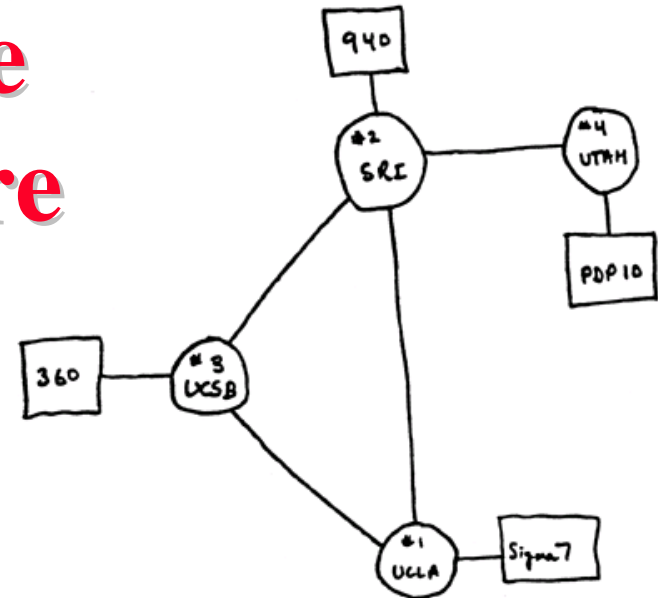# Internet 3.0: Future Internet Architecture

Raj Jain, WUSTL

Arjan Durresi, IUPUI
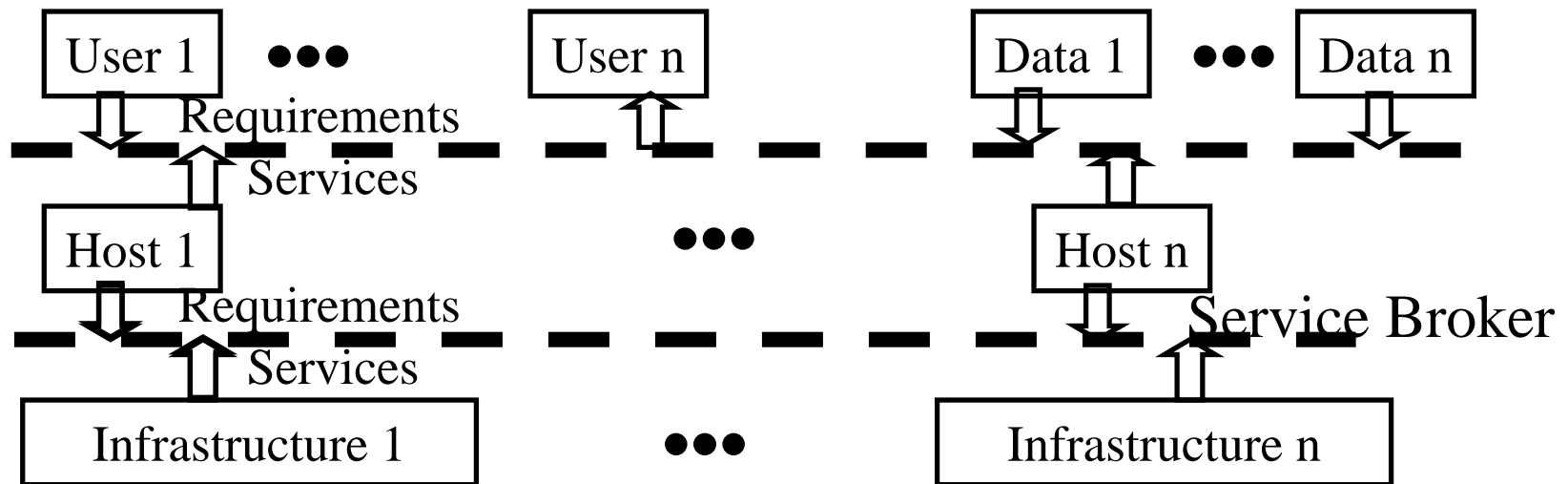
Maarten Sierhuis, CMU/NASA

Ravi Sandhu, UTSA

Nikita Borisov, UIUC

NSF Future Internet Summit, October 14, 2009

Washington University in St.Louis

http://www.cse.wustl.edu/~jain/talks/in3_nsf.htm

Our Vision

```
┌────────┐         ┌────────┐       ┌────────┐       ┌────────┐
│ User 1 │  ●●●    │ User n │       │ Data 1 │  ●●●  │ Data n │
└────────┘         └────────┘       └────────┘       └────────┘
```

Requirements

Services

```
┌────────┐                          ┌────────┐
│ Host 1 │          ●●●             │ Host n │
└────────┘                          └────────┘
```

Requirements   Service Broker

Services

```
┌──────────────────┐                ┌──────────────────┐
│ Infrastructure 1 │      ●●●        │ Infrastructure n │
└──────────────────┘                └──────────────────┘
```

- ❑ **Goals:** Distributed Ownership, Security, Mobility, Energy Aware, User/Data Centric

Solution:

- ❑ Realms=Trust Regions.
  Realm managers: Policy, Organizational fns
- ❑ **Policy-based**, Multi-Tier, **Object-oriented**. Objects$\Rightarrow$ services.
- ❑ Service broker $\Rightarrow$ Allows **Application based networking**
- ❑ **Multi-Tier Mobility, multi-homing, virtualization**

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Vision: What's New Today?

Security

1. Trust = Fn(ID, attributes, role, policy, context, …) Includes confidentiality, integrity, Authentication, availability, privacy
2. Context=Sensitivity of data being accessed, Application (Banking vs. Netflix)
3. Object Security $\Rightarrow$ Trust and Protection for Users, Data, Hosts, Infrastructure
4. Service Broker may provide independent verification, isolation of infections, trouble shooting, conflict resolution, ….
5. Example of Policy/Security Specification: XACML (Access Control Markup Language)

Ack: Cetin Seren (Mentor), George Kesidis

Washington
University in St.Louis

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Why Exciting?

1. Policy Based
2. User- and Data- centric networking
   Data $\Rightarrow$ Distributed Systems, Distributed Services
3. Multi-systems users
4. Commercial reality: Multiple Owners
5. Comprehensive: Not just routing. Security, energy, mobility, disruption tolerance
6. ID-Locator Separation: Mobility.
   Including user mobility and data mobility
7. Transition: Incremental implementation
8. Object oriented Approach
9. Intelligence in the network $\Rightarrow$ Suitable for 3B
10. Service Broker $\Rightarrow$ Application based Networking
11. Allows both host-centric or network centric solutions

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Research Challenges

1. Policy Models and Representation
2. ID, attributes and trust models for User and Data
3. Self-defense mechanisms
4. Monitoring and Measurement:
   - Troubleshooting,
   - Independent verification,
   - Conformance to contracts
5. Service Broker Architecture: Economic/QoS/Security Negotiations
6. Transition: Incremental approach to implementation