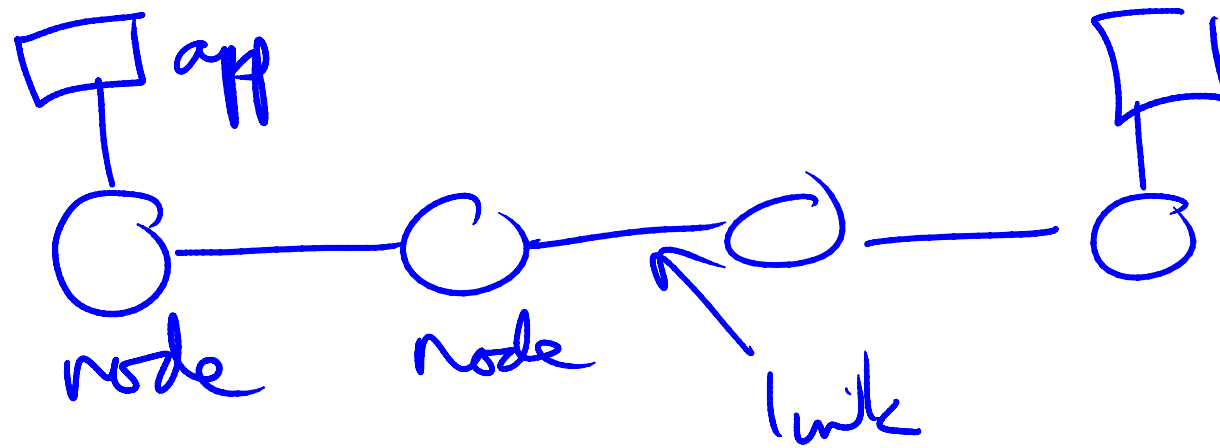# Computer Networks

Network Components (§1.2)

David Wetherall (djw@uw.edu)
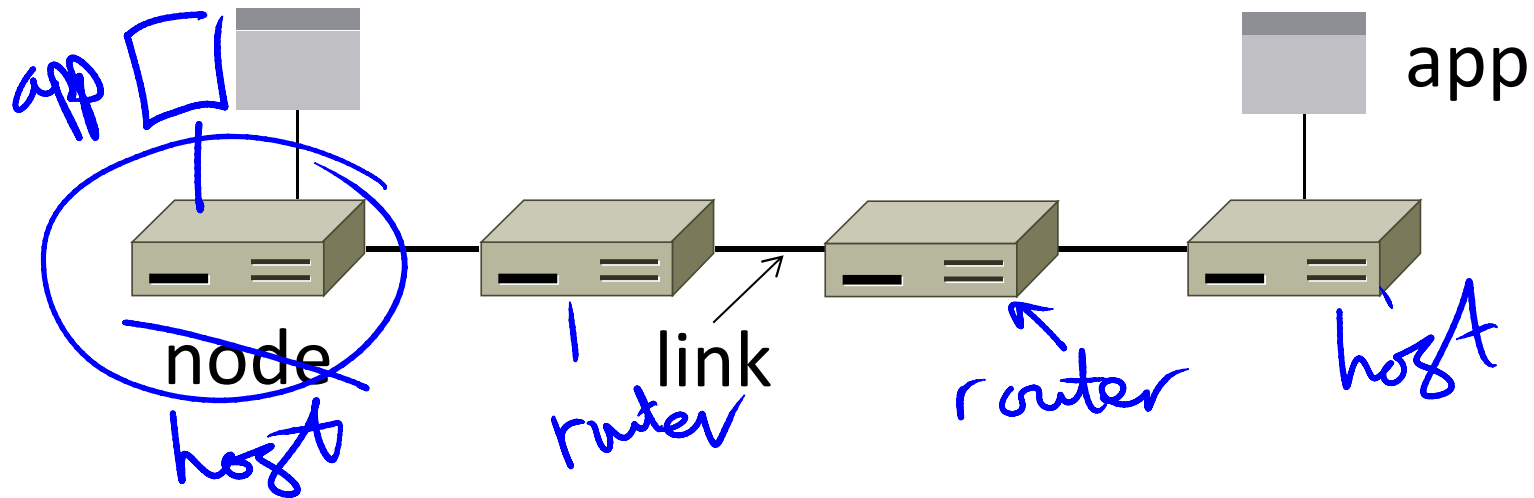Professor of Computer Science & Engineering

UNIVERSITY *of* WASHINGTON
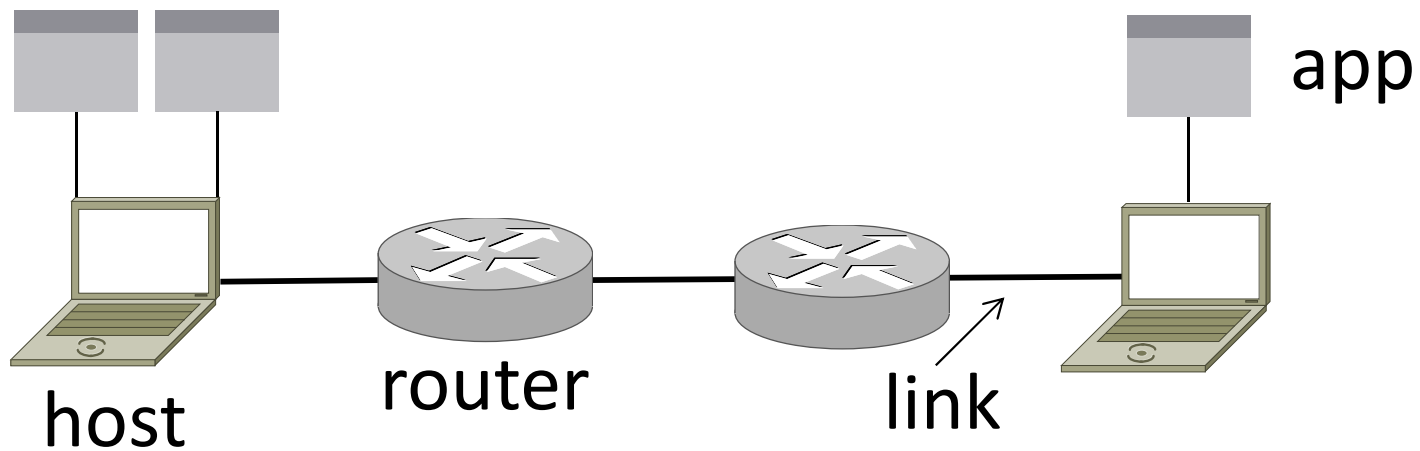
Parts of a Network

app

node

node

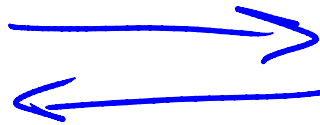link

Parts of a Network (2)

app

node   link   host

app

router   router

Parts of a Network (3)

app

router

host

link

Component Names

| Component	Function	Example
Application, or app, user	Uses the network	Skype, iTunes, Amazon
Host, or end-system, edge device, node, source, sink	Supports apps	Laptop, mobile, desktop
Router, or switch, node, hub, intermediate system	Relays messages between links	Access point, cable/DSL modem
Link, or channel	Connects nodes	Wires, wireless

Types of Links

- ## Full-duplex
  - Bidirectional

- ## Half-duplex
  - Bidirectional

- ## Simplex
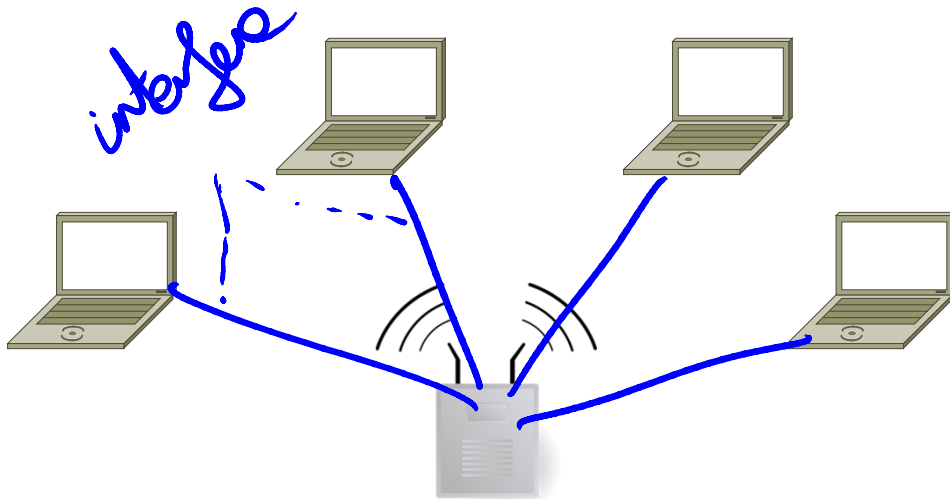 - unidirectional

Wireless Links

- Message is <u>broadcast</u>
  - Received by all nodes in range
  - Not a good fit with our model
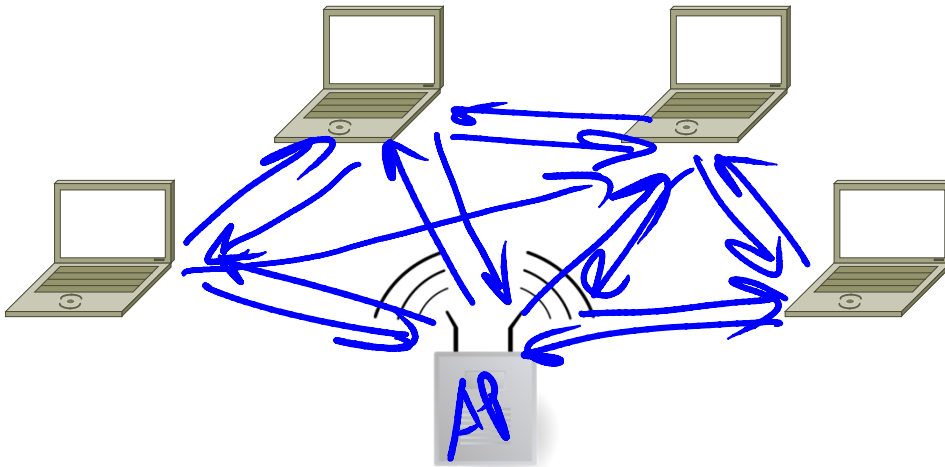
Wireless Links (2)

- Often show logical links
  - Not all possible connectivity

A Small Network
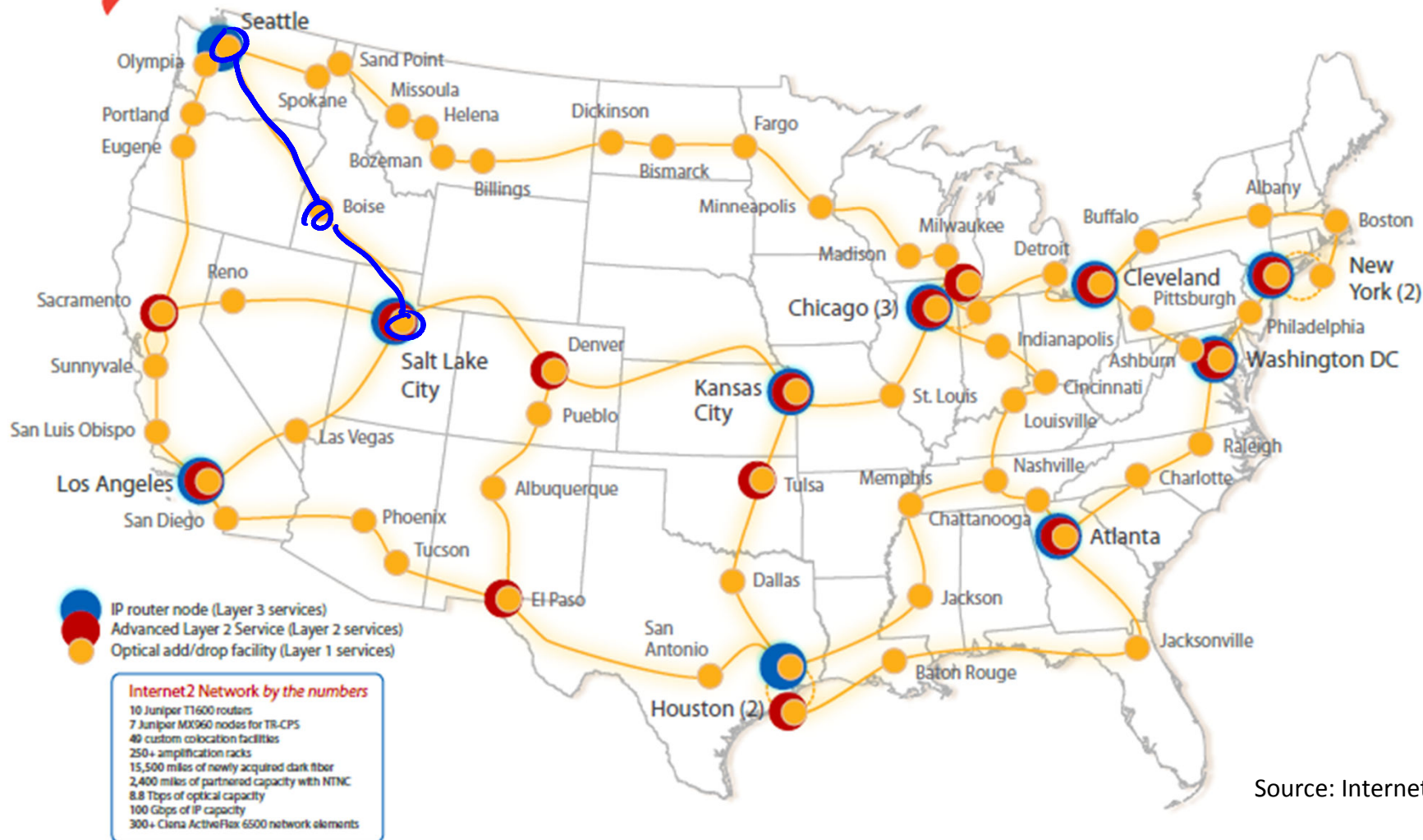
- Connect a couple of computers

- Next, a large network …

Internet2 Network Infrastructure Topology

October 2012

INTERNET 2®

IP router node (Layer 3 services)
Advanced Layer 2 Service (Layer 2 services)
Optical add/drop facility (Layer 1 services)

Internet2 Network *by the numbers*
10 Juniper T1600 routers
7 Juniper MX960 nodes for TR-CPS
40 custom colocation facilities
250+ amplification racks
15,500 miles of newly acquired dark fiber
2,400 miles of partnered capacity with NTNC
8.8 Tbps of optical capacity
100 Gbps of IP capacity
300+ Ciena ActiveFlex 6500 network elements

IN SUPPORT OF
U.S.UCAN

NETWORK PARTNERS
ciena
cisco.
INDIANA UNIVERSITY
infinera
juniper

Source: Internet2

Example Networks

- Commonly known by type of technology or their purpose

- [see how many you can give]

Example Networks (2)

- WiFi (802.11)
- Enterprise / Ethernet
- ISP (Internet Service Provider)
- Cable / DSL
- Mobile phone / cellular (2G, 3G, 4G)
- Bluetooth
- Telephone
- Satellite ...

Network names by scale

Scale	Type	Example
Vicinity	<u>PAN</u> (Personal Area Network)	Bluetooth (e.g., headset)
Building	<u>LAN</u> (Local Area Network)	WiFi, Ethernet
City	<u>MAN</u> (Metropolitan Area Network)	Cable, DSL
Country	<u>WAN</u> (Wide Area Network)	Large ISP
Planet	The <u>Internet</u> (network of all networks)	The Internet!

Internetworks

- An <u>internetwork</u>, or <u>internet</u>, is what you get when you join networks together
  - Just another network

- The <u>Internet</u> (capital "I") is the internet we all use
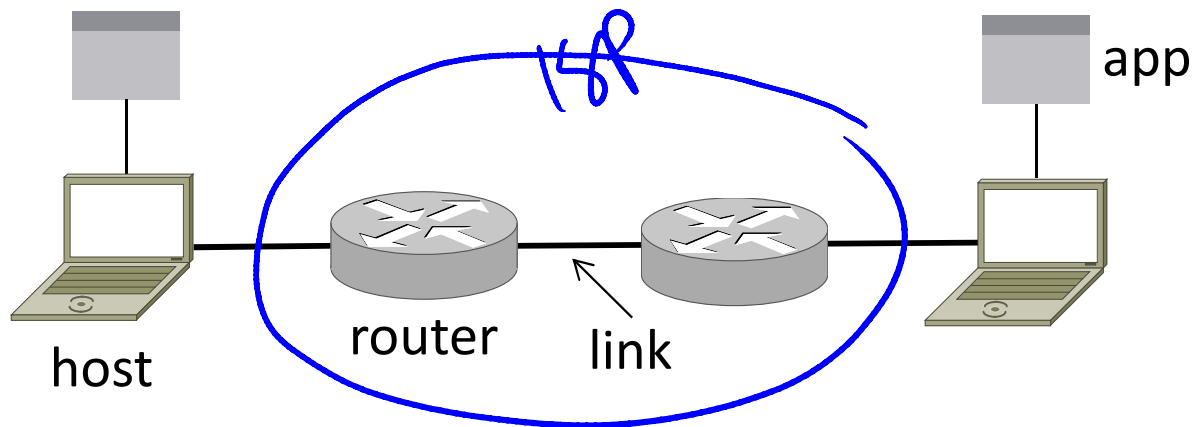
Network Boundaries

- What part is the "network"?
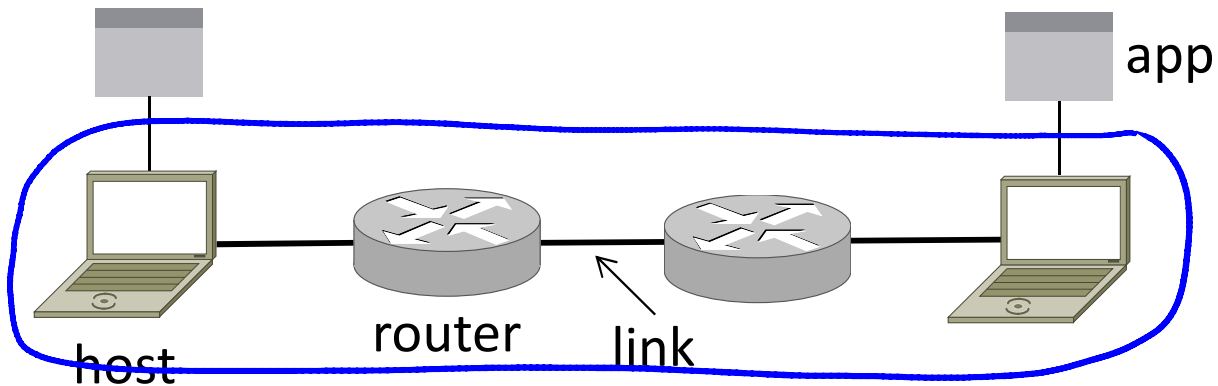
Network Boundaries (2)

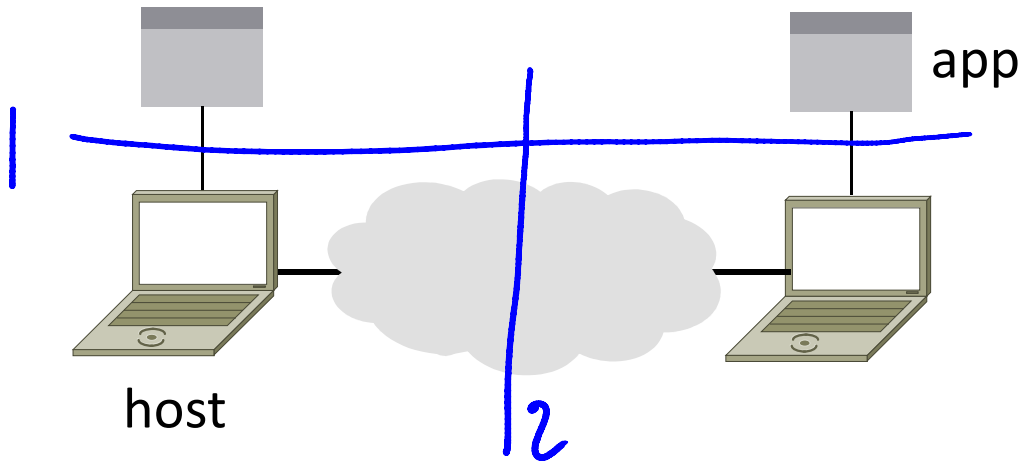- What part represents an "ISP"?

Network Boundaries (3)
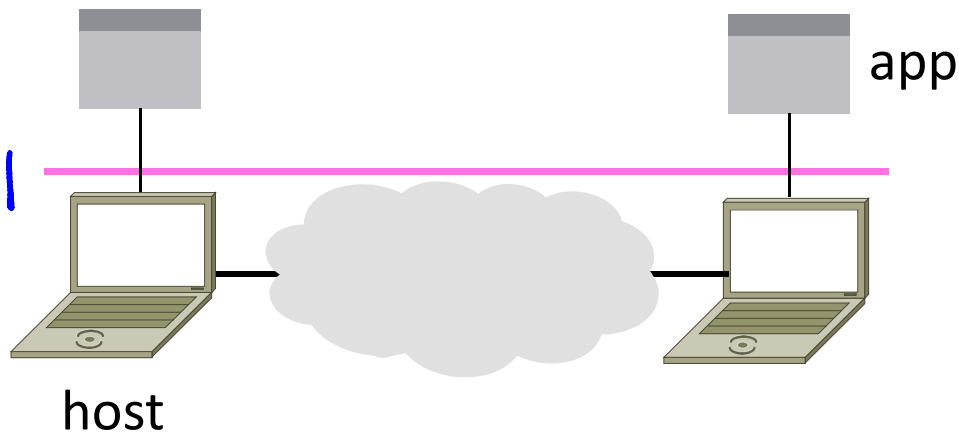
- Cloud as a generic network

Key Interfaces

- Between (1) apps and network, and (2) network components
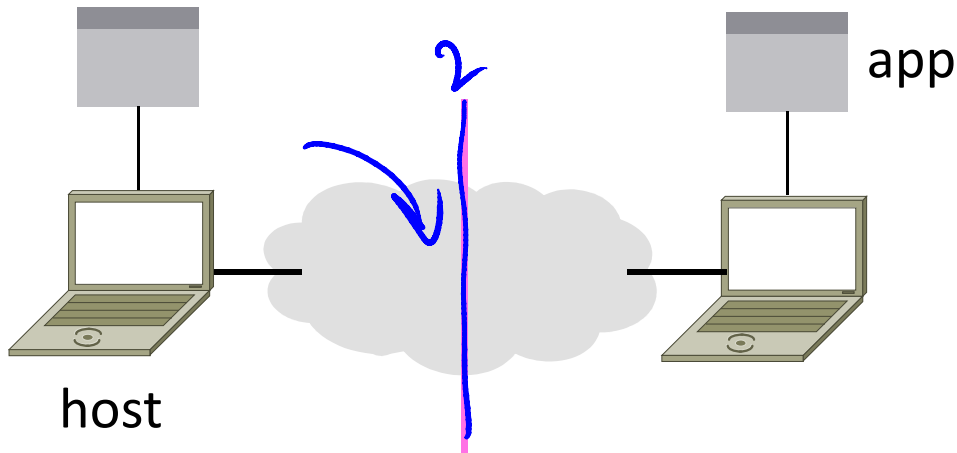 - More formal treatment later on

app

host

Key Interfaces (2)

1. Network-application interfaces define how apps use the network
   - Sockets are widely used in practice

Key Interfaces (3)

2. Network-network interfaces
   define how nodes work together

   – <u>Traceroute</u> can peek in the network

host

app

END

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