IPv6 Support in Home Gateways

Chris Donley

c.donley@cablelabs.com

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Agenda

- Introduction
- Basic Home Gateway Architecture
- DOCSIS® Support for IPv6
- CableLabs eRouter Specification
- IETF IPv6 CPE Router
- IPv6 Transition Technologies
- Ongoing Initiatives

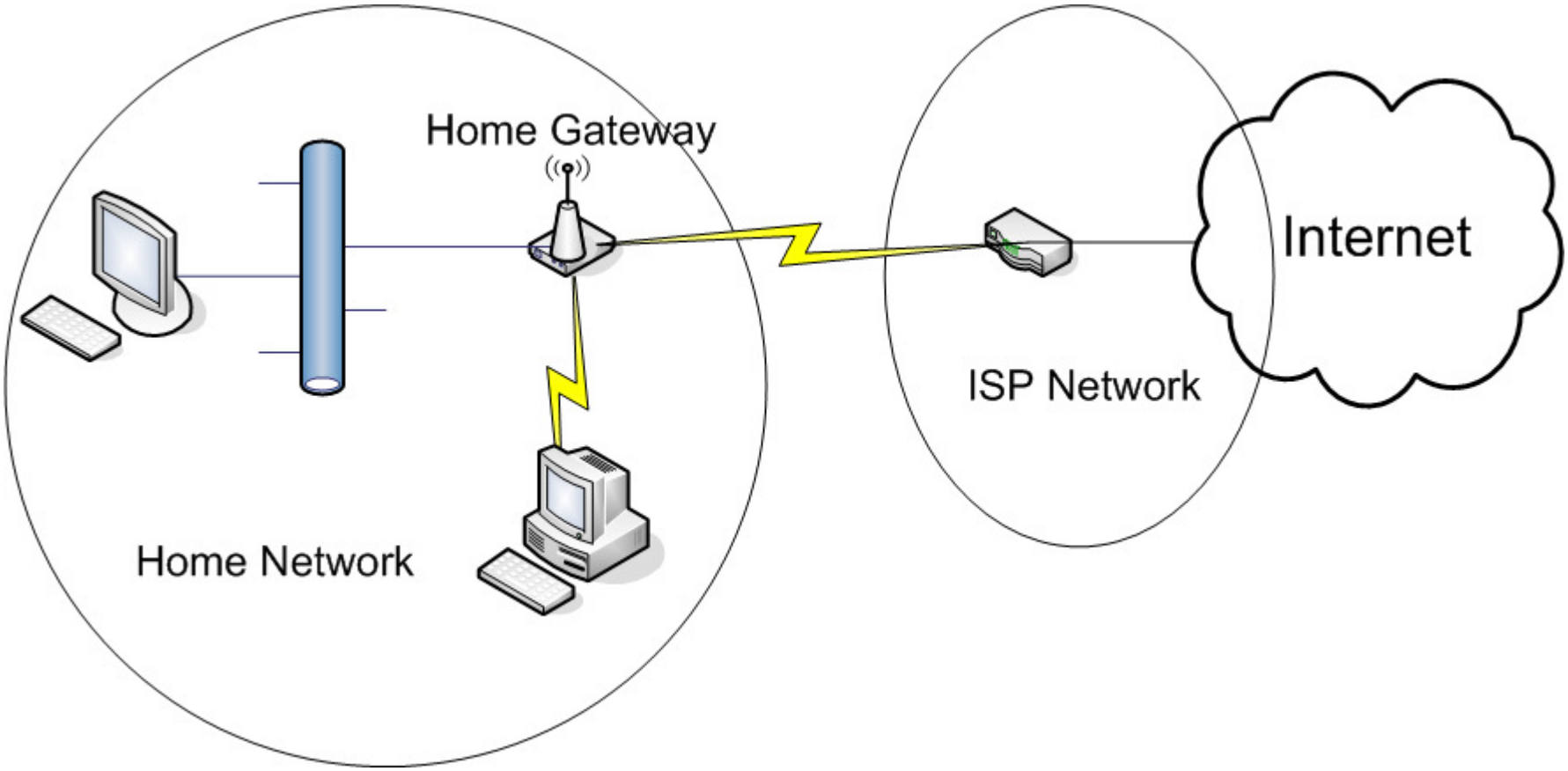
Introduction

- Service Providers are beginning to offer IPv6 service
- Home Gateways are instrumental in determining IPv6 service characteristics
- CableLabs and the IETF have developed compatible specifications for IPv6 Home Gateways
- During the transition to IPv6, co-existence with IPv4 is required
  - » Many clients will not be upgradable to IPv6
  - » A significant amount of content will remain accessible only through IPv4
- As we approach IPv4 exhaustion, new transition technologies such as NAT444, Dual-Stack Lite, and 6RD will be important for such gateways.

Basic Home Gateway Architecture

- Basic IPv6 Home Gateways are envisioned as extensions of existing IPv4 gateways
  - One or two customer-facing interfaces
  - One physical service provider-facing interface
- Gateways assign addresses to CPE devices
  - Stateless Address Autoconfiguration (SLAAC, RFC 4862)
  - Stateful DHCPv6 (RFC 3315)
- Gateways provide some level of security to home networks

Home Gateway Architecture



DOCSIS® Support for IPv6

- DOCSIS specifications define a broadband data network over hybrid fiber coax plant
  - » Cable Modems (CMs) are bridges
  - » Cable Modem Termination Systems (CMTSs) include routers
- DOCSIS 3.0 added IPv6 support in 2006
  - » CM can provision in IPv4, IPv6, or Dual-Stack mode
  - » CMs use stateful DHCPv6 to acquire an IPv6 address
  - » Stateless Address Autoconfiguration not supported
    - – CPEs attached to a Cable Modem must use DHCPv6 to acquire an address
    - – CPEs require a Home Gateway to use SLAAC
  - » CMs and CMTSs forward IPv4/IPv6 subscriber traffic
- IPv6 support has also been added for DOCSIS 2.0 CMs

CableLabs eRouter Specification

- CableLabs developed eRouter in 2006 to define a lightweight IPv4/IPv6 Home Gateway
  - eRouter combines a CM with a CPE router
  - http://www.cablelabs.com/cablemodem/specifications/e-router.html
- WAN-side configuration
  - stateful DHCPv6
  - requests DNS servers
  - requests Prefix Delegation for LAN interfaces
- LAN-side configuration
  - Prefix obtained via DHCPv6 advertised in RA
  - Supports Stateless Address Autoconfiguration (SLAAC) or stateful DHCPv6 for CPE provisioning
  - DNS information shared via DHCPv6 or RFC 5006 Recursive DNS Server option in the RA
- Multicast Proxy
  - Provides support for music/video streaming services

IETF IPv6 CPE Router

- CableLabs and MSOs are working with Cisco and Broadband Forum to define IETF IPv6 Home Gateway requirements
  - Currently an IETF Internet Draft
  - http://tools.ietf.org/html/draft-ietf-v6ops-ipv6-cpe-router-05
- IPv6 CPE Router draft based in part on eRouter
  - Supports stateful DHCPv6 on the WAN
  - Supports SLAAC or DHCPv6 on the LAN
- Includes use cases to support Broadband Forum
  - IPv6 over PPP
  - SLAAC address acquisition on the WAN interface
- Requires “simple security” (packet filtering)
  - http://tools.ietf.org/html/draft-ietf-v6ops-cpe-simple-security-11
- Draft cleared Working Group Last Call, an important step on its way to becoming an RFC

IPv6 Transition

- IPv4 address space is nearly exhausted
- During the transition to IPv6, IPv4 will not be immediately retired
  - » Many clients will not be upgradable to IPv6 and will take several years to be replaced
  - » A significant amount of content will remain accessible only through IPv4
- Implications for Service Providers
  - » Operators will need to continue to provide IPv4 Internet access beyond the IPv4 address exhaustion date
    - – Dual-stack clients will need access to IPv4 content
    - – IPv4 only clients will need IPv4 connectivity

Transition Technologies

- Transition originally planned as a gradual evolution
- Three older technologies are key building blocks
  - » Dual-Stack
    - – Run IPv6 and IPv4 simultaneously
  - » Tunnels
    - – Encapsulate one protocol inside the other
  - » Translation
    - – Convert one protocol into the other using NAT
- Next generation transition technologies are being developed to deal with IPv4 exhaustion
  - » Evolving methods build upon or combine traditional ones to support both protocols

Emerging Technologies for Gateways

- NAT444 ("Double NAT")
  - IPv4-only NAT
  - Performed at Home Gateway and at a Carrier Grade NAT (CGN) in ISP network
- Dual-Stack Lite
  - Combines dual stack, tunneling, and NAT
  - IPv4 traffic tunneled inside IPv6 from the dual-stack Home Gateway to the CGN
  - CGN uses NAT to multiplex multiple subscribers behind a single IPv4 address
  - Allows service providers to leverage IPv6 in the network without requiring a unique IPv4 addresses per subscriber
- IPv6 Rapid Deployment (6RD)
  - Updated 6to4 tunnel encapsulates IPv6 inside IPv4 from the dual-stack Home Gateway to a specific service provider router
  - Allows for rapid deployment of IPv6 when a service provider has not upgraded its access network
  - Offers service providers additional control over the IPv6 tunnel

Ongoing Initiatives

- CableLabs and the IETF have defined compatible Home Gateway specifications
  - » New gateways that support IPv6 offer similar features and services as existing IPv4-only gateways
  - » CableLabs, MSOs, and vendors tested compliant devices in an April interoperability event
- Continued specification development will add support for transition technologies
  - » NAT 444 shares an IPv4 address with multiple devices
  - » Dual-Stack Lite tunnels IPv4 across an IPv6 network
  - » 6RD tunnels IPv6 across an IPv4 network when Service Provider upgrades are not feasible