WHITE PAPER

July 2000

DELIVERING BROADBAND ACCESS IN EUROPE

PAV DATA SYSTEMS

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1. Introduction

The current forecast from technology analysts is that mass use of the internet worldwide will be driven by the roll out of its second coming, broadband internet. The theory is that consumers and businesses have felt let down by the internet so far, disappointed by its slow speed of service, the excessive number of connection attempts needed to start surfing and the prohibitive cost of spending long periods online.

Most European consumers use dial up internet connections at the moment, providing them with a 56 KB/s capacity pipe. This connection can handle basic internet tasks but labours when asked to download even a modest set of graphics. This unsatisfactory state of affairs is stunting the growth of European e-commerce. For example, fashion e-tailer boo.com created a highly advanced site for viewing images of its clothing but few potential buyers were able to download the graphics, making true e-commerce impossible and leading to commercial failure.

One recent study suggested that for e-commerce retailers, nothing less than 34 MB/s would be the requisite norm by 2002. This is probably accurate but at the moment, very few businesses in Europe actually have this capacity.

The other major issue is that the cost of accessing the internet through rapid connections is far too high for most consumers and the reserve of large corporates alone. While a number of Internet Service Providers recently launched totally free access in the UK (i.e. no connection fee and no call charges), this only appiled to the weaker 56 KB/s dial-up connections. And as consumers have been finding, the actual download speed of these connections slows down alarmingly as the volume of users increases. In the UK, the Chancellor Gordon Brown has publicly stated his fears that the high cost of accessing the internet is holding back the UK economy by preventing the growth of e-commerce.

So where's the solution? The answer is broadband access – technology with the ability to deliver the kind of internet the public always hoped it would be – fast, multimedia, always on, cost-effective etc – and make proper e-commerce viable as a result.

The object of this white paper is to examine the obstacles and solutions to delivering broadband access. The hurdles basically split into two flavours – regulatory and technical. The ability to provide a broadband solution is to a large extent dictated by a country's regulatory climate. This condition, in turn helps determine which of the five major access technologies to adopt. Also, each broadband access technology has pronounced and inherent strengths and weaknesses, which need to be assessed carefully before a rollout strategy is decided on.

2. The history of the local loop

Deregulation of the global telecoms industry dates back to the 1980s and has picked up pace more recently. The aim is to encourage the development of new communication services and drive down the cost for consumers and businesses by allowing multiple companies to compete in the market alongside the former state-owned monopoly telecoms operators.

In the early 1980s, some governments began to open access to national networks. This often took the form of creating a duopoly. In the UK for example, Cable & Wireless, then Mercury joined British Telecommunications in the market. The duopoly strategy, as opposed to full open competition recognised that the sums of money required to build a modern national network are huge investments for the private sector which would understandably want to see a significant return almost immediately.

The next sign of change was the award of licenses to cable companies to build local networks that could offer telephone and internet services, as well as TV channels.

More recently, in the early 1990s, a new breed of telecoms company emerged, such as Colt in the UK and MCI Worldcom in the US that specifically targeted Metropolitan areas with powerful fibre-optic cable networks.

The situation now in most parts of Europe – and increasingly so in Africa and Asia - is that there are several competitors to the former incumbent operators for national and international communication services. The cost of communicating has been driven down as a result and new, innovative product bundles proliferate.

However, little of this deregulatory activity has focused on opening access to the local loop telephone networks that run directly to homes and offices. Most local loop lines remain in the complete control of the former incumbent telecom operators. However, it is over these networks that most current internet traffic must travel. The result is that one company is able to control the rollout timetable and price of high-speed internet connectivity. In such an environment, it's inevitable that true broadband internet access is priced out of the reach of the general public and most businesses.

3. The criticality of broadband internet for e-commerce

When the technology industry bandies around a word of phrase – in this case 'broadband' – as the answer to our prayers, there is always a degree of concern that the proposed solution may be nothing more than hype. After all, ISDN received the star treatment only a few years ago but is barely mentioned today.

The hype behind broadband is more justified and stems from the huge dissatisfaction with today's internet registered by everyday users. In a recent survey from analysts Ovum, 89% of internet users said they were unhappy with the quality of the internet in its current, dial-up form – citing speed as the main reason for the problem.

With dial-up access, the consumer experience of the internet is not a smooth one. Every factor is in place to discourage consumers from using the internet as a means of buying goods and services. Firstly, the consumer has to wait to dial-up to the internet, then wait again while the low capacity connection searches for the web page selected. When the consumer finally reaches a web site and is ready to start buying, the waiting game kicks off again as individual pages of information and graphics need to be downloaded. Super-human patience is required for a sale to be completed.

Broadband solves all three issues instantly. Firstly, it provides an 'always on' connection so instead of having to dial-up to the internet for each shopping spree, the consumer simply clicks and receives an immediate response. Broadband internet access is not charged by time online, simply by a monthly subscription. By charging like a TV rather than a parking meter, broadband encourages consumers to keep surfing.

Broadband packs a much higher capacity connection than dial-up access – megabits rather than kilobits. As a result, finding sites and downloading graphics is instantaneous, not laborious. Broadband delivers a hassle-free and fully multimedia internet experience, which increases reality and stimulates the desire to participate for consumers.

A recent survey by Jupiter Communications found that Europe is home to 12 out of the world's top 20 web sites for sophistication. The continent's potential as a centre for e-commerce is undoubted but until broadband is more freely available, consumers don't have the tools required to capitalise.

In the US on the other hand, broadband internet access proliferates. According to internet market specialists, Zona Research Inc., 66% of US companies have already acquired broadband internet connections. While the bulk of these are the more expensive leased lines connections, 20% of US companies have already installed cost-effective DSL broadband connections or

plan to do so during the next 12 months. And DSL is gaining ground among US consumers as well.

The result is a US economy geared up for e-commerce with high speed internet connections. The efforts of European Governments to catch up by making low cost, broadband access more available focus on creating competition in the local telephone exchanges, over which today's internet connections must run. Deregulated local exchanges will mean mass-market broadband access arrives sooner as competition drives prices down.

4. Current efforts to unbundle local loop networks in Europe

After years of inertia, European Governments have realised that they have a key role to play in breaking the monopoly enjoyed by the incumbent telecom operators in the local telephone networks.

A recent European Union two-day 'dot com' summit in Lisbon concluded with the resolution that members will work to 'enable Europe to become the most competitive and dynamic knowledge-based economy in the world'. The key is promoting internet growth by introducing greater competition in local access exchanges. A target has been set of full unbundling of the local loop in each member state by the end of 2001.

Commenting on the internet, UK Prime Minister Tony Blair said that the EU would now benchmark itself against the best in the world, rather than turn in on itself. So how will Europe actually fair?

Belatedly, competition in the local loop is on the horizon and the prospect of low cost, broadband internet access for all a reality. However, this state of affairs is still a year to 18 months away in most countries by which point the US will have extended its internet advantage still further.

Also, while European Government has outlined a proposed timetable, the pace at which broadband access becomes available rests firmly in the hands of the extremely powerful incumbent operators. It is their job to upgrade the local telephone networks to handle broadband connectivity and fair to assume that none of them will see this task as having maximum priority. After all, by unbundling and upgrading the telephone exchanges, they open the door to competition.

These are the regulatory issues that surround the availability of broadband access in Europe. It is now time to study the technology options.

5. The copper solution

Copper is seen as the conventional solution to delivering higher bandwidth internet services. It involves upgrading today's telephone networks so that they can handle new high-speed access technologies, such as DSL.

DSL breathes new life into the tired telephone wires, allowing consumers and businesses to achieve rapid internet access speeds. There are a number of variants, some of which are used to implement leased lines at up to 2Mbit/s and others which are designed for the residential market which are asymmetrical – i.e. they offer much more bandwidth downstream to the user from the exchange than upstream to the exchange from the user.

But speed is not the only benefit that DSL brings. It also provides an 'always on' internet link 24 hours a day, removing the hassle of dialling the internet and expensive charges from the telephone companies.

In addition, anyone using DSL can run their own web server, receive instant email, video conference and access the company network at high speed from home or on the move. DSL is seen as the solution to spur consumers to use the internet more often and make real teleworking viable for European executives.

Most countries in Europe have started, or are about to start xDSL deployment. Pioneer Consulting has forecast over 5 million users globally by 2001, and nearly 16 million by 2003.

DSL is capable of delivering all the benefits of broadband internet access but question marks surround its availability as an immediate mass market solution. Firstly, DSL requires a high quality local loop network with minimal interference. This means that the condition of the wiring throughout the local loop has to be individually tested to ensure compatibility with DSL. Also, the loading coils and bridge taps used in local exchanges to extend reach and allow line sharing are not conducive to DSL access. The result is that the incumbent operators who own the local loop need to do a considerable amount of planning, investigation and network upgrading before DSL can be deployed. None of them are likely to hurry as the arrival of DSL will cannibalise the lucrative revenues they already recoup from dial-up and leased line access.

Once the local loop network is ready, the DSL supplier has to gain access to the incumbent's local telephone exchange to co-locate the DSL Access Multiplexers. Again, there is potential for delaying the speed at which this is made possible. With that hurdle cleared, the DSL supplier will then need to deal with the incumbent for wholesale access to the local network. Unless Governments take a tougher regulatory stance than previously seen, incumbents will be able to over-charge rival suppliers for wholesale supply

and drive the price of DSL out of reach for many businesses and consumers as a result.

The final issue to consider – and one that has so far been overlooked by many commentators – is that the bulk of the copper network in many European cities is of dubious age and quality and may not be able to support DSL services anyway. Analysts predict that there might be up to 20% of Europe that cannot be served due to a lack of suitable copper pairs.

6. The fibre-optic solution

Fibre-optic cable has the potential to deliver high-speed and high capacity giving plenty of room for today's and tomorrow's broadband internet applications. It is already used extensively to create Europe's national, Metropolitan area and cross-continental networks. Organisations such as US-Dutch joint venture, KPNQwest are deploying advanced fibre-optic networks to connect major and second cities throughout Europe for example.

This type of network architecture is increasing the availability and driving down the cost of bandwidth in Europe. However, it tends to be supplied at present in large-scale backbone networks, ideal for corporates that need to link multiple sites across Europe, and not in the local access networks that run directly to the homes and offices of consumers and small businesses. If 'fibre to the curb' as it is known became a reality in Europe, broadband internet availability issues would be solved. However, the development of local access fibre networks is not advanced on the continent and would require considerable time and investment in manpower and installation.

The lowest cost for a 'fibre to the curb' solution in an urban environment is around US $40,000 per km and that is in Australia where wayleaves for crossing private land are not required. The price is considerably higher in European cities which tends to put fibre-optics out of reach for the smaller user and totally unaffordable in rural access networks.

7. The cable solution

Today's cable networks passing homes in Europe are used for TV transmission, telephony and increasingly, some basic broadband internet applications. Broadband internet over plain cable networks is always on and ramps up access speeds. Cable modems are already used extensively by consumers throughout the US and are starting to roll-out throughout Europe.

However, the shared medium (with TV and telephony) and limited-upstream bandwidth of cable modem systems means they are not well suited to high-bandwidth business applications, such as videoconferencing, which need significant transmission from the user.

Also cable is a shared resource so access speeds can drop alarmingly with large numbers of concurrent users. This is likely to deter most businesses from cable modems because of the lack of bandwidth guarantees. And many cable networks have not been extended into business districts anyway, so operators can only target a limited part of the business market.

Most of the UK cable operators are marketing cable modems as a high-speed Internet service for consumers and analysing alternative access technologies for business purposes.

8. The Radio solution

Radio transmission for business purposes has been evolving over the last 50 years and Local Multipoint Distribution Systems (LMDS) have been used recently and successfully to bring standard telephony services to developing countries for the first time.

The difference with the latest generation of LMDS solutions is that they are designed to deliver data services such as internet access. Many of Europe's giant equipment manufacturers have entered the radio arena, including Ericsson and Alcatel and claim to have developed systems that deliver access speeds of 25 MB/s now and 100 MB/s in the near future. This is more than enough bandwidth to handle broadband internet applications, a considerable advance on the access speeds afforded by a traditional solution such as DSL.

Major trials of Metropolitan area radio networks have occurred during the last two years and a number of network building specialists have launched themselves into the European market – e.g. Winstar, WFI and Granger Telecom – to capitalise on the drawbacks with rival DSL roll-outs on the continent.

However, radio has problems of its own. Firstly, the radio spectrum is a limited and valuable resource. So much so, that it is regulated and licensed. For example, Europe is witnessing astronomical prices being paid for radio licenses in Government-run UMTS auctions.

The result is that there is only room for a few players to offer a broadband internet service via radio. Most license applicants will go away empty-handed and those who are successful will have to shoulder huge costs for winning, which will ultimately need to be recouped by being passed on to consumers and businesses. The lack of true competition in the market will also ensure that prices for broadband access products will remain too high for mass-market consumption.

Also, wireless LMDS for Metropolitan area internet access has yet to be fully proven. However, judging by the reliability rates of other radio applications, there will be problems with interference and call drop out. This is likely to cause the same frustrations with internet access that consumers currently experience with dial-up connections.

Finally, though radio can handle today's broadband internet applications, it reaches a capacity ceiling around 100 MB/s. As a result, when gigabit level internet functions are introduced, radio will be unable to deliver the bandwidth consumers and businesses need to be able to take advantage of them.

9. The satellite solution

Satellite systems for delivering broadband internet have received plenty of publicity recently. This is largely because of ambitious plans revealed by Microsoft's Bill Gates and Craig McCaw, founder of McCaw Cellular to put nearly 300 satellites in low orbit around the earth to provide high-speed internet access. However, this system is not due to start operations before 2001, eliminating its usefulness as an immediate broadband solution.

There are several existing satellite schemes in operation currently offering broadband internet access. The most popular are the very small aperture systems (VSATS), which communicate downstream to a small antenna, with a wireline return. Pioneer Consulting has forecast 650,000 subscribers globally for broadband satellite services in 2001 and nearly 5 million in 2003.

But satellite systems do have a fundamental drawback, namely that it is not economical to provide upstream capacity to a satellite from a user terminal. The problem revolves around physics. Satellites must be 36,000 km above the earth in order to appear stationery, and that needs terminals capable of sending an incredibly powerful signal. Unfortunately, terminals with this power are far too expensive for the mass market so wireline solutions are needed to help with the upstream leg of the journey.

If these are the immediate problems, the long-term future is no rosier. Terrestrial solutions will always be able to make bandwidth available more cheaply and with lower latency than satellite systems. Also investment costs are very high and the failure of Iridium's mobile satellite service has prompted considerable caution from the financial community.

10. The optical wireless access solution

Optical wireless access is the newest entrant to the broadband internet space and hotly tipped as a likely solution to the problems so far outlined. It works in the same way as fibre-optic cable, that is with a laser transmitter and receiver working in the infra red light spectrum. However, instead of using glass fibre as the conductor for the light beams, it uses free space.

The key benefit of optical wireless is that because it uses light rather than radio spectrum, it is totally free of license restrictions. And as a wireless solution, it bypasses the regulatory and construction problems that dog copper and cable connections. As a result, optical wireless is the one broadband internet solution that can be deployed immediately. New customers can actually be connected in hours not weeks or months (the average leased line connection time quoted by BT is four to six weeks).

Optical wireless access systems are also relatively inexpensive to use, costing only a tiny fraction of a 2 MB/s leased line from an incumbent PTO (BT quotes nearly £30k for annual rental of a 2 MB/s leased line connection) and need very little maintenance once the equipment is installed.

The optical systems do require a clear line of sight to work effectively, and are usually sited on top of tall buildings. This has an environmental benefit as there is no need for large towers to be constructed, for example and no danger from RF emissions as with high frequency radio systems. It has been said that optical wireless comes under threat from extreme weather conditions, such as static freezing fog and heavy rainfall. Independent laboratory and field tests, including those of the US Army Space & Missile Defense Command centre, prove that this is not the case, and that optical wireless is as reliable as any other radio-based system.

The architecture of broadband optical wireless access networks is extremely scalable, which means it can start very small (2 Mb/s) and grow large (up to 622 Mb/s) without redundant equipment costs. This low speculative network outlay means suppliers can see a fast return on investment, typically in months rather than years.

So with all these advantages, why are optical wireless systems not being widely deployed across Europe? The answer is probably a general scepticism over using infra red compared to more traditional access technologies. However, today's systems are already providing 155 MB/s connections and can be found in Metropolitan area networks throughout the US and the Far East. Developers claim gigabit-ready solutions will be available within 18 months.

According to leading weekly telecoms newsletter, America's Network 'savvy technology companies have been working on optimising laser as a commercial

communications alternative, leveraging off research conducted over decades by the US Military, NASA and foreign governments. Now their work is being picked up by supplier giants such as Lucent and Nortel'.

The move into the market of companies of this size should see a steep rise in the use of optical wireless access solutions. And as the newsletter points out, the technology is likely to be very popular in Europe and Asia where City authorities are much less keen on allowing competitive carriers to dig up the streets, due to congestion, than in America.

11. Conclusion

Europe does not trail the US in e-commerce because its population is averse to using new technology. The continent's love affair with the mobile phone dispels any such notions. The problem is that the broadband infrastructure which makes using the internet a smooth experience simply is not in place yet in Europe.

Internet subscriptions continue to rise in Europe but true use of the medium to shop for services is not viable with archaic dial-up connections. European Governments have finally latched onto this issue and are busy breaking the strangleholds of incumbent telcos on the local telephone exchanges, over which much broadband internet access will need to be provided.

However, the fruits of these efforts are still several months away and once successful, they come up against technical limitations in the mass roll-out of DSL technology. For broadband access to be widely available across Europe as soon as possible, it will require a hybrid roll-out of different technologies – employing the optical wireless and other wireless solutions in the short term and the copper and cable technologies when available several months down the line. Through its speed of roll-out, high capacity levels and low cost of ownership, optical wireless systems in particular look a strong solution for ISPs looking to provide broadband internet access immediately.

Instead of backing one horse, European broadband internet suppliers need the flexibility to use a melange of different access technologies to provide consumers and businesses with the best possible solution both now and in the future.