

Total Cost of Ownership Comparison of PCs With Hosted Virtual Desktops

Mark A. Margevicius, Michael A. Silver, Federica Troni

The total costs associated with owning and operating PCs are significant and complex. As organizations struggle with cost management, they are evaluating alternatives to traditional desktops that can potentially save money. Hosted virtual desktops (HVDs) are one such alternative that can deliver on reducing cost.

Key Findings

- The total cost of ownership (TCO) of HVDs can range between 2% and 10% lower than comparable desktops.
- For many organizations, capital costs will remain a barrier to adoption of HVDs, due to the infrastructure costs associated with servers, networks and storage.
- HVDs have benefits that are not captured by the TCO model, such as being a solution for remote access, offering better physical security and fulfilling compliance needs.

Recommendations

- Organizations evaluating HVDs should use TCO as one of the criteria in determining the appropriateness of this architecture. Most organizations that implement this architecture should also realize that an infrastructure build-out will likely be required. We caution organizations to lay out a complete data management strategy as part of the plan because the amount of storage (and how it is backed up) can dramatically affect capital costs.

ANALYSIS

Issues related to operating system migrations, PC replacements, operational PC costs and PC security concerns have organizations questioning their client-computing strategies. One solution is HVDs. The appeal of delivering the desktop from a centralized infrastructure without a noticeable compromise in user experience, ease of migration and better physical security are attractive to organizations of all sizes. This hybrid "centralized-distributed computing" approach offers an environment that is more easily managed, controlled, secured and supported. But the data center build-out required for desktop services is a costly proposition, and needs to be carefully planned and budgeted.

Gartner's TCO model is a model of costs that are typically seen in many organizations, and not a measurement of actual customer costs. The TCO model should act as a framework to help customers understand the major cost categories associated with HVDs. Migration costs are not included, and must be factored into the organization's return on investment (ROI). We also recommend that all organizations evaluating HVDs estimate their costs to understand what their situations would be.

TCO is not an ROI analysis, and many organizations will choose to implement a given architecture or technology (in this case, HVDs) because it delivers tangible benefits besides cost savings. TCO defines the cost side of the value equation; organizations also are encouraged to determine their ROIs as part of any technology investments.

Assumptions

For this TCO model, we have made several assumptions about the "typical" computing environment. We have also established four different use scenarios that are common among organizations. For all scenarios, we assume that each organization has 2,500 users, is deploying thin-client hardware as user devices, and is centralizing its HVDs in the same data center. We assume that each user will have a static virtual machine that needs to be provisioned, deployed and maintained. We also assume that the organization is highly centralized and has relatively low geographical complexity (that is, campus environment). More-dispersed organizations may have significantly different costs, especially for improved network communications, in an HVD desktop environment. For labor costs, we use the salary costs outlined in Figure 1.

Figure 1. Base Annual Salaries Used (a 33% Burden Rate Is Included)

Tier 1	\$ 45,000
Tier 2	65,000
Tier 3	85,000
Manager	80,000
Data Entry User	\$ 25,000
Structured-Task User	45,000
Knowledge Worker	80,000
Power User	150,000

Source: Gartner (August 2008)

Four Different Scenarios

In selecting different scenarios, we have attempted to define the most-common uses of HVDs. The primary differences between the different scenarios are the types of servers used, the amount of storage required per user and the level of concurrency that can be used for the HVD infrastructure.

For all scenarios, we assume that thin-client devices cost \$400 each and have an expected life cycle of six years, Microsoft Windows costs \$110 per client device per year as part of Vista Enterprise Centralized Desktop (covering a thin-client device), and server costs are \$10,000 for a dual-socket quad-core and \$6,000 for a dual-socket dual-core. Servers have an expected life cycle of four years. Application software costs are the same as a comparable desktop configuration, where we allocate \$1,162 per user. We also allocate \$150 per user for server virtualization and brokering software, and allocate storage costs at \$2 per month per gigabyte (5GB costs \$10 per month). The final assumption we make is that each core of the server microprocessor supports five concurrent users, which means that an eight-way server supports 40 users, while a four-way server supports 20 users. The costs presented are per user per year.

It is important to understand that these are the assumptions for this model and that organizations are encouraged to create their own models with appropriate assumptions. For example, some organizations may choose to increase the number of users per core to six or seven, change the amount of user storage from 5GB to 10GB and may choose to leverage old PCs versus buying thin clients.

Scenario 1

In this scenario — typically implemented for task-oriented users or knowledge workers — users have a dedicated virtual machine and administer their own images, and they can add software from the Internet and other sources. We assume that the organization will support the 2,500 users concurrently on 63 dual-socket quad-core servers, where each user requires 5GB of storage for applications and data. The detailed costs associated with this scenario are seen in Figure 2. The TCO for this scenario is \$5,315 per user per year; of that, \$3,073 (58%) are end-user costs and \$2,242 (42%) are direct costs.

Figure 2. Scenario 1: 2,500 Concurrent Users, Dual-Socket Quad-Core Servers, 5GB Storage Per User

HVDs TCO Scenario 1	Client Cost per User	Server Cost per User	Total Cost per User
Hardware	\$ 70	\$ 83	\$ 153
Hardware Maintenance	60	8	68
Software	885	19	904
Software Maintenance	155	4	159
IT Software	70	25	95
Data Center Allocation	-	15	15
Hardware, Software and Facilities	\$ 1,240	\$ 153	\$ 1,393
Tier 1	\$ 126	\$ -	\$ 126
Tier 2	62	4	67
Tier 3	114	3	117
Security	45	8	53
Desktop Management	117	8	125
IT Operations	\$ 464	\$ 23	\$ 487
Administration	\$ 86	\$ 5	\$ 91
Management	78	1	79
User Training	45	-	45
IT Training	-	-	-
Disposal	25	1	26
Storage Allocation	120	-	120
Third-Party Services (Software)	-	-	-
Administration	\$ 354	\$ 7	\$ 362
Training	\$ 442	\$ -	\$ 442
Fixing	2,502	-	2,502
Downtime	129	-	129
End-User Costs	\$ 3,073	\$ -	\$ 3,073
Hardware and Software	\$ 1,240	\$ 153	\$ 1,393
IT Operations Labor	464	23	487
Administration Labor	354	7	362
Direct Costs	\$ 2,059	\$ 183	\$ 2,242
End-User Costs	\$ 3,073	\$ -	\$ 3,073
TCO	\$ 5,131	\$ 183	\$ 5,315

Source: Gartner (August 2008)

Scenario 2

For this second scenario, we assume that the organization will support the 2,500 users concurrently on 125 dual-socket dual-core servers. Again, users are administrators with respect to their own images and can add software from the Internet or other sources and require 5GB of

storage each. The TCO for this scenario is \$5,399 (see Figure 3), of which end-user costs are \$3,073 (57%) and direct costs are \$2,242 (43%). This TCO scenario is \$84 more expensive than Scenario 1 because of the increased number of servers and additional supporting infrastructure.

Figure 3. Scenario 2: 2,500 Concurrent Users, Dual-Socket Dual-Core Servers, 5GB Per User

HVDs TCO Scenario 2	Client Cost per User	Server Cost per User	Total Cost per User
Hardware	\$ 70	\$ 100	\$ 170
Hardware Maintenance	60	9	69
Software	885	38	923
Software Maintenance	155	8	163
IT Software	70	50	120
Data Center Allocation	-	2	2
Hardware, Software and Facilities	\$ 1,240	\$ 206	\$ 1,446
Tier 1	\$ 126	\$ -	\$ 126
Tier 2	62	8	71
Tier 3	114	6	120
Security	45	16	61
Desktop Management	117	16	133
IT Operations	\$ 464	\$ 46	\$ 510
Administration	\$ 86	\$ 10	\$ 96
Management	79	3	81
User Training	45	-	45
IT Training	-	-	-
Disposal	25	3	28
Storage Allocation	120	-	120
Third-Party Services (Software)	-	-	-
Administration	\$ 355	\$ 15	\$ 370
Training	\$ 442	\$ -	\$ 442
Fixing	2,502	-	2,502
Downtime	129	-	129
End-User Costs	\$ 3,073	\$ -	\$ 3,073
Hardware and Software	\$ 1,240	\$ 206	\$ 1,446
IT Operations Labor	464	46	510
Administration Labor	355	15	370
Direct Costs	\$ 2,060	\$ 266	\$ 2,326
End-User Costs	\$ 3,073	\$ -	\$ 3,073
TCO	\$ 5,132	\$ 266	\$ 5,399

Source: Gartner (August 2008)

Scenario 3

Scenario 3 is identical to Scenario 2, with the exception of storage. In this simpler deployment (see Figure 4), users have a lower requirement to store data and no external storage is required. This may apply for organizations that are deploying HVDs on directly attached server storage, typical for smaller deployments (departmental or small business). By eliminating externally attached storage, organizations can reduce their TCO by 10%. Deployments that do not require additional external storage will become more common in the future, as new technologies for image provisioning and management, as well as the integration of other application delivery mechanisms, become available. This will enable the creation of images containing simply the operating system, with users' settings and applications delivered independently.

Figure 4. Scenario 3: Simple Configuration — 2,500 Concurrent Users, Dual-Socket Dual-Core Servers, No Storage Requirements

HVDs TCO Scenario 3	Client Cost per User	Server Cost per User	Total Cost per User
Hardware	\$ 70	\$ 100	\$ 170
Hardware Maintenance	60	9	69
Software	885	38	923
Software Maintenance	155	8	163
IT Software	70	50	120
Data Center Allocation	-	2	2
Hardware, Software and Facilities	\$ 1,240	\$ 206	\$ 1,446
Tier 1	\$ 126	\$ -	\$ 126
Tier 2	62	8	71
Tier 3	114	6	120
Security	45	16	61
Desktop Management	117	16	133
IT Operations	\$ 464	\$ 46	\$ 510
Administration	\$ 86	\$ 10	\$ 96
Management	79	3	81
User Training	45	-	45
IT Training	-	-	-
Disposal	25	3	28
Storage Allocation	-	-	-
Third-Party Services (Software)	-	-	-
Administration	\$ 235	\$ 15	\$ 250
Training	\$ 442	\$ -	\$ 442
Fixing	2,502	-	2,502
Downtime	129	-	129
End-User Costs	\$ 3,073	\$ -	\$ 3,073
Hardware and Software	\$ 1,240	\$ 206	\$ 1,446
IT Operations Labor	464	46	510
Administration Labor	235	15	250
Direct Costs	\$ 1,940	\$ 266	\$ 2,206
End-User Costs	\$ 3,073	\$ -	\$ 3,073
TCO	\$ 5,012	\$ 266	\$ 5,279

Source: Gartner (August 2008)

Scenario 4

For this final scenario, we recognize that some customers will deploy HVDs to take advantage of concurrency. These scenarios are common for organizations that have groups in different time zones, run 24/7 operations (such as call centers) and where the work day is divided into three

shifts of eight hours each. Our assumptions for this model include a 3-to-1 concurrency level (one thin client for every three users), meaning that we will have 7,500 users, but can only support 2,500 users on the system concurrently. Under this scenario, we assume that users are locked down and cannot change their system images. Other assumptions include deployment on 63 dual-socket quad-core servers, where each user requires 5GB of storage. The TCO of this model yields the lowest of all the scenarios, primarily because of decreased capital costs. By comparison, Scenario 4 is 48% to 49% less costly than Scenarios 1, 2 and 3 (see Figure 5). The costs presented for Scenario 4 are per user, not per device.

Figure 5. Scenario 4: 3:1 Concurrency, 5GB of Storage Per User, Dual-Socket Quad-Core Servers

HVDs TCO Summary: Scenario 4	Client Cost per User	Server Cost per User	Total Cost per User
Hardware and Software	\$ 378	\$ 52	\$ 430
IT Operations Labor	230	7	238
Administration Labor	318	2	321
Direct Costs	\$ 927	\$ 61	\$ 988
End-User Costs	\$ 1,244	\$ -	\$ 1,244
TCO	\$ 2,171	\$ 61	\$ 2,232

Source: Gartner (August 2008)

HVDs TCO Comparisons Between Hosted Virtual Clients and PCs

Most organizations use different levels of manageability to support their lines of business and their users. Many organizations struggle with the degree of manageability; some clients require very tight control of a PC's operations (for example, in finance and government) while others choose to manage in a more laissez faire fashion. Similarly, with HVDs, organizations can decide whether they want to allow users to install their own applications or whether they want to prevent it.

To accommodate the spectrum of manageability, Gartner uses four levels of manageability in its TCO models:

- **Wide open** — Users can install applications, change settings; little to no management tools used
- **Somewhat managed** — Some management tools, but light on process and policy
- **Moderately managed** — Tools and good processes and policies, but users can install software and change at least some settings
- **Locked down and well-managed** — Intense use of tools, established processes and policies in place, users are locked down and cannot install software or change critical settings

The first three levels of manageability yield a TCO that is less costly or similar to that of a comparable desktop (see Figures 6, 7 and 8). In Figure 9, we list the TCO improvements for locked-down and well-managed environments. The improved TCO ranges anywhere between 2% and 10% for comparable desktop environments, with the average savings around 6%. Regardless of the degree of manageability, Scenario 3 yielded the best cost savings compared

with desktops, with an average of 8%. Scenario 1 closely follows with a 7% savings, while Scenario 2 saves on average 5% over comparable desktops. Deeper analysis shows that in all scenarios, most cost savings are those attributed to improvements in end-user productivity. In our client conversations, many customers identify end-user costs as "soft costs," which are difficult to quantify. Equally telling, an issue identified by clients is the cost associated with hardware and software. In all scenarios, the capital costs associated with HVDs are equal to or slightly higher (5% to 10%) than with comparable desktops. Although not ideal, these capital costs are offset by lower labor costs for HVDs, which makes the direct costs for HVDs 1% to 7% higher. Table 1 notes the percentage savings by scenario and level of manageability.

Table 1. HVD Savings Over Comparable Desktops

	Unmanaged	Somewhat Managed	Moderately Managed	Locked Down and Well-Managed	Average TCO Savings per Scenario
Scenario 1	9%	8%	7%	2%	7%
Scenario 2	8%	7%	5%	(0.4%)	5%
Scenario 3	10%	9%	8%	4%	8%

Source: Gartner (August 2008)

Figure 6. HVDs TCO Comparison: Unmanaged Scenarios

HVDs TCO: Comparison of Different Levels of Manageability	Unmanaged Desktops	Unmanaged HVD 1	Unmanaged HVD 2	Unmanaged HVD 3
Hardware	\$ 300	\$ 153	\$ 170	\$ 170
Hardware Maintenance	42	68	69	69
Software	750	904	923	923
Software Maintenance	150	159	163	163
IT Software	70	95	120	120
Data Center Allocation	-	15	2	2
Hardware, Software and Facilities	\$ 1,312	\$ 1,393	\$ 1,446	\$ 1,446
Tier 1	\$ 117	\$ 126	\$ 126	\$ 126
Tier 2	228	67	71	71
Tier 3	98	117	120	120
Security	97	53	61	61
Desktop Management	151	125	133	133
IT Operations	\$ 690	\$ 487	\$ 510	\$ 510
Administration	\$ 74	\$ 91	\$ 96	\$ 96
Management	68	79	81	81
User Training	30	45	45	45
IT Training	14	-	-	-
Disposal	30	26	28	28
Storage Allocation	-	120	120	-
Third-Party Services (Software)	-	-	-	-
Administration	\$ 216	\$ 362	\$ 370	\$ 250
Training	\$ 442	\$ 442	\$ 442	\$ 442
Fixing	3,019	2,502	2,502	2,502
Downtime	187	129	129	129
End-User Costs	\$ 3,649	\$ 3,073	\$ 3,073	\$ 3,073
Hardware and Software	\$ 1,312	\$ 1,393	\$ 1,446	\$ 1,446
IT Operations Labor	690	487	510	510
Administration Labor	216	362	370	250
Direct Costs	\$ 2,218	\$ 2,242	\$ 2,326	\$ 2,206
End-User Costs	\$ 3,649	\$ 3,073	\$ 3,073	\$ 3,073
TCO	\$ 5,867	\$ 5,315	\$ 5,399	\$ 5,279

Source: Gartner (August 2008)

Figure 7. HVDs TCO Comparison: Somewhat-Managed Scenarios

HVDs TCO: Comparison of Different Levels of Manageability	Somewhat- Managed Desktops	Somewhat- Managed HVD 1	Somewhat- Managed HVD 2	Somewhat- Managed HVD 3
Hardware	\$ 299	\$ 153	\$ 170	\$ 170
Hardware Maintenance	43	68	69	69
Software	725	873	892	892
Software Maintenance	150	159	163	163
IT Software	75	99	124	124
Data Center Allocation	-	15	2	2
Hardware, Software and Facilities	\$ 1,293	\$ 1,367	\$ 1,420	\$ 1,420
Tier 1	\$ 111	\$ 119	\$ 119	\$ 119
Tier 2	193	57	61	61
Tier 3	99	109	112	112
Security	90	49	57	57
Desktop Management	146	116	124	124
IT Operations	\$ 639	\$ 450	\$ 473	\$ 473
Administration	\$ 72	\$ 88	\$ 93	\$ 93
Management	68	79	81	81
User Training	31	47	47	47
IT Training	15	-	-	-
Disposal	30	26	28	28
Storage Allocation	-	125	125	-
Third-Party Services (Software)	-	-	-	-
Administration	\$ 215	\$ 365	\$ 374	\$ 248
Training	\$ 433	\$ 433	\$ 433	\$ 433
Fixing	2,539	2,104	2,104	2,104
Downtime	150	102	102	102
End-User Costs	\$ 3,122	\$ 2,639	\$ 2,639	\$ 2,639
Hardware and Software	\$ 1,293	\$ 1,367	\$ 1,420	\$ 1,420
IT Operations Labor	639	450	473	473
Administration Labor	215	365	374	248
Direct Costs	\$ 2,147	\$ 2,183	\$ 2,267	\$ 2,141
End-User Costs	\$ 3,122	\$ 2,639	\$ 2,639	\$ 2,639
TCO	\$ 5,269	\$ 4,822	\$ 4,906	\$ 4,781

Source: Gartner (August 2008)

Figure 8. HVDs TCO Comparison: Moderately Managed Scenarios

HVDs TCO: Comparison of Different Levels of Manageability	Moderately Managed Desktops	Moderately Managed HVD 1	Moderately Managed HVD 2	Moderately Managed HVD 3
Hardware	\$ 298	\$ 153	\$ 169	\$ 169
Hardware Maintenance	44	68	70	70
Software	699	843	862	862
Software Maintenance	150	159	163	163
IT Software	79	104	129	129
Data Center Allocation	-	15	2	2
Hardware, Software and Facilities	\$ 1,271	\$ 1,341	\$ 1,394	\$ 1,394
Tier 1	\$ 105	\$ 113	\$ 113	\$ 113
Tier 2	159	48	52	52
Tier 3	92	101	104	104
Security	81	45	53	53
Desktop Management	135	107	115	115
IT Operations	\$ 572	\$ 414	\$ 436	\$ 436
Administration	\$ 69	\$ 84	\$ 89	\$ 89
Management	68	78	80	80
User Training	32	49	49	49
IT Training	15	-	-	-
Disposal	30	26	28	28
Storage Allocation	-	131	131	-
Third-Party Services (Software)	-	-	-	-
Administration	\$ 214	\$ 369	\$ 377	\$ 246
Training	\$ 424	\$ 424	\$ 424	\$ 424
Fixing	2,059	1,706	1,706	1,706
Downtime	111	76	76	76
End-User Costs	\$ 2,594	\$ 2,206	\$ 2,206	\$ 2,206
Hardware and Software	\$ 1,271	\$ 1,341	\$ 1,394	\$ 1,394
IT Operations Labor	572	414	436	436
Administration Labor	214	369	377	246
Direct Costs	\$ 2,056	\$ 2,123	\$ 2,207	\$ 2,077
End-User Costs	\$ 2,594	\$ 2,206	\$ 2,206	\$ 2,206
TCO	\$ 4,650	\$ 4,329	\$ 4,413	\$ 4,282

Source: Gartner (August 2008)

Figure 9. HVDs TCO Comparison: Locked-Down and Well-Managed Scenarios

HVDs TCO: Comparison of Different Levels of Manageability	Locked- Down and Well-Managed Desktops	Locked- Down and Well-Managed HVD 1	Locked- Down and Well-Managed HVD 2	Locked- Down and Well-Managed HVD 3
Hardware	\$ 294	\$ 152	\$ 169	\$ 169
Hardware Maintenance	45	69	70	70
Software	648	782	801	801
Software Maintenance	150	159	163	163
IT Software	88	112	137	137
Data Center Allocation	0	15	2	2
Hardware, Software and Facilities	\$ 1,226	\$ 1,288	\$ 1,341	\$ 1,341
Tier 1	\$ 93	\$ 101	\$ 101	\$ 101
Tier 2	91	29	33	33
Tier 3	77	84	87	87
Security	64	37	45	45
Desktop Management	112	90	97	97
IT Operations	\$ 438	\$ 340	\$ 363	\$ 363
Administration	\$ 63	\$ 78	\$ 82	\$ 82
Management	68	77	80	80
User Training	35	53	53	53
IT Training	15	-	-	-
Disposal	30	26	28	28
Storage Allocation	-	142	142	-
Third-Party Services (Software)	-	-	-	-
Administration	\$ 210	\$ 376	\$ 385	\$ 243
Training	\$ 406	\$ 406	\$ 406	\$ 406
Fixing	1,099	911	911	911
Downtime	33	22	22	22
End-User Costs	\$ 1,539	\$ 1,339	\$ 1,339	\$ 1,339
	\$ -			
Hardware and Software	\$ 1,226	\$ 1,288	\$ 1,341	\$ 1,341
IT Operations Labor	438	340	363	363
Administration Labor	210	376	385	243
Direct Costs	\$ 1,874	\$ 2,005	\$ 2,089	\$ 1,947
End-User Costs	\$ 1,539	\$ 1,339	\$ 1,339	\$ 1,339
TCO	\$ 3,413	\$ 3,344	\$ 3,428	\$ 3,286

Source: Gartner (August 2008)

In conclusion, we compare Scenario 4, where we have a 3-to-1 user-to-device ratio, with a similar desktop scenario. In both cases, we have 2,500 client devices and 7,500 users, only 2,500 of which will use the client device concurrently (see Figure 10). Both deployments are locked and

well-managed. The HVDs scenario has a 1% lower overall TCO, but 11% higher direct costs. The costs presented for this scenario are per user, not per device.

Figure 10. 3-to-1 User-to-Device Ratio

3:1 User to Device Ratio	Locked-Down and Well-Managed Desktops — 3:1 User-to-Device Ratio	HVD 3:1 User-to-Device Ratio — Total Cost per User
Hardware	\$ 101	\$ 51
Hardware Maintenance	15	23
Software	216	261
Software Maintenance	50	53
IT Software	29	38
Data Center Allocation	-	5
Hardware, Software and Facilities	\$ 412	\$ 430
Tier 1	\$ 69	\$ 85
Tier 2	88	23
Tier 3	24	28
Security	24	13
Desktop Management	118	89
IT Operations	\$ 323	\$ 238
Administration	\$ 38	\$ 50
Management	57	67
User Training	32	53
IT Training	12	-
Disposal	10	9
Storage Allocation	-	142
Administration	\$ 150	\$ 321
Training	\$ 365	\$ 377
Fixing	964	846
Downtime	30	21
End-User Costs	\$ 1,359	\$ 1,244
Hardware and Software	\$ 412	\$ 430
IT Operations Labor	323	238
Administration Labor	150	321
Direct Costs	\$ 885	\$ 988
End-User Costs	\$ 1,359	\$ 1,244
TCO	\$ 2,243	\$ 2,232

Source: Gartner (August 2008)

This research is part of a set of related research pieces. See "Extending the Gartner PC Total Cost of Ownership Model to Alternative Client Technologies" for an overview.

REGIONAL HEADQUARTERS

Corporate Headquarters

56 Top Gallant Road
Stamford, CT 06902-7700
U.S.A.
+1 203 964 0096

European Headquarters

Tamesis
The Glanty
Egham
Surrey, TW20 9AW
UNITED KINGDOM
+44 1784 431611

Asia/Pacific Headquarters

Gartner Australasia Pty. Ltd.
Level 9, 141 Walker Street
North Sydney
New South Wales 2060
AUSTRALIA
+61 2 9459 4600

Japan Headquarters

Gartner Japan Ltd.
Aobadai Hills, 6F
7-7, Aobadai, 4-chome
Meguro-ku, Tokyo 153-0042
JAPAN
+81 3 3481 3670

Latin America Headquarters

Gartner do Brazil
Av. das Nações Unidas, 12551
9º andar—World Trade Center
04578-903—São Paulo SP
BRAZIL
+55 11 3443 1509