

Networking as a Service (NaaS): Cloud Centric Networking in a Federated Environment

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These slides and audio recording of this presentation are available
at http://www.cse.wustl.edu/~jain/talks/ms_smt10.htm

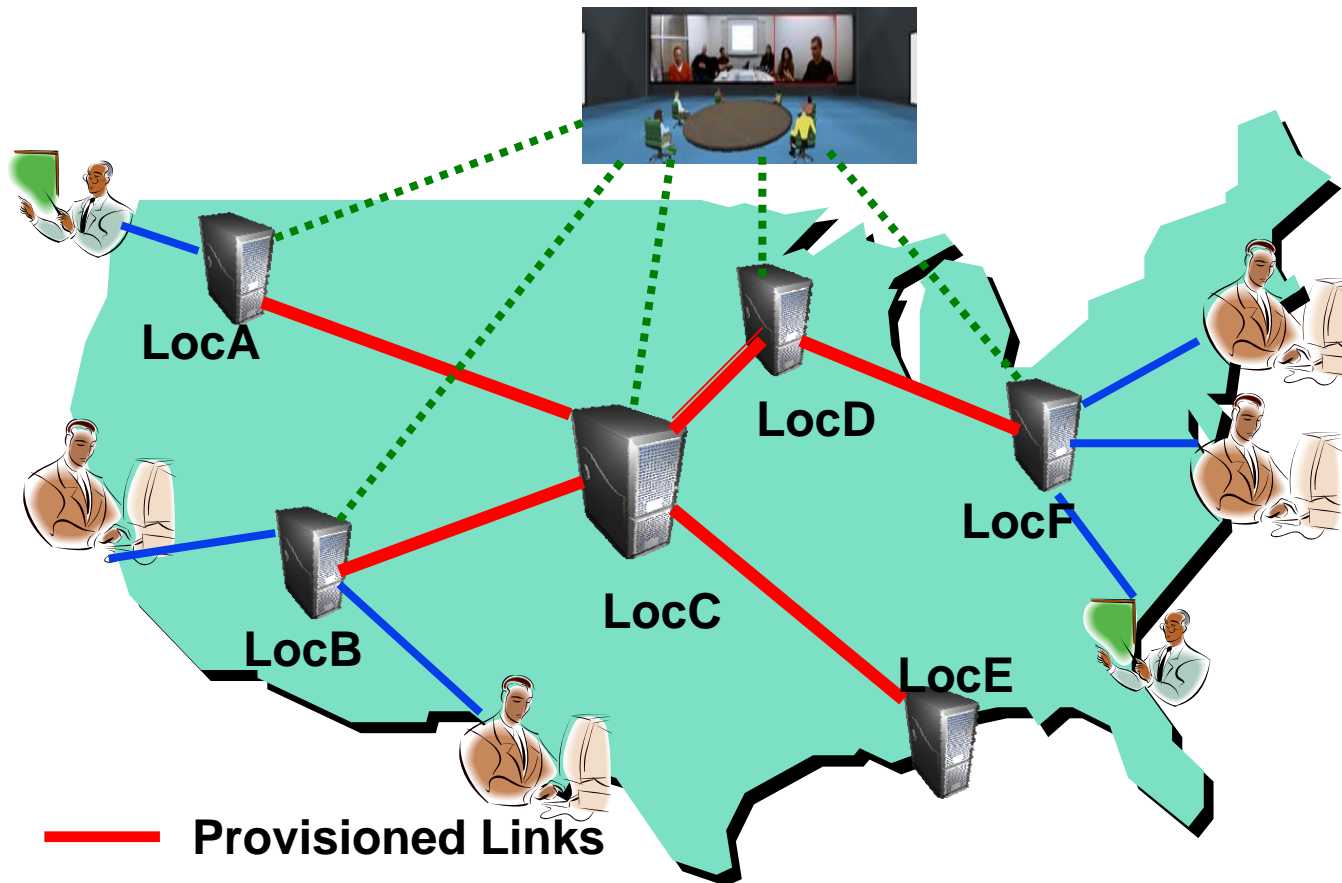


- ❑ Distributed Applications with/without clouds
- ❑ Benefits of cloud **computing**
- ❑ Need for cloud **networking**
- ❑ Our Proposal: **Elastic Pipes**

Problem Background and Motivation

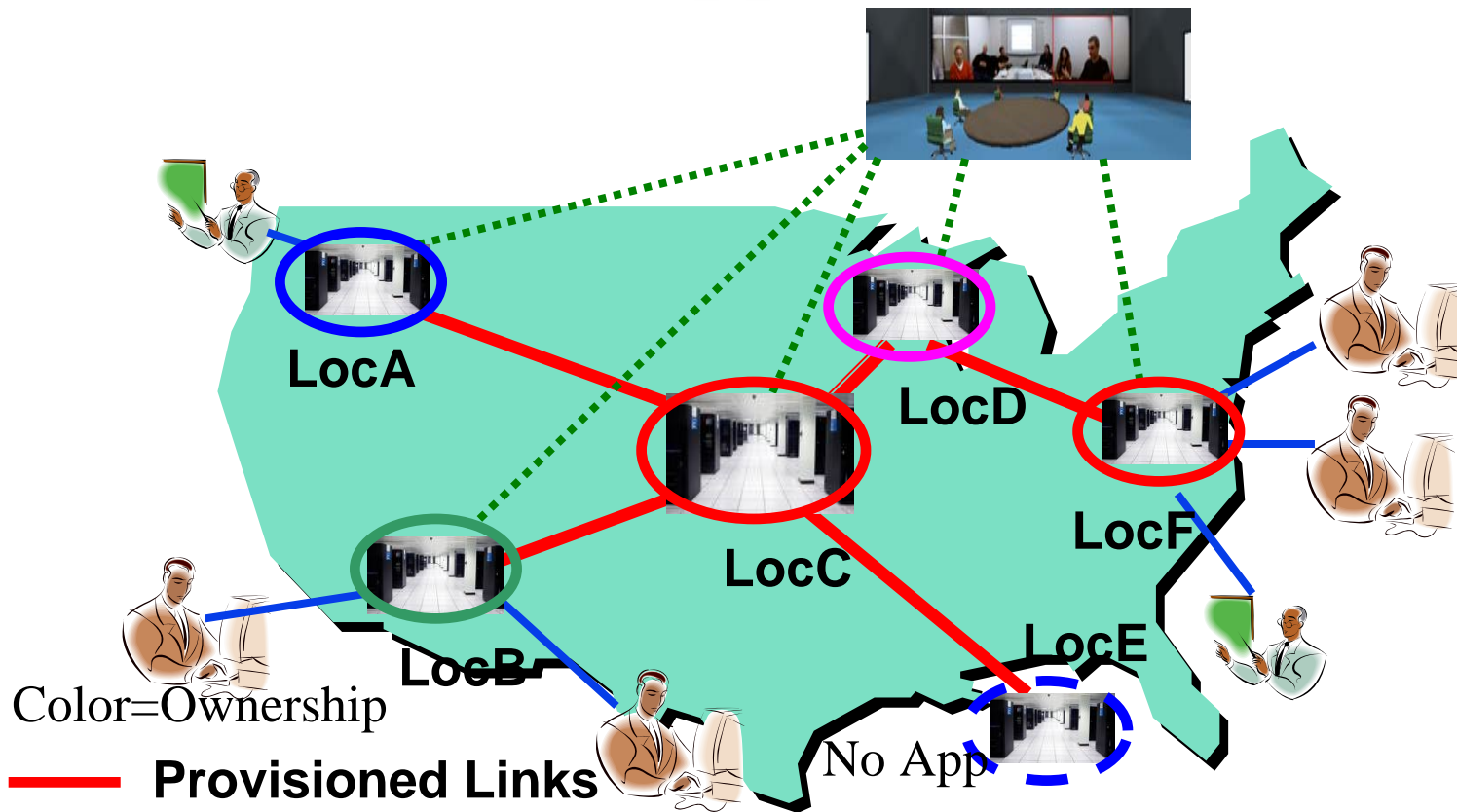
- ❑ Distributed applications benefit from cloud computing, which
 - ⇒ Allows **sharing** the computing Resources
 - ⇒ Allows resources to be **dynamically** allocated/deallocated
 - ⇒ Service provider **does not expose** internal structure
- ❑ However, the network infrastructure is fixed.
 - Not shared by multiple cloud owners
 - Cannot be dynamically allocated
- ❑ Elastic pipes allow:
 - Infrastructure owners to advertise their capabilities
 - Cloud users to dynamically lease these links
- ❑ Extends all the cloud properties from computing to networking

Distributed Application Example



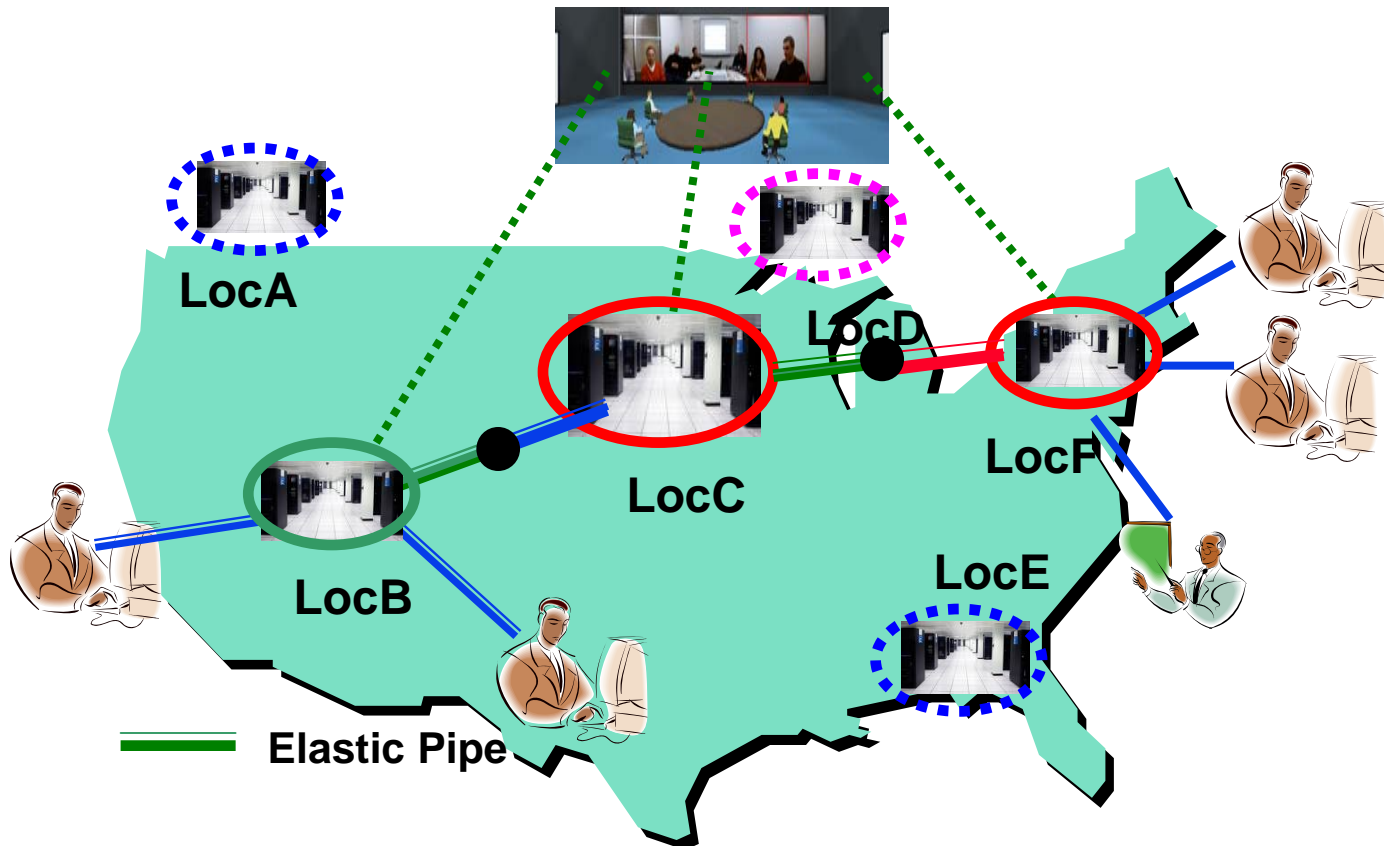
Dedicated Servers and Network \Rightarrow Cost is independent of load

Distributed Application w Clouds



Cloud Computing \Rightarrow Pay as you go
Dedicated Network \Rightarrow Cost is independent of load

Distributed Application w Elastic Pipes

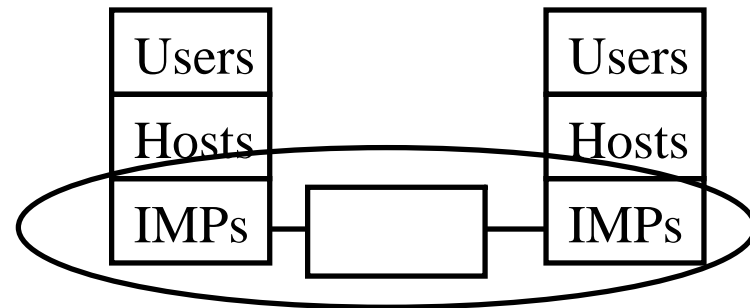


Multi-ownership Infrastructure
Dynamically setup increase/decrease capacity

Internet Generations

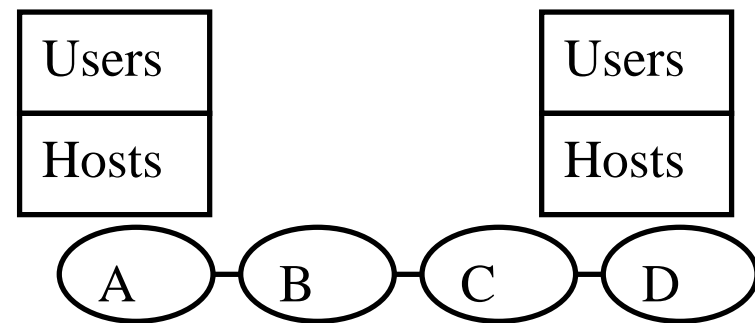
Internet 1.0 (1969 – 1989)

- Single ownership \Rightarrow Trust
- complete knowledge
- Algorithmic optimality \Rightarrow RIP



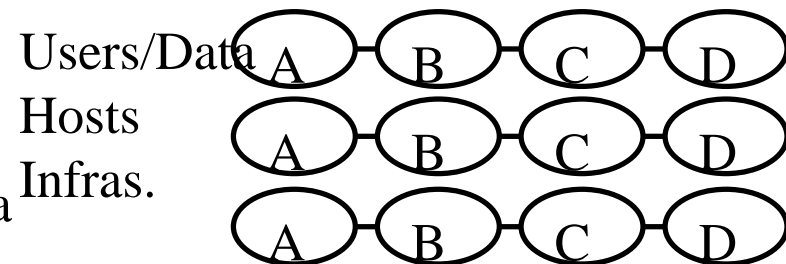
Internet 2.0 (1989–2009) Commerce

- Multiple ownership of infrastructure \Rightarrow Distrust, **Security**
- No knowledge of internal topology and resources
- *Policy based* routing \Rightarrow BGP

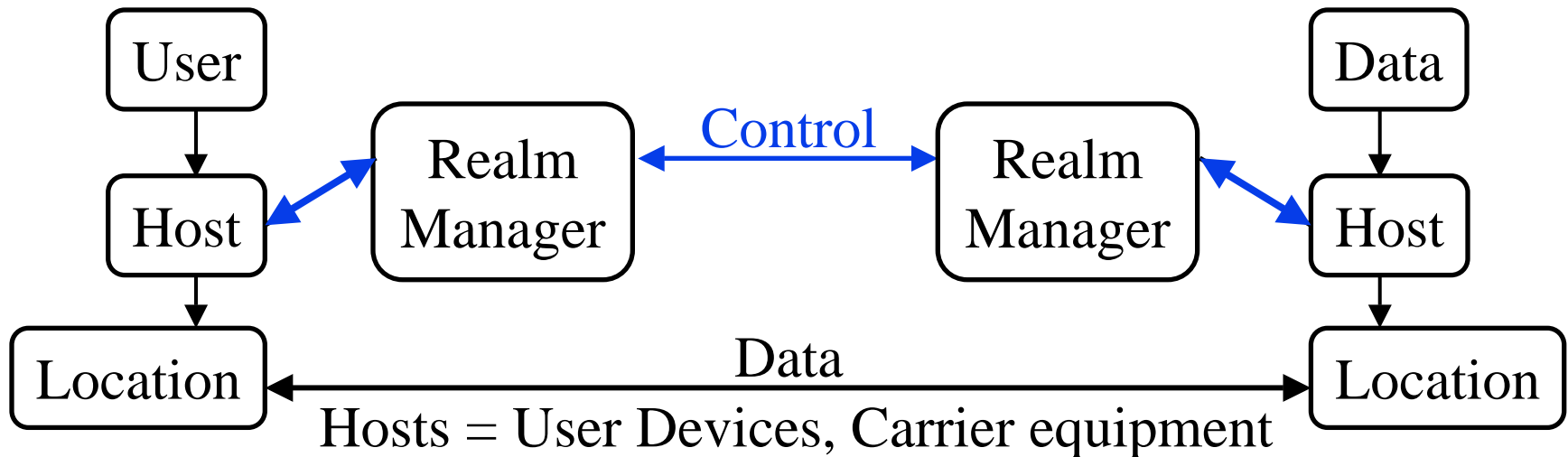


Internet 3.0 (2009–2029) Commerce

- Users, Content, Host ownership
- Requirements, Service Negotiation
- Mobility of users and distributed data



Policy Based Networking Architecture

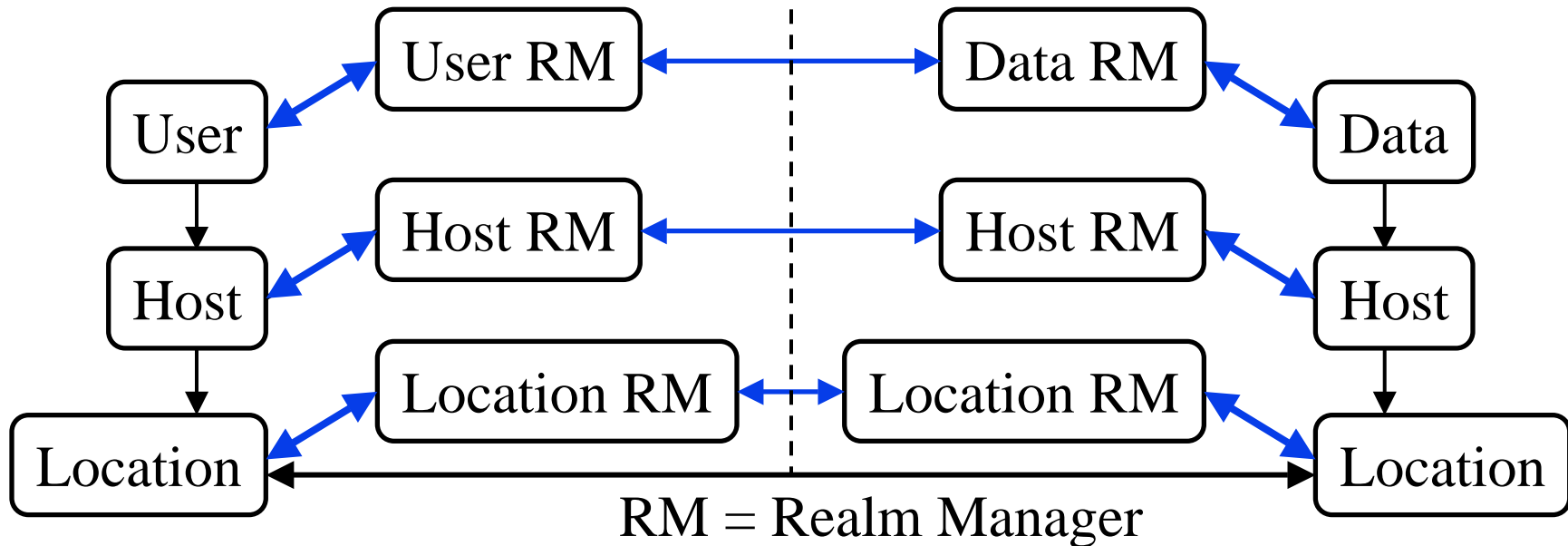


Realm managers (RM): Many organizational functions

- ❑ 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 Energy-aware networking

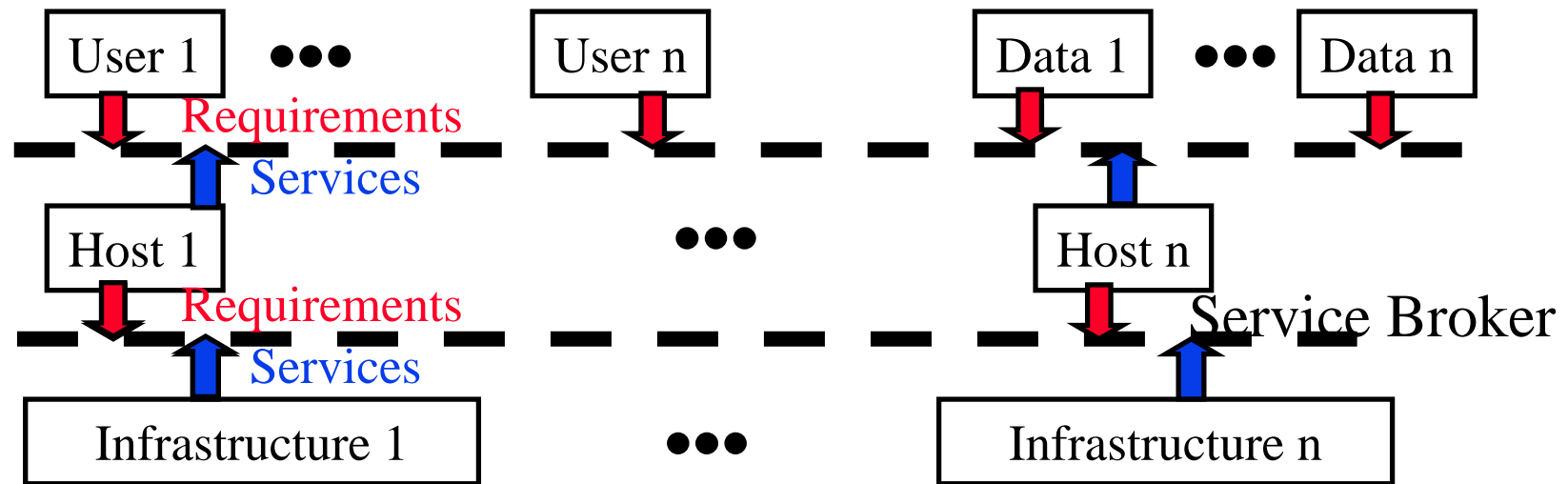
Ref: <http://www.cse.wustl.edu/~jain/papers/milsa.htm>

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.
- ❑ Ref: <http://www.cse.wustl.edu/~jain/papers/bcs08.htm>

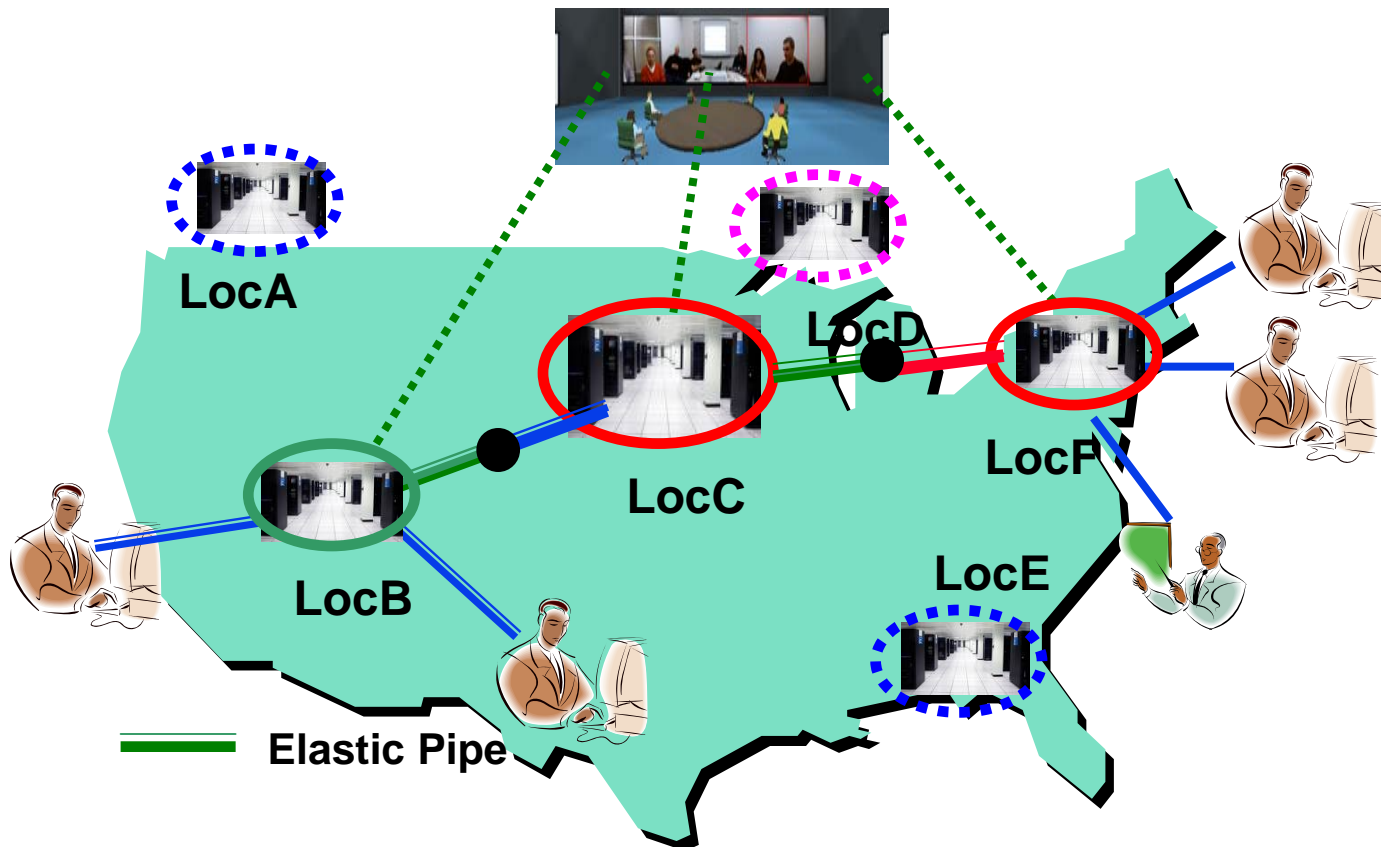
Object-Based Service Oriented View



- ❑ Objects provide services. Higher tiers specify the requirements
- ❑ Tier service broker (shown by dotted line) composes a service
 - can negotiate with multiple realms in that tier
 - Can monitor and provide independent verification
- ❑ Higher tier may not/need not find details of lower tiers

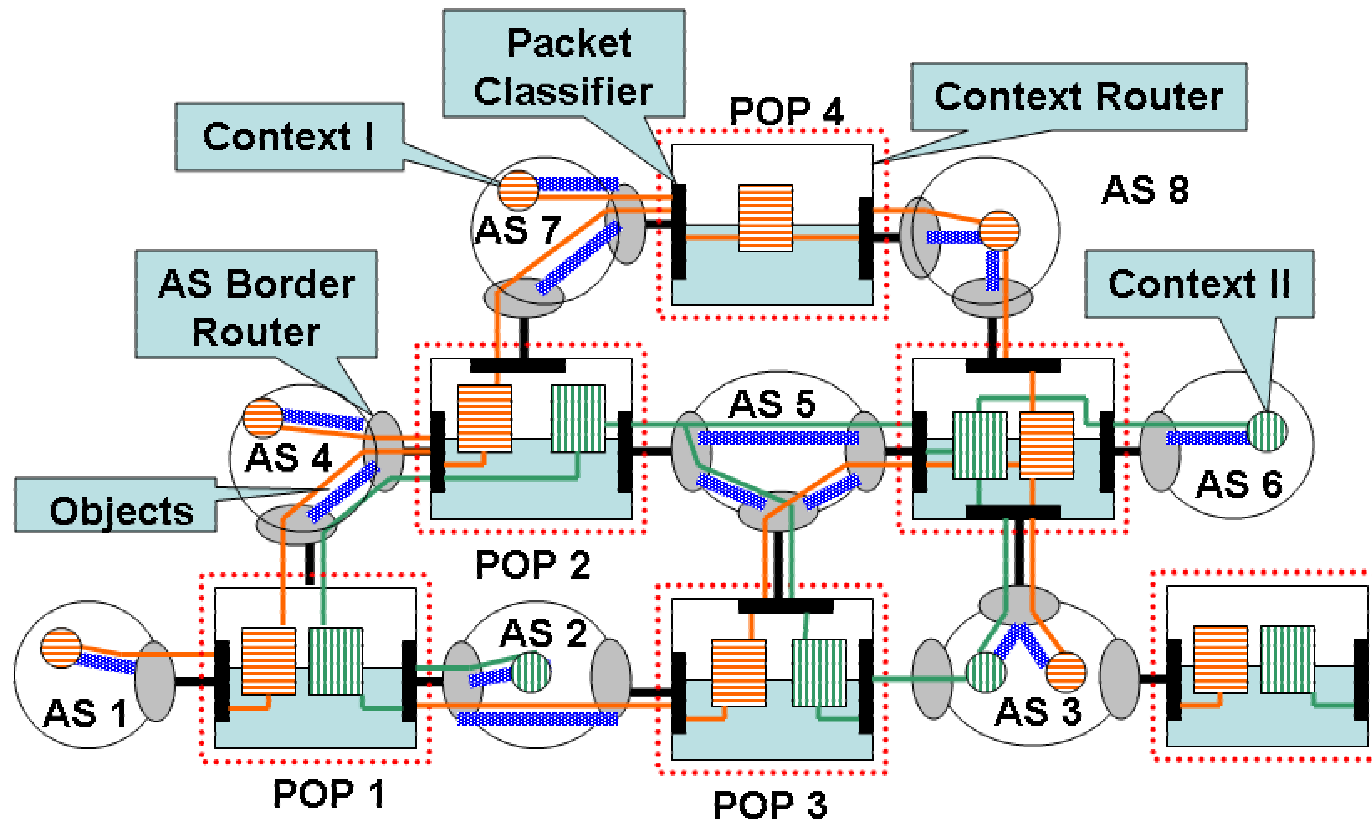
Allows creating requirement specific networking context

Distributed Application w Elastic Pipes



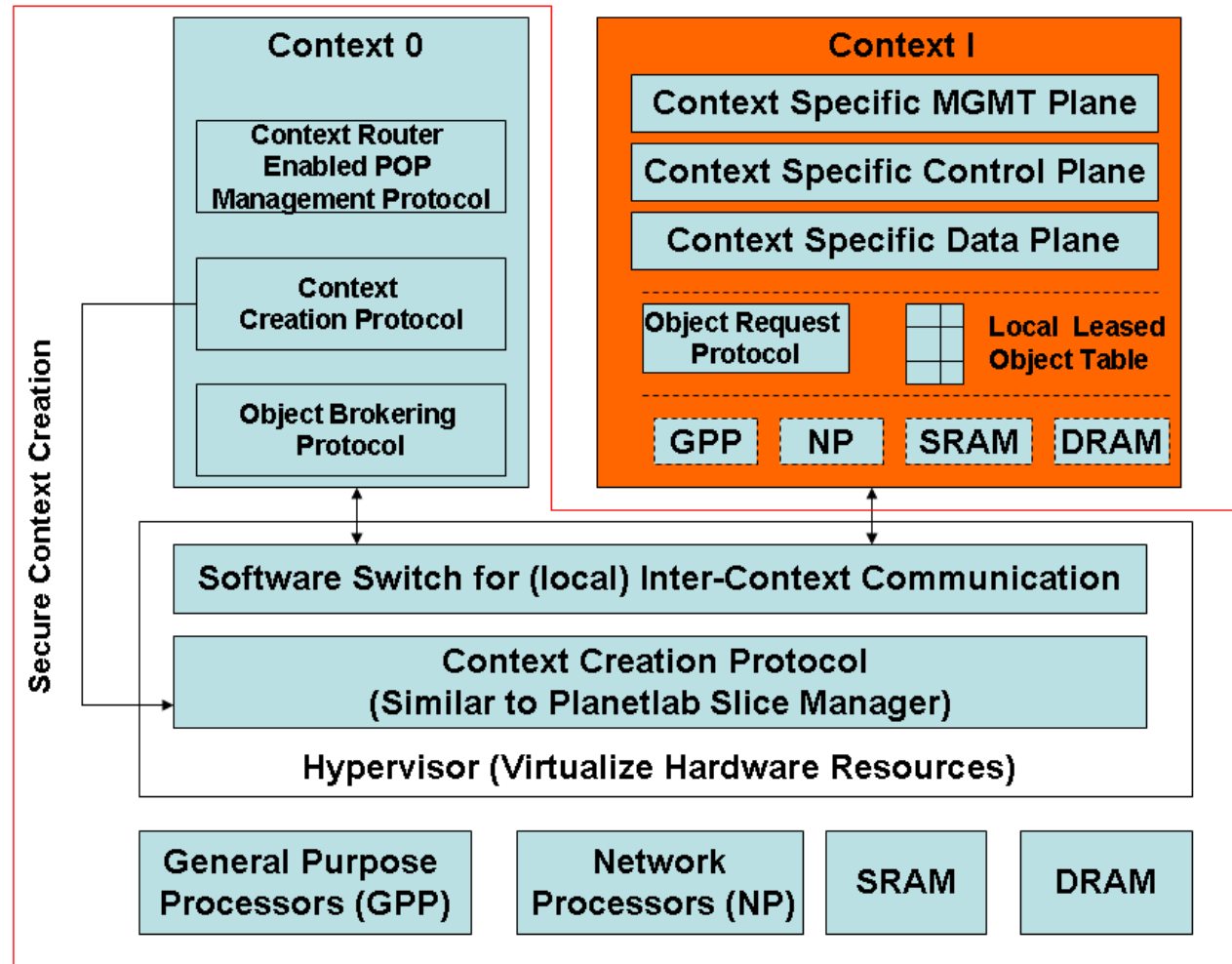
- ❑ Carriers advertise link objects
- ❑ PoPs advertise connectivity services

Application Specific Networking Architecture: Context Router

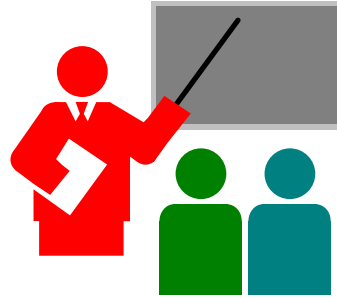


- ❑ POP's enhanced with Context Routers

Context Router Design



Summary



1. Cloud computing allows computing to be offered as a service
⇒ Shared resources, Dynamic Allocation, Service provider control
2. Need cloud networking that allows networking to be offered as a service ⇒ Dynamic creation of paths between clouds
3. Three tiers of objects: Data, Hosts, Infrastructure
4. Need a multi-tiered object-based service oriented architecture for the Internet ⇒ Internet 3.0

References: Internet 3.0

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References: Internet 3.0 (Cont)

- ❑ Jianli Pan, Raj Jain, Subharthi Paul, Mic Bowman, Xiaohu Xu, Shanzhi Chen, "**Enhanced MILSA Architecture for Naming, Addressing, Routing and Security Issues in the Next Generation Internet,**" Proceedings of IEEE International Conference in Communications (ICC) 2009, Dresden, Germany, June 14-18, 2009, <http://www.cse.wustl.edu/~jain/papers/emilsa.htm>
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- ❑ Jianli Pan, Subharthi Paul, Raj Jain, Mic Bowman, "**MILSA: A Mobility and Multihoming Supporting Identifier Locator Split Architecture for Naming in the Next Generation Internet**," Proceedings of IEEE Global Communications Conference (GLOBECOM) 2008, New Orleans, LA, USA, 30 November - 4 December 2008, <http://www.cse.wustl.edu/~jain/papers/milsa.htm>
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