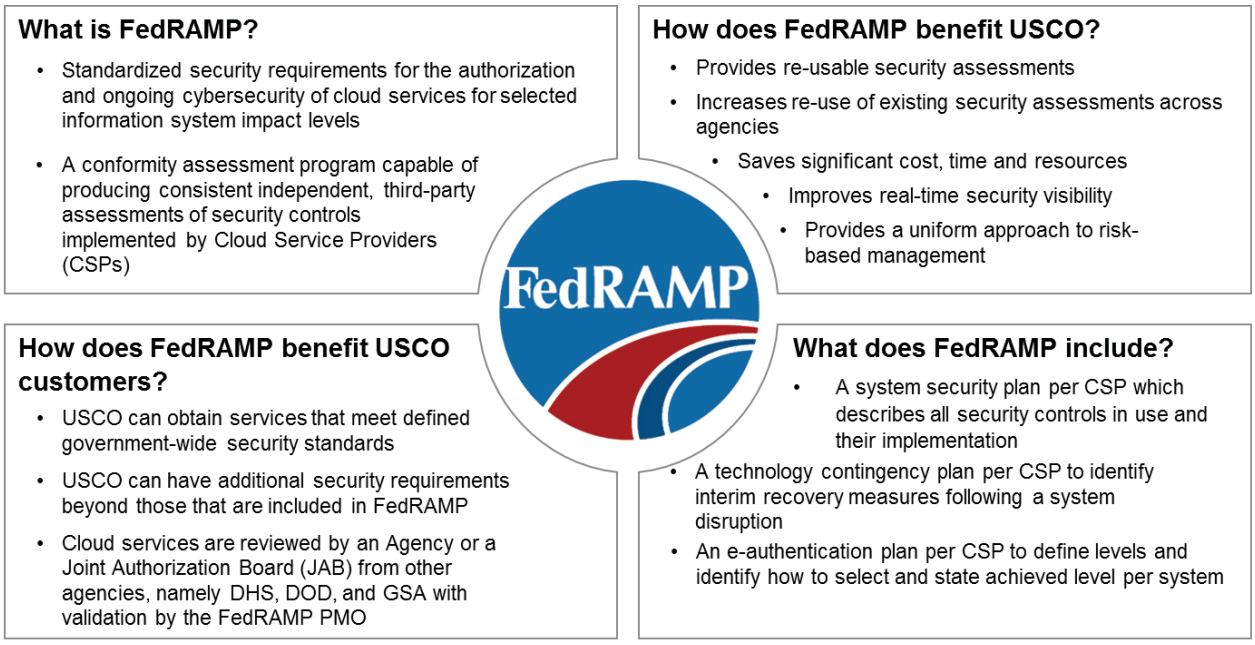


Figure 1.1-2: FedRAMP Summary

1.2 Modernization Roadmap

The IT Plan is designed to be phased in sequentially. To enable delivery of the right capabilities at the right time, the IT Plan logically phases and prioritizes thirty-four proposed initiatives based on criticality, complexity, and cost. This results in the phases shown in Figure 1.2-1:

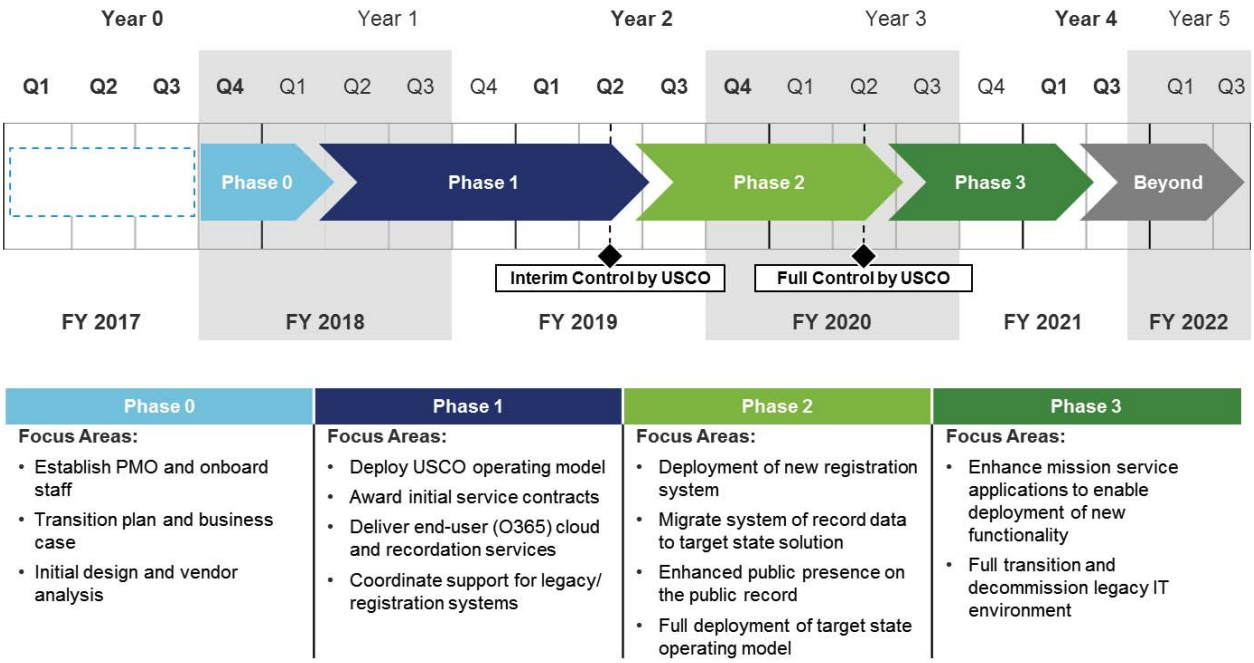


Figure 1.2-1: Overview of the Modernization Roadmap

These phases delineate how the USCO can achieve its goal of a modern IT system, and include general timeframes.

1.3 Cost Estimate

As a companion to the IT Plan, the USCO has developed a high-level notional cost model. The cost model provides a high-level understanding of the budget required to transition to the desired future state and also to sustain the ongoing IT costs over a five-year period.

To provide a holistic perspective, the cost model includes the following key cost elements:

- Budget required to fully design, develop, and deploy the proposed future state architecture
- Budget required to continue to support the on-going operations of the future state architecture for a five-year period
- Budget required to support technology refresh of IT hardware (*e.g.*, three years for laptops, four years for core infrastructure hardware)
- Budget required to operate a fully-modernized IT organization and to support planned growth from 400 to no more than 650 USCO staff users

Figure 1.3-1 summarizes the key findings of the cost estimate.

	Cost Analysis	Benchmarks & Trends	Risks & Implications	Recommendation
IT Operating Model	• USCO will require addition of 39 IT FTEs to successfully transition and support on going operations • Staff will focus on high-value activities	• IT FTE (including contractors) Govt. benchmark of 8.9% - 9.8% (Gartner)1 • USCO 12.6% slightly higher however given the public facing mission the FTE count is within reasonable range.	• USCO may face challenges in finding and staffing key resources	• USCO should identify and on-board key staff by Day 1, prior to the start of the effort (i.e. pre-Phase 0/in FY17) to avoid resource gaps and delays with transition activities
USCO DME Costs	• 36 different project initiatives identified across 4 phases • Requires strong PMO in 2018	• Agencies are finding it easier to re-platform legacy applications rather than migrating to cloud.	Timeline can be significantly impacted without proper support, governance and communication from leadership	• Transition and migration are often high risks items and requires strong PMO office to ensure on-time and on-budget execution. Sourcing for PMO office should start in FY17
Application Operations & Maintenance	• O&M development support for mission apps and other COTS solutions • Non-mission services like CRM, Case Mgmt. sourced	• Across different organizations and types of applications, alternatives to traditional models account to more than 50% of software implementations (Gartner)[2]	• USCO's systems development processes are less mature and are supportive of on premise based solution	• Adopt iterative and agile development approaches with multidisciplinary teams to achieve agility and speed of software delivery
IT Infrastructure	• Minimal infrastructure owned and operated • Core infrastructure sourced but managed by USCO staff • Key factors driving cost includes on-premise IT, cloud hosting, DR, and managed NOC and SOC services	• Between now and 2020, nearly half of productivity improvements in government IT will come from economies of scale — moving to shared services and cloud-based operations. (Gartner)[3]	• USCO will need to triage incidents and issues and the help desk will need to be trained to support new service desk process	• Implement strong SLAs and vendor management for on-time service delivery • Provide adequate training to staff and get acclimated to the new service desk process
End User Enablement	• End user enablement includes support for productivity tools like email, mobile devices,	• Agencies including DOJ & IRS have adopted O365 • Others are taking advantage of economies of scale through shared service model	• Limited change management and training will impact adoption rate and will likely impact overall productivity	• Provide adequate training and support to staff to ease the transition to new productivity tools

Sources:
1. Gartner, IT Key Metrics Data 2016: Small and Midsize Enterprise Executive Summary 31 tbl. 5 (2015).
2. Gartner, Forecast Overview: Enterprise Application Software, Worldwide, 2014 (2014), https://www.gartner.com/doc/2861417/forecast-overview-enterprise-application-software.
3. Gartner, Economies of Scale and Agility in Government: Guidance for the U.S. Federal Government (FITARA) and Elsewhere (2015), http://my.gartner.com/portal/server.pt?open=512&objID=202&mode=2&PageID=5553&resId=3099217&ref=Alerts.

Figure 1.3-1: Key Cost Estimate Findings

The total estimated IT budget across the planned five-year implementation timeframe is $165 million, with risk variants of +15% ($190 million) and -5% ($157 million). The costing model is discussed in detail in Section 6 of this IT Plan. The total estimated IT budget is allocated between $97 million for capital investment under Development, Modernization, and Enhancement ("DME") and $68 for Operations and Maintenance ("O&M") expenses over a planned five-year implementation period. Figure 1.3-2 shows a breakdown of these costs over the duration of the projected implementation.

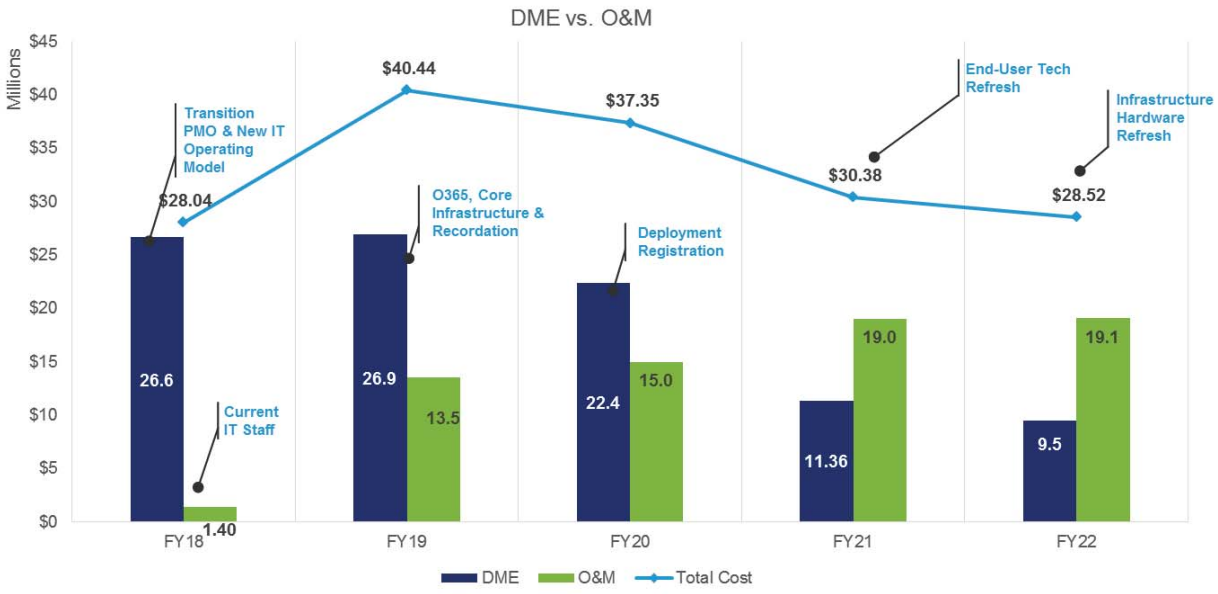


Figure 1.3-2: DME vs. O&M Breakdown

At the conclusion of the implementation period, the plan anticipates that operating costs would require an increase in the USCO base budget of approximately $25 million in FY 2023 and beyond.

1.4 Key Considerations and Next Steps

While the IT Plan aims to minimize risk and be as comprehensive as possible, the following risks have been identified, with corresponding mitigation options, as listed in Table 1.4-1.

Risk	Description	Mitigation
Performance	If USCO cannot provide the necessary level of application and service performance then the transition may not be successful	Establish high SLAs with vendors/services and hold vendors accountable
Budget	Uncertainty around IT budgets may create uncertainty when forecasting spending during the transition	Employ Program Management Office (PMO) practices to have greater control and visibility over IT budgeting and forecasting
Mission	Changes in USCO business service offerings may occur faster than USCO IT can adapt during transition	Employ iterative and parallel system development processes for timely support of business and functional requirements
Operating Model	USCO IT needs to rebuild its entire operating model during the transition to one focused on strategy, architecture, engineering, and vendor management, and any unforeseen issues may prevent the future state from being achieved in the proposed timeline	Receive buy-in from leadership and ensure that adequate support is in place to adopt and execute the newly-defined operating model

Risk	Description	Mitigation
Talent	USCO IT may not be able to source the services and talent needed to support the new operating model	Rely on contracting services to fill in skill set gaps
Authority	Failing to obtain full budget control and contracting authority may prevent USCO from completing IT modernization within the proposed timeline	Define budget process and ensure dedicated resources appropriately skilled to manage budget execution and contracting functions effectively.
Development	USCO will be developing multiple new applications on new platforms and may encounter challenges that delay delivery of applications and extend the lifespan of legacy applications	Ensure project managers follow project schedule and communicate any risks to management
Data Migration	USCO needs to migrate data from multiple different legacy systems and platforms; any issues with this data migration may result in loss of data integrity or service disruptions	Verify integrity of data once migration is complete; switch over to new platform only once verification is successful to prevent service disruption
Unwind Costs	USCO may have to pay unexpected costs to exit current licensing or service provider agreements	Analyze current licenses and service provider agreements to determine whether any costs are associated with existing contracts

Table 1.4-1: Identified Risks with Potential Mitigations

Given the provisional nature of this IT Plan, the USCO intends to revisit and revise the plan, as necessary, as requirements are further defined. Additionally, there are a number of key activities (*e.g.,* budget approvals, on-boarding staff) that require attention and action during the pre-planning phase (FY 2017) to avoid delays in execution. These activities include the establishment of a strong transition Program Management Office ("PMO") within the Copyright Technology Office to coordinate planning and execution of the broader modernization effort.

2.0 Proposed IT Operating Model

To achieve and maintain the future state architecture, the USCO's operating model will need to evolve into one focused on strategy, architecture, engineering, and vendor management. Figure 2.0-1 shows a functional view of a representative IT operating model.

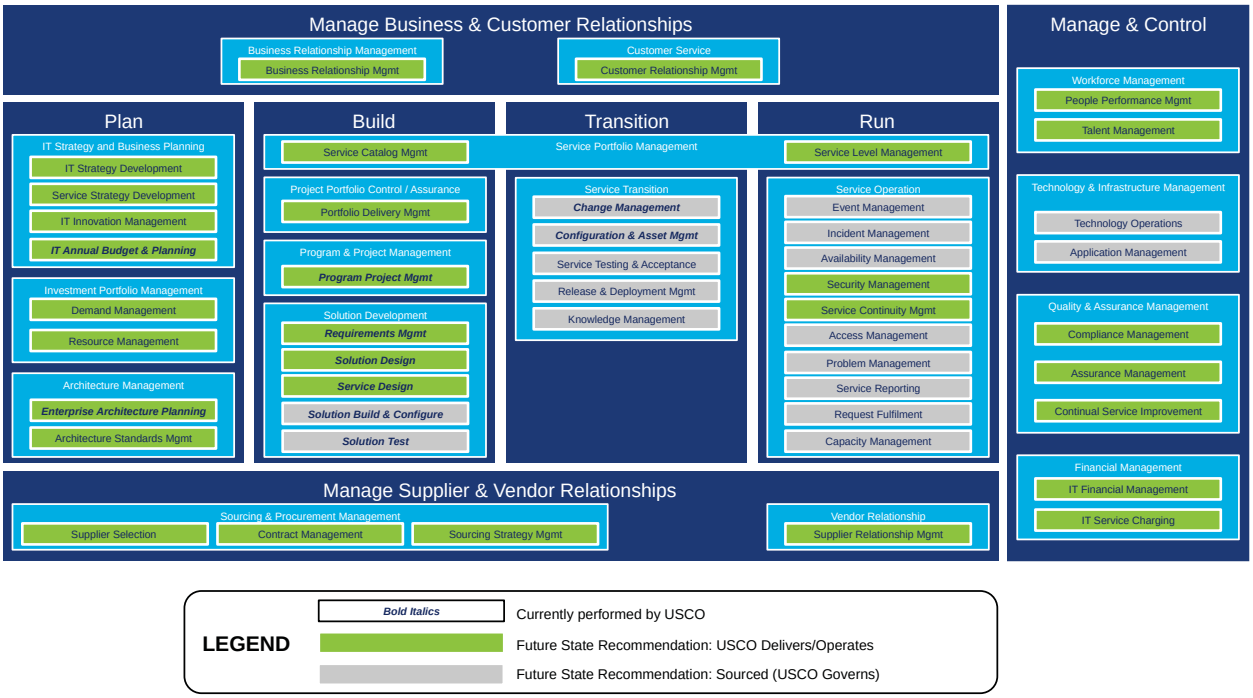


Figure 2.0-1: Representative Operating Model - Functional View

This operating model informs the notional high-level targeted IT organization design. However, the USCO would undergo an organizational design analysis prior to organization stand up.

2.1 IT Sourcing Model

The USCO is in a unique position to take advantage of "As a Service" IT technologies, such as cloud service delivery models. As shown in detail above in Figure 1.1-1, there are four general core drivers for considering cloud delivery models. These include: (1) the current operating model relies on LoC infrastructure and platform support; (2) the USCO's relatively small size does not allow it to gain economies of scale under a CAPEX approach; (3) the cloud market now has dedicated federal service offerings and security standards; and (4) the USCO does not currently have the staff to own and operate IT infrastructure.

In light of these core drivers and as part of the IT strategy development, a set of hosting options were identified and analyzed to determine whether each option would be the best strategic fit for the

USCO. Thereafter, an analysis of the USCO's mission needs, current capabilities, and strategic direction divided this set of hosting options into potential and eliminated hosting options, as shown in Figures 2.1-1 and 2.1-2.

	Pros	Cons	Evaluation
SaaS Cloud • Application, Platform, and Infrastructure layers provided	• Reduces upfront costs and improve time to application utilization • Shifts responsibility for system, application and facilities maintenance and upgrade • Provides some level of infrastructure redundancy • Eliminates software development tool selection	• Requires strong contractual mechanism to extract USCO data if needed • Provides specific application that is only useful if USCO has matching business need	*SaaS is a good option where there is a match between the provided application and customer need. It shifts the burden for app & systems upkeep to the vendor, allowing USCO to focus on its mission.*
IaaS & PaaS Cloud • **IaaS** – CPU, RAM, storage, and network provided. • **PaaS**– Builds on IaaS by adding technology platform (e.g., database or application development)	• Reduces upfront costs and utilize runtime expense vs. capital expense • Builds privacy utilizing software controls • Provides some level of infrastructure redundancy • IaaS - Shifts responsibility for systems and facilities maintenance • PaaS – Shifts responsibility for systems, facilities and application platform maintenance • PaaS – Improves time to application deployment by removing upfront procurement and build phase up to application platform	• Risks vendor lock-in if custom components are utilized • Offers many vendors with widely varying offerings and services • Forces operational model changes for existing IT shops • Removes visibility at infrastructure (IaaS) and application platform (PaaS) layers	*PaaS and IaaS shift daily IT support requirements to the service providers allowing USCO to focus on its mission.* • *PaaS is a good option for building applications, where control of application platform and below is not required* • *IaaS is a good option where you want to maintain control at the O/S level and above, but can transfer infrastructure control*
Managed Host • Facilities, Internet, network, systems and storage services provided.	• Options include physical separation of hosts or using a shared hosting IaaS model • Shifts responsibility for systems and facilities maintenance and upkeep to hosting provider • Provides closest scenario to own Datacenter	• Utilizes similar model to LoC OCIO provisioning • Requires upkeep and maintenance of COTS applications • Focuses more on server provisioning than services automation	*A managed hosting solution that is already approved to deliver Government services is a good fit for USCO capabilities that don't fit any cloud option. USCO can include technical skills in your contract and shift the burden of systems and skills upkeep to the provider.*

Figure 2.1-1: Identified Hosting Options

	Pros	Cons	Evaluation
Build Data Center • Build and maintain stand alone facility to house USCO systems.	• Builds physically separate systems • Provides complete control of IT environment	• Initiates large upfront capital expenses • Introduces property management • Leverages USCO IT as the provider for facilities, systems, storage, and network • Allocates Federal regulation adherence solely to USCO • Creates focus on facilities and systems physical upkeep	*Given the breadth & depth of available services in today's market, building and maintaining a data center does not make sense for USCO.*
Co-location • Facilities and Internet provided	• Builds physically separate systems • Utilizes provided facilities level services	• Initiates large upfront capital expense • Leverages USCO IT as systems SLA provider • Allocates Federal regulation adherence solely to USCO • Creates responsibility for non-mission critical, labor-intensive functions of system patching and upgrading	*Given the breadth & depth of available services in today's market, housing physical infrastructure in a co-location facility and acquiring the skills to maintain it do not make sense for USCO.*

Figure 2.1-2: Hosting Options Eliminated due to Lack of Alignment with USCO Needs

Further, there are multiple types of clouds and cloud service delivery models that the USCO considered, as shown in Figure 2.1-3.

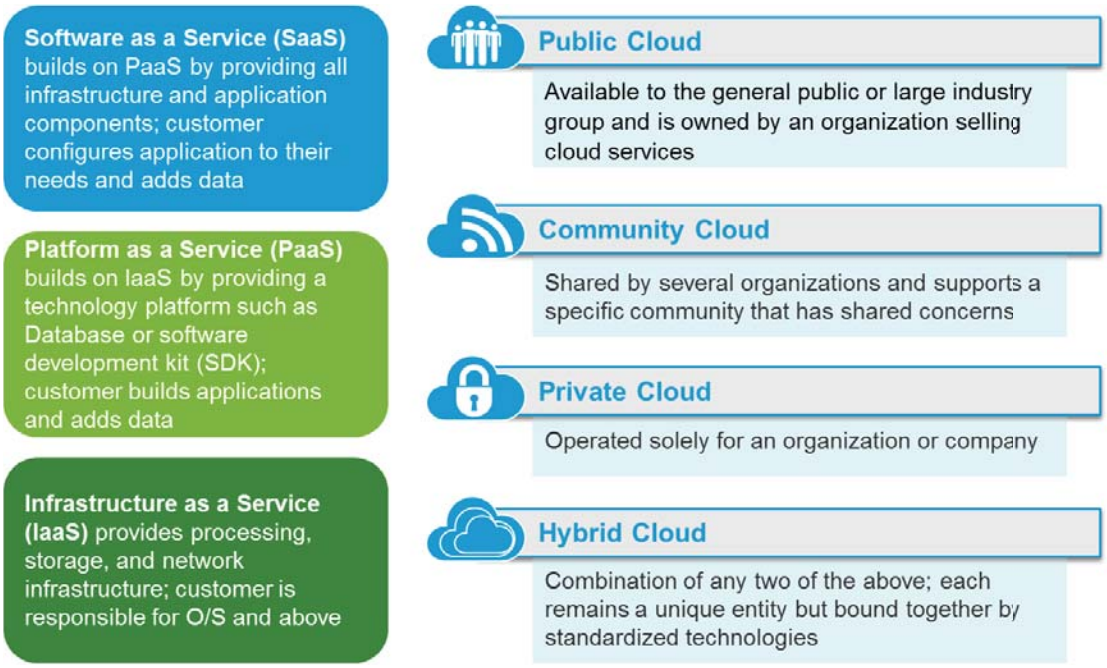
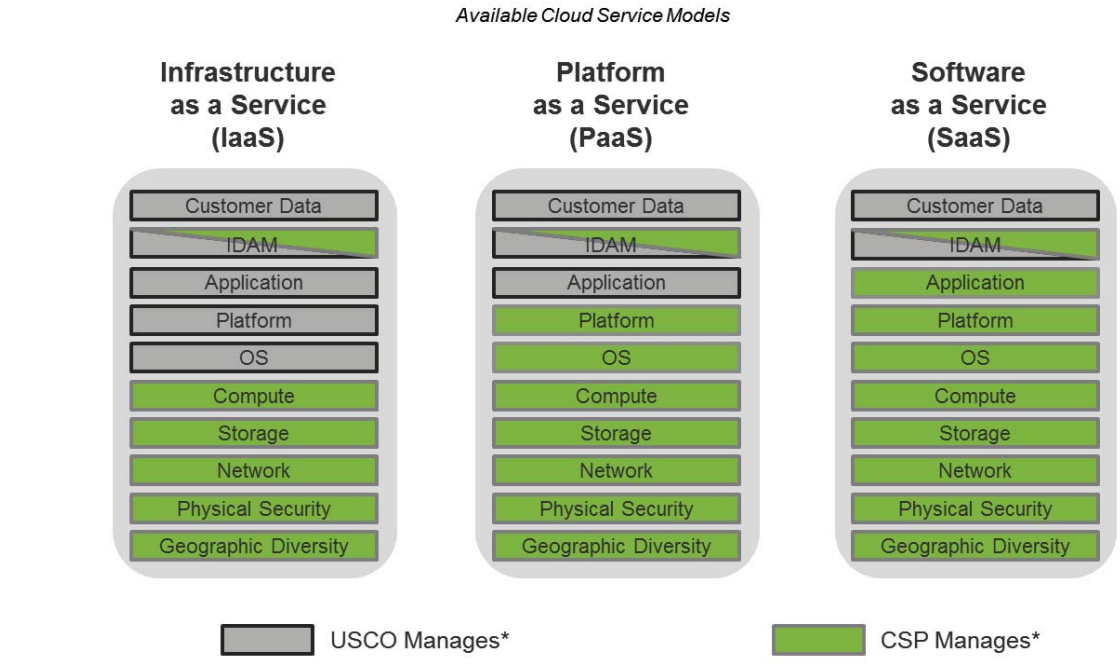


Figure 2.1-3: Cloud Options

Different cloud as a service offerings would require the USCO to undertake different levels of management responsibility and associated investments in hardware, talent, and skill sets, as shown in Figure 2.1-4.



*Management includes purchase and licensing where applicable, technical skills, problem resolution and installation, maintenance, and upgrade responsibilities.

Figure 2.1-4: Layer Ownership for Different Cloud as a Service Options

The potential benefits of a cloud-based model, including compared to a managed-host model become apparent when considering the planned-for Digital Asset Archive. As the USCO digital assets grow in volume, cloud-based storage solutions may provide significant cost benefits over owned long-term storage options. Figure 2.1-5 depicts a preliminary analysis comparing costs related to cloud versus owned (*i.e.*, on-premises) options for long-term storage of digital assets.

	Build On-Premise Archive Storage	Procure Archive Storagefrom Cloud Storage Provider
Description	USCO architects and engineers solution then procures all the infrastructure and services needed to implement, operate, and maintain the long-term archive storage equipment NOTE: to replicate durability/redundancy provided by available cloud services, USCO would need to have at least 1–2 additional data storage locations	USCO procures long-term archive storage from a cloud storage provider and is responsible for architecting and engineering the interface to the cloud storage environment and providing governance over the vendor (e.g., periodically sampling stored files to validate data integrity)
Estimated TCO Monthly Cost/GB	$0.11[1]	$0.007[2,3]
Estimated USCO Monthly Storage Costs (60 TB[4,5])	$13,200 per month[6] for storage in two locations	$437.58 per month[3,6]
Relative Headcount Considerations	High – requires dedicated storage architects and engineers, contracted support for operations and maintenance	Low – architects and engineers needed to help design solution, otherwise only steady state resource needs are around governance and vendor management
Relative Control Provided	High – USCO owns design, management, operations, and maintenance of the storage environment and can configure as desired	Low – data stored on servers owned by the cloud storage provider, can encrypt data prior to sending to cloud storage provider
Relative Infrastructure Needs	High – USCO will need data center facilities to support storage equipment needs in addition to the physical storage hardware necessary	Low – no storage infrastructure needed at USCO facilities; data sent to provider over network
Other Comments	Estimated Total Cost/GB only accounted for over three years and doesn't account for refresh costs; cost also assumes USCO already has data centers Building own storage infrastructure would require significant facility procurement costs (lease or buy) and power costs to meet cooling and system demands (demand which may exceed capacity of Madison building)	Risk that pricing scheme may change or that USCO regulations/security requirements may prevent data from being stored in the cloud

Sources:
1. Gartner, The Issues and Costs of Building Your Own Storage, Compared to Buying Storage or Using Cloud Storage (2015), https://www.gartner.com/doc/3138319/issues-costs-building-storage-compared.
2. Amazon Web Services Glacier service used for analysis based on it being depicted as a notational option in the To-Be Architecture Analysis section.
3. *Simple Monthly Calculator*, Amazon Web Services, https://calculator.s3.amazonaws.com/index.html (Inputs: US-East Region, 60 TB storage, 150,000 UPLOAD requests per month (rounded up total electronic deposits received in FY2015 (data provided by USCO) and divided by 12 months), 20 GB retrieved per month (assumption), 1.5 TB data transfer in, no inter-region data transfers, no data transfer out).
4. Data provided by USCO for current digital asset storage (60 TB growing by 1.5 TB/month), no storage growth accounted for in this analysis.
5. The current USCO digital asset repository does not include digital assets that are submitted on disks/drives (e.g., films), if those films are to be copied to the Digital Assist Archivein the future then storage needs would be expected to increase significantly.
6. Decimal definition of Terabytes and Gigabytes used in analysis (i.e., 1 TB = 1000 GB).

Figure 2.1-5: Rough Cost Comparison between Cloud and On-Premise Long-Term Storage

Given the USCO's current state IT and future objectives, the IT Plan concludes that a PaaS solution offers a number of benefits. A PaaS solution can deliver mission critical applications and systems in a flexible and scalable manner, with minimal capital expenditures, as shown in Figure 2.1-6.

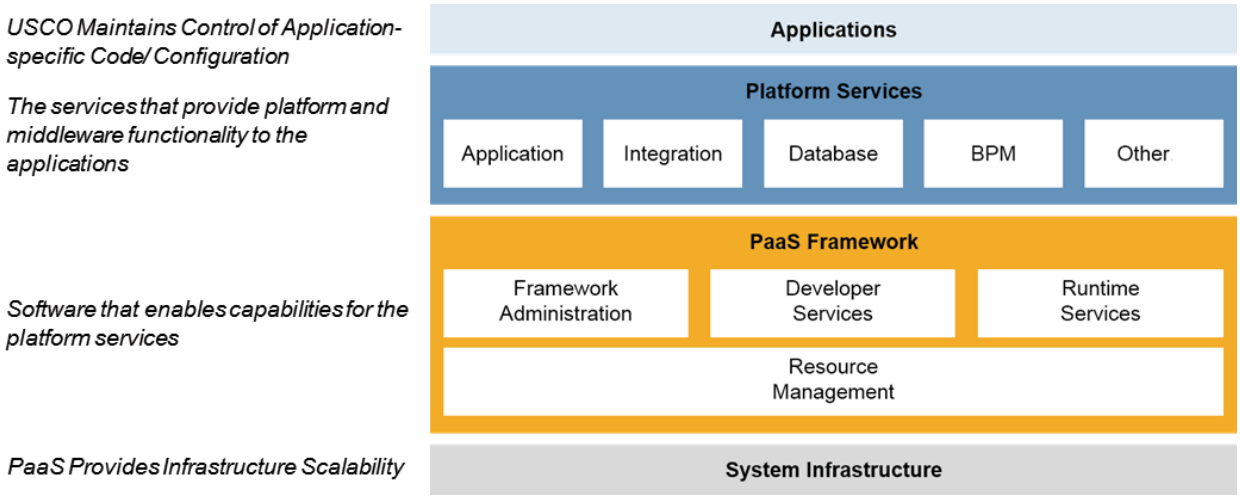


Figure 2.1-6: PaaS Provided Capabilities

Using a PaaS solution provides benefits such as:

- Pre-packaged modules that can be configured or incorporated into the USCO's applications to decrease development time
- Infrastructure scalability to ensure adequate amounts of processing and storage capacity is available, minimizing the risk of performance degradation
- Significantly reduced costs associated with procuring, managing, maintaining, operating, and refreshing infrastructure, and no need to pay for associated data center costs (*e.g.*, cooling)

However, the USCO is aware of the following potential drawbacks to using PaaS:

- Potential for vendor lock-in if there are platform-specific programming/application development requirements
- Risk that capabilities are not obtained in a cost-effective manner if the licensing model is not well understood
- As part of refinement and planning for eventual implementation of this provisional IT Plan, the USCO will continue to analyze the selection of a cloud solution, including various cloud service delivery models

2.2 Cybersecurity

The USCO will need to determine which specific cybersecurity functions to source within its modernized IT security operating model. Figure 2.2-1 depicts a notional Security Operating Model.

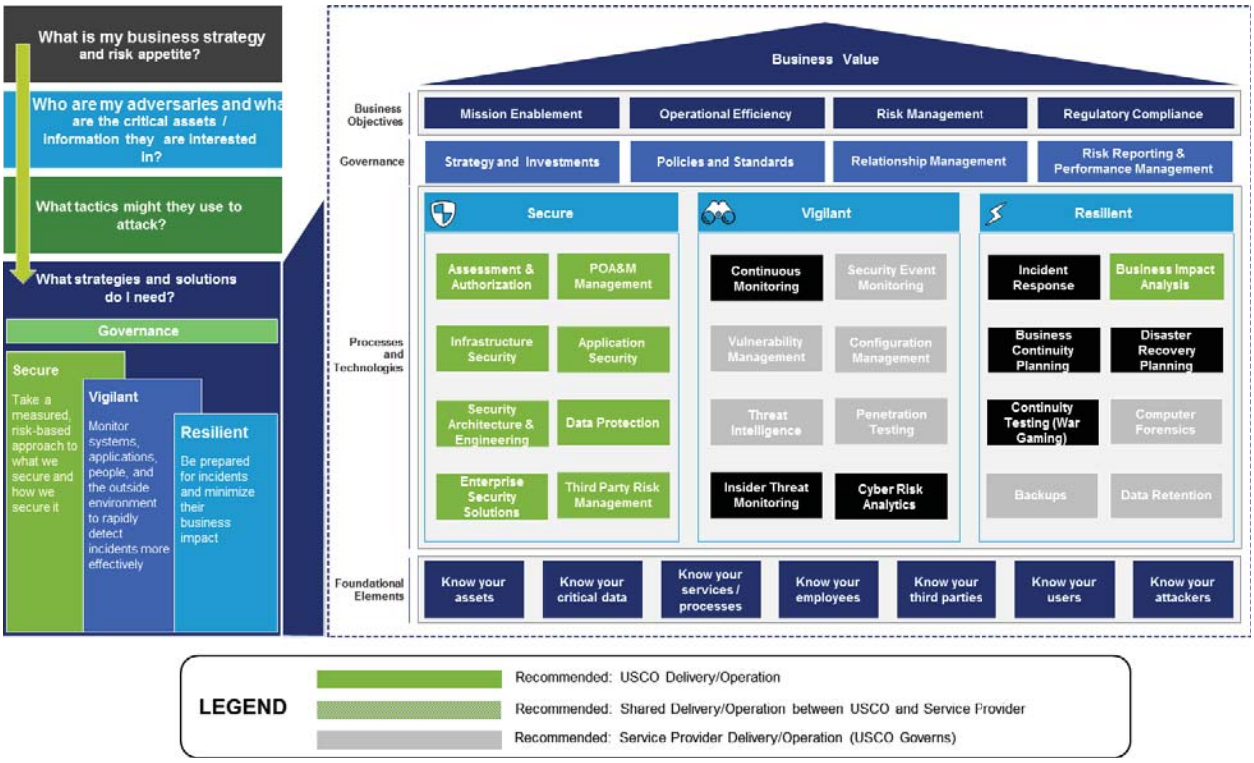
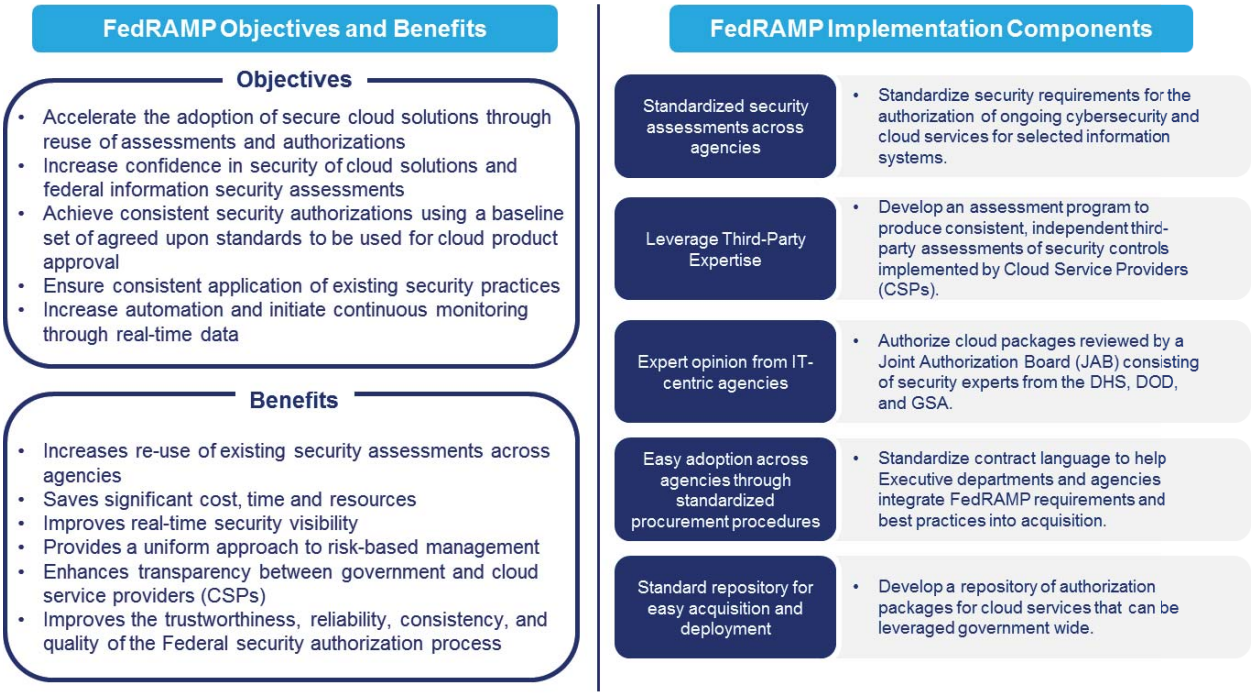


Figure 2.2-1: Notional Security Operating Model

Strong IT security is an important priority, especially for a cloud-first strategy. FedRAMP establishes a set of security standards for federal cloud services that should serve as a baseline as the USCO builds its security model. FedRAMP is a government-wide program that provides a standardized approach to security assessment, authorization, and continuous monitoring for cloud products and services. The USCO's adoption of FedRAMP standards is expected to reduce duplication and save cost, time, and staff required to conduct redundant agency security assessments.

Beyond FedRAMP, USCO intends to implement greater levels of security of varying degrees depending on the system. In addition, the USCO CIO has indicated a preference for outsources monitoring services to an expert SOC service.

Figure 2.2-2 provides an overview of FedRAMP.



Source: GENERAL SERVICES ADMINISTRATION, http://www.gsa.gov
Note: USCO Applications will still need to receive Authorization to Operate (ATO).)

Figure 2.2-2: Overview of FedRAMP

3.0 Future Architecture

The USCO's future state architecture is structured around scalable deployment and service models to reduce complexity and support new and emerging requirements. It makes use of capabilities provided by cloud technologies to minimize the CAPEX required by the USCO.

In the future state, the USCO will continue to be responsible for delivering multiple mission-critical services to external customers and internal users, as shown below in Figure 3.0-1

Core drivers enabling USCO to consider cloud delivery models:

Combined, these drivers enable the USCO to take advantage of technologies that enable IT delivery of capabilities and services in a timely, scalable, and agile manner, supporting the USCO's vision of becoming a twenty-first century model for government.

The IT Plan also calls for modernization of the USCO data management systems. Currently, the USCO processes different types of data and in multiple systems, as listed in Figure 3.0-1. The IT Plan proposes processing and storing data in a limited set of systems to avoid data management overhead.

Data Type	Description	Source	Processing System	Storage System	Retention Policy
Copyright Registration	Includes both the copyright application data received from the applicant plus the associated metadata applied during USCO processing	USCO receives from applicant	Back end registration application	System of record	Retained indefinitely
Digital Asset	Deposit material (e.g., document, photograph, sound recording) received from the applicant with their copyright application	USCO receives from applicant	Back end registration application	System of record during USCO processing, then archived to long-term asset storage solution	Retained for last surviving author's life plus 70 years (if created after Jan 1, 1978); for anonymous works retained for 95 years from publication or 120 years from creation
Certified Copy of Digital Asset	Certified version of the original digital deposit produced by USCO and provided to the copyright owner	Asset storage solution	Back end registration/ application (to validate SHA256 hash)	N/A (provided to copyright owner)	N/A (copy of digital deposit provided back to copyright owner; digital deposit remains stored in archive)
Recorded Document	Publicly recorded copyright-related document	USCO receives via mail (list of titles may be submitted electronically)	Back end recordation application	System of record	Retained indefinitely
Public Record	Publicly accessible records of copyright ownership	USCO system of record via ETL	Public record	Public record	Retained indefinitely
Legacy Data	Data from current USCO systems that needs to be accounted for in the future state	Current USCO systems (eCO, COINS Archive, CORDOCS, CORCATS, DOCLOG, LILOS, BCS)	N/A	System of record	Retained according to relevant provisions of the Copyright Act

Figure 3.0-1: Summary of USCO Data Sets

This retention policy referenced in Figure 3.0-1 is provisional and may require adjustment after reconciliation with National Archives and Records Administration schedules.

3.1 Approach

To determine which USCO applications are suitable for a cloud-based model, each mission-critical or back-office application was analyzed against a set of agreed-upon criteria. Figure 3.1-1 provides a high-level overview of the approach used to evaluate whether cloud-based architecture was suitable for each application.

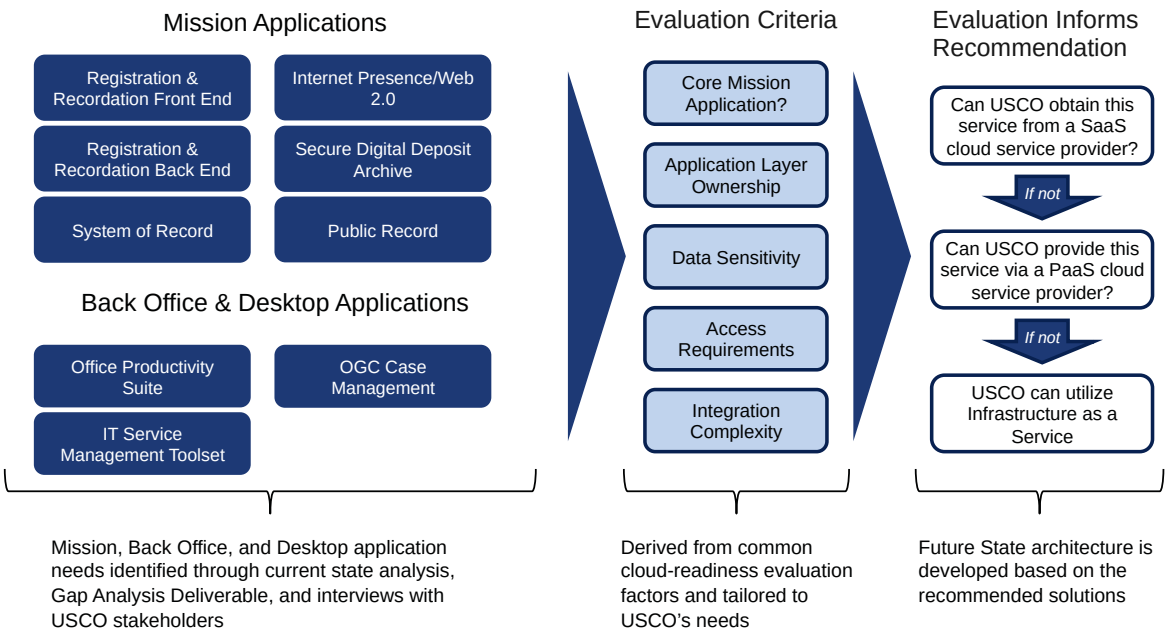


Figure 3.1-1: Approach to Developing the Future Architecture

Figure 3.1-2 depicts the application of the evaluation criteria for each mission-critical application. No evaluation criteria precluded the USCO mission-critical applications from being delivered via a PaaS solution.

Criteria / Application	Registration & Recordation Front End	Registration & Recordation Back End	System of Record	Public Record	Digital Asset Archive	copyright.gov (Web Presence)
Core Mission Application?	Yes	Yes	Yes	Yes	Yes	Yes
Application Layer Ownership Needed?	No identified legal or business requirement to control app layer code	No identified legal or business requirement to control app layer code	No identified legal or business requirement to control app layer code	No identified legal or business requirement to control app layer code	No identified legal or business requirement to control app layer code[1]	No identified legal or business requirement to control app layer code
Data Sensitivity Level	Public Data	Private Data	Public Data[2]	Public Data	Private Data[3]	Public Data
Access Requirements	Internet Accessibility Required	USCO Access Only	USCO Access Only	Internet Accessibility Required	USCO Access Only	Internet Accessibility Required
Integration Complexity	Few integration points	Few integration points	Few integration points	Few integration points	Few integration points	Few integration points
Recommendation	PaaS solution provides flexibility and speeds application development. Given USCO's unique requirements a SaaS solution would not provide scalable adaptability.	PaaS solution provides flexibility and speeds application development. Given USCO's unique requirements a SaaS solution would not provide scalable adaptability.	PaaS solution provides flexibility and speeds application development. Given USCO's unique requirements a SaaS solution would not provide scalable adaptability.	Given public nature of content, recommend hosting in the cloud	Given the expected growth in storage needs and cost to build, own, and maintain own storage infrastructure[4], use a cloud storage provider	Given public nature of content, recommend hosting in the cloud

Sources:
1. There is precedent for off-site storage of assets (e.g., use of federally-certified commercial records storage facility for physical deposits off-site).
2. While USCO augments the public data submitted by the registrant during copyright registration/recordation processing (e.g., correspondence with registrant, justifications, updated disclaims, final disposition), this additional data does not meet SBU/Classified criteria.
3. Any member of the public can inspect USCO-possessed deposits (i.e., it is data that can be provided to the public), however access will be restricted to inspection at USCO facilities.
4. Rough, high-level costs estimate provided in Appendix.

Table 3.1-2: Output of Application Hosting Evaluation Process

The evaluation also concluded that use of cloud technologies would be appropriate for the USCO's back-office applications.

Hosting key mission systems and services outside of the USCO systems will require tighter governance and strong SLAs with vendors to ensure adequate service delivery. Figure 3.1-3 shows an approach to identify and develop SLAs that meet the USCO's business needs.

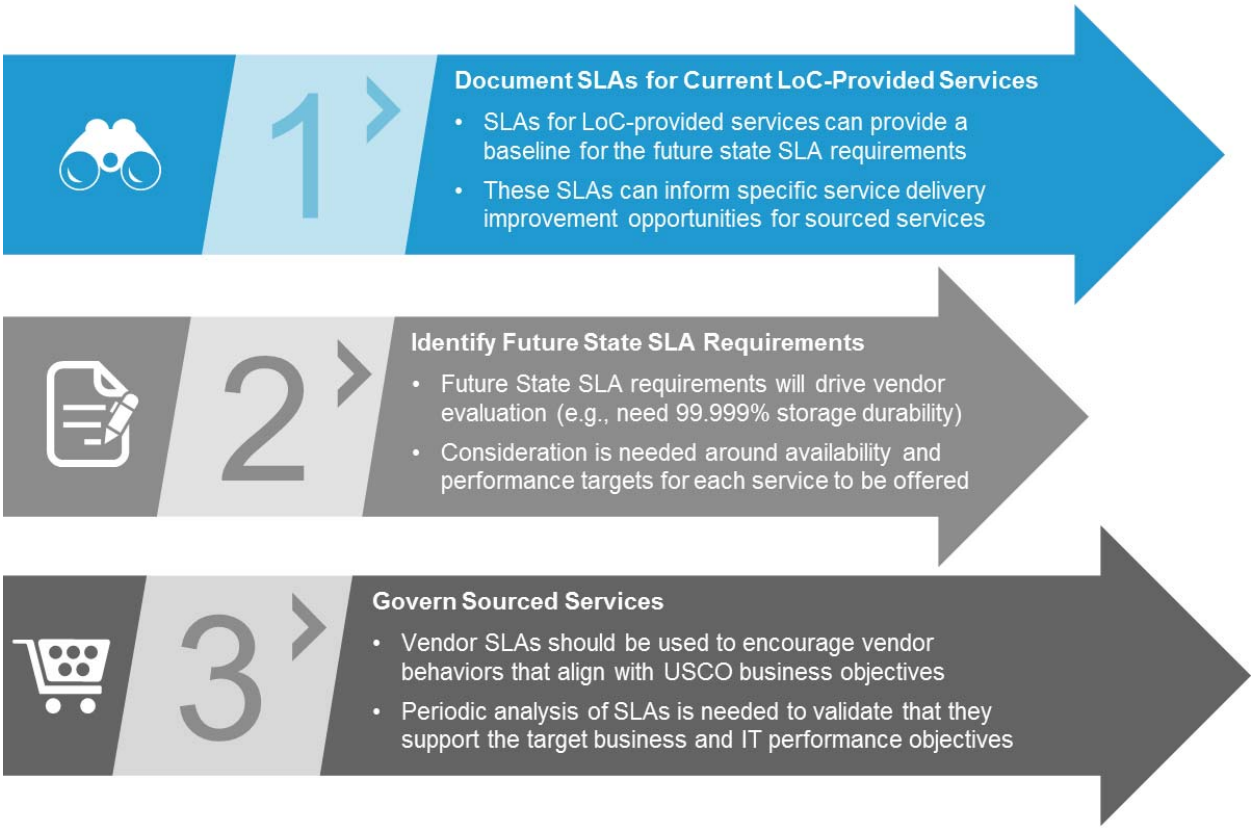
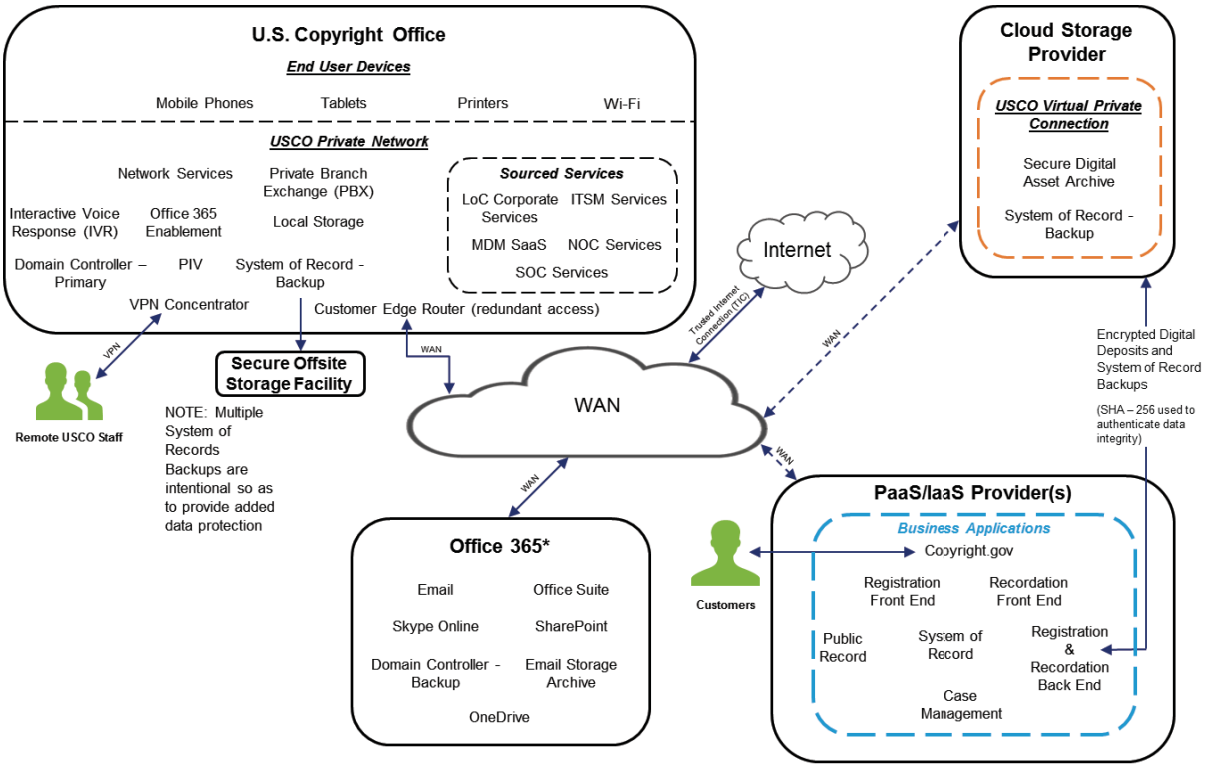


Figure 3.1-3: An Approach to Developing SLAs

3.2 Overall Architecture

The IT Plan proposes a future state architecture to meet the overall needs of the USCO, as shown in Figure 3.2-1.



**Vendors and services listed are representative market solutions that were selected solely to develop the required costs estimates. There are multiple providers who deliver these services. USCO will need to perform a selection process prior to implementation to determine the best solution.*

Figure 3.2-1: USCO Future State Architecture

3.3 Mission Services

Building the Digital Asset Archive and System of Record backup at a FedRAMP-compliant cloud storage provider can reduce long-term costs using a highly durable architecture. Figure 3.3-1 provides an example of such an architecture.

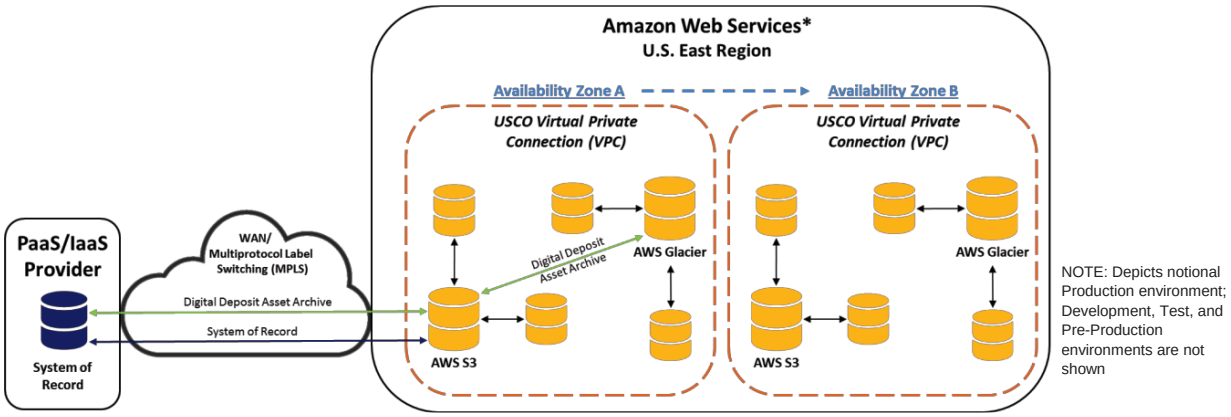


Figure 3.3-1: Notional Digital Asset Archive Cloud Storage Architecture[18]

A trusted Cloud Service Provider ("CSP") offers the following:

- A high degree of storage durability with services that have built-in physical redundancy and data replication
- Reduction of long-term storage costs with commodity storage services

The Digital Asset Archive solution must include these features:

- Encrypts assets in transit and at rest
- Validates integrity of assets with SHA-256 checksum during upload and retrieval processes, as is necessary for the USCO to provide certifiable copies for litigation
- Utilization of standard Application Programming Interfaces ("APIs") to reduce integration complexity between CSPs & SaaS providers

Backing up the System of Record to a CSP mitigates the risk of loss of mission-critical system-of-record data by replicating to cloud storage outside of the PaaS mission-critical applications platform.

Finally, from a DR and Continuity of Operations ("COOP") perspective, there are the following considerations:

- Cloud architecture skills must realize the correct level DR/COOP design
- Focus on understanding the USCO role vs. the CSP role in architecting against and recovering from failure

3.3.1 PaaS versus IaaS

For the mission-critical applications, the USCO will need to select between IaaS and PaaS models of delivery. Figure 3.3.1-1 depicts some characteristics of each option.

[18] Vendors and services listed are representative market solutions that were selected solely to develop the required costs estimates. There are multiple providers who deliver these services. USCO will perform a selection process prior to implementation to determine the best solution.

Assessment Criteria	IaaS	PaaS
Scope of Responsibilities	• Application Development: find, install, configure, and update software developer kits (SDK) • Application Development: find, install, configure, and update relevant libraries/software dependencies • Source Code: find, procure, implement, and maintain tool • Identity and Access Management: utilize single sign on federation with Active Directory • Identity and Access Management: build and maintain rules for infrastructure access • Problem Management: application and platform layer • Problem Management: infrastructure layer • Change Management: application and platform layer • Change Management: infrastructure layer • Release Management: find, procure, implement, and maintain tool • O/S: perform maintenance and patching • Security: implement for developed applications • Security: implement for O/S, storage, and network • Capacity Management: analyze data, monitor, and build and maintain processes to adjust scale as needed • DR/COOP: design and implement application layer redundancy • DR/COOP: design and implement system layer redundancy	• Application Development: use available code platform (e.g., Java, .Net, proprietary) • Source Code: use provided tools • Identity and Access Management: utilize single sign on federation with Active Directory • Change Management: application layer • Security: implement for developed applications • Release Management: use available tooling • DR/COOP: understand provided disaster resilience and augment as necessary
Vendor Lock-in Considerations	• Using basic VM (compute), storage, and network services only helps mitigate vendor lock-in, however, many IaaS service providers offer proprietary services that aid maintenance and management activities, which may be hard to transition away from	• Higher chance of vendor lock-in with platforms with proprietary APIs or programming languages, however there area wide number of PaaS providers in the market offering different configurations that may meet the requirements that are identified
Risks	• Delivery – need to plan, procure, configure, and maintain infrastructure layer may delay ability to provide business applications by target dates • Maintainability – infrastructure layer responsibilities may force resources to be allocated away from maintaining applications	• Transition – platform may no longer meet requirements or the vendor may make strategic decisions that prevent the platform from continuing to be used

Figure 3.3.1-1: Characteristics of IaaS and PaaS

USCO's primary mission applications (Registration and Recordation) can be categorized as request fulfillment systems, an application type with a number of PaaS options in the market.

Consideration of PaaS Platform. Using a FedRAMP-compliant PaaS platform for infrastructure and installed application layers will allow focus to be placed on building out the future mission-critical applications for the USCO. Figure 3.3.1-2 provides a notional depiction of a PaaS-based solution.

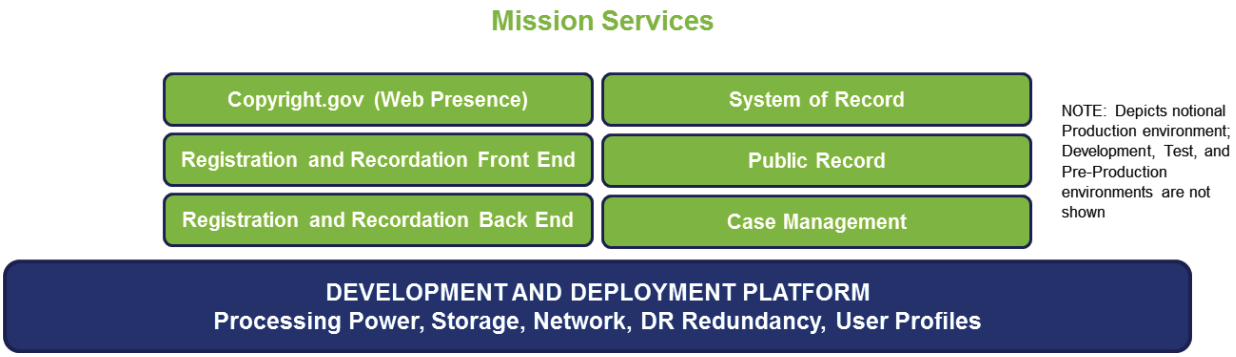


Figure 3.3.1-2: Notional PaaS Solution Architecture

The PaaS platform offers the following advantages:

- Allows teams to focus on registration, recordation, and other mission application functionality rather than infrastructure support

- Takes advantage of size and reduces PaaS service costs by purchasing only the services the USCO requires, rather than pursuing more costly enterprise licenses
- Provides platform redundancy as a base for data loss prevention; however, it will also be necessary to consider options to replicate critical data to additional locations
- Integration internally and externally through standard APIs

The PaaS platform can also support several types of operational enhancements:

- Create a team of cloud architects focused on service provider capabilities
- Implement reporting and tracking functions to improve business process visibility and facilitate quick response to customers and vendors
- Improve integration across the USCO mission applications with a singular platform
- Utilize platform redundancy to meet RPOs and RTOs
- Engage third-party storage capabilities to ensure continuity of System of Record and digital assets

Consideration of IaaS solution. Alternatively, IaaS solutions could provide the USCO with additional control, albeit with greater risk. Figure 3.3.1-3 shows a notional IaaS-based architecture.

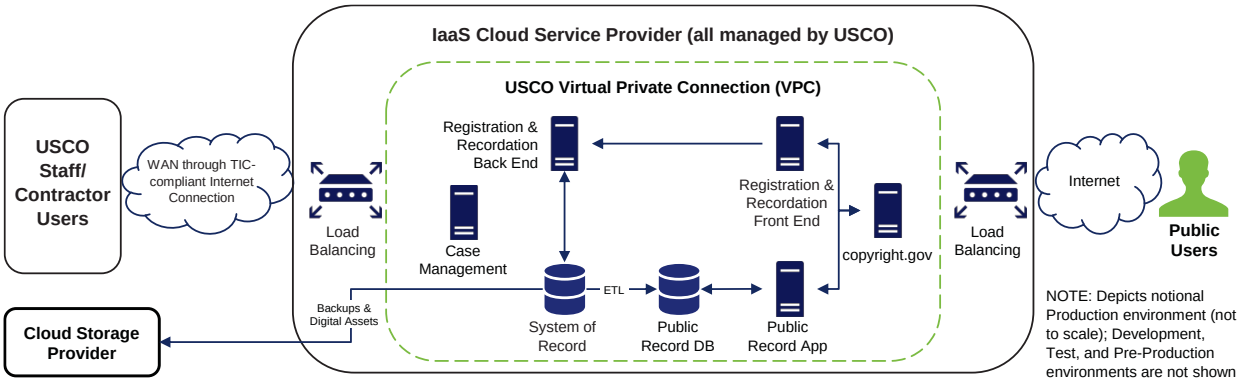


Figure 3.3.1-3: Notional IaaS-focused Architecture

An IaaS-based solution offers the following advantages:

- Removes the need for the USCO to procure, install, manage, maintain, and refresh server, storage, and networking hardware
- Allows USCO teams to focus on building infrastructure resiliency and the application platform that will enable the creation of registration, recordation, and other mission-critical applications
- The USCO will be responsible for procuring infrastructure services and configuring to scale as needed to meet changing demands
- The USCO retains the responsibility to architect and engineer all aspects of the mission critical services solution
- Standardize stack (*i.e.*, operating system ("OS"), IaaS compute configuration) to reduce development time

Using IaaS services can provide the following operational enhancements:

- Create a team of cloud and application platform architects focused on service provider capabilities
- Implement available infrastructure and application services to automate functions and reduce repetitive technical tasks
- The USCO is responsible for architecting redundancy and DR capabilities to meet RPOs and RTOs
- Engage third-party storage capabilities to ensure continuity of System of Record and digital assets

3.4 Infrastructure Services

Although minimal, the IT Plan will require the USCO to stand up certain infrastructure components to enable connectivity and functionality for shared services. Figure 3.4-1 depicts the proposed USCO infrastructure IT footprint.

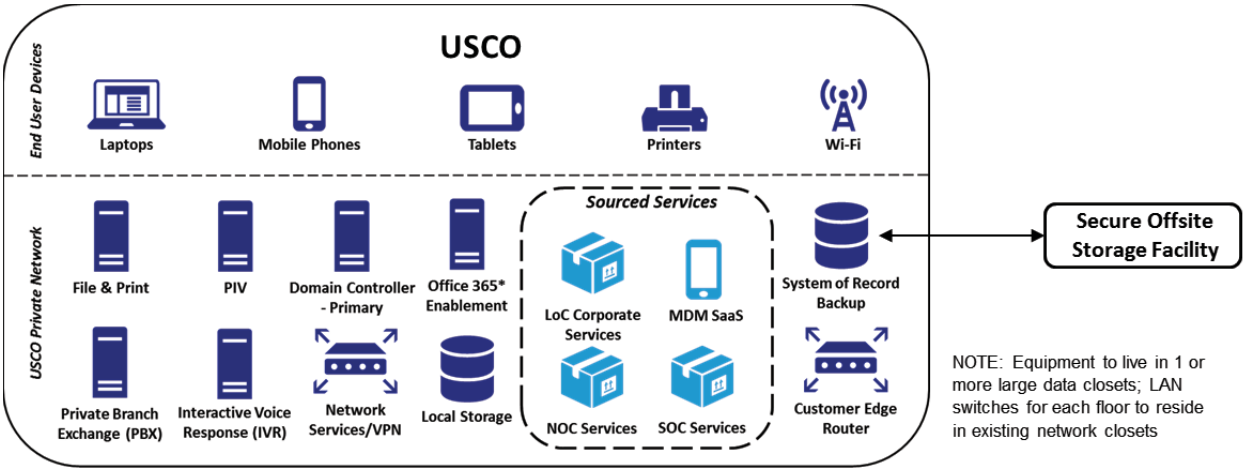


Figure 3.4-1: USCO Infrastructure Footprint

This architecture has connectivity and functionality related characteristics that will require USCO to:

- Pursue core skills for design and implementation of networking, identity and access management, compute, and storage
- Build a private USCO LAN (local area network) /WAN (wide area network) to provide staff interconnectivity, access to cloud-shared services, end user enablement tools, and a VPN (virtual private network) for remote workforce enablement
- Contract services to build and support the USCO network infrastructure
- Utilize Networx[19] contract to obtain network services such as WAN and TIC (trusted internet connections)-compliant internet

[19] Vendors and services listed are representative market solutions that were selected solely to develop the required costs estimates. There are multiple providers who deliver these services. The USCO will perform a selection process prior to implementation to determine the most appropriate solution.

- Contract Network Operations Center ("NOC") services to monitor and support WAN SLA's

From a staff enablement perspective, the proposed architecture has these characteristics:

- As recommended by consultants to the USCO, leverages Office 365[20] to reduce technical staffing and infrastructure spending
- Enables remote workforce access to productivity tools from web browsers
- Builds small set of servers to support USCO-operated Active Directory and Office 365 enabling services of federation, synchronization, and three-factor authentication
- Provides leased laptops to shift refresh and maintenance responsibility to service provider
- Builds PBX infrastructure to support voice and call center services

3.5 Desktop Services

Using a cloud-based desktop productivity tool suite can reduce infrastructure support requirements. However, the USCO retains responsibility for managing and configuring security controls. Figure 3.5-1 depicts desktop enablement services provided by Microsoft's Office 365 suite.

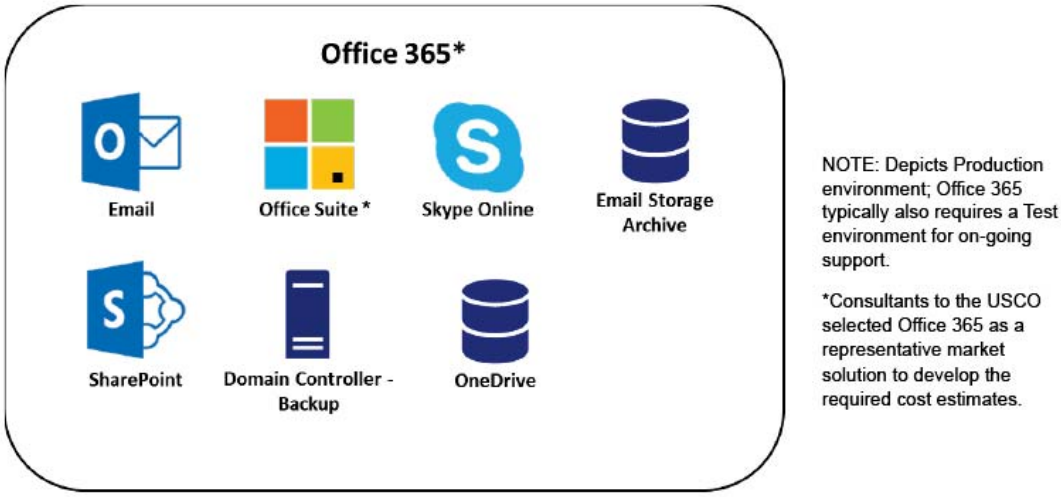


Figure 3.5-1: Capabilities Provided by Microsoft Office 365

Using a solution such as Office 365 enables the following:

- Allows the USCO IT team to focus on building mission-critical applications instead of desktop enablement infrastructure
- Reduces the number of vendors by selecting a comprehensive service that meets staff needs

In addition, a desktop architecture and engineering team is needed to design and maintain the USCO desktop image.

[20] Vendors and services listed are representative market solutions that were selected solely to develop the required costs estimates. There are multiple providers who deliver these services. The USCO will perform a selection process prior to implementation to determine the most appropriate solution.

From a broader desktop services point of view, the USCO will gain the following capabilities:

- Global access to email and calendar across laptops, mobile phones, and tablets
- Document sharing across sites and remote workforce with SharePoint and OneDrive
- Reduction in storage maintenance with inbox size managed by the vendor
- Remote workforce enablement with access to MS tools anywhere using a web connection

The end user computing device leasing program can be used to gain application version compliance at refresh cycles.

This type of a solution also has implications for DR and COOP, specifically:

- Utilizes SaaS service redundancy as a base for data loss prevention
- Reviews business requirements for email replication planning
- Focuses on understanding of the USCO role vs. CSP role in architecting against and recovering from failure

A key decision for the USCO will be whether to purchase or lease staff/contractor computing devices. Figure 3.5-2 lists some of the associated benefits and challenges for each option.

Lease Staff/Contractor Computing Device	Purchase Staff/Contractor Computing Device
Benefits: • Equipment stays up-to-date • Predictable expenses • Low upfront cost • Acquire sophisticated technology that might be otherwise unaffordable • Flexible and offers more options - aren't as restricted by high up-front costs or other hesitations to try something new that may help your business • Not responsible for maintenance	**Benefits:** • Control over maintenance and refresh cycles • Own the equipment • No commitment and contracts with leasing company • Option to sell equipment if no longer needed • Complete control over selection of products
Challenges: • Higher costs in the long run • Obligated to keep paying even if equipment is no longer needed • Availability of products is limited to stock of leasing company	**Challenges:** • High upfront cost • Stuck with outdated and obsolete equipment • Responsible for all maintenance including hiring staff to conduct maintenance

Figure 3.5-2: Benefits and Challenges Related to the Leasing or Purchasing of Staff/Contractor Devices

3.6 IT Service Management ("ITSM")

The USCO will focus on ITSM process governance and consider leveraging a suite of tools operated by an IT service provider to manage IT performance. Figure 3.6-1 shows some of the ITSM services, functions, and processes that can be sourced.

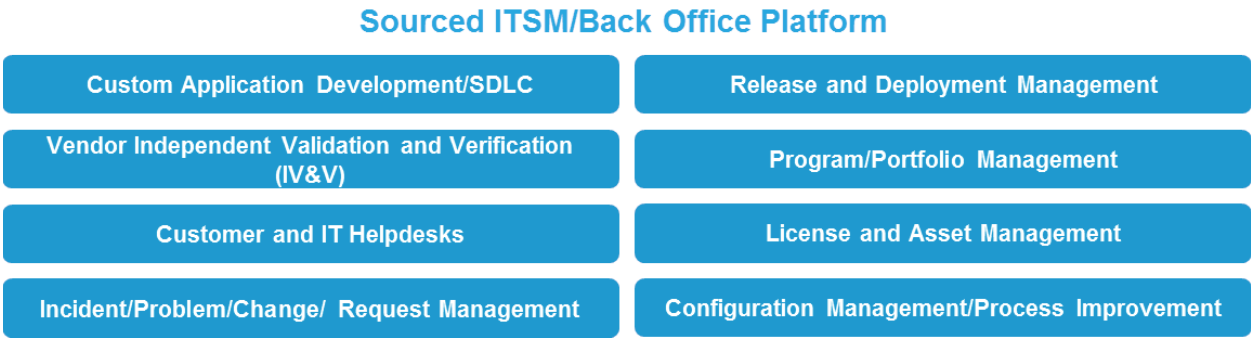


Figure 3.6-1: ITSM Services that can be sourced

Using an ITSM as a service approach provides the following benefits:

- Minimizes time to access ITSM tooling
- Realizes objective to use contract resources for daily administrative and operational tasks
- Reduces the need to update and maintain toolsets by making vendors bring their own tools
- Uses SLAs to govern tool and service performance
- Focuses the USCO IT organization on process rather than infrastructure and application upkeep

From an IT governance perspective, under an ITSM as a service approach, the USCO would:

- Maintain governance and ownership of ITSM processes
- Implement available reporting and tracking functions to improve business process visibility and response to customers and vendors
- Build processes to tie governance objectives to vendor performance across the agency
- Integrate ITSM performance measures in vendor contracts
- Incorporate ITSM service platform redundancy requirements into vendor agreements to meet RPOs and RTOs

3.7 Disaster Recovery ("DR")

The USCO must account for legacy application DR support until those applications are decommissioned, while ensuring comprehensive planning for the future state architecture. Figure 3.7-1 shows a notional DR architecture.

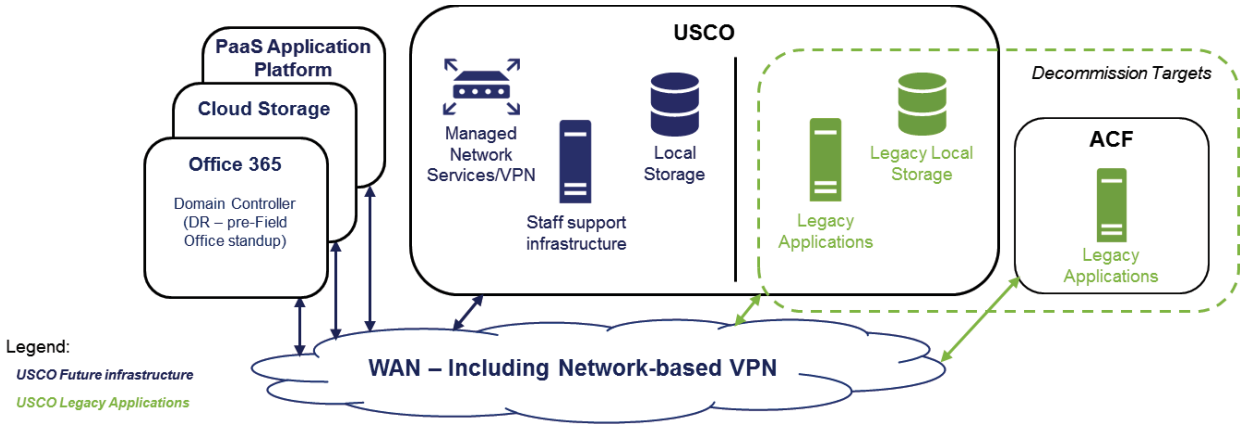


Figure 3.7-1: A Notional DR Architecture

The DR architecture depicted in Figure 3.7-1 has the following characteristics:

- Ensures RPOs and RTOs are documented for each function and included in requirements for service decisions
- Focuses on understanding of the USCO role vs. CSP role in architecting against and recovering from failure
- Utilizes application and CSP infrastructure and platform resiliency where possible to meet RPOs & RTOs
- Implements GSA Networx managed network services to provide general network services including network-based VPN on loss of Madison, necessary to provide for redundancy in case of network problems

Legacy environment DR is achieved through:

- Evaluating how to best support legacy systems until decommissioned
- Utilizing existing DR plans until legacy applications are decommissioned

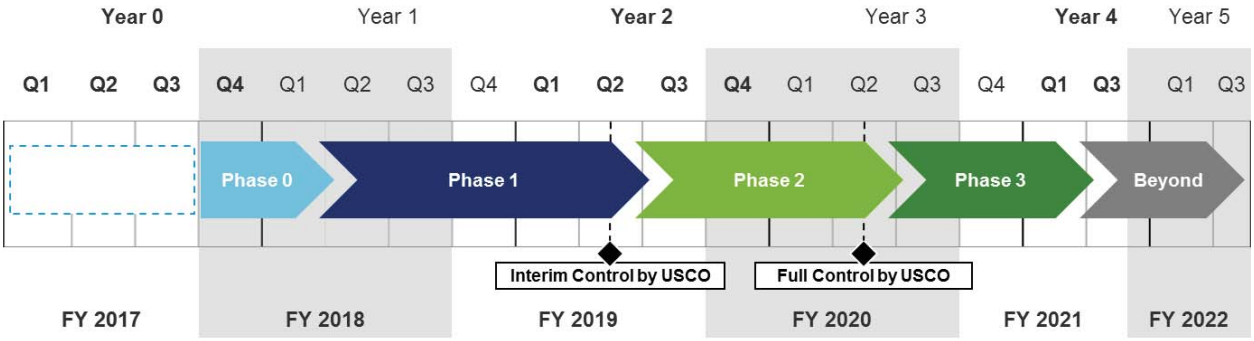
4.0 Modernization Roadmap

As part of the IT Plan, the USCO has developed a high-level notional roadmap to achieve its target state. This notional roadmap highlights and sequences key IT initiatives required to reach the modernized target state while maintaining support for the needs of the USCO and the copyright community.

The USCO proposes a phased approach towards implementation of the provisional IT Plan. Key factors that affected the prioritization and sequencing of IT projects included:

- Criticality
- Cost
- Complexity

Prioritization is necessary to ensure that the required capabilities are implemented and available as needed throughout the five-year implementation period. The roadmap also serves as a key input to the Cost Estimate provided below, providing sequencing information to account for costs in the appropriate fiscal year. Figure 4.0-1 provides a high level summary of the Modernization Roadmap.



Phase 0	Phase 1	Phase 2	Phase 3
Focus Areas: • Establish PMO and onboard staff • Transition plan and business case • Initial design and vendor analysis	**Focus Areas:** • Deploy USCO operating model • Award initial service contracts • Deliver end-user (O365) cloud and recordation services • Coordinate support for legacy/ registration systems	**Focus Areas:** • Deployment of new registration system • Migrate system of record data to target state solution • Enhanced public presence on the public record • Full deployment of target state operating model	**Focus Areas:** • Enhance mission service applications to enable deployment of new functionality • Full transition and decommission legacy IT environment

Figure 4.0-1: Overview of USCO Modernization Roadmap

4.1 Timelines for Each Phase

This section provides a more detailed view of the sequencing of each of the thirty-four key initiatives that were identified during analysis.

Phase 0, the first step in the transition process, calls for the establishment of a strong PMO to ensure that the overall approach, resources, tools, budget, controls, and schedule are in place to effectively

and efficiently manage the transition. Figure 4.1-1 shows the initiatives and timing that comprise Phase 0.

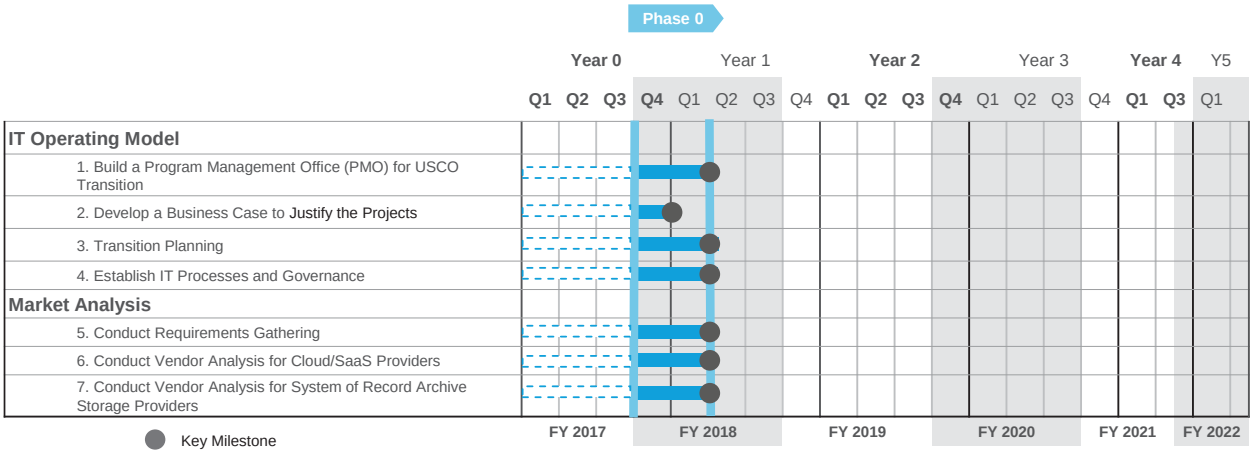
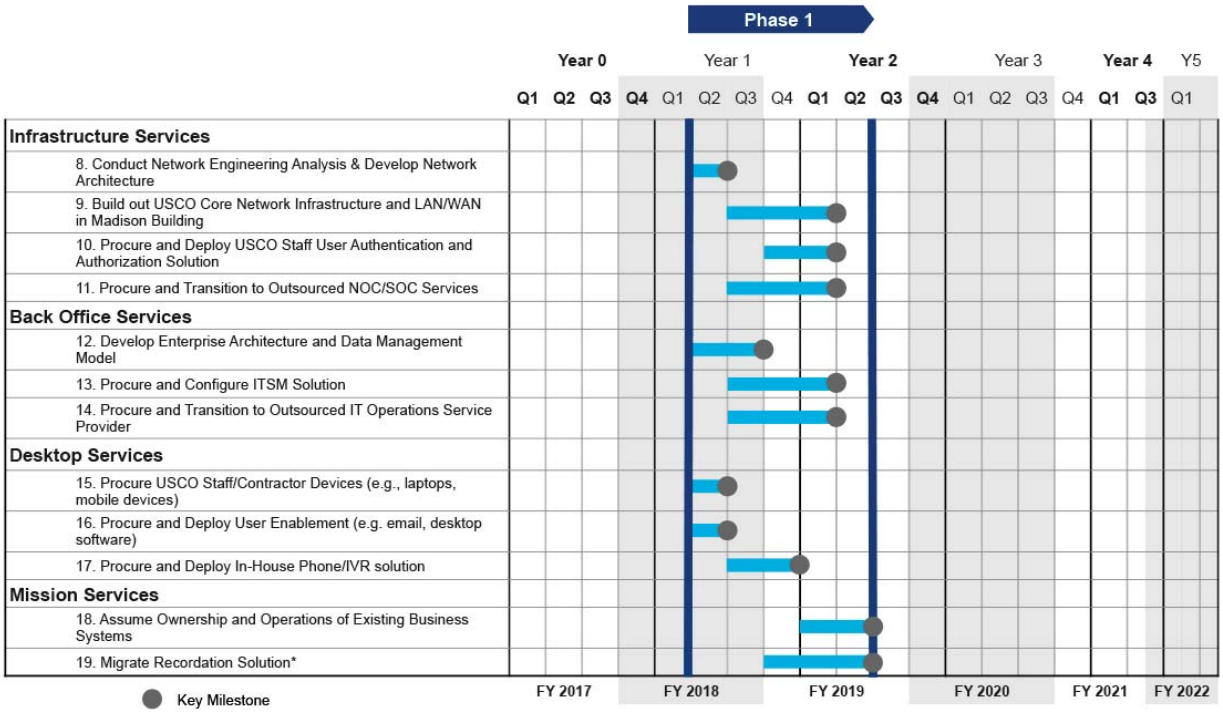


Figure 4.1-1: Phase 0 Timeline

Next, Phase 1 focuses on enabling key capabilities across infrastructure, back-office, desktop, and mission-critical services. This Phase will require strong collaboration and oversight as a number of initiatives are planned and executed in parallel over an extended duration. Figure 4.1-2 shows the initiatives and timing that comprise Phase 1.



*Assumption: Current USCO goal is to have a new Recordation solution built by end of FY17. Migration activity involves moving the new Recordation capability from its interim location to the future state location

NOTE: Identified initiatives have estimated duration lengths based on currently known information and may vary based on changing requirements or operating environment

Figure 4.1-2: Phase 1 Timeline

Phase 2 includes the design and development of mission-critical services. The USCO will adopt best practices supporting parallelism and agility to drive system development speed. Figure 4.1-3 shows the initiatives and timing that comprise Phase 2.

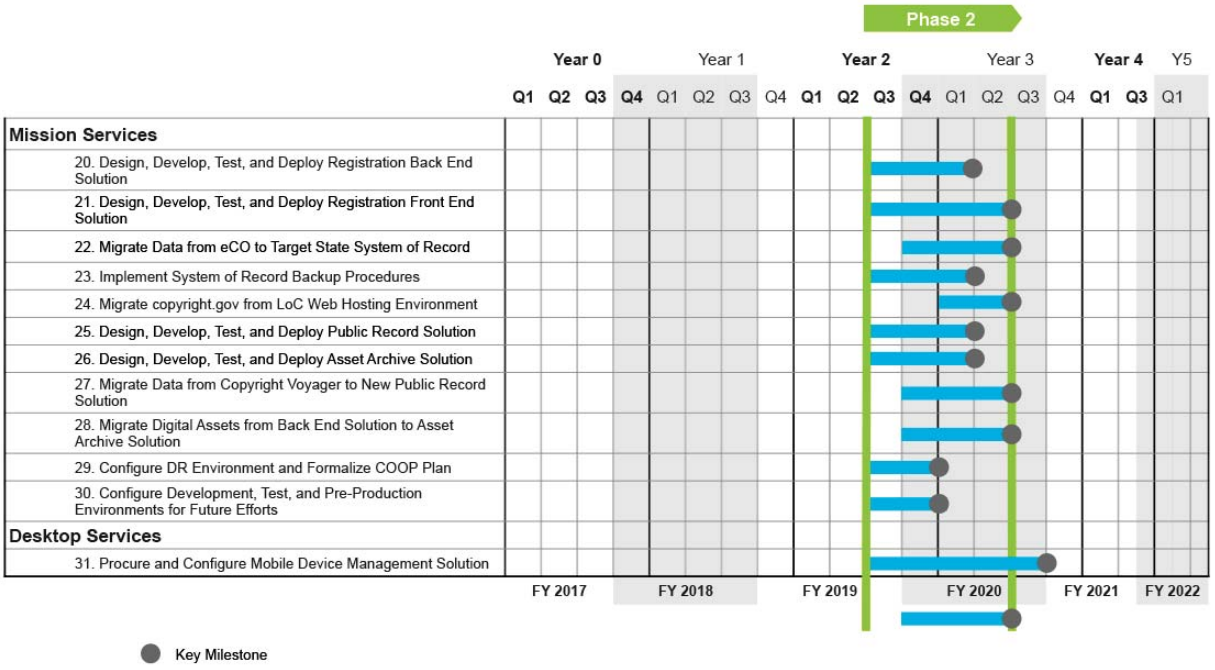
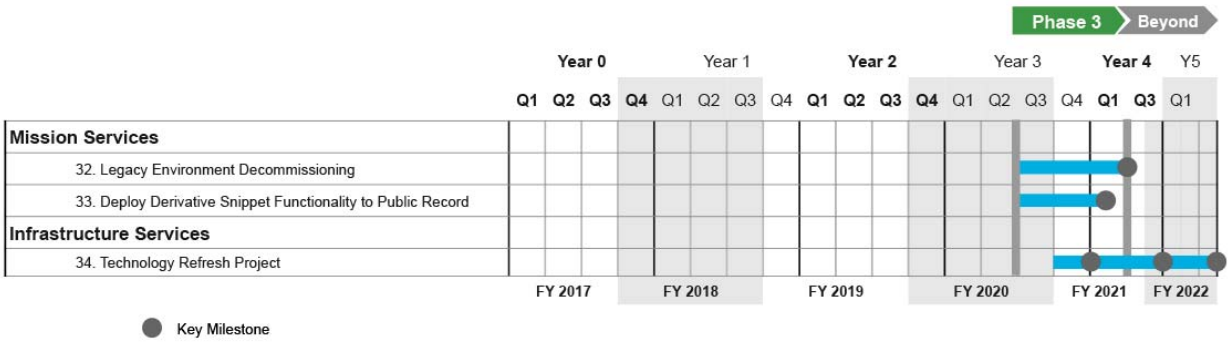


Figure 4.1-3: Phase 2 Timeline

Phase 3 and beyond includes the decommissioning of the USCO legacy environment and the creation of additional functionalities. Figure 4.1-4 shows the initiatives and timing that comprise Phase 3 and beyond.



NOTE: Identified initiatives have estimated duration lengths based on currently known information and may vary based on changing requirements or operating environment

Figure 4.1-4: Phase 3 and Beyond Timeline

While the USCO has estimated duration lengths for each of the identified initiatives in each of the Phases, these estimates are based on currently-known information and are subject to change based on changing requirements, operating environment, or other information.

4.2 Analysis of Modernization Roadmap Initiatives

Figure 4.2-1 provides the criteria used for the criticality, complexity, and cost analysis for each of the identified initiatives.

	Criticality	Cost	Complexity
High	Project that is critical to achieving successful and timely separation from LoC systems	Project estimated to cost $1.5M+	Project with substantial amount of development and/or integration
Medium	Project that delivers capabilities that USCO currently has but are not critical to a successful Day 1	Project estimated to cost $500,000 - $1.5M	Project with moderate amount of development and/or integration
Low	Project that delivers capabilities that build on current USCO IT capabilities	Project estimated to cost <$500,000	Project with minimal amount of development and/or integration

Figure 4.2-1: Roadmap Analysis Factors

Figure 4.2-2 provides a breakdown of all the identified Modernization Roadmap initiatives with the associated criticality, complexity, and cost analysis.

Initiative Number	Initiative Name	Criticality	Cost	Complexity	Proposed Timing	Timing Justification	Category
1	Build a PMO for USCO Transition	High	Low	Medium	Phase 0	Necessary for day-to-day USCO operations	IT Operating Model
2	Develop a Business Case	High	Low	Medium	Phase 0	Necessary to justify the projects	IT Operating Model
3	Transition Planning	High	Low	Medium	Phase 0	Necessary prior to beginning separation from LoC systems	IT Operating Model
4	Establish IT Processes and Process Governance	High	Medium	Medium	Phase 0	Necessary for all future IT activities and capabilities to operate effectively	IT Operating Model
5	Conduct Requirements Gathering	High	Low	Medium	Phase 0	Necessary for day-to-day USCO operations	Vendor Analysis
6	Conduct Vendor Analysis for Cloud/SaaS Providers	High	Low	Medium	Phase 0	Necessary to justify the projects	Vendor Analysis
7	Conduct Vendor Analysis for System of Record Archive Storage Providers	High	Low	Medium	Phase 0	Necessary prior to beginning separation from LoC systems	Vendor Analysis
8	Conduct Network Engineering Analysis and Develop Network Architecture	High	Low	Low	Phase 1	Necessary to be able to build out dedicated USCO core network and LAN/WAN	Infrastructure Services
9	Build out USCO Core Network Infrastructure and LAN/WAN	High	High	High	Phase 1	Needed to support initial USCO operations and fully separate from LoC systems	Infrastructure Services

Initiative Number	Initiative Name	Criticality	Cost	Complexity	Proposed Timing	Timing Justification	Category
10	Procure and Deploy USCO Staff User Authentication and Authorization Solution	High	Low	Medium	Phase 1	Identity and user authentication and authorization are fundamental to being able to securely use the proposed cloud-based services	Infrastructure Services
11	Procure and Transition to Outsourced NOC/SOC Services	High	Medium	Medium	Phase 1	Required for USCO to be able to manage and securely operate its network	Infrastructure Services
12	Develop Enterprise Architecture and Data Management Model	Medium	Medium	Low	Phase 1	Strategic documents that inform transition and new system development efforts	Back-Office Services
13	Procure and Configure ITSM Solution	High	Medium	Medium	Phase 1	Necessary to support USCO operated IT services on Day 1	Back-Office Services
14	Procure and Transition to Outsourced IT Operations Service Provider	High	High	Medium	Phase 1	Necessary to support USCO operated IT services on Day 1	Back-Office Services
15	Procure USCO Staff/Contractor Devices	High	High	Low	Phase 1	Necessary for day-to-day USCO operations	Desktop Services
16	Procure and Deploy User Enablement (e.g., email, desktop software)	High	Low	Low	Phase 1	Necessary for day-to-day USCO operations	Desktop Services
17	Procure and Deploy in-house Phone/IVR solution	High	Medium	Medium	Phase 1	VOIP is needed to support Phase 1 communications needs	Desktop Services
18	Assume Ownership and Operations of Existing Business Systems	High	High	High	Phase 1	Critical to separating from LoC systems	Mission Services
19	Migrate Recordation Solution	High	Medium	Medium	Phase 1	Critical to separating from LoC systems	Mission Services
20	Design, Develop, Test, and Deploy Registration Back-End Solution	High	Medium	High	Phase 2	Necessary for day to day USCO operations	Mission Services

Initiative Number	Initiative Name	Criticality	Cost	Complexity	Proposed Timing	Timing Justification	Category
21	Design, Develop, Test, and Deploy Registration Front-End Solutions	High	High	High	Phase 2	Modernizing the Copyright Registration application is a key USCO mission goal	Mission Services
22	Migrate Data from Siebel[21] to Target State System of Record	High	Medium	High	Phase 2	Providing a modernized system and data architecture for the System of Record is mission-critical; need to migrate and validate data integrity for terabytes of records	Mission Services
23	Implement System of Record Backup Procedures	Medium	High	Medium	Phase 2	Wait to begin backups until System of Record is deployed and data validation is completed	Mission Services
24	Migrate copyright.gov from LoC Web Hosting Environment	Low	Low	Low	Phase 2	Low Level of Effort (LOE); not critical to have operational on the first day of modernized USCO operations	Mission Services
25	Design, Develop, Test, and Deploy Public Record Solution	High	Medium	Low	Phase 2	Public can use existing Voyager system until new system stood up	Mission Services
26	Design, Develop, Test, and Deploy Asset Archive Solution	Medium	Medium	Medium	Phase 2	Existing Voyager system can be used during transition period	Mission Services
27	Migrate Data from Copyright Voyager to new Public Record Solution	Medium	Medium	High	Phase 2	Large amounts of existing data would need to be migrated and validated	Mission Services
28	Migrate Assets from Back-End Application to Asset Archive Solution	Medium	Medium	High	Phase 2	Large amounts of existing assets would need to be migrated and validated	Mission Services

[21] Siebel refers to the USCO's online registration system, which is built on a Siebel/Oracle Customer Relationship Management ("CRM") application.

Initiative Number	Initiative Name	Criticality	Cost	Complexity	Proposed Timing	Timing Justification	Category
29	Configure DR Environment and Formalize COOP Plan	Medium	Low	Medium	Phase 2	Majority of target state is cloud-based with embedded DR capabilities	Mission Services
30	Configure Development, Test, and Pre-Production Environments for Future Efforts	Medium	Medium	Medium	Phase 2	Environments needed for go-forward efforts; may be able to leverage environments from transition period	Mission Services
31	Procure and Configure Mobile Device Management Solution	Medium	Medium	Low	Phase 2	Necessary to enable “Bring Your Own Device” (BYOD)	Desktop Services
32	Legacy Environment Decommissioning	High	Low	Low	Phase 3	Legacy environment can be decommissioned once future state is running smoothly	Mission Services
33	Deploy Derivative Sample Functionality to Public Record	Low	Medium	Medium	Phase 3	Additional functionality to be added to Public Record; dependent on policy decisions	Mission Services
34	Technology Refresh Project	Low	Low	Low	Phase 3	Assuming a 3-year refresh cycle for staff devices and a 4-year refresh cycle for infrastructure (*e.g.*, servers, networking equipment)	Infrastructure Services

5.0 Cost Estimate

As part of the overall provisional IT Plan, the USCO prepared the following high-level notional cost model. The cost model provides a high-level understanding of the budget required to transition to the desired future state while sustaining ongoing IT costs over a five-year period.

5.1 Approach

To provide a holistic perspective, the cost model includes the following key cost elements for a budget required to:

- Fully design, develop, and deploy the proposed target architecture
- Continue to support the ongoing operations over a five-year period
- Support technology refresh of IT hardware (*e.g.*, three years for laptops, four years for core infrastructure hardware)
- Operate a fully-modernized IT organization and to support planned growth from 400 to no more than 650 USCO staff users

In building the cost estimate, the USCO developed a high-level notional architecture, analyzed high-level requirements for mission services, evaluated its costs associated with the existing IT environment, and prioritized the identified IT initiatives. Figures 5.1-1 and 5.1-2 provide an overview of the components within and the approach used to develop the cost estimate.

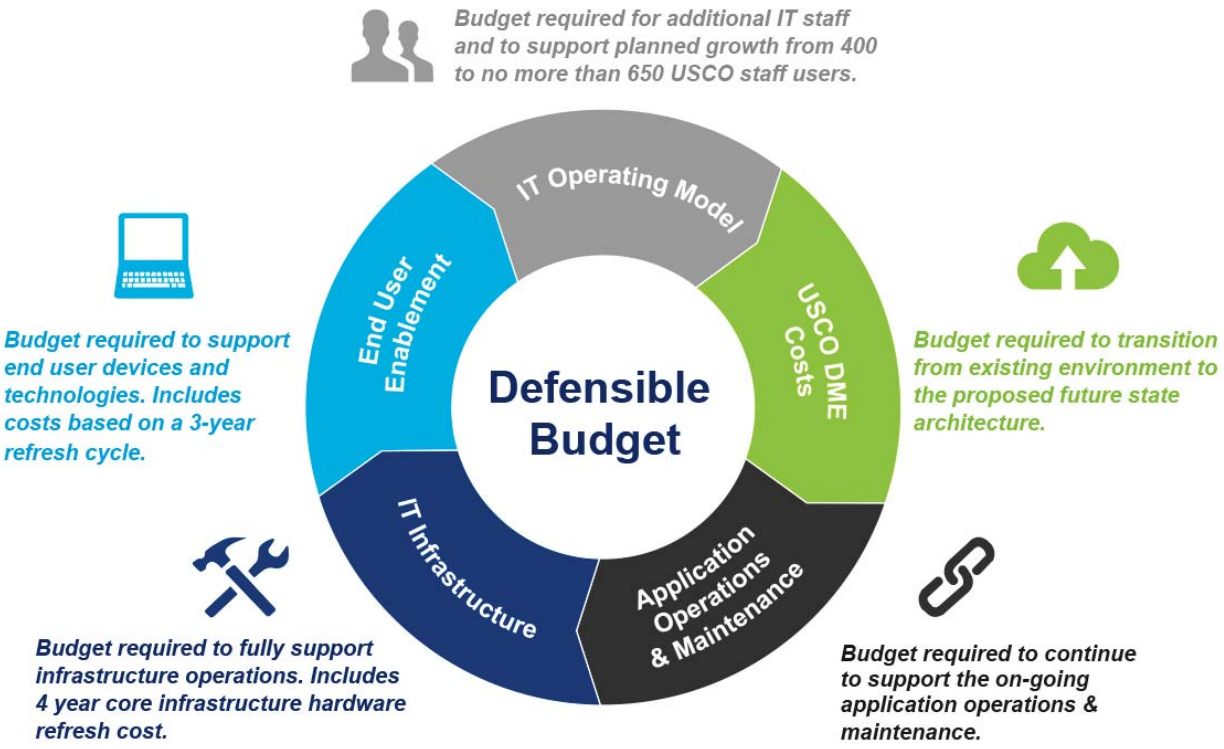


Figure 5.1-1: Components of the Cost Estimate

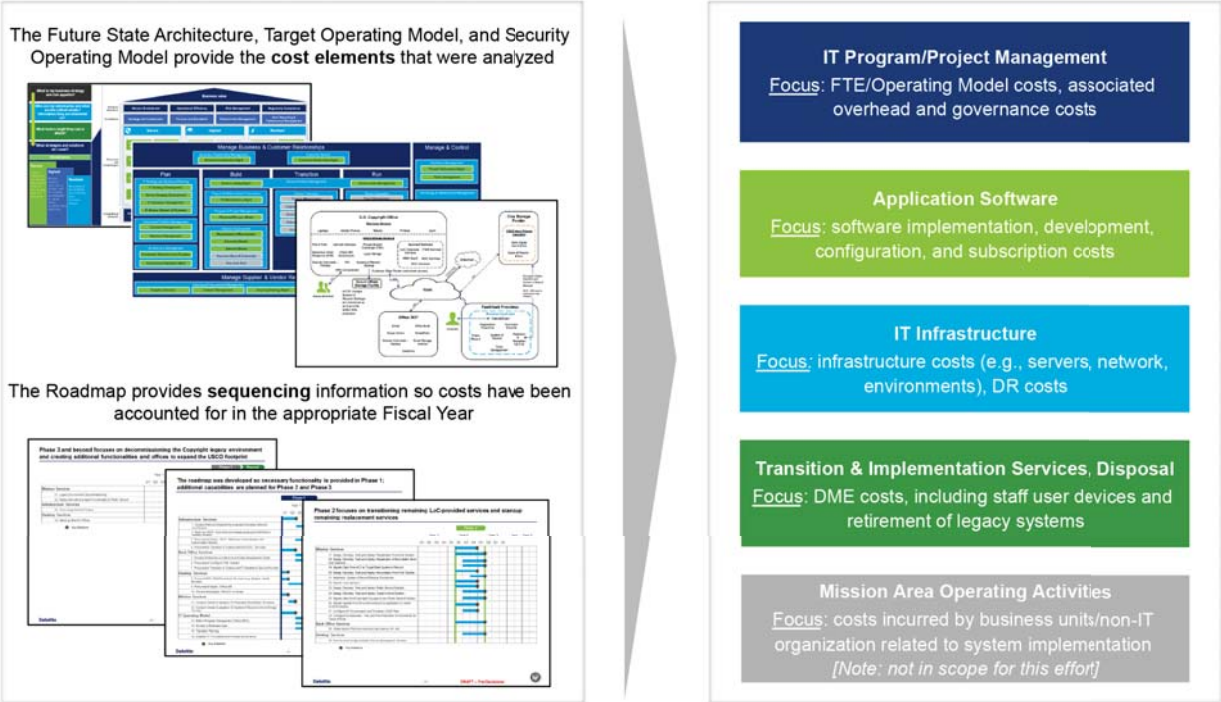


Figure 5.1-2: Approach to Develop Cost Estimate

This approach to building the cost model included developing high-level notional architecture, understanding high-level requirements for mission services, evaluating costs associated with existing IT environment, and prioritizing identified IT initiatives.

5.2 Assumptions

To create a preliminary cost estimate for the IT Plan, it was necessary to make some core assumptions about the implementation and functioning of the target system. These core assumptions are subject to change, which could drive the cost estimate to vary accordingly, and are described in this section. The timeline included in the IT Plan assumes that the USCO will begin executing its IT Plan on January 1, 2018, based on a FY 2018 budget request, and that, to improve outdated architectural design and poor user interface, the USCO will adopt a clean-slate approach to replacing existing mission-critical systems in the future architecture. Moreover, it is expected that the USCO will migrate data from current applications prior to retiring any legacy applications and that there are no documented USCO requirements or policies that prohibit data from being stored in a public or government cloud (although the USCO would implement significant security measures wherever cloud solutions are to be leveraged). The IT Plan also assumes that the USCO will use executive branch security standards (*e.g.*, any cloud services will be obtained from FedRAMP-compliant providers) as a security standard baseline and leverage standard SLAs with vendors (*e.g.*, cloud providers) and, as needed, will build greater security into all business plans. Another assumption is that Copyright Act record retention rules, and federal data retention standards (*e.g.*, National Archives and Records Administration requirements) will require storage of data beyond the duration of the business case or longer. Additionally, given the likelihood that modernization will generate a greater volume of registrations for the USCO, digital storage is assumed to grow at its current (*i.e.*, 2015) rate for the first three years of the business case and at 1.5 times the current rate

afterward.[22] The next assumption is that the USCO IT talent must include managers, strategists, architects, and engineers. USCO IT staff will be responsible for managing vendors providing delivery, operations, and maintenance services.

The IT Plan also includes architectural, roadmap, and cost implications for the following new features in order to provide a conservative cost estimate, however, the USCO may determine not to implement these future capabilities: (1) derivative samples (*e.g.*, thumbnails, clips of sound recordings) in the public record; and (2) capability to digitally sign all digital assets.[23] To plan further, it is expected that the USCO will have a target state internal user base of no more than 650 staff/contractors at peak staffing and will provide workforce mobility capabilities to all of those users. Additionally, the USCO will have the authority to execute procurements independently and the capability to provide appropriate levels of vendor oversight. Finally, the IT Plan assumes that personnel required to provide customer service support for external stakeholders/public users of USCO applications will be funded by the USCO general budget. However, the infrastructure costs required to support these customer service activities will be paid by the USCO IT budget.

For purposes of preparing a cost estimate, the IT Plan provides the flexibility for offsite staffing or office space. If, in the future, it is prudent to explore options like these (for example, office space for limited operations or public meetings in other cities), the USCO can include this option in appropriate planning without undermining the overall phase sequence, although deciding whether or not to exercise such an option will affect the bottom line of the average costs assumed in this provisional cost estimate.

[22] The USCO will need to continue to study, analyze, and model storage requirements.

[23] Digital assets include copyrighted works under the care of the USCO for storage and/or litigation support.

5.3 Key Findings

Compared to benchmarks and trends, the proposed cost estimate for the IT Plan appears to be within a reasonable range. Figure 5.3-1 depicts a summary of the key findings from this comparison.

	Cost Analysis	*Benchmarks & Trends*	*Risks & Implications*	*Recommendation*
IT Operating Model	• USCO will require addition of 39 IT FTEs to successfully transition and support on going operations • Staff will focus on high-value activities	• IT FTE (including contractors) Govt. benchmark of 8.9% - 9.8% [1] • USCO is 12.6%. However, given the public-facing USCO mission the FTE count is within reasonable range.	• USCO may face challenges in finding and staffing key resources	• USCO should identify and on-board key staff by Day 1, prior to the start of the effort (i.e. pre-Phase 0 in FY17) to avoid resource gaps and delays with transition activities
USCO DME Costs	• 36 different project initiatives identified across 4 phases • Requires strong PMO in 2018	• Agencies are finding it easier to re-platform legacy applications rather than migrating to cloud.	• Timeline can be significantly impacted without proper support, governance and communication from leadership	• Transition and migration are often high-risks items and requires strong PMO office to ensure on-time and on-budget execution. Sourcing for PMO office should start in FY17
Application Operations & Maintenance	• O&M development support for mission apps and other COTS solutions • Non-mission services like CRM, Case Mgmt. sourced	• Across different organizations and types of applications, alternatives to traditional models account for more than 50% of software implementations[2]	• USCO's systems development processes are currently configured for supporting a local data center-based solution	• Adopt iterative and agile development approaches with multidisciplinary teams to achieve agility and speed of software delivery
IT Infrastructure	• Minimal infrastructure owned and operated • Core infrastructure sourced but managed by USCO staff • Key factors driving cost includes on-premise IT, cloud hosting, DR, and managed NOC and SOC services	• Between now and 2020, nearly half of productivity improvements in government IT will come from economies of scale — moving to shared services and cloud-based operations.[3]	• USCO will need to triage incidents and issues and the help desk will need to be trained to support new service desk process	• Implement strong SLAs and vendor management for on-time service delivery • Provide adequate training to staff and get acclimated to the new service desk process
End User Enablement	• End user enablement includes support for productivity tools like email, mobile devices, laptops, etc.	• Agencies including DOJ & IRS have adopted O365 • Others are taking advantage of economies of scale through shared service model	• Limited change management and training will impact adoption rate and will likely impact overall productivity	• Provide adequate training and support to staff to ease the transition to new productivity tools

Sources:
1. Gartner, IT Key Metrics Data 2016: Small and Midsize Enterprise Executive Summary 31 tbl. 5 (2015).
2. Gartner, Forecast Overview: Enterprise Application Software, Worldwide, 2014 (2014), https://www.gartner.com/doc/2851417/forecast-overview-enterprise-application-software.
3. Gartner, Economies of Scale and Agility in Government: Guidance for the U.S. Federal Government (FITARA) and Elsewhere (2015), http://my.gartner.com/portal/server.pt?open=512&objID=202&mode=2&PageID=5553&resId=3099217&ref=Alerts.

Figure 5.3-1: Key Cost Estimate Findings

The total estimated IT budget across the five-year period is $165 million. Accounting for uncertainty by applying a degree of risk variance of +15% yields an estimated cost of $190 million, whereas a negative variance of -5% yields an estimated cost of $157 million.

Figure 5.3-2 provides a breakdown over each of the five fiscal years proposed in the implementation timeline.

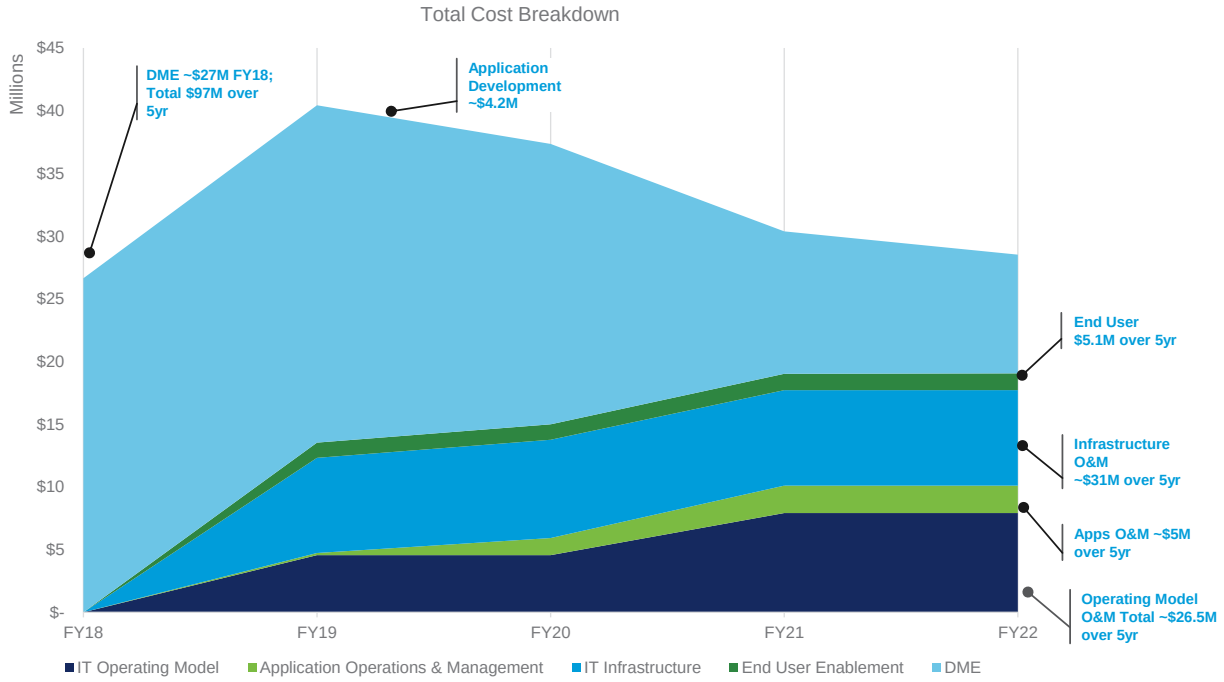


Figure 5.3-2: Breakdown of Cost Estimate

The capital investment required to support IT modernization across the five-year period is $97 million of the estimated total IT budget costs of $165 million as shown in Figure 5.3-3.

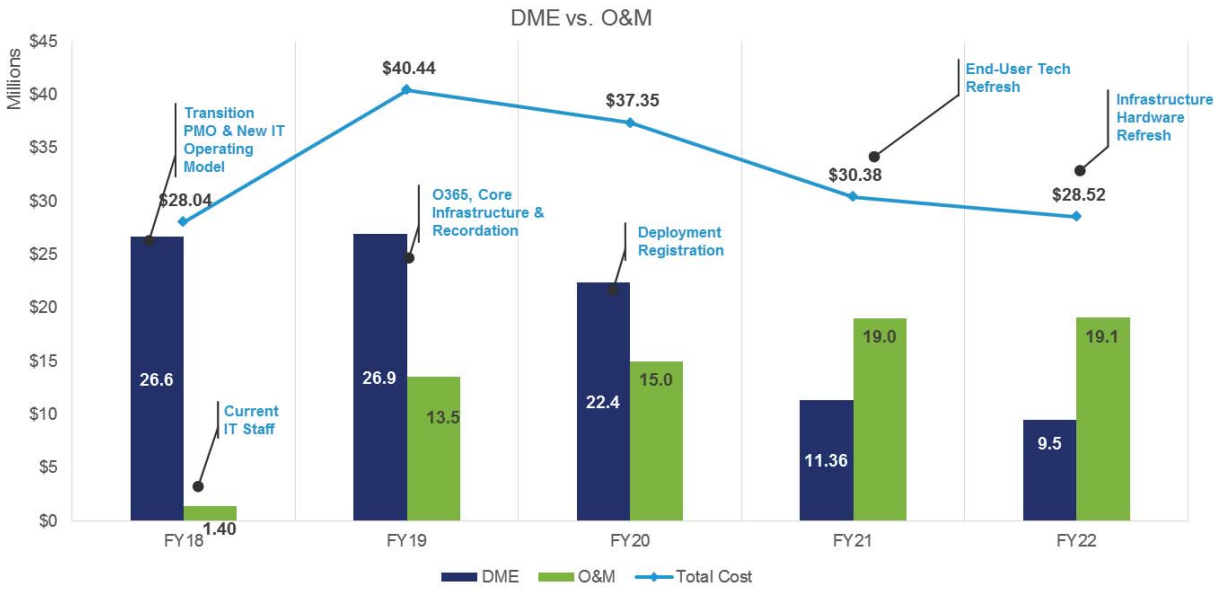


Figure 5.3-3: DME vs. O&M Breakdown

The following are key points about the DME vs. O&M breakdown:

- $97 million of total budget accounts to DME[24] ("Capital Investment") over a five-year period
- $68 million of total budget accounts to steady state operations over a five-year period
- $25 million total IT operating budget in FY 2023 and beyond

5.3.1 IT Operating Model

The following key assumptions were made for the IT Operating Model analysis:

- The USCO IT resources identified in the proposed Operating Model are assumed to be hired by the start of the transition (October 1, 2017) and retained throughout the duration of the five-year implementation period.
- Government Full Time Employees ("FTEs") are not promoted during the duration of the five-year implementation period (FY 2018 – FY 2022).
- An IT employee training budget of $1,500 per employee per year was selected, based on Computer Economics' median benchmark value.[25]
- The Operating Model, resource levels, and resource counts were derived from a notional potential Operating Model and assumes that the proposed resources are able to accomplish the proposed task/responsibility breakdown.
- Contractor Labor Categories ("LCATs") and rates are sourced from GSA's Alliant Governmentwide Acquisitions Contract ("GWAC") Large Business, using government-site labor in year 10 of the contract.[26] Average rates have been used for each LCAT and no discounts from the published GSA rates have been applied.
- Government FTE labor costs broken down as follows:
  - CIO, CTO, CISO, Directors:
    FY 2018 – FY 2020: 50% O&M / 50% DME
    FY 2021 – FY 2022: 75% O&M / 25% DME
  - Architects, Engineers, Managers:
    FY 2018 – FY 2020: 0% O&M / 100% DME
    FY 2021 – FY 2022: 50% O&M / 50% DME
  - All Others:
    FY 2018 – FY 2020: 65% O&M / 35% DME
    FY 2021 – FY 2022: 100% O&M / 0% DME
- Inflation, escalation, and cost of living adjustments ("COLA") are not incorporated into the cost estimate.

While this initial operational model is high-level, the USCO will complete a more granular organizational design analysis prior to deployment.

---

[23] As part of DME, capital costs include hardware, software development and acquisition costs, commercial off-the-shelf acquisition costs, government labor costs, and contracted labor costs for planning, development, acquisition, system integration, and direct project management and overhead support. *See* OFFICE OF MGMT & BUDGET, GUIDANCE ON EXHIBITS 53 AND 300 – INFORMATION TECHNOLOGY AND E-GOVERNMENT (2012), https://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/fy14_guidance_on_exhibits_53_and_300.pdf.

[25] COMPUTER ECONOMICS, INC., BENCHMARKS FOR IT TRAINING BUDGETS (Oct. 2015), https://www.computereconomics.com/custom.cfm?name=postPaymentGateway.cfm&id=2146.

[26] GENERAL SERVICES ADMINISTRATION, ALLIANT PRICING: LOADED HOURLY PRICING FOR WORK DONE ON GOVERNMENT SITE (last reviewed Dec. 7, 2015), http://www.gsa.gov/portal/content/103877.

Figure 5.3.1-2 depicts some key trends and an FTE vs. contractor labor count breakdown in this IT Plan.

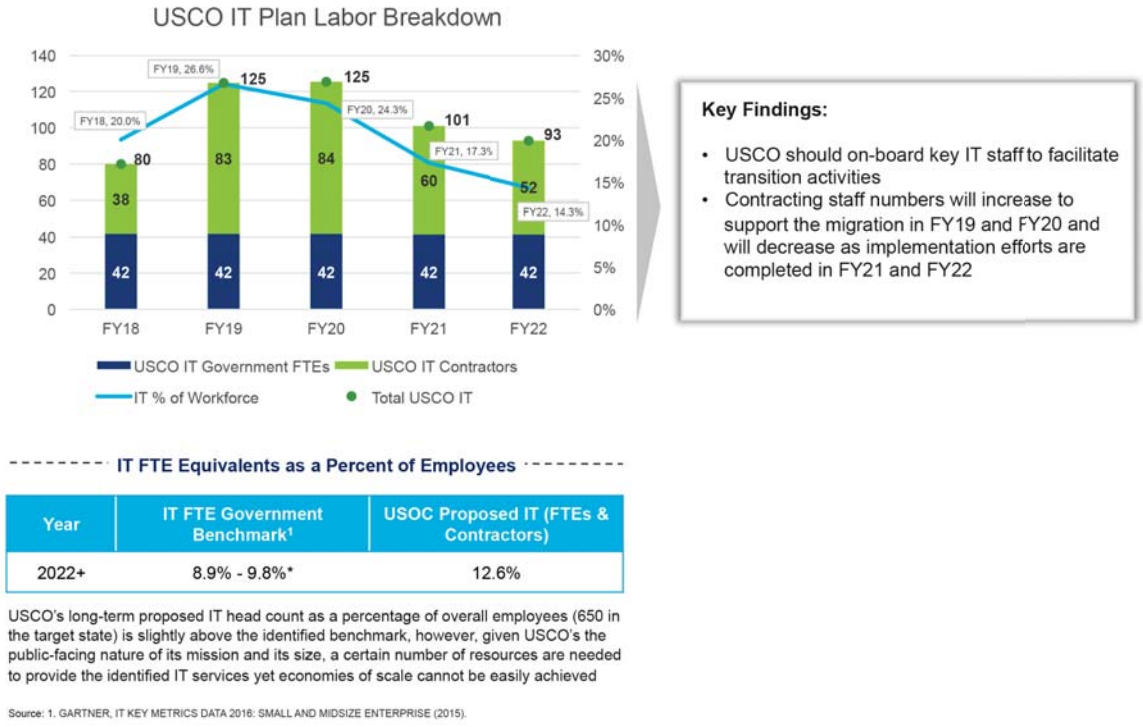


Figure 5.3.1-2: Key USCO IT Labor Statistics

5.3.2 Development, Modernization, & Enhancement ("DME")

The following key assumptions were made for the DME analysis:

- There will be at least one project manager for the identified implementation projects (*e.g.*, Initiative 9 – Build Out USCO Core Network Infrastructure and LAN/WAN, Initiative 22 – Migrate Data from Siebel to Target State System of Record)
- The coexistence cost for Siebel can be approximated by using the number of contractors currently providing O&M support for Siebel (2[27] plus half the number of contractors currently providing development support (4[28])
- An IT employee training budget of $1,500 per employee per year was selected, based on Computer Economics' median benchmark value[29]

[27] UNITED STATES COPYRIGHT OFFICE, COPYRIGHT TECHNOLOGY OFFICE – ORGANIZATIONAL CHART CURRENT STATE (NOVEMBER 2015) (on file with Copyright Technology Office).

[28] UNITED STATES COPYRIGHT OFFICE, COPYRIGHT TECHNOLOGY OFFICE – ORGANIZATIONAL CHART CURRENT STATE (NOVEMBER 2015) (on file with Copyright Technology Office).

[29] COMPUTER ECONOMICS, INC., BENCHMARKS FOR IT TRAINING BUDGETS (Oct. 2015), https://www.computereconomics.com/custom.cfm?name=postPaymentGateway.cfm&id=2146.

- Contractor LCATs and rates are sourced from GSA's Alliant GWAC Large Business, using government-site labor in year 10 of the contract.[30] Average rate used for each LCAT and no discounts from the published GSA rates have been applied
- The USCO will build its target state applications and not leverage a large COTS solution (*e.g.*, Siebel)
- The USCO will have a recordation solution developed on AWS by the end of FY 2017
- Inflation, escalation, and COLA are not incorporated in the cost estimate
- Continued hosting of the current IT environment at LoC (including any applicable facility costs) was not incorporated in the cost estimate

Figures 5.3.2-1 through 5.3.2-4 depict the cost analysis for each phase of implementation of the IT Plan:

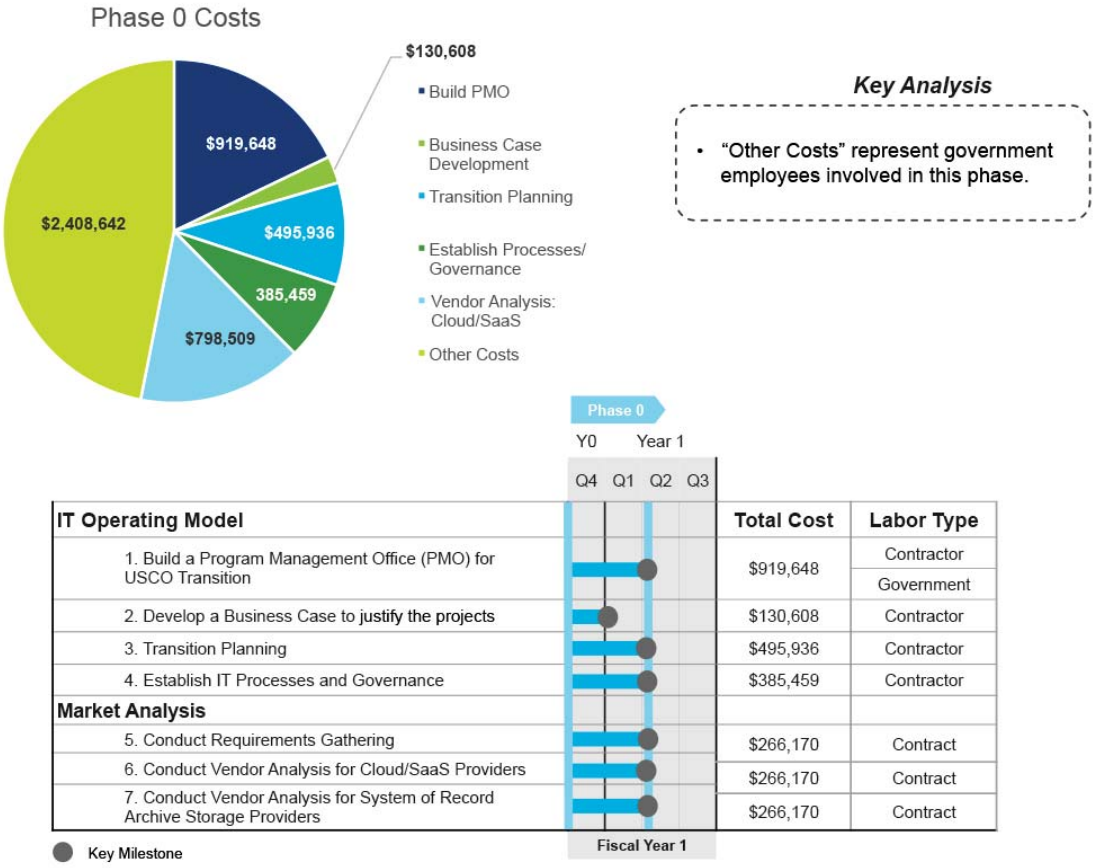
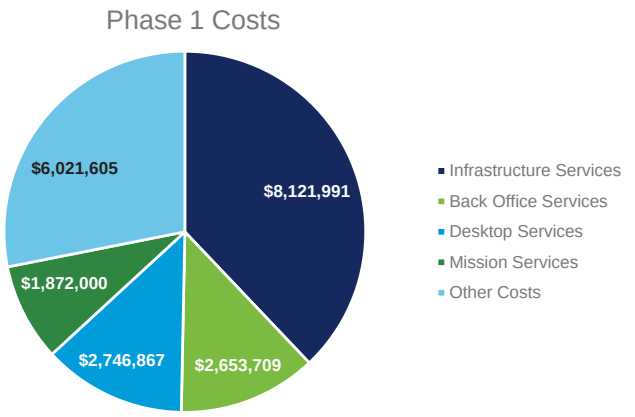


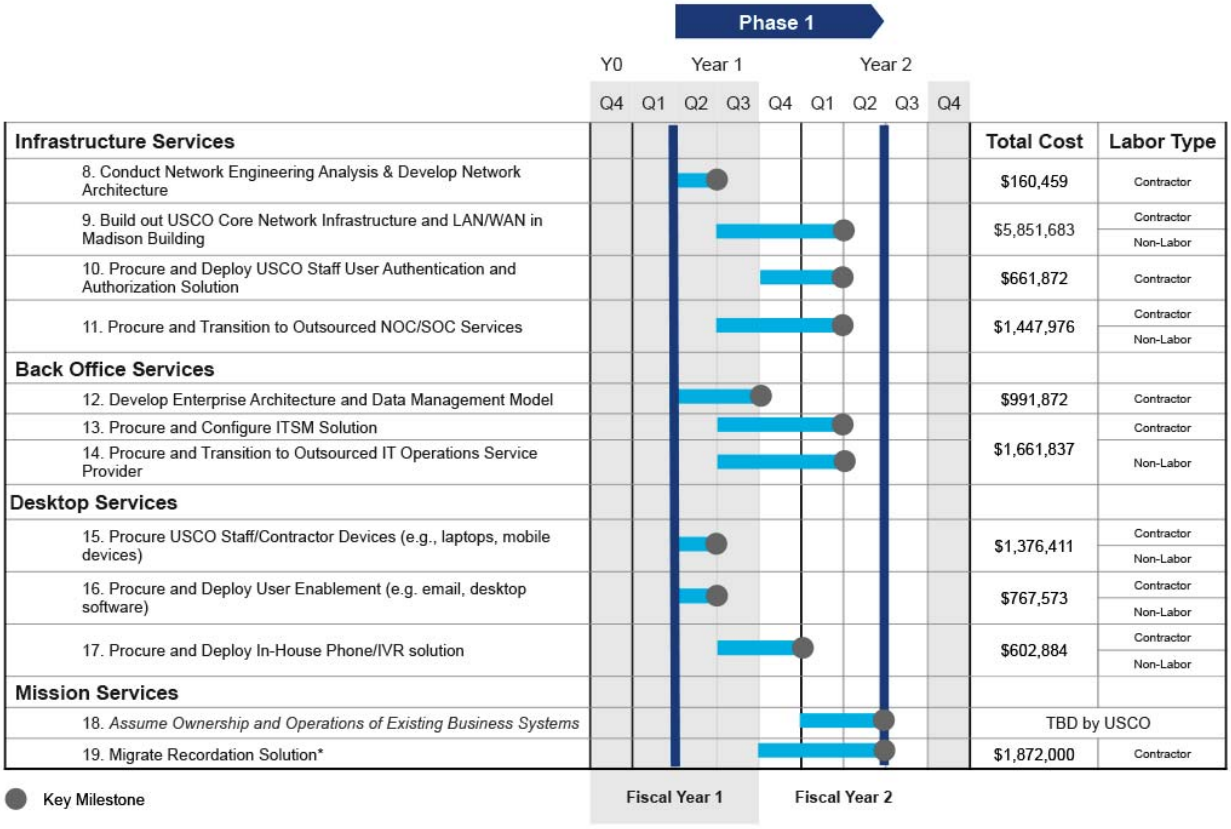
Figure 5.3.2-1: Cost Analysis for Phase 0

[30] GENERAL SERVICES ADMINISTRATION, ALLIANT PRICING: LOADED HOURLY PRICING FOR WORK DONE ON GOVERNMENT SITE (last reviewed Dec. 7, 2015), http://www.gsa.gov/portal/content/103877.



Key Analysis

- $3.9 Million of Infrastructure Services costs are categorized as non-labor, consisting of hardware and software solutions. The remainder of the Infrastructure costs is made up of contractors.'
- $1.3 Million of Desktop Services will go toward hardware and software solutions
- "Other Costs" represent government FTE costs for FY18 and FY19. These are the same government employees from Phase 0, but will experience increased utilization in phase 1.



	Total Cost	Labor Type
Infrastructure Services		
8. Conduct Network Engineering Analysis & Develop Network Architecture	$160,459	Contractor
9. Build out USCO Core Network Infrastructure and LAN/WAN in Madison Building	$5,851,683	Contractor Non-Labor
10. Procure and Deploy USCO Staff User Authentication and Authorization Solution	$661,872	Contractor
11. Procure and Transition to Outsourced NOC/SOC Services	$1,447,976	Contractor Non-Labor
Back Office Services		
12. Develop Enterprise Architecture and Data Management Model	$991,872	Contractor
13. Procure and Configure ITSM Solution	$1,661,837	Contractor
14. Procure and Transition to Outsourced IT Operations Service Provider		Non-Labor
Desktop Services		
15. Procure USCO Staff/Contractor Devices (e.g., laptops, mobile devices)	$1,376,411	Contractor Non-Labor
16. Procure and Deploy User Enablement (e.g. email, desktop software)	$767,573	Contractor Non-Labor
17. Procure and Deploy In-House Phone/IVR solution	$602,884	Contractor Non-Labor
Mission Services		
18. *Assume Ownership and Operations of Existing Business Systems*	TBD by USCO	
19. Migrate Recordation Solution*	$1,872,000	Contractor

*Assumption: Current USCO goal is to have a new Recordation solution built by end of FY17. Migration activity involves moving the new Recordation capacity from its interim location to the future state location.

Note: Identified initiatives have estimated duration lengths based on currently known information and may vary based on changing requirements or operating environment.

Figure 5.3.2-2: Cost Analysis for Phase 1

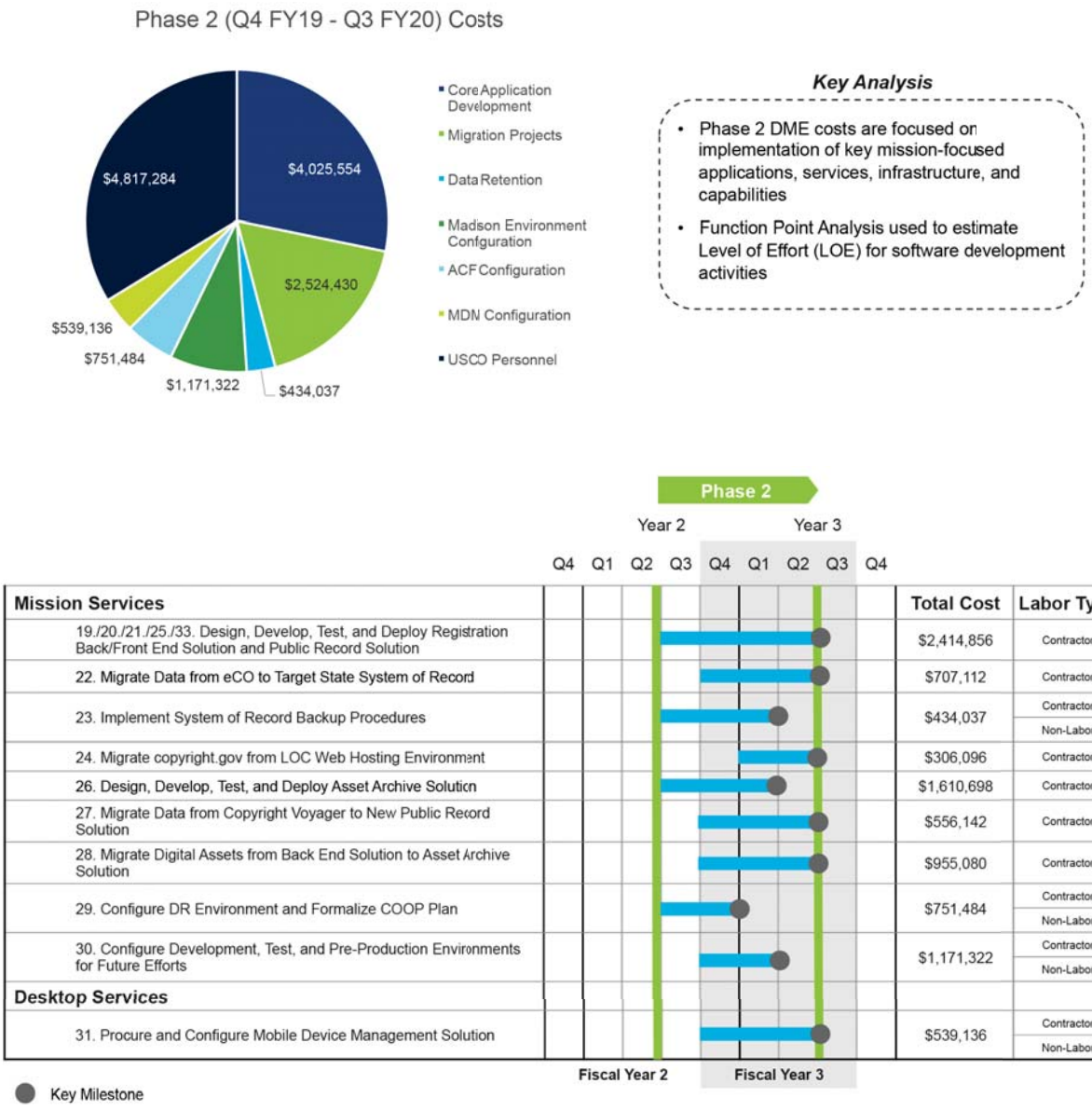


Figure 5.3.2-3: Cost Analysis for Phase 2

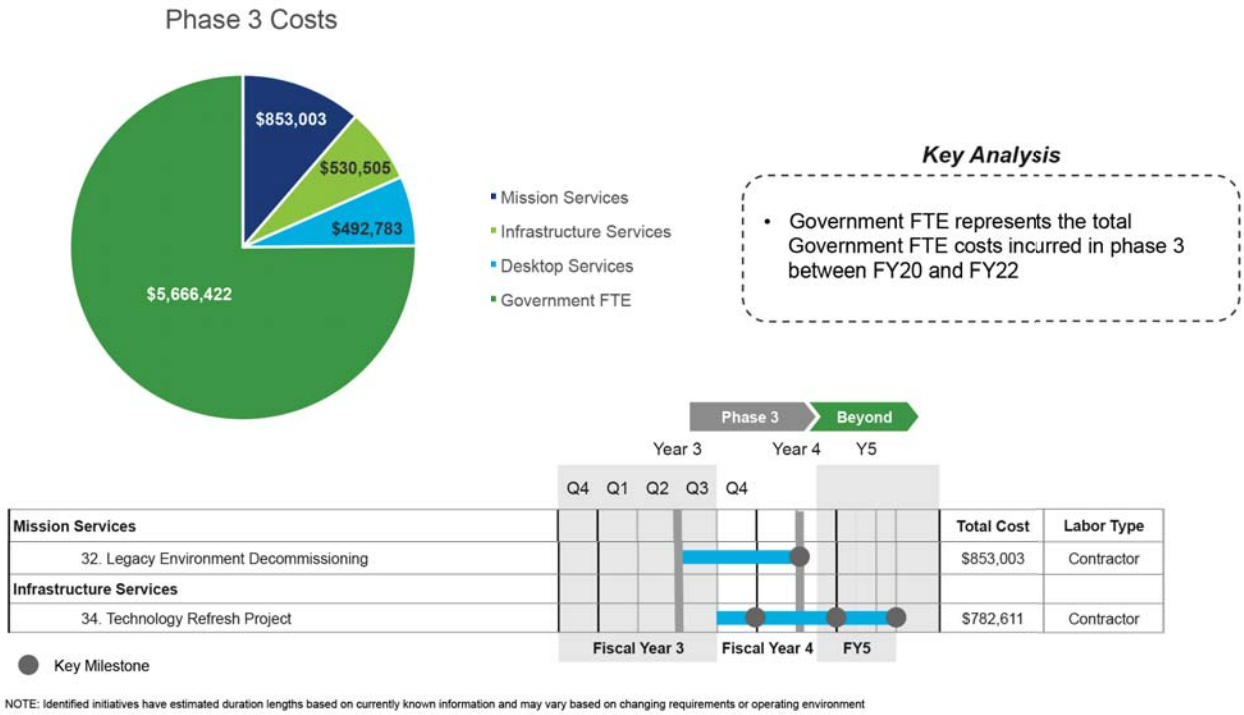
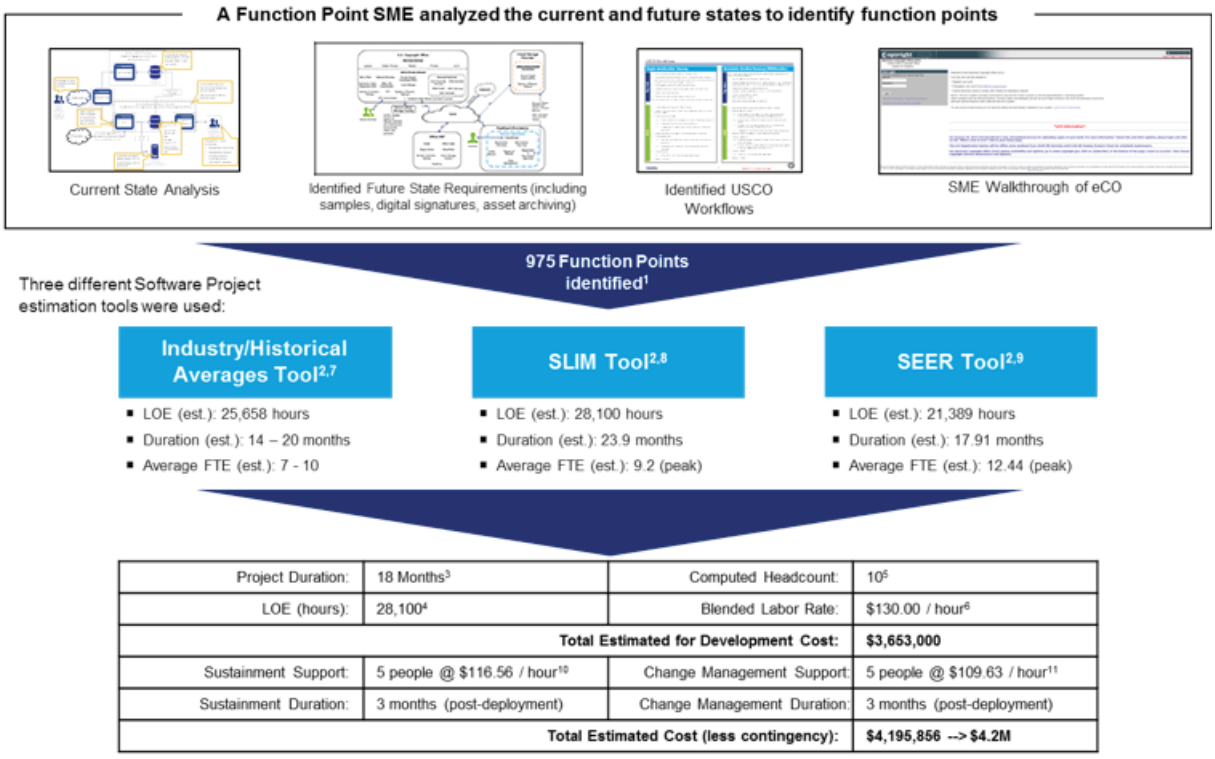


Figure 5.3.2-4: Cost Analysis for Phase 3

5.3.2.1 Software Development Cost Estimation Approach

Function Point project management software analysis was used to estimate the level of effort ("LOE") required to develop the new mission applications, as shown in Figure 5.3.2.1-1.



Project Duration:	18 Months[3]	Computed Headcount:	10[5]
LOE (hours):	28,100[4]	Blended Labor Rate:	$130.00 / hour[6]
		Total Estimated for Development Cost:	**$3,653,000**
Sustainment Support:	5 people @ $116.56 / hour[10]	Change Management Support:	5 people @ $109.63 / hour[11]
Sustainment Duration:	3 months (post-deployment)	Change Management Duration:	3 months (post-deployment)
		Total Estimated Cost (less contingency):	**$4,195,856 --> $4.2M**

1. Function Point analysis includes 30% margin to account for potential scope increase/changes.
2. Estimate includes standard software lifecycle activities, they do not include IV&V support time, user time, travel or training for development staff, or maintenance/post-deployment support.
3. Source: Transition Roadmap (Initiatives 19, 20, 21).
4. Used the Highest LOE estimate from the three tools (SLIM).
5. Divided LOE by standard hours in project duration.
6. Blended Labor Cost derived from Gen. Servs. Admin., Alliant GWAC Large Business—Government Site Year 10 (May 1, 2018-April 30, 2019).
7. Deloitte Proprietary Tool.
8. SLIM Suite Overview. QSM. http://www.qsm.com/tools
9. SEER For Software. GALORATH. http://galorath.com/products-software/SEER-Software-Cost-Estimation/
10. Gen. Servs. Admin., Application Developer—Senior LCAT in Alliant GWAC Large Business—Government Site Year 10 (May 1, 2018-April, 30, 2019).
11. Gen. Servs. Admin., Training Specialist—Senior LCAT in Alliant GWAC Large Business—Government Site Year 10 (May 1, 2018-April, 30, 2019).

Figure 5.3.2.1-1: Function Point Analysis Used for USCO Mission Application Development Cost Estimation

The Function Point analysis itself was based off of an analysis of the current Siebel application and the requirements and workflows identified in the Figures 5.3.2.1-2 through 5.3.2.1-4.

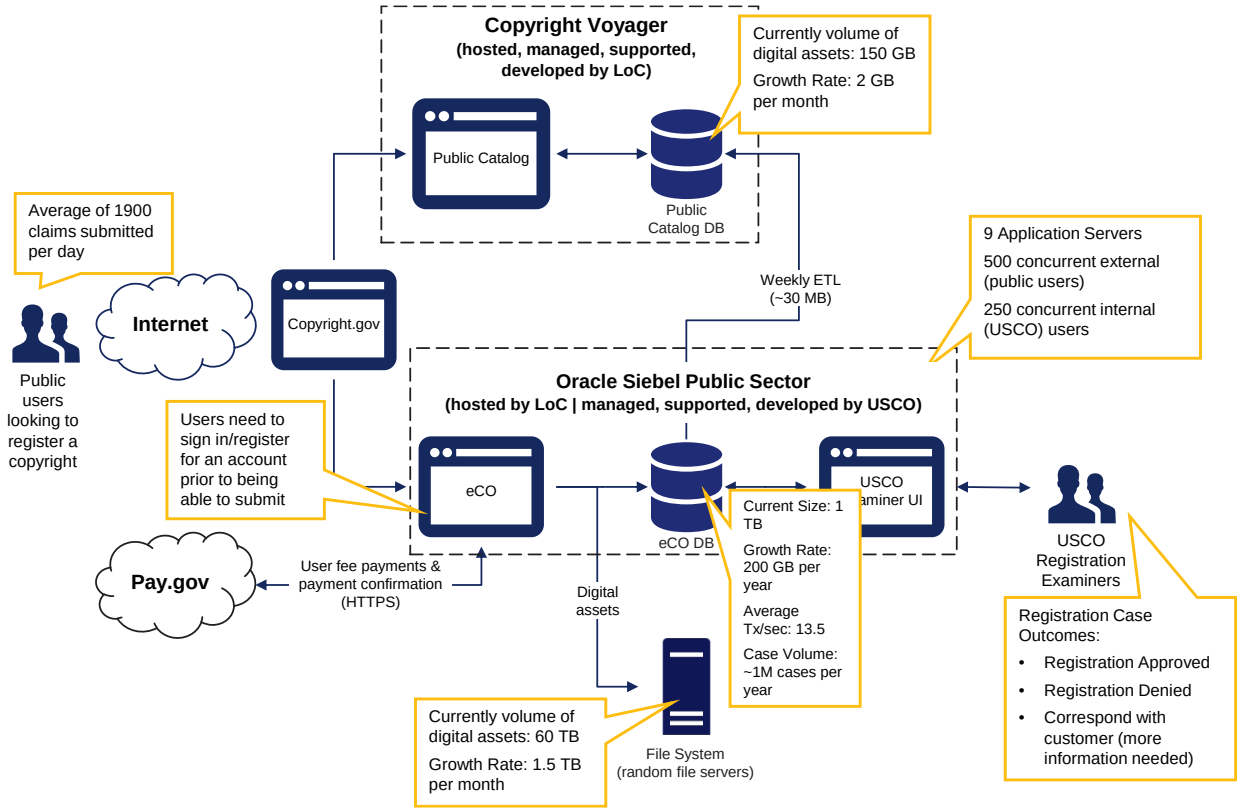


Figure 5.3.2.1-2: Current State Architecture

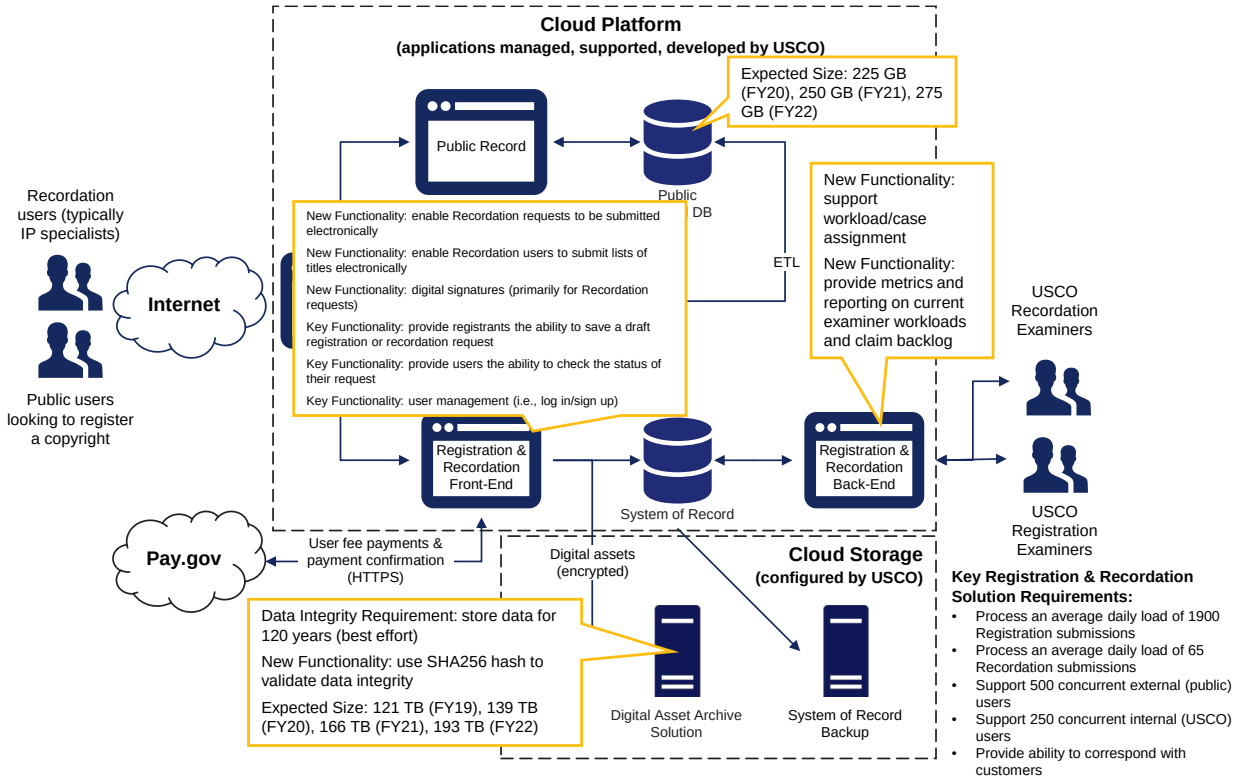


Figure 5.3.2.1-3: Notional Future State Architecture

One of the major pieces of additional functionality in the future state is the addition of a recordation workflow to the core mission application (the Siebel replacement), as shown in Figure 5.3.2.1-4.

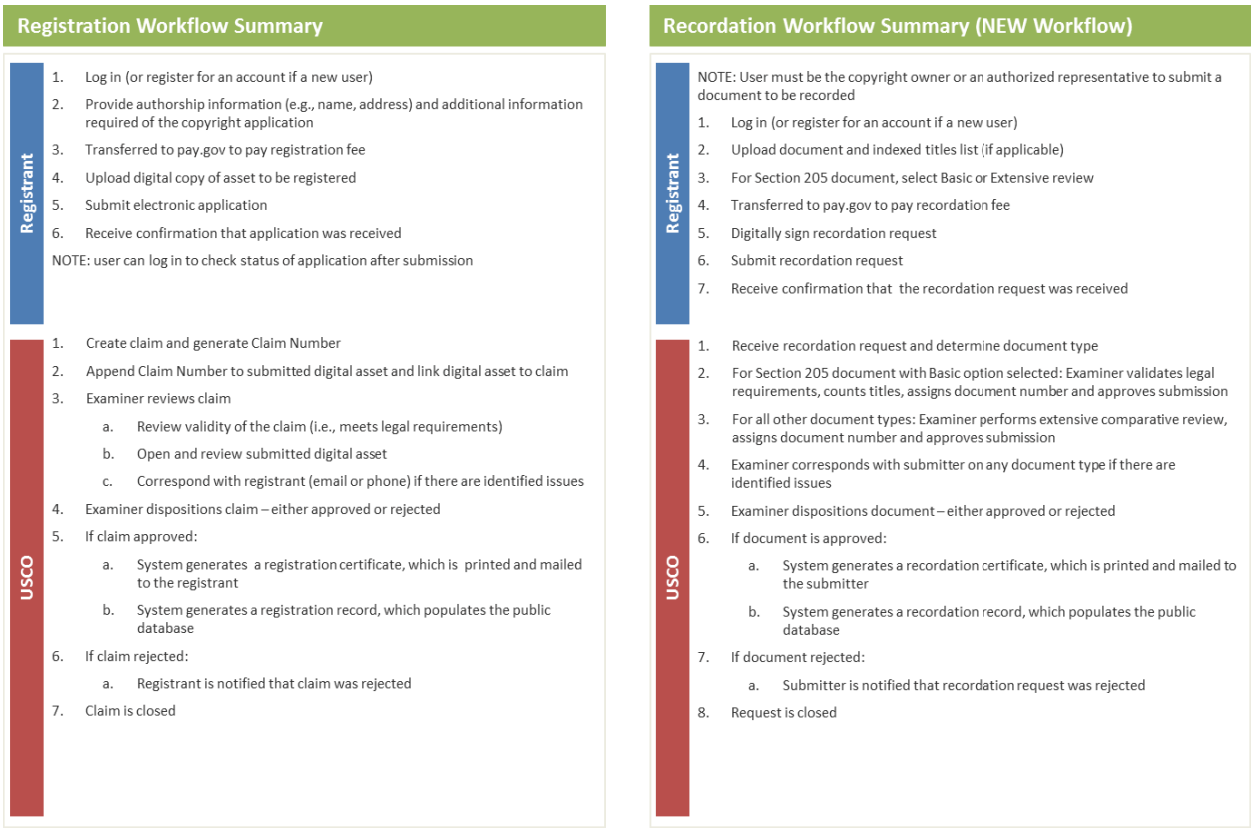


Figure 5.3.2.1-4: Future State Workflows

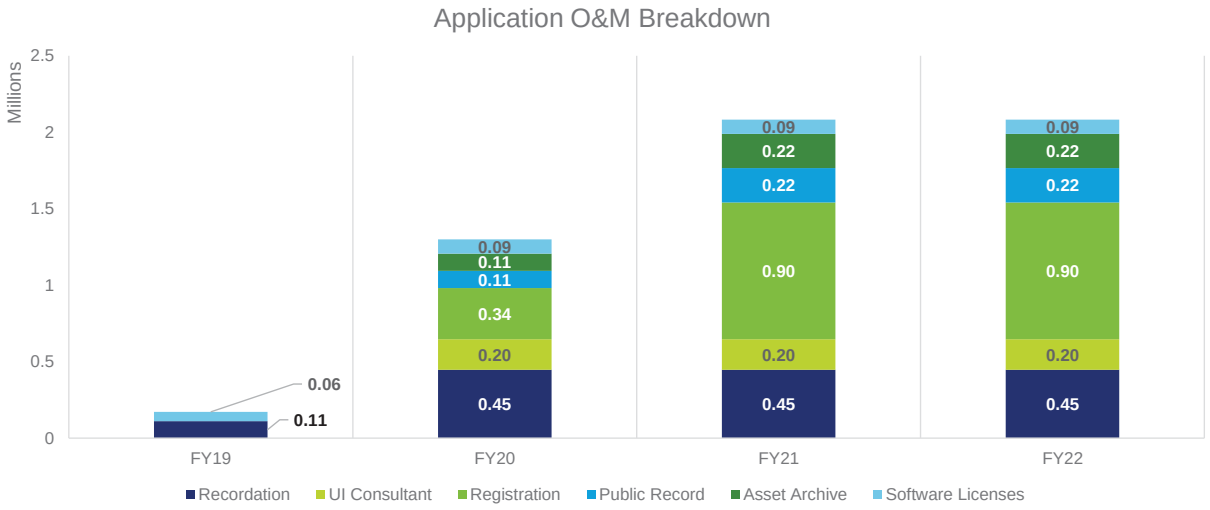
5.3.3 Application Operations & Maintenance

The following key assumptions were made for the Applications O&M analysis:

- The USCO will build target state applications and not leverage a large COTS solution (*e.g.*, Siebel)
- Demand will grow at the current rates for the first three years of the business case and 1.5 times the current rates for the final two years
- The USCO will have a recordation solution developed by the end of FY 2017
- Government FTEs in the Application Development organization identified in Section 6.2.1, IT Organization & ITSM, will provide oversight and management of the O&M contractors identified
- The number of resources required to provide O&M support to the future state applications is equal or less to the number of contractor resources currently supporting USCO's Siebel (currently two contractor resources); the USCO has made the following complexity assumptions for the future state applications:
  - Registration & recordation front-end: equally complex as Siebel
  - Registration & recordation back-end: equally complex as Siebel
  - Public record: less complex than Siebel
  - Digital Asset Archive: less complex than Siebel

- Only labor and licenses are required for application O&M support (*i.e.*, no additional equipment or services need to be procured); infrastructure costs for non-production environments are accounted for as part of IT Infrastructure O&M
- Identified application O&M contractors will be full-time resources (*i.e.*, 100% utilized) and not contracted through a retainer or other part-time arrangement
- Given the public-facing nature of many of the USCO's future state mission-critical applications, the USCO assumes there will be need for a full-time (*i.e.*, 100% utilized) User Interface ("UI") Consultant
- There will be ten users for the proposed Salesforce[31] Customer Relationship Management ("CRM") software; Salesforce's Professional license can be used for costing until detailed CRM related requirements are gathered
- There will be fifty users for the proposed case management solution; IBM's Case Manager is a reasonably representative market solution that can be used for costing
- Costs were obtained from GSA Advantage when available; no inflation, escalation, or discounts were applied to any of the identified costs through the duration of the five-year implementation timeline

Figure 5.3.3-1 provides the cost analysis.



Key Analysis

- Key costs driving the Application operations include support for Registration, Recordation, Public Record, Asset Archiving, and other costs associated with COTS licenses.
- Applications go live Q4 of FY20, resulting in only one quarter of application-related costs for that year. The cost breakdown for FY21 and FY22 represent full years of application-related costs
- Total **steady state operations cost is ~$6M over a 5 year period**

Figure 5.3.3-1: Application O&M Cost Analysis

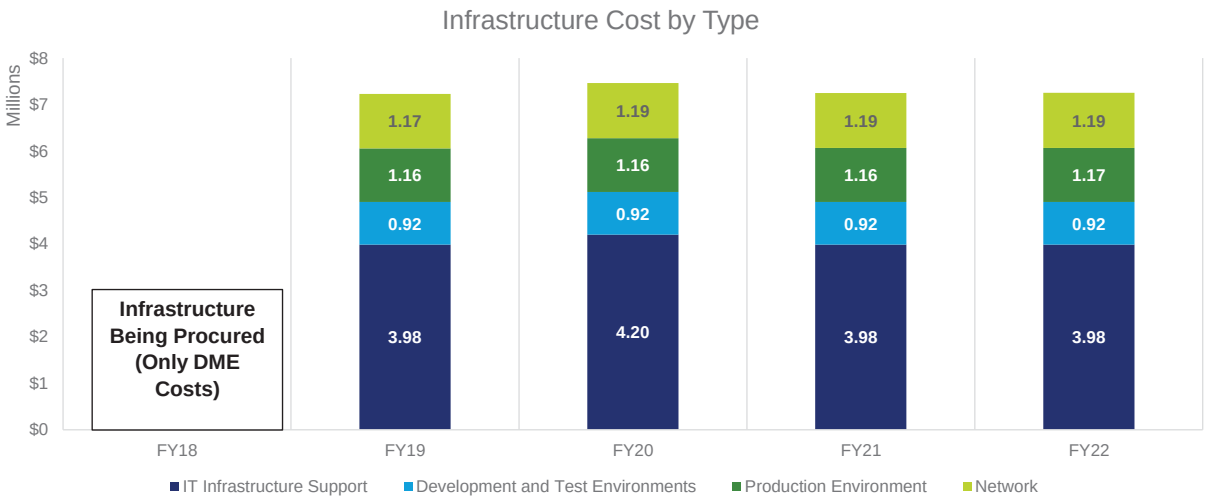
[31] As explained above, vendors and services listed in this provisional IT Plan are representative market solutions that were selected solely to develop the required costs estimates. There are multiple providers who deliver these services. The USCO will perform a selection process prior to implementation to determine the best solution.

5.3.4 IT Infrastructure

The following key assumptions were made for the IT Infrastructure analysis:

- A four-year refresh cycle for servers and networking equipment
- Annual maintenance support will cost 20% of the purchase price for each piece of hardware procured
- The identified cloud IaaS/PaaS provider is a representative solution for the identified core mission applications and provides the necessary development and testing tools as part of the procured cloud service
- The rate of storage growth for both the Digital Asset Archive and System of Record will be at the current growth rate for the first three years of the business case (FY 2018 – FY 2020) and 1.5 times the current growth rate for the final two years of the business case (FY 2021 – FY 2022)
- Personal Identity Verification ("PIV") enrollment will be conducted by a non-IT organization, but the USCO IT team will be responsible for procuring the PIV enrollment solution
- FedRAMP-compliant cloud services are 25% higher than the comparable commercially available costs
- The NOC and Security Operations Center ("SOC") will monitor 1,500 nodes
- Costs were obtained from GSA Advantage when available; no inflation, escalation, or discounts were applied to any of the identified costs through the duration of the business case

Figure 5.3.4-1 provides the cost analysis.



Key Analysis

- Infrastructure costs accounts **to $28.4M** and includes on premise, cloud hosting, DR, and managed NOC and SOC services
- The FY20 increase in IT Infrastructure Support comes with the use of Voice Network Support Contractor
- Total infrastructure cost (labor and non-labor) operation costs over a 5 year period – ~**$31M**

Figure 5.3.4-1: Infrastructure O&M Cost Analysis

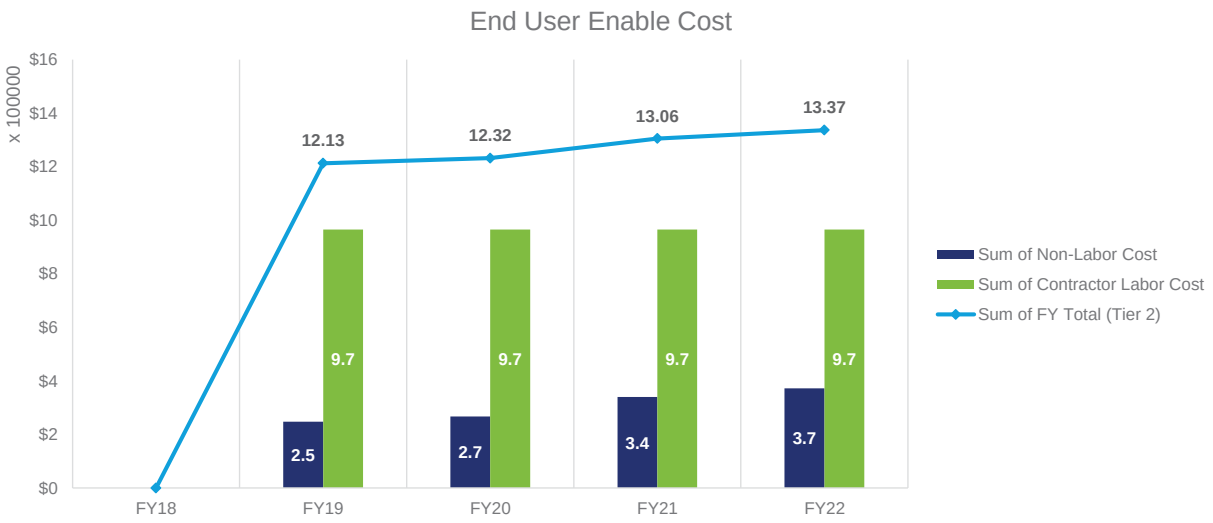
5.3.5 End User Enablement

The following key assumptions were made for the End User Enablement analysis:

- Office 365 E3 used as a representative solution for the identified office productivity solution need
- GSA Laptop Upgrade 1 Specification (Dell Latitude E6440) is representative of the laptop requirements in the future state
- All USCO users will receive a laptop with a three-year refresh period
- Same price (initial purchase, refresh purchase) for each year in the business case
- The USCO will choose a Bring Your Own Device ("BYOD") mobility strategy; AirWatch Mobile's[32] Blue Level solution is a representative solution for the identified Mobile Device Management ("MDM") Software as a Service ("SaaS") need
- AirWatch will be able to receive the appropriate approvals (*e.g.*, FedRAMP) needed to provide an SaaS-based MDM solution to U.S. Government customers
- The USCO will have a need for ten video-teleconferencing suites; Cisco's SX10 solution meets the identified video-teleconferencing needs
- Each USCO employee will have an IP phone
- Costs were obtained from GSA Advantage when available; no inflation, escalation, or discounts were applied to any of the identified costs through the duration of the business case

Figure 5.3.5-1 provides the cost analysis.

[32] As explained above, vendors and services listed in this provisional IT Plan are representative market solutions that were selected solely to develop the required costs estimates. There are multiple providers who deliver these services. The USCO will perform a selection process prior to implementation to determine the best solution.



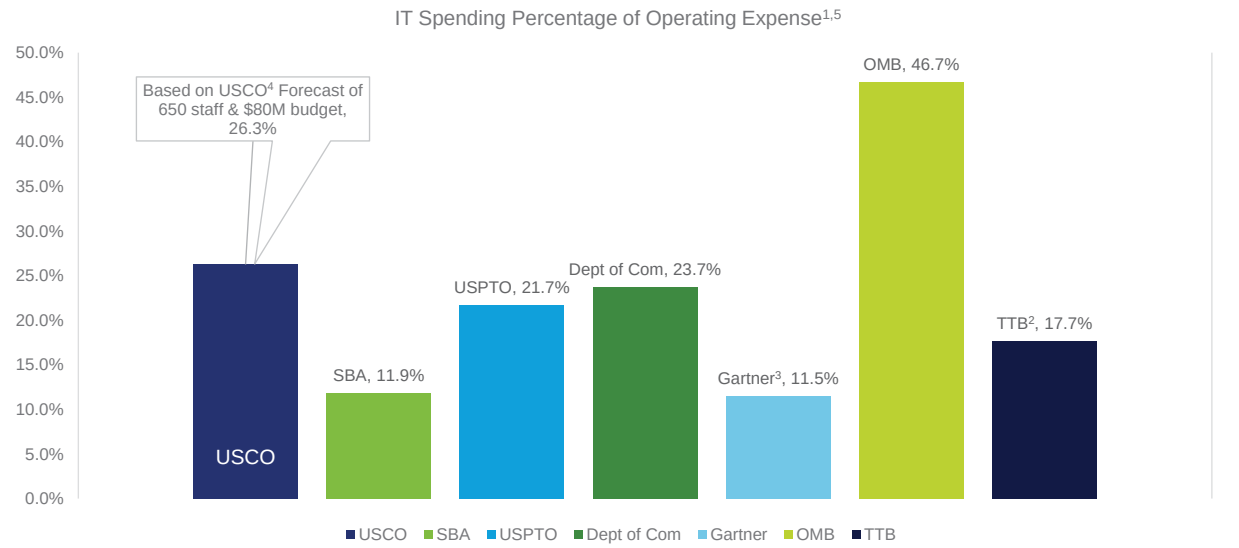
Key Analysis

- End User Enablement cost include – end user computing devices & services, productivity tools (e.g. email)
- The gradual increase in non-labor costs are the result of a yearly increase in the number of required software subscriptions
- For costing purposes, we have accounted for Microsoft's Office 365 E3 offering – which includes email, office suite (Word, Excel, PowerPoint), and conferencing and IM facilities.
- Total cost (labor and non-labor) – **$5.1M**

Figure 5.3.5-1: End User Enablement O&M Cost Analysis

5.3.6 Comparison to Benchmarks

Given the significant role that IT will play in supporting new and ongoing operations in the modernized, twenty-first century copyright system, the range of projected IT spending as a percentage of operating expense appears reasonable and within the expected limits based on benchmarking to comparable agencies. Figure 5.3.6-1 compares the USCO's expected IT spend to similar (size or mission) agencies.



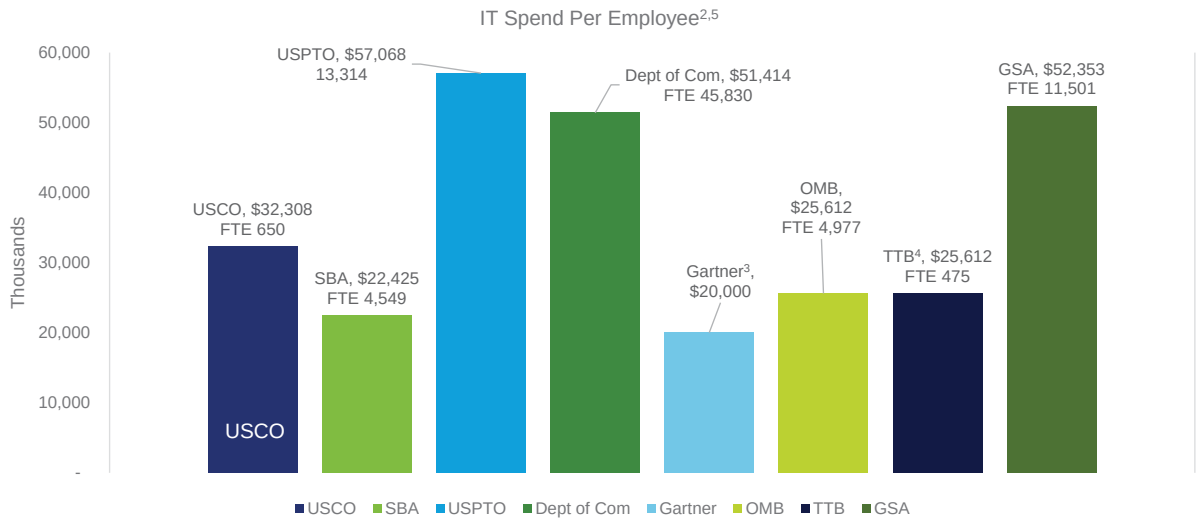
Key Notes

- The metric for IT spending as a percentage of operating expenses is often used by government enterprises to track effectiveness
- Based on future forecast, with budget of $80M[4] and 650 staff members, USCO's IT spending provides view of the role IT plays in overall spending patterns and comparable to organizations with similar mission service – like USPTO & similar in size (TTB, etc.)
- Certain organizations with a greater level of IT investment relative to operating expense are viewed IT as a strategic enabler, and this provides USCO IT to be a strategic partner to business and help improve business performance and productivity levels

1. IT Dashboard FAQ, IT Dashboard FY2016 Edition, https://myit-2016.itdashboard.gov/faq.
2. Department of Treasury, TTB Program Summary by Budget Activity, http://www.ttb.gov/pdf/budget/fy2016bib.pdf.
3. Gartner, IT Key Metrics Data 2016: Small and Midsize Enterprise Executive Summary 19 tbl. 3 (2015).
4. Budget forecast: current budget of $55M, IT O&M Beyond FY22 is ~$20M and ~$5M Misc. expenses = $80M.
5. Based on O&M analysis.

Figure 5.3.6-1: Comparison of Expected USCO Spend to Benchmark Agencies

Given the importance of technology to fulfilling the USCO's mission, the cost analysis also concludes that the forecasted IT spend per employee is within a reasonable range. Figure 5.3.6-2 shows a comparison of IT spend per employee to comparable agencies.



Key Notes

- Increase in IT spending per employee[1] provides a pulse check to measure link between IT Investment versus Automation. Variations in this level can help drive meaningful conversation around automation across processes, products, and delivery methods.
- However, certain industries with the highest level of IT spending per employee are those that typically tend to be the most information-intensive, and include banking and financial services, insurance, and certain national and international government.[2]

1. The count of employees (i.e., head count, excluding enterprise contractors and consultants), regardless of whether these employees are frequent users of the technology supported by the IT organization. This includes full-time and part-time employees, or as reported in the public record.
2. IT Dashboard FAQ, IT Dashboard FY2016 Edition, https://myit-2016.itdashboard.gov/faq.
3. Gartner, IT Key Metrics Data 2016: Small and Midsize Enterprise Executive Summary 22 tbl. 4 (2015).
4. Department of Treasury, TTB Program Summary by Budget Activity, http://www.ttb.gov/pdf/budget/fy2016bib.pdf.
5. Based on O&M analysis.

Figure 5.3.6-2: Comparison of IT Spend per Employee to Benchmark Agencies

5.4 Conclusions

Based on the above cost analysis, the overall IT budget of $165 million over a five-year period for the IT Plan appears within a reasonable range of expectations. The risk variance of +15% ($190 million) and −5% ($157 million) of the overall total cost provides a buffer for additional gaps or risks.

As noted above, this provisional IT Plan does not include detailed requirements for all applications, although contingencies have been built in across the different cost elements through the key assumptions discussed above (IT Operating Model, transition phases, Application O&M, IT Infrastructure O&M, and End User Enablement).

Finally, the cost estimate assumes that a number of key activities (budget approvals, on-boarding staff) will receive required attention and action during the pre-planning phase (FY 2017) to avoid delays in execution; such delays could jeopardize the accuracy of the cost estimate.

6.0 Risks and Next Steps

The USCO has the exciting opportunity to utilize technology to become a model for twenty-first century government and to fulfill its mission of fostering the creation and dissemination of creative works. However, realizing this opportunity within the projected timeframe will require sustained focus to complete a significant amount of work. In addition, IT modernization is not without risks that will need to be further identified, analyzed, and mitigated.

6.1 Identified Risks and Mitigation

While the future state aims to minimize risk and be as comprehensive as possible, Table 7.1-1 lists identified risks with potential mitigations.

Risk	Description	Mitigation
Performance	If USCO cannot provide the necessary level of application and service performance then the transition may not be successful	Establish high SLAs with vendors/services and hold vendors accountable
Budget	Uncertainty around IT budgets may create uncertainty when forecasting spend during the transition	Employ PMO practices to have greater control and visibility over IT budgeting and forecasting
Mission	USCO business service offering changes may occur faster than USCO IT can adapt during transition	Employ iterative and parallel system development processes for timely support of business and functional requirements
Operating Model	USCO IT needs to rebuild its entire operating model during the transition to one focused on strategy, architecture, engineering, and vendor management; any unforeseen issues may prevent the future state from being achieved in the proposed timeline	Receive buy-in from leadership and ensure adequate support is in place to execute the newly defined operating model
Talent	USCO IT may not be able to source the services and talent needed to support the new operating model	Rely on contracting services to fill in skillset gaps
Authority	Failing to obtain full budget control and contracting authority may prevent USCO from completing IT modernization within the proposed timeline	Define budget process and ensure dedicated resources are appropriately skilled to manage budget execution and contracting functions effectively
Development	USCO will be developing multiple new applications on new platforms and may encounter challenges that delay delivery of applications and extend the lifespan of legacy applications	Ensure project managers follow project schedule and communicate any risks to management

Risk	Description	Mitigation
Data Migration	USCO needs to migrate data from multiple different legacy systems and platforms; any issues with this data migration may result in loss of data integrity or service disruptions	Verify integrity of data once migration is complete and switch over to new platform only once verification is successful to prevent service disruption
Unwind Costs	USCO may have to pay unexpected costs to exit current licensing or service provider agreements	Analyze current licenses and service provider agreements to determine if any costs are associated with existing contracts

6.2 Next Steps

This IT Plan should be considered provisional. The USCO plans to revisit and revise the plan, if necessary, as requirements are further defined and feedback received. In addition, a number of key activities (budget approvals, on-boarding staff) require attention and action during the pre-planning phase (FY 2017) to avoid delays in execution. As an initial matter, these key activities include the implementation of a strong Transition PMO to coordinate planning and execution of the broader modernization effort and ensure a successful transition to a twenty-first copyright organization.

Appendices

Appendix A – Source Materials

The following documents were used in the development of the IT Plan:

- USCO Strategic Plan
- Library of Congress Enterprise Architecture – Copyright Office
- Copyright Office Special Project Sequence
- USCO Deployment Plan and Cost Estimates
- Siebel Application Architecture (across Production, Pre-Production, Test, and Development environments)
- USCO Process documentation
- Statistics on current application utilization, sizing, growth, and file type breakdowns
- OCIO USCO Organization Chart (Functional and Personnel)
- USCO Service Level Agreement
- Costing for Congressional Testimony
- USCO Licensing Costs
- Library of Congress Security Framework

Appendix B – Cost Basis of Estimate

B.1 Introduction

B.1.1 Purpose

The cost basis of estimate ("CBOE" or "Cost Estimate") report provides a record of the procedures, ground rules and assumptions, data, environment, and events that underlie a cost estimate's development or update. Good documentation provides credibility to the cost estimate, aids in analysis of changes to program cost, enables reviewers to effectively assess the cost estimate, and populates agency databases for estimating costs of future programs.

Properly documenting cost estimates is considered a best practice[33] for developing high-quality cost estimates, for several reasons.

Documentation is essential to validating and defending cost estimates and provides a credible answer to probing questions by decision makers and oversight groups.

Step-by-step documentation of an estimate provides detailed information and a repeatable process.

Good documentation facilitates analyzing program cost changes and contributes to the collection of cost and technical data to support future cost estimates.

Well-documented cost estimates are essential to providing validation, credibility, and reconciling differences for independent reviews and providing decision makers better information.

The CBOE report provides adequate detail of the estimates allowing replication by anyone and serves as a reference to support future estimates. Documenting the cost estimate makes a written justification, showing how it was developed and aiding in updating, as key assumptions change and more information becomes available.

Estimates should be documented in this report to show parameters, assumptions, descriptions, methods, and calculations used to develop a cost estimate. The recommended practice is using a narrative with cost tables to describe the basis for the estimate, with a focus on the methods and calculations used to derive the estimate. With this standard approach, the documentation provides a clear understanding of how the cost estimate was constructed. Moreover, cost estimate documentation should explain why particular methods and data sets were chosen and why these choices were reasonable. It should also reveal the pros and cons of each method selected. Finally, there should be enough detail so the documentation serves as an audit trail of backup data, methods, and results, allowing for clear tracking of a program's costs as it moves through various lifecycle phases.

This estimate provides a structured accounting of all resources and associated costs required to complete the USCO IT Plan. This estimate reflects the information that is available during the

[33] GOVERNMENT ACCOUNTABILITY OFFICE, GAO COST ESTIMATING AND ASSESSMENT GUIDE: BEST PRACTICES FOR DEVELOPING AND MANAGING CAPITAL PROGRAM COSTS (Mar. 2009), http://www.gao.gov/new.items/d093sp.pdf.

Planning phase of the agency's lifecycle and includes costs for the lifecycle phases, cost categories, and cost types that are noted in Table B-2.

Table B-2: Lifecycle Phases and Cost Categories Included in Estimate

Lifecycle Phases	Cost Categories	Cost Types
Planning (Phase 0)	IT Organization & ITSM	Federal Labor Costs
Infrastructure Transition (Phase 1)	Application Operations & Maintenance (O&M)	Contractor Labor Costs
Application Transition (Phase 2)	IT Infrastructure O&M	Capital Expenditure Costs
Cutover and Decommission (Phase 3)	DME	Ongoing Maintenance Costs
Steady State (Post-Phase 3)	Desktop/Staff User Devices and Services O&M	

This estimate was prepared to support the development of the USCO's IT Budget for the FY 2018 budget cycle. The estimate was requested by Douglas Ament, USCO Chief Information Officer ("CIO"), and development of the IT component cost estimate was approved under the investment selection process. This estimate includes IT costs to plan for and execute the transition, including engineering, building, deploying, and operating new target state systems.

B.2 Summary & Recommendations

B.2.1 Executive Summary

The following table provides a summary of the key Cost Estimate outputs.

Table B-3: Summary of Key Cost Estimate Outputs

Cost Category	FY18*	FY19*	FY20*	FY21*	FY22*
IT Organization & ITSM	$1.4 M	$4.6 M	$4.6 M	$7.9 M	$7.9 M
Application O&M	$0	$0.2 M	$1.4 M	$2.2 M	$2.2 M
IT Infrastructure O&M	$0	$7.6 M	$7.8 M	$7.6 M	$7.6 M
DME	$26.6 M	$26.9 M	$22.4 M	$11.4 M	$8.9 M
Desktop/Staff User Devices and Services O&M	$0	$1.2 M	$1.2 M	$1.3 M	$1.3 M
Total Spend	**$28.0 M**	**$40.4 M**	**$37.3 M**	**$30.3 M**	**$28.5 M**
DME % and O&M % of Total Spend	DME: 95% O&M: 5%	DME: 67% O&M: 33%	DME: 60% O&M: 40%	DME: 38% O&M: 62%	DME: 31% O&M: 69%

Cost Category	FY18*	FY19*	FY20*	FY21*	FY22*
Total Headcount	**75.5**	**120.05**	**115.75**	**95**	**91**
Total Government FTE	41	41	41	41	41
Total Contractor Count	34.5	79.05	74.75	54	50

*Note: Costs in this table have been rounded

Since the USCO plans to implement a fully modernized IT organization, a significant amount of cost in the initial three fiscal years is focused on building out the infrastructure, capabilities, and core applications that would be required. Therefore there are high levels of DME spending from FY 2018 – FY 2020 with it tapering off in the last two fiscal years to be focused more on enhancements.

Similarly, the plan is for the USCO to pursue a cloud-first IT strategy, with as many applications and services hosted in the cloud as possible. Therefore, O&M expenses may be higher than if the USCO decided to pursue a buy-and-build strategy. Capital expenditures, however, should be lower as a result because fewer pieces of infrastructure will need to be refreshed.

Overall the cost estimate demonstrates the costs associated with the USCO's pursuit of a cloud-first, operational expense ("OPEX") oriented IT strategy for the future state.

B.2.2 Recommendations

The Cost Estimate presented in this document is a preliminary estimate based on the known set of requirements and capabilities identified in the IT Plan. As the USCO continues to develop and refine requirements throughout the course of the planning and execution of this modernization effort, the cost estimate will be updated to reflect this additional information. The USCO will review the CBOE on a periodic basis and develop a process to incorporate requirements and decisions as they are formalized.

The USCO has a unique opportunity to invest in building a modernized IT organization with minimal legacy commitments. Given the USCO's relative lack of maturity around IT cost estimation, the cost estimation processes, tools, and activities developed to support and iterate on this CBOE provide a starting point for the USCO to mature this organizational capability.

B.3 Cost Basis of Estimate Report Organization and Contributors

The following sections briefly describe the documentation structure and content for the CBOE. This document is organized to provide a breakdown of the underlying ground rules and assumptions that compose the cost estimate, as well as the technical scope and components that make up the system that is being estimated. Ground rules, assumptions, and constraints—which underpin the technical structure of the cost estimation—are included in the latter sections of this report.

B.3.1 Cost Basis of Estimate Report Organization

B.3.1.1 Introduction

This section provides background and context for the cost estimating effort.

B.3.1.2 Summary & Recommendations

This section provides a summarized view of the cost estimate outputs.

B.3.1.3 Cost Basis of Estimate Report Organization and Contributors

This section describes how the CBOE report is structured.

B.3.1.4 Scope and Technical Description

This section identifies the components of the USCO future state that have been analyzed.

B.3.1.5 Cost Estimate Results

This section provides a more granular view into the outputs of the cost estimating effort.

B.3.1.6 Risks and Issues

This section captures any risks and issues identified during development of the cost estimate.

B.3.1.7 Ground Rules & Assumptions, Constraints

This section documents the guiding principles, assumptions, and constraints that informed the cost estimate analysis.

B.3.1.8 Estimating Methodology Summary

This section provides a summary of the approach used to develop the cost estimate.

B.3.2 Estimate's Objective

The cost estimate for the IT Plan has been developed to support the planning and budgeting for development and operation and maintenance of the program for the period FY 2018 – FY 2022. These estimates have been designed to include all anticipated federal labor, contract labor, and physical IT infrastructure acquisition costs for this period. This is the initial estimate and does not reflect updates to a previous lifecycle estimate.

B.3.3 Scope of Cost Analysis

Cost estimates will include physical IT infrastructure, both contract and federal labor, and will extend through FY 2022.

B.4 Scope and Technical Description

Please refer to the IT Plan for the proposed Future Architecture and rationale.

B.4.1 Excluded Scope

The following significant scope elements have been excluded from this estimate:

- Any IT costs related to the provision of shared or outsourced services for non-IT business functions (*e.g.*, financial management, human capital)
- Costs borne by non-IT mission/business units to modify processes or otherwise adapt to new applications and systems in the future state

B.5 Cost Estimate Results

The following sections summarize the results of the Cost Estimate.

B.5.1 Cost Summary

The following table provides the outputs of the Cost Estimate by top level and sub-category.

Table B-4: Summary of Results by Category and Sub-Category

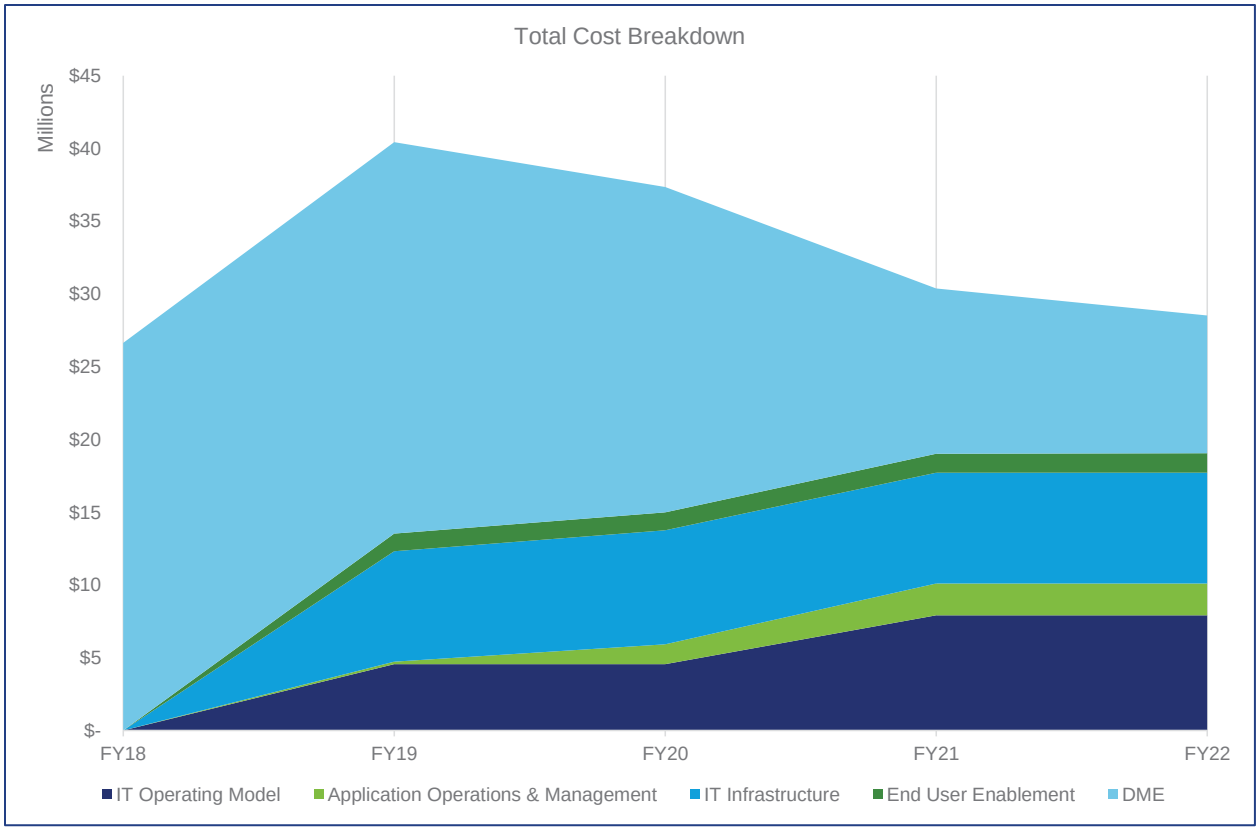
Cost Category	FY18*	FY19*	FY20*	FY21*	FY22*
IT Organization & ITSM	$1.4 M	$4.6 M	$4.6 M	$7.9 M	$7.9 M
IT Leadership	$1.0 M	$1.0 M	$1.0 M	$1.6 M	$1.6 M
IT Personnel	$0.4 M	$0.4 M	$0.4 M	$1.7 M	$1.7 M
Security	$0	$0	$0	$1.3 M	$1.3 M
ITSM	$0 M	$2.9 M	$2.9 M	$2.9 M	$2.9 M
Sustainment/ Contingency	$0 M	$0.2 M	$0.2 M	$0.4 M	$0.4 M
Application O&M	$0	$0.2 M	$1.4 M	$2.2 M	$2.2 M
Mission Applications	$0	$0.2 M	$1.3 M	$2.1 M	$2.1 M
Middleware	$0	$0	$0	$0	$0
Interfacing Applications	$0	$0	$0	$0	$0
Sustainment/ Contingency	$0	$0	$0.1 M	$0.1 M	$0.1 M
IT Infrastructure O&M	$0	$7.6 M	$7.8 M	$7.6 M	$7.6 M
IT Infrastructure Support	$0	$4.0 M	$4.2 M	$4.0 M	$4.0 M
Development Tools	$0	$0	$0	$0	$0
Development and Test environments	$0	$0.9 M	$0.9 M	$0.9 M	$0.9 M
Production Environment	$0	$1.2 M	$1.2 M	$1.2 M	$1.2 M
Disaster Recovery (DR) Environment	$0	~$0	~$0	~$0	~$0
Network	$0	$1.2 M	$1.2 M	$1.2 M	$1.2 M
Sustainment/ Contingency	$0	$0.4 M	$0.4 M	$0.4 M	$0.4 M
DME	$26.6 M	$26.9 M	$22.4 M	$11.4 M	$9.5 M

Cost Category	FY18*	FY19*	FY20*	FY21*	FY22*
Phase 0	$5.1 M	$0	$0	$0	$0
Phase 1	$10.6 M	$10.8 M	$0	$0	$0
Phase 2	$0	$3.8 M	$10.4 M	$0	$0
Phase 3	$0	$0	$1.4 M	$3.4 M	$3.0 M
Other DME Costs	$3.8 M	$4.3 M	$3.7 M	$3.6 M	$2.7 M
Contingency	$7.1 M	$7.9 M	$6.9 M	$4.3 M	$3.8 M
Desktop/Staff User Devices and Services O&M	$0	$1.2 M	$1.2 M	$1.3 M	$1.3 M
Devices and Services	$0	$0.2 M	$0.2 M	$0.3 M	$0.3 M
Shared User Equipment	$0	$0.3 M	$0.3 M	$0.3 M	$0.3 M
Desktop Support	$0	$0.7 M	$0.7 M	$0.7 M	$0.7 M
Sustainment/ Contingency	$0	$0.1 M	$0.1 M	$0.1 M	$0.1 M
Total Spend	$28.0 M	$40.4 M	$37.4 M	$30.4 M	$28.5 M
DME % and O&M % of Total Spend	DME: 95% O&M: 5%	DME: 67% O&M: 33%	DME: 60% O&M: 40%	DME: 38% O&M: 62%	DME: 31% O&M: 69%

*Note: Costs in this table have been rounded

The following graph shows the distribution of costs per year for each of the five fiscal years in the CBOE analysis.

Figure B-1: Total Cost Breakdown across the Five FY Business Case



The following table shows a breakdown of the cost pools over the five fiscal years in the Cost Estimate analysis.

Table B-5: Cost Pools by Time Cost Summary

Cost Category	FY18*	FY19*	FY20*	FY21*	FY22*
Government Labor Costs	$6.3 M	$6.3 M	$6.3 M	$6.3 M	$6.3 M
Contractor Labor Costs	$9.4 M	$19.8 M	$19.0 M	$13.5 M	$11.6 M
Non-Labor Costs	$11.5 M	$13.0 M	$11.0 M	$9.9 M	$10.4 M

*Note: Costs in this table have been rounded

B.5.2 Schedule and Milestones Summary

The CBOE uses a project start date of October 1, 2017. The following table identifies the key milestones for each identified phase of the USCO restructuring project.

Table B-6: USCO Restructuring Project Milestones

Phase	Start	End
Phase 0	10/01/2017	03/31/2018
Phase 1	04/01/2018	06/30/2019
Phase 2	07/01/2019	06/30/2020
Phase 3	07/01/2020	06/30/2021
Post-Phase 3	07/01/2021	09/30/2022
Overall	**10/01/2017**	**09/30/2022**

B.5.3 Staffing Summary

The USCO's headcount (both Government FTE and Contractor) can be expected to increase from its current levels (approximately 43: 25 Government, 18 Contractor). To fully modernize its IT enterprise, the USCO has to take responsibility for a number of IT capabilities, processes, functions, services, and applications that are currently provided by LoC thereby necessitating additional resources.

The following table depicts the breakdown of Government FTE count and Contractor FTE count across the business case's five-fiscal-year duration.

Table B-7: Government Labor Count vs. Contractor Labor Count

Cost Category	FY18	FY19	FY20	FY21	FY22
Total Government FTE	41	41	41	41	41
SES	2	2	2	2	2
GS-15	4	4	4	4	4
GS-14	27	27	27	27	27
GS-13	8	8	8	8	8
Total Contractor Count	34.5	79.05	74.75	54	50
Total Headcount	**75.5**	**120.05**	**115.75**	**95**	**91**

B.6 Risks and Issues

The following risks and issues have been identified. Items with an *Up Arrow* are positive points about the estimate whereas items with a *Down Arrow* indicate areas of uncertainty and risk. The *Neutral Bullets* are primarily informational comments.

- ↑ Government labor costs are fully burdened per OMB guidance
- ↑ Contractor labor costs are sourced from GSA's Alliant GWAC using the mean (average) rate for each LCAT from the Large Businesses with work performed on the government site price list

- ↑ When possible, non-labor costs have been sourced from GSA Advantage
- ↑ Risk adjustments of -5% and +15% have been identified to reflect the relative level of certainty in the cost estimate
- ↑ Cost forecast is backed by systems, application, telecom, and hardware architecture analysis appropriate for this lifecycle phase of the USCO restructuring project; this includes analysis and preliminary development of notional architectures for key infrastructure cost drivers (*i.e.*, IaaS solution, network)
- – The cost model includes built-in contingency costs for each identified top-level cost category to cover unforeseen costs for each of those categories
- ↓ A formal IT Operating Model and IT Organization design effort have not been conducted, therefore the identified counts of government FTEs and contractor FTEs in the future state may not be accurate
- ↓ Representative solutions have been identified as needed, in the event the identified solution does not meet the requirements that will be developed then the identified costs for these non-labor costs may change
- ↓ Detailed functional, business, and technical requirements for the future state applications have not been documented, therefore the application development costs (including requirements development, design, testing, and deployment) and underlying infrastructure associated with each of those applications may not be accurate
- ↓ The USCO will still need to make a number of decisions around the future state architectures, IT Operating Model, and service providers; these decisions may impact values identified for the relevant cost elements
- ↓ Preliminary architectures have not been developed and associated engineering analyses have not been conducted for key infrastructure components (*i.e.*, IaaS solution, network), which impacts the uncertainty of the cost forecast
- ↓ Assumptions have been made around the number of resources required to execute the identified projects. In the event the level of effort ("LOE") for these projects is significantly different from what has been identified in the Roadmap (e.g., due to unforeseen circumstances or delays) then the costs may vary from those identified for the relevant cost elements

B.7 Ground Rules and Assumptions, Constraints

Estimates are usually based on limited information and so need to be bound by the ground rules, assumptions, and constraints that make estimating possible. These constraints bind the estimate's scope, effort, cost, schedule, staffing, and quality, and are accounted for using assumptions. These assumptions document baseline conditions from which the estimate was built. The following sections document the ground rules, assumptions, and constraints that impact this estimate.

The overall philosophy underlying the costing approach was to provide a conservative cost estimate covering the relevant transition and steady state cost elements (e.g., federal labor, external labor, and non-labor elements).

B.7.1 Ground Rules and Assumptions – General

B.7.1.1 Scope and Technical Solution

Reference the IT Plan for a complete set of ground rules and assumptions around the scope, technical solution, and timeline.

B.7.1.2 Labor Rates

- Government FTE salaries are from the FY2015 GS Schedule and SES Schedule, for Step 5 of the identified level, and with Washington, DC, locality pay adjustment incorporated
- Government FTE salaries are loaded with markups (i.e., retirement, insurance, Medicare, and miscellaneous benefits) per OMB Circular No. A-76 (Attachment C)[34]
- Government FTE salaries are not escalated for COLA, inflation, or any projected year-over-year GS or SES pay schedule adjustments during the duration of the business case
- Government FTE executives were assumed to be either SES-level or GS-15 level
- For non-executive government FTEs, the following labor levels were assumed:
  - Architects, Engineers, Managers, Service or Application Owners – GS-14
  - All Others (Analysts, Administrative Assistants) – GS-13
  - Should a formal IT organization design effort be conducted these labor levels may change
- Contractor labor categories and associated rates (mean (average) rate for each labor category) are from the Alliant GWAC contract (Large Businesses, work performed on government site) provided by GSA[35]
- When multiple levels of seniority (e.g., junior, journeyman, senior, expert) are available for a given contractor LCAT the senior level was chosen to provide a conservative blended rate estimate
- The total government FTE Standard Labor Hours is 2080 in a given fiscal year, for contractor labor the total is 1920 in a given fiscal

B.7.1.3 Non-Labor Costs

- Non-labor costs are sourced from GSA Advantage[36] when prices are availability; if prices are not available through GSA Advantage then vendor commercial pricing is used
- For prices obtained through GSA Advantage, no discount is applied as no discount rate has yet been negotiated for USCO
- Assumptions have been made around the nature of certain licenses (*e.g.*, recurring, non-recurring, monthly, annual, per user, per device) and the number of users/devices/components that those licenses apply to; these assumptions around license types and number of licenses needed may change as additional information is identified

---

[34] *Performance of Commercial Activities,* [*OMB A-76*] (May 29, 2003), http://www.whitehouse.gov/sites/default/files/omb/assets/omb/circulars/a076/a76_incl_tech_correction.pdf.

[35] GENERAL SERVICES ADMINISTRATION, ALLIANT GOVERNMENTWIDE ACQUISITION CONTRACT (last reviewed Feb. 6, 2016), http://www.gsa.gov/portal/content/104793.

[36] *Advantage*, GENERAL SERVICES ADMINISTRATION, https://www.gsaadvantage.gov/advantage/main/start_page.do (last visited Feb. 23, 2016).

B.7.1.4 Schedule, Milestones, Durations

- The USCO will migrate data from current applications prior to retiring any legacy applications
- Copyright Act records retention rules and federal data retention standards (e.g., National Archives and Records Administration requirements) will require storage of data beyond the duration of the business case or longer

B.7.2 Ground Rules and Assumptions – Cost Element Structure ("CES")

Ground Rules and Assumptions ("GR&A") are used to help address the limited information available at the time the cost estimate is developed.

In addition to the GR&A identified below, also refer to the IT Plan for additional assumptions associated with the overall future state, Modernization Roadmap, and Cost Estimate.

B.7.2.1 IT Organization & ITSM

1. The USCO IT resources identified in the proposed Operating Model are assumed to be hired by the start of the business case (October 1, 2017) and retained throughout the duration of the business case
2. The CIO and CTO will carry over from the current IT organization
3. The USCO will have four sub-CIO/CTO level executives in the target state: a Chief Information Strategy Officer; a Director, Data, Strategy & Planning; and a Director, Application Development; a Director, Operations
4. The USCO Budget Officer and the one Administrative Assistant will carry over from the current IT organization
5. The USCO IT will need to hire an IT talent manager and an additional support staff person
6. We assume the following breakdown of government labor costs between the IT Organization & ITSM and Transition cost categories and associated DME or O&M cost categorization:
    - CIO, CTO, CISO, Directors: 50% IT Organization & ITSM (O&M) / 50% Transition (DME) from FY 2018 – FY 2020; 75% IT Organization & ITSM (O&M) / 25% Transition (DME) from FY 2021 – FY 2022
    - Architects, Engineers, Managers: 0% IT Organization & ITSM (O&M) / 100% Transition (DME) from FY 2018 – FY 2020; 50% IT Organization & ITSM (O&M) / 50% Transition (DME) from FY 2021 – FY 2022
    - Analysts, Administrative Assistants: 65% IT Organization & ITSM (O&M) / 30% Transition (DME) from FY 2018 – FY 2020; 100% IT Organization & ITSM (O&M) / 0% Transition (DME) from FY 2021 – FY 2022
7. We assume that the government labor costs for the COR, the identified architects and engineers, the identified service and process owners, the identified vendor managers, and the identified analysts are Transition related costs through Phase 2 of the Modernization Roadmap (i.e., through Q3 FY 2020) and IT Organization & ITSM costs from Q4 FY 2020 through the end of the business case
8. A formal Security Operating Model development effort has not been conducted, therefore the identified counts of security-related government FTEs and contractor FTEs in the future state may not be accurate
9. Government FTEs are not promoted during the duration of the business case (FY 2018 – FY 2022)

10. We assumed the Computer Economics provided median benchmark value for IT employee training budgets, that cost benchmark indicates $1,500[37] per employee per year
11. Three change management consultants are needed to provide change management and training support during the transition period and will be contracted on full-time basis for the first two years of the business case
12. The IT Operating Model, resource levels, and resource counts were derived from a notional potential IT Operating Model and assumes that the proposed resources are able to accomplish the proposed task/responsibility breakdown
13. We assume that ServiceNow can be used as a representative solution and cost for the tool the ITSM contractor will bring as part of the procured service
14. We assume that the Help Desk/Service Desk contractor will use the tool/platform provided by the ITSM contractor
15. We assume a 15% contingency is a reasonable estimate for the level of risk and uncertainty associated with the IT Operating Model & ITSM cost estimate

B.7.2.2 Application Operations & Maintenance (O&M)

1. We assume that the government FTEs in the Application Development organization identified in the IT Organization & ITSM section (7.2.1) provide oversight and management of the O&M contractors identified and that no contractor project managers are needed
2. We assume the number of resources required to provide O&M support to the future state applications is either equal to the number of contractor resources currently supporting our Siebel (2 contractor resources[38]) or less than that number (0 – 1 contractor resources); we have made complexity assumptions for the following applications:
   - Registration & Recordation Front-End: equally complex as Siebel
   - Registration & Recordation Back-End: equally complex as Siebel
   - Public Record: less complex than Siebel
   - Digital Asset Archive: less complex than Siebel
3. We assume that only labor is required for application O&M support (i.e., no additional equipment or services need to be procured)
4. We assume the identified application O&M contractors will be full-time resources (i.e., 100% utilized) and not contracted through a retainer or other part-time arrangement
5. Given the public-facing nature of many of USCO's future state applications, we assume there will be need for a full-time (i.e., 100% utilized) UI Consultant
6. We assume there will be 50 users for the proposed Salesforce CRM software and that Salesforce's Professional license can be used for costing until detailed CRM related requirements are gathered
7. We assume that there will be 50 users for the proposed OGC solution and that IBM's Case Manager is a representative solution for costing
8. We assume that Cisco's Unified Contact Center Express ("UCCX") and Telepresence Server are representative solutions for IVR/Call Center management and video teleconferencing, respectively

---

[37] COMPUTER ECONOMICS, INC., BENCHMARKS FOR IT TRAINING BUDGETS 4 (Oct. 2015), https://www.computereconomics.com/custom.cfm?name=postPaymentGateway.cfm&id=2146.

[38] U.S. COPYRIGHT OFFICE, COPYRIGHT TECHNOLOGY OFFICE – ORGANIZATIONAL CHART CURRENT STATE (NOVEMBER 2015) (on file with Copyright Technology Office).

9. We assume a security tool stack of Splunk (for data analysis), Oracle GRC (for Governance, Risk & Compliance support), and Watchguard (for Data Loss Prevention)
10. We assume a 15% contingency is a reasonable estimate for the level of risk and uncertainty associated with the Application O&M cost estimate

B.7.2.3 Infrastructure Operations

1. We assume that the managed network security services provider will provide a Security Information & Event Management tool as part of their contract
2. We assume that the estimates for number of servers, network devices, databases, and data that informed the derivation of Network Support, Server Support, Data Administration, Data Management Support, and Voice Network Support operations contractors based on industry benchmarks are accurate
3. We assume that the security contractors used to remediate any security vulnerabilities or incidents can be procured on a retainer (i.e., less than full-time) basis
4. We assume the NOC and SOC will be monitoring 1500 nodes
5. We assume there will be 5 network incidents per month and 4 major outages per year, each major outage requiring 3 days to resolve
6. The USCO will need 2000 square feet of data center space in the Madison Building for local infrastructure needs
7. We assume a four-year refresh cycle for server and networking equipment
8. We assume that hardware vendor support will cost 20% of the purchase price for each piece of hardware procured
9. We assume that Microsoft Azure is a representative solution for the identified PaaS/IaaS need in the future state
10. We assume that the Microsoft Azure solution includes the necessary development and testing tools
11. We assume that the rate of storage growth for both the Digital Asset Archive and System of Record will be at the current growth rate for the first three years of the business case (FY 2018 – FY 2020) and 1.5 times the current growth rate for the final two years of the business case (FY 2021 – FY 2022)
12. We assume that PIV enrollment will be conducted by a non-IT organization but that USCO IT is responsible for procuring the PIV enrollment solution
13. We assume that Cisco's BE6000H is a representative solution for the main Unified Communications ("UC")/Video Teleconferencing/Voice over Internet Protocol ("VOIP") control server
14. We assume that the inputs to the Microsoft Azure sizing calculations, the inputs to the AWS Glacier sizing calculations, and the local server (*i.e.*, located at Madison Building) sizing calculations are all representative
15. We assume that the networking equipment identified in the notional architecture is representative of equipment expected in the Future State
16. We assume a 15% contingency is a reasonable estimate for the level of risk and uncertainty associated with the IT Infrastructure Operations cost estimate

B.7.2.4 Transition

1. We assume there will be at least one contractor project manager for each of the following initiatives: 1, 9, 10, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, and 33

2. We assume that the government labor costs for the COR, the identified architects and engineers, the identified service and process owners, the identified vendor managers, and the identified analysts are Transition related costs through Phase 2 of the Modernization Roadmap (i.e., through Q3 FY 2020) and IT Organization & ITSM costs from Q4 FY 2020 through the end of the business case
3. We assume that the Madison Building server footprint build out will occur at the end of Initiative 9
4. We assume that any initial equipment procurement costs (e.g., servers, laptops, networking equipment) and any initial licensing costs (e.g., subscriptions) occur as Transition cost elements
5. We assume that the identified resource quantities and LCATs are representative of the resources need to achieve the tasks identified in the Modernization Roadmap
6. We assume that the durations identified in the Modernization Roadmap for each initiative will be achieved by the resources identified in each initiative
7. We assume that the equipment identified in the notional architecture for procurement in the Transition phase is representative of equipment expected in the future state
8. We assume that the coexistence cost for Siebel can be approximated by using the number of contractors currently providing O&M support for Siebel (two contractors)
9. We assume a 35% contingency is a reasonable estimate for the level of risk and uncertainty associated with the Transition cost estimate

B.7.2.5 Desktop/Staff User Devices and Services

1. We assume a linear USCO user growth between 400 users and 650 users
2. We assume Office 365 E3 as a representative solution for the identified office productivity solution need
3. We assume that the GSA Laptop Upgrade 1 Specification[39] is representative of the laptop requirements in the future state
4. We assume that the identified laptop configuration that meets the GSA Laptop Upgrade 1 Specification (Dell Latitude E6440) is a representative solution for the future state
5. We assume that all USCO employees will receive a laptop and that there will be a three-year refresh period
6. We assume the same price for laptops (initial purchase, refresh purchase) for each year in the business case
7. The USCO will choose a BYOD mobility strategy and that AirWatch Mobile's Blue Level solution is a representative solution for the Mobile Device Management ("MDM") Software as a Service ("SaaS") need; we also assume that AirWatch will be able to receive the appropriate approvals (e.g., FedRAMP) needed to provide a SaaS-based MDM solution to U.S. Government customers
8. The USCO has a need for 10 video-teleconferencing suites and that Cisco's SX10 is a representative solution for video-teleconferencing needs
9. We assume that each USCO employee will have an IP phone
10. We assume that there will be 50 Call Center agents (employees or contractors), with labor costs paid out of the general USCO budget
11. We assume a 15% contingency is a reasonable estimate for the level of risk and uncertainty associated with the Desktop/Staff User Devices and Services cost estimate

[39] GENERAL SERVICES ADMINISTRATION, GOVERNMENTWIDE STRATEGIC SOLUTIONS FOR DESKTOPS AND LAPTOPS INITIATIVE (last reviewed Feb. 12, 2016), http://www.gsa.gov/portal/mediaId/234615/fileName/WorkstationsSpecs_TandCs_web_Accessible.action.

B.7.3 Constraints

Constraints impact the level of fidelity and uncertainty in the cost model. They may include factors like data availability, timeline, and specificity of requirements.

Estimates were developed around the following constraints:

B.7.3.1 Functional Scope

The functional scope identified for this initiative is based on the USCO's current set of capabilities and the USCO identified new functionality. Please refer to the IT Plan for the full set of capabilities, applications, functionality, etc. to be implemented in the future state.

B.7.3.2 Technical Scope and Solution

A full set of technical requirements have not been developed for the proposed set of future state applications. Therefore a more detailed and comprehensive estimate of software development, migration, and re-platforming could not be performed. Please refer to the IT Plan for the full set of capabilities, applications, functionality, etc. to be implemented in the future state.

B.7.3.3 Procurement and Contracting

The USCO is not currently authorized to award contracts and all procurements are conducted through the Office of Contracts and Grants Management of the LoC. Given that the USCO does not have a defined set of standard rates or LCATs used in their IT procurements, the cost estimates for contractor labor levels are the mean (average) rates for each LCAT from the Alliant GWAC provided by GSA.[40]

We estimated the expected contract cost for a given outsourced or managed service by identifying the expected labor component of the contract and the expected tool or system costs borne by the contractor providing the service.

B.7.3.4 Staffing

A detailed IT Organizational design initiative has not been conducted. Therefore, a comprehensive set of IT Organizational requirements and demands have not been identified nor have the current USCO IT Organization requirements demands been baselined. The proposed level of IT staffing is based on a mapping of the proposed IT Operating Model to the expected demands as identified in the IT Plan.

---

[40] GENERAL SERVICES ADMINISTRATION, ALLIANT GOVERNMENTWIDE ACQUISITION CONTRACT (last reviewed Feb. 6, 2016), http://www.gsa.gov/portal/content/104793.

B.7.3.5 Schedule, Milestones, Durations

The business case is limited to a five fiscal year period beginning in FY 2018. Related activities may occur before the business case begins (e.g., in FY 2017) but these activities will not be accounted for in this Cost Estimate. Please refer to the IT Plan for the entire Modernization Roadmap.

B.7.3.6 Cost and/or Funding

The USCO does not currently have insight into the amount of LoC IT budget allocated for USCO IT operations. Therefore we are unable to derive any values from the current USCO IT budget and cannot use the current USCO IT budget as a baseline or input into the cost model.

B.8 Estimating Methodology

B.8.1 Cost Estimating Process Summary

The primary methodology used to develop this estimate was as follows:

Step 1 – Identified top-level cost categories

a. IT Organization & ITSM – this category is intended to capture all the non-transition USCO IT personnel costs as well as steady-state costs related to Security and ITSM operations and contractor support
b. Application Operations & Maintenance – this category is intended to capture all the steady-state application O&M costs (e.g., break-fixes, application patching) for the identified target state applications
c. IT Infrastructure Operations – this category is intended to capture all the ongoing IT infrastructure related costs and includes cost elements such as IaaS services, hardware refresh costs, and infrastructure support costs
d. Transition – this category is intended to capture all the one-time costs (labor and non-labor) associated with the USCO's transition from their current state (*i.e.*, all IT services provided by LoC) to the target state
e. Desktop/Staff User Devices and Services Operations & Maintenance – this category is intended to capture the end user devices and services that will need to be procured; cost elements in this category are primarily those whose costs are driven by the number of USCO staff in the organization

Step 2 – Identify IT Organization & ITSM cost elements

a. Analyze the proposed IT Operating Model to identify high-level functional areas the future state IT organization would need; map expected IT Operating Model demands to functional areas to identify proposed positions and number of resources required[41]; validate proposed staffing model with Subject Matter Experts ("SMEs") for reasonableness

[41] For insight into this process please review the relevant IT Operating Model sections of the IT Plan.

b. Use industry benchmarks to identify expected training budget per employee
c. Estimate the level of change management support needed to facilitate the USCO IT organization's transition to the future state operating model
d. Analyze the proposed Security Operating Model to identify resource needs, mapping them back to the functions identified in the Security Operating Model; validate proposed Security staffing model with SMEs for reasonableness
e. Identify contractor support needed to support ITSM, Service Desk, and local office activities; if contractors are expected to provide tools then estimate the cost for a representative tool to include as a means to estimate an all-in contract cost
f. Derive time parameters for cost elements from the Modernization Roadmap; differentiate between one-time and ongoing costs as needed
g. Identify whether cost elements are a DME cost or an O&M cost; primarily this decision is driven by whether the cost element can be capitalized (*i.e.*, is it a capital expense or a start-up cost or a one-time cost) or is it a recurring operational expense
h. Apply 15% contingency to cost totals in each sub-category

Step 3 – Identify Application O&M cost elements

a. Identify the applications requiring O&M support and estimate the level of O&M contractor support by basing it on the level of O&M support the USCO currently has for their core application (Siebel); validate estimate with SMEs for reasonableness
b. Identify additional ongoing application O&M support resources (*e.g.*, UI specialist)
c. Identify ongoing license costs for Commercial Off The Shelf ("COTS") applications that the USCO will utilize in the future state based on expected number of users and identified GSA license costs
d. Derive time parameters for cost elements from the Modernization Roadmap; differentiate between one-time and ongoing costs as needed
e. Identify whether cost elements are a DME cost or an O&M cost; primarily this decision is driven by whether the cost element can be capitalized (i.e., is it a capital expense or a start-up cost or a one-time cost) or is it a recurring operational expense
f. Apply 15% contingency to cost totals in each sub-category

Step 4 – Identify IT Infrastructure O&M cost elements

a. Identify steady-state infrastructure operations costs like contractor support for server and network operations, NOC and SOC costs, and managed network security costs; validate cost estimates for these services with SMEs for reasonableness
b. Estimate floor space needs at the Madison Building and utilize benchmark data center square footage costs to identify a cost for the proposed Madison Building IT footprint
c. Using understanding of future state needs and available functional requirements, identify a notional architecture and sizing for the identified IaaS provider (Microsoft Azure); use this notional architecture and sizing to calculate cost for the relevant development, test, pre-production, and production environments through the vendor provided estimation tools
d. Identify hardware vendor support costs and ongoing licensing costs for forecasted hardware and software for each environment (development, test, pre-production, production)

e. Identify relevant hardware refresh costs for each environment (development, test, pre-production, production) and use initial purchase prices as the estimated cost for the refresh hardware/software/licensing costs
f. Model cloud storage needs using the USCO data on current state storage utilization, forecast out cloud storage growth, and use identified cloud storage vendor (AWS Glacier) provided estimation tools to derive an annual cloud storage cost for each year in the business case
g. Identify any remaining hardware support, licensing, or refresh costs (e.g., for PIV equipment, VOIP and video teleconferencing servers)
h. Use notional Disaster Recover ("DR") architecture to identify costs to backup mission critical applications and data sets; derive cost estimates based on identified DR/backup method (*e.g.,* for cloud backups use cloud vendor estimation tools, for offsite backups estimate cost for equipment to store data to tape) and identified DR equipment
i. Use notional network architecture and specifications to identify network costs (*e.g*., WAN, data transfer) for both non-recurring and recurring items; also use the notional network architecture and specifications to identify representative network equipment costs, including costs for equipment refresh, equipment licenses, peripherals, and support; validate network and network hardware costs with SMEs for reasonableness
j. Derive time parameters for cost elements from the Modernization Roadmap; differentiate between one-time and ongoing costs as needed
k. Identify whether cost elements are a DME cost or an O&M cost; primarily this decision is driven by whether the cost element can be capitalized (*i.e*., is it a capital expense or a start-up cost or a one-time cost) or is it a recurring operational expense
l. Apply 15% contingency to cost totals in each sub-category

Step 5 – Identify Transition cost elements

a. For each Modernization Roadmap initiative, identify the estimated government labor, contractor labor, and non-labor needs required to deliver the initiative within the defined timeline; these costs may include project managers, application developers, SMEs, consultants, contractors, initial equipment purchases, and configuration/stand-up support, among others; validate estimates with SMEs for reasonableness
b. Compute estimated coexistence cost (i.e., legacy system operations during transition period) using the USCO-provided data
c. Derive time parameters for cost elements from the Modernization Roadmap; differentiate between one-time and ongoing costs as needed
d. Identify whether cost elements are a DME cost or an O&M cost; primarily this decision is driven by whether the cost element can be capitalized (*i.e*., is it a capital expense or a start-up cost or a one-time cost) or is it a recurring operational expense
e. Apply 35% contingency to cost totals in each sub-category

Step 6 – Identify Desktop/Staff User Devices and Services O&M cost elements

a. Develop user count model to generate expected USCO user counts for each fiscal year in the business case
b. Derive expected software subscription costs using per user costs for representative solutions and the computed expected USCO user counts

c. Derive expected end user hardware costs using per user costs for representative solutions and the computed expected USCO user counts
d. Identify shared end user hardware including expected support and refresh costs
e. Identify expected level of contractor desktop support
f. Derive time parameters for cost elements from the Modernization Roadmap; differentiate between one-time and ongoing costs as needed
g. Identify whether cost elements are a DME cost or an O&M cost; primarily this decision is driven by whether the cost element can be capitalized (*i.e.*, is it a capital expense or a start-up cost or a one-time cost) or is it a recurring operational expense
h. Apply 15% contingency to cost totals in each sub-category

B.8.2 Software Sizing Process Summary

The volume of software to be designed, developed, and tested—is the primarily cost driver of all software development and migration projects. For the IT Plan estimate, Function Point ("FP") analysis was conducted.

USCO engaged a certified Function Point specialist to analyze the current state system, target workflows, identified future state capabilities, and preliminary requirements. Once the FP analysis was completed, the certified Function Point specialist used three different tools to arrive at an LOE estimate – a proprietary Industry/Historical Averages tool, the SLIM tool, and the SEER tool. Each of these tools provided different outputs based on the models and algorithms used in the product and are captured in the table below. The SME FP estimate is shown in the following table as well.

Table B-8: Outputs of Function Point Analysis

Parameter	Estimate
Number of Function Points (with 30% margin for potential scope changes)	975 FP
Industry Average/Historical Productivity Rate (FP/hour)	0.038
Effort Hours	25,658
Industry Average Schedule (Months)	14 – 20
Industry Average Estimated Staff (Average FTE)	7 – 10
SLIM PI	12.0
SLIM Effort Hours	28,100
SLIM Schedule	23.9
SLIM Peak Staff	9.2
SEER Effort Hours	21,389
SEER Schedule (Months)	17.91
SEER Peak Staff	12.44

The estimated LOE, the number of Effort Hours identified was used to identify the number of contractors needed to complete this development project. The approach used to develop the blended rate for these contractors is shown in the table below.

Table B-9: Application Development Blended Rate Buildup

Parameter	Estimate
Team Buildup (LCATs and Rates from Alliant GWAC)	10 FTEs over 1.5 year project
0.5 Program Manager	$191.34 / hour
1 Project Manager	$146.65 / hour
1 Enterprise Architect (LCAT representative of recommended Senior Business Architect)	$174.12 / hour
1 Application System Analyst – Senior (LCAT representative of recommended Architect)	$114.05 / hour
1 Application Developer – Master (LCAT representative of recommended Developer - Senior)	$147.47 / hour
2 Application Developer – Senior (LCAT representative of recommended Developer – Midlevel)	$116.56 / hour
1 Application Developer – Journeyman (LCAT representative of recommended Developer - Junior)	$91.25 / hour
1 Test Engineer – Senior (LCAT representative of recommended Tester resource)	$118.44 / hour
1 Tech Writer	$78.91 / hour
0.5 Information Assurance/Security Specialist – Senior (LCAT representative of recommended Security resource)	$123.05 / hour
Total Hours over 1.5 year project duration	28,100
Total Cost over 1.5 year project duration	$3,543,986.05
Computed Blended Rate	$126.12 / hour
Rounded Blended Rate (this rate used for Cost Estimate)	$130 / hour

Sustainment and Change Management projections were estimated via labor and activity forecasts per the GR&A identified above.

B.8.3 Sensitivity Analysis and Risk Adjustment

For the operations-focused cost categories (i.e., IT Organization and ITSM, Application Operations & Maintenance, IT Infrastructure Operations, and Desktop/Staff User Devices and Services O&M) a 5% risk-based contingency was embedded into the cost total for each category. This risk-based contingency is based on the nature of the cost elements within each of these categories. The majority of these cost elements can be costed with a moderate level of certainty (e.g., number of laptops, number of Government IT FTEs) given the known parameters of the target state (e.g., target number of USCO staff).

In addition, a 10% sustainment cost was applied to each of the O&M cost categories (i.e., IT Organization and ITSM, Application Operations & Maintenance, IT Infrastructure Operations, and Desktop/Staff User Devices and Services O&M). These sustainment costs are meant to capture any additional costs that occur post-deployment and prior to the application or service fully transitioning into O&M. These costs may include items like application hotfixes, additional software deployments to user laptops, and remedying infrastructure misconfigurations.

For the Transition cost category, a 35% risk-based contingency was embedded into the total cost for the category. Given the limited set of requirements across many aspects of the proposed transition effort (e.g., network, IaaS platform sizing, floor space needs, applications) and risk associated with an organization-wide modernization effort a higher level of risk contingency was needed compared to the operations-focused cost categories.

The limited set of requirements for the target state solution prevented an in-depth risk analysis.

Appendix C – USCO Application Scoring Results

The following table depicts scoring[42] results for USCO key capabilities in the application assessment framework.

Table C-1: Application Assessment Framework Output

Criteria	Definition	Scoring Definition	Weight	Registration and Recordation Front End	Registration and Recordation Back End	System of Record	Public Record	Digital Asset Archive	Web Presence/ copright.gov	OGC Case Management	ITSM Toolset	End-User Enablement
Core Mission Application?	Application is core to meeting legal obligations of USCO	5 – Core mission application 0 – Not core mission application	*3*	15	15	15	15	15	15	15	0	0
Application Layer Ownership Needed?	Build from code; utilize platform to build applications; make use of SaaS	5 – Build from code 3 – Utilize PaaS 0 – Utilize SaaS	*3*	9	9	9	0	0	0	0	0	0
Data Sensitivity Level	Security requirement of data in application	5 – Classified 3 – Private 1 – Public	*3*	3	9	3	3	9	3	3	9	9
Access Requirements	Who needs to be able to use application	5 – Internal USCO only 3 – Internal USCO and internet accessible 1 – Internet accessible only	*2*	2	10	10	2	10	2	10	6	6
Integration Complexity	In future state, high number of or complex integration points? Stand alone? Standard API integration	5 – High number or complex integration 3 – Moderate number or complexity of	*2*	2	2	2	2	2	2	2	6	2

[42] Weighting is included by multiplying a criterion weight with its assigned score. Highest possible score is 65. Lowest possible score is 3. Scores near the possible high indicate a need to own/build infrastructure whereas scores near the possible low indicate cloud service potential.

	points?	integration 1 – No or few standard API integration										
			Total:	**31**	**45**	**39**	**22**	**36**	**22**	**30**	**21**	**17**

The following table provides the rationale for each application.

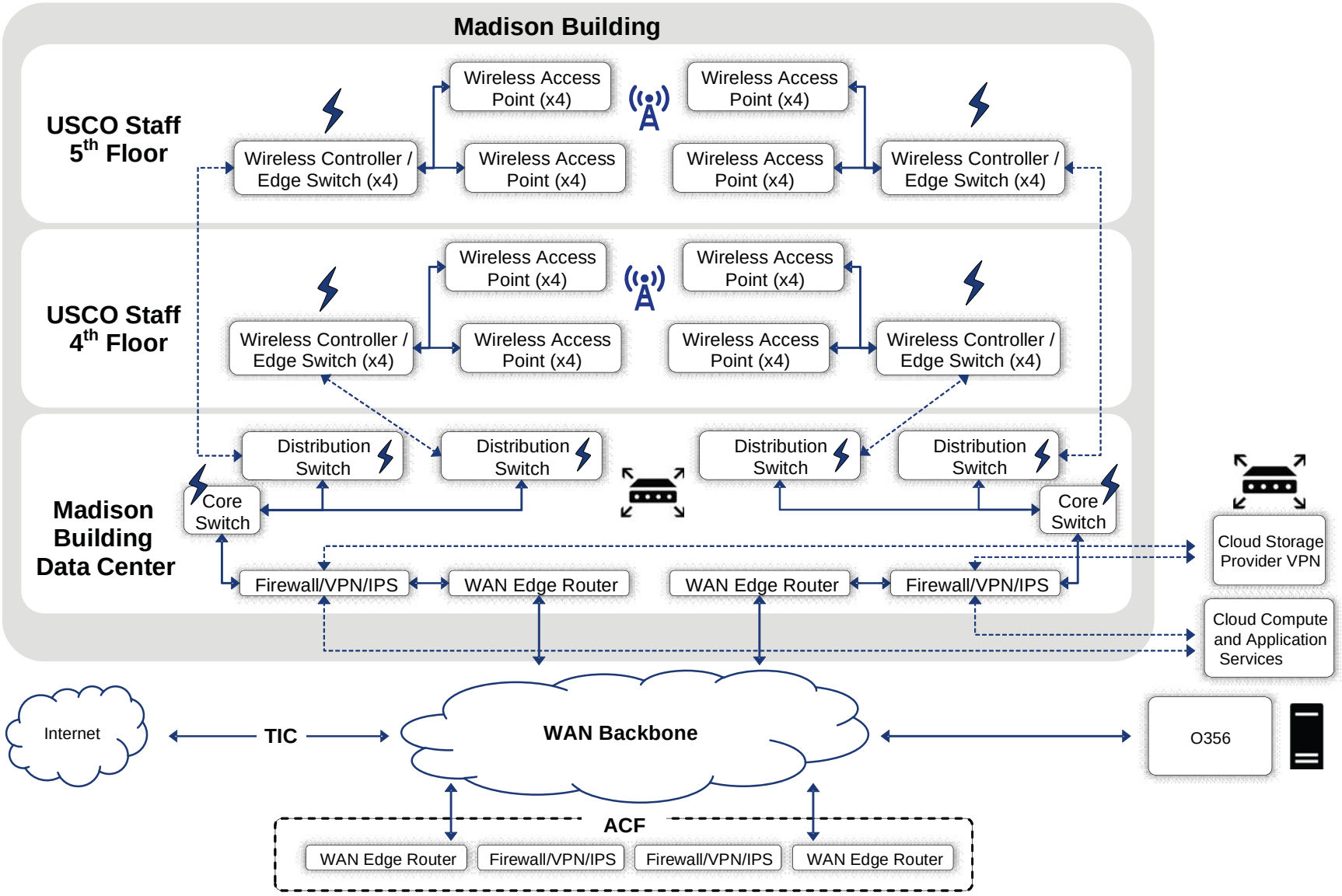
Table C-2: Application Assessment Framework Rationale

Criteria	Registration and Recordation Front End	Registration and Recordation Back End	System of Record	Public Record	Digital Asset Archive	Web Presence/ copright.gov	OGC Case Management	ITSM Toolset	End-User Enablement
Core Mission Application?	Core mission capability	Core mission capability	Core mission capability	Core mission capability	Core mission capability	Core mission capability	Core mission capability	Not core mission capability	Not core mission capability
Application Layer Ownership Needed?	There is no identified legal or business requirement to control app layer code. Data source is public; however, USCO requires the ability to build process-specific applications.	There is no identified legal or business requirement to control app layer code. Data source is public; however, USCO requires the ability to build process-specific applications.	There is no identified legal or business requirement to control app layer code. Data source is public; however, USCO requires the ability to build process-specific applications.	Will be a translated, extracted set of data from the System of Record that is deemed required by the public; it should not require code layer ownership by USCO.	No requirement for USCO to own the underlying long-term application or database layer for this capability. There is precedent with the storage of physical assets/acquisitions at a commercial facility.	Based on the nature of USCO's mission the underlying technology that will house data on a Web 2.0 site is not considered to be a competitive advantage and could be housed anywhere.	Can be provided by a 3rd party or utilize modern cloud services. This is more efficient from multiple points: time to deliver, operational run cost, skillset ownership.	Can be provided by a 3rd party or utilize modern cloud services. This is more efficient from multiple points: time to deliver, operational run cost, skillset ownership.	Can be provided by a 3rd party or utilize modern cloud services. This is more efficient from multiple points: time to deliver, operational run cost, skillset ownership.
Data Sensitivity Level	Public data	Private data	Public data	Public data	Private data. Goal is to ensure integrity of the asset over the required lifetime	Public data	Public data	Private data	Private data
Access Requirements	Internet accessibility required	Internal USCO network access only	Internal USCO network access only	Internet accessibility required	Internal USCO network access only	Internet accessibility required	Internal USCO network access only	Internal USCO network access and internet access	Internal USCO network access and internet access
Integration Complexity	Few integration points. Utilize standard APIs	Few integration points. Utilize standard APIs	Few integration points. Utilize standard APIs	Few integration points. Utilize standard APIs	Assets will be moved from the System of Record to the secure archive once a registration is complete. Therefore there will be an interface between these 2 databases with a potential middleware tool in between to facilitate transport to a 3rd party location. These interfaces should still be minimal and able to utilize standard APIs	Few integration points. Utilize standard APIs	Few integration points. Utilize standard APIs	Due to the large number of services it is anticipated that integration between those services and other USCO systems could be at the moderate level of volume and complexity. However, standard API interfaces with these tools should reduce complexity.	Few integration points. Utilize standard APIs

Criteria	Registration and Recordation Front End	Registration and Recordation Back End	System of Record	Public Record	Digital Asset Archive	Web Presence/ copright.gov	OGC Case Management	ITSM Toolset	End-User Enablement
Recommendation	Engage PaaS provider • Data source is 100% public • Can utilize PaaS functions to build USCO custom mission applications • Look for FedRAMP compliant providers to get a baseline set of security standards • Adheres to guiding principles: consider cloud service solutions as viable options for hosting non-sensitive data; minimize the amount of infrastructure and services USCO has to procure and manage; align on a standardized technology “stack” to promote reusability, standardization, and ease of management	Engage PaaS provider • Data source is 100% public • Can utilize PaaS functions to build USCO custom mission applications • Look for FedRAMP compliant providers to get a baseline set of security standards • Adheres to guiding principles: consider cloud service solutions as viable options for hosting non-sensitive data; minimize the amount of infrastructure and services USCO has to procure and manage; align on a standardized technology “stack” to promote reusability, standardization and ease of management	Engage PaaS provider • Data source is 100% public • Can utilize PaaS functions to build USCO custom mission applications • Look for FedRAMP compliant providers to get a baseline set of security standards • Adheres to guiding principles: consider cloud service solutions as viable options for hosting non-sensitive data; minimize the amount of infrastructure and services USCO has to procure and manage; align on a standardized technology “stack” to promote reusability, standardization and ease of management	Engage PaaS provider • Data source is 100% public • Can utilize PaaS functions to build USCO custom mission applications • Look for FedRAMP compliant providers to get a baseline set of security standards • Adheres to guiding principles: consider cloud service solutions as viable options for hosting non-sensitive data; minimize the amount of infrastructure and services USCO has to procure and manage; align on a standardized technology “stack” to promote reusability, standardization, and ease of management	Engage CSP • Data source is 100% public • PaaS providers are focused on application platform provision and not data archive solutions • Look for PaaS and CSPs that have existing integration capability • Look for FedRAMP compliant providers to get a baseline set of security standards • Look for CSP that offers hashing APIs to ensure integrity of your assets • Adheres to guiding principles: consider cloud service solutions as viable options for hosting non-sensitive data; minimize the amount of infrastructure and services USCO has to procure and manage; align on a standardized technology “stack” to promote reusability, standardization and ease of management	Engage PaaS provider • Data source is 100% Public • Can utilize PaaS functions to build USCO custom web presence • Look for FedRAMP compliant providers to get a baseline set of security standards • Adheres to guiding principles: consider cloud service solutions as viable options for hosting non-sensitive data; minimize the amount of infrastructure and services USCO has to procure and manage; align on a standardized technology “stack” to promote reusability, standardization, and ease of management	Engage PaaS provider • Data source is 100% Public • Can utilize PaaS functions to build USCO custom mission applications • Look for FedRAMP compliant providers to get a baseline set of security standards • Adheres to guiding principles: consider cloud service solutions as viable options for hosting non-sensitive data; minimize the amount of infrastructure and services USCO has to procure and manage; align on a standardized technology “stack” to promote reusability, standardization, and ease of management	Engage ITSM service provider and utilize their core applications and services • Procure these functions as a service and focus on core mission of building and supporting USCO services • Design and implement processes for these functions, but not the tools • Adheres to guiding principles: consider cloud service solutions as viable options for hosting non-sensitive data; minimize the amount of infrastructure and services USCO has to procure and manage; align on a standardized technology “stack” to promote reusability, standardization, and ease of management, prioritize speed to independent IT operation	Engage productivity suite provider • Not a core mission capability. Avoid building large infrastructure and introducing new requirement for upkeep and maintenance • Providers may offer a comprehensive suite of productivity and collaboration tools • Adheres to guiding principles: consider cloud service solutions as viable options for hosting non-sensitive data; minimize the amount of infrastructure and services USCO has to procure and manage; align on a standardized technology “stack” to promote reusability, standardization, and ease of management, prioritize speed to independent IT operation

Appendix D – Supporting Cost Estimate Tables

The following device types, quantities, and models were used to derive the WAN/LAN Hardware and Software cost elements.


Madison Building
USCO Staff 5th Floor
Wireless Access Point (x4)
Wireless Access Point (x4)
Wireless Controller / Edge Switch (x4)
Wireless Access Point (x4)
Wireless Access Point (x4)
Wireless Controller / Edge Switch (x4)
USCO Staff 4th Floor
Wireless Access Point (x4)
Wireless Access Point (x4)
Wireless Controller / Edge Switch (x4)
Wireless Access Point (x4)
Wireless Access Point (x4)
Wireless Controller / Edge Switch (x4)
Madison Building Data Center
Distribution Switch
Distribution Switch
Distribution Switch
Distribution Switch
Core Switch
Core Switch
Firewall/VPN/IPS
WAN Edge Router
WAN Edge Router
Firewall/VPN/IPS
Cloud Storage Provider VPN
Cloud Compute and Application Services
Internet
TIC
WAN Backbone
O356
ACF
WAN Edge Router
Firewall/VPN/IPS
Firewall/VPN/IPS
WAN Edge Router

Device Type	Quantity	Model	Device Justification	GSA Cost per Device
WAN Edge Router Hardware (Madison)	2	Cisco ASR1001 - Mfr Part No: ASR1001-2XOC3POS-C – 4 GBE Built-in OC3 IDC, Dual P/S- Rack Mountable	2 routers to facilitate local loop circuit path diversity. Network design should include 2 distinct circuits into Madison from 2 distinct local offices	$23,731.93
Wan Edge Router Hardware (ACF)	2	Cisco ASR1001 - Mfr Part No: ASR1001-2XOC3POS-C – 4 GBE Built-in OC3 IDC, Dual P/S- Rack Mountable	2 routers to facilitate local loop circuit path diversity	$23,731.93
WAN Edge Router memory upgrade	4	Cisco Memory – 16 GB - Mfr Part No: M-ASR1K-1001-16 GB=-C	Upgrade for all 4 WAN Edge Routers	$11,500.88
WAN Edge Router base license	4	2.5 G to 5 GBPS license for ASR 1001-X - Mfr Part No: FLSA1-1X-2.5-5G	Cisco license for all 4 WAN Edge Routers	$8,284.40
Firewall/VPN/IPS Hardware (Madison)	2	Cisco ASA 5585-X SSP-10, FirePower SSP-10 16GE - Mfr Part No: ASA5585-S10F10XK9 (Dual AC)	1 Firewall device per WAN Edge Router.	$47,981.69
Firewall/VPN/IPS Hardware (ACF)	2	Cisco ASA 5585-X SSP-10, FirePower SSP-10 16GE - Mfr Part No: ASA5585-S10F10XK9 (Dual AC)	1 Firewall device per WAN Edge Router.	$47,981.69
Firewall/VPN/IPS Security License	4	Cisco ASA 5500 Security Context License - Mfr Part No: ASA5500-SC-20-C (20 Firewall)	Cisco Security software license per Firewall device	$9,127.67
Firewall/VPN/IPS VPN License	4	CISCO ASA 5500 Series SSL VPN License - Mfr Part No: ASA5500-SSL-500-C (500 User)	Cisco VPN software per Firewall device. Having this at ACF provides resiliency for remote worker connectivity in case of loss of Madison	$21,902.78
Core Switch Hardware (Madison only)	2	Cisco Catalyst 4507R-E 3YR SmartNet24x7x4OS with Supervisor 7E Ent Serv Bundle - Mfr Part No: CON-30SP-WSC410GB	Core Switches are internal LAN. 2 are required in Madison to enable volume of port connections to LAN extending devices and servers	$14,265.17
Core Switch Hardware -Additional (Madison Only)	4	Cisco 4500 48-Port Switching Module - 48 x 10/100/1000 Base-T LAN 12.50 MBps - Mfr Part No: WS-X4648-RJ45V+E=-C	Based on proposed server count and WAN Edge + Distribution Switch connectivity, 96 ports per Switch should enable all connections with redundancy for critical production servers	$5,476.79
Core Switch Software (Madison Only)	2	Cisco CAT4900 IOS Enterprise Services SSH - Mfr Part No:S49ESK9-12254SG= (IOS software for Catalyst 4500)	Cisco Core Switch software license	$2,559.19

Device Type	Quantity	Model	Device Justification	GSA Cost per Device
Distribution Switch Hardware (Madison Only)	4	Cisco Catalyst 4507R-E 3YR SmartNet24x7x4OS with Supervisor 7E Ent Serv Bundle - Mfr Part No: CON-30SP-WSC410GB	2 per floor will provide enough connections for the next layer to facilitate all staff equipment. Require 2 per floor to account for distance coverage	$14,265.17
Distribution Switch Hardware - Additional (Madison Only)	4	Cisco 4500 48-Port Switching Module - 48 x 10/100/1000Base-T LAN12.50 MBps - Mfr Part No: WS-X4648-RJ45V+E=-C	Hardware to enable 48 ports per Distribution Switch. This facilitates Edge Switch connections and allows for growth	$5,476.79
Distribution Switch Software (Madison Only)	4	Cisco CAT4900 IOS Enterprise Services SSH - Mfr Part No:S49ESK9-12254SG= (IOS software for Catalyst 4500)	Cisco Distribution Switch software license	$2,559.19
Edge Switch/Wireless Controller Hardware (Madison Only)	16	Cisco Catalyst 3850 48Pt- POE+ GE, IP Base 715W PS, w/ 5 AP license - Mfr Part No: WS-C3850-48PW-S (stackable 1U each)	These provide connectivity for VOIP phones, Wireless Access Points and all other network attached devices in CO staff space. Need 14 x 48 ports to meet 650 VOIP phones. Adding 2 more for additional connections per floor. 8 per floor to ensure coverage across the building	$7,708.50
Edge Switch/Wireless Controller Software License (Madison Only)	16	Cisco C3850 48Port IP Base to IP Svcs Electronic RTU LICS - Mfr Part No: L-C3850-48-S-E	Cisco Edge Switch software license	$5,130.40
Edge Switch/Wireless Controller Stacking Cable (Madison Only)	32	Cisco Stackwise-480-50CM Stacking Cable - Mfr Part No: STACK-T1-50CM=-C	Connector for Edge Switch stackable components	$78.20
Edge Switch/Wireless Controller Redundant Power Module (Madison Only)	16	Cisco Power Supply - Hot-Plug / Redundant - Mfr Part No: PWR-C1-715WAC=-C	Redundant power supply for Edge Switches	$731.79
Wireless Access Point Hardware (Madison Only)	32	Cisco Aironet 3700i, Internal Antenna - Mfr Part No: AIR-CAP3702I-E-K9	Wi-Fi provider. 2 per Edge Switch to ensure floor coverage. All CO staff are on 2 floors in Madison	$956.50

The following services were used to derive the Networx contract WAN cost elements.

MPLS WAN Backbone	Service Justification	Service Cost

IPS Dedicated - OC3c (155 Mb/s) - CONUS MRC CLIN: 744360 Service Level: Routine Frequency: MRC Unit: PORT(4 - 2 each - Madison & ACF) FY 2016	WAN: Service is required by a "telco provider" to create your WAN backbone which provides a secure patch to connect your facilities	$252,485.76 annually
DAA Metro Ethernet 150 Mbps, via Optewan NRC CLIN: 768356 Service Level: Routine Frequency: NRC Unit: PORT (4 - 2 each - Madison & ACF)	WAN: Connectivity from your telco provided WAN via their local office to your facilities. You will want the circuits from 2 distinct local offices coming into Madison for resiliency. This is represented by 2 ports for each facility	$6,634.00 up front NRC
DAA MRC - OC3 Unavailable via Networx as it's a custom cost. Market research indicates $20,000 - $45,000 MRC for this connection type. Will use $35,000/mo for budgeting	WAN Monthly recurring cost. This is a custom cost depending on your defined requirements, but we were able to find an industry range and priced you just above midpoint	$420,000.00 annually

TIC Compliant Internet	Service Justification	Service Cost
MTIPS Dedicated OC3c (155 Mbps) MRC CLIN: 745360 Service Level: Routine Frequency: MRC Unit: PORT (2) FY 2016	TIC Compliant ISP connection monthly recurring cost	$450,293.00 annually

WAN Management	Service Justification	Service Cost
MNS Managed Network Implementation, Maintenance and Management, device up to 155 Mbps peak - Connectionless NRC CLIN: 280260 Service Level: Routine Frequency: NRC Unit: Device (4)	Set up cost for service that provides overall management of WAN infrastructure, including real-time proactive network monitoring, rapid troubleshooting and service restoration	$2,342.40 up front NRC

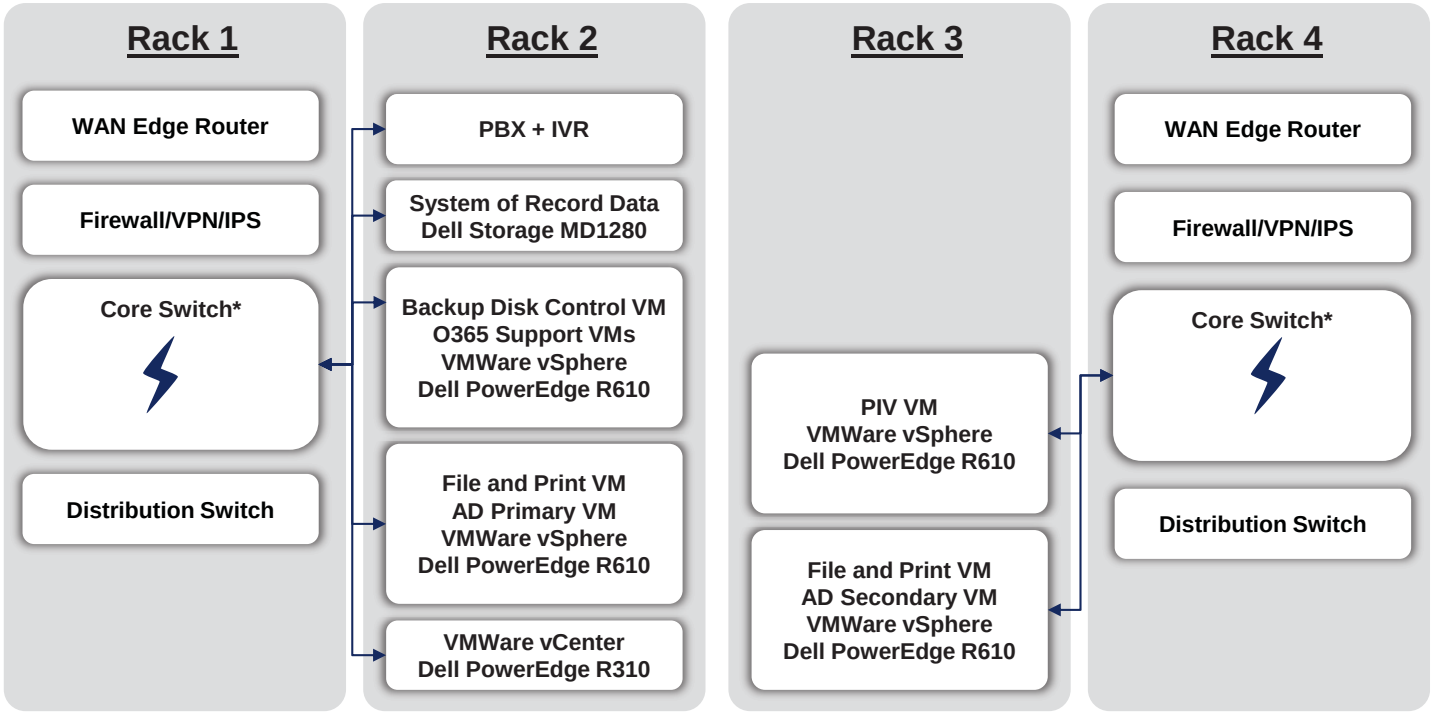
MNS Managed Network Implementation, Maintenance and Management, device up to 155 Mbps peak - Connectionless MRC CLIN: 280360 Service Level: Routine Frequency: MRC Unit: Device (4) FY 2016	WAN Managed Network service monthly recurring cost	$4,223.52 annually

Managed Tiered Security Services	Service Justification	Service Cost
MTSS Help Desk Service - Tier 2 NRC CLIN: 224010 Service Level: Routine Frequency: NRC Unit: User Seat (10)	Set up cost for WAN help desk that provides a single point-of-contact help desk capability for all issues concerning service delivery 24X7	$83.60 up front NRC
MTSS Help Desk Service - Tier 2 MRC CLIN: 224005 Service Level: Routine Frequency: MRC Unit: User Seat (10) FY 2016	Help Desk Service: Monthly recurring cost	$1,978.00 annually
MFS Network-Based Managed Firewall Service: Tier II NRC CLIN: 300202 Service Level: Routine Frequency: NRC Unit: FIREWALL (4) FY 2016	Set up cost for service that will help reduce service disruptions caused by malicious access, and prevent unauthorized access to or from private networks	$11,873.72 up front NRC
MFS Network-Based Managed Firewall Service: Tier II MRC CLIN: 300302 Service Level: Routine Frequency: MRC Unit: FIREWALL (4) FY 2016	Managed Firewall service monthly recurring cost	$19,180.32 annually
IDPS Intrusion Detection and Prevention Service Tier II NRC CLIN: 340002 Service Level: Routine Frequency: NRC Unit: IDPS DEVICE (4) FY 2016	Set up cost for service that enables the monitoring and identification of potential security threats, and helps reduce network service disruptions caused by malicious attacks. IDPS analyzes packet activity for indications of network attack, misuse, and anomalies. The service then generates alerts and records suspicious events	$3,487.40 up front NRC

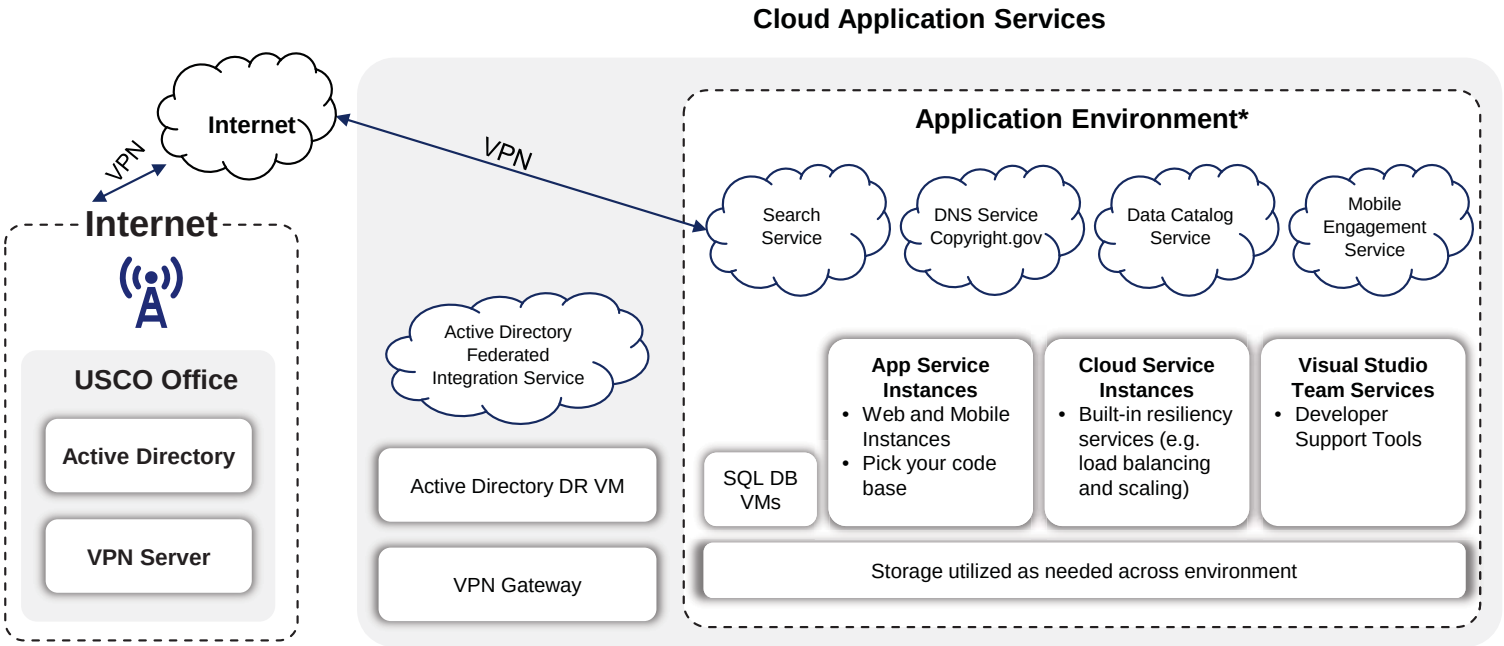
IDPS Intrusion Detection and Prevention Service Tier II MRC CLIN: 340102 Service Level: Routine Frequency: MRC Unit: IDPS DEVICE (4) FY 2016	IDPS monthly recurring cost	$62,772.48 annually
VSS 10 scans NRC (Vulnerability Scan Service) CLIN: 350007 Service Level: Routine Frequency: NRC Unit: Block of 10 scans (10)	Frequency based cost for service that searches for security holes, flaws, and exploits on agency systems, networks and applications. VSS helps to guard the agency network infrastructure against emerging threats	$530.70 annually for 10 scans
INRS Internet Protect NRC (Incident Response - Internet Protect) CLIN: 370002 Service Level: Routine Frequency: NRC Unit: USER (10)	Set up cost for service that enables agencies to complement in-house security expertise, or obtain outside assistance with a greater depth and breadth of experience. The service provides proactive services that are designed to prevent incidents, and reactive services that provide support for responding to malicious events. In addition, INRS provides forensics services that can assist in apprehending and prosecuting offenders	$1,080.70 up front NRC
INRS Internet Protect, 1 to 15 Users MRC (Incident Response - Internet Protect) CLIN: 370102 Service Level: Routine Frequency: MRC Unit: SUBSCRIPTION (1) FY 2016	Incident Response service monthly recurring cost	$11,758.20 annually

The following device types, quantities, and models were used to derive the server Hardware and Software cost elements.

Madison Building
Data Center

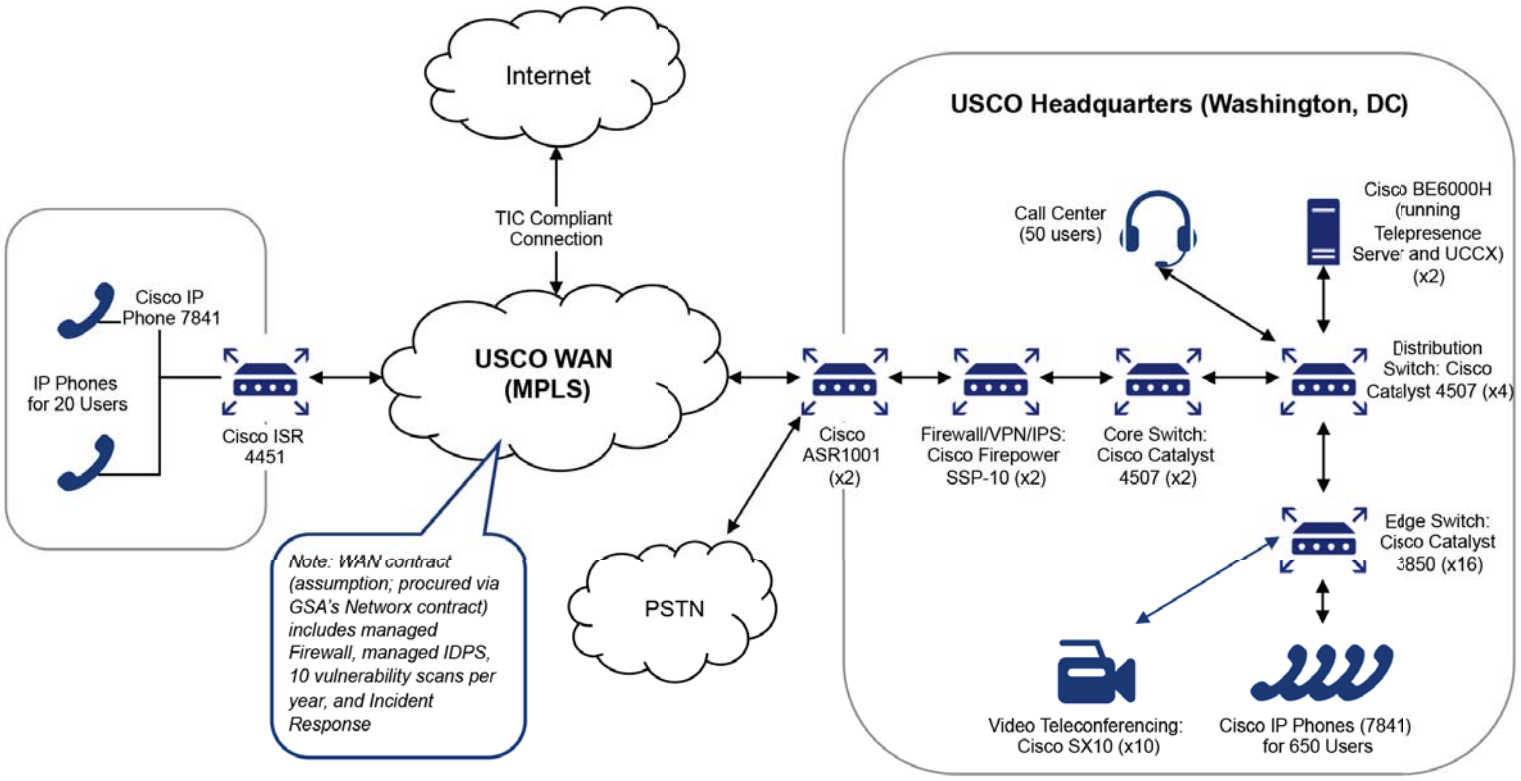


* Network design will determine if redundancy between switches and services is required.



PaaS Service	Functionality That Enables USCO Application Development
App Service	Select coding language or mobile platform for immediate development; start with Recordation web front end; add mobile functionality to enable remote support; extend to customers with EAI and B2B capabilities
Cloud Services	Instances facilitate more complex n-tier and hybrid solution development on multiple coding languages; local code emulation shows code result and execution pre-launch; scaling, monitoring and alerting are built in
Visual Studio Team Services	Augment development process with version control for code; tolling and dashboards to facilitate agile teams; auto-testing on any code change to ensure continuous integration

*See all PaaS service functionality for USCO in Appendix "Cloud Application Services cost elements" slides



Server Hardware	Number Projected	Device Justification	GSA Unit Price
Dell PowerEdge R610 Rackmount Server: Mfr Part No: 2 x 2.66 GHZ (six core), 64 GB, 6 x 1 TB SATA (Aventis Systems)	4	4 for Production based on 11 applications to support with estimate of 3 VM's per server. Allows for physical redundancy for Active Directory Domain Controllers and File and Print services. Room for growth included	$6,124.99
Dell PowerEdge R610 Rackmount Server: Mfr	4	4 for Pre-Production to match capacity in production for testing	$6,124.99

Part No: 2 x 2.66 GHZ (six core), 64 GB, 6 x 1 TB SATA (Aventis Systems)		and possible local failover support	
Dell PowerEdge R610 Rackmount Server: Mfr Part No: 2 x 2.4 GHZ (six core), 32 GB, 6 x 500 GB SATA (Aventis Systems)	4	4 for Test based on 11 applications to support. Reduced processing and storage components as redundancy and performance aren't required	$3,923.48
Dell PowerEdge R610 Rackmount Server: Mfr Part No: 2 x 2.4 GHZ (six core), 32 GB, 6 x 500 GB SATA (Aventis Systems)	4	4 for Development based on 11 applications to support. Reduced processing and storage components as redundancy and performance aren't required	$3,923.48
Rail kit for Dell PowerEdge R610	16	Aventis Systems. 1 per R610 server	$133.05
Dell PowerEdge R310 Rackmount Server: Mfr Part No: 2.53 GHZ (Quad Core), 16 GB, 4 x 1 TB SATA	2	Meets standalone VMware vCenter requirement. 1 can manage production and for network isolation, 1 can manage all other environments. Aventis Systems	$2,296.27
Rail kit for Dell PowerEdge R310	2	Aventis Systems. 1 per R310 server	$133.05

Direct Attach Storage Hardware	Number Projected	Device Justification	GSA Unit Price
Dell Storage MD1280, 84 Hard drive chassis: Mfr Part No: 210-AEIW	1	Direct attached storage chassis for enablement of System or Record and Digital Asset local storage	$28,593.92
Dell 6 TB 7.2K RPM SAS, 3.5 IN (x42)	1	252 TB of disk drive to facilitate System of Record & Digital Asset volume	$19,887.95

Vmware Software	Number Projected	Device Justification	GSA Unit Price
Federal Basic Support for VMware vCenter Configuration Manager Instance for 1 year	5	VMware software support cost. x 5 for 5 years - Promark Technology VC-CM-G-SSS-F - Need 2 (1 Prod, 1 everything else)	$4,083.18
US Federal VMware vCenter Server 6 Standard for vSphere 6 (per Instance)	2	vCenter software license cost. Promark Technology VCS6-STD-F (1 prod, 1 everything else)	$4,630.38
US Federal VMware vSphere 6 Enterprise Plus for 1 processor	196	vSphere software license cost. VMware Carahsoft VS6-EPL-F (multiply by # of procs)	$3,239.88

The following services were used to derive the Cloud Application Services cost elements.

Production Environment			
Service*	**Service Component Selection**	**Service Justification**	**Monthly Service Cost**
App Service	East US, Standard, S3 (4 cores, 7GB RAM, 50 GB Storage), 1 instance, 744 hours, 1 IP SSL connections	Instances allow you to select a coding language or mobile platform to start developing immediately; start with your Recordation front end web service; add mobile functionality to enable remote service; extend to your biggest customers with EAI and B2B integration capabilities	$336.60
Cloud Services	East US, D5 V2 (16 cores, 56 GB RAM, 800 GB SSD), 9 instances, 744 hours	Instances facilitate more complex N-tier and hybrid solution development on multiple coding languages; local code emulation shows code result and execution pre-launch; scaling, monitoring and alerting are built in	$16,646.26
Visual Studio Team Services	North Central US, 10 users	Augment the development process with version control for software code; tooling and dash boards to facilitate agile teams; auto-testing on any code change to ensure continuous integration	$30.00
Virtual Machines	East US, Windows OS, Standard Tier, D1 (SSD, 1 Core, 3.5GB RAM, 50 GB disk), 2 instances, 744 hours	Backup Active Directory enterprise solution in case of loss of Madison	$208.32
Mobile Engagement	Central US, 150000 active users/mo	Facilitates push communications to customers to stay engaged	$1,244.00
SQL Database	East US, Single DB, Premium Tier, P2 (250 DTUs(=200 db transactions per second), 500 GB DB), 6 DB's, 744 hours	Standalone SQL DB VM's to provide data source for your applications	$5,580.00
Storage	East US, File Type, Basic Tier, GRS data redundancy (multiple asynchronous copies to a geo disbursed DC), 250 TB, 1000000 storage transactions	Cloud storage to facilitate production environment. Geographic redundancy service selected	$25,600.00
Search	East US Standard Tier, 10 units, 744 hours	Service to add search to the public record; index, availability and scalability managed by provider; allows tracking of searches to gain utilization insight	$2,499.84
Data Catalog	East US Standard Tier, 200 100-user units	Included as potential source for data warehousing functions of discovery, metadata tagging and access management	$10,000.00

Bandwidth	Zone 1, 120 TB	Data transfer out of Azure has cost. This is a placeholder with high water mark @ 2 x current Digital Asset total volume	$9,307.73
Azure DNS	East US, 2 Hosted DNS zones, 5 million DNS queries	Copyright.gov will be hosted in Cloud. Providers can manage the domain availability	$1.50
VPN Gateway	East US, Standard Tier, 744 hours, VPN gateway type	Based on staffing and data requirements, IPSEC VPN connectivity will be more cost effective than private Telco direct connect	$141.36
Azure Active Directory	East US, Basic Tier, MFA per user, 650 users	Federated integration with your existing Active Directory Enterprise Directory	$910.00
Support options	Professional Direct - Priority handling, escalation phone line, < 1 hr response time	Enterprise support license to ensure greatest range of support options + fastest response time	$1,000.00

Dev/Test/Pre-Prod Environments

Service*	Service Component Selection	Service Justification	Monthly Service Cost
App Service	East US, Standard, S3 (4 cores, 7 GB RAM, 50 GB Storage), 1 instance, 744 hours, 1 IP SSL connections	Instances allow you to select a coding language or mobile platform to start developing immediately; start with your Recordation front end web service; add mobile functionality to enable remote service; extend to your biggest customers with EAI and B2B integration capabilities	$336.60
Cloud Services	East US, D4 (8 cores, 28 GB RAM, 400 GB SSD), 17 instances, 744 hours	Instances facilitate more complex n-tier and hybrid solution development on multiple coding languages; local code emulation shows code result and execution pre-launch; scaling, monitoring and alerting are built in	$14,165.76
Visual Studio Team Services	North Central US, 10 users	Augment your development process with version control for your code; tooling and dash boards to facilitate agile teams; auto-testing on any code change to ensure continuous integration	$30.00
Mobile Engagement	Central US, 150000 active users/mo	Facilitates building of push communications to customers to stay engaged	$1,244.00
SQL Database	East US, Single DB, Standard Tier, S3 (100 DTUs(=100 DB transactions per second), 250 GB DB), 12 DB's, 744 hours	Standalone SQL DB VM's to provide data source for your applications	$1,799.88

Storage	East US, File Type, Basic Tier, LRS data redundancy (multiple copies within a DC), 250 TB, 1,000,000 storage transactions	Cloud storage to facilitate development, test & pre-production environments. This is above storage built into Cloud Service, VM's and SQL DB's	$20,480.00
Search	East US Standard Tier, 10 units, 744 hours	Improved search functionality is a key requirement for future platform. Utilize service to build it	$2,499.84
Data Catalog	East US Standard Tier, 200 100-user units	Included as potential source for data warehousing functions of discovery, metadata tagging and access management	$10,000.00
Bandwidth	Zone 1, 60 TB	Data transfer out of Azure has cost. This is a placeholder with high water mark	$5,006.93
Azure DNS	East US, 2 Hosted DNS zones, 5 million DNS queries	Copyright.gov will be hosted in Cloud. Providers can manage the domain availability for you	$1.50
VPN Gateway	East US, Standard Tier, 744 hours, VPN gateway type	Based on staffing and data requirements, IPSEC VPN connectivity will be more cost effective than private Telco direct connect	$141.36
Azure Active Directory	East US, Basic tier, MFA per user, 650 users	Federated integration with your existing Active Directory Enterprise Directory	$910.00
Support options	Professional Direct - Priority handling, escalation phone line, < 1 hr response time	Enterprise support license to ensure greatest range of support options + fastest response time	$1,000.00

The following table lists the End User Enablement O&M costs.

Cost Element	Labor Type	Units	Total Cost
5.1 Devices and Services			
5.1.1 Software Subscriptions			
Office Productivity Suite (Office 365 E3) - Year 2	Non-Labor	468	$112,320
Office Productivity Suite (Office 365 E3) - Year 3	Non-Labor	516	$123,840
Office Productivity Suite (Office 365 E3) - Year 4	Non-Labor	584	$140,160

Office Productivity Suite (Office 365 E3) - Year 5	Non-Labor	650	$156,000
Mobile Device Management SaaS Subscription - Year 2	Non-Labor	584	$43,800
Mobile Device Management SaaS Subscription - Year 3	Non-Labor	650	$48,750
VOIP User Licenses - Year 2	Non-Labor	468	$65,520
VOIP User Licenses - Year 3	Non-Labor	516	$72,240
VOIP User Licenses - Year 4	Non-Labor	584	$81,760
VOIP User Licenses - Year 5	Non-Labor	650	$91,000
Call Center Agent Licenses [Steady State]	Non-Labor	50	$50,000
5.2 Shared User Equipment			
Multifunction Device Support Contract [Steady State]	Contractor Labor	1	$250,522
Video Teleconferencing Equipment Support Contractor [Steady State]	Contractor Labor	1	$865,920
5.3 Desktop Support			
Desktop Support Contractor [Steady-state]	Contractor Labor	4	$2,744,218
5.4 Sustainment/Contingency			
Contingency (5%) [Year 2]	Non-Labor	1	$57,775
Contingency (5%) [Year 3]	Non-Labor	1	$58,687
Contingency (5%) [Year 4]	Non-Labor	1	$62,169
Contingency (5%) [Year 5]	Non-Labor	1	$63,671

Appendix E – Acronyms

Acronyms	
Acronym	**Definition**
API	Application Programming Interface
AWS	Amazon Web Services
BYOD	Bring Your Own Device
CAPEX	Capital Expense
CBOE	Cost Basis of Estimate
CES	Cost Element Structure
CIO	Chief Information Officer
CISO	Chief Information Security Officer
COLA	Cost of Living Adjustment
COOP	Continuity of Operations
COTS	Commercial Off The Shelf
CRM	Customer Relationship Management
CSP	Cloud Service Provider
CTO	Chief Technology Officer
DME	Development, Modernization, and Enhancement
DR	Disaster Recovery
FedRAMP	Federal Risk and Authorization Management Program
FP	Function Point
FTE	Full Time Employee
FY	Fiscal Year
GR&A	Ground Rules and Assumptions
GS	General Schedule

GSA	General Services Administration
GWAC	Governmentwide Acquisition Contract
HQ	Headquarters
IaaS	Infrastructure as a Service
IT	Information Technology
ITSM	IT Service Management
LCAT	Labor Category
LoC	Library of Congress
LOE	Level of Effort
MDM	Mobile Device Management
NOC	Network Operations Center
OGC	Office of General Counsel (USCO)
O&M	Operations and Maintenance
OPEX	Operational Expense
OS	Operating System
PaaS	Platform as a Service
PIV	Personal Identity Verification
PMO	Program Management Office
RPO	Recovery Point Objective
RTO	Recovery Time Objective
SaaS	Software as a Service
SDK	Software Development Kit
SES	Senior Executive Service
SLA	Service Level Agreement
SME	Subject Matter Expert

SOC	Security Operations Center
SOM	Security Operating Model
UC	Unified Communications
UCCX	Unified Contact Center Express
UI	User Interface
USCO	United States Copyright Office
VOIP	Voice over Internet Protocol
VPN	Virtual Private Network

Appendix F – Glossary of Terms

Community Cloud: Type of cloud shared by several organizations and supports a specific community that has shared concerns

Development, Modernization, and Enhancement ("DME"): Costs for projects leading to new IT assets/systems and projects that change or modify existing IT assets to: substantively improve capability or performance; implement legislative or regulatory requirements; or to meet an agency leadership request. Capital costs as part of DME can include hardware, software development and acquisition costs, COTS acquisition costs, government labor costs, and contracted labor costs for planning, development, acquisition, system integration, and direct project management and overhead support.[43]

Example Costs:
- Racks for Madison Building servers
- Licenses when refresh equipment is procured
- New application functionality development work
- Transition PMO

Hybrid Cloud: Combination of two or more types of clouds (Community, Public, or Private), which remain unique entities but are bound together by standardized technologies

Infrastructure as a Service ("IaaS"): Provides processing, storage and network infrastructure; customer is responsible for operating system and beyond

Operations and Maintenance ("O&M"): Phase of an asset in which the asset is in operations and produces the same product or provides a repetitive service. O&M is synonymous with "steady state."[44]

Example Costs:
- CSP monthly/annual recurring fees
- Outsourced NOC and SOC services
- Government labor overseeing outsourced operations
- Hotfix releases for new applications

Platform as a Service ("PaaS"): Builds on IaaS by providing a technology platform such as Database or Software Development Kit ("SDK"); customer builds applications and adds data

Private Cloud: Type of cloud operated solely for an organization or company

Public Cloud: Type of cloud available to the general public or large industry group and is owned by an organization selling cloud services

---

[43] *Preparation, Submission, and Execution of the Budget,* [*OMB A-11*] (Jun. 2015), https://www.whitehouse.gov/sites/default/files/omb/assets/a11_current_year/a11_2015.pdf.

[44] *Id*.

Software as a Service (“SaaS”): Builds on PaaS by providing all infrastructure and application components; customer configures application to their needs and adds data