



Sun Ray™ Overview

White Paper

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Overview of Sun Ray Computing

Although the concept of true thin client computing has beguiled software architects for many years, Sun engineers have made it a reality. Sun Ray technology is, to date, the only thin client of its kind to offer workstation-class user functionality, whether in LAN or WAN deployments. Originally developed on Sun's Solaris™ Operating System, Sun Ray Server Software is also available on Trusted Solaris for the SPARC architecture and on three Linux variants for the x86 architecture: Red Hat, SuSE, and Sun's Java Desktop System.

Introduction

Over the last several years, Sun Ray deployments in a wide variety of settings have repeatedly shown that thin client desktops can surpass ordinary PCs and workstations in raw performance, reliability, and stability while delivering significant return on investment (ROI).¹ Sun Ray thin clients, which are stateless and virtually free of mechanical breakdowns, enhance security with encryption and authentication in addition to the extra security that can be built into smart cards. With or without smart cards, however, Sun Ray session mobility enables users to access their work anywhere on a corporate local LAN or WAN,² or even from home.

Users find a rich functional environment through an “always on, always available” desktop resource at any available Sun Ray desktop unit (DTU). Mobility and freedom from ties to an individual desk or machine have increasing appeal, not only in a globalized economy, but also in an IT world where, as is the case with Sun's own campuses, telecommuting and office sharing have become increasingly common.

1. Forrester Research, *The Total Impact of Deploying Sun Ray Thin Clients*, March 2004.

2. Local Area Network (LAN) and Wide Area Network (WAN) are usually referred to by their acronyms.

In contrast to the cumbersome, expensive, labor-intensive computing models that struggle to manage hardware and software on a multiplicity of individual desktops, Sun Ray computing provides a powerful, elegant, efficient way to manage users and their sessions centrally.

Recently, IT management has had to focus increasingly on data security and integrity as well as on stemming the costs associated with desktop administration and maintenance. Sun has always recognized the importance of security. While Sun Ray thin client systems reduce expenditures, in many cases dramatically, they do not sacrifice functionality, performance, availability, or security. In fact, they provide extra stability and several levels of security unavailable on competing platforms.

What *Is* a Thin Client?

A thin client can be almost any computing device that enables users to perform computing tasks remotely, on a server. The prospect of coupling greater computing ability with the cost savings of economy of scale is the main reason why “client-server computing” became a buzz word throughout the 1990s.

At that time, the clients in most client-server models were either workstations or fully equipped PCs that interacted with large, server-resident applications. These applications were useful for data mining and esoteric scientific and engineering disciplines, among other things. The desktop machines, however, were properly considered clients, but not *thin* clients; in fact, because they were required to do a great deal of computing for ordinary tasks locally, they were more accurately characterized, then and now, as fat clients.

The need for complex desktop hardware, such as enterprise-level PCs — with local copies of proprietary software, constant component upgrades, and continual administrative overhead — diminished, and in many cases eliminated, the potential advantages of the client-server model. Even the popular Microsoft Windows-based terminals (WBTs) that are marketed today as thin clients seem much more like the old fat clients because of their many hardware components, expensive local software for productivity and connectivity, and even resident operating systems and browser software.³ In the case of WBTs, fat and somewhat thinner-client versions require a great deal of attention from users and system administrators alike.

3. These hardware and software components are customarily replaced on a three-year cycle, according to common practice as well as Moore’s Law.

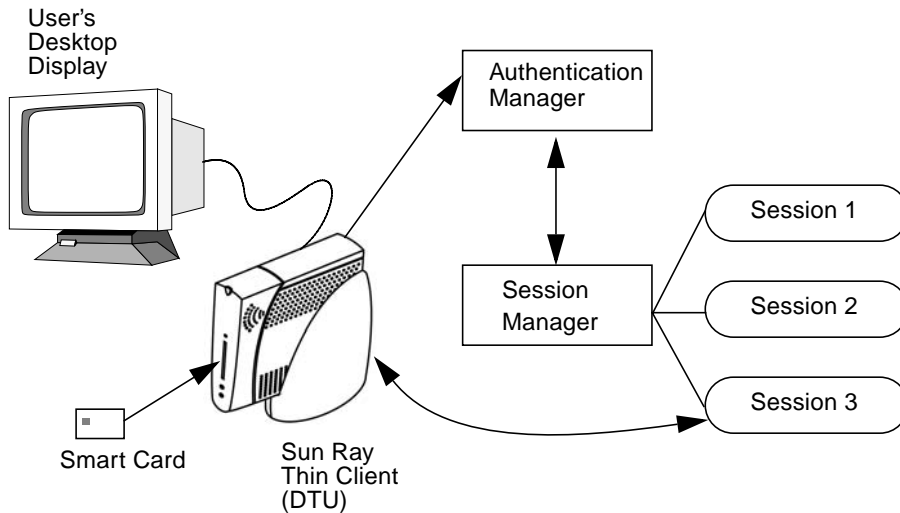
In contrast, although Sun Ray thin clients provide users with seamless access to all the applications and utilities they normally use on their workstations or PCs, *all* actual computing is performed on remote servers. The physical desktop unit — consisting of client, monitor, keyboard, mouse, and a built-in smart card reader — needs only enough memory and computing power to recognize keystrokes and mouse events and to display pixel data received from the server. No computing is performed locally, so the Sun Ray desktop unit (DTU) needs no local operating system, no hard drive, and no cooling fan. As a consequence, it seldom needs to be replaced.

Performing the most CPU-intensive computing tasks on a large server allows more work to be done than would be possible on individual workstations or PCs, with considerably greater efficiency in terms of time, money, and hardware and software resource utilization. At the same time, when the desktop is freed from local applications, files, operating system, and storage media, theft of the unit cannot lead to loss of data. The absence of local media, files, applications, and operating system — which is what defines a thin client as stateless — also means that the desktop does not require local administration. Instead, users are administered centrally, at the server. System administrators are freed from odious and repetitive tasks, such as loading software updates on dozens or hundreds of individual desktops, while Sun Ray Server Software enables them to manage users with their choice of GUI-based tools from any browser or traditional UNIX® OS-style CLI-based tools.

Nevertheless, as partial implementations of the client-server computing model became more common, the problem was redefined as how to leverage centralized computing to provide a rich, stable user experience without excessive administrative cost or downtime. The solution, it is now easy to see, lay in developing true thin-client platforms, which not only offered users the computing power they wanted but provided additional advantages that were not otherwise possible. The most salient of these advantages — such as *session mobility*, or *hot desking*, which allows users to access their files, their applications, and their work from virtually any thin client, and the cost savings associated with zero-administration desktops — are available only in Sun Ray implementations.

Sun Ray Computing Model

The Sun Ray system relies upon a network-dependent computing model in which all computing is performed on a server, with input and output data passed back and forth between the Sun Ray server and the Sun Ray thin clients.



User sessions — groups of services controlled by the Session Manager and associated with a user through an authentication token — reside on a server and are directed to a Sun Ray desktop unit.

Because Sun Ray thin clients are stateless, a user's session can be redirected to any Sun Ray desktop unit on the appropriate network or subnetwork when that user logs in or inserts a smart card. The session seems to "follow" the user to the new thin client. This session mobility is the key architectural feature that enables hot desking — the ability of users to access their sessions from any thin client on their network.

Simple, Elegant Architecture

The Sun Ray architecture consists of two components: the Sun Ray thin client DTU and the Sun Ray Server Software.

The Sun Ray DTU is a simple, unmanaged, always-on, low-cost device that requires no desktop administration yet provides the experience users expect from a high-end workstation. Unlike Microsoft Windows-based terminals and PCs, Sun Ray thin clients do not need to be upgraded when new applications are introduced or more computing power is required. With the Sun Ray smart card interface, a user simply inserts a smart card into any available Sun Ray thin client and instantaneously accesses an existing session — there is no boot process to wait for.

Sun Ray Server Software provides user authentication and encryption between server and client as well as user session management. It not only enhances security, but also helps reduce the complexity and administration of the IT environment. In fact, in the most extensive testing ever conducted by Sun Microsystems, users were enthusiastic about the convenience of having their sessions available to them as they went from one machine to another, with or without the use of smart cards. Especially in universities and research laboratories, users liked the freedom of carrying a smart card instead of a laptop computer. Government agencies and companies with prominent intellectual property concerns also found the reduction of the risk of data loss to be of considerable value.

High-Availability Groups

Sun Ray Server Software allows servers to be configured in high-availability (HA) groups to ensure service whenever a server goes offline.⁴ Most implementations include at least one high-availability group. Once a high-availability group is set up, Sun Ray Server Software provides automatic load balancing, optimizing performance by distributing sessions among the servers in the group. New sessions are distributed among available servers, and the load balancing algorithm takes into account each server's load and capacity so that larger or less heavily loaded servers can host more sessions.

Because Sun Ray users and their sessions are centrally managed, the thin clients themselves require no administration. User state is centralized on the server and linked by an interconnect fabric of standard Ethernet cables and switches, whether physically dedicated, implemented with a virtual LAN

4. High-availability groups are also known as failover groups.

(VLAN), or implemented on a LAN. Even in remote broadband implementations using DSL or cable modems, the DTU never requires software updates or memory upgrades.

The result is a desktop environment that is stateless, which leads to security benefits and a reduced total cost of ownership. Users access their work from any location on the appropriate network or subnetwork, while administrative tasks are consolidated at the server level, for the benefit of the network administrator and IT staff.

Platform and Application Interoperability

The Sun Ray architecture reflects Sun's Open Systems philosophy. Sun Ray systems can access a very large application base, including StarOffice™ productivity software, with no proprietary extensions, as well as the Java Desktop System. In fact, Sun Ray users have access to any application developed to Web standards, written in the Java™ language, or that runs on the Solaris Operating System or any of three major Linux variants. Applications running on Linux, mainframes, or Microsoft Windows, and Windows XP are available through third-party interoperability products.

For instance, for those who are accustomed to Microsoft or other common legacy office suites, Citrix and Tarantella allow them to use their old applications on their Sun Ray desktops. In fact, Sun Ray implementations offer access to more technical applications, such as high-end CAD/CAM and PCB layout packages, than other thin clients. At the other end of the scale, Sun Ray implementations also provide a modern, multimedia-ready desktop with CD-quality audio playback and recording, USB ports, USB serial devices and printers, and PDA synchronization.

Sun Ray implementations are flexible enough to completely eliminate the need for Windows servers. However, when Windows servers are already configured at a customer site, the addition of a Sun Opteron-based server allows the Sun Ray Server Software to communicate with the Windows servers and, if necessary, be deployed to run Microsoft Windows.

The Sun Ray system enables both administrators and users to take full advantage of the tools they choose and also achieve considerable cost savings. The fact that Sun Ray systems require absolutely no desktop administration means that skilled administration staff can be freed to perform more important work than upgrading hundreds of desktops or holding users' hands when their PCs crash.

For further administrative control in a Solaris environment, Sun Management Center software monitors managed objects, including the Sun Ray system itself, Sun Ray services, failover (HA) groups, interconnects, and

desktops. Each managed object is monitored separately and has independent alarm settings. Sun Management Center software also monitors Sun Ray Server Software daemons that authenticate users, start sessions, manage devices, and handle DHCP services.

IT Security

With no local operating system or local applications, the Sun Ray DTU is virtually immune to virus attacks. Additionally, the lack of local storage helps to protect corporate data and intellectual property; it also makes the DTU a very unattractive target for theft.

Using switched network gear for the last link to the thin clients makes it very difficult for a malicious PC user or network snooper to obtain unauthorized information. Because switches send packets only to the proper output port, a snooper plugged into another port receives no unauthorized data. If the server and wiring closet are secure, the last step is switched, and the thin client is plugged directly into the wall jack, then it becomes virtually impossible for communications between the server and the DTU to be intercepted.

The protocol used for communication between the Sun Ray DTU and the server can further be protected with ARCFOUR 128-bit encryption.

For instance, login security now provides the administrator with the identity of the card holder (usually the user name) plus some kind of card-based user authentication. Because this level of authentication depends on what software is installed at the site and which smart card vendor is used, it offers extra flexibility to site administrators.

In addition to the normal UNIX login, the smart card usually includes the user's name, password, and PIN, and may also use a symmetric key interface (SKI) or some other form of challenge/response authentication.

In the case of symmetric keys, the key is embedded in the user's card while another identical key is located elsewhere, such as on the server. It is not very hard to protect a private key on a smart card, and it is even less difficult to protect a private key on the server. This level of security is suitable for a wide range of IT applications.

Public Key Infrastructure (PKI) challenge/response authentication relies on a private key and a public key. The smart card has a private key, usually in a certificate, and the server also has a private key; however, the two keys are not identical. Instead, each has a corresponding public key that does not need to be protected. The challenge/response dialog requires the server and the card to authenticate one another, for which they use their corresponding public keys. This results in yet another layer of protection.

Some customers are now making use of biometric storage — finger prints, retinal scans, facial patterns, and other data. Stored securely on a smart card, biometric data is extremely difficult to forge and cannot be extracted from the card. The card can also “sign” data so that it is verifiable and can therefore be trusted. Wider acceptance and implementation of biometric data can be expected in the near future.

Clients: Ultra-Thin Versus Not-So-Thin

The client-server computing model has been popular for over ten years, and has been part of Sun Microsystems’ computing philosophy for even longer.⁵

The evolution of the desktop is reflected in the types of devices most commonly used today, although there is some confusion in today’s marketplace because not all terminology is carefully or precisely defined. For instance, unlike Sun Ray thin clients, which could be categorized as “ultra-thin clients” by comparison, most products currently touted as thin clients are not true thin clients at all, but are in fact fat clients⁶ of one sort or another. Some have slimmed down over time, and they perform somewhat better than they used to, but the fact that they are not stateless devices — they still have some combination of local files, communication protocols, required storage, operating system, and sometimes browser software — means that they continue to be expensive and cumbersome to maintain. They also require expensive upgrades on a regular schedule, often leading to “upgrade fatigue” for users as well as IT staff.

X Terminals

X Terminals in many ways resemble updated versions of the old “dumb” terminals that were prevalent in the mainframe-dominated world of the 1980s. Because they use local fonts and run a local X Server process, which is both CPU- and memory-intensive, they often require extra processing power for better performance. X Terminals provide only limited functionality. In addition to relying on outdated technology, they can be expensive and must maintain state — of data, applications, file system, operating system — on the desktop.

5. When Sun first promoted the idea that “the network is the computer”, some people found it hard to grasp.

6. A typical fat client is an enterprise-level PC, complete with hard disk, OS, cooling fan, and local applications.

WBTs

Windows-based terminals (WBTs) provide access to Microsoft Office and run on Microsoft Windows platforms. They correspond nicely to the efforts to put PCs and other fat clients on networks, and some of them are thinner than others. Unfortunately, they too have only limited functionality, although even the thinnest of them need to perform rendering on the desktop. Those that most nearly approximate true thin-client status seldom offer the performance that users demand, which causes a cycle of upgrades from which few units can escape. In addition, WBTs must maintain state locally and are not capable of enabling some of the more enticing Sun Ray capabilities, such as LAN- or WAN-based session mobility.

Low-Cost PCs

Low-cost PCs are flexible devices capable of hosting via PC X Server software. They correspond to a later period of Web ubiquity and are in common use today. However, they suffer from intrinsic unreliability and should not be considered true thin clients.

Although initial acquisition cost is low, functionality is limited because low-cost PCs lack many of the features found in enterprise-class PCs. A short product life cycle, costly software upgrades, and the need for continual desktop system administration make the total cost of ownership very high for medium and large installations. Like other PC-type devices, when lost, stolen, or broken, they are conducive to data loss. Where serious intellectual property issues or security concerns are at stake, they have proven to be a poor choice; the consequences so far have ranged from the inconvenience of lost personal files to national security alerts and the suspension of vital government research projects.

Sun Ray Thin Clients

Sun Ray thin clients enable *all* computing to be done remotely. They represent the first successful implementation of true thin-client computing, and they run on multiple hardware and software platforms, including three popular Linux variants as well as the extremely stable and reliable Solaris Operating System⁷. Compared to other devices, Sun Ray DTUs have a moderate cost of acquisition and a very low total cost of ownership because, once acquired, they do not have to be replaced and never require local software upgrades or desktop system administration.

7. For the most sensitive and secure applications, Sun Ray Server Software also runs on Trusted Solaris (TSOL).

Various models of Sun Ray DTU are available, differing primarily with respect to size and type of screen. All Sun Ray DTUs include a smart card reader, a keyboard, and a mouse. Sun Ray DTUs have no local disks, operating systems, or applications; they are therefore considered *stateless*. Statelessness is what makes thin clients thin. It also helps to make them secure and easy to maintain. For instance, although USB mass storage devices are supported, the ability to use them is administered centrally so that sites with security requirements can easily disable their use to remove the sort of risk imposed by PCs and other fat clients that permit or even encourage the loss of data in case a physical device is stolen.

Smart Cards

What people call a smart card looks and feels like a credit card with an embedded microprocessor and memory. The chip on a smart card allows for portable storage of confidential information. Unlike the magnetic strip on a credit card or the contents of a floppy disk, the processing power on a smart card allows a password to protect its contents so that only authorized users can access the card. Cards with built-in cryptography allow for highly secure end-to-end communications and are an excellent way to store a digital identity.

In a typical Sun Ray implementation, the smart card can also serve as a company ID/electronic door key, government Common Access Card, or a student ID card. Like an ATM card, the card itself is protected from unauthorized use by a password or PIN. The card can be configured to contain other applications and information, such as security permission levels, as well.

Summary

The Sun Ray system is the first thin-client implementation that actually delivers a full, rich, high-performance user environment with unparalleled security and the convenience of session mobility (or hot desking). By centralizing all computing, including rendering, in the server and not the desktop, the Sun Ray computing model fulfills the original promise of client-server computing. Stateless thin-client desktops have the extra advantage of never requiring local system administration.

Sun Ray users now have the power of an individual workstation plus access to legacy and traditional office productivity software as well as advanced UNIX applications and utilities — or Linux freeware, depending on implementation — without the acquisition cost or maintenance requirements of workstations or the intrinsic instability of PCs. In fact, they have access to the Solaris Operating System and Java applications as well as to other flavors of UNIX software, 3270 front ends, and Microsoft Windows, the latter in conjunction with technology from various third-party software vendors.

For convenience, users can access their work, or sessions, from any Sun Ray desktop in their workgroup, or on the corporate LAN or WAN, if the company or organization chooses to enable this feature — because Sun Ray Server Software redirects user sessions to users' logins (or to tokens on their smart cards).

Similarly, administrators and IT managers are freed from many of the constraints imposed by networked PCs and other fat clients. They manage users centrally, at the server, so the need for system administration and costly software upgrades on the desktop are completely eliminated, and administrators seldom have to deal with individual user complaints.

Encryption and authentication make communication between server and client relatively secure, and the absence of local data on the client desktop makes theft of intellectual property, or even ordinary user data, impossible at the hardware level. In addition, smart cards enable extra levels of login security and user authentication as well as the means to write and embed custom security applications on smart cards.

Sun Ray computing combines extensive power and functionality, freedom from the individual desktop, and extra levels of security with low total cost of ownership. That is why it is expected to become the premier platform for enterprise computing as well as a key technology in the next decade.



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