

Communication, evolution, innovation;
networking developments to meet common goals.

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WNL

A few questions...

- Where are we now?
- What are we doing now?
- What do the users need now?
- What do the users need for the future?
- What's going on elsewhere?
- How are others planning for the future?
- What should we plan for?
- How do we get there?

Where have we come from?

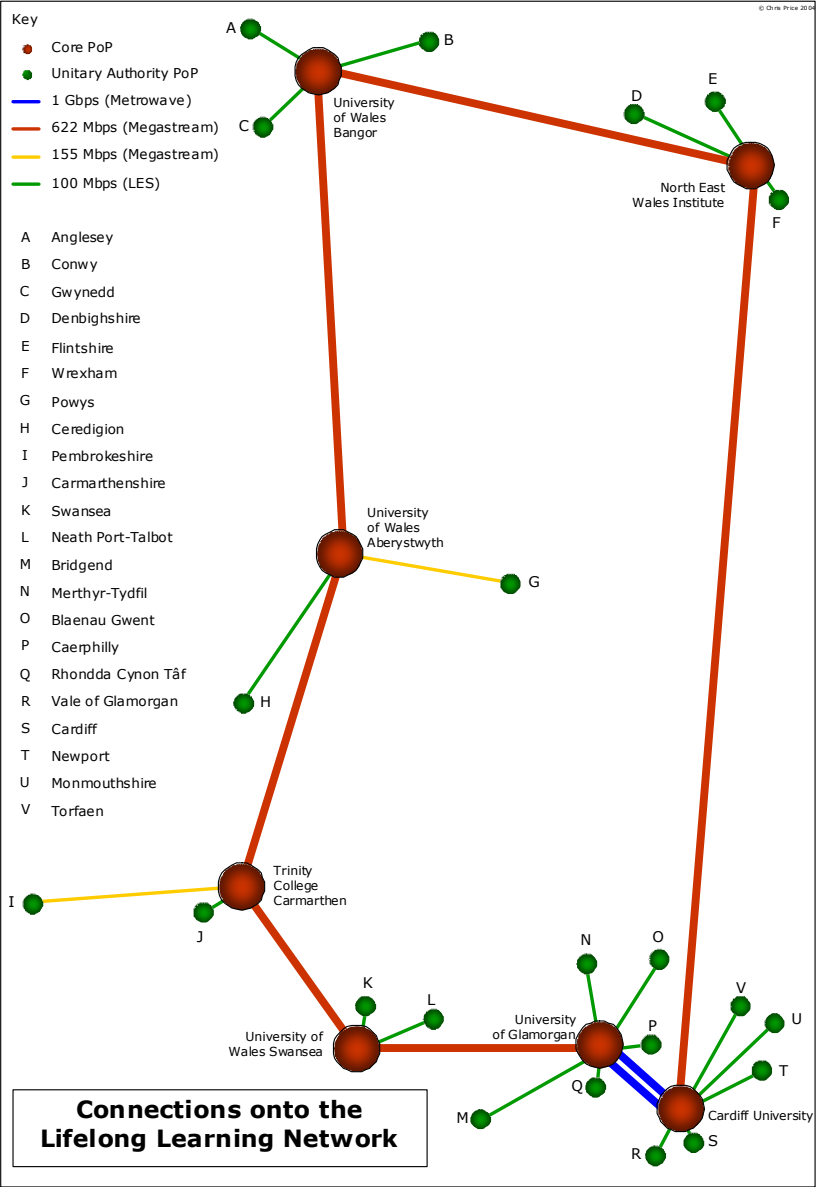
Pre August 2002

- Individual connections for majority of Unitary Authorities
- Schools connected by LEA's
- Some schools opted out
- In general lower bandwidths
- Many commercial service providers

What do we have?

After August 2002

- High bandwidth backbone
- Public IP addresses provided by UKERNA
- 22 UA's linked to backbone at minimum 100Mbps
- Fairly resilient ring topology
- Primary link into SJ4 @ 1 Gpbs from Cardiff to Bristol through 2.5 Gbps pipe



Where are we now?

May 2004

Failover link into SJ4 @ 100 Mbps from Wrexham to Warrington. (Currently in progress)

75% secondary schools at 8Mbps or above

47% primary schools at 2Mbps or above

48% of libraries at 8Mbps or above

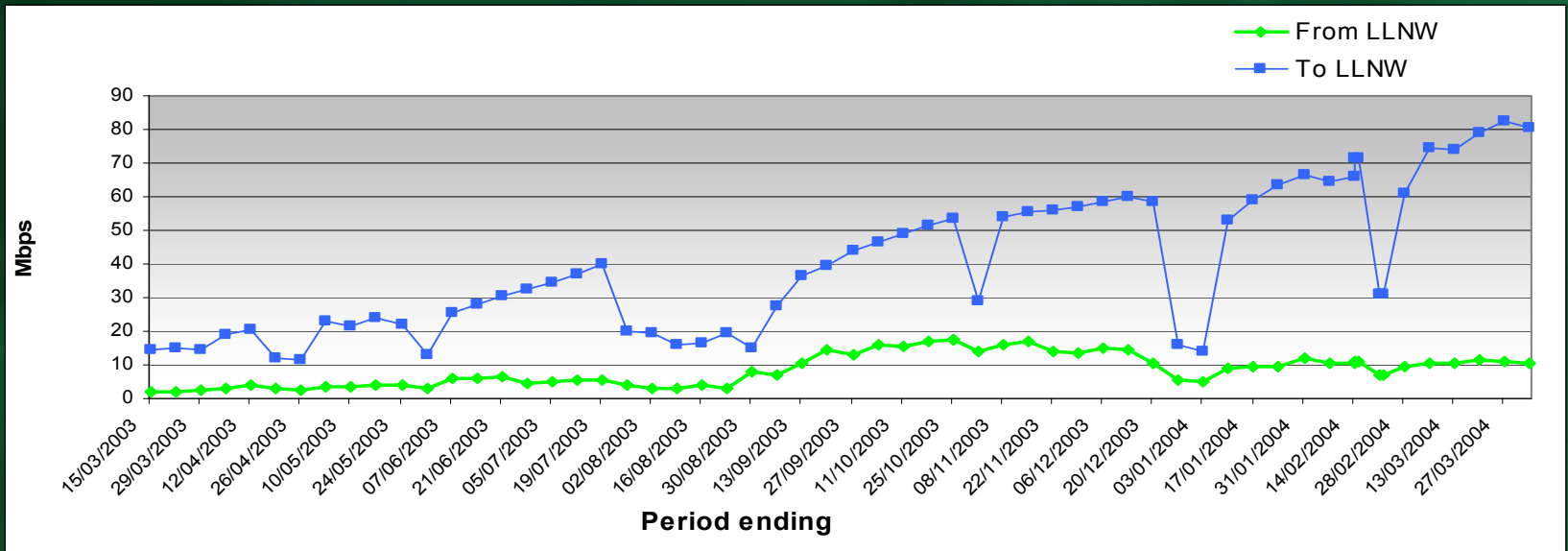
35% of ICT Centres at 2Mbps or above

Significant (and continuous) growth in the use of the networks

Innovators, people championing ICT

Schools interested in video-conferencing

Utilisation of the LLN



Traffic gathered on the egress point of LLN (link onto SJ4).

Data averaged out over 7 days.

90th percentile, top 10th percentile discarded.

Hides peak flows – saves the WAG money!

The future?

May 2004 and onwards

LEA networks growing in scale

Increased reliance upon the Internet for all

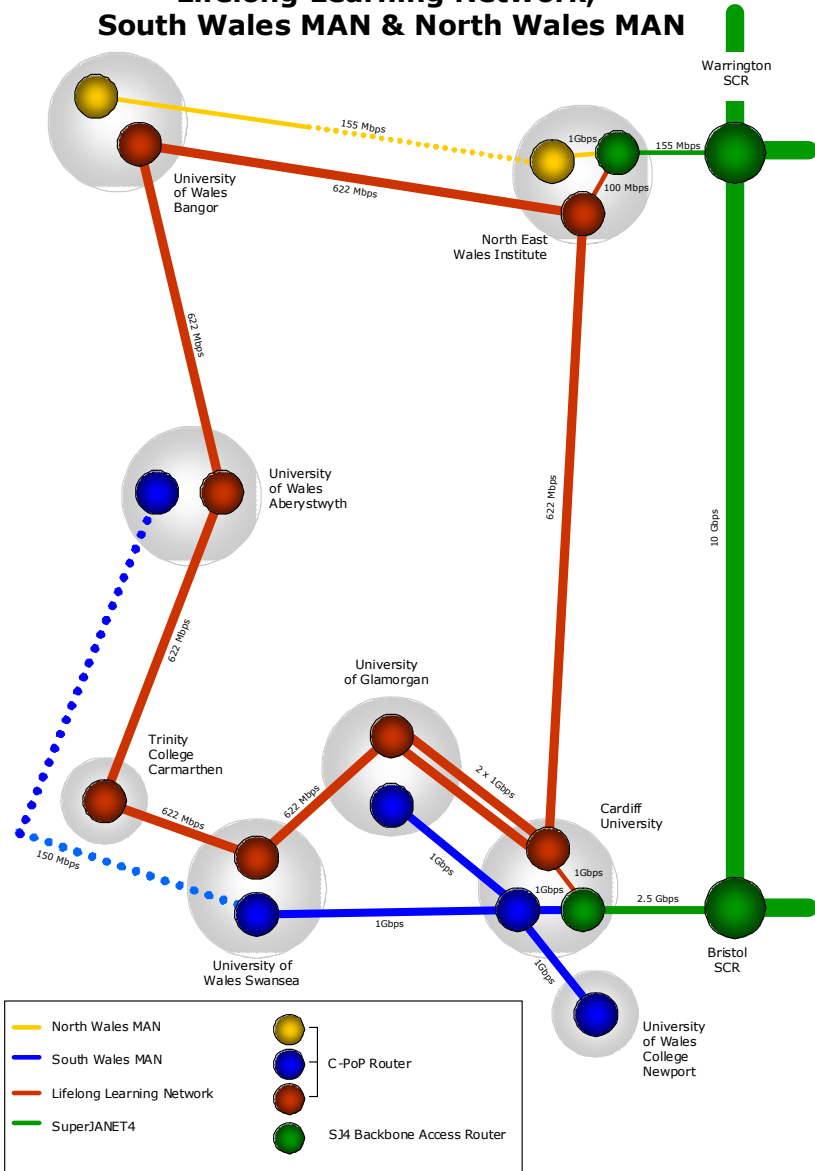
High-bandwidth, feature rich, media rich content

Video-conferencing pilot at CYDAG schools underway

Hot spots of video-conferencing activity across the
country

Reprocurement of the network (end of July 2005)

Lifelong Learning Network, South Wales MAN & North Wales MAN



Evolution of the network

More sites, ELLeN

Wider remit

- How will procurement affect things?

New technologies and applications

- Voice and Video over IP (VoIP)
- Video conferencing
- Content rich media (audio, video)

Adoption of 'new' standards

- Multicast
- IPv6

Expanding the network isn't the same as developing the network

The purpose of today's event

Feedback from service users indicates that the LLN is being used for certain types of applications that will/can benefit from...

- Rapid,
- Reliable
- Secure

... end-to-end transmission of data

Is now the time to investigate the options and adopting a system-wide holistic approach to implementing policy that will make this delivery possible?

Content Delivery

Massive amounts of information available on the web

Originally just static images and text, not particularly bandwidth heavy.

In more recent years, a move to multimedia delivered via the WWW (streaming audio and video).

Increasing bandwidths make this possible, but the data places a strain on the networks

Content Delivery

Lots of Government-led initiatives to digitise and encode educational content

BBC, Granada, Channel 4 digitising thousands of hours of educational material.

Several hundred terrabytes of information will be made available over the network.

What might be the potential impact upon networks?

Multicast; do we need it?

At present, most multimedia `streamed` is unicast.

A client/server connection in which a client receives an on-demand stream of stored content from a server, or receives a broadcast of live content. Individual video/audio streams are sent to each user individually.

Because each viewer initiates a new stream when viewing the same source, this approach to media delivery can result in increased network congestion as multiple, identical streams are sent at the same time.

Multicast; do we need it?

Multicast (point-to-multipoint) is a communication pattern in which a source host sends a message to a group of destination hosts.

The first major advantage of using multicasting is the decrease of the network load.

Is there a need to develop and enable multicast transmission on the LLN backbone in preparation for the future?

H.323 Protocol for Videoconferencing

Video-conferencing place additional requirements upon the network infrastructure.

To date, there has been more than adequate bandwidth headroom upon the network backbone

There has not been a requirement to shape or control the flow of traffic

We have had `equality` of service.

A requirement for QoS ?

Certain applications...

- IP videoconferencing
- VoIP
- V VoIP
- Streaming media

...can have very strict requirements upon the underlying network infrastructure.

QoS and Videoconferencing

H.323 Protocol

- latency needs to be minimised
- jitter (the variation in latency) needs to be minimised

These applications require preferential queuing to avoid congestion impacting on the application

Should we implement QoS to protect data that has strict sequential and temporal requirements?

Should other traffic take precedence under congestion?

Should very large data transfers (e.g. FTP) behave 'altruistically'?

Classification of Service

Applications can be quantified by their QoS requirements

A distinct group of requirements forms a *Class of Service*

Networks can be made QoS-aware so that...

- routers
- switches
- firewalls
- gatekeepers

...recognise and process each defined Class of Service appropriately

Three Classes for QoS?

Premium

- requires low latency and low jitter (consistent latency)
- e.g. IP videoconferencing, VoIP

Assured

- Routing Updates
- Streaming Media

Best Efforts (*BE*)

- 'normal' Internet traffic,
- e.g. www

Management domains.

Numerous management domains.

- SJ4
- LLN
- Unitary Authority networks
- Local Education networks
- Local Area Networks

All operated and managed by different groups of people

Forwarding policy

It may be necessary to implement policies for queueing/scheduling

No congestion = no queues

Queue lengths affect latency

Prioritising some traffic above other traffic

Selective dropping under severe resource congestion?

Standardising Forwarding Policy

Potential problems if some traffic is prioritised over other traffic.

What is stopping anyone marking ALL of their traffic as *Premium* and getting a better service at the expense of others?

What's to prevent undesirables doing this with a Denial-of-Service attack?

Implementation of QoS

1. Gathering information on type and volume of traffic
2. Implementation of QoS policy on edge routers
3. Implementation on backbone

Cannot proceed until each stage is complete!!!

e.g. cannot afford to allow unregulated *Premium* traffic into the core once the forwarding policies are activated

Timescales...?

It's going to take:

- cooperation
- collaboration
- a lot of measuring and monitoring
- a lot of planning
- a lot of testing
- quite a while to roll out

Any risk to the production network, and interruption to users must be minimised

For the SJ4 backbone this took 15 months

...and we know there is a lot of other work going on...

Where do we go from here...?

Should we now be preparing the networks for the future?

If so, how do we take things forward?

Do we agree that this will need collaboration, cooperation and contribution from everybody?

Wales is in many ways ahead of the game. Can we stay at the front?

Thank you

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