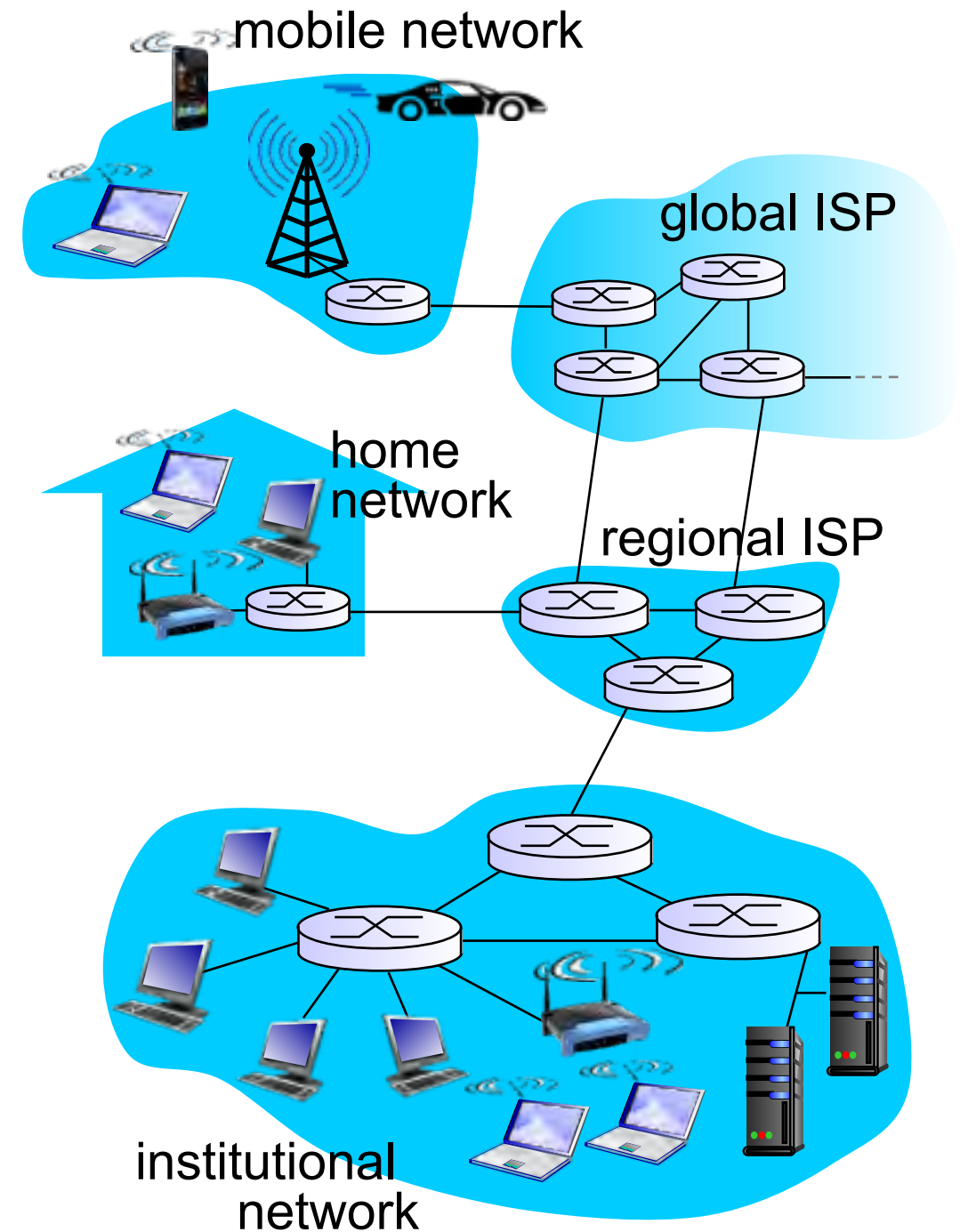


Network Overview

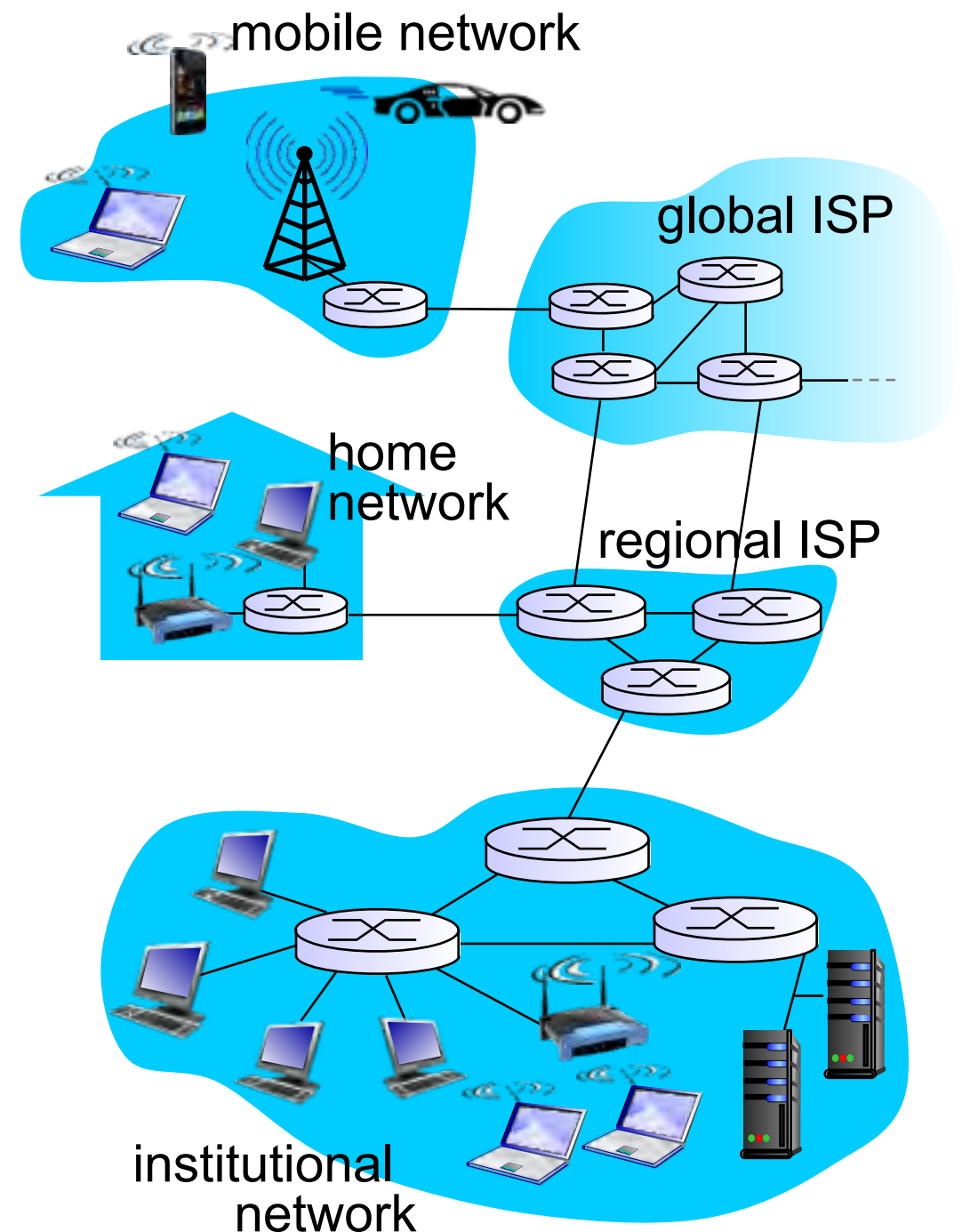
What's the Internet: “nuts and bolts” view

- Internet: “network of networks”
 - Interconnected ISPs
- protocols control sending, receiving of msgs
 - e.g., TCP, IP, HTTP, Skype, 802.11
- Internet standards
 - RFC: Request for comments
 - IETF: Internet Engineering Task Force



What's the Internet: a service view

- Infrastructure that provides services to applications:
 - Web, VoIP, email, games, e-commerce, social nets, ...
- provides programming interface to apps
 - hooks that allow sending and receiving app programs to “connect” to Internet
- provides service options, analogous to postal service

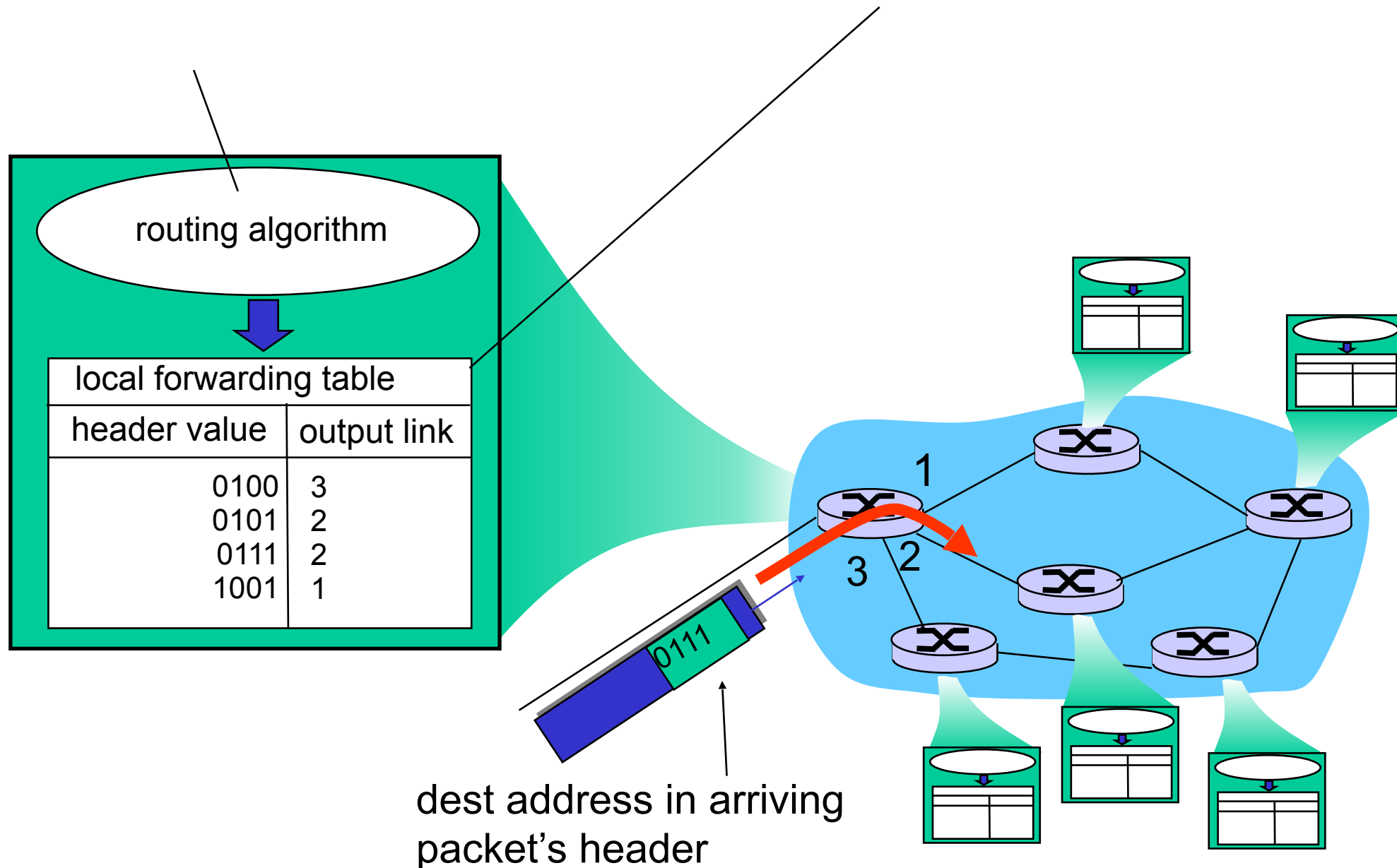


Two key network-core functions

routing: determines source-destination route taken by packets

- *routing algorithms*

forwarding: move packets from router's input to appropriate router output



Protocol “layers”

*Networks are complex,
with many “pieces”:*

- hosts
- routers
- links of various media
- applications
- protocols
- hardware, software

Question: _

is there any hope of *organizing*
structure of network?

.... or at least our discussion of
networks?



Why layering?

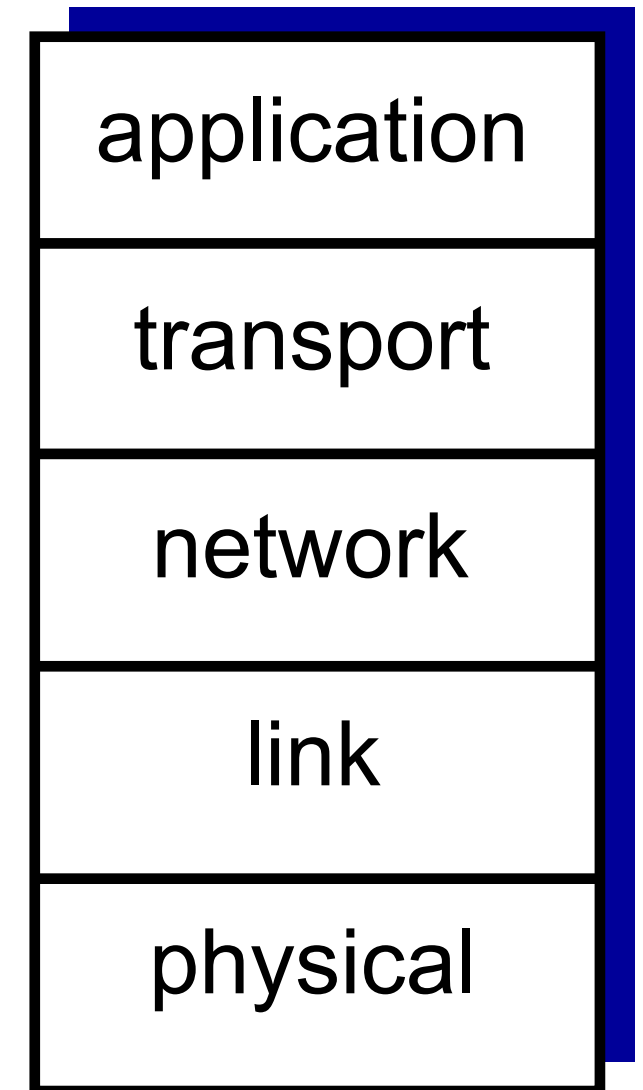
dealing with complex systems:

- ❖ explicit structure allows identification, relationship of complex system's pieces
 - layered *reference model* for discussion
- ❖ modularization eases maintenance, updating of system
 - change of implementation of layer's service transparent to rest of system
 - e.g., change in gate procedure doesn't affect rest of system

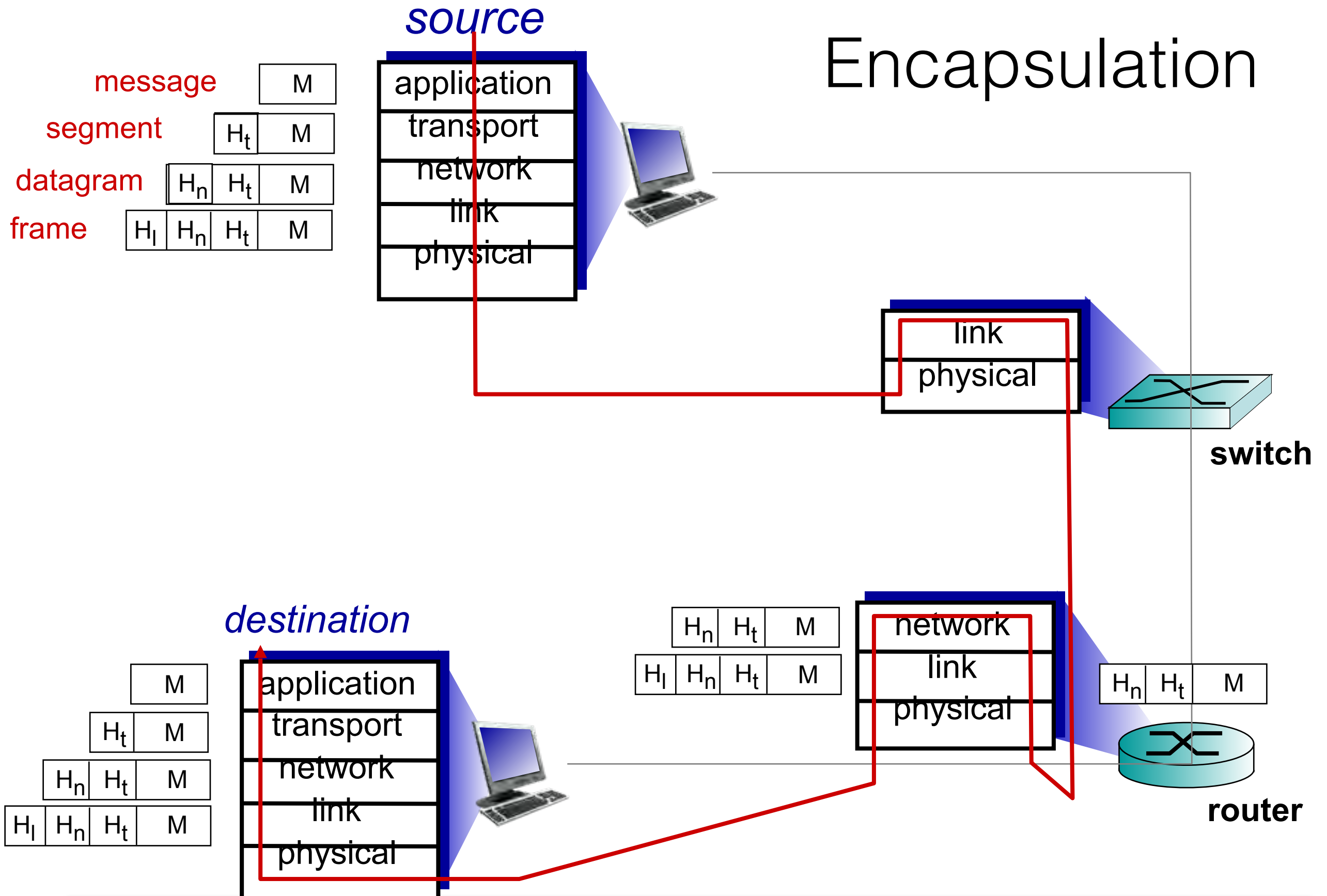


Internet protocol stack

- ❖ *application*: supporting network applications
 - FTP, SMTP, HTTP
- ❖ *transport*: process-process data transfer
 - TCP, UDP
- ❖ *network*: routing of datagrams from source to destination
 - IP, routing protocols
- ❖ *link*: data transfer between neighboring network elements
 - Ethernet, 802.111 (WiFi), PPP
- ❖ *physical*: bits “on the wire”

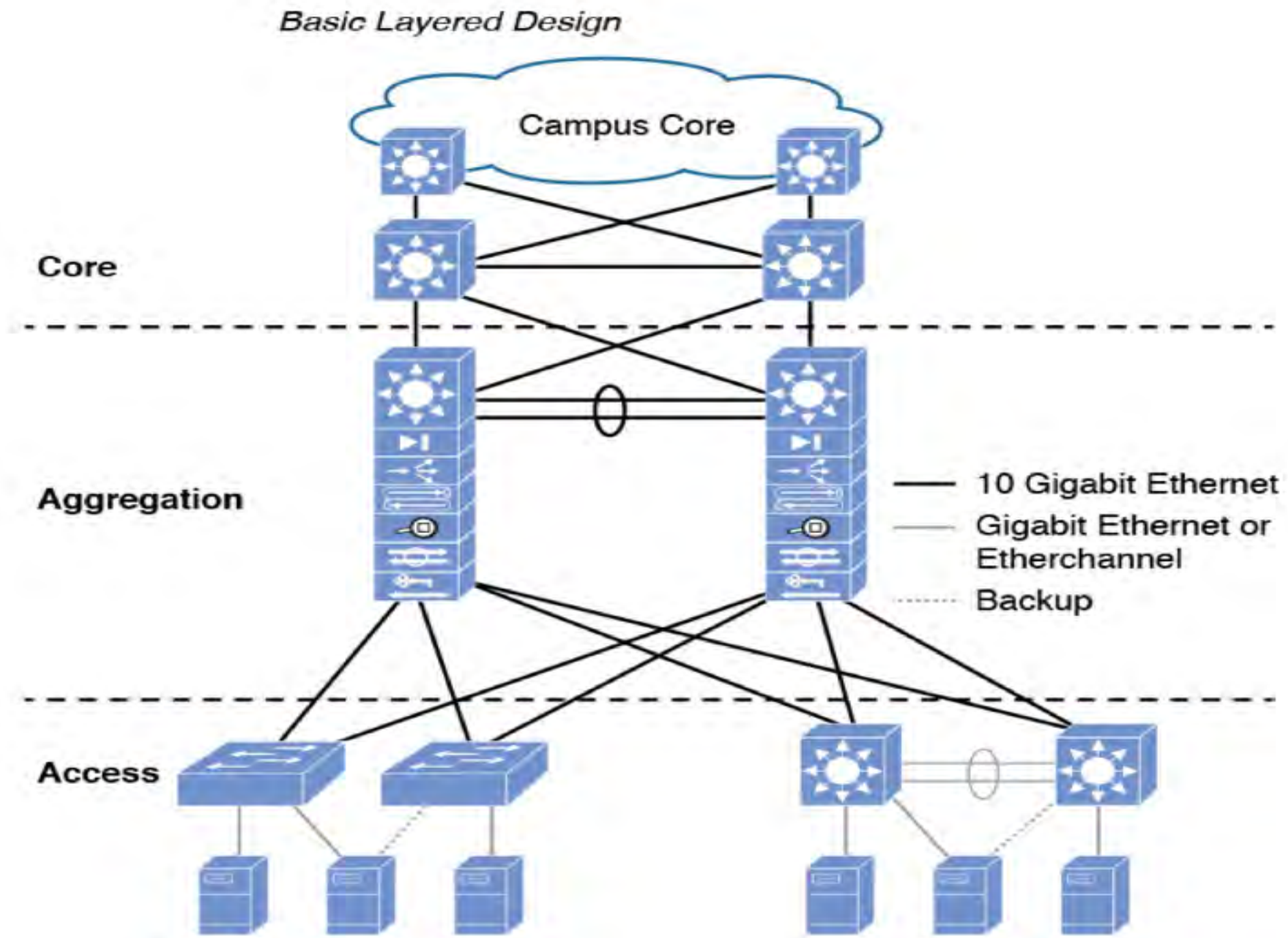


Encapsulation



Network Virtualization

Traditional Data Centers



Addressing

- The key to all of this is the addressing scheme.
- The Layer 3 or IP address is used to get the packet across the wide-area network to the right data center
- Layer 2 address tells all the switches in the data center which server the traffic should be sent to.
- In the preceding scenario, the following was true:
 - The application was associated with a single server,
 - and all the application-based addressing and programming of the network was based on where that physical server was located,
- Server were dependent on a layer 3 routing subnet (location dependent)
 - Server's IP address will route to the correct data center's access switch



Addressing with Virtual Machines

- First is that VMs do not roll off a factory line.
 - They get created
- VM machines move a lot
 - As a result, we have some new problems to solve.
 - First, who or what creates MAC addresses, and
 - Second, how do we account for all this moving around because the rest of the network has to know where to send traffic



Addressing with Virtual Machines

- VM software such as VMSphere or Citrix provides
 - Unique MAC address for each VM created.
 - These VM managers also assign a virtual NIC (vNIC) or multiple vNICs
 - NIC is a specific piece of equipment within a device that uses the MAC address.
- Most of these VM managers also enable you to manually configure the MAC
 - By assigning each individual VM its own MAC
 - You can address that VM individually on the network
 - VM MAC is independent of the physical server's network card
 - Capable and free to migrate to another server without any restrictions



Network Virtualization

- Similar to server virtualization
- Abstraction of the network endpoints from the physical arrangement of the network.
- Network Virtualization refers to the creation of logical groupings of endpoints on a network.
- Endpoints are abstracted from their physical locations
 - VMs can look, behave, and be managed as if they are all on the same physical segment of the network.



Network Virtualization

- Not new
 - VLAN, VPN, MPLS
 - Group physically separate endpoints into logical groups.
 - Enhances efficiencies in traffic control, security, and network management.
- Network is virtualized to get VM mobility
- What is new here:
 - Automation and management tools that have been purposely built for the scale and elasticity of virtualized data centers and clouds.

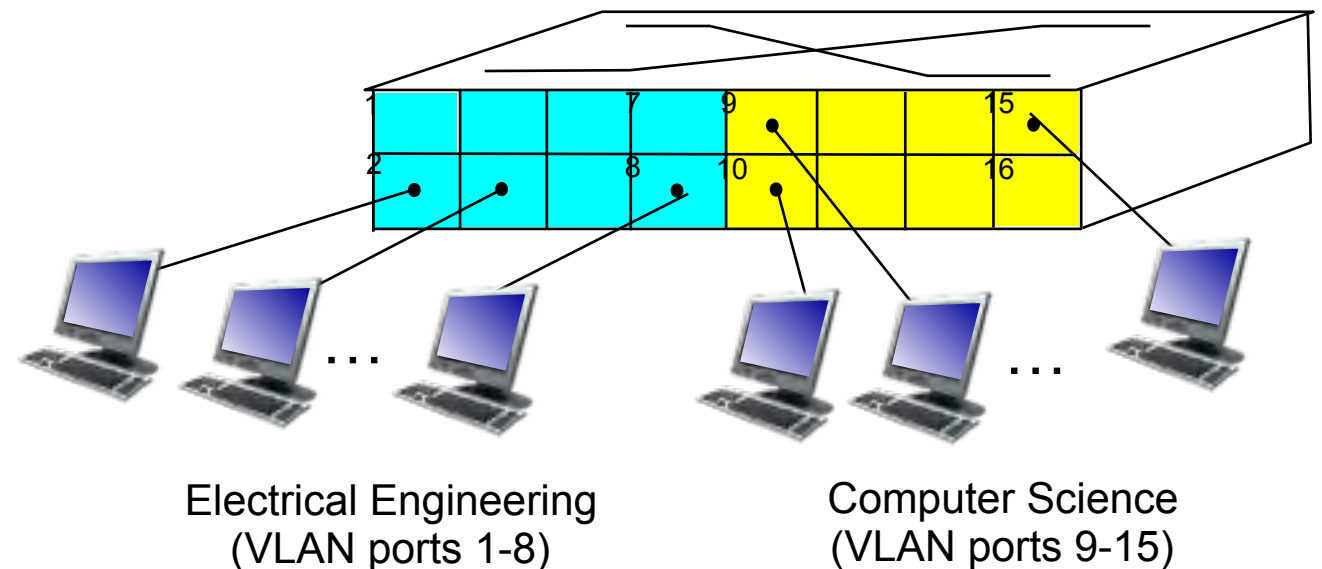


VLANs

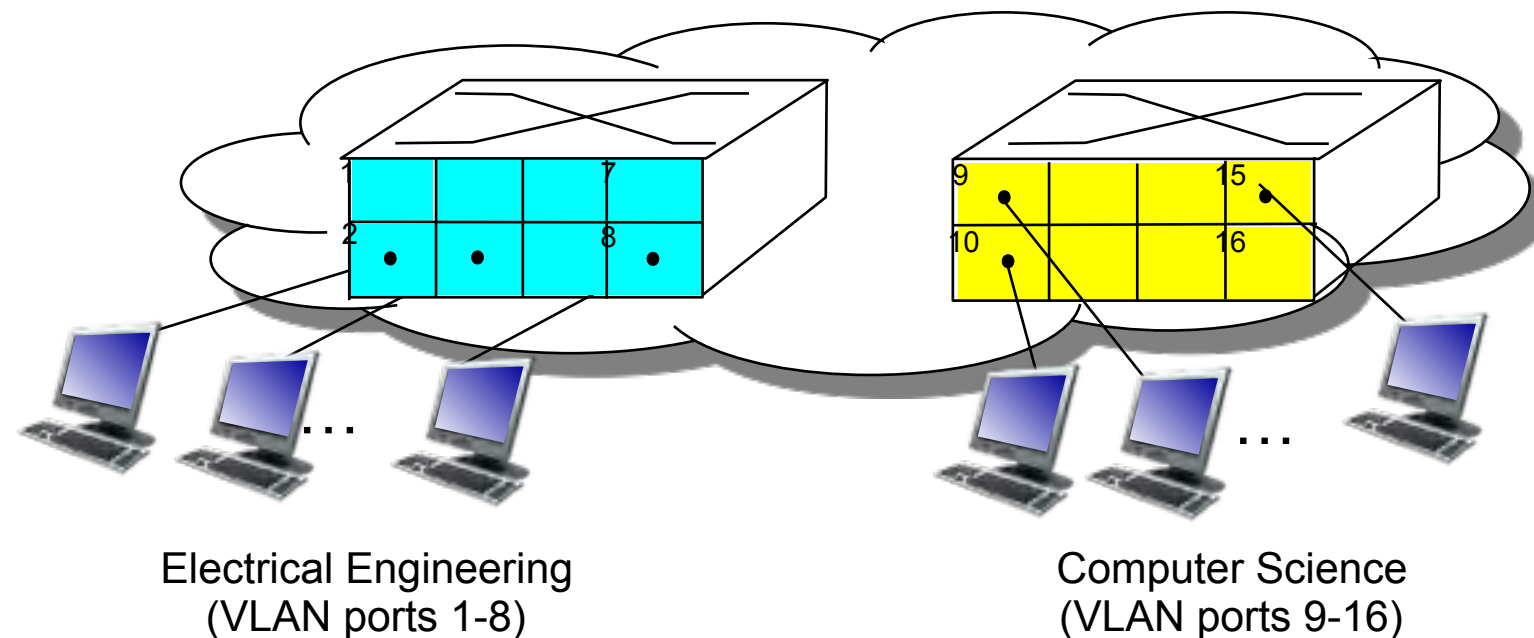
Virtual Local Area Network

switch(es) supporting VLAN capabilities can be configured to define multiple virtual LANS over single physical LAN infrastructure.

port-based VLAN: switch ports grouped (by switch management software) so that single physical switch

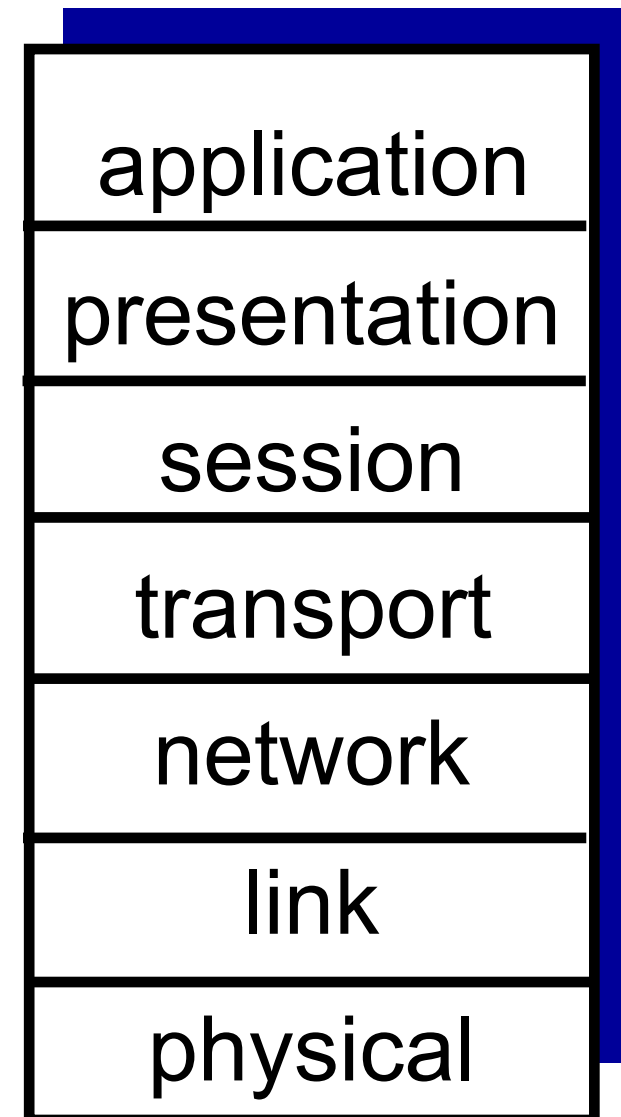


... operates as multiple virtual switches



Network Functional Virtualization (NFV)

- NFV refers to the virtualization of Layer 4 through 7 services
- Basically, this is converting certain types of network appliances into VMs,
 - which can then be quickly and easily deployed where they are needed.
- NFV came about because of the inefficiencies that were created by virtualization.
- Virtualization causes a lot of problems, too.
 - One of them was the routing of traffic to and from network appliances
 - With VMs springing up and being moved all over, the traffic flows became highly varied
 - Cause problems for fixed appliances that had to serve the traffic.
- NFV allows to create a virtual instance of network function (Firewall, Load Bal)
- Can be easily “spun up” and placed where it is needed, just as they would a VM.



Virtualizing the network

- Network virtualization allows users to fully realize server virtualization features:
 - vMotion, snapshot backups, and push button disaster recovery (to name just a few).
 - The most common reason for virtualizing the network is precisely to get VM mobility



Summary

- Good old technique that has been around for many years
 - Makes server virtualization, and connecting VMs, easier and efficient.
 - It's easy to see why when you imagine the VMs being spun up here, there, and everywhere in a virtualized data center or cloud and
 - then being paused, moved, started again, or even being moved while still being active.
- With all that spontaneous creation without any regard for the specific physical location in the data center
 - or even with regard to a specific data center
 - having the ability to create and manage logical groupings becomes critical.

