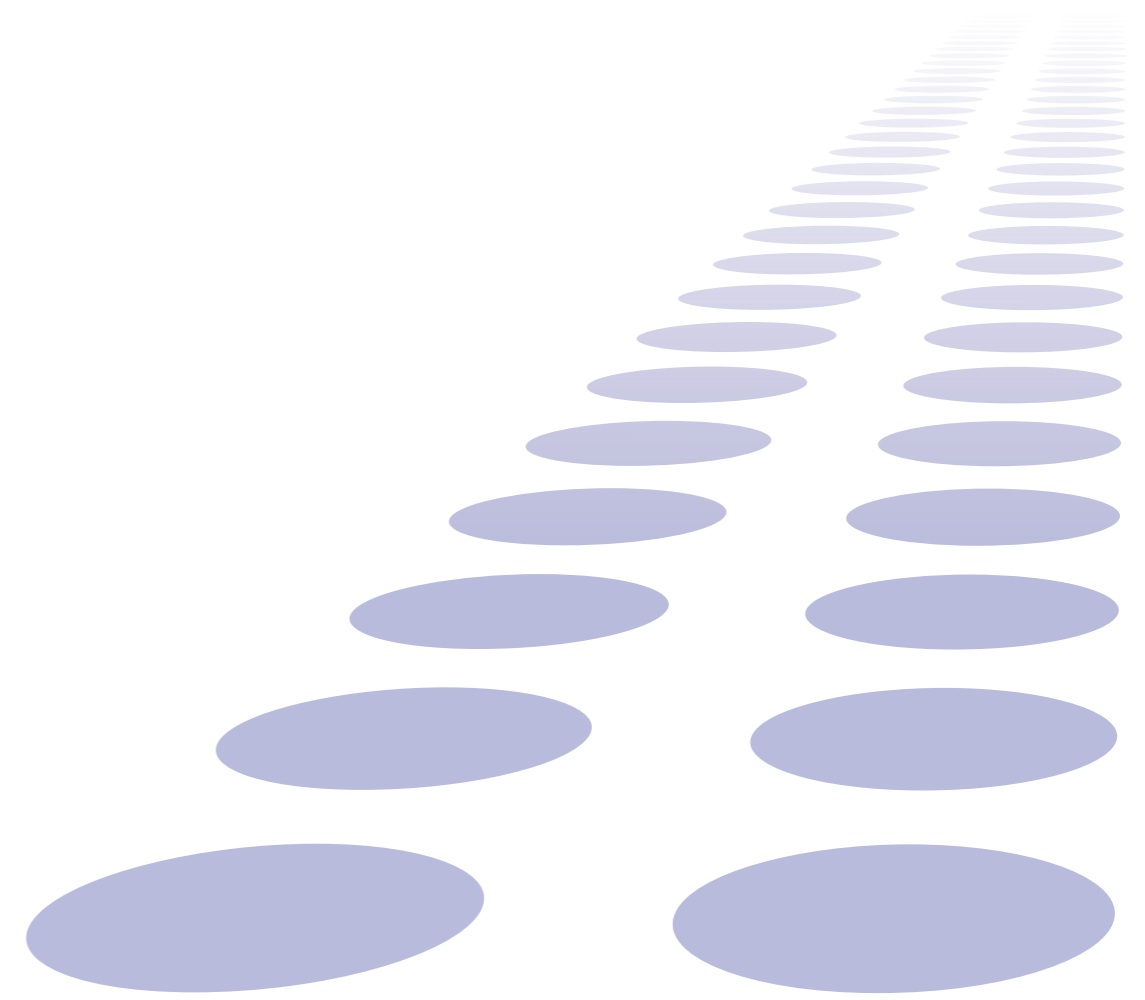


Inter-site Ethernet

A guide to choosing your Ethernet service provider



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Key topics

- The market for Ethernet is continuing to grow, as UK organisations appreciate the cost savings, performance and efficiency gains to be made from deploying services based on this transport technology.
- Businesses that choose Ethernet-based connectivity for their corporate Local and Wide Area Networks can expect greatly increased productivity and profitability, as well as significant competitive advantage, from the capacity to introduce new applications and services to customers and staff.
- When choosing an Ethernet service provider, companies need to consider a range of factors including:
 - the fibre-based coverage offered by the provider
 - the methods used to protect, optimise and guarantee network performance
 - the price and flexibility of deploying future services.

1 Introduction

More and more enterprises are choosing Ethernet connectivity for Internet Protocol (IP) services – not just for their Local Area Networks (LANs) but also as a means of easily, flexibly and cost-effectively connecting geographically spread sites.

Ethernet offers superior network performance at vastly reduced cost compared to traditional Leased Lines or services based on Asynchronous Transfer Mode (ATM) or Frame Relay transport technologies. It makes it affordable and achievable for organisations of any size to create a single network that is easier to manage, provides the flexibility to grow with the business and enables new applications to be added as required, simply and cost-effectively.

The tangible business and IT management benefits of the technology are fuelling massive growth in the adoption of Ethernet services by UK corporations, with market estimates for continued growth over the next few years already being exceeded.

2 Business drivers

There are compelling business reasons why companies are embracing Ethernet as their connectivity of choice for the corporate LAN and Wide Area Network (WAN):

- major cost savings
- increased IT efficiency
- improved business protection
- greater productivity and customer service.

2.1 Major cost savings

Integrating WAN and LAN into a single, national Ethernet-based LAN generates considerable cost savings for a number of reasons.

Reduced price & flexibility of bandwidth

Bandwidth on Ethernet is less expensive than bandwidth on Frame Relay or ATM-based networks and you only pay for the bandwidth you actually need. This means you can get far greater capacity for an equivalent investment – in fact, businesses can expect to treble their bandwidth capacity for the same price as their current Frame Relay/ATM networks.

Where providers offer scalable bandwidth upgrades, you can initially set lower capacity while you determine your network's needs, then increase capacity as and when required, easily and cheaply, without having to replace the fibre over which the service runs.

You can explore the opportunity to use your greater bandwidth capacity to introduce new services and applications that will improve your overall efficiency and competitive edge:

- consolidate servers and storage networks to facilitate their management and reduce IT costs
- take advantage of multimedia applications to improve business practices and customer service, such as delivering interactive training courses with live video
- use Voice over IP to enhance staff productivity by introducing hot-desking
- move to thin clients within a web-based software architecture, saving capital equipment costs (servers and software) and minimising hardware wastage.

The reduced cost and greater bandwidth flexibility of inter-site Ethernet enables you to be confident that your network availability will be robust enough to support new services, as well as increasing the performance of existing applications.

Reduced hardware

As Ethernet is well-established within the LAN environment – there are almost a billion Ethernet interfaces in use worldwide today – and increasingly being adopted on the WAN, equipment is more readily available and costs far less than the traditional WAN routing equipment used to support Frame Relay/ATM based networks.

By enabling you to consolidate your WAN into a single network, you can make major savings by eliminating the need for the hardware involved in multiple networks. With fewer systems to purchase and house at additional sites, you can save on the capital cost of servers and related equipment. This has a knock-on effect of reducing software licensing fees and support costs.

Facilities management

Centralising your network also simplifies its management, monitoring and back-up and streamlines the administration of software licensing, generating further cost savings.

Before Metro and National Ethernet services became widely available, companies had two main options for their network management. They could either allocate networking staff to manage the main servers on the network at every physical location, or centralise resources and connect them via ATM or Frame Relay – both of which were expensive. This also resulted in many companies under-utilising their capital equipment by being forced to duplicate resources across multiple sites, often implementing upgrade programmes before some sites became truly obsolete and failing to optimise the skills and availability of their staff across the entire network.

An Ethernet-based network also gives you flexibility in where you centralise your network management. Rather than recruiting and locating staff in headquarters, for example, you can instead choose to move network management to a regional office, where staff skills are cheaper to acquire and property overheads lower. According to Ovum¹, 70% of the cost savings from consolidating network resources comes from such staff and accommodation cost reductions.

Reduced staff costs

The overall staff costs of managing a single Ethernet network are lower than with ATM/Frame Relay-based networks, because Ethernet skills are widely available and cheaper to recruit than WAN/router specialists.

2.2 Increased IT efficiency

With Ethernet, the integrated LAN can effectively extend anywhere, yet be managed centrally. This is both cost-effective and efficient.

Simplified management

The WAN can use the same protocol as the LAN, making it far easier to manage the two. Companies that have Wide Area or Metro Area Ethernet solutions can also manage their LAN and WAN with a common set of management tools – which in turn removes the need to source and recruit specialist skills in Frame Relay or ATM technologies.

Lower maintenance

Centralising the management of the network also simplifies system monitoring and back-up, substantially reducing the level of maintenance needed on the network.

Strategic deployment of IT resources

By reducing maintenance and management issues with an Ethernet-based network, you can reallocate staff that would previously have been required for reactive management and maintenance to IT projects that proactively support business progress.

The optimal network

With no geographical constraints and less drain on budgets, you are free to design the ideal network to exactly match the needs of your business.

2.3 Improved business protection

Disaster Recovery, the process of regaining access to the data, hardware and software necessary to resume critical business operations after a natural or man-made disruption, often implies preparation for a freak catastrophic incident. However, very often the type of events that can affect business continuity are much more mundane or routine occurrences, such as a power cut, or even simple human error.

So it's vital to ensure uninterrupted availability of that information in the event of system downtime – for whatever reason – and to deal swiftly with any issue that affects any part of the network and has the potential to threaten the smooth operation of your business.

Ensuring business continuity

The growing importance of adequate business continuity measures is being driven by companies' dependence on IT and by the higher expectations of their customers, who demand the kind of 24x7 service that can only be delivered by the most robust technology.

Historically, putting a business continuity or disaster recovery solution in place to protect the business was a complex and expensive task. However, Ethernet now makes it possible to deploy a highly cost-effective solution by enabling business-critical data to be backed up remotely over a high speed network between corporate HQs, regional locations and business continuity sites.

For example, over an Ethernet network, it is easy to mirror corporate databases in real time. If a live database should go down, an up-to-date back-up copy is immediately available and easily accessible to any employee over the network, regardless of their physical location.

2.4 Greater productivity & customer service

The benefits of Ethernet-based networks can also enable you to explore new ways to increase staff productivity and levels of customer service to gain a valuable edge over your competitors.

Deliver improved service to customers

Over a secure Ethernet connection, you are able to make information much more immediately accessible to staff, no matter where they are located. They can hold virtual meetings, develop more collaborative working practices and use electronic whiteboards to share and discuss information. Training can also be delivered in interactive sessions, independent of location, over the network rather than on costly, time-consuming training days – enabling it to be delivered much more frequently.

This all results in better informed and better trained staff able to provide greater levels of personalised, immediate service to customers.

Deliver new services to customers

Customers increasingly expect to interact with their suppliers using the web or multimedia applications. For example, nowadays, most telephony providers, utilities and banks provide billing and customer service information online. Ethernet's affordable high throughput of data means that it is well-suited to support such services by enabling them to be delivered cost effectively and quickly over a high quality network.

Depending upon the nature of their business, companies can also look to introduce innovative new services such as multimedia and interactive presentations, to enhance how they attract and sell to both customers and prospects.

Deliver new services to employees: VoIP & video

Many UK enterprises are adopting Voice over IP (VoIP) in a phased manner to take advantage of significant call cost savings, easier systems management and the new applications that can dramatically improve communication, productivity and service levels. However, VoIP makes heavy demands on bandwidth and network resources, and requires low latency, low packet loss and small voice packets to perform properly.

With the ubiquitous high-quality bandwidth capacity delivered by Ethernet, companies can maximise the opportunities presented to them by VoIP capability. Innovative solutions such as video conferencing to aid employee training and minimise travel costs, as just one example, can be deployed with full confidence in the robust performance of such applications.

3 Underlying Ethernet technologies

There are numerous technologies and connection mechanisms that can underpin an Ethernet service. You need to choose a service based on underlying technology that will suit both the IT and commercial needs of your company – not just in the short term, but in the future when you may wish to explore new business opportunities.

3.1 Short haul & Metro Ethernet

Point-to-point Ethernet services are based on supplying a dedicated fibre pair for each connection, which is physically laid through the service provider's local hub site. No routing takes place – data packets go in one end and come out the other, exactly as they went in. The advantage of this is that there is no routing overhead and faster delivery.

Multi-site Ethernet services for the metro (regional) area often use switched Ethernet technology and do not usually touch a core network. This delivers better performance than a service that traverses a provider's core network. However, metro-based services are restricted to the regional area, and generally the benefits of long haul connections will outweigh any loss of throughput over longer distances.

The ideal provider is one with good local presence and an extensive national core network, which can provide a combination of both short and long haul Ethernet services.

3.2 Long haul Ethernet

3.2.1 General

In the case of long haul or National Ethernet, a portion of the service is usually carried over some form of core network. Multi Protocol Label Switching (MPLS) is widely accepted as the best type of core network for supporting both legacy and future applications. This is partly because many service providers plan to offer the highly attractive Virtual Private LAN Services (VPLS) over their MPLS core network.

3.2.2 MPLS

MPLS provides the ability to define and support different classes of service to individual flows of traffic, prioritising bandwidth and enabling you to make the most efficient use of your capacity to ensure carrier class delivery without increased cost.

3.2.3 Virtual Private LAN Services

VPLS enhances a service provider's MPLS core network by providing a connectionless Ethernet service, delivering any-to-any connectivity, and gives far greater flexibility, scalability and cost efficiency when it comes to managing traffic flows. VPLS also allows multiple services to be delivered to customers over single rather than multiple access circuits.

Adoption of VPLS will undoubtedly accelerate technology change, reduce IT costs and allow use of new applications to increase productivity. In addition, as VPLS is protocol-independent and operates at Layer 2, there is greater security for customers as the service provider has no view of, or control over, the customer's routing – of particular importance to the 'high end' corporate Enterprise.

3.2.4 Developing carrier Ethernet solutions

Technologies such as Provider Backbone Transport (PBT) claim to provide Ethernet services which aim to match traditional networks delivering Quality of Service (QoS) and protected paths.

4 Choosing your Ethernet service provider

Several UK service providers offer National and Metro (regional) Ethernet services, and any evaluation to differentiate between them should consider:

- coverage of fibre-based local access
- price
- network performance
- flexibility to add future services
- terms and coverage of Service Level Agreements (SLAs)
- security.

4.1 Coverage of fibre-based local access

Ethernet services above 2Mbps tend to be provided using fibre, rather than copper, line plant in the last mile. Therefore, for Ethernet services, you should shortlist operators that have deployed fibre to street cabinets already, thereby reducing the cost of bringing Ethernet services to your business premises.

It's also important to understand service providers' ability to connect into every site in your network, which depends on the number of Points of Presence (PoPs) they have. A service provider with more PoPs is more likely to have a PoP close to all the sites in your network, and therefore is more likely to be able to provide comprehensive Ethernet coverage.

4.2 Price

With most Ethernet services, the dedicated access circuit is generally the highest cost component, while shared resources such as the service provider's core network provide significant economies of scale, and are a small proportion of cost to the service provider. The shorter the access circuit, the more likely the service provider will be able to provide a low cost circuit. Therefore a large number of PoPs is a strong indicator that the service provider will be able to offer an economical solution.

4.3 Network performance

For all their limitations, ATM and Leased Lines do provide reasonably high levels of performance when measured in terms of latency, packet delivery and jitter. When replacing inter-site networks that use technologies like ATM or Leased Lines, it is important that the new network matches the performance of the old – not least because users do not appreciate cost savings at the expense of network performance.

When considering Ethernet services, you should be aware of the following:

Avoid over-provisioning

With packet-based networks like Ethernet, particularly those delivered over a shared core network, it is possible for service providers to contend their network in the same way that Asymmetric Digital Subscriber Line (ADSL) broadband internet access is contended to reduce the service provider's cost per customer. The better providers are those whose networks have been built with enough spare capacity in the core to respond comfortably to peaks in demand throughout the day.

Latency, packet loss and jitter

As latency, packet loss and jitter significantly impact the delivery of Voice and Video over IP, inter-site performance should ideally match LAN performance.

Voice

Voice over IP requires low latency, low jitter and moderate levels of packet loss and a network that can also manage a high volume of small voice packets (typically 40bytes). If your VoIP traffic is going to traverse your network more than once, such as in a 'hub and spoke' network, traffic may be routed into a hub site and back out to a branch (or spoke) site. In this instance, the latency, jitter and packet loss that your traffic experiences will be twice that quoted by your service provider.

Video

'Real time, two-way' Video over IP such as video conferencing applications requires low latency, whereas streaming video or Closed Circuit Television (CCTV) does not place such high requirements on the packet delivery system.

Data

Data back-up and restoration necessitates low packet loss.

A good rule of thumb is that the lower the latency and jitter figures cited by a provider, the better their service will be. It also pays to consider whether a provider can support 'any-to-any' connectivity between your sites.

Performance of existing applications

If you intend to consolidate your servers into just one or two nationwide locations, then you need to bear in mind that established applications may be designed to operate over a network with LAN levels of performance, where jitter and latency would be very low.

To get a clear indication of a provider's network performance, review their SLAs and be wary of those who do not include target levels for performance. This is often an indication that they over-provision or contend their core networks, which will inevitably jeopardise the performance of your network.

Latency

The time taken for traffic to travel from one end user site, across the inter-site network or link, and reach the other side. Some service providers quote 'round trip delay', which is simply double the latency figure. Latency is measured in milliseconds. VoIP and real-time video are both sensitive to high latency.

Jitter

The latency of a link is not constant: a series of measurements collected from one route will show a variety of latency times. Jitter is the amount by which this latency varies, i.e. the difference between the shortest and the longest latency time measured. Jitter is also measured in milliseconds. VoIP is more sensitive to jitter than real-time video (as opposed to streaming video). However, excessive levels of jitter can nevertheless disrupt both voice and video.

Packet loss

Also known as packet delivery, a measure of the percentage of packets that successfully traverse the inter-site network. Almost all types of packet, frame or cell-based networks lose a small amount of traffic. If applications are using a higher layer protocol like Transmission Control Protocol (TCP) then these lost packets can be retransmitted. However, many applications use User Datagram Protocol (UDP), which does not retransmit lost traffic. VoIP, Video over IP or data backup are examples of applications which use UDP and can therefore be vulnerable to packet loss. Choosing a service provider whose network has a low packet loss is therefore important.

4.4 Flexibility to add future services

An inter-site service that is future-proof will be able to support new applications as they are introduced further down the line. Even if applications such as VoIP and multimedia are not current requirements, it is important for your business to have the flexibility to incorporate these technologies quickly and easily should the need arise in the future. Being able to take advantage of these new technologies without having to reinvest in your inter-site connections is therefore an important requirement when reviewing providers.

A future-proof inter-site service also gives you the option of agreeing a long-term contract and benefiting from term discounts, safe in the knowledge that there will be no need for costly upgrades if new applications are needed in the future.

Supporting Virtual Private LAN Services

Not all Ethernet inter-site services are based on state-of-the-art technology such as MPLS – some are even based on ATM. Whilst Ethernet presentation of ATM services brings some of the benefits delivered by true switched Ethernet services, it suffers significant drawbacks.

The fixed size of ATM cells means that small packets (e.g. VoIP packets) have to be carried in two ATM cells with most of the second cell being 'padded' out to make it up to the mandatory ATM cell size. The effect of this padding is that throughput on an access circuit can reduce by up to 35%, with a 100Mbps service only being able to support 65Mbps of traffic.

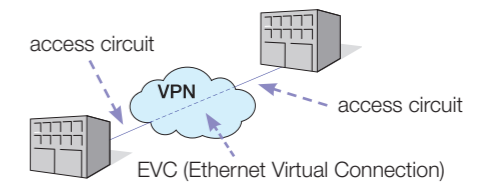
MPLS-based or true switched Ethernet-based services, by contrast, don't suffer from this limitation so there's no need to investigate the packet sizes of your existing network traffic.

MPLS-based core networks make it possible to deliver potentially attractive services such as Virtual Private LAN Service. VPLS permits national end-to-end Ethernet (i.e. Layer 2) services to support any-to-any or peer-to-peer traffic – making network management much easier and enabling new applications to be plugged in as and when required at vastly lower cost than in a multipoint network.

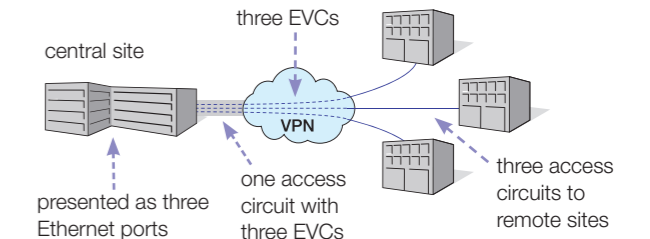
In the Heavy Reading Survey², 68% of Enterprises rated VPLS as an important requirement in the future prosperity of their business. Because of its current and growing future importance, it is worth making sure that the long-haul Ethernet services offered by your chosen service provider don't have any technology barriers that prevent them from being able to support VPLS.

Possible topologies

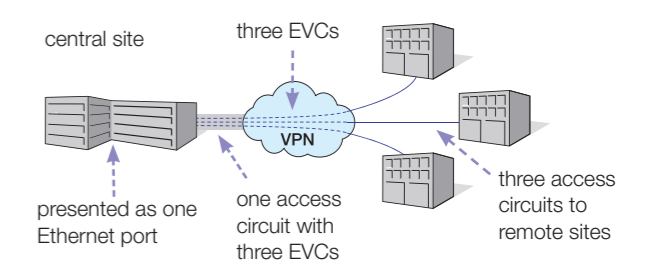
Point-to-point



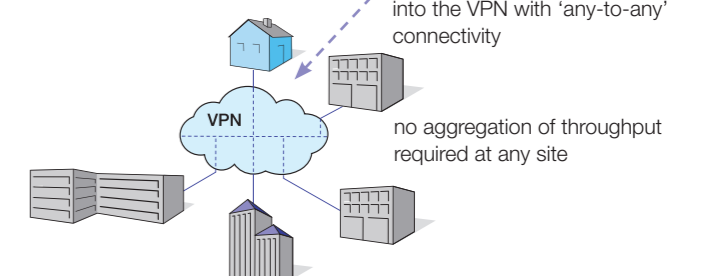
Multiple point-to-point



Point-to-multipoint



Any-to-any



4.5 Terms & coverage of Service Level Agreements

Many SLAs only cover part of the service, and very often exclude the access circuits as they are provided by a local access wholesaler and are therefore outside the control of the overall inter-site service provider. Look for providers that include all elements of the service, including the access circuits.

Additionally, examine the terms applied by a provider to fault resolution. For fault repairs, guarantees are usually measured in hours and / or annual availability, and it is vital to check that the service provider considers that the fault has started when either the customer or the service provider detects the problem.

4.6 Security

Security is an important concern with any network.

Fortunately, most of the technologies that underpin inter-site Ethernet products are generally considered safe and, where there are risks, they are well understood. None of the inter-site Ethernet products on the market today rely on the internet as the backbone network, therefore the risks of inherent Denial of Service (DoS) or IP Security (IPSec) weaknesses that affect internet-based Virtual Private Networks (VPNs) do not apply.

However, if any of your sites have an internet connection, adequate inter-site and internet security solutions must be put in place by the service provider. This will typically include firewalls at the gateway to the internet and access restrictions to different parts of the internal network for different users, using such methods as Virtual LANS (VLANs).

5 Conclusion

Ethernet-based connectivity for corporate LAN and WAN offers broad business benefits. A massive growth in spend on Ethernet services by UK companies is being fuelled by their recognition that this mode of transport for IP services gives superior technical performance at a vastly reduced cost than traditional Frame Relay or ATM technologies. By using Ethernet-based connectivity to integrate Wide Area and Local Area Networks into a single, national LAN, you can expect to:

- **save costs**
Bandwidth, equipment and supporting specialist skills are all far less expensive when compared with Frame Relay, ATM and other alternatives. Consolidation and centralised management also minimises hardware requirements, and reduces capital and software licensing costs
- **facilitate network management**
With Ethernet, the integrated LAN can effectively extend anywhere, yet be managed centrally. This makes the network easier to maintain and saves IT resources that could be deployed more strategically to support your business
- **protect business continuity**
You can take advantage of the greater speed and bandwidth of Ethernet connectivity to deploy robust disaster recovery measures and ensure staff can access business-critical information in the event of a major outage or catastrophe, regardless of their location
- **flexibly develop their business and services**
Ethernet connectivity underpins applications like VoIP, multimedia and real-time video to enable you to provide value-added services to customers and staff, such as online provision of information, collaborative working and distance learning.

6 Making the right choice

Choosing the right service provider can have a critical impact on how fully you can exploit these benefits and opportunities.

When comparing providers, you should apply the following guidelines:

Checklist for sourcing an Ethernet service provider

- ✓ Identify cable companies with fibre, not copper-based coverage, that have good local presence and an extensive national core network to enable them to provide a combination of both short and long-haul Ethernet services. A large number of PoPs will also enable the provider to offer you the best-priced solution.
- ✓ Seek evidence that the provider does not over-provision capacity, which will degrade the performance of your network, but instead offers end-to-end Ethernet services. Look also for providers that publish and include target levels for network availability within their SLAs.
- ✓ Check the terms on which support services such as fault resolution are delivered, to guarantee the level of service you are paying for.
- ✓ Choose a provider that can provide the requisite security applications and measures to safeguard your network from attack and potentially crippling outages.
- ✓ Look for the flexibility to introduce new applications quickly, easily and cost-effectively onto your network in the future without the need to exit expensive, constraining contracts or undergo costly or disruptive upgrades.

7 Glossary

¹ Ethernet in the WAN – Cause and Effect, Ovum.

² 2004 Survey of Ethernet Service Providers, Heavy Reading.