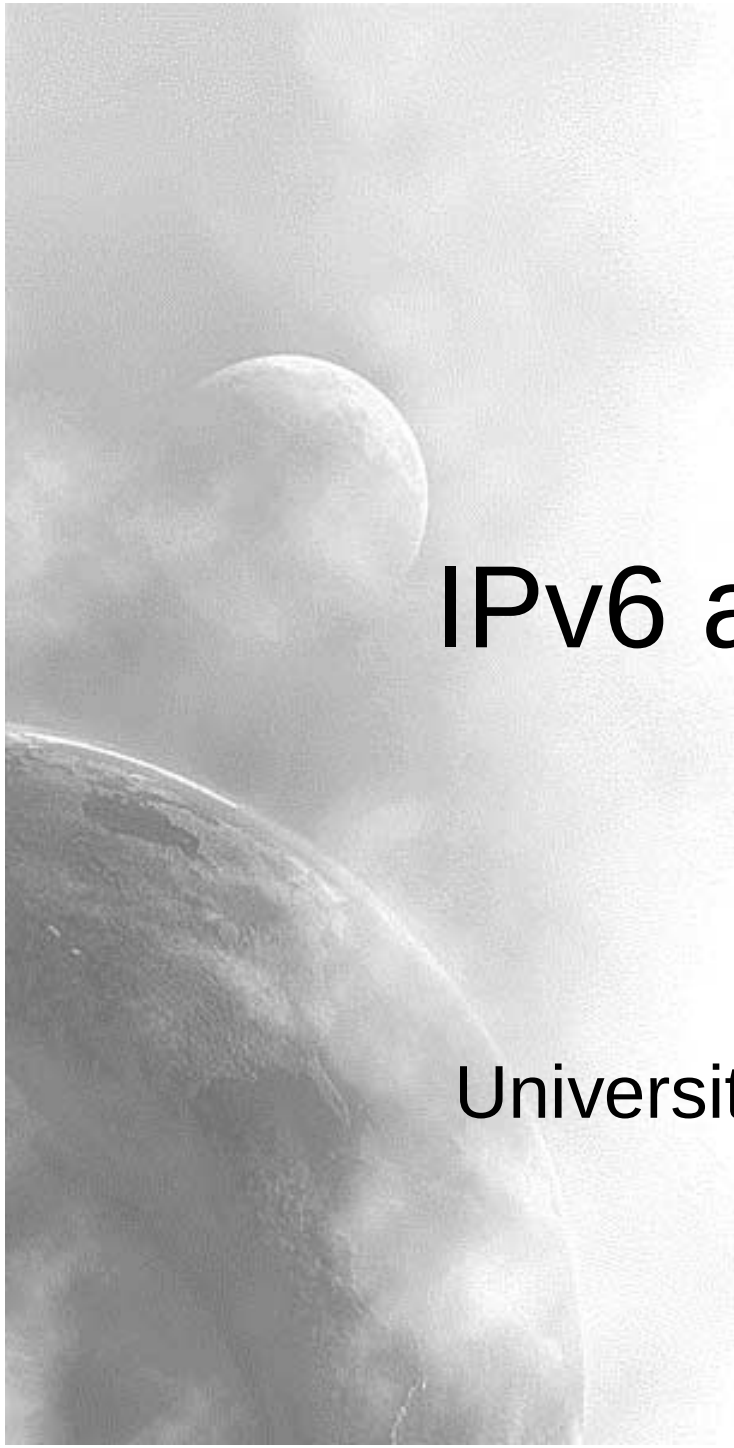

IPv6 and Multimedia

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Multimedia applications

- How can IPv6 help development of…
  - Streamed media (audio, voice and video)
  - Quality of service
  - Multicast
  - Mobile media
  - Information sharing
  - The pervasive information fabric

Multimedia network apps

- Demand for services
  - Access to databases and directory services
    - While static or on the move
    - Tailored, seamless services, per user
  - Location-based user interface
    - GPS can be built in to mobile device
  - Migrating agent services
    - launch agent into network, collect result later
  - High performance visualisation experiments
    - Utilising the “GRID” of computing resources
- But why do these need IPv6?

Pressures for IPv6

- Transition of the Internet
  - Always-on devices
    - Cable modems, ADSL, I-mode, 3G devices
  - Higher bandwidth
    - Both on fixed lines and wireless (2Mbit UMTS, 11Mbit WLAN)
  - Shift to peer-to-peer
    - Napster, ICQ, Games, VoIP
  - More devices
    - And trend to bigger proportion wireless – e.g. Bluetooth
    - Currently 70M IP nodes on Internet, 500M mobile phones

IP Everywhere

- The Internet Protocol is becoming pervasive
  - but it was designed over 20 years ago
- More and more devices are using IP
  - and they require global reachability
  - places a demand on IP address space
  - 1 billion IP devices by 2003
  - requires IP routing to be scalable, no NAT!

Who wants address space?

- Third generation mobile
  - UMTS, as directed by the 3GPP
  - predictions of 1B mobile handsets by 2002/3
  - each device needs to be addressable
- Emerging nations
  - e.g. China, Asia, Africa, South America
  - missed out on IPv4 “gold rush”
- Home networking
  - consumer devices addressable by mobile user

3G Concept Devices

IPv6 FORUM

Streamed media

- Delivering media
  - To or from any IP-enabled device
  - IPv6's 128-bit addressing offers global reachability
- Secure media
  - End-to-end IPsec – no NAT
  - No NAT means no kludges as with FTP
  - But end-to-end IPsec means no layer 4 peeking

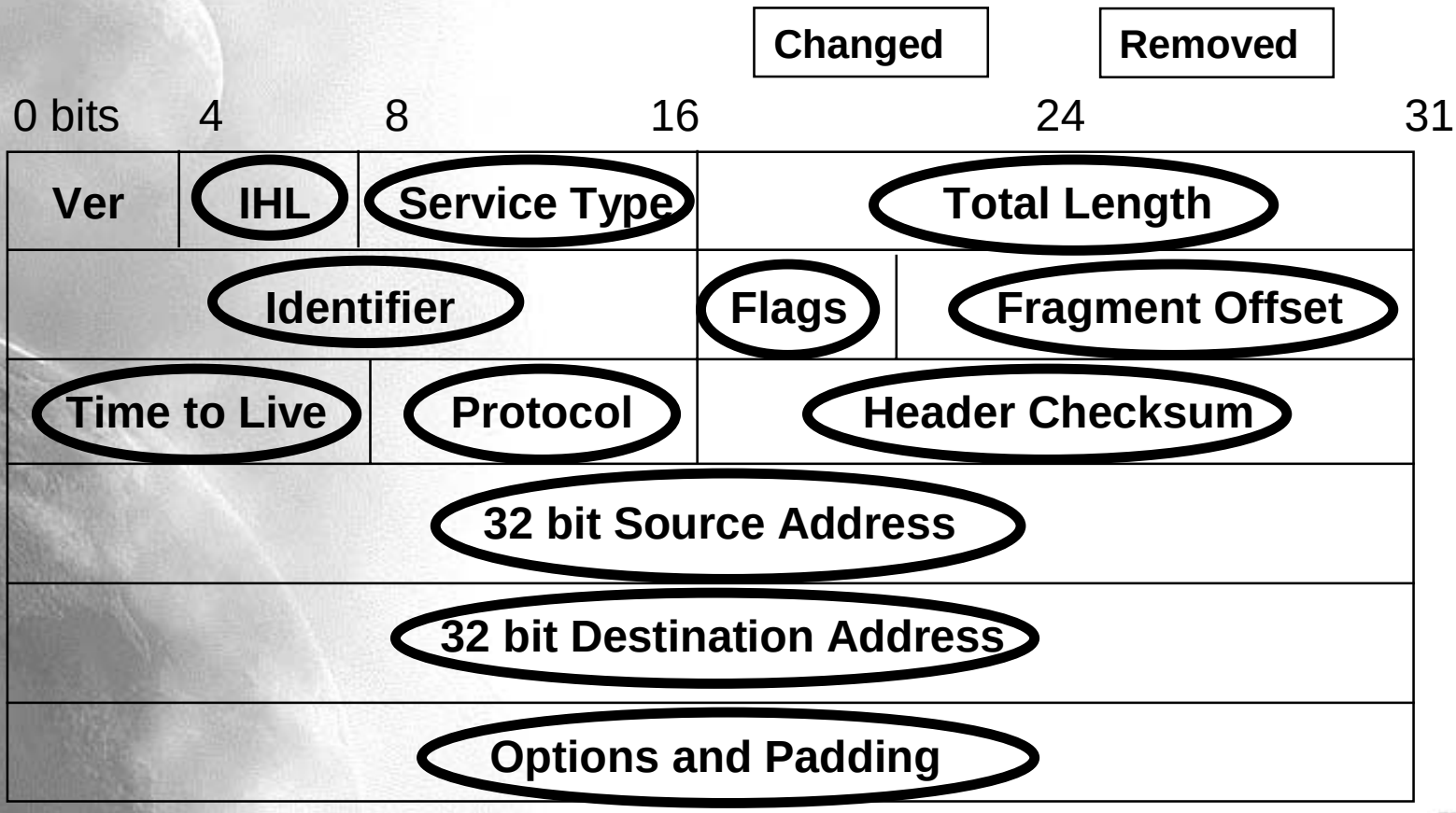
Public domain software

- UCL “mice” tools
  - Vic, Rat
  - IPv4 and now IPv6
  - Includes SDR and SPAR
  - http://www-mice.cs.ucl.ac.uk/multimedia/software/
- Icecast
  - IPv6 enabled Internet jukebox
  - http://www.icecast.org

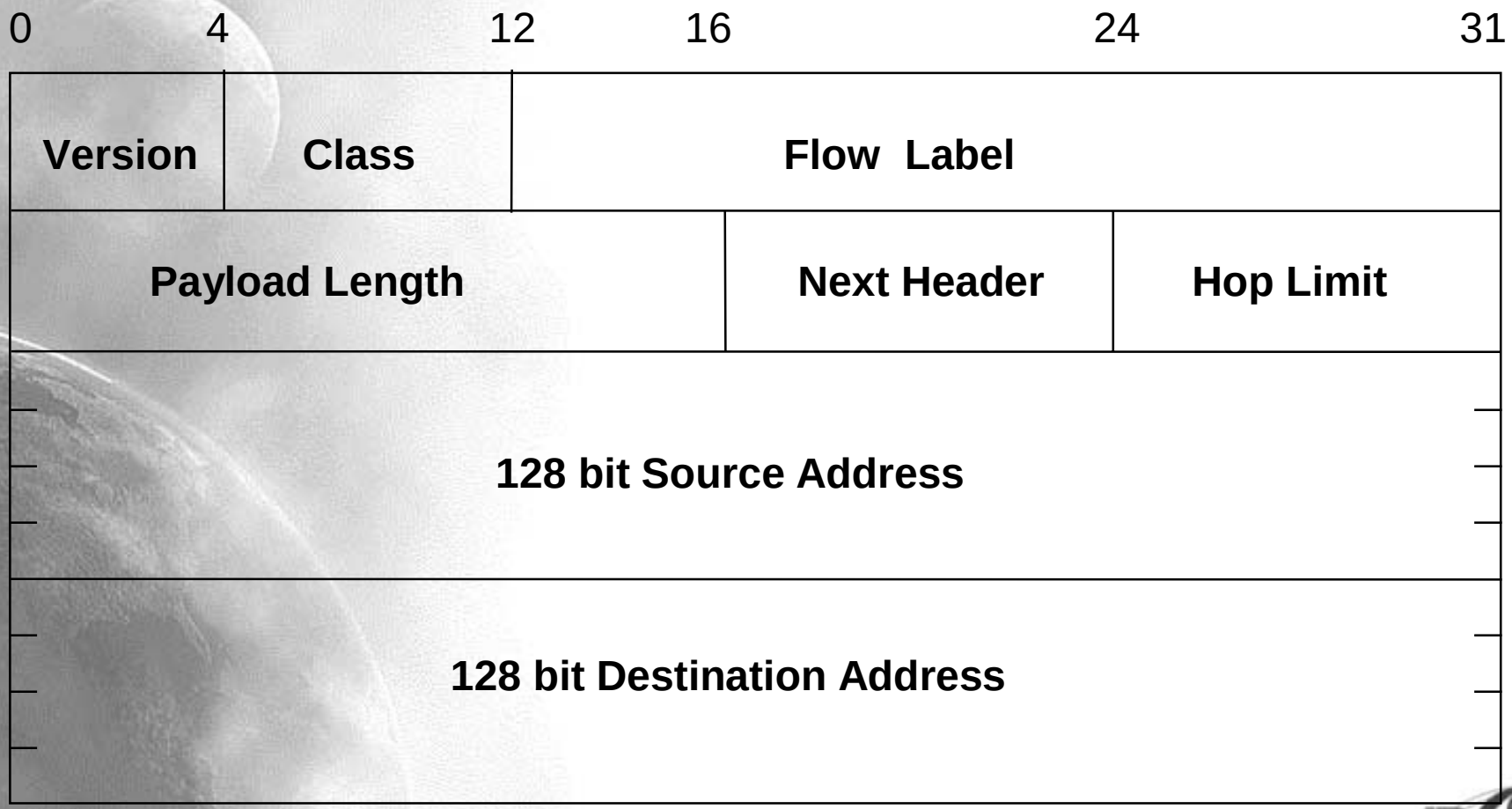
Quality of Service

- Guaranteeing quality of media delivery
  - Obviously important for applications such as voice
- People's perception of QoS varies
  - But can be specified in empirical terms
- Arguments for QoS by overprovisioning
  - But doesn't handle peak/burst usage situations
- Does IPv6 offer anything special?

IPv4 header changes



Simplified IPv6 header



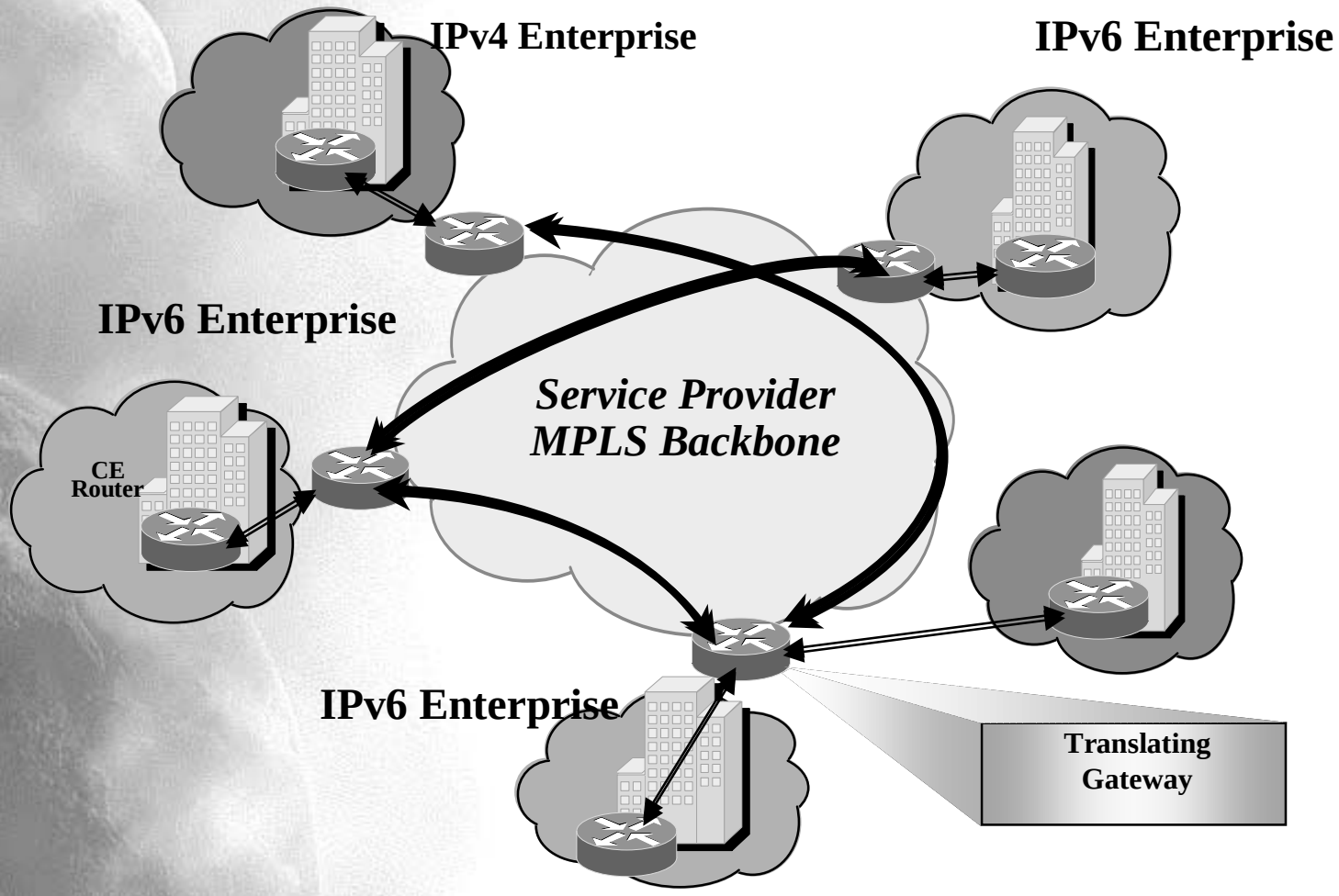
QoS support in IPv6

- Two QoS-related IPv6 header fields
- 20-bit Flow label
  - Geared to IntServ, but may have other uses
    - e.g. implemented in Lancaster RSVP media server
- 8-bit Traffic Class indicator
  - Geared to DiffServ
    - e.g. 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
    - Fixed-length headers, no fragmentation
  - 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 to IPv6
  - May run IPv6 over MPLS

IPv6 over MPLS



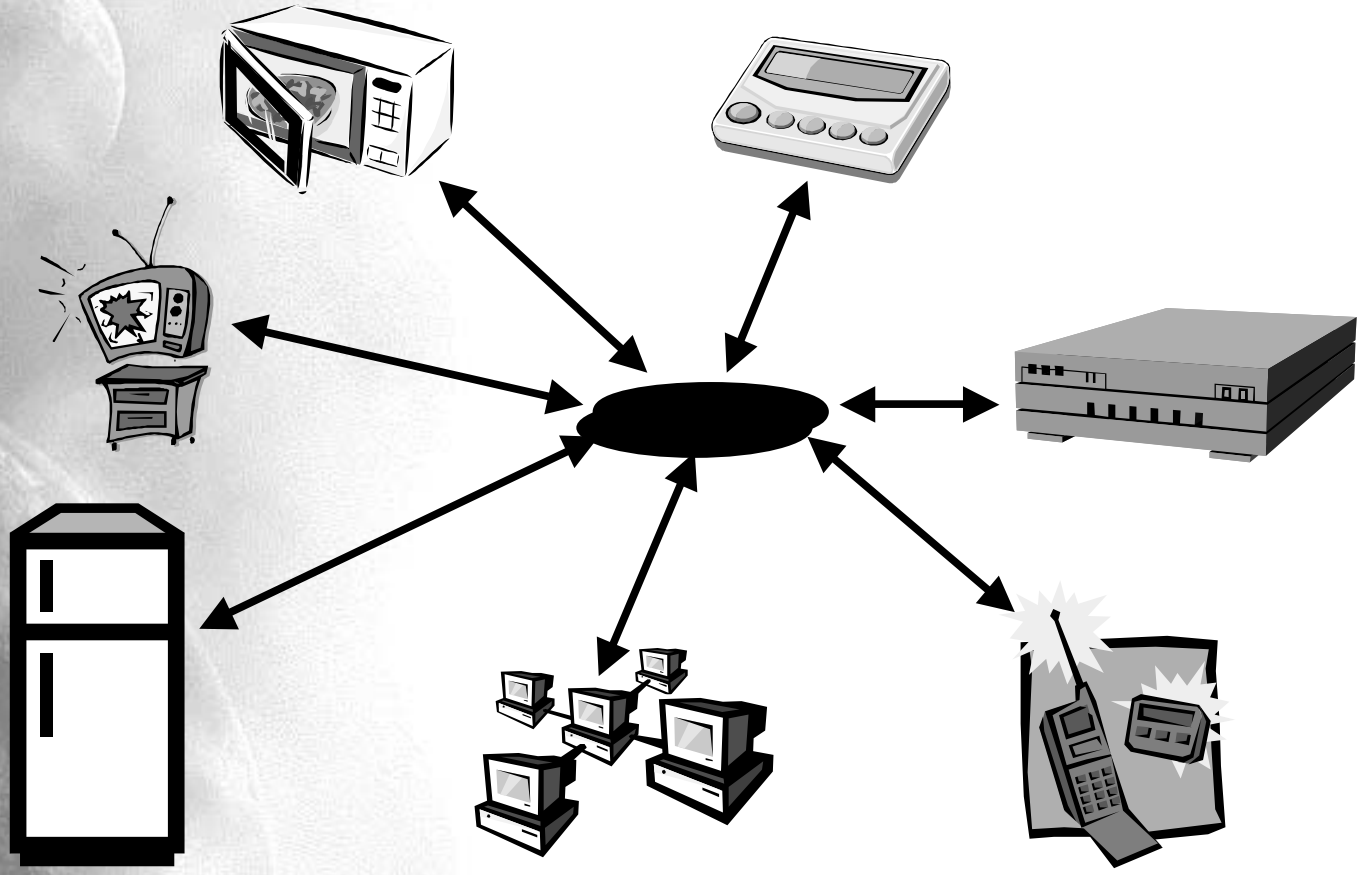
For further study

- Other uses of the flow label field
  - may be useful for aggregated flows
    - Single RSVP flows don’t scale well
- Possible additional header types
  - using the “next header” construct of IPv6
    - IPv6 header design is extensible
    - But does require additional “loop” processing

Pervasive Information Fabric

- Networked media any and everywhere
  - Distributed and embedded systems
  - Dynamic and mobile systems
- Media of diverse type, size and quantity
  - Devices tuned to functionality, e.g. WAP
- “IP over Everything”
- Service location
  - Service Discovery Protocol, akin to Jini

IPv6 in the Home



Information sharing

- Ad-hoc sharing of data
  - Automatic setup of devices advantageous
  - IPv6 has stateless autoconfiguration
    - IP-enabled devices can join local (wireless) networks
  - High street scenario
    - Join networks as you roam a city
    - Get offered appropriate information at an appropriate place
  - Meeting room scenario
    - Share link information
    - Share PDF annotations

Mobile media

- Information that follows you
- Want streams to follow
  - mobile presentation device (e.g. hand-held TV)
  - to new device (e.g. wall-mounted screen)
- Media may change bandwidth
  - 100Mbit Ethernet
  - 11Mbit wireless
  - Bluetooth

Mobile IPv6

- Better mobility support
  - no explicit foreign agent
    - Thanks to autoconfiguration in foreign network
  - no triangular communication via home agent
    - Binding update allows direct communication
  - anycast feature allows home agent “farms”
    - Improves scalability
- IPv6 is protocol of choice for mobile nodes

Multihoming with IPv6

- Multihoming will be more common
  - Devices can autoconfigure on many prefixes
  - Multiple IP addresses per host may be the norm
  - Host selects src/dst address to use
  - Router can suggest preferences to hosts
- Multimedia services
  - Can select provider on per-service per-ISP basis
  - Gives customer choice and thus value

Multicast

- One to many media transmission
- Typically used for
  - Video
  - Audio and music
- Can be used for distribution of other data
  - Links to appropriate media
  - Advertisements

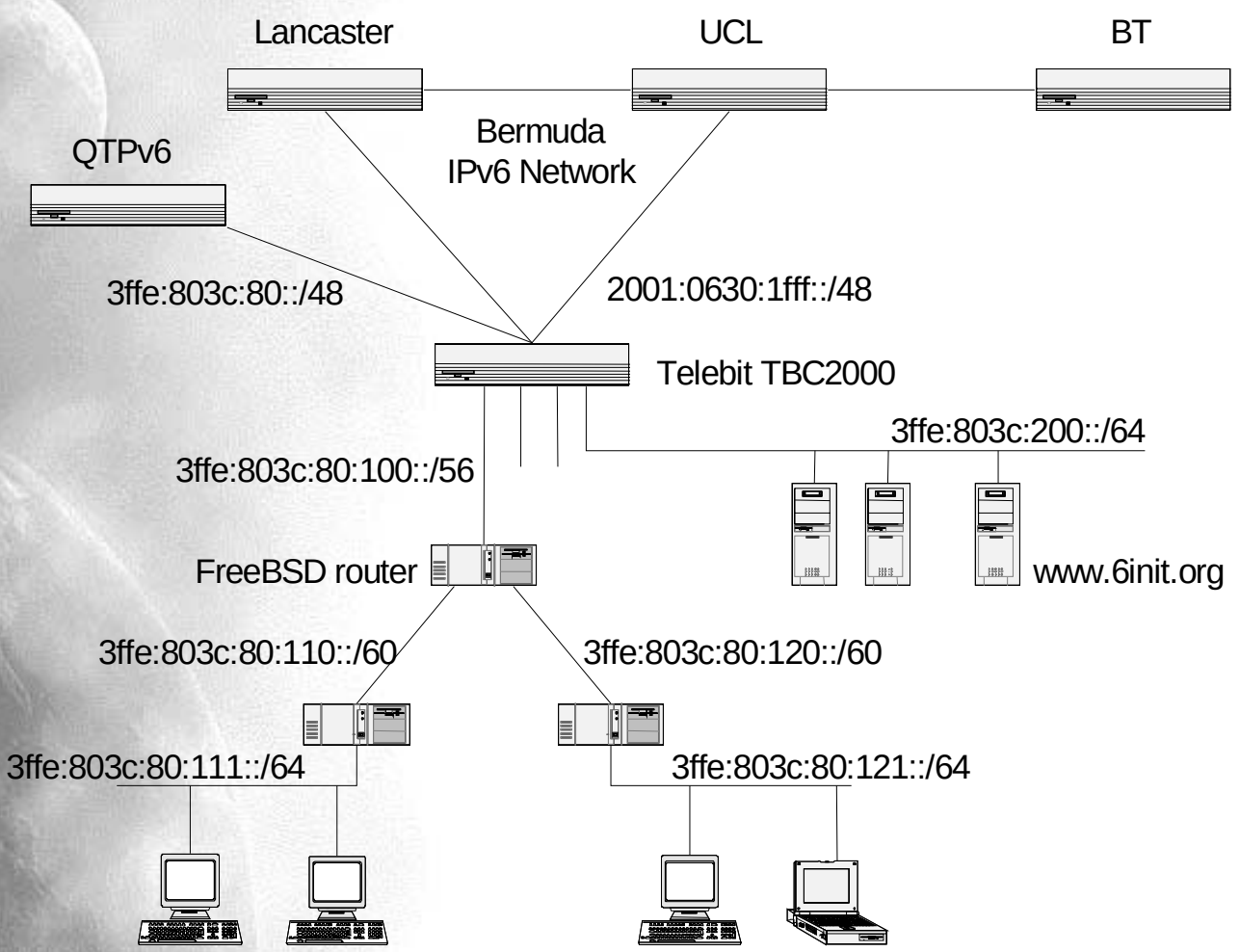
Address scoping

- IPv6 Scoped addresses
  - Link-local, site-local, and global unicast addresses
  - No concept of “private” IP space as per IPv4
  - Offers better multicast scope control
- Can offer multicast to site
  - e.g. all hosts connected to corporate network

Protocol Independent Multicast (PIM)

- Comes in flavours
  - Dense mode (DM)
    - receive by default
  - Sparse mode (SM)
    - receive on request
- FreeBSD (+KAME) implements PIM for IPv6
  - Runs extensively now on WIDE network (Japan)
    - http://www.wide.net
  - Run locally at Southampton
    - On PCs with quad-Ethernet NICs
    - http://www.ipv6.ecs.soton.ac.uk

Southampton IPv6



6INIT

- 12 partner EU project (Jan'00 - Apr'01)
  - Pan-European deployment, 5 regional clusters
  - Includes BT, Telia, Ericsson, Berkom
  - See http://www.6init.org
- Applications:
  - Stock exchange
  - News-on-demand
  - Media streaming
    - Audio streams, MIDI QBH recognition

IPv6 FORUM

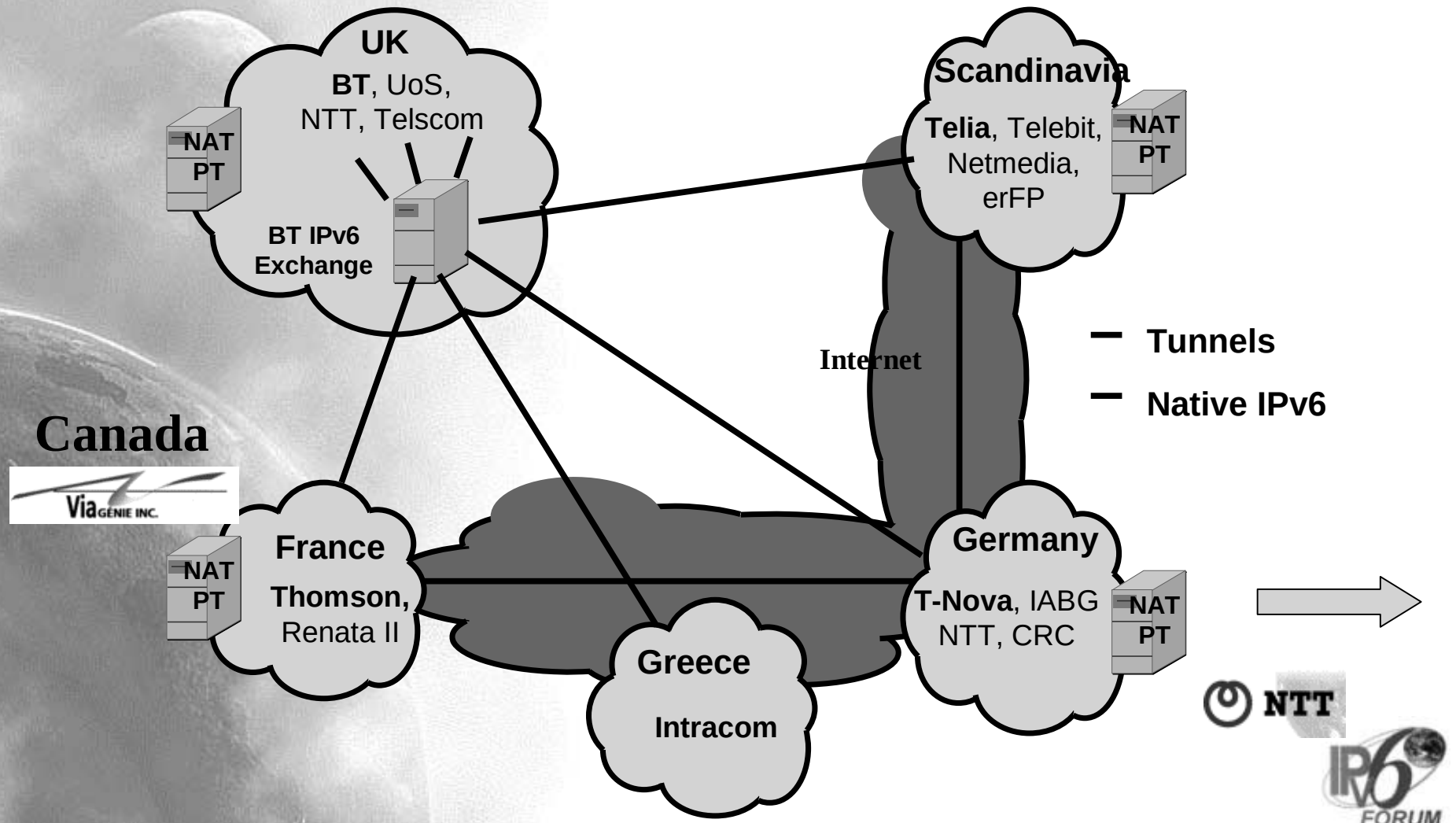
6INIT

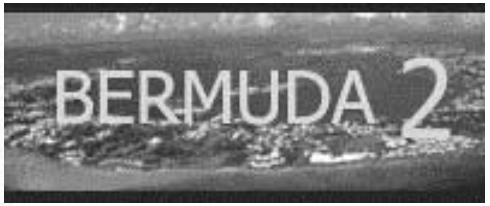
- IPv4/IPv6 integration issues
  - Using NAT-PT for IPv6-only islands
- Also deploying:
  - QoS (DiffServ)
  - IPsec (FreeSWAN)
  - VoIPv6 (SIP)

- 6WINIT wireless follow-up project
  - Begins January 2001

IPv6 FORUM

6INIT clusters





- A UK academic IPv6 deployment study
  - Southampton, UCL, Lancaster
    - Transition methods analysis
    - QoS-enabling vic/rat conferencing tools (with NASA)
    - Management and addressing issues
    - Policy definition and enforcement
    - Wireless access methods
    - IPsec and VPN study (with ISI)
  - Drivers: SuperJANET4, new FE colleges online
  - See http://www.ipv6.ac.uk/bermuda2/

IPv6 Deployment Strategies

- Plan A: Driven by new applications
  - 3GPP/UMTS - mobile IPv6 handsets
  - Home networking - plug and play devices
  - Metering - utility services
- Plan B: Transition of existing Internet
  - IPv4 and IPv6 must co-exist
  - access IPv4 applications from IPv6 networks
    - and vice-versa

Transition from IPv4 to IPv6

- IPv4/IPv6 interworking
  - IPv6-in-IPv4 tunnels
  - Automated tunnel brokers, e.g. www.freenet6.net
  - NAT/PT and Ultima (BT)
  - Dual stack IPv4 and IPv6
    - easier if you have enough IPv4 addresses
  - Proxy methods
  - DSTM, 6to4, 6over4, ...
- Different scenarios require different tools

The Quake API test

- Took 32 hours for 2 programmers from Viagenie (Canada) to retrieve the source, find where to make changes, code the changes, setup a public Quake server and play the first Quake game over IPv6.
- http://www.viagenie.qc.ca/en/ipv6/quake/ipv6-quake.shtml



Conclusions

- IPv6 offers an excellent framework for multimedia application environments
  - Pervasive, mobile, ad-hoc, secure, end-to-end
  - But QoS issues not magically solved
- IPv6 implementations increasing
  - Enables application building/porting
  - Novel applications ahead of ported applications
- IPv6 standards hardening
  - Core specs done, many following

If you’re new to IPv6...

- Read IPv6 Forum articles
- Deploy IPv6 software
  - FreeBSD with KAME stack (www.kame.net)
  - excellent for host/router/API trials
- Get connected to the 6bone
  - apply for pTLA or use www.freenet6.net
- Track standards bodies
  - ipng and ngtrans IETF working groups/e-mail lists

Sites to visit

- IPv6 Forum - http://www.ipv6forum.com
  - conference presentations and reports
  - implementation and deployment lists
- IETF - http://www.ietf.org
  - standards and draft standards
  - ipng and ngtrans working groups
- My e-mail: tjc@ecs.soton.ac.uk