



Binary Code and Source Code

- Binary code

- Machine language (native code)
 - Example of instruction set directly executable by CPU
 - Represented by hexadecimal numbers
- Byte-code
 - Executed by virtual machine
 - Used for Java, etc.

```
0010000 0a29 2020 2020 2023 6874 7369 6920 2073
0010020 2061 6574 706d 726f 7261 2079 6168 6b63
0010040 7520 746e 6c69 7720 2065 6163 206e 696c
0010060 6576 7720 7469 2068 6874 2065 6564 6166
0010100 6c75 2074 6573 7261 6863 7020 7461 7368
0010120 200a 2020 6920 2066 205b 4c24 5f44 494c
0010140 5242 5241 4e59 3233 505f 5441 2048 3b5d
0010160 7420 6568 0a6e 2020 2020 2020 5320 5359
0010200 4554 5f4d 444c 4c5f 4249 4152 5952 334e
0010220 5f32 4150 4854 243d 444c 4c5f 4249 4152
0010240 5952 334e 5f32 4150 4854 200a 2020 2020
0010260 2020 7865 6f70 7472 5320 5359 4554 5f4d
0010300 444c 4c5f 4249 4152 5952 334e 5f32 4150
0010320 4854 200a 2020 2020 2020 444c 4c5f 4249
0010340 4152 5952 334e 5f32 4150 4854 3a3d 2422
0010360 6473 705f 6f72 2267 243a 444c 4c5f 4249
```

- Source code

- Programming language
 - Understandable to people
 - Modifiable
- Requires conversion to binary code
 - Conversion by compiler, byte-code compiler or interpreter

```
/*
 * Initialize directory-related fields in the mount structure.
 */
static void
xfs_dir_mount(xfs_mount_t *mp)
{
    uint shortcount, leafcount, count;

    mp->m_dirversion = 1;
    shortcount = (mp->m_attoffset -
        (uint)sizeof(xfs_dir_sf_hdr_t)) /
        (uint)sizeof(xfs_dir_sf_entry_t);
    leafcount = (XFS_LBSIZE(mp) -
        (uint)sizeof(xfs_dir_leaf_hdr_t)) /
        ((uint)sizeof(xfs_dir_leaf_entry_t) +
        (uint)sizeof(xfs_dir_leaf_name_t));
```



Compilers and Interpreters



Programming Languages

- Major interpreted languages



OSS and Proprietary Software

- Software as a product
 - Difference between software product and 'goods'
- Issues with software products
 - Problems such as illegal copy and piracy
- Countermeasures
 - What were the countermeasures against such issues in the past?
- Emergence of Open Source
 - Spotlighted as a novel software paradigm
 - Turning point of software business





Issues with Software Products

- Illegal copying, piracy
 - Casual copying
 - Particularly rampant in Asia (but incidence is not necessarily zero in US/Europe)
 - Accelerated by developments in P2P technology
 - Winny
 - WinMX
 - gnutella
 - Demise of copyright system?
- Vulnerabilities
 - Security holes
 - Bugs
 - Increased complexity of software



Countermeasures

- Measures against illegal copying
 - Hardware-based solutions
 - USB dongles, etc.
 - Copy protection technology
 - Superdistribution systems
 - Digital watermarks
 - Software-based countermeasures
 - License keys
 - Serial keys
 - Non-technology solutions
 - Comprehensive licensing agreements
 - Educational initiatives
- Measures to address vulnerabilities
 - Patches
 - Security patches
 - Bug patches
 - Automatic updates
 - Cost of maintenance cannot be ignored





Levels of Releasing Source Code

1. Readable source code

- Useful for technology acquisition and checking security holes
- Ex. Early Unix, Shared Source (Microsoft)

2. Modifiable source code for local use

- For customization or tuning
- Embedded use is permitted
- Source code may not be redistributed

3. Freely usable, modifiable and redistributable source code

- Qualifies as OSS
- Enables smooth implementation of bazaar-style joint development
- Distributable as part of a *distribution*



Benefits of Releasing Source Code



Truth and Misunderstanding about OSS

- “Open Source” is a proper noun
 - That is also trademarked
- “Free Software” and “Free Beer”
 - Freedom and free-of-charge
- Is it adequate only publishing source code?
 - More than just releasing source code
- OSS movement is neither totalism nor communism
 - Based on selfish idea rather than altruistic
 - cf. “Benefits of Releasing Source Code”



Growth of Linux Market

- Internet servers
 - Web, e-mail, DNS, firewalls
 - Already established in this field
- Workgroup servers
 - File sharing, client-server systems
 - Deployment rapidly increasing as segment enters growth period
- Servers for backbone systems
 - High reliability servers for large-scale tasks
 - Finance, telecommunications, e-government, etc.
 - Studies by OSDL's Carrier Grade Linux (CGL) working group, etc.
 - Serious deployment began in 2003

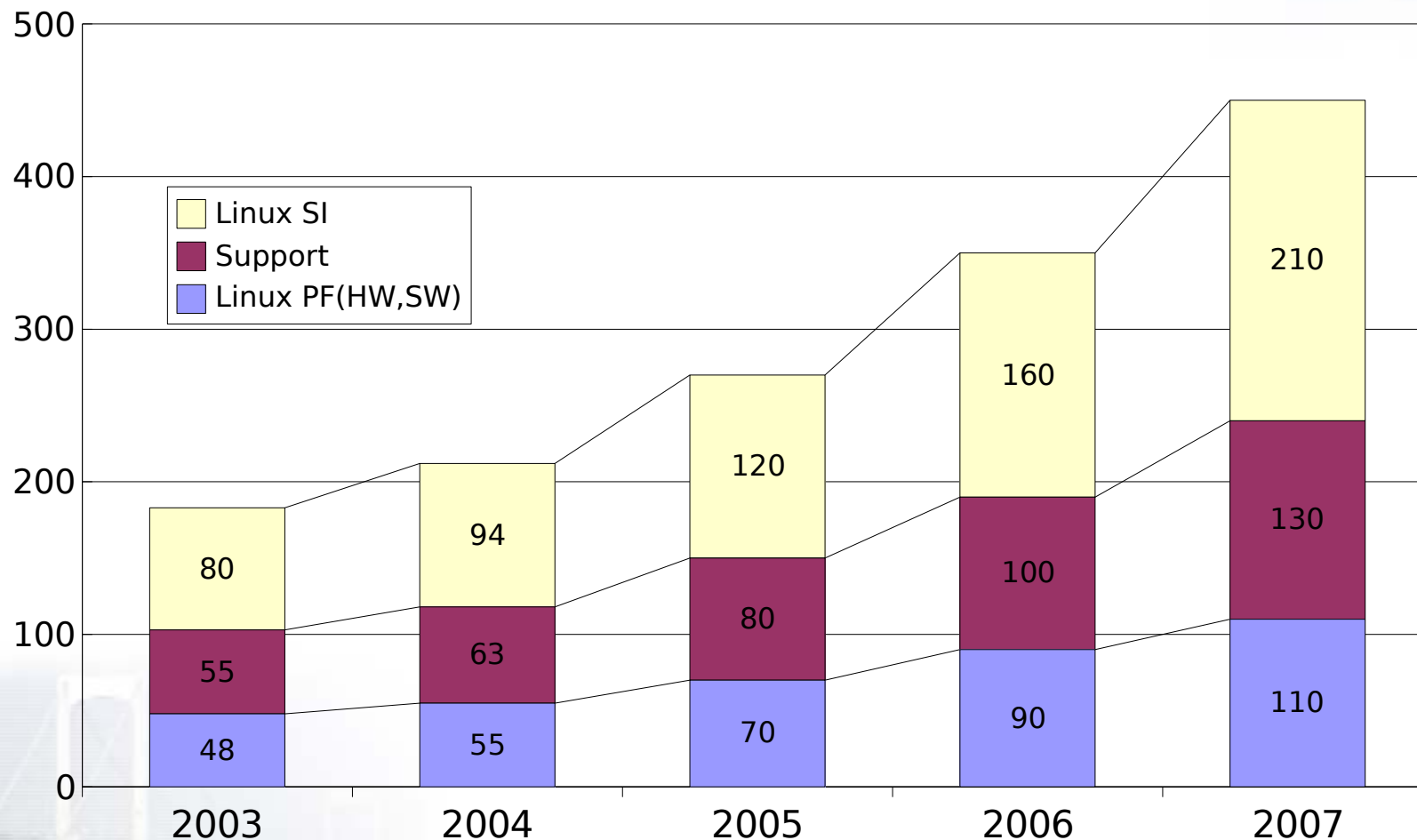




Linux Market in Japan

Forecast for Growth of Linux Business in Japan

Billion
Japanese
Yen



Source: NEC Corporation



Types of Systems Development Using OSS

- Market penetration and reasons for OSS system adoption
 - More than half of small-scale servers adopt OSS
 - Major reasons are relatively lower cost and stability of OSS
- Typical OSS system structures
 - LAMP/LAPP systems
 - Java-based systems
 - Conventional applications for OSS servers



Market Penetration and Reasons for OSS System Adoption



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OS (Operating System)

- # An Introduction to Open Source Software



Linux

- Unix for PC, brainchild of Linus Torvalds
 - Created in 1991
 - Bazaar-style development; ported to various platforms ranging from embedded to mainframe
 - Architectures supported:
 - x86, PPC, Alpha, MIPS, SPARC, etc.
- Strict definition and wider definition
 - Strict definition: Linux kernel
 - Wider definition: Linux package (distribution) with applications
 - cf. “About Distributions”
 - Diverse range of Linux systems popular worldwide



FreeBSD, NetBSD, OpenBSD

- BSD : Berkeley Software Distribution
 - Unix-compatible OS created by William Joy(Bill Joy) and Chuck Haley
 - Based on Unix V6 with networking enhanced
 - Highly influential on development of today's Internet-related technologies
- FreeBSD/NetBSD/OpenBSD
 - Open Source OS'es derived from BSD
- Features
 - FreeBSD: Emphasis on stability; frequently used for servers, etc.
 - NetBSD: Runs on diverse platforms
 - OpenBSD: Emphasis on security
 - FreeBSD derivatives: DragonFly BSD, Firefly BSD, etc.



Other OS Trends

- Shared Source Initiative
 - Microsoft's strategic response to OSS
 - Source code for Microsoft products released through individual agreements with governments, universities and enterprises
 - Prohibits release of modified source code
 - Not free to redistribute
 - Completely removed from OSS; does not fit definition of OSS
- Developments in Solaris OS
 - Source code released as OpenSolaris in June 2005
 - Some codes only available in binary files; not fully OSS

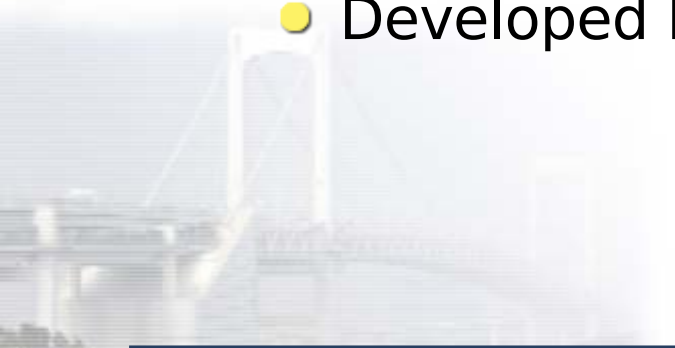


Middleware

- Web application frameworks
 - Middleware as a framework for constructing Web applications
 - JBoss, Tomcat, etc...
- libraries
 - Software libraries as enormous assets
 - Example of libraries
 - Widget set, graphics library, etc.



Web Application Frameworks

- 
- # Developed I



Servers

- Web server
 - Apache
- Mail servers
 - MTA
 - ML server
 - POP3/IMAP
- DB server
 - PostgreSQL/MySQL/Firebird
- DNS
 - BIND
- File shareing
 - Samba/WebDAV
- LDAP
 - OpenLDAP
- Mining server
 - namazu
- CMS
 - XOOPS/Zope
- Business applications
 - E-Learning, e-commerce and many others



Web (HTTP) Servers

- Apache
 - De facto standard for HTTP servers
 - 72% market share (according to E-soft survey of May 2005) http://www.securityspace.com/s_survey/data/200505/index.html
 - History
 - Developed in 1995 by Rob McCool at NCSA
 - Development stalled when McCool later left NCSA
 - Developers in various places began modifying Apache
 - These developers got in touch and started up Apache Project
 - Name originates from “a patchy” server and the Apache Native Indian tribe
 - Features
 - Light, fast and reliable (uses modules)
 - Runs on many platforms (Unix, Mac, Windows)



Mail Transfer Agents (MTA)

- Sendmail
 - Long used on Unix (developed in 1982)
 - Supports various protocols
 - Many security holes
 - Commercial version sold by Sendmail, Inc.
- Postfix
 - Interoperable with Sendmail
 - Simple to configure
- qmail
 - Fast, robust
 - No security holes discovered
 - Simple to configure
 - Not OSS, strictly speaking (distribution of modified versions is restricted)



Database Management Systems (DBMS)

- PostgreSQL top in Japan; MySQL top worldwide



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- A 3D rendering of a chessboard with silver and gold pieces. The board is black and white checkered, and the pieces are arranged in their starting positions. The background is a solid green color.

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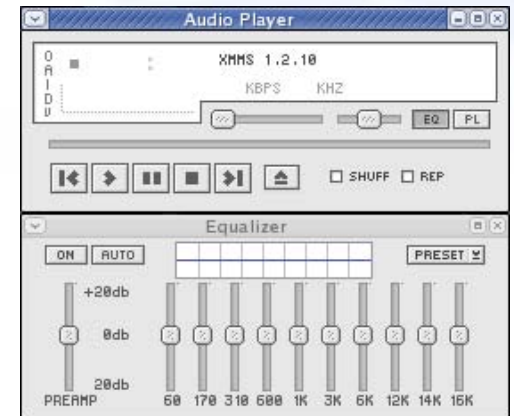
Video

- xanime, mtv, plaympeg
 - First wave of video players
- MPlayer, Xine
 - Support many video formats
 - MPEG, AVI, ASF, WMA, QT, MOV, etc.
 - Continued development in danger due to software patent issue
- XawTV, tvtime
 - TV viewing software relying on TV capture device
- Kino, Coriander
 - Saves video from FireWire (IEEE 1394) cameras
- Other tools: FFmpeg (video format converter), Ogle (DVD player), etc.



Audio, Music

- XMMS (X Multimedia System)
 - Audio file and CD player
- LAME (Lame Ain't an MP3 Encoder)
 - MP3 encoder
- Ogg Vorbis
 - Free music compression format
 - Designed to replace other compression formats having many rights issues
- RoseGarden
 - Desktop music creation tool
- Timidity
 - software MIDI synthesizer



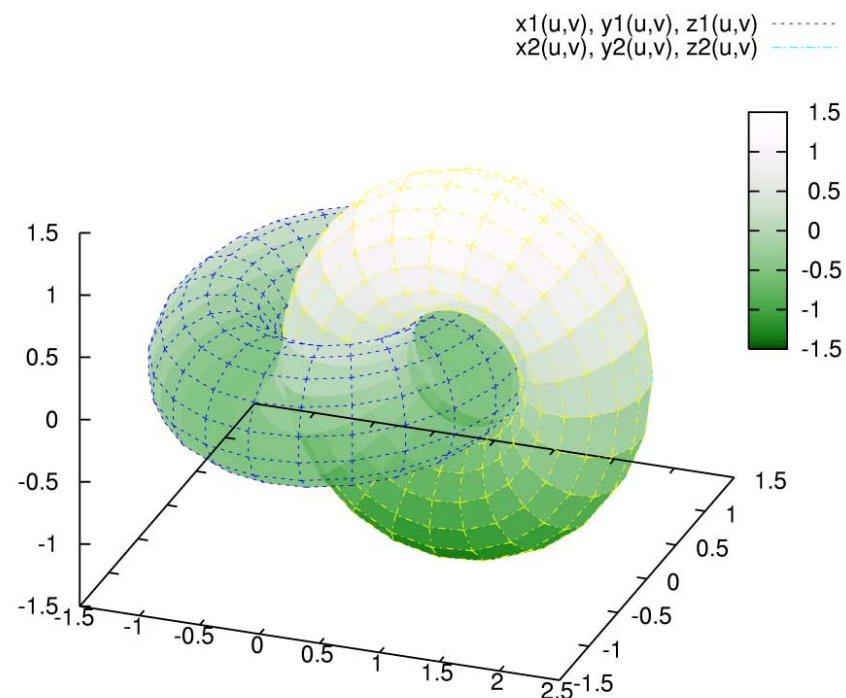
XMMS



Computation, Science and Technology

- R
 - Statistical computing package
 - Compatible with S language
- SciLab, Octave
 - Science and technology computing software
 - Compatible with MATLAB
- Maxima
 - Formula manipulation software
 - Comparable to Mathematica
 - Capable of high quality formula display when used with TeXMac

- gnuplot
 - Plotting software



Graph drawn in gnuplot



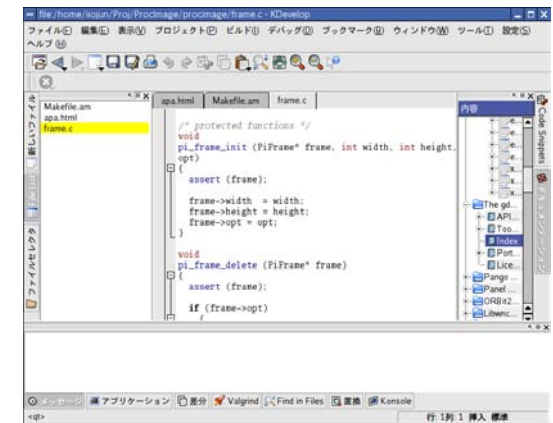
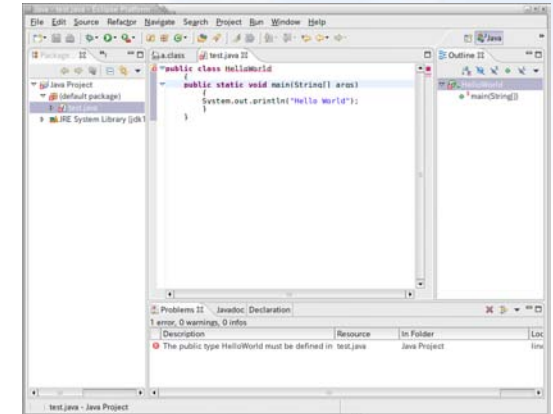
Developing Languages

- gcc (GNU Compiler Collection)
 - Collection of compilers for C, C++, Fortran, Java, etc.
 - Standard compiler for development on Unix
- Perl
 - Strong text processing
 - Flexibility to use various syntax for same process
 - TMTOWTDI: There's More Than One Way To Do It.
 - Frequently used for system management and CGIs
- PHP
 - HTML-embedded, server-side scripting language
 - Main language for Java and Web system development
 - LAMP/LAPP
- Python
 - Features block designation using indentation
- Ruby
 - Developed by Yukihiro Matsumoto
- Python and Ruby are rival languages
 - Python is an object-oriented version of Perl



Integrated Development Environments (IDE)

- Eclipse
 - Development environment implemented in Java
 - Supports languages other than Java
 - Plug-ins for C/C++ development
 - C/C++ Development Toolkit (CDT)
- IDE for various desktop environments
 - Kdevelop for Qt/KDE
 - Anjuta for GTK+/GNOME
- Other IDE
 - WideStudio
 - For creating GUI applications using C/C++







Turbolinux

- Developed and marketed by Japanese company Turbolinux, Inc.
 - Japan: No. 2 in Linux server OS market share (2003 survey) *1
 - China: No. 1 in Linux server OS market share (2003 survey) *2
 - Released Chinese version of Linux
 - Joined UnitedLinux industry consortium in 2002
 - Purpose: Establish standard distribution for Linux
- Focus on desktop Linux OS
 - Releases: Turbolinux 10 Desktop, etc.
 - Enhanced with Windows-like GUI
 - Comes with player supporting Windows Media video files

*1 IDC, "China Linux 2004—2008 Forecast and Analysis," July. 2004

*2 IDC Japan, "Operating System Market in Japan: Linux Market Analysis and Forecast 2003—2007" (In Japanese)



(4) Philosophy and History of Open Source Software

- History of OSS
 - Looking round the evolutionary process of OSS from “Birth of Hackers” to current situations where OSS is widely spread in enterprise market
- Definition of OSS
 - Use the term OSS correctly by knowing strict definition of “Open Source Software”
- OSS Licenses
 - To understand meanings of software licenses and categories of licenses



History of OSS

- Birth of hackers
 - Basis of emerging free software
- Free software movement and FSF
 - Free software as freedom of software
- Copyleft
 - Fundamental structure to keep freedom of software
- Spread of the Internet
 - Free software played an important role
- Birth of Linux
 - A pioneer of “Bazaar model development”
- Growth of OSS, and Launch of OSI
 - Market share of OSS has enhanced for business use
- Penetrating the enterprise market
 - Many major computer vendors join the OSS enterprise market



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Free Software Movement and FSF (1980s)



Copyleft

- Copyleft
 - Stipulates freedom of program and freedom of modified or extended versions
- Protects freedom of software from copyright
 - Does not abandon copyright
 - Manages copyright and ensures freedom of license
 - Right of copyright holder cannot be abandoned under Japanese law, preventing notion of public domain software





- # An Introduction to Open Source Software



Birth of Linux (Early 1990s)

- Linux released by Linus Torvalds in October 1991
 - Student at Helsinki University in Finland
- Licensed under GPL
 - Free Software success story
- Pioneered bazaar-style development model
 - Frequent beta releases in mid-development
 - Many developers send bug reports and patches
- Driving factor in emergence of Open Source
 - Business success of Linux drew attention to effectiveness of bazaar-style development and its software, but Free Software movement was too radical for companies



Growth of Open Source; Launch of Open Source Initiative (Late 1990s)



Definition of OSS



Definition by Open Source Initiative

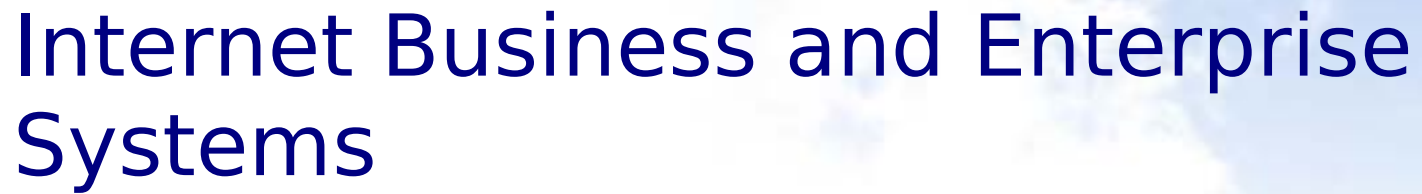
- Prescribed by the Open Source Definition (OSD)
 - Wider recognition leads to greater misuse of term
 - Criteria for OSS licenses
 - Over 50 licenses approved
- Based on Debian Free Software Guidelines (DFSG)
 - OSD places greater emphasis on distribution criteria
- Free Software complies with Open Source definition
- Free Redistribution
- Source Code
- Derived Works
- Integrity of The Author's Source Code
- No Discrimination Against Persons or Groups
- No Discrimination Against Fields of Endeavor
- Distribution of License
- License Must Not Be Specific to a Product
- License Must Not Restrict Other Software
- License Must Be Technology-Neutral



OSS Application Fields

- Network servers
 - Of any field, network applications were the quickest to adopt OSS
- Internet business and enterprise systems
 - Became popular from B2B to enterprise systems
- Embedded systems
 - OSS is widely used in embedded environment
- EWS (Engineering Work Station)
 - Descended from Unix workstation
- Desktops
 - Usability is improved to satisfy average users





Internet Business and Enterprise Systems





- From Unix to PC-Unix (Linux, *BSD)
 - Same system operation and user interface
 - Same applications are used
 - Or many comparable OSS can be used
 - Can reduce hardware costs
 - Switching from Unix machines to IBM PC-compatible machines leads to significant cost savings
- OSS development supported by EWS users
 - Continue to uphold the principle of “user as developer”



Desktops



Deploying OSS

- Deploying a new OSS environment
 - Dual booting
 - CD booting
 - Using a Virtual Machine
- Using OSS under Windows
 - The first step is trying to use OSS applications under Windows
- Cygwin
 - The package to use GNU software under Windows



- Slightly better than the previous configuration



CD Booting

- OS boots directly from CD-ROM
 - Leading example: Knoppix
- Can run on diskless system
 - User data stored in USB memory, etc.
 - Some OS'es save data to CD-R at shutdown
 - Temporary files operate on RAM disk
- Advantages
 - Easy to try new environment
 - CD-ROM based, so minimal risk of harming system
- Disadvantages
 - System cannot be extended
 - Cannot apply security patches, etc.



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(10) Issues with OSS

- Lack of applications, human resources and guarantees
 - Factors lacking in order to utilize OSS the most effectively
- Legal risks
 - Who secures legal risks in using OSS?
- OSS deployment on desktops
 - Desktop use is backward in comparison with server use
- Diversity
 - What makes the issue of software complex?
- Standardization trends and localization
 - Standardization to eliminate diversities
 - Localization to use domestically in each nations