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CH.1 LABSIM NOTES CONDENSED

Category	Protocol	Description
Web	**HTTP**	**Hypertext Transfer Protocol:** • Used by web browsers/servers to exchange files (web pages) through WWW/intranets • Info requesting/responding protocol • Typically used to req/send web docs: Also used for comm bet agents
	HTTPS	**HTTP over SSL:** Secure form of HTTP: Uses SSL to encrypt data before transmitted
Sec	**SSL**	**Secure Sockets Layer:** Secs msgs being transmitted on Internet: RSA for auth/encryption
	TLS	**Transport Layer Security:** Ensures msgs being transmitted on Internet private/tamper proof **Implemented through 2 protocols:** **1. TLS Record:** Can provide connection sec w/encryption (DES for ex) **2. TLS Handshake:** Provides mutual auth/choice of encryption method ○ Vers 1.2 is updates to improve on past flaws found in 1/1.1
File xfer	**FTP**	**File Transfer Protocol:** Generic method of transferring files • Can protect access by req usrnames/passwds • Allows file transfer bet dissimilar sys • Can transfer both bin/txt files • Doesn't use encryption: Sent over clear txt
	TFTP	**Trivial File Transfer Protocol:** Similar to FTP: Lets you transfer files bet host/FTP server • Doesn't provide usr auth/error detection • Often used when files need to be transferred bet sys quickly • B/C doesn't perform error detection: Faster than FTP: Susceptible to trans errors
	SFTP	**Secure FTP:** Uses SSH to sec data transfers: SSH ensures they're encrypted
	SCP	**Secure Copy:** Used to sec transfer files bet sys: Relies on SSH to ensure encrypted
Email	**SMTP**	**Simple Mail Transfer Protocol:** Used to route electronic mail through internetwork • Bet mail servers for sending/relaying mail • Email clients to send mail • Some email client programs: MS Outlook: Receiving mail from Exchange server
	POP3	**Post Office Protocol 3:** Used to retrieve email from remote server/DL it to local client over TCP/IP
	IMAP4	**Internet Msg Access Protocol v4:** Email retrieval protocol • Enables usrs to access email from various locs • W/out need to transfer msgs/files back/forth bet computers • Msgs remain on remote mail server/not auto dl'd to client sys
Network	**DHCP**	**Dynamic Host Config Protocol:** Auto assign addresses/config params to hosts • Hosts receive config info at startup: Reduces amt of manual config on each host
	DNS	**Domain Name Service:** Address/name resolution
	NTP	**Network Time Protocol:** Used to comm time sync info bet sys
	LDAP	**Lightweight Dir Access Protocol:** Used to search/retrieve data from/update dir service • Follows client/server model • 1/more LDAP servers contain dir data: Client connect to server to make dir service req
Mgmt	**SNMP**	**Simple Network Mgmt Protocol:** For managing complex networks • Let's network hosts exchange config/status info

		• Info can be gathered by mgmt SW/used to monitor/manage network
	Telnet	**Remote Terminal Emulation:** Allows computer to remotely access con of a sys
	SSH	**Secure Shell:** Allows secure interactive control of remote sys • Uses RSA public key crypto for connection/auth • Uses IDEA alg by default: Can use Blowfish/DES • Preferred alt to Telnet
Transport	**TCP**	**Transmission Control Protocol:** Ensures accurate/timely delivery of comms bet 2 hosts. **Provides following services to ensure msg delivery:** • Sequencing of data packets • Flow control • Error checking • Ack of packets sent • Retransmission of lost packets
	UDP	**User Datagram Protocol:** Host-to-host protocol like TCP • Doesn't ack each packet transmitted • Doesn't allow for retransmission of lost packets • Reduces overhead: Faster comm: Ideal for audio/video
Control	**ICMP**	**Internet Control Msg Protocol:** Works w/IP to prevent errors/control info by allowing hosts to exchange packet status info **2 common mgmt utilities:** **1. Ping** **2. Traceroute** ICMP msgs check connectivity **Also works w/IP to send notices for following:** • Destinations unreachable • Which route/hops packet takes through network • Whether devices can comm
	IGMP	**Internet Group Membership Protocol:** Defines host groups • All group members can receive broadcasts (multicasts) intended for group • Multicast groups can be composed of devices w/in same/across networks (connected w/rtr)

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CH.2 LABSIM NOTES MODIFIED

Twisted pair components: 2 wires carry sigs (1 conductor carries +/other -): 22 gauge copper wiring

- PVC/Plenum: Insulation surrounds wire: Plenum: Fire-resistant/non-toxic)
- 2 wires twisted: Reduces EMI: Electromagnetic Interference/Crosstalk: Equal wires cancel EMI

Pairs bundled in outer sheath: Classified by sheath:

- **STP: Shielded Twisted Pair:** Grounded outer copper shield: Around bundle of twisted pairs/each pair: Adds EMI protection
- **UTP: Unshielded Twisted Pair:** No grounded copper shield: Easier to work w/less expensive

UTP cable types:

Type	Connector	Description
Phone	RJ11	PC to phone jack: Dial-up: 2 pairs of twisted cable (4 wires)
Cat 3	RJ45	10Mb eth0/16Mb token ring
Cat 5	RJ45	Supports 100Mb eth0/1000Mb (Gb) and ATM
Cat 5e	RJ45	Better EMI protection than Cat5: 100Mb/Gb eth0
Cat 6	RJ45	10Gbps eth0/high-BW comm: Solid plastic core: Keeps twisted pairs separate/from being bent
Cat 6a	RJ45	Better EMI/crosstalk protection than Cat6: Better performance w/10Gbps eth0

2 connector types used w/twisted pairs:

Connector	Description
RJ11	4 connectors: Up to 2 pairs of wires: Telephone wiring
RJ45	8 connectors: Up to 4 pairs of wires: eth0/token ring connections **RJ48C:** Used for specific WAN connections (T1): Different wiring

Coaxial: Older: Usually implemented w/bus: Not good for ring/star

- Ends of cable must be terminated
- 2 conductors that share common axis w/in single cable

Components: 2 concentric metallic conductors:

- Inner conductor: Carries data: Copper/Copper coated w/tin
- Mesh conductor: 2nd physical chan: Also grounds cable: Aluminum/Copper coated tin

Insulator surrounds inner conductor: Keeps sig separated from mesh conductor: PVC plastic

Advantages	Disadvantages
Resistant to EMI/Phys damage	Costs more than UTP: Unsupported by newer standards

Coaxial cable grades: Use cables w/same resistance rating (impedance):

Grade	Uses	Resistance
RG-58	**AKA: Thinnet:** 10Base2 eth0	50 ohm
RG-59	Cable TV/Networking	75 ohm
RG-6	Cable/Satellite TV/Networking • Less sig loss than RG-59: Better for networking apps over few ft. distance	75 ohm
RG-8	**AKA: Thicknet:** 10Base5 eth0	50 ohm

Connectors:

Connector	Description
F-Type	Twisted onto cable: Satellite/TV/Cable broadband
BNC	Molded onto cable: 10Base2 eth0
AUI	DB15 serial connector: 10Base5 eth0

DB25	25 pins in 2 rows: Top row 13/lower 12: Parallel/RS-232 serial/SCSI

Fiber: 1 strand transmits sigs/other receives

Components:

- **Core:** Carries sig: Plastic/glass
- **Cladding:** Maintains sig in center of core as cable bends
- **Sheath:** Protects cladding/core

Advantages	Disadvantages
Immune to EMI Resistant to eavesdropping High transmission rates Greater distances w/out repeater	Expensive/Difficult/Training req to attach connectors to cables

Multimode/Single mode fiber cables NOT interchangeable:

Type	Description
Single Mode	Data transfers through core w/single light ray: AKA mode • Core diameter: 10 microns • Distances up to 3 km: Delivers rates of up to 10Gbps • Cable can extend great distance
Multimode	Data transfers through core using multiple light rays • Core diameter: 50-100 microns • Distances under 2km: Rates of up to 1Gbps • Distance limited w/cable lengths

Connector types:

Type	Description
ST Connector	**Single/Multimode:** Keyed/bayonet-type: AKA: Push-in/twist connector: Each wire: Separate connector • Nickel plated w/ceramic ferrule for core alignment: Prevents light deflection • Exposed fiber tip: Polished: Ensures light is passed/no dispersion
SC Connector	**Single/Multimode:** AKA: Push-on/pull-off connector type: Locking tab • Each wire: Separate connector • Ceramic ferrule: Ensures proper core alignment/prevents deflection from light rays • Assembly: Exposed fiber tip must be polished
LC Connector	**Single/Multimode:** Plastic connector: Locking tab: Similar to RJ45 • Single connector w/2ends • Ceramic ferrule to ensure core alignment/prevent deflection • Half size of other fiber connectors
MT-RJ Connector	**Single/multimode:** Plastic connector: Locking tab • Ceramic ferrule to ensure proper core alignment/prevent light ray deflection
FC Connector	**Single mode:** Each wire has separate connector/threaded connector • Designed to stay sec connected in envs where it may exp physical shock/intense vibration
Fiber Coupler	Used in optical fiber w/1/more input fibers/ and 1/7 output fibers: • Light entering input fiber can appear at 1/more outputs • Power distribution depends on wavelength/polarization • Wavelength-sensitive couplers used as multiplexers

Crossover cable configs:

Cable	Description
Straight-through	2 standards for creating straight-through: **T568A: Pins 1-8:** GW/G/OW/B/BW/O/BrW/Br **T568B: Pins 1-8:** OW/O/GW/B/BW/G/BrW/Br Once you choose standard: Use same for all cables to avoid confusion
Crossover	Easiest way to create crossover? Arrange wires using T568A in 1st connector/T568B in 2nd

Ethernet specs use following pins:
Tx pin: Transmitting sig
Rx pin: Receiving a sig
Pin 1: Tx+
Pin 2: Tx-
Pin 3: Rx+
Pin 4: Unused
Pin 5: Unused
Pin 6: Rx-
Pin 7: Unused
Pin 8: Unused

Be aware when making cables for Ethernet:

- Cat 5/5e/6/6a come w/wires that have either solid/stranded cores
  - Solid for longer runs inside walls/ceiling
  - Stranded for drop cables where freq movement occurs/flexibility needed

Components for wiring distribution:

Component	Description
Demarc point	**Demarcation Point:** Line that marks boundary bet telco equip/private network/phone sys • LEC responsible for all equip on 1 side of the demarc • Customer responsible for all equip on other side • AKA MPOE: Min Point Of Entry/EU-POT: End User Point Of Termination • Often ID'd by orange plastic cover on wiring component
MDF	**Main Distribution Frame:** Main wiring point for building: LEC installs demarc to MDF
IDF	**Intermediate Distribution Frame:** Smaller wiring distribution point w/in building • Typically located on each floor directly above MDF
Demarc ext	Demarc Extension: Extends demarc point from original loc to another w/in building • Usually single wire bundle that attaches to existing demarc/supplies term point to diff loc
Vertical cross connect	Connects MDF on main floor to IDFs on upper floors: Cabling runs vertically bet MDF/IDFs
Horizontal cross connect	Connects IDFs on same floor: Cabling runs horizontally bet IDFs
25 pair cable	Consists of 25 pairs of copper wires in single bundle (total of 50 wires) Often used for phone installs that have multiple lines: Replacing multiple Cat3/5/5e/6 in single bundle • Horizontal/vertical cross connects bet MDF/IDFs **Individual wires w/in 25 pair use following color coding scheme:** **10 colors used in 2 different groups:** • Group 1: White/red/black/yellow/violet • Group 2: Blue/orange/green/brown/slate ○ 5 wires of each color **Every colored wire in group 1 paired w/each color in group 2:** • Instead of using solid colors: Some use striped wires to uniquely ID each wire/matching wire • Can use RJ21 to connect 25 pair cable to other wiring devices
100 pair cable	Consists of 100 pairs of copper wires in single bundle (200 wires) • Use same coloring scheme as 25 pair wires: Repeated 4x • Each bundle of 25 wires wrapped together w/colored nylon str to help separate wires of same color
66 block	Punchdown block for connecting individual copper wires together: • 25 rows of 4 metal pins: Pushing wire into pin pierces plastic sheath on wire, making contact w/metal pin **2 diff 66 block configs:** • **Non-split Block:** 25 pair block: All 4 pins bonded (electrically connected): Connect single wire w/up to 3 others • **Split Block:** 50 pair block: Each set of 2 pins in row bonded: Connect single wire to 1

	other wire ○ Use bridge clip to connect left 2 pins to right 2 pins ○ Adding/rem bridge clip easy way to connect wires w/in row for easy testing purposes
110 block	Punchdown block for connecting individual wires together: • Comes in various sizes for connecting pairs of wires (50/100/300 pair) **Rows of plastic slots:** Each connects 2 wires together: • 1st wire into plastic slot on 110 block • 2nd wire into slot on connecting block • C-4 connectors: 4 pairs of wires | C-5 connectors: 5 pairs of wires **When connecting data wires on 110 block:** • White w/blue stripe: Solid blue • White w/orange stripe: Solid orange • White w/green stripe: Solid green • White w/brown stripe: Solid brown
Patch panel	Device commonly used to connect individual stranded wires into female RJ45's

Use punchdown tool to insert wires into 66/110 blocks:

- Pushes wire into the block/cuts off excess wire
- Position blade on side of clip toward end of wire
- Blade for 66: Straight | Blade for 110: Notch in blade

Conditions caused by faulty wiring:

Issue	Description
EMI/RFI	**Electromagnetic Interference/Radio Frequency Interference:** External sigs that interfere w/normal comms Common sources: Generators/motors (elevator)/radio transmitters/welders/transformers/fluorescent lighting **To protect against:** • Use fiber instead of copper: Fiber immune • Use shielded twisted pairs: Metal foil that encloses all wires: Some may include drain wire **Drain wire:** Bare wire in cable that absorbs EMI/RFI • Avoid installing cables near EMI/RFI sources
Crosstalk	Interference caused by sigs w/in twisted pairs of wires • Twisting of wires into pairs helps reduce crosstalk/Each pair twisted at diff rate to reduce crosstalk • Often introduced w/in connectors: Where twists removed to add connector • Can also occur where wires crushed/plastic coating worn **7 forms of crosstalk:** 1. **NEXT: Near End Crosstalk:** Measured on same end as transmitter 2. **FEXT: Far End Crosstalk:** Measured on opposite end from transmitter 3. **Alien Crosstalk:** Introduced from adjacent parallel cables
Attenuation	**dB loss:** Loss of sig str from 1 end of cable to other • Longer cable: More attenuation: Never exceed max length defined by arch • Higher temp experience more attenuation • Repeater regenerates sig/removes effects of attenuation
Impedance mismatch (echo)	**Impedance:** Measure of resistance w/in trans medium: Ohms Ω • All cables must have same impedance rating: Rating for cable must match transmitting device • Mostly factor in coaxial cables: Choose cable w/correct rating (50/75 Ω) based on network type • Never mix cables w/diff ratings When sigs move from cable w/1 impedance rating to cable w/another: • Some of sig reflected back to transmitter: Distorts sig • With video (TV): Mismatch manifested as ghosting of image • Cable distance: Doesn't affect impedance

Shorts	When sigs take path other than intended • In case of twisted pair: Sig sent on 1 wire arrives on diff one • Shorts occur when 2 wires touch: Worn jackets/crushed/metal object piercing 2/more wires
Open circuit	When cut in wire prevents sig from reaching end of wire
Miswired	Incorrect wire positions on both connectors **7 wiring problems possible:** **Reverse connection:** When cable wired using 1 standard on 1 end/another standard on other end: Crossover • May be intentional: Can cause problems when used instead of straight-through **Wiremapping:** Matching of wire w/pin on 1 end w/same pin on other end **Split pair:** When a single wire in 2 diff pairs is reversed at both ends: May still work, but crosstalk • When 568A/B standards for drop cables followed: 1 pair split to meet the standards • Common split pair error: Place all wire pairs in order in connector instead of splitting according to standard • When connecting cables use punchdown block: Pairs no split
Bad term/Connector	Occurs when incompatible/incorrect connector used: Can result in reduced performance/connection loss

Impt issues:

Issue	Description
Connectors	When working w/fiber: • For light to pass through: Fiber w/in jack must line up w/fiber in connector ○ Wrong connector: Misaligned fibers/disrupting light sig • Dirty connectors: Can disrupt light sig: Methods to clean: ○ Connectors where ferrule protrudes out of connector (FC): ○ Wipe end of ferrule w/lint-free cloth: Small amt of denatured alcohol • End of ferrule less accessible: Specialized cleaning too: Some tools plug in cable/clean by pumping handle • Clean jacks on ints: Specialized cleaning stick
Polishing	**Insertion loss:** When connector install on end of fiber: Degree of sig loss **Back-reflection/ORL: Optical Return Loss:** Corrupt data transmitted can damage transmitter • As little ORL as possible **Polish grading designations:** **PC: Physical Contact:** Usually used w/single mode: • Ends of fiber polished w/slight curvature so when cable end is inserted into connector • Only cores touch each other **SPC: Super Physical Contact/UPC: Ultra Physical Contact:** Polishing uses higher grade of polish • More curvature than PC: Reduces ORL reflections **APC: Angled Physical Contact:** Polishing used to reduce back reflection • APC connector: 8-degree angle cut into ferrule: Prevents reflected light from traveling back down fiber • Any reflected light bounced out into cable cladding instead • Can only use APC connectors w/other angle-polished ○ Otherwise: Connector causes excessive insertion loss: APC connectors: Green
Cabling	Fiber cable much less forgiving phys abuse than copper: Core fragile/easily damaged by handling • Wavelength mismatch: Causes issues: Can't mix/match diff types of cable
Media Adapters	Switches/rtrs allow insert **GBIC: Gigabit Int Converter:** Empty slot convert int from copper to fiber wiring • Other: **SFP: Small Form-Factor Pluggable** module to accomplish **7 issues occur when using fiber media adapters:** • Some GBIC/SFP modules: Multimode fiber: Others use single: Make sure correct type • Media adapter modules malfunction: If lost connectivity on 1 of links: Ensure adapter module working correctly

Attenuation	Light signals transmitted through fiber exp attenuation as pass through cable **7 factors contribute to sig loss:** • Cable length/Connectors/Splices • Can use factors to calc how much sig loss (dB) should be expected in given run of fiber **Loss budget:** The sig loss calc: Sum avg loss of components used in cable run to generate total attenuation end-to-end **When calc loss budget for segment of fiber:** • Connectors: 0.3 dB loss each • Splices: 0.3 dB loss each • Multimode: 1-3 dB loss per 1000 meters: Depends on thickness/quality of cable • Single mode: 0.4-0.5 dB loss per 1000 meters: Depends on thickness/quality of cable **Link Loss Margin:** Total attenuation: Should be no more than 3 dB less than total power at trans source. • Example: Total power output at trans source of cable run is 15 dB: Total attenuation shouldn't exceed 12 dB ○ Ensures cable will continue to func as components (LED light trans/connectors) degrade w/age/use

Troubleshoot phys connectivity

Tool/Method	Description
Loopback plug	Reflects sig from transmit port on device to receive port: Verify device send/receive sigs • Failure in test indicates faulty NIC • Successful test: Problem in cabling/another device • DIY: Connect wire from pin 1 to wire pin 3: Wire pin 2 to wire pin 6
Smart jack	Loopback plug installed at demarc point for WAN: Techs at CO can send diagnostic cmds to smart jack • Successful test indicates problem is w/in **CPE: Customer Premises Equip**
Good spares	Set of working components to test w/: Ex: NIC • Changing drop cable/Moving device from 1 switch port to another
Cable tester	Verifies cable can carry sig from 1 end to other/all wires in correct positions • Can check for mis-wire conditions [wire mapping/reversals/split pairs/shorts/open circuits] • Tell diff bet crossover/straight-through • Single unit tests both ends of cable at once • Plug into 1 end of long cable run to test
TDR/OTDR	**Time-Domain Reflectometer:** Device sends electrical pulses on wire in order to discover info • Measures impedance discontinuities: Echo received on same wire in response to sig Results can ID vars: • Estimated wire length/impedance • Loc of splices/shorts/open circuits **Optical Time-Domain Reflector:** Same funcs as TDR: Fiber: Sends light pulses into cables • Measures light scattered/reflected back to device Results can ID vars: • Loc of break/cable length/sig attenuation
Certifier	Multi-func tool: Verifies cable/install meet reqs for specific arch implement • Cat 6 used w/BW at/above 1000Mbps ○ Errors in connectors/wires: Can cause to function at 100Mbps instead • Validate BW of NIC's/switches: Duplex settings • Include toner probe/TDR/cable tester • Expensive/used by orgs specialize in wiring installs
Toner probe	2 devices used together to trace end of wire from known endpoint to term point in wiring close • Tone generator to 1 end of wire: Sends sig on it • Wiring closet: Touch probe to wires/place close to • Sound at probe: Indicates generated tone detected: Wire touched term point for

	trace
Multimeter	Tests electrical properties: Measures 7 params: • AC/DC voltage • Current (amps)/Resistance (ohms) • Capacitance/Freq
Voltage event recorder	Tracks voltage conditions on power line: • Basic records: Occurrence of undervoltage/overvoltage • Advanced: Track over time/create graph/save data • Some UPS: Include simple recorder
Env monitor	Monitors env conditions of specific area/device • Internal conditions [case/CPU] • Conditions w/in server room [temp/humidity/water/smoke/motion/air flow] • Notify when specified temp reached
Wire Snips	Snips: Cut wires to length/remove damaged sections: Example: Diagonal cutter

Post 3

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CH.3 LABSIM NOTES MODIFIED

Network adapter: Responsible for converting bin data into fmt to be sent on network medium
Transceiver: Responsible for converting digital data into digital sigs to be sent on medium

- Type of sig sends depends on type of network
- Fiber sends light/wired sends electronic/wireless sends radio
- To receive sigs: Converts digital sigs from network to digital

Modem: Converts bin data to analog waves [modulation] on sending end: Analog waves to bin [demodulation] on receiving
Network adapters:

- **L1:** They send/receive sigs on medium
- **L2:** Must follow rules for media access/read phys address in a frame

Components used by adapter:

Component	Description
Transceiver Module	Used to change media type of port on device [switch/rtr] **Most common types:** • **GBIC: Gigabit Int Converter:** Larger-sized transceiver: Firs in port slot: Gigabit media: Copper/Fiber • **SFP: Small Form-Factor Pluggable:** Similar to GBIC: Smaller: AKA Mini-GBIC • **XFP:** Smaller in size to SFP: Used for 10 Gigabit networking
Media Converter	Used to connect adapters using diff media types • L1: Don't read/modify MAC address • Only convert 1 media type to another w/in same arch (like Ethernet) ○ Must be done using bridge/rtr • Converting from 1 arch to another would req mod frame contents to DLL address
MAC	Unique identifier burned into ROM of every eth0 NIC: • 12-digit [48-bit] hex # (0-9/A-F) • Often written as 00-B0-D0-06-BC-AC/00B0.D006.BCAC • Globally unique by design: 1st half (6 digits) assigned to each manufacturer ○ Manufacturer determines rest of address: Unique value ID's host address ○ Manufacturer uses all addresses in original assignment can apply for new MAC assignment • Devices use MAC to send frames to other devices on same subnet
ARP	Used by hosts to discover MAC of device from its IP • Before 2 devices can comm: Must know MAC of receiving device If MAC unknown: ARP does following to find: 1. Sending device sends out broadcast frame 2. All hosts on subnet process broadcast frame looking at destination IP 3. If dest IP matches its own address: Host responds w/frame that includes its own MAC as sending MAC 4. Original sender reads MAC from frame/associates IP address w/MAC saving it in its cache Once sender knows MAC of receiver: Sends data in frames addressed to dest device • Frames include **CRC: Cyclic Redundancy Check:** Detects frames corrupted during trans

Common connection devices used w/in LAN:

Device	Description

Hub	Central connecting point of phys star/logical bus: Manage comm among hosts using following method: 1. Host sends frame to another host through hub 2. Duplicates frame/sends it to every host connected to hub 3. Host to which frame addressed accepts frame: Every other host ignores frame **L1:** Repeat incoming frames w/out examining MAC in frame
Bridge	Device that connects 2/more media segments on same subnet: Filters traffic bet both based on MAC in frame **Builds DB on MAC's to make fwding decisions:** • Begins by examining source MAC of incoming frame: If source isn't in fwding DB ○ Entry for it made in DB: Associating it w/media segment **Destination address is examined:** • If dest address not in DB: Frame sent out all segments except for 1 it was received • If dest address in DB: Frame fwded to appropriate segment: If segment diff from 1 it was received on • Broadcast frames fwded to all segments except 1 which they were received **Regarding:** • Separates 1 part of subnet from another: Eliminates unneeded traffic bet segments: Keeps from wasting BW • All segments connected on same subnet/share common subnet address • Can connect 2 segments use diff types of network arch **L2:** Read MAC contained in frame to make fwding decisions • Frame fwding happens independently of upper-layer protocols
Switch	Multiport bridge: Performs filtering based on MAC: Provides addl features not found in bridge: • Can process multiple frames simultaneously • Guaranteed BW to each switch port • Can make addl fwding decisions based on MAC **L2:** Autonomous in function: No port mgmt/config: Managed switches allow port config changes: Including: Port speed/Duplexing/Filters MAC/VLAN's
Wireless AP	Hub for wireless network: • Any msg sent to any wireless host connected to AP can be received by all other hosts **L2:** Can read DLL address in frame • Often config as bridge: Connecting wireless/to/wired segment: Both wireless/wired on same subnet

Common internetworking devices:

Device	Description
Router	A device that connects 2/more network segments/subnets • Each subnet has a unique logical address • Can be used to connect subnets w/in single LAN/as gateways to connect multiple LANs • Can connect networks w/diff archs • Maintain info in DB called a table
FW	A router w/addl sec features: Can be programmed w/sec rules to restrict flow of traffic • HW or SW
L3 switch	Switch capable of L3 functions: Reading addresses/routing packets bet subnets

Post 4

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CH.4 LABSIM NOTES MODIFIED

Ethernet Details:

<table>
<tr><th>Characteristic</th><th>Description</th></tr>
<tr><td>Topology</td><td>Topologies: Phys bus/logical bus | Phys star/logical bus | Phys star/logical star</td></tr>
<tr><td>Devices</td><td>NICs/Switches/Rtrs/Hubs [obsolete]</td></tr>
<tr><td>Trans Media</td><td>UTP: Unshielded Twisted Pair/RJ45 connectors/Fiber/Coaxial [thinnet/thicknet]</td></tr>
<tr><td>Media Access Method</td><td>Contention-based media access methods: 802.3: CSMA/CD: Carrier Sense, Multiple Access/Collision Detection Devices use following to send data:
• Device listens to trans medium to determine if free before sending data (carrier sense)
• If not free: Waits a random amt of time/listens again: If free: Transmits msg
Collision: 2 devices transmit at same time
• Sending devices detect collision/send jam sig to notify all other hosts
Backoff: Both devices wait random length of time before attempting to resend original msg (backoff).
<table>
<tr><th>Mode</th><th>Description</th><th>BW</th></tr>
<tr><td>Half-duplex</td><td>CD on: Can send/receive in only 1 direction
• Connected to hub? Half-duplex</td><td>10Mbps: 10BaseT/100Mbps for 100BaseT/etc</td></tr>
<tr><td>Full-duplex</td><td>CD off: Can send/receive at same time
• Req: Full-duplex capable NIC
• Switches w/dedicated ports</td><td>20Mbps: 10BaseT/200Mbps for 100BaseT/etc</td></tr>
</table>
</td></tr>
<tr><td>Phy Address</td><td>ID’d by using MAC: BIA: Burned In Address</td></tr>
<tr><td>Frames</td><td>Unit of data ready to be sent on medium
Components:
• Preamble: Set of alternating 1/0’s terminated by 2 1’s (11) that mark it as frame
• Destination addr: ID’s receiving hosts MAC
• Source addr: ID’s sending host’s MAC
• Data: Info to be transmitted
Optional bits pad frame: Bet 64/1518 bytes: If smaller than 64 bytes: Junk data in pad to make it req min
CRC: Cyclic Redundancy Check: Calcs performed on frame to check for errors/corruption</td></tr>
</table>

Implementation Comparison:

Category	Standard	BW	Cable Type	Max Segment Length
Ethernet	10BaseT	10Mbps (half d) 20Mbps (full d)	Twisted pair (Cat3/4/5)	100 meters
	10BaseFL	10Mbps (full d)	Fiber	1,000-2,000 meters

Fast	100BaseTX	100Mbps (half d) 200Mbps (full d)	Twisted pair (Cat5/+): 2 pairs	100 meters
	100BaseFX	100Mbps (half d) 200Mbps (full d)	Fiber	412 meters / 2,000 meters
Gigabit	1000BaseT	1,000Mbps (half d) 2,000Mbps (full d)	Twisted pair (Cat5e/+)	100 meters
	1000BaseCX (short copper)		Special copper (150 ohm)	25 meters: Used w/in wiring closets
	1000BaseSX (short)		Fiber	220-550 meters
	1000BaseLX (long)			550 meters / 5 kilometers
10 Gigabit	10GBaseT	10 Gbps (full d only)	Twisted pair (Cat6/7)	100 meters
	10GBaseSR/10GBaseSW		Multimode fiber (w/OM3 fiber)	300 meters
	10GBaseLR/10GBaseLW		Single mode fiber	10 kilometers
	10GBaseER/10GBaseEW		Single mode fiber	40 kilometers

Notes:

- Max cable length UTP “T” implementation: 100 meters for all standards
- Standards support max of 1024 hosts on single subnet
- 10GBase standards ending in W: SONET
- 10Base2/5: Coaxial
- 10GBaseSR: Can also be used w/OM4: Optical Multimode 4 fiber: Increases supported distance to 400 meters

2 Specifications provide addl func:

Type	Description
Ethernet over HDMI	Allows network-enabled entertainment devices to share data through HEC: HDMI Eth Chan w/out addl cables • Done by connecting single device [TV] to network with eth cable • TV shares connection using HDMI w/any other entertainment device w/HEC functionality
Ethernet over Power Line	Allows for network comms to be transmitted over existing AC power lines • Plugged into AC outlet: Cable plugged into device • Another EOPL device connected to same AC circuit • Devices multiplex AC copper power lines • Transmit digital sigs at freq higher than AC power already on circuit

Cable type in various connection scenarios:

Cable Type	Use
Straight-	Connects each wire to same pin on each connector (pin 1 to pin 1):

through	• Used when crossover performed w/hub or switch **Use when connecting:** • Workstation to regular port on hub/switch • Rtr to regular port on hub/switch • Reg port on hub/switch to an uplink port on a hub/switch
Crossover	Matches Tx: Transmit wires on 1 connector w/Rx: Receive wires on other connector • Used when crossing not performed auto: When crossover being performed twice **Use when connecting:** • Workstation to workstation/rtr to rtr/workstation to rtr (back-to-back config) • Uplink port on hub/switch to uplink port on hub/switch • Workstation/rtr to uplink port on hub/switch • Hub/switch using reg port to hub/switch using reg port
Rollover	Cable w/RJ45 connector on 1 end: RS232 (serial) connector on other end • Use to connect serial port on workstation to con connector on rtr/switch • Then run term program on workstation to connect to con of rtr/switch to perform config/mgmt • May have RJ45 on both ends: Req adapter to convert RJ45 to serial When term w/RJ45 on both ends: Wires w/in connectors rolled over to opposite connector: • Pin 1: Pin 8 • Pin 2: Pin 7 • Pin 3: Pin 6 • Pin 4: Pin 5

Generally:

- Crossover when connecting 2 like devices
- Straight-through when connecting diff devices/port types
- If crossover not performed by either device: Crossover cable
- If crossover performed by both devices: Crossover to perform crossing 3x
- If crossover performed by 1 device: Straight-through

Most installs: Straight-through used from hub/switch in wiring closet to wall plate

Tell diff bet crossover/straight-through:

- If wires in same order on both connectors: Straight-through
- If wires in diff order: Crossover

On some hubs/switches: Uplink port has button: Lets you use as reg (w/crossing) or uplink port (w/out crossing)

- Others: Uplink port shared with 1 reg port: Can use either, but not at same time
- Some hubs/switches include letter X in port labeling to ID ports that perform crossing
- Most modern switches use: Auto-MDI/MDIX: Senses cable type: Performs crossing based on

Fault Domain: Location of a phys problem: Often by ID'ing boundary bet comm devices

Compares single break in network affects comm:

Topology	Effect
Bus	Break means end of bus no longer terminated: No devices comm Examples:

	• When cable on network breaks: Each end of cable on either side of break loses its termination • When cable becomes loose/d.c: Computer not connected to network/terminated
Star	Break means device connected to central device through that cable can no longer comm • All other hosts will be able to comm w/other devices
Ring	Break means msgs can only travel in 1 direction (downstream) up to break • Computers can send msgs downstream to other devices: Not able to receive responses
Mesh	Break single link in mesh: No effect on comm • Data can be routed to dest device by taking diff path through mesh

Troubleshooting light combos:

Light			**Meaning**
Link	**Activity**	**Collision***	
Unlit	**Unlit**	**Unlit**	NIC no connection to network: Light to be lit? Must detect connection to another device **Possible causes:** • Bad NIC/cable/Missing device/Switch or hub port turned off or bad
Red/Amber	**Unlit**	**Unlit**	NIC detects sig: Not what's expected **Possible causes:** • Faulty transceiver on NIC/remote device • Incorrect cabling • Incompatible networking standards
Solid Green	**Unlit**	**Unlit**	Valid connection: Activity light never up? No data being received • Check all components/connections
Solid Green	**Flashing**	**Unlit**	Normal: Valid/active connection **Heartbeat/Keepalive:** Activity light periodically flashes even if not sending data
Solid Green	**Flashing**	**Flashing/Lit occasionally**	Normal: Small # of collisions expected on Ethernet network that uses hub • If full-duplex switches: Should have no collisions
Solid Green	**Flashing constantly**	**Flashing/Lit occasionally**	Constant traffic sent/received on link: Chattering/Jabbering: Constantly busy/sending data: Faulty NIC
Solid Green	**Flashing**	**Flashing/Lit constantly**	If collision light constantly flash: Too many collisions Possible causes: • Too many devices on segment: As # increases: # of collisions increase • Reducing # of devices/using switches/bridges/rtrs to divide network ○ Multiple collision domains: Will reduce # of collisions • Faulty cabling/cable runs too long • Faulty NIC: Doesn't properly sense medium before transmitting