

Lecture 33

CS625: Advanced Computer Networks
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<http://www.cse.iitk.ac.in/users/braman/courses/cs625-fall2003/outline.html>

Topic for today

- IP Next Generation, IPv6
- IP Next Layer (IPNL) [FG01]
- *Scribe for today?*

IPv4 Address Exhaustion

- Exponential growth of the Internet
 - Address space exhaustion
- First fix: CIDR (Class-less Inter-Domain Routing)
 - Further growth ==> eventual address space exhaustion
- Network Address Translation (NAT)
 - Solution emerged out of need
 - Not standardized from inception

NAT: Pros and Cons

- Advantages:
 - Expands IPv4 address space
 - Site isolation: benefits provider and customer
 - Site can be attached to multiple ISPs, without appearing on the default-free BGP entries
- Disadvantages
 - Prevents peer-to-peer applications
 - No globally visible address
 - Port and address translation problems for many applications: e.g., H.323 or SIP
 - New application addition is difficult
 - Breaks end-to-end semantics

Solving IPv4 Address Exhaustion

- Two possibilities
- NAT extended architecture
 - IP Next Layer (IPNL) [FG01]
 - Preserves “characteristics” of IPv4
 - May be acceptable
- IPv6
 - Much bigger address space
 - Other flexibilities as well
 - Need transitioning approach

IPNL Overview

- Features:
 - Hosts have long-lived, global addresses
 - Routers are stateless
 - Network address prefix is independent of location
 - Packets cannot be easily hijacked
- Implementation:
 - Changes to end-hosts and NAT-boxes
 - IPNL layer in-between IPv4 and transport
 - No changes to routers, or DNS

IPNL Architecture

- Some definitions:
 - Realms: private and global/middle
 - NL-routers: front-door, internal
- Routing based on FQDN (Fully Qualified Domain Name) or IPNL address
- IPNL treats IPv4 as a multi-access link-layer
 - At every NL-router, IPv4 address in packet is changed
 - IPv4 address does not have any meaning beyond a realm

Routing by FQDN

- DNS zone associated with a realm
- Zone-based routing information at NL-routers
 - Dynamic routing
 - Routing entries for all zones behind a front-door
- FQDN lookup at the beginning of connection
 - DNS record points to the middle-realm IP of front-door

Routing by IPNL Address

- IPNL Address:
 - 4 bytes of Middle-Realm IP (MRIP) of front-door
 - 2 bytes of Realm Number (RN)
 - 4 bytes of End-Host IP (EHIP)
- RN and EHIP are *not* globally unique
- NL-routers also know to route by RN
 - Similar to BGP

IPv6

- Larger address space: 128 bits
- Efficient and extensible IP datagram