ITES 3H Deliverables

White Paper

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1.1. Standardized Configurations - Thin Client

Implementing thin-client configurations offers several advantages over traditional workstation and personal computer solutions, including ease of administration, simple and effective security, and substantial infrastructure cost savings. The following sections detail the engineering resources and timelines necessary for deploying thin clients within organizations of both less than and greater than 500 employees, as well as the overall benefit of such architectures.

1.1.1. Resources and Timeline to Facilitate the Development and Maintenance of the Thin Client Configurations

Each thin-client implementation GTRI performs is completed using four separate phases: Requirements Analysis, Proof of Concept, Pilot and Testing, and Final Production Rollout. Implementation resources and timelines are dependent on the number and complexity of desired applications, user counts by defined user roles, and security aspects of the specific project.

To ensure timely and efficient completion of each task, GTRI leverages the expertise of our on-staff Project Managers to lead project organization and resources. GTRI will use a Level 3 Project Manager to manage each phase of thin-client deployment. For any size project, engineering resources will be drawn from GTRI's expert Enterprise Systems Engineers. A Level 4 Enterprise System Engineer will complete system requirements analyses, and perform overall configuration, on both the server/storage level and user level at the physical thin-client device. The engineer performs all system architecture configurations and operating system, virtualization, and application installation tasks, providing customers with a fully integrated thin-client solution. A Level 1 Enterprise Systems Engineer assists in deployment of thin-client devices in the Pilot and Production Rollout Phases. He or she performs physical device, operating system, and application installation on end-user thin client terminals and ensures efficient completion of the implementation effort. GTRI's labor description of these resources is given in the following table:

Exhibit 1 – Labor Descriptions

Requirement	Description
Enterprise Systems Engineer Level 1 (SV-ESE1)	▪ Consulting engineer for integrated systems and/or application architecture for small to medium data center environments ▪ Can perform system, OS, application, hardware installation, and troubleshooting ▪ Helps define system and application architecture ▪ Has fundamental knowledge of multiple system applications, hardware platforms, and operating systems ▪ Possesses base-level understanding of system and network protocols, concepts and operating systems ▪ Requires associates degree in a related field with a minimum of 2 years of experience
Enterprise Systems Engineer Level 4 (SV-ESE4)	▪ Serves as a consulting engineer for integrated systems and/or application architecture for small to medium data center environments ▪ Can perform system, OS, application, and hardware installation and troubleshooting ▪ Helps define system and application architecture ▪ Has fundamental knowledge of multiple system applications, hardware platforms, and operating systems ▪ Possesses base-level understanding of system and network protocols, concepts and operating systems. ▪ Requires associates degree in related field with a minimum of 2 years of experience
Project Manager	▪ Develops and maintains a Project Plan and leads medium-to-large complex projects and major phases of very large projects, including the project organization, tasks, and resources as defined by the client contract

Requirement	Description
Level 3 (SV-PM3)	▪ Acts ass direct customer liaison ▪ Provides oversight and technical review of project tasks and provides functional analysis for optimal design configurations ▪ Interprets regulations, policies, and other constraints and assesses impact to project costs and schedule ▪ Assists the PM in identifying required system/software/design changes for documents, as well as configuration management storage processes and databases ▪ Develops and implements systems and performance strategies ▪ Develops and maintains management controls to ensure the project is completed on time, within budget, and compliant with customer specifications ▪ Ensures quality management practices are implemented ▪ Requires Bachelor's degree, project management coursework, and 6 years of experience.

Several assumptions have been made for the overall system architecture and software configurations to give an accurate representation of the resources and timeline required to complete the required implementations:

- Only core office applications (Microsoft Word, Excel, PowerPoint, Outlook, Visio, etc.) and a web browser will be installed. Installation of additional custom-built applications from the customer are out of the scope of these examples.
- The customer has existing volume licensing available and the necessary infrastructure in place to support Microsoft Office volume licensing.
- The network storage will be configured to support desktop hosting, Inputs/Outputs per Second (IOPs) requirements, and base implementation.
- A shared terminal service-style infrastructure will be leveraged for this implementation. Dedicated thin-client images are out of scope.
- A single network security classification is assumed for each user of both implementations, while multi-level network security is not included within these deployments.

Given these assumptions, the following table shows the engineering resources and associated timelines needed to complete the necessary phases of the required thin-client implementations.

Exhibit 2 – Engineering Resources and Timeline per Deployment Phase

Deployment	Requirements Analysis	Proof of Concept	Pilot Phase	Production Rollout
Less than 500 users (Shown with deployment of 500 users)	SV-ESE4: 48 hours for analysis, 20 hours for architecture design	SV-ESE4: ~ 93.5 hours SV-PM3: ~ 17 hours	SV-ESE4: ~ 112 hours SV-ESE1: ~ 30 hours SV-PM3: ~ 22 hours	SV-ESE4: ~ 168 hours SV-ESE1: ~ 279 hours SV-PM3: ~ 31 hours
More than 500 users (Shown with deployment of 1000 users)	SV-ESE4: 48 hours for analysis, 20 hours for architecture design	SV-ESE4: ~ 116 hours SV-PM3: ~ 27 hours	SV-ESE4: ~ 140 hours SV-ESE1: ~ 60 hours SV-PM3: ~ 32 hours	SV-ESE4: ~ 209 hours SV-ESE1: ~ 557 hours SV-PM3: ~ 49 hours

For deployments of greater than 500 users, incremental increases in user counts are expected to increase the duration of deployment phases (except for Requirements Analysis). For example, a deployment increase of 500 users changes engineering efforts in each phase as follows:

Exhibit 3 – Changes in Engineering Timeline per Deployment Phase

Requirements Analysis	Proof of Concept	Pilot Phase	Production Rollout
No Change	**SV-ESE4:** Increase ~ 24% or 22.5 hours per 500 users	**SV-ESE4:** Increase ~ 25% or 28 hours per 500 users	**SV-ESE4:** Increase ~ 25% or 41 hours per 500 users
	SV-PM3: Increase ~ 58% or 10 hours per 500 users	**SV-ESE1:** Increase ~ 100% or 30 hours per 500 users	**SV-ESE1:** Increase ~ 100% or 278 hours per 500 users
		SV-PM3: Increase ~ 45% or 10 hours per 500 users	**SV-PM3:** Increase ~ 58% or 18 hours per 500 users

To mitigate dramatic timeline increases when deploying solutions to organizations with many users, GTRI will add Level 1 Enterprise Systems Engineers as necessary. Because this engineer's primary function will be placing and wiring thin-client devices in the Pilot and Production Rollout Phases, adding even a single engineer of this level to the project can reduce the total hours necessary to complete these phases, with little to no additional cost. This is not true, however for adding Level 4 Enterprise Systems Engineers, whose primary role is system design and configuration of system components and software. Additional engineers of this caliber would not decrease overall engineering hours enough to justify the additional cost. The decision to increase engineer quantities will be discussed with each customer on each project, based on the desires and tasks of the individual customer.

Maintenance of deployed thin-client implementations is possible in both CONUS and OCONUS installation sites through maintenance offered directly through GTRI and our teaming partners. Our in-house expertise, as well as our partnership with Raytheon, allows us to contract thin-client maintenance in any location worldwide, including austere environments. These maintenance services include NOC and helpdesk support, day-2 installation support, user and administrator training, system user additions and removals, life-cycle management and phasing out of legacy systems, application and software updating, and system and application optimization. Any combination and level of maintenance can be requested at any time, during or after system installation, with maintenance timelines dependent upon the level of service support requested. All thin-client maintenance and service support options will be available through the entire life of the contract.

1.1.2. Describe the Engineering Efforts Required to Implement and Migrate Thin Client Solutions over the Life of the Contract

The responsibilities of GTRI's Enterprise Systems Engineers are described in the following sections, which detail the four thin-client implementation phases defined above. These phases apply to each thin-client implementation, regardless of size or complexity.

1.1.2.1. Requirements Analyses (Phase 1)

In small or large thin-client implementations, it is essential to define and clarify exact customer requirements. Regardless of project complexity or business practice, identifying end goals with a set of clear deadlines lays groundwork to check whether the project has been successful when rollout begins. Defining these requirements and goals begins with initial discussions between GTRI engineers and customer employees and includes physical on-site surveys to lay expectations for the final project

implementation. This step is identical for any size of thin-client implementation, as the information gathered is crucial for architectures serving fewer than or more than 500 users. These key aspects and requirements are defined in the following tables:

Exhibit 4 – User and Application Requirements

Requirement	Description
Number of users	Needed to understand the quantity of thin-client devices and total user sessions
Types of applications	Needed to identify subsequent standard, vertical, or specialized applications and to determine communications protocols: ▪ Microsoft Remote Display Protocol (RDP) ▪ Citrix Independent Computing Architecture (ICA) ▪ NoMachine NX protocol for UNIX and Linux environments
Application user load	Used to determine the number and complexity of user sessions and user configuration needs by light, medium, and heavy/power users

With user and application requirements defined, Engineers will analyze the physical hardware requirements and procurement needed by the customer to achieve their thin-client environment goals. The following table is a guideline to aid in determining the computing power and storage requirements needed based on the number and complexity of user sessions and applications:

Exhibit 5 – Computing Requirements

User Type	Number of Applications	Computing Requirements
Light User	2 - 4 simultaneous applications Examples: ▪ Web browser ▪ Microsoft Outlook ▪ Microsoft Word/Excel	▪ Approximately 15 users per physical processing core ▪ 8 – 10 IOPS Required ▪ Approximately 150 users per 128 GB Random Access Memory (RAM), including server overhead requirements for physical server running 150 users on 128 GB RAM.
Medium User	5 – 7 simultaneous applications Examples: ▪ Web browser ▪ Microsoft Office Suite (PowerPoint, Excel, Outlook, Word, etc.) ▪ PDF Reader	▪ Approximately 15 users per physical processing core ▪ 10 – 15 IOPS Required ▪ Approximately 150 users per 128 GB RAM, including server overhead requirements for physical server running 150 users on 128 GB RAM
Heavy/Power User	8 or more simultaneous applications: Examples: ▪ Web browser with multiple tabs ▪ Microsoft Office Suite (PowerPoint, Excel, Outlook, Word, etc.) ▪ PDF Reader ▪ WinZip	▪ Approximately 5-8 users per physical processing core ▪ 25 - 40 IOPS ▪ Approximately 2 - 6 GB RAM per user, dependent on individual workload, including server overhead requirements for physical server

Defined computing requirements determine the number of physical servers required to operate the thin-client infrastructure. During on-site surveys, it is then determined what (if any) existing hardware within the customer's infrastructure can be migrated to perform some of the computing load required, as utilizing available resources can drastically reduce project cost. Additional and new hardware requirements are then determined. This includes requirements for quantities of physical servers, storage, and thin-client devices. With a clear definition of the amount of physical hardware needed to successfully and efficiently operate the thin-client infrastructure, the final customer requirements can be defined. These include system administration, network infrastructure requirements, additional digital services to be considered, physical peripherals required by the users, and austere-environment considerations.

Thin-client architectures offer centralized system administration in which nearly all aspects of the environment can be administered and managed from a central location within the architecture. This yields tremendous savings and lowers administration costs compared to architectures that use distributed workstations to employees. In these architectures, the time and effort to administer and manage individual client sessions and network configurations is drastically reduced. By making an early determination of the management goals of the environment and how the customer will use this central administration and the management, we will identify what, if any, additional administration software is needed, to ensure immediate, efficient management. Administration considerations are described in Exhibit 6.

Exhibit 6 - System Administration.

Requirement	Description
Type of system administration	Indicates the best system administration method and software options of the many vendor offerings for levels of thin-client administration software, with a multitude of advantages and features
Number of administrators	Helps determine level of volume administration licensing necessary to accomplish administration goals of the organization

It is crucial to also understand the existing network infrastructure and plans for how the thin-client environment will merge with it. Such an understanding assures that the new environment will operate exactly as the customer intends, allowing users to perform their mission-critical tasks efficiently and on time. Imperative network considerations are described in Exhibit 7:

Exhibit 7 - Network Infrastructure.

Requirement	Description
Existing network infrastructure	Used to determine how the new thin-client architecture will be merged with the existing network infrastructure
Number and organization of existing Virtual Local Area Networks (VLAN)	Used to determine if existing VLAN structure will be used in thin-client architecture
Remote VPN requirements	Used to determine if configuration of existing or new VPN system is necessary

Every customer's infrastructure is unique, in that individual requirements differ from organization to organization. It is crucial to outline these requirements during early discussions and on-site surveys to gain an understanding of the additional requirements.. For example, understanding additional functions such as multi-media streaming, IP Telephony and VoIP, Systems Applications Products Graphical User

Interface (SAP GUI), terminal emulations for direct host access, and print server functionalities helps define an implementation timeline. Examples of such digital services are shown in Exhibit 8:

Exhibit 8 - Additional Requirements.

Category	Example
Communications/Virtualization Protocols and Add-Ons	Citrix ICA, Microsoft RDP, PCoIP, NoMachine NX, XDMCP, Thin-Linc, Sun Secure Global Desktop
Security	Cisco VPN Client, Citrix VPN with NetScaler, Aladdin eToken, Kobil myIdentity
Virtualization	VMware VDI Client, Citrix ICA 10
Host Access	Terminal Emulations
SAP Access	SAP GUI
Application Delivery	Citrix Storefront
Print Services	Thin Client as Print Server, ThinPrint Client
Firmware-Internal Applications and Bandwidth Optimization	Browsers: Internet Explorer, Mozilla Firefox, etc.
Firmware-Internal Plug-Ins	Java Runtime Environment, Acrobat Reader, .NET Runtime Environment
Multimedia	Microsoft Media Player, MPlayer, Real Player, Flash Player, etc
IP Telephony	VoIP (SIP Client)

Next, peripheral requirements must be defined to allow the organization and users to maximize system efficiency and meet the architecture goals. This analysis identifies the number of monitors, keyboards, mice, smartcard readers, and other devices to procure before deploying the thin-client architecture, to ensure users are able to complete their tasks as soon as deployment is completed. Peripheral examples are given in the following table:

Exhibit 9 - Peripherals.

Requirement	Description
Monitors	Some thin-client options are integrated onto a monitor, while other options are not. Other factors to consider are terminal connections to the monitors; are Video Graphics Array (VGA) or Digital Visual Interface (DVI) connections required?
Keyboards	How many and what types of keyboards are best suited for the customer? Countless options, both standard and ergonomic, are available from a multitude of different manufacturers.
Mice	Like keyboards, a wide variety of mice are available, both wired and wireless. Which option(s) are best suited for the customer?
Smartcard Readers	In some instances, the customer may require additional security that can be met with the inclusion of a smartcard readers at users' thin-client stations. In this case, there are a multitude of options that connect directly to the stations via Universal Serial Bus (USB) connections that meet a variety of customer security needs.

Austere environment consideration should be included with discussions of end-location conditions, logistics, and support infrastructure. Architecture designers must evaluate bandwidth and link availability of the long-haul communications services providing connectivity to the local network. Logistics to FOBs are often case by case and must be coordinated deliberately and specifically for the installation location. Some FOBs have more robust logistics channels than others. Regional tensions often require logistics channels to be diverted or closed all together. Contingency plans for each risk are required. Additional considerations are:

- **Equipment staging:** On-site staging is often not possible or is cumbersome. Alternate plans such as staging in place, at installation location, or at a Theater collection hub should be considered.
- **Local services:** Power, HVAC, and protection from the environments should be considered. Snowy, rainy, and cold conditions such as those in the mountainous regions of Afghanistan can be as dangerous as the hot and dusty conditions associated with other Theaters.
- **Access controls:** In a typical CONUS deployment, the unit controlling network access is co-located at the installation site or within two or three time zones. For installations at FOB locations, however, Engineers must verify access credentials before departures, coordinate testing and validation, and establish alternative acceptance criteria with supported organizations.

A broad and thorough understanding of each of these critical customer requirements lays firm groundwork for a smooth and efficient architecture deployment. Knowing each of these needs allows for an accurate implementation timeline, with the proper resources to complete the project in the remaining three phases of deployment. These requirements analyses, as well as design architectures, are performed by Level 4 Enterprise Systems Engineers. Regardless of the expected size of the future environment, the requirements analysis remains the same, yielding a similar expected duration of this phase for each project.

1.1.2.2. Proof of Concept (Phase 2)

The first phase of the physical implementation is the Proof of Concept Phase, involving minimal hardware and software configurations. Typically, Engineers implement a single server chassis with a single storage device. Configuration of the single server, with all necessary server virtualization software installed, is used to monitor and troubleshoot the initial server, storage, and end-user performances not only throughout this phase, but of the following phases of the deployment as well. When the system is operating properly, the Pilot Phase begins.

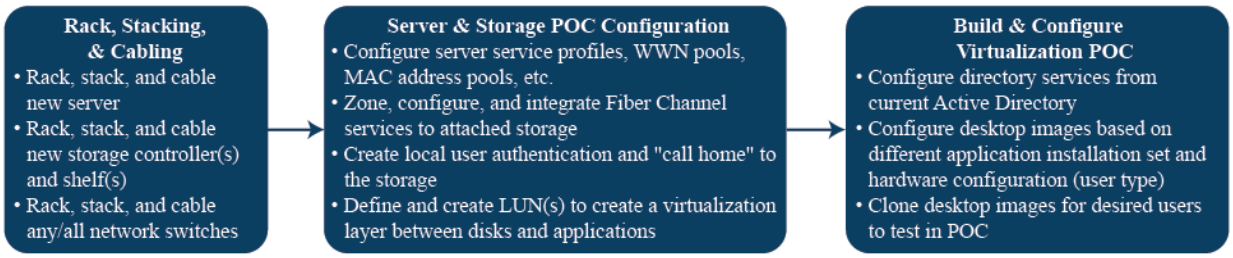

Exhibit 10 - Proof of Concept.

1.1.2.3. Pilot Phase (Phase 3)

Much like the Proof of Concept Phase, the Pilot Phase of the project deployment uses minimal hardware and software configuration and is solely purposed to test and monitor minimal user instances before the Production Rollout Phase can begin. Within the Pilot Phase, user endpoints with physical thin clients are configured based on the system and application requirements of individual user groups determined in the site surveys. These user groups are monitored against the existing server and data storage configurations deployed in the Proof of Concept to determine if user groups are configured properly. Any

troubleshooting of instance configuration is performed in this phase to help facilitate timeliness and ease of configuration of the remaining virtual instances in the Production Rollout Phase. When troubleshooting is completed and each instance operates at full capacity and efficiency, the Production Rollout Phase can take place.

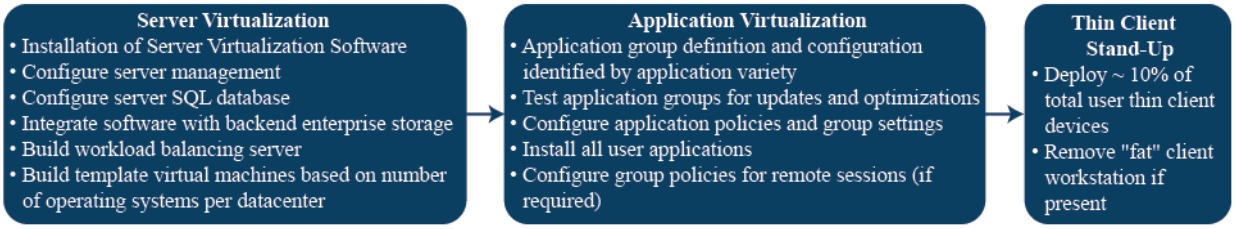

Exhibit 11 - Pilot.

1.1.2.4. Production Rollout (Phase 4)

When user groups are configured and all systems are deemed operational, the remaining server, storage, virtualization software, and end-user, thin-client workstations are configured and integrated. User instances configured in the Pilot Phase are simply "cloned" and installed on corresponding thin-client workstations until each device is configured with its proper operating environment. Engineers monitor the systems to assure that all systems and configurations are operating properly and the thin-client environment is implemented accurately. As the final implementation progresses, full high availability (as defined in the requirements analysis) is deployed, all thin clients are deployed to all users, users are migrated away from their existing workstation configuration to a production environment on the thin-client implementation, and all configurations receive a final check and revalidation.

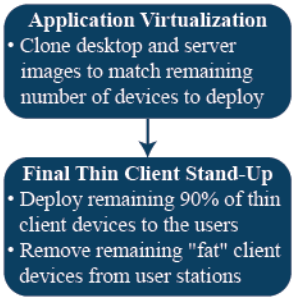

Exhibit 12 - Production Rollout.

Only when all thin-client systems are up and fully operational will the old workstation solutions be removed from end users' desks. A temporary freeze period is then undertaken to ensure complete operational effectiveness. During this time, a "Day 2" support window (which may be several days or several months depending on the size of the thin-client deployment) will begin, with GTRI staff remaining on site to resolve any issues that arise. After the Day 2 support window, the on-site administration team takes full operational support responsibility.

1.1.3. Understanding of Impact of Thin Client Solutions and How the Proposed Solution will Reflect the Evolution of Product Offerings During the Life of the Contract

Implementing a thin-client infrastructure has many advantages over traditional distributed desktop or laptop infrastructures. Thin-client environments optimize data center equipment to create secure, virtualized servers and desktops. This centralization makes patch distribution easier, lowers maintenance costs, reduces the amount of equipment to be managed, and reduces recapitalization costs. With only a single wire routed to each desk, each user can simultaneously and securely access multiple classified domains from a single thin-client workstation. This allows for rapid movement of data between multiple defined networks of different classification levels to users with proper authentication credentials. Administrators are able to configure and manage disparate networks in the infrastructure, fully defining security levels of individual networks and managing active directories and authentication for each. When fully implemented, the thin-client architecture is an incredibly secure environment that significantly reduces the number of devices and workstations deployed within the office.

These solutions also substantially reduce the amount of contract labor needed to move or add workstations. Virtual desktops enable the swift removal of a compromised virtual computer and the creation of a pristine copy of the virtual instance the next time the user logs in. When adding virtual machines to an existing environment, unless a new user type must be defined and configured, the process is as simple as cloning a virtual instance on a new workstation. Administrators can plan on fast, efficient deployments of thin clients as their organization grows, rather than effort-intensive additions of desktop machines. When user groups are added or altered, administrators can define and configure the user type, environment, and network authentication methods without the concern of inadvertently disabling existing user groups. Mission-critical tasks of the organization are uninterrupted as the virtualized desktop infrastructure expands and advances.

Thin-client architectures also provide unique virtualization and communication protocols,-eliminating the need for local Central Processing Unit (CPU) power, memory, and storage. Computational operations are performed on virtualized server equipment that houses all necessary CPU power and memory, to perform organizational tasks across the infrastructure. High-capacity network storage attached to server networks provides all necessary data storage capabilities, to securely back up each user's files and data. Altogether, this substantially reduces the physical hardware needed for users. With the computational necessities handled in the datacenter, the thin-client infrastructure significantly reduces infrastructure costs, with thin-client workstations typically housing far less powerful components than traditional workstations.

Finally, by consolidating power, space, cooling, and operational efficiencies, a thin-client infrastructure will be able to drastically lower the long-term operations and management costs for supporting end users' computing needs. A thin-client infrastructure also significantly increases operational efficiency as the demands of the mission shift and evolve over time. By moving the control and management points to centralized locations, administrators can much more efficiently update the systems to support the end user and the troops in the field. Providing access to multiple classification levels on a single thin client also provides more efficient views into the data while clearing up precious desk space in offices and in mobile units.

It is expected that the technology behind thin-client solutions, as well as all the benefits associated with such infrastructures, will evolve and advance over the life of the five-year contract. Virtualization software on server, client device, and application levels undergoes routine software upgrades, with major upgrades requiring full version evolutions. New and more powerful technology reflecting greater efficiencies and more securable designs, is under development and will be implemented when perfected. The same is true for hardware components contained within thin-client infrastructures. More powerful and faster technologies for processing and storage create the need for system upgrades, both minor and major, that can produce new generations of components and devices. Every thin-client solution GTRI proposes will reflect these latest technologies and equipment generations that guarantee our customers' infrastructures are operating with the most efficient and powerful options available. Users will optimally perform their mission tasks with the availability of these advanced thin-client technologies, which are constantly made available within GTRI's product line.

1.2. Thin-Client Configurations

1.2.1. Design Overview

To create a highly reliable and efficient thin-client infrastructure, GTRI will leverage the proven power and integrity of the Cisco FlexPod Datacenter solution. FlexPod is a converged compute, networking, and enterprise storage solution developed through collaboration with Cisco and NetApp. It features efficient, highly securable, and scalable configurations. In particular, the FlexPod Datacenter option is designed for

medium- to large-sized enterprises whose datacenters focus on virtualized computing and storage, highly available clustered storage, unified 10GbE networking, multi-latency for heavy workloads, and management tools to facilitate configurations and administration.

Both proposed thin-client designs will utilize this Cisco FlexPod Datacenter solution. The configurations are built for 500 and 1000 heavy users, as defined by the application requirement of eight (8) or more simultaneous applications per user. They will each utilize Cisco Unified Computing System (UCS) B200 M3 blade servers for application and virtualization computing, NetApp FAS3250 network storage devices for storage backup and Input/Ouput (I/O) requirements, Citrix XenServer 6.2 for server virtualization, Citrix XenDesktop 7.0 for device virtualization, and two Citrix NetScaler MPX 9700 appliances for performance and application optimization. Each system also includes Samsung TC191W Thin Client terminals for use at user locations. These all-in-one Thin Client devices feature built in LED displays coupled with powerful processing and graphics components. They are ideal for environments that may require heavy graphics application processing, as well as those seeking to consolidate infrastructure space with an all-in-one device option. Individual system designs as well as full Bill of Materials (BOMs) for each of these required designs are described within Section 3.1.1.1.

It should be noted that each of these designs are built under the assumption that each Thin Client user is defined as a heavy application user. All computing and storage components have been designed under this assumption and are capable of operating and performing all tasks of the given number of heavy users. Systems can and will be scaled down if necessary to meet the lower demands of light and medium users in environments that do not require such high numbers of heavy application users. The purpose of showing the following designs is to demonstrate the maximum amount of processing power that would be required for the given number of users of the systems.

1.2.1.1. Proposed High Level Designs

Below are GTRI's proposed solutions for the required Thin Client deployments with the assumption given previously. A high-level design architecture is given for each configuration, as well as a full detailed Bill of Materials (BOM) for each component contained within each architecture.

Less than 500 Users

The first architecture is that of an infrastructure operating with a maximum of 500 heavy users:

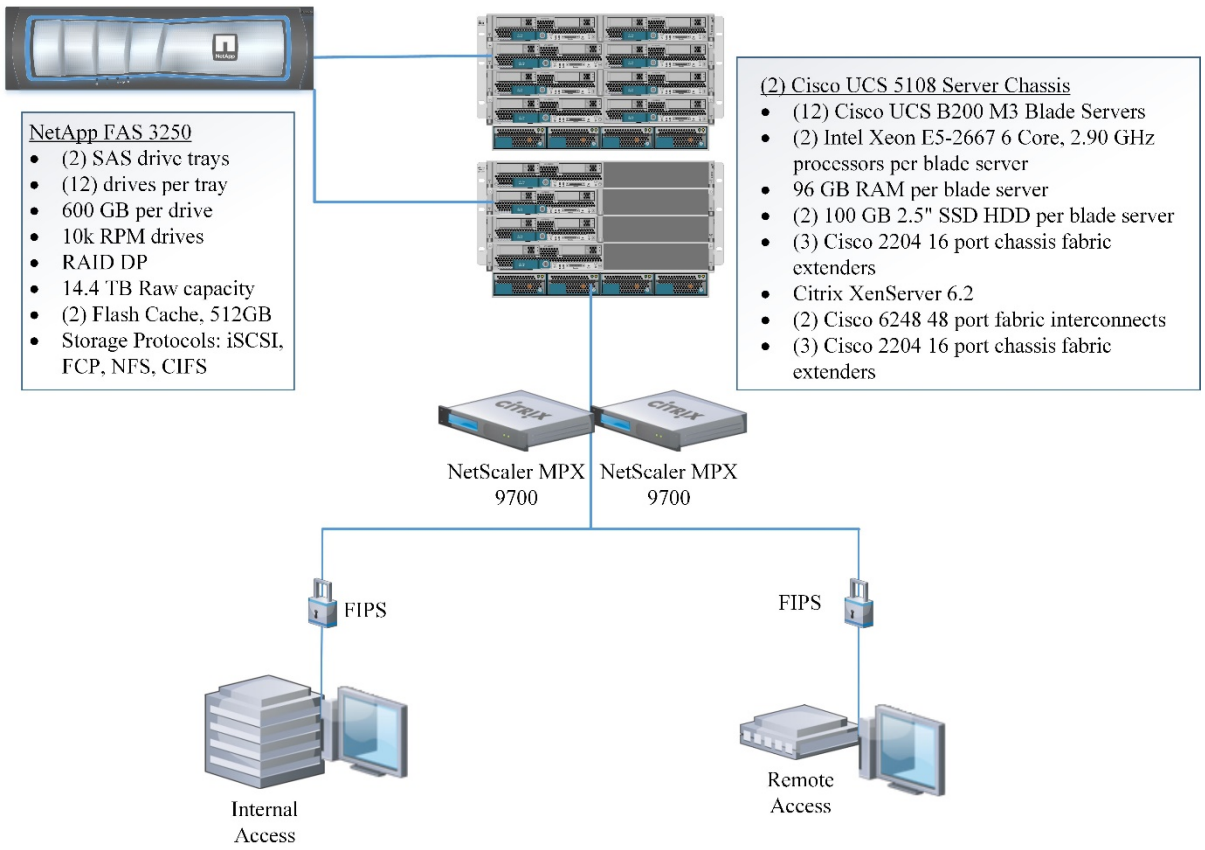

Exhibit 13 - High Level Design of Architecture Supporting Up To 500 (Heavy) Users.

Exhibit 14 - 500 User Architecture Detailed BOM.

Cisco UCS Blade Servers and Fabric Extenders			
Line No.	**Quantity**	**Manufacturer Part Number**	**Part Description**
1	1	N20-C6508-UPG	UCS 5108 Blade Svr AC Chassis/0 PSU/8 fans/0 fabric extender
2	1	CON-SNT-2C6508	SMARTNET 8X5XNBD 5108 Blade Server Chassis
3	8	UCSB-B200-M3-D	UCS B200 M3 Blade Server w/o CPU mem HDD mLOM/mezz (1D)
4	8	CON-SNT-B200M3-D	SMARTNET 8X5XNBD UCS B200 M3 Blade Se
5	16	UCS-CPU-E5-2667	2.90 GHz E5-2667/130W 6C/15MB Cache/DDR3 1600MHz
6	96	UCS-MR-1X082RY-A	8GB DDR3-1600-MHz RDIMM/PC3-12800/dual rank/1.35v
7	8	N01-MMIRROR	Enable memory mirroring
8	8	UCS-SD100G0KA2-G	100GB 2.5 inch Enterprise Value SSD
9	8	UCSB-MLOM-40G-01	Cisco UCS VIC 1240 modular LOM for M3 blade servers
10	8	MSWS-12-ST2S	Windows Server 2012 Standard (2 CPU/2 VMs)
11	8	CON-ISV1-M12ST2S	ISV 24X7 MS Support Std (2 CPU/2 VMs); List Price is ANNUAL
12	8	MSWS-12-ST2S-RM	Windows Server 2012 Standard (2 CPU/2 VMs) Recovery Media
13	8	N20-BBLKD	UCS 2.5 inch HDD blanking panel
14	16	UCSB-HS-01-EP	CPU Heat Sink for UCS B200 M3 and B420 M3
15	2	UCS-IOM-2204XP	UCS 2204XP I/O Module (4 External 16 Internal 10Gb Ports)
16	4	UCSB-PSU-2500ACPL	2500W Platinum AC Hot Plug Power Supply for UCS 5108 Chassis
17	4	CAB-C19-CBN	Cabinet Jumper Power Cord 250 VAC 16A C20-C19 Connectors
18	1	N20-FW011	UCS Blade Server Chassis FW Package 2.1
19	1	N01-UAC1	Single phase AC power module for UCS 5108
20	1	N20-CAK	Accessory kit for UCS 5108 Blade Server Chassis
21	8	N20-FAN5	Fan module for UCS 5108
22	1	N20-C6508-UPG	UCS 5108 Blade Svr AC Chassis/0 PSU/8 fans/0 fabric extender

Cisco UCS Blade Servers and Fabric Extenders			
23	1	CON-SNT-2C6508	SMARTNET 8X5XNBD 5108 Blade Server Chassis
24	1	UCS-IOM-2204XP	UCS 2204XP I/O Module (4 External 16 Internal 10Gb Ports)
25	2	UCSB-PSU-2500ACPL	2500W Platinum AC Hot Plug Power Supply for UCS 5108 Chassis
26	2	CAB-C19-CBN	Cabinet Jumper Power Cord 250 VAC 16A C20-C19 Connectors
27	1	N20-FW011	UCS Blade Server Chassis FW Package 2.1
28	1	N01-UAC1	Single phase AC power module for UCS 5108
29	4	UCSB-B200-M3-D	UCS B200 M3 Blade Server w/o CPU mem HDD mLOM/mezz (1D)
30	4	CON-SNT-B200M3-D	SMARTNET 8X5XNBD UCS B200 M3 Blade Se
31	8	UCS-CPU-E5-2667	2.90 GHz E5-2667/130W 6C/15MB Cache/DDR3 1600MHz
32	48	UCS-MR-1X082RY-A	8GB DDR3-1600-MHz RDIMM/PC3-12800/dual rank/1.35v
33	4	N01-MMIRROR	Enable memory mirroring
34	4	UCS-SD100G0KA2-G	100GB 2.5 inch Enterprise Value SSD
35	4	UCSB-MLOM-40G-01	Cisco UCS VIC 1240 modular LOM for M3 blade servers
36	4	MSWS-12-ST2S	Windows Server 2012 Standard (2 CPU/2 VMs)
37	4	CON-ISV1-M12ST2S	ISV 24X7 MS Support Std (2 CPU/2 VMs); List Price is ANNUAL
38	4	MSWS-12-ST2S-RM	Windows Server 2012 Standard (2 CPU/2 VMs) Recovery Media
39	4	N20-BBLKD	UCS 2.5 inch HDD blanking panel
40	8	UCSB-HS-01-EP	CPU Heat Sink for UCS B200 M3 and B420 M3
41	1	N20-CAK	Accessory kit for UCS 5108 Blade Server Chassis
42	4	N20-CBLKB1	Blade slot blanking panel for UCS 5108/single slot
43	1	N20-CBLKI	Fabric extender slot blanking panel for UCS 5108
44	2	N20-CBLKP	Power supply unit blanking panel for UCS 5108
45	8	N20-FAN5	Fan module for UCS 5108
46	2	UCS-FI-6248UP-UPG	UCS 6248UP 1RU Fabric Int/No PSU/32 UP/ 12p LIC

Cisco UCS Blade Servers and Fabric Extenders			
47	2	CON-SNT-FI6248UP	SMARTNET 8X5XNBD UCS 6248UP 1RU Fabrc Intercnnct/2 PSU/2
48	2	UCS-FI-DL2	UCS 6248 Layer 2 Daughter Card
49	4	UCS-PSU-6248UP-AC	UCS 6248UP Power Supply/100-240VAC
50	4	CAB-9K12A-NA	Power Cord 125VAC 13A NEMA 5-15 Plug North America
51	2	N10-MGT011	UCS Manager v2.1
52	2	UCS-ACC-6248UP	UCS 6248UP Chassis Accessory Kit
53	2	UCS-BLKE-6200	UCS 6200 Series Expansion Module Blank
54	4	UCS-FAN-6248UP	UCS 6248UP Fan Module

NetApp FAS3250 Network Storage			
Line No.	**Quantity**	**Manufacturer Part Number**	**Part Description**
55	1	FAS3250-R6	FAS3250 Enterprise Storage System
56	2	FAS3250AE-FC-BASE-R6	FAS3250HA SYS With Dual Cntrlr & IOXM & 8G FC
57	2	SW-3250A-CIFS-C	SW,CIFS,3250A,-C
58	2	SW-3250A-FCP-C	SW,FCP,3250A,-C
59	2	SW-3250A-NFS-C	SW,NFS,3250A,-C
60	2	SW-FLASH-CACHE-C	SW,Flash Cache,-C
61	2	SW-ISCSI-C	SW,iSCSI,-C
62	2	SW-3250A-ONTAP8-C	SW,Data ONTAP Essentials,3250A,-C
63	2	DS2246-1007-12S-EN-R6-C	DSK SHLF,12x600GB,10K,EN,-C
64	1	X6585-R6-C	Cable,Ethernet,3m RJ45 CAT6,-C
65	4	X6553-R6-C	Cable,Cntlr-Shelf/Switch,2m,LC/LC,Op,-C
66	8	X6559-R6-C	Cable,SAS Cntlr-Shelf/Shelf-Shelf/HA,5m,-C
67	4	X6562-R6-C	Cable,Ethernet,5m RJ45 CAT6,-C
68	2	X-SFP-H10GB-CU5M-R6-C	Cisco N50XX 10GBase Copper SFP+cable,5m,-C,R6
69	2	X2065A-EN-R6-C	HBA SAS 4-Port Copper 3/6 Gb QSFP PCIe,EN,-C
70	2	X5515A-R6-C	Rackmount Kit,4N2,DS14-Middle,-C,R6
71	2	X5526A-R6-C	Rackmount Kit,4-Post,Universal,-C,R6
72	2	FAS-V32XX-CHASSIS-R6-C	FAS/V32XX,Chassis,AC PS,-C,R6

NetApp FAS3250 Network Storage			
73	1	DOC-32XX-C	Documents,32XX,-C
74	8	X800E-R6-C	Power Cable North America,-C,R6
75	2	X1973A-R6-C	Flash Cache 512GB PCIe Module 2,-C
76	1	CS-O2-4HR-VA	SupportEdge Premium 4hr Onsite,VA

Citrix MPX 9700			
Line No.	**Quantity**	**Manufacturer Part Number**	**Part Description**
77	2	EW3A0000777	NETSCALER MPX 9700 FIPS ENT ED 2X10GX SFP+ 8X1000BASE-X SFP+ ELA-2
78	2	LM00108-E2	ELA2 1YR GOLD MNT NETSCALER MPX 9700 FIPS 10GE ENT ED
79	500	MW2A0000108	ELA2 XENDESKTOP ENTERPRISE NAMED LICENSE W/ 1 YR SA

Samsung Thin Client Devices			
Line No.	**Quantity**	**Manufacturer Part Number**	**Part Description**
80	500	TC191W	Samsung TC191W All-in-One thin client display. 1.00GHz AMD Ontario processor, 8 GB SSD, 2 GB DDR3 RAM, 4 x USB 2.0, GbE, 19.0” LED display

Greater than 500 Users

Below is the architectural design for an infrastructure of 1000 heavy users, followed by the detailed BOM of each component within the design. It should be noted that additional system hardware is necessary to scale beyond this 1000 heavy-user build. Each additional 500 heavy users will require twelve (12) additional server blades configured as described below. An additional twenty-four (24) 600 GB SAS storage disk drives are required at a minimum to support the additional IOPs and application storage needed for 500 additional heavy users. Additional NetScaler MPX 9700 appliances are not necessary for deployments under 10,000 users. Each appliance is capable of operating with 10,000 concurrent SSL users, making additional appliances for projects with user counts under this value unnecessary.

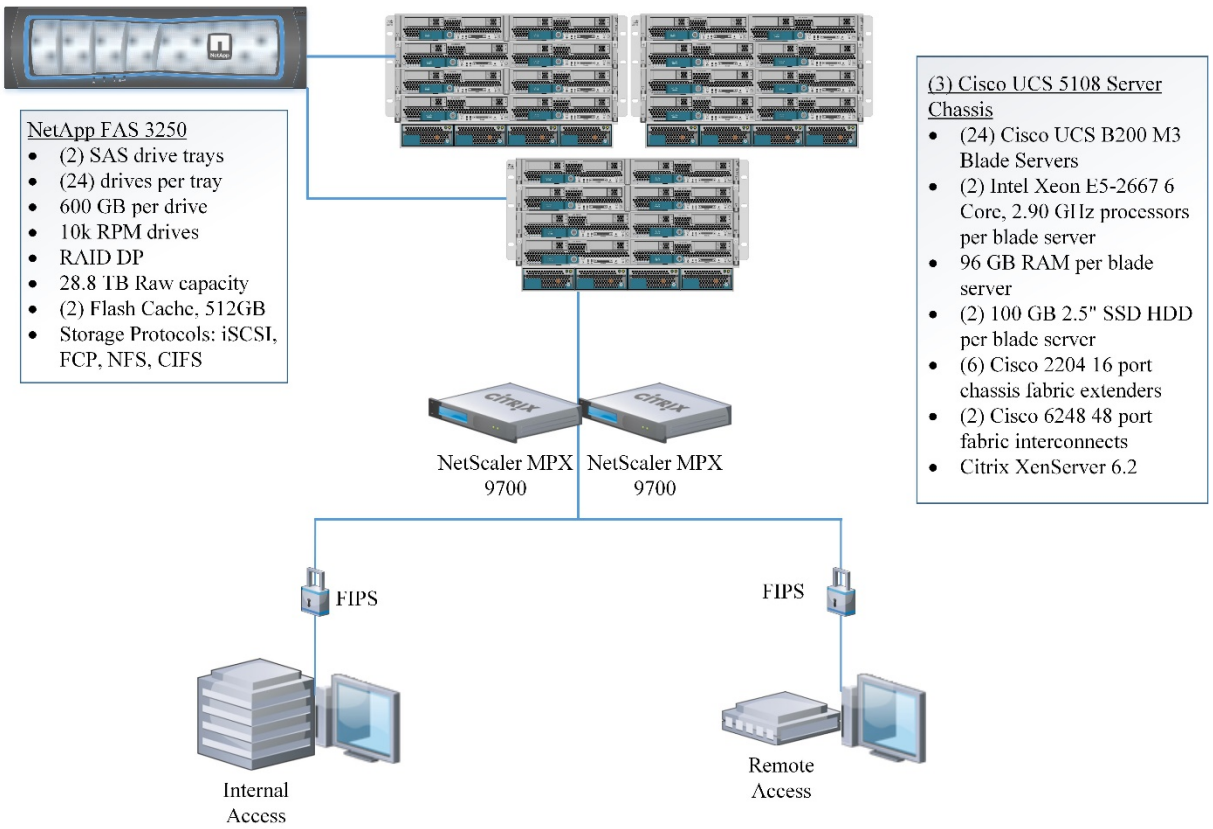

Exhibit 15 - High Level Design of Architecture Supporting Up To 1000 (Heavy) Users.

Exhibit 16 - Up to 1000 User Architecture Detailed BOM.

Cisco UCS Blade Servers and Fabric Extenders			
Line No.	**Quantity**	**Manufacturer Part Number**	**Part Description**
1	3	N20-C6508-UPG	UCS 5108 Blade Svr AC Chassis/0 PSU/8 fans/0 fabric extender
2	3	CON-SNT-2C6508	SMARTNET 8X5XNBD 5108 Blade Server Chassis
3	24	UCSB-B200-M3-D	UCS B200 M3 Blade Server w/o CPU mem HDD mLOM/mezz (1D)
4	24	CON-SNT-B200M3-D	SMARTNET 8X5XNBD UCS B200 M3 Blade Se
5	48	UCS-CPU-E5-2667	2.90 GHz E5-2667/130W 6C/15MB Cache/DDR3 1600MHz
6	288	UCS-MR-1X082RY-A	8GB DDR3-1600-MHz RDIMM/PC3-12800/dual rank/1.35v
7	24	N01-MMIRROR	Enable memory mirroring
8	24	UCS-SD100G0KA2-G	100GB 2.5 inch Enterprise Value SSD

Cisco UCS Blade Servers and Fabric Extenders			
9	24	UCSB-MLOM-40G-01	Cisco UCS VIC 1240 modular LOM for M3 blade servers
10	24	MSWS-12-ST2S	Windows Server 2012 Standard (2 CPU/2 VMs)
11	24	CON-ISV1-M12ST2S	ISV 24X7 MS Support Std (2 CPU/2 VMs); List Price is ANNUAL
12	24	MSWS-12-ST2S-RM	Windows Server 2012 Standard (2 CPU/2 VMs) Recovery Media
13	24	N20-BBLKD	UCS 2.5 inch HDD blanking panel
14	48	UCSB-HS-01-EP	CPU Heat Sink for UCS B200 M3 and B420 M3
15	6	UCS-IOM-2204XP	UCS 2204XP I/O Module (4 External 16 Internal 10Gb Ports)
16	12	UCSB-PSU-2500ACPL	2500W Platinum AC Hot Plug Power Supply for UCS 5108 Chassis
17	12	CAB-C19-CBN	Cabinet Jumper Power Cord 250 VAC 16A C20-C19 Connectors
18	3	N20-FW011	UCS Blade Server Chassis FW Package 2.1
19	3	N01-UAC1	Single phase AC power module for UCS 5108
20	3	N20-CAK	Accessory kit for UCS 5108 Blade Server Chassis
21	24	N20-FAN5	Fan module for UCS 5108
22	2	UCS-FI-6248UP-UPG	UCS 6248UP 1RU Fabric Int/No PSU/32 UP/ 12p LIC
23	2	CON-SNT-FI6248UP	SMARTNET 8X5XNBD UCS 6248UP 1RU Fabrc Intercnnct/2 PSU/2
24	2	UCS-FI-DL2	UCS 6248 Layer 2 Daughter Card
25	4	UCS-PSU-6248UP-AC	UCS 6248UP Power Supply/100-240VAC
26	4	CAB-9K12A-NA	Power Cord 125VAC 13A NEMA 5-15 Plug North America
27	2	N10-MGT011	UCS Manager v2.1
28	2	UCS-ACC-6248UP	UCS 6248UP Chassis Accessory Kit
29	2	UCS-BLKE-6200	UCS 6200 Series Expansion Module Blank
30	4	UCS-FAN-6248UP	UCS 6248UP Fan Module

NetApp FAS3250 Network Storage			
Line No.	**Quantity**	**Manufacturer Part Number**	**Part Description**
31	1	FAS3250-R6	

NetApp FAS3250 Network Storage			
32	2	DS2246-1014-24S-EN-R6-C	DSK SHLF,24x600GB,10K,EN,-C
33	1	X6585-R6-C	Cable,Ethernet,3m RJ45 CAT6,-C
34	4	X6553-R6-C	Cable,Cntlr-Shelf/Switch,2m,LC/LC,Op,-C
35	8	X6559-R6-C	Cable,SAS Cntlr-Shelf/Shelf-Shelf/HA,5m,-C
36	4	X6562-R6-C	Cable,Ethernet,5m RJ45 CAT6,-C
37	2	X-SFP-H10GB-CU5M-R6-C	Cisco N50XX 10GBase Copper SFP+cable,5m,-C,R6
38	2	X2065A-EN-R6-C	HBA SAS 4-Port Copper 3/6 Gb QSFP PCIe,EN,-C
39	2	X5515A-R6-C	Rackmount Kit,4N2,DS14-Middle,-C,R6
40	2	X5526A-R6-C	Rackmount Kit,4-Post,Universal,-C,R6
41	2	FAS-V32XX-CHASSIS-R6-C	FAS/V32XX,Chassis,AC PS,-C,R6
42	1	DOC-32XX-C	Documents,32XX,-C
43	8	X800E-R6-C	Power Cable North America,-C,R6
44	2	X1973A-R6-C	Flash Cache 512GB PCIe Module 2,-C
45	2	FAS3250AE-FC-BASE-R6	FAS3250HA SYS With Dual Cntrlr & IOXM & 8G FC
46	2	SW-3250A-CIFS-C	SW,CIFS,3250A,-C
47	2	SW-3250A-FCP-C	SW,FCP,3250A,-C
48	2	SW-3250A-NFS-C	SW,NFS,3250A,-C
49	2	SW-FLASH-CACHE-C	SW,Flash Cache,-C
50	2	SW-ISCSI-C	SW,iSCSI,-C
51	2	SW-3250A-ONTAP8-C	SW,Data ONTAP Essentials,3250A,-C
52	1	CS-O2-4HR-VA	SupportEdge Premium 4hr Onsite,VA

Citrix MPX 9700			
Line No.	**Quantity**	**Manufacturer Part Number**	**Part Description**
53	2	EW3B0000777	NETSCALER MPX 9700 FIPS ENT ED 2X10GX SFP+ 8X1000BASE-X SFP+ ELA-3
54	2	LM00108-E3	ELA3 1YR GOLD MNT NETSCALER MPX 9700 FIPS 10GE ENT ED
55	1000	MW2B0000108	ELA3 XENDESKTOP ENTERPRISE NAMED LICENSE W/ 1 YR SA

Samsung Thin Client Devices			
Line No.	**Quantity**	**Manufacturer Part Number**	**Part Description**
56	1000	TC191W	Samsung TC191W All-in-One thin client display. 1.00GHz AMD Ontario processor, 8 GB SSD, 2 GB DDR3 RAM, 4 x USB 2.0, GbE, 19.0” LED display