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A Technical Introduction to the Caldera Network Desktop

A Caldera, Inc. white paper

The last two years have seen the rise of a unique phenomenon in the computing industry: the growth of the Linux operating system from a student project to a commercially viable solution that is widely discussed on the Internet and in the trade press.

This white paper examines several technical aspects of the Caldera Network Desktop, a complete operating system based on Linux. The Caldera Network Desktop combines numerous commercial products with the Linux operating system, while supporting the distributed, open development model that created Linux. This model provides both developers and consumers of technology with a stronger technology base and greater freedom of choice.

What Is Linux

Linux is a full-featured 32-bit operating system. It was developed as a fully POSIX-compliant operating system for Intel microcomputers. Linux was not developed by any one company or individual, however. It was created by the Internet community. Linux is unique among production operating systems because all of its source code is available to anyone. Members of the Linux community continue to support Linux via the Internet by contributing their time and talents to its development. In return, they are always assured of having full access to the operating system source code, as well as all future work by other Linux developers.

THE GNU GENERAL PUBLIC LICENSE

The copyright to Linux is held by Linus Torvalds of Helsinki, Finland, the person who started the Linux project. But the system that makes the cooperative development of Linux possible is called the Gnu General Public License (GPL). The GPL was proposed by Richard Stallman of the Free Software Foundation as a way to encourage the devel-

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opment and spread of valued software without the barriers to entry that traditionally encumber products getting to market, or stifle their development once they are in an established market.

A piece of software that is declared by its author to be under the GPL is said to be copylefted, as opposed to copyrighted. Whenever a copylefted product is distributed, its source code must be available as well, so that any user of the product can alter it, recompile it, and reconfigure it ad infinitum. But any changes, fixes, or upgrades that are made to that source code must be placed back in the original product, with the source code of the new contribution. Thus the product continues to improve without the improvements being held by a single individual or company.

Further, any individual or company can package products that are licensed under the GPL, and charge a nominal fee for the distribution media and packaging, but they must still make the source code to the product available. Anyone who buys the product is free to recopy, alter, or redistribute the product, so long as the GPL is followed.

What advantages does using the GPL for an operating system kernel provide for the computing industry at large? There are several:

- All developers play on a level field; everyone can develop exactly what they need, without concern about the installed base of another developer.
- Support costs are reduced by allowing anyone to alter, enhance, repair, or code to the operating system.
- Standards are easily promoted. Rather than just a specification, the standard is available for everyone to actually use and build on.

LINUX TODAY

As a result of the GPL and the work of so many talented developers, Linux today boasts the same features as almost any commercial 32-bit operating environment. In addition, the time required to evaluate, implement, and test new features is substantially reduced compared to normal corporate development cycles.

While this development system might seem chaotic, it is based on a cooperative system of knowing who manages what pieces, and funneling contributions or problems through the accepted channels, though those channels are much more fluid in nature than a traditional development environment. The result has yielded a system that develops new features and repairs bugs at a speed that normal corporate development environments cannot match, for three simple reasons:

- Every developer who contributes to Linux feels ownership in the product. Their names are in the source code, and they feel vested in testing the features that they requested or developed themselves.
- Every developer has the complete source code to the product. Even within corporations, most developers cannot easily access source code to areas that they are not working on. And the limited number of developers in a corporation hardly compares to the Internet community.

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- The product is not in the control of a single commercial entity that seeks to control it for its own purposes. Where a commercial entity might control development to manage upgrade cycles, maintain an installed base, or increase profits, Linux development proceeds in areas that users feel are warranted, at a pace that fits their needs.

CALDERA AND LINUX

While many companies have created products around Linux, and have greatly assisted the spread of this technology, Linux still faces difficulty in being accepted as a commercial operating environment. Some of the reasons for this will be obvious from the discussion above, where some of the problems below are listed as features of Linux:

- Linux has no accountability: no formal industry group or company exists to ensure support, continued development, and fixes. If everyone can change the OS, how can anyone tell what they will be running their systems on?
- Linux is not supported by many mainstream applications, either in vertical or horizontal markets. The idea of developing applications to a continuously changing OS has proven a strong deterrent for potential developers of commercial Linux applications.
- Linux cannot provide a complete solution with desktop environment, local area network administration, productivity or mission-critical applications, and graphical utilities.
- Linux is often mistakenly perceived as having been developed by unskilled students.
- Linux installation and configuration are challenging for the uninitiated.

CALDERA'S PHILOSOPHY

Caldera, Inc. has removed these barriers to growth and widespread acceptance, and pushed Linux forward as a viable, complete computing solution for both vertical and horizontal markets. Caldera products shield end-users from the ordered chaos that creates and grows Linux, so they can use it as their operating system of choice. Caldera provides a support and feedback mechanism that connects end-users to the Linux development community, while providing customer-driven support and other commercial services.

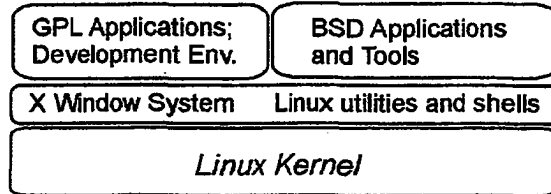
In order to remove the barriers to acceptance that Linux has faced, Caldera provides the following missing pieces to the Linux story.

- An accountable corporate focal point that supports technical and non-technical, organizational and individual users of Linux, with the infrastructures that they need to feel secure in running Linux.
- A strong support to developers and promoters within the Linux development community, including making contributions back to the Linux kernel and related components.
- A complete, robust, Linux operating system, available via FTP or on CDROM.
- Products that provide a complete operating environment by adding commercial software to Linux, in order to fill the gaps that prevent Linux from being considered in many mainstream environments. This includes adding interface, utility, networking, and administration components.

What is Linux

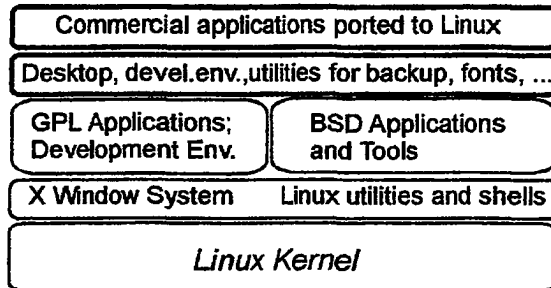
- A fully-developed domestic and international reseller channel through which Caldera products and Linux applications can be distributed. By providing a market, this channel will encourage the development of applications on Linux, and provide a focal point for users of Linux who need specific software.

FIGURE 1. Current Linux distributions provide a complete but limited environment, all freely available.



The Linux community has provided a solid base and framework, as shown above. Caldera adds value to Linux by creating and providing a platform for commercial products that can appeal to major users, and spread the use of Linux to new areas that traditionally would not have considered using it.

FIGURE 2. As Caldera's Network Desktop product adds value to Linux, it becomes a complete commercial solution.



To make this strategy effective, Caldera follows these steps to leverage technologies for the benefit of all users:

- Partner with other companies or groups who have useful technologies
- License technologies to integrate into existing Caldera products
- Build key technologies that provide value for Caldera customers

To emphasize the scope of what Caldera provides to both the existing Linux community and to current and future end-users of Linux, we describe in the following section some of the technologies of the Caldera Network Desktop, with the benefits that they bring. We begin with a description of some features that are part of all Linux distributions.

Linux Features of The Caldera Network Desktop

The Caldera Network Desktop provides a complete, full-featured operating environment suitable for deployment in many diverse arenas.

Because the Caldera Network Desktop is built on top of Linux, it has all of the advanced features of the Linux operating system. In addition, Caldera has added many components to the operating environment. In this section the features of Linux are discussed.

Many features of the Caldera Network Desktop are inherent in Linux as the underlying operating system. Some key benefits of Linux are:

- True multi-tasking, multi-user, 32-bit operation
- Internet connectivity
- Standards compliance
- Complete X Window System™
- Complete GNU tools and standard UNIX utilities
- Intel iBCS compliance
- Support for multiple file system types
- Support for DOS and DOS applications
- A wide range of peripheral support

MULTITASKING, MULTIUSER

Linux is a fully pre-emptive, multi-user, multi-tasking operating system. It provides virtual memory, protected memory spaces, and a variety of inter-process communication (IPC) mechanisms, such as shared memory, message queues, semaphores, and pipes. Linux runs on 32-bit microprocessors, and is able to fully utilize advanced 32-bit hardware.

A POSIX threads facility (pthreads) is also available for finer grain process control. (See also Standards Compliance below.)

These multitasking features of Linux, which were a part of its initial design, enable users to fully utilize scarce and expensive resources, both in computer hardware and in user's time. For example, a Caldera Network Desktop system enables multiple users within an organization to browse the Internet, while providing a Worldwide Web page to users outside of the organization, all simultaneously.

PERIPHERAL SUPPORT

The list of peripheral devices that Linux supports is long, and is growing rapidly. It includes standard devices such as IDE hard drives and a variety of graphics cards, as well as numerous multimedia devices and specialized high-capacity storage devices.

Even complex multimedia PCs can take advantage of the features of the Caldera Network Desktop, because it interoperates with such a wide variety of peripherals.

STANDARDS COMPLIANCE

From its inception, Linux was designed to be a POSIX1003.1-compliant operating environment. Linux also provides extensions that provide compatibility with BSD UNIX

and System V UNIX systems, as well as additions and extensions that are not found in other UNIX operating systems.

Linux has benefitted greatly from two decades of research and development on prior UNIX systems. Linux was built from scratch in just the past couple of years, with reference to the research of the past, but without reference to the code; it therefore has a cleaner, more streamlined architecture than legacy UNIX systems that were updated and refitted from year to year as research advancements continued. The Caldera Network Desktop will run in 8 megabytes of memory and as little as 75 megabytes of disk space.

X WINDOWS SYSTEM

Linux, like nearly every UNIX platform in use today, uses The X Window System[™] for its graphical subsystem. This system provides a rich suite of capabilities ranging from 3D rendering to distributed, client/server, graphical display. Linux uses an implementation of X11R6 (the most recent release of X) developed by The XFree86 Project, Inc., a not-for-profit corporation whose primary charter is to design, develop and distribute, as free software, enhancements to The X Window System, a product of The X Consortium, Inc.

Caldera includes the XFree86 system. But the default installation uses a commercial X server called Accelerated X, which provides better performance and supports a wider variety of graphics devices.

As an industry standard, The X Window System is well-known for its robust feature set and distributed applications, which allow users to operate graphical applications across network connections, including across the Internet. X also provides very rich management and configuration abilities to fully utilize the capabilities of every user's hardware investment.

GNU TOOLS

Including with Linux are many utilities and tools for system administration and end-user use. A major source of these utilities is the "GNU tools" collection from the Free Software Foundation. GNU tools include popular C compilers, editors, graphical tools, scripting languages, Internet access tools, and other utilities.

The GNU tools allow the Caldera Network Desktop to be used as a complete development environment. They also integrate functionality required for standard Internet operations, such as newsreaders, scripting languages that Worldwide Web servers often rely on, and editors for creating documents and configuration files.

INTEL BCS2 COMPLIANCE

Much progress has been made in making Linux support existing applications developed for other UNIX systems, such as SCO UNIX and other systems that are compliant with the Intel Binary Compatibility Standard (iBCS2). Because of this effort, a large number of currently-available UNIX applications can be used immediately on Linux platforms. These include applications such as WordPerfect for SCO UNIX and Oracle version 7 for SCO UNIX.

Users of the Caldera Network Desktop will immediately be able to choose from a wide variety of off-the-shelf UNIX applications that can be used in mission-critical situations, particularly in vertical markets. iBCS2 compliance also aids developers seeking

to port applications to Linux by providing a well-defined standard for binary compatibility.

INTERNET CONNECTIVITY

Linux was designed in a collaborative effort by individuals and groups on the Internet. Thus, there is an intense pressure for Linux to support all Internet protocols and capabilities. It is tested and used in an almost innumerable set of configurations and environments. All of this makes for strong and stable support for Internet protocols.

Linux provides support built into the kernel for IP firewalling, IP accounting, and subnet masks. Solid support is also provided for other Internet protocols, including the following abbreviated list: IP, ICMP, UDP, TCP, ARP, RARP, SLIP, RIP, IGRP, DNS, PPP, SNMP, SMTP, BOOTP, Sun RPC, NNTP, NTP, POP3, FTP, HTTP, LPD, NFS, Telnet, r-utilities and others.

No other operating environment can provide a higher level of integration with Internet, UNIX, and other TCP/IP networks.

FILE SYSTEMS

Linux allows users to access a variety of diverse filesystems as part of a single directory tree. Linux uses, as its native filesystem, a BSD UNIX-like filesystem, commonly called *ext2fs* in the Linux community. Support for other filesystems includes: DOS FAT filesystems; NFS; ISO9660, including Rock Ridge extensions (commonly used for CDROM access); HPFS (used by IBM OS/2™); and System V UNIX. Preliminary work has been done to support the Windows95™ DOS filesystem, the Windows NT™ filesystem (NTFS), and the Apple Macintosh™ filesystem.

Support for additional network filesystems and facilities is also close to completion. For example, Windows For Workgroups™ (WFW3.11) clients can access Linux as a peer system. With these systems in place, WFW3.11 clients have full access to resources (filesystems, printers, Internet gateways, etc.) located on a Linux machine. Tools are also under development to access WFW3.11 as a server, with Linux as the client system.

Linux also includes a native filesystem called */proc* that provides user-level interfaces to kernel structures and accounting facilities. For example, various real-time statistics and system management values (via the SNMP protocol) are easily accessed by using the */proc* filesystem.

Caldera's support for NetWare® filesystem access is described in the next section.

By supporting a large variety of filesystems, the Caldera Network Desktop seamlessly supports integration with other computers and networked filesystems as part of the single directory tree that a user accesses.

DOS

One of the freely available extensions to Linux is the "DOS Box" product, commonly called DOSEMU (DOS Emulation) in the Linux community. The name is slightly misleading because DOSEMU does not emulate DOS, but rather emulates the components of an Intel PC that are necessary to allow a copy of DOS and associated DOS utilities to run.

Additional Features of The Caldera Desktop

Extensive work in this area over the past 18 months has allowed DOSEMU to demonstrate support for a very large base of DOS applications, including such favorites as WordPerfect 5.1 for DOS and the popular game, DOOM. Supported applications include many other best-selling personal productivity applications, graphics-intensive applications, and even applications that require enhanced-mode capabilities.

Work has even been done to support DPMI protected-mode facilities, thus allowing applications that use this mechanism to run comfortably under Linux.

The DOS Box, like iBCS2 compliance mentioned above, allows a large number of existing programs to run on the Caldera Network Desktop, including many personal productivity applications. Because the DOS Box functions as a process under Linux, multiple DOS programs can easily be started at the same time, and can interoperate with Linux applications.

Additional Features of The Caldera Desktop

Many other features of the Caldera Network Desktop are not part of Linux, but are additional technologies that Caldera has integrated into the operating environment. These include the following:

- Easy installation and configuration on new or existing systems
- A desktop interface (user interface components, including configuration tools)
- Full NetWare connectivity and administration tools
- Netscape Navigator 2.0 Internet Client Browser
- Accelerated X 1.2
- Integrated graphical Internet clients and servers
- Graphical text editing
- A powerful, distributed backup utility
- A font server providing Postscript and TrueType fonts

DESKTOP INTERFACE

Caldera has licensed a technology base from Visix Software, Inc., upon which a rich desktop interface has been developed. This interface provides graphical file browsing with a powerful file typing mechanism, the ability to launch programs graphically, full drag-and-drop capabilities with visual and sound feedback, color wheels, action-sound associations, a large icon base (with editing), a programmable tool bar, many preference settings, and much more.

This desktop provides a graphical backdrop from which commonly accessed files or applications are immediately available. The desktop includes default behaviors for different classes of files, allowing them to be launched or dropped onto other icons, according to their type. These defaults are fully programmable through the graphical configuration tools to match the preferences of any user.

Additional Features of The Caldera Desktop

The Caldera desktop interface provides a graphical browsing mechanism for not only the local filesystem, but also network systems that have been mounted locally, including multiple NetWare Directory Services trees that may be visible from the user's machine. This seamless browsing of many local and remote systems provides an intuitive interaction model for network objects and local filesystem objects.

By providing a single graphical browsing system for all local and remote file systems, the Caldera Network Desktop becomes an interface to the entire networked world, or to as much of it as a user chooses to see. NetWare services, FTP servers, locally mounted server directories, and other resources are all located on a single desktop, with common file typing and drag-and-drop functionality.

EASY INSTALLATION

Installation of the Caldera Network Desktop is straightforward and simple. The installation program can install from a network or CDROM, and can work with existing partition on a hard disk to preserve a multiple-OS system.

Many of the common difficulties of installing Linux have been overcome by eliminating the need to choose and make boot diskettes, or be intimately familiar with all the hardware components of a system.

FULL NETWARE CONNECTIVITY

Linux includes support for IPX, the transport protocol commonly used for NetWare® access. Caldera has enhanced that support, and contributed that work back to the Linux community. This work allows Linux to provide full IPX functionality, including IPX routing. The IPX functionality in Linux does not rely on any proprietary technology from Novell, Inc.

In addition to enhancing IPX in Linux, Caldera has licensed technology directly from Novell as the basis for full NetWare connectivity via the NetWare Core Protocol (NCP). Caldera provides full client access to NetWare 3.x and NetWare 4.x servers. This includes NetWare Directory Services (NDS), RSA based authentication, NDS browsing, and NDS administration. Both command line and graphical tools are provided. Users can administer NetWare objects directly from the Desktop interface, without learning new utilities. For example, double-clicking a User object allows you to edit that object; dragging a file to a printer object prints the file.

Through other Novell technology that Caldera has licensed, the Caldera Network Desktop can access NetWare servers from within the Linux DOS Box (described in the previous section).

The Caldera Network Desktop thus becomes a premier NetWare client, capable of full interaction with and management of the thousands of NetWare servers located in organizations throughout the world. The multitasking features and Internet connectivity of the Caldera Network Desktop make it the perfect platform for managing heterogeneous distributed corporate networks.

NETSCAPE NAVIGATOR

A fully licensed version of the Netscape Navigator 2.0 is included with every copy of the Caldera Network Desktop. This popular tool allows users to browser Internet and Intranet resources in many formats, including Worldwide Web documents, FTP files,

Additional Features of The Caldera Desktop

newsgroup postings, and local or remote email accounts. In addition, Netscape 2.0 supports Java applets that are now used on many large Web sites.

Netscape is used as the online documentation viewer for all Caldera help and documentation files. This integrated system allows updated technical support and documentation materials to be made available to users in a single coherent interface.

ACCELERATED X

With the advent of high-speed, high-resolution graphics cards, Accelerated X becomes a key component of the Caldera Network Desktop in providing a high-performance graphical display that rivals many RISC workstations.

Created by X Inside, a leader in graphics software technology, Accelerated X provides a simple-to-use configuration utility, plus a long list of supported hardware devices. Special features such as multiple simultaneous monitors are also supported.

GRAPHICAL TEXT EDITING

Users of UNIX and Linux systems are accustomed to using character-based text editors that can be somewhat challenging to learn and use. These popular tools include vi and emacs. While these are included with the Network Desktop, users who are not familiar with these tools will likely prefer the CRiSPlite text editor that is included as the default text editor.

CRiSPlite uses a menu bar, icons, and standard keystrokes for editing to remove the learning curve normally associated with editing files on a UNIX system. CRiSPlite provides powerful features like pattern searching, multiple buffers, and user-defined setting. Professional developers may even wish to upgrade to the full version of the CRiSP editor.

GRAPHICAL INTERNET PRODUCTS

Caldera has incorporated a graphical internet browser as part of the desktop metaphor and windowing system. This browser provides all local or remote system documentation, including online help, online reference manuals, UNIX man pages, and connections to remote technical support.

As an Internet browser, this tool provides access to Worldwide Web sites, gopher servers, and FTP servers through graphical windows. The local file system (which seamlessly shows network systems as well under Linux) can also be displayed in this browser. In the future, a graphical email reader and newsgroup reader will be a part of this system. Users can access almost any information resource that they wish to use with a single graphical interface, be it a local or remote resource.

BACKUP UTILITY

Data security in networked environments requires regular archival of important data. The Network Desktop includes a complete backup utility: Caldera's BACKUP.UNET, licensed from MTI, a leader in RAID and large disk subsystems.

This backup system can be operated either from the command line, or from a set of Motif-based graphical dialogs. Full, incremental, and selective backups and restores are supported, and can be operated on a regular, timed basis. Backups can be completed from any accessible filesystem onto any accessible storage device on the network, all controlled from any machine on the network. BACKUP.UNET is available from MTI

The Caldera Network Desktop

for other UNIX systems as well, allowing the Caldera Network Desktop to be part of a comprehensive backup strategy for larger UNIX networks.

FONT SERVER

The Caldera Network Desktop provides a commercial X11 Font Server to supplement the font capabilities of the X Window System. This enhanced font server provides scalable typefaces, including TrueType® and Type 1 PostScript fonts. Caldera's font server applies transformations on fonts, and can return outline data for a character or a set of characters as either a mix of Bezier curves and polylines, or just polylines.

Using the Caldera font server, users can upgrade their systems and the documents that they view and create by installing additional fonts, which are available from many third-party developers, such as Adobe and Bitstream.

Applications on the Caldera Network Desktop are more versatile and functional because they are able to take advantage of the myriad fonts available in these popular formats, and include them in the documents that they create. Users are not constrained to use fonts from a particular application or environment vendor.

The Caldera Network Desktop

Caldera is committed to providing operating environments of high quality and versatility by building on the Linux kernel and adding value through commercial applications. As Caldera encourages the growth of Linux within its sphere, the natural development cycle of Linux will continue to refine and expand its uses. Caldera will be a part of this growth, and will facilitate it by enhancing the value that Linux and its applications provide to a wide spectrum of users.