Recursive InterNetwork Architecture

Abraham Matta
Computer Science
Boston U.

Short presentation at the November 1st, 2010 CS Seminar on Faculty Projects
What’s wrong with today’s Internet?

- The **new brave world**
  - Larger scale, **more diverse** technologies
  - **New services**: content-driven, context-aware, mobile, socially-driven, secure, profitable, …

- **Custom point-solutions**: No or little “science”

- Lots of problems: Denial-of-service attacks, bad performance, hard to manage, …
Questions?

- Is the Internet’s architecture fundamentally broken that we need to “clean slate”?  
  - Yes

- Can we find a new architecture that is complete, yet minimal? If so, what is it?  
  - RINA? "A Better Network Structure"

- Can we transition to it without requiring everyone to adopt it?  
  - Yes
Internet’s view: one big, flat, open net

- There’s no building block
- The “hour-glass” model imposed a least common denominator
- We named and addressed the wrong things
- We exposed addresses to applications
Ex1: Bad Addressing & Routing

Want to send message to “Bob”

Alice → “Bob” \( \rightarrow I_1 \)

Bob multi-homed destination

To: \( I_1 \)

- **Naming “interfaces”** – i.e., binding objects to their attributes (Point-of-Attachment addresses) – makes it hard to deal with multihoming and mobility

- **Destination application process identified by a well-known (static) port number**
Ex2: Ad hoc Scalability & Security

- Network Address Translator aggregates private addresses
- NAT acts as firewall
  - preventing attacks on private addresses & ports
- But, hard to coordinate communication across domains when we want to
Our Solution: divide-and-conquer

- Application processes communicate over (distributed) IPC facility
- How IPC managed is hidden → better security

- IPC processes are application processes of lower IPC facilities
- Recurse as needed
  → better management & scalability

- Well-defined interfaces → predictable service
Recursive Architecture based on IPC

DIF = Distributed IPC Facility (locus of shared state=scope)
Policies are tailored to scope of DIF
RINA allows scoping of services

- The DIF is the building block and can be composed
- E2E (end-to-end principle) is not relevant
  - Each DIF layer provides service / QoS over its scope
- IPv6 is/was a waste of time!
  - We can have many layers / levels and not need too many addresses within a DIF layer
RINA: Good Addressing – private mgmt

- want to send message to “Bob”

- Destination application is identified by “name”
- App name mapped to node name (address)
- Node addresses are private within IPC layer
  - Need a global namespace, but not address space
  - Destination application process is assigned a port number dynamically
RINA: Good Addressing - late binding

want to send message to “Bob”

- Late binding of node name to PoA (point-of-attachment) address
- PoA address is “name” at the lower DIF level
- Node subscribes to different DIF layers
Nothing more than applications establishing communication

- Authenticating that A is a valid member of the DIF
- Initializing it with current DIF information
- Assigning it an internal address for use in coordinating IPC
- This is enrollment

NAT? Not really!
Current / Future Work

- Complete specification of IPC mechanism (data transfer & control) and management (routing, security, resource allocation, …)

- Prototyping and evaluation
  - Local testbed
  - Wide-area testbed: PlanetLab, GENI
  - Support for mobility, multihoming, service composition, …

- Experiment with new services
  - E.g., EaaS (Enclave as a Service)
Collaborators

- PhD Students:
  - Karim Mattar
  - Vatche Ishakian
  - Gonca Gursun
  - Joseph Akinwumi
  - Flavio Esposito
  - Yuefeng Wang

- Undergraduates:
  - Ethan DeGracia

- Alumni:
  - Gowtham Boddapati, Akamai
  - Peng Ge, Epic Systems
  - Qi Guo, Epic Systems
  - Safae Lahjouji, ENSI-Bourges

- Faculty:
  - John Day
  - Lou Chitkushev

- Outside Collaborators:
  - Patrick Phelan, TSSG, Ireland
  - Eduard Grasa, i2CAT, Spain
  - Eleni Trouva, i2CAT, Spain
  - Steve Bunch, TRIA Network Systems
More @
http://csr.bu.edu/rina