A Novel Incrementally-Deployable Multi-granularity Multihoming Framework for the Future Internet

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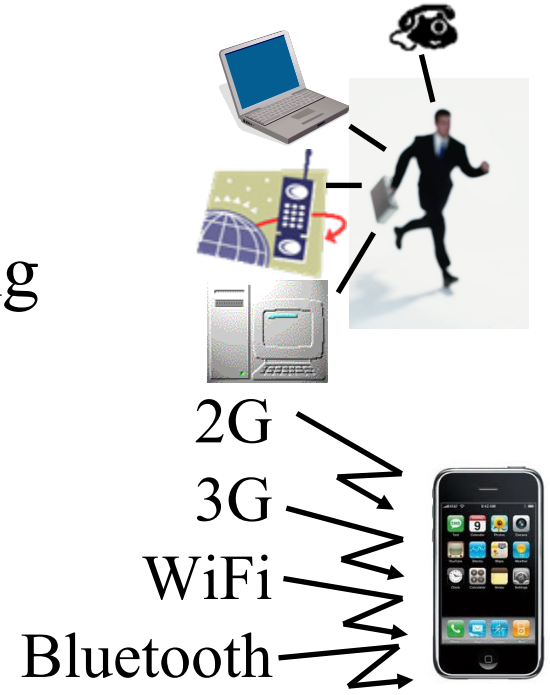
These slides and Audio recordings of this talk are at:
http://www.cse.wustl.edu/~jain/papers/slice.htm

1. Problem
2. Current Solutions
3. Our Solution
4. Quantification of benefits

Trend: Multihoming + Mobility

- Cloud computing and storage
- Anytime Anywhere computing
- Dynamically changing Locator
- User/Data/Host/Site/AS Multihoming
- User/Data/Host/Site Mobility
- Multihomed stub ASs have doubled in the last 5 years, and their routing prefixes have increased by 50%



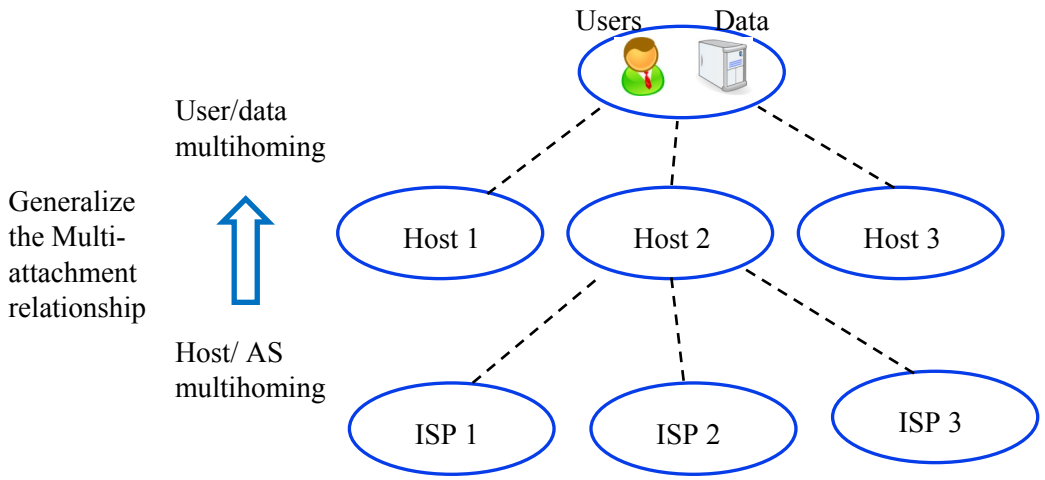
Mobile Telephony already distinguishes ID vs. Locator
We need to bring this technology to IP.

Current Solutions

- Host multihoming:
  - Patches to DNS
  - Patches to inter-domain routing (CIDR
  - New transport protocols (SCTP)
  - ID-Locator split: I3, …
- Often there is no location privacy, no ownership concept
- The ID-Location mapper must belong to the domain of ownership
- AS multihoming is also an issue and is solved by very different methods. E.g., Provider independent address
  Leads to scaling issues in the Internet
- Multi-homing is limited to hosts. Not user or data.
  Data-oriented network (DONA), content-oriented networks, and Mobile People Architecture (MPP)

Our Solution

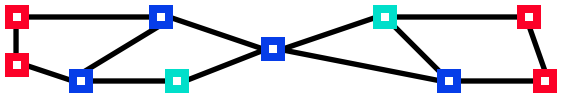
1. Define domain of ownership: **Realm**
2. **Tiers** of objects: Users/Data, hosts, sites, AS
3. **Slices**: Grouping of realms



Design Principles and Goals

- Principles:
  - 1. Evolution (Not Revolution) and Coexistence (Backward Compatibility)
  - 2. Incremental Deployment
  - 3. Organizational Control
  - 4. Location Privacy
- Goals:
  - 1. Extensibility and Flexibility
  - 2. Support for a Scalable Internet
  - 3. Easiness of Developing a Prototype for Incremental Development
  - 4. Smooth Integration of Security, Mobility, and other Functions

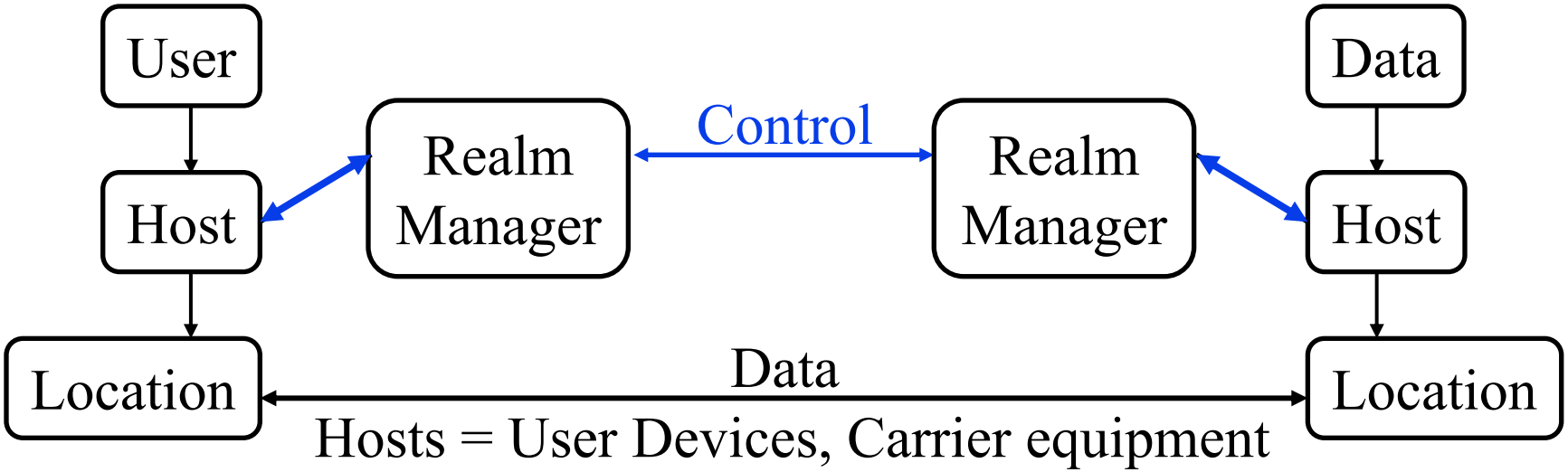
Realms



- Object names and Ids are defined within a realm
- A realm is a **logical** grouping of objects under an administrative domain
- The Administrative domain may be based on Trust Relationships
- A realm represents an organization
  - Realm managers set policies for communications
  - Realm members can share services.
  - Objects are generally members of multiple realms
- Realm Boundaries: Organizational, Governmental, ISP, P2P,…

Realm = Administrative Group

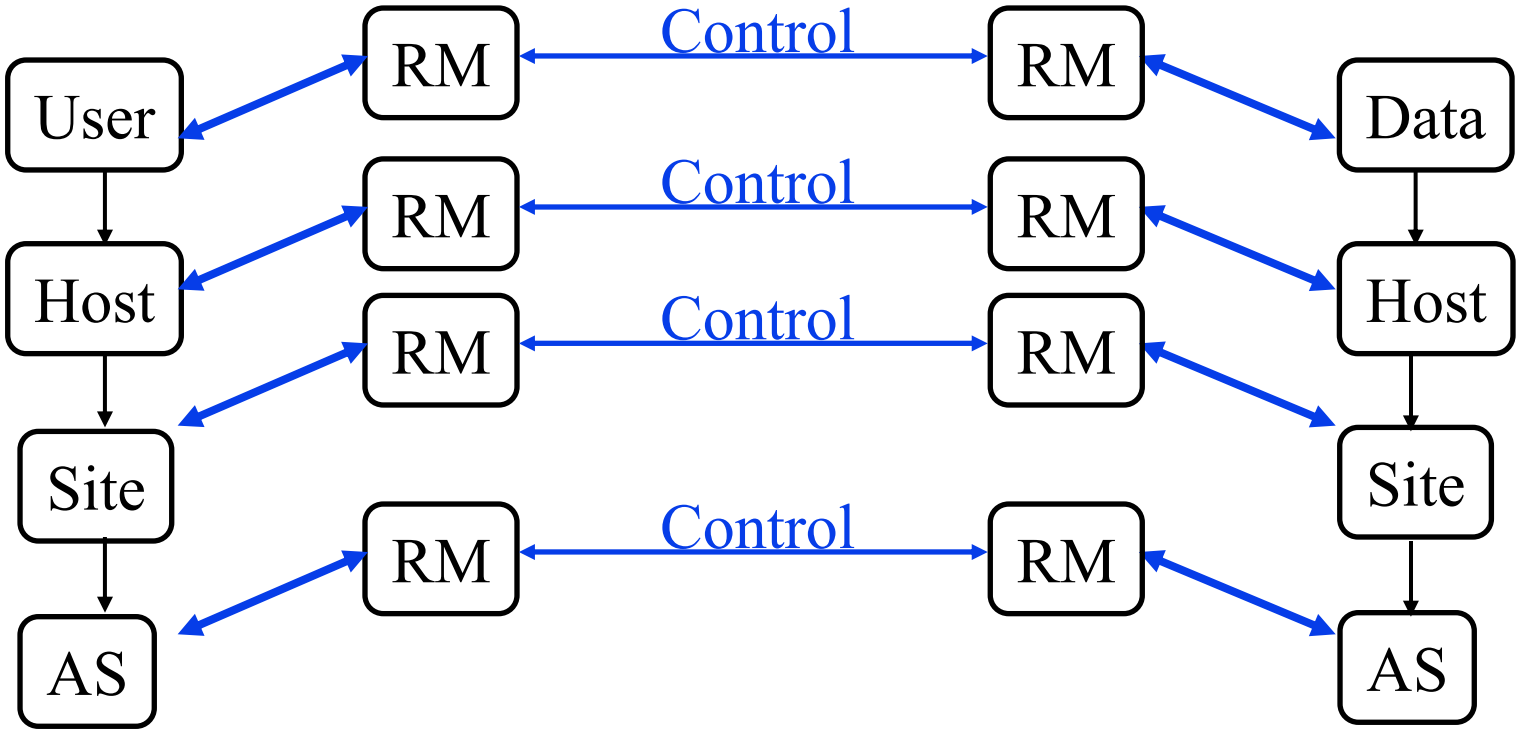
Organizational Representation



Realm managers:

- Resolve current location for a given host-ID
- Enforce policies related to authentication, authorization, privacy
- Allow mobility, multi-homing, location privacy
- Different from several other ID-locator splitting proposals. Our Emphasis on organizational control.
- Ref: [PAN08]

Organizational Representation: Tiers

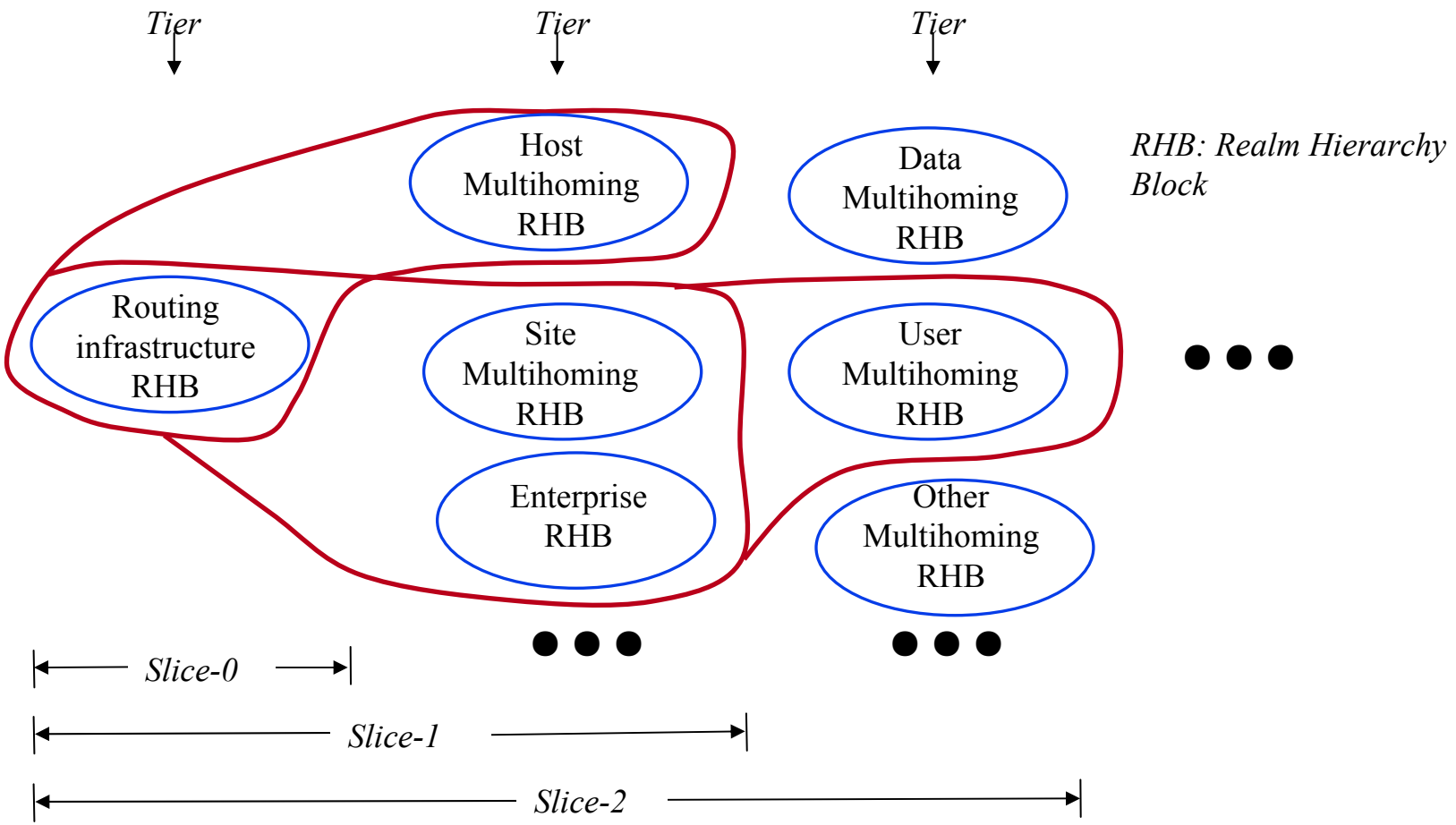


Tiers = Realms with similar functions

RHB = Real Hierarchy Blocks = Groups of Realms in a tier

Slices = Groups of RHBs to realize specific multihoming function

Slices

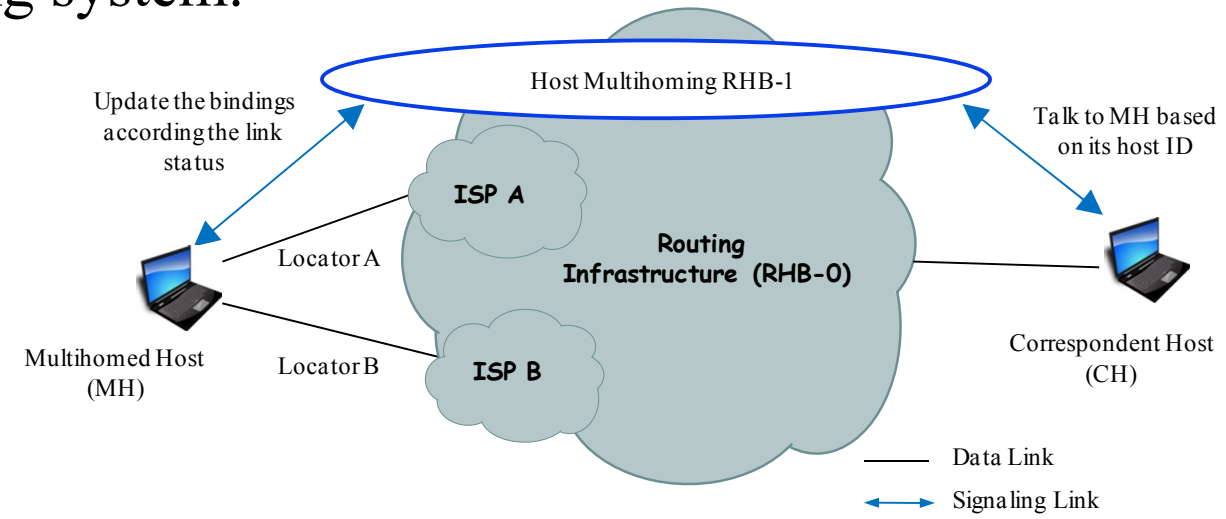


Terminologies Comparisons

	Scope	Definition	Example
Layer	Single host protocol stack	Software stack encapsulated into logically dependent but implementation independent layers	Physical layer, link layer, network layer, transport layer, application layer
Hierarchy	Any hierarchical structure	Arrangement of items into vertically or horizontally ordered set or acyclic directed graph	Routing hierarchy, social hierarchy
Realm	Same organization or policy boundary	Objects grouped together according to common affiliation or policy	A user realm, a company realm, a department realm, a routing realm
Tier	Multiple realms	Realms with similar function	Infrastructure tier, host tier, data tier
Slice	Across multiple tiers and RHBs	Extensible grouping of realms or RHBs to realize specific multihoming function	Slice-0, Slice-1, Slice-2

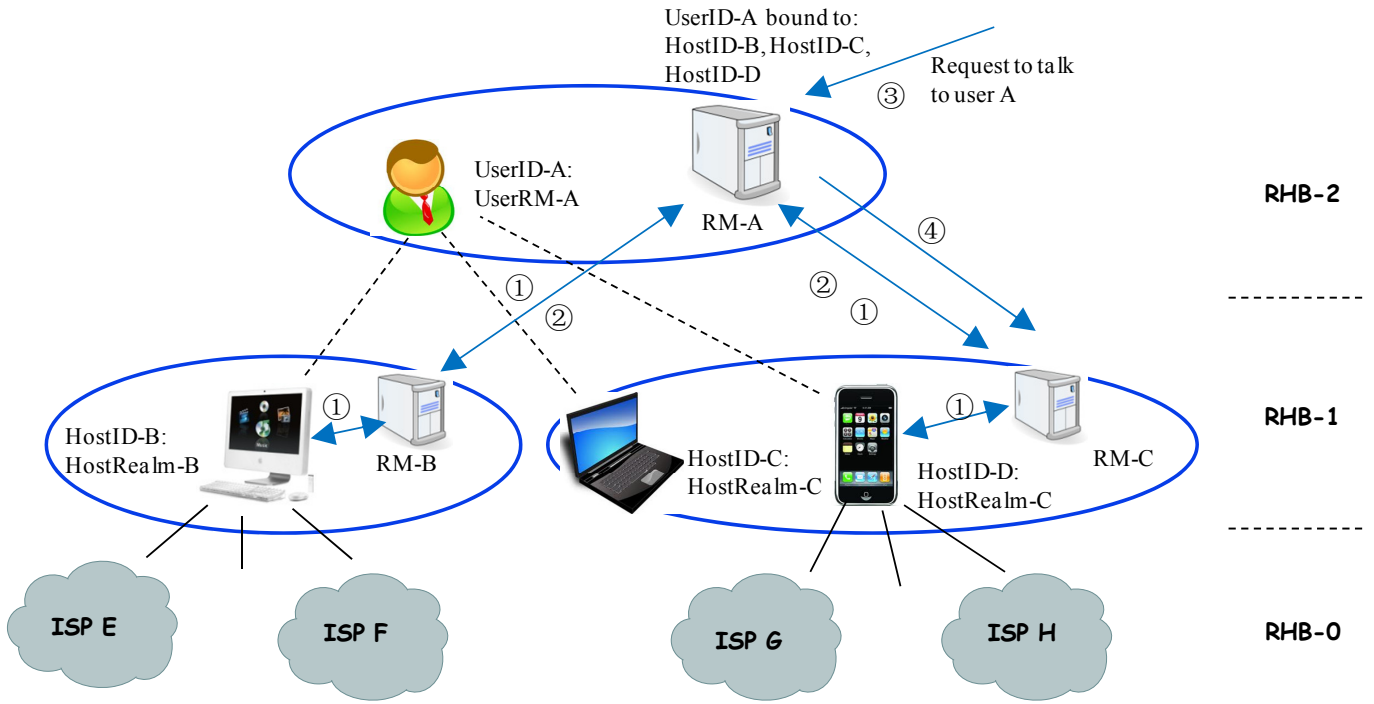
Host/Site Multihoming Example

- Multihomed Host (MH) monitors links status and updates the bindings between the MH host ID and locators to the RHB-1
- Network translates the ID to the correct locator of the MH. Thus, location privacy is maintained.
- RHB-1 and RHB-0 have separate and independent ID spaces. Hence, multihoming does not add any complexity in the inter-domain routing system.



Data/User Multihoming Example

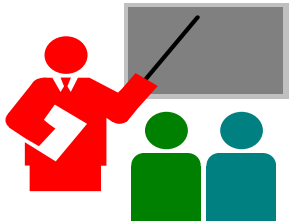
- Goal is to create the virtual "multi-attachment"
- We achieve this goal by decoupling the ID and locator semantic and creating "realms" to manage the IDs



Routing Scalability Alleviation

- We estimated two deployment speeds scenarios (10%/year and 20%/year) and found that the total prefixes contributed by the multihomed stub-ASs can decrease significantly. The first one decreases from around 90K to 30K in 5 years, and the second one takes almost 2.5 years to achieve the same results

Summary



1. Address the current deficiencies in multihoming efforts
2. Extend the multihoming from host/AS to user and data level taking advantage the "multi-attachments" essence
3. Location privacy is important
4. Realm = Organization boundary = Trust domain
5. Id-locator mapping is not disclosed outside the "Realm-Hierarchy" or Slice.