



Building a Custom Linux Distribution for Your Company

Stan Zitello

Chief Architect
LLS

Tamora Zitello

IT Operations Consultant II
Hewlett Packard

What Is a Distribution?

- In the beginning (circa 1991) there was
 - The **Linux** kernel
 - Some **gnu** tools
- Soon Linus added
 - More and more tools
 - Applications
- Then many people added
 - Their own choices for tools
 - Frequently, *lots of choices*
 - Their own choices for applications
 - Frequently, *lots of choices*
- Thus, the **distribution** was born

Why build your own Distribution?

- Software Control
 - Own all of the software components and versions
 - No reliance on other companies distribution
- File System Control
 - Decide the layout of the file system
 - Decide what, where and how big all the applications are
- Security
 - Control the configuration and inclusion of all software
 - Audit trail on entire build process and all patching
- Maintain usefulness of “old” hardware

Why build your own **Linux** Distribution?

- Cost Control
 - No Usage Fees
 - More “Unix” CPU horsepower/dollar :
- High Performance Computing
 - High density processing with Blade servers
 - Clustering with Beowulf, Mosix, LVS, Sistine GFS
- High Availability Computing
 - Lifekeeper, FailSafe, Heartbeat
- Familiarity
 - Easy learning curve from any Unix version
- Customer Demand
 - For applications
 - For the data center

How do you begin?

- Create a Basic Build Environment
 - Where?
 - Computer with reasonable CPU power and available disk space
 - Why?
 - Provide a **clean environment** of tools for the creation of the distribution
 - How used?
 - As the initial *chroot* environment
 - Isn't this like a cross-compile toolset?
 - Yes
 - Do we really have to do it this way?
 - Yes*

Contents of the Build environment

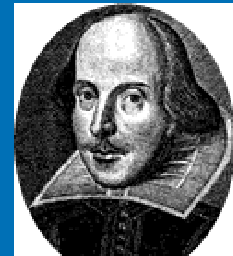
- Everything necessary to **bootstrap** the distribution
 - Compiler
 - Binary utilities (linker, assembler, profiler)
 - Shell
 - Basic file utilities
- NOT everything necessary to build the complete distribution
 - Previously built components will be used to satisfy the requirement of new components

Lets Build --- No, Wait!

“Light, seeking light, doth light of light
beguile.”

Billy Shakes

Loves Labour's Lost



Company Linux Distribution – Company Needs

- Customizing the distribution for the company
 - Company specific **network protocols**
 - Company specific **services**
 - Company specific **security needs**
 - Company specific **applications**
- Hard work
 - Knowledge mining
 - Iterative
- Maximize the advantage

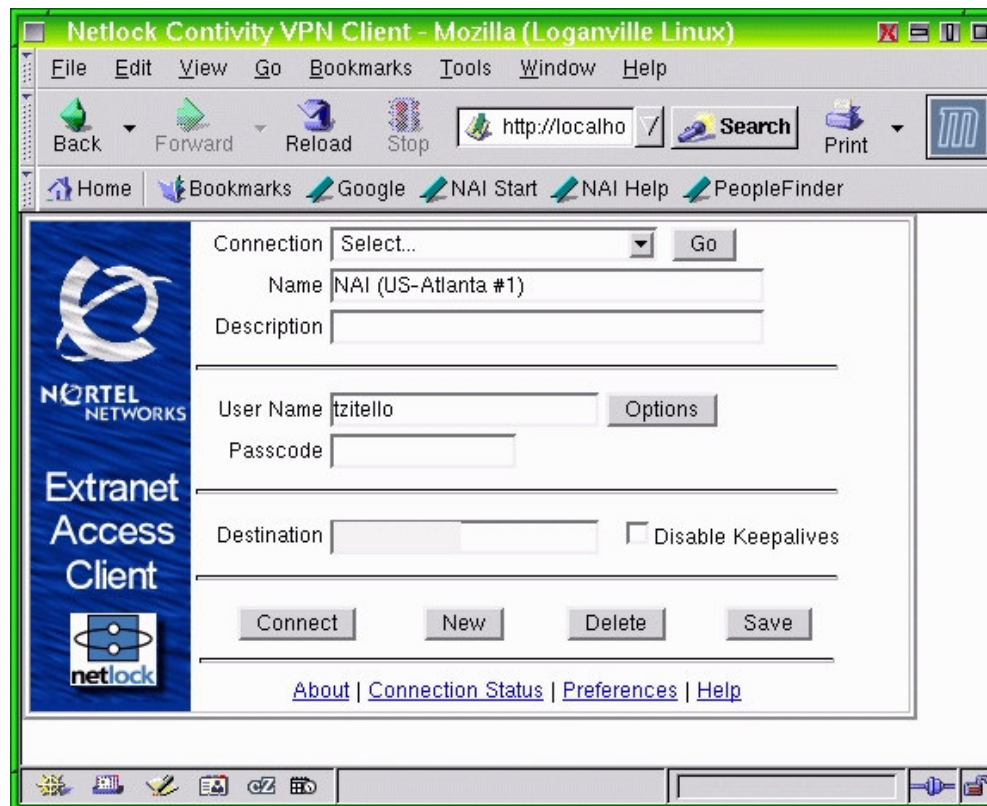
Corporate Constraints

- A case study
- HP Managed Services
 - Our mission is to be the seamless extension of our customers' IT organization by focusing on operational excellence and driving profitable growth.



Remote Connectivity

- Hewlett-Packard uses Contivity for VPN access
- Linux user client is Netlock
 - Netlock client requires 2.4.20 build
 - Requires a license



Communication to network printers

- Numerous types of HP jet-direct printers
- Communication with each printer type
 - lpr and lpd daemons



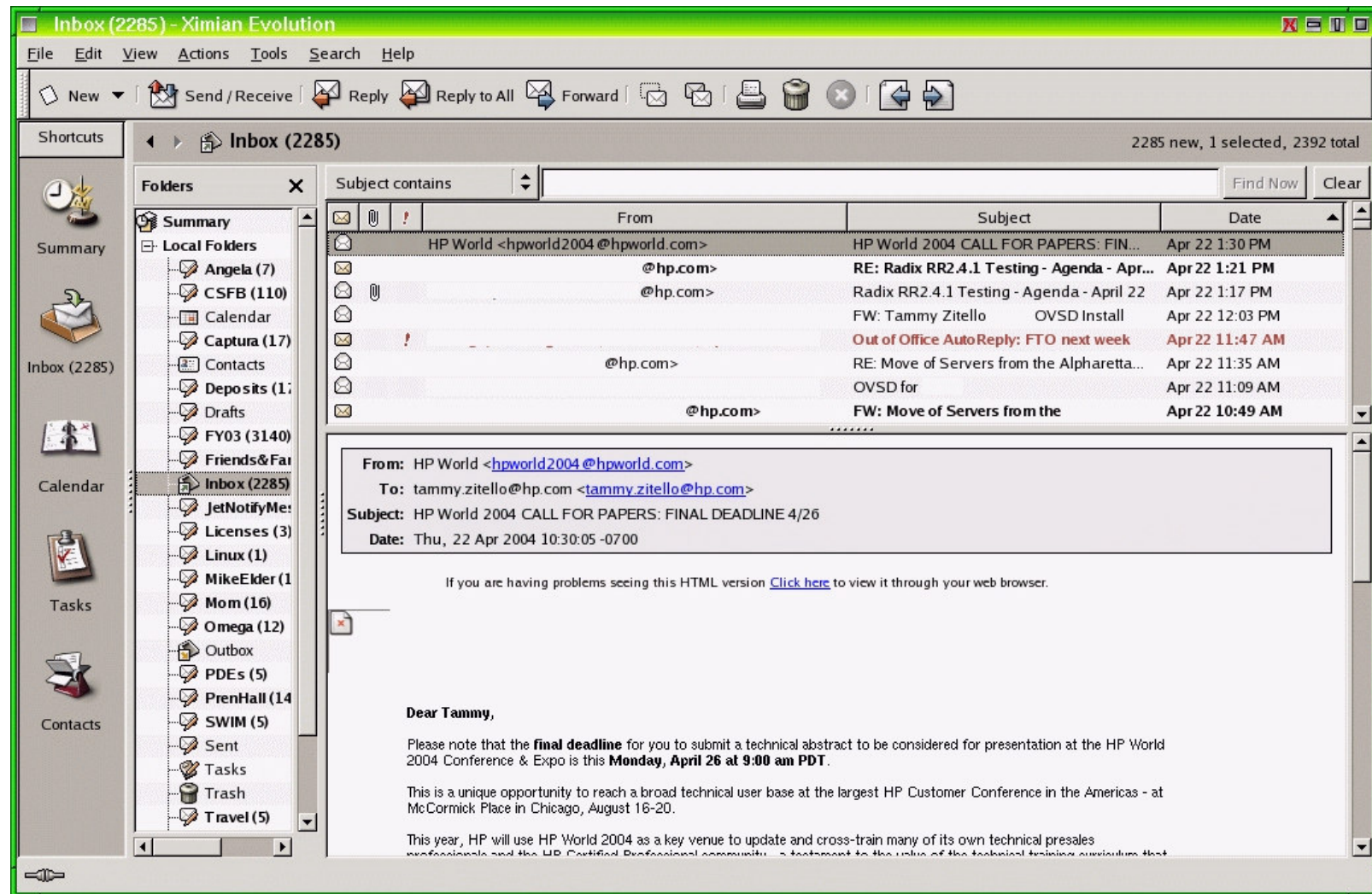
Modern browser

- Interact with many client web-sites
- Web site developed using modern tools
- Many of these tools rely on features found only in modern browsers
- Browsers available under Linux include
 - Mozilla
 - Konqueror (KDE)

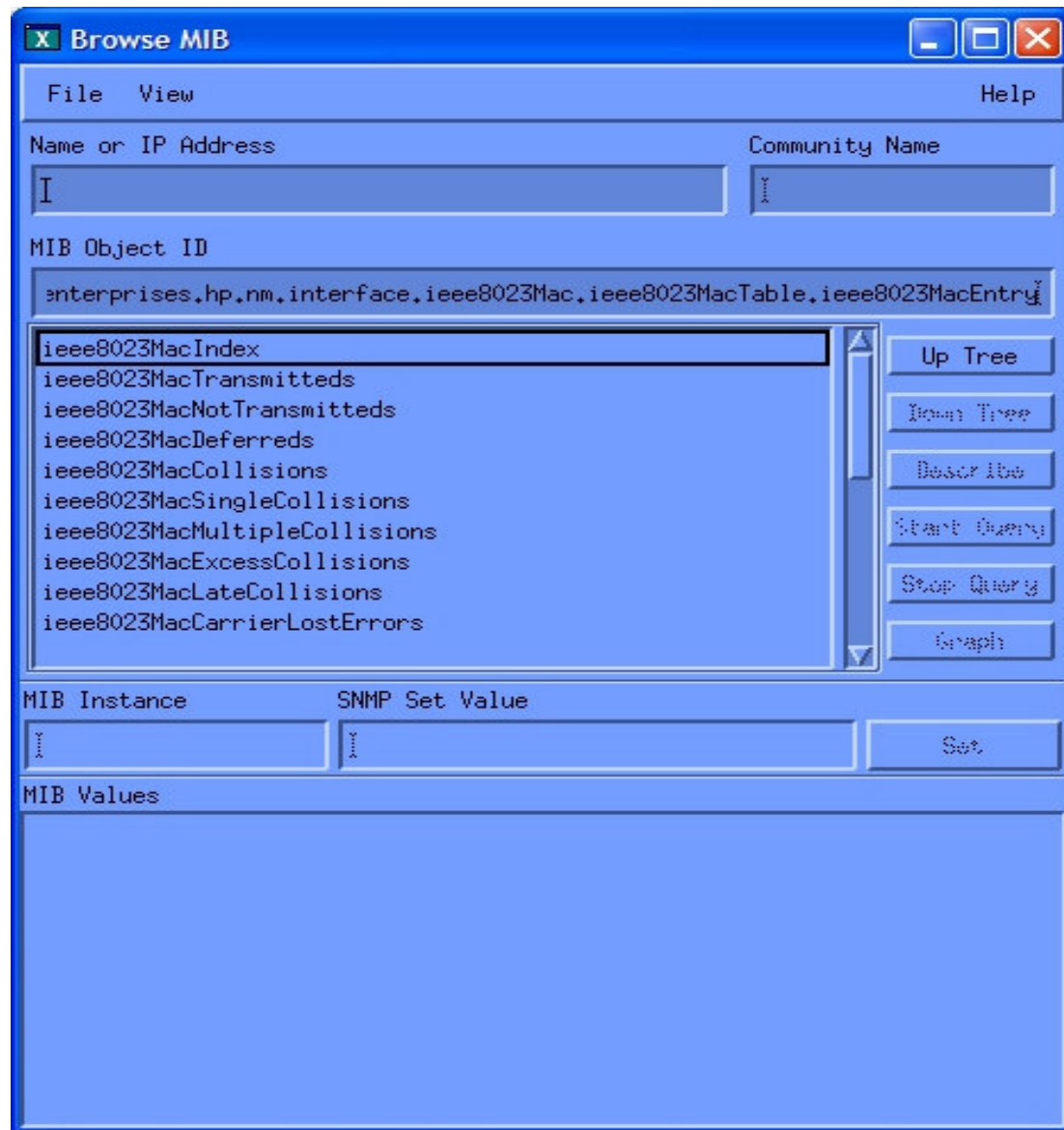
Mail & calendar tool

- Mail & calendar tool
 - IMAP/POP3 is supported on Exchange
 - Know your exchange server IP address
 - Novell (formerly Ximian) Evolution
 - Send/receive email from Exchange server
 - Send/receive appointments
 - View others calendars
 - Import data into Evolution

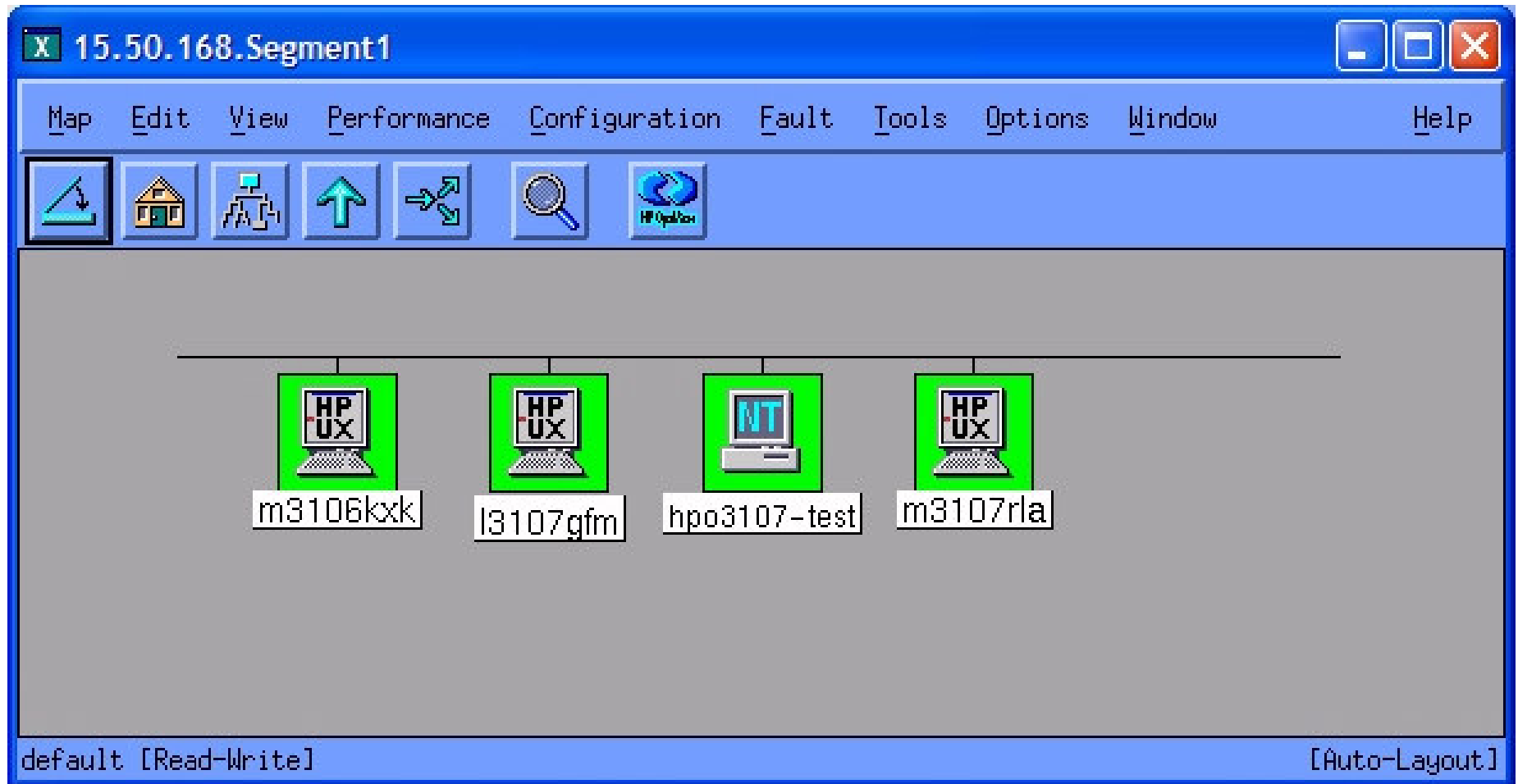
Mail and Calendar Tool (continued)



HP OpenView fonts



Ability to Install COTS Applications



IP Command Line Tools

- Command line tools (telnet, ftp, ping, snmpget, etc.)
- logie01:/home/tzitello> **snmpwalk logie02 system**
 - system.sysDescr.0 : DISPLAY STRING- (ascii): HP-UX logie02 B.11.00 A 9000/785 2005830448
 - system.sysObjectID.0 : OBJECT IDENTIFIER:
.iso.org.dod.internet.private.enterprises.hp.nm.system.hpux.hp9000s700
 - system.sysUpTime.0 : Timeticks: (86839733) 10 days, 1:13:17.33
 - system.sysContact.0 : DISPLAY STRING- (ascii):
 - system.sysName.0 : DISPLAY STRING- (ascii): logie02
 - system.sysLocation.0 : DISPLAY STRING- (ascii):
 - system.sysServices.0 : INTEGER: 72
 - system.sysORLastChange.0 : Timeticks: (0) 0:00:00.00

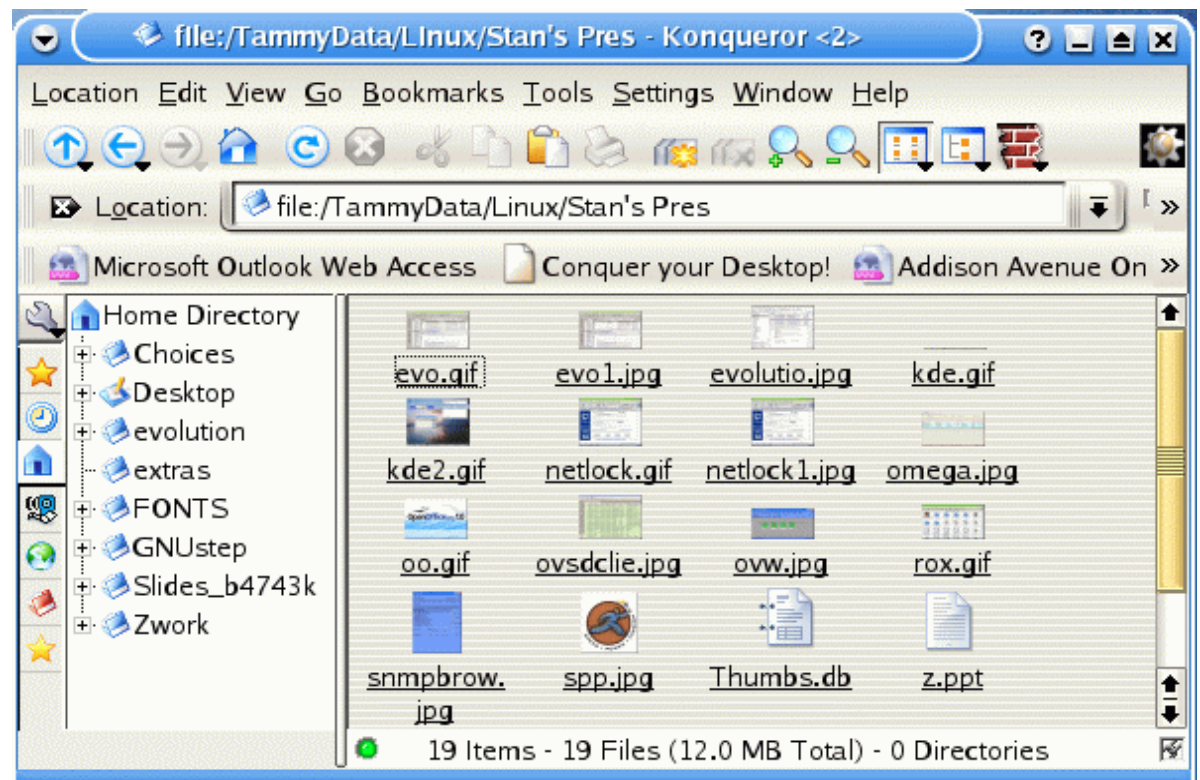
Office Suite of Applications

- Office applications
 - Word processor, text editor
 - Spreadsheet
 - Presentation



Desktop Environment

- Friendly user interface to Linux
 - Session management
 - File browser
 - Clock
 - Calculator
 - Virtual desktops



Architectural Considerations

- One crucial decision has already been made
 - Full blown corporate distribution
- Installability
 - Full distribution only?
- Build Automation
 - Beyond the obvious
 - Relationship to installability
 - Knowledge of build bits and install bits
 - Ability to create **binary archives** (*packages*)
- Many more decisions to make
 - Standards Based
 - Unencumbered

Unencumbered Considerations

- Kernel
 - 2.4? -> 2.4.what?
 - 2.6? -> 2.6.what?
 - 2.2, 2.2 ?!
- Graphical Environment
 - Integrated Desktop?
 - Heavy? Gnome, Kde
 - Light? Xfce
 - Simple Window Manager
 - Fvwm, Mwm, Twm
- Standards battle for underlying technologies

Standards

“The nice thing about standards is that there are so many of them to choose from.”

Professor Andrew S. Tanenbaum

Author of MINIX



“Standard” Architectural Considerations

- File System Layout
 - FHS 2.3 is well known

/ — the root directory

| — bin Essential command binaries

| — boot Static files of the boot loader

| — dev Device files

| — etc Host-specific system configuration

| — home User home directories (optional*)

| — lib Essential shared libraries and kernel modules

| — media Mount point for removable media

| — mnt Mount point for mounting a filesystem temporarily

| — opt Add-on application software packages

| — root Home directory for the root user (optional*)

| — sbin Essential system binaries

| — srv Data for services provided by the system

| — tmp Temporary files

| — usr Secondary hierarchy

| — var Variable data

Linux Standard Base

- From the **Free Standards Group**
 - Mission Statement:
 - To develop and promote a set of standards that will increase compatibility among Linux distributions and enable software applications to run on any compliant system. In addition, the LSB will help coordinate efforts to recruit software vendors to port and write products for Linux
- Current standard is LSB 1.3
 - LSB 2.0 in public review
- Includes
 - Object Formats, Dynamic Linking, Base Libraries, Utility Libraries, Graphics Libraries, Installation, Commands, Users and Groups, Execution Environment and System Initialization

Libraries and Kernel Headers

- What is the “Standard” Library?
 - Probably glibc
 - Current version is 2.3.2
 - Supports ISO C, Posix and other standards
- Other standard libraries
 - Libc5
 - Older, precursor to current glibc
 - Dietlibc
 - Optimized for small size: creates small, statically linked binaries
 - Uclibc
 - Small C Library for developing embedded systems
- Kernel Headers
 - “The fact is, that the header files should match the library you link against, not the kernel you run on.”

X11

- XFree **was** the standard version of X11 for years
 - Current version is 4.4.0
 - Controversial change to license at 4.3.99.903
 - Redistributions of source code must retain the above copyright notice, this list of conditions, and the following disclaimer.
 - Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution, and in the same place and form as other copyright, license and disclaimer information.
 - The end-user documentation included with the redistribution, if any, must include the following....
- X.org **appears** to be the new standard
 - Current version is X11R6.7.0
- History of sharing technology between X.org and Xfree.org

Building the Distribution Approach: Create a “Proof” Base

- Why?
 - To **know** that we have a solid foundation for our distribution
- How do we know have it?
 - Create a full featured **“Base”** that is bootable
 - Boot from it and the recreate the build environment
 - Rebuild the base in this environment
 - Boot into this newly created Base
 - This base, built exclusively from our binaries, is the **Proof Base**
 - The starting point for all further distribution work

Building the Base: Automation

- Executables (scripts) to build all of the individual components of the distribution
 - Extraction to the build area
 - Setup of build environment (control vars)
 - Compilation
 - Installation into base
 - Identification of all constituent parts
 - Creation of binary archives (**packages**)
 - Special consideration for non-exclusive configuration

Building the Base: Order

- What packages are built first, second,...last
 - Dependencies of the components being built must be taken into consideration.

01 makedirs	n-13 joe
02 grouppwd	n-12 dialog
03 makedevs	n-11 zcursesutils
04 includefiles	n-10 zdfm
05 manpages	n-09 zbase
06 glibc	n-08 man
07 gcc	n-07 misc
08 zlib	n-06 sysvinitz
09 findutils	n-05 apm
10 gawk	n-04 at
11 ncurses	n-03 crond
12 vim	n-02 hdparm
13 bison	n-01 bc
14 less	n install

Building the Base: Customization

- Beyond the process of creating a custom distribution
 - How much customization work should be expected?
 - Enough to make the distribution as useful, as easy to use and administer, as possible
 - What should be customized?
 - Areas perceived by your company as weak in standard distributions
- Example: **System Startup**

Building the Base: Customization

- Installation Software
 - Administrative tools should be found or created to do:
 - Initial installation
 - Package addition
 - Installed package enumeration
 - Enumeration of available packages
- Helper utilities
 - Tools to aid in the creation of the distribution and/or in its use
- Configuration
 - Lightweight customizations typically aimed at ease-of-use
- Other
 - Compilation corrections
 - Missing documentation
 - Code driven configuration

Components of the Base

- What software should be included?
 - Enough to provide reasonable functionality
 - Administrative tools
 - Basic Network functionality
 - CUI Tools
 - Editors
 - Mail readers
 - Web browsers
 - File System Browsers
 - Some Network Services
 - NFS
 - Web Server
 - **Maybe** X11
 - **Only** the foundation software
 - Beware of “base creep”

Locating the Software Source Code

- Candidates can be anywhere on the internet
 - Common sites for much of the base
 - Kernel.org <http://www.kernel.org/mirrors/>
 - Freshmeat <http://freshment.net/projects/component>
 - Sourceforge <http://sourceforge.net/projects/component>
 - Gnu.org <http://www.gnu.org/prep/ftp.html>
 - Beyond the base
 - X.org <http://freedesktop.org/~xorg/X11R6.7.0/src>
 - Xfree <ftp://ftp.xfree86.org/pub/XFree86/4.4.0/source>
 - Gnome <http://ftp.gnome.org/pub/GNOME/desktop/2.6>
 - KDE <http://www.kde.org/download>
- **Searchers** are invaluable

Source Code Patches

- Opportunity for a common Linux patch site exists
 - Linux, Gnu, Desktops, Common Apps, etc
- Check the main source code site
 - Kernel.org has a small set of patches
 - Kernel
 - Gcc
 - Glibc
 - Binutils
 - Gnu.org has patches for some of its software
 - Can be tricky to locate

Hard Bits

- Expect some difficulties
 - Configuration **tricks** that will have to be figured out
 - Inordinate amounts of **time** spent trying to locate software
 - Well known applications that **will not compile**
 - If you are lucky: paste the error text into a web searcher
- Expect to learn a lot on the first build in particular
 - Much wailing and gnashing of teeth
 - Examples
 - Testing the integrity of created packages
 - Need for post-install scripts
 - Hard links
- The Good news
 - Almost every problem will be solvable

Beyond the Base: Finishing the Distribution

- For this presentation, only have time for the base
 - Need to add Desktop environment and applications
 - Much larger installed and built footprint than base (5x)
 - Easier than base build
 - No need for “**Proofing**”
 - Provided we have done the required work on the base
 - Not analogous to testing
 - **Follow the base paradigm**
 - Decide on the components to include
 - Locate the source code
 - Patch as necessary
 - Create the automation to perform the build and package creation

Post Creation Issues

- Iteration
 - Beta test
 - Constraint Validation
 - Ease of Use
- **Case Study**

Web-based “Java” applications

File Edit View Help									
Tammy Zitello									
UNITED STATES		176 Hours To Track		104:00 Hours Tracked		Deadline: 22 July 2004			
Week 1 Week 2 Week 3 Week 4 Week 5 Total									
No	Customer	Project	Service	Technology	Activity	Coverage	Mon 05 Jul	Tue 06 Jul	
1	Administrative - ALL	Admin_Meeting	N.A.	NONE	N.A.	Standard	8:00	0:00	
2	HPMS Initiatives - WW	Generic POR Projects	Consulting	NONE	Service Planning	Standard	0:00	3:00	
3	INTERNAL PROGRAMS - NA	Support Processes	Consulting	NONE	Change Management	Standard	0:00	4:00	
4	Internal Projects - WW	33571 Radix Initiatv	Application Mgmt	NONE	Build Test Implem.	Standard	0:00	1:00	
5						Standard	0:00	0:00	
...							8:00	8:00	

Windows specific applications

- Sorry, only IE 5.5 and higher are supported
- Netmeeting
- Visio diagrams

Standalone Java Apps

hp OpenView service desk

File Edit View Favorites Tools Actions Help

Advanced Find... All Closed Service calls (Table)

Service Desk

Service call (Filter Applied)

Drag a column header here to group by that column.

ID	Status	Priority	Description	Created	Deadline	Organization	Caller	To workgroup	To person
2	Closed	Low	testing notification	02/03/03 17:33:...	02/05/03 17:33:...	HP		OVSD Background Fi...	
58	Closed	Low	user can't get sd to ru...	02/11/03 14:13:...	02/13/03 14:13:...	Delivery Infrastructure		OVSD Background Fi...	
65	Closed	Low	group notifications ar...	02/12/03 11:38:...	02/14/03 11:38:...	Delivery Infrastructure		Delivery Infrastructure...	
72	Closed	High	test	02/12/03 14:06:...	02/12/03 22:06:...	Delivery Infrastructure		Backup Support Spe...	
107	Closed	Low	This is a test of the n...	02/19/03 12:03:...	02/21/03 12:03:...	Delivery Infrastructure		Scheduling Change I...	
108	Closed	Low	Testing ANT notificati...	02/19/03 12:43:...	02/21/03 12:43:...	Delivery Infrastructure		Scheduling Change I...	
131	Closed	Top	sdqsdqsdqds	02/21/03 15:15:...	02/21/03 19:15:...	Delivery Infrastructure		Memill Lynch Case Ad...	
135	Closed	Low	Testing Subcontract f...	02/21/03 22:36:...	02/23/03 22:36:...	Delivery Infrastructure		UX Change Implemen...	
151	Closed	None	Test	02/26/03 08:17:...	03/02/03 08:17:...	Delivery Infrastructure		Media First Level Sup...	
176	Closed	Low	teste de status	03/13/03 08:32:...	03/15/03 08:32:...	Delivery Infrastructure		Delivery Infrastructure...	
189	Closed	Top	erro de HW no servid...	03/17/03 09:40:...	03/17/03 13:40:...	Delivery Infrastructure		Delivery Infrastructure...	
198	Closed	High	Customer experiencin...	03/25/03 14:43:...	03/25/03 22:43:...	ABC Company	Doe, John	Test UX First Level S...	
204	Closed	Low	Exchange Server 2000	04/07/03 05:07:...	04/09/03 05:07:...	Rolfs Test Bul1		Default Test Group fo...	
220	Closed	None	Poor performance wit...	04/22/03 13:49:...	04/26/03 13:49:...	ABC Company	Doe, John	Test UX First Level S...	FLS-UX, TestLogin
232	Closed	Low	problem with applicati...	04/30/03 12:23:...	05/02/03 12:23:...	ABC Company	Doe, John	Test Oracle First level...	FLS-ORA, TestLogin
237	Closed	Medi...	Performance Issue	05/02/03 12:24:...	05/03/03 12:24:...	ABC Company	Doe, John	Test Oracle First level...	FLS-ORA, TestLogin
259	Closed	High	Experiencing perform...	05/21/03 12:27:...	05/21/03 20:27:...	ABC Company	Doe, John	Test Oracle First level...	FLS-ORA, TestLogin
260	Closed	None	Performance issues w...	05/22/03 12:25:...	05/26/03 12:25:...	ABC Company	Doe, John	Test Oracle First level...	FLS-ORA, TestLogin
261	Closed	High	Poor performance wit...	05/23/03 12:27:...	05/23/03 20:27:...	ABC Company	Doe, John	Test Oracle First level...	FLS-ORA, TestLogin
263	Closed	Low	Client not able to ope...	05/27/03 14:30:...	05/29/03 14:30:...	Delivery Infrastructure		Tampa Data Center P...	
273	Closed	Low	This is just a test...	05/29/03 15:32:...	05/31/03 15:32:...	Delivery Infrastructure		woodytest	
299	Closed	Low	For testing - test case...	06/04/03 11:17:...	06/06/03 11:17:...	ACME Test Company	Acme Person	HP Messaging Opera...	
315	Closed	Low	retest #1	06/05/03 15:37:...	06/07/03 15:37:...	ACME Test Company	Acme Person	TESTG1	
316	Closed	Low	test	06/05/03 16:02:...	06/07/03 16:02:...	ACME Test Company	Acme Person	TESTG1	
321	Closed	Top	an update from custo...	06/05/03 16:49:...	06/05/03 20:49:...	ACME Test Company	Acme Person	TESTG1	
322	Closed	Low	a description	06/05/03 17:28:...	06/07/03 17:28:...	ACME Test Company	Acme Person	TESTG1	
326	Closed	Low	a description	06/05/03 18:17:...	06/07/03 18:17:...	ACME Test Company	Acme Person	TESTG1	
333	Closed	Low	test call	06/06/03 11:40:...	06/08/03 11:40:...	Delivery Infrastructure		TESTG1	
359	Closed	Top	WF-10	06/10/03 09:27:...	06/10/03 13:27:...	Delivery Infrastructure		Delivery Infrastructure...	

416 item(s)

Post Creation Issues

- Installation Technique
 - Network Install
 - Custom Built
 - COTS (Altiris, Radia)
 - CD Install
 - Image based
 - Package based
 - Deployment
 - By department
 - By site

Testing

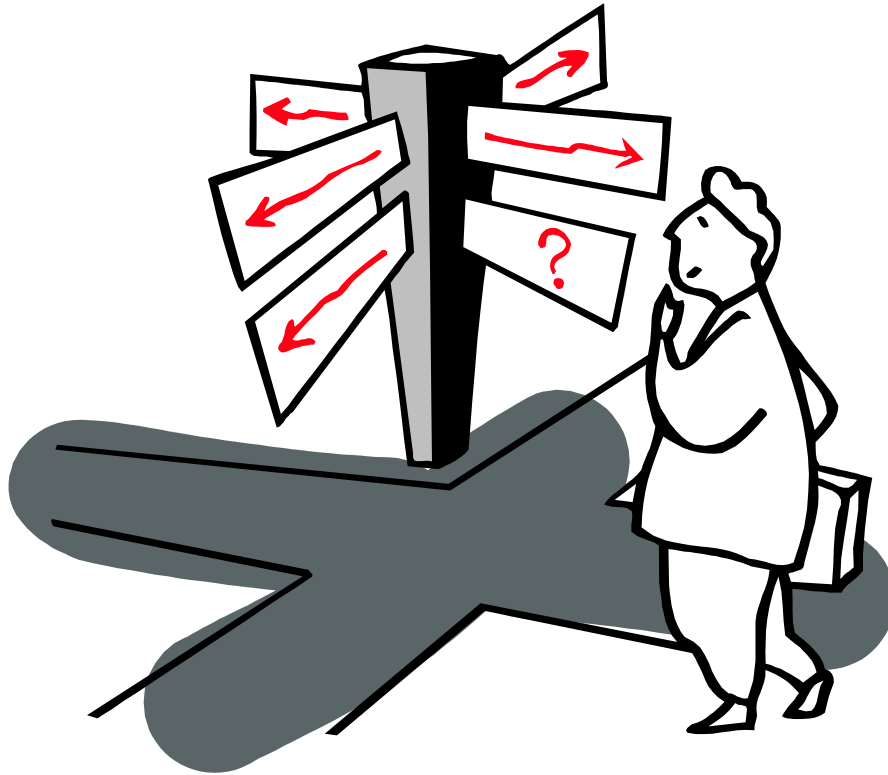
“Testing? What's that? If it compiles, it is good, if it boots up it is perfect. .”

Linus Torvalds

Well known penguin lover



Questions



HP WORLD 2004

Solutions and Technology Conference & Expo

Co-produced by:

