Addressing Issues

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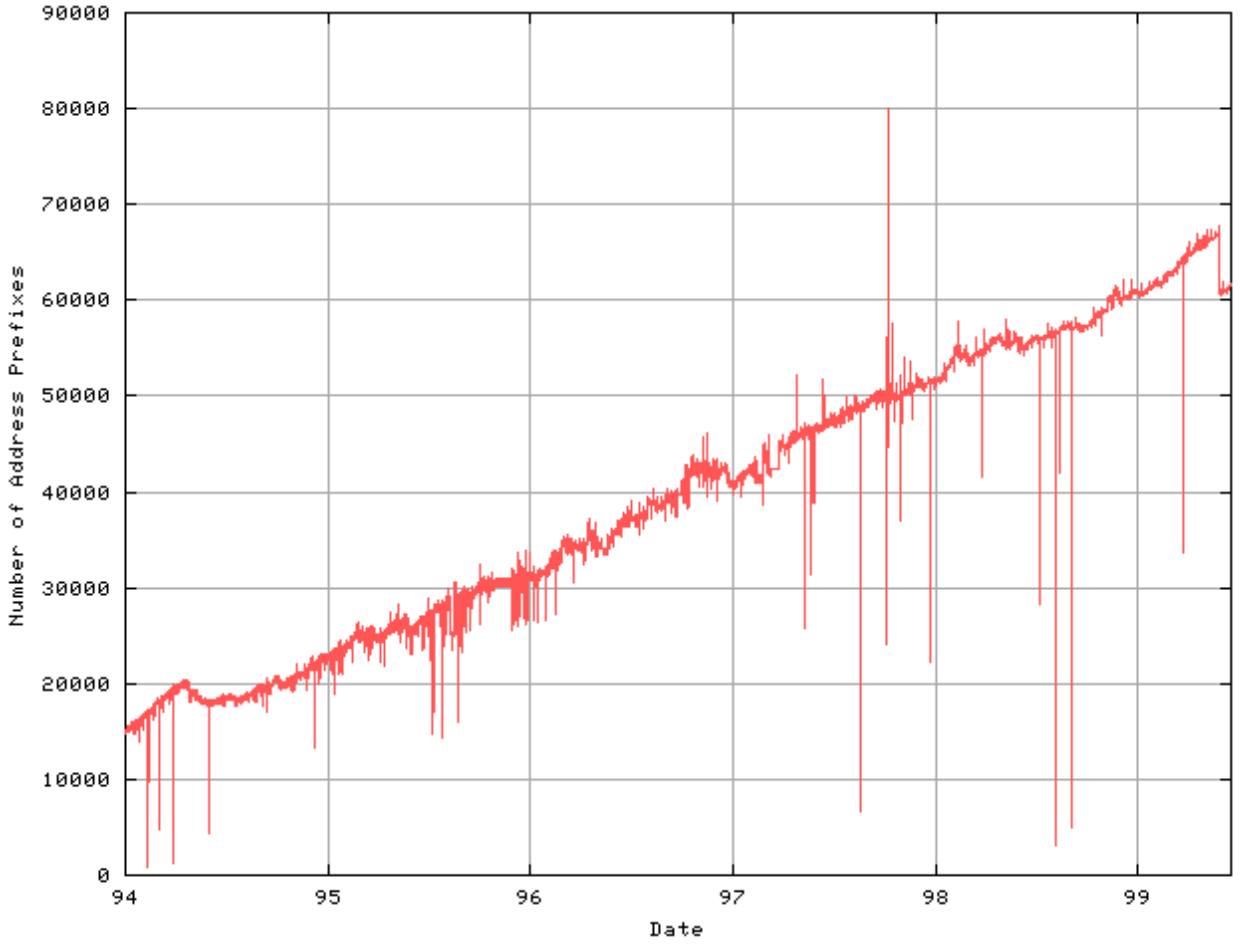
Addressing Issues

- Routability, hierarchical addressing, and address ownership
- Address Scarcity
- Allocation Policies
- Static vs. Dynamic/Private vs. Global Addressing
- Multi-homing and Virtual Hosting
- Confederations/National NICs

Routability

- The Internet is growing fast
  - Faster than router vendors can keep upgrading router technology (and keep router prices reasonable)
- Every address allocated outside a service provider block must show up in the global routing tables
  - The number of entries in those tables are very limited
  - Every update to those entries must be propagated globally
- Some service providers are filtering out smaller globally routed allocations
  - Smaller allocations affect fewer people and tend to “flap” more
  - If ISPs don’t filter, their routers melt

Internet Routing Table Growth



Hierarchical Addressing

- The only way high performance large networks can get larger is if you hide information
  - Details always take time/resources to process
- One way to hide information is to aggregate it
  - +65 aggregates all telephone numbers in Singapore
  - “Ulaan Bataar”, Mongolia aggregates all postal addresses in Ulaan Bataar
  - 202.12.28.0/22 aggregates all 1024 hosts from 202.12.28.0 - 202.12.31.255
- Internet addresses are hierarchically assigned
  - Service providers get a block from a regional registry
    - The ISP’s customers get address from that ISP block
      - The ISP customer’s customers get addresses from the customer block

Address Ownership

- The problem with hierarchical addressing?
  - If a site changes providers, it should renumber out of the old provider's address space into the new
    - If not, the non-aggregatable addresses be treated the same as top level aggregated addresses
      - i.e., must show up in the global routing tables
  - This implies the service providers own the addresses not the customers
- Renumbering can be expensive
  - Dynamic addressing can help

Address Scarcity

- The Internet is growing fast
  - There are concerns that 4,294,967,295 addresses are not sufficient
    - Especially given an average utilization < 1%
  - Some people think we have already run out of IPv4 addresses
- However:
  - Only about half of the address space has been used
  - New technologies (NAT, ALG) reduce the need for addresses
  - As address gets scarcer, organizations will have incentive to use it more efficiently

Address Registry Policies

- RFC 2050 documented address allocation procedures
  - Documents current practice
    - Took two years to write
    - Makes no claims whether current practice is a good idea or not
- Policies documented by RFC 2050 were defined by the “Internet Community”
  - An uneasy balance between end users and service providers
- Official authority is the IANA
  - But where does the IANA get its authority?

Static vs. Dynamic Addressing

- Dynamic addressing
  - When dialing up to the Internet, addresses assigned when the modem connects
  - LANs can be configured so that machines get Internet addresses when they boot
- Efficient use of address space
  - Only those machines on the net have addresses
- Can be inconvenient

- Static Addressing
  - Addresses are assigned to the user or the machine, regardless of whether it is connected
- Can be convenient as Internet connectivity OK over physical disconnect/reconnect
- Can be less efficient in use of address space
  - Particularly if users have multiple dialup accounts

Private vs. Global Addressing

- Private addressing
  - Use of networks that cannot be routed on the Internet with address translation techniques to provide Internet connectivity
- Very efficient
  - Only one Internet address necessary for an entire site
- Controversial
  - Thought to break fundamental TCP/IP assumptions
  - Adds another point of failure
- Global Addressing
  - Using normal Internet addresses
- Can be particularly wasteful for sites which do not connect to the Internet or do so through firewalls
  - Don't really need global addresses for this
- Provide most flexibility in case site decides to connect to the Internet

Multi-homing

- Multi-homing is defined as a single site having multiple connections to the Internet
  - Usually done for reliability reasons
    - But may not offer the level of reliability thought
- For multi-homing to be effective, addresses must be in the global routing tables
  - The less aggregated the address, the more likely it will still be visible if part of the network goes away
  - But, filters still apply...

Virtual Hosting

- The WWW protocol (HTTP 1.0) is broken
  - Each web site requires an additional IP addresses, even though a single machine can host multiple web sites
  - Results in a single machine having hundreds or thousands of addresses
- Fixed in HTTP 1.1
  - But a lot of browsers won't understand 1.1 for a while

Confederations/National NICs

- APNIC and ARIN have an intermediate layer between the regional registry and the ISP
  - Confederations of service providers, perhaps organized by national boundaries (national NICs)
- Can provide better local support
  - For the same reason the regional registries were created
- Can contribute to the global routing load
  - Unless the confederations only assign to ISPs

Internet Protocol Version 6

- People were (are) very worried about running out of address space
  - 2^{32} just doesn't go as far as it used to…
- IPv6 fixes this problem and some others
  - 128 bits of address space
    - 340,282,366,920,900,000,000,000,000,000,000,000+ possible addresses
  - Simplifies IP header, adds more easily processed options, includes "flow tags"
- Prototype implementations available from most vendors
  - ISPs less than enthusiastic
    - IPv6 does not solve routing problems

Summary

- Internet Addresses are a critical resource managed via a hierarchy of allocation entities
  - ISPs are the normal allocators for most
  - Regional registries generally allocate to ISPs
- Efficiency of use predominates concerns
  - Primarily due to routability requirements
  - Also concerns about availability of addresses
- IPv6 resolves the availability issue
  - But doesn't address the routability issue