Internet Protocol Addresses

What are they like and how are the managed?

Paul Wilson APNIC

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"On the Internet, nobody knows you're a dog..."



"On the Internet, nobody knows you're a dog."

by Peter Steiner, from The New Yorker, (Vol.69 (LXIX) no. 20)

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Overview

- What is an IP address?
 - …and what it is not
- What is an IP address like?
 - IP address characteristics
 - ...and functions as an identifier
- How are IP addresses managed?
 - A brief history
 - Address management today

What is an IP Address?



What is an Address?

- An identifier which includes information about how to find its subject (according to some rules of interpretation)
- Normally hierarchical
 - Each part provides more specific detail
- For example...
 - APNIC, Level 1, 33 Park Rd, Milton, Brisbane, Australia
 - -www.apnic.net
 - pwilson@apnic.net

What is an IP Address?

- Internet identifier including information about how to reach a location (via the Internet routing system)
- IPv4: 32-bit* number
 - 4 billion different addresses available
- IPv6: 128-bit number
 - 16 billion billion addresses available
- For example...
 - -202.12.29.142
 - A computer within APNIC's network (202.12.29/24)



Internet Address Routing





Internet Address Routing



What else is an IP Address?

• IP addresses are...

Internet infrastructure addresses

– a finite Public Resource

- not "owned" by address users

not dependent upon the DNS

IP does not mean "Intellectual Property"





IP Address Characteristics

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What is "my" address?

- IP Address = Network interface address
 - Not a computer's address
 - Nor a person's address





Is "my" address unique?

• Not necessarily...

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- Public IP address = unique
- Private* IP address = non-unique



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Is IPv6 different?

- Interface address
 - Identifies a network interface
 - Not a person or computer
- Permanence?
 - Addresses may be transient
 - Due to need for Provider-based addressing
- Uniqueness?
 - All devices should have a public address
 - Due to much larger address space

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Summary so far

- IP Addresses identify location
 Provide specific information for routing
- IP Addresses identify interfaces

 Not computers, companies or users
- IP Addresses often change
 - And may not be unique
- IPv4 and IPv6 addresses are identical – Exception: uniqueness





IP Address Management

Early Address Management

- Early 1990's: Internet scaling problems
- Address depletion
 - due to classful architecture
 - 3 choices: A, B or C
- Routing table overload
 - Due to lack of route aggregation
- Internet widely projected to fail
 - Growth would stop by mid-'90s
 - Urgent measures required
 - Action taken by IETF / Internet community

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Global Routing Table: '88 - '92



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Evolution of Address Management

- 1993: Development of "CIDR"
 - addressed both technical problems
- Address depletion
 - Through more accurate assignment
- Routing table overload
 - Through address space aggregation
- Administrative problems remained
 - Increasing complexity of CIDR-based allocations
 - Increasing awareness of conservation and aggregation goals
 - Need for fairness and consistency

Evolution of Address Policy

- RFC 1366 (1992)
 - Described the "growth of the Internet and its increasing globalization"
 - Additional complexity of address management
 - Set out the basis for a <u>regionally distributed</u> <u>Internet registry system</u>
- 1990s establishment of RIRs
 - APNIC, ARIN, RIPE NCC (LACNIC later)
 - Regional open processes
 - Cooperative policy development
 - Industry self-regulatory model

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About APNIC

- Regional Internet Registry for the Asia Pacific
 - 800 ISP members in 42 economies
 - 7 National Internet Registries
 - Established in 1993
- Non-profit service organisation
 - IP address allocation and registration
 - Training and education
 - Infrastructure activity: Root servers
- Community
 - Open Policy Meetings
 - Co-founder of APRICOT
 - ISOC member Platinum programme
 - ITU Sector Member



IP Address Management

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Address Management Objectives

Conservation

- Efficient use of resources
- Based on demonstrated need

Aggregation

- Limit routing table growth
- Support provider-based routing

Registration

- Ensure uniqueness
- Facilitate trouble shooting

Policy Development

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- Industry self-regulatory processes
 - Open to all interested parties
 - Facilitated by RIR staff
- Policy implementation
 - RIR processes
 - ISPs and other affected parties

Policy Development Principles

Open

- Anyone can participate
- Regular policy meetings
- Mailing lists

Transparent

- Published minutes
- Policy meeting archives
- Mail list archives
- RIR boards

Bottom-up

- Internet community
- Stakeholders
- Technology interests
- IETF

Documented

- Policy documents
- Implementation procedures

Policy Development Cycle

Need

Open

- Anyone can participate
- Regular policy meetings
- Mailing lists

Evaluate

Transparent

- Published minutes
- Policy meeting archives
- Mail list archives
- RIR boi Discuss

Bottom-up

- Internet community
- Stakeholders
- Technology interests
- IETF Implement

Documented

- Policy documents
- Imp Consensus Jures

Conclusions

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Conclusions

- IP addresses
 - Infrastructure addresses
 - Interface identifiers
 - Very limited use for other purposes
 - NOT useful as generic digital IDs
- IP address management
 - Result of 20 year evolution on the Internet
 - Supported Internet growth to date
 - Stable well-understood system
 - Open to all interested participants

Thank you

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