



IP Next Generation

IP Next Generation - Agenda

- **Rationale behind IPv6**
- **Protocol Features**
- **Transition Strategy**
- **Routing**
- **IPv4 functionality comparison**
- **IPng Standards Status**
- **Conclusion**

Rationale behind IPv6

- **Address depletion concerns**
- **Opportunity to optimize on many years of deployment experience**
- **Integrate multimedia, security, autoconfiguration etc.**
- **Protocol remains the same in principal**

IPv4 Address Depletion ?!

- **Perceived address space depletion** (circa 1994)
- **Routing Table explosion**
- **Unsuitability of Class “B” addressing**
- **CIDR/Supernetting developed as medium term reprieve**
 - Address allocation plans and Routing protocol support**
 - Today 40,000 routes carried on Internet backbone**
- **Current IETF estimates - sufficient addresses until year 2010**

IPng Features/Functionality

- **Expanded Address Space**
- **Autoconfiguration**
- **Class of Service/Multimedia support**
- **Security**
- **IPv4 ↔ IPv6 Transition Strategy**



Expanded Address Space/Optimization of IPv4

IPv4 Header:

Version	IHL	Type of Service	Total Length	
Identification			Flags	Fragment Offset
Time to Live	Protocol		Header Checksum	
Source Address				
Destination Address				
Options				Padding

- **Address space quadrupled to 16 bytes**
- **Fixed Length**
(optional headers daisy-chained)
- **No Checksumming**
(Done by Link Layer)
- **No hop-by-hop segmentation**
(Path MTU discovery)
- **Flow Label/Priority**
(Integrated QoS support)

IPv6 Header:

Version	Priority		Flow Label	
Payload Length			Next Header	Hop Limit
Source Address				
Destination Address				



IPv6 Autoconfiguration

- **Stateless**

 - Host autonomously configures its own address

 - Link Local Addressing**

 - (single subnet scope, formed from reserved prefix and link layer address)

- **Stateful**

 - DHCPng

- **Addressing Lifetime**

 - Facilitates renumbering

 - Addresses defined as valid, deprecated or invalid



IPv6 Class of Service

- **Flow based, defines “flow label” and “priority”**
- **Designed for premium services/real-time multimedia**
- **Well suited to carrying Tag value for expedited Cisco IOS™ Tag Switching**
- **Can be combined with Source Routing header options**
- **Currently work in progress**

RSVP with IPv6

IPv6 <----> ATM QoS

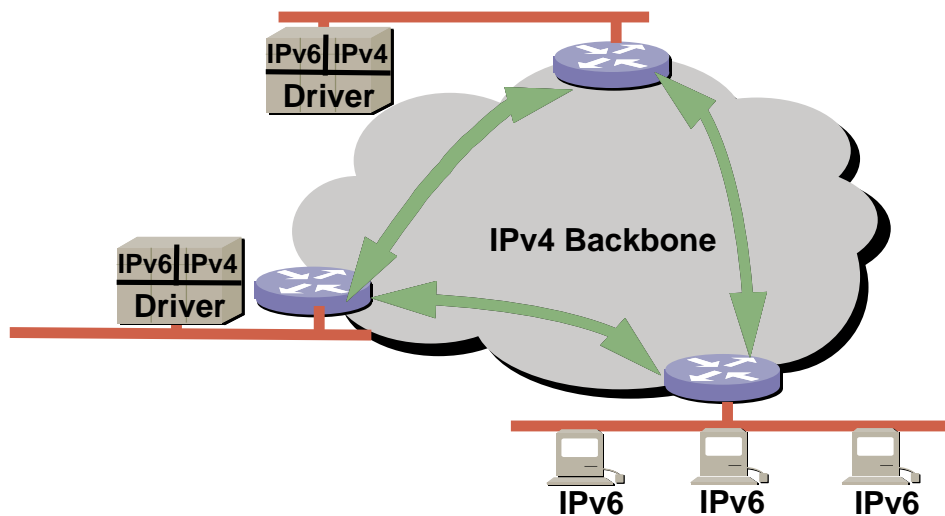


IPv6 Security

- **Authentication/Integrity without confidentiality**
 - Current exportability considerations
- **Authentication - MD5 based**
- **Confidentiality - DES in Cipher Block Chaining (CBC) mode**
 - encrypt entire datagram or IP payload
- **Retain existing use of (packet filtering based) firewalls**

▶ IPv6 Transition Strategy

- **Goal - facilitate partial/incremental upgrades**
(Hosts, Servers, DNS, Routers)
- **Host approach - Dual Stack (IPv6 API defined)**

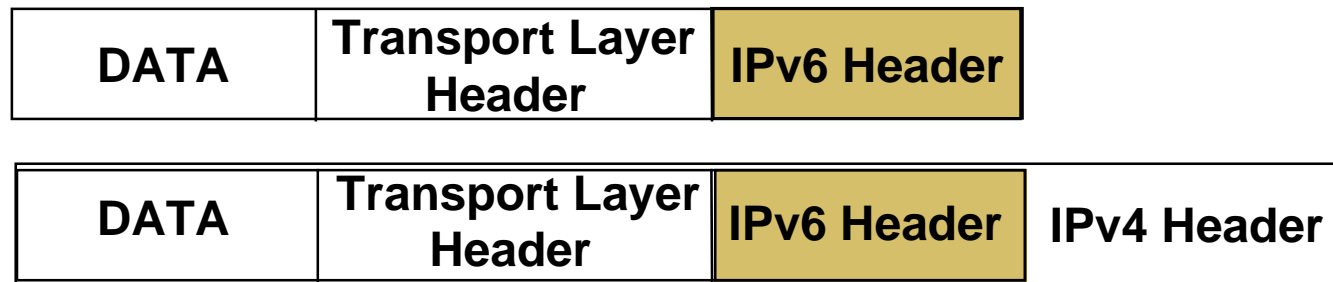


- **Network approach - Tunneling**



IPv6 Transition - Tunneling

- Tunneling more efficient than building new IPv6 topology



- Configured tunnels - manual point-2-point links
- Automatic tunnels - via IPv4 compatible IPv6 addresses
(96 bits of zeros prefix - 0:0:0:0:0:0/96)
- Router \longleftrightarrow Router tunnels - underlying infrastructure remains transparent
- Cisco instrumental in building existing “6-Bone”



IPv6 Routing

- **Hierarchical Addressing**
- **Routing Protocols**
- **Neighbour Discovery**

IPv6 Routing - Hierarchical Addressing

- **Key to scaleable routing, multiple levels**

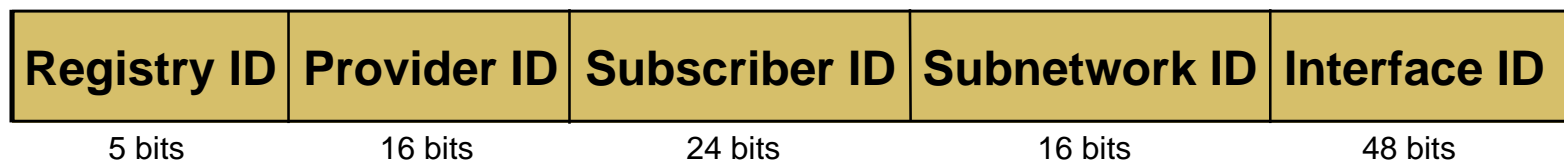
Routing tables fivefold increase - existing IPv4 and quadrupled IPv6 tables

- **Hierarchical from the start**

- **Address assignment**

Provider based

- **Test address space allocation available:-** (RFC 1897)



IPv6 - Routing Protocols

- **Existing routing protocols require extensions for IPv6:-**

RIPv6 -	(Same destination/mask/metric information as RIPv2)
OSPFv6 -	(Link State records, Network Areas, Router ID all 128 bits)
EIGRP -	(Reflects Cisco's future proofing commitment)
Integrated IS-IS -	(Existing 20 byte NSAP support facilitates IPv6 address/routing)
IDRP -	(not BGP4)

- **Currently RIPv6 and OSPFv6 “Proposed Standards within the IETF**

IPv6 - Neighbour Discovery

- **Protocol functions as combination of:-**
 - ARP
 - ICMP Redirect
 - Router Discovery
- **Fully dynamic, interactive Host \leftrightarrow Router**
- **Routers/Hosts periodically announce themselves**
- **Incorporates support for Neighbour Unreachability Detection (NUD) and Host Mobility**



IPv6 Standards Status

- **Cisco Engineering significant contributors (authors/editors) to IPv6 Working Groups**
- **Several key components now “Proposed Standards”:-**
 - Basic Specification**
 - Address Formats**
 - RIPv6/OSPFv6**
 - ICMP/IGMP**
- **Issues remaining open:-**
 - DHCP - redundancy, integration with DNS**
 - Addressing Registries**
 - IPv6 over all media (NBMA - ATM, Frame Relay)**

IPv6 - Conclusion

- **IP Next Generation will provide for future Internet growth and enhancement**
- **Medium term comparable functionality available with IPv4 (e.g. NAT, DHCP, RSVP etc.)**
- **Cisco committed to facilitating future customer transitions**
- **Further Information:-**

<http://www.cisco.com/warp/customer/732/ipv6/index.html>

<http://www-6bone.lbl.gov/6bone>

<http://playground.Sun.COM:80/pub/ipng/html>