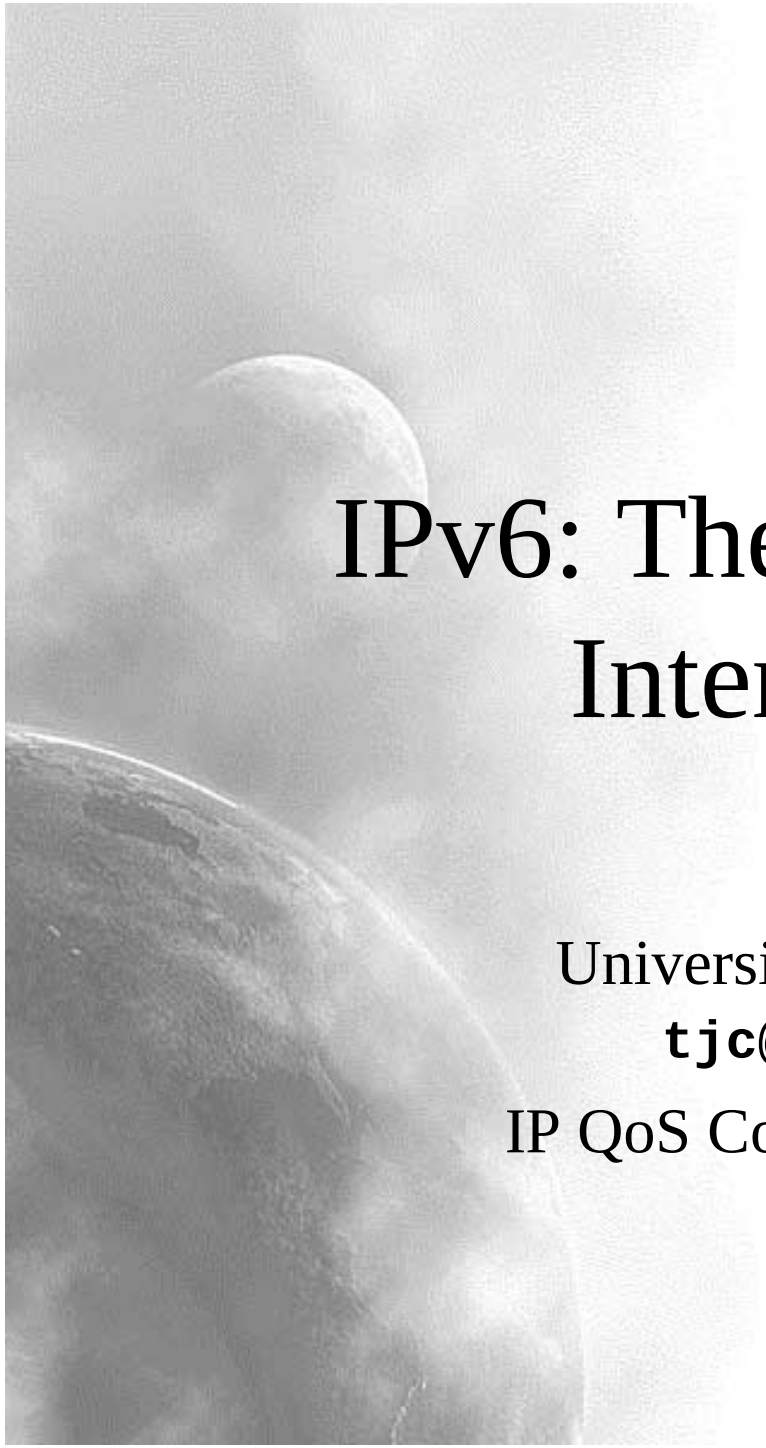

IPv6: The New Generation Internet Protocol

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IPv6 FORUM

Famous quotes

- "I think there is a world market for maybe five computers"
  - Thomas Watson, IBM, 1943
- "640K should be enough for anybody"
  - Bill Gates, 1981
- "32 bits ought to be enough address space"
  - Vint Cerf, 1977

IP Everywhere

- The Internet Protocol is becoming pervasive
  - but it was designed over 20 years ago
- More and more devices are using IP
  - places a demand on IP address space
  - requires IP routing to be scalable

Internet growth

- Current estimates
  - 300M users online worldwide, US/Europe-centric
  - 70M hosts connected
- IPv4 with 32-bit addressing allows 4B hosts
  - but allocation has been done inefficiently
  - CIDR and NAT have patched the problems a little
  - but the ship is still sinking...

CIDR and NAT

- Classless Inter-Domain Routing
  - registries allocated blocks (16M hosts) to CIDR
  - address space allocated in aggregated fashion
  - reduces size of default-free zone routing table
  - but registries unable to honour large block requests
- NAT
  - masquerade multiple hosts behind pool of IP addresses
  - has scaling issues
  - breaks end to end transparency/security model

Address space demands

- Third generation mobile
  - UMTS, as directed by the 3GPP
  - Predictions of 1B mobile handsets by 2002
  - each device needs to be addressable
- Emerging nations
  - China, Asia, Africa, South America
  - with 1 IP per person, IPv4 cannot cope

New models of computing

- Always-on devices
  - ADSL, cable modems, mobile handsets,...
  - “Wiring up the Cities” (Telia)
- Pervasive devices
  - embedded CPUs
  - with new communications media, e.g. Bluetooth
  - perhaps many per office or household
  - person to host and also host to host

Benefits of IPv6

- Increased address space
  - 128-bit addresses in place of 32-bit
  - removes IPv4 address space barrier (“Yv4”)
- More efficient routing
  - aggregated address allocations
  - fixed length headers
  - no fragmentation en route

Benefits (2)

- Reduced management requirement
  - autoconfiguration of hosts
  - also offers support for ad hoc networking
- Improved methods to change ISP
  - router renumbering
  - new DNS methods (e.g. DNAME records)

Benefits (3)

- Better mobility support
  - no explicit foreign agent
  - no triangular communication via home agent
  - anycast feature allows home agent “farms”
- Multihoming enabled
  - devices can autoconfigure on many prefixes
  - multiple IP addresses per host may be the norm

Benefits (4)

- IPsec mandated
  - authorisation and encryption as standard
  - though still need key exchange/PKI methods
- Scoped addresses
  - link and site local
  - better multicast scoping

Quality of Service

- IPv6 header has two QoS-related fields
- 20-bit Flow label
  - geared to IntServ use
  - implemented in Lancaster RSVP media server
- 8-bit Traffic Class indicator
  - geared to DiffServ use
  - implemented in Thomson IPv6 edge device

How does IPv6 help QoS?

- Usage problems remain the same as IPv4
  - but IPv6 is a more streamlined protocol
  - its key benefit over IPv4 is scalability
  - many features of IPv6 are IPv4 “bolt-ons”

- Consider IPv6 when implementing
  - future QoS products will require IPv6
  - methods used for IPv4 can be brought over to IPv6

How mature is IPv6?

- Core IETF specifications already completed
- Many (inter)national deployments exist
- Vendors are pledging commercial support
- ISPs are rolling out commercial services
- 3GPP has adopted IPv6
- Production IPv6 address space is being assigned

- But still plenty to do...

IPv6 Deployments

- Commercial ISPs
  - IIJ, NTT, BT
- International deployments
  - 6Bone, WIDE (Japan), Internet 2 (US/Canada)
- European academic networks
  - JANET, DFN, Surfnet, ACONet, Renater
- European projects
  - 6INIT, QTPv6

IANA/ICANN

- Delegating IPv6 production address space
- Allocations made via regional registries
  - ARIN (Americas), APNIC (Asia), RIPE (Europe)
- Allocating under 2001::/16
  - So far: ARIN (6), APNIC (13), RIPE (19)
  - e.g. UK-JANET-19991019 2001:0630::/35
  - UK-BT-19990903 2001:0618::/35

6INIT

- 12 partner EU project (Jan'00 - Apr'01)
  - Pan-European IPv6 deployment, 5 regional clusters
- Applications:
  - stock exchange, news-on-demand, media streaming
- IPv4/IPv6 integration issues
- Also deploying:
  - QoS (DiffServ), IPsec (FreeSWAN) and VoIPv6 (SIP)
- See: www.6init.org

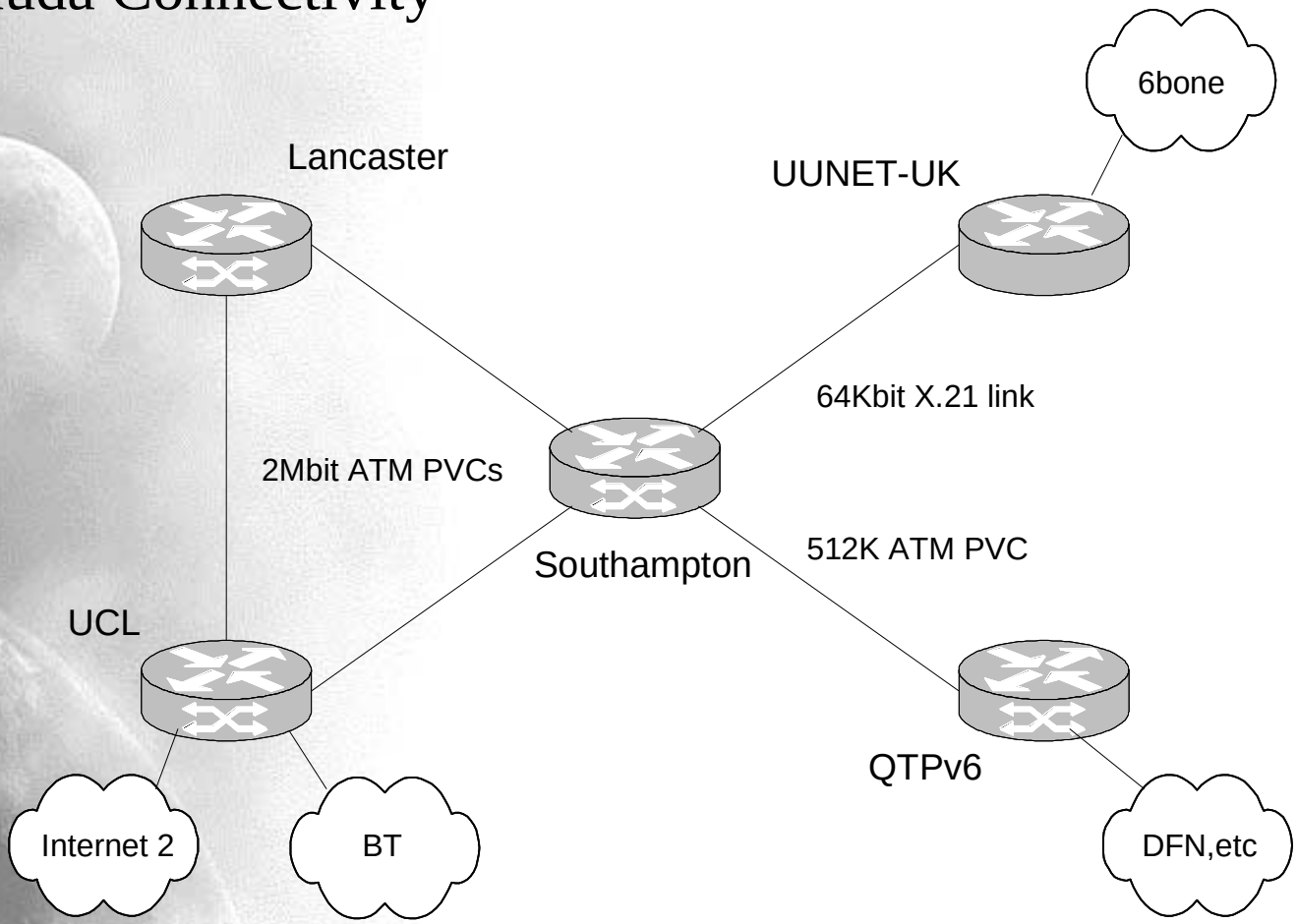
UK Academic Network

- Bermuda project
  - JANET expanding, IPv6 needs investigation
- Examining IPv6 deployment issues
  - interoperability, DNS, management
  - applications: multicast, PIMv6
- Runs as PVCs over current JANET ATM network
  - SuperJANET4 coming online soon
    - IPv6 roadmap required in tender

Address allocation for JANET

- IPv6 addressing scheme
  - 2001:0630::/35 assigned to JANET
    - though it is really a /29 allocation
  - registries want only 8K routes in Default-free Zone
- How to assign to JANET Institutions?
  - One /48 per site?
  - Implies 65K networks at 8K sites
  - but “small customer” can get a /48?

Bermuda Connectivity



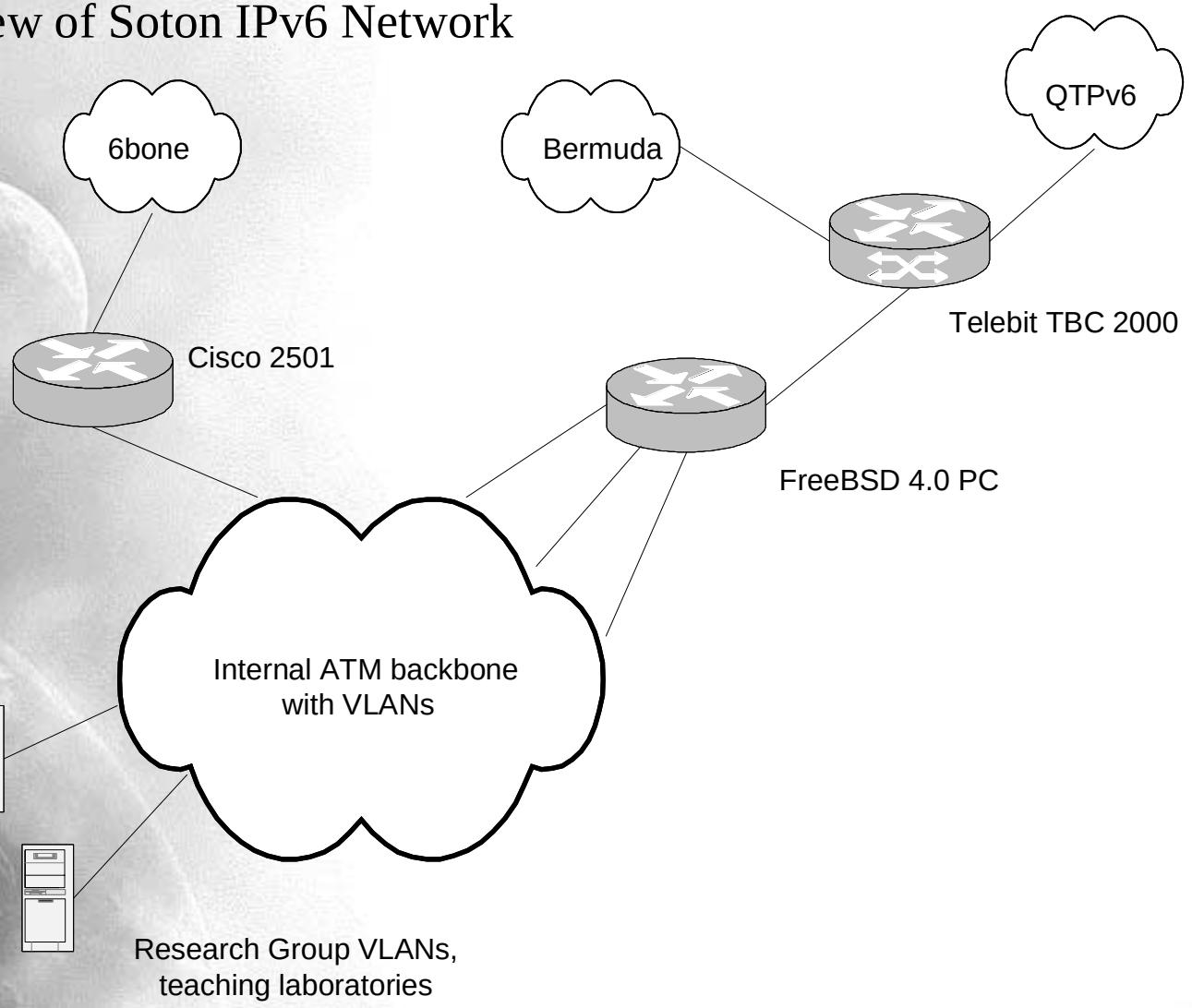
Vendor host support

- Solaris 8: available with IPv6 since March 2000
- Windows 2000: preview released March 2000
- FreeBSD: IPv6 as standard in FreeBSD4.0
- Linux: IPv6 packages available
- Compaq: Tru64 Unix has IPv6 early access kit
- IBM: AIX 4.3

Vendor router support

- Cisco IOS: commercial version October 2000
- Telebit: first commercial IPv6 router, TBC2000
- FreeBSD 3.4 or 4.0 (KAME stack)
- Zebra (GNU router project)
- 3Com Netbuilder II, software v11.3
- Hitachi NR60, GR2000

Overview of Soton IPv6 Network



Core applications

- DNS
  - BIND 9 (beta 4) offers native IPv6 DNS lookups
  - Viagenie preparing IPv6 root name server
- World Wide Web
  - Apache server
  - MSIE for NT4, Mozilla and Lynx. No Netscape.
- E-mail
  - Sendmail 8.10 has IPv6 built-in

Other applications

- Routing protocols, e.g. BGP4+
- The “Mbone” audio/video multicast tools
  - vic, rat, SPAR
- Quake, IRC, INN, ...

- IPv6 API implemented in vendor OS solutions
  - porting (C code) is not a huge issue
  - Java support is still missing from Sun

Transition/Integration

- IPv4 will exist a long time
  - must therefore integrate and co-exist
- Deployments likely to happen from the edges
- When deploying an IPv6 network you may
  - need to connect to other IPv6 networks
  - need to connect to IPv6 hosts over IPv4 networks
  - need to connect to IPv4 hosts
- A variety of tools exist...

Integration methods

- IPv4/IPv6 interworking
  - IPv6-in-IPv4 tunnels
  - Automated tunnel brokers, e.g. www.freenet6.net
  - NAT/PT and Ultima (BT)
  - Dual stack
    - easier if you have enough IPv4 addresses
  - Proxy methods
  - DSTM, 6to4, …
- Different scenarios require different tools

IPv6 Forum

- Founded in July 1999
  - Now has 85 member institutions
  - Most major players have joined
- Activities
  - Holds IPv6 Summits (four to date)
  - Dissemination of IPv6 information (via Web site)
    - www.ipv6forum.com
  - Participation in other events to raise awareness

Headlines in the Press

- As reported at the IPv6 Forum site:
  - "Nokia demonstrates IPv6 live in the UK"
  - "BT offers free IPv6 trial"
  - "IPv6 ready for prime time"
  - "Nokia adopts IPv6 for mobile Internet"
  - "Microsoft and Cisco to support IPv6"
  - "NTT to be first ISP to offer IPv6"
  - "IIJ to launch native IPv6 service"

Conclusions

- IPv6 will deploy
  - UMTS may drive wide deployment by 2002/3
- Core standards done
- Vendor and application support hardening
- QoS issues remain the same as IPv4
  - but IPv6 is a scalable protocol
  - so be prepared to implement IPv6 solutions

For more info

- IPv6 Forum
  - www.ipv6forum.com
- 6INIT Project
  - www.6init.org
- UK IPv6 sites
  - www.ipv6.org.uk
- IPv6 at Southampton
  - www.ipv6.ecs.soton.ac.uk