West Cheshire College low cost 2Mbit/s connection using ‘Baseband’ EPS 8 links

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Overview

This case study describes the planning and implementation of a 2Mbit/s near Megastream quality link between LANs (Local Area Networks) at sites at West Cheshire College using a BT EPS 8 (Engineering Performance Specifications 8)) circuit with DSL (Digital Subscriber Line) modems. The motivation for the project, the equipment and its installation are considered. The performance and reliability as experienced in practice over a period of six months are discussed. Post installation issues such as the performance and benefits are also assessed.

Executive Summary

Main Points:

- Point-to-point inter-campus network links less than 4km apart.
- Replacement for high cost, low performance ISDN (Integrated Service Digital Network) -2 based link.
- Implemented using ‘Baseband’ four wire circuit and ‘Baseband’ DSL modem routers.
- Achieved 2Mbit/s Megastream-like connection at a fraction of the cost.
- Total first year cost including circuit and equipment £ 4,124.
- Annual running cost – £744 (excluding maintenance/support).
- Reliability and performance since 8 July 2003 installation 100%.
- Benefits – can now use student records system at remote site and Internet access vastly improved.

Introduction

West Cheshire College comprises a main campus at Handbridge Centre in Chester, a secondary campus at Grange Centre in Ellesmere Port and a technology campus at Capenhurst. All sites are linked by BT Megastream 2Mbit/s circuits, with Handbridge Centre acting as the central hub site. The connection to JANET and the Internet is via a 2Mbit/s link to Handbridge. The college also runs a catering college at Greenbank Centre in Chester, some 500m from the main site and a routed ISDN-2 (128 kbit/s) connection was put in place in 2000 to support the 18 staff and over 100 students at this site.

The ISDN link from the catering college was unsatisfactory on two counts – the expense of

call charges and the insufficient bandwidth to support access to student records on the College Information System based at the main campus. Internet access and e-mail over the link was possible, but very slow. The motivation for the project was to make better use of the funds being spent on the existing ISDN-2 link through the provision of a better quality service.

Service Requirements and Constraints

No particular service level requirements were specified and no specific budget was allocated, so an investigation of what was possible was undertaken.

Ideally the link would support access to the student records system and Intranet. This is an SQL Server based database, with bespoke front end. It is therefore relatively bandwidth-efficient, but still required a minimum bandwidth of 256 kbit/s.

Identification of Possible Solutions

The two sites were geographically very close to each other and shared the same BT exchange, which meant that a low cost installation of copper or fibre optic circuits might be possible.

The following technologies were considered:

- Broadband connection to ISPs (Internet Service Providers) with VPN (Virtual Private Network) to provide link between campuses. Due to the distance independence of the cost, this is becoming a classic solution for small branch sites where:
    - ADSL (Asymmetric Digital Subscriber Line) is available.
    - The primary need is for Internet access.
    - The performance requirements for links between sites are less demanding (or performance can be boosted by the use of thin client systems).
- BT’s Kilostream N with routers at each site to support the link. As the sites share the same exchange, this meant that a main link element would not be involved in a circuit and high annual charges could be avoided. Furthermore, if low bandwidth (sub-320 kbit/s) circuits were employed, the connection charge could also be kept to a minimum.
- BT’s LAN Extension Service 2 (LES 2). The sites are less than 3.5km apart and a single router to segregate the two campus networks would provide a fibre-optic based 10Mbit/s link. High installation costs would be balanced by relatively low cost for the high bandwidth offered.
- BT’s Baseband EPS 9 two wire copper circuit, with DSL modem routers at each site to support the link. EPS 9 is designed for voice traffic, but capable of supporting digital traffic through the use of DSL modems. BT’s EPS 8 is similar to EPS 9, but has a four wire circuit and is therefore capable of handling duplex communications at greater bandwidth.
- Microwave / IR (Infra-red) Laser was considered, but not pursued because there is no line of sight between any buildings on the two campuses.

Cost/Technical Comparisons

A number of potential suppliers were contacted in order to obtain budgetary cost indications for the various solutions. Many suppliers are able to provide products from well known manufacturers such as Cisco® and 3Com® which support the leased line and LAN extension

solutions. However, for the Baseband EPS solutions it was necessary to search the Internet to identify companies able to provide EPS modem routers. Two companies – Lanode Ltd and Controlware Communication Systems – offered products capable of providing a solution. Lanode offered the Ascom AM2048-CAP and Controlware Communication Systems offered the Tut Systems® MXL2300™.

The following table summarises the options available.

Circuit	Bandwidth	Connection Cost (£)	Equipment Cost (£)	Annual Circuit Rental (£)	
Broadband with VPN	2Mbit/s 256 kbit/s contended	300	300	1,300	No
Kilostream N 256K	256 kbit/s	1,500	Routers x 2 @ 1,000 each	3,796	No
LES 2	10Mbit/s	9,000	Router x 1 @ 1,000 each	1,400	No
EPS 9 (2 wire)	1-2Mbit/s quality dependent	840	Ascom x 2 @ 650 x 2	410	No
EPS 8 (4 wire)	Up to 2Mbit/s depending on line quality	1,080	Ascom x 2 @ 650 x 2	744	No

Table 1: Summary of Available Options

The VPN solution comprised a 256 kbit/s upstream and 2Mbit/s downstream ADSL broadband service from a local ISP, coupled with a Draytek Vigor 2600 ADSL router supporting VPN at the remote site and a ‘branch office’ firewall supporting VPN at the main campus. The problem with this broadband VPN approach was its complexity, limited upload speed of 256 kbit/s, variable contended service performance and higher overall costs than some of the solutions in the longer term due to annual costs.

Regarding the LES 2 and Kilostream based solutions, the college was confident that these would have provided operationally effective solutions, but the cost was considered to be

prohibitive.

The EPS 8 solution appeared to offer performance, reliability and low cost – the best potential value for money. It was therefore decided to select this solution and to determine its feasibility for the West Cheshire College link.

Feasibility

The first step was to contact BT to verify the two sites were connected to the same exchange. Ideally, telephone lines into the exchange should also go to the same part of the exchange to facilitate patching within the frame. A call to BT Private Wires (0800 400400) was made, quoting telephone numbers at each site. Because the achievable bandwidth is dependent on the length of the copper cables due to attenuation and noise, the approximate distance between the catering college, telephone exchange and back to main campus was ascertained using maps, such as OS Landranger or online maps at:

http://www.streetmap.co.uk/ [1]

http://www.multimap.com/ [2]

http://www.ordnancesurvey.co.uk/oswebsite/getamap/ [3]

It was determined that the circuit length would be approximately 2km. West Cheshire College Low Cost 2Mbps Connection Using EPS 8 Links Page 4 of 8

The Ascom AM 2048CAP is capable of supporting the data rates indicated in the table below, assuming 0.4mm gauge cable.

Bandwidth (Mbit/s)	**Distance (km)**
1Mbit/s on 1 Pair	2.5 - 4.0
2Mbit/s on 1 Pair	1.8 - 3.3
2Mbit/s on 2 Pairs	2.5 - 4.0

Table 2: Data Rate Achievable vs Length of Circuit

For an interconnect wire distance of 2km the indication was that a bandwidth of at least 1024 kbit/s would be achievable, which made the project viable.

NB: Final verification that BT could supply the Baseband EPS 8 circuit was only possible once an order had been placed for the required circuit (as is the case for other BT services).

The second step was to choose the Baseband modem routers. It was decided to evaluate

both of the products that had been identified before making a final selection. Agreement was reached with both suppliers to carry out this trial.

In its basic form, the Ascom AM2048 DSL modem has the following features:

- Multiple interface options (X.21, V.35, G.703, 10BaseT, USB).
- Latest DSL technology.
- Data rates of n x 64 kbit/s to 2048 kbit/s.
- 2/4 wire technology.
- Remote configuration.
- Extensive self test features.
- Stand-alone or rack mountable.

With the X.21 interface it could be connected to a router. However a router module is available for the modem itself which adds the following features and benefits:

- No need for separate routers.
- Direct Ethernet 10BaseT connection.
- Compatible with AM128E, AM512, AM1024 & AM2048-CAP.
- Simple configuration.
- Supports IP and IPX (Internetwork Packet Exchange).
- Static Routing and RIP (Routing Information Protocol.
- NAT (Network Address Translation) supported.

In order to keep the solution as simple as possible and to keep costs to a minimum, the specification for the Ascom unit to be installed at the main campus and the catering college included the router module.

The specifications and functionalities of the MXL 2300 unit were similar to the Ascom modem. It was simply more expensive. It was included in the trial to see if it offered any performance or reliability advantages over the Ascom unit.

Project Planning

The project was split into several phases as detailed in the following outline of project plan:

Phase	**Timeline**
1. Establish the feasibility of procuring and install a Baseband EPS 8 circuit between the catering college campus and Handbridge Centre campus through research and discussions with suppliers.	Week 1
2. Pre-tendering quotations to establish budgetary prices.	Week 2

3. Obtain expenditure approval / allocate from budget. 4. Select a supplier; tendering / request for quotations and site surveys. 5. Place orders for procurement of equipment and installation and commissioning services.	Week 3
6. Installation.	Week 7
7. Commission and test.	Week 7-8

Table 3: Project Timeline

Procurement

BT was the only possible supplier of the Baseband EPS 8 circuit in the area and an order was placed.

A supplier for the DSL modem/router was selected through a process of requesting final quotations. The selection basis was best value for money. Lanode Ltd. won the order because they were able to offer the most cost-effective solution.

The cost of the whole project was as follows:

Project costs	**£**
Supply EPS 8 Baseband circuit	1,080
First year circuit rental	744
Supply and installation of DSL modem routers	1,300
Total project first year cost:	**3,124 +VAT**

Table 4: Project Costs

Implementation

The locations for the termination units of the EPS 8 circuit were specified to be the computer rooms at the main campus site and at the catering college site. The lead time between placing the order with BT and installation was 30 days. A site survey was required ahead of the installation and BT installed the circuits satisfactorily on the day they specified.

The DSL modem routers arrived on time. First a back-to-back test was carried out with the Ascom AM2048 units to check the units worked. Then they were connected to the EPS 8 NTUs (Network Termination Units) at each site. The units were then connected via RJ45 Ethernet cable to the LAN switches at each site. There was no need to carry out any modifications to network addressing at either site. The interfaces on the modem routers were simply configured for the various network addresses and RIP enabled.

Testing over the circuit was achieved by copying across large databases. It was found that the quality of the EPS 8 circuit was such that a full 2Mbit/s transmission speed could be reliably achieved.

All staff PCs at the catering college were set up to access the student records system on the College Information System based at the main campus. It had hitherto been impossible to access these over the old ISDN link. Over the new Ascom modem / EPS 8 2Mbit/s link, highly satisfactory performance was achieved.

The major purpose of the project – to permit access to the student records system – was achieved.

There were no major technical, management or supplier related issues encountered in the installation. The Ascom modem was operationally evaluated for three days. No problems were encountered. In fact users were amazed at the performance of web browsing at the catering college over the link.

The alternative more expensive TUT Systems MXL2300 modems were then installed for comparison. Following a back-to-back test, they were connected to the EPS 8 NTUs at each site and then connected via RJ45 Ethernet cable to the LAN switches at each site. The interfaces on the modem routers were configured for the various network addresses and the RIP (Routing Information Protocol) was enabled.

As with the Ascom units, testing over the link was achieved by copying across large databases and the quality of the EPS 8 circuit was such that a full 2Mbit/s transmission speed could be reliably achieved.

The TUT Systems MXL2300 modems were operationally evaluated for three days. No problems were encountered.

At the end of the trial period, as both sets of equipment performed equally satisfactorily. It was decided to choose the Ascom solution as this was the least expensive. The Ascom units were reinstalled and have been operational ever since.

Operational Performance and Reliability

The college’s experience over the six month period since installation on 8 July 2003 has been more than satisfactory. The system has worked flawlessly and no further configuration or

attention has been required.

Benefits of Project

As hoped at the start of the project, the improved link has made possible access to the College Information System. This has had a major impact on the effectiveness of administration staff at the catering college.

Internet access over the old ISDN link was possible, but very slow. This has markedly improved with the 2Mbit/s EPS 8 based link.

As anticipated, e-mail performance has not been noticeably affected as this is not a bandwidth-sensitive application.

The aim of the project was to make better use of the funds being spent on the existing ISDN-2 link. This has clearly been achieved. Expenditure on the ISDN link was running at £300 per month. The new EPS 8 circuit costs £62 per month. The cost of support and maintenance of the routers is similar to that for the ISDN equipment. Therefore a cost saving of approximately £240 per month has been achieved and performance has been improved beyond recognition.

Lessons Learned

There have been no negative experiences. The project was carefully planned, the suppliers performed admirably and the implementation went without problem. There is little that might have been done better.

Since the first Baseband EPS 8 link installation, the college has been able to make further savings by using this technology. One of the college's 2Mbit/s Megastream connections between Ellesmere Port Library and the Grange site has been replaced with a much cheaper EPS 8 circuit, saving around £2,250 in annual rental charges. The two sites also shared the same BT exchange and were approximately 1km away from each other.

Summary

The replacement of an ISDN link with a 2Mbit/s link between local sites (less than 4km apart) using a BT EPS 8 circuit with DSL modem routers, has provided a low cost 2Mbit/s near Megastream quality reliable connection between sites. The total cost of ownership over the predicted lifetime of the link is very much smaller than any other services available from telecommunications service providers and will result in a net saving of approximately £2,800 per annum on just one circuit.

A moderate level of project management and co-ordination was required to implement a successful service but no major problems were encountered. The effort involved has resulted in much enhanced network services to staff and students on a major campus of the college. All the objectives of the project have been met, including provision of access to student records, enhanced web browsing and cost savings.

Any college that has a need to connect the computer networks on campuses which share a common BT exchange are strongly recommended to consider implementing a similar Baseband EPS 8 based system.

2mbits-connection-using-%E2%80%98baseband%E2%80%99-eps-8

Links
[1] http://www.streetmap.co.uk/
[2] http://www.multimap.com/
[3] http://www.ordnancesurvey.co.uk/oswebsite/getamap/