

Network OS, LAN OS, Client-Server

INFO 341

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Objectives

- What is a NOS?
- What are common services of a NOS?
- What are some disadvantages of a peer-to-peer network?
- Name some requirements of an NOS?
- What are some characteristics that differentiate a client from a server?
- What is a protocol port number?
- What is port scanning?

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Early LAN Options

- By the late 1980's the personal computer revolution was in full force
 - Desktop PCs with their own CPU and storage were capable of running applications themselves, they were not terminals to a larger machine
- But users wanted more than stand-alone operation
 - Wanted to share files with others easily
 - Wanted to share expensive peripherals
 - All within their "local" area

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[More Early LAN OSes]

- New technologies like Ethernet and Token Ring were becoming available and Network Operating Systems began to appear
 - IBM's PC LAN
 - Novell Netware
 - Banyan Vines
 - Apple File Protocol
 - NFS. Unix existed as an operating system in this era but it was only available on high-end equipment, no interoperability options at all for PCs
- Most basic service was a "redirector"
 - Tricked DOS into thinking it had a disk drive that it didn't or a printer it didn't
 - Could "map" a drive, or capture the LPT port to an alternate location

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[Two Generic Approaches]

- Peer-to-Peer Networking
 - In peer-to-peer networks, each machine provides services and consumes services
- Network Operating Systems (NOS)
 - In the NOS approach a special dedicated machine, a server, is used to manage and provide special services

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[Peer-to-Peer]

- Several p2p systems
 - AppleTalk, AFS
 - Novell, Personal NetWare
 - MS, Windows for Workgroups, Windows 95
- These all provided basic file sharing and print sharing services
- This is not in the same sense as today's P2P file sharing networks

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Peer-to-Peer Networks

- Takes advantage of existing desktop computing power and networking connectivity
- Computers communicate directly among themselves and can act as both clients and servers, sharing their own files or devices with others

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Reasons to P2P

- Makes efficient use of computing resources
- Simple to setup for small networks
- Flexible network architectures
- Does not require network/IT administrator (in theory)
- Inexpensive, basic peer-to-peer capabilities are bundled into modern operating systems

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Reasons not to P2P

- Does not scale up
 - Difficult to find resources (files, printers, etc)
 - Too many network requests tend to bog down desktop PC's
- No common security framework
 - Each PC has its own user accounts & passwords
 - End-users screw up all the time and don't consider security at all
- Difficult to troubleshoot network problems
 - What happens when Mary turns off her PC?!

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[Network Operating System (NOS)]

- Network OSes rely on a special machine, a server, to manage resources and provide services
- There have been several NOS
 - Novell, NetWare 3.x and NetWare 4.x
 - Banyan Vines
 - Artisoft Lantastic
 - Microsoft, NT Server, Win2K Server, ...

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[Basic/Required NOS Services]

- File sharing
- Printer sharing
- Application sharing
- Access control
- User/Resource accounting
- Backup/Restore of attached devices

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[Novell Netware]

- The "king" of PC LAN Network operating systems
- Required very little memory in a day when DOS had a limit of 640K
- Used a protocol called IPX (the Internet was here but no web yet, Internet to the desktop was not yet prevalent)
- Very full featured, ability to add users, assign rights to users, easy to setup printer sharing
- Very fast and efficient even on low-end equipment
- Still "widely" deployed today and still very high performance

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[Microsoft NOS]

- Had some early products including "LAN Manager" but their "redirector" software was memory intensive and slow.
- Not until Windows NT 4 did Microsoft have a reasonable Network Operating System but it still did not seem to pose much threat to Novell
- With Windows 2000 Microsoft really got its act together and finally made inroads to this market, unseating Novell
- Today Windows 2K, Windows XP Pro, Windows Server 2003, Linux, and Mac OS X battle it out

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[Why sever based NOS?]

- High Security
 - Centralized authentication & authorization
- High Centralization of resources
 - Storage and peripheral devices can be easily shared
- High Performance
 - Servers can be dedicated to a single task to support thousands of clients
- Easier to maintain
- But...
 - Central point of failure
 - May need additional staff to maintain it properly
 - More expensive, may need to purchase a server OS
- Enter clustering technologies (more prevalent in Linux, for example see the top500.org site)

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[What is a server?]

- Even a low-end PC can be a server by...
 - Enabling it's peer-to-peer networking capabilities through the OS
 - Running a built in "service" like a Web service or FTP service
 - Installing a 3rd party service and making that service accessible to others
 - Of course if it really is low-end, how well it performs these duties is another matter

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Server Characteristics

- Servers share similar characteristics
 - More powerful hardware, more sophisticated OS
 - Waits passively for client requests
 - Serves requests from arbitrary clients
 - Starts services automatically on boot
 - Service is often special, privileged program

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Client Characteristics

- Clients share similar characteristics
 - Runs locally on a user's PC
 - Invoked by a user for a single session
 - Initiates contact/request for a service
 - Generally, accesses one service at a time
 - Does not require special hardware or a sophisticated OS

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The Architecture of the Internet

- The vast majority of Internet applications are called "client/server" applications
- There are (3) distinct pieces to such an application
 - The client
 - The server
 - The protocol a client and server use to communicate with each other

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Differing Software Architectures

- Standalone Applications
 - Run by themselves
 - Things like Microsoft Word, Excel, PowerPoint
 - Things like Adobe Photoshop
- Host Based Applications – Master/Slave relationship
 - Run only on a central host like a mainframe or Unix box
 - All the processing and work is done by the host.
 - In the “old days”, connecting to a mainframe using a dumb terminal, then running software located on that mainframe would be considered using a host based application. The host does everything, all the processing, and it even displays the results on your dumb terminal screen for you.

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Web Client/Server Example

- The client is a program like Netscape or Internet Explorer
- The server is a piece of software like IIS or Apache
- The client provides the end-user interface, the buttons, the menus, etc.
- The server provides the information itself
- The client talks to the server using a protocol called HTTP
- Note: As you may have seen, some pages look different between Netscape and IE. That's because each client takes the same data and then has to figure out what to do with it. Depending on the capabilities of the client, what an end-user sees can be different.

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Advantages of Client/Server

- Many different clients and servers can be built by different developers to meet the needs of end-users
 - Netscape Mail, Outlook, Eudora, Outlook Express, Pine – all different email clients with different icons, menus etc. The end-user selects the one they like best.
 - On the backend though, the server still does the same thing, it could care less what client you use, as long as the client you use talks the same protocol it does so that messages can be exchanged.
 - The programs themselves (eg. IE) or Apache may be completely independent of each other, the programmers that wrote one don't have to know anything about the other and they can still work together to complete the task
 - This provides choice

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Disadvantages of Client/Server

- May be implementation differences at the client level, developers may interpret the standards differently
- The developer of either the client or the server can make mistakes causing interoperability problems
- Both the client and the server must be there to work – what happens if the network connection between the client and server fails?
- Version problems can appear, client upgrades or updates may be required if the server changes

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Multiple Services on a Server

- Server equipment is often high end
- Servers often spend a great deal of their time waiting, just waiting, for a client to request the service
- TCP defines a 16 bit 'protocol port number' as a logical connection over the network
- These 'port' numbers solve the problem of providing multiple services over a single network wire
- Note that hosting a variety of services on a single server is technically quite feasible, given the horsepower available at the high end. However, it multiplies the security concerns. Also if one service consumes all the computer's resources, it can impact and crash the other services, hence there is a reliability issue.

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Protocol Ports

- We use a layer of abstraction called a "port" as a way to offer multiple services from a single box
- Services (like a web server or a quote server) run on "well know ports"
 - Web servers for example usually run on port 80
 - In Unix the file /etc/services often shows these well know ports
- When we install a service and run it, it will normally run such that it starts listening for connections on that well-known port
- Clients know that when we specify a machine name that we probably want to use one of these well known ports to make the connection
- It is often possible to change the port a service runs on or the port a client will connect to for special purposes

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[Port/Service Discovery]

- How do you know what 'port' a service is using?
 - Memorize it
 - Use an API in software
 - /etc/services

- "Port scanning" software can be used as a way to detect what services your server is offering
 - By port scanning, some hackers will look for ways to attack you based on the services that are running on your server

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[Summary]

- NOS Introduction
 - Novell, MS NOS
- Peer-to-Peer Systems
- Client-Server Architecture
- Client/Server Characteristics
- Ports

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