Mobile IP
(and why you probably don’t need it)

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Flat vs Hierarchical Addressing

- Flat - address independent of location
  - full node lists in every routing table
    - Ethernet, most other LANs
- Hierarchical - at least part of the address identifies approximate topological location
  - routing tables much more compact
    - IP, postal addresses, telephone numbers
    - actually hierarchies of flat address spaces

Intra-System Mobility

- Both packet and cellular networks provide local mobility with flat addressing
  - Ethernet bridging/switching
  - Intra-system (I.e., city) cellular handoffs
- Works well in small networks, but doesn’t scale

The Routing Table Problem

- To scale, a network needs hierarchical, topologically-based addressing
- This is fine for nodes whose network attachment points don’t change (often)
- But what about nodes that move?

The Mobility Problem

- If a host moves only locally, there may be no problem
  - if the local subnet is flat addressed
- Longer distance moves require global routing updates
  - obviously impractical in a large network even for small numbers of moving hosts

The Generic Solution

- Leave the hierarchical network intact
- Create special entities that “own” the mobile node address
- Mobiles report their locations (*register)* with the stationary entities
- Traffic to the mobile nodes is relayed by the stationary entities

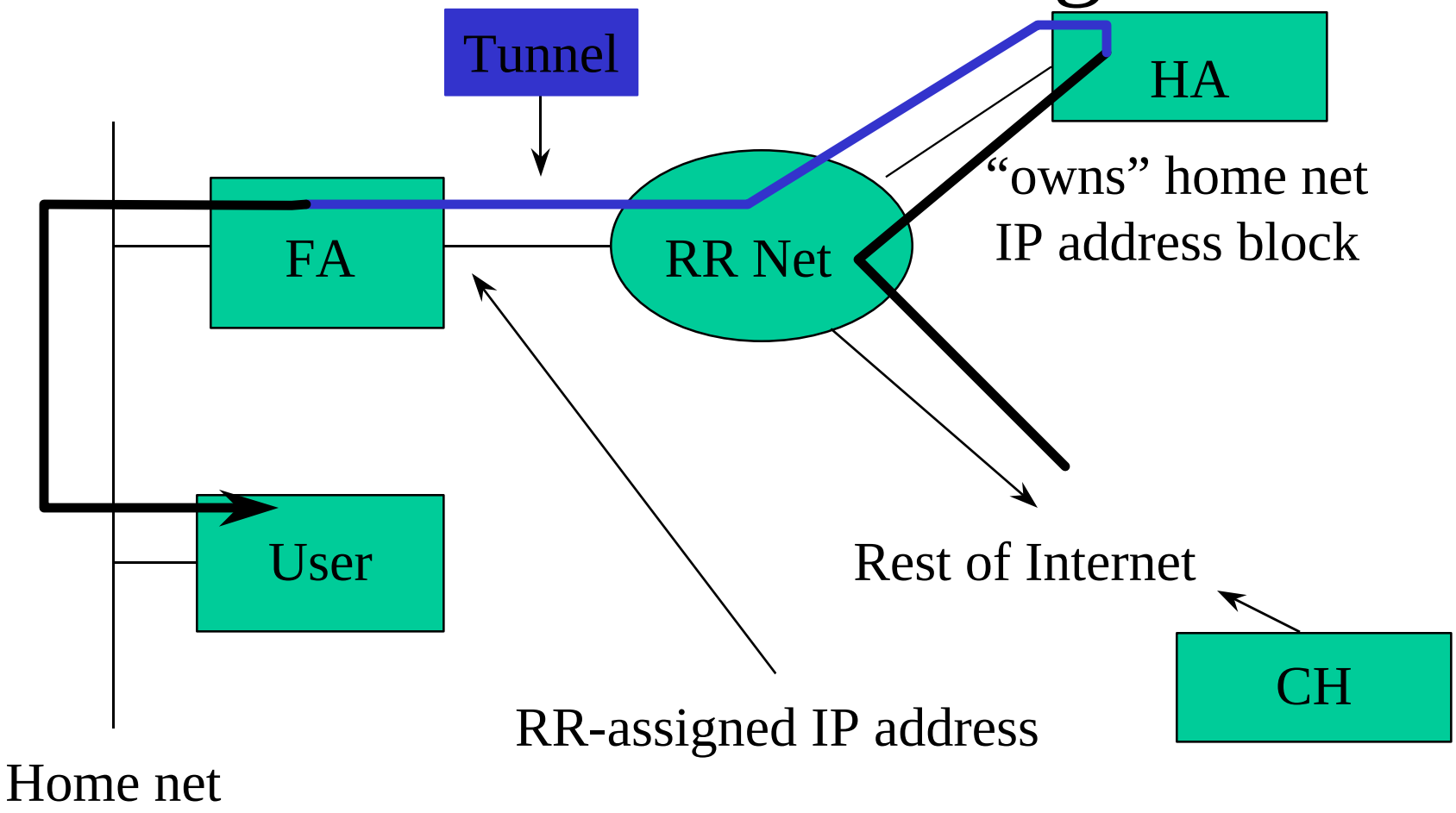
IP/Cellular Terminology

- Mobile Host (MH)
- Home Agent (HA)
- Foreign Agent (FA)
- Correspondent Host (CH)
- Cellular Subscriber
- Home Location Register (HLR)
- Visitor Location Register (VLR)
- Landline subscriber

Mobile IP Registration

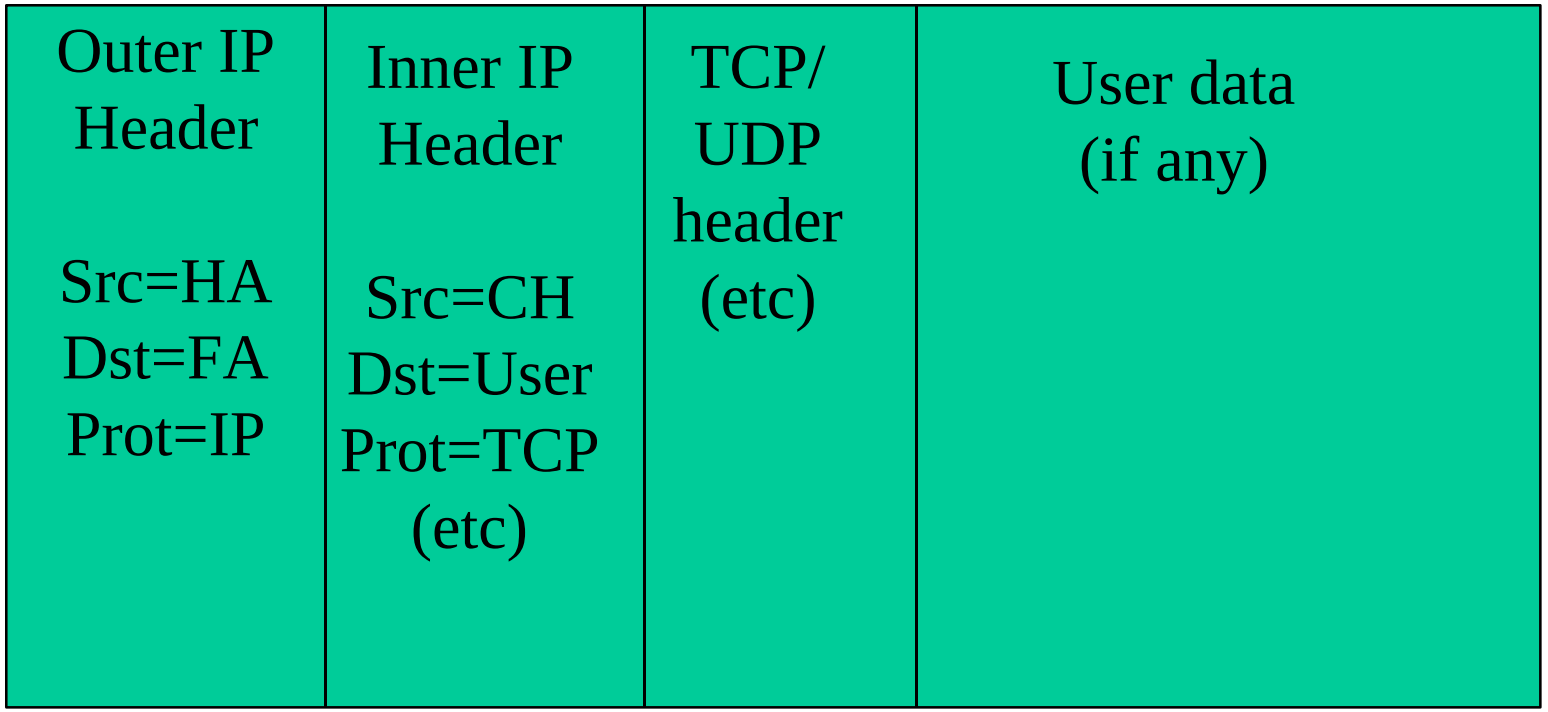
- When a mobile host moves to a new network, it identifies itself to the local net's foreign agent, which in turn registers it with the user's home agent
- Packets to the mobile host are routed normally to the home agent, tunneled to the foreign agent and delivered to the user

IP-in-IP Tunneling



FA and HA can be Linux, BSD, NOS, etc

Tunneled Packet Format



Cellular Registration

- When a cell phone moves to a new system, it identifies itself to the serving system's VLR, which in turn registers it with the user's HLR
- Calls to the mobile phone are routed normally to the HLR, then forwarded to the serving system and delivered to the user
- Authentication is a serious issue

Problems

- Non-optimal routing in the stationary-mobile direction
- Normal routing in the mobile-stationary direction
  - except that IP source address ingress filtering, a common but misguided security mechanism, frequently requires tunneling in both directions

Do We Need Mobility?

- Most (all?) existing mobile Internet applications are clients only, i.e., they always send the first packet
- Special-purpose application protocols preserve this (e.g., POP)
- Driven by the intermittent nature of mobile Internet connectivity
- Dynamic addressing is universal in ISPs

The Cost of Mobility

- Implementation complexity issues aside, mobility entails significant per-packet costs due to non-optimum routing
- Mobility should therefore remain an option even if it is implemented, i.e.,
- Servers use the static address; clients continue to use dynamic addresses

Application Level Mobility

- H.323 gatekeepers and analogous mechanisms in Internet telephony
- Many other application-level “login and wait” mechanisms
  - IRC, etc
- POP (Post Office Protocol)
  - turns a server into a client
  - clients don’t need mobility

Application Mobility Advantages

- Increased efficiency
  - no need for home or foreign agents
  - no triangle or rectangle routing
- Better application integration
- Improved user privacy (if data is encrypted)
  - nonce IP address not as useful for tracking
- Improved resistance against targeted denial-of-service attacks over low-speed media

Predictions

- Mobile IP will not be widely used for its original purpose:
  - all important mobile apps are either clients, which don't require mobility, or have application-level mobility built in
- Mobile IP could well find its niche in *stationary* virtual private networks
  - Home LANs on cable modem, ADSL, etc

Lessons Learned

- Sometimes generality is too expensive
  - especially when existing ad-hoc mechanisms already meet 99% of the needs
- Mechanisms designed for one environment may in fact be better applied elsewhere