IPv6 in the Home Makes Sense

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Home networking

- Five years ago…
  - Restricted to a smaller number of PCs
  - Connectivity via on-demand 56k dialup
  - Access *from* the home to the Internet
- Now...
  - New IP-enabled devices emerging
  - Always-on broadband connectivity emerging
  - Business and work habits changing
- Creating potential for…
  - New services within and *into* the home

Potential network devices

- Including:
  - PC devices – including laptops and PDAs
  - Gaming consoles, e.g. PlayStation 2
  - Webcams, MP3 players, …
  - IP phones
  - White goods: fridges, microwaves…
  - Home control and automation devices
  - Wall-mounted digital picture displays
  - Portable digital video or audio players
  - Digitial TV, Tivo, TV conferencing systems
  - Utility devices, e.g. electricity meter
  - Cars

IP for cameras

- Nokia 7650, Ericsson T68i
  - Picture messaging
  - Mainly over GSM

- Panasonic has produced an 802.11b wireless webcam
  - Easier deployment

- Ricoh has a wireless digital camera: i700
  - Web server built in

IP for fridges

- The infamous "Internet fridge"
  - Now made by LG Electronics
- Includes:
  - LCD display
  - 4 Speakers
  - Email client
 - Possibly a webcam

IP for microwaves

- Built in Japan:
  - Sharp RE-M210
- Web browser
  - Download recipes
  - Uses "cooking data device"
- Can work with set of basic ingredients

献立情報レンジ ＜RE-M210＞
（お料理情報ボックス、パソコンは別売）

IP for sensor devices

- Temperature sensor MicroNode
- Always-on, large-scale deployment
- InternetNode ran demo at NetworId
  - http://i-node.co.jp
- Runs IPv6, Java VM, on 40Mhz CPU, 1MB RAM
- Collaboration of WIDE and Yokogawa
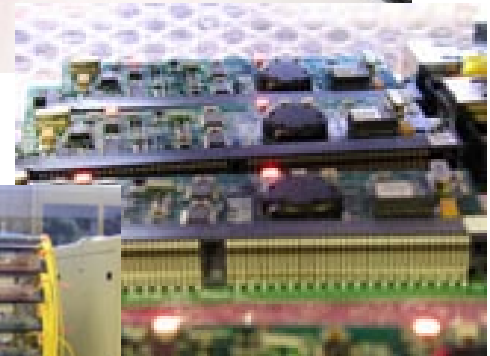
Key components

- Home networking needs a combination of
  - Direct network layer connectivity
    - Restore original Internet principles
  - Always-on bandwidth (in and out)
    - Broadband deployment needed
  - Easy physical connectivity
    - Leverage residential wireless LANs
- We are "creating the edge"

Broadband: xDSL and cable

- Rapid growth of adoption in recent months in UK:
  - Jan 2002: 332,000
  - Jun 2002: 709,000
  - Aug 2002: 810,000
- Current UK growth 50,000 users per month
- But limited bandwidth compared to Japan and the USA, typically
  - 512K downstream
  - 256K upstream
- Upstream is important to serve applications from the home.

- UK breakdown:
  - NTL home 37% (Cable)
  - Telewest 23% (Cable)
  - BT Openworld/BT Broadband 17% (ADSL)
  - Others (BT Wholesale) 15% (ADSL)
  - BT business 8% (ADSL)

- Overall:
  - Total Cable 60%
  - Total ADSL 40%
  - Target set for 5M UK users by 2005.

ADSL in Europe

- Led by SE, DE, BE, DK
  - Barriers include serving remote locations, unbundling of the local loops, …

DSL lines of total lines
Source: ECTA, April 2002
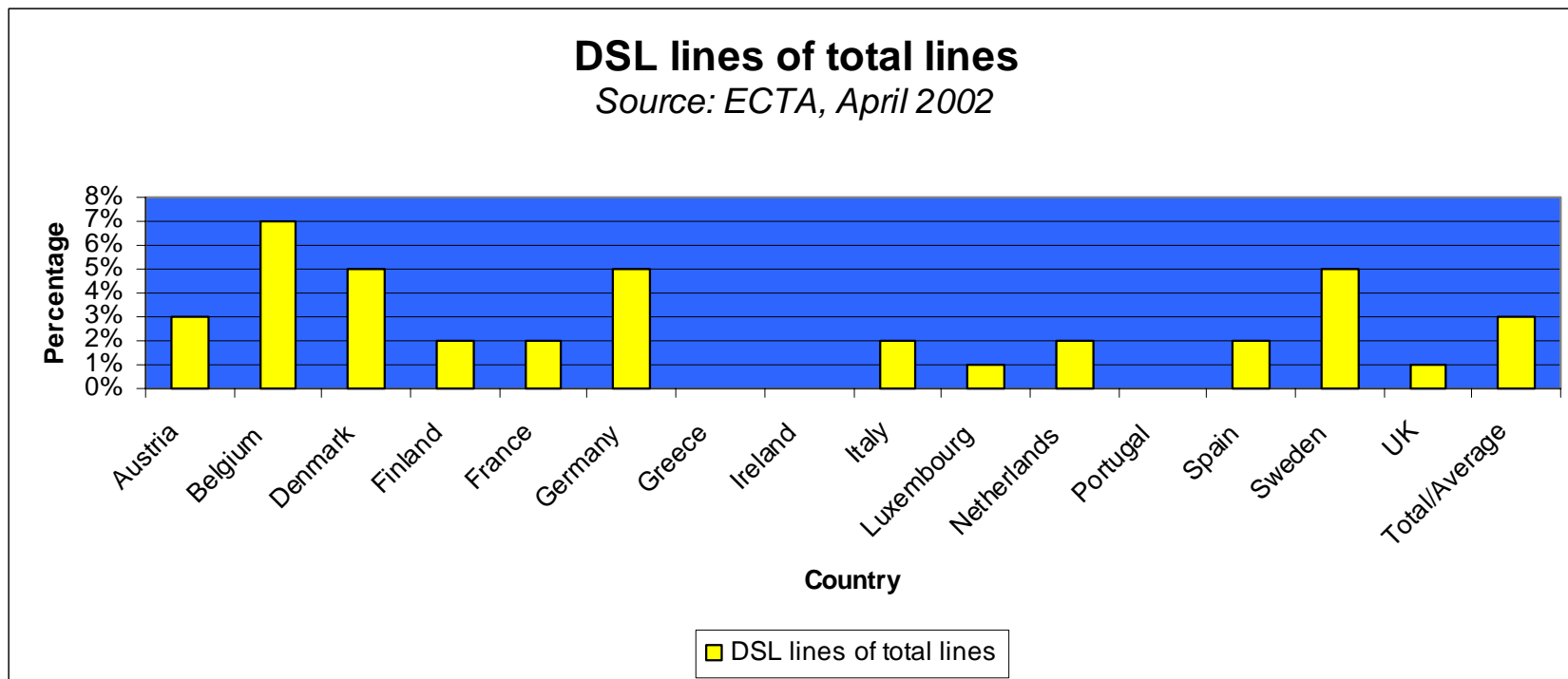
Why not IPv4?

- Limited IP (IPv4) address space
- Home nets typically have 1 global IPv4 address
- Internal devices on a network must therefore use private addresses and Network Address Translation (NAT).
  - NAT is acceptable for simple applications with client in the home and server on the Internet (e-mail, Web surfing, file downloads…)
  - NAT breaks end-to-end IPsec
  - Running two services on two internal devices (e.g. web servers) means only one can use the standard service port (80 for http)
    - Many home devices will have web interfaces

Home network requirements

- Need devices to be globally reachable
- Want "plug and play" networking
- Low configuration and maintenance
  - Simplicity for average user
- Security of access to home devices
- Allow a wide range of devices
  - But using common protocols – http, snmp
- Running over various media
  - Wire(less), Firewire, IP over power
  - 802.11a for higher quality video

IPv6 Advantages

- IPv6 includes
  - Huge IP address space
    - Ability to globally address devices
    - Thus no need to battle with NAT
  - Stateless autoconfiguration
    - Adds to simplicity for typical users
  - IPsec support should be present in a "full implementation" of IPv6
    - Developers can thus build secure applications
  - Improved Mobile IP functionality
  - Site-scope addressing for the home

IPv6 and Security

- Primary IPv6 definition lies in RFC2460
  - States that a "full implementation" includes both AH and ESP security headers.
  - But RFC2460 does not mandate use of IPsec
  - To date, many IPv6 implementations do not include support for IPsec, but changing, e.g. Mobile IPv6
  - Should LCNA devices include a full IPsec implementation?
- Security also can apply to physcial layer
  - 802.11b uses WEP encryption
- … and to the transport or application layer
  - e.g. SSL or PGP
- Application of security must be easy for users
  - Use simple "association" mechanisms
  - No widespread PKI deployment yet

IPv4-IPv6 migration

- Two philosophies…

- IPv6-only internal networking
  - Requires transition aids at the home gateway router
    - e.g. NAT-PT or proxy services
  - Or content providers offer dual IP services
    - e.g. use IBM Web Services, Microsoft .NET

- Dual-stack internal networking
  - Keep IPv4+NAT for some devices
    - e.g. for existing PC usage
  - New devices can be IPv6-only
  - Allows incremental introduction of IPv6

Peer to Peer Applications

- Made (in)famous by file sharing applications like Napster and Gnutella
  - People associate p2p with piracy, but it offers more…
- Peer to Peer implies direct communication
  - Person or device to person or device
  - Requires globally addressable IP devices
- IP networking capability appearing in smaller, low-power devices
  - SD-format card with 802.11b
  - Web server on a Bluetooth chip
- But p2p empowers end user, not a sold ISP service
 - ISP should offer supporting services (multicast, etc)

IPv6 for gaming

- PlayStation 2 includes IPv6 support
  - Developed for a broadband adaptor
  - Dual-stack IPv4-IPv6 implementation
  - Included in the Standard Developer Kit
  - Integrate games, movies and music
- Any home can run a gaming server
  - No NAT tricks required
  - Reduces the server costs for developer
    - Except for large-scale role-playing games
  - Developer can add new features in games
    - e.g. VoIP for player chatting

IPv6 for webcams

- Examples like Jennicam (1996-)
  - People actually like "big brother"
  - Many webcams in a single house…
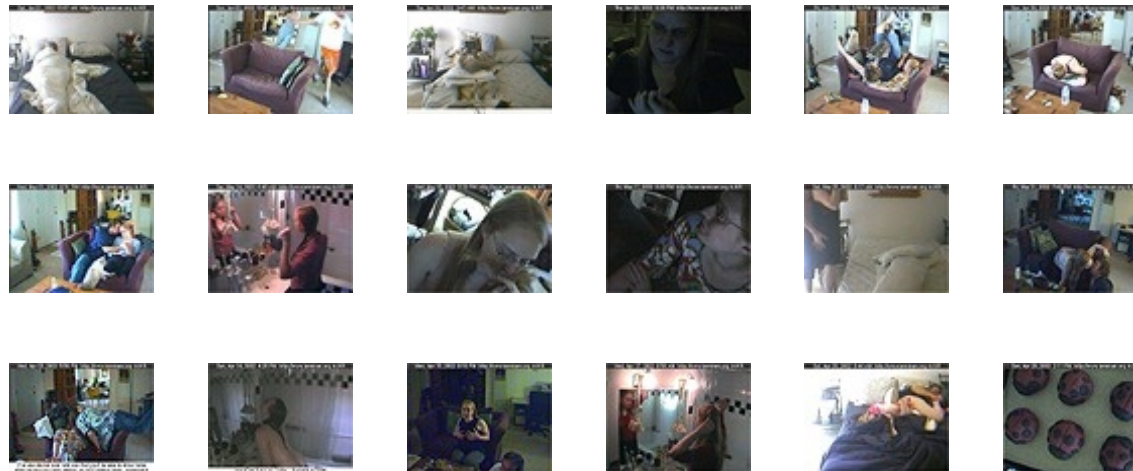
IPv6 for utilities

- Meter readings periodic, often estimated
- Possible to offer IPv6 metering
  - Could develop SNMP objects for metering or run over http protocol
- Always-on monitoring adds value:
  - Real-time information on customer usage
  - Could help understand customer needs
  - Reduces need for staff to read meters
- Can also run IP over power lines
  - Gain IP service and metering in one go
  - See the EU IST programme 6POWER project

New applications

- Combination of IPv6, broadband and Wireless LANs
- Examples…
  - Ad-hoc video-based conferencing (safer for kids)
  - Watch movies on portable displays
  - Watch over baby on the fridge display
  - Monitor or control home remotely, including Tivo
  - Check on elderly relatives via device activity
  - Share cooking recipes with friends
  - Compare weight loss with friends
  - Location-awareness – is my friend at home?
  - Run new types of games between friends' houses
    - Includes remote control WLAN toys
  - Enable remote diagnosis of appliance and vehicle faults
  - Upload music and videos to in-car entertainment devices
  - Take part in interactive distance learning
  - …

IPv6 for embedded devices

- Home devices need cheap networking
  - Low Cost Network Appliances (LNCA
  - Such devices have limitations
- IETF IPv6 WG has some "minimum requirements" Internet Drafts
- Includes LNCA, though not yet adopted by IPv6 WG:
  - Non-PC embedded systems
  - See: draft-okabe-ipv6-lcna-minreq-02.txt
  - at http://www.ietf.org/internet-drafts/
- Some debate over special requirements
  - Would all LCNA devices support all IPsec?
  - Do LCNA devices need transition aids?

Home deployment issues

- Must deploy new IPv6-enabled edge router
  - May be native IPv6, more likely to offer 6to4
  - IPv6 islands over IPv4 better than NAT islands
  - May run IPv6-only, but likely to be dual stack now
- Missing standards pieces
  - e.g. IPv6 prefix delegation
- ISP available address space
  - A /32 is "only" 65K static /48 customers
    - Static assignment avoids need for Dynamic DNS
    - But how will devices be (DNS) named?
- Other requirements
  - Service discovery, QoS, IPv6 Multicast, intrusion,…
  - Interactions with personal area networks (PANs)

Look to Japan…

- IPv6 Promotion Council Showroom
  - IPv6 Galleria
- http://www.v6pc.jp/

The future…

- IPv6 is ready and deploying to the home now
  - Dual stack services in Japan (NTT and IIJ)
  - New gateway device required, but can be incremental if IPv4 supported also
  - New ISP infrastructure required for native IPv6 to the home
- Broadband and wireless also key enablers
  - Now well over 10 million European broadband users
- IP-enabled devices appearing
  - IPv6 solves global addressing/NAT problem
  - Should develop for at least dual-stack now (e.g. PS2)
  - End user will probably never know IPv6 is used
- New applications enabled
  - New opportunities for start-up and existing companies
- Still scope for research and development