

ELEN 4017

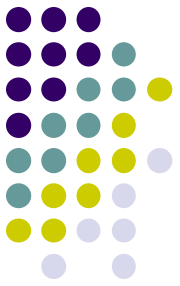
Network Fundamentals

Lecture 31



Purpose of lecture

- Data Link Layer
 - Link-layer devices
 - Course summary

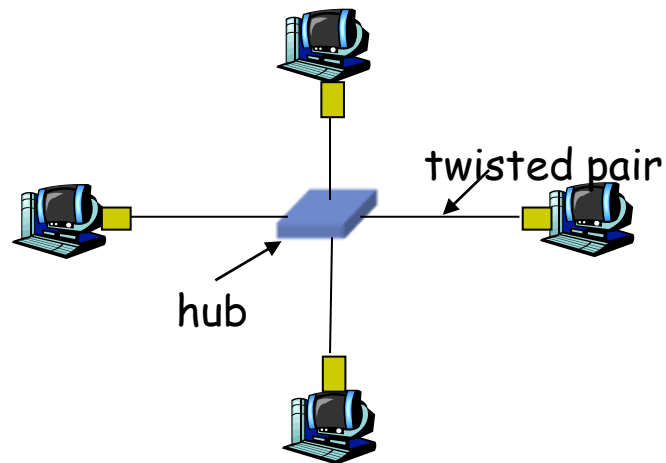




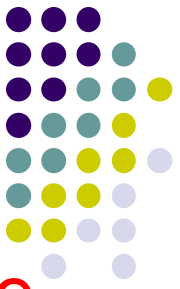
Hubs

... physical-layer (“dumb”) repeaters:

- bits coming in one link go out *all* other links at same rate
- all nodes connected to hub can collide with one another
- no frame buffering
- no CSMA/CD at hub: host NICs detect collisions

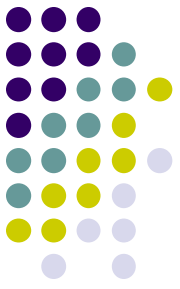


Switch

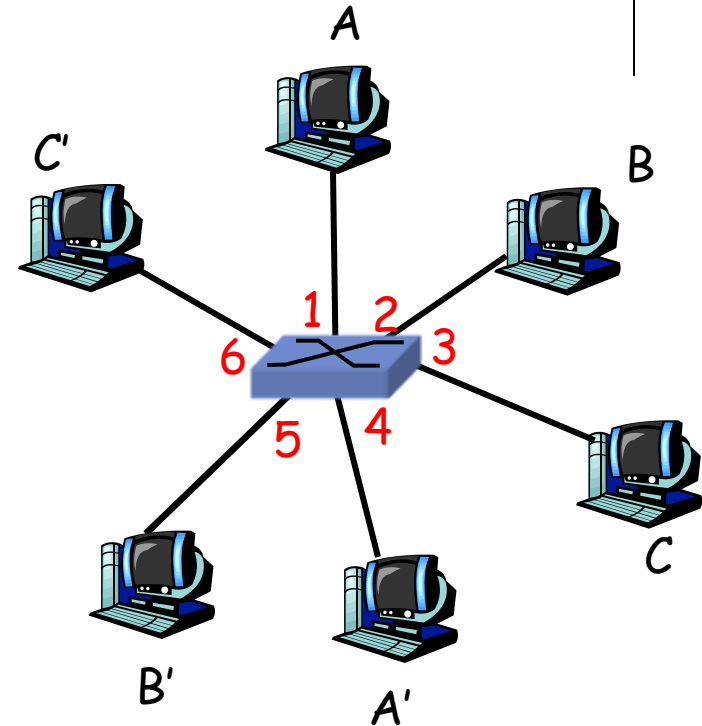


- link-layer device: smarter than hubs, take *active role*
 - store, forward Ethernet frames
 - examine incoming frame's MAC address, *selectively* forward frame to one-or-more outgoing links when frame is to be forwarded on segment, uses CSMA/CD to access segment
- *transparent*
 - hosts are unaware of presence of switches
- *plug-and-play, self-learning*
 - switches do not need to be configured

Switch: allows *multiple* simultaneous transmissions



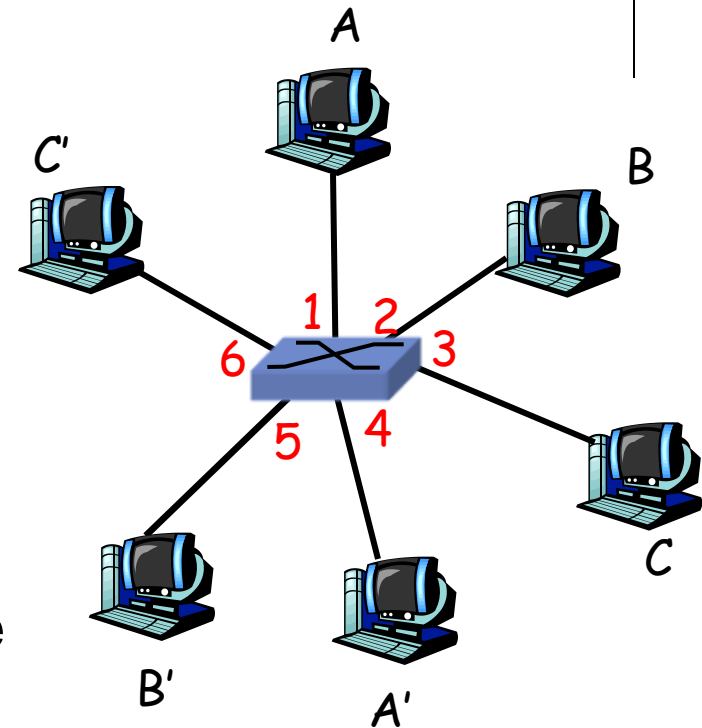
- hosts have dedicated, direct connection to switch
- switches buffer packets
- Ethernet protocol used on *each* incoming link, but no collisions; full duplex
 - each link is its own collision domain
- **switching**: A-to-A' and B-to-B' simultaneously, without collisions
 - not possible with dumb hub



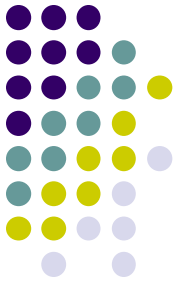
*switch with six interfaces
(1,2,3,4,5,6)*

Switch Table

- Q: how does switch know that A' reachable via interface 4, B' reachable via interface 5?
- A: each switch has a **switch table**, each entry:
 - (MAC address of host, interface to reach host, time stamp)
- looks like a routing table!
- Q: how are entries created, maintained in switch table?
 - something like a routing protocol?

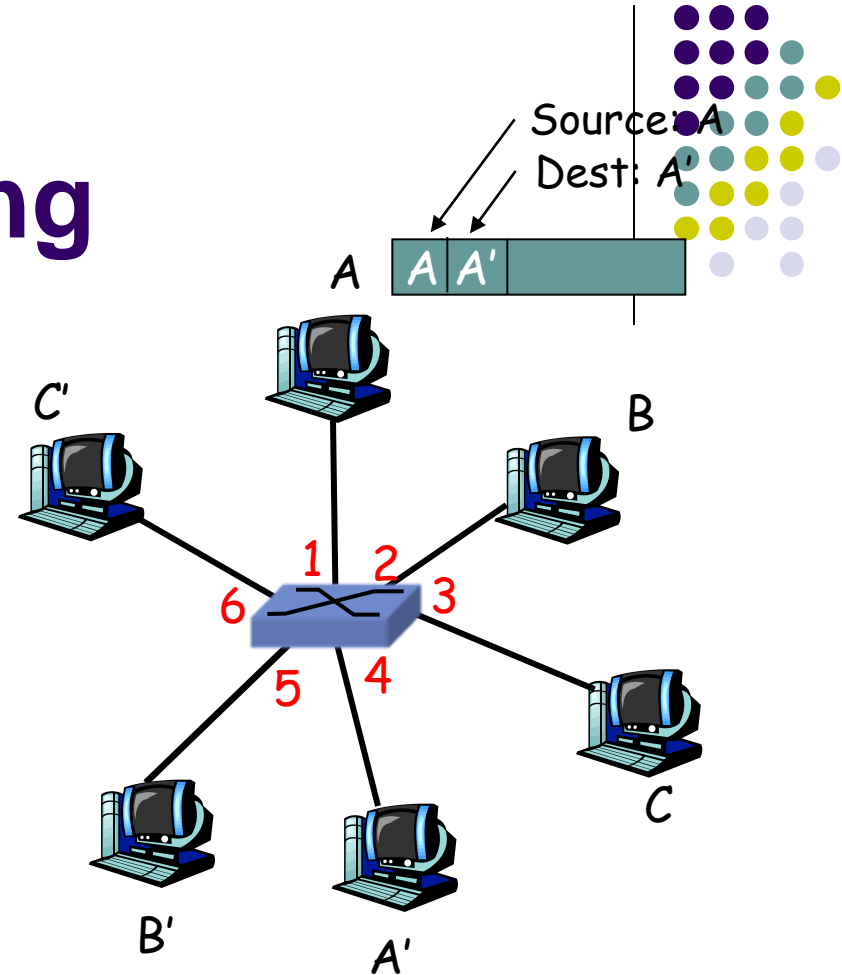


*switch with six interfaces
(1,2,3,4,5,6)*



Switch: self-learning

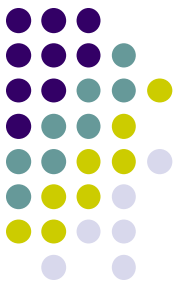
- switch *learns* which hosts can be reached through which interfaces
 - when frame received, switch “learns” location of sender: incoming LAN segment
 - records sender/location pair in switch table



MAC addr	interface	TTL
<i>A</i>	<i>1</i>	<i>60</i>

*Switch table
(initially empty)*

Switch: frame filtering/forwarding



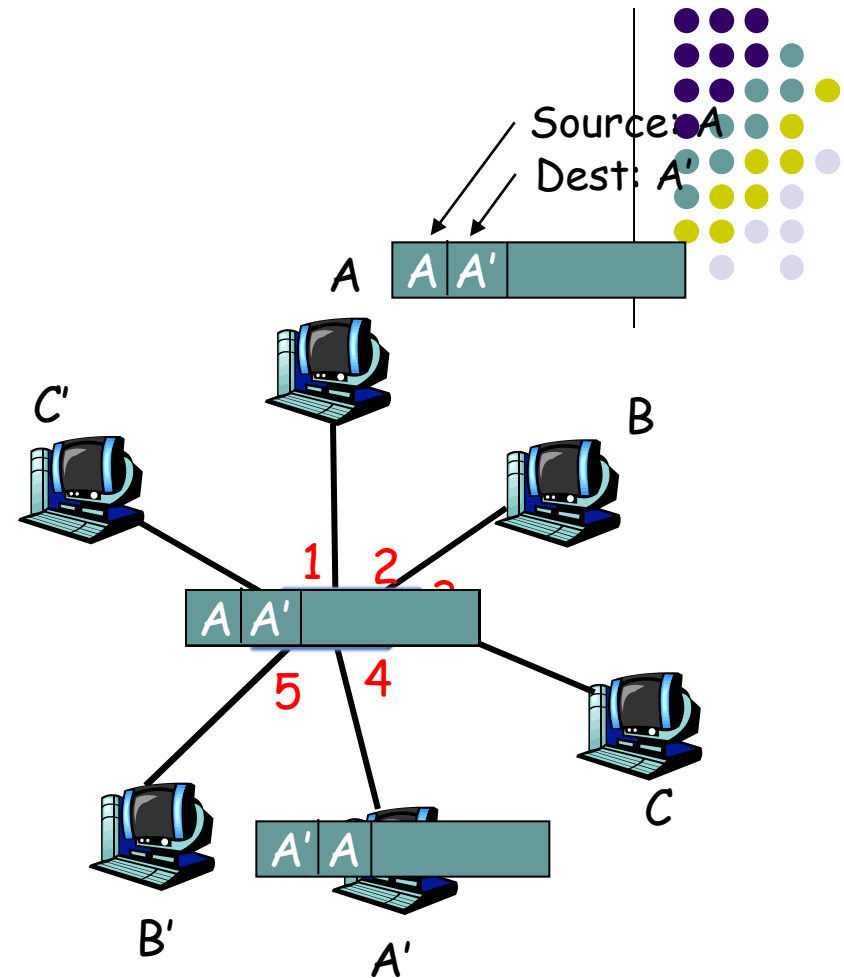
When frame received:

1. record link associated with sending host
2. index switch table using MAC dest address
3. **if** entry found for destination
 then {
 if dest on segment from which frame arrived
 then drop the frame
 else forward the frame on interface indicated
 }
 else flood

*forward on all but the interface
on which the frame arrived*

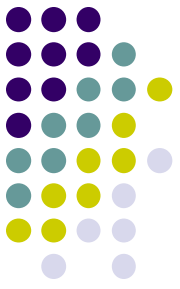
Self-learning, forwarding: example

- frame destination unknown: *flood*
- destination A location known: *selective send*



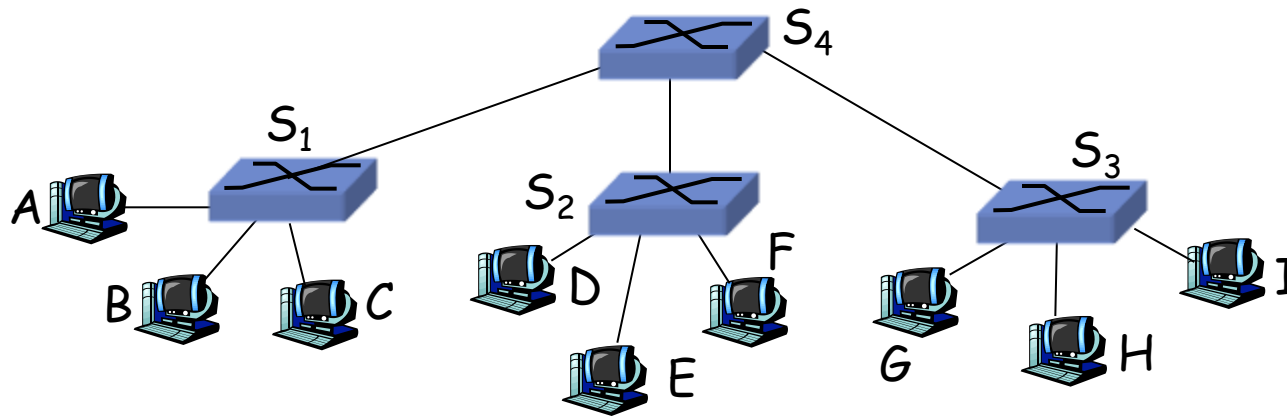
MAC addr	interface	TTL
A	1	60
A'	4	60

*Switch table
(initially empty)*



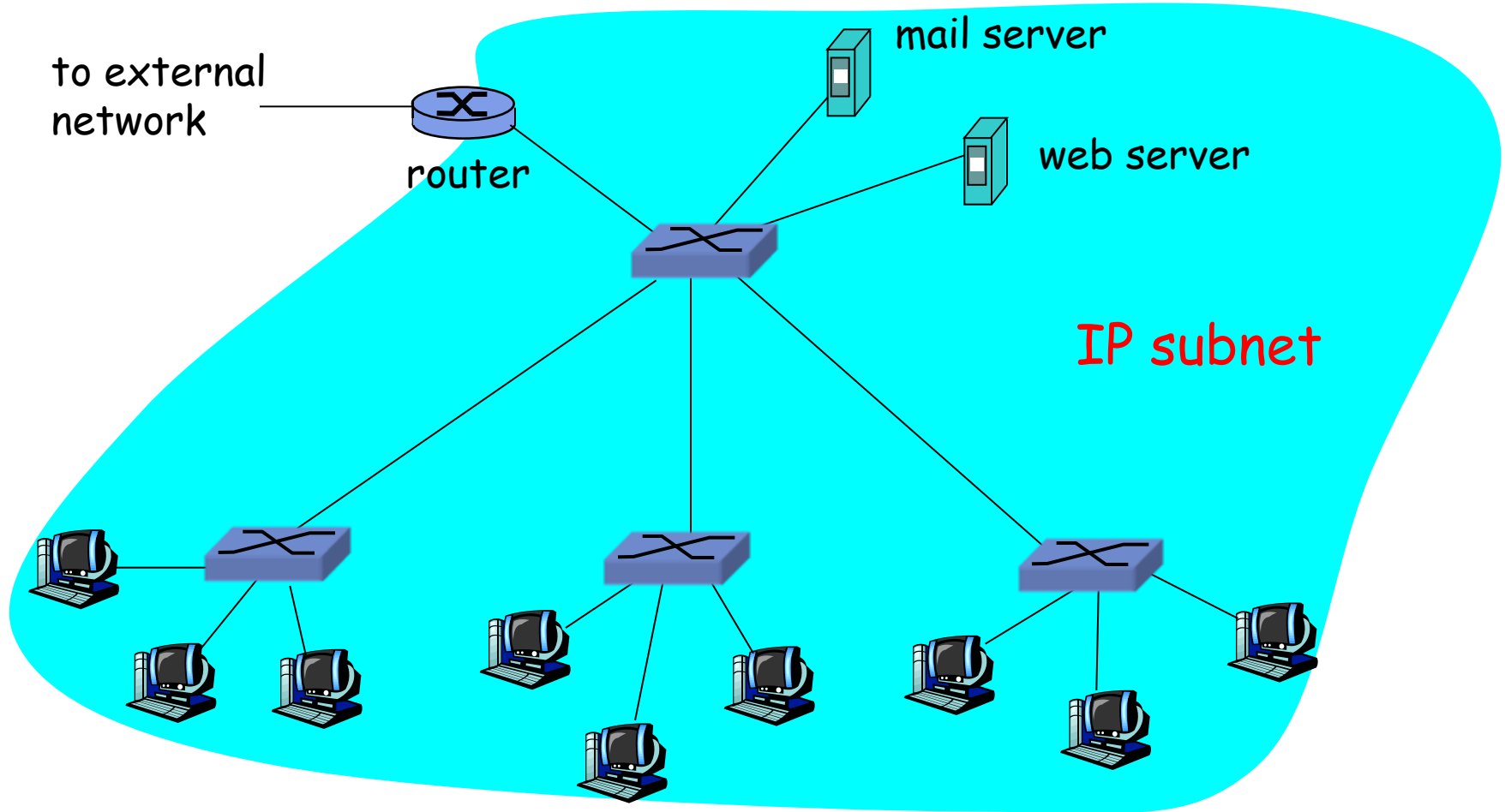
Interconnecting switches

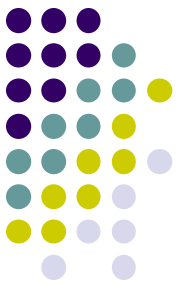
- switches can be connected together



- Q: sending from A to G - how does S₁ know to forward frame destined to F via S₄ and S₃?
- A: self learning! (works exactly the same as in single-switch case!)

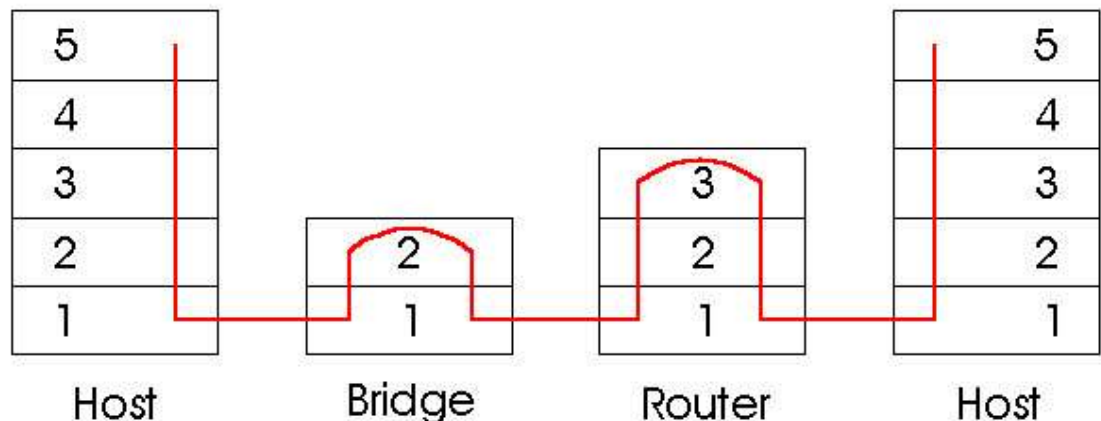
Institutional network





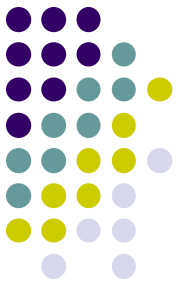
Switches vs. Routers

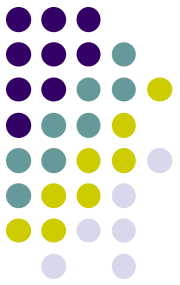
- both store-and-forward devices
 - routers: network layer devices (examine network layer headers)
 - switches are link layer devices
- routers maintain routing tables, implement routing algorithms
- switches maintain switch tables, implement filtering, learning algorithms



Purpose of lecture

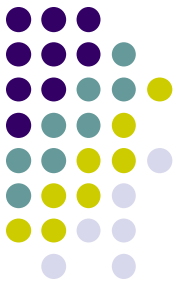
- Data Link Layer
 - Link-layer devices
 - **Course summary**





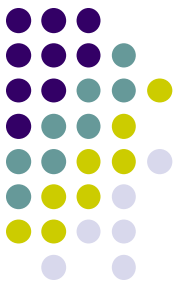
What we've covered

- Overview of networking
- **Applications** and the application layer (web, email, file sharing, video)
- **Transport layer** (Reliable transfer, FSM, flow control, shortcomings)
- **Network layer** (Routing, forwarding, hierarchies)
- **Link layer** (Multiple access, Ethernet LANs, switches)



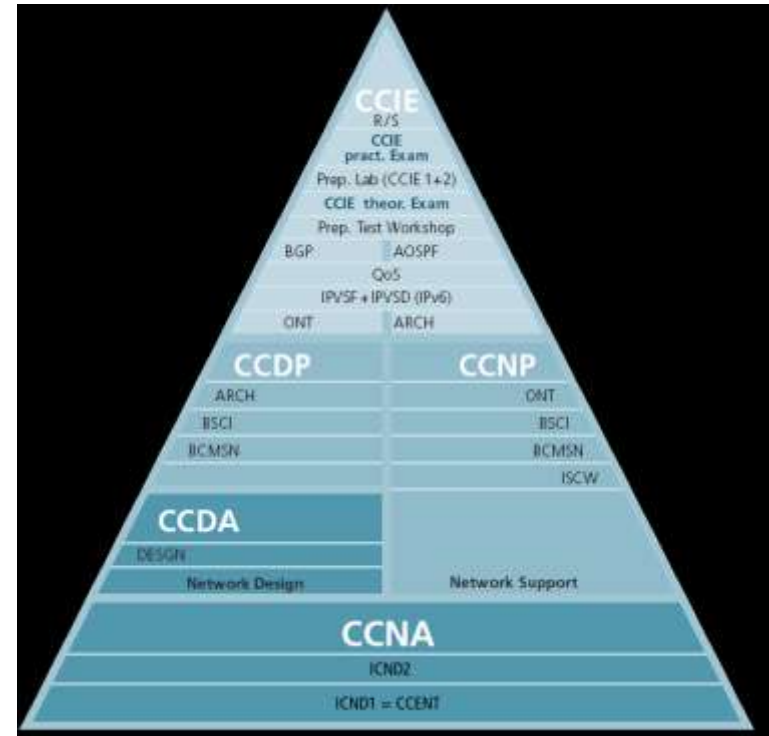
What remains

- Wireless communications:
 - Wifi, GSM, GPRS, 3G, Wimax
- Multimedia networking
 - Improving internet behaviour to provide quality guarantees
- Security – SSL, TLS, certificates, ...



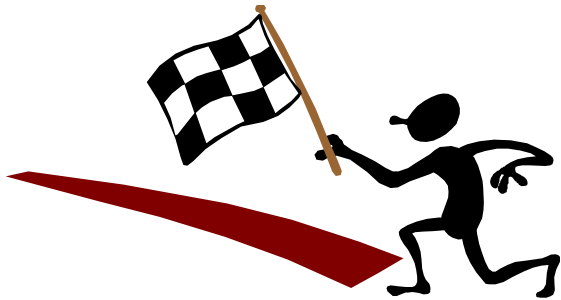
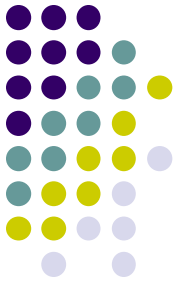
A career in networking

- Certifications in IT / Communications industry.
- Specialist roles – Cisco / Nortel.
- Networking underpins most IT systems today, so the knowledge is very useful for an Information Engineer



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That's all folks



Thanks

