Wireless as seen by the Internet

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Internet Protocol Requirements from Link Protocols

Wireless links are not the same as wired links

- Mobility is a significant new phenomenon
- Dropped packets do not indicate congestion
- Session bandwidth highly variable

Network Stacks vs. Wireless

Application Layer

Resource Discovery
- File Servers
- Print Servers

New Applications
Multimedia
Profile Mgmt
Link Adaptation

Transport Layer

Congestion control
Flow control
Quality of Service

Network Layer

Addressing
Routing
Location Management
Handoff
Authentication

Physical / Link Layer

Signal Modulation
Encryption / Compression
Interference
Fading Effects
Power Control
Channel Access – FDMA, TDMA, CDMA

Physical Medium Requirements

- Compatible spectrum allocation
- Compatible modulation scheme

Bandwidth Requirements

9600 bits per second is *not* enough

- The *World Wide Web* is what people want
- Web pages are designed for access by dial-up users
- 28.8 Kbps at least, 56 Kbps would be good

Web is driving E-commerce. That alone should be enough motivation.

Establishing Connectivity

Should allow for easy mobility, small cells, rapid handoff

- Local Broadcast channel for basestation beacon
- Better, to allow a small amount of control data
  - IPv6 Neighbor Discovery
  - Mobile IP
- And, operation between personal mobile units (without basestations?)

Interworking

100ms latency at most

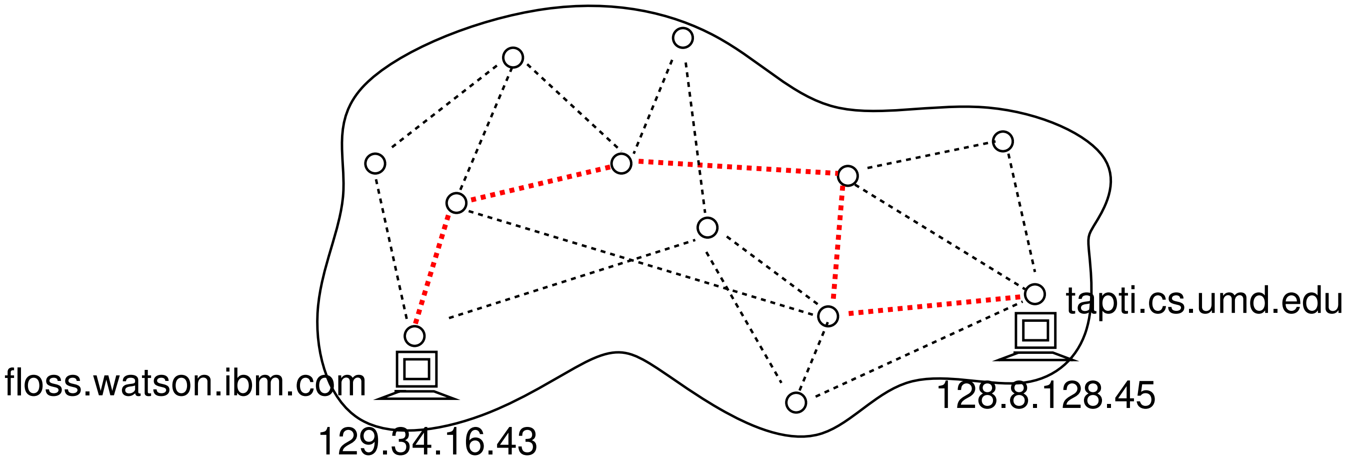
- CDPD is 500ms
- Desirable: direct Internet connection from each cellular provider (roamops WG)

Subnetwork layer should *not* require packet traversal from point of attachment to *home network*.

Mobile units need dynamically assigned IP addresses (dhc WG)

Mobile units need to implement Internet Protocol without need for an "Internet Gateway"

Routing in the Internet

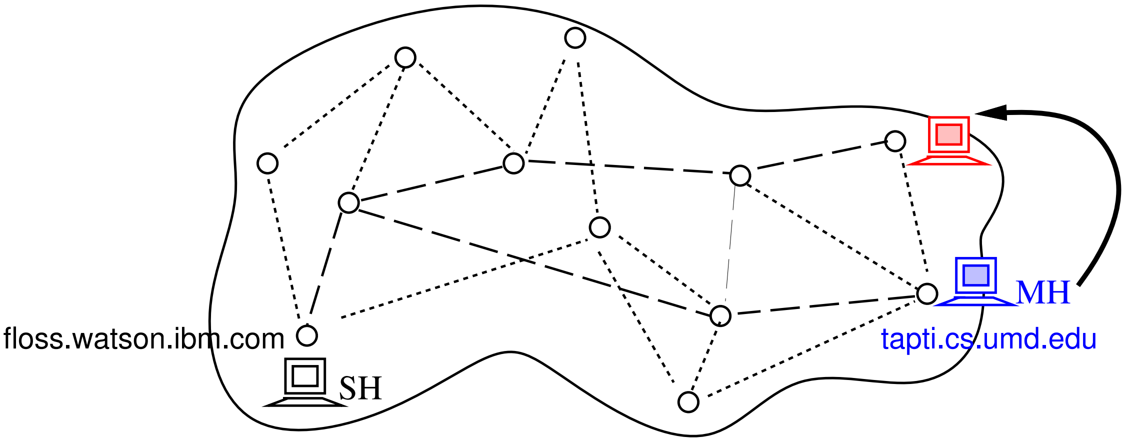


- Datagrams in the Internet flow from one link to another via routers.

- Computers, although usually known by their name as stored in the Domain Name Service (DNS), send and receive datagrams based on their IP (Internet Protocol) addresses.

- Internet routing is dynamic, unpredictable, subject to congestion, and performed on a best-effort basis. IP does not absolutely guarantee that datagrams will be delivered.

Connections between Internet computers



Connection := <129.34.16.43, sh_port #, 128.8.128.45, mh_port #>

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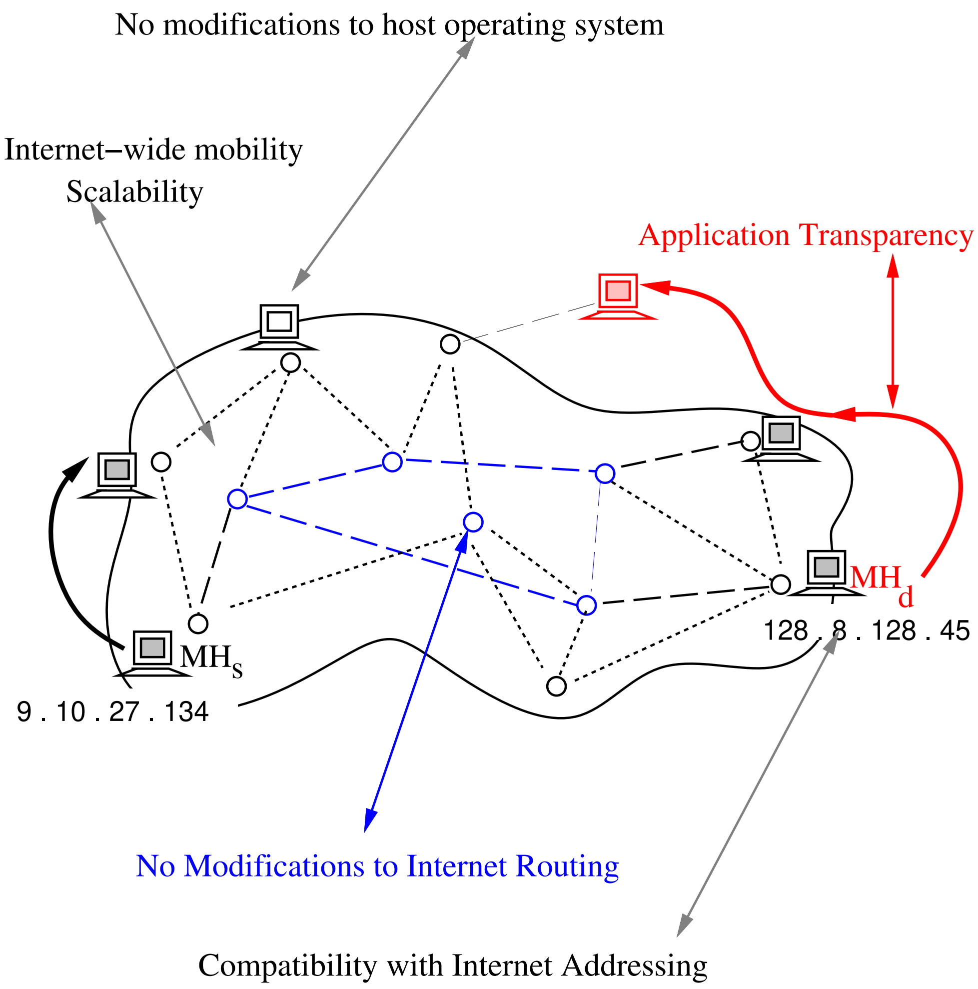
TCP connections are defined by source and destination IP addresses and port numbers.

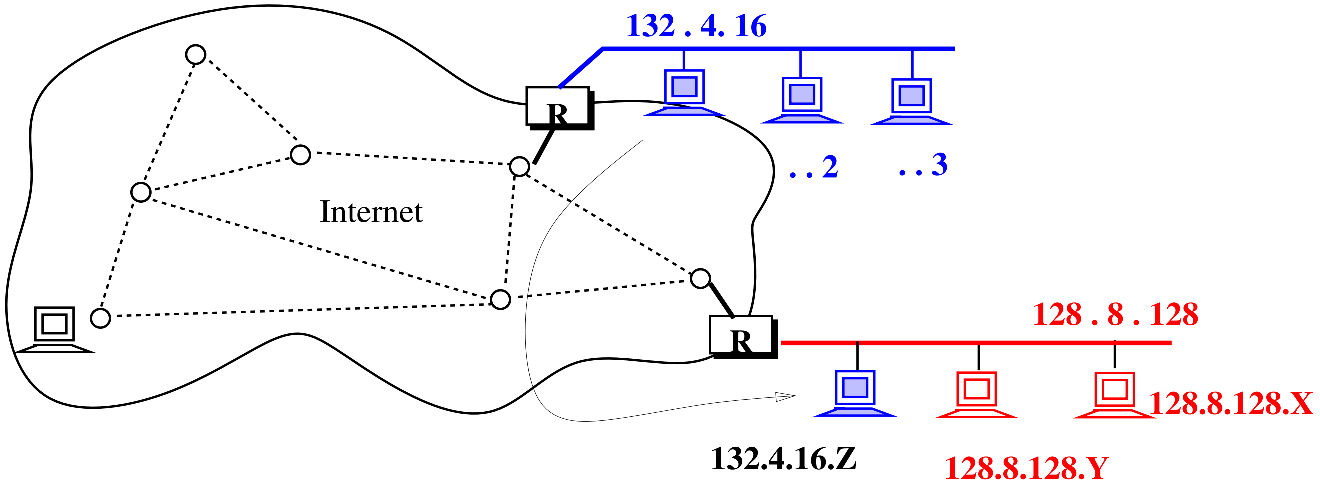
Mobile computers violate the assumption that the IP addresses define the topological relationship of the "connected" computers.

Characteristics of allowable solutions for mobility



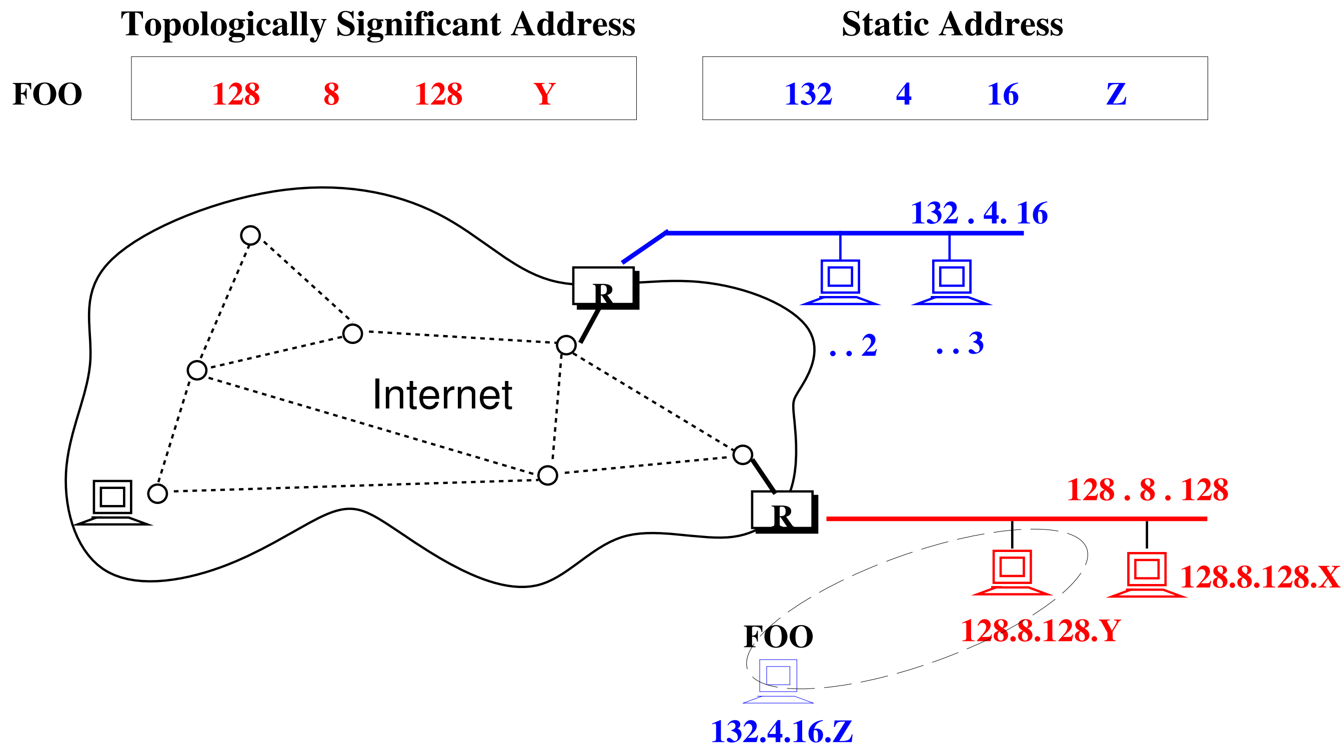
Compatibility (in all respects) with existing Internet computers, applications

IP's subnet model vs. Mobility



Mobile computers move from one IP subnet to another, but have the wrong "subnet prefix" for the destination subnet.

Solution: two-tier IP addressing



- The mobile computer keeps its static IP address, but borrows the service of a "care-of address" on whatever IP subnet it happens to be visiting

- This care-of address, if offered by a mobility agent at the mobile node's new point of attachment, can be used by many visiting mobile nodes

Adaptivity

Applications will need to know link conditions

- Bit-Error Rates
- Available Bandwidth
- Signal Strength
  - for routing subsystems
  - higher-level power control

Selectivity

Higher-level protocols need to control link-layer operation

- Use of compression
- Security parameters
- Proxy identification (e.g., for voice recognition)
- Software radios

Quality of Service

- Multicast
- Bandwidth Reservation
- Integrated Services (per-flow)
- Differentiated Services (aggregated)

Conclusion

Needed: compatible standards for universal connectivity

Needed: more speed

Wireless means mobility and easier portability. Both of them mean higher level protocols need more help.

Greater wireless penetration may require less reliance on central office control of the mobile units, more "best effort" routing, more integration with Internet routing.