Building a Coreless Internet Without Ripping Out the Core

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All clients have access to all resources.
The Reality

- Access to network resources is a function of location within the topology.
Blossom Approach

- A peer-to-peer overlay network for sharing perspectives.
A Coreless Internet: the meaning of names and addresses is a function of their context.
“The IP suite imposes a single networking model and addressing scheme over the many different underlying network types it supports... Although helpful for a number of years, while the network was undergoing its initial ‘big bang’ phase, the approximations in the model are now becoming too out-of-step with reality.”

—Jon Crowcroft et al., *Plutarch*, 2003
“Without consensus, some experts say that countries might move ahead with setting up their own domain name system, or DNS, as a way of bypassing Icann.

“The United States argues that a single addressing system is what makes the Internet so powerful, and moves to set up multiple Internets would be in no one’s interest.”

—Tom Wright, “EU Tries to Unblock Internet Impasse.”

_The New York Times_, 30 September 2005
Some Types of Fragmentation

- **Firewalls** (Security)

- **NAT**
  - Network Isolation (Management)
  - Perception of Address Scarcity (Business Model)

- **Others**: Content Filtering, Multiple Namespaces (Political), Anycast (Efficiency), etc.
The Inherent Conflict

- **Homogenization** promotes universal access and consistency
- **Fragmentation** provides distributed management and location specificity
- Both are *essential* to the success of the Internet
Blossom Central Principles

• [1] Eliminate access restrictions derived from how an observer is connected to the network.

• [2] Allow an observer to select a perspective from which to view and access network resources.
What We Gain
Multiple services with the same name may coexist within different local namespaces (meaningful names within a local space).
What We Gain [2]: Universal Access

If A can talk to B and B can talk to C, then B can talk to C on behalf of A (circumvent technical barriers).
What We Gain [3]: Distributed Management

Adding a network and its abundance of resources to the system need not require specific allocation of names, addresses, or routing from centralized authorities.
What We Gain [4]: Deployability

- Must function in the absence of explicit participation of service providers:
  - Network access providers (ISPs)
  - Content providers (legacy Internet services)
- Must provide substantial benefit in the absence of widespread adoption
- Must require minimal (preferably zero) modification to OS or application software
Our implementation uses Tor to build circuits.
Blossom Setup

resources

directory

clients
Establish persistent connection
Publish to directory server

resources

F1

F2

directory

F3

cients
"C
"C

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Clients can now access Resources
Coreless Approach:
LOCAL directory servers
Directory Propagation (Control Plane)

d1 via {d4, d2}
d2 via {d4}
d3 via {d4}
d4
d1: {F1, F2, F3, F4}

d1 via {d2}
d2
d3
d1: {F1, F2, F3, F4}

d1
d1: {F1, F2, F3, F4}

F1
F2
F3
F4
Design Tradeoffs (What We Lose)

- New **Namespace** Constraints.
  - Do we need globally unique identifiers?
  - Do we need a new DNS?

- New **Discovery** Constraints.
  - Request forwarders by attributes rather than name

- New **Scalability** Constraints.
  - Directory Size.
  - Control Messages.
Empirical Questions

• How far can Blossom scale...
  – ...before connection latency becomes intolerable for users?
  – ...before directory sizes become unmanageable?

• What can we do to minimize the size and frequency of control messages?

• How can we measure the performance of our transport mechanism (e.g. Tor)?
Philosophical Questions

• What do we lose by building circuits rather than sending independent datagrams?

• How can we use Blossom to enhance Internet search?

• How can Blossom co-exist with reasonable policies established to restrict access to Internet resources?

• How can Blossom co-exist peacefully with unreasonable causes of fragmentation (e.g. oppressive regimes)?
http://afs.eecs.harvard.edu/~goodell/blossom/
Routing Around Obstacles

- **TRIAD** (Cheriton/Gritter 00)
  - uses globally-unique, hierarchical, DNS-style names to identify networks
  - names propagate through system using BGP-like advertisements

- **RON** (Andersen et al. 01)
  - heal network topology by responding faster than BGP
  - limited to small confederations
Indirection

- I3 (Stoica et al. 02)
  - register services with the infrastructure
  - use a commonly-accessible rendezvous point for connectivity
  - substantial inspiration for later work
Decoupling Policy from Mechanism

- **FARA** (Clark et al. 03)
  - create associations between nodes without requiring global namespace
  - provides a general framework for discovery

- **Platypus** (Snoeren/Raghavan 03)
  - enforce routing policy should on forwarding plane rather than control plane
  - relies upon cooperation from network access providers
Interoperating with Middleboxes

- **UIP** (Ford 03)
  - argument: hierarchical naming provides efficiency/scalability at the cost of flexibility
  - create single, flat namespace for accessing UIP-enabled resources

- **DOA** (Walfish 04)
  - middleboxes no longer considered harmful
  - create network extension boxes to provide seamless e2e access to DOA resources
Non-Universal Namespaces

- **Untangling the Web** (Walfish 04)
  - DNS hostnames have special value derived from content provided by web services
  - semantic-free referencing to provide globally-unique self-certifying names
  - client resolves names to semantic-free tags using third-party service, uses resolved tag to access content
Extending NATs

- **IPNL** (Francis/Gummadi 01)
  - FQDNs as end-system identifiers
  - stateless routers (part of network-layer infrastructure)
  - site-centric: requires configuration and deployment of “frontdoors” between private networks and the core
Embracing Heterogeneity

- **Plutarch** (Crowcroft et al. 03)
  - coreless
  - acknowledges fragmentation as inevitable
  - requires special configuration of middleboxes to act as gateways between “contexts”
  - resolves names via a peer-to-peer search