SEER AKADEMI
Linux Networking
Lecture 5
DNS Continued

Hello everyone again welcome to the Linux networking class this is the, the, the topic is actually the Linux programming languages as you know today we are still going to continue the Linux networking today's lecture 5 we will be talking about the DNS where we left off last time so let me just do a small recap.

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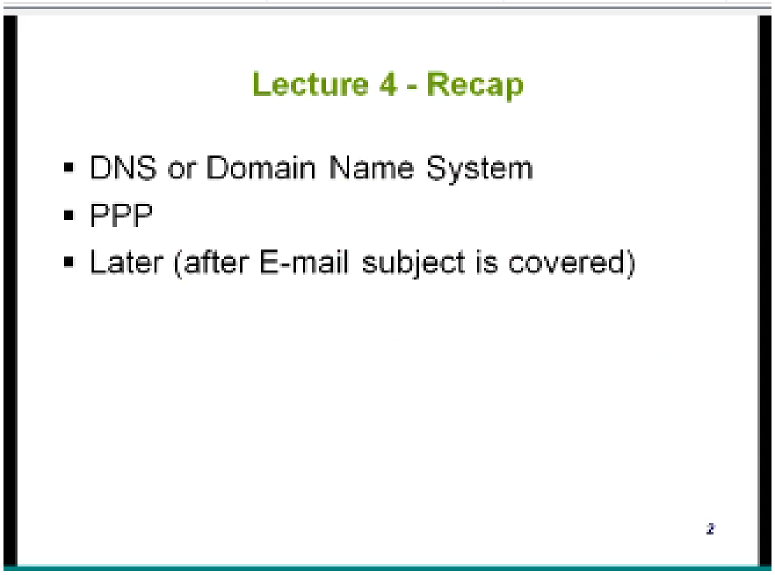

Lecture 4 - Recap

- DNS or Domain Name System
- PPP
- Later (after E-mail subject is covered)

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We talked about the DNS or the domain name system we talked about the point-to-point protocol, and then essentially like I mean the remaining the major recap we will do it little later because we have one more topic to cover in this section, so I just want to leave it leave you with this that so we know that the domain name system is used to map the domain names into their IP addresses this is and we know the IP address is 4 more 4 octets 3 of them denotes the network bits to which the host belongs to.

And in the last one itself is the host number in the network or how dare you define the host is identical and then we know that actually there is the third net mark which use it to separate the network address humble host and what is typically not the last octet but it is also like them and you be the minion subset of that update or even a it can input into the third octet also so and then we also saw we saw how the point-to-point protocol works through the Gateway basically like whenever there is a message that needs to be transmitted essentially like a minute.

If it is within the network it so many cases directly to that force and it will exchange the message if it wants to go outside the network then it goes through it maybe and then the default gateways are all more the directories are actually stored in more videos for computers that we saw and then how they interact we will come to that one a little bit later and we will formally take it that section.

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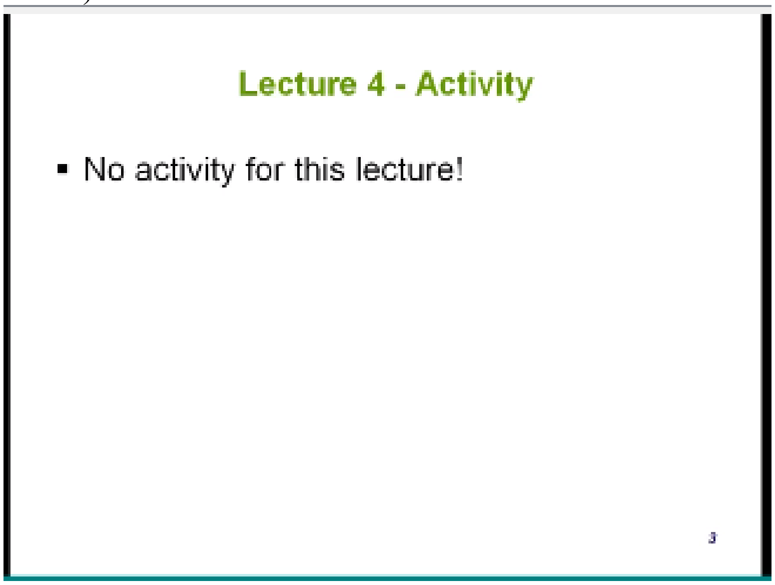

Lecture 4 - Activity

- No activity for this lecture!

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Any activity for today actually not pass any activity or this lecture again we will complete the in the email aspect as to the level two applications of the domain name system itself in subsystems and then the other one is the email, we also briefly saw like more adding the third lecture our web server works or client-server architecture works where we open port and basically communicate server and basic action if it is back and forth using the same IP protocol or the OSI protocol that we talked about and we learnt earlier so let me now talk about the remaining section or this topic.

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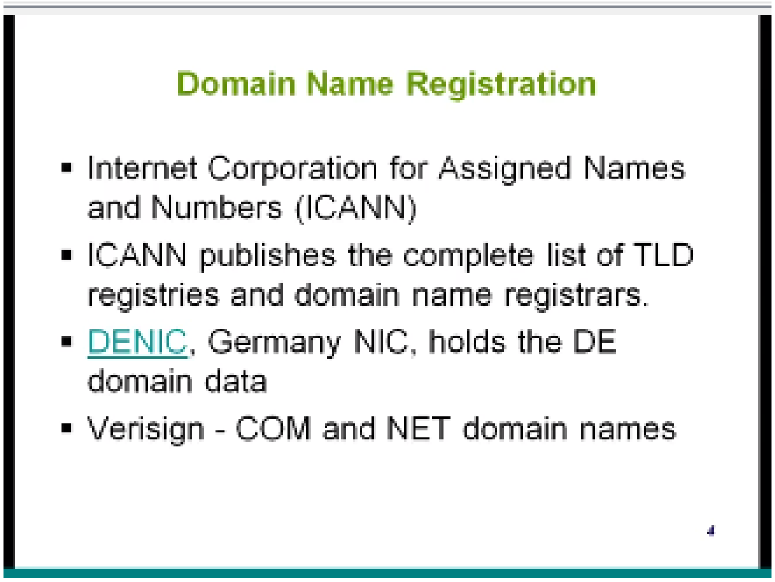

Domain Name Registration

- Internet Corporation for Assigned Names and Numbers (ICANN)
- ICANN publishes the complete list of TLD registries and domain name registrars.
- DENIC, Germany NIC, holds the DE domain data
- Verisign - COM and NET domain names

Oh before I go there I also wanted to give you a brief look into the domain name registration itself, the domain name registration or the worldwide domains is controlled by this operation for the Internet Corporation for Assigned mean from mumbles we refer it to as, I can I can publishes the complete list of the top-level domains domain registries and domain name registrars, there is another one called B and I see Phoenix which is the German Enoch that holds all the Germany based data and then similarly there are other play other network, centers essentially like which also hold the top-level domain data for the distances of the so big corporations.

And then there is also this company called Verisign which it is used to actually or even now it controls the dot-com and the dot net domain means so anytime if you want to buy a dot-com domain name unique approach and white actually they do charge money there are several companies which give you the main names today like Google, several other companies for a charge basically we do from the end balance to 50$ 60$ so and you can also like up like the reckoning.

I can and will register on the menu for a fee they also charge for that this is kind of the top load remains essentially Megan and then you can actually form multiple domains and the Google's of the world, actually can distribute the main names because they sublet or subcontractors they are the subcontractors for some domain names so, so that you can buy it from um fernanda they also probably charge some maintenance and the labels of value added services will sound setting up a webpage from you operating with some additional data things like that.

So I think it is a profitable business proposition for everyone I just want to keep you keep it in keep this in mind, when you go through all the things that you saw like this commercially motivated a lot of things of that, so let us look at email.

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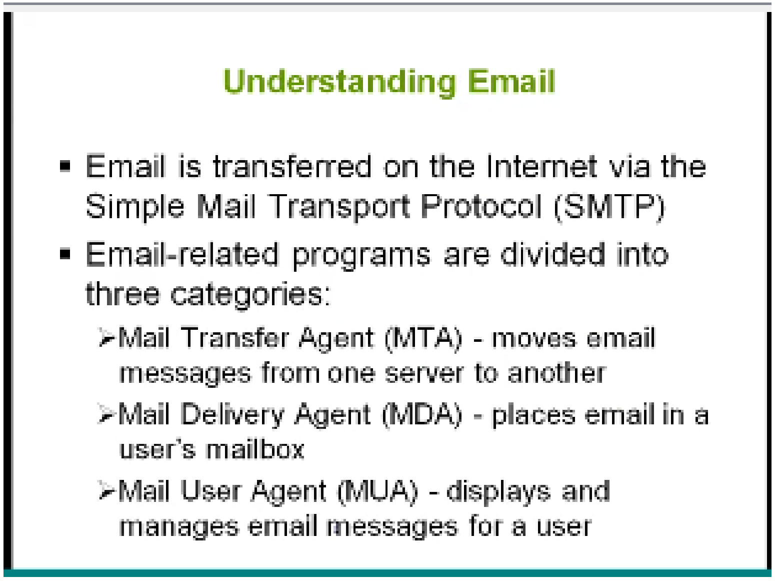

Understanding Email

- Email is transferred on the Internet via the Simple Mail Transport Protocol (SMTP)
- Email-related programs are divided into three categories:
  - ➢Mail Transfer Agent (MTA) - moves email messages from one server to another
  - ➢Mail Delivery Agent (MDA) - places email in a user's mailbox
  - ➢Mail User Agent (MUA) - displays and manages email messages for a user

So the email actually is transferred on the internet using this SMTP very widely known this is a Simple Mail Transfer Protocol, email itself is divided into three categories mail transfer agent which is actually moving the mail from messages from one server to another, mail delivery which places the mail into the mailbox, and then the mail user agent displays and manages well email messages or user, this gives kind of an overview of how things do work as you know like I mean the conjugation of name is Sally you know they form you need to know who is the mail server essentially.

So you need to register that server into your machine and then you need to identify yourself as an address so once the address is no make server it is more then you, you will be able to send the emails out which basically goes to server and server distributes to the whole internet and so we will go through this things in detail.

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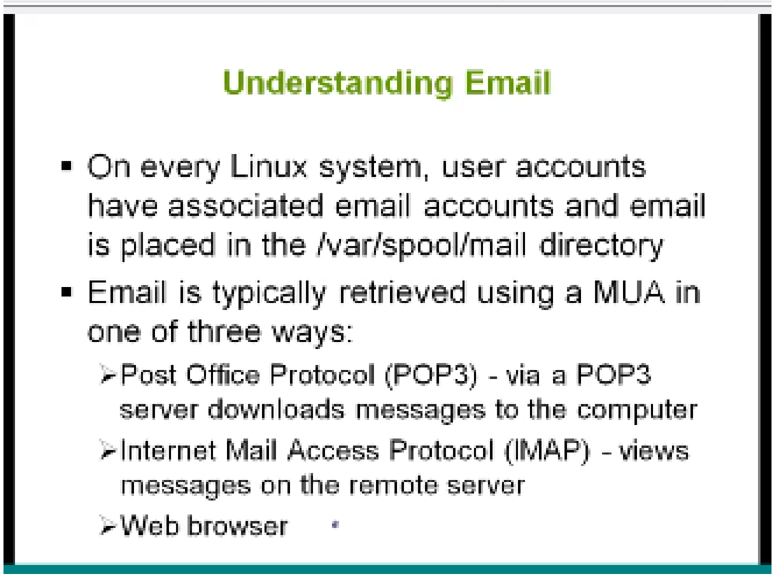

Understanding Email

- On every Linux system, user accounts have associated email accounts and email is placed in the /var/spool/mail directory
- Email is typically retrieved using a MUA in one of three ways:
  - ➢Post Office Protocol (POP3) - via a POP3 server downloads messages to the computer
  - ➢Internet Mail Access Protocol (IMAP) - views messages on the remote server
  - ➢Web browser

So the user accounts have associated mail accounts they so every user has related mail and the email is pasted in this, this particular directory it is slash var, slash full school slash name again go back to your lecture 1 and lecture 2, from the Linux system we mentioned that actually everything is represented as files or folders in Linux and then this mail delivery mail is also kept in a pile under this direction, and then the mail is retrieved using this one of these days one is the post office protocol of POP 3 which is it used to be like very popular until recently this pop3 essentially like I mean it is server is download messages to the computer.

And then nowadays more prevalent one is the IMAP, IMAP this is the internet mail access protocol the IMAP servers are again it they just form into like two different classes of cells and nowadays the more prevalent one is the IMAP service and then the finally let you have the web browser it is just an act mail client that is very popular when you talk about like Yahoo main or Gmail in fact behind the Gmail actually on that server is also there painting for Yahoo, Yahoo and I think it would prevail like I am at service.

And then those servers tell you the main difficulty with puzzles so very kind so now they talk about the puck mail which is like a email filter so the previous one like I mean we talked about this though all these various IMAP, IMAP is absent and POP 3 they are like they come under the mail user agent essentially letting them studied here.

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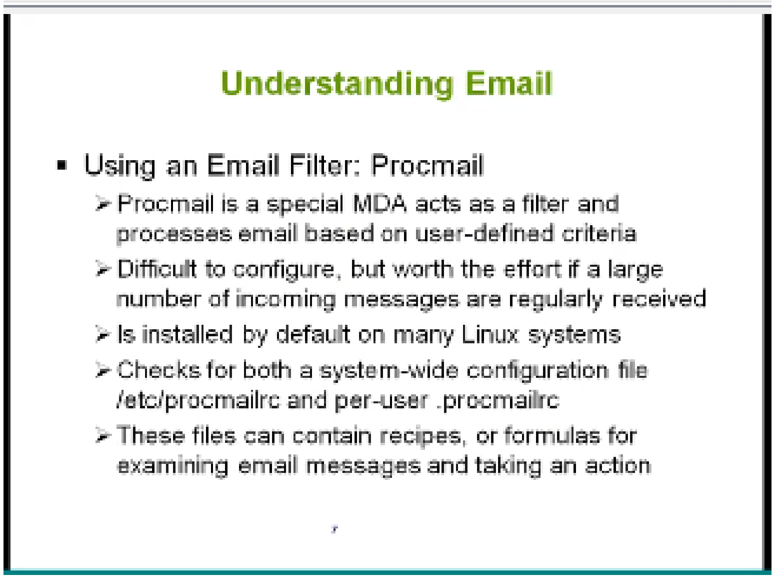

Understanding Email

- Using an Email Filter: Procmail
  - ➢ Procmail is a special MDA acts as a filter and processes email based on user-defined criteria
  - ➢ Difficult to configure, but worth the effort if a large number of incoming messages are regularly received
  - ➢ Is installed by default on many Linux systems
  - ➢ Checks for both a system-wide configuration file /etc/procmailrc and per-user .procmailrc
  - ➢ These files can contain recipes, or formulas for examining email messages and taking an action

We will talk about the mail delivery document so the proc mail is a special delivery agent that acts as a filter and process the email we have based on some user defined IP it is it is difficult to configure but sometimes if you are using more missiles or also you want to save them um like, in a very ordered fashion then personally then, the configuration may be worth it Proc mail is installed by default you can think of brought me in the form of automatic styling.

So you have many folders that contain bins and then you can automatically file them into various things which one that you want to look at first prioritizing and also let some nails like and directly go into junk mail things like that so you can set up the booths and recipes and problems for that the proc mellitus checks for a system-wide configuration file which is stored in flash ETC / hotmail RC, and then it goes into your home directory to look for a dot product in our simple.

So there are some the configuration is done in two ways so there is a global configuration that resides in the slash ET / protocol RC that file you can override that with the dot Walkman our selection, again this file will have the recipes and calmness and all those form what you want to state the action one for a given message.

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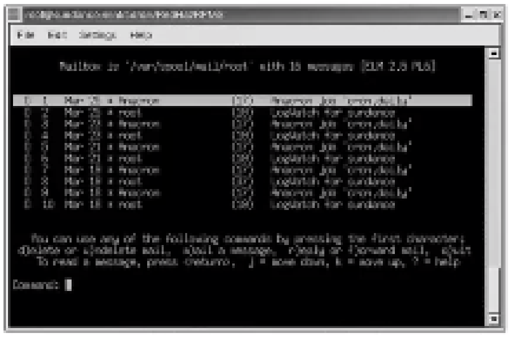
Linux Email Clients



```
        Mailbox is '/var/spool/mail/root' with 15 messages [ELM 2.5 PL5]

 O  1   Mar 23 x Anacron            (37)   Anacron job 'cron.daily'
 O  2   Mar 23 x root               (38)   LogWatch for sundance
 O  3   Mar 22 x Anacron            (37)   Anacron job 'cron.daily'
 O  4   Mar 22 x root               (38)   LogWatch for sundance
 O  5   Mar 21 x Anacron            (37)   Anacron job 'cron.daily'
 O  6   Mar 21 x root               (38)   LogWatch for sundance
 O  7   Mar 19 x Anacron            (37)   Anacron job 'cron.daily'
 O  8   Mar 19 x root               (38)   LogWatch for sundance
 O  9   Mar 18 x Anacron            (37)   Anacron job 'cron.daily'
 O  10  Mar 18 x root               (38)   LogWatch for sundance

   You can use any of the following commands by pressing the first character;
 d)elete or u)ndelete mail,  m)ail a message,  r)eply or f)orward mail,  q)uit
   To read a message, press <return>.  j = move down, k = move up, ? = help

Command: █
```

Figure 3-12 The Elm text-mode email reader

So now let us look at the dealer itself this is again the user a that think of it, it is a text mode email reader I think like you all like familiar with, you we have it the various other email client outflow or Yahoo name or email this looks likes like Miss primitive but here it is basically like I mean this is wrong way that even it is programs can communicate to you so here the programs actually sending you messages looking to the jobs and also late sum of all lot before what is new move.

We will learn about how to send mail to yourself from programmatic way things like that in when we talk about the programs themselves like Mail and things like that there is irritant you put some mail programs here you can see that basically like it comes to the first mailing and it bakes for the command so here the commander is pretty much like a UNIX bi base command days when we down page warm up and then you can also like the delete mail, and undelete mail delete this B and then you and then if you want to mail a message you discuss on M.

And then if you want to reply to this mail take R and or if you want forward the name to another user then you have Q will quit and again you can think of this as another command interpreter they are basically like present all the data and then it waits for your command here so based on the command that you type in it performs a next action so that is that is a very easy to understand email reader and some writer well.

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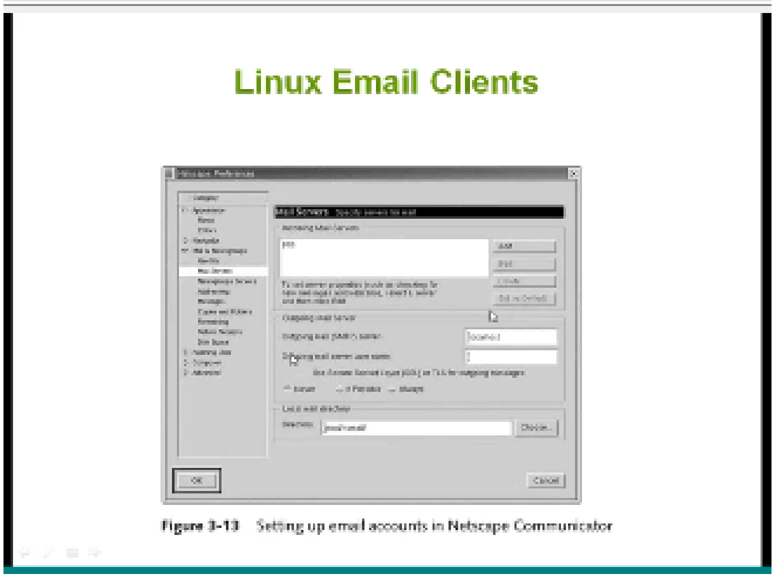

Linux Email Clients

Figure 3-13 Setting up email accounts in Netscape Communicator

So slightly more complicated like I mean so clear is one set up using the Netscape communicator this is like some more old think oh here again it is a pops were basically decided and this is an incoming swap and of doing is an SMTP server so here we set up all those things basically and then the where you want to keep the main, that is the route and uh this is Netscape man so what you keep it there, and then you can actually like I mean this is the mail server setup so and then you can add multiple incoming pop servers.

If you have like we want to consolidate account from multiple sources then you can just stand all goes for the observable tables and then you can also the outgoing server is typically only one and then here the local host open server then there are other options here like the secure socket layer which is all like much more secure communication, so essentially like I mean you can set it up as whether you want to use it all the time or never use it or wherever it is available then use it in the settings so pretty much this is this is what you will use to set up the main kind of spice a little bit old this particular setup because let us get coming together is something.

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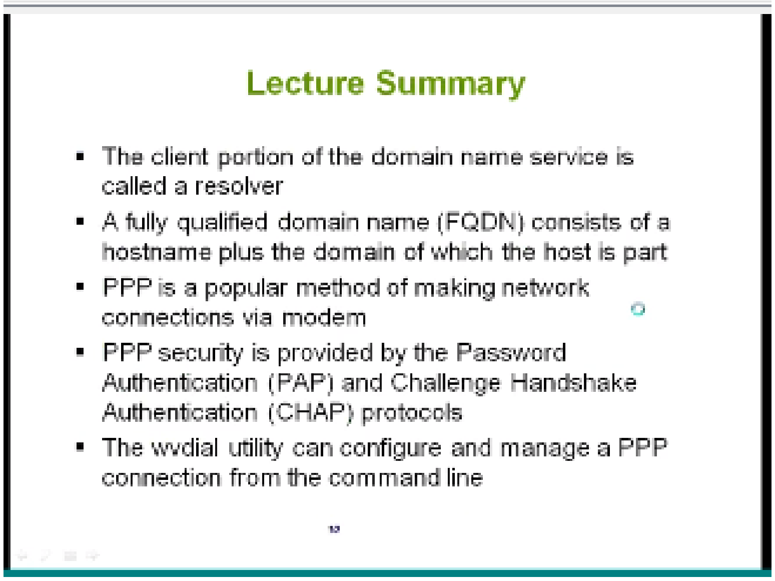

Lecture Summary

- The client portion of the domain name service is called a resolver
- A fully qualified domain name (FQDN) consists of a hostname plus the domain of which the host is part
- PPP is a popular method of making network connections via modem
- PPP security is provided by the Password Authentication (PAP) and Challenge Handshake Authentication (CHAP) protocols
- The wvdial utility can configure and manage a PPP connection from the command line

That we seldom use nowadays either like Google Chrome or in Linux one of the most problem one actually yeah so that that is pretty much concludes the actual area what I was gonna say will form the Firefox browser is much more common in women Firefox also allows all these different applications so now let me come to the end of this lecture so we started the our lecture with the domain name service itself look at the resolver basically it is essentially the kind portion of domain name service.

And it is always nothing but because the domain name is the IP address so the fully qualified domain name to be enter the server hostname plus the domain name of the horse that is basically like an insult is for it is all there essentially so a typical example will use also IBM walk my division dot-com which is fully qualified the meaning and then the point-to-point protocol that means all was a popular method for making Metro connections we are modern and point-to-point protocol, is followed by the password authentication app and the challenge handshake authentication protocols password authentication is a very simple thing with available just ask for a password.

And then basically provide the password a with that the challenge handshake is more, more involved and that is why it is more secure that is basically it is like an RSA token basically there are anonymous generators which are synced random number generators and then essentially generating that random number and on the server side also it is generating posting and then basically you are asked to provide that you challenge the server with that, or essentially like I mean you put your magic pin into this to generate a random Mambo.

And that pin when it is sent to the server, server also generates a random uncle and then you compare those two responses and if the response is matched that is when you can authenticate the Machine and then that as well again in the communication, will start we also saw the WB dial utility that took on the configure the manage the PPP connection from the command line.

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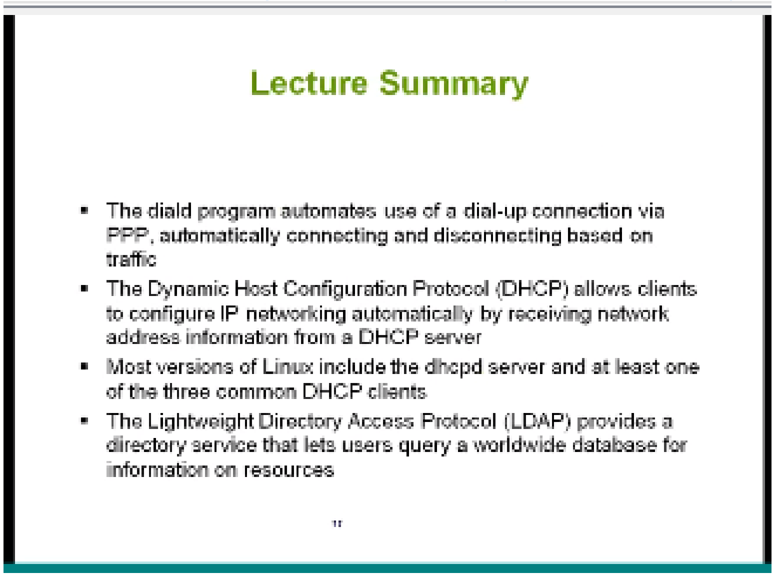

Lecture Summary

- The diald program automates use of a dial-up connection via PPP, automatically connecting and disconnecting based on traffic
- The Dynamic Host Configuration Protocol (DHCP) allows clients to configure IP networking automatically by receiving network address information from a DHCP server
- Most versions of Linux include the dhcpd server and at least one of the three common DHCP clients
- The Lightweight Directory Access Protocol (LDAP) provides a directory service that lets users query a worldwide database for information on resources

The dial D program this automates the use of dial-up connection where PPP automatically connecting and disconnecting this traffic again these are all something that we learnt about, and essentially like the nature that make how to make those connections and see how the functions will impact how the connections can be used more then we also look at the dynamic host configuration protocol DHCP where the clients can configure IP networking automatically by receiving the network address information from the DHCP server.

So this I will say is one of the reasons why internet ,because you look at the IP space itself or actually the IP addresses are octets ,so we have inherently some limitation between 2 for 24 servers over the world that are possible, and because those are the unique addresses that can be generated with 24 bits or the 1st 3 octets of IP addressing , but today and we can actually put together multitudes of addresses and also we can communicate between these multitude of addresses, much more than this 2^{24} bit like very very easily and without any loss of communication.

It is a collision of addresses escalation the reason why we can do this because of this dynamic host configuration protocol, which means that when you go into a subnet, that we know about you know the term subnet ,now we learnt about this ,so when you go into subnet the different subnets can have the same address and they can still communicate between each other without in position because of the DHCP server which can resolve collisions and addresses and route them properly.

So a simple application will be like if you are say, so leasing a internet connection from either your cable company or any of one of the providers is basically , again ISP has a subnet and the ISP subnet is sending you an office , but tomorrow there is one more person , but I added to the network all the high speed cells actually have some new customers to serve , so there is inherently like I mean.

The ISP can run out of the address space whatever they are using , so instead what they can do is they can start another subnet ,so the subnets will be different, will have different addresses but they internally will have the DHCP servers, and the server will now assign addresses to the various hosts in a dynamic fashion, so that means that you guys can have the same address, but there is a DHCP server or the gateway which resolves these addresses and make sure that you are connecting to them.

And the communication is appropriate, the benefit of this is now the ISP can initially can sell only like, so many offices or they can serve only so many clients, but now with having subnets after subnet dating ,so maybe 10 times more clients than ,what they originally had with a number of ideas and for you also it is a similar process, the DHCP server automatically sends what it wants, the time to be configured as.

So you only know like about what address, that you are sending the things to and it automatically figures out , whom to send ,so most versions of Linux include a DHCP D server and at least one of the 3 common DHCP clients, the Lightweight Directory Access Protocol are the LDAP that provides the directory services, that lets users query a worldwide database or information of the resources.

So again , we know about the directions essentially the LDAP is essentially like ,I mean keeps only like ,so much information about the neighboring gateways or neighboring hosts ,and then essentially ligament, when needs the additional information it ,gets it from that sources and the message is also passed to those main server ,so this again made the whole communication process .

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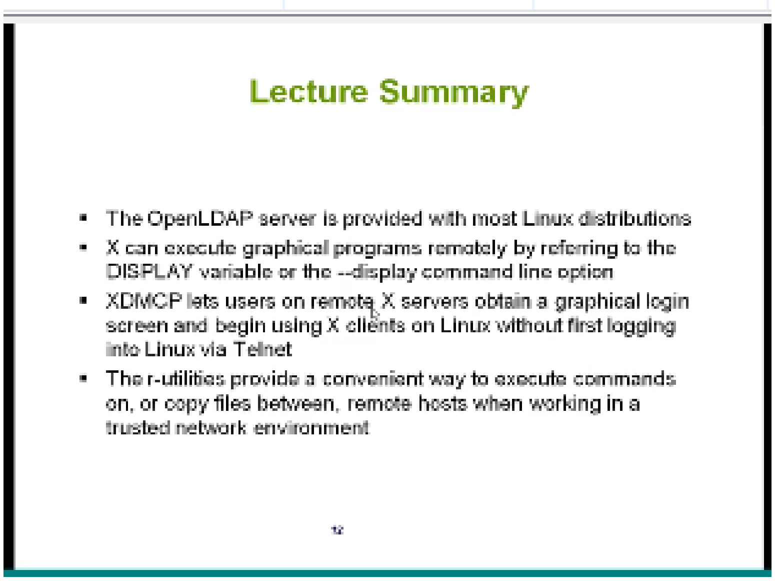

Lecture Summary

- The OpenLDAP server is provided with most Linux distributions
- X can execute graphical programs remotely by referring to the DISPLAY variable or the --display command line option
- XDMCP lets users on remote X servers obtain a graphical login screen and begin using X clients on Linux without first logging into Linux via Telnet
- The r-utilities provide a convenient way to execute commands on, or copy files between, remote hosts when working in a trusted network environment

So one of the LDAP servers that provided with the Linux distribution is the Open LDAP and then the x-term itself ,can execute graph graphical programs remotely by referring to display variable usually I mean like the -- display command in the command line option , we can also open up a port, if the hostname which corresponds to a display and then, we can display various graphical items .

So we can do is like a remote terminal and steal the remote terminal and state in our terminal things ,like that are possible today and this XDMCP this lets users on remote X servers , obtain the graphical login screen and begin using the X clients on Linux ,without first logging into Linux via Telnet and then there is this remote utilities are starts with r that are that provided convenient way to execute commands.

So to copy files, we use r cp and to open a remote shell I think you all know the command , it is r sh , this is like again once you open the remote shell ,then you cannot work on that machine, r cp s are copying which means to remote copy into servers, that are in the network or essentially like connected in network and want to copy between each other .

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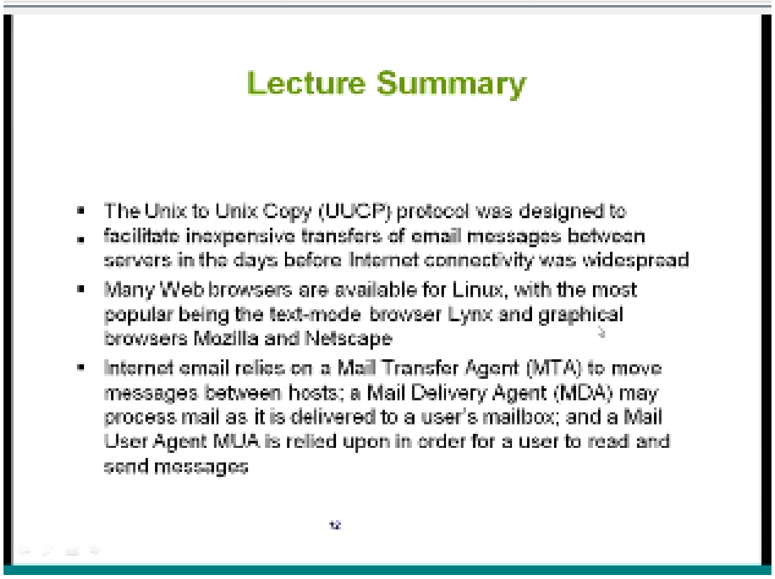

Lecture Summary

- The Unix to Unix Copy (UUCP) protocol was designed to
- facilitate inexpensive transfers of email messages between servers in the days before Internet connectivity was widespread
- Many Web browsers are available for Linux, with the most popular being the text-mode browser Lynx and graphical browsers Mozilla and Netscape
- Internet email relies on a Mail Transfer Agent (MTA) to move messages between hosts; a Mail Delivery Agent (MDA) may process mail as it is delivered to a user's mailbox; and a Mail User Agent MUA is relied upon in order for a user to read and send messages

Then we also saw about the UUCP protocol or the UNIX to UNIX Copy protocol ,this is designed to facilitate inexpensive transfers, it is mostly like the email messages, between the servers and this was again, it was used before Internet connectivity was widespread , there is slightly different from the FTP protocol ,that we saw earlier FTP ,also achieve this kind of thing, one is, this one is UUC P is mostly machines that are connected in the same network.

Whereas FTP can go between networks as well ,so and then the web browsers many of them are available for Linux ,we already saw that, the popular being the Mozilla Firefox and the Net scape, I will still say that actually the use of Skype is kind of waning at this point ,there are some text mode browsers called links, so in the graphical area Firefox is probably, the most prevalent browser at this point .

And this is very similar to as all the all the key features ,so dislike them either the Internet Explorer or the Chrome browser ,so I think like, I mean you will be using Mozilla Firefox or more often on a Linux box , then the internet mail itself, that relies on the mail transformation to move the messages between both, we did not see an example of this because this is pretty much under the hood or transmission that happens .

We although, we learn about the mail delivery agent usually and then the mail delivery agent processes the mail ,as it is delivered to the users mailbox ,we saw one example of that and then the main user agent ,that is used to read the mail and send messages.

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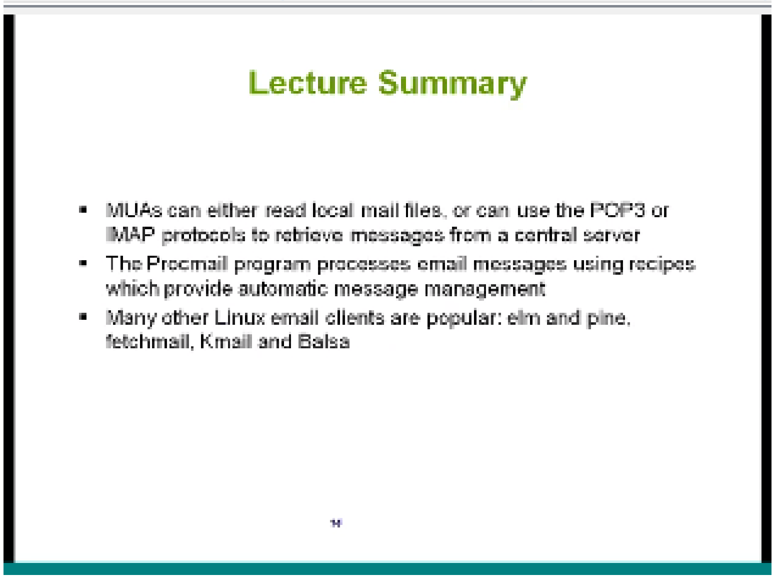

Lecture Summary

- MUAs can either read local mail files, or can use the POP3 or IMAP protocols to retrieve messages from a central server
- The Procmail program processes email messages using recipes which provide automatic message management
- Many other Linux email clients are popular: elm and pine, fetchmail, Kmail and Balsa

So the mail user agent, that is use to read the mail files the mail user agent needs local mail file or it can also use this path tree or the IMAP protocol to retrieve messages for muscle failure, the local messages essentially all previously it used to send between the two computers and basically war that distorting the mail file that you are also already saw the VAR school dot slash the, proc mail is used as a delivery agent basically as the mail gets delivered it autumn it provides like the message management, automatic filing, automatic replies, things like that um.

And these things you can construct the test recipe and then we also saw that there are two basically like two files that are used for configuration this is a simplified and then also a local form and finally like I am in the mail client because there are many popular ones for Elm is one element I am basically with I wore the you can say like if they are MUA formal mail user agents, we saw an example of the text-based main support LM oh.

This is essentially like I mean the, the interphase and commands are dislike using a visual editor okay there are other males also that a kind of popular page male female Walter and one thing I will ask you is secondly to use man mail commands to just see what happens when you invoke a mail and then see how the mail work or what are the different commands, what are the different options available and then, are there any arguments you can also think of that and then see with as many arguments for that.

So this will pretty much conclude the overall lecture on the mainland the DNS hope this one was useful now we go into more visible file system, where we talk about whole file system structure in the Linux we, we actually let you pair it briefly we know that there are different files like flashy teasing, flash war, flash there, flash route all those different types for system now we will learn about how to do it between the networks and what happens when we go up and how do we

maintain consistently because there are some metrics that are fairly important to maintain that Tennyson area so let us start looking at the, the file systems.
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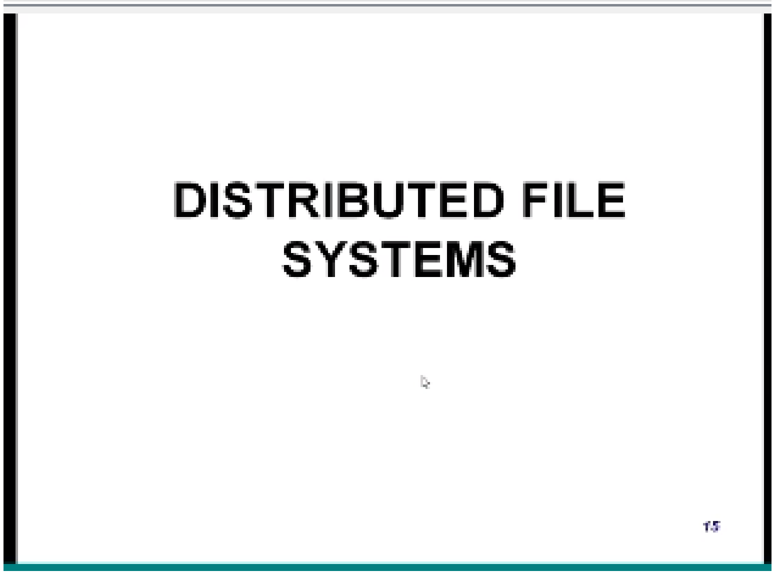

DISTRIBUTED FILE SYSTEMS

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So we will talk about the distributed file system within the context of Linux.
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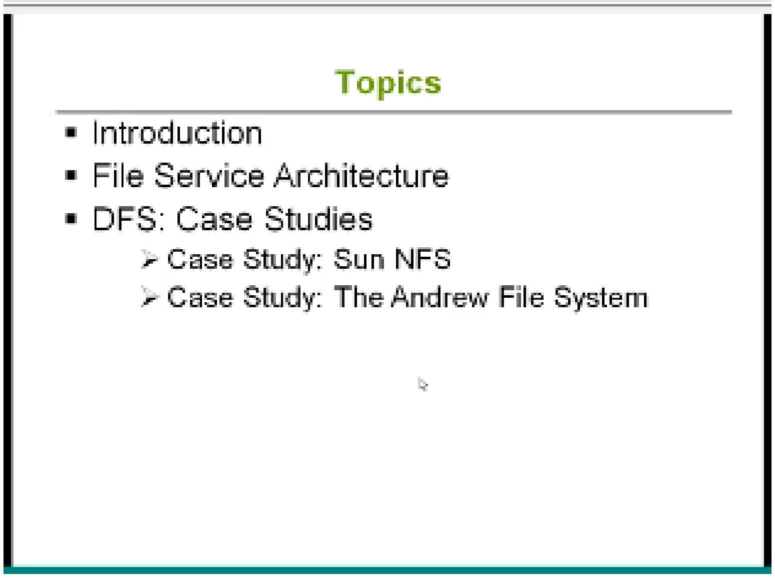

Topics

- Introduction
- File Service Architecture
- DFS: Case Studies
  - Case Study: Sun NFS
  - Case Study: The Andrew File System

So in this section we will be talking with or an introduction then we will go into the file services architecture and then we will take up two very popular case studies one go son NSS system the network file system this has been like, analyzed and overanalyze and under analyze whatever impulse and objectives, and we will always call this one and then the second one that we will look at is the amplified system it is also distributed network PI system which was initially started at CMU or the punning University.

And then as a part of the Android project essentially so we will learn about that for these two assistants as a part of this distributed system and just compare, compare and contrast what is in each of them.

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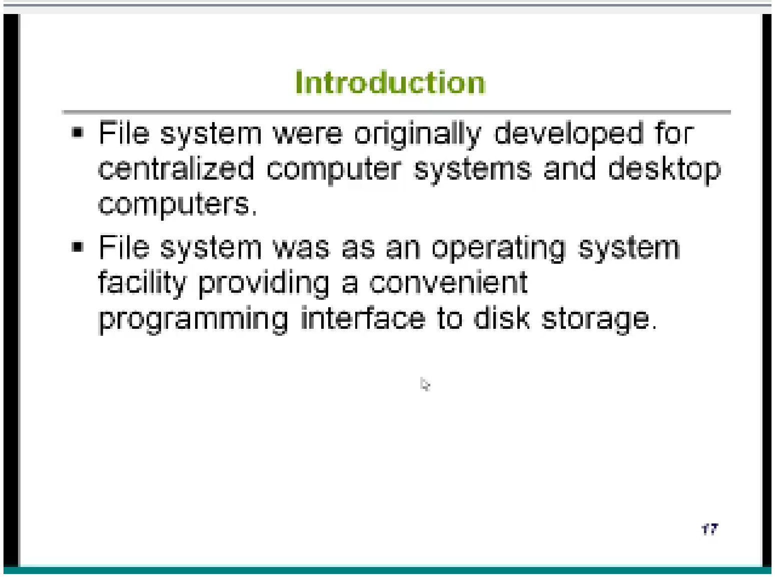

Introduction

- File system were originally developed for centralized computer systems and desktop computers.
- File system was as an operating system facility providing a convenient programming interface to disk storage.

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Let us look at the file system the file system is essentially originally developed for a central centralized simple system or a desktop system, it was basically it was an operating system facility providing a convenient programming is to this storage, so you know that basically the memory itself we will go into the various other piece of memory but there is a storage that you can think of in the software context there the programs are stored I think like when we started looking at the shells we learn to cope with programs and the processes.

Through at a glance actually like you can think of there is a system their programs are stored and that needs to be brought out, whenever they are queried and then basically microphones process instance of running program is a person typing solve, so now to get that program out the file system even is operating systems way to provide a user method to access these program for things that are stew.

So instead of like saying that okay go to second call on this for to get me my program you can say simply then go to slash home slash x / y and that is what my program lips, so it is basically like I mean so there is a lot of translation that goes on behind the scenes but now the interesting challenges like this is the disk is the flash whole disk is not on your computer, and I it is residing somewhere else how do you make sure that you can see that you need on the other hand you can also think of this as cave, is that descriptors is not available what happens you see it do you, you do not see how the computers will be up to it so we will learn about that.

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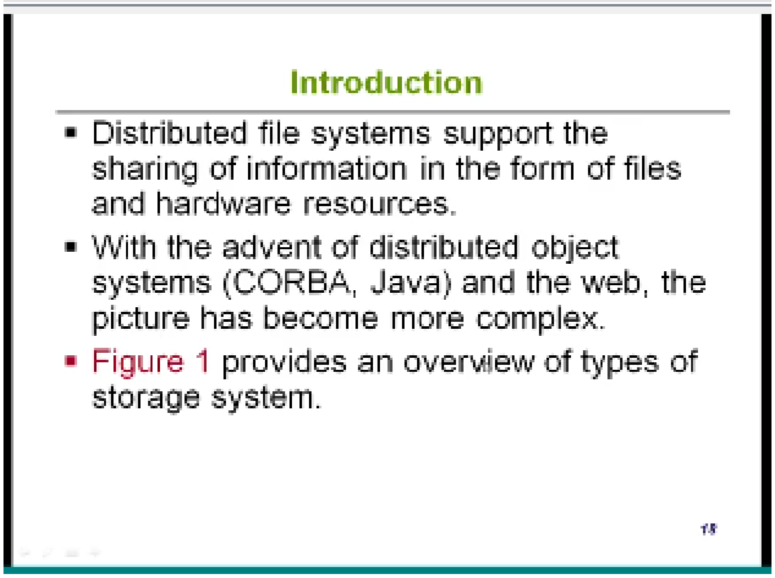

Introduction

- Distributed file systems support the sharing of information in the form of files and hardware resources.
- With the advent of distributed object systems (CORBA, Java) and the web, the picture has become more complex.
- Figure 1 provides an overview of types of storage system.

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So a distributed file system support sharing of information in the form of files and hardware resources, so there are the distributed object systems like the core behind Java and there the picture has become much more complex, so what I mean is like again exactly the same thing basically now the your disk is no longer resides in your computer it besides far away maybe you have connected through a network into that particular computer, and you know how to access it what should be the name of that can you name it as slash home slash for same as another selection box in your computer.

So think of it this way now the you saw like I mean the ID addresses I get with the translators between the IP addresses, and there are DNS resolvers similarly you can think of now the files can be distributed and every file needs to have an address or a unique name because you do not have the unique thing then you would not be able to access that or there will be like name collisions, so how do you provide that unique name and how do you manage the whole PI system infrastructure those are the things that we will do in about so before we start that let's look at the types of storage systems this is one of the key part and one of the key things that we will go through.

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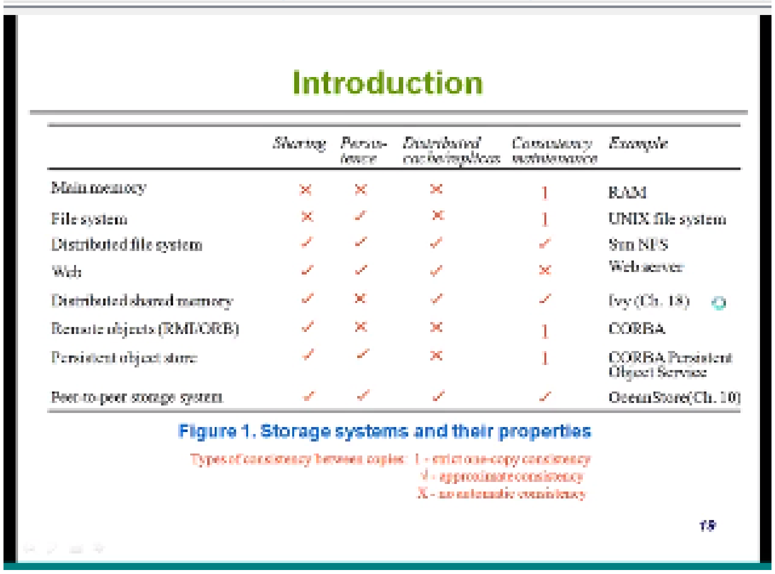

Introduction

	Sharing	Persis-tence	Distributed cache/replicas	Consistency maintenance	Example
Main memory	✗	✗	✗	1	RAM
File system	✗	✓	✗	1	UNIX file system
Distributed file system	✓	✓	✓	✓	Sun NFS
Web	✓	✓	✓	✗	Web server
Distributed shared memory	✓	✗	✓	✓	Ivy (Ch. 18)
Remote objects (RMI/ORB)	✓	✗	✗	1	CORBA
Persistent object store	✓	✓	✗	1	CORBA Persistent Object Service
Peer-to-peer storage system	✓	✓	✓	✓	OceanStore(Ch. 10)

Figure 1. Storage systems and their properties

Types of consistency between copies: 1 - strict one-copy consistency
√ - approximate consistency
X - no automatic consistency

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First of all I want to interview certain more key concepts here so look at in this table look at the all the polymers, so we have make sharing is one of the attributes that we will be what the memory storage system, for now then the persistence what do you mean by persistence so sharing we know that actually with the same thing can be shared between multiple sources or the just single resource, for example a main memory in this case is just shared by this that one CPU.

Today if you know about any of the computing systems there are gradations of this memory, all the way from the l0l cache to l2 cache to specific l3 cache also and then going to ha this is especially true when we talk about the multi-core systems where the machine, is not just for buying Single pore but one of the cores that are working and each core can operate one or more threads of competing, so in elegant if you have a dual code machine internally can execute four programs simultaneously in the system.

And so like I mean some program can share the memory come programs may not even main memory can be shared between the two threads, whereas the caches cannot be shared between put and each core can have if its own cache and this it divides it between sites public press also, so again sharing is one of the attribute of will be, the second one is persistence so what do we mean by per resistance.

Resistance is something that that is the data that we write into a particular storage is always there then it is always there or not depends on the persistence of the particular system how much it is persistent, so for example in main memory the data may not be persistent because, wherever we write actually that that data gets overwritten very quickly with something else so usually like I mean this is when we was smaller and what they very, very faster or thanking high bandwidth.

We will also talk about that then there is a distributed cache the replicas basically so then we the cache is nothing but a buffer, so if you want to serve a particular entity or servant know like a CPU then you need to have provide this with the data whenever it needs it not whenever the data is available, so there is a big difference in those two if you only want to provide then the data is available then probably like 99.1 or 99.9 percent the CPU will be this star.

Because you would not be able to get to the people so you want to provide it then it needs it as opposed to then the data is available, so the cache is a good means to provide both because you can prefetch the data and keep it in the cache and the CPU, will only access the cache whereas when the cache is getting emptied it gets more data so that cash distributed cache and replicas backs again determined that is another determinant of the storage system.

So in the storage system like main memory or even a simple file system you may not have any distributed cache of it because then the, the fourth point is the consistently maintenance here actually like I mean its form depends on how you maintain the consistency of data, so the high bandwidth or the memories that are very close to the computing system so they will have a consistency maintenance property as for one copy consistent here it is represented I for one, and so the example is a ramp of the wobble quota for main memory.

You can think of basically it only has only one copy does not store more than one copy because that you can think of this as like better it is so close to that the computing device the data is constantly getting updated so you do not you cannot keep more than one copy because suddenly like other copy becomes stale, so it becomes say varies so you do not want to have more than one copy I system again the same thing.

And we will talk about the distributed file systems and mobile thing I also want to have well add one more property to this one which is the bandwidth which is not covered here, again so for the past memories essentially Ling or the memories that are they post the computing module opening platform we want them to have extremely high bandwidth, so that the computer the CPU never starves for data and there are ways of doing that but one thing is they just use the same atomic physics which is so use the speed-up of ramp to make sure that those CDs are so well.

So let us look at and compare the various for two people main memory if you think of main memory has a storage it has very the strict one copy consistency ,but other than that it does not I am sharing it in a persistence it does not have distributive cache of because, now let us look at a standard file system which is basically confined to that particular client, again that one does not allow sharing it has persistence essentially, and it does not have any distributed cache caches or replicas and then the consistent in maintenance is boom beautiful strict one copy.

Now let us look at the, the dispute file system visible file system allows you to share those persistence of data, allows distributed cache on replicas, and it is also it manages consistency which is again you do not need to have like the multiple I mean a single copy for this, so it is kind of consistent basically like flow changing but I do think that any point of time, you can read out that and read out the particular this will file system storage and then get the same data back.

So an example could be the Sun in SS which we will move 30 in detail more now the other one is the web there again it has sharing positions it also provides the distributive cache and or replicas, but it does not provide the consistency so when you go when you do something and then when you come back it may not be consistent anymore, so typical example will be as itself and then there are other things basically a distributed shared memory which is again the concept is sharing.

So it allows you to share but it does not provide persistence it allows the distributed cache and replicas and then what it also allows the consistency then there is something called remote the objects are RMI or ORP the example could be like this for bar that we talked about earlier, this provides only sharing no persistence no discernible tabs and also like this one public existence and then there is something called persistent object store.

This provides the persistence essentially and they also allows the sharing it does not allow distributed cache or replicas and, then the consistency maintenance evolved over it is only one copy consistency then we have peer-to-peer storage systems they provide all of them then an example could mean the ocean store.

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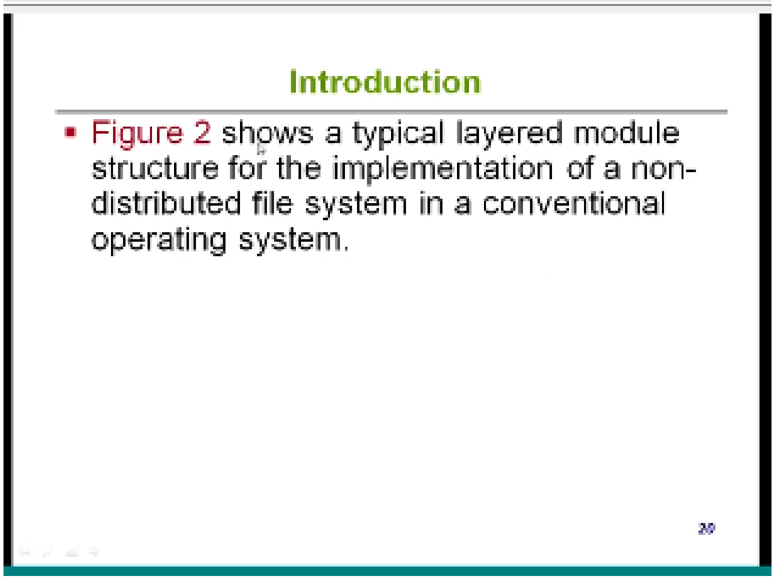

Introduction

- Figure 2 shows a typical layered module structure for the implementation of a non-distributed file system in a conventional operating system.

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So now let us look at the module structure of the non distributed file system.

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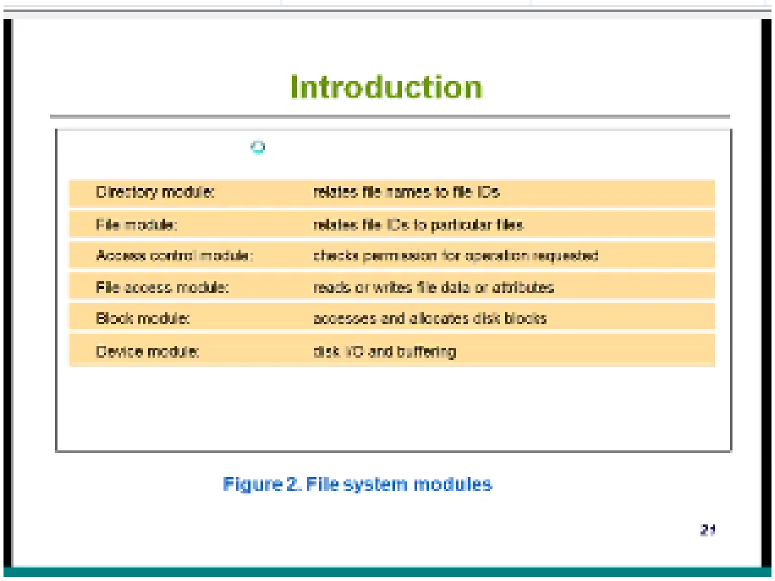

Introduction

Directory module:	relates file names to file IDs
File module:	relates file IDs to particular files
Access control module:	checks permission for operation requested
File access module:	reads or writes file data or attributes
Block module:	accesses and allocates disk blocks
Device module:	disk I/O and buffering

Figure 2. File system modules

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So this one it is basically like since it is a non network system it, it has a directory module this basically like relates the file names over PI mountain, so it is kind of the same as so a DNS resolver hope you can pick up, the file module itself relate the file ID to particular files, the directory model acting can also have the directory name associated with it here basically like them in the file module makes a file ID to the bottom of falls.

And then the access sample mobile this text for the permission of the operation that is requested we also saw this in the beginning of lecture to, where we could assign the files with various properties or permissions like read the write execute, so the file access model check for walk the block module accesses and allocates the baseball, so as I mentioned they completely moment which sector which block we have the program is to say so that is all taken care by the block module and then the device module does the disk i/o and the buffering so it basically communicates to the dish and then stores they involve so this is a very simple single user PI system essentially.

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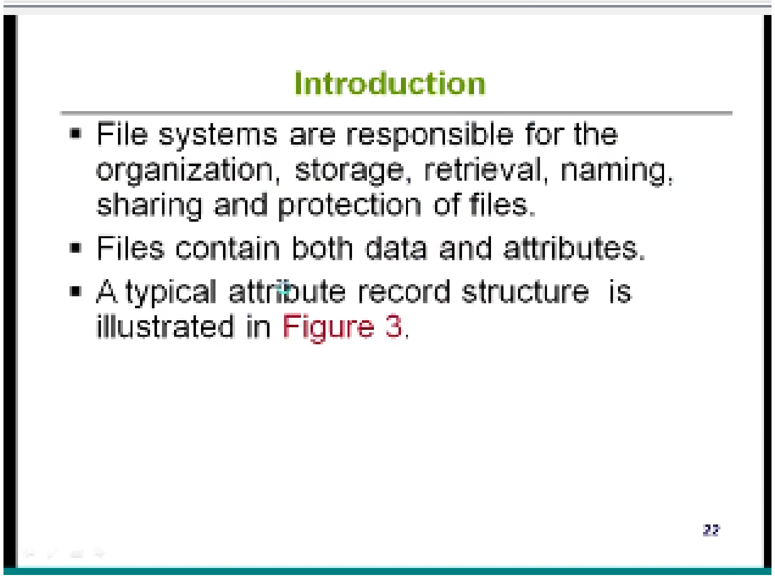

Introduction

- File systems are responsible for the organization, storage, retrieval, naming, sharing and protection of files.
- Files contain both data and attributes.
- A typical attribute record structure is illustrated in Figure 3.

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And then the, the file systems essentially is that is their the organized store retrieve and some name sharing naming below for sharing and protection of various lights, so the files can contain data and attribute, so let us look at some of the attributes of the Ripper structure here.

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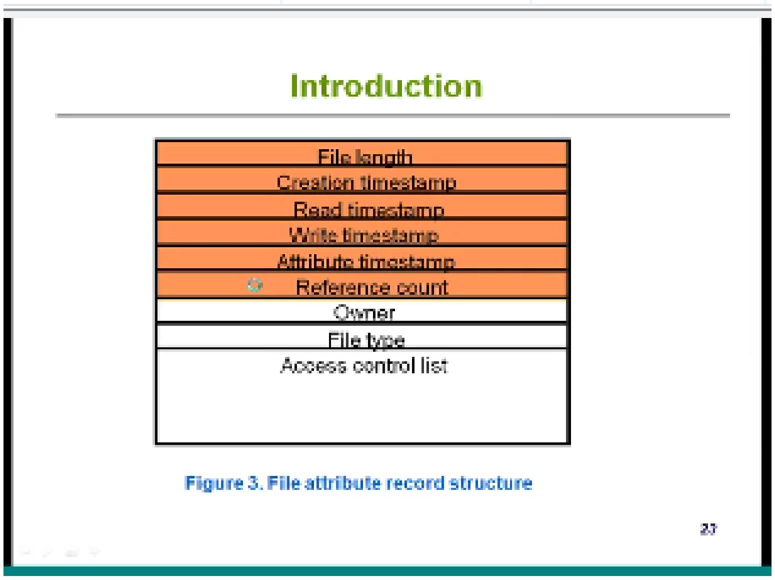

Introduction

File length
Creation timestamp
Read timestamp
Write timestamp
Attribute timestamp
Reference count
Owner
File type
Access control list

Figure 3. File attribute record structure

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So the things that you want to store the file length then it was created at creation time stamp then it was last read, read time stamp and then when was it updated with some data which is the right time stamp and then any, any other attributes empowered that and then the attributes time stamp also home and then finally a lesson found given and then there is also like to make the encoding inform of the owner and the file type.

And then who or who cannot access the file for the access control list and that is also provided so that it goes with the software and essentially like I mean goes with this file and if it if the user is not authorized then it would not like let you see they put not you would not be able to be.

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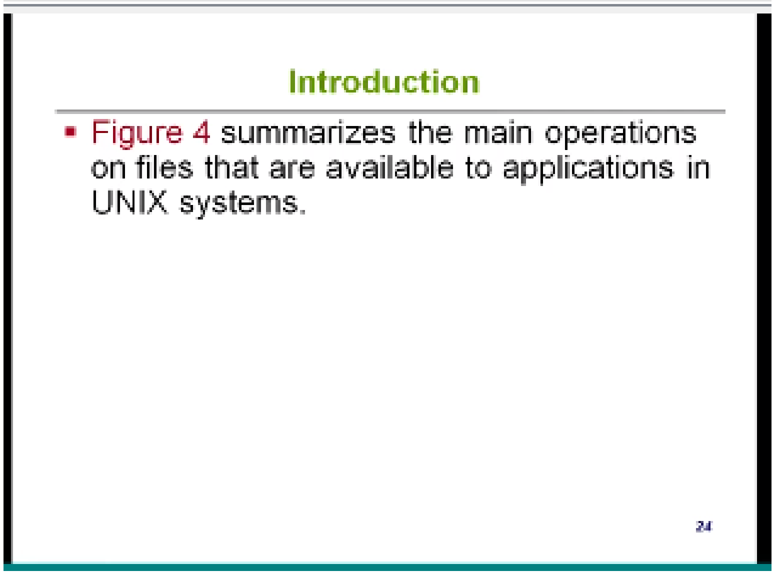

Introduction

- Figure 4 summarizes the main operations on files that are available to applications in UNIX systems.

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So in the next figure that will be basically with all the operations on the files that are available.

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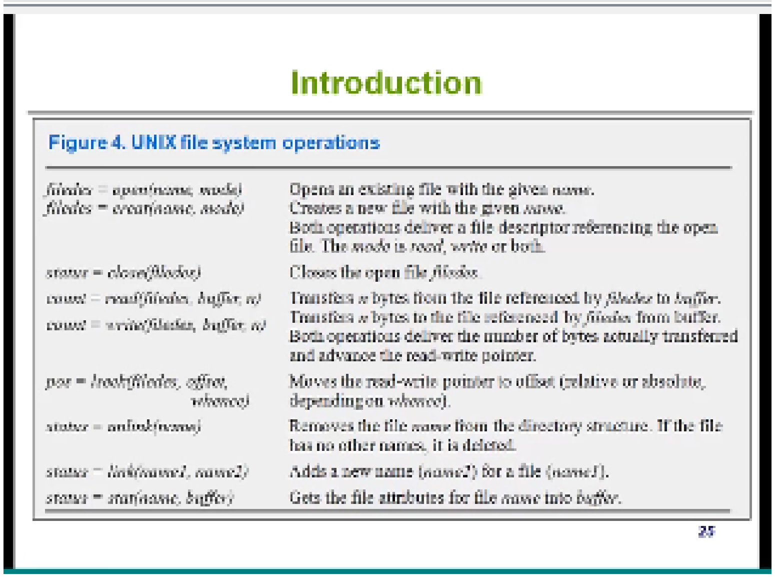

Introduction

Figure 4. UNIX file system operations

filedes = open(name, mode) *filedes = creat(name, mode)*	Opens an existing file with the given *name*. Creates a new file with the given *name*. Both operations deliver a file descriptor referencing the open file. The *mode* is *read*, *write* or both.
status = close(filedes)	Closes the open file *filedes*.
count = read(filedes, buffer, n) *count = write(filedes, buffer, n)*	Transfers *n* bytes from the file referenced by *filedes* to *buffer*. Transfers *n* bytes to the file referenced by *filedes* from buffer. Both operations deliver the number of bytes actually transferred and advance the read-write pointer.
pos = lseek(filedes, offset, whence)	Moves the read-write pointer to offset (relative or absolute, depending on *whence*).
status = unlink(name)	Removes the file *name* from the directory structure. If the file has no other names, it is deleted.
status = link(name1, name2)	Adds a new name (*name2*) for a file (*name1*).
status = stat(name, buffer)	Gets the file attributes for file *name* into *buffer*.

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To applications in the unit system you, so when we say open and the name and the mold essentially like I mean, so that opens the an existing file or open the file with a given name essentially and then, when we say like filed is equal to create name mode this is actually creating a new file essentially so the file descriptor is in this file DS essentially the extensible, which is kind of a just a number that it returns it is typically the pointer to the head of heep or section of memory.

Where that particular file is reading so I pause me, then you have status that you can set and usually like when you do a close, and then you can give the file handle so I am going to refer this as Phi handle from now onwards the file descriptor essentially it is like a pointer to the head of the file so that we know that that is the start of the file and then we can even read that the fields that we mentioned in the previous slide.

Which is these thing by length patient times, times etc so the file that gives a pointer to that particular head of that particular table um we can give the count so here like I mean me the store account in a variable called count so the command is again read filed as buffer n, so essentially the buffer stores the n bytes of read in bytes of the file I will yes and it stores it essentially like anymore the buffer and then that fort is in the town.

So the town displays the number of bytes essentially but, so you can also do my site file this buffer on the end they both deliver the number of bytes actually transferred between the grants and the they both deliver the number of bits, that are actually transferred and it also advances the read pointer to the location you, and then the other command is the LC command and see the file D is off set for whens essentially like I mean it takes the rear a pointer a bit offset related to another absolute number.

And that is given by this vent so we variable, and then the other one is unlink name this removes the finding from the better constructor if the file has no other names then the file is tilted actually, then he saw a soft link earlier this is the hard link of the link name one need to this adds a new name called me in two, two name one again it just provides another pointer to the same feather even mentioned the file name two or name one asset then the other command is the status amend this is STAT or this is STAT and then essentially that gives like the gets all the file attributes of the file name, and then stores it into buffer..

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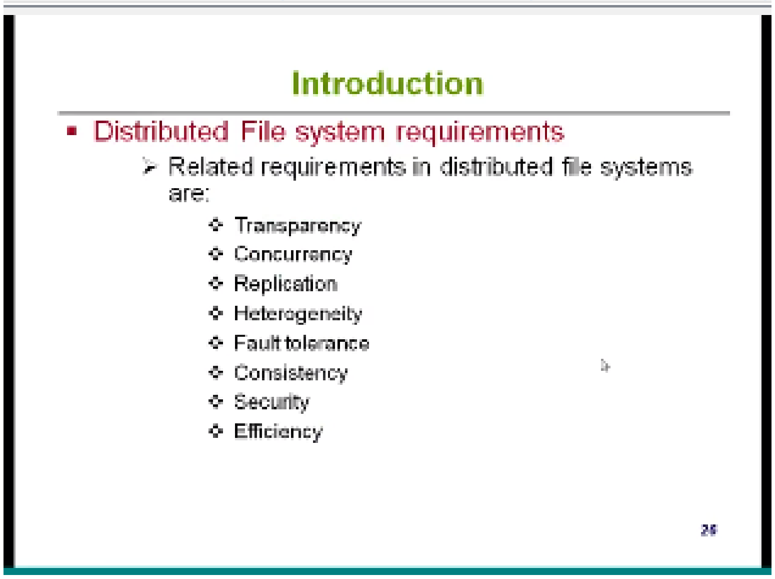

Introduction

- Distributed File system requirements
  - Related requirements in distributed file systems are:
    - Transparency
    - Concurrency
    - Replication
    - Heterogeneity
    - Fault tolerance
    - Consistency
    - Security
    - Efficiency

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So we studied about few things essentially looking for we will talk about this briefly and then we will stop at this point, and then the next time oh no we would not next time we will expand this such a ball give you all the definitions of all these different terms and then we will move forward, so just wanted to give you this basically the distributed file system requirements eventually.

If requires transparency, concurrency, replication, erogeneity, all tolerance consistency which is different from the transparency other things, security and efficiency, so we will talk about what each term means in the context of distributed file system, and then also how to compare different file systems in the next chapter Thanks.