Linux Thin-Client Conversion in a Large Cardiology Practice: Initial Experience

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DESCRIPTION OF THE MEDICAL PRACTICE

Capital Cardiology Associates (CCA) is a single-specialty cardiology practice with offices in New York (Albany, Troy, Oneonta and Latham) and Massachusetts (Pittsfield). In 2003, CCA converted its IT system from a Microsoft-based network to a Linux network employing Linux thin-client technology.

CCA consists of more than 40 physicians, surgeons and providers, practising in seven offices and seven hospitals in New York and Massachusetts and employing approximately 200 employees. In 2003, activity stats were: 128,000 patient visits (office and hospitals), 92,000 diagnostic tests, 6,000 catheterizations and interventions, 800 open-heart surgeries and more than 380,000 billed services with yearly revenue of more than US$22 million.

CCA is highly wired with extensive MIS dependency. Applications include eScribe, an Oracle-driven, Internet-based electronic patient record (http://www.escribeonline.com), billing and patient data collection (Medical Manager, AIX-based), pacemaker-monitoring application (PACEART), cardiac catheterization and procedure imaging applications, patient services tracking (via spreadsheets), financial and business applications (MAS 90, FRx), analytical software (Touchpoint), payroll and employee time monitoring (Kronos, ADP), word processing and general spreadsheets, physician and employee shared time schedules, shared Intranet-based daily hospital rounds and procedure activity lists, hospital patient data access (via Citrix), e-mail, calendaring and address books.

THE BUSINESS SITUATION IN 2003

Rapid network expansion due to rapid (>15%) yearly growth over the previous seven years necessitated extensive upgrading of the entire network, which was installed in 1997 and was a mixed environment of MSWindows 95, 98, and 2000. The options included upgrading everyone to Windows 2000, or going with a Linux solution. We operate out of seven offices and an additional seven hospitals, so we are heavily dependent on fast and simple access to our office systems from all locations. Having an enterprise-wide stable environment that could be centrally managed to eliminate expensive remote desktop support was one of the major business goals in this transition.

We analyzed the core IT network features needed for optimal business conduct and agreed on the following:

a. Easy and fast inter-networking via broadband Internet where available
b. Shared file access environment
c. Low incremental cost of network expansion
d. Need for minimized remote on-site IT support
e. Complete integration of key business applications (billing, business records, EMR, diagnostic tests)
f. Low virus/worm susceptibility
g. Ability to restrict or eliminate user options and preferences to increase employee productivity
h. Long-term control and predictability of costs

Based on previous experiences with Windows 95/98 desktops, user abuse of non-business functions (e.g., games, music files, Internet, etc.) constituted a significant loss of employee productivity. If the average employee spends 15 minutes per day "playing" with the computer, he/she would waste more than 50 hours per year. At $15 per hour, that translates into $750 per employee each year. For 200 employees, the productivity loss could amount to $150,000 per year. Thus, we considered the ability to prevent those abuses an important network function. We believe that the structure of the standard Windows desktop actually entices employees to use and abuse non-business applications. Linux would much better control this cost.

WHAT APPLICATIONS DO EMPLOYEES REALLY NEED?

Most employees (patient check-in, patient check-out, billing, nursing and tech support) need only a few core functions:

1. MIS appointment and charge/payment posting
2. E-mail
3. Internet access (including our EMR)
4. Basic word processing and spreadsheet functions

More complex business applications are used by relatively few employees (accounting, payroll, analytical software).

The use of specialty diagnostic software (pacemaker checks etc.) is limited to a few technical employees.

We compared a Linux thick-and thin-client conversion to a Windows upgrade, and analyzed how each option would affect our core IT network features.

Microsoft's main strengths are the abundant availability of qualified vendors and technical support. Its main weaknesses include frequent crashes, high service costs due to frequent desktop problems, high virus/worm susceptibility and software costs.

Linux thick-client's main strength is the stability of the Linux operating system and its low susceptibility to virus damage. In addition, licensing costs are low to absent. The presence of a thick-client desktop, however, demands on-site desktop IT support as application software and programs reside on the local hard drive.

Linux thin client features all the advantages of the Linux thick client, plus the virtual absence of on-site desktop IT support. The thin client consists of a diskless ("dumb") computer that boots directly from a central server. All file and program access is off of central servers. The only remaining desktop hardware option is the power switch. Thus, there is virtually no desktop breakdown potential and onsite desktop IT service needs are minimal. There is no end-user abuse potential.

A COST COMPARISON OF THE LINUX DESKTOP – THICK VS. THIN

1. **Costs per added workstation** (*hardware, licences, installation support*) Thin client reduces costs: cheaper hardware and labour costs, no software costs.
2. **Remote locations.** Thin client greatly reduces remote onsite labour costs.
3. **Coordination of service and installations.** Thin client reduces installation costs. Desktops are configured centrally and simply plugged into the remote network. No significant onsite labour costs.
4. **User abuses.** Thin client reduces "user powers," thus increasing employee productivity.

COST COMPARISON: WINDOWS VS. LINUX

A. Servers

Hardware requirements for the central server, routers, switches, etc. are essentially the same with Linux as with Windows. Due to previous hardware obsolescence we had to do extensive upgrading of servers and routers.

Estimated costs for new hardware were $86,500 or $433 per desktop.

Labour and supply costs for cabling, network programming, initialization, migration and training were $107,500, or $538 per desktop. Total costs for servers and routers, etc. plus complete installation was $194,000 or $970 per desktop.

Our projections did estimate Windows to be between 5 and 10% less expensive depending on old hardware reuse.

B. Desktops

Incremental costs for each new or replaced desktop are listed below. Thin-client Linux is significantly cheaper at $800 per desktop vs. Windows at $1,600. This difference is mainly due to cheaper hardware and shorter installation time. The estimated hardware life of the thin-client appliance is at least 5 years, possibly up to 10.

Table 1: Incremental cost details for desktops

	Thick Client Microsoft	Thick Client Linux	Thin Client Linux
Desktop workstation/ appliance	$900	$800	$300
Flat panel monitor	$400	$400	$400
Install costs @ $50/hour	$300 6 h	$200 4 h	$100 2 h
Initial cost	$1,600	$1,400	$800

Desktop costs per year of operation including periodic software upgrades, onsite labour costs, and depreciation are far lower with Linux thin client at $233 vs. Windows at $830.

This steep difference is due to both much lower depreciation costs spread over more years as well as only minimal onsite labour costs.

LINUX INSTALLATION AND LESSONS LEARNED

The switchover was done over a weekend and was relatively painless for most employees. Linux worked as designed and all billing, appointment and clerical software worked flawlessly.

Table 2:

	Thick Client Microsoft	Thick Client Linux	Thin Client Linux
Hardware depreciation	$480 per year over 3–5 years	$413 per year over 3-5 years	$213 per year over 5 years
Yearly software upgrade costs	3-year renewal	$0	$0
Yearly desktop labour costs @ $50/hour	$250 5 h	$250 5 h	$200 4 h
Yearly costs: desktop and depreciation	$830	$663	$233

Proprietary software (accounting, human resources) initially did not adapt well due to lack of vendor support. Thus, subsequently we bypassed the issue by keeping these functions segregated on dedicated Windows boxes. Efforts are currently under way to remedy this problem with Windows emulation software such as Win4Lin by NetTraverse.

Other shortcomings include limitations of the Internet browser Mozilla. Some websites cannot be successfully accessed unless Windows Internet Explorer is used. We used emulation software and successfully bypassed this issue.

OpenOffice with word processing and spreadsheet programs works very well in our network environment, and for most users there is no significant difference between OpenOffice and MS Office. However, if files need to be sent out by e-mail, they must be saved in the Microsoft format so that the intended recipient can open them (unless he/she also uses OpenOffice).

Employee Training

One area of concern was adequate communication and training of employees.

The three most important steps in the conversion to Linux are communication, communication and communication. The transition was anxiety-provoking for many employees. Some minor changes such as a different log-on prompt, different icons and screen layout were cause for concern. Printing issues were another area of concern. Linux thin client uses a central configuration for all printers, thus the local desktop control typical for Windows is lost. A default printer is set up for each user as well as a menu to allow printing to other printers (even at other locations).

The ideal transition to Linux would have included advance training sessions on the new desktop as well as OpenOffice training. In this area we fell short and would have benefited from a more formal training and transition schedule.

However, due to the nature of work for most staff, the amount of training is very limited. The application programs on Linux are identical to Windows; there are no training issues. OpenOffice is not a Linux product. It is an open-source application providing functionalities similar to those of MSOffice 2000. Its main advantage is its price. It's free to download or is available at minimal cost from Red Hat or other vendors, including a download option from the Internet. It does require a few hours per user to become adequately familiar. This was accomplished within two to three weeks for most staff. For a larger organization, the software savings from not using Office 2000 are substantial and recurring.

IN HINDSIGHT: WAS IT WORTH IT?

Absolutely!

Network stability has been phenomenal: no downtime in more than eight months. Our system is configured with extensive system monitors to constantly monitor all vital signs and sound alarms (including direct cell phone calls) when alarm parameters are reached. Thus, processes that might lead to system crashes are monitored and remedied by IT staff before they become systemic.

Desktop maintenance has been outstanding. We had not a single desktop breakdown. We are in the process of slowly replacing the older, larger computers with new commercially available thin-client appliances that fit in your palm. These units will likely last for a very long time and are completely maintenance-free.

We are about eight months into the Linux Thin Client. We had estimated the yearly operating costs to be 37% less with it. These savings appear to be materializing nicely and we will likely exceed them in the future.

Figure 1: Cost Comparisons Between Thick MS, Thick LN and Thin LN

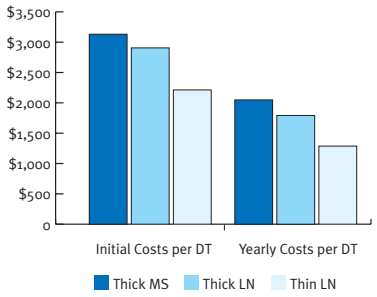

Figure 1 shows the cost comparisons between Windows (Thick MS), Linux thick client (Thick LN) and Linux thin client (Thin LN) for initial costs per desktop and yearly costs per desktop.

We believe that a healthcare business with IT needs similar to ours will be rewarded handsomely by switching to Linux thin client as a long-term IT business strategy.

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