Linux Introduction

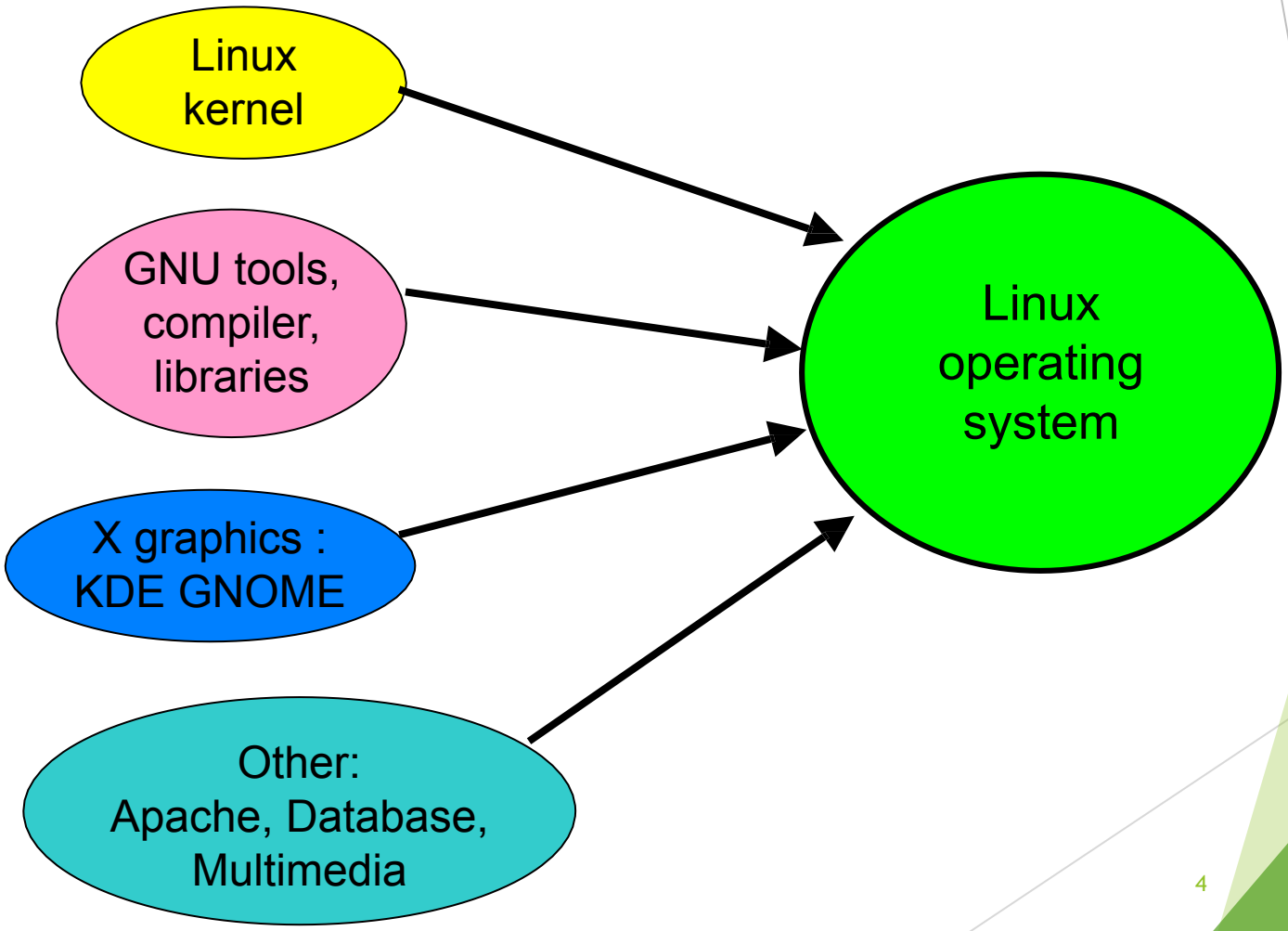
Agenda

* Purpose of an Operating System (OS)
* Key features of the Linux OS
* Origins of the Linux operating system
* Linux distributions and where to find them
* Common uses of Linux in the industry

Introduction to Linux

* What Is Linux?
  * Usually meant to refer to a UNIX-like operating system
  * Free implementation of UNIX, cannot be called UNIX
  * Implementation of the POSIX specification
  * **L**inux **I**s **N**ot **U**ni**X**
* Linux refers just to the **kernel**
  * Much of the non-kernel software is GNU
  * Other components come from many organizations, groups, & individuals

Linux Operating System



Operating Systems

* An operating system (OS) is a collection of **software** that manages computer **hardware** resources and provides common services for computer programs
  * **Hardware:** physical components inside a computer
  * **Software:** set of instructions or programs that allow hardware components to manipulate data

http://en.wikipedia.org/wiki/Operating_system

Operating Systems (Hardware)

* **Hardware** components include:
  * Processor (CPU)
  * Physical memory (RAM)
  * Hard disk drives
  * Sound cards, microphones
  * Video cards, webcams
  * Circuit boards
  * Sensors: GPS, gyroscope, magnetometer

Operating Systems (Software)

* **Software** components include:
  * Processor (CPU) instructions [math, multi]
  * Memory Manager (real or virtual)
  * Process Manager
  * Scheduling Manager
  * Hardware drivers [disk drives, video, sound, sensors]
  * Security [user, access control, terminations]

Operating Systems (Features)

* **Features** include:
  * Real-time or Scheduling Manager
  * Multi-user
  * Multi-tasking
  * Networking
  * Distributed – supercomputers!
  * Embedded http://www.raspberrypi.org/
    * The Raspberry Pi is a credit-card sized computer that plugs into your TV and a keyboard!
    * http://www.ouya.tv/ Android gaming console

Operating Systems (Software)

* Two different types of software:
  * **Applications**: programs designed for a specific use and with which a user interacts
    * Command Line Interface or prompt (CLI)
    * Graphical User Interface (GUI)
    * Desktop tools [calculator, file manager, web browser]
  * **Operating system** software:
    * Device Drivers: interacts with hardware
    * Abstraction Layer: interacts with user applications via Application Programming Interface (API)

Operating Systems (continued)

* Graphical user interface (GUI):
  * component of an OS that the user can interact with using the keyboard or the mouse
* System services:
  * applications that handle system-related tasks:
    * Printing
    * Scheduling programs
    * Provide network access

Operating Systems

A Linux graphical user interface

Operating Systems Comparison

* Name & History
* Creator
* Cost
* License
* Target system type

  * http://en.wikipedia.org/wiki/Comparison_of_operating_systems

The Linux Operating System

* Linux OS
  * Runs a variety of applications on a variety of different hardware components
* Multiuser and Multitasking OS
  * Has the ability to manage thousands of tasks at the same time
  * Allows multiple users to access the system simultaneously

Versions of the Linux Operating System

* Core component is called the Linux **kernel**
  * Written almost entirely in the C programming language
  * Software can be used to modify appearance of Linux, but the kernel is common to all Linux
* Important to understand Linux **kernel version** numbers to decide which version is appropriate for **user needs: x86 or 64**

https://www.kernel.org/

The GNU System

* The GNU system comes from the Free Software Foundation: **FSF.ORG**
  * Founded by Richard M. Stallman in the 1980s
  * Objectives were to create freely distributable UNIX tools
    * Software should be free from patents & commercial ownership
  * GNU provides many UNIX commands & useful applications
    * Linux and GNU were an ideal match in the early 1990s
      * Linux kernel needed supporting software
      * GNU needed a kernel (it now has the Hurd)

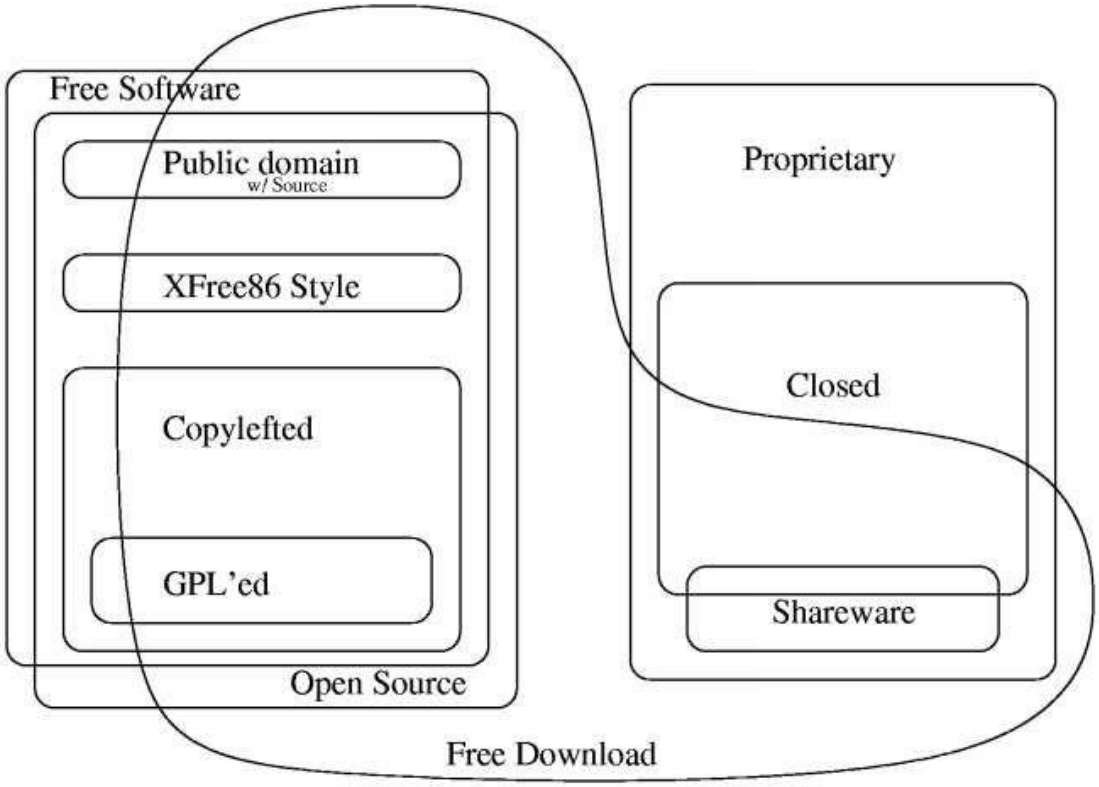
Licensing Linux

* Open Source Software (OSS):
  * Programs distributed and licensed so that the source code is available, free of charge, to anyone who wants to examine, utilize, or improve upon it
  * Mayor repository sources:
    * http://www.gnu.org/
    * http://sourceforge.net/
    * http://www.fsf.org/
    * https://github.com/plans

Licensing Linux (continued)

* Implications of OSS:
  * Developed very rapidly through widespread collaboration
  * Bugs (errors) are noted and promptly fixed
  * Features evolve quickly based on users' needs
  * Perceived value of the software increases because it is based on usefulness, not on price

Licensing Linux (continued)



Types of Open Source Licenses

* GNU Public License (GPL):
  * Stipulates that the source code of any software published under its license must be freely available
  * Users who modify the source code must also redistribute the modified code freely
* Artistic license: OSS license allowing source code to be distributed freely, changed only at discretion of original author

Types of Closed Source Licenses

* Most **closed source** software is sold commercially
  * Usually bears label of manufacturer, such as Microsoft or Electronic Arts software
* **Freeware:** distributed free of charge; source code usually not available
* **Shareware:** initially free, but requires payment after a period of time or for use of certain features

Linux Advantages: Meeting Business Needs

* Common software available for Linux includes:
  * Scientific and engineering software
  * Software emulators
  * Web servers, Web browsers, and e-commerce suites
  * Desktop productivity software
  * Graphics manipulation software
  * Database software
  * Security software

Linux Advantages: Stability and Security

* Customers using a closed source OS must rely on the OS vendor to fix any bugs
  * Waiting for a hot fix may take weeks or months
* Bugs and security loopholes in OSS programs can be identified and fixed quickly
  * Code is freely available and scrutinized by many developers

Linux Advantages: Flexibility for Different Hardware Platforms

Partial list of hardware platforms on which Linux can run:

- Intel x86, IA-64
- MIPS
- Mainframe (S/390)
- ARM, Atom
- Alpha
- M68K
- PA-RISC
  - SPARC
- Ultra-SPARC
- **PowerPC**: Nintendo, PS3, Xbox 360

http://en.wikipedia.org/wiki/List_of_Linux_supported_architectures

Linux Advantages: Ease of Customization

* Ability to control the inner workings of the OS
  * To use Linux as an Internet Web server, compile the kernel to include only the support needed to be an Internet Web server
    * Results in a much smaller and faster kernel
  * Can choose to install only software packages needed to perform required tasks
  * Can use shell and PERL scripts to customize or automate tasks

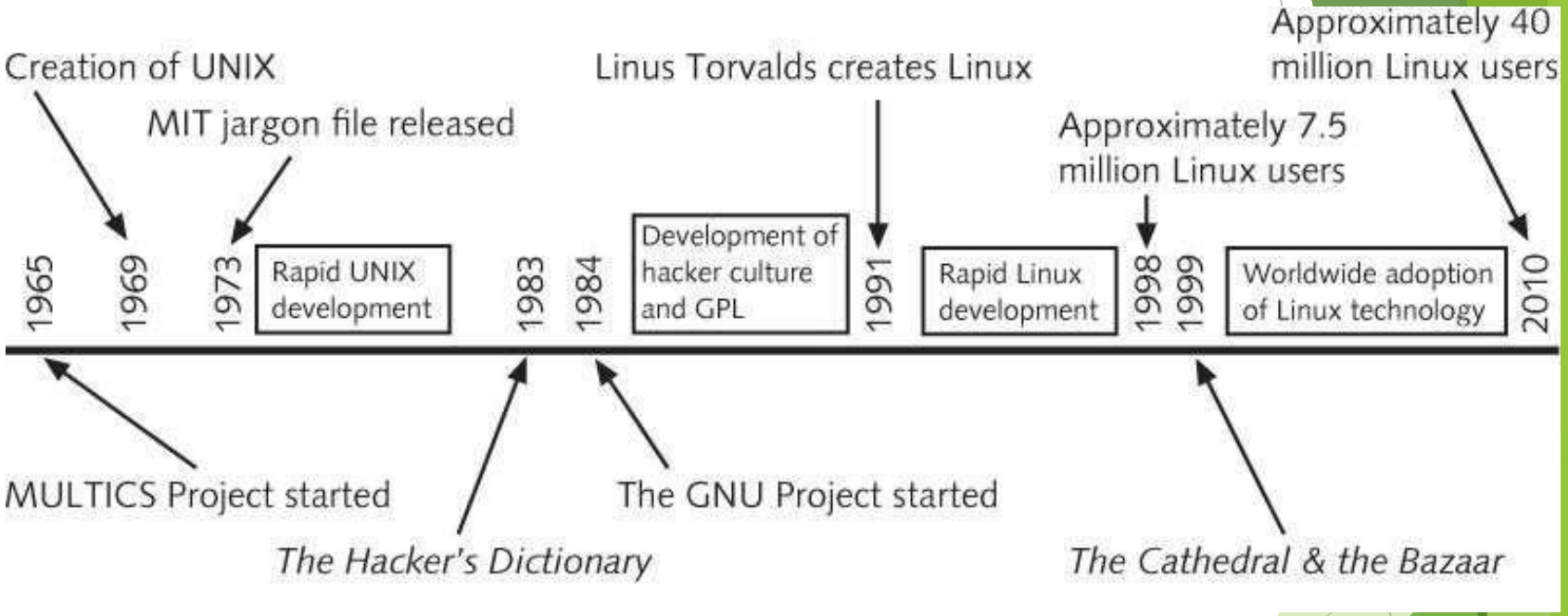
Linux Advantages: Ease of Obtaining Support

* Linux documentation can be found on the Internet
  * Frequently asked questions (FAQs)
  * HOWTO documents
* Linux newsgroups
* Linux User Group (LUG): Open forum of Linux users who discuss and assist each other in using and modifying the Linux OS

Linux Advantages: Cost Reduction

Operating System	Linux	Closed Source Operating System
Operating System Cost	$0	Greater than $0
Cost of Administration	Low: Stability is high, and bugs are fixed quickly by open source developers.	Moderate/High: Bug fixes are created by the vendor of the operating system, which could result in costly downtime.
Cost of Additional Software	Low/None: Most software available for Linux is also open source.	High: Most software available for closed source operating systems is also closed source.
Cost of Software Upgrades	Low/None	Moderate/High: Closed source software is eventually retired, and companies must buy upgrades or new products to gain functionality and stay competitive.

The History of Linux



Timeline of UNIX and Linux development

UNIX

* Evolved from Multiplexed Information and Computing Service (MULTICS)
* The first true multitasking, multiuser OS
* Written in the C programming language
  * Portable OS
* OS from which Linux originated

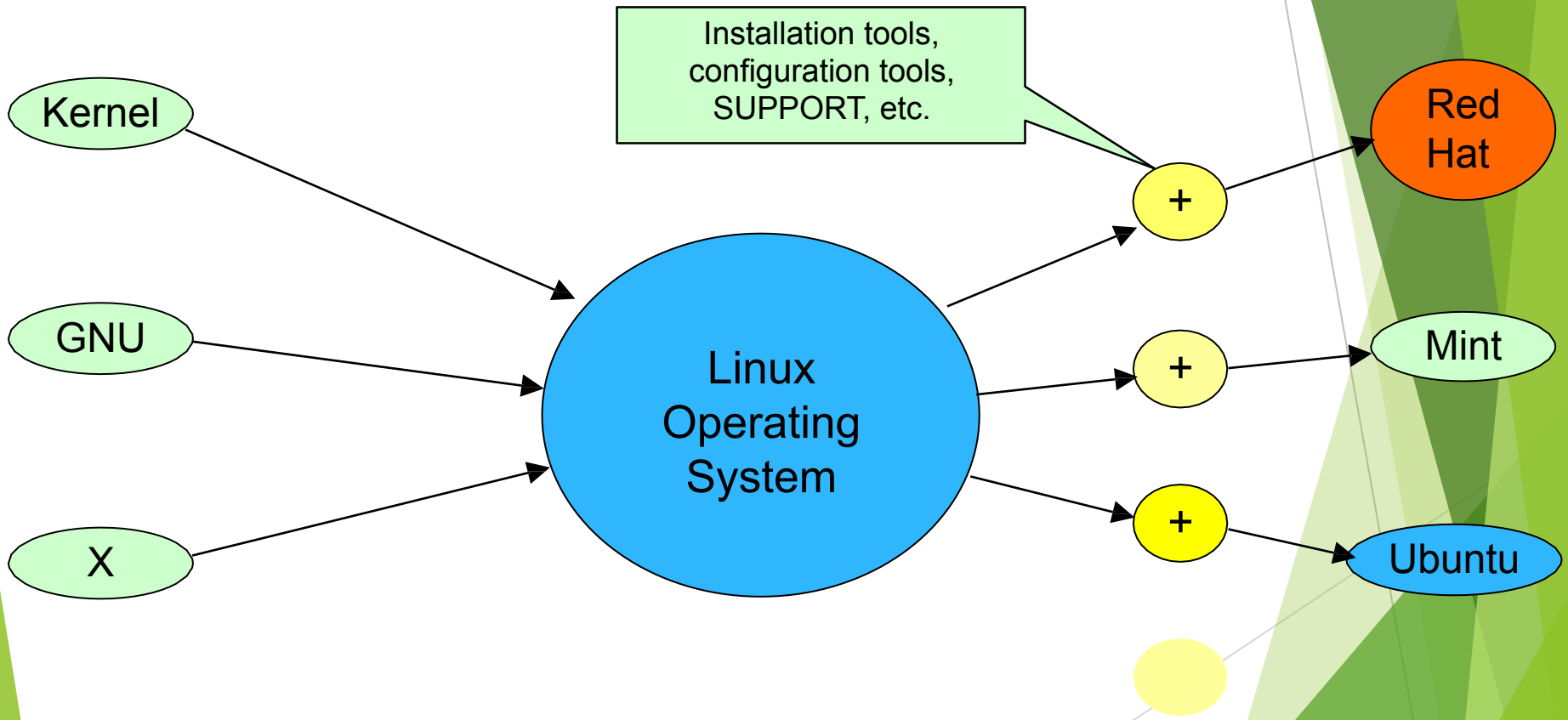
UNIX (continued)

* Berkeley Software Distribution (BSD)
  * Version of the original UNIX source code
* Common flavors of UNIX today include:
  * Sun Microsystems's Solaris UNIX
  * Hewlett-Packard's HP-UX
  * IBM's AIX UNIX

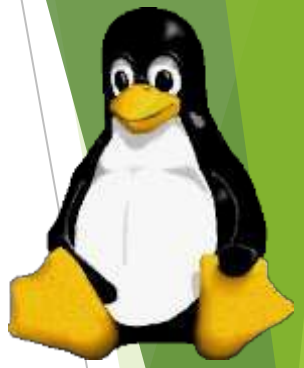
Linux

* First developed by Linus Torvalds in 1991
  * Published under the GNU license
* Linux kernel developed collaboratively and centrally managed
  * Hackers developed Linux add-on packages and distributions
  * Linux is simply a by-product of OSS development

Linux Distributions



What Is a Linux Distribution?



* A Linux distribution is:
  * A preconfigured **kernel**
  * GNU utilities
  * X graphical environment (KDE, GNOME)
  * Other generic software components (Apache)
  * Distributor-specific **installation** & **configuration**
  * **Support**

X

* A powerful networked graphical environment
  * Developed at MIT, freely distributable
  * X.org - complete implementation of X based on the X11R6 standard
* Servers typically do not require graphics
  * Some useful system administration tools are graphical
  * X graphical tools can be run on a server and displayed remotely

MIT = Massachusetts Institute of Technology

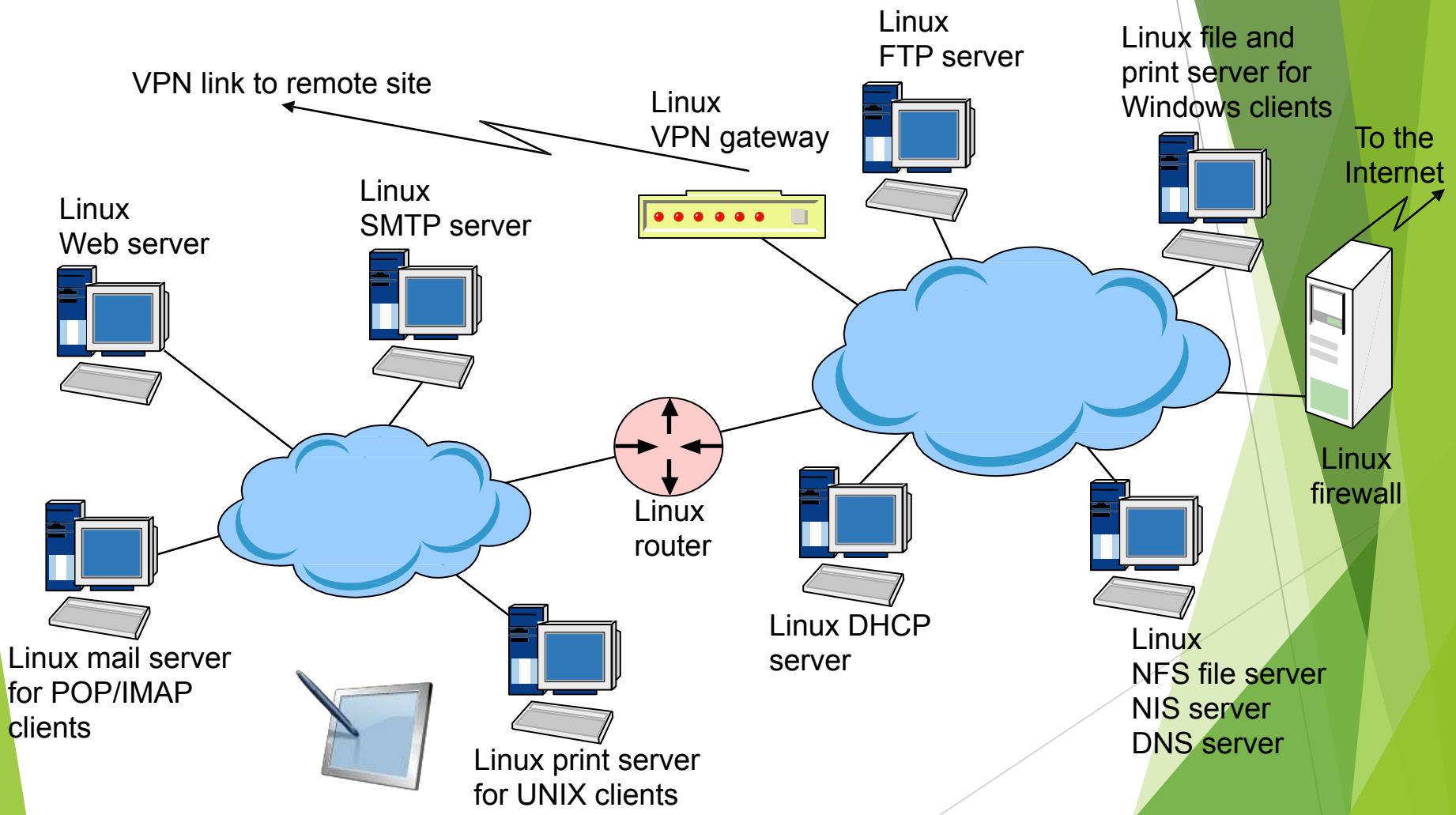
Other Linux Applications

* UNIX software packages have been ported
  * UNIX packages are often distributed in source form
    * Korn Shell, emacs, zip, chkconfig
  * Many server components are generic UNIX software
    * Apache, sendmail, BIND, Samba
* Some software components are
  * Free implementations of commercial applications
    * OpenSSH, OpenMotif, GNUPG
  * Internationalization
    * Multiple languages
    * Unicode support!

Common Uses of Linux

* May be customized to provide services for a variety of companies in a variety of situations
  * **Workstation** services: services used on a local computer
  * **Server** services: services made available for other computers across a network
  * **Mobile** devices: tablets and cell phones!
  * **Game Consoles**

What Could Your Net Look Like?

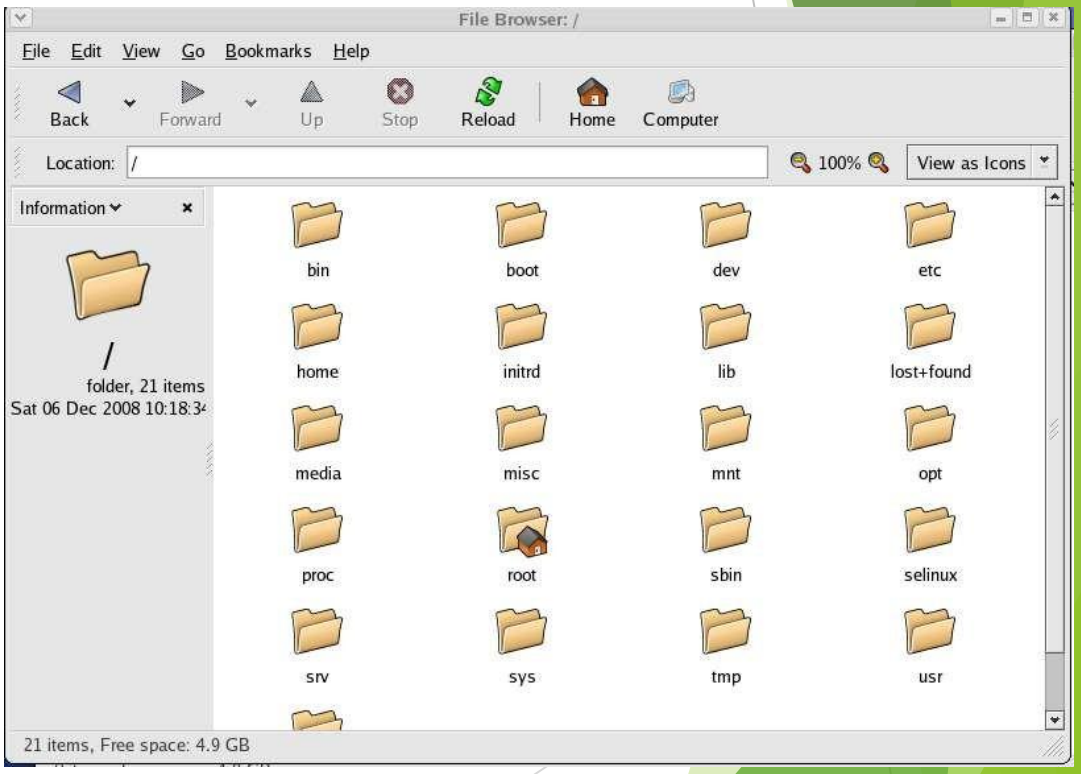


File and Print Servers

- Linux is well-suited for centrally sharing resources
  - More economical to share files and printers over a network
  - Inherently fast and light
  - A distribution specific to a certain task can be installed on the central server
  - Can share resources with a computer running another OS

Navigating Filesystem

* Using Nautilus (Gnome graphical filesystem browser)
  * Click on “Computer” icon or
  * “Applications”, “System Tools”, “File Browser”



Application Servers

* Application server: intermediary between a client computer and a database
* Database: organized collection of data that is arranged into tables of related information
* Database Management Systems (DBMS): set of programs designed to allow for creation, modification, manipulation, maintenance, and access of information from databases
* Application servers can provide management functionality

Supercomputers

* Clustering: combining several smaller computers to act as one large supercomputer
  * Beowulf clustering: most common Linux method of clustering
* Scalability: the ability for a computer to increase workload as the number of processors increases
  * Clustering computers often results in better scalability than adding processors to a single computer

Scientific/Engineering Workstation

* Scientific and engineering community often needs customized programs (NASA, NOA)
* OSS programs can be used or modified
  * OSS software available for physics, astrophysics, biophysics, biocomputation, data mining, and many other scientific and engineering fields

Office/Personal Workstation

* Workstation software designed for end users in office and home environments
* OSS packages available for:
  * Graphics editing software
  * Desktop publishing software
  * Media software
  * Financial software
  * Office productivity suites
  * Bittorrent clients

Non Distribution Linux

* Mobile Linux
  http://en.wikipedia.org/wiki/Embedded_Linux
* Game console Linux http://openpandora.org
* Embedded Linux http://elinux.org
* Automobile consoles & Google TV
* Older hardware
* Printers & Network equipment

Installing Linux: Hardware

Type of Hardware	Requirement
central processing unit (CPU)	Minimum: Pentium Pro class – 200MHz Recommended: Pentium Pro class – 400MHz
random access memory (RAM)	Minimum for text-mode: 256MB Minimum for graphical: 384MB Recommended for graphical: 512MB
free disk space (hard disk drive)	Minimum: 90MB free space (for a minimal installation) Full Installation: 10GB free space Recommended: 20GB free space Additional free space for file storage or other software you plan to install
additional drives	DVD drive (for DVD-based installation)
peripheral devices	Fedora-compliant peripheral devices (for example, video cards, sound cards, network cards)

Fedora 13 hardware requirements

Summary

* Purpose of an Operating System (OS)
* Key features of the Linux OS
* Origins of the Linux operating system
* Linux distributions and where to find them
* Common uses of Linux in the industry