Site Multihoming and Provider-Independent Addressing using IPv6

Dipl.-Ing. (M.Sc.) Dirk Henrici
University of Kaiserslautern, Germany
Group Integrated Communication Systems
email: henrici@informatik.uni-kl.de
Outline

Renumbering and Multihoming in IPv6

- Motivation and Challenges
  - Renumbering
  - Multihoming

- Current Practices and Research
  - IPv4
  - IPv6

- Our Approach
  - ULIDs
  - NetMapping
Hierarchical routing in IPv6

⇒ A site needs to be renumbered if its ISP is changed
Motivation

Multihoming

➔ create failsafe Internet connection

Hierarchical routing in IPv6

➔ Each host has more than a single IP address
Renumbering

- not feasible in practice in large networks
  (even if hostnames are used wherever possible)
  because:
  - much planning and many steps required
  - renumbering without interruption of services difficult
  - auto-configuration features not sufficient
  - IP-based access control lists in routers, firewalls etc.
  - IP-addresses present in configfiles of servers (e.g. resolv.conf)

- categorically avoid the need to renumber a network
Challenges

Multihoming

**Functionality**
- transport-layer survivability
- traffic engineering capability
- enforcement of administrative policies
- route selection by hosts optionally possible

**Basic Requirements**
- scalability
  (neither affect IPv6’s hierarchical routing nor inject BGP routes)
- security

**Manageability**
- do not affect the end-to-end model
- simple setup and administration
- do not require new infrastructure

**Feasibility**
- do not require changes in hosts
- do not require cooperation between ISPs
- compatible to existing Internet standards
  (e.g. permit ingress and egress filtering)
- transition possible without a flag day
Current Practice: IPv4

IPv4 multihoming

Scenario 1: public address space

Scenario 2: IP masquerading

Address of example host: 131.246.9.116

Address of example host: 192.168.1.42
Evaluation

**IPv4 Multihoming**

**Functionality**
- transport-layer survivability
- traffic engineering capability
- enforcement of administrative policies
- route selection by hosts optionally possible

**Basic Requirements**
- scalability
  (neither affect IPv6’s hierarchical routing nor inject BGP routes)
- security

**Manageability**
- do not affect the end-to-end model
- simple setup and administration
- do not require new infrastructure

**Feasibility**
- do not require changes in hosts
- do not require cooperation between ISPs
- compatible to existing Internet standards
  (e.g. permit ingress and egress filtering)
- transition possible without a flag day

http://www.icsy.de

Dirk Henrici, AG ICSY, University of Kaiserslautern, Germany
IPv6 multihoming: There is no standardized solution yet.

*RFC 4057: IPv6 Enterprise Network Scenarios; June 2005*

“4.9. Multihoming

At this time, current IPv6 allocation policies are mandating the allocation of IPv6 address space from the upstream provider. If an enterprise is multihomed, the enterprise will have to determine how it wishes to support multihoming. This also is an area of study within the IETF and work in progress.”
Current Practice: IPv6

Approaches to Multihoming
(categorization according to IETF draft)

- Routing
- Mobility
- Identity Considerations
  - Identity Protocol Element
  - Modified Protocol Element
- Modified Site-Exit and Host Behaviors

→ many proposals exist
  e.g. transport layer solution (SCTP), shim6
First step:
Use “Unique Local Addresses” within sites

- Equivalent to private addresses in IPv4
  - not routable within the Internet
  - but: globally unique

- 1:1-mapping at site-exit routers
  - between UL-addresses and globally routable addresses
    (network mapping: exchange of network prefix)

- Solely use UL-addresses within site
  - solves renumbering issue, eases access control lists etc.

- So far: Simple! But: End-to-end model not completely satisfied

Our solution: “SiMIA”
Second step:
Use UL-addresses for **identifier/locator-split**

- Make UL-addresses available in the **DNS**
  - exploit longest prefix match (RFC3484) & compatibility
- Use **UL-addresses as identifiers** wherever possible
  - always, excepting for Internet routing (locator) and non capable sites
- **Network mapping** at site-exit routers between address spaces

Our solution: “SiMIA”
Our solution: “SiMIA”

Example
Communication between hosts in two sites, both employing “SiMIA”

UL-addresses are used as interface identifiers and as locators within sites

INET-addresses are used as interface locators for ISPs and in the Internet backbone
Assessment of our solution

Multihoming with “SiMIA”

Functionality
- transport-layer survivability
- traffic engineering capability
- enforcement of administrative policies
- route selection by hosts optionally possible

Basic Requirements
- scalability
  (neither affect IPv6’s hierarchical routing nor inject BGP routes)
- security (but we need to be careful!)

Feasibility
- do not require changes in hosts
- do not require cooperation between ISPs
- compatible to existing Internet standards
  (e.g. permit ingress and egress filtering)
- transition possible without a flag day

Manageability
- do not affect the end-to-end model
- simple setup and administration
- do not require new infrastructure
Summary

• Introduction into challenges and current practices regarding renumbering and multihoming in IPv6
• Presentation of the idea behind our solution which is based on
  – Usage of “Unique Local Addresses” in LANs
  – Network mapping in site-exit routers
  – Use UL-addresses for identifier/locator-split

Thank you for your attention!

email: henrici@informatik.uni-kl.de
Publications can be found on our website “http://www.icsy.de”.