Moving Desktops to the Cloud

The Costs and Benefits of Virtual Desktop Infrastructure Solutions

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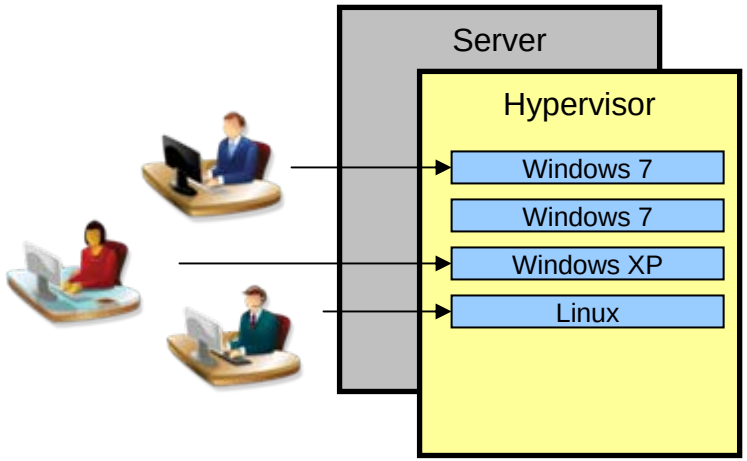
What is the cloud?

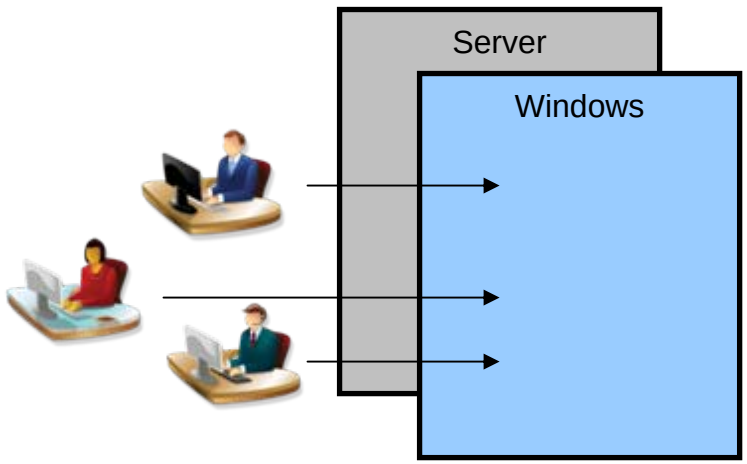
- Datacenter that users can connect to via LAN, WAN, or Internet
- Virtualized Resources (Processing & Storage)
- Dynamically Scalable
- IT is provided as a service that users connect to
- Types of cloud
  - Private
  - Community
  - Public

How do you move desktops to the cloud?

- Virtual Desktop Infrastructure
  - Users connect to a desktop in the datacenter running on a virtual machine
  - Each user has their own logical desktop but shares a physical machine
  - Desktops can be non-persistent



- Terminal Services (Remote Desktop Services)
  - Users connect to a server that makes a desktop user interface available
  - Each user shares a physical and logical machine



Paper Overview

- Examined two approaches to centralized desktop computing
  - Virtual Desktop Infrastructure (VDI)
  - Terminal Services-based Trusted Computing Solution (TCS)
- Compared to a “baseline” distributed desktop computing alternative
- Estimated life cycle costs for each alternative
- Evaluated qualitative benefits and limitations of each alternative
- Conducted sensitivity analysis and examined cost drivers
- Discussed the implications of moving desktops to the cloud on cost estimating and future trends

Methodology

- Estimate costs for a hypothetical organization
  - 10,000 users
  - 8,000 users require access to 2 networks
  - 2,000 users require access to 3 networks
- Cost model is based on a single approach to VDI and TCS
- Cost categories included:
  - Hardware
  - Software
  - Maintenance / Recurring Licensing
  - Labor
  - Electrical Consumption
  - Data Center Operations

Methodology

- Cost categories excluded:
  - User interface items that can be identical across alternatives (monitors, KVM switches, printers, etc.)
  - Applications to perform the organization's mission
  - Data migration
  - Facilities construction
  - Workforce productivity loss or enhancement
- Data is from a combination of publicly available sources, previous studies, and assumptions

VDI Alternative

- Best of breed approach in selecting components
  - Thin Client Device
  - Hypervisor
  - Connection Broker
  - Server Hardware
  - Enterprise Storage
  - Microsoft VECD Licensing for Windows 7

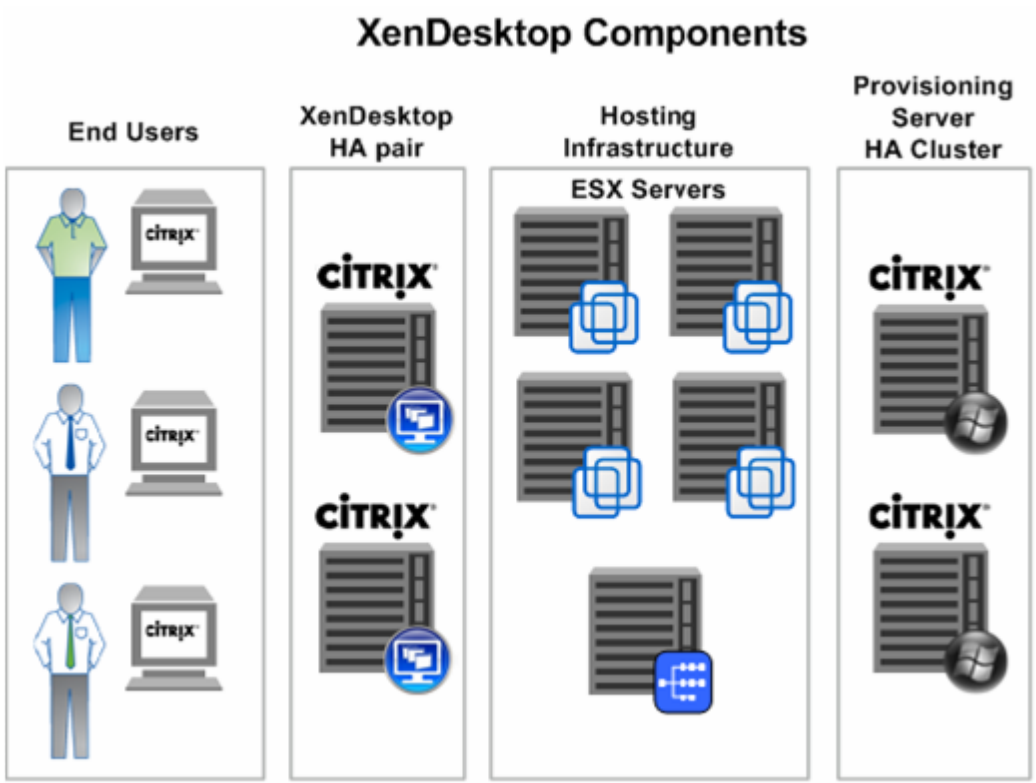
VDI Alternative

- Thin Client Device
  - Energy efficient
  - Onboard multimedia processing
  - Embedded OS with write-filter
- Hypervisor
  - Scalable with low overhead
  - Real time load balancing and distributed resource scheduling
- Connection Broker
  - Efficient connection protocol
  - Linked clones
  - USB extensions
  - Graphics acceleration
  - Multi-monitor support

VDI Alternative

- Server Hardware
  - Blades or stand alone
  - High density
  - High availability
  - Energy efficient
- Enterprise Storage
  - Tier 1: High performance storage for linked clones
  - Tier 2: User data
- Microsoft VECD Licensing for Windows 7

VDI Alternative



Adapted from Deployment Guide for XenDesktop 3.0 and VMware ESX Server on NetApp

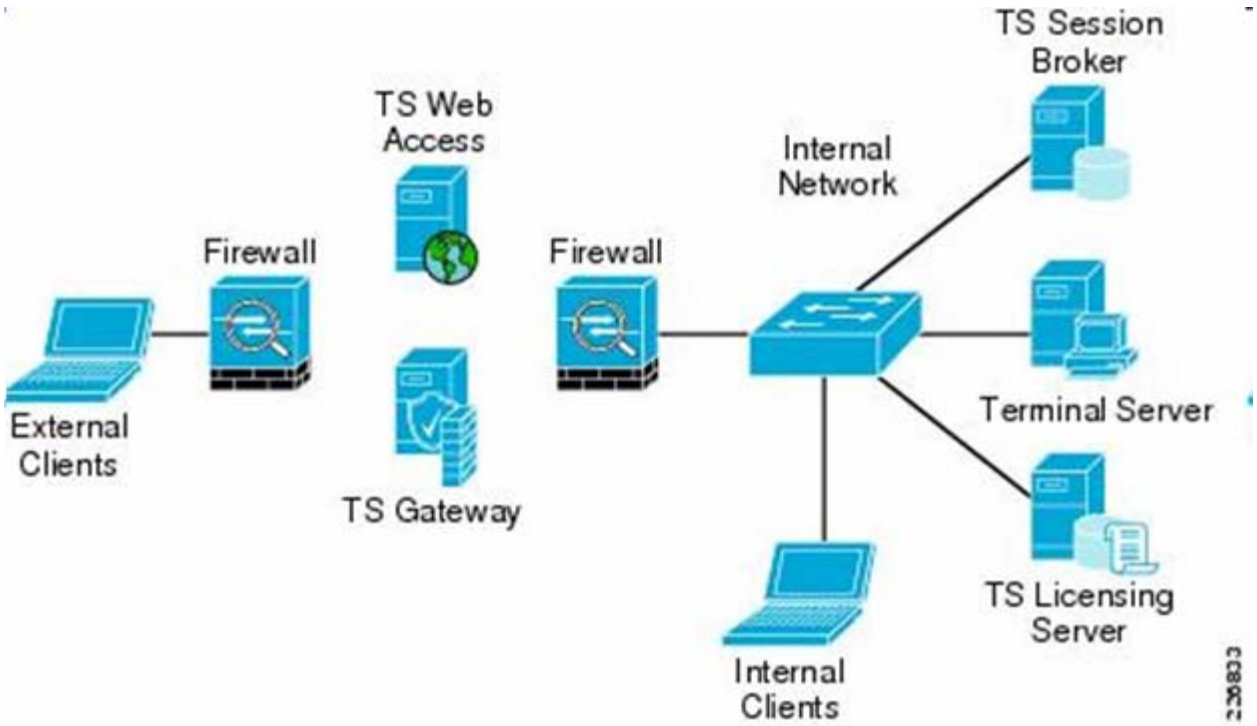
Trusted Computing Solution (TCS) Alternative

- Sun Microsystems trusted computing approach
  - Ultra-Thin Client Device
  - Sun Ray Session Server (SRSS) with Trusted Solaris
  - Windows Terminal Services
  - Server Hardware
  - Enterprise Storage

Trusted Computing Solution (TCS) Alternative

- Ultra-Thin Client Device
  - Lowest energy consumption
  - Stateless device
- Sun Ray Session Server (SRSS) with Trusted Solaris
  - Ability to connect to multiple networks and maintain segregation of data
- Server Hardware
  - Blade Servers
- Enterprise Storage
  - Tier 2: user data
- Windows Terminal Services

Trusted Computing Solution (TCS) Alternative



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Baseline Distributed Computing Alternative

- Typical Desktop Environment
  - Workstation at the user's desk
  - Centrally installed applications
  - Some local user data / some datacenter storage
  - Intended for use at a single geographic location
- Management Software
  - Remote management and control
  - Automated security patches
  - Automated data backup

Why are organizations moving desktops to the cloud?

- Security
- Accessibility
- Reliability
- Longer refresh cycles
- Less consumption
- Scalability
- Centralized management and control

Security

- Stateless thin clients or write-filters
- Non-persistent images (VDI only)
- Remote access without moving any corporate data from the datacenter
- Lockable USB ports

Accessibility

- Enables hoteling or other hot desking strategies
- Desktop is available from clients throughout the enterprise
- Remote access can provide users 100% of their programs and functionality
- Desktops can be delivered with a variety of Operating Systems
- Ability to connect to multiple networks over a single wire (TCS only)

Reliability

- Backend solution designed for high availability with redundancy
- Server hardware has higher MTBF than desktop hardware
- Datacenter is a controlled environment
- Thin client has no moving parts
- Longer refresh cycles

Less Consumption

- Energy efficiency
- Fewer physical devices
- Network bandwidth

Scalability

- Additional resources can be added dynamically
- Upgrades are non-disruptive
- Additional desktops are easily provisioned

Centralized Management and Control

- Lower support ratios
  - More reliable infrastructure
  - Issues can be fixed remotely
  - Fewer physical hardware devices to manage
- Software licensing easier to manage
  - Enables use of enterprise licensing

VDI vs. TCS

- VDI
  - Customizable desktop
  - Multiple OS on same server
  - Applications cannot conflict
  - Active load balancing
  - Virtual resources (memory over commit)
- TCS
  - Lower overhead allows more users per server
  - Less storage space required
  - Connectivity to multiple networks over a single wire through Trusted OS

Disadvantages of VDI and TCS

- No connectivity = no desktop
- Limited ability to display robust multi-media (Full Screen HD video)
- Limited ability to support 3D graphics and CAD applications
- Limited support for peripheral devices (TCS especially)

Cost Element Structure

1.0	Hardware
1.1	User Interface
1.2	Servers
1.3	Storage
2.0	Software
3.0	Maintenance/Recurring Licensing
4.0	Network
5.0	Labor
5.1	Design
5.2	Install
5.3	Operations
6.0	Electrical Consumption
7.0	Data Center Operations

Cost Analysis Assumptions

Investment Assumptions	
Real Discount Rate	2.30%
Investment Lifecycle	13 Years

Tech Refresh Cycle Assumptions	
Server	5 Years
Software	5 Years
Thin Clients	7 Years
Desktop "Thick Client"	3 Years

User Assumptions	
Network 1 Users	10,000
Network 2 Users	2,000
Network 3 Users	10,000

Virtualization Ratio Assumptions	
VDI Solution	28:1
TCS Solution	40:1

Support Ratios	
Tier 1	**FTE**
VDI Solution	.150 per 100 users
TCS Solution	.150 per 100 users
Baseline Distributed Computing	.200 per 100 users
Tier 2	
VDI Solution	.050 per 100 users
TCS Solution	.050 per 100 users
Baseline Distributed Computing	.150 per 100 users
Tier 3	
VDI Solution	.050 per 100 users
TCS Solution	.050 per 100 users
Baseline Distributed Computing	0.025 per 100 users

Environmental Assumptions	
Energy Rate	0.11 $/KWH
Datacenter Annual Cost / Sqft	8.39 $/sqft
Datacenter Annual Cost / Rack	234.92 $/year

Cost Analysis Results – Initial CAPEX

- Baseline has lowest initial CAPEX

Alternative	Cost $000s	Percent of Baseline
VDI	18,255	127%
TCS	15,986	111%
Baseline	14,381	100%

- VDI requires more HW and SW due to fewer users per server compared to TCS and greater storage requirements

- Baseline CAPEX highly dependent on desktop unit price
  - $606 desktop unit price assumed based on 30% discount from list from major manufacturer

Cost Analysis Results – Labor Operations

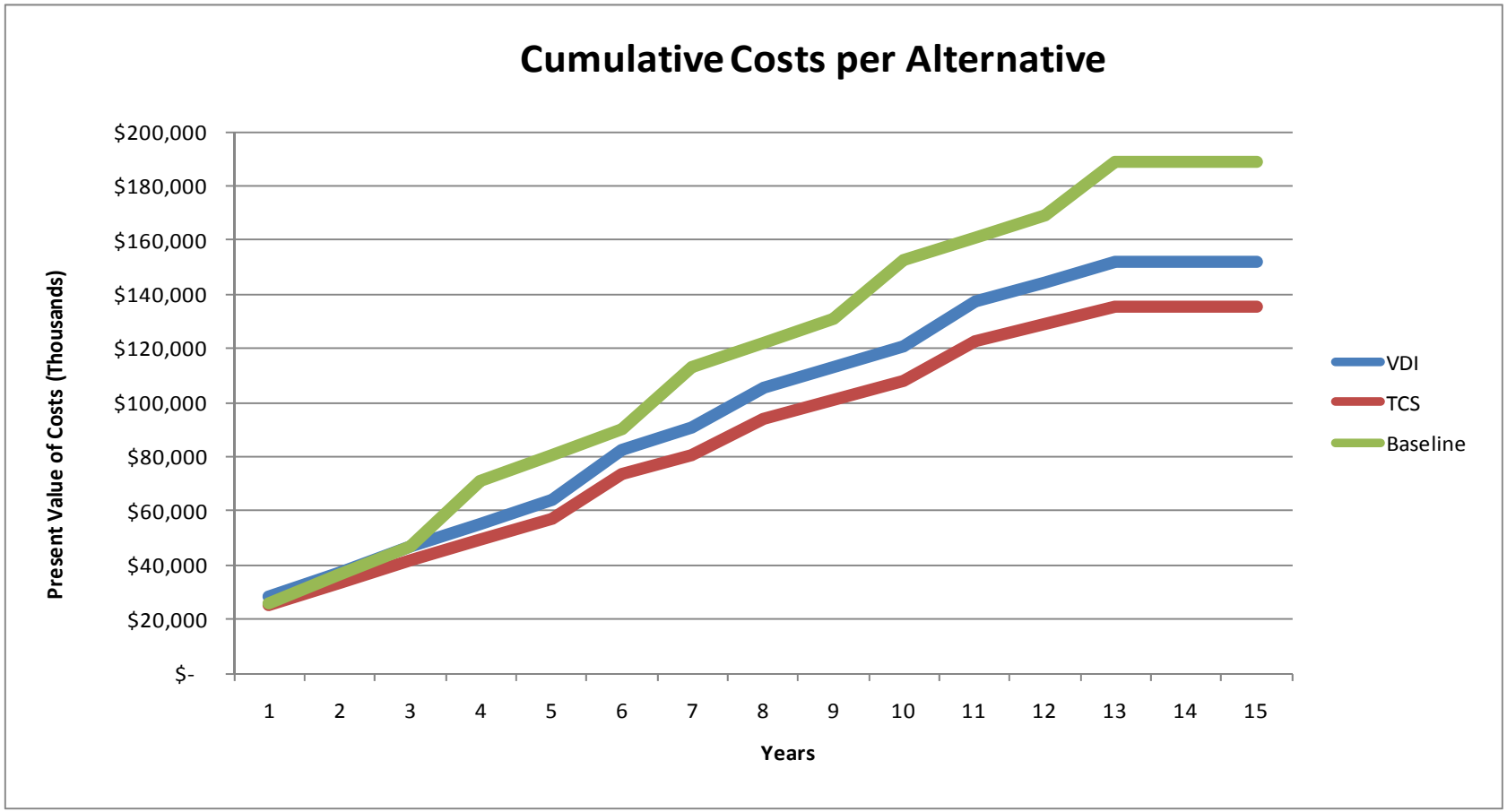
- Baseline alternative's CAPEX advantage is quickly erased by higher labor costs for operations
- Annual operations labor is ~30% lower for VDI and TCS than the baseline
- VDI and TDS have one support person for every 182 users
- Baseline has one support person for every 121 users

Alternative	Tier	FTEs	Annual Cost $000s
VDI & TCS	1	33	3,243
VDI & TCS	2	11	1,206
VDI & TCS	3	11	1,663
VDI & TCS	**TOTAL**	**55**	**6,112**
Baseline	1	44	4,324
Baseline	2	33	3,617
Baseline	3	5.5	832
Baseline	**TOTAL**	**82.5**	**8,773**

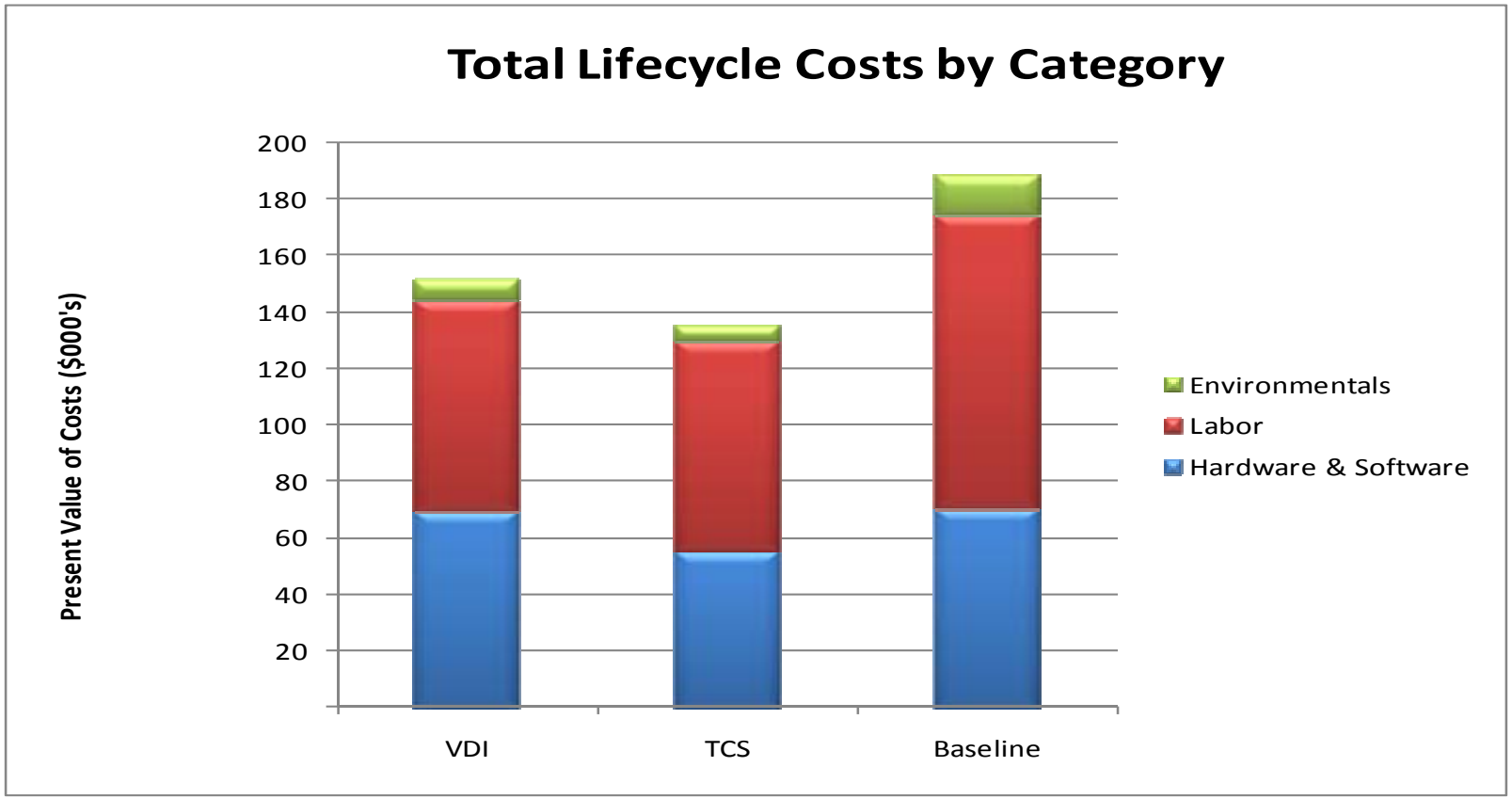
Cost Analysis Results – Lifecycle Costs

Discounted 2010 Dollars		VDI Costs	TCS Costs	Baseline Costs
1.0	Hardware	$ 31,418	$ 32,549	$ 58,449
1.1	User Interface	$ 12,229	$ 11,117	$ 58,449
1.2	Servers	$ 16,447	$ 19,065	$ -
1.3	Storage	$ 2,743	$ 2,366	$ -
2.0	Software	$ 26,307	$ 15,854	$ 4,580
3.0	Maintenance/Recurring Licensing	$ 4,783	$ 131	$ -
4.0	Network	$ 7,012	$ 6,375	$ 7,012
5.0	Labor	$ 74,887	$ 74,716	$ 104,303
5.1	Design	$ 2,216	$ 2,216	$ -
5.2	Install	$ 3,094	$ 2,924	$ 4,435
5.3	Operations	$ 69,576	$ 69,576	$ 99,868
6.0	Electrical Consumption	$ 7,221	$ 5,694	$ 14,654
7.0	Data Center Operations	$ 43	$ 37	$ -
TOTAL		**$ 151,670**	**$ 135,356**	**$ 188,998**

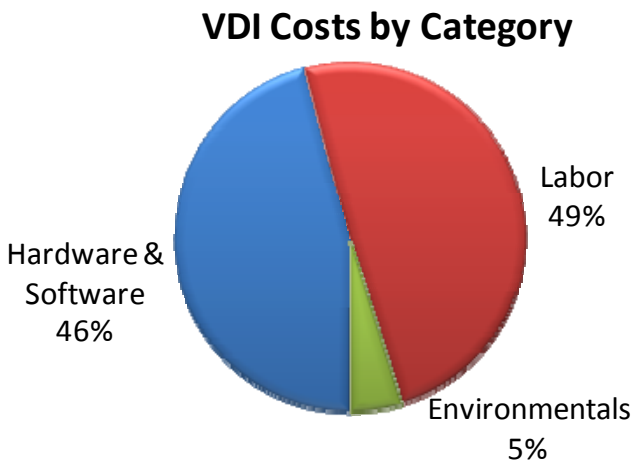
Cost Analysis Results – Lifecycle Costs

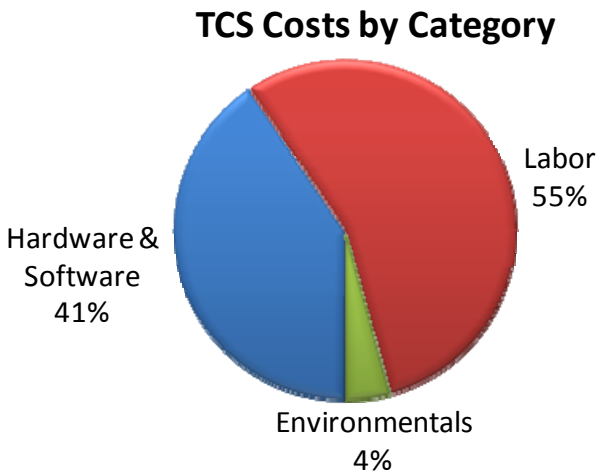


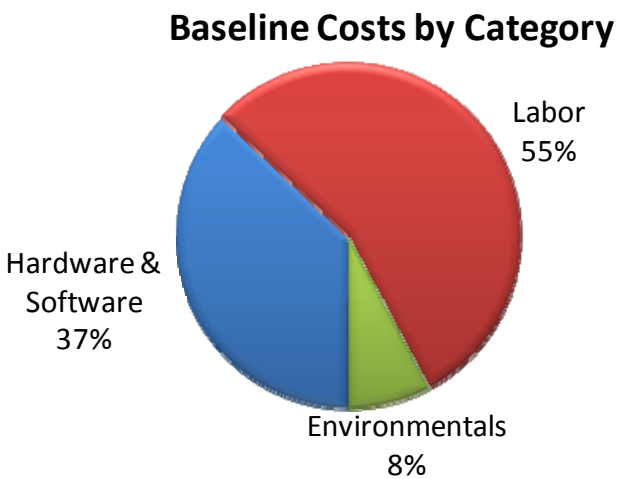
Cost Analysis Results



Cost Analysis Results







Cost Analysis Results – Simple Return on Investment

- The TCS solution had the highest ROI over the 13-year lifecycle because the higher number of users per server allowed for lower hardware costs and installation labor

Alternative	Simple ROI over lifecycle	Annualized ROI
VDI	24.61%	1.89%
TCS	39.63%	3.05%

Cost Drivers

- Labor Operations Support Ratios
- Virtualization Ratios
- Tech Refresh Cycles

Sensitivity Analysis –Refresh Rates

- Both VDI and TCS alternatives retained positive ROI in alternate refresh rate scenarios

Sensitivity Chart Desktop Tech Refresh

Alternative	3-Year	4-Year	5-Year	6-Year
VDI	24.61%	15.73%	7.42%	6.86%
TCS	39.63%	29.68%	20.37%	19.74%

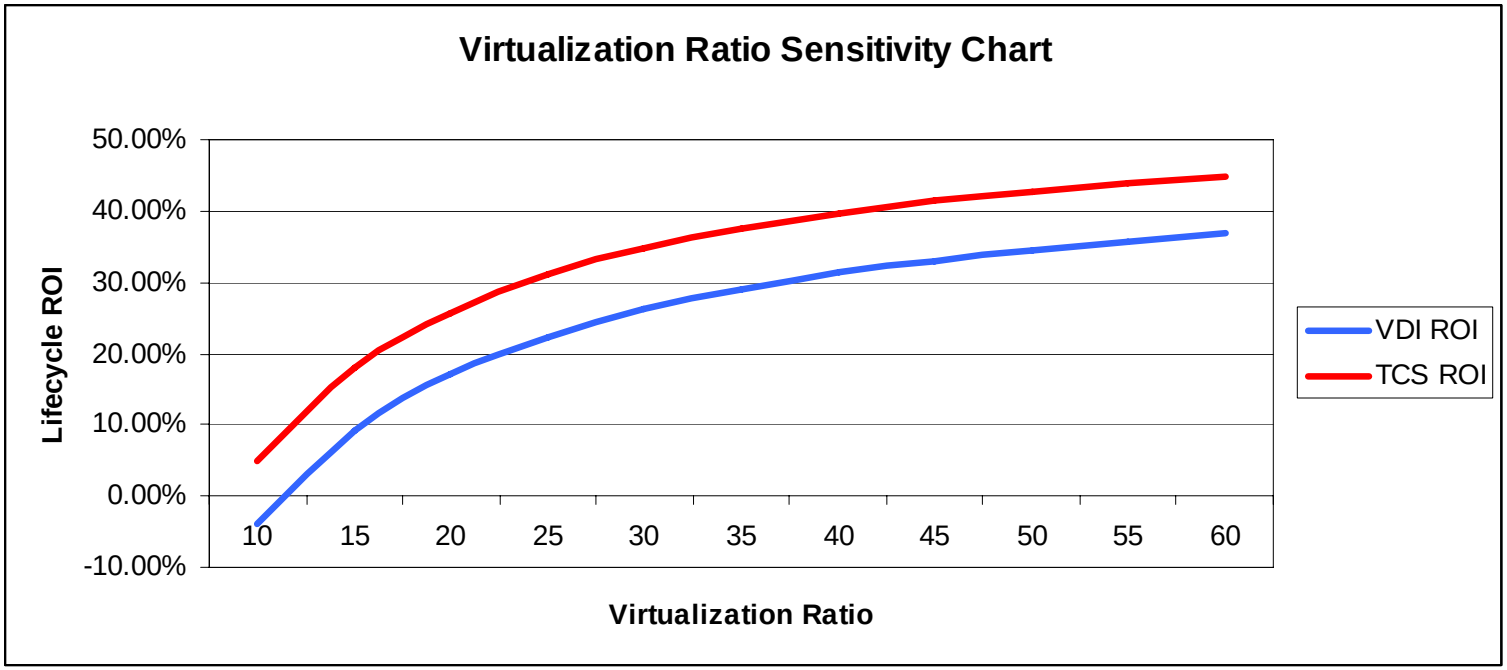
Sensitivity Chart Thin Client Tech Refresh

Alternative	5-Year	6-Year	7-Year	8-Year
VDI	19.59%	19.91%	24.61%	24.73%
TCS	33.90%	34.27%	39.63%	39.77%

Sensitivity Chart Server & SW Tech Refresh

Alternative	3-Year	4-Year	5-Year	6-Year
VDI	10.64%	17.44%	24.61%	25.13%
TCS	24.02%	31.62%	39.63%	40.21%

Sensitivity Analysis –Virtualization Ratio



Sensitivity Analysis – Labor Support Ratios

Sensitivity Chart Operations Labor Support Ratio

	60%	85%	100%	115%	130%
VDI ROI	52.61%	33.82%	24.61%	16.59%	9.54%
TCS ROI	75.77%	51.30%	39.63%	29.63%	20.97%

Cost Analysis Limitations

- Requires economies of scale
  - Large economies of scale with software and hardware
  - Small economies of scale with baseline desktop hardware
  - Support ratio assumptions are valid only for large enterprises
- Support ratios dependent on complexity of baseline environment
- Number and nature of legacy applications will determine the difficulty in migrating to a new desktop operating model
- Application virtualization can impact VDI and TCS strategy and costs

Emerging Desktop Technology Trends

- Enterprise migrations to Windows 7
- Continued improvement to VDI software offerings
  - Enhanced multimedia support
  - On the fly de-duplication of storage
- Hardware improvement
  - Higher virtualization ratios
  - Continued rapid decline in enterprise storage costs per terabyte
- Public Cloud Offerings– Desktops as a service

Conclusion

- VDI is a viable desktop strategy that provides cost savings to large enterprises over a traditional distributed computing model
- VDI may require new charge-back models for shared and virtualized resources
- The economics of VDI will continue to improve through
  - Competition among VDI software vendors
  - Declining storage costs
  - Increasing server capabilities
- Desktops as a Service will bring VDI to small business