Research on Very High Bandwidth Connectivity

Final Report

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1. EXECUTIVE SUMMARY

Introduction

1.1. Ofcom engaged CSMG to review the market for Very High Bandwidth Connectivity (VHBC) services in the UK. The scope of the research was to provide a more in-depth understanding of how end-users procure and consume these services, and the extent to which end-users feel there is sufficient choice of credible suppliers. The research took place between late November 2012 and January 2013.

1.2. In June 2012, Ofcom published a consultation for the Business Connectivity Market Review[1] (BCMR). Ofcom proposed that the market for Multiple Interface Symmetric Broadband Origination (MISBO)[2], which is the upstream wholesale product for retail VHBC, is competitive in the Western, Eastern and Central London Area (WECLA), but subject to significant market power from BT in the rest of the country.

1.3. In order to help further understanding of the VHBC market, CSMG was asked to gather qualitative data on the VHBC market both from end-users of VHBC and also from organisations that procure VHBC wholesale in order to resell on to end-users.

1.4. The scope of VHBC services for this research includes leased lines:

 (i) of any bandwidth delivered by Wavelength-Division Multiplexing (WDM) equipment installed at the end-user's premises or in a data-centre which houses the end-user's ICT infrastructure, and/or

 (ii) of bandwidth >1Gbits/s delivered from a single interface of any type (usually Ethernet).

1.5. This report presents key findings from our interviews with organisations that procure VHBC services: either for their own use, or to resell to end-users, or both. We define "wholesale buyers" as those companies which provide connectivity services to business end-users, buying some or all of the fibre to do this from a third party such as BT Openreach. One of the five wholesale buyers owned a considerable proportion of their own network, the remainder used wholesale access to meet the majority of their customers' fibre demand. Three of the wholesale buyers we spoke to added additional communication services – such as data centre hosting – to some or all of their client contracts. All other interviewees were defined as "end-users", even if they procured some connectivity for or on behalf of clients as part of a contract for other services, such as a financial trading platform.

1.6. We define "dark" fibre as being fibre optic cable procured from the network owner, and lit by either the end-user or their systems integrator – installing and operating optical networking equipment at each end. "Lit" services are defined as connectivity services in which the optical networking equipment is supplied and operated by the service provider.

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[1] http://stakeholders.ofcom.org.uk/consultations/business-connectivity-mr/
[2] MISBO is a wholesale product market that encompasses two types of terminating segments. The first are those delivered with WDM equipment at the customer's premises (providing services at any bandwidth). The second are terminating segments with any interface delivering a service faster than 1Gbit/s.

1.7. It was important to draw the distinction between choice at the retail level – which could be based on multiple providers offering resold third party fibre for all or part of the route – and choice at the level of underlying fibre infrastructure.

1.8. This is a redacted version of the full report. The full report contains a detailed case study on each organisation interviewed; these were used to inform the conclusions in this report. These full case studies have been redacted at the interviewees' request as they contain commercially sensitive information. Interviewees participated on the basis that their views and experiences would be aggregated and anonymised in the public version of the report.

Approach

1.9. Between the end of November 2012 and the beginning of January 2013, CSMG interviewed individuals representing key end-users and wholesale buyers in the UK VHBC market. We spoke to the individual(s) who had responsibility for decision-making on how to procure VHBC services.

1.10. In total, we interviewed 30 organisations: of which 25 were end-users of VHBC services, and five were wholesale buyers of VHBC services.

1.11. In addition to the 30 core interviews, we spoke to two additional organisations representing key stakeholder groups in the VHBC market – one network equipment manufacturer, and one network assurance specialist.

1.12. Due to the sample size of the study, we are unable to draw statistical inferences from the data gathered. Instead, the research focuses on gaining an in-depth and qualitative understanding of particular market features. Where we present numbers and/or percentages, this is in order to report findings from our study with greater clarity and precision. We quote percentages either as a total of the 30 interviewees, as a total of the 25 end-users or as a total of the five wholesale buyers.

1.13. We focussed the majority of our interview programme on organisations which had some or all of their VHBC services located outside London, because competition levels within the WECLA area at the wholesale level were believed to be satisfactory already.

1.14. Many of the organisations interviewed were major international corporations; the interview focused on their use and experience of the UK VHBC market, although some of these organisations offered comparative comments on how UK market compared with other markets they have experienced around the world.

1.15. In selecting interviewees, we initially targeted a broad range of verticals to ensure that any assumptions we had about which sectors used VHBC would not overly bias our selection process. It became apparent relatively quickly, however, that many VHBC users were coming from the same sectors – banking, finance, insurance, asset management, media, education/research, utilities, although we saw select examples of companies from other sectors, such as local government, healthcare, and law.

1.16. Inevitably, some of our interviewees were targeted based on hypotheses about likely users of VHBC services, so it is possible that our sample includes a disproportionate number of high-volume users of VHBC services. We feel that this does not invalidate the study.

Overview of Findings

Demand for VHBC Services

1.17. Current demand for VHBC services is being driven by the increased use of off-site data centre services and cloud computing, as well as high volumes of data from large numbers of customer transactions, financial trading, and intensive use of imaging and video data.

1.18. Demand for VHBC services looks set to increase in the future, with most organisations (16, 53%) predicting a 10-50% increase in their demand for VHBC services over the next three years.

1.19. Future demand for VHBC services will be driven by a number of sector-specific factors: the need for ever-lower latencies and growing trading volumes in finance; growing appetite for richer content and HD video in media; the aggregation of large numbers of CCTV channels used to prevent fraud and theft in retail; and data-intensive research programmes and teaching methods in higher education and research. Representatives across multiple sectors noted that use of videoconferencing and data centre hosting was increasing.

Purchasing Behaviour & Supply Preferences

1.20. End-user preferences for supply method were typically driven either by a desire to retain some control over the network in-house, or by a ICT services procurement strategy of aggregation and outsourcing.

1.21. Organisations that retained in-house control of their network often preferred to use dark fibre services, and to minimise their use of third party fibre when buying lit services.

1.22. Other organisations had chosen to reduce the size of their internal ICT staff and minimise costs through aggregation, looking to fully outsource management of their network – and sometimes additional services – to a single provider.

1.23. We saw 12 end-users (48%) who had sponsored network build-out in the past. Five end-users (20%) said they were unwilling to sponsor network build-out, either because it was prohibitively expensive or because they felt the onus for this should lie with the service provider.

Choice of Supplier

1.24. Factors commonly used by interviewees to choose between different communications providers included: price and commercial arrangements (25 interviewees, 83%); network reliability and service level (22 interviewees, 73%); lead time for provisioning new connections (nine interviewees, 30%); level of post-sales support (five interviewees, 17%); route/latency (four interviewees, 13%); reach of the providers' network (three interviewees, 10%); the track-record of the supplier (three interviewees, 10%); and the ease with which the network can be upgraded (three interviewees, 10%).

1.25. The service providers most commonly as named suppliers – either at the retail or the wholesale level – by interviewees were: BT (20 interviewees), Cable & Wireless (15 interviewees), Virgin Media (11 interviewees), Colt (seven interviewees), and Level 3 (seven interviewees).

Contractual Arrangements & Switching Power

1.26. All five wholesale buyers and 11 end-users (44%) reported being able to negotiate with their supplier when procuring VHBC services – most commonly on price, but also on route and Service Level Agreements (SLAs) on some occasions. Only three end-users (12%) explicitly said they were unable to negotiate, this was either due to the rules of the tender process, or because the VHBC service was being procured as part of a wider fixed contract framework.

1.27. We saw VHBC contract lengths range from 1 year to 25 years. The most common reported contract lengths were 3 – 5 years.

1.28. Annual retail prices for VHBC services ranged from £10,000 for a 10Gbit/s Ethernet connection within central London to £80,000 for a connection to a remote site.

1.29. Contracts were typically structured around an initial installation fee, followed by regular fixed payments through the life of the contract. Six end-users (24%) had either a break clause or a benchmarking clause, or both, written into the contract. Break clauses give the option of terminating the contract early (for example, in the event of unsatisfactory service), and benchmarking clauses give the option to review the contract terms in-life against the rest of the market.

1.30. 11 end-users (44%) said they would actively go back to the market when their current contract expires to ensure they were getting the best value for money. Eight end-users, however, expressed reluctance to switch providers: for three, this was due to high switching costs; four others were trying to avoid the burden of setting up a new contractual framework with a new supplier; one said they would only switch if there had been architectural changes to their requirements; and one was willing to switch supplier at the retail level (to get the best price), but was worried about service disruption when switching to a different fibre network.

1.31. While all interviewees said they had a choice of provider for lit services at the retail level, 17 end-users (68%) felt that their options for switching to a different underlying fibre provider were limited. 11 interviewees (44%) explicitly said that they could switch to a different wholesale buyer of BT fibre, but had no other option to switch providers at the level of underlying infrastructure.

Satisfaction with Choice and Supply Options in the UK VHBC Market

1.32. When asked to rate their overall satisfaction with supply and choice in the VHBC market, interviewees gave an average rating of 5.9 (on a 1-10 scale with 10 representing maximum satisfaction). Ratings represented nearly the full range of possible answers, from 2 to 9, and there was minimal difference between the average ratings from wholesale buyers (5.5) and end-users (5.9).

1.33. The average rating from the four organisations whose VHBC experience was exclusively within the London area was 7.8, substantially higher than the average rating from the remaining 21 interviewees (5.5) that answered this question.

1.34. The nine interviewees (30%) giving high scores (7/10 - 9/10) were broadly satisfied with competition and supply. The 12 (43%) giving scores in the 4/10 - 6/10 range generally expressed moderate to considerable dissatisfaction, typically having encountered "limitations" in the market in terms of choice or ease of provision, and suffered poor service levels. Finally, the three (10%) that gave scores of 2/10 or 3/10 were "frustrated" by the lack of choice, long

lead times and unreliable service, and in one case, was the difficulties in getting a supply of any VHBC services at all.

1.35. Many interviewees had problems with a lack of choice – with nine interviewees (30%) drawing a clear distinction between satisfactory levels of competition in the London area, and less satisfactory competition elsewhere in the UK. Five (17%) interviewees drew a slightly different distinction, believing that Glasgow there were a number of cities beyond London – such as Manchester, Bristol, Birmingham, , York and Leeds – which also offered reasonable levels of choice. Both groups of interviewees agreed that regions outside major metro zones rarely had a choice of infrastructure-level provider, and that BT was often the only fibre provider available, perhaps re-sold by another service provider.

2.   CURRENT USE OF VHBC

2.1.   Of the 30 organisations interviewed, 24 were current users of VHBC representing a broad cross-section of sectors (see Section 10):

Figure 1: Current Users of VHBC Services

Organisation	VHBC Services Procured	Current Drivers of Demand for VHBC Services
End-user 1	• >50 VHBC connections	• Predominantly for mobile backhaul/M2M communications • Some VHBC used for internal projects and technology testing
End-user 2	• Approx. 30 VHBC connections at their 2 data centre sites in the Wiltshire area, most of which is procured directly by their clients from carriers • Also procuring some dark fibre wholesale from a service provider and selling it on to clients • The majority of clients take services >1Gbit/s	• Hosted services and disaster recovery • Clients across many sectors using >1Gbit/s services, including providers of satellite TV services, local councils, and financial institutions
End-user 3	• Approx. 40 10Gbit/s connections across 4 routes connecting key offices and data centres in London, and 2 other locations in the North of Britain	• Data mirroring/disaster recovery between data centres • High volumes of banking transaction data generated by millions of customers using multiple channels (cash machines, online banking, telephone banking, in-branch database access)
End-user 4	Two sets of managed DWDM services: • Between 2 data centres in the North East • Between central London headquarters and a data centre in the South East	• South Yorkshire data centres are primarily for retail banking operations – maintaining live bank account records for millions of customers across Europe • Welwyn Garden City data centre use is largely driven by financial trading needs
End-user 5	• 4 DWDM dark fibre connections connecting London offices to a South East data centre • 3-4 10Gbit/s Ethernet connections connecting London offices to a second South East data centre • 8 DWDM dark fibre connections connecting London offices	• High volume of financial market data • Demand for minimizing latency
End-user 6	• 8-9 internal DWDM dark fibre connections at 10Gbit/s between 2 data centres in South-East England and 2 head office sites in London	• High volume of real-time data use in financial trading and asset management
End-user 7	• Approx. 5 internal VHBC connections between offices in London and data centres in the South East area, predominantly within the M25	• High volume of real-time financial data • Demand for low latency

End-user		
End-user 8	• Approx. 5 connections between 3 data centres across the South-West England at 10Gbit/s • Use some managed dark fibre services to provide connectivity around large, remote power generation campuses	• Industrial monitoring: measurements from electricity-generating equipment, and extensive archived records of readings from nuclear facilities • Customer relationship management: data on usage and billing for 7.5 million customers • Energy trading system • Replication links between data centres for disaster recovery
End-user 9	• Six 10Gbit/s Ethernet connections linking 4 data centres in South-East England	• VHBC enables operating a shared platform across multiple sites, allowing data mirroring for disaster recovery, splitting active servers across multiple physical locations, and virtually shifting active servers running in one location to another
End-user 10	• Approx. 5 connections to hosted data centre facilities at 10Gbit/s	• Voice over IP to handle high volumes of customer calls • Energy trading • Industrial monitoring/energy exploration • Accessing CRM databases and applications
End-user 11	• Two 10Gbit/s connections between an external collocated data centre in West London and central London headquarters • One 5Gbit/s connection from the West London data centre to Scotland headquarters	• High volumes of financial data needing real-time access • Need to keep detailed records of financial activity
End-user 12	• 10Gbit/s triple dark fibre backbone rings between 5 key points of presence	• Data from CCTV, and Urban Traffic Management Control (UTMC) systems
End-user 13	• Diverse 10Gbit/s fibre pairs completing a connection between two data centres (40/50km) apart in South Wales	• Heavy use of live data analysis in insurance industry • Some corporate/CRM traffic
End-user 14	• 2.5Gbit/s DWDM ring between main data centre (Oxford) and disaster recovery site, part of a colocation facility in South-East England	• Data mirroring for disaster recovery • These high volumes of data are driven by the company's need to provide real-time access to considerable amounts of rich media
End-user 15	• WDM dark fibre link to musculoskeletal clinic from central hospital	• External access to clinical systems based at the central hospital, medical imaging
End-user 16	• 16 short distance, 10Gbit/s Ethernet connections to interconnect MAN sites within the same geographical locations in a city in Scotland	• Real-time video services • Collaboration tools such as Lync, instant messaging
End-user 17 (A data centre)	• Encourage build-out by carriers to serve data centre clients, do not procure connectivity directly	• Financial services clients are particularly heavy users of VHBC connectivity
End-user 18	• 4 VHBC connections connecting data centres in the Yorkshire area	• Data centre connectivity: data mirroring for disaster recovery, splitting servers across multiple sites • Logistics/supply chain data, pricing files and transaction data

End-user 19	• 10Gbit/s Ethernet ring connections connecting 4 core network nodes in South-East England • 10Gbit/s point to point connection between a data centre and an external client data centre, both sites in the North of England	• Internal data centre connectivity • Connectivity procured on behalf of clients (unusual to be at VHBC levels)
End-user 20	• 80 lit 10Gbit/s connections nationwide	• Transferring large media (video) files between sites
End-user 21	• 5 80-90km DWDM dark fibre lengths at 20Gbit/s (2x10Gbit/s) used as core of MAN, with branch access connections for 2-3 sites using 10Gbit/s dark fibre	• Processing for bandwidth-hungry research programmes • Use of IT in teaching and learning • Student use of bandwidth
End-user 22	• A core multi-10Gbit/s dark fibre MAN network in a city in Scotland, using WDM equipment on some connections.	• Processing for bandwidth-hungry research programmes such as LHC research projects, or a piece of research with the BBC which used 750Mbit/s for a very high definition video feed • Videoconferencing, use of IT in teaching and learning
End-user 23	• 25-50 VHBC connections including DWDM, 10Gbit/s Ethernet, and 2Gbit/s fibre channels services, in the London area and South West England	• Capacity: centralization and consolidation in data centres, and the need to retain increasing volumes of past data • Speed: reducing latency for high-frequency trading
End-user 24	• A 10Gbit/s dark fibre service from central London office to a data centre elsewhere in the London area	• Storing, sharing, retrieving and emailing documents quickly and reliably (utilisation is likely to be far from 100%)

2.2.   We also conducted interviews with one organisation which was actively investigating options and pricing for procuring VHBC services for the first time:

Figure 2: Future Users of VHBC Services

Organisation	VHBC Connections Procured	Use of VHBC Connections
End-user 23	• Currently using two diverse 1Gbit/s point-to-point dark fibre WDM connections between Leeds' two large hospitals, with many smaller 100Mbit/s branches • Upgrading to a 10Gbit/s core with 1Gbit/s branches	• Inter-site sharing of medical data – particularly from genetics research/cancer diagnosis which can generate 500MB images

2.3. Finally, we interviewed five wholesale buyers of fibre which procured fibre wholesale from network owners, before retailing it to end-users:

Figure 3: Wholesale buyers of VHBC Services

Organisation	VHBC Connections Procured	Use of VHBC Connections
Wholesale buyer 1	• UK-wide dark fibre WDM backbone – predominantly at 100Gbit/s connections, with some 40Gbit/s connections • 14 regional access connections, ranging from 100Mbit/s for smaller institutions, with larger institutions taking 10Gbit/s or multiple 10Gbit/s services (usually Ethernet)	• Research becoming increasingly data-intensive, especially fields such as bioinformatics, radio astronomy, with more inter-site collaboration • Use of ICT and rich media in teaching and learning • 80 million daily users accessing the Internet through the network
Wholesale buyer 2	• Approx. 10 VHBC connections procured on behalf of clients • Procure 10Gbit/s connections for own network backbone	• VHBC clients are predominantly financial institutions
Wholesale buyer 3	• Approx. 10% of 1Gbit/s clients have or plan to shift to 10Gbit/s services	• Client demand for off-site cloud services
Wholesale buyer 4	• <10% of clients requiring VHBC-level services	• Data mirroring (for disaster recovery) in data-intensive industries like financial services, and live trading.
Wholesale buyer 5	• Currently serving around 15 customers (including other carriers) with 10Gbit/s services.	• Often selling to other carriers rather than direct to consumers. Market demand in general being driven by cloud computing, convergence of voice/video/data, and the growing demand for mobile backhaul.

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3.   LOCATION OF VHBC CONNECTIVITY

3.1.   Of the 30 interviewees, nine (30%) had VHBC services at numerous sites throughout the UK, including all of five wholesale buyers. Nine (30%) used VHBC services localised to a single specific region outside the London area. Seven (23%) organisations had VHBC at two or three specific regions: with one exception, London was always one of these regions. Five (17%) used VHBC exclusively within the London area:

Figure 4: Where Interviewees Had VHBC Presence

- Nationwide
- Single non-London region
- 2-3 distinct regions
- London area only
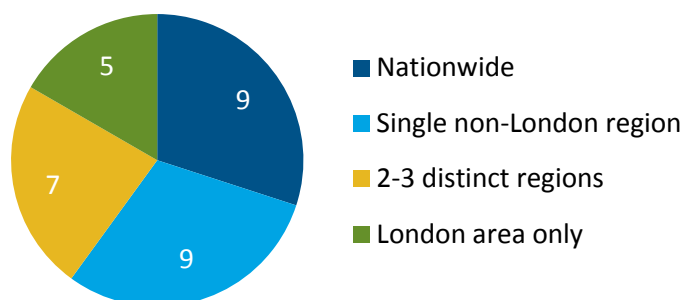
3.2.   15 interviewees (50%) had built data centres, either for their own use, or in order to sell hosted services to clients. Of these, seven reported that VHBC availability was a major factor in where the data centre was sited – the remainder were primarily siting the data centre to be near key company sites, such as their headquarters. Two of the data centre operators interviewed reported looking for a minimum of three carriers at or near a site when locating new data centres. The third data centre operator, however, said that availability of the power supply they wanted – a >100MVA diverse supply – was a far greater concern than availability of VHBC at a site.

3.3.   One wholesale buyer, who also provided data centre services to clients, said that the onus to build out to a data centre often lies with the carrier rather than the data centre operator. Carriers will often build out to data centres, as the future business opportunities from lighting the site may be considerable. Nevertheless, the same interviewee also discussed a fellow data centre operator who had been struggling to encourage carriers to build out to a new site in East Anglia.

3.4.   End-users building their own data centres reported that they faced a choice either to look for sites where VHBC was available, or to sponsor network build-out, or finally to lay their own fibre. One exception was a large retail bank that found that providers had been willing to spread the cost of past network build-out over the life of the contract. This interviewee later found that other service providers were building out to the data centre site (which is shared with other users) "semi-speculatively" – in other words, to lay fibre with no guarantee of a future contract, but to allow the service provider to credibly bid for future contracts at that site.

3.5.   One end-user with a proprietary data centre in the Oxford area reported that they had considered relocating their data centre to the London area in order to get a better choice of VHBC providers. In particular, they were looking for access to more than one provider to better ensure a diverse and resilient network, at a commercial level as well as a physical level.

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3.6.   Beyond the siting of data centres, no organisation outside the media industry reported siting any of their VHBC-connected sites based on where they could get good access to VHBC services; these other sites were typically large offices, hospitals, and universities which had stood on a site for a considerable time and could not easily be relocated.

3.7.   Within the media industry, a major UK broadcaster reported that the vast majority of media services companies and production companies had been forced to site themselves in the London area since the supply of VHBC services was inadequate elsewhere in the country.

3.8.   Most end-users made heavy use of off-site data centre hosting. However, one end-user in the financial services sector reported preferring to keep a considerable portion of IT infrastructure on-site at a head office; this was a strategic decision allowing for easier management of the servers by IT staff based at the office, and a greater control over the security of these servers.

4. FUTURE DEMAND FOR VHBC

4.1. The majority of organisations forecasted a material increase in demand for VHBC services over a 3-year horizon.

Figure 5: Future change in demand for VHBC services
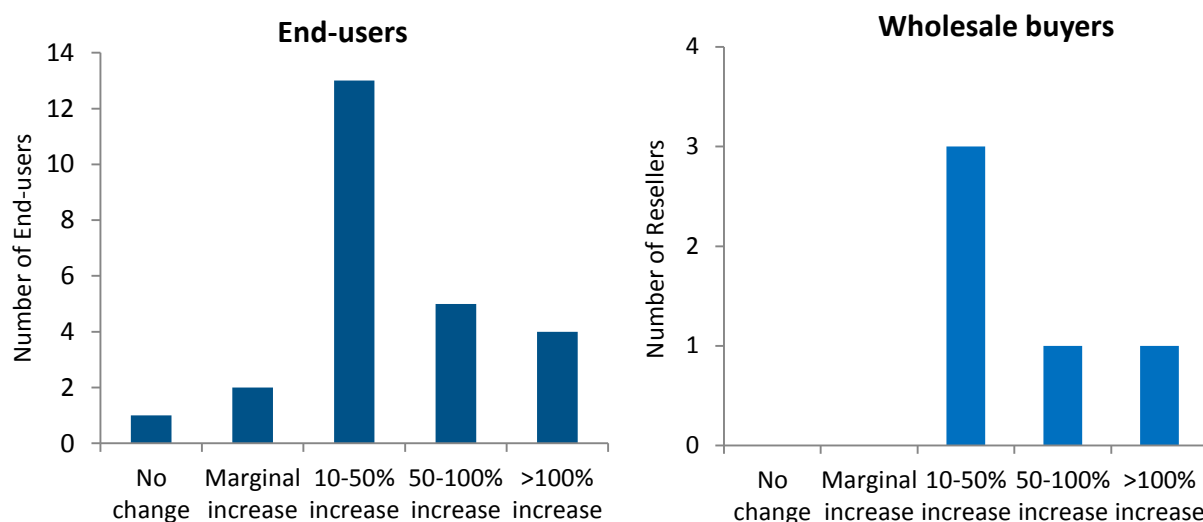
4.2. End-users typically reported low average utilisation levels on their VHBC services, which allowed for peaks in demand. Long before existing connections were approaching 100% utilisation, organisations would therefore look to procure additional network capacity, either by upgrading the bandwidth of existing connections or by procuring new connections. The decision to upgrade existing connections or procure new connections depended on relative costs of each method, as well as other specific wishes such as increasing network resilience by taking new routes. Because of these factors, interviewees often had difficulty separating their predicted need for new connections from their increased utilisation of existing connections.

4.3. The factors driving growth in demand for VHBC services varied by industry. In finance, the need for ever-lower latencies and growing trading volumes would drive VHBC uptake: the pursuit of low latencies, according to two of the eight financial services interviewees, would lead to the adoption of microwave transmission technology in the near future. The network equipment manufacturer we talked to said the industry was seeing more R&D investment in free space optics. In retail, the introduction of extensive CCTV networks to prevent checkout scan avoidance and use of data-intensive Oracle retail/distribution systems may lead to growing VHBC requirements at key aggregation sites. In higher education and research, already extensive use of VHBC connectivity may increase further as teaching and learning become more IT-centric, and as research programmes generate and share even higher volumes of data. Finally, in media, demand for richer content and HD video over IP networks looks set to grow, increasing media sector demand for VHBC services. Representatives from more than one sector identified the growing popularity of videoconferencing and data centre hosting as additional factors.

4.4. Since VHBC services were usually needed at a relatively small number of key sites, many end-users predicted minimal or no change in the number of sites they needed to use VHBC

connections at. One interviewee actually predicted a reduction in the number of sites that would need VHBC connectivity as a result of consolidation of the business' property footprint – but much of this consolidation would be of sites outside the UK, so VHBC demand within the UK would be largely unchanged. Ten end-users (40%), however, did foresee a need to serve new sites with VHBC connections, as a result of business growth or, in the financial information services sector, a need to upgrade connections to their customer sites to VHBC speeds in pursuit of lower latencies and the ability to provide richer content.

4.5. Three wholesale buyers (60%) predicted modest growth in the market for VHBC services of 5-10% per year, driven by migration of IT systems to the cloud, and the use of IT to automate existing services (e.g. online banking). Two (40%) disagreed, including the interviewee who owned the majority of their own network, who predicted a 100% increase in demand over the next 3 years.

4.6. Two wholesale buyers (40%) predicted that the media sector would show the most dramatic increases in demand for VHBC services – a view supported by the interviewee at the broadcaster and content producer we spoke to, who predicted a 300-400% increase in VHBC demand over 3 years.

4.7. Of the two carrier-neutral data centre operators, one said that it was a minority of clients who took VHBC services, while the second found that clients using VHBC were in the majority. This may reflect the fact that the first data centre had been established for much longer, the second data centre therefore reflecting more recent practices, and perhaps indicating an upward trend in use of VHBC services at data centres.

4.8. Our understanding of the market is that high bandwidth services are typically available as 1Gbit/s services, 10Gbit/s services, 40Gbit/s services, or 100Gbit/s services. This was borne out by market evidence from what services our interviewees were using. Therefore, most organisations' experiences of upgrading to VHBC services means upgrading from 1Gbit/s services to 10Gbit/s services. With this in mind, two interviewees said that before demand for 10Gbit/s services could become widespread, 1Gbit/s services would first have to be commoditised – in other words, easily and affordably procured and widely adopted. Only when organisations had installed 1Gbit/s services would they consider making the jump to 10Gbit/s services.

4.9. Finally, two end-users suggested that their VHBC requirements may not grow linearly with growth in data use: they were deploying more advanced compression techniques to minimise their need to buy expensive high-bandwidth connectivity. One noted a trade-off between investing in compression and investing in bandwidth, and that their preference was to invest in bandwidth where possible.

5. PURCHASING BEHAVIOUR AND SUPPLY PREFERENCES

Buying Dark Fibre or Lit Services

5.1. 20 end-users (80%) procured at least some dark fibre as part of their VHBC network. Of these, eight preferred to use dark fibre services wherever there was an adequate business case to do so, as they enjoyed the flexibility and control dark fibre services gave. The others had dark fibre as part of their network for historical reasons, but would in many cases prefer to take lit services in future either due to the business rates payable on lighting fibre, or because of availability problems with dark fibre supply, or finally because of their procurement strategy, for example consolidating their connectivity to an outsourced managed contract with a single service provider that does not supply dark fibre.

5.2. Two interviewees found that buying dark rather than lit services typically became cost-effective above the 10Gbit/s level, although one said the boundary was much higher, perhaps closer to an overall capacity level 40Gbit/s. Two organisations seemed to be using dark fibre more because of the remoteness of their location and so had paid for new dark fibre routes to be dug. In both cases, these digs had taken place a long time ago, so it was not clear why this supply method had been chosen over, for example, sponsoring the build out of lit fibre.

5.3. There were a number of factors identified by end-users for why they did not use any dark fibre, or why they used only a small amount of dark fibre and not more. Six end-users (24%) felt they lacked the skills and expertise which they perceived as being necessary to procure a dark fibre service, so used minimal dark fibre or none at all. Three end-users (12%) found that it was generally cheaper to use lit services for their current bandwidth requirements, particularly in light of the business rates on fibre-based communications, so restricted their dark fibre use or did not use any. Finally, six end-users (24%) mentioned problems with lack of supply of dark fibre as a reason for not using more dark fibre.

5.4. The five wholesale buyers had varying attitudes to use of dark fibre: one mainly procured lit services, but occasionally used dark fibre in select places where the economics made sense (for clusters of customers generating sufficiently high aggregate demand), or for historical reasons; one would like to use more dark fibre but was finding it hard to get access and make the business case work; and the remaining two had a dark fibre backbone, in one case, this was a very extensive nationwide dark fibre backbone. The remaining wholesale buyer, which owned a large part of their network outright, generally bought lit services where it was necessary to use third party fibre, noting that carriers were usually reluctant to sell dark fibre to each other because of the high profit margins possible when reselling dark fibre.

Network Management

5.5. We saw a spectrum of end-user preferences for network management style. At one end lay organisations whose strategic aims were to minimise the size of their internal ICT team, in a bid to reduce costs, and therefore wanted to outsource network design and management as far as possible. Such organisations typically wanted to minimise the number of supplier relationships that needed to be managed, using a single communications provider even if they were using extensive third party fibre. At the other end of the spectrum, interviewees preferred to retain control of network management in house. At its most extreme, this meant taking dark fibre services and retaining responsibility for identifying break locations in the fibre – to be reported to and fixed by the service provider – and management of all other layers of the protocol stack.

5.6. Organisations' preferences appear to be becoming increasingly polarised on this issue – we saw examples both of companies looking increase their use of outsourcing and aggregation in their telecommunications strategy, as well as examples at the other end of the spectrum of companies finding ways to take control of lower levels of the protocol stack.

5.7. Of the 25 end-users interviewed, ten (40%) showed a clear preference for outsourcing network management, while ten (40%) showed a preference for retaining control of at least some network management where possible. The remaining 20% of end-users lay in the middle of the spectrum, with no clear preference, or with a preference that was contingent on specific circumstances.

5.8. An organisation's position on this spectrum did not segment clearly by factors such as industry or company size. Rather, the preference seemed to be driven more by a long-standing philosophy or attitude within a given company's ICT department about the relative merits of insourcing or outsourcing. One interviewee, for example, described how his team had over 250 years' telecommunications experience between them, and that this therefore allowed them to take on much of the network management in-house.

5.9. A preference to retain control of network management in-house was linked to the use of dark fibre: all ten companies that expressed a preference to in-source some network management had at least considered very seriously the business case for using dark fibre, and in all but 3 instances, had found the business case sufficiently strong that they procured at least some dark fibre services.

5.10. All wholesale buyers reported a preference for taking control of the management of more aspects of their network, as this allowed them to lower network costs, as well as reducing lead times for provisioning new services or upgrading existing ones.

Use of Third Party Fibre

5.11. Many end-users seemed relatively indifferent to the use of companies that do not own underlying network infrastructure, such as systems integrators and network resellers, stating that they would be willing to use them if they were offering the best combination of price and service, provided they were assured of the company's credibility.

5.12. Only one end-user showed a clear preference for using a systems integrator because they felt this gave them a better sense of the value for money they were getting on separate aspects of the service, by separating the cost of the connectivity product itself from the cost of the network management service. They also found that using a systems integrator with global reach made it easier for the company to procure an integrated international network spanning numerous service providers' networks.

5.13. Wholesale buyers identified a number of reasons why their clients had chosen them as a service provider. All four wholesale buyers who did not own the majority of their network claimed that they were able to offer VHBC services at a reduced rate, sometimes 30% less the network owner's retail price, by buying large numbers of connections from different network owners at discounted rates and passing the savings on to their clients. One wholesale buyer noted that they could often offer the most significant cost savings when network owners would have had to go off-net in order to provision a particular connection, mentioning two examples of network owners that will charge a premium for going off-net. This same wholesale buyer also found that they were able to bring newer technologies to the market faster than larger players. Finally, two of the wholesale buyers offer considerable

additional services on top of the connectivity service, such cloud and colocation services, unified communications, and consultancy services. Clients often came to them seeking a broader ICT services package, of which the VHBC service was just one element.

5.14. Of the 20 end-users that shared information about their retail-level supplier[3], 11 believed that their supplier procured at least some of their network from a third party. With only one exception, this meant using fibre primarily or exclusively from BT Openreach. Seven interviewees said it was sometimes hard to know whether their service provider was using fibre from a third party: service providers will not typically make clear in a quotation which route sections – if any – will be supplied by a third party. Three separate interviewees reported that the first time they became aware of their supplier's use of third party fibre was when a BT worker arrived on-site for a site inspection. A further interviewee said that they had particular difficulty finding out when their supplier was using third party fibre when this fibre was in the central part of a route, rather than in the "last mile". The lack of visibility over the provider of underlying infrastructure was a problem for these companies when they tried to use different providers to create a diverse route: if they were both using the same infrastructure provider, the routes are not considered to be diverse.

5.15. There were three main reasons why interviewees would use fibre resold by a third party, rather than going direct to the network owner:: either they were getting a cheaper contract from the alternative service provider; or the connectivity formed part of a larger package of services from the supplier; or the provider of the "last mile" fibre was not connected to other key sites in the network.

5.16. Three interviewees noted problems in getting faults resolved quickly or suffered poorer network service quality as a result of a poor working relationship between their retail-level and infrastructure-level suppliers.

5.17. Seven end-users (28%) preferred to eliminate use of third party fibre and go directly to the owner of the fibre wherever possible – they found that this gives better control over the network, especially over elements such as route length and diversity, and avoids "handover" problems between the two providers, for example a breakdown in communication over which provider is responsible for resolving a particular fault, leading to delays in resolving problems with the network.

5.18. End-users' opinions on the use of third party fibre tended to correspond to where they fell on the spectrum of preferences for outsourcing or insourcing network management. Companies that preferred to retain control of their network often expressed preferences for going directly to the fibre owner: companies that outsourced heavily were usually indifferent to the use of third party fibre.

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[3] "Retail-level" suppliers included network operators with whom the end-user had a direct contract, or a systems integrator or reseller who did not own the fibre infrastructure but did own the relationship with the end-user.

Sponsoring Network Build-out

5.19. The costs of sponsoring network build-out – paying a fee to a service provider to cover some or all of their costs in expanding their network to serve a specific client – are sometimes included in a basic "installation fee", and are at other times spread over the life of the contract. Nevertheless, paying a (sometimes very substantial) network build-out fee up-front seems to be commonplace in the VHBC market, with 12 end-users (48%) reporting sponsoring network build-out in the past.

5.20. Five end-users (20%) were not willing to sponsor network build-out, in one case solely because it was prohibitively expensive, but in the remainder of cases also partly because interviewees felt that the onus for network expansion should lie with the network owner.

5.21. One end-user reported building out some of their own fibre in the past, because of an active preference to get a dark fibre connection to their data centre over which they had a high degree of control, rather than as a reflection of any problems with service availability.

5.22. Three end-users (12%) found that the only credible bids they had were from providers that were already on-net at the required sites, or at least had fibre in close proximity, in two cases because the costs of digging new fibre were prohibitively high, and in one case because the lead times for network build out were prohibitively long.

5.23. Of the wholesale buyers we spoke to, two do build out their own network where it made economic sense to do so. A further two do build out some of their own fibre, driven by local demand, often in preference to sponsoring build-out from a wholesaler. One of these explained that they will use a combination of fibre from multiple providers to get close to the necessary site, and then dig the "last mile" itself if it is not too far. This wholesale buyer also noted that they will occasionally deploy a wireless "last mile" solution over distances of up to 6km and for speeds up to and including 1Gbit/s – this would not, therefore, be appropriate for VHBC clients.

5.24. The final wholesale buyer, on the other hand, does not build any of its own fibre, and has not been willing to sponsor network build-out. They feel that being asked by their wholesale vendors to sponsor network build-out is unreasonable and unfair; the onus to upgrade the network should lie with the network owner, who can use the improved network to serve other wholesale or retail clients.

6.   CHOICE OF SUPPLIER

Number of Suppliers Used

6.1.   Closely related to the decision to outsource network management was the decision on how many supplier relationships to have. Seven of the ten end-users who preferred to outsource management of their network also preferred to minimise the number of supplier relationships which needed to be managed. This sometimes meant reducing the number of relationships to just a single supplier across all ICT services (voice, data, colocation/cloud services), but in other cases – particularly for larger, more complex organisations – this meant using a single provider for all connectivity services, but going to other providers for other ICT services.

6.2.   Other end-users had multiple suppliers. Three did this to ensure they got the best value for money for each connection they procured, buying each connection individually and from the supplier offering the most attractive terms. Seven used multiple suppliers in order to get diversity at a commercial as well as physical level – here, different suppliers would be present at the same sites in order to create this desired diversity. The remaining interviewees went to multiple suppliers simply in order to source the fibre they needed in different locations, since no one supplier had reach across all the required sites.

Figure 6: How Many Suppliers Each End-user Used
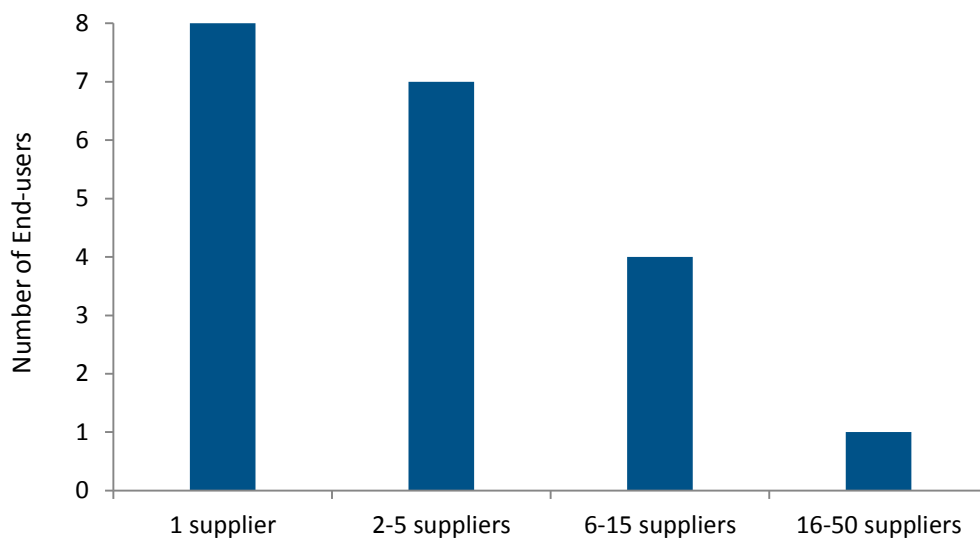
6.3.   The interviewee who reported close to 50 suppliers was a data centre operator, whose clients procured connectivity from a wide range of national and international suppliers. Not all of these suppliers were offering services at the VHBC level.

6.4.   Wholesale buyers each procured from a wide variety of fibre owners. This was partly because a single providers' network would be insufficient to provide the necessary geographic coverage, but also to offer clients the most appropriate service for their needs. For example, some clients will require a "premium" service, and are happy to pay more for stronger SLAs, diversity, or lower latency, while others would rather simply meet their bandwidth needs for the more affordable price.

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6.5. Of the ten end-users preferring to outsource the management of their VHBC services, five procured the VHBC services as part of a wider ICT services contract – commonly with voice services or data centre hosting – further reducing the work needed to manage supplier relationships and achieving cost-savings through economies of scope.

Choosing a Service Provider

Figure 7: The frequency with which factors appeared in End-users' top three criteria which they use to choose between alternative retail-level VHBC suppliers
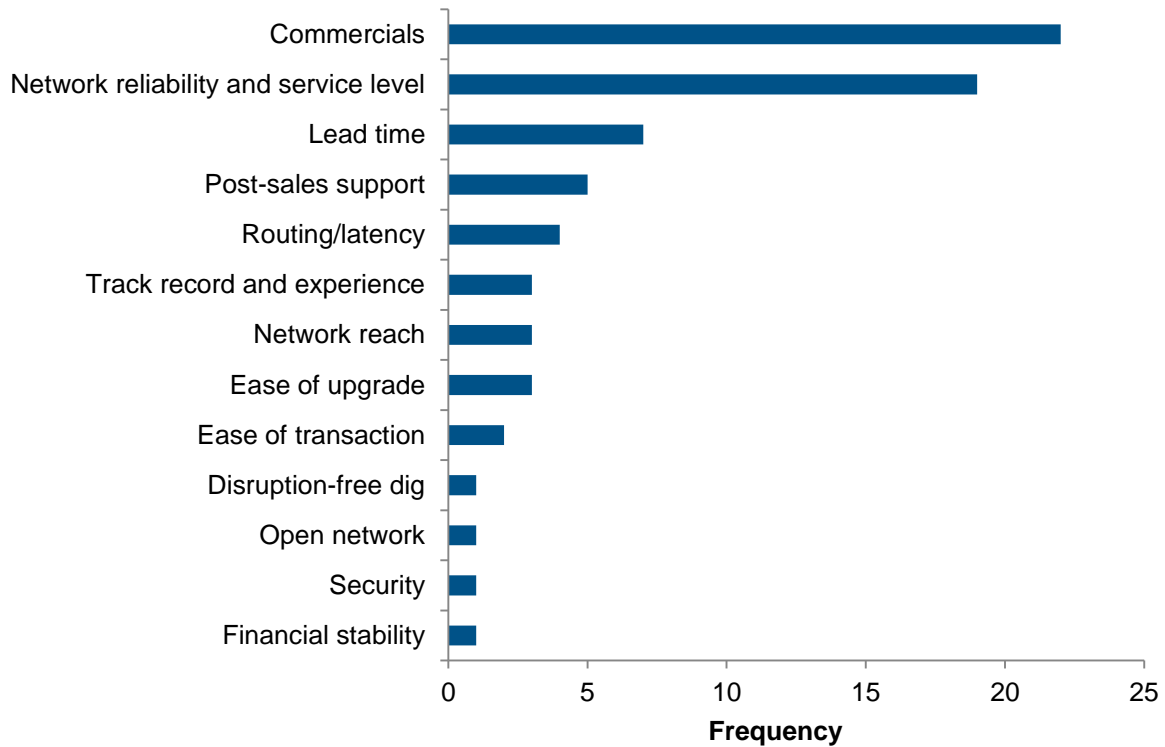
Figure 8: The frequency with which factors appeared in Wholesale buyers' top three criteria which they use to choose between alternative retail-level VHBC suppliers
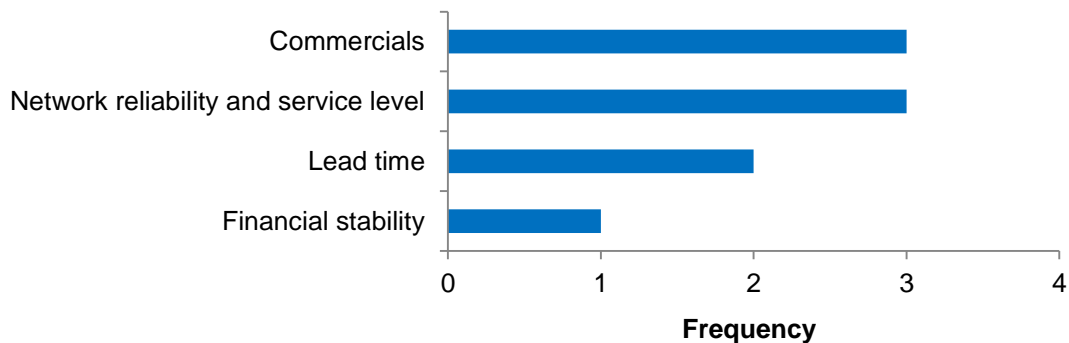
6.6. Nearly all interviewees ranked the *commercials* of a potential contract among the top three criteria which they used to choose between alternative service providers. This referred to overall price or cost in all cases, but for three organisations, this also encompassed contract structure. Two organisations wanted to minimise up-front (capital) costs and have higher on-

going (operational) costs; in contrast, one public-sector organisation preferred higher up-front costs as they could secure one-off grant funding more easily than on-going funding.

6.7. *Network reliability and service level* encompassed factors such as network up-time, response times, and re-routing guarantees, and specific SLAs surrounding network metrics such as jitter.

6.8. *Lead time* for building networks and provisioning new services was very important to many companies – and was a factor mentioned by the ten interviewees even if they did not rank it in their top three criteria. For wholesale buyers, reliability on meeting lead times was often the single most important factor, as they risked reputational damage if their vendor creates delays.

6.9. Level of *post-sales support* offered was important to five interviewees.

6.10. The fibre *route* taken was important for two reasons: most commonly to ensure diversity and improve resilience, but also to minimise latency. A low latency is important for live trading – particularly algorithmic trading – and rapid delivery of time-critical financial data, and hence was important to many financial sector companies.

6.11. The *reputation and experience* of suppliers was valued by a number of interviewees, a successful track record giving users reassurance of the supplier's ability to deliver a reliable service in the future.

6.12. *The network reach* of the service provider's fibre was valuable to some companies, usually to allow the straightforward purchase of future connections under the same contract framework.

6.13. *Ease of upgrade* was important to companies considering their future requirements – they look for suppliers who were likely to keep pace with future technological developments, and are always able to offer an up-to-date network.

6.14. The *ease of a transaction*, the ease with which suppliers could be dealt with, was important to some interviewees. This often meant using pre-existing suppliers, removing the need to set up a fresh contractual framework with a new supplier.

6.15. Minimising *disruption to city life* by digging up roads to lay fibre was important to the local authority we spoke to, who understandably felt a responsibility to their local residents.

6.16. This local authority also wanted an *open network* which was available to other wholesale buyers, in order to encourage retail-level competition in the city and improve broadband provision in the area.

6.17. *Security* is important to certain central government departments, as reported by a data-centre operator that was hosting some government services. Here, clients look for a dedicated line and robust encryption of communications.

6.18. Finally, *financial stability* of the organisation helped to reassure one user that they would be able to deliver over a long contract period.

Supplier Credibility

6.19. 26 interviewees (87%) shared details of who their current suppliers were – both at the retail level, and, wherever possible, at the level of underlying infrastructure. It is possible that interviewee's answers were not fully comprehensive, particularly when they use numerous suppliers, and it also possible that they named suppliers of sub-VHBC services.

Figure 9: Suppliers Identified by Interviewees

Supplier	No. Interviewees Naming This Supplier as a Direct or Indirect Supplier	Details
BT	20	• Used as a primary supplier by 7 end-users • Provider of underlying infrastructure resold by another service provider for 8 end-users • Used as a primary supplier by 1 data centre's clients • Selling directly to 3 wholesale buyers • Providing managed services of 3rd party fibre for 1 end-user
Cable & Wireless[4]	15	• Used as a primary supplier by 12 end-users, using BT Openreach fibre for at least 8 of these • Selling directly to 2 wholesale buyers • Used as a primary supplier by 1 data centre's clients
Virgin Media	11	• Used as a primary supplier by 5 end-users • Providing managed services of 3rd party fibre for 1 end-user • Provider of underlying infrastructure resold by another service provider for 3 end-users • Selling directly to 1 wholesale buyer and indirectly to 1 wholesale buyer • Used as a primary supplier by 1 data centre's clients
Colt	7	• Used as a primary supplier by 6 end-users • Selling directly to 1 wholesale buyer
Level 3[5]	7	• Used as a primary supplier by 5 end-users • Selling directly to 2 wholesale buyers
Verizon	4	• Used as a primary supplier by 3 end-users • Selling directly to 1 wholesale buyer
Geo	4	• Used as a primary supplier of dark fibre by 1 end-user • Used as a fibre provider to 1 end-user who uses a third party to manage their network • Supplying fibre wholesale to 1 data centre, who sells it on to its clients • Selling indirectly to 1 wholesale buyer

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[4] Now part of the Vodafone Group. References to the acquired company "THUS" were listed under Cable & Wireless.
[5] References to the acquired company "Global Crossing" were listed under Level 3.

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AboveNet/Zayo	3	• Used as a primary supplier by 2 end-users • Selling directly to 1 wholesale buyer
KCom	3	• Used as a primary supplier by 1 end-user • Wholesale buyer of 3rd party fibre for 1 end-user • Selling directly to 1 wholesale buyer
Vitesse	3	• Used as a primary supplier by 2 end-users • Used as a primary supplier by 1 data centre's clients
TalkTalk	2	• Used as a primary supplier by 1 end-user • Selling indirectly to 1 wholesale buyer
SSE	2	• Used as a primary supplier and aggregator by 1 wholesale buyer • Selling directly to 1 wholesale buyer
Easynet	2	• Selling directly to 1 wholesale buyer • Selling indirectly to 1 wholesale buyer
FibreSpan	2	• Selling directly to 2 wholesale buyers
Pinacl	2	• Providing managed services of 3rd party fibre for 2 end-users
CityFibre	2	• Provider of underlying infrastructure resold by another service provider for 2 end-users
EU Networks	2	• Used as a primary supplier by 2 end-users
Tata	1	• Used as a primary supplier by 1 end-user
Hibernia	1	• Used as a primary supplier by 1 end-user
Telia	1	• Used as a primary supplier by 1 end-user
Swisscom	1	• Used as a primary supplier by 1 end-user
Fujitsu	1	• Selling directly to 1 wholesale buyer
NTT	1	• Selling directly to 1 wholesale buyer
Gamma	1	• Selling directly to 1 wholesale buyer
FibreSpeed	1	• Selling directly to 1 wholesale buyer
Accenture	1	• Providing managed services of 3rd party fibre for 1 end-user

6.20. A new supplier's credibility was usually determined by prospective clients primarily by the supplier's ability to serve the required sites with connections of the appropriate specifications. Some interviewees reported investigating potential suppliers' long-term financial stability to assess their long-term viability.

6.21. The geographic coverage of a supplier's network was rarely identified as a determinant of whether the supplier was credible or not. Seven major national or international players did, however, express preferences for using suppliers with sufficient scale to supply them with services on a national, or even global, basis.

6.22. One end-user we spoke to, who was excluded from the analysis elsewhere in this report [6], could offer a different perspective on geographic reach. Based in Inverness, they wanted to be assured that any potential service provider had engineers and components stores located sufficiently nearby that they could meet strict response time requirements.

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[6] Their aggregate requirements were in one sense at VHBC levels (2x 1Gbit/s connections) but they did not meet the strict inclusion criteria for this report, since these connections were on different fibres.

7. CONTRACTUAL ARRANGEMENTS AND SWITCHING POWER

Procurement Process

Figure 10: Procurement Method (Number of Respondents by Method)

- ■ Formal tender
- ■ Approach suppliers directly
- ■ Method varies
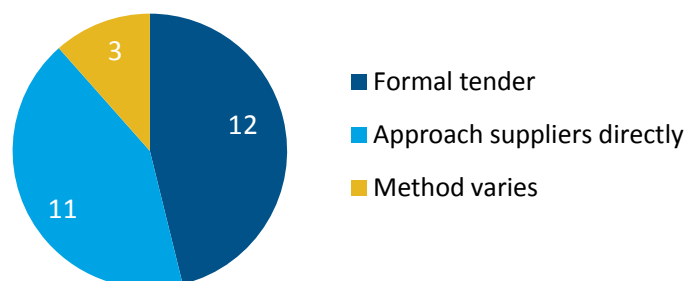
7.1. 25 end-users and wholesale buyers reported their procurement method. Of these, 12 interviewees (48%) are relying predominantly on formal tenders, including seven public sector bodies. We noticed that use of tenders tended to be for larger scale projects, often when procuring multiple connections or when buying connectivity along with other ICT services. Indeed, the three companies that said their procurement method varied used tenders for larger projects and directly approached suppliers for smaller projects.

7.2. One end-user tendered for lower bandwidth connections, but said that they found this method unhelpful at >1Gbit/s speeds since there were so few suppliers available offering these speeds in the necessary area. In other words, the level of choice is insufficient to justify the time and expense of launching a formal tender.

7.3. Wholesale buyers usually procured fibre using established relationships or frameworks with key fibre wholesalers, rather than tenders. One, however, had used a tender to procure a major nationwide dark fibre network backbone.

7.4. 18 interviewees discussed their ability to negotiate on contracts: 15 of these, including all five of the wholesale buyers, reported being able to negotiate on at least price as part of the procurement process, with three organisations reporting discounts of around 30% and one reporting discounts of around 50% on a dark fibre service. Four were also able to negotiate on route taken in order to achieve true route diversity, and seven could negotiate on SLAs, adding bespoke requirements such as stronger latency and rerouting guarantees. One interviewee had found that smaller players were more willing to enter negotiations with them than the larger players – although we did find examples elsewhere of organisations that were able to negotiate with these larger players, typically for very large or long-term contracts.

7.5. Only three organisations (10%) explicitly said they were unable to negotiate as part of the procurement process – one of these was procuring VHBC as part of a wider fixed contract framework with a long-standing ICT services supplier; the remaining two were public sector organisations, which were bound by rigid public procurement rules when running a tender. Not all of the interviewees who used formal tenders felt they were unable to negotiate, though – some private sector organisations reported negotiating hard before the final bids were submitted in a tender process.

Contract Structure

7.6. Contracts ranged from 1 year to 25 years. The most common contract lengths reported by end-users were 5 years (seven end-users, 28%) and 3 years (four end-users, 16%). Two end-users pushed for short contract lengths (e.g. 12 months), one was doing this on low-latency connections which they might want to change as even shorter routes become available from other providers, while the other did this for connections which were likely become redundant as offices closed.

7.7. Two wholesale buyers (40%) reported pushing for shorter terms (e.g. 12 months) with their wholesale provider, in anticipation of steep future price declines in the VHBC market in particular. By contrast, they believed that prices for lower bandwidths would remain relatively constant.

7.8. Two wholesale buyers (40%) purchased dark fibre connectivity on contracts of 10 years or more. One explained that this long length was to minimise the number of times they needed to repeat the procurement exercise in future, since it was time-consuming and costly process. One data centre also reported a long contract period – of 25 years – in order to spread the cost of extensive fibre build-out over a long period.

7.9. With no reported exceptions, contracts were structured as a regular, fixed fee throughout the life of the contract, payable annually, quarterly, or monthly. In many cases, there was an initial installation fee, particularly if the user was sponsoring network build-out.

7.10. The biggest single driver of price was location: shorter routes understandably resulting in cheaper prices, but comparable connections also being more expensive the more remote the location. In one instance, an unfavourable geology drove the price of a relatively short dig very high. We did not gather precise data on route length, so cannot compare different reported prices directly, but the interviewees who procured similar connectivity in multiple locations typically reported pricing for similar services in, around, and to London being much lower than in other locations (such as Aberdeen, Glasgow or Yorkshire). In one example, an interviewee reported an 80 mile connection in Scotland was £4,000 more expensive than the same type of service over a 400 mile distance down to London. Two wholesale buyers noted that prices were driven by the distance of the site from the UK's "figure of 8" backbone fibre loop.

7.11. Price also varied by provider, with some providers offering a better quality network – for example, greater resilience or lower latency – and charging more for it.

Switching power

7.12. Six end-users (24%) reported having either a break clause or a benchmarking clause, or both, written into the contract[7]. Break clauses give the option of terminating the contract under certain conditions – such as unsatisfactory service – and benchmarking clauses allow for in-life review of contract terms (especially price) relative to the rest of the market, for example a different provider's price for an equivalent service.

7.13. One interviewee felt that the use of benchmarking clauses for some VHBC services (in this case, DWDM dark fibre) was of limited use, since the benchmarking is against 10Gbit/s Ethernet which they regard to be a very different service, and hence a poor comparison product to benchmark against.

7.14. 11 end-users (44%) said they would actively go back to the market when their current contract expires to ensure they were getting the best value for money. One wholesale buyer supported this observation, noting that their current and prospective clients were becoming more aggressive in switching providers to get better prices.

7.15. Eight end-users (32%), however, expressed reluctance to switch providers – but they would nonetheless have switched in the event of a significant drop in service levels if they believed they could get better service elsewhere for an affordable price. In many of these eight cases, in-contract benchmarking clauses guaranteed a certain level of service and a certain price point relative to the rest of the market, and so potential need to switch was minimal.

7.16. These eight end-users identified a range of reasons underlying this reluctance to switch. In three instances, this was due to high switching costs resulting from a new provider's equipment installation or dig costs. For four others, reluctance to switch was more due to the effort involved in setting up a new contractual framework with a new supplier, or the administrative burden of a fresh procurement process. Another said they would only switch if there had been architectural changes to their requirements, assuming the benchmarking is functioning properly. Finally, one end-user said they would be willing to switch supplier at the retail level (to get the best price), but had reservations about switching to a different fibre network, being concerned that the handover period would be far from smooth, and that the company would face considerable risk of service interruptions.

7.17. One end-user's attitude to switching providers varied by circumstance: they were actively looking to switch their low-latency trading connections to the provider with the shortest possible route, but were less motivated to switch on other connections, especially where they had gone through the time and expense of sponsoring build-out to a site.

7.18. All end-users said they would be able to switch their retail-level provider, but 17 (68%) felt that their options for switching to a different underlying fibre infrastructure were limited, with 11 explicitly saying that they could only switch to a different wholesale buyer of BT Openreach fibre in many areas. These interviewees, therefore, would be unable to resolve problems with the network itself by switching provider.

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[7] We note that the remaining interviewees did not explicitly say that they did not have a break clause or a benchmarking clause, but rather were reluctant to share details of their contract terms or were not certain of such contractual details.

8. INTERVIEWEE SATISFACTION WITH SUPPLY, CHOICE AND SERVICE IN THE VHBC MARKET

8.1.   We asked interviewees to rate their satisfaction with the supply and choice of VHBC services. The average rating was 5.9 on a 1-10 scale (with 10 representing maximum satisfaction). Ratings represented nearly the full range of possible answers, from 2 to 9 (See Figure 11), and there was little difference between the average ratings from wholesale buyers (5.5) and end-users (5.9). See Figure 12 overleaf for detailed comments from individual interviewees.

Figure 11: Interviewee ratings of satisfaction with choice and supply
of VHBC services, 1-10 scale (10=maximum satisfaction)
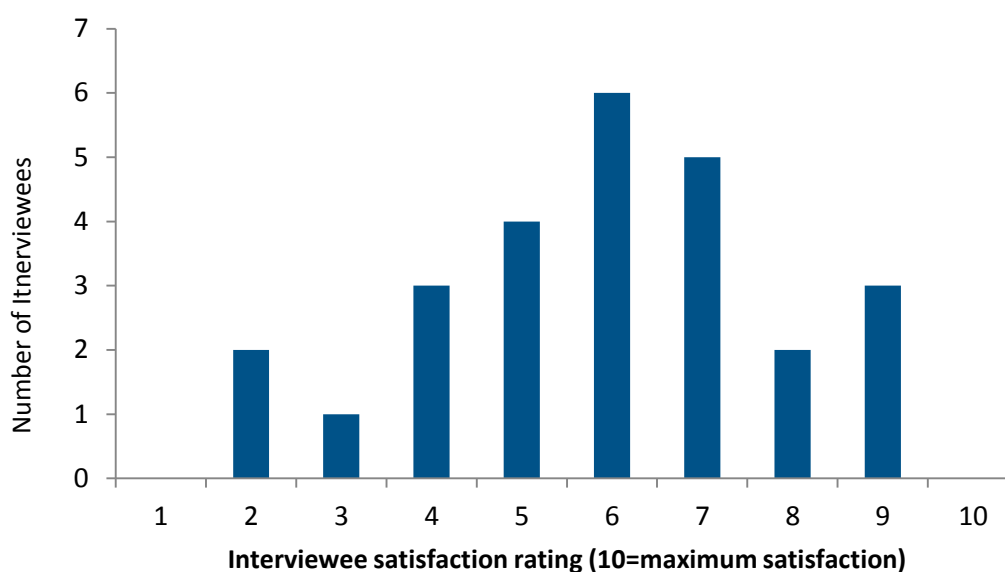
8.2.   Two of the three interviewees who gave a rating of 9/10 had all of their UK VHBC sites located within or very close to the London area, the other was in Edinburgh.

8.3.   While giving a low rating (5/10) at the time of interview, one wholesale buyer anticipated a 2-point improvement (to 7/10) within 12 months, as existing fibre owners expanded their networks, and as new entrants overcame the very high barriers to entry and entered the market.

8.4.   Conversely, one end-user foresaw that his rating would drop from 8/10 to 6/10 in the coming years, as the dark fibre services they procured became harder and harder to procure, as the number of providers willing to offer dark fibre services decreased.

8.5.   The average rating from the four organisations whose VHBC experience was exclusively within the London area was 7.8, substantially higher than the average rating from the remaining 22 interviewees (5.5) that answered this question.

8.6.   When commenting on geographic variation in supply and choice in the VHBC market, most interviewees felt it was possible to get supply where they needed it, although fibre dig costs were sometimes prohibitively (or approaching prohibitively) expensive, particularly for more remote locations. Many felt that, rather than supply, the problem lay more in lack of choice – with nine interviewees (30%) drawing a clear distinction between satisfactory levels of competition in the London area, and less satisfactory competition elsewhere in the UK. Five

interviewees (17%) drew a slightly different distinction, believing that there were a number of cities beyond London – such as Manchester, Bristol, Birmingham, Glasgow, York and Leeds – which also offered reasonable levels of choice.

8.7. Both groups of interviewees agreed that regions outside major metro zones rarely had a choice of infrastructure-level provider, and that BT was often the only fibre provider available, perhaps re-sold by another service provider.

8.8. Three of the interviewees who were satisfied with supply and competition recognised that this was at least partly because their VHBC sites were within the well-served London area, and a further three because they were fortunate enough to have been sited in a well-served location outside London (Wiltshire, South Wales, or York).

Figure 12: Interviewee Comments on Competition, Supply, and Geographic Variation

Satisfaction Rating	Where VHBC Sites Are Located	Comments on Competition and Supply in the VHBC Market	Comments on Geographic Variation in the VHBC Market
An end-user 9	The London area	The market is very good – there is lots of choice and it's very competitive. Services and prices [in London] are better than we see in New York.	Choice is more restricted outside London – but we have little experience of this.
An end-user 9	South-East England	We have few problems getting the connectivity we need.	Our data centres are in business parks in South-East England – we recognise that other areas are less well-served.
An end-user 9	Edinburgh	Satisfied, as VHBC is now being generally available from multiple providers at the retail level.	Have not experienced considerable changes by geography – but have little experience outside Edinburgh.
An end-user 8	Nationwide	We are fairly satisfied – our main problem is with lead times.	We often have difficulty getting a choice of providers outside London. There is a lack of availability of VHBC supply in some areas – particularly at the higher bandwidths (>20Gbit/s).
An end-user 8	Glasgow	Access to 10Gbit/s services are less commonly offered around the country [than lower bandwidth services]… we were very lucky to get the dark fibre supply we needed.	Glasgow is relatively well-served, but supply becomes much harder outside the city. Other operators use BT tails – no-one else can afford to build out their network.
An end-user 7	Surrey, London	We are fairly satisfied, on the whole, but recognise this is a function of our location.	

An end-user **7**	London, Scotland	Network owners could do more to build out their core networks – it is often hard to get a choice of diverse routes.	London is particularly good – we have lots of choice here, and find the prices are reasonable. While we did have a choice of providers for the Scotland site, off-net providers that required (extensive) fibre build-out were prohibitively expensive for us... even the on-net provider came close to being prohibitively expensive.
An end-user **7**	Nationwide	We'd certainly like more choice, but we haven't had a problem getting VHBC services where we have needed them – but getting a high degree of resilience is difficult.	You're fine if you're within the Virgin Media footprint they are very price aggressive... but you can always get a BT link.
An end-user **6**	South-East England area	In what our business needs, we are pushing the boundaries [of what the market can supply]... we are restricted in time to market, and in competitors we can find who are willing to light buildings.	Even London could be better [in terms of choice], areas outside London are especially poor.
An end-user **6**	Wiltshire	Competition seems very good – there is much choice.	We were fortunate to be in an area with good choice of providers nearby.
An end-user **6**	London, Edinburgh, Manchester	We are reasonably satisfied, but it [the UK market] compares poorly to our experience internationally.	We are very satisfied in London and the South-East [of England], but choice reduces outside London...it's particularly limited in Scotland.
An end-user **6**	Bradford	We do have choice [at the retail level] but whoever we switched to would still be using BT fibre.	
An end-user **6**	London area, Gloucestershire	The UK is a little behind the US in terms of choice, but far better than some other regions, such as South Africa or some parts of Asia. Service levels are so poor that we employ an entire team to manage our compensatory service credit allocations.	London offers a good choice of providers; the choice is less good in other areas.
An end-user **5**	South Yorkshire, London, Hertfordshire	It's not a sole market – there are parts of the EU where we have a choice of 1 [providers]. It's not that bad in the UK – but we can find ourselves with just 1 or 2 providers if we have strict latency or diversity routings. It would be better if choice was increased.	The market is buoyant in London, less so in the North of England.

An end-user 5	South-West England	BT has a monopoly on network services. Other providers are very restricted in what they can use.	It is difficult to bring VHBC outside the M25… bandwidth is still very expensive outside London. We see particular problems with VHBC supply in rural and coastal areas.
An end-user 5	The North Yorkshire region		Service and competition levels in York are fine – Scarborough has no choice of fibre provider.
An end-user 4	South Wales	The market is limited to the point of being monopolised. It is a lot harder to provision services than it should be.	We were fortunate that we were in a fibred region, but we know access is more limited elsewhere.
An end-user 4	Manchester	There is some competition for lit services in urban environments, but little competition for long distance dark fibre connections.	Companies that say they will build out fibre usually mean within a city, not to out-of-town locations. There, you rely on BT.
An end-user 3	Nationwide	We are frustrated by the lack of choice of providers. [Though interviewee recognised that their specifications were very demanding]	There is a lack of choice in more remote locations – you'll often be stuck on BT tails.
An end-user 2	Nationwide	Often, you are ultimately buying from BT Openreach whichever supplier you choose	Apart from London and a few isolated pockets such as Manchester, it is very difficult to get a supply of many VHBC services – especially dark fibre
An end-user 2	Oxford, Woking	Our choice [of providers] is very limited.	We have considered relocating the Oxford area data centre to London to get a choice of providers
An end-user No rating given	The London area	There is sufficient choice in the market.	There is some regional variation – for example, there are few choices in Scotland.
An end-user No rating given	Yorkshire	Before we sponsored build-out of a wide-reaching fibre network, which is increasingly open to other users, service in the city was poor.	
An end-user No rating given	London	Broadly satisfied with our current provider, have not investigated the wider market in any detail.	
A wholesale buyer 7	Nationwide	Levels of choice are okay, but we do have service problems: billing, service responsiveness, network issues.	Anywhere outside big metro areas can be challenging.
A wholesale buyer 6	Nationwide	There is only one game in town outside London, and that's BT.	

A wholesale buyer **5**	Nationwide	Competition levels are higher than ever, but there is plenty of room to grow. The market is only just starting to take off.	Some cities such as Manchester, and maybe Bristol, are becoming more like London [in having a competitive market]. Fibre build-out more than 20 miles from the UK's "figure of 8" fibre loop is usually very costly.
A wholesale buyer **4**	Nationwide		London, and some other urban centres like Birmingham, Glasgow and Leeds have a reasonable choice of service providers… otherwise it's usually just BT.
A wholesale buyer *No rating given*	Nationwide	There are few providers who can offer VHBC services – maybe 3 or 4. The market is fairly restricted.	Availability is sporadic, geographically; cities on the UK's "figure of 8" fibre loop are well-served – London, Bristol, Birmingham, Manchester, Glasgow, Leeds, Leicester. The London to Manchester route is especially well-served thanks to the requirements of the media.

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9. WIDER PROBLEMS WITH VHBC SUPPLY

Although no question was specifically designed to elicit information on any of the following issues, a number of interviewees commented unprompted on these problems when asked for their opinions on supply and choice in the VHBC market.

Lead Times

9.1. 11 end-users (44%) reported suffering long lead times, with three finding this to be a very serious problem, which was holding their business back. Three noted that delays were especially long when their primary supplier used a third party – BT Openreach – to that build out "last mile" connectivity.

9.2. For one wholesale buyer, lead time for build-out – and reliability on meeting the quoted lead time – was the criterion for selecting wholesale vendors of third party fibre.

Figure 13: Interviewee Comments on Lead Times

Organisation	Primary Supplier	Comment
End-users	Numerous, inc. BT, Cable & Wireless, Virgin Media, Level 3, Colt, Verizon, TalkTalk.	We have major problems with lead times – it can take 3 months to get a site survey, and a further 3 months to get installation. The whole process can sometimes take over a year, with major implications for business. There is insufficient competition outside the M25 to drive lead times down.
	AboveNet/Zayo, Geo, Vitesse, Swisscom	We find that smaller, more agile players – such as Vitesse – can often offer far better lead times than larger players.
	Not answered	Lead times for lighting new buildings are very long.
	BT, Virgin Media and Cable & Wireless	We find we have to rely on BT Openreach for laying fibre, whoever we are procuring the service from… the [network build-out] process is very slow, and it is hard to get firm dates and prices. It's holding the business back. [Referring both to VHBC and sub-VHBC services]
	Pinacl (Systems Integrator), using CityFibre fibre	BT had quoted a 90-day lead time, but past experience suggested it could be 6 months [and so we used a dark fibre alternative].
	Cable & Wireless	We could switch provider, but much of the network would still be resold BT fibre, so would still face the same problems with lead times. [Referring both to VHBC and sub-VHBC services]
	Cable & Wireless	We sometimes have lead times of 6-18 months.
Wholesale buyers	N/A	We have found some wholesale providers to be unreliable in the past [in terms of lead times], so we avoid these providers in order to protect our reputation with our customers.

Route Diversity

9.3.   14 end-users (56%) highlighted true physical route diversity as being a key issue for them. Of these, six said they struggled to achieve the route diversity they needed, usually because suppliers were not sufficiently open with their route map data. This was a particular problem when users demanded network diversity at the commercial as well as physical level – i.e. they wanted to use different suppliers to ensure resilience – because suppliers were reluctant to share their route data with each other.

9.4.   A number of organisations said that they had been able to overcome these problems by building trusting relationships with their suppliers, and one reported having a clause in their contract that stipulated annual route map updates from their service provider, to ensure diversity was maintained after any future changes in network architecture.

9.5.   One of the wholesale buyers said that ensuring the route diversity was a key part of their service offering for their clients.

Figure 14: Interviewee Comments on Route Diversity

Organisation	Primary Supplier	Comment
End-users	Numerous, inc. BT, Cable & Wireless, Virgin Media, Level 3, Colt, Verizon, TalkTalk.	We have problems getting route diversity – even when approaching the same operator, their idea of a diverse route may be two sides of the same road – we had network problems due to this when both sides of a road were dug up during the Olympics.
	Cable & Wireless, BT	With good relationships with our suppliers, we don't have a problem getting the necessary route information from them – though we still have to work hard to make sure diverse routes meet our specified 5m minimum distance requirement.
	Not answered	We have problems with getting route diversity due to lack of openness on the part of service providers when discussing route. Service providers consider route maps to be proprietary… it's sometimes better to go to a single provider to guarantee diversity.
	BT, Virgin Media and Cable & Wireless	Sharing of routes [by service providers] isn't very good – we work to build relationships and get the necessary co-operation. We have a regulatory requirement to prove our resilience – it is a condition of our utilities licence.
	BT, Verizon (using Cable &Wireless fibre)	A key driver is route diversity. We often struggle to get information about physical paths taken from providers: they say the information is confidential. It's sometimes better to go to one provider to get route diversity. BT charge a premium for this service, but at least they can confirm they are using a fully diverse route.
	BT N3 network, using Virgin Media fibre	True route diversity is essential to us – we have one 2-mile route and one 27-mile route between the two

| | | end-points. MPLS networks are not good enough for hospital use, as they cannot deliver the necessary diversity guarantee. |
| | Cable & Wireless | BT is so often the only fibre provider with fibre to a site, that they can charge whatever they want for building out a second route to the site to give diversity. |

Supply of Dark Fibre

9.6.   Of the 20 interviewees that used dark fibre as part of their network, assessment of dark fibre supply varied. Some felt that the lack of dark fibre supply from major players was holding back the development of the dark fibre market, while others had managed to build considerable dark fibre networks by using fibre from other players.

9.7.   Eight interviewees cited poor availability of dark fibre as a reason for not using more (or any) dark fibre. Two additional interviewees who used dark fibre heavily at present were concerned that supply of dark fibre was going to become more restricted in the future as incumbent operators acquired smaller operators, and adopted a policy of selling higher-margin lit services.

Figure 15: Interviewee Comments on Dark Fibre Access

Organisation	Where VHBC Sites are Located	Comment
End-users	The London area	Even though people like BT and Verizon do not sell dark fibre, if you want it [dark fibre access], you can generally get it.
	South-West England	We would only use dark fibre if it was available as a managed service.
	London, Scotland	The supply of dark fibre is generally quite good.
	Nationwide	The dark fibre market is currently quite immature.
	Nationwide	We have a good supply of dark fibre in London, we'd love to use it more widely across the country but the availability is not there.
	The West Yorkshire region	We want a dedicated line… our ideal solution would be self-supply by dark fibre, but we find that this is not a realistic solution yet as the market is quite immature. We have a lack of confidence in the level of support which dark fibre providers would be able to provide.
	London, Gloucestershire	We ran parallel tenders for both dark fibre and lit services. Not only did we have fewer options for dark fibre, but we felt we were being offered premium prices for buying the fibre dark rather than lit.
Wholesale buyers	Nationwide	We used dark fibre from four network operators to build a nationwide dark fibre backbone.
	Nationwide	We would love to buy more dark fibre, but it is hard to get access.

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Business Rates on Lighting Fibre

9.8. Finally, eight interviewees (27%) highlighted concerns about the business rates on fibre-based communications, commonly referred to as the "fibre tax". Six of these said they were having to take lit services rather than buy dark fibre, as they would prefer, because of the high rates of tax payable on lighting fibre. Two were currently using much more dark fibre than lit, but said they may have to move back to lit services in the future because of the high rates.

9.9. Two end-users would like to see more clarity regarding the use of self-managed dark-fibre. Both were uncertain of exactly what their regulatory/legal obligations were (e.g. whether they needed a telecoms licence), but in particular, who was responsible for paying the rates on lighting fibre. One of these had believed that they did not need to pay these rates because they were using the fibre themselves rather than reselling it, but have recently received an unexpected bill for 3 years' business rates (which they will settle promptly).

9.10. One of the wholesale buyers echoed these views, stating that they would be keen to build out more of their own fibre, but that the rates payable on lit fibre is damaging their business case.

9.11. Three interviewees expressed the belief that BT does not pay rates for lighting fibre proportionate to its network size, and said that they felt this was unfair on smaller operators and end-users buying dark fibre.

Figure 16: Interviewee Comments on Fibre Business Rates

Organisation	Comment
End-users	The very high level of the fibre tax is a major reason why we have to use limit their use of high-bandwidth fibre services. We feel that the level of fibre tax which BT pay is unfair. We would like to see everyone paying the same rates as BT – or preferably, no tax at all.
	We find the level of the fibre tax quite unbelievable. Through use of videoconferencing, laying fibre has been used to reduce the number of people travelling – making fibre use more expensive may result in increased pressure on road and rail transport systems.
	The high level of tax on dark fibre may pressurise us into moving back to managed lit services.
	We may have to increase our use of managed lit services as tax obligations become more onerous. The fibre tax is arbitrary and unfair – we do not see why smaller, more agile players should get taxed while more dominant players such as BT are given tax relief.
Wholesale buyers	Costs are currently prohibitive for new entrants to the market, and for existing players looking to expand their network. In particular, the fibre tax is not helping the business case for network build-out, and gives larger players – particularly BT – an unfair tax advantage.

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Duct Access

9.12. A small number of both end-users and wholesale buyers were considering taking self-supply via dark fibre to the next stage, and building out their own fibre. Four interviewees, including two wholesale buyers, were disappointed at the lack of duct access available in the market, which was preventing them undertaking more widespread build-out.

Figure 17: Interviewee Comments on Duct Access

Organisation	Comment
End-users	The lack of duct access is holding back the roll-out of mobile broadband services.
	We would like to see BT being more open in giving duct access.
Wholesale buyers	Would love to get more duct access to allow build-out of own fibre network more easily, and to avoid the need to dig up roads.
	We would love to be able to use BT's duct network more freely.

10. OVERVIEW OF ORGANISATIONS INTERVIEWED

End-users Interviewed

- A broadcaster and media production house
- A carrier-neutral data centre
- A carrier-neutral data centre
- A data centre operator
- A financial information services company
- A financial services company
- A global enterprise
- A Janet Regional Network Operator
- A Janet Regional Network Operator
- A large retail bank
- A large retail bank and financial services company
- A large retail bank and financial services company
- A leading insurance company
- A leading insurance company
- A leading IT services company
- A leading supermarket chain
- A local government authority
- A major asset management institution
- A major utilities company
- A major utilities company
- A publishing and information services company
- A regional NHS trust
- A regional NHS trust
- A telecommunications equipment and service provider
- An international law firm

Wholesale buyers Interviewed

- A nationwide fibre reseller
- A nationwide fibre reseller
- A nationwide telecoms operator
- A nationwide fibre reseller and IT services company
- A nationwide fibre reseller and IT services company

11.   GLOSSARY

CRM	Customer Relationship Management
FTTH	Fibre To The Home
FTTP	Fibre To The Premises
MAN	Metropolitan Area Network
MPLS	Multiprotocol Label Switching
MVA	Megavolt Ampere (a unit measure of apparent power)
LAN	Local Area Network
RFQ	Request For Quotation
SLA	Service Level Agreement
VHBC	Very High Bandwidth Connectivity (>1Gbit/s)
VoIP	Voice over Internet Protocol
WAN	Wide Area Network
WDM	Wavelength Division Multiplexing
WECLA	West, Eastern and Central London Area

12. ACKNOWLEDGEMENTS

13. CONTACT DETAILS

CSMG is a specialist strategic consultancy focused exclusively on the telecoms and digital media sectors. With offices in North America, Europe and Asia, we work for wide range of companies around the globe in these converging industries.

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Appendices

14. APPENDIX 1: INTERVIEW GUIDE

Introduction and Screening

- Introduction/Positioning
  - CSMG is supporting Ofcom in a review of potential competition in the market for Very High Bandwidth Connectivity (VHBC) services. The objective is to provide Ofcom with data on, and insight into, how UK End-users procure and consume VHBC services. At the end of the project, Ofcom plans to publish a report summarising findings.
  - We will keep accurate records of discussions which help us to understand the issues involved. But we will also respect the confidentiality of our sources and will not reveal details if we have agreed to keep discussions private.

- Are you responsible for the decision-making on business connectivity services on some or all of the sites your business has?
  - *If the company outsources their ICT to a third party (e.g. a SI, data centre), then the respondent should only answer questions if they know – in detail – how the solution is purchased and managed. Interviewer to explain the sorts of questions that will be asked to see if the respondent is comfortable answering them.*
  - *If not, seek referral to relevant employee and end call*

- Explain definition of VHBC
  - VHBC covers services of bandwidth greater than 1Gbit/s, but also includes services of lower bandwidth delivered with wavelength-division multiplexing (WDM) equipment installed to the premises of the End-user.

- Does your organisation currently purchase VHBC services or use dark fibre?
  - If not, are you actively looking to procure VHBC services (i.e. have you issued a tender or contacted potential suppliers)?
  - *If not, end call*

- Please provide an overview of the number of connections you buy, speeds and interfaces.
  - What interfaces do each of these connections use – (e.g. traditional such as SDH, Ethernet, WDM)
  - *Check consistency with VHBC scope. If not, end call*

Background Questions

[In most cases, will be clarified before phone call through desk research]

- What is the main area of business your company is involved in?
  - Manufacturing
  - Communication and IT
  - Utilities
  - Retail
  - Finance
  - Insurance
  - Education and research
  - Local government
  - Central government
  - Media
  - Construction
  - Health
  - Legal
  - Services

- [In most cases, will be clarified before phone call through desk research, but if not possible:] Approximately how many employees does your company have worldwide?
  – How many of these are based in the UK?

- [In most cases, will be clarified before phone call through desk research, but if not possible:] What is your company's annual turnover?

Drivers of Demand

I would first be grateful if you could help me understand what drives demand for VHBC services.

- Why does your [name of organisation] need VHBC services?
  – Do you use VHBC for intra-company connectivity? Describe services and purpose.
  – Do you use VHBC for inter-company connectivity? Describe services and purpose.

- Is the use of these services concentrated at a number of key sites or is it distributed?
  – What drives this choice?
  – What is the network architecture between these sites – e.g. ring, hub-and-spoke, or point-to-point.

- How many sites require VHBC and where are they located?
  – Are you happy to share the addresses of these premises?
  – If not, could you tell me – with as much precision as possible – where these premises are located?
  – Why were these sites chosen for infrastructure that requires VHBC services?
  – Do you have any sites which do not currently require VHBC services? If so, how many and where are they?

- On what basis do you choose the location of ICT infrastructure, for example, between your own sites, or to data centres?
  – To what extent is VHBC availability a factor in this decision?
  – *[If VHBC availability is a factor]* |How far does the availability of competitive VHBC services influence the choice of location (i.e. to make sure you locate in areas where there is sufficient choice of VHBC providers)?

- Thinking first in terms of the number of connections, is your current use of VHBC likely to increase, decrease or stay the same over the next 3 years?
  – By how many connections?
  – (If increase), what proportion of these are likely to be at new sites and where will these be located?
  – What are the drivers behind this change?

- Thinking now in terms of capacity of existing connections, is your current use of VHBC likely to increase, decrease or stay the same over the next 3 years, and why?
  – By how much?
  – *[If increase]*, what proportion of this is likely to be at new sites and where will these be located?
  – What are the drivers behind this change?

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Customer Purchasing Behaviour

I would now like to ask about how you procure VHBC services.

- Do you use lit fibre or dark fibre, or both? If both, what proportion of each?
- Who is your current supplier(s)?
  - *[If multiple providers]* Do all providers serve all of your sites or do different providers serve different areas? What is the rationale for having multiple providers?
  - *[If single provider]* Do you have a preference for having a single provider?
  - Do you know if they own/control the underlying physical network infrastructure, or whether it is bought/rented from another network operator?
    › *[If they buy/rent] Which operator owns the underlying infrastructure?*
    › *Why do you not contract this operator directly?*

- *[Dark fibre users only]* What considerations led you to choose dark fibre rather than a lit service?
  - Help me understand how you operate dark fibre services. By yourself or by a third party provider (e.g. the supplier of the "dark" fibre, or by a systems integrator?

- *[Dark fibre non-users]* Would you consider self-supply via "dark" fibre, a realistic solution,
  - Why/why not?
  - Is it possible that this will change as *[your firm's]* needs and circumstances evolve?

- Which suppliers of VHBC do you consider to be credible, and why?
  - Are suppliers who do not manage the underlying network infrastructure, such as systems integrators, credible competitive alternatives? If no, why not?
  - Are suppliers who do not own/control the underlying physical infrastructure credible competitive alternatives?
    › *[If no] why not?*

  - How important is geographic coverage in the credibility of suppliers?
    › *[If important] Please explain.*

- When procuring VHBC, do you typically use tenders or source supply directly?
- Do you purchase VHBC services on a standalone basis or as part of a broader ICT solution? Why?
- What are the key criteria you use when deciding which communications provider to use? (*Prompt if necessary:* e.g. cost, quality of service, speed and ease of implementation, resilience, network reach, easier to deal with, better SLAs, better customer management etc.)
  - Please rank your top 3 most important criteria
  - *[If they do not use BT]* How do you rate BT against these criteria?

- *[If they tender]* Thinking about the last time you tendered, which providers were invited to bid and how many responded?
  - With the exception of the successful bid, how many could have delivered the VHBC services you needed for an acceptable price?
  - *[If there is a difference between the number of bids and the number of credible bids]* Why were the other bids not considered credible?
  - When did this tender take place?

- Do you prefer single or multiple providers, and why?

- How long is your existing contract with your dark fibre/VHBC supplier? Does this include an option to review the terms of the contract (for example a break clause)?
- Are you likely to issue a tender at the end of your existing contract? If not, why?
- Under what circumstances (if any) would you consider switching providers?
  - *[If they would not consider this under any circumstances, probe as to why.]*
  - What would you do in response to a significant (e.g. 10-20%) price increase or in response to a significant drop in service quality? Do you have a credible threat of switching (either to another CP or to self-supply)?
  - *[If yes]* To who?
  - *[If not]* Would you consider re-locating or would you be able to 'sponsor' new entry? (By this, we mean would they be willing to fund/part-fund network extension of another CP to their sites).

Pricing

I now want to ask about how prices for your VHBC services are set.

- Do you agree prices for individual sites or connections, or single price for multiple services?
- When procuring VHBC services in the past, what was the process by which you agreed a price with your communications provider?
- Was there room for negotiation?
  - *[If yes]* Which elements were negotiable? e.g. upfront cost, recurring cost, SLA
  - What benefits did you get from the negotiation, and what was the magnitude of these benefits?

- Would you be happy to share what you currently pay for VHBC services?
  - Could you help me understand the pricing structure – for example, was there an initial set-up cost on top of an annual rental?
  - *[If not]* Could you share an approximate range?
  - *[If hesitating, offer option of aggregating data before passing it on to Ofcom]*

Satisfaction with Existing Levels of Choice

Finally, I'd like to talk about your satisfaction levels with the current level of choice in the market. Throughout this section, we refer to "supply" in the broad sense – whether that is a supplier of lit fibre or a supplier of dark fibre.

- How satisfied are you with the choice of suppliers available and the services offered?
  - How do you rate these suppliers against the criteria we discussed earlier?

- Does this level of choice vary by geography (especially in comparison with London)? If so, how?
- Have you experienced difficulties in finding suppliers willing to serve you in particular areas? Precisely which areas were these, and what were the reasons for the lack of supply?

- Thinking over a three year horizon, do you anticipate that the levels of supplier choice will increase, decrease or stay the same?
  – Could you quantify the magnitude of this change?
  – What are the reasons for this change?

<u>Close</u>

- Clarify confidentiality arrangements.
- Determine whether interviewee is happy to answer follow-up questions by email.
- Thank and close.