



IPv6 as a Practical Solution to Network Management Challenges

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IPv6 as a Management Tool – Precursors

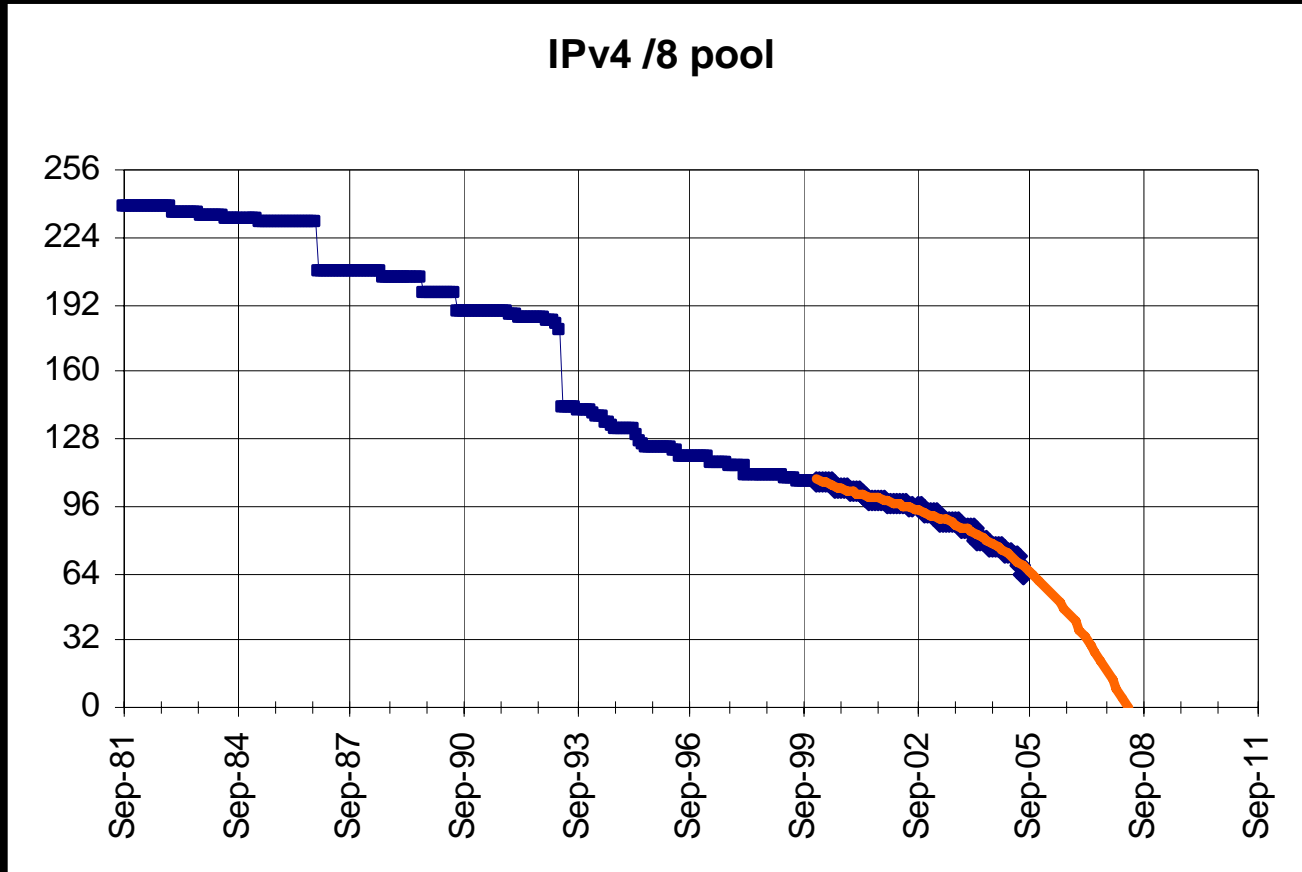
Elements of Network Management

Deploying IPv6 for Network Management Purposes

Conclusions

IPv6 as a Management Tool – Precursors

Typical Drivers - IP Global Addresses



Full discussion in the Sept. 2005 issue of the Internet Protocol Journal
www.cisco.com/ipj

Typical Drivers – New Services

NTT-East rolled out native IPv6 multicast services instead of IPv4 offering IP TV, Music and games:

<http://www.ipv6style.jp/en/action/20040902/index.shtml>



The IPv6 solution is scalable since it allows for the replication to be performed at the Access Layer.

Unforeseen Drivers - IP Private Addresses

- **RFC 1918 is not sufficient for large environments**
 - **COMCAST (IPv6 top priority)**
 - **Time Warner**
- **There was a request to ARIN to increase RFC 1918. It was denied and the guideline was: “get global addresses” -> This leads to faster exhaustion of the global address space**

IPv6 for Management!

- **RFC 1918 limitations can best be addressed with IPv6**
- **MSOs decided to deploy IPv6 first for managing the Cable Modems and other managed devices, later for service. Actions taken:**
 - they analyzed what would work best from a provisioning but also from service perspective
 - working aggressively on standardizing IPv6 support in Cable environments -> DOCSIS 3.0
 - they push the vendors to integrate IPv6 in cable infrastructure devices
 - they started to deploy IPv6 in the core, gaining expertise
 - they are developing requirements for management tools

Elements of Network Management

Aspects of Network Management

- **Access Management** - leverages tools such as Authentication Authorization Accounting (AAA) in order to control and monitor user access to network resources based on subscriptions and policies
- **Provisioning** - leverages a set of tools and mechanisms to deliver an IP address, a prefix or a set of prefixes to a host or a network device. Additional information such as Domain Name, DNS server addresses and TFTP server addresses are also provided in order to enable devices to complete their configuration. DHCP is typically used in IPv4 while in IPv6 stateless DHCP, statefull DHCP and DHCP Prefix Delegation
- **Management Information Retrieval** - essential in collecting the statistics gathered by or available on the network devices. Telnet, FTP, TFTP, SSH or RSH can be used to log into managed devices and collect the necessary information. SNMP and Netflow can be used to collect network device statistics.

Aspects of Network Management (cont)

- **Fault Management** - critical in quickly identifying problems that are impacting services, troubleshooting them and providing the fix necessary to reduce downtimes. Netflow or IPflow along with various topology, routing and forwarding troubleshooting tools can be used to perform this management function
- **Performance Management** tools are used to monitor network's ability to support the requirements of the various services provided such as Data, Voice and Video. This aspect of NM is essential when providing service based on a Service Level Agreement (SLA). Many tools are available to monitor network performance: IP SLA, NAGIOS, MRTG, Weathermap, etc

Deploying IPv6 for Network Management Purposes

Goal

Use IPv6 to provide the infrastructure for network management regardless of supported services and the IP version used to support these services

Implement via IPv6:

- Access Management**
- Provisioning**
- Management Information Retrieval**
- Fault Management**
- Performance Management**

Use IPv6 to create an abstraction layer between the infrastructure and the services

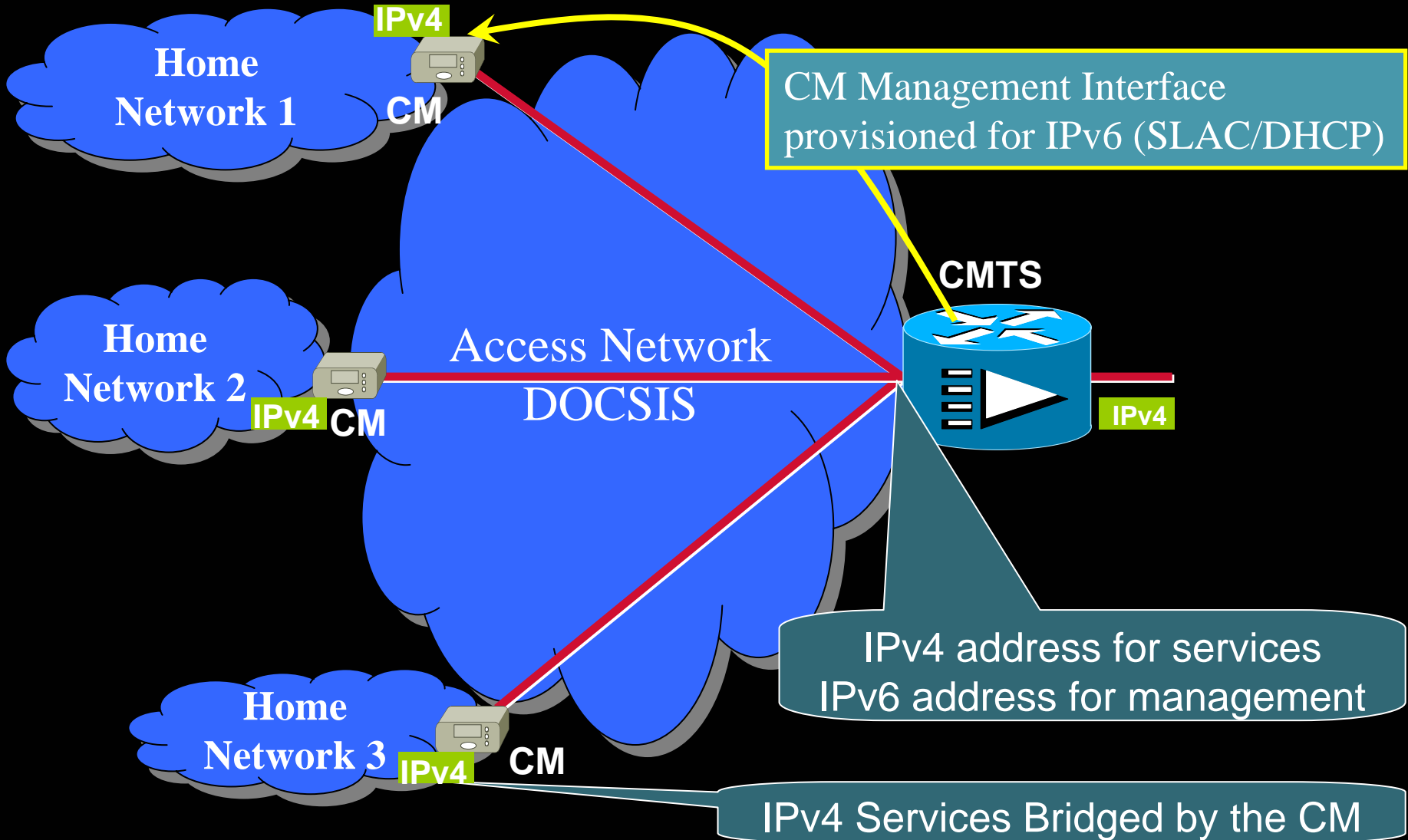
Benefits

- **Little IPv6 traffic and small number of prefixes do not take significant resources away from IPv4**
- **IPv6's larger address space can be used to manage more devices**
- **IPv6 addresses are easy to manage in a hierarchical manner reflecting things such as device type, device location, services supported by the device, etc.**
- **Closed environment facilitates the separation between the control and service planes of the network, it limits the exposure to security threats**
- **IPv6 downtime will not lead to service downtime**

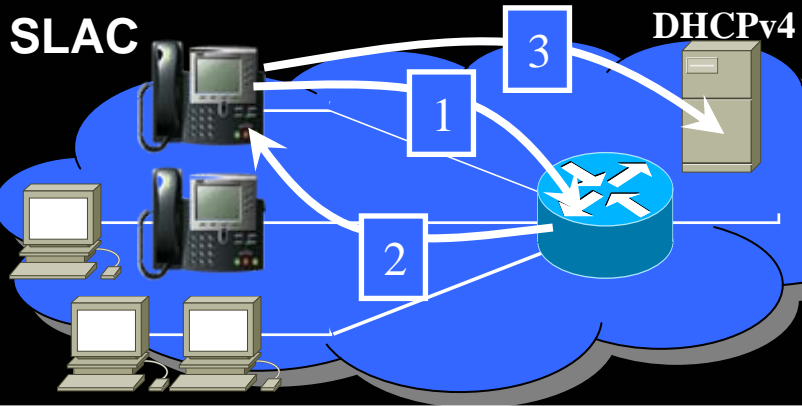
Models

- **Native**
 - IPv6 manages only IPv6 information
- **Hybrid**
 - IPv6 manages IPv6 and IPv4 information

Native Model

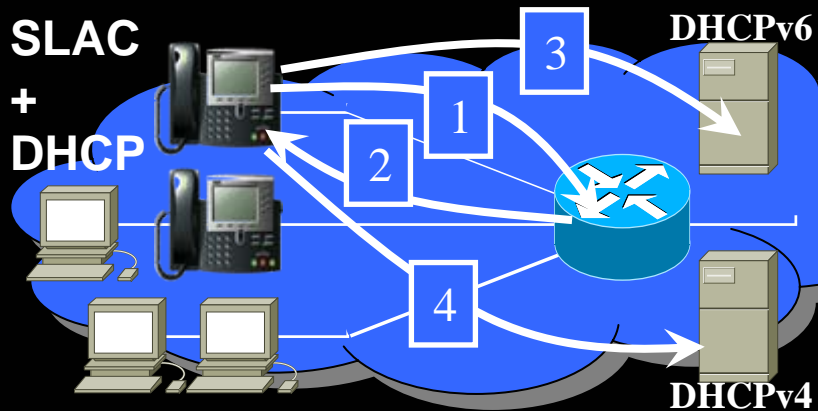


Hybrid Model – Operation Mode

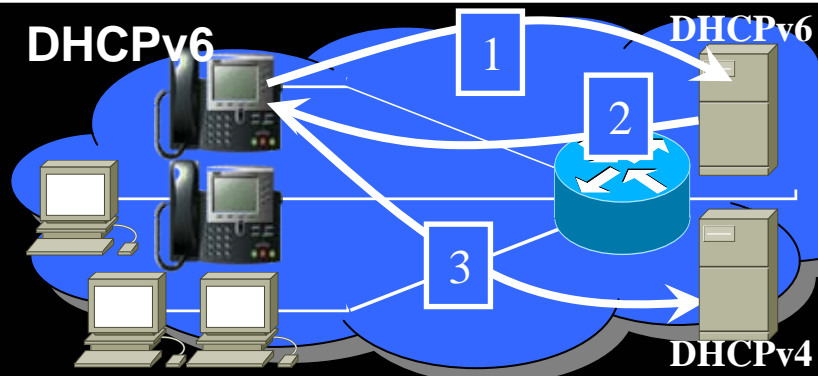


1. Router Solicitation
2. Router Advertisement extended to indicate operation mode: IPv4, IPv6 or dual-stack
3. If so advised, continue with IPv4 provisioning

Hybrid Model – Operation Mode

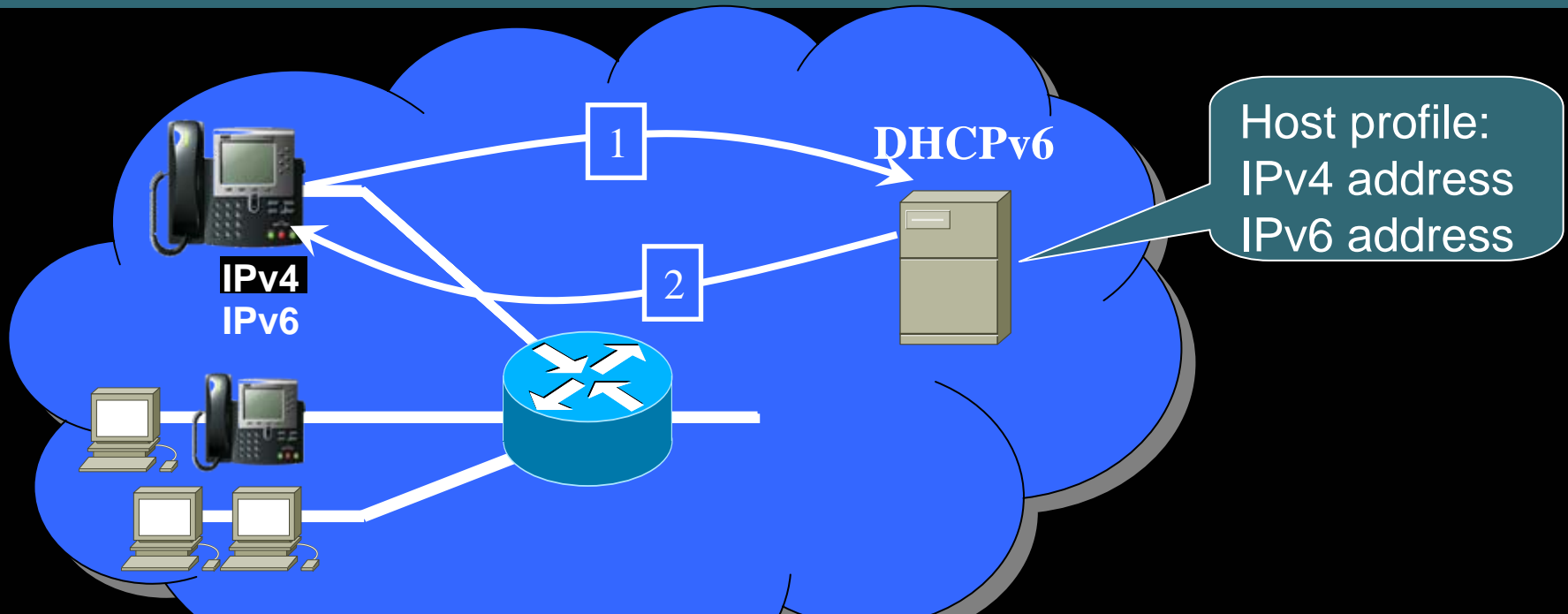


1. Router Solicitation
2. Router Advertisement with IPv6 prefix and O bit set for other config via stateless DHCPv6
3. DHCPv6 request followed by reply with the additional IPv6 info and op mode.
4. If so advised, continue with IPv4 provisioning



1. DHCPv6 request
2. IPv6 provisioning and op mode: IPv4, IPv6 or dual-stack
3. If so advised, continue with IPv4 provisioning

Hybrid Model - Consolidated Provisioning

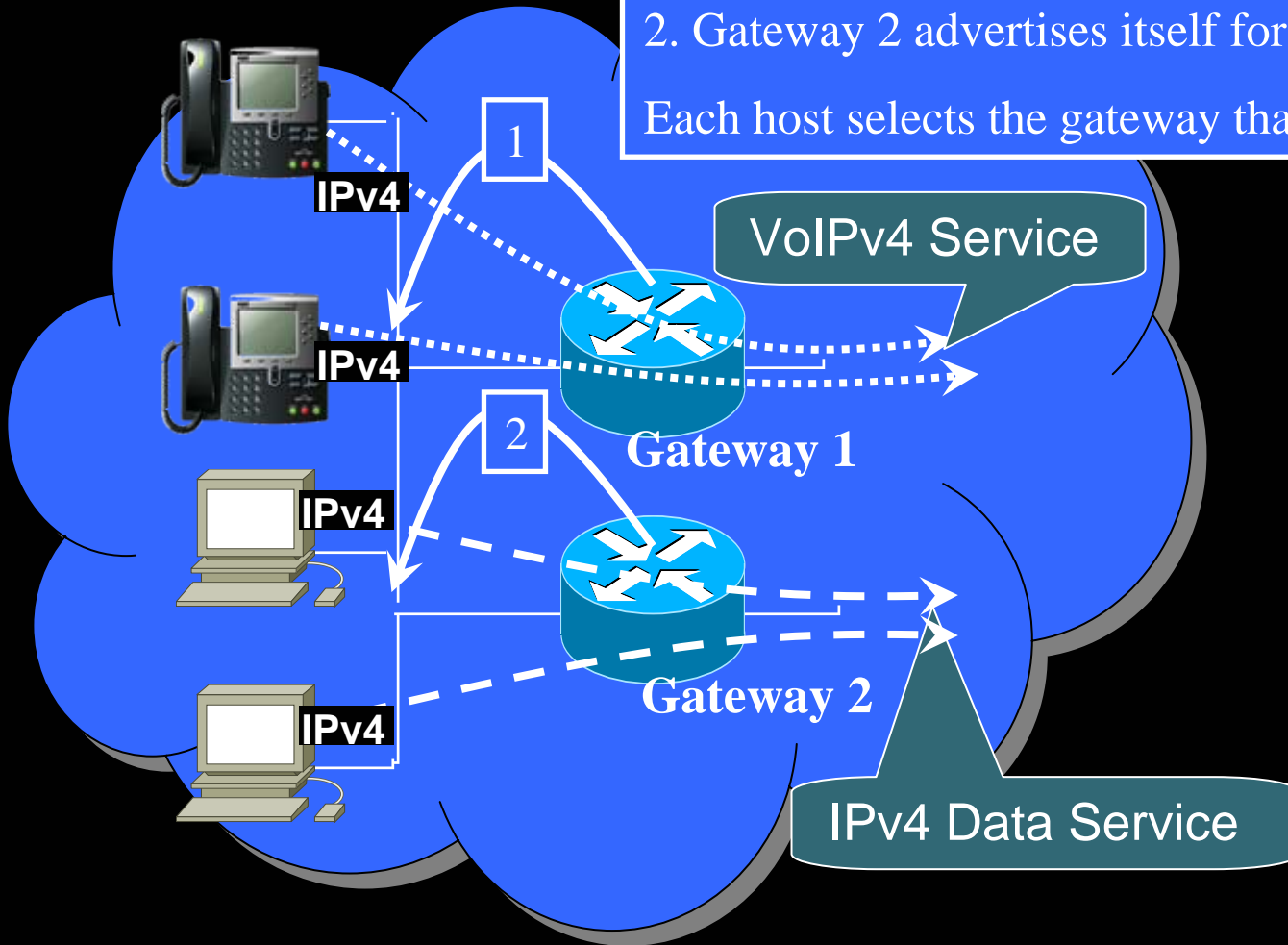


The host is either configured for statefull auto-configuration or it is instructed through Router Advertisement to use the DHCPv6 server

- 1) Request sent to DHCPv6
- 2) Based on the host profile, the DHCPv6 server responds with either an IPv6 address or both an IPv6 and an IPv4 address. Optionally, the reply can indicate the recommended host operation

Hybrid Model – Topology Discovery

1. Gateway 1 advertises itself for VoIP services
 2. Gateway 2 advertises itself for Data services
- Each host selects the gateway that suits its service needs



Statefull vs Stateless

- **Stateless – big promise but A good idea but it could be developed further for more leverage, for more scalability**
- **Statefull – originally discounted by IPv6-ers as a provisioning option but it returned with a vengeance, developed more features and capabilities**

Both have their role but stateless has a lot of growth potential.

Conclusions

- **Using IPv6 for network management is a very practical option**
- **Expand its use in this context, leverage some of its specific tools to create an abstraction layer**
- **Work in progress**

References

- **“Deploying IPv6 Networks” Cisco Press, 2006**
<http://www.ciscopress.com/title/1587052105>
- **J. Brzozowski, “Managing IPv6 Deployment and Co-existence”, 6sense, July 2005.**
- **R. Draves and D. Thaler, "Default Router Preferences and More-Specific Routes", RFC4191, November 2005.**
- **J. Arkko et al., “SEcure Neighbor Discovery (SEND)”, RFC3971, March 2005**

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