

DATA CENTER CONSOLIDATION & REGIONAL EFFICIENCIES

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(Project Lead: Michael Dean)

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Introduction

The Office of Information Services (OIS) in conjunction with the Regions, Office of Administration (ADM), Office of the Chief Financial Officer (OCFO), Computer Security Office (CSO) and the Technical Training Center (TTC) under the Office of the Chief Human Capital Officer (OCHCO) are undergoing a key initiative to look at cost savings and efficiency gains the Agency can achieve in an increasingly fiscally constrained operating environment. The three primary drivers for this initiative stem from (1) the Executive Office of the President's Federal Data Center Consolidation Initiative (FDCCI) to shut down and consolidate under-performing data centers and optimize the data centers in the federal inventory; (2) the Office of Management and Budget's (OMB) Fiscal Year (FY) 2014 PortfolioStat initiative to drive cost savings and efficiencies while concentrating on high impact IT investments and the delivery of IT services; and (3) a key Congressional Directive which mandates federal agencies to develop a comprehensive plan to cut corporate costs by May 2015.

To that end, OIS worked with the above mentioned offices to form a cross-organizational Integrated Project Team (IPT) to identify areas where efficiencies can be gained. The initiative was led by the Region I, Information Resources Branch Chief with participation from both headquarters and regional staff.

Project Scope

The regions/TTC ("regions") in conjunction with OIS identified and evaluated potential regional efficiencies gained through system consolidation, standardization, or elimination. The primary systems evaluated during this effort were the regional data centers. Specifically, the team:

- Verified the number of regional data centers
- Assumed regional data center consolidation will occur, and determined the minimum number of regional data centers required for the regions to safely and successfully perform their missions.
- Based on the high level data center consolidation schema, determined a very rough estimate of implementation timelines and investment costs.
- Created an inventory of all major server systems in each regional data center.

In addition to the data center evaluation, the team looked at other potential IT process and systems efficiencies within the regions. Specifically the team evaluated current IT processes and systems to determine where efficiencies could be gained through system consolidation, standardization, or elimination.

The overall timeframe for this project was approximately 8 weeks, ending April 30, 2015.

Summary Results

As part of this project, the IPT visited each of the regions to discuss and better understand their concerns with data center consolidation. The concerns noted in Appendix A (see “[Regional Data Center Consolidation Concerns](#)”) describe the regional feedback. The regions believe the recommendations throughout this report address and help mitigate the concerns, and will place the NRC in a better position to manage NRC data centers of the future.

Number of Regional Data Centers

According to this IPT’s interpretation of OMB’s data center definition, the regions currently have a total of eight data centers (see section, “[Number of Regional Data Centers](#)”).

Data Center Consolidation Summary Recommendation

- Two data centers, primary at HQ and duplicate backup in RIV, with a third in another location if needed to support incident response (IR) and/or continuity of operations (COOP). Detailed analysis to be performed to determine:
 - Servers and equipment to remain in the regions
 - Infrastructure improvements needed to support regional data center consolidation.
 - Requirements for data replication to support IR and COOP functions in the regions.

- Virtualize most regional servers in the consolidated data centers, and separate the virtual servers into discrete regional environments. The regions will provide server support via the industry recognized cloud service objectives of Infrastructure as a Service (IaaS).

- Incorporate regional data center requirements into the new Information Technology Infrastructure and Service Support (ITISS) contract.

- Perform a detailed cost benefit analysis to determine the investment costs to consolidate data centers and the maintenance costs for a long term sustainable solution that meets agency operational needs.

Data Center Consolidation Time and Investment/Cost Estimate

- A **very rough** estimate (swag) of the time required to complete the regional data center consolidation project is approximately 2 to 7 years depending on the consolidation steps (see section “[High Level Steps and Associated Time](#)”).

- A **very rough** estimate (swag) of the investment required to complete the regional data center consolidation project is an approximate \$17 million initial investment then an additional maintenance cost of \$15.5 million annually. Please keep in mind that this estimate was based on incomplete data and should not be used for budget planning purposes. This IPT recommends an in depth analysis be performed in order to

determine true cost estimates for regional data center consolidation (see "[Consolidation Costs](#)").

Other Potential Regional IT Efficiencies

The regions believe there are other efficiencies that can be gained through standardization, consolidation and elimination. The opportunities for regional IT efficiencies are described at a high level within this report (see section, "[Other Opportunities for Regional Efficiencies](#)"). It is recommended that these efficiencies be further evaluated to determine efficiencies and cost savings that could be achieved.

Number of Regional Data Centers

Number of Regional Data Centers

1. Region I: Two (2):
2. Region II: One (1)
3. Region III: One (1)
4. Region IV: Two (2)
5. TTC: Two (2)

Total Regional Data Centers: Eight (8)

OMB Data Center Definition

A closet, room, floor or building for the storage, management, and dissemination of data and information. Such a repository houses computer systems and associated components, such as database, application, and storage systems and data stores. A data center generally includes redundant or backup power supplies, redundant data communications connections, environmental controls (air conditioning, fire suppression, etc.) and special security devices housed in leased (including by cloud providers), owned, collocated, or stand-alone facilities. Under this revised definition, neither square footage nor Uptime Institute tier classifications are required to define a facility as a data center. This definition excludes facilities exclusively devoted to communications and network equipment (e.g., telephone exchanges and telecommunication rooms).

The End State for Regional Data Center Consolidation (How Consolidation Should Look)

- Minimum of two data centers, primary at HQ and duplicate backup in RIV, with the possibility of a third in another location if needed to support IR and/or COOP.
- Backup data center in RIV must be a redundant site that can fully support the entire NRC, similar to that of the primary data center site to ensure that the agency can fulfill the primary mission essential function (PMEF) and the mission essential functions (MEFs) in a COOP event.
- Virtualize most regional servers in the consolidated data centers, and separate the virtual servers into discrete regional environments. The regions will provide server support via the industry recognized cloud service objectives of Infrastructure as a Service (IaaS). Specifically, virtualize and consolidate required servers at HQ, but have the regions manage their centralized virtual servers remotely. Having the regions manage their respective virtual servers remotely maintains regional ability to establish service priorities and ensures timely response times for critical functions. Additionally, distributed management of systems allows for more customized customer centric support. (Platform as a Service (PaaS) cloud services would not provide the flexibility to maintain the required timeliness and quality of service in the regions.)

- Regions continue to have server administrative rights and resources to provide required support on region specific virtual servers and equipment that cannot be consolidated
- HQ provides assistance to regions when required (e.g. provision virtual servers, install patches, and provide backup and data redundancy services).
- Servers to remain in the regions:
 - IR/COOP servers that must be physically located in the regions as determined by the IR Standardization Project (IRSP) team.
 - Systems that cannot move due to latency issues
 - Physical security systems that must be located in the regions as determined by ADM
- Implement a combination of symmetric/asymmetric replication based on region-specific IR and COOP functions. Specifically, analyze the requirements for data center replication to determine the cost benefit of replication both at HQ and the regions that will provide timely, reliable data that would be needed to support IR, as well as the PMEF and the MEFs during COOP events.

Consolidation Steps and Associated Time Requirements

1. Conduct studies [Estimated time: 3-9 months]
 - a. Determine servers and equipment to remain in the regions based on the following considerations:
 - IR/COOP: The IRSP team should determine which servers, systems, and/or equipment, if any, need to be physically located in the region(s) to support region-specific responsibilities for IR and for PMEF and MEFs during a COOP.
 - Latency: Systems that must be physically located in the region(s) due to latency issues such as the TTC simulation servers
 - Physical Security: ADM should determine if systems required to support physical security can be located remotely.
 - b. Perform an infrastructure analysis be performed to determine required bandwidth and system upgrades requirements to support the added user calls/queries of centralized systems.
 - c. Determine the requirements for data replication to support IR and COOP functions in the regions.
 - d. Conduct an in depth cost benefit analysis to determine the investment costs to consolidate data centers and the maintenance costs for a long term sustainable

solution that meets agency operational needs. Consolidation efforts should be based on the savings identified in the analysis results. The cost benefit analysis should not only consider the cost of transitioning to the new data centers, but also such things as the sunk costs of current systems, cost of data hosting under the ITISS contract, and system decommissioning costs. If the results of the analysis show costs are reduced and agency efficiencies are gained through consolidation, then steps 2 through 5 would be implemented.

2. Write IaaS cloud service support and replication requirements into the new Information Technology Infrastructure and Service Support (ITISS) contract. Specifically, the contract should contain appropriate provisions for service levels to support both regional and HQ operational needs. Note: Consolidation should occur after the contract has been awarded to ensure that regional service level requirements are met. [Estimated time: 2 years]
3. Upgrade systems [6 months – 1 year]
 - a. Upgrade CPU power, infrastructure bandwidth, etc. as required based on the study results.
 - b. Implement replication changes
4. Consolidate regional data centers based on systems lifecycle, i.e. consolidate systems when they are due for refresh. [Estimated time: 2-3 years]
5. Decommission excess data centers in the regions. [Estimated time: 6-9 months]

Consolidation Investment/Cost Estimate

The regions do not have the budget to perform or sustain any consolidation efforts. Therefore, HQ should budget for all data center consolidation efforts to include consolidating data centers, decommissioning data centers, and cost associated with ongoing maintenance and support of data center consolidation. We recommend an in depth analysis be performed in order to determine true cost estimates for regional consolidation.

Provided below are very rough estimates (swag) of costs along with other costs that should be considered in an in depth cost analysis. The estimates provided are based on incomplete data and should not be used for budget planning purposes. Please also see “Appendix C,” for the estimated annual cost breakdown.

Estimated Investment/Cost

- Centralized NRC hosting and basic redundancy - \$15.5 million (annual)
- Migration of software & services - \$950,000 (one time)
- FISMA compliance (ATO) - \$500,000 (one time)

Other Potential Regional Consolidation Costs (not considered in this estimate)

- Bandwidth expansion of HQ and redundant site(s)
- Enhanced replication for HQ and two redundant site(s), if applicable.
- Enhanced replication for regional PMEF/MEF IT systems
- Required re-work of current infrastructure for systems/equipment to remain in regions
- Decommissioning of regional systems
- Required changes in regional lease agreements
- Transportation costs

Other Opportunities for Regional Efficiencies (Standardize, Consolidate or Eliminate)

Help Desk Applications

- Standardize regional help desk systems based on functionality and value to both the customers and support staff.
- Regional help desk systems in one or more regional office are used for not only IT support but also facilities support. Any potential changes to regional help desk systems should retain this functionality.
- Remedy system is too cumbersome for the regions and does not allow for regional customization.

Electronic Bulletin Boards

- Standardize regional Electronic Bulletin Boards based on functionality and value to both the customers and support staff.

Regional Disaster Recovery Locations

- Standardize the functionality and management of regional disaster recovery (DR) sites. The purpose of these DR sites is to have a consolidated work facility for regional management in the event that a regional office building became unusable.

Applications Development/Management

- Where feasible, standardize the development and management of applications that support regional and/or agency operations.
- Primavera and several Cold Fusion applications used by both HQ and the regions are housed and managed in the regions. What is the impact and path forward for both Primavera and Cold Fusion as a result of consolidation?

Telecommunications

- Eliminate regional BCM50 systems from the RISE sites, which will reduce regional PBX systems from approximately 35 to 5.
- Defer to the Unified Communications IPT for other telecommunications recommendations.

Recommendations for Other HQ Services

- HQ should consider providing an enterprise contract vehicle for more applications such as MS Visio, which would leverage economies of scale and reduce costs.
- When a requirement and solution are presented to HQ and they are not accepted, HQ should provide an alternative cost effective recommendation.
- Provide cost effective alternative IT equipment and systems under the ITISS contract. For example traveling inspectors should be issued lighter laptops or tablets without added costs from regional budgets (i.e. one size does not fit all).
- Streamline the authorization and receipt process for new hardware, software, and other systems. The regional experience for receipt and authorization has been over 6 months for many IT systems and equipment.

Appendices

Appendix A – Regional Data Center Consolidation Concerns

Compliance

- Consolidation may impact regional ability to maintain compliance with MD 6.2 Continuity of Operations Program (COOP), which states,
 - Section III.C.3: “Provide technical assistance and support for implementing the NRC COOP program.”
 - Section III.G.5: “Ensure that regional sites possess operational capabilities to assume and perform the PMEF, as assigned; and, if required, the MEFs, in accordance with the COOP Plan.”

Technical

- Consolidation of some systems will result in application latency that could negatively affect user experience.
- Some systems cannot be managed remotely; therefore, cannot be consolidated

Quality of Service

- Adequately supporting the regions requires timely high quality service due to its inspection and IR missions.
- Centralizing and adding additional regional responsibilities to HQ may increase service level response times.
- The reliability of centralized data centers without the shared support of regional efforts may be a challenge.

Loss of Data

- A disaster at HQ would result in a significant loss of data throughout the entirety of the NRC instead of being limited to one region.
- A disaster at HQ would result in a single point of failure in that all primary NRC data and systems would reside at Region IV.

ITISS Contract

- The ITISS contract should have separate service level agreements (SLA) for regional vs HQ priority response time.
- HQ should better test new systems that are to be rolled out to ensure they work for the regions as well as HQ.
- One size fits all model for equipment and services may not work for both HQ and the regions. For example, traveling inspectors need quick service response times and lighter laptops than most in HQ.
- Dell leased equipment is very expensive, and in some cases the regions have determined government furnished equipment (GFE) is a better value for the federal government.

Financial Considerations

- The regions do not have the budgets to consolidate, decommission, and support the ongoing costs associated with data center consolidation.
- Power consumption cost savings may not be realized in all regions because energy costs are covered within some facility leases.
- Some regional systems do not incur additional annual costs beyond the sunk cost of the equipment.
- Man-hour costs, infrastructure upgrade, and building modifications (e.g. HVAC, power upgrades, and wall build or removal) should be considered in the overall cost benefit analysis of consolidation.

Communications

- Communications between the regions and HQ must improve if consolidation is to be successful.
- Regions feel as though they have been an afterthought when IT decisions were made in the past especially when considering, rolling out, and managing IT services.

Regional Staffing

- Data Center management represents only a portion of regional IT staff responsibilities, which must be considered when determining FTE requirements.
- The NRC may lose institutional system knowledge which in many cases helps bridge the ITISS knowledge gap between and during contract periods.

Appendix B – List of Data Center Servers and Associated Applications

RI	Server Name	Description	Server SW Applications	Leased or GFE
	R1PLSHVESX001	VMW Host - ADDM	HQ Unknown	Core Seat
	R1PWSST01	Drive Array	Drive Array	Core Seat
	R1DP1 Ncircle	Ncircle	Vulnerability checking device	GFE
	R1MP01	Multipurpose	WU's / SEP	Core Seat
	R1DC01	Domain Controller OLD - Decomm	Turned off	Core Seat
	R1-810BLOX1	Info Blox DHCP	DHCP Appliance	Core Seat
	R1MS02	Exchange Mailbox	Exchange 2003	Core Seat
	R1PWSDCADS01	Domain Controller NEW - Active	New 2012 Domain Controller	Core Seat
	R1MS03	Exchange Mailbox	Exchange 2003	Core Seat
	R1MS01	Exchange Transport	Exchange 2003	Core Seat
	R12K3ACC1	PACS	Old GE Facilities Commander	GFE
	R1DAS01A	Exchange Drive Array	Drive Array	Core Seat
	R1DAS01B	Exchange Drive Array	Drive Array	Core Seat
	HQ2K8PSPD3	HRMS COOP Data	HQ Device	GFE
	HQ2K8PSPF3	HRMS COOP File	HQ Device	GFE
	HQ2K8PSPW3	HRMS COOP Web	HQ Device	GFE
	HQ2K8PSPA3	HRMS COOP App	HQ Device	GFE
	R1PWSHY001	MSHV Physical File/Print Host Server	File Server Only	Core Seat
	R1PWSHY002	MSHV Physical File/Print Host Server	File Server Only	Core Seat
	R1VWCND001	Virtual Node on R1PWSHY001	File Server Only	Core Seat
	R1VWCND002	Virtual Node on R1PWSHY002	File Server Only	Core Seat
	R1VWCMG001	Logical Cluster Manager	Virtual Object of File Server	Core Seat
	R1VWCFS001	Logical File Server on Cluster	Virtual Object of File Server	Core Seat
	R1VWCPS001	Logical Print Server on Cluster	Print Server	Core Seat
	R1PWSWS001	Web - Virtual on ESX003	MS IIS Web Server	Leased Seat
	R12K3IT	IT - Virtual on ESX003	IT File Server M: Drive	Leased Seat
	R1PLSHVESX002	VMW Host - RoomView	ESXI 5.5 Host Server	Leased Seat
	R1PWSD001	SQL Virtual on ESX003	SQL 2005	Leased Seat
	R1VWSFSIT001	New IT server on Host ESX002	IT File Server M: Drive	Leased Seat
	R1VLSASADM001	ADDM Virtual Server	HQ Device - Unknown	Core Seat
	R1VWSASADM001	ADDM Virtual Server	HQ Device - Unknown	Core Seat
	R1PLSHVESX003	VMW Host - Misc Servers	ESXI 5.5 Host Server	Leased Seat
	IT WatchDog	IT WatchDog Device 1035	Environmental Monitoring Device	GFE
	R1-NAS1000S	NAS	NAS Storage Device	GFE
	R1TS01	Tape Server	Tape Server	Core Seat
	R1-SF3D2000	FireSource	Intrusion Device	Core Seat
	R1PWSSP001	IMS1 Command	Controls AV source routing / Office 2010	GFE
	R1PWSSP002	IMS2 BU Command	Controls AV source routing / Office 2010	GFE
	R1PWSSP003	IMS3 Exec	Controls AV source routing / Office 2010	GFE
	R1PWSSP004	IMS4 Team1	Controls AV source routing / Office 2010	GFE
	VRTX Server	Quad server ESXi Host System	Host Server	Core Seat
	R1VWASPAC01	PAC Server	New GE Facility Commander	Core Seat

R11	Server Name	Description	Server SW Applications	Leased or GFE
	R2MS01	Email Transport Server	Email Transport Server	Leased
	R2MS02	Email Server	Email Server	Leased
	R2MS03	Email Server	Email Server	Leased
	R2MP01	Multi-Purpose Server	Multi-Purpose Server	Leased
	R2TS01	Tape Server	Tape Server	Leased
	R2PWSDCADS01	Domain Controller	Domain Controller	Leased
	R2PWSHY001	File and Print Server	File and Print Server	Leased
	R2PWSHY002	File and Print Server	File and Print Server	Leased
	R2VWCND001	File Server (Cluster Node)	File Server (Cluster Node)	Leased
	R2VWCND002	Printer Server (Cluster Node)	Printer Server (Cluster Node)	Leased
	R2VWCFS001	Virtual File Server	Virtual File Server	Leased
	R2VWCMG001	Cluster Manager for Virtual File and Print Servers	Cluster Manager for Virtual File and Print Servers	Leased
	R2VWCPS001	Virtual Printer Server	Virtual Printer Server	Leased
	R2VWASPAC01	PACS Server	PACS Server	Leased
	R22KBAC01	Web Server	BackUp Exe 9.1	GFE
	R22K3WS01	Web Server	Web Services/Cold Fusion	GFE
	R22K3SQ01	SQL 2005 Cluster Node/ SQL Server/ File Services	SQL 2005 Standard	GFE
	R22K3SQ02	SQL 2005 Cluster Node/ SQL Server/ File Services	SQL 2005 Standard	GFE
	R2SAN01	SAN	Dell/EMC AX100i	GFE
	R2SAN02	SAN	Dell/EMC AX4-5i	GFE
	R2PWSRV001	Room View Server	Room View SE/ SQL 2008 R2	GFE
	R2SYM001	Virtual (SYMON Display Server)	Symon	GFE
	RVWNMGS001	Virtual (Management Server)	TFTP, TACACs, Cisco IPS Manager	GFE
	R2VWSAV001	Virtual (Antivirus Server)	Symantec Endpoint	GFE
	R2VWSDC001	Virtual (Domain Controller)	Active Directory, DNS	GFE
	R2VWSDC002	Virtual (Domain Controller)	Active Directory, DNS	GFE
	R2VWSYLS001	Virtual (Sys Log Server)	Kiwi Syslog	GFE
	R2VWVMC001	Virtual (V Center)	ESXi Vcenter	GFE
	R2VWWSUS01	Virtual (Window Update Server)	Windows Update Services	GFE

R III	Server Name	Description	Server SW Applications	Leased or GFE
	R3VWCFS001	Virtual Host for Main File server	File Services G:P:R:S:	Leased
	R3VWCPS001	Virtual Host for Print Server	Network Printers	Leased
	R3VWCND001	Virtual Host for File and print servers	Redundant - File Services G:P:R:S:	Leased
	R3VWCND002	Virtual Host for File and print servers	Redundant – Network Printers	Leased
	R3PWSHY001	Physical server host for R3VWCND001	Main server Hosting Virtual	Leased
	R3PWSHY002	Physical server host for R3VWCND002	Backup Server Hosting Virtual	Leased
	R3DC01	Domain Controller	Nrc.gov domain controller	Leased
	R3MS01	Mail server 1	Exchange server 1	Leased
	R3MS02	Mail server 2	Exchange server 2	Leased
	R3MS03	Mail server 3	Exchange server 3	Leased
	R3DAS1	Mail server Storage	Exchange Storage	Leased
	R3PLSHVESX001	Virtual server platform for future expansion	New Exchange servers	Leased
	R3TS01	Tape Backup Server	Tape Backup Server	Leased
	R3MP01	Multipurpose server	SCCM package server	Leased
	R3KM01	KM storage	KM podcasts	GFE
	R3KM02	Overflow File Storage	Additional Storage	GFE
	R3KM03	Overflow File Storage and webserver	Regional Intranet Server	GFE
	R3KM04	Overflow File Storage	Additional Regional Storage	GFE
	R3SQL02	SQL 2005 Server	Database server	GFE

RIV	Server Name	Description	Server SW Applications	Leased or GFE
	AR-R4-5350	COOP Server	COOP	Leased
	Bluecoat	COOP Server	COOP	Leased
	Cisco PIX	COOP Server	COOP	Leased
	COOP-SUN1	COOP Server	COOP	Leased
	Finjan	COOP Server	COOP	Leased
	Ironport	COOP Server	COOP	Leased
	PACS Server	Facility access	GE Facility Commander	Leased
	R3NCircle			Leased
	R4-0IS01	COOP Server	COOP	Leased
	R4-0IS02	COOP Server	COOP	Leased
	R4ADM01	Application Server	Exchange 2007 Mgt Console	Leased
	R4APP01	Application Server	MySQL	GFE
	R4CALLPILOT01	Voicemail	Proprietary voicemail software	GFE
	R4CALLPILOT02	Voicemail	Proprietary voicemail software	GFE
	R4CMC01	Virtual Servers Supporting PACS CITRIX, Exchange (non- operational)		Leased
	R4DAS01	Email storage for R4MS01 and R4MS02 Exchange Servers	Leased	
	R4DP1	COOP Server	COOP	Leased
	R4-ENVOY01	COOP Server	COOP	Leased
	R4IT01	File Server	Shared Drives	GFE
	R4MP01	File Server		Leased
	R4MS01	Exchange Server	Exchange 2007	Leased
	R4MS02	Exchange Server	Exchange 2007	Leased
	R4MS03	Exchange Server	Exchange 2007	Leased
	R4NAC01	Network Access Control	Forescout	Leased
	R4NAC02	Network Access Control	Forescout	Leased
	R4NACM	Network Access Control Management Server	Forescout	Leased
	R4NAS01	File Server	Data Storage	GFE
	R4PWBES02	Blackberry Enterprise Server		Leased
	R4PWSQLM02	Database Server for the BES		Leased
	R4PWSDCADS01	Domain Controller		Leased
	R4PWSHY001	File and Printer Servers		Leased
	R4PWSHY002	File and Printer Servers		Leased
	R4SYMON	Digital Content Server	Proprietary digital content software	GFE
	R4TS01	Tape Server	ArcServe	Leased
	R4WEB01	Web Server	Dreamweaver, Cold Fusion, JQuery	GFE
	RPS4	RPS Backup Server		Leased

TTC	Server Name	Description	Server Applications	Leased or GFE
	TTPLSHVESX001	Utilized for inventory collection purposes	VMware & BMC Atrium Discovery Proxy	Leased
	TTDAS01	Power Vault for the Exchange system	Exchange 2007	Leased
	TTMS03	Mail Server (Passive node)	Exchange 2008	Leased
	TTMS02	Mail server (Active Node)	Exchange 2009	Leased
	TTMS01	Mail hub transport	Exchange 2010	Leased
	TTDC01	Old Domain Controller, replaced by TTPWSDCADS01.	N/A - Decommissioned	Leased
	TTPWSHY001	FPS - Hosts TTVWCND001, backup for TTPWSHY002.	Hyper-V Manager & Double-Take	Leased
	TTPWSHY002	FPS - Hosts TTVWCND002, backup for TTPWSHY001.	Hyper-V Manager & Double-Take	Leased
	TTVWCND001	Virtual FPS - Hosts File service, backup for TTVWCND002.	Hyper-V Manager & Double-Take	Leased
	TTVWCND002	Virtual FPS - Hosts Print service, backup for TTVWCND001.	Hyper-V Manager & Double-Take	Leased
	TTTS01	Tape Backup server	ARCServe Backup	Leased
	TTMP01	Multipurpose server. Among other things, this server serves as quorum for the FPS	Vital QIP	Leased
	TTPWSDCADS01	New Domain controller just placed into production	Active Directory & DFS	Leased
	VRTX	Installed but not in production. Each of the four blades will host a virtual sever	virtual sever such as the PACS and the Exchange system	Leased
	2K3ACCT	Physical Access Control Server	Facility Commander	GFE
	PBX	Telephone System	CallPilot 202i Voicemail	Leased
	Papaya	Production web server	Apache, ColdFusion	GFE
	Mango	Staging web server and remote logging server (RHEL 5.9)	Apache, ColdFusion, Rsyslog	GFE
	Tomato	SQL Server (Windows 2008 R2)	MS SQL Server	GFE

Appendix C – Annual Investment Estimate (“swag,” not to be used for budget purposes)

Hosting and Storage Cost

Tables 1 & 2 below provide the estimated recurring hosting and storage costs to consolidate TTC servers. Using TTC as the baseline, Table 3 provides the estimated annual hosting and storage costs for each region based on the size and number of regional servers that would be consolidated.

Table 1: TTC (Baseline), Hosting Costs								
Server Type	Number of Servers	Size	Enhanced DR (Y/N)	Number CPUs	Memory (GB RAM)	Monthly Hosting Cost per Server	Monthly DR Cost per Server (DR01)	Extended Total Annual Cost
PowerEdge	1	Medium	Yes	2	8	\$540.40	\$772.28	\$15,752.16
PowerVault	1	Custom 1	Yes	32	128	\$6,484.80	\$772.28	\$87,084.96
PowerEdge	5	Medium	Yes	2	8	\$540.40	\$772.28	\$78,760.80
PowerEdge	4	Medium	Yes	2	8	\$540.40	\$772.28	\$63,008.64
2950	1	Jumbo	Yes	12	24	\$2,161.60	\$772.28	\$35,206.56
PowerEdge	1	Medium	Yes	2	8	\$540.40	\$772.28	\$15,752.16
PowerEdge	1	Medium	Yes	2	8	\$540.40	\$772.28	\$15,752.16
PowerEdge	1	Jumbo	Yes	8	32	\$2,161.60	\$772.28	\$35,206.56
HP DL-580	2	Custom 2	Yes	64	256	\$8,106.00	\$772.28	\$213,078.72
Total:	17							\$559,602.72

Table 2: TTC (Baseline), Storage Costs						
Server Type	Number of Servers	TB	Enhanced DR Y/N	Monthly Storage Cost per TB	Monthly DR Cost	Extended Total Annual Cost
PowerEdge	6	TB	Yes	\$501.76	\$50	\$72,253.44
PowerVault	48	TB	Yes	\$501.76	\$50	\$578,027.52
PowerEdge	8	TB	Yes	\$501.76	\$50	\$96,337.92
PowerEdge	4	TB	Yes	\$501.76	\$50	\$48,168.96
2950	3	TB	Yes	\$501.76	\$50	\$36,126.72
PowerEdge	20	TB	Yes	\$501.76	\$50	\$240,844.80
PowerEdge	48	TB	Yes	\$501.76	\$50	\$578,027.52
Total:	137					\$1,649,786.88

Table 3: Estimated Total Annual Hosting and Storage Investment	
TTC (Baseline)	\$2,209,389.60
Region I	\$4,418,779.20
Region II	\$2,209,389.60
Region III	\$2,209,389.60
Region IV	\$4,418,779.20
Total Annual Investment	\$15,465,727.20

Appendix D – Explanation of Terms

- Infrastructure as a Service (IaaS): provides you with virtual servers, firewalls, load balancing, redundancy/replication. This offers the most flexibility to the customer.
- Platform as a Service (PaaS): provides you with the operating system, languages to code, databases type. This offers less flexibility than IaaS
- Recovery Point Objective (RPO): The acceptable rollback point or how much recent data loss your organization can tolerate, expressed in minutes or hours.
- Replication Types
 - Backup – most data loss, anything not save during the prior backup will be lost
 - Asymmetric – some data loss, primarily that which is in transit during the disaster will be lost and that which is still buffered may be lost.
 - Symmetric – negligible data loss, but there is a distance limitation for implementation