A Future Internet
Architecture Based on De-Conflated Identities

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http://www.cse.wustl.edu/~jain/papers/deconf.htm
Overview

1. Internet Generations
2. 3-Tier Model of Internet 3.0
3. ADI Object Identifiers: Host ID, Infrastructure ID
4. ADI Operations:
   A. Mapping and Negotiations
   B. Site Multihoming, Traffic Engineering
Conflated IDs

- Conflated ID = ID/Locator confusion
- IP Address = TCP End point ID, IP Address
- Communication Paradigm = Ownership, Policies
- ADI = Architecture based on De-conflated Identities
- Specific proposal for ID structure
# Internet Generations

- **Internet 1.0** (1969 – 1989)
  - Single ownership $\Rightarrow$ Trust
  - complete knowledge
  - Algorithmic optimality $\Rightarrow$ RIP

- **Internet 2.0** (1989–2009) Commerce
  - Multiple ownership of infrastructure $\Rightarrow$ Distrust, **Security**
  - No knowledge of internal topology and resources
  - *Policy based* routing $\Rightarrow$ BGP

- **Internet 3.0** (2009–2029) Commerce
  - Users, Content, Host ownership
  - Requirements, Service Negotiation
  - Mobility of users and distributed data

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Realm managers (RM): Many organizational functions
- Allow mobility, multi-homing, location privacy
- ID-Locator: Resolve current location for a given host-ID
- Policy Monitoring. Conformance to Contracts. Troubleshooting.
- Enforce policies related to authentication, authorization, privacy
- Proxy services enabling hosts to sleep
  \[ \Rightarrow \text{Energy-aware networking} \]
3-Tier Model of Internet 3.0

- Both Users and data need hosts for communication
- Data is easily replicable. All copies are equally good.
- Users, Hosts, Infrastructure, Data belong to different realms (organizations).
- Each object has to follow its organizational policies.

Note: This presentation is limited to the bottom two tiers.
ADI Host ID Layer

- Implements logical end-to-end functions between host realms (like IPSec)
- Separates physical end-to-end path
- Logical connections are shielded from infrastructure changes, host mobility
- Logical layer provides security and other policy negotiations
- New HID-aware transport protocols

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<th>Transport</th>
<th>Host ID Layer</th>
<th>Infrastructure connectivity</th>
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ADI Object Identifiers

- Host ID = <Realm ID, Object ID>
- Infrastructure ID = <Realm ID, Object ID>
Host ID

- 128 bit like IPv6
  ⇒ Compatibility with IPv6 applications
- HRID
  ⇒ Locate service access points, mapping, security, ...
- Hierarchical structure ⇒ Easy global management

![Diagram of Host ID structure]

Country ID  Authority ID  Region ID

Example
Infrastructure ID

- Infrastructure Realms: Similar to Autonomous Systems
- Explicit policy negotiations between realms
- Each realm has independent local IPv4 address space
- Helps in renumbering

**IRID** (96 bits)  **IOID(IPv4)** (32 bits)
ADI Operations

IR = Infrastructure Realm
IRID = Infrastructure realm ID
IRBR = IR Border Router
IOID = Infrastructure Object ID

1. Get Locator of Destination host
2. Tunneled to local IRBR
3. Packets forwarded based on Dest IRID
4. ID/Locator Mapping System
5. Packets tunneled based on IOID
6. IR #3

- DNS = Static, DHT = No concept of ownership
- Mapping based on ownership

IR= Infrastructure Realm
IRID = Infrastructure realm ID
IRBR = IR Border Router
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Transport
HID(128 bits)
IID(IPv6-like)
IPv4 Layer

IR = Infrastructure Realm
IRID = Infrastructure realm ID
IRBR = IR Border Router
IOID = Infrastructure Object ID

DNS=Static, DHT=No concept of ownership
Mapping based on ownership

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Site Multihoming

- Provider Independent (PI) Addresses ⇒ Scalability Issues
- Site multihoming used for local link redundancy
- Does not allow hosts' traffic engineering or fault tolerance
- In ADI, a host ID may be mapped to multiple Infrastructure IDs
- Host tier may inform infrastructure tier about path problems
- Infrastructure tier may inform host tier about multiple paths
Rewrite source IRID. Route using source IRID

Site BR rewrites source IR of the outgoing packets
1. 3-Tiers of Ownership/Policy: Users/Data, Hosts, Infrastructure ADI handles the bottom two tiers
2. All tiers are organized as Realms
3. 128 bit Host IDs and Infrastructure IDs ⇒ IPv6 Application compatibility
4. Host ID = <n-bit Host Realm ID, 128-n bit Host object ID> Allows hierarchical aggregation of host IDs
5. Infrastructure ID = <96-bit Infrastructure Realm ID, 32-bit Infrastructure ID> ⇒ Allows IPv4/IPv6 in the core