IPv6 as the Future of the Internet

The Basics

- IPv6 was developed to “overcome the problem of IPv4 address exhaustion” (Bajrami, 2019)
  - 128-bit (2128) addresses, 3.4 x 1038 unique IP addresses.
  - Written in hexadecimal notation, separated into 8 groups of 16 bits
    - Ex: 2001:db8:1234::f350:2256:f3dd/64
  - Can be configured manually, using Stateless Address Auto Configuration (SLAAC) or DHCPv6.
  - Minimum packet size of 1280 bytes
  - Supported by Linux, macOS, Solaris, (Free, Open, and Net) BSD, and Windows.

Disruptive or Sustaining?

- IPv6 could be seen as a **sustaining** technology (Loshin, 2004)
  - Reducing cost of production
    - Advancing an existing technology will have less of tradeoffs (e.g. no need to invest in a completely new protocol/associated technology)
  - Improving performance
    - That which matters to customers (e.g. IPSec protocols)
  - Adding Features
    - Meeting or exceeding customer needs (e.g. an infinite network space)

Pros and Cons (Hoffman, 2020)

- Pros
  - Efficient routing
    - Makes routing tables more efficient
  - Multi-routing
    - Uses multi-cast addressing
  - Directed local access
    - Supports **broadcast**, which allows “in-depth packet flow”
  - Increased capacity and network configuration
    - “resources are efficiently allocated to accommodate any other web addresses”
  - More mobility
    - Avoids triangular routing

Pros and Cons (Hoffman, 2020)

- Cons
  - System issues
    - IP addresses must be entered manually and memorized
  - Complexity in network topology
    - Prefixes are not easily fit – “the text is barely legible”
  - Device upgrade
    - Networking device enhancement; consultants may be required
  - Local networking changes
    - Manual IP address assignment
  - Confusion in the IP schemes
    - Lack of automatic backward compatibility with IPv4

Pros and Cons (Hoffman, 2020)

- IPv6 and IPv4 can be used together
  - Dual-stack network
    - Both protocols are run together
    - Can be supported by major network carriers
  - Tunneling
    - One protocol can tunnel inside the other
    - Does not disturb connectivity
  - NAT-PT
    - Mechanism which “translates the IPv6 packets in IPv4 packets”

Future Outlook

- IPv6 will be a gateway to backwards compatibility with Ipv4 – 4.3 billion addresses (BlueCat, 2023; Hoffman, 2020)
- Invented with security in mind (Hiley, 2022)
  - Encryption with IPSec
    - Requires good key management – especially public keys (Turnbull, 2005)
- Several optional security features (Brumley, 2022)
  - Data confidentiality
  - Data integrity
  - Data origin authentication
  - Anti-replay of packets

Conclusion

- IPv6
  - Gateway to IPv4 compatibility
  - Sustainable technology for current vendors
  - IPSec protocols
  - Overall continuity for network access

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