SelNet
A Virtualized Link Layer

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Overview

- Context
- SelNet description
- Problem 1: Road Warrior scenario
- Problem 2: Distributed Proxy scenario
- Architectural discussion
SelNet Context: Internet IPv4 architecture

- **Collapsing** of identity, access & location
  - Mobility is hard to get right

- **Lack of adjustable** indirection
  - NAT, Proxies, CDNs...

- **Lack of extensible** naming & addressing schemes
  - Stuck with DNS + IPv4

- The deployment problem
  - No IPv6, Multicast, QoS, mobility…
SelNet

SelNet is a virtualized link layer (underlay network)

Its components are:

- **Packet Processing Functions (PPFs)**—typically forwarding functions, but also transcoding, routing...
- **XRP** (eXtensible Resolution Protocol) — API for steering resolution process
- **SAPF** (Simple Active Packet Format) — Data forwarding via label switching
SelNet Approach

- Don’t attack the network layer, go under it!
- Provide flexible indirection:
  - Network support (routing, mobility etc. . .)
  - Application support (CDN, Proxies etc. . .)
Problem Scenario 1: Mobile Road Warrior

- How to solve this with the IP toolbox
  - NAT for address rewriting?
  - Multiple addresses via Mobile IP?
  - Multiple namespaces via VPN?
**SelNet-style Solution**

- **XRP** – steering resolution activity
- **SAPF** – data forwarding via label switching
Under the hood

Remote node behind firewall

- Registers with distributed clearing house (i3?)

Client node

- Discovers current mappings from clearing house
- Contacts waypoint node via XRP
- Sets up SAPF path to destination via waypoint
- Resolution process maps remote node to local network

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What’s the difference?

- No IP-in-IP tunneling required
- Just SAPF header added to packet
- **Identity** of node not obscured, just location
- Network operator can restrict which nodes export their presence
Problem Scenario 2: Distributed Proxies

One Terminal, Multiple Usage
We envision that users prefer to carry only one terminal but with multiple usage. Such terminal must then be configurable.
Problem Scenario 2: Distributed Proxies part II

- Small, mobile devices with widely varying access networks
- Content adaptation for small displays or low-bandwidth links
- Create per-session service overlay
- Fight against the overly direct Internet
Issues with current distributed proxy architectures

- Source routing
  - How to route between proxies?

- Reverse path
  - Ensure that it is the same as the forward path

Indirection in a user-defined way is difficult
Another SelNet-style Solution

XRP query: what is desired & how to get it
Differences?

- Source routing
  - XRP discovery sets up custom route
- Reverse path
  - XRP back pointers force correct reverse path

User-controlled indirection mediated by server
Some thoughts on access control...

No communication can take place until resolution is complete

- Intermediate nodes have to approve
  - destination
  - method of reaching destination

- Can be complex or trivial:
  - Route all IPv4 traffic
  - Route only traffic which conforms to a policy

Who is allowed to do what indirection?
Temporary Networking

**Temporary Networks** are on the rise

- Custom, bespoke networks per service/application
- Short-lived but still full citizenship
- State/complexity trade-off a big issue
- Information flow – core to edge & vice versa
Architectural issues

Indirection seems to be a key issue

- Lack of controllability in the current Internet
- Loose-source routing was the way to go
- Also achievable via naming
- Cause of current stress + patches
Where is indirection placed currently?

Multiple proposals, multiple places

- Mobile IP – Attached to the side of IP
- NAT – indirection in the access network
- Dynamic DNS – naming is the key
- Proxies – application-specific indirection
Related Work on Indirection

- **Internet Indirection Infrastructure** (Stoica et al.)
  - Rendezvous-style communication for IP
- **Role-based Architecture** (NewArch project)
  - From Protocol Stacks to Protocol Heaps
- **Nimrod** (Chiappa et al.)
  - Loose Source Routing & LS Algorithms
- **Plutarch** (Crowcroft et al.)
  - Multiple Contexts bridged together with IFs
Conclusions

- **Indirection** scenarios problematic for IPv4 + DNS
- SelNet provides *native* support for *adjustable* indirection
- Rough prototype implemented, needs further refinement
- State/complexity management of XRP future challenge