Transitioning to IPv6

Share Session 10414

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Applications are Changing

What is IPv6

Updated version of the Internet Protocol (IPv4)

Defined in RFC 1752

New features

- **Larger address space**
- **Encapsulation**
- **Class of service for audio, video, etc.**
- **Multicast support**
- **Authentication**
- **Encryption**
- **Automatic configuration/reconfiguration**
- **Support for non-IP protocols**

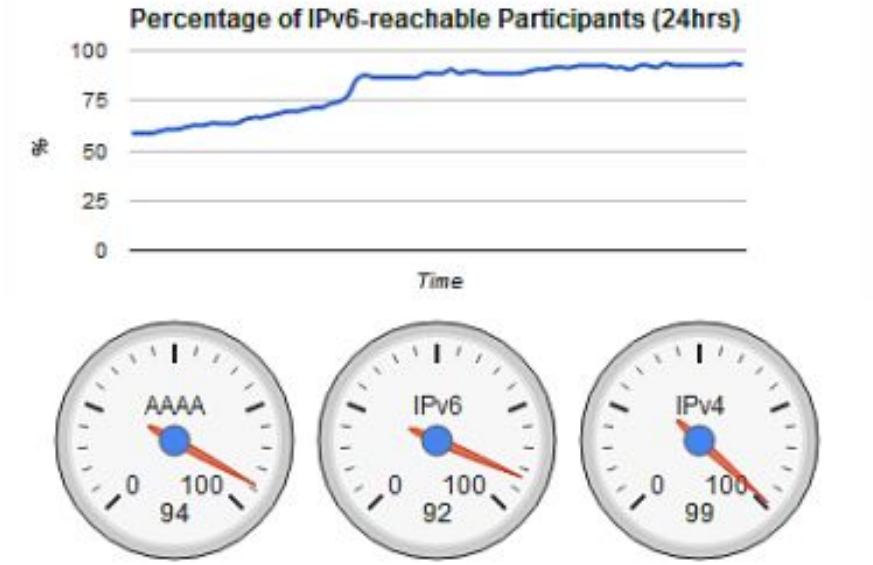
Coexist with IPv4

IPv6 Technology Scope

IP Service	*IPv4 Solution*	*IPv6 Solution*
Addressing Range	32-bit, Network Address Translation	128-bit, Multiple Scopes
Autoconfiguration	DHCP	Serverless, Reconfiguration, DHCP
Security	IPSec	IPSec Mandated, works End-to-End
Mobility	Mobile IP	Mobile IP with Direct Routing
Quality-of-Service	Differentiated Service, Integrated Service	Differentiated Service, Integrated Service
IP Multicast	IGMP/PIM/Multicast BGP	MLD/PIM/Multicast BGP,Scope Identifier

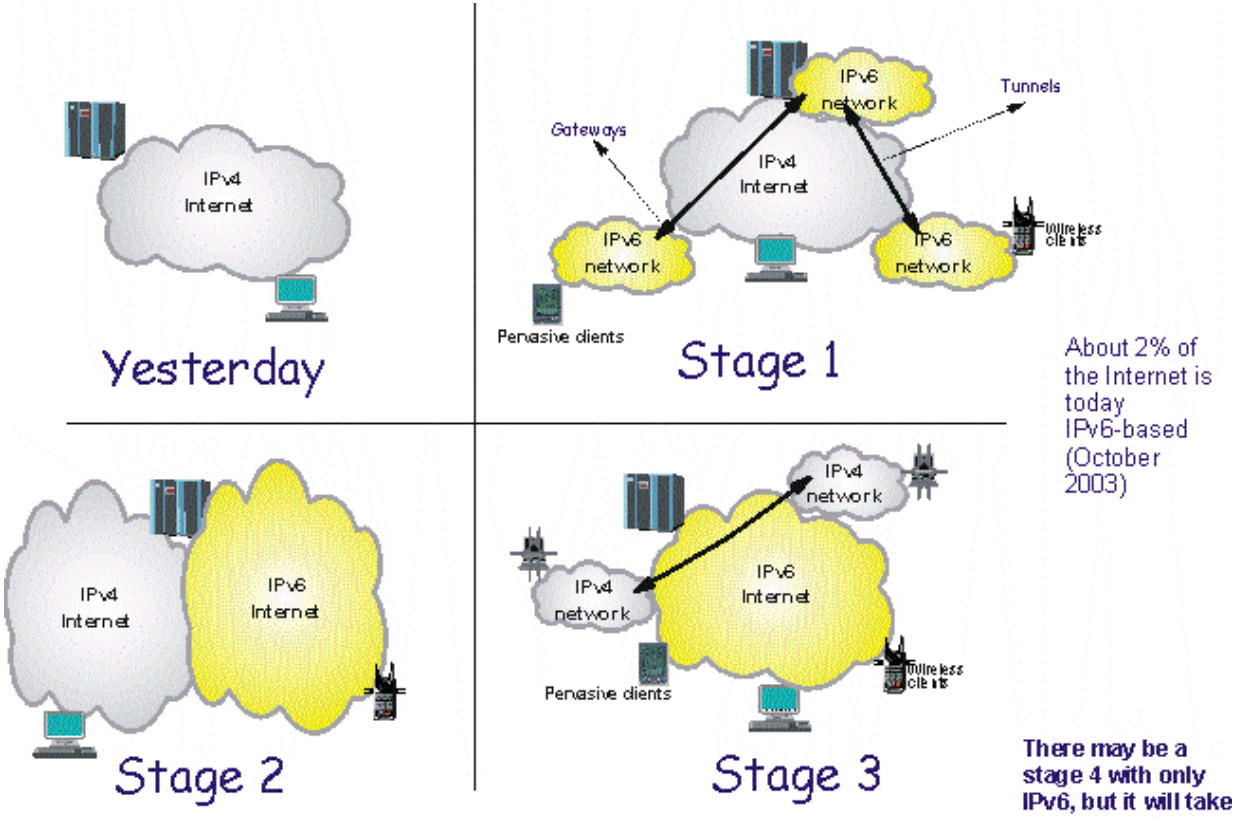
IPv6 Day

The Internet Society is testing the availability and reachability of World IPv6 Day participants from our servers in the UK. The dials below indicate the percentages of participants announcing IPv6 DNS records, reachable from ISOC over IPv6, and reachable from ISOC over IPv4.

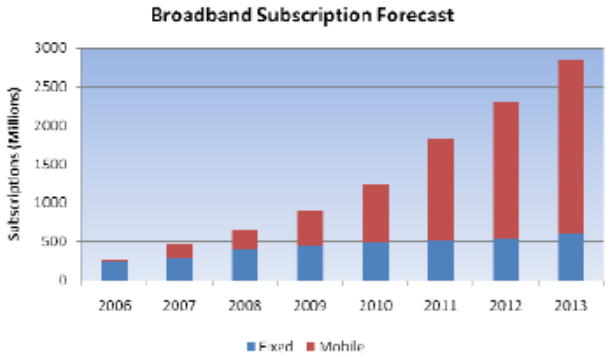


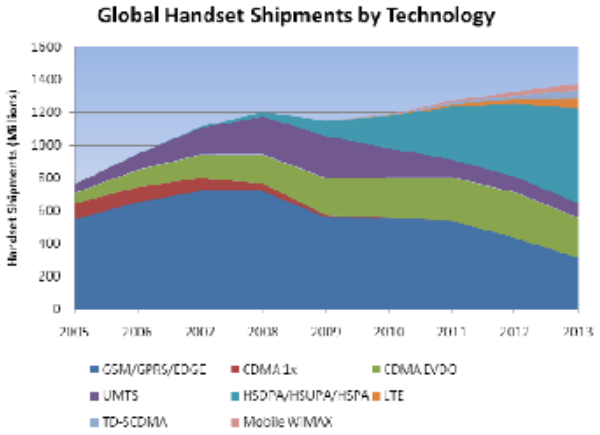
Last updated: Wed Jun 8 23:48:13 UTC 2011.

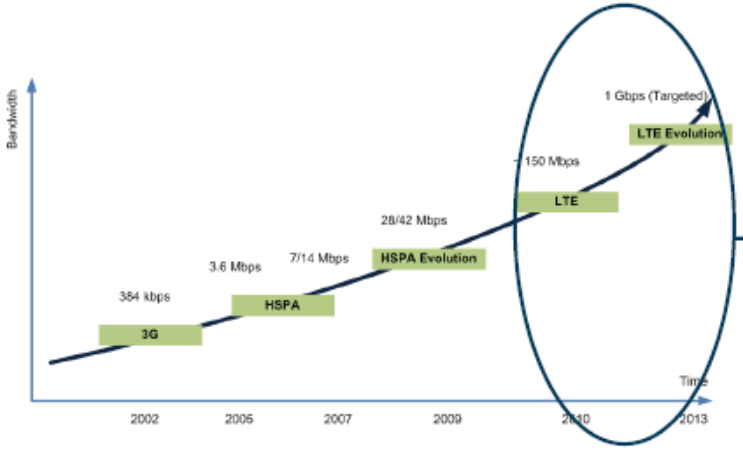
IPv6 Transition Paths



Number 1 Application Driver: Mobile IP



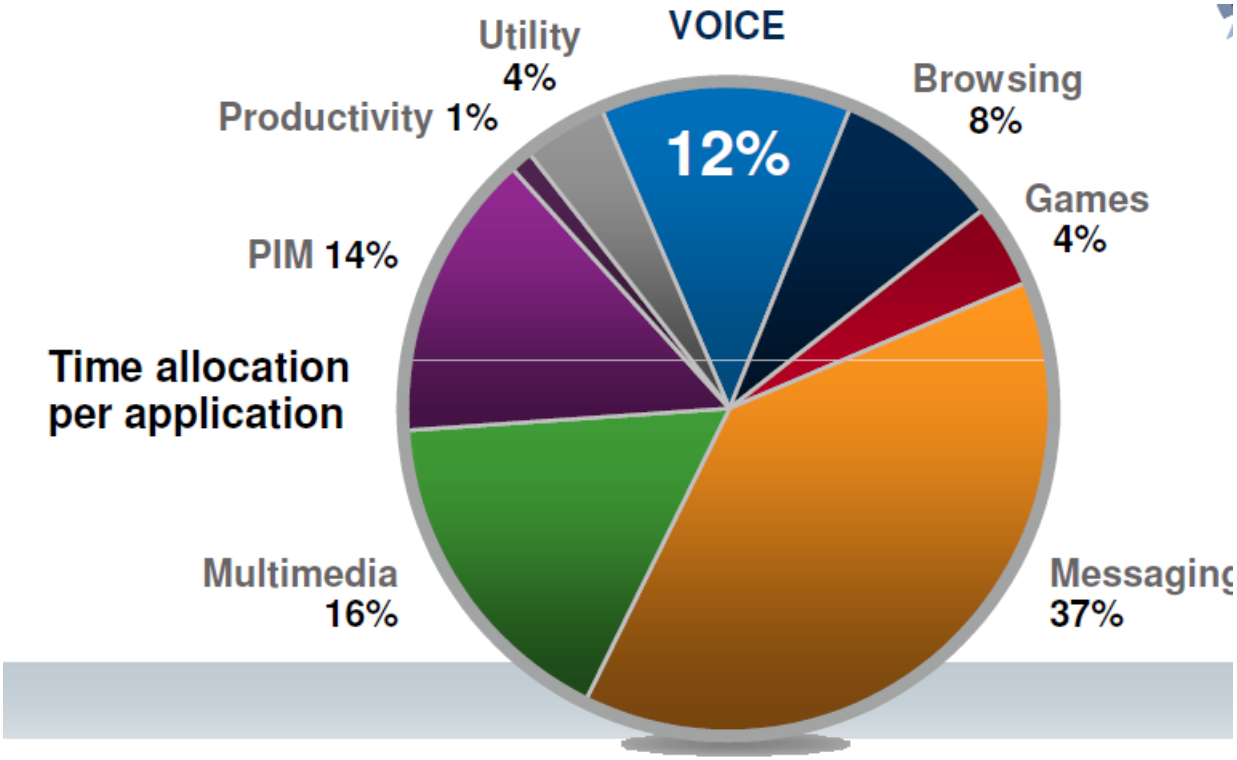




LTE stands for Long Term Evolution – Technology to provide all IP networking; In other words, IP from Mobile terminal to support growing mobile broadband needs

Source: Ericsson, ABI

IPv6 – New Information Types – Critical to LTE



Voice is 12% of usage

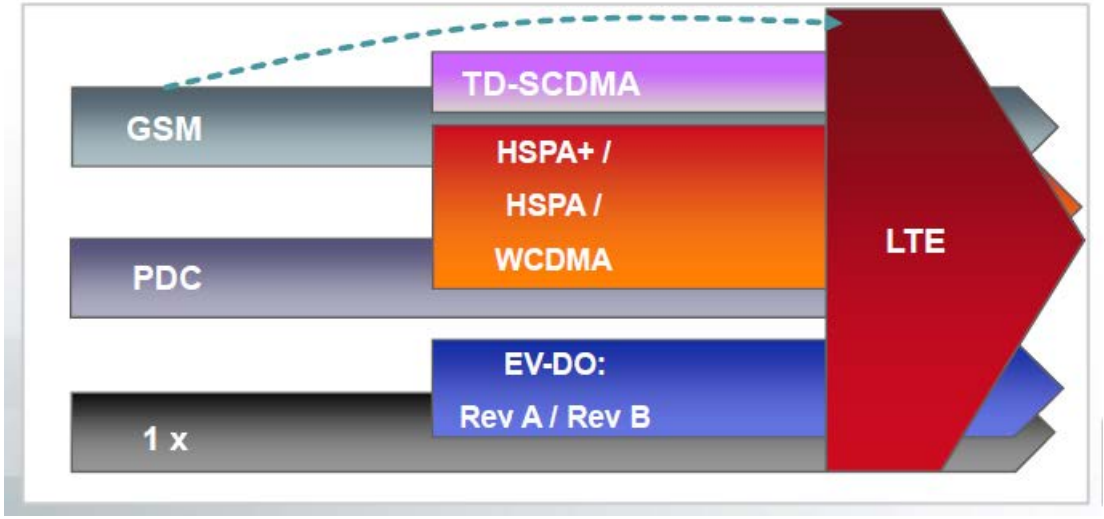
LTE – 4G

Flat IPv6 network

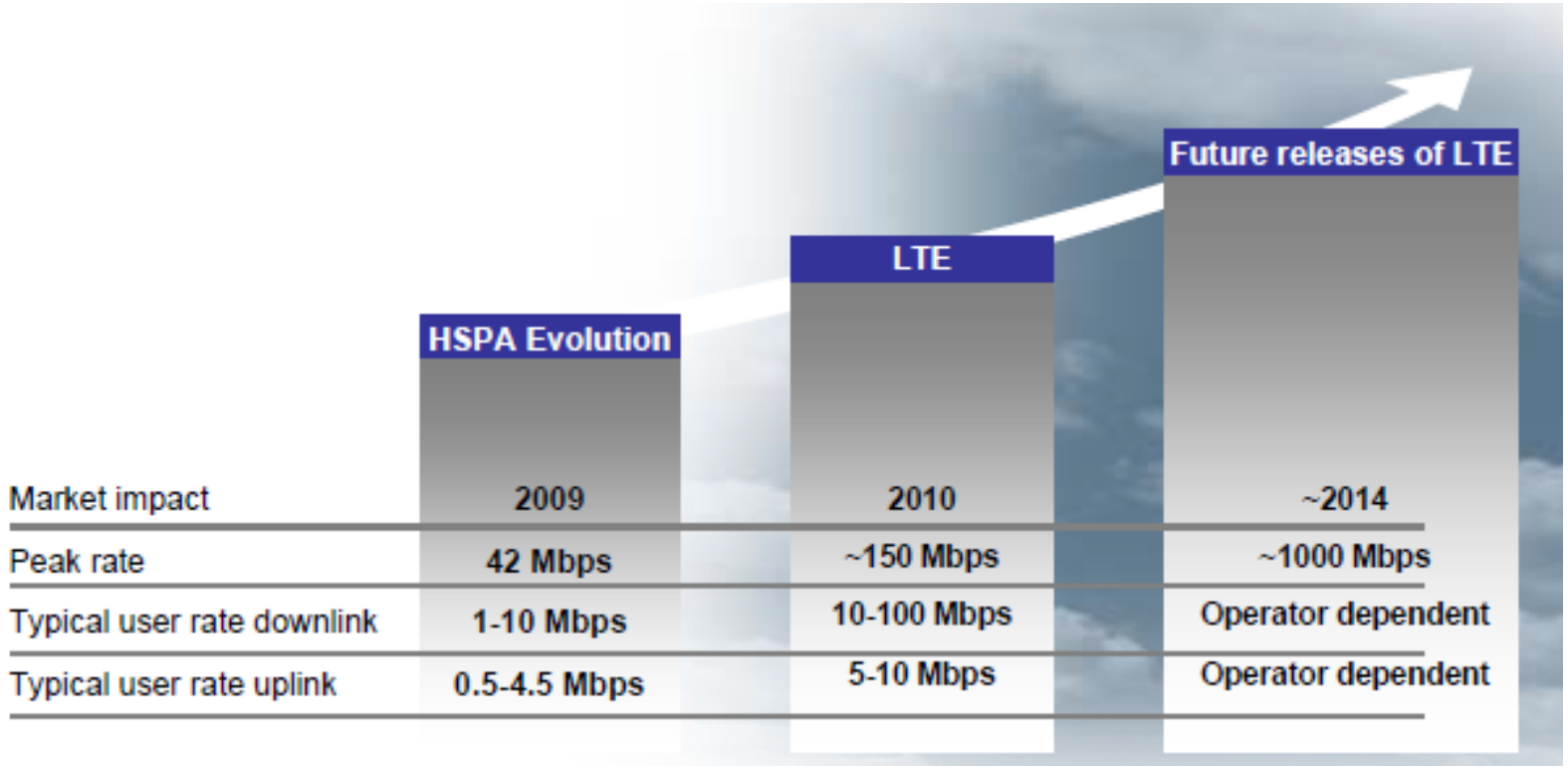
High Through-put

Low Latency

Increased spectrum flexibility

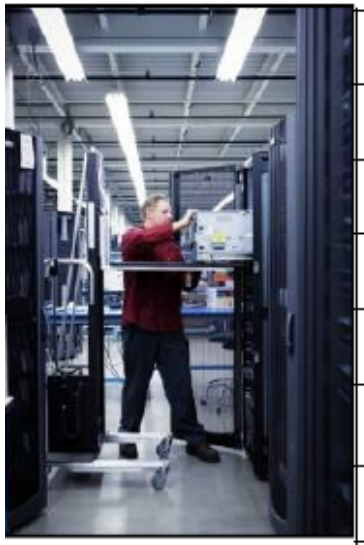


Future of LTE



Market impact	2009	2010	~2014
Peak rate	42 Mbps	~150 Mbps	~1000 Mbps
Typical user rate downlink	1-10 Mbps	10-100 Mbps	Operator dependent
Typical user rate uplink	0.5-4.5 Mbps	5-10 Mbps	Operator dependent

Enterprise Driver of IPv6 – CLOUD Computing



Enterprise Class	Global class
On-premise	Hybrid/off-premise
100s -1000s of nodes	10,000+ nodes
Proprietary	Commodity
HW resiliency	SW resiliency
Max performance	Max efficiency
Silo'ed Resources	Shared Resources
Clusters	Grids/Cloud
Static	Elastic
Shared storage	Replicated storage
Facility costs	Power Usage Efficiency

Cost-Center

Value/
Revenue-Center

Courtesy: John Rhoton
Distinguished Technologist
HP EDS CTO Office

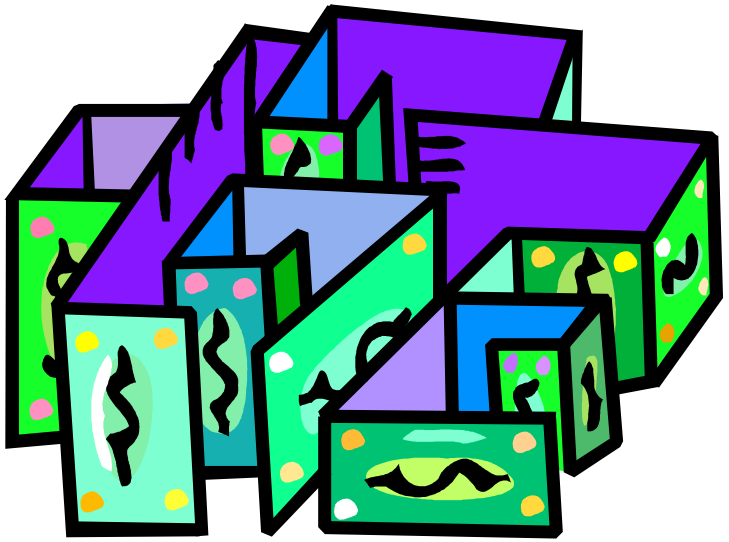
NAT Makes IPv4 Enterprise Successful
NAT Breaks Cloud Computing

Overhead due to Translation

Protocol incompatibilities

Peer-Peer breakage
- Instant messaging
- Interactive games
- VOIP
- Netmeeting
- BitTorrent

Scalability



Business IPv6 Demand Drivers

More network appliances

Mandates for Government Agencies

Control operation expenses for IT

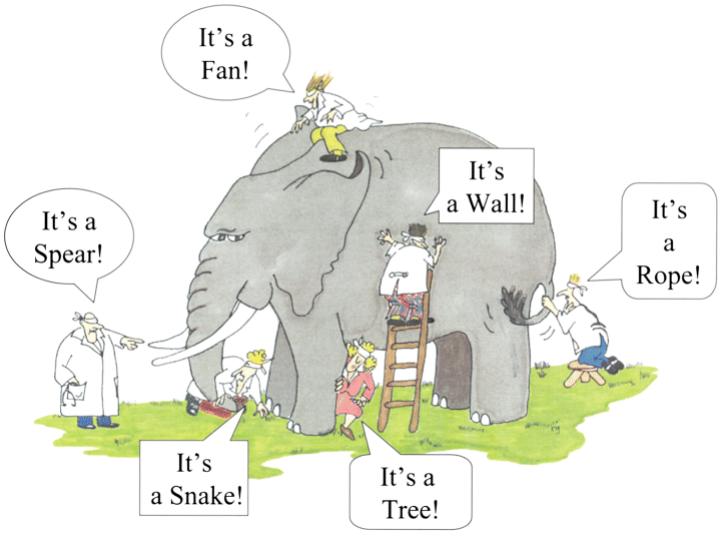
Elimination of complex NAT networks

Strong intrinsic security

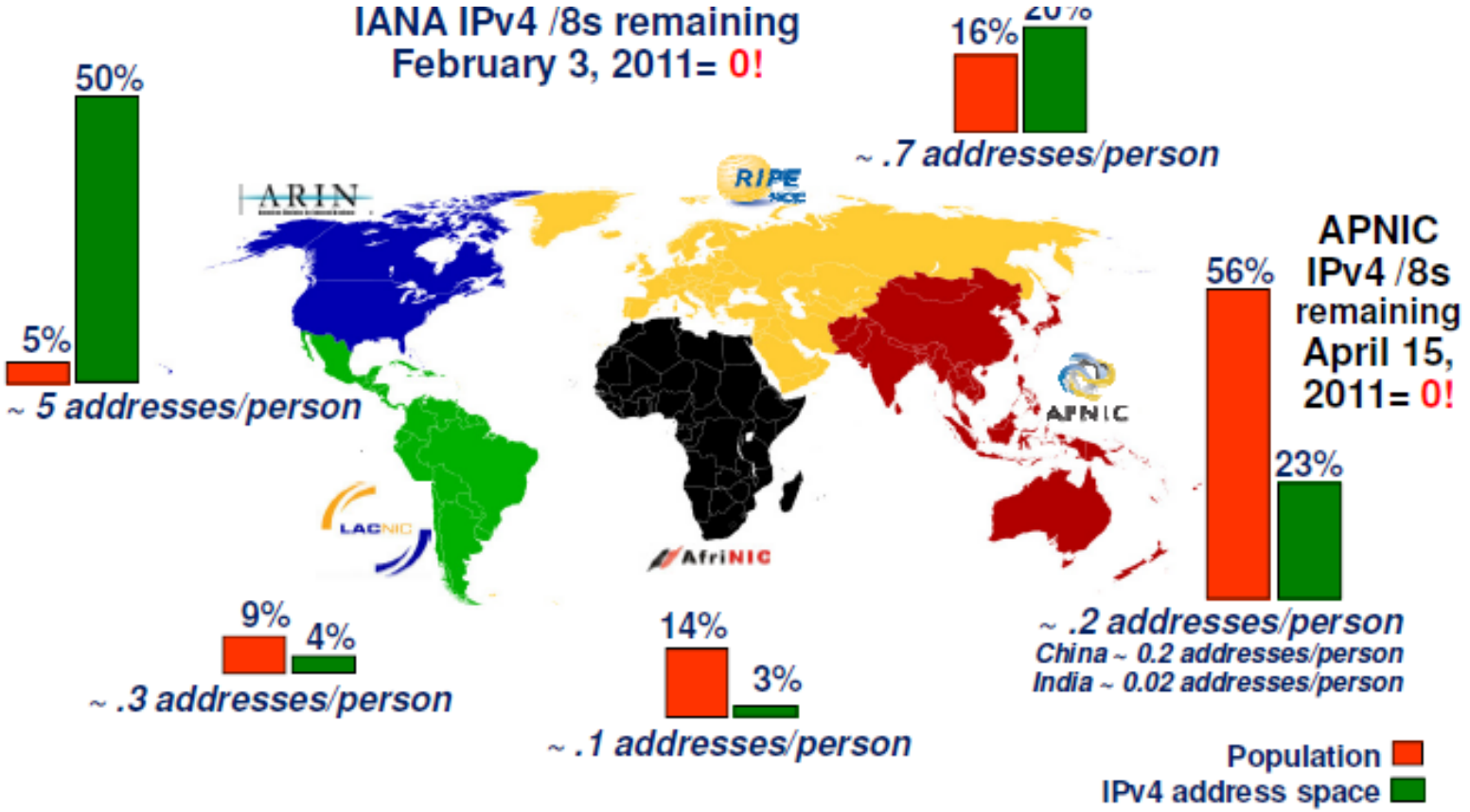
Robust mobility support

Greater flexibility and simplicity

Business process improvements



IPv6 Address Importance



Regional IPv4 depletion will occur unevenly
(see www.ipv4depletion.com for details)

History Repeats !

It will always take longer than planned

The best plans are always changed

It will always be more complicated than planned

Why deploy something if you cannot manage it

Why deploy something if you cannot secure it

Deployment Considerations

Compatibility issues between IPv4 and IPv6

Vendor interoperability issues

Potential security issues

Service management

Existing hardware and software support of IPv6

Cost of potential hardware and software upgrades

Cost of education

Global public routing practices continue to evolve

DNS Issues Behind Many IPv6 Rollout Problems

Poor DNS Planning

Well documented

RFC 3596
(DNS extensions to support IPv6)
RFC 3901 and 4472
(DNS transport operational guidelines)
RFC 4074
(Common misbehavior for IPv6 responses)
RFC 5211
(An Internet Transition Plan)

Be sure to consider

- Transport
- Dedicated vs dual stack resolvers
- Name space fragmentation
- Placement related to NAT devices, load balancers, etc
- Applications

IPv4 Dependencies

DNS –inserting AAAA records

Operational support and maintenance

FCAPS – Fault, Configuration, Availability, Performance and Security systems for measurement and reporting

IP address tools and automated deployment systems

Education

Infrastructure components – DNS, firewalls, IDSs, routers, switches

IPv6 Risk Mitigation

Security organizations need to be early adapters

Increase level of security controls during initial IPv6 deployment

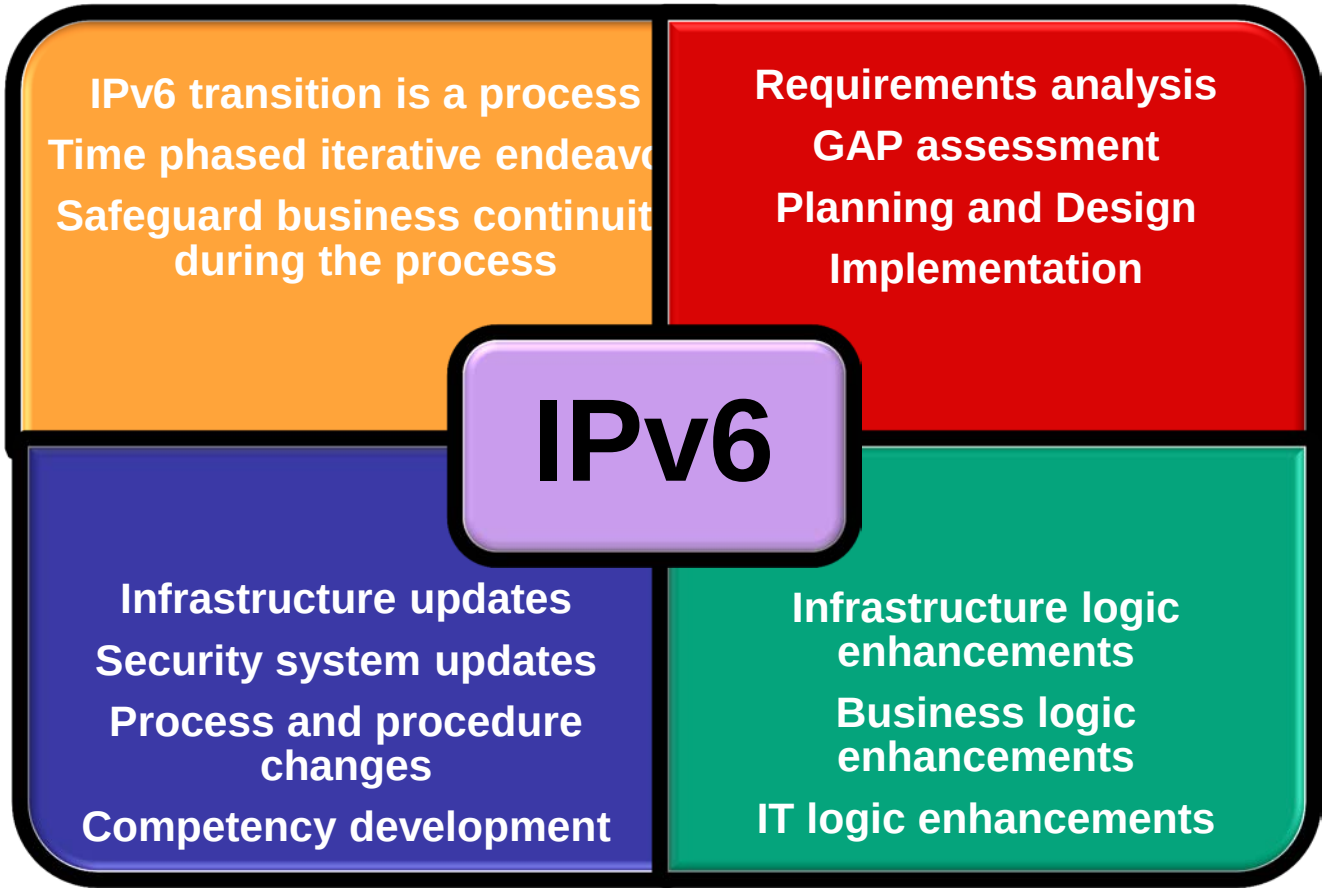
Monitor for false router advertisement

Authenticate routers and other infrastructure devices

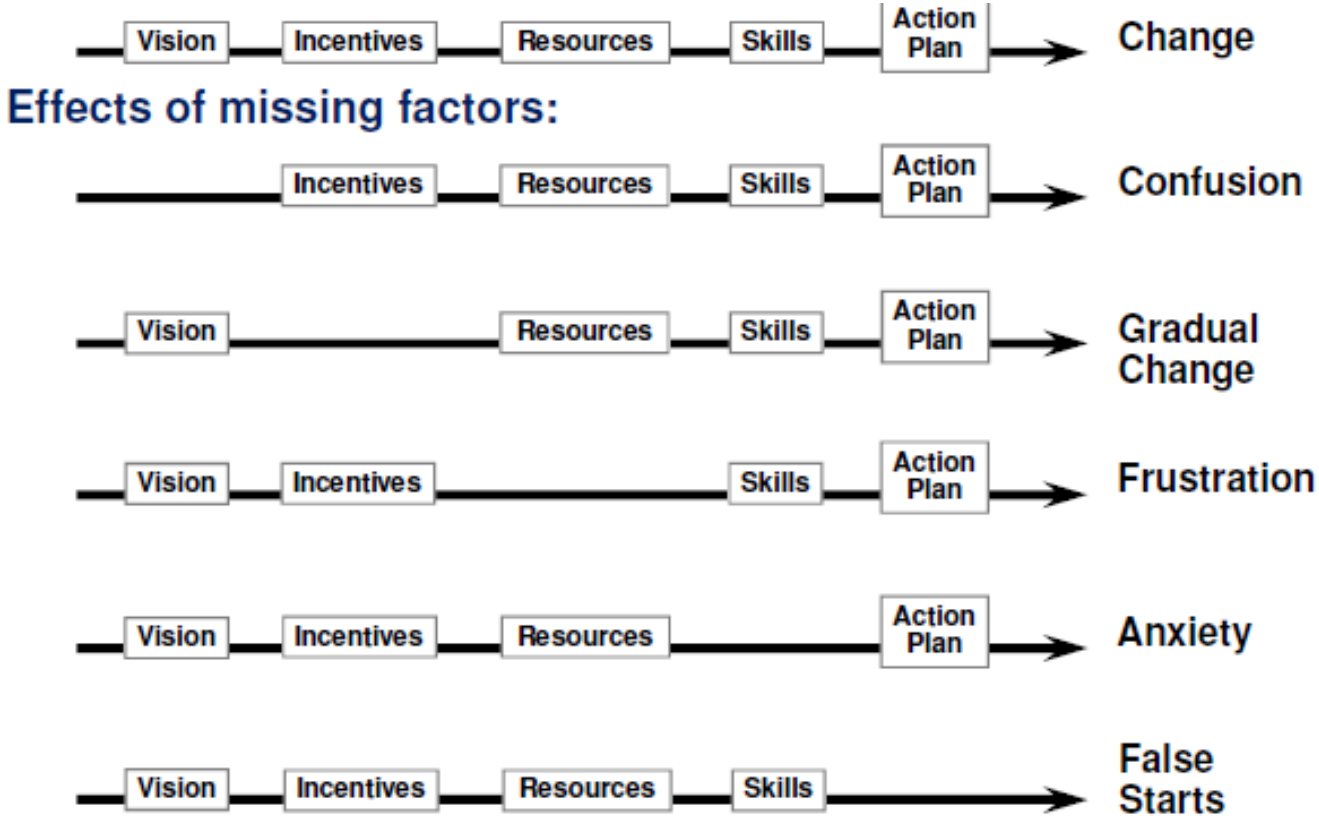
Develop filtering strategies

Enforce multicast scope limits at appropriate boundaries

Deployment Elements

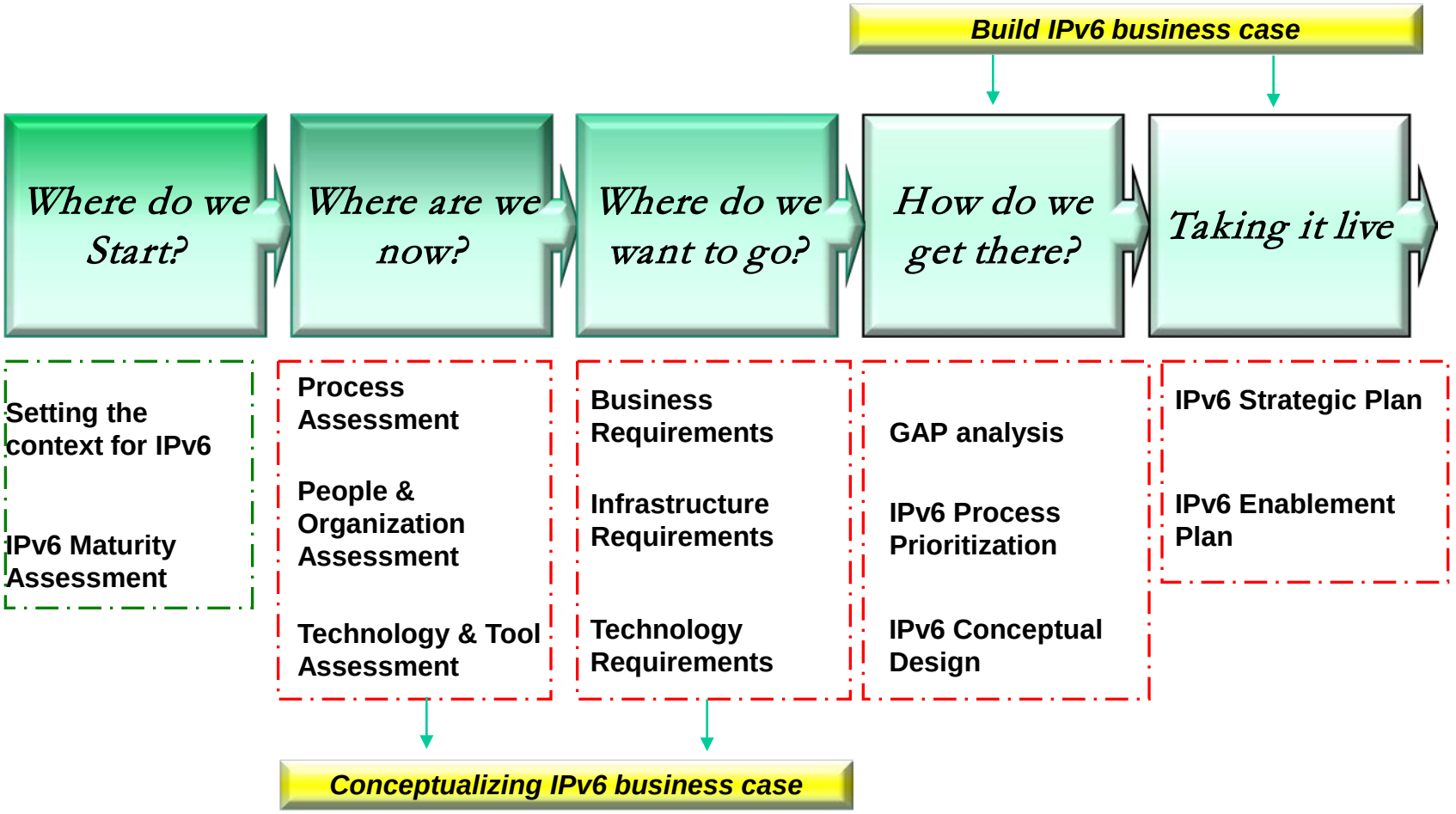


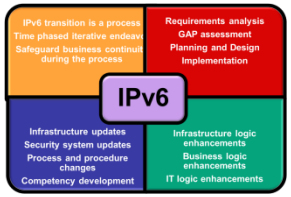
Critical Success Factors for any Transition



From Enterprise Corporation a consulting firm no longer in existence

Building the Transition Plan





IPv6 Preliminary Assessment

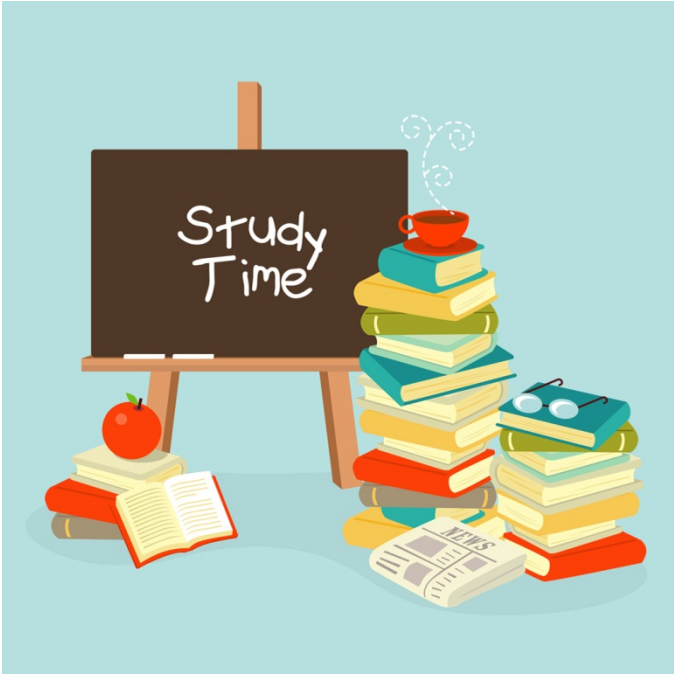
Educational services on IPv6 transition

- – Presentations covering industry trends
- – Case studies including lessons learned and caveats

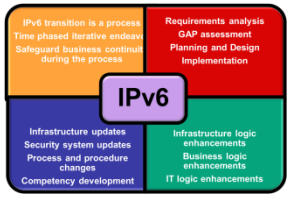
Situational analysis and requirements elicitation

- – Review of overall market-specific business context and drivers for IPv6
- – Preliminary assessment of existing network infrastructure: architecture, deployed components and systems
- – Preliminary assessment of business logic systems, applications, and services
- – Review of IT and network operations management
- – Review of security management

Development of strategic IPv6 roadmaps



IPv6 Assessment



Detailed assessment of network capabilities and systems

Hardware, software, associated management tools

Identification of business and technical drivers for IPv6 transition

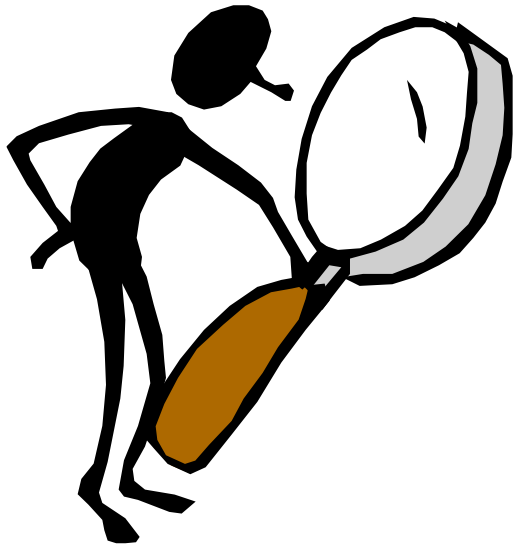
Detailed assessments and compliance analysis

Site survey, network logic, business logic, security management and compliance, evolution plans

Education and competency development

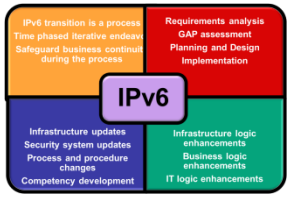
Benefits, industry directions, standards, compliance, vendor roadmaps

Training, reports on IPv6 readiness findings, detailed transition roadmaps



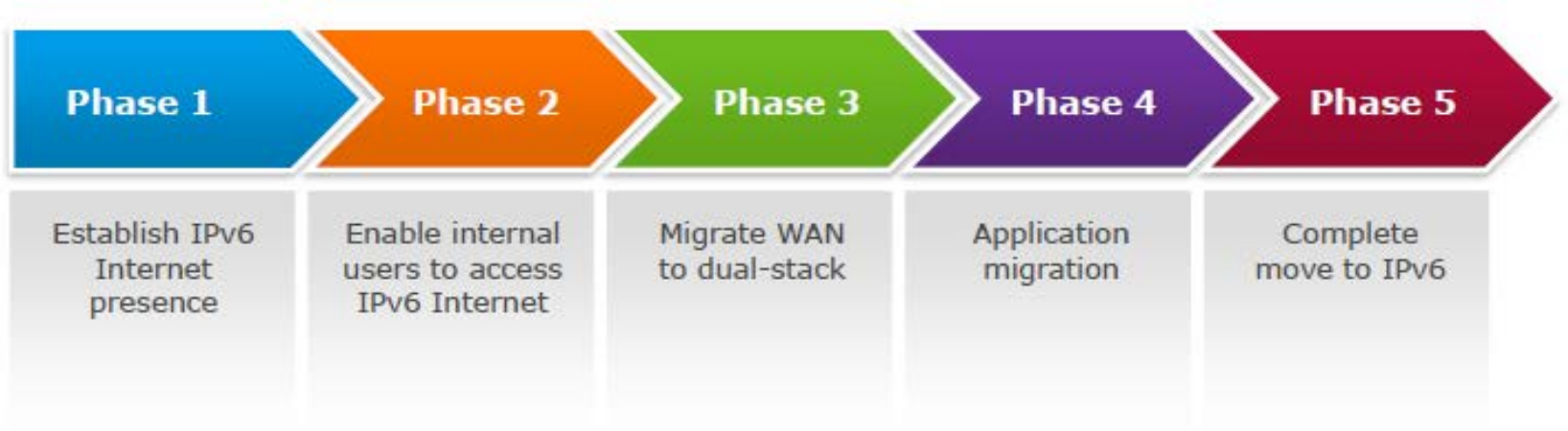
IPv6 Planning

A comprehensive, enterprise-wide migration strategy



Provide vertical-specific industry analysis and best practices
Identify technologies and develop a target compliant architecture
Develop a POC lab simulation environment prior to migration
Define IP addressing framework, automated tools, management processes
Develop detailed project management plan
Develop detailed pre and post-migration test plans and success criteria
Recommend migration paths for non compliant network devices
Develop the detailed implementation plan and related documents
Provide education, coaching, and training

IPv6 Transition Technologies



Have a Report Card

Report Card	PASS/ FAIL/Document
Define IPv6 support levels for infrastructure components	
Baseline existing server, application, and infrastructure (DNS, routers, etc) elements for key KPI's	
Deploy Infrastructure on IPv6	
Perform IPV6 infrastructure "internal move"	
Perform IPv6 infrastructure "external move"	
Connect and test external IPv6 connections	
Define items that will never support IPv6	
Failover testing of the management modules	
Failover testing of the network switches	

Report Card	PASS/ FAIL/Document
Device activation	
Zero Downtime Upgrades	
Baseline core network elements before and after	
Datacenter upgrades	
Increased infrastructure to administrator ratio	
Reduced deployment times	
Infrastructure cost savings	
Labor cost savings	
Centralized management of IPv6infrastructure	

IPv6 Design Motto

Tunnel where you must!

Go Native where you can!

Tunneling Issues

Latency

Where are the tunnel endpoints

Distant 6to4 relays

Broken Teredo servers

6to4 Tunneling

IPv6 traffic tunneled to go through an IPv4 network
- www.sixxs.net – Worldwide tunnel broker

Address - 2002:wwxx:yyzz::/48
- wwxx:yyzz is both the NLA and the colon-hexadecimal representation of an IPv4 address assigned to the site or host

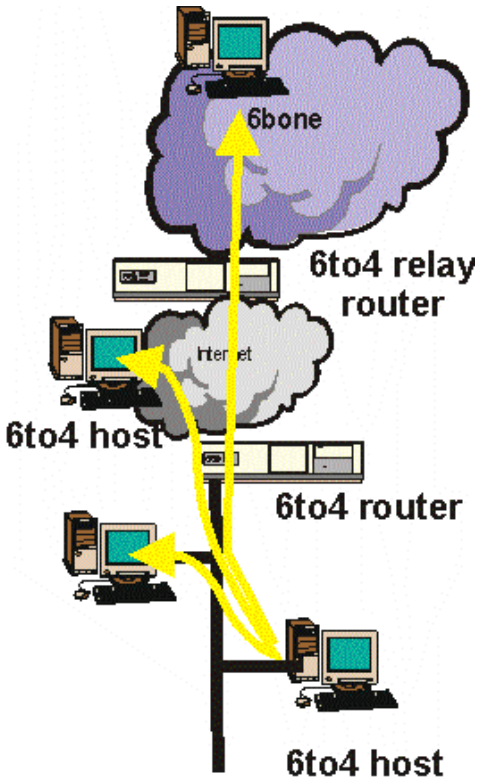
2002:wwxx:yyzz:[Subnet]:{Interface ID}

6to4 host - an IPv6 host that is configured with at least one 6to4 address

6to4 router - an IPv4/IPv6 router that forwards 6to4 traffic between 6to4 hosts within a site or 6to4 relay routers on the IPv4 Internet

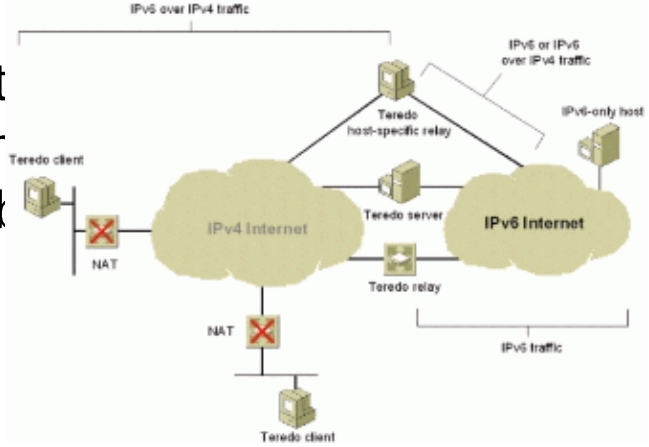
6to4 relay router - an IPv4/IPv6 router that forwards 6to4 addressed traffic between 6to4 routers on the IPv4 Internet and hosts on IPv6 networks

Anycast
2002:C058:6301::



Teredo

- 6to4 tunnels requires the tunnel end point public IPv4 address…..so for many that m NAT device…Many NAT devices cannot b upgraded
- Teredo encapsulates IPv6 in UDP/IPv4 datagrams.
  - Diagnoses UDP over IPv4 (UDPv4) connectivity and discovers the kind of NAT
  - assigns a globally-routable unique IPv6 address to each host using it;
  - encapsulates IPv6 packets inside UDPv4 datagrams for transmission over an IPv4 network (this includes NAT traversal);
  - routes traffic between Teredo hosts and native (or otherwise non-Teredo) IPv6 hosts.



IPv6 Translations

NAT-PT (Network Address Translation and Protocol Translation)

Translates by mapping each IPv6 address onto one from a pool of IPv4 addresses

Upside: easy to implement and understand

Downside: Limits simultaneous access to multiple services with a network

Breaks end-end networking

Single point of failure

NAPT-PT (Network Address Translation plus Port Translation)

Protocol gateway translates the IPv4/IPv6 network addresses and also maps port across boundaries

Upside: Easy to implement, adds support for more simultaneous sessions

Downside: Breaks end-end networking, single point of failure

SIIT (Stateless IP/ICMP Translation)

IP packets and ICMP messages are translated between IPv4 and IPv6 with temporary assignments of IPv4 addresses creating a one-one mapping

Upside: Does not require state detail to be maintained

Downside: Does not save on IP addresses, single point of failure

IPv6 Design Mistakes

Assuming you need feature parity – you want functional parity

Assuming you need your entire network running IPv6

Assuming that your existing security, logging and monitoring products support IPv6

Challenges
Managing and monitoring transition services

Inconsistent advice from vendors

IPv6 Transition Plan

Physical and logical implementations of the developed IPv6 transition plan

Detailed project management of every aspect of implementation and Management

- Physical installations
- Device configurations
- Execute pre and post-test plans
- Documentation
- Design and configurations procedures
- Fine-tune network elements

IPv6 Security

Hardware: Routers, servers, switches, firewalls, etc.

Software: Applications, tools, scripts, databases, etc.

Documentation: Policies, procedures, best practices

Access Control: Authentication, Authorization, Accounting

Forensics: preservation of evidence, data privacy protection

Business and Legal (SOX, HIPPA, GLB, etc)

Business Continuity

IPv6 Security Types of Attacks

Layer 1: (primarily physical) wiretapping, tapping, console access, rogue devices, etc.

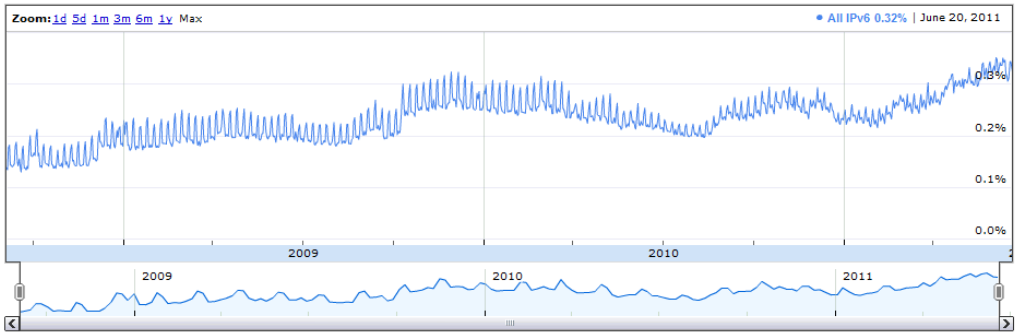
Layer 2 attacks: VLAN “hopping”; MAC, DHCP, ARP, spoofing; …..

Layer 3: IP spoofing, DoD/DDoS, routing, smurf, tunneling, translation, transition

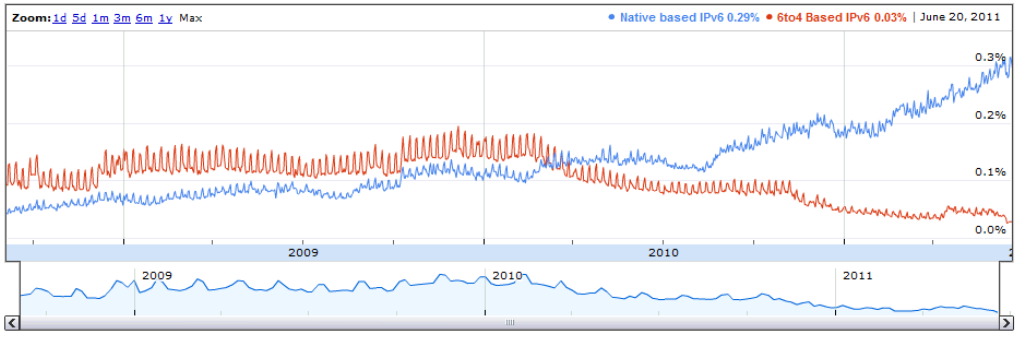
Layer 4-7: viruses, worms, application, rogue software, Man in the Middle

All Layers
reconnaissance, unauthorized access
sniffing

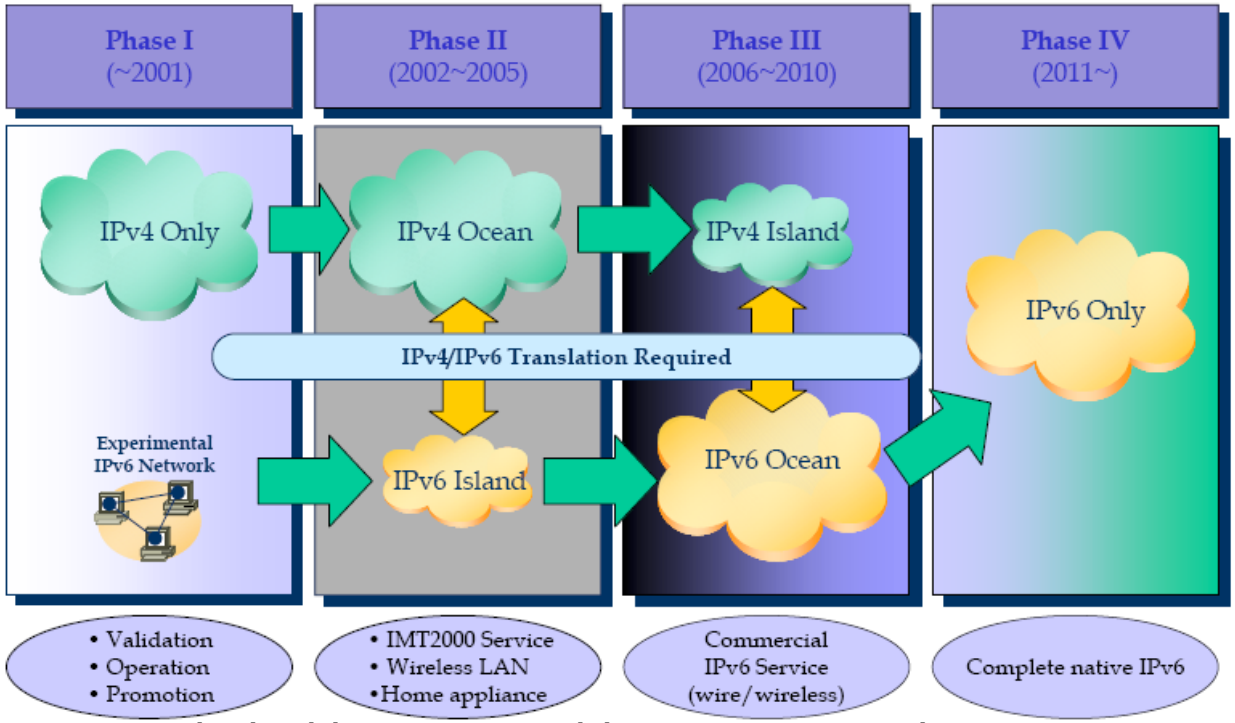
Google IPv6 Statistics



This is the Native IPv6 vs. 6to4/Teredo graph and shows what connectivity method is used by users. More connectivity is now native than before.



IPv6 Transition Roadmap – Leading Korean ISP



Expanded with country wide support services
6NGIX provides exchange among ISPs
Korea dvanced Network providing IPv6 for orgnizations now
By end of 2009 3 new ISPs moving to IPv6 backbones
Public Sector transition planned for 2011

Implementation Snapshot

Acquire Provider Independent IPv6 space

Do native IPv6 peering or use a tunnel service

Get external firewall and external routing working

Trial public IPv6 with external DNS and Mail

Evaluate transition services as needed

Test your applications in a lab

Get internal IPv6 routing, DNS & DHCP working

Dual stack your servers

Provide dual stack to your workstation vlans

Deploy VPN dual stacked

AES Sessions at Share

Mar 12, 2012: 1:30-2:30 10715: Keeping Your Network at Peak Performance as You Virtualize the Data Center
Mar 14, 2012: 8:00-9:00 10397: IPv6 Basics
Mar 14 2012: 1:30-2:30 10395: IPv6 Tunneling Technologies
Mar 14, 2011: 1:30-2:30 10720: **Network Problem Diagnosis with OSA Examples**
Mar 15, 2012: 3:00-4:00 10401: IPv6 Performance Management
Mar 16, 2012 9:30-10:30 10393: CSI Maui: The Case of the Compromised Server
Mar 16 2012 11:00-12:00 10414 IPv6 Transitioning

QUESTIONS?

Grazie

Danke

ありがとうございました

Merci

ขอบคุณ

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நன்றி
Tamil

Obrigado

References

Microsoft links:
Microsoft IPv6 page – http://www.microsoft.com/ipv6
IPv6 Source/Dest Address selection process - http://technet.microsoft.com/enus/library/bb877985.aspx
Microsoft Infrastructure Planning and Design Guides - http://technet.microsoft.com/en-us/library/cc196387.aspx
Microsoft Exchange: Understanding IPv6 Support in Exchange 2010 - http://technet.microsoft.com/en-us/library/gg144561.aspx
Cisco links:
Cisco Validated Design - http://www.cisco.com/en/US/netsol/ns817/networking_solutions_program_home.html
IPv6 Addressing Plan from RIPE:
RIPE IPv6 Address Planning Guide - http://www.ripe.net/training/material/IPv6-for-LIRs-Training-Course/IPv6_addr_plan4.pdf

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• Deploying IPv6 in Branch Networks:
http://www.cisco.com/en/US/solutions/ns340/ns414/ns742/ns816/landing_br_ipv6.html
• CCO IPv6 Main Page:
http://www.cisco.com/go/ipv6
• Cisco Network Designs:
http://www.cisco.com/go/designzone
• ARIN IPv6 Wiki:
http://www.getipv6.info/index.php/Main_Page
• World IPv6 Day (June 8, 2011):
http://isoc.org/wp/worldipv6day/
• IPv6 at IBM
http://www-01.ibm.com/software/info/ipv6/index.jsp
• IBM IPv6 Compliance
http://www-01.ibm.com/software/info/ipv6/compliance.jsp
• Security for IPv6 Routers
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