

IT 6204

Section 1.0

Introduction to System & Network Administration



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1.1 Essential duties of the system administrator



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What is Systems Administration?

System Administration, sis'tem ad-min'is-tra'shon, n.

Activities which directly support the operations and integrity of computing systems and their use and which manage their intricacies (complexity).

These activities minimally include **system installation, configuration, integration, maintenance, performance management, data management, security management, failure analysis /recovery, and user support**.

In a inter-networked computing environment, the **computer network** is often included as part of the complex computing system.



Being a SysAdmin Professional

- System Administration, if done well, should be equal parts:
 - Technical skills
 - People & communications skills
 - Problem solving & Common sense
 - Personal Commitment
- “**SysAdmin** involves a tension between authority and responsibility on one hand and service and co-operation on the other.”



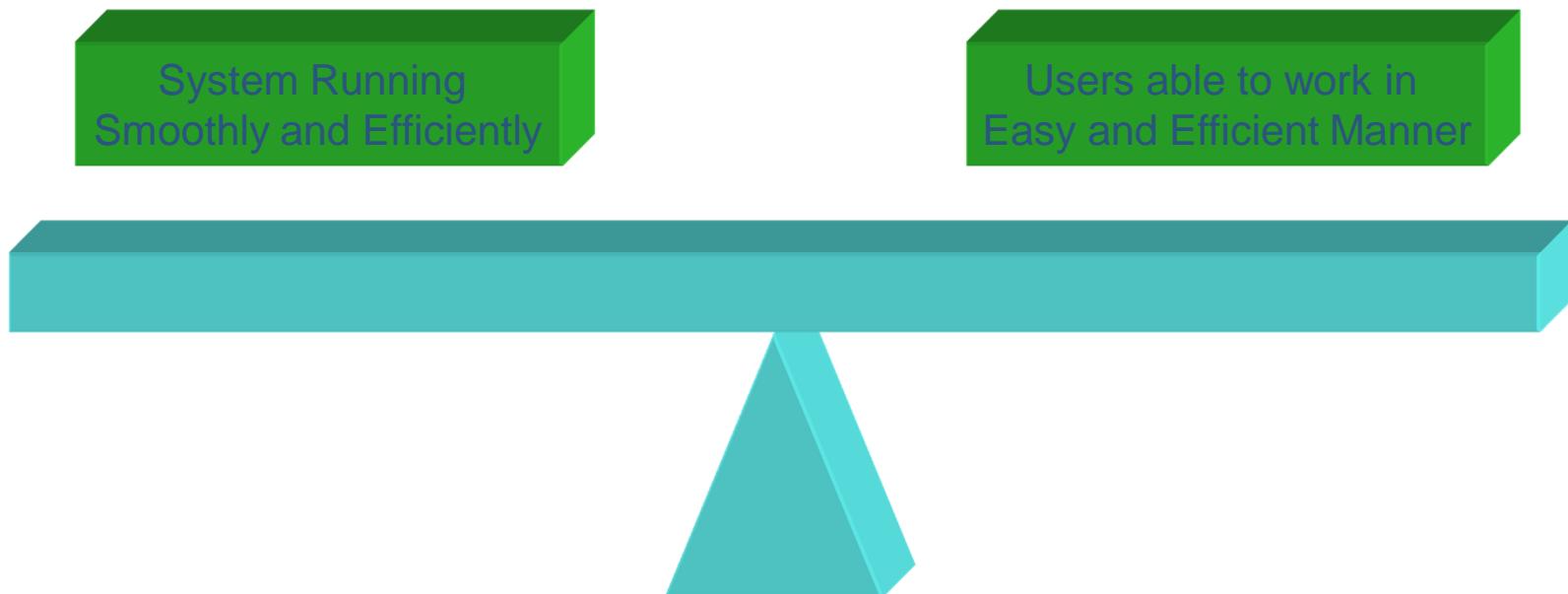
System Administration: An introduction

- Who is a system administrator?
 - Anyone who managers a computer not solely for their own use.
- What are the goals of system administration?
 - Ensure that computing systems run correctly and as efficiently as possible
 - Ensure that all users can and do use the computing systems to carry out their required work in the easiest and most efficient manner.

These are conflicting goals.



Who is a System Administrator?



Tasks of a Network Administrator

- Security Management
- Performance Management
- Planning for Growth
- Fault Management and Recovery
- Account/User Management
- Networked Application Support



Security Management

- Firewalls
- Usernames
- Password control
- Resource Access Control

Performance Management

- Availability
- Response Time
- Accuracy

Planning for Growth

- A Network (or any organisation) is not static
- Growth means increased load on a network. This must be planned for....
- Systems eventually need replacement. This must be planned for – in advance...



Fault Management and Recovery

- Monitoring
 - Reporting status
- Testing
 - Fixes and Patches
 - Updates
 - Repairs
 - Change Management

Account / User Management

- Communication Facilities
 - Connection - Rental - Charges
- Hardware Usage
 - Lease - Rent - Hire
- Consumables Usage
 - Power, Paper, Media
- Software Usage
 - Licensing,
 - Tolls,
 - Application usage



Account / User Management

- Accounts are Managed for:
 - Intrusion detection / prevention
 - Charging for Services
 - Legal protection of the Organisation

Networked Application Support

- Client / Server systems support
- Internet support
- Server support
 - Applications and Hardware
- Helpdesk
 - Trouble report / Bug fixes
 - Printing
 - eMail



How to be a Sys/Net Admin (Yet another Job Description...)

- Learn Operating System basics
- Learn shell utilities and script programming
- Learn how to Install and Configure OS
- Learn Web, DNS, Email, Proxy, ...
- Learn TCP/IP networking
- Learn about system tuning and accounting
- Learn Compile and Customization



Goals of System/Network Administration

- Put together a network of computers
- Get them running
- Keep them running (despite Users....)
- Provide a Service to Users
- Requires skills of
 - Mechanic
 - Sociologist
 - Researcher



Challenges of System/Network Administration

Systems or Network Administration is more than just installing computers or networks.

It is about planning and designing an efficient community of computers that allow users to get their jobs done.



Challenges of Administration

- Design Logical, Efficient networks
- Easily deploy & update many machines
- Decide what services are needed
 - know the business tasks & customers
- Plan and implement adequate security
- Provide comfortable User environment
- Be able to fix errors and problems
- Keep track of & be able to use knowledge



Comparison of System/Network Management Styles

- Fire-Fighting
 - Managing by responding to situations when they happen (Reactive)
- Preventative management
 - Monitor network and make repairs and changes before problems appear (Proactive)
- These are two opposite extremes.
Most real managers combine both.

Fire-Fighting

- Investigate the Fault or Problem
 - Isolate the problem and identify/define it
 - Use tests and tools to diagnose the problem
 - Solve the problem and document the solution
- Prioritize multiple problems

Preventative Management Techniques

- Capacity Planning
- Simulation and Testing
 - load generators
 - Benchmarks
- Performance Monitors and System Tuning
 - Network analysis and modelling
 - Load balancing
 - Hardware upgrades

Sources of Information for System/Network Administrators

- Manuals and Online Documentation
- World Wide Web
- RFCs, FYIs, ...
- News groups, Discussion lists, WebLogs, Blogs,
.....
- Meetings, Seminars, Examinations ...
 - SAGE/Usenix, Microsoft TechNet/TechEd,
RHCE
- How-To books



Successful System Administration

- Need to find a balance between
 - Authority and responsibility
 - Service and cooperation
- A few Basic strategies
 - Plan it before you go it
 - Make it reversible
 - Make changes incrementally
 - Test, test, test before you unleash it on the world
 - Know how things REALLY work.



Successful System Administration

- Example: editing system configuration files.
 - Keep a copy before any change to the configuration file
 - For original version, using suffix of .dist, .orig
 - For further changes, using suffix of .old, .sav, .yymmdd, etc
 - Keep the current modification date
 - cp -p
 - Plan how to back up if the change didn't work – say system does not even boot
 - Such as boot to single user mode and copy the old version back
 - Test the change on a non-production environment first
 - Eliminate the most obvious problems
 - Make one major change at a time
 - Make the test easier

Successful System Administration

- Successful system administration
 - Careful planning
 - Habit
 - Change root password regularly
 - Faithfully making backups (no matter how tedious)
 - Testing every change several times
 - Sticking to policies you've set
- Handling crises
 - Have the foresight
 - Take time to anticipate and plan for the emergency
 - Prevent crises by carrying out all careful procedures.



Final Word on System Admin

The task of system administration is a balancing act. It requires patience, understanding, knowledge and experience.

(eg. Working in a casualty ward of a hospital)

In order to be good at system administration, a certain amount of dedication is required with both theoretical and practical skills.

Even though the best system administration tool are free, companies actively seeking to pay consultants/system administrators to set up and maintain administration tools for them!!



1.2 Unix and Linux Distributions



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Multics

- Bell Labs join “Multics” project of GE and MIT in 1965
- Primitive version of Multics running on GE 645
- Bell Labs ended its participation of Multics in 1969



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Unics / UNIX

- Former Multics group at Bell Labs wanted to continue system programming
- Ken Thompson used a cast off PDP-7 to play the game “Space-Travel”
- With Dennis Ritchie, Ken gradually implemented an operating system for PDP-7
- The new OS was named “Unics” as opposed to “Multics”



UNIX

- UNIX was originally written in assembler and “B”
- Dennis Ritchie improves “B” and named it “C”
- In 1973, most of UNIX was rewritten in C
- UNIX was migrated from PDP-7 to a PDP-11



UNIX

Unix creator Dennis Ritchie dies aged 70

Pioneering computer scientist Dennis Ritchie has died after a long illness.

Dr Ritchie was one of the creators of the hugely influential Unix operating system and the equally pioneering C programming language.

A vast number of modern technologies depend on the work he and fellow programmers did on Unix and C in the early days of the computer revolution.

Those paying respects said he was a "titan" of the industry whose influence was largely unknown.

The first news of Dr Ritchie's death came via Rob Pike, a former colleague who worked with him at Bell Labs. Mr Ritchie's passing was then confirmed in a statement from Alcatel Lucent which now owns Bell Labs.

Jeong Kim, president of Alcatel-Lucent Bell Labs, said Dr Ritchie would be "greatly missed".

"He was truly an inspiration to all of us, not just for his many accomplishments, but because of who he was as a friend, an inventor, and a humble and gracious man," said Mr Kim.



Dr Ritchie (middle) and Mr Thompson were awarded the US National Medal of Technology for their work on Unix

Related Stories

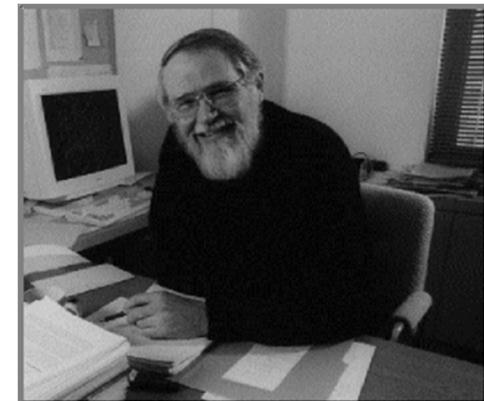
[Steve Jobs of Apple dies at 56](#)

[Key computer conservationist dies](#)

[Father of British computing dies](#)

BSD

- In 70s AT&T was under a courts order not to sell software
- AT&T gave away UNIX to Universities charging only for media
- Kernighan took UNIX to his University at Berkeley
- Berkeley released BSD (Berkeley Software Distribution) version of UNIX
- BSD too went through many releases until BSD 4.4 was released. This too became accepted in the commercial world So, two competing versions reined namely System V and BSD1



System V & GNU

- In 1984, AT&T was divested, and was allowed to sell UNIX
- AT&T developed more versions, until it released a commercial version called System 3 and this was followed by System V Release 4 – SVR4 (supported by many vendors)
- UNIX became commercial, source code restricted
- Richard M Stallman (RMS) left MIT AI Labs to found the GNU (GNU's Not UNIX) Project under Free Software Foundation
- The goal of the GNU was to create a free UNIX like operating system
- GNU defined the word “free” as in “free speech”, not as in “free beer”



GNU's
Not
Unix

GNU

- GNU distributed it's software under the GNU General Public License (GPL)
- GPL mandated changes to GPLed programs also to be under GPL
- By 1990, the GNU system was almost complete
- “GNU Herd”, the kernel of the GNU system was not ready



<http://www.gnu.org/>



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Finally on Unix

- Most of the Unix versions were ***based on BSD or System V***
- **IEEE** developed a standard to enable various flavors of Unix to inter-network. This ANSI standard known as **POSIX** (Portable OS Interface for Computer Environments) is the collective name of a family of related standards specified by the IEEE to define the application programming interface (API), along with shell and utilities interfaces for software compatible with variants of the Unix operating system, although the standard can apply to any operating system. The term POSIX was suggested by Richard Stallman in response to an IEEE request for a memorable name.



What is Linux?

- Linux is a free Unix-type operating system originally created by ***Linus Torvalds*** with the assistance of developers around the world.
- Linux is an independent POSIX implementation and includes true multitasking, virtual memory, shared libraries, demand loading, proper memory management, TCP/IP networking, and other features consistent with Unix-type systems.
- The source code for Linux is freely available to everyone.
- 'Linux' refers to the kernel part of the OS.
- The kernel will run on many platforms: PDP/11, Alpha, Cray,
- x86, PowerPC, PDAs and many more.
- Today



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The Origins of Linux

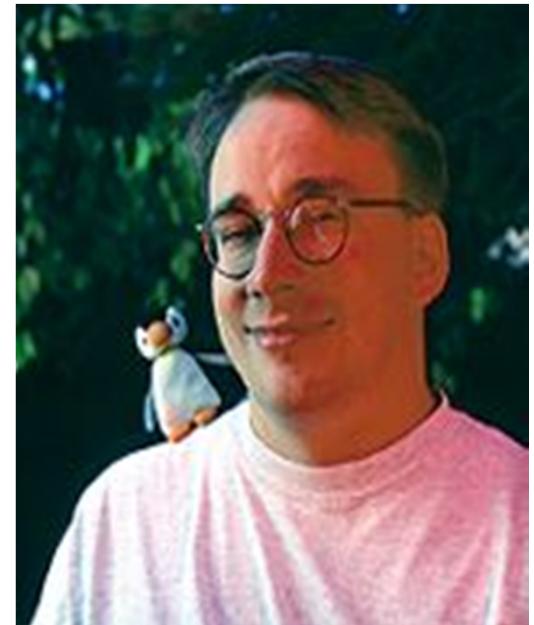
The Beginning

The core of the Linux operating system was coded by a Finnish programmer called Linus Benedict Torvalds in **1991**, when he was just 21. He had got a new 386, and he found the existing DOS and UNIX too expensive and inadequate.

In those days, a UNIX-like tiny, free OS called **Minix** was extensively used for academic purposes. Since its source code was available, Linus decided to take Minix as a model. In his own words,

'I wanted to write a better Minix than Minix'

In order to encourage wide dissemination of his OS, Linus made the source code open to public. At the end of **1992** there were about a hundred Linux developers. Next year there were 1000. And the numbers multiplied every year.



The Origins of Linux (Contd.)

- 1991 – Linux is created as a hobby by Linus
- 1992 – First public version (Linux 0.02)
- 1993 – First prefabricated Linux distributions
- 1996 – Support for non-Intel processors
- 1999 – 2.2 kernel released
- Then 2.4 and 2.6 kernels ...

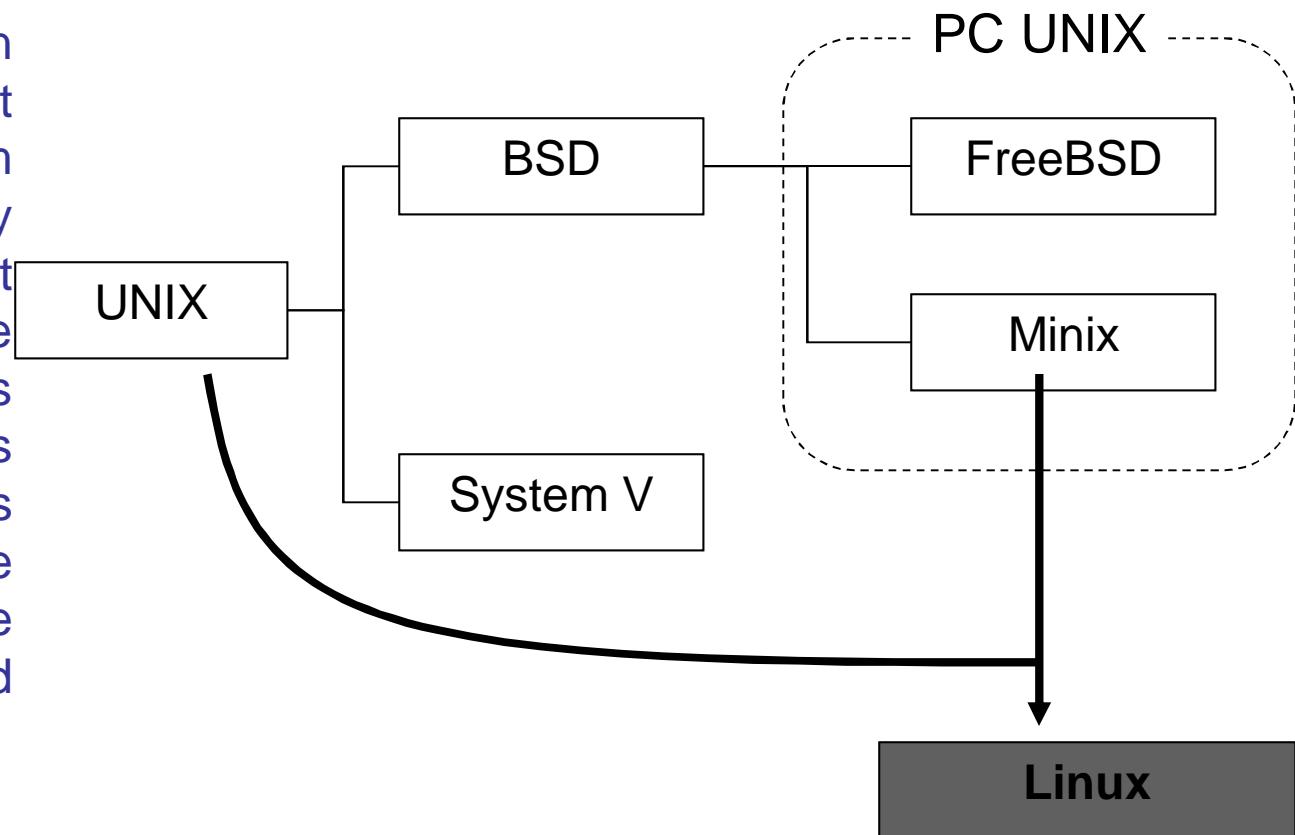
Though Linus never imagined it, Linux quickly became a general tool for computing. People stopped looking at Linux as a toy, and began to think about it seriously. Today there are thousands of applications that can be run on Linux, from Office Suites to 3D games. Hundreds of Linux User Groups the world over discuss ways to make Linux work better. Many number of web sites, and thousands of newsgroups and mailing lists talk about Linux.



Linux Lineage

While many UNIX systems are based on System V of AT&T or BSD (Berkeley Systems Distribution) of the University of California, Berkeley, Linux has been developed without using the source codes of these two systems.

As a result, Linux can function as an independent UNIX-type operating system and can be freely redistributed without infringing the license. The development of Linux has been based on the activities of many volunteers and its functions and reliability are comparable with any of the commercially marketed UNIX systems.



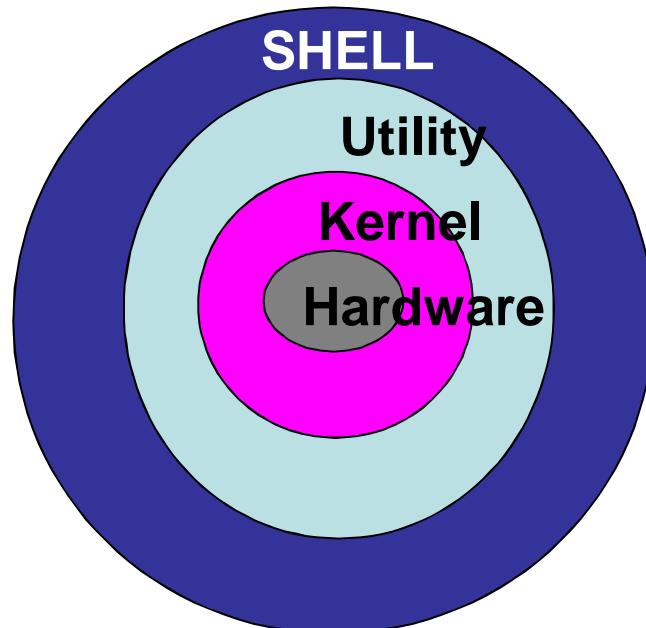
What is Linux Really?

- Linux itself is just kernel

The heart of the system; takes care of memory management, interrupt handling, etc

(i.e. a common interface between user process and hardware)

- The kernel is only useful when used in conjunction with other software
 - GNU Project
 - XFree86
 - Others



Linux Distributions



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What is a Linux Distribution?

- Takes the kernel (2.6) & other software and sells/gives them to you
- Provide a “friendly” method of installing the system
- Provide security updates and bug fixes
- Provide a method for installing and removing extra software
 - A ‘**packaging**’ system
- Provide their own utility software, e.g.
 - Printer setup,
 - Network setup,
 - And so on
- Each distribution has its own characteristics
- Though the OS is the same, the bundled software do vary from one distribution to another.

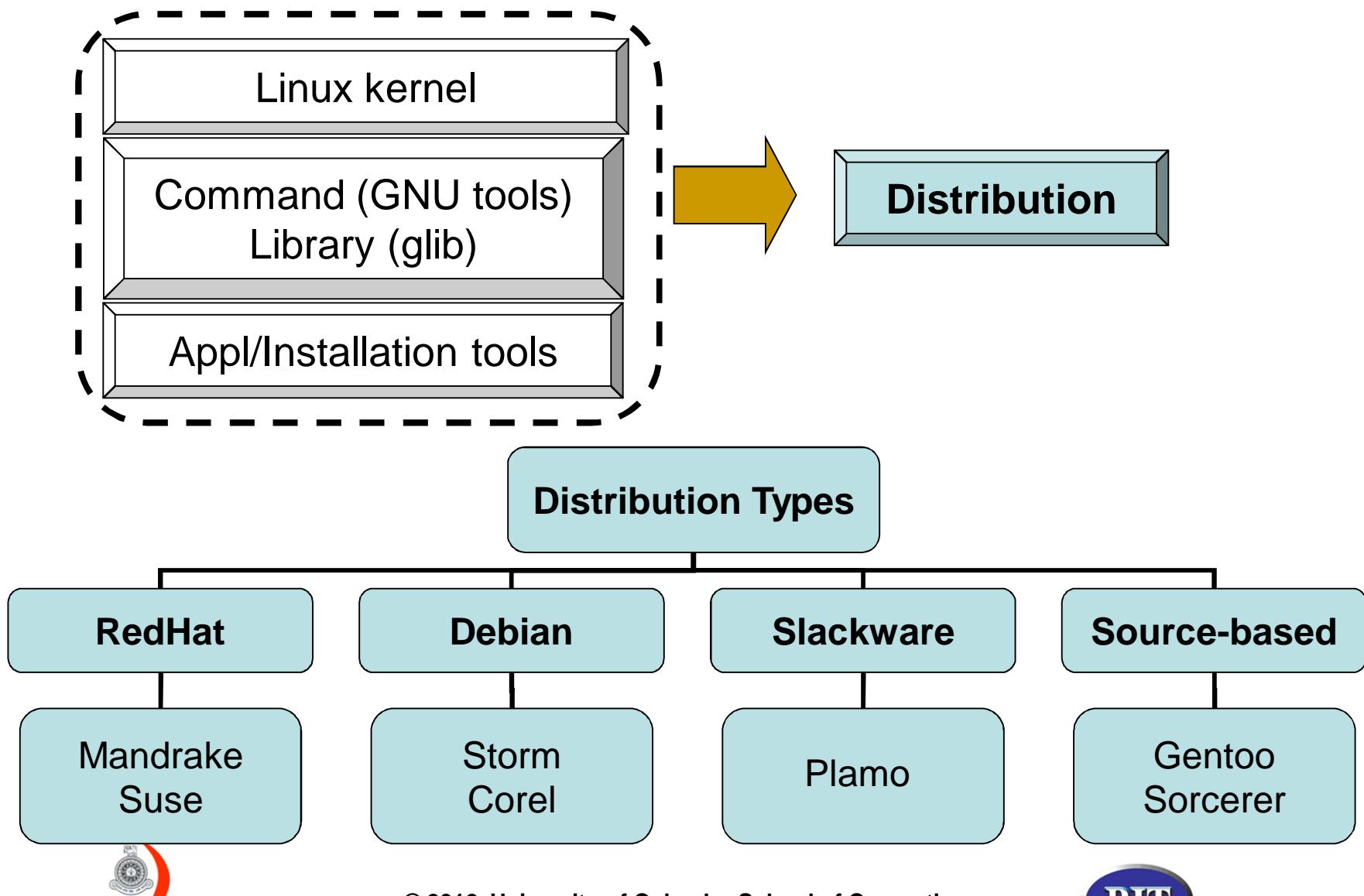


What Makes Distributions Different?

- System Installer
 - Anaconda (Red Hat, Fedora and ...)
 - Yast (SuSE)
- Package Management
 - RPM (Red Hat, Fedora, SuSE and ...)
 - DEB (Debian based distros)
 - TGZ (Slackware based distros)
- Configuration System
 - Yast (SuSE)
 - system-config-* (Fedora)
- Packages



Major Distribution Types



Popular Linux Distributions

Last 12 months			Last 6 months			Last 3 months			Last 1 month		
1	Ubuntu	2150▼	1	Ubuntu	2294-	1	Ubuntu	2531▼	1	Mint	2467▼
2	Mint	1776▲	2	Mint	2147▲	2	Mint	2525-	2	Fedora	2234▼
3	Fedora	1502▲	3	Fedora	1547▲	3	Fedora	1801▼	3	Ubuntu	2039▼
4	openSUSE	1276-	4	Debian	1475▲	4	Debian	1404-	4	Debian	1490▼
5	Debian	1266▲	5	openSUSE	1296-	5	openSUSE	1371▼	5	openSUSE	1263▼
6	Arch	856▲	6	Arch	1009▲	6	Arch	1108▲	6	Arch	1209▼
7	PCLinuxOS	827▲	7	PCLinuxOS	886▲	7	PCLinuxOS	941▲	7	PCLinuxOS	1018▼
8	Sabayon	763▼	8	Puppy	859▲	8	Slackware	847▼	8	Puppy	975-
9	Puppy	758▲	9	CentOS	771-	9	Puppy	845▲	9	Mageia	913▲
10	Mandriva	710-	10	Sabayon	745▼	10	CentOS	827-	10	CentOS	795▲
11	CentOS	643-	11	Mandriva	731-	11	Mandriva	717-	11	Mandriva	726▼
12	Slackware	593-	12	Slackware	690-	12	Mageia	606▲	12	Zorin	662▲
13	Lubuntu	532-	13	Chakra	571▲	13	Chakra	583▲	13	Slackware	614▼
14	Ultimate	516▼	14	Ultimate	523▼	14	MEPIS	562▼	14	Scientific	607▲
15	FreeBSD	484-	15	FreeBSD	513-	15	Lubuntu	556-	15	Bodhi	566▲
16	Chakra	471▲	16	MEPIS	509▲	16	Sabayon	519▼	16	BackTrack	558▼
17	MEPIS	467-	17	Lubuntu	488▲	17	Bodhi	481▲	17	Lubuntu	552▼
18	Gentoo	409-	18	Scientific	486▼	18	Zenwalk	467▼	18	MeeGo	527▲
19	CrunchBang	407▲	19	CrunchBang	469-	19	Scientific	467▼	19	Pinguy	519▼
20	Tiny Core	394-	20	Gentoo	450-	20	Gentoo	463▼	20	Red Hat	512▼
21	Red Hat	372-	21	Red Hat	411-	21	Ultimate	446-	21	Chakra	493▲
22	Zenwalk	367-	22	Zenwalk	403-	22	Kubuntu	407▲	22	MEPIS	472▼
23	Peppermint	353-	23	Zorin	396▲	23	Red Hat	400-	23	Super OS	460▲
24	PC-BSD	347-	24	PC-BSD	388▲	24	FreeBSD	398-	24	Zenwalk	437▼
25	Vector	343▼	25	Vector	371▼	25	Pinguy	394▲	25	Gentoo	429▼
26	Kubuntu	339-	26	Mageia	355▲	26	Zorin	389▲	26	Sabayon	424▼

<http://distrowatch.com/>



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Linux Kernel Release Number

➤ Release Number a.b.c

- a - means major release
- b - if b is odd means development release
if b is even means stable release
- c - minor number (patch number of major release)

➤ Linux Kernel maintainer

- Release 2.0.x - David Weinehall
- Release 2.2.x - Marc-Christian Petersen
(former maintainer Alan Cox)
- Release 2.4.x - Willy Tarreau
(former maintainer Marcelo Tosatti)
- Release 2.6.x - Linus Torvalds (Current Development)
- Latest stable version is 3. (Check the Internet) O

<http://www.kernel.org/>

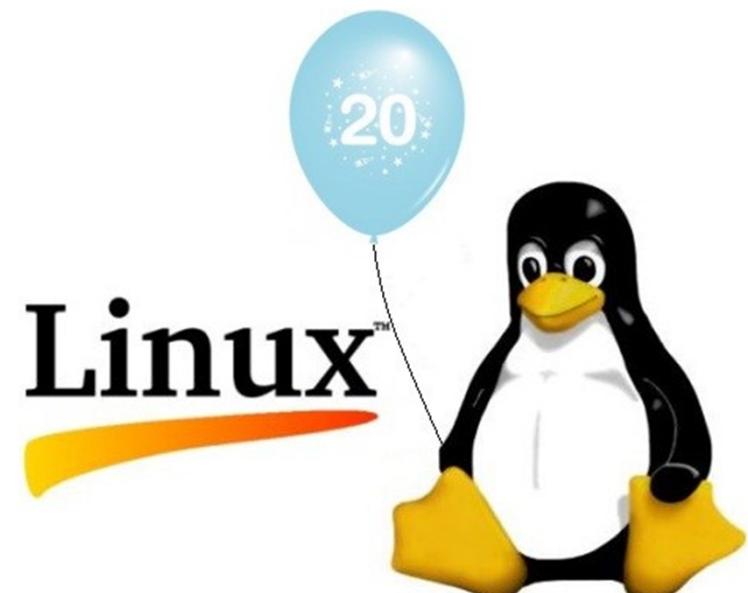


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Linux Kernel

- Linus Torvalds releases Linux kernel version 3 to celebrate 20 years of penguin-powered computing
- This third iteration, currently named 3.0.0-rc1, comes 15 years after 2.0 first hit the web. Also included is code optimized for AMD's Fusion and Intel's Ivy and Sandy Bridgesilicon, and some updated graphics drivers, too.
- Despite these tasty new treats, Torvalds is quick to point out that this new release is an evolutionary change and unleashing the big three-oh was all about moving into a third decade of distribution, not about overhauling the OS.



What is GNU/Linux?

- GNU/Linux is
 - Operating System that compose with
 - LINUX – Core Kernel
 - GNU Software – Free software
- GNU/Linux is free.
- You can redistribute and modify GNU/Linux while you don't break GPL.



1.3 Ethics

Ethics

- Systems and Network administrators play a critical role in the security and availability of the systems and networks they are responsible for. During the course of their duties it is inevitable that they will come into contact with sensitive, personal or restricted information.
- For these reasons system and network administrators must display an exemplary work ethic.
- Systems Administration is a profession.
 - It is a powerful profession.
 - A Systems Administrator must be ethical
 - Respect private information
 - Do not abuse power



Being a System Administrator

- Systems Administrators need extremely high privileges, which involve rights over other people's files and directories. They must have such rights as they need access to directories and files to investigate problems, change passwords, perform backups, etc.

- The Super User – The user with such far reaching powers is known as the Super-user. The one in UNIX is called root. Root owns the UNIX implementation and has rights to everything - including deleting all files (including the Kernel!!) on the system. The root password must only be known by one person (and a copy kept in a sealed envelope in a safe). For security reasons, you cannot have many people with root password.

SAGE Code of Ethics (1/3)

- The integrity of a system administrator must be beyond reproach.
 - SAs come in contact with privileged information regularly
 - Need to protect integrity and privacy of data
 - Must uphold law and policies as established for their systems
- A system administrator shall not unnecessarily infringe upon the rights of users.
 - No tolerance for discrimination except when required for job
 - Must not exercise special powers to access information except when necessary

SAGE Code of Ethics (2/3)

- Communications of system administrators with all whom they may come in contact shall be kept to the highest standards of professional behavior.
 - Must keep users informed of computing matters that might affect them
 - Must give impartial advice, and disclose any potential conflicts of interest
- The continuance of professional education is critical to maintaining currency as a system administrator.
 - Reading, study, training, and sharing knowledge and experiences are requirements

SAGE Code of Ethics (3/3)

- A system administrator must maintain an exemplary work ethic.
 - A sysadmin can have a significant impact on an organization – a high level of trust is maintained by exemplary behavior
- At all times system administrators must display professionalism in the performance of their duties.
 - Need to be professional, even when dealing with management, vendors, users, or other sysadmins
- SAGE is now known as Usenix LISA (Special Interest Group for Sysadmins) and for more information visit:
<https://www.usenix.org/lisa>



Ethics – LOPSA

- The League of Professional System Administrators (LOPSA) is a nonprofit corporation with members throughout the world. Their mission is to advance the practice of system administration; to support, recognize, educate, and encourage its practitioners; and to serve the public through education and outreach on system administration issues.
- LOPSA's System Administrators' Code of Ethics can be found at: <https://lopsa.org/CodeOfEthics>

1.4 Man Pages & Online Documentation

man page

- The Linux equivalent of HELP is **man** (manual)
- A **man page** (short for **manual page**) is online software documentation, serving as content for the man system, for an entity typically encountered in Unix /Linux systems.
- Such entities include computer programs (including library and system calls), formal standards and conventions, and even abstract concepts. A user may invoke a man page by issuing the **man** command.
- Use **man <command>** to display help for that command
- Use **man -k <keyword>** to find all commands with that keyword
- Output is presented a page at a time. Use **b** for to scroll backward, **f** or a space to scroll forward and **q** to quit



man page layout

- All man pages follow a common layout that is optimized for presentation on a simple ASCII text display, possibly without any form of highlighting or font control. Sections present may include:
- **NAME:** The name of the command or function, followed by a one-line description of what it does.
- **SYNOPSIS:** In the case of a command, you get a formal description of how to run it and what command line options it takes. For program functions, a list of the parameters the function takes and which header file contains its definition. For experienced users, this may be all the documentation they need.

man page layout

- **DESCRIPTION:** A textual description of the functioning of the command or function.
- **EXAMPLES:** Some examples of common usage.
- **SEE ALSO:** A list of related commands or functions.
- Other sections may be present, but these are not well standardized across man pages. Common examples include:
OPTIONS, EXIT STATUS, ENVIRONMENT, KNOWN BUGS, FILES, AUTHOR, REPORTING BUGS, HISTORY and COPYRIGHT.

Linux Documentation Project

- The Linux Documentation Project (LDP) is working on developing good, reliable documentation for the Linux operating system.
- The overall goal of the LDP is to collaborate in taking care of all of the issues of Linux documentation, ranging from online documentation (man pages, HTML, and so on) to printed manuals covering topics such as installing, using, and running Linux.
- Visit <http://tldp.org/docs.html> for more details.

1.5 RFCs as Other Documents

Request for Comments (RFC)

- A Request for Comments (RFC) is a memorandum published by the Internet Engineering Task Force (IETF) describing methods, behaviors, research, or innovations applicable to the working of the Internet and Internet-connected systems.
- The IETF adopts some of the proposals published as RFCs as Internet standards.
- Request For Comments (RFC's) documents were invented by Steve Crocker in 1969 to help record unofficial notes on the development of the ARPANET. They have since become the official record for Internet specifications, protocols, procedures, and events.
- To connects to the RFC repository maintained by the IETF, visit: <http://www.ietf.org/rfc.html>



Request for Comments (RFC)

- Anyone can submit a document to be an RFC, although in practice they are generated by the *Internet Engineering Task Force*, and then reviewed by the IETF groups, various experts, and the RFC Editor before publication. An RFC is never updated, although it may be superseded by later revisions. RFC 2026, *The Internet Standards Process -- Revision 3*, provides a good description of the Internet standards development process, and is updated by RFC 3932.
- **RFC Editor:** Funded by the Internet Society to edit and publish RFCs online. The RFC Editor maintains the master repository of RFCs as well as RFC meta-data, which can be searched online. The search results include the meta-data, links to the RFC text itself, and links to any errata. Visit: <http://www.rfc-editor.org/index.html>

End of Section 1.0