



IPv6 Co-existence & Integration

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Key Aspects Reminder



- **IPv6 is NOT a feature. It is about the fundamental IP network layer model developed for end-to-end services and network transparency**
- **Deployments of production IPv6 infrastructures are under way, the time has come to move our focus to edge, access and usage**

6Bone is phasing out, 6NET is closed,...

- **Today's IPv6 deployment drivers do not rely on uncovering the “future killer application” anymore, they focus instead on:**

Performing the same as on IPv4 but on a larger scale

Operational cost savings or simpler network models when deploying applications

Leading the innovation



Expanding the Internet with IPv6

Innovation's

Business – Applications - Services

Community,
Geo-
localization,
Time
synchronization

Grid, Triple
Play, RFID,
Zigbee

**Adding IPv6 to the Internet
*Integration & Co-Existence***

New Market
Places

Networks in
Motion,
Public safety
&
Emergency

Infrastructures for new Services

IPv6 Integration & Co-existence

- **Many ways to deliver IPv6 services to End Users, Most important is End to End IPv6 traffic forwarding as applications are located at the edge.**
- **Service Providers and Enterprises may have different deployment needs and mechanisms but basic steps are common**
 - IPv6 addressing scheme
 - Routing protocol(s)
 - IPv6 services (QoS, Multicast, DNS,...)
 - Security
 - Network Management



IPv6 Integration Per Application Model



Windows Vista™



Today, all O.S. are Dual-Stack



- As soon as the infrastructure is IPv6 capable...IPv6 integration can follow a non-disruptive “per application” model

6net Applications summary

name	category	class	summary	status	responsible	modified
6UMS	Streaming	C	IPv6-enabled unified messaging system	6UMS is being developed by UoS in Euro6X, but will be made available to 6NET. Existing tools will be re-used where appropriate.	UoS	2003-01-16
Agent Framework	E-business	C	Framework for agent research	Available, in Java. Unicast works. Multicast not tested yet.	UoS	2003-01-24
AMUSE	Streaming	C	Adaptive Multimedia Support Environment	Available. Usage limited to Sony and WP5. Work planned to support MobileIPv6.	Sony	2003-01-27
AWM	E-business	No	Application Workload Modeler	Released product with IPv6 support for zSeries. Needs special build for Linux/Intel.	IBM	2003-04-14
Bonephone	Streaming	B	Internet phone sending and receiving SIP messages	Demo version released.	FIHG	2003-04-10
CDN	Edge Services	C	Content Distribution Networks	No specific work at the moment.	Cisco	2003-01-16
DVTS	Streaming	C	Application for sending and receiving Digital Video	The source and binaries for DVTS on various platforms are available from the DVTS URL.	UCL	2003-01-16
Edge Server	Edge Services	C	IBM Edge Server	Porting to IPv6 in progress.	IBM	2003-01-16
EGP	Gaming	No	Experimental Gaming Platform	Sony has stopped working on EGP. This activity has been dropped.	Sony	2003-03-27
FreeAMP	Streaming	A/B	Free unicast/multicast MP3 player	The code has been released on the web. Both a unicast and a multicast MP3 source will be activated in a network which will be available to all 6NET partners.	GARR	2003-01-24
FunnelWeb	E-business	C	Application level active services	Implemented as a Java application. Available on request within the project.	UCL	2003-01-16
Globus	E-business	C	GLOBUS toolkit (Grid)	Release 2.0 available. Globus 3.0 is expected early 2003. 6NET expectation is to get IPv6 support enabled as a patch for Globus 2.0, later as an integral part of Globus 3.0.	UCL	2003-01-16
GnomeMeeting	Streaming	C	Open source H323 Linux application	Deployment and support in progress for Greek Research Network community	GRNET	2003-02-05



New Generation of Internet Appliances

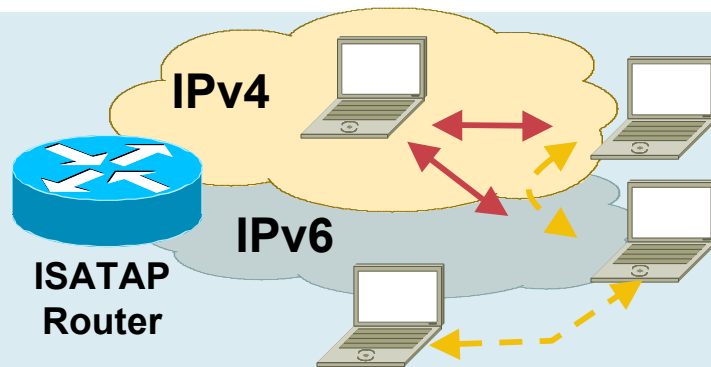
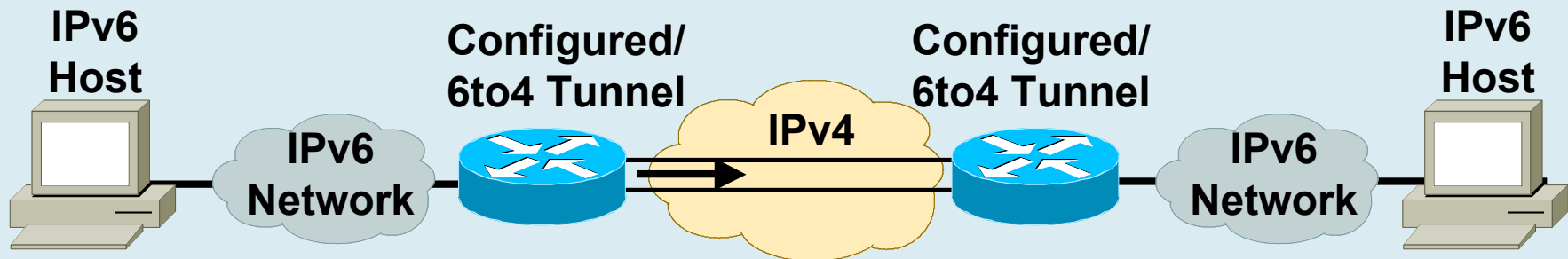
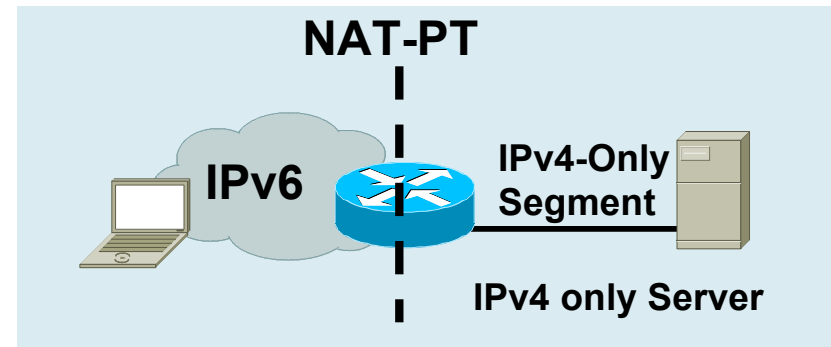
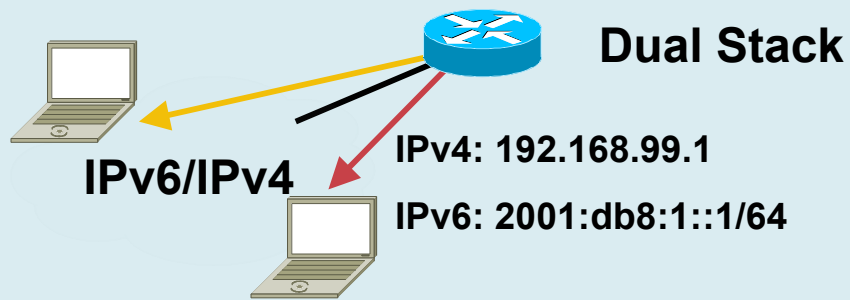
ENTERPRISE DEPLOYMENT



Start Here: Cisco IOS Software Release Specifics for IPv6 Features

http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/ipv6_c/ftipv6s.htm

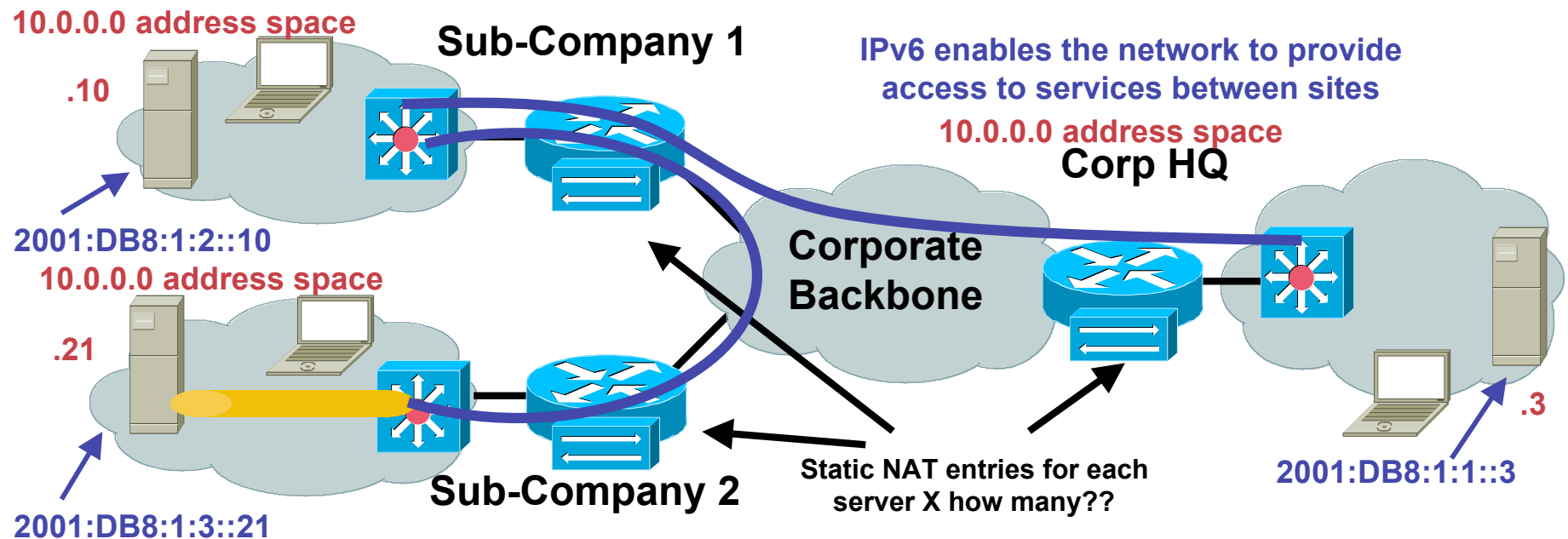
IPv6 Coexistence in the Enterprise



ISATAP Tunneling

Dual Stack
IPv4 and IPv6 Addresses

NAT Overlap



- Merger and acquisition complexity force many to leave existing IPv4 address space in place vs. full integration/consolidation
- When server-to-server or client-to-server service is required then single/double static NAT translations are often required
- IPv6 can be deployed to enable service access per site and/or per application

SERVICE PROVIDER DEPLOYMENT



Start Here: Cisco IOS Software Release Specifics for IPv6 Features

http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/ipv6_c/ftipv6s.htm

IPv6 in the SP: What Does It Do for Me?

- **Benefits for the ISP (short term):**
 - Expanded private use address pool for internal devices
 - Ability to acquire large enough address blocks to avoid impeding rollout/subscriber-growth business plans
 - Not lose existing or new customers due to lack of support**
- **Benefits for the ISP (long term):**
 - Reduction in 'application failure' related support calls caused by IPv4/NAT
 - Ability to remove customer-managed infrastructure component (NAT) from the path, improving application support
 - Ability to deploy new service offerings into the home without dealing with translation issues and address constraints**

Today's Network Infrastructure

- **Service Providers core infrastructure are basically following two paths**
 - MPLS with its associated services**
 - MPLS/VPN, L2 services over MPLS, QoS,...**
 - Native IPv4 core with associated services**
 - L2TPv3, QoS, Multicast,...**
- **IP services portfolio—Access**
 - Enterprise: Lease lines**
 - Home Users/SOHO: ADSL, FTTH, Dial**
 - Data Center: Web hosting, servers,...**
- **Next step—The integration of IPv6 services**

IPv6 Tunnels & Native IPv6

- **ISP scenario**

 - Configured Tunnels or Native IPv6 between IPv6 Core Routers

 - Configured Tunnels or Native IPv6 to Enterprise's Customers

 - MP-BGP4 Peering with other 6Bone users

 - Connection to an IPv6 IX

 - 6to4 relay service

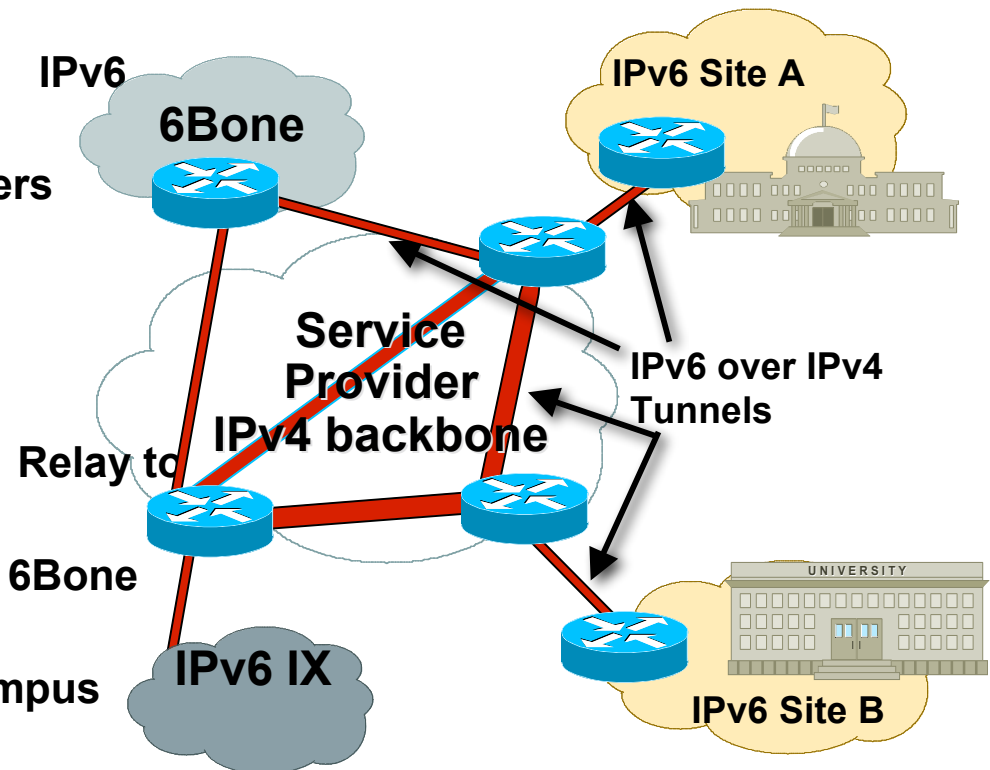
- **Enterprise/Home scenario**

 - 6to4 tunnels between sites, use 6to4 connect to the IPv6 Internet

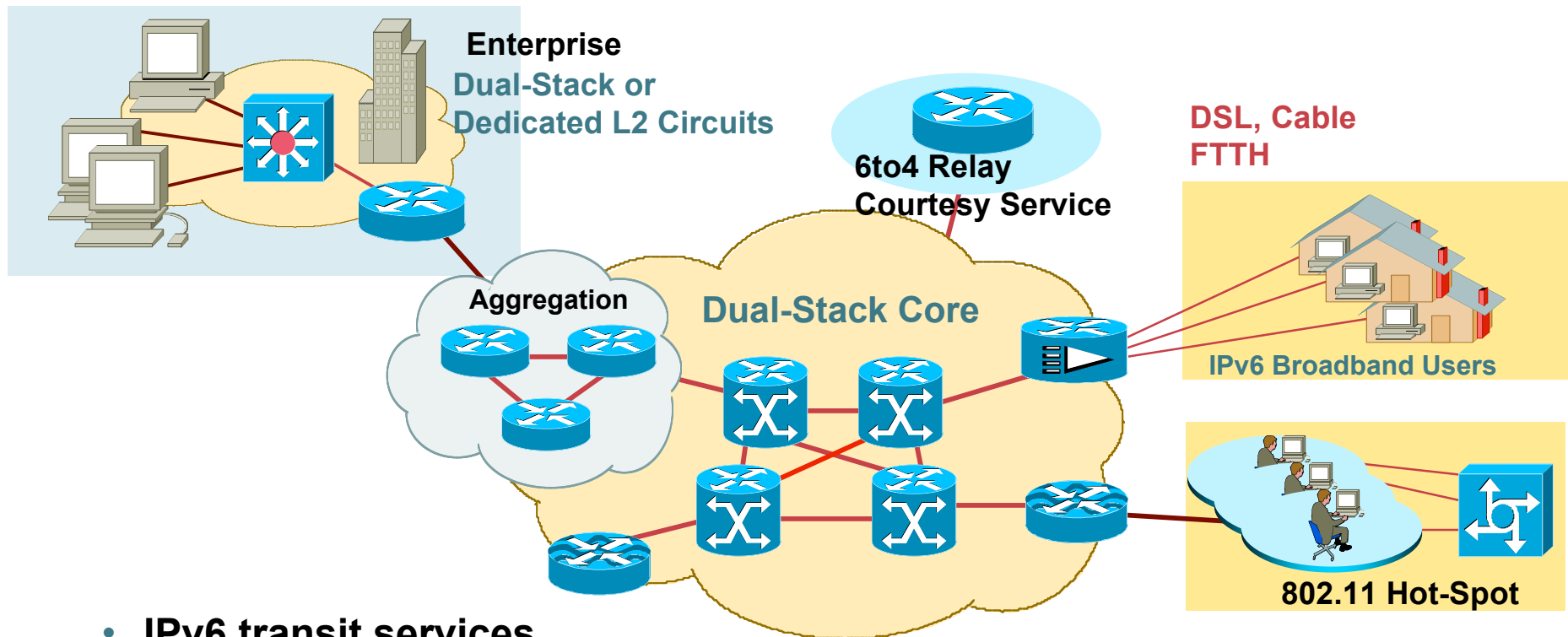
 - Configured tunnels between sites or to 6Bone users

 - ISATAP tunnels or Native IPv6 on a Campus

Use the most appropriate



Dual-Stack IPv4-IPv6

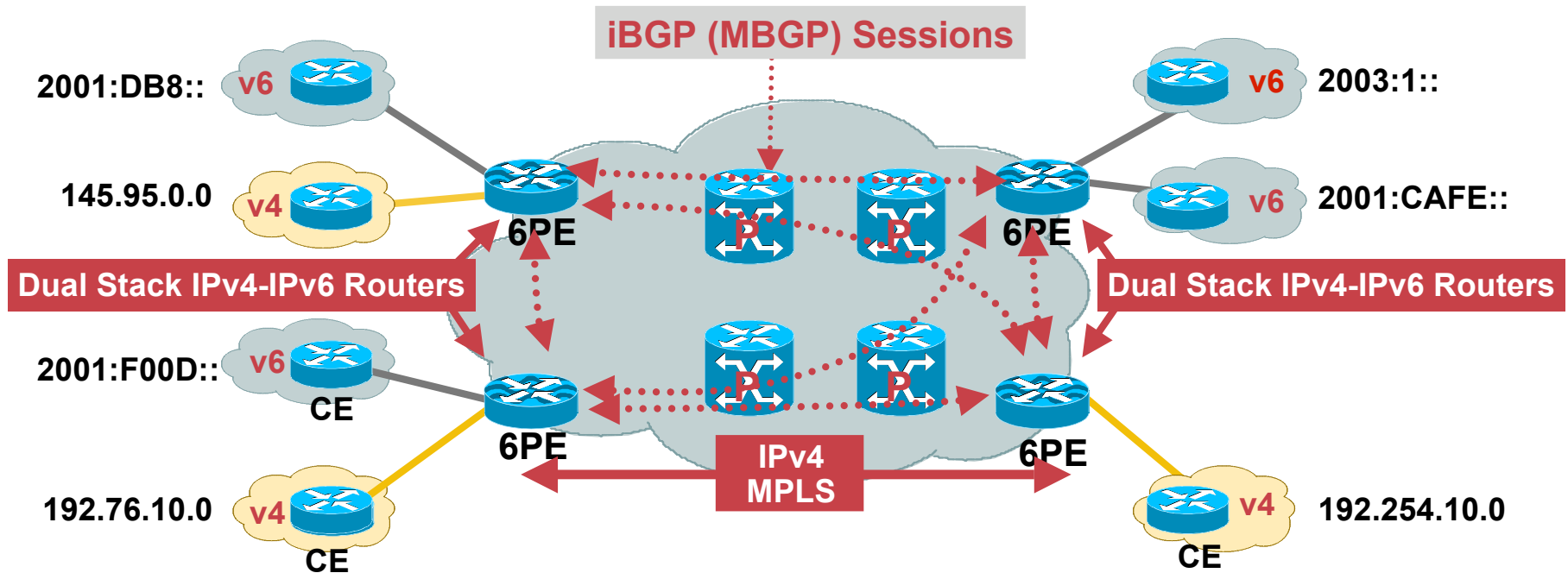


- IPv6 transit services
- IPv6 enabled on Core routers
- Enterprise and consumer IPv6 access
- Additional services
 - IPv6 multicast for streaming

IPv6 over MPLS

- **Many service providers have already deployed MPLS in their IPv4 backbone for various reasons**
- **MPLS can be used to facilitate IPv6 integration**
- **Multiple approaches for IPv6 over MPLS:**
 - IPv6 over L2TPv3**
 - IPv6 over EoMPLS/AToM**
 - IPv6 CE-to-CE IPv6 over IPv4 Tunnels**
 - IPv6 Provider Edge Router (6PE) over MPLS**
 - IPv6 VPN Provider Edge (6VPE) over MPLS**
 - Native IPv6 over MPLS**

IPv6 Provider Edge Router (6PE) over MPLS



- IPv6 global connectivity over and IPv4-MPLS core
- Transitioning mechanism for providing unicast IP
- PEs are updated to support dual stack/6PE
- IPv6 reachability exchanged among 6PEs via iBGP (MBGP)
- IPv6 packets transported from 6PE to 6PE inside MPLS

http://www.cisco.com/warp/public/cc/pd/iosw/prodlit/iosip_an.htm

6PE Summary

- **Core network (Ps) untouched (no HW/SW upgrade, no configuration change)**
- **IPv6 traffic inherits MPLS benefits (wire-rate, fast re-route, TE, etc.)**
- **Incremental deployment possible (i.e., only upgrade the PE routers which have to provide IPv6 connectivity)**
- **Each site can be v4-only, v4+v6,**
- **P routers won't be able to send ICMP messages (TTL expired, traceroute)**

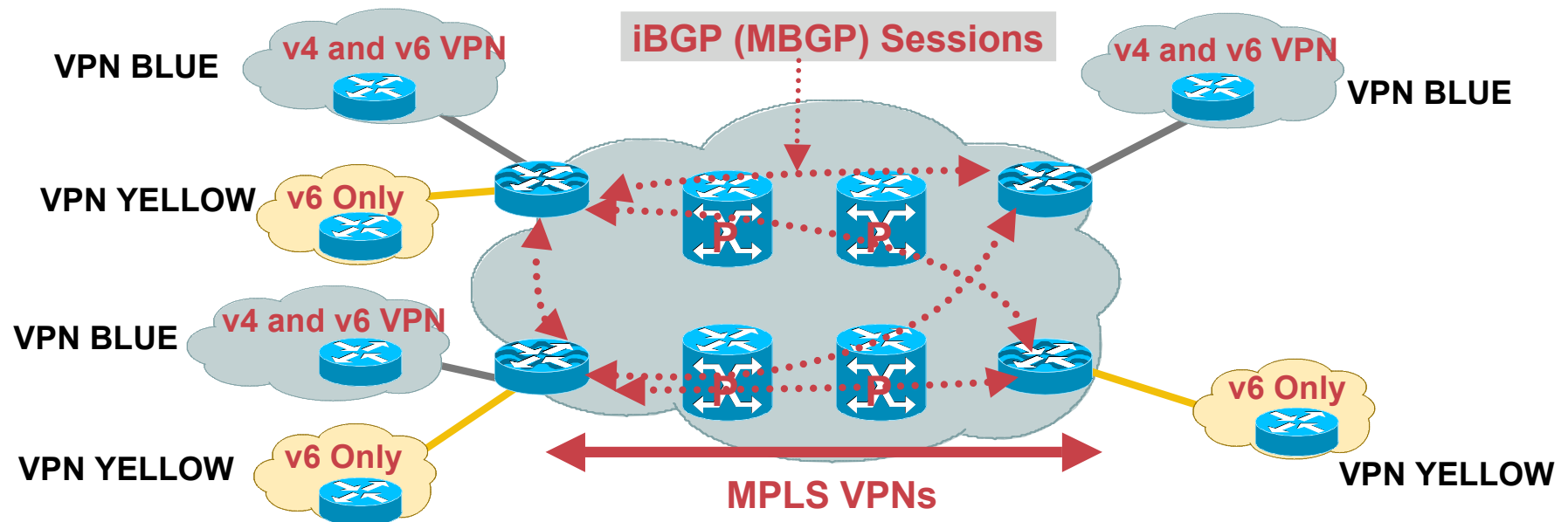
Application Note—IPv6 over MPLS (Cisco® 6PE)

http://www.cisco.com/warp/public/cc/pd/iosw/prodlit/iosip_an.htm

“IPv6 Over MPLS” presentation:

<http://www.cisco.com/warp/public/732/Tech/ipv6/docs/IPV6overMPLS.pdf>

6VPE Deployment



- **6VPE ~ IPv6 + BGP-MPLS IPv4 VPN + 6PE**
- **Cisco 6VPE is an implementation of <draft-ietf-bgp-ipv6-vpn> over MPLS/IPv4**
- **VPNv6 address:**
Address including the 64 bits route distinguisher and the 128 bits IPv6 address
- **MP-BGP VPNv6 address-family:**
AFI "IPv6" (2), SAFI "VPN" (128)
- **VPN IPv6 MP_REACH_NLRI**
With VPNv6 next-hop (192bits) and NLRI in the form of <length, IPv6-prefix, label>
- **Encoding of the BGP next-hop**

6VPE Summary

- **6VPE simply adds IPv6 support to current IPv4 MPLS VPN offering**
- **For end-users: v6-VPN is same as v4-VPN services (QoS, hub and spoke, internet access, etc.)**
- **For operators:**
 - Same configuration operation for v4 and v6 VPN**
 - No upgrade of IPv4/MPLS core (IPv6 unaware)**
- **Cisco 6VPE is an implementation of <draft-ietf-bgp-ipv6-vpn> over MPLS/IPv4**
- **<draft-ietf-l3vpn-bgp-ipv6-xx>**
 - BGP-MPLS VPN extension for IPv6 VPN**
 - Generic for operations over any tunneling technique (MPLS, IPsec, L2TPv3, GRE)**

SERVICE PROVIDER—ACCESS



Drivers for IPv6 in Broadband

- **Network Management:** The most striking aspect of Broadband Access Services is the large number of users that imply a larger number of devices to be managed by providers. Even the private IPv4 address space will be unable to withstand the expected needs. IPv6 is seen as the answer to this problem.
- **New Services:** The current business models for Network Access Provider (wholesale model) avoid handling users at Layer 3 at the access layer. These models do not scale for services such as Multicast. IPv6 offers the address resources needed to deploy such services optimally.
- **Prepare for the Future:** Build an infrastructure that would be ready for the new services and IP enabled appliances.

Broadband Home and IPv6 – a Must!

Home Networking

- IPv6 enables bi-directional reachability for multiple devices, is not intended to a single PC
- Bandwidth increase and symetric access to generate contents
- Easy plug and play

IP Video



Printer



PDA

IP Phone & Fax



Wireless Laptop

- Distance learning
- Video calls
- MP3/MP4 downloads

Wired Devices

- Streaming Video/Audio
- Print/file sharing



Broadband Internet Access



Triple Play Services

- Multiple devices served in a Home
- Commercial download
- TV guide



Wireless Gaming



Broadband Access Point

- Multiplayer gaming
- Video on demand
- Home security
- Digital audio
- Domestic appliances

IPv6 Multicast-Based Multimedia Services (NTT-East Example)

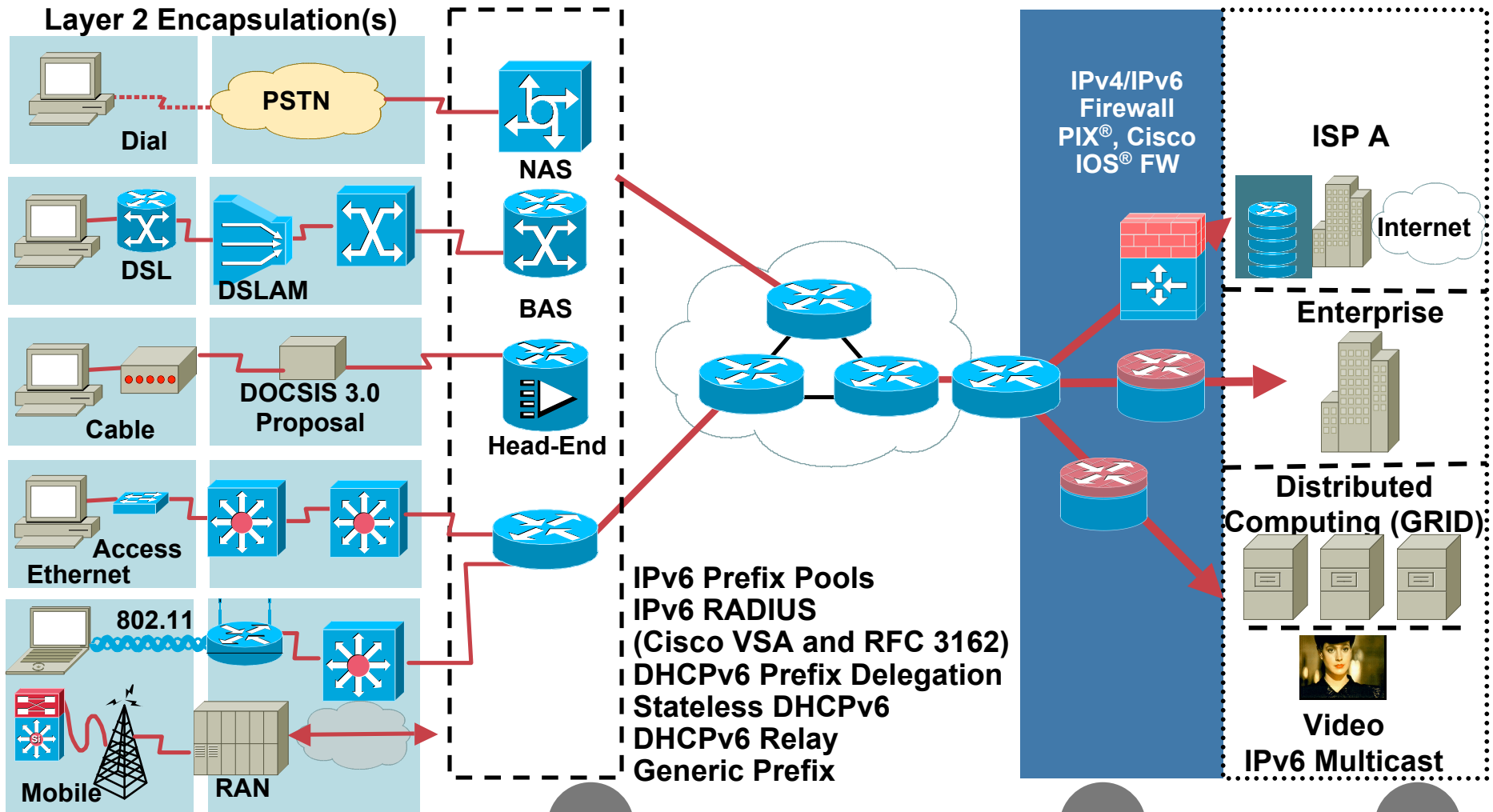
- NTT-East rolled out native IPv6 multicast services instead of IPv4 offering IPTV, music and games:

<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

Cisco IOS IPv6 Broadband Access Solutions



ATM RFC 1483 Routed or Bridged (RBE)
PPP, PPPoA, PPPoE, Tunnel (Cable)

Dual-Stack or MPLS (6PE) Core

IPv4/IPv6

Network Assessment

- **A key and mandatory step to evaluate the impact of IPv6 integration**
- **May be split in several phases**
 - Infrastructure – networking devices
 - Hosts, Servers and applications
- **Must be as complete as possible to allow upgrade costs evaluation and planning**
 - Hardware type, memory size, interfaces, CPU load,...
 - Software version, features enabled, license type,...
- **Difficult to complete if a set of features is not defined per device's category for a specific environment**
 - IPv6-capable definition, knowledge of the environment and applications, design goals

Summary

Markets Perspective

IPv6 enables innovation, scalability and simplicity

Software Developer Perspective

Applications must be “IP agnostic”

Network Manager Perspective

Infrastructure must be deliver IPv6 up to the edge/access layer

The End-User Perspective

IP version needs to be transparent



Conclusion

- **Start now rather than later**
 - Purchase for the future and test, test and then test some more**
 - Start moving legacy application towards IPv6 support**
- **Things we did not talk about, but they are very important to consider**
 - ISP multihoming solutions (Multi6 WG)—“Goals for IPv6 Site-Multihoming Architectures” (RFC 3582)—<http://www.ietf.org/html.charters/multi6-charter.html>**
 - Other transition methods such as EoMPLS, L2TPv3**
- **Things to consider:**
 - Don't assume your favorite vendor/app/gear has an IPv6 plan**
 - Full parity between IPv4 and IPv6 is still a ways off**
- **Enterprise and SP deployments Scenarios**
 - <http://www.ietf.org/internet-drafts/draft-ietf-v6ops-bb-deployment-scenarios-05.txt>**
 - [Scenarios and Analysis for Introducing IPv6 into ISP Networks \(RFC 4029\)](#)**
 - [IPv6 Enterprise Network Scenarios \(RFC 4057\)](#)**
 - [Procedures for Renumbering an IPv6 Network without a Flag Day \(RFC 4192\)](#)**

More Information

- **Cisco.com IPv6** - <http://www.cisco.com/ipv6>
- **Cisco IPv6 Solutions**
http://www.cisco.com/en/US/tech/tk872/technologies_white_paper09186a00802219bc.shtml
- **Cisco.com IPv6 e-Learning**
- **Cisco Learning Partner IOS IPv6 class**
- **Cisco Networkers IPv6 Techtorial**
- **Cisco Press IPv6 books**
- **6NET deliverables** – www.6net.org

CISCO SYSTEMS

