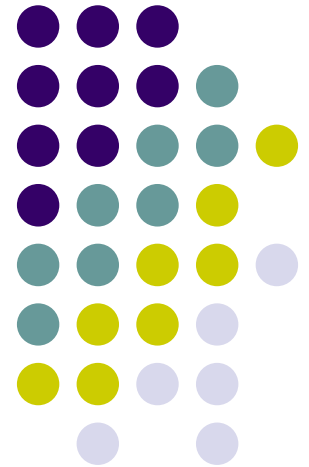


IPv6 transition: moving into the campus

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Agenda



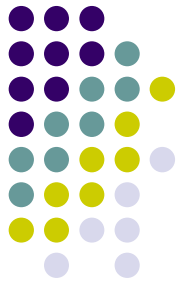
- Basics of transition
- Where is IPv6 deploying?
- NREN transition
- Campus transition
- Case studies
- 6NET involvement

Transition aspects



- Two key aspects to deploying IPv6 in the European research networks
 - Enabling IPv6 in the National Research and Education Networks (NRENs)
 - Enabling IPv6 in the university (campus) networks
- Also interested in
 - IPv6 access for researchers and students in commercial networks, e.g. ADSL, wifi hotspots
- Need tools to facilitate IPv6 availability

Views of transition



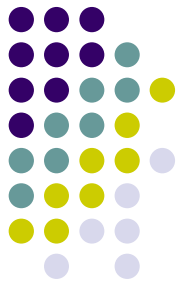
- User
 - Should be unaware of IP version
- Application developer
 - Should write IP version independent code
- Stack/router developer
 - Offer protocols for both stacks
- NREN/campus network operator/admin
 - Support specific transition tools

Various approaches



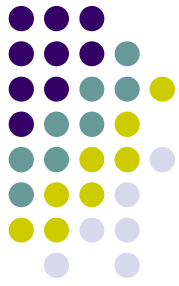
- Tunnels (“connecting IPv6 clouds”)
 - Running IPv6 encapsulated over IPv4 links
 - IPv6 packet is data payload of IPv4 packet
 - May be automatic or manually configured tunnels
- Translation methods (“IPv4<->IPv6 services”)
 - Layer 3: Rewriting IP header information
 - Layer 4: Rewriting TCP headers
 - Layer 7: Application layer gateways (ALGs)
- Dual Stack
 - Servers/devices speaking both protocols
 - Choose the protocol available in the target system

Transition toolbox



- Plethora of methods available
 - To the NRENs
 - To the campuses
- No single method fits all
- NRENs
 - Largely concerned with deploying dual-stack
 - Also support services: 6to4 relay, tunnel broker
- Campuses
 - Also largely interested in dual-stack
 - But much higher complexity in the systems being used

Where is IPv6 deploying?



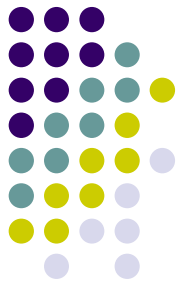
- In the academic research networks
 - European NRENs, GÉANT, Internet 2, CA*net4, WIDE (Japan), Korea, China and links between
 - Heralded at recent Global IPv6 Launch event
- In research projects
 - 6NET, Euro6IX
- In pre-commercial networks and pilots
 - Moonv6 (including US DoD sites)
 - See the SubTLA allocation list
- Full commercial deployment still lacking

How is it deploying?



- Almost universally dual-stack
 - On the NREN backbone networks first
 - Challenge now is early enterprise adopters
- Dual-stack? So what do we gain?
 - An enhanced environment where NATv4 + IPv6 is deployed (use IPv4 for mail, www, and IPv6 for new apps)
 - An environment for future IPv6-only devices
- What's the catch?
 - Service and application interaction considerations
 - Performance issues

6NET: NREN case studies



- Offering IPv6 transport across an NREN
- Most common method is dual-stack
 - Two NRENs have deployed parallel infrastructure
 - Two have used 6PE (MPLS)
- Reported in D2.2.3 (see www.6net.org)
 - Includes theory and scenarios
 - IETF ISP transition analysis
 - Three NREN case studies
 - Survey of NREN solutions
- Most NRENs have a service, as does GEANT
 - Deployment issue now pushed to the edge

6NET: Campus case studies



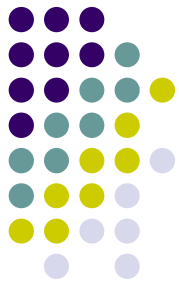
- Undertaking transition at sites including
 - Southampton
 - Lancaster
 - Muenster (JOIN project)
- Collaborating with Euro6IX project partners
 - UPM
 - UMU
- Current status in 6NET document D2.3.3-bis1
 - See www.6net.org for text

Campus scenarios



- Aggregating experience at the sites
 - Some overlaps for common technology, some differences
 - The more sites to draw experience from, the better
- Producing detailed studies
 - Scenarios and analyses
- Contribute to
 - 6NET D2.3.4 (“site transition cookbook”)
 - Plain language campus transition white paper
 - IETF drafts for IPv6 Operations WG
 - Knowledge base for transition “SWOT” team

Transition methodology



- Analyse current IPv4 systems scenario
- Identify gaps
 - Work around gaps if possible
 - Evaluate the limitations where barriers are firm
- Obtain IPv6 address space
- Obtain external IPv6 connectivity
- Deploy IPv6 “on the wire” internally
 - Perhaps using protocol VLANs, perhaps ISATAP
- Enable IPv6 in services and management tools
- Ensure policy and security issues are covered

Transition components



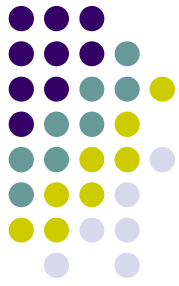
- Network
- Address allocation
- Management and monitoring
- Services
- Host and device platforms
- User tools

Network components



- Internal physical links
 - Ethernet
 - Wireless LAN
- Routing and logical subnets
 - Typically /24 - /26 sized subnets
- Firewall
 - Stateful usually required
- Remote access
 - Dialup, VPN
- Uplink connectivity to campus/MAN

Address allocation



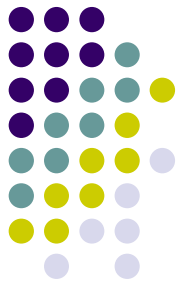
- Network prefix allocation
 - Hierarchical, provider assigned
- Address allocation
 - Address plan
- Address management
 - Manual
 - Stateful DHCPv6
 - Stateless address autoconfiguration
 - RFC3041 privacy addresses
 - (Need to consider site policy here)

Management and monitoring



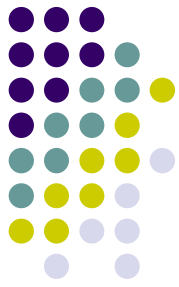
- Device configuration and monitoring
 - SNMP
- Statistical monitoring
 - MRTG, Cisco Netflow
 - RIPE NCC Test Traffic server
- Service monitoring
 - Nagios
- Intrusion detection (IDS)
 - Snort
- Authentication systems
 - For WLAN: 802.1x

Service/server components (1)



- Email
 - Sendmail, MS Exchange, WU-IMAP
- Web hosting
 - Apache 1, Apache 2, IIS 4, IIS 5
- Databases
 - MySQL, MS SQL
- Directory services
 - NIS, LDAP, Active Directory, RADIUS
- DNS
 - BIND

Service/server components (2)



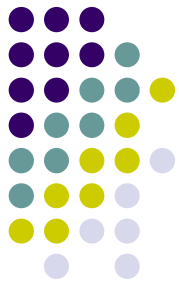
- NTP
 - Dedicated hardware, RIPE NCC Test Traffic server
- Usenet News server
 - dnews
- Multicast
 - PIM-SM (not using SSM for IPv4)
- Remote login
 - sshd
- File serving
 - NFS, samba

Host and device platforms



- Server platforms
 - Windows 2000, 2003, NT
 - Solaris 8, 9
 - Linux
 - SGI
- Desktop systems
 - Windows 98, 2000, ME, XP
 - Linux, MacOS/X
- PDAs
 - Windows CE/.NET, PalmOS, Linux, Zaurus

User tools (1)



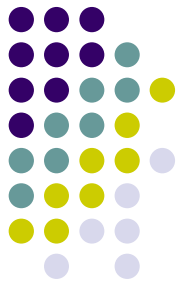
- Dedicated hardware
 - Printers
 - Webcams
- Mail clients
 - Outlook, Eudora, Mutt, Pine
- Web browsers
 - MSIE, Mozilla, Safari, Opera
- Conferencing tools
 - AccessGrid
 - H.323 (NetMeeting, GnomeMeeting, OpenMCU)

User tools (2)



- Other collaboration tools
 - IRC, Jabber, MSN Messenger, cvs
- Login clients
 - ssh
- NTP clients
 - ntp.org tools
- USENET News client
 - nn, Mozilla
- Host communications
 - X11, vnc, PC Anywhere

Gap analysis (1)



- Layer 3 functions on Layer2/3 switching equipment
 - IPv6 injected into VLANs via parallel IPv6 routers
- NFS/samba IPv6 support
- MS Exchange, Outlook, Eudora
- AccessGrid IPv4 only
- Some Apache 2 modules lack 1.3 functionality
- IPv6 support in MS Active Directory
 - Use of OpenLDAP?
- IPv6 dnews support
- IPv6 for WLAN access control (web redirect, 802.1x)

Gap analysis (2)



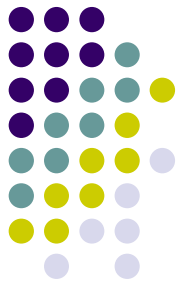
- IPv6 support for Windows 98, ME, 2000
 - Must upgrade to Windows XP
- DHCPv6 implementations
 - Required for DNS resolver discovery, at least
- IPv6 support for Irix
- IPv6 support for various PDA platforms
- Reverse DNS wildcards?
 - Sendmail wants to reverse lookup IP addresses
- MLDv2 snooping in Ethernet switches
- IPv6 for X11 (xfree has copyright issues)

Planned outputs



- Specific detailed cookbook
 - Within 6NET, by December 2004 (D2.3.4)
- Generalised campus transition white paper
 - Jointly with Euro6IX, around October 2004
 - Paper aimed at *senior management* in universities
 - The detailed 6NET cookbook is aimed at administrators
- IETF contributions
 - Campus scenario, initial analysis, by August IETF
- Knowledge base for “SWOT” team
 - During January - June 2005, as 6NET extension

Southampton status



- IPv6 available internally
 - Using parallel IPv6 routers (BSD)
 - Injecting IPv6 into IPv4 VLANs (congruent subnets)
- Dual-stack services
 - DNS servers done (BIND9), web and email now
- New IPv6 services
 - Mobile IPv6 deployment (linking community network)
- Want to share experiences!
 - Please contact us
 - Also looking for sites to join the 6NET case study
 - Email: tjc@ecs.soton.ac.uk