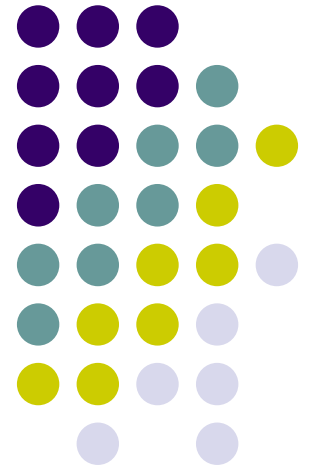


# IPv6 transition: moving into the campus

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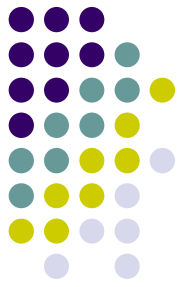


# Agenda



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

# Transition aspects



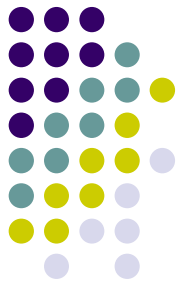
- Two key aspects to deploying IPv6 in the European research networks
  - Enabling IPv6 in the National Research and Education Networks (NRENs)
  - Enabling IPv6 in the university (campus) networks
- Also interested in
  - IPv6 access for researchers and students in commercial networks, e.g. ADSL, wifi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

# Views of transition



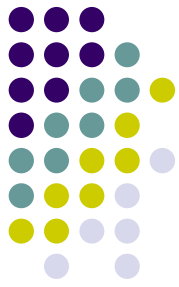
- User
  - Should be unaware of IP version
- Application developer
  - Should write IP version independent code
- Stack/router developer
  - Offer protocols for both stacks
- NREN/campus network operator/admin
  - Support specific transition tools

# Various approaches



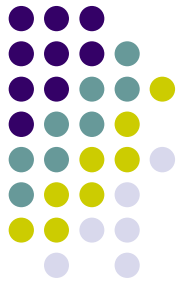
- Tunnels (“connecting IPv6 clouds”)
  - Running IPv6 encapsulated over IPv4 links
  - IPv6 packet is data payload of IPv4 packet
  - May be automatic or manually configured tunnels
- Translation methods (“IPv4<->IPv6 services”)
  - Layer 3: Rewriting IP header information
  - Layer 4: Rewriting TCP 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?



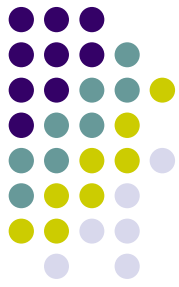
- Almost universally dual-stack
  - On the NREN backbone networks first
  - Challenge now is early enterprise adopters
- Dual-stack? So what do we gain?
  - An enhanced environment where NATv4 + IPv6 is deployed (use IPv4 for mail, www, and IPv6 for new apps)
  - An environment for future IPv6-only devices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

# 6NET: NREN case studies



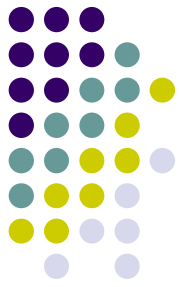
- Offering IPv6 transport across an NREN
- Most common method is dual-stack
  - Two NRENs have deployed parallel infrastructure
  - Two have used 6PE (MPLS)
- Reported in D2.2.3 (see [www.6net.org](http://www.6net.org))
  - Includes theory and scenarios
  - IETF ISP transition analysis
  - Three NREN 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



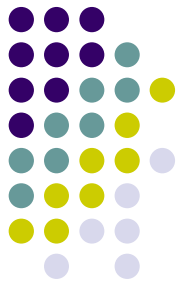
- Undertaking transition at sites including
  - Southampton
  - Lancaster
  - Muenster (JOIN project)
- Collaborating with Euro6IX project partners
  - UPM
  - UMU
- Current status in 6NET document D2.3.3-bis1
  - See [www.6net.org](http://www.6net.org) for text

# 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



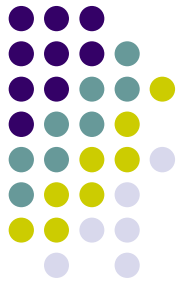
- Analyse current IPv4 systems scenario
- Identify gaps
  - Work around gaps if possible
  - Evaluate the limitations where barriers are firm
- Obtain IPv6 address space
- Obtain external IPv6 connectivity
- Deploy IPv6 “on the wire” internally
  - Perhaps using protocol VLANs, perhaps ISATAP
- Enable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

# Transition components



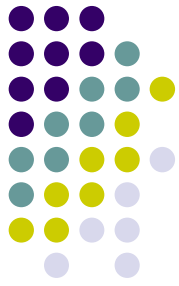
- Network
- Address allocation
- Management and monitoring
- Services
- Host and device platforms
- User tools

# Network components



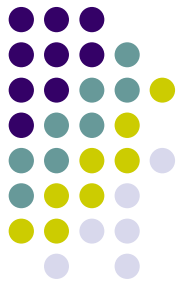
- Internal physical links
  - Ethernet
  - Wireless LAN
- Routing and logical subnets
  - Typically /24 - /26 sized subnets
- Firewall
  - Stateful usually required
- Remote access
  - Dialup, VPN
- Uplink connectivity to campus/MAN

# 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



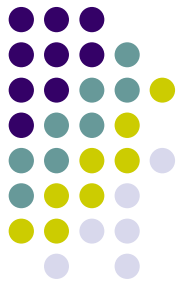
- Device configuration and monitoring
  - SNMP
- Statistical monitoring
  - MRTG, Cisco Netflow
  - RIPE NCC Test Traffic server
- Service monitoring
  - Nagios
- Intrusion detection (IDS)
  - Snort
- Authentication systems
  - For WLAN: 802.1x

# Service/server components (1)



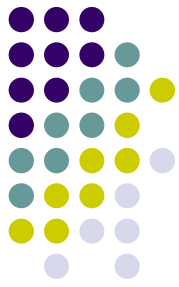
- Email
  - Sendmail, MS Exchange, WU-IMAP
- Web hosting
  - Apache 1, Apache 2, IIS 4, IIS 5
- Databases
  - MySQL, MS SQL
- Directory services
  - NIS, LDAP, Active Directory, RADIUS
- DNS
  - BIND

# 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



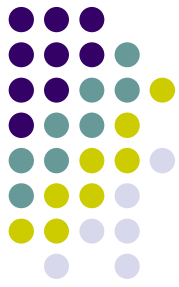
- Server platforms
  - Windows 2000, 2003, NT
  - Solaris 8, 9
  - Linux
  - SGI
- Desktop systems
  - Windows 98, 2000, ME, XP
  - Linux, MacOS/X
- PDAs
  - Windows CE/.NET, PalmOS, Linux, Zaurus

# User tools (1)



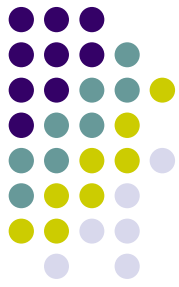
- Dedicated hardware
  - Printers
  - Webcams
- Mail clients
  - Outlook, Eudora, Mutt, Pine
- Web browsers
  - MSIE, Mozilla, Safari, Opera
- Conferencing tools
  - AccessGrid
  - H.323 (NetMeeting, GnomeMeeting, OpenMCU)

# User tools (2)



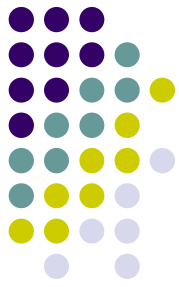
- Other collaboration tools
  - IRC, Jabber, MSN Messenger, cvs
- Login clients
  - ssh
- NTP clients
  - ntp.org tools
- USENET News client
  - nn, Mozilla
- Host communications
  - X11, vnc, PC Anywhere

# Gap analysis (1)



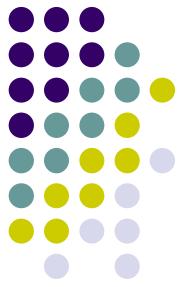
- Layer 3 functions on Layer2/3 switching equipment
  - IPv6 injected into VLANs via parallel IPv6 routers
- NFS/samba IPv6 support
- MS Exchange, Outlook, Eudora
- AccessGrid IPv4 only
- Some Apache 2 modules lack 1.3 functionality
- IPv6 support in MS Active Directory
  - Use of OpenLDAP?
- IPv6 dnews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

# Gap analysis (2)



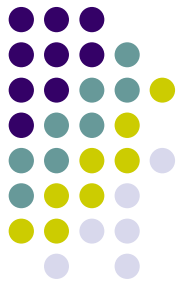
- IPv6 support for Windows 98, ME, 2000
  - Must upgrade to Windows XP
- DHCPv6 implementations
  - Required for DNS resolver discovery, at least
- IPv6 support for Irix
- IPv6 support for various PDA platforms
- Reverse DNS wildcards?
  - Sendmail wants to reverse lookup IP addresses
- MLDv2 snooping 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](mailto:tjc@ecs.soton.ac.uk)