



Integration of IPv6 Services

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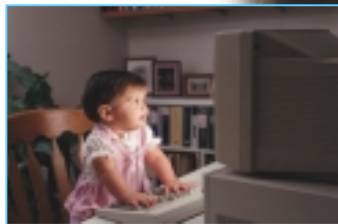
Auto-Configuration

Large Address Space

The Ubiquitous Internet



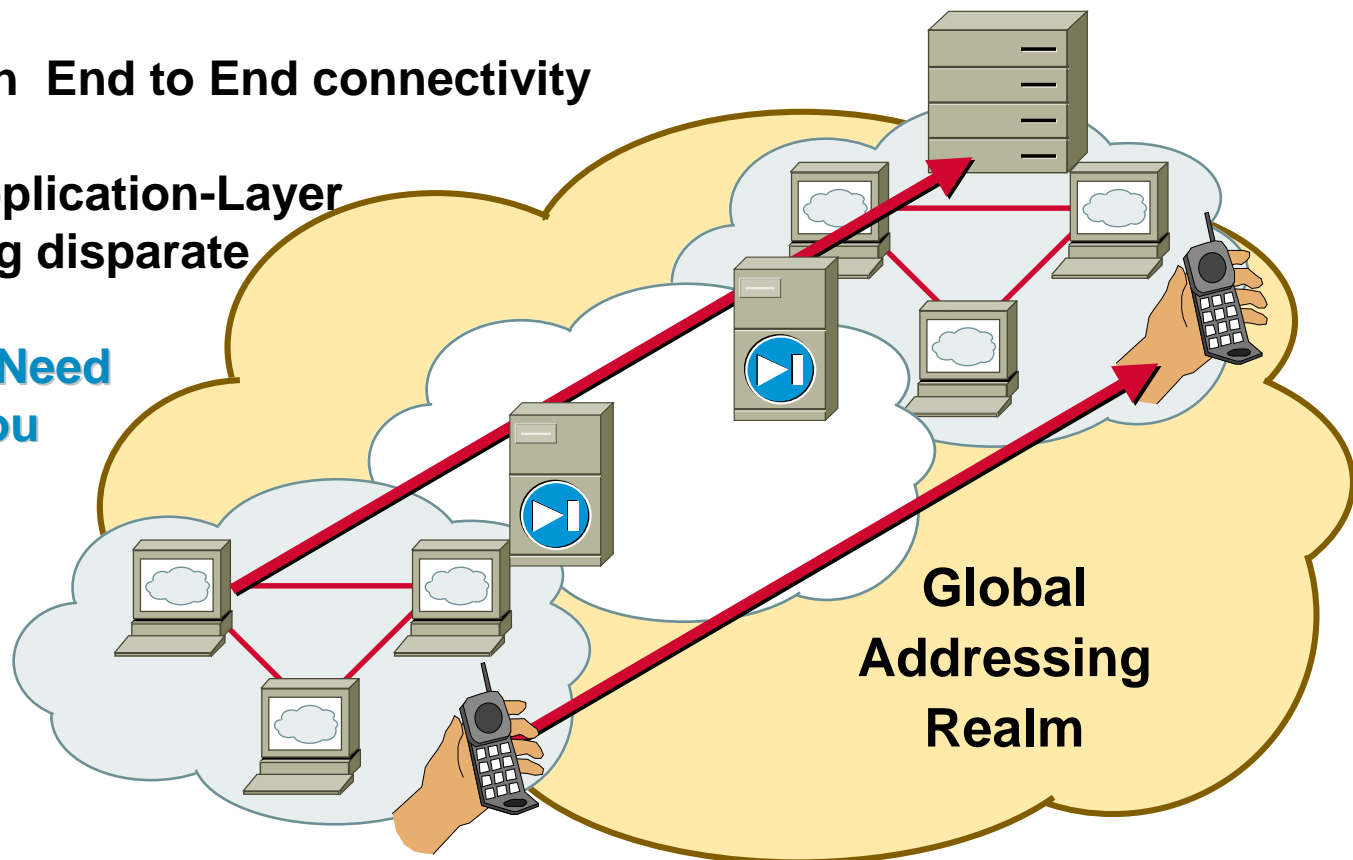
Enhanced Mobility



Coming Back to an End-to-End Architecture

New Technologies/Applications for Home Users
'Always-on'—Cable, DSL, Ethernet@home, Wireless,...

- Internet started with End to End connectivity for any applications
- Today, NAT and Application-Layer Gateways connecting disparate networks
- **Always-on Devices Need an Address When You Call Them**, eg.
 - Mobile Phones
 - Gaming
 - Residential Voice over IP gateway



IPv6 @Cisco Systems

- **Co-chair of IETF IPv6 WG and NGtrans WG**
- **Well Known Cisco 6Bone router**
 - ~ 50 tunnels with other companies
 - acts as 6to4 Relay
 - Official Cisco IPv6 prefix registered to ARIN (2001:0420::/35)
- **‘Founding Member’ of the IPv6 Forum**
- **Official CCO IPv6 page is www.cisco.com/ipv6**
 - Cisco IPv6 Statement of Direction published last June
 - Cisco IOS IPv6 EFT available for free since 3 years
 - ~around 500 sites running Worldwide
- **Ready to deliver a commercial release of Cisco IOS IPv6**
 - including Cisco IOS IPv6 training & TAC support

Cisco IOS Roadmap: The Confluence of IPv4/IPv6

IOS Release	Market Target
Phase I IOS 12.2(1)T Q1 CY 2001	Early Adopter Deployment
Phase II Mid-2001	Production Backbone Deployment
Phase III Beyond Mid-2001	Enhanced IPv6 Services

**IOS
upgrade
=
Free IPv6
support**

Cisco IOS IPv6 Phase I

IOS Release	IPv6 Features Supported
<p>Phase I Early Adopters IOS 12.2(1)T Q1 CY 2001</p> <p>Any router able to run this release Cisco 800 to Cisco 7500</p>	<p>IPv6 Basic specification (RFC 2460) ICMPv6, Neighbor Discovery Stateless auto-configuration RIPv6 (RFC 2080) Multi-Protocol extensions for BGP4 (RFC 2545 & 2858) Configured and Automatic Tunnels 6to4 Tunnel Standard Access List IPv6 over Ethernet (10/100/1000Mb/s), FDDI, Cisco HDLC, ATM and FR PVC, PPP (Serial, POS, ISDN) Ping, Traceroute, Telnet, TFTP,</p>

IOS
upgrade
=
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Cisco IOS IPv6 Phase II

IOS Release	IPv6 Features under development
<p>Phase II Backbone Deployment</p> <p>Cisco IOS 12.2(3)T or (4)T</p> <p>Estimated EFT dates in ()</p> <p>Specific Cisco 12000 release on 12.0ST</p>	<p>i/IS-ISv6 (Q1 CY01) CEFv6/dCEFv6 (Q3 CY01) Dial (Q2 CY01) Extended Access List (Q3 CY01) NAT-PT (Q2 CY01) IPv6 Edge router (6PE) over MPLS (Q3 CY01) DNS AAAA client (Q1 CY01) IPv6 MIB (Q3 CY01) Phase I Sustaining</p>

Cisco IOS Roadmap: The Confluence of IPv4/IPv6

**IOS
upgrade
=
Free IPv6
support**

IOS Release	IPv6 Features Supported
Phase I IOS 12.2(1)T Q1 CY 2001	Multiprotocol BGP, RIPv6, ICMPv6, ND, Tunnel Support, 6to4, Ping, Traceroute, Telnet, FTP, Standard Access Lists, Etc. NB. Some hardware run specific IOS train
Phase II Mid-2001	CEFv6, IPv6 over MPLS, Protocol Translation IPv6 ↔ IPv4, Additional Routing Protocols (e.g. Integrated IS-IS), Dial, IPv6 MIB, Etc.
Phase III CY2002	Hardware Acceleration, OSPFv3, Mobility, Multicast, Voice-over-IPv6, Security, QoS...

Deployment of IPv6 Services: What our Customers are saying !

Satisfy Business Drivers, aka. Applications requiring end-to-end IPv6 traffic forwarding, geographies with registry allocations issues

No Flag Day

No Performance Penalty, implementation must be scalable and reliable

Minimize operational upgrade costs and training expenses

Investment Protection & Low startup cost

Incremental Upgrade/Deployment

Preserve IPv6 - IPv4 connectivity/transparency

Strategy that reflects this ...

Starting with Edge upgrades enable IPv6 service offerings now

Deployment scenario

- **Many ways to deliver IPv6 services to End Users**
Most important is End to End IPv6 traffic forwarding
- **Service Providers and Enterprises may have different deployment needs**
- **IPv6 over IPv4 tunnels**
- **Separate native IPv6**
no impact on IPv4 traffic & revenues
various data link layers ATM, FR, Serial, Sonet/SDH, WDM
- **Dual stack Networks**
IPv6 over MPLS or IPv4-IPv6 Dual Stack Routers

Routing in IPv6

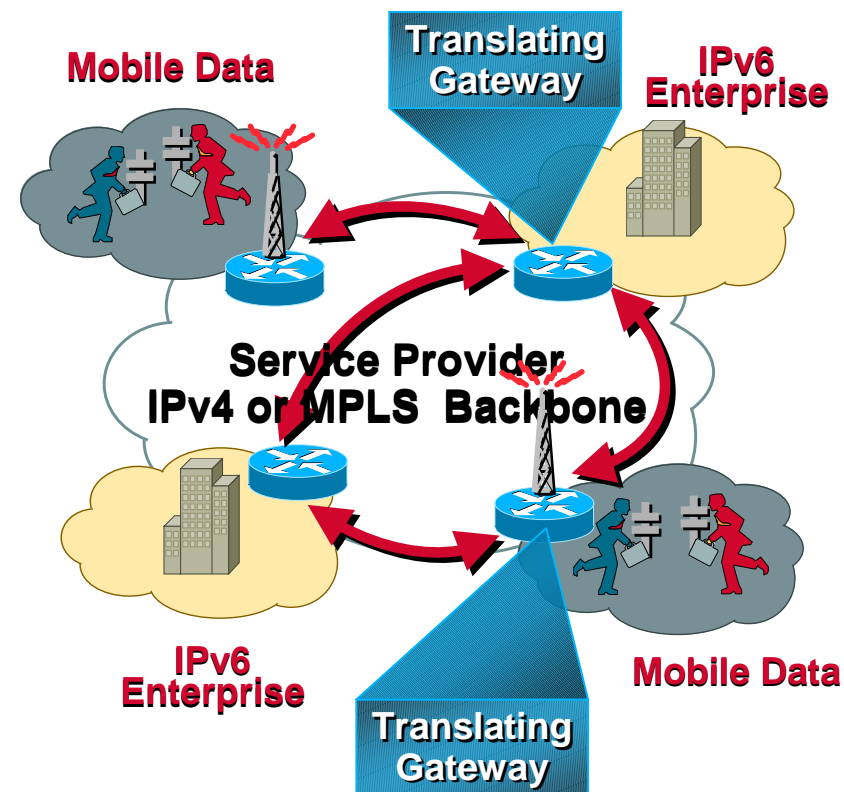
- **As in IPv4, IPv6 have two family of routing protocols: IGP and EGP**
 - IGP are RIPng (RFC 2080), OSPFv3 (RFC 2740) and Integrated IS-ISv6 (draft-ietf-isis-ipv6-01.txt)**
 - EGP is MP-BGP4 (RFC 2858 and RFC 2545)**
- **IPv6 still uses the longest-prefix match routing algorithm.**

IPv6 Tunnels over IPv4 or MPLS Infrastructure

- IPv6 over IPv4 Internet
ala 6Bone
- Any Cisco IOS 12.2(1)T routers can be used as IPv6 router
 - 6to4 Tunnel
 - Manual Tunnel
 - Automatic Tunnel
 - IPv4compatibleIPv6
- Leveraging defined Tunneling Technology
- No impact on existing IPv4 or MPLS infrastructure
 - using high-speed POS interfaces

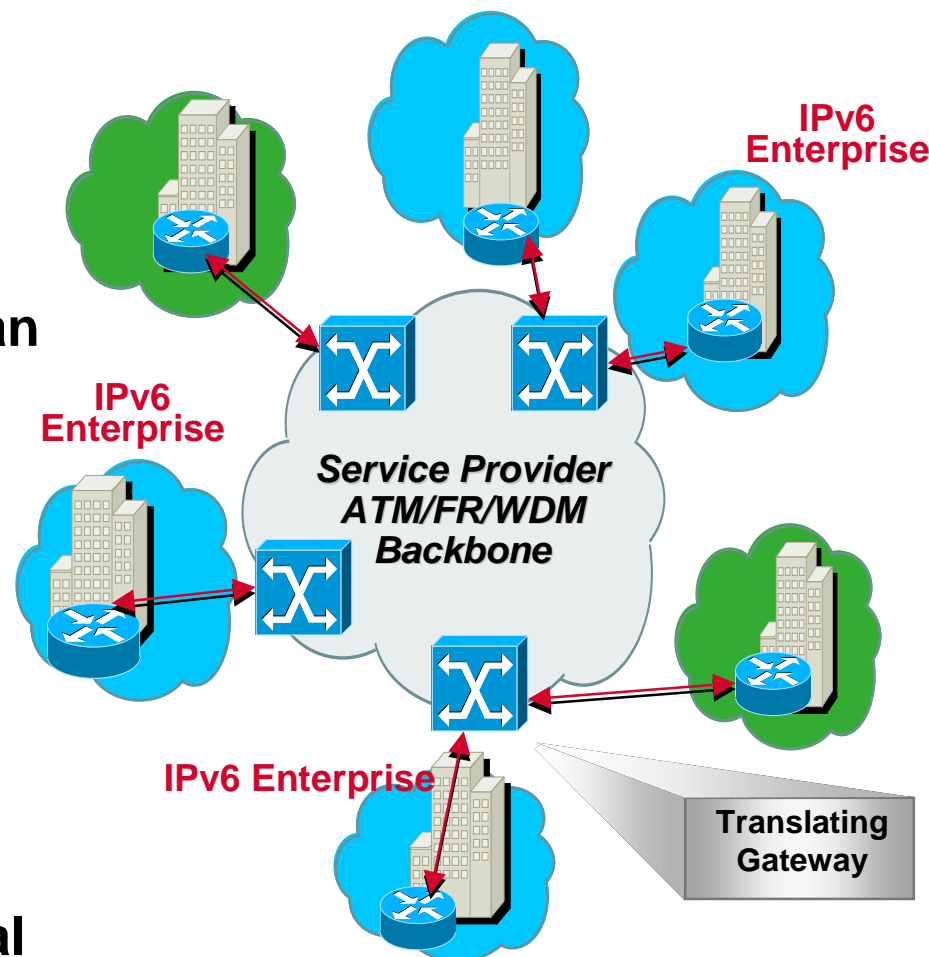
Edge IPv6 Infrastructure:

IPv6 over IPv4 Internet:

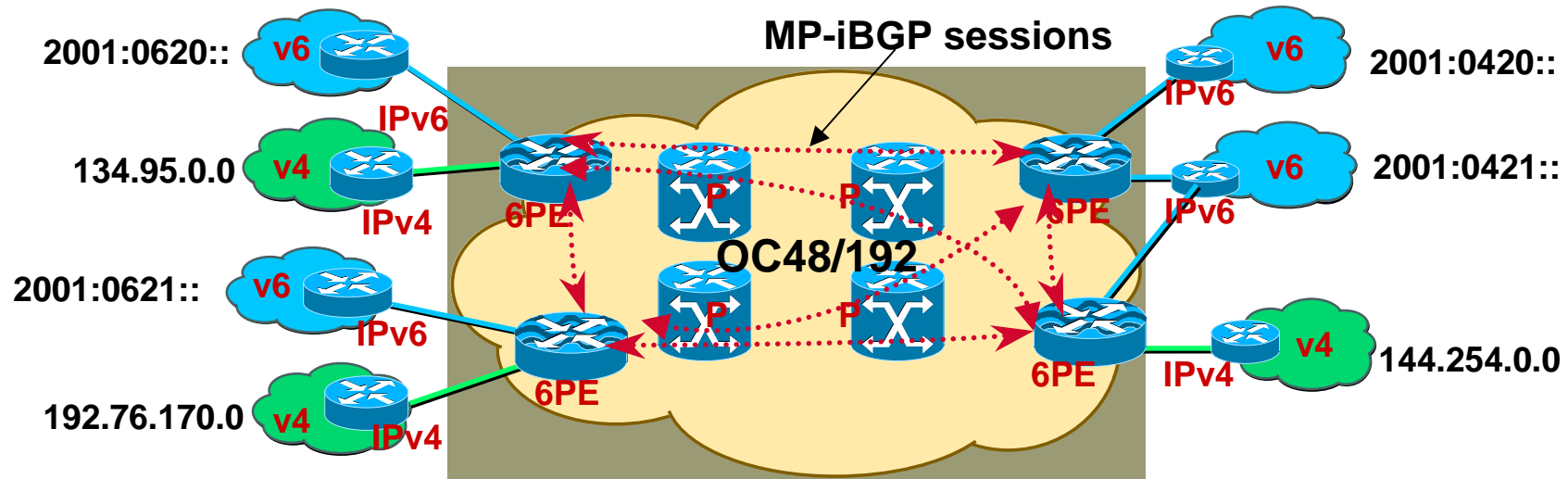


Native IPv6 over Dedicated Links

- **Native IPv6 links over dedicated infrastructures**
No impact on IPv4 traffic and revenues
- **Any Cisco IOS 12.2(1)T routers can be configured**
ATM & Frame Relay PVC's
Serial Lines, Sonet/SDH, FE/GE
- **Cisco 12000 with Sonet/SDH interfaces can get IPv6 support**
Today, EFT on private 12.0ST branch
- **IPv6 over FE/GE, ATM or Sonet/SDH can run over an optical infrastructure (dedicated lamda)**



IPv6 Edge Router (6PE) over MPLS



- Many Carriers, large ISP and Mobile SP have invested on MPLS infrastructure
 - Core devices may be ATM switches, GSR or other vendor's routers
 - Leverages of MPLS features, eg. MPLS/VPN, TE, CoS,...
- UMTS Release 5 requires IPv6
 - GSM, GPRS and UMTS Release 99 needs circuit switching as well as IP
- Multiple implementation's options to integrate IPv6
 - IPv6 on CE, IPv6 over AToM, IPv6 Edge router (6PE), native IPv6 MPLS
 - 6PE allows the SP to offer IPv6 at lower cost and risk

Dual Stack IPv4-IPv6 backbone

- Can be achieved beginning with Cisco IOS 12.2(1)T but have to consider the following:

IPv4 Hardware Forwarding
versus IPv6 Software Forwarding

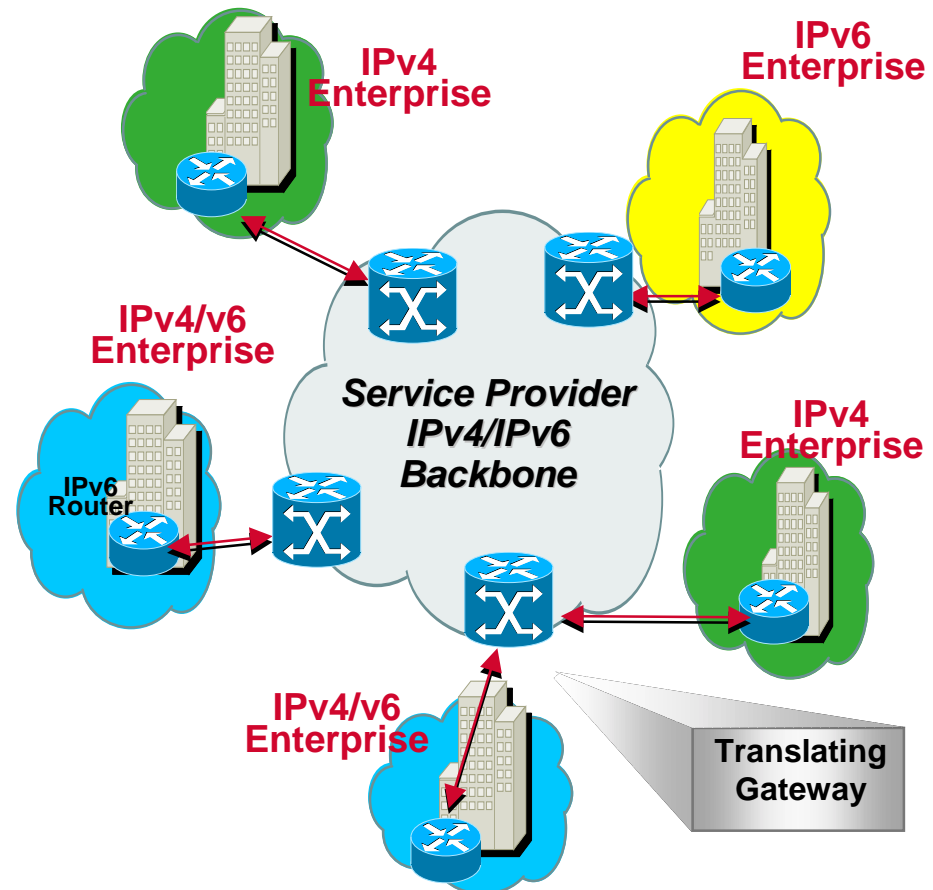
Memory size for IPv4 and IPv6
routing tables

Should IPv4 and IPv6 route to a
single dual-stack edge router the
same?

Dual stack management?

- IPv4 and IPv6 traffic should not
impact each other.

Require more feedback &
experiments



Native IPv6-Only Backbone?

- Requires:

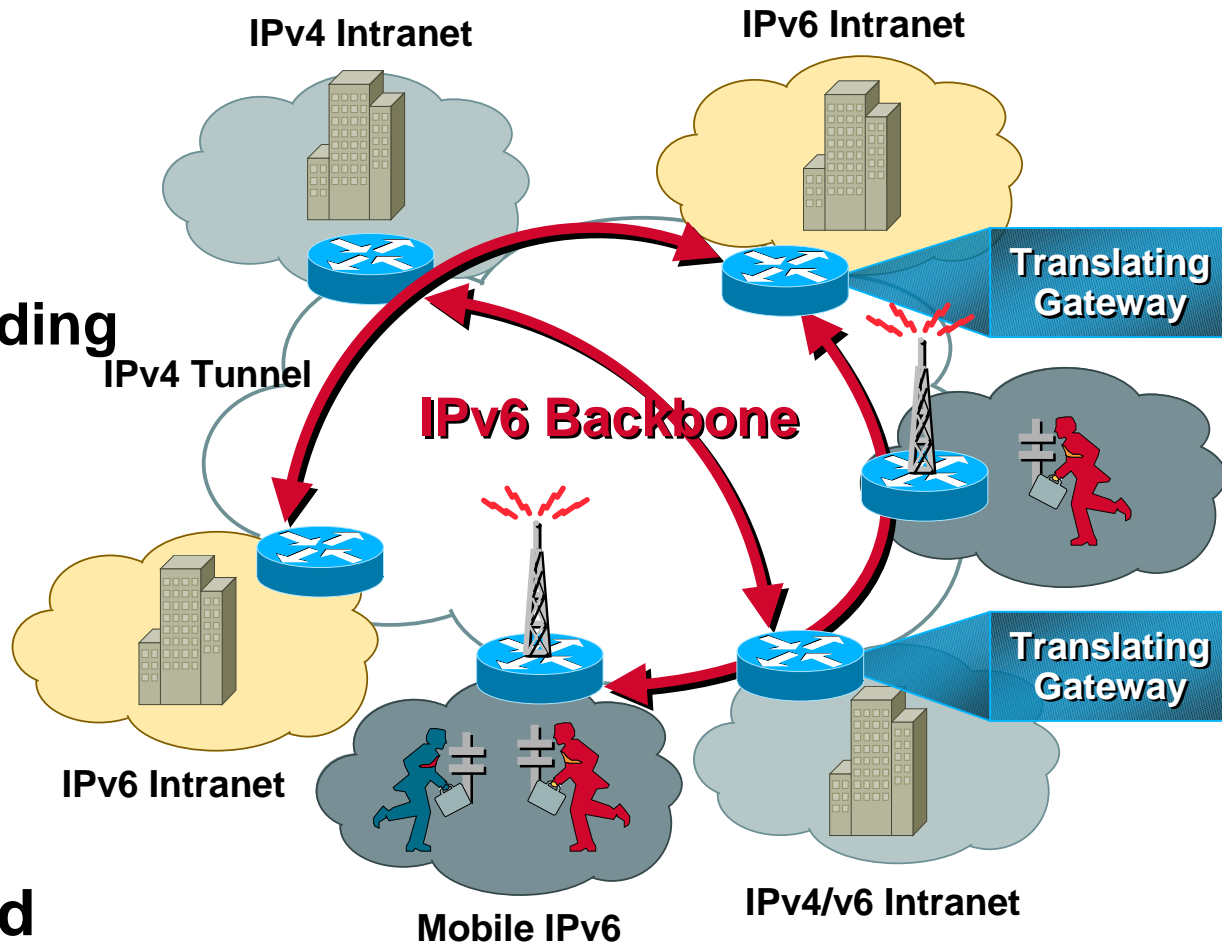
IPv4 over IPv6
Tunnels for
IPv4 traffic

Hardware forwarding
for IPv6

NAT-PT for
IPv4-IPv6
communications

Network
Management
over IPv6

- Not recommended
today



Open Challenges

- **Determining future IPv6 routing table size**
- **IPv6 performance level needed, based on REAL IPv6 traffic expectations**
 - Next 12 months?, 24 months?
- **Mobile IPv6**
 - Clients, Application and Network design
- **IPsec versus Firewall on IPv6 networks**
- **IPv6 QoS features set needed for 3G networks**
- **Network Management tools**
- **Transition Tools, which ones?**
 - NAT-PT ALG support?
- **Field Training**
- **Interoperability**
- **Others ?**

IPv6 - Conclusion

IPv6 ready for production deployment ?

- **Monitor Commercial IPv6 products & Services availability**
 - Major O.S., applications and infrastructure for the IT industry
 - New IP appliances, eg. 3G (NTT DoCoMo,...), Gaming,....
 - IPv6 Services from ISP
- **Be Ready for IPv6 Integration and IPv4-IPv6 Co-existence**
 - Training, applications inventory and IPv6 deployment planning
- **Get Cisco IOS 12.2(1)T: the Confluence of IPv4/v6**
 - www.cisco.com/ipv6

Questions?

Cisco IOS™



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