

Three Generations of Thin-Clients

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Executive Summary

Thin client infrastructures are becoming more and more prevalent in Industry as well as Government sectors due to the enormous cost savings and reliability. The thin client technology evolved towards the end of the 20th century. Since its evolution technology has helped advance the thin client paradigm into its 3rd generation as evidence by Pano Logic's zero client.

Background

Ever since Dan Bricklin invented VisiCalc and users "sneaked" Apple II's into the workplace, a constant battle between users and Information Technology (IT) personnel for control of the desktop has existed. Currently there is an ongoing truce which manifests itself as a PC running Microsoft Windows connected to a TCP/IP network. Generally, the IT departments and users negotiate which applications are made available to users and the users maintain file permissions.

Thin clients came into existence as a mechanism for the IT department to reduce service calls by taking back control of the user's desktop. Throughout this existence, the thin client architecture has gone through 3 generations of evolution.

Generation One

The 1st generation thin client is a terminal-like workstation with backend servers that perform the bulk of duties. IT departments love this setup while users despise it due to the constraints imposed on tailoring the desktop. Generation one thin client options consist of three varieties:

1. Basic Terminals – Often used as a green screen replacement. This variety offers a Microsoft terminal services client and networking protocol to access server hosted applications.
2. Browser Terminals – This variety provides a local windows-like User Interface (UI) shell and browser software to access hosted applications.
3. Line-of-Business (LOB) Terminals – This variety provides support for a limited (typically one) locally executed application.

1st generation thin-clients (compared to conventional PCs) relocate the processing from the desktop to the server(s). This thin client generally uses low-power, low-capability processors from VIA Technologies and Transmeta Corporation. The thin clients have a small amount of RAM and use a firmware-embedded Operating System (OS), either MS Windows CE, Windows XPe, or an embedded variant of LINUX for communication. The thin clients communicate with the server using Microsoft Terminal Services (MTS), Citrix Presentation Server (CPS), or X-Windows. Microsoft refers to this arrangement as Presentation Virtualization or server-based computing.

This arrangement offers the ability to run shared multiuser applications on a terminal server. The users connect to the applications from a thin client which runs the UI. With this kind of arrangement, applications can be published (users can create shortcuts on their virtual desktop) or desktops can be published (e.g., a school can have one standard desktop for faculty, and another for students).

With and XPe thin-client, Microsoft allows the thin-client vendor to provide a limited number of applications embedded in the local firmware (typically Internet Explorer 6 and/or Telnet). This arrangement requires Client Access Licenses (CALs) and Citrix Presentation Server and associated user licenses (if used) for each addition to any core operating system (e.g., Windows Server 2003) or software licenses.

It can be argued that the Total Cost of Ownership (TCO) for these 1st generation thin-clients is low compared to the conventional PC setup. There is also an argument for a low Size, Weight, and Power (SWaP) index.

A criticism of the 1st generation thin-client arrangement is that all users operate from one instance of an operating system and if one user manages to lock up or crash the OS, it impacts all of the other users.

Generation Two

The 2nd generation thin-client aims to satisfy user needs while still satisfying the IT department's hardware centralization goal. This model employs a blade server with an individual blade serving each user's needs. A thin-client workstation uses a virtual PCI bus to connect the two components. Unlike 1st generation thin-clients, the user has his/her own instance of their familiar operating system (Windows or LINUX). This paradigm preserves the users expected PC desktop experience and eliminates the situation where one user can impact others with an OS lockup or crash. It can also be argued that the TCO for this setup is somewhat lower than that of a standard PC.

The lower TCO, compared to the alternatives, is less than ideal due to the relatively high cost of individual blades and their blade enclosure chassis'. This arrangement requires desktop XP (or LINUX) licenses and blade communication software for each user.

Generation Three

The 3rd generation thin-client aims to achieve the TCO and SWaP of the 1st generation while satisfying the same user and IT department's satisfaction goals of the second. This is achieved by replacing the 2nd

generation blades with Virtual Machines in a VMware server or equivalent (e.g., Citrix's XEN). The latest Pano Logic and Sun Microsystems's SunRay 2FS thin-clients are stateless devices, and because of this, are often referred to as Zero-Clients. There is no local storage device within the zero-client and no processing takes place locally. The zero-client aspects enhance system security, particularly in a multi-classification multi-compartmented network; by ensuring remnants of one session do not transgress to another. The Pano Logic and the SunRay2FS were the only thin-clients examined that share this attribute.

PanoLogic's Zero-Client

The Pano Logic zero-client is based on Field Programmable Gate Array (FPGA) technology. It has no supplementary CPU, firmware, or RAM.

The entire user session runs on the server. When in use, the Pano Logic uses less than 5 Watts of power while only 2 Watts when idle. It currently has dual monitor capability with video resolutions up to 1920x1200. Network connectivity is via 10BaseT/100BaseT Ethernet. The unit also provides local USB and audio capability. Each Pano Logic zero-client runs its own Windows XP (or Vista) instance in a virtual machine on a VMware server.



This Windows-centric arrangement requires a Windows XP (or Vista) license for each user and VMware ESX license(s) for the server(s).

Sun Microsystems's SunRay

The SunRay 2FS, Sun's flagship thin-client, is a bit larger than the Pano Logic zero-client, but retains the same basic functionality. Rather than employing an FPGA, it uses a local CPU (Raza Microelectronics, Inc. Alchemy Au1550 MIPS RISC processor) and firmware, but no local RAM to handle communications with a Solaris UNIX (SPARC or X86) or a LINUX server. It has direct support for 10BASE-T/100BASE-T and 100Base-FX Fiber Optic Ethernet. It has two DVI/I connectors supporting up to 1920x1200. It also has audio and USB capabilities. It uses slightly more power than the Pano Logic (8 Watts vs. 5 Watts) and does require more back-end server and software support.

Zero-client SunRays support Windows only via the SunRay Connector (SRC). The SRC is software licensed from Microsoft, which uses their Remote Desktop Protocol (RDP) to communicate with a separate Windows 2003 server running Windows Terminal Services (similar to the 1st generation thin-client's connectivity scheme.) As a result, only a Presentation Virtualization is available to the Windows user. This arrangement requires a Windows 2003 Server, a Solaris or LINUX server and SunRay Connector Licenses (to support SunRay connectivity), a Windows 2003 server license, and its associated CALs.