Final Report for the Department of Trade and Industry (DTI)

Sophisticated broadband services

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Sophisticated broadband services

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Analysys

0 Executive summary

This document is the third report of the study commissioned to Analysys by the Department of Trade and Industry (DTI) to examine the market for sophisticated broadband services across the G7,[1] Australia, Ireland, South Korea and Sweden. This report summarises Analysys's findings on the performance of these countries regarding both the availability (coverage) and usage of sophisticated broadband services. The availability (coverage) data is estimated at the end of the first quarter of 2006; the usage data is estimated as of the end of 2005.

The coverage findings are based on a combined survey and desk research approach for fixed and mobile broadband infrastructure operators identified across the 11 countries under study. Coverage results are provided for downstream, upstream and mobile technologies.

The usage findings are based on estimates produced by Analysys through reference to free, publicly available data sources.

0.1 Fixed coverage

Exhibit 0.1 below shows the availability of 1, 2, 4 and 8Mbit/s *downstream* services in each of the countries included in the study. This chart (and similar ones later in the report) is ranked on the availability of 1Mbit/s services.

[1] Canada, France, Germany, Italy, Japan, the UK and the USA.

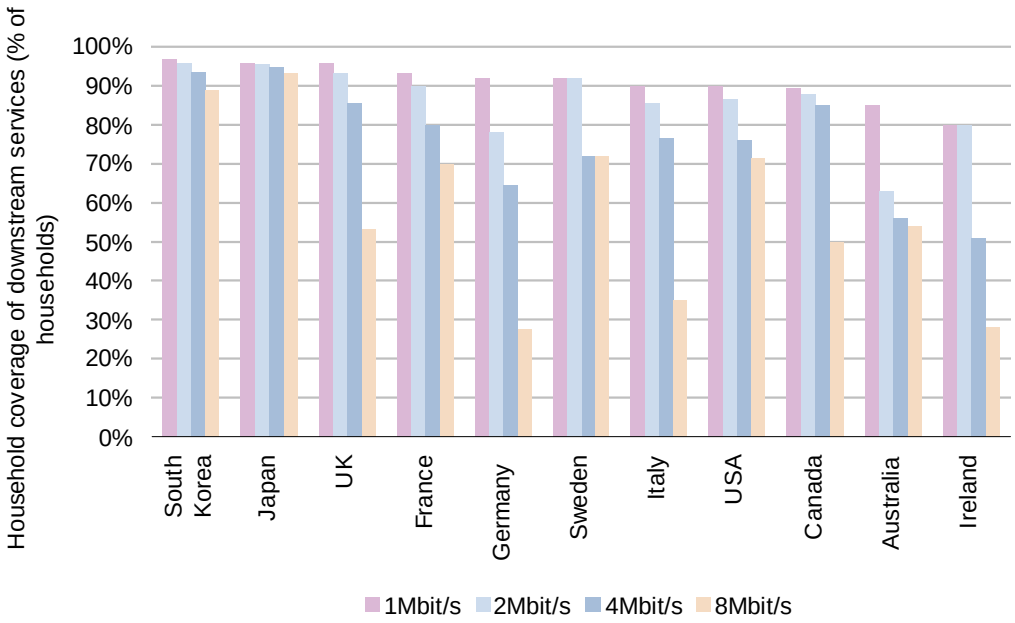

Exhibit 0.1: *Availability of downstream sophisticated broadband services by country, Q1 2006 [Source: Analysys]*

As can be seen from the chart above, the UK performs well in terms of the availability of 1 and 2Mbit/s services,[2] and has improved markedly in terms of 4 and 8Mbit/s availability over the last six months (as predicted) following the recent launch of BT's ADSL Max products, increased interest in unbundling and 10Mbit/s services from the combined ntl/Telewest entity. It is unlikely that the UK will see a similar increase in availability in these speed ranges in the near future: ADSL2+ will provide some improvements in practical performance over ADSL but will be limited to unbundled exchanges in the short term (we expect that BT will introduce ADSL2+ during its 21st Century Network (21CN) roll-out but this will only be reaching completion by 2009/10), and the cable operator is unlikely to significantly expand the reach of its network (which currently supports 10Mbit/s services).

The availability of 1, 2, 4 and 8Mbit/s *upstream* services in each of the countries included in this study is shown in Exhibit 0.2 below.

2 Availability of 1Mbit/s in the UK is the same as in Japan, with positioning decided alphabetically after ranking in order of 1Mbit/s availability.

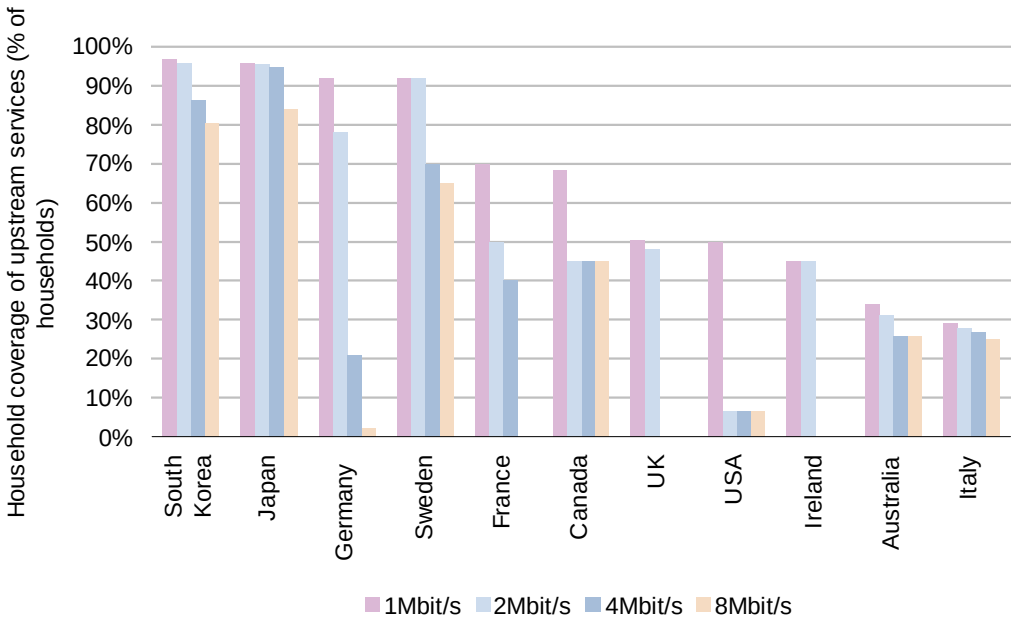

Exhibit 0.2: *Availability of upstream sophisticated broadband services by country, Q1 2006 [Source: Analysys]*

As can be seen from the chart above, the UK is towards the bottom of the rankings on the availability of upstream broadband services.[3] Increasing availability of higher downstream speeds could lead to wider coverage of 1 and 2Mbit/s upstream services. With the lack of fibre and wireless based services (which contribute to upstream availability across a number of countries), and the announcement from BT in August 2005 that it was to 'pause' its SDSL roll-out, it is unlikely that the UK will improve significantly on the current upstream position over the next year or so.

0.2 Mobile coverage

We also provide details on the current level of 3G availability and the penetration of public WLAN hotspots across the countries included in this study.

3 Including business-focused products such as BT Business Broadband and SDSL. This excludes leased lines and similar products.

0.2.1 3G coverage

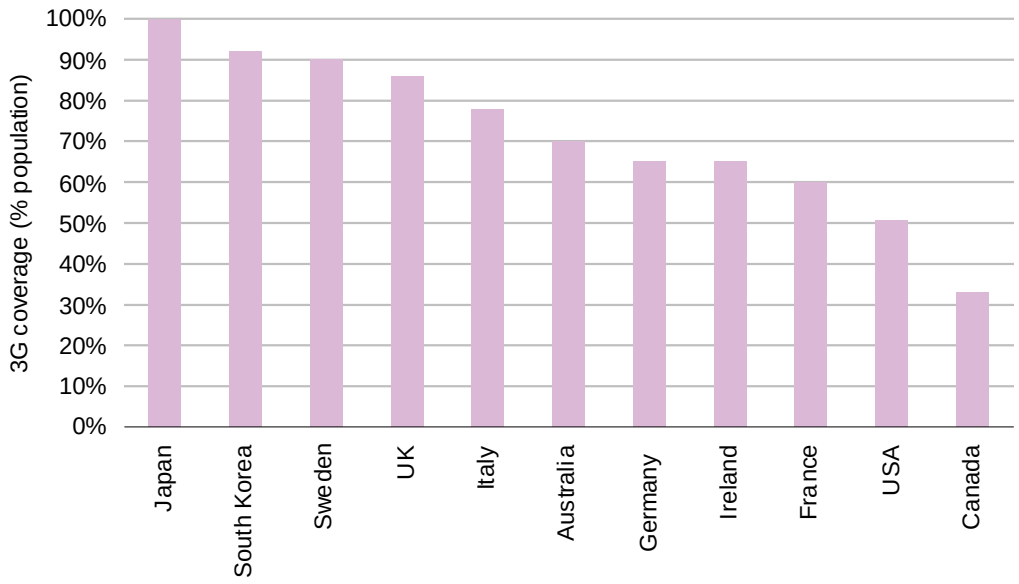

Exhibit 0.3: *3G coverage, Q1 2006 [Source: Analysys]*

Japan and South Korea lead the way in the availability of 3G mobile services, as well as being at the forefront in terms of higher-speed broadband coverage. 3G services have recently been launched in Canada, with the coverage figures shown here estimated from TELUS's press coverage regarding its network roll-out. The high coverage in Japan and South Korea can be attributed to a number of factors, including the early launch of 3G services in these two countries and the high population density. South Korea may also have benefited from the award process, whereby contestants had to place bids for licences within a price range specified by the government. This may have left more funding available for network roll-out than would have been the case had the licences been awarded at much higher prices.

3G licences often contain coverage requirements which must be met as a condition of the licence. For example, the Swedish licences originally contained a requirement for 99.98% population coverage by the end of 2003. This target has not been met and the regulator, PTS, has reiterated the requirement for this coverage level to be reached and has allowed the operators to share infrastructure and utilise 3G roaming to achieve this aim.

By comparison, the German 3G licences contain coverage conditions of 50% of population by the end of 2005, with operators allowed to share the passive components of their infrastructure.

0.2.2 Public WLAN

Exhibit 0.4: *Public WLAN hotspots per million people, Q4 2005 [Source: Analysys, Informa Telecoms]*

Data regarding the number of public WLAN hotspots for Q1 2006 is not available and we therefore present data for Q4 2005 in the exhibit above.

The availability of public WLAN hotspots is considerably higher in South Korea than in any of the other countries included in the study on a per-capita basis, with France and the UK leading the group behind South Korea. The UK's figures are boosted by The Cloud's strategy of adding WLAN capability to many of its terminals in pubs and restaurants.

0.3 Initial coverage conclusions

Exhibit 0.1 and Exhibit 0.2 above show that, unsurprisingly, the countries which have historically been viewed as broadband leaders (Japan, South Korea and Sweden) can also be considered as such regarding the availability of higher-speed downstream and upstream

services. As discussed earlier, the availability of 4 and 8Mbit/s services in the UK has increased rapidly over the last six months, having undergone a step change following the launch of ADSL Max by BT. However, the UK remains behind in the overall availability of upstream services.

It is unlikely, in the short term, that the UK will be able to match the performance of Japan, South Korea and Sweden across a wide range of both downstream and upstream speeds as these countries have benefited from a number of factors which are not directly applicable to the UK:

- government financial support for network investment
- very favourable demographics for network roll-out – specifically, a high proportion of multi-dwelling units (MDUs)
- a national culture of high-technology adoption and usage, and a comfort with new technology.

In terms of mobile and wireless local area network (WLAN) coverage, the UK is towards the top of the rankings thanks, in part, to the relatively early launch of 3G. True 'nomadic' wireless, where users can access high-speed services while on the move, is still to emerge. This may form a more compelling product than 3G for some users, though this very much depends on location and tariffs.

0.4 Initial usage conclusions

Exhibit 0.5 below shows the UK's position compared to the other countries covered by this study for each of the indicators of Internet usage by broadband businesses (i.e. businesses with broadband Internet connections). Countries are ranked according to usage by broadband businesses except for the ecommerce indicator which is for all connected businesses.

It would appear that the UK is doing reasonably well in comparison with the other countries that are part of this study. It has the highest percentage of broadband businesses ordering online and ranks third for WLAN and ecommerce. For the other two indicators, the UK is just below mid-table. It seems that the increased availability of broadband, combined with the UK government's efforts to stimulate ICT usage, have had an impact on usage.

Rank	*Ordering online*	*WLAN*	*VoIP*	*Paying government*	*Ecommerce*
1	**UK**	USA	Japan	Australia	USA
2	Germany	Sweden	South Korea	Sweden	Japan
3	USA	**UK**	Ireland	France	**UK**
4	Canada	Ireland	USA	Ireland	South Korea
5	Ireland	Australia	Sweden	South Korea	Sweden
6	Sweden	Germany	**UK**	Canada	Ireland
7	South Korea	Italy	France	**UK**	Germany
8	Australia	Canada	Australia	Italy	France
9	Japan	Japan	Italy	USA	Canada
10	France	France	Canada	Germany	Italy
11	Italy	South Korea	Germany	Japan	

Exhibit 0.5: *Summary ranking of business indicators, Q4 2005 [Source: Analysys][4]*

Drawing detailed conclusions from the residential indicators is more problematic, due to the paucity of good source data, and the high degree of estimation that is therefore required to create them. The results must be treated with caution. Countries are only included in the summary table in Exhibit 0.6 below if they were able to produce a reasonable estimate. This means that not all 11 countries are represented for each indicator.

Rank	*Downloading TV, video and movie clips*	*Use of online gaming*	*Use of VoIP*	*Ecommerce spend*
1	South Korea	South Korea	Japan	South Korea
2	USA	Sweden	France	**UK**
3	France	Japan	Sweden	France
4	Australia	Australia	Italy	Germany
5	**UK**	USA	USA	Italy
6	Germany	Canada	Germany	USA
7	Italy	Italy	Canada	Canada
8	Sweden	**UK**	South Korea	Japan
9	Japan	France	Australia	Ireland
10	Ireland	Germany	Ireland	
11		Ireland	**UK**	

Exhibit 0.6: *Summary ranking of residential indicators, ranked by percentage of Internet users, Q4 2005 [Source: Analysys]*

4 The UK is equal with Sweden in terms of WLAN usage, but is positioned third in the ranking due to being after Sweden alphabetically.

The UK appears in the bottom quartile for use of VoIP; the third quartile for Internet gaming; the second quartile for TV, video and movie clip downloads; and the top quartile for ecommerce spend per Internet user.

When compared to the previous report from September 2005, the UK has improved from mid-table to first in the number of businesses ordering online (based on new information which has become available since the previous report) and has maintained its position in the remaining indicators with a movement up or down of one place on each of them. For the residential indicators, the UK has maintained its position on the whole, having dropped a place in a couple of indicators. In particular, the UK has fallen one place to last in terms of use of paid-for VoIP (which does not include the use of free VoIP packages such as Skype). However, the emergence of a number of VoIP offerings (e.g. from Wanadoo, BT and Vonage) should lead to an increase in VoIP usage in the UK over the next few years.

1 Introduction

The Department of Trade and Industry (DTI) has commissioned Analysys to examine the market for sophisticated broadband services across the G7, Australia, Ireland, South Korea and Sweden.

Over the past few years, the availability of 'basic' broadband services (i.e. a minimum 512kbit/s downstream service) has grown to over 80% in all countries included in this survey. This, combined with falling prices, has led to growing interest in both the availability of higher-speed broadband services and the usage to which individuals and organisations are putting their Internet connections – for example, use of VoIP, making purchases over the Internet, online gaming, and TV and video downloads. This study examines the market for higher-speed broadband services and usage of selected types of Internet-based content.

During a series of meetings between Analysys, the DTI and the Broadband Stakeholder Group (BSG),[5] it was agreed that both the **coverage** and **usage** of sophisticated broadband will be tracked during the study, covering the following areas:

- **fixed coverage –** the availability, by downstream and upstream speed, of fixed broadband services (including fixed wireless access (FWA))
- **mobile coverage –** the availability of 3G mobile services, WLAN hotspots and other emerging mobile or nomadic technologies (such as WiMAX)
- **usage –** the take-up of key broadband-enabled applications and general Internet usage.

5 The meetings were held on 7 February, 10 March and 23 March 2005.

This document is the third report of this study and summarises Analysys's findings on the market for sophisticated broadband services.

The remainder of this document is structured as follows:

- *Section 2* – outlines the methodology that we have adopted for the coverage section of the study.

- *Section 3* – presents our findings on the availability (coverage) of sophisticated broadband services across the 11 countries under study.

- *Section 4* – presents our findings on the usage of sophisticated broadband services in the countries under study and the methodology employed; it also contains two short trends analysis articles focusing on the state of a particular service and discussing market developments.

2 Coverage of sophisticated broadband services – methodology

Given the relative paucity of detailed and up-to-date broadband coverage information by speed available in the public domain, we have adopted a combined survey and desk research approach. We have identified and contacted a number of large[6] and small fixed broadband infrastructure operators in each of the countries under study; additionally, for each of the 11 countries the mobile operators have also been identified.

Where large fixed operators have not supplied coverage information, we have estimated coverage levels using publicly available data. This estimation process is less preferable than sourcing the data directly from the operators and the results for any countries where this approach has been required for the bulk of operators (in Germany, for example) are subject to lower levels of confidence.

The data sources we have used for this estimation process include:

- operator Web sites
- press coverage
- industry resources/Web sites
- technological limitations of different technologies (for example, see Section 2.1)
- underlying demographic data.

As would be expected from such an exercise, the accuracy of any such estimations is heavily dependent on the amount and quality of the available source data.

6 More than 100 000 subscribers, with the exception of Ireland where we included eircom, ntl-Chorus and BT Ireland.

In the case of mobile operators, data regarding 3G coverage on these operators was, where available, drawn from mobile operator profiles held by Analysys Research.

In summary, there are some gaps in the data that is available in the public domain. In these cases, we have had to make estimates based on our own experience. However, over time, we would expect the amount of estimation to reduce, both as more services become available and operators publicise their coverage more.

2.1 Technical limitations of DSL technologies

ADSL is currently the most widespread DSL variant for broadband, although ADSL2+ deployments are now becoming more commonplace. Exhibit 2.1 shows the maximum downstream speed achievable using these two variants of DSL by line length, and shows that ADSL and ADSL2+ offer similar speeds where the line length is over 3km, with ADSL2+ offering considerably higher speeds below this distance. Other variants, such as VDSL, offer even higher downstream speeds, but over much shorter distances.

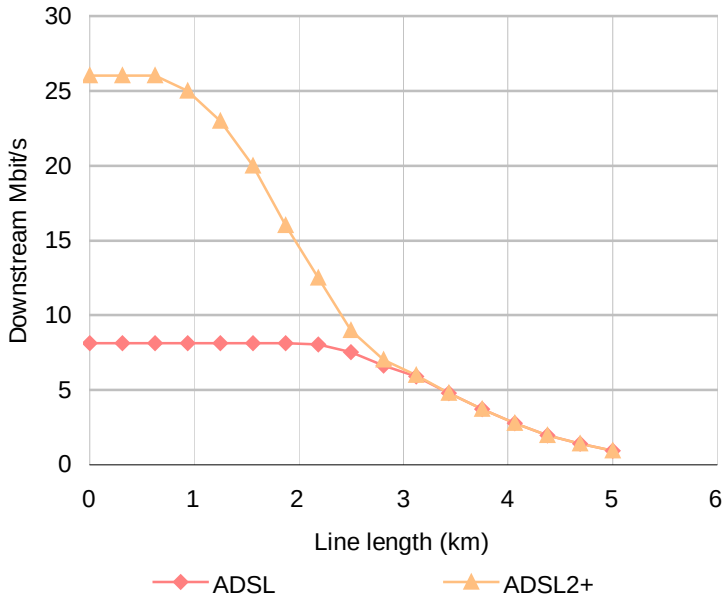

Exhibit 2.1: *Maximum downstream speed of ADSL and ADSL2+ by line length [Source: Analysys]*

The variation of performance with distance has implications for end-users and reduces the size of the addressable market for a given speed. In order to interpret this fully, the distribution of line lengths is needed.

2.2 Distribution of line lengths

Exhibit 2.2 below shows the distribution of the length of the incumbent's copper lines across a number of countries, ranked in order of increasing line length. Each individual exchange will have its own distribution of line lengths and this chart can only be used as an indication of the correction factor that will need to be applied to coverage statements due to technical limitations. For example, consider the case in which an organisation enabled sufficient exchanges in the UK with ADSL2+ to cover 50% of PSTN lines. The lines enabled by this organisation would not all be of 2km length or less, and so a correction factor would need to be applied to estimate the actual coverage of 15Mbit/s services (the maximum speed available over a 2km copper line).

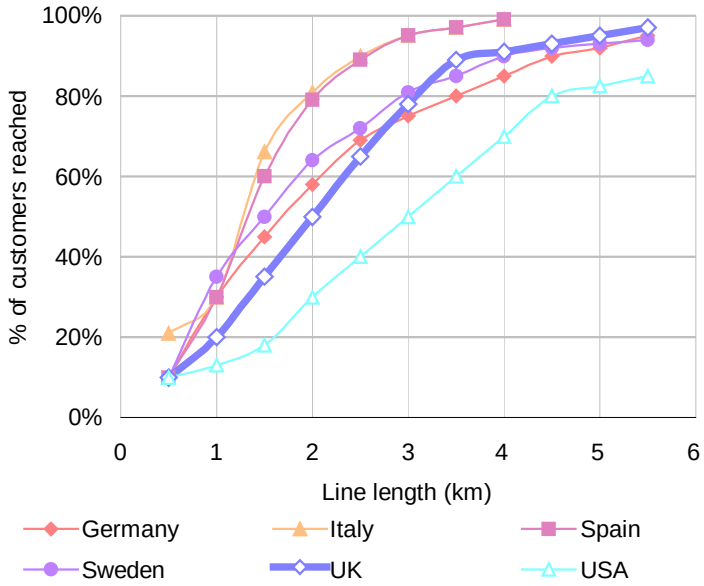

Exhibit 2.2: *Distribution of copper line lengths [Source: IEEE, Telefónica]*

The chart above can therefore be combined with Exhibit 2.1 to give an indication of the *theoretical distribution of maximum speed* (excluding issues of line material and quality of installation) using ADSL2+ and ADSL technologies that can be achieved in the UK, as illustrated in Exhibit 2.3 below. This shows that, for example, ADSL2+ technology could

potentially offer approximately 15Mbit/s to 50% of lines compared to 8Mbit/s via ADSL. It also clearly shows that ADSL is limited to around 8Mbit/s downstream, whereas ADSL2+ offers up to 26Mbit/s but can only serve a relatively small number of lines to this speed.

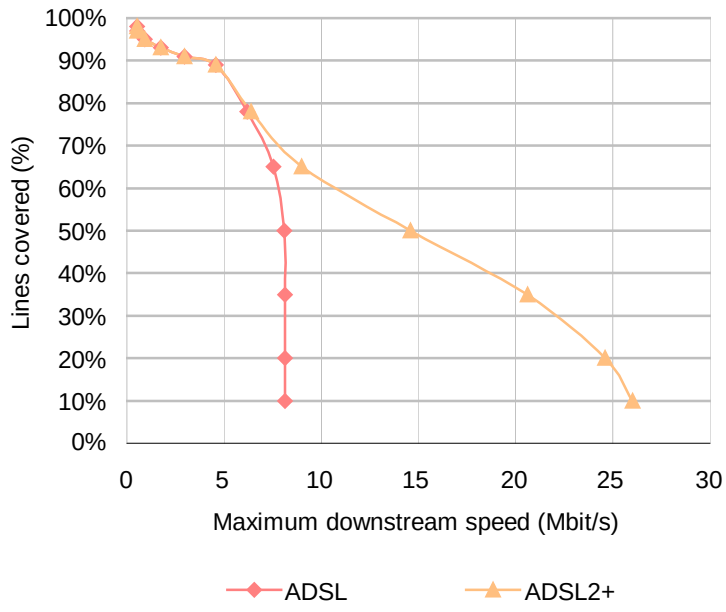

Exhibit 2.3: *Theoretical distribution of maximum ADSL2+ and ADSL speeds in the UK [Source: Analysys, IEEE]*

During March 2006, BT announced the launch of its ADSL Max retail and wholesale products, offering rate-adaptive broadband speeds up to 8Mbit/s downstream and 832kbit/s upstream. At the analyst presentation covering the launch of these products, BT presented data on the proportion of the population that it expected to be able to receive broadband by downstream speed. This is shown below in Exhibit 2.4.

Max speed	*% UK population covered*
512kbit/s	98%
1Mbit/s	96%
2Mbit/s	93%
3Mbit/s	89%
4Mbit/s	78%
5Mbit/s	63%
6Mbit/s	42%
>6.5Mbit/s	25%

Exhibit 2.4: *Estimated population coverage of ADSL Max by downstream speed in the UK [Source: BT]*

The table above shows that the *practical* performance of ADSL in the UK is some way behind the *theoretical* performance implied by the line lengths in the UK and the technical capabilities of the technology. There are a number of factors contributing to this, including:

- the quality of the copper line and any faults it may contain
- noise from wiring in the home or interference (e.g. from radio)
- crosstalk (i.e. noise from adjacent/nearby copper lines in the network).

Where possible, the impact of such issues on the coverage figures for each country is taken into account in our estimates.

2.3 UK-specific analysis

For the UK we provide a regional breakdown on the results in addition to the national picture. This has been calculated using a sophisticated geographic analysis by post-sector and exchange area.

For downstream and upstream xDSL coverage, we have combined lists of enabled exchanges by operator,[7] products available from each operator, number of households for each exchange area, and estimations on the average percentage of households connected to an enabled exchange that can actually receive a service of a given speed (i.e. line length limitations) to calculate servable households per exchange by downstream and upstream speed.

For cable-modem services, we have combined availability by post-sector, the number of households per post-sector and products offered by each of the cable network operators to calculate servable households by post-sector by downstream and upstream speed.

We subsequently generated the set of all areas where post-sectors and exchange areas overlapped; we then combined this with the data sets on servable households by xDSL and cable modem to arrive at the final result.

FWA services in the UK contribute little incremental coverage to that provided by xDSL and cable modem, and operate at speeds comparable to these two technologies.

7 Sources: individual operators and www.samknows.com.

3 Coverage of sophisticated broadband services – results

This section presents our findings on the availability (coverage) of sophisticated broadband services across the 11 countries under study.

The following three areas have been examined:[8]

- **downstream speed –** specifically services that are mass-marketed to residential and business customers and are not bespoke. Services in this category include ADSL, ADSL2+, VDSL (where affordable), cable modem and fixed wireless access (FWA); excluded are leased lines, LES (LAN extension services) and similar products

- **upstream speed –** as above, but covering the upstream speeds of the listed technologies

- **mobile/nomadic technologies** – including 3G, WLAN and emerging wireless technologies such as WiMAX.

We have excluded from our analysis the services that are available 'everywhere' to allow the results to show differentiation in coverage between countries. For example, satellite services and leased line services have been excluded from the asymmetric and symmetric technologies respectively.

8 The previous version of this report covered asymmetric and symmetric services rather than upstream and downstream. It was felt that this categorisation did not accurately reflect the availability of higher-speed services in countries such as Japan and Sweden where symmetric services are widely available at mass-market residential prices.

In most markets, asymmetric services are targeted mainly at residential customers, with symmetric services targeted at businesses. In other words, higher speed upstream services tend to be focused on businesses rather than residential users and are priced at a premium. This approximation is not valid when specific asymmetric services are offered to businesses but not to residential users or where fibre-to-the-home (FTTH) services are offered as a mass-market proposition to residential customers (for example, by FastWeb in Italy or Yahoo! and NTT in Japan).

Mobile/nomadic technologies complete the overall picture by giving an indication of how ubiquitous broadband access is (for example, is it available even when someone is travelling?).

In each of the following sections, we give details on the current (end of March/mid-April 2006) coverage of downstream and upstream speeds for each of the countries included in the study. We also briefly list the data that we have received from operators and the estimations that have been required to arrive at a national picture.

For the UK, we have provided tabular results containing coverage data for each of the UK regions. These have been generated using exchange-by-exchange data on availability of services where such data exists, along with post-sector level information on the availability of cable-modem services (FWA services add a small incremental amount of coverage to that provided by xDSL and cable modem).

As would be expected, any estimations will mean lower levels of confidence in the results but, over time, we would hope that the need for estimations will decrease as more operators publish data on the availability of higher-speed services.

3.1 Interpretation of the results

The results contained in the following sections show the coverage of broadband services by downstream and upstream speed. For example, a bar at 2Mbit/s shows the percentage of households covered by a service of *2Mbit/s or higher*.

This study reports on the 'headline' speed of broadband products and takes into account technical limitations. For example, Tiscali France offers ADSL2+ services up to 20Mbit/s.

Technical issues with xDSL technologies result in the actual availability of the maximum 20Mbit/s being less than the number of households connected to the exchange. We report the coverage level taking into account such technical limitations.

However, this study does *not* take into account contention and network performance issues, although from the end-users' perspective, this can be significant – see, for example, Exhibit 3.1 below, which shows that a French user who could theoretically receive 20Mbit/s is unlikely, in practice, to achieve this.

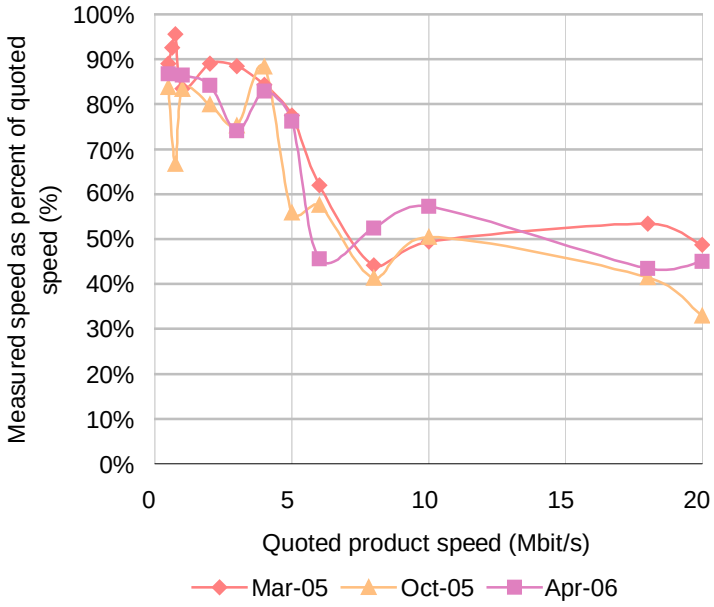

Exhibit 3.1: *Measured downstream speed versus quoted speed, France, 15 March 2005, 27 October 2005 and 20 April 2006 [Source: Analysys, www.grenouille.com]*

3.2 United Kingdom

In the UK, broadband is primarily available through xDSL and cable modem. At the end of March 2006, BT launched its ADSL Max retail product and Broadband Max wholesale products, offering up to 8Mbit/s downstream and 832kbit/s upstream depending on line length and quality. The higher upstream date rates are currently only available on the retail business offerings and the wholesale Max Premium products (which are targeted at business users). BT plans to make these products available across all exchanges which have been enabled to offer ADSL (5500 out of approximately 5600 in the UK). They are currently available at approximately 5350 exchanges. BT also offers symmetric services up to 2Mbit/s on around 800 exchanges.

The two longest established LLUB operators are Bulldog and Easynet: as of March 2006, Bulldog had unbundled just over 400 exchanges and offered ADSL at 8Mbit/s and SDSL at 2Mbit/s. Meanwhile, Easynet had unbundled 232 exchanges and offered ADSL2+ at up to 24Mbit/s and SDSL at 2Mbit/s, having launched its ADSL2+ platform across all of its unbundled exchanges in November 2005 following successful trials. Bulldog's services have a 400kbit/s upstream speed, while Easynet offers upstream speeds of up to 800kbit/s.

A number of other operators, such as AOL, Pipex, Tiscali, Wanadoo and Zen Internet, have moved into LLUB although they offer services using ADSL which are 'up to' 8Mbit/s and do not increase broadband availability beyond that available. through BT. In contrast, Be Broadband had unbundled approximately 100 exchanges by the end of March, primarily in London, and offers ADSL2+ services up to 24Mbit/s downstream and 1.3Mbit/s upstream.

The recently merged cable operators ntl and Telewest (which continue to offer services under their distinct brands) offer up to 10Mbit/s cable-modem services, with Telewest announcing the completion of its network upgrade in early April. The results in this report assume the completion of this network upgrade. Both ntl and Telewest currently have a maximum upstream speed of 300–400kbit/s.

Exhibit 3.2 and Exhibit 3.3 below respectively illustrate the coverage of downstream and upstream services in the UK. The launch of BT's ADSL Max/Broadband Max products and the completion of network upgrades by the cable operators has resulted in much higher availability of 8Mbit/s downstream (up from approximately 10% in September 2005 to over 50% by the end of March 2006). Similarly, the launch of ADSL2+ by Easynet, combined with the expansion of Be's network, has increased the availability of 16Mbit/s and 24Mbit/s.[9] There has been no change in the overall availability of upstream speeds in the UK, although the proportion attributable to residential-focused products (i.e. excluding SDSL services from BT, Easynet and Bulldog) has increased due to the introduction of ADSL Max and Be's ADSL2+ roll-out.

[9] We have decreased the proportion of lines assumed to be able to receive 16 and 24Mbit/s services via ADSL2+ as a result of information contained in BT's analyst briefing accompanying the launch of its ADSL Max products – other evidence on the practical performance of ADSL2+ is scarce. As a result, the increase attributable to Easynet's ADSL2+ launch is smaller than may be expected.

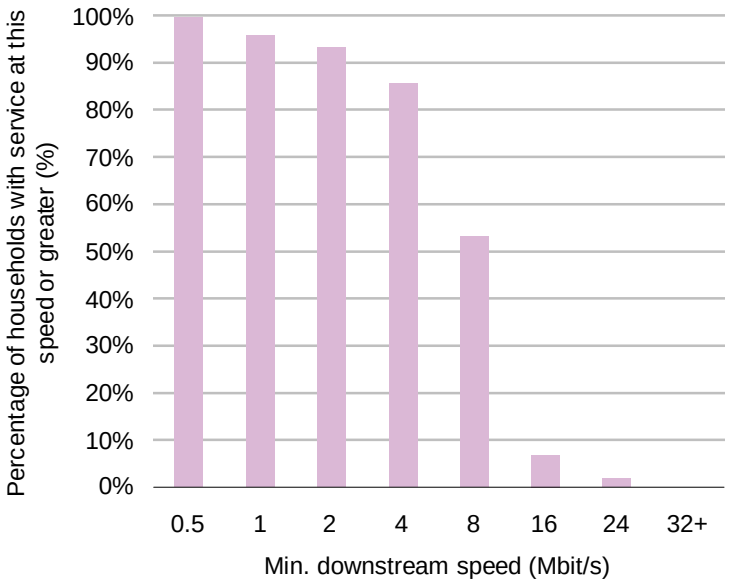

Exhibit 3.2:

UK downstream coverage, Q1 2006 [Source: Analysys]

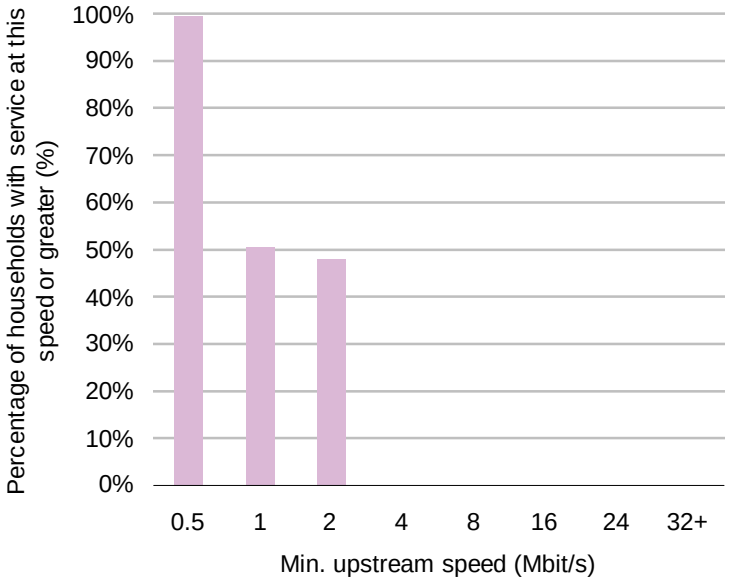

Exhibit 3.3:

UK upstream coverage, Q1 2006 [Source: Analysys]

Regional coverage

Exhibit 3.4 and Exhibit 3.5 below show the household coverage by downstream speed and upstream speed for Q1 2006 in each of the UK's regions.

	0.5	*1*	*2*	*4*	*8*	*16*	*24*	*32+*
East Midlands	99%	96%	93%	86%	56%	4%	1%	0%
East of England	100%	96%	93%	86%	54%	4%	1%	0%
London	100%	96%	93%	88%	71%	24%	7%	0%
North East	100%	96%	93%	86%	55%	4%	1%	0%
North West	100%	96%	93%	87%	60%	6%	2%	0%
Northern Ireland	100%	96%	93%	84%	42%	0%	0%	0%
Scotland	100%	96%	93%	85%	46%	3%	1%	0%
South East	99%	96%	93%	84%	47%	6%	2%	0%
South West	99%	96%	93%	83%	38%	3%	1%	0%
Wales	98%	95%	92%	81%	33%	0%	0%	0%
West Midlands	100%	96%	93%	87%	61%	6%	2%	0%
Yorkshire and Humberside	100%	96%	93%	86%	52%	5%	2%	0%
National	100%	96%	93%	86%	53%	7%	2%	0%

Exhibit 3.4: *Coverage of households by minimum downstream speed, Q1 2006 [Source: Analysys] NOTE: '100%' entries are less than 100% due to rounding*

	0.5	*1*	*2*	*4*	*8*	*16*	*24*	*32+*
East Midlands	99%	44%	42%	0%	0%	0%	0%	0%
East of England	100%	45%	43%	0%	0%	0%	0%	0%
London	99%	90%	86%	0%	0%	0%	0%	0%
North East	100%	30%	29%	0%	0%	0%	0%	0%
North West	100%	58%	56%	0%	0%	0%	0%	0%
Northern Ireland	100%	39%	37%	0%	0%	0%	0%	0%
Scotland	100%	38%	36%	0%	0%	0%	0%	0%
South East	99%	54%	52%	0%	0%	0%	0%	0%
South West	99%	36%	35%	0%	0%	0%	0%	0%
Wales	98%	27%	26%	0%	0%	0%	0%	0%
West Midlands	100%	54%	51%	0%	0%	0%	0%	0%
Yorkshire and Humberside	100%	38%	36%	0%	0%	0%	0%	0%
National	100%	50%	48%	0%	0%	0%	0%	0%

Exhibit 3.5: *Coverage of households by minimum upstream speed, Q1 2006 [Source: Analysys]*

As shown below in Exhibit 3.6, coverage of basic 512kbit/s downstream services is primarily from BT, with the cable-modem operators and local loop unbundlers also providing coverage, with some of these offer higher-speed services than BT.

	BT	*Easynet*	*Bulldog*	*Be*	*ntl*	*Telewest*
East Midlands	99%	11%	21%	0%	51%	0%
East of England	100%	10%	17%	1%	39%	9%

London	99%	49%	77%	54%	23%	30%
North East	100%	12%	3%	0%	26%	23%
North West	100%	16%	33%	0%	33%	21%
Northern Ireland	100%	0%	0%	0%	36%	0%
Scotland	100%	7%	26%	0%	15%	25%
South East	99%	18%	26%	0%	33%	5%
South West	99%	9%	14%	0%	10%	20%
Wales	98%	0%	12%	0%	26%	0%
West Midlands	100%	17%	30%	1%	15%	40%
Yorkshire and Humberside	100%	14%	23%	1%	19%	27%
National	100%	17%	29%	7%	27%	18%

Exhibit 3.6: *Availability of 512kbit/s downstream services by region and broadband infrastructure operator (% of households), Q1 2006 [Source: Analysys]*

3.3 Australia

The majority of lower-speed coverage in Australia is provided by the incumbent's (Telstra) DSL services. Higher-speed services are being provided by Telstra and Singtel Optus' cable-modem services as well as a number of local loop unbundlers (e.g. Singtel Optus, Agile/Internode, iiNet), which are beginning to offer ADSL2+ products. FWA providers, such as BigAir and Access Providers, offer some symmetric coverage.

Broadband coverage by downstream and upstream speeds in Australia is shown in Exhibit 3.7 and Exhibit 3.8 respectively.

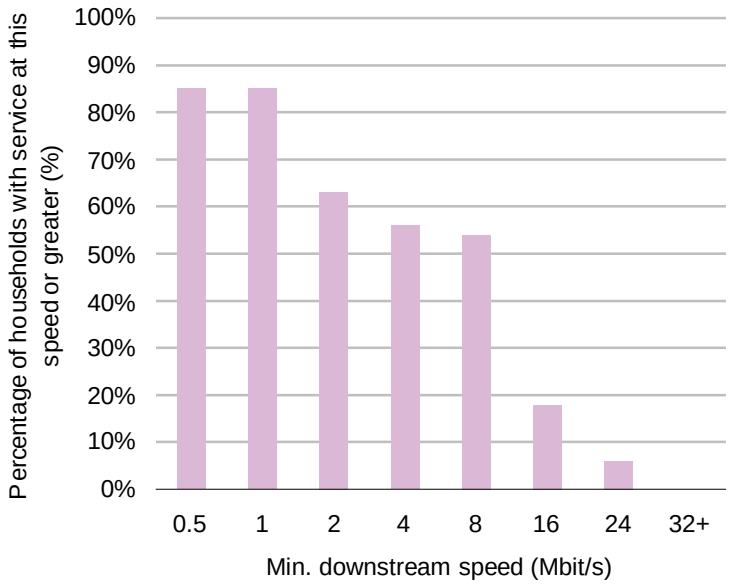

Exhibit 3.7: *Australian downstream coverage, Q1 2006 [Source: Analysys]*

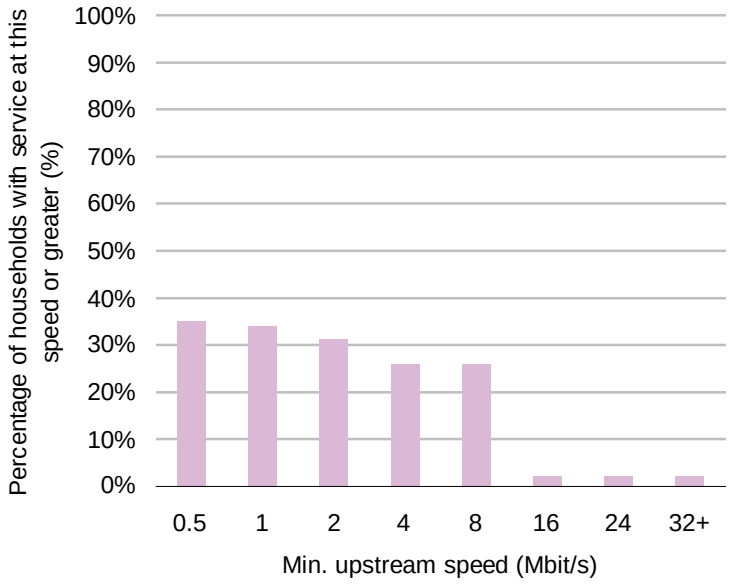

Exhibit 3.8: *Australian upstream coverage, Q1 2006 [Source: Analysys]*

Data gathered and estimations

Telstra's ADSL services, available at downstream speeds of up to 1.5Mbit/s, cover approximately 85% of Australian premises, with its cable-modem service passing around

2.6 million homes (35%) and running at 'uncapped' downstream speeds at up to 17Mbit/s. These services offer a maximum upstream speed of 256kbit/s.

Singtel Optus offers ADSL services at up to 1.5Mbit/s downstream and 256kbit/s upstream, with coverage overlapping with Telstra. As of April 2006, it had unbundled 100 exchanges, which Analysys estimates covers approximately 10% of households,[10] with services offered at up to 20Mbit/s downstream and 820kbit/s upstream. Singtel Optus also offers cable-modem services over its cable network (covering 1.4 million households – 19% of the Australian total) which run at 9.9Mbit/s downstream and 256kbit/s upstream.

Agile Communications and Internode offer ADSL2+ services running at up to 24Mbit/s downstream and 1Mbit/s upstream in 43 exchanges. We estimate that these exchanges serve 4% of the Australian population.

iiNet offers ADSL2+ at speeds of up to 24Mbit/s (downstream) and 1Mbit/s (upstream) on its own network. The company has installed DSLAMs in exchanges covering 2.83 million households and plans to unbundle a further 150 exchanges to reach a total of 4.2 million households. Performance data from the company shows approximately 10% of customers can receive speeds in the region of 20Mbit/s. We have assumed a 50% overlap with Singtel Optus' cable network.

TransACT offers ADSL services at up to 2Mbit/s in the Canberra and Queanbeyan areas, covering more than 90 000 households.

Primus offers ADSL up to 6Mbit/s downstream and 640kbit/s upstream on the 100 exchanges it has upgraded to date to business users, with 1.5Mbit/s services available to residential users. Analysys estimates that the company currently covers 10% of the Australian population, although much of this coverage will overlap with competitors such as iiNet.

10 The company has previously stated that it would need to unbundle 200 exchanges to match its cable network coverage of 19%of households.

PowerTel offers SHDSL services up to 2Mbit/s and 10 and 100Mbit/s symmetric Ethernet services to businesses.[11] As of the end of 2005, PowerTel had enabled 120 exchanges, which Analysys estimates equates to 15% of businesses and households. No further information regarding PowerTel has been available.

Symmetric services are also available via Access Providers and BigAir, which offer up to 8 and 10Mbit/s respectively in parts of Sydney, Melbourne, Brisbane and Adelaide and share infrastructure. BigAir provides coverage to 75% of households in Sydney. Analysys estimates that the combined coverage of these operators is 20% of Australian households.

3.4 Canada

Higher-speed services in Canada (in excess of 5Mbit/s) are primarily offered by the cable network operators, with a number of FWA operators (such as Alternative Broadband and TeraGo) offering symmetric services. Coverage details for these FWA operators are not available and the results in this section are therefore subject to a lower level of confidence.

Exhibit 3.9 and Exhibit 3.10 below illustrate the respective coverage of downstream and upstream services in Canada.

11 For this reason, its asymmetric coverage has been excluded from the asymmetric measure for Australia.

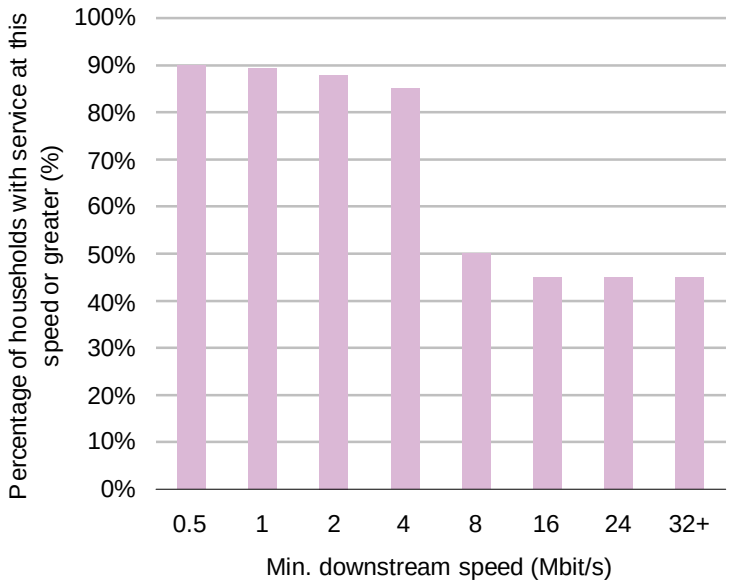

Exhibit 3.9: *Canadian downstream coverage, Q1 2006 NOTE: coverage due to FWA on this chart is subject to a lower level of confidence [Source: Analysys]*

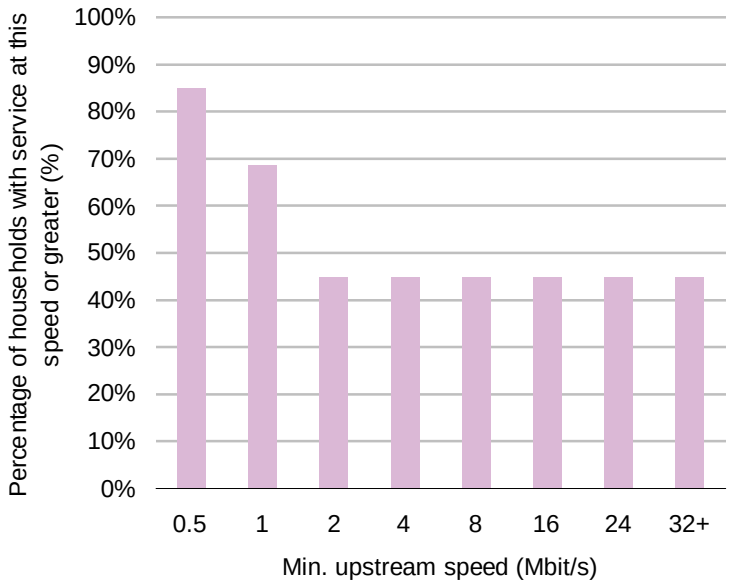

Exhibit 3.10: *Canadian upstream coverage, Q3 2005. NOTE: coverage due to FWA on this chart is subject to a lower level of confidence [Source: Analysys]*

Data gathered and estimations

Bell Canada provides ADSL services up to 5Mbit/s to customers in Ontario, Quebec and Atlantic Canada. As of the end of 2005, the company served 85% of lines passed in Ontario and Quebec and, as of the end of 2003, 65% of homes in Atlantic Canada. Bell Canada has not supplied any further information.

Aliant provides ADSL services in Atlantic Canada (Newfoundland, Nova Scotia, Prince Edward Island and New Brunswick – 7.6% of the Canadian population), offering up to 5Mbit/s; it aims to cover 79% of households in the region by the end of 2005, up from 72% at the end of 2004.

TELUS offers ADSL services up to 2.5Mbit/s to households in Alberta, British Columbia and Eastern Quebec (4Mbit/s to businesses). Analysys estimates that its 2.5Mbit/s service is available to 13% of Canadian households, with the 1.5Mbit/s service available to 16% of households.

FCI Broadband offers ADSL services at up to 8Mbit/s downstream and 800kbit/s upstream in the Greater Toronto area. More precise coverage data is not available and we have assumed that the company covers 50% of Greater Toronto, which is equal to 6.5% of Canadian households.

For cable-modem services, Rogers Cable offers up to 6Mbit/s (8Mbit/s for businesses) to 27% of the Canadian population (99% of the 3.39 million homes passed in Ontario, New Brunswick and Newfoundland), with upstream speeds available up to 0.8Mbit/s (1Mbit/s for businesses).

Cogeco Cable passes 1.45 million homes in Ontario and Quebec, of which 91% were cable modem capable by the end of March 2006, resulting in over 11% of Canadian households being able to receive Cogeco's cable-modem services up to 10Mbit/s downstream and 1Mbit/s upstream. Shaw Cable passes 3.2 million homes in Alberta and British Columbia and thereby covers 27% of Canadian households, offering downstream speeds up to 7Mbit/s and upstream services up to 1Mbit/s. Vidéotron passes 2.4 million homes in Quebec (20% of Canadian households) and offers services up to 10Mbit/s downstream and 800kbit/s upstream to all homes passed, with an unquoted proportion (unequal to 100%) able to receive speeds up to 16Mbit/s downstream and 1Mbit/s upstream.

Alternative Broadband and TeraGo offer symmetric FWA services across Toronto, Markham, Mississauga, Richmond Hill, North York, Rexdale, Brampton, Barrie, London, St. Catherines, Windsor, Winnipeg, Calgary, Kelowna and Victoria (Alternative Broadband) and British Columbia, Alberta, Manitoba, and Ontario (TeraGo). Neither of the two companies provides more accurate coverage information; both offer services up to 100Mbit/s. We have assumed that 50% of the population in the areas listed above is

covered, equating to a total of 45% of the Canadian population. As a result, this estimate is subject to a lower level of confidence.

A pre-WiMAX network, Inukshuk, was launched by Rogers Communications and Bell Canada in September 2005 and aims to reach more than two-thirds of the Canadian population within three years. The network currently covers 40% of the population, however no speed or pricing details are available and this network has been excluded from our estimates.

As of the end of 2004, 89% of the Canadian population had access to broadband.[12]

3.5 France

Local loop unbundling (LLUB) has proved popular in the French broadband market, with a number of operators launching services that offer speeds 'up to' (*'jusqu'à'*) a particular speed. In these cases, subscribers receive the highest downstream speed available, up to a maximum limit, given their line characteristics. It is often the case that the line can support a higher speed than the user receives due to 'designed-in' contention. This study reports the maximum possible speed excluding this contention, rather than that actually experienced by end-users as this is dependent on the individual service provider.

In addition, the cable network operators offer high-speed broadband services up to 20Mbit/s.

Broadband coverage by downstream and upstream speeds in France is shown in Exhibit 3.11 and Exhibit 3.12 respectively.

12 Source: Canadian Radio-television and Telecommunications Commission.

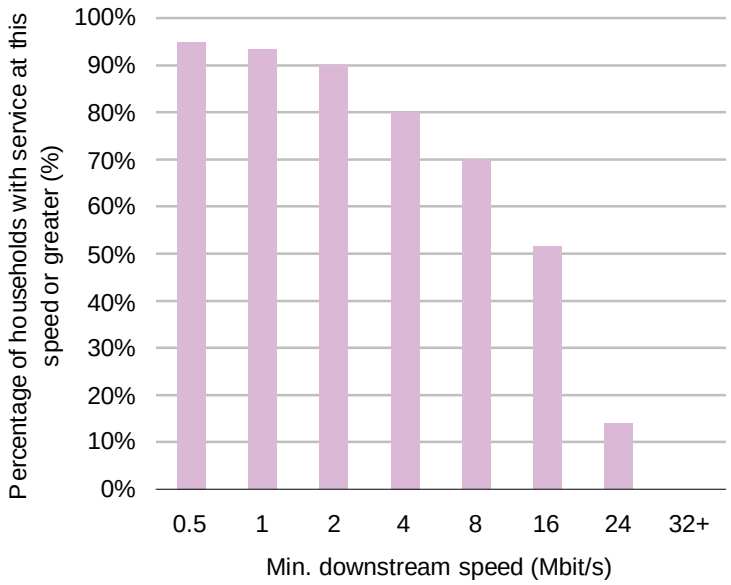

Exhibit 3.11:

French downstream coverage, Q1 2006

[Source: Analysys]

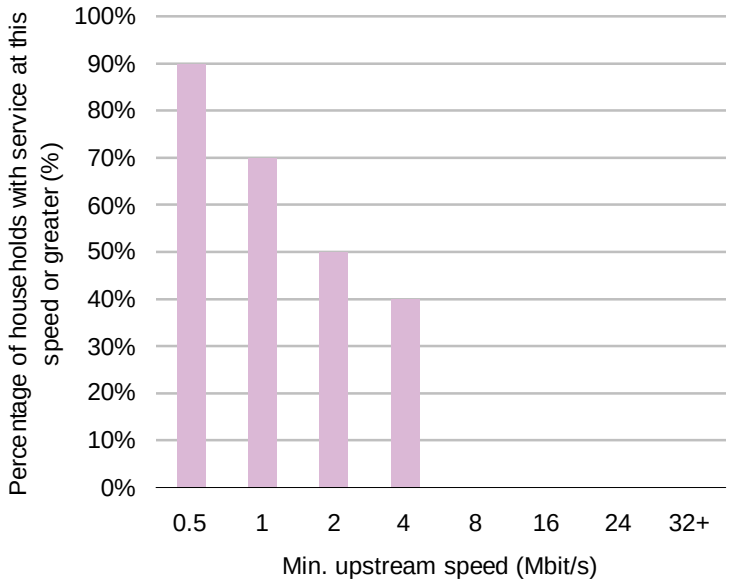

Exhibit 3.12:

French upstream coverage, Q1 2006

[Source: Analysys]

Data gathered and estimations

As of the end of June 2005, France Telecom covered 92% of the French population and expected to reach 96% by the end of 2005 and 97% by the end of 2006. The company

offers ADSL2+ services at up to 18Mbit/s downstream (and 1Mbit/s upstream), with symmetric services up to 4Mbit/s.

LLUB has proven popular in France, with 54% of households and approximately 55% of businesses connected to unbundled exchanges as of the end of March 2006.[13] Free (part of the Iliad group) has 'more than 1500 unbundled local areas'[14] and offers ADSL2+ services up to 24Mbit/s (with 1Mbit/s upstream). For non-unbundled lines, the company offers up to 10Mbit/s downstream and 1Mbit/s upstream. Exact details on the number of lines connected to unbundled exchanges is not available. AOL France offers ADSL2+ services up to 18Mbit/s in unbundled areas but, again, the number of exchanges is not available. Tiscali France offers services up to 20Mbit/s in unbundled areas and we expect that this coverage overlaps entirely with other operators.

In August 2005, neuf telecom and Cegetel merged to form Neuf Cegetel. By March 2006, the company was able to serve 70% of the population via its unbundled ADSL2+ network at up to 20Mbit/s downstream and 1Mbit/s upstream.

AFORM (the Association Française des Opérateurs de Réseaux Multiservices) reported in June 2004 that there were 8.9 million households marketable by the French cable operators, of which 6.34 million (71%) were cable-modem enabled (25% of French households). AFORM does not provide any more recent data on its Web site.

During March 2005, Cinven acquired both NC Numericable (which passes 1.7 million Internet-capable homes out of 2.31 million total marketable homes) and France Telecom Cable (1.53 million marketable homes – Analysys estimates that 1.1 million of these are cable-modem capable). The combined operator, currently operating under the Numericable brand, is planned to operate under the name 'Ypso' and offers cable-modem services at up to 20Mbit/s (512kbit/s upstream).

The combined UPC and Noos networks, now owned by UnitedGlobalCom Inc. (UGC), were able to offer services up to 20Mbit/s to 3.36 million French households, with upstream speeds of 512kbit/s There are also a number of smaller cable network operators in France offering cable-modem services (for example, Est Vidéocommunication) that

13 Source: ORTEL (Observatoire Régional des Télécommunications), France Telecom.

14 Source: www.iliad.fr. – note that these do not equate to local exchanges.

account for less than 10% of the total marketable homes. The cable networks of these operators do not overlap.

3.6 Germany

We have received very few responses from German operators to our enquiries, and data on broadband coverage is hard to come by. The results in this section are therefore based on approximations using the small amount of data that is available and are subject to lower levels of confidence. Deutsche Telekom has announced plans to roll out a VDSL network to customers, potentially offering speeds in the 50-100Mbit/s range downstream (over short distances). However, the company has requested special regulatory treatment in relation to this new infrastructure. . The progress of this request, as well as of the network roll-out, will be of interest over the next few months.

Exhibit 3.13 and Exhibit 3.14 below show the respective coverage of downstream and upstream services in Germany.

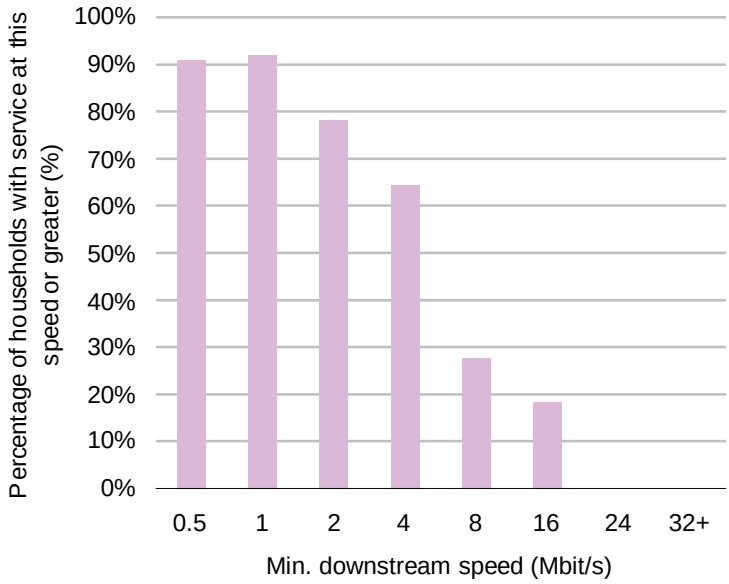

Exhibit 3.13: *German downstream coverage, Q1 2006. NOTE: this chart is subject to a lower level of confidence [Source: Analysys]*

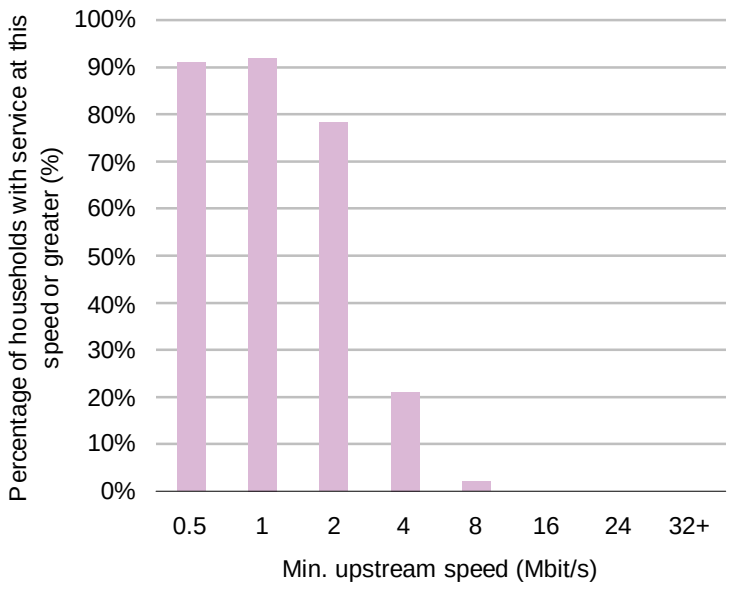

Exhibit 3.14:
German upstream coverage, Q1 2006. NOTE: this chart is subject to a lower level of confidence [Source: Analysys]

Data gathered and estimations

At December 2005, T-Online offered basic DSL to over 91% of German households at speeds of up to 6Mbit/s (576kbit/s upstream), with plans to launch services up to 16Mbit/s in May 2006. The company also offers SDSL services up to 2Mbit/s.

Arcor offers ADSL2+ services at up to 16Mbit/s to 46% of the German population, as well as reselling Deutsche Telekom's wholesale services and offering symmetric services at up to 4Mbit/s. Hansenet (under the Alice brand) offers ADSL2+ services up to 16Mbit/s to residential users. These operators also offer symmetric services of varying speeds (Hansenet offers SDSL up to 9.2Mbit/s). There is little in the way of coverage data available for these organisations.

Analysys estimates that local loop unbundlers in Germany are present in exchanges covering 50% of the German population. However, due to the lack of coverage information available from German operators, this estimate is subject to a lower level of confidence.

3.7 Ireland

The Irish broadband market has had a slow start, with little new investment from eircom until recently and a low percentage of the cable networks being upgraded to offer cable-modem services. However, LLU is showing signs of increased effectiveness with some higher speed services becoming available from players such as Magnet Networks (which is offering speeds up to 24Mbit/s),[15] Smart Telecom and BT Ireland. FWA services also provide a sizeable amount of coverage.

Broadband coverage by downstream and upstream speeds in Ireland is shown in Exhibit 3.15 and Exhibit 3.16 respectively.

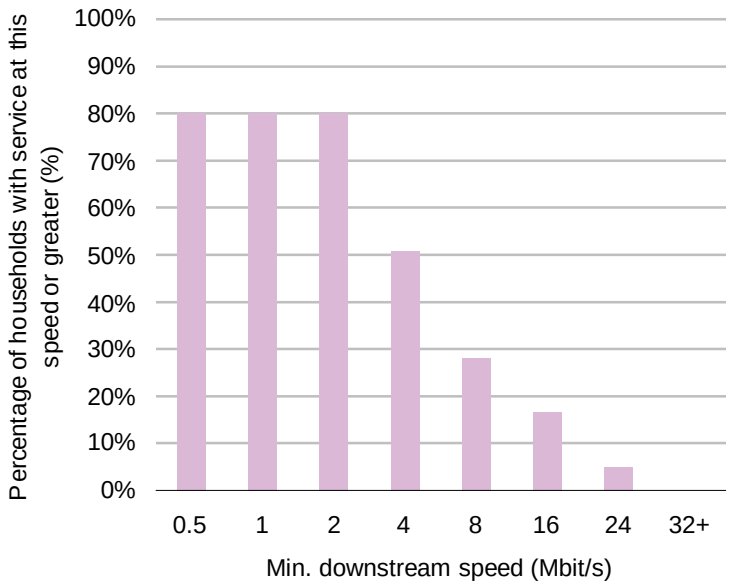

Exhibit 3.15:
Irish downstream coverage, Q1 2006
[Source: Analysys]

[15] http://www.magnetnetworks.com/news/27-11-05.shtml.

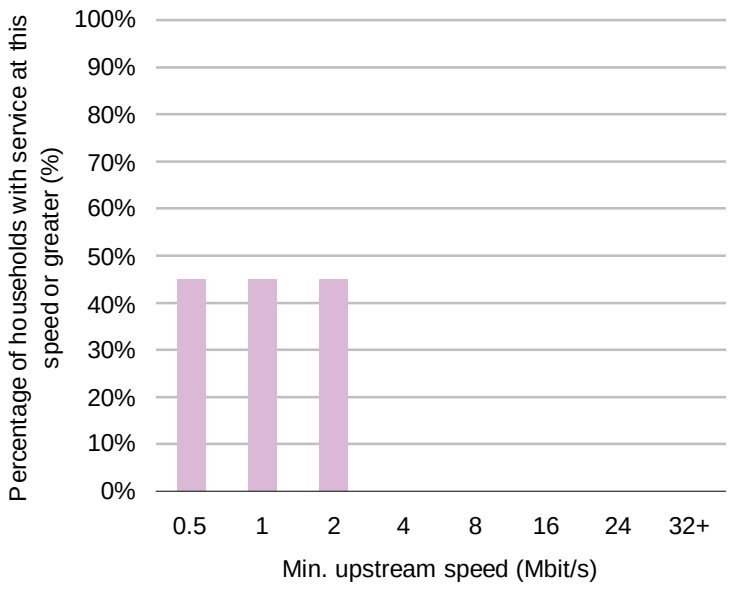

Exhibit 3.16:

Irish upstream coverage, Q1 2006

[Source: Analysys]

Data gathered and estimations

As of April 2006, 85% of eircom's lines were connected to an ADSL-enabled exchange. However, the prospectus issued by eircom prior to the acquisition of the Meteor Group (August 2005) states that, as of March 2005, approximately 77% of lines connected to DSL-enabled exchanges are capable of carrying ADSL at speeds from 1Mbit/s to 4Mbit/s. eircom can therefore currently supply ADSL services to around 65% of Irish households. The company offers residential services up to 3Mbit/s (384kbit/s upstream), with business services up to 5Mbit/s (512kbit/s upstream).

BT Ireland (Esat BT) offers ADSL services over unbundled local loops up to 3Mbit/s, as well as using eircom's wholesale products. The company estimates that its unbundled exchanges cover approximately 400 000 lines.

During March 2006, Smart Telecom announced that it would increase its downstream speeds to 6Mbit/s and upstream speeds to 512kbit/s. It has begun a programme of unbundling exchanges and offers 2Mbit/s ADSL services. As of June 2005, the company had unbundled 18 exchanges and planned to reach 64 by the end of the year. Detailed coverage information is not available, although the company has stated that it will be able

to provide access to over 1 million residential customers once its unbundling programme is completed.

Leap Broadband offers ADSL services at up to 2Mbit/s, SDSL services at up to 2Mbit/s and wireless services at up to 4Mbit/s (asymmetrical) and 2Mbit/s (symmetrical). Wireless services are available in Dublin, Galway, Cork and Limerick, with ADSL services offered on both a wholesale basis from eircom and via unbundled local loops in the Dublin and Leinster regions. Magnet Networks, which is owned by the same company as Leap Broadband, offers ADSL2+ up to 24Mbit/s services to approximately 700 000 homes. The company has stated that most installed lines have been able to support speeds which enabled the use of triple play services (a minimum of 12Mbit/s). The company also offers a fibre-to-the-home (FTTH) service to a limited number of housing developments in Ireland, with 30 000 homes in its development pipeline over the next three years.

At the start of September 2005, Digiweb launched its Metro service, offering wireless broadband services up to 6Mbit/s (in Dublin, Cork, Limerick, Galway, Waterford and Dundalk, with upstream speeds up to 2Mbit/s). DSL-based services are offered up to 4Mbit/s through approximately 140 enabled exchanges. The company plans to offer services to 70% of the population by Q2/Q3 2006. Detailed coverage information is not available.

A number of other FWA operators are active in the Irish market, offering symmetric services up to 3Mbit/s, although, as is the case for most of the Irish market, coverage information has been scarce. Irish Broadband covers 500 000 households in 23 cities (37% of Irish households, including Dublin, Cork, Galway, Waterford and Limerick). Nova Networks operates in Cork city and its suburbs. Last Mile Broadband serves Westmeath, Offaly, Roscommon, Longford and some of the surrounding regions. Analysys estimates that up to 45% of Irish households can receive FWA services, although much of this coverage will overlap with eircom's network.

ntl and Chorus, now both owned by Liberty Global/UPC, offer broadband services up to 6Mbit/s and 3Mbit/s respectively. ntl's network can supply broadband services to approximately 10% of Irish households. This coverage overlaps, on the whole, with eircom's DSL footprint. Analysys estimates that 14% of households are covered by the combined footprint of Chorus and ntl.

3.8 Italy

The Italian market has provided a case study for FTTH in the form of FastWeb. ADSL speeds on offer from Telecom Italia have historically been low, although this has changed since the middle of 2005 as both the incumbent and local loop unbundlers have introduced higher-speed services.

Exhibit 3.17 and Exhibit 3.18 below show the respective coverage of upstream and downstream services in Italy.

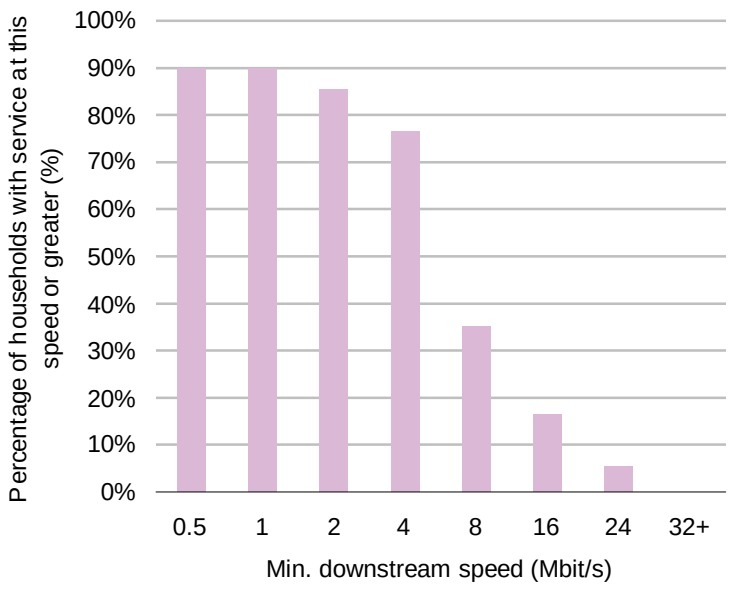

Exhibit 3.17:

Italian downstream coverage, Q1 2006

[Source: Analysys]

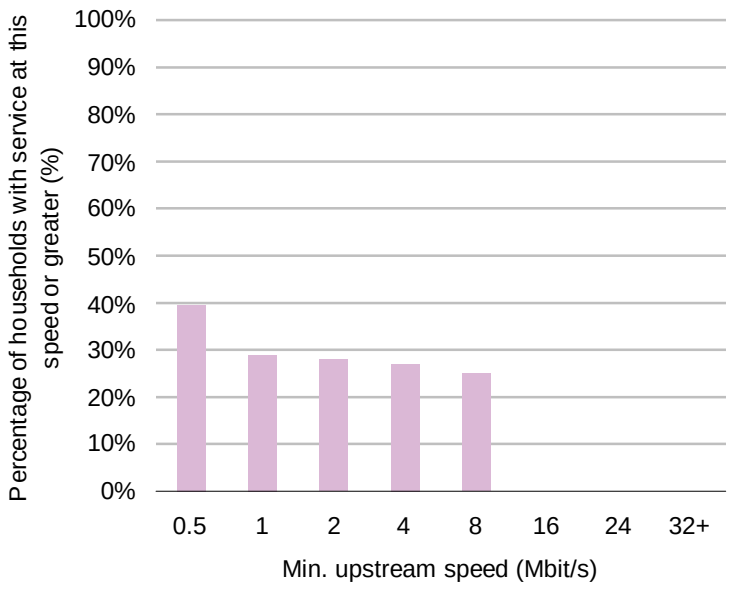

Exhibit 3.18:

Italian upstream coverage, Q1 2006 [Source: Analysys]

Data gathered and estimations

At the end of 2005, Telecom Italia had enabled exchanges covering 90% of Italian households. The company offers ADSL services up to 4Mbit/s (256kbit/s upstream), with the highest speed available to 85% of connections. The company also offers symmetric HDSL services to businesses, running at up to 8Mbit/s.[16] There are no coverage figures for this service and we estimate that it is available to 25% of Italian households/businesses. In addition, the 8Mbit/s service will not be available to the full footprint.

FastWeb has unbundled exchanges covering 33% of the population and offers ADSL services of 6Mbit/s (at 512kbit/s upstream),[17] along with symmetric FTTH services of 10Mbit/s to a further 6.5% of the population. Wind is also active in unbundling and, as of December 2005, covered approximately 30% of the Italian population.[18] The company offers ADSL services up to 4Mbit/s, with ADSL2+ up to 12Mbit/s (1Mbit/s upstream). When FastWeb was rumoured to be considering acquiring Wind during 2004, it was stated that the combined coverage of the

16 Source: www.191.it; *Interbusiness Liberty* product.

17 10% of lines are unable to support video services due to loop length/quality.

18 Source: Presentation "Wind Strategy Update", 17 May 2005.

two organisations would be 30% of the Italian population. The vast majority of Wind's coverage can therefore be expected to overlap with FastWeb.

As of December 2005, Tiscali had unbundled exchanges serving approximately 40% of the Italian population. The company offers ADSL2+ services up to 24Mbit/s.

3.9 Japan

VDSL and FTTH are the main access technologies in Japan, with some cable-modem coverage providing overlapping coverage. The broadband providers in Japan do not provide a breakdown of their coverage levels by speed.

The coverage of downstream and upstream services in Japan is illustrated in Exhibit 3.19 and Exhibit 3.20 respectively.

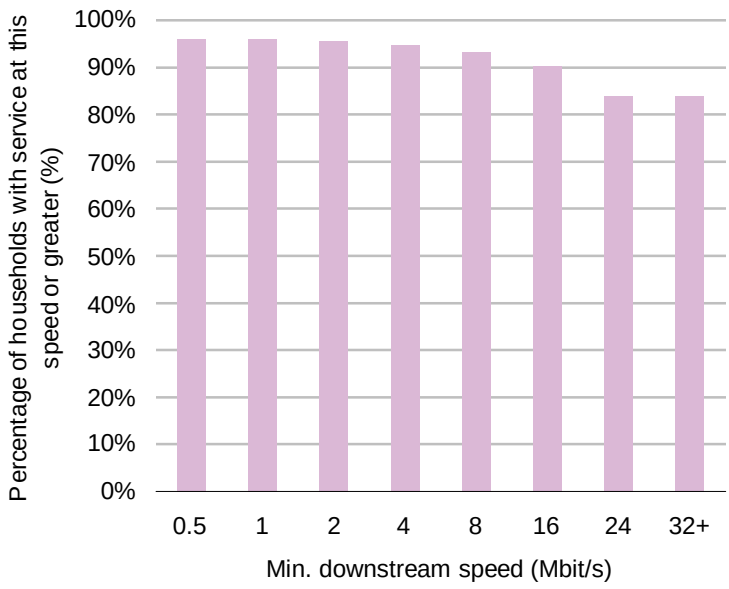

Exhibit 3.19: *Japanese downstream coverage, Q1 2006 [Source: Analysys]*

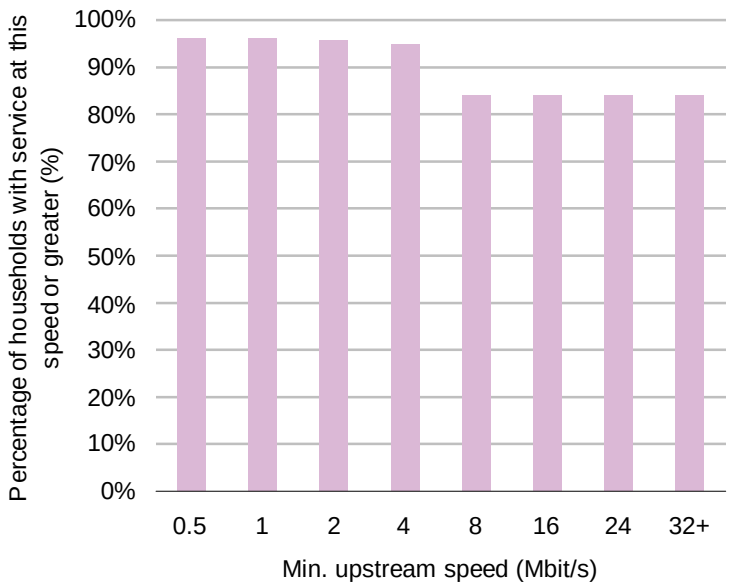

Exhibit 3.20:

Japanese upstream coverage, Q1 2006

[Source: Analysys]

Data gathered and estimations

In Japan, fibre extends closer to the customer than in many other countries and, due to the short length of copper to the end user, it can support much higher speeds than would otherwise be the case.

According to a survey released by the Ministry of Internal Affairs and Communications in December 2004, broadband is not available to 11.5% of Japanese municipalities. These municipalities are mainly in rural and mountainous areas and are not heavily populated, so the corresponding number for the percentage of population not covered is much lower.

NTT states that it offers VDSL broadband services to more than 95% of Japanese households at up to 50Mbit/s, but does not split this coverage down by speed. Similarly, Yahoo! states that it can serve 90% of telephone lines with VDSL services up to 50Mbit/s, but does not provide a breakdown by speed. It should be noted that the performance of VDSL falls off very much more rapidly than other DSL variants such as ADSL and ADSL2+. Exhibit 3.19 above shows a conservative estimate of this in Japan given the short line lengths.

Symmetric services are available in Japan over fibre . NTT West's business plan for 2005/06 stating that the company aimed to have fibre optic coverage of 84% by the end of March 2006, increasing to 87% by March 2007. Similarly, NTT East's business plan states a coverage target of 85% (to increase to 88% by March 2007). This fibre will be used to support fibre-to-the-home borne-services (FTTH) and fibre to the basement or curb (FTTB/X) along with LAN Ethernet within buildings, or VDSL, for the final connection. NTT is targeting overall fibre coverage of 100% by the end of the decade and offers fibre services up to 100Mbit/s. NTT also offers ADSL services at up to 47Mbit/s (5Mbit/s upstream). Yahoo! offers 100Mbit/s symmetric services to around 1500 central offices, with the main 2000 central offices serving 80% of the population.

3.10 South Korea

Korea Telecom and Hanaro control around 90% of the South Korean broadband market, with widespread availability of fibre-based services boosting coverage.

Exhibit 3.21 and Exhibit 3.22 below show the respective coverage of downstream and upstream services in South Korea.

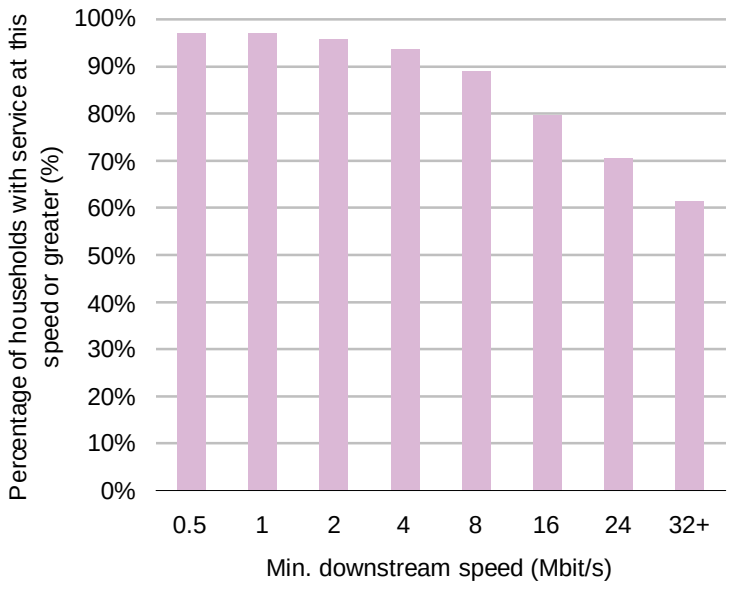

Exhibit 3.21: *South Korean downstream coverage, Q1 2006 [Source: Analysys]*

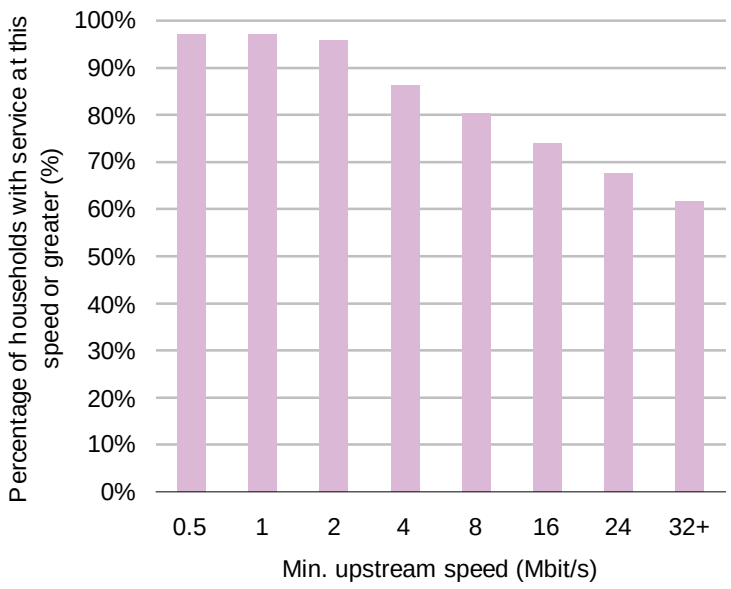

Exhibit 3.22:

South Korean upstream coverage, Q1 2006 [Source: Analysys]

Data gathered and estimations

As of the end of 2005, Korea Telecom's Megapass services covered 95% of the Korean territory through xDSL, FTTH, WLAN and satellite services. The company offers ADSL and VDSL services, running at up to 8Mbit/s over ADSL and 50Mbit/s over VDSL. Korea Telecom also offers FTTB/H services at up to 100Mbit/s. Not all households will receive the highest speeds possible due to the fall-off in performance of xDSL technologies.

At the end of 2005, the combined Hanaro-Thrunet could offer Internet services to 12.57 million households (80% of the national total) through hybrid fibre coax or xDSL. Its HFC services ran at up to 10Mbit/s and covered 8.6 million households at the end of 2005. ADSL and VDSL services are available at up to 20Mbit/s, with 2 million homes able to receive VDSL services by the end of March 2006. It covers 4.7 million households (30% of the national total) with FTTx and 2.2 million homes (14% of the total) with FTTH services at 100Mbit/s. A further 160 000 households are covered by FWA at 2Mbit/s.

Broadband availability in Korea was of the order of 97% as of the end of September 2005.[19]

19 Source: Ovum.

In South Korea, as is the case in Japan, fibre extends closer to the customer than in many other countries. xDSL technologies can therefore support much higher speeds than in other countries.

3.11 Sweden

ADSL2+ and VDSL services in Sweden, combined with FTTH availability from B2 Bredbandsbolaget and high-speed services available from the cable network operators, contribute to Sweden's high availability of sophisticated broadband.

Exhibit 3.23 and Exhibit 3.24 below show the respective coverage of upstream and downstream bandwidths in Sweden.

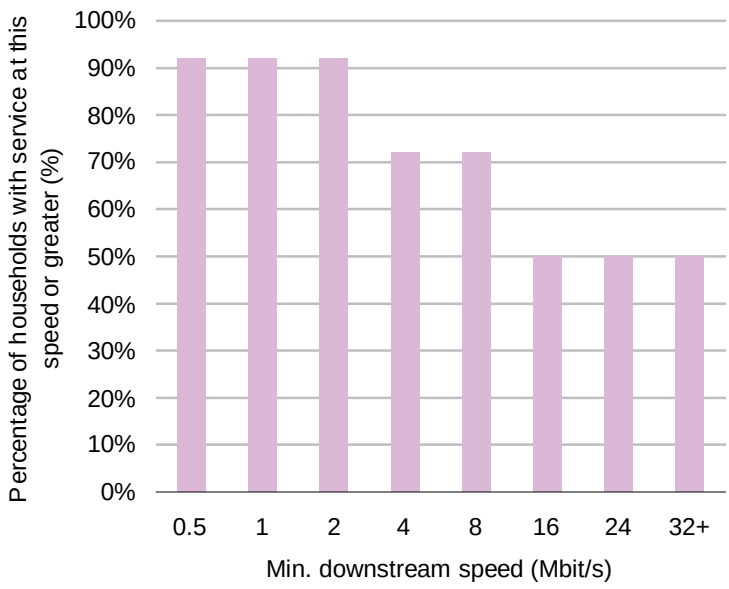

Exhibit 3.23: *Swedish downstream coverage, Q1 2006 [Source: Analysys]*

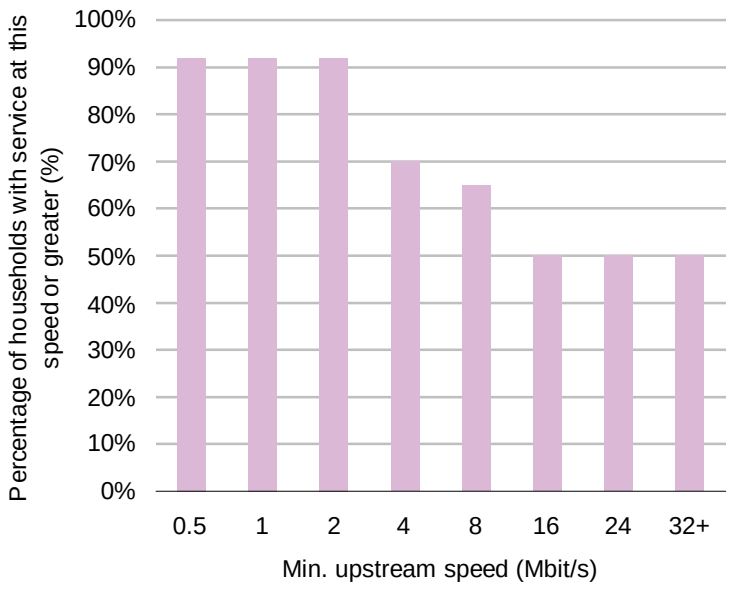

Exhibit 3.24:

Swedish upstream coverage, Q1 2006

[Source: Analysys]

Data gathered and estimations

TeliaSonera offers ADSL, ADSL2+ and Ethernet services up to 24Mbit/s to the Swedish population, with 92% of households being able to receive services up to 2Mbit/s, falling to 20% for 24Mbit/s. The company's coverage overlaps 60% with competitors such as Telenor, Song Networks and B2 Bredbandsbolaget.

B2 Bredbandsbolaget offers ADSL, ADSL2+, VDSL, Ethernet and FTTH services running up to 100Mbit/s. The company's network passes 2.2 million homes (52% of the national total). FTTH is available to 300 000 households (7% of the national total).

Song Networks offers ADSL and ADSL2+ services to approximately 30% of the Swedish residential market. Meanwhile, Tele2 offers ADSL services up to 8Mbit/s.

In addition to xDSL and fibre providers, cable network operators such as comhem and UPC offer high-speed cable-modem services to 24% and 6.8% of households respectively. UPC's services run at up to 24Mbit/s (8Mbit/s upstream), with comhem offering up to 8Mbit/s (1Mbit/s upstream).

Based on information from contacts within the Swedish telecoms industry, around 50% of Swedish businesses have access to upstream services, with fibre available on most business parks of an average size or greater. SDSL is widely available in Sweden. We have

estimated fibre availability at 50% of households, with SDSL services available on a comparable basis to ADSL.

3.12 The USA

Both DSL and cable-modem services offer high-speed services in the USA, with DSL typically running up to 3Mbit/s (although Covad offers 6Mbit/s ADSL services). Cable-modem services are available up to 10Mbit/s, although the available speed depends on the network. Higher speed services are becoming available through an increase in the number of homes passed by fibre, for example through the roll-out of services by Verizon.

Downstream and upstream coverage in the USA is respectively shown in Exhibit 3.25 and Exhibit 3.26 below.

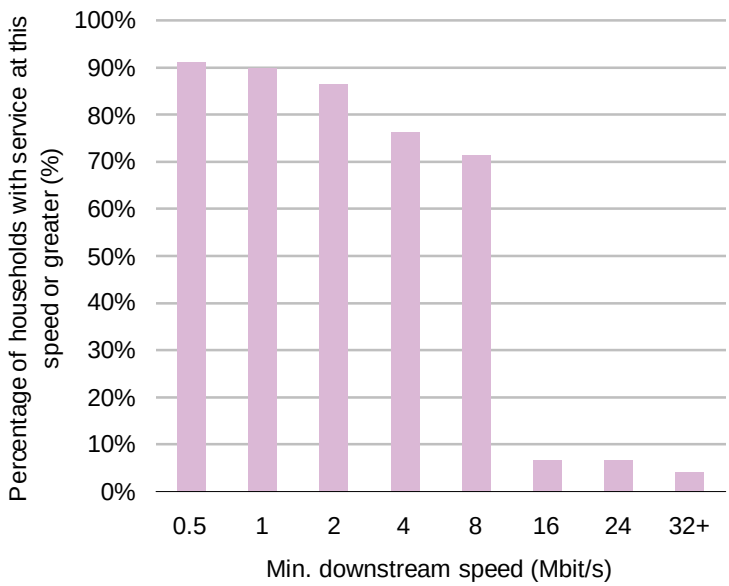

Exhibit 3.25:

US downstream coverage, Q1 2006

[Source: Analysys]

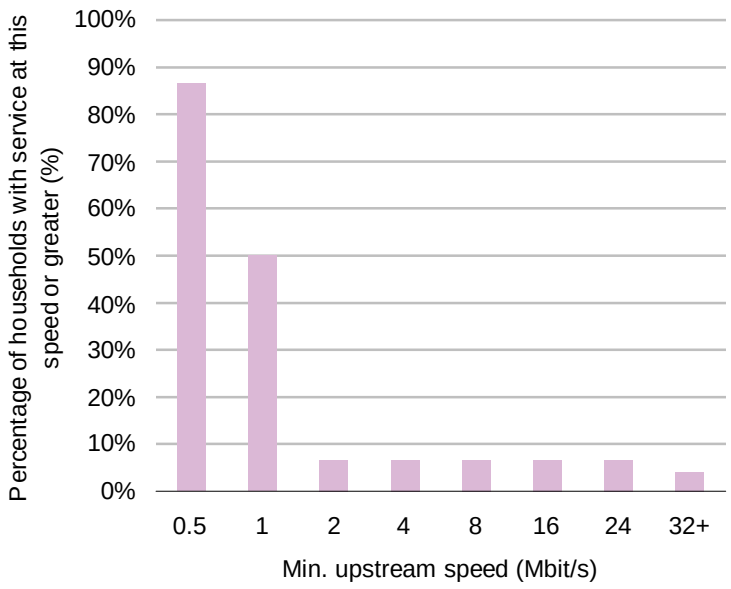

Exhibit 3.26:

US upstream coverage, Q1 2006 [Source: Analysys]

Data gathered and estimations

As of February 2006, FTTH deployments passed over 3.6 million homes, an increase of approximately 1 million over four months.[20]

DSL services are available from a wide range of incumbent local exchange carriers (ILECs) and competitive local exchange carriers (CLECs), with a number of cable network operators offering cable-modem services. The ILECs are: Bellsouth, Qwest, Verizon and SBC.

Bellsouth offers ADSL services up to 6Mbit/s (512kbit/s upstream). The company passes 16 million homes, of which 85% are DSL-enabled, with approximately 40% of this figure able to receive 6Mbit/s downstream.

Verizon's network passes 33% of the US population. ADSL reach is only around 80% due to line length/quality issues, resulting in ADSL coverage of 26% of US households from Verizon with speeds up to 3Mbit/s (768kbit/s upstream). The company estimates that more than 50% of homes passed can receive this speed. It also offers upstream services through

20 Source: Fiber-to-the-Home (FTTH) Council and the Telecommunications Industry Association (TIA).

both FTTP[21] (which reached 3 million homes by the end of 2005 – 3% of the US total – at speeds of 5, 15 and 30Mbit/s) and by 'tuning' ADSL lines to offer upstream services up to 1.5Mbit/s.

AT&T (formerly SBC) offers ADSL services up to 6Mbit/s (608kbit/s upstream) to around 30% of the US population, as well as symmetric services up to 1.5Mbit/s. AT&T began a controlled market launch of Project Lightspeed in December 2005, and expects to reach 18 million households by the end of 2008 with speeds of 20-25Mbit/s

Qwest offers DSL downstream services up to 5Mbit/s to 7.6 million households (6.9% of national households). The upstream speed for the 5Mbit/s service is around 768kbit/s.

Covad offers ADSL services up to 6Mbit/s to 50% of national households, with 18% of national households able to receive 3Mbit/s services and 16% able to receive 6Mbit/s. The company also offers SDSL services up to 1.5Mbit/s over the same footprint.

Comcast offers cable-modem services up to 8Mbit/s (768kbit/s upstream) to 41 million homes (37%), although its highest speed services are not yet available across the whole of its network. RCN offers cable-modem services up to 20Mbit/s over its network. Analysys estimates that RCN's network passes approximately 5% of US households, although coverage of the 20Mbit/s service represents only 0.5% of US households. Similarly, Mediacom, which passes 2.8 million homes, provide cable-modem services of up to 10Mbit/s (1Mbit/s upstream) to less than 3% of US households.

Cox Communications' cable network provide cable-modem service up to 9Mbit/s (1Mbit/s upstream) to 9.6% of US households, although the highest speed services are only available to 50% of these households. Cox Communications' network completely overlaps with DSL coverage from the ILECs and CLECs.

Charter Communications offers cable-modem services up to 3Mbit/s to 10% of US households. Time Warner passes more than 19 million homes (17.5%) with services up to 8Mbit/s. Cablevision offers speeds up to 30Mbit/s downstream and 2Mbit/s upstream to 4% of US households, and symmetric services up to 50Mbit/s.

21 Fibre-to-the-premise.

4 Usage of sophisticated broadband services – results

This section contains the Q4 2005 results for sophisticated broadband usage in the countries under study. The following indicators are covered, with definitions for each indicator available in the results section below:

- business indicators
  - broadband businesses ordering online
  - use of wireless LANs
  - use of VoIP
  - broadband businesses transacting with government online
  - ecommerce revenue

- residential indicators
  - downloading TV, video and movie clips
  - use of online gaming
  - use of VoIP
  - ecommerce spend

The results for all of these indicators are based on estimates produced by Analysys through reference to free, publicly available data sources. The indicators have been estimated as at the end of Q4 2005.

The residential indicators have been chosen following a BSG Metrics Group survey and approval of the choices by the DTI.

In addition, the report contains two short trends analysis articles focusing on the state of a particular service and discussing market developments:

- Will increasing broadband speeds create consumer demand for online storage?
- Usage capped broadband services.

4.1 Methodology for business indicators

The business indicators specifically look at usage by businesses with broadband, compared with usage by businesses with narrowband Internet access to see if there are discernible differences in usage or take-up patterns. A broadband business is defined as a business with at least one Internet connection that is faster than 256kbit/s. Businesses that have leased lines and fibre connections are therefore included, along with those that use mass-market broadband services based on cable modem, Ethernet or xDSL.

The business indicators rely heavily on analysis of survey data collected for previous iterations of the *Business in the Information Age* study, undertaken by the DTI. The survey data for the *Business in the Information Age* study covers all the countries addressed by this study, although the numbers of responses in individual countries are sometimes quite small. For instance, while the average number of respondents per country claiming narrowband was 214 in 2002, by 2004 this had dropped to an average of 177 per country, and in Korea in 2004 the number of respondents using narrowband Internet in 2004 was only 10. Consequently, in these cases a higher error margin applies.

Exhibit 4.1 and Exhibit 4.2 below show the number and percentage of respondents to the *Business in the Information Age* study in 2004 who had either narrowband or broadband access. The total number of companies surveyed includes those without access to the Internet. In the UK, 2716 interviews were conducted in total, and 500 interviews were conducted in each of the other countries.

	Broadband respondents 2004	*Narrowband respondents 2004*
UK	1052	904
Australia	180	153
Canada	208	133
France	193	146
Germany	191	71
Ireland	195	141
Italy	216	89
Japan	219	73
South Korea	302	10
Sweden	252	82
US	213	144
Average	**293**	**177**

Exhibit 4.1: *Sample sizes for the most recent study [Source: Analysys]*

	Broadband respondents	*Narrowband respondents*
UK	39%	33%
Australia	36%	31%
Canada	42%	27%
France	39%	29%
Germany	38%	14%
Ireland	39%	28%
Italy	43%	18%
Japan	44%	15%
South Korea	60%	2%
Sweden	50%	16%
US	43%	29%
Average	**43%**	**22%**

Exhibit 4.2: *Implied broadband and narrowband penetration [Source: Analysys]*

The results in this study are not presented in the same way as in the *Business in the Information Age* study. In that study, the phrase '30% of businesses' meant businesses representing 30% of *employees* in the country. In this study, '30% of businesses' means 30% of all entities, irrespective of the number of employees they represent. This approach maximises the likelihood of identifying compatible data sets for other countries during the study period as other sources we have found are not presented in the same way as the *Business in the Information Age* study.

In addition to showing usage as a percentage of broadband and narrowband businesses, many of the business indicators show usage or take-up as a percentage of all businesses. This means take-up as a percentage of all businesses that participated in the survey, irrespective of whether they had an Internet connection or not.

Business in the Information Age has not been updated since its April 2005 iteration. However, some more recent reliable data has become publicly available since this data was published. For the business VoIP indicator, the *Business in the Information Age* data are cross-referenced against detailed research that Analysys has conducted into business VoIP in Western Europe. In addition, it has been possible to gather some reliable data from national statistical agencies, as well as government and regulatory bodies. Nonetheless, there was a shortage of new data for some indicators and some countries. It was therefore necessary to make estimates for Q4 2005 based on historic growth trends and by examining trends in comparable indicators, incorporating new data where available. Estimates made on the basis of historic growth trends were compared, where possible, with more complete data series for peer countries that historically have had a similar usage pattern for the metric in question at an equivalent point in their development. We have also cross-checked with other national indicators such as the recent growth of enterprise broadband usage and current levels of broadband penetration. The new data that is available does not typically make a distinction between broadband and narrowband businesses, presenting data in aggregated form. As such, the data is useful for understanding how the overall size and growth of the market, but it does not tell us the split between broadband and narrowband. To estimate the difference in usage patterns between narrowband and broadband businesses, past differences were observed as well as trends of growth or decline in usage for each of the indicators through time.

As the 2005 estimates are drawn from several sources, it is not possible to express the expected accuracy of the results in terms of a percentage error margin. We have therefore devised a colour coding mechanism for the business usage charts, which provides information about the quality of the underlying information. The colour coding scheme shows comparative confidence levels between different data points. Those with the highest confidence levels do not necessarily have a small margin for error, but they are those data points that we believe are the most reliable.

Colour coding on residential chart	*Comparative confidence*
Full colour bar on chart	Highest confidence: new and reliable data has become available for this estimate of better quality than that derived from extrapolating forward the *Business in the Information Age* 2004 data
Hashed bar on chart	Mid-range confidence: Data is based on the *Business in the Information Age* study with little, if any supporting data

Exhibit 4.3: *Colour coding scheme used for business charts [Source: Analysys]*

4.2 Methodology for residential indicators

For the residential indicators, very few data sets specifically cover broadband usage, with most data sets covering general Internet usage (i.e. both narrowband and broadband). Therefore, the residential indicators included within cover both narrowband and broadband usage.

Extensive effort has been invested to identify sources of data to underpin the residential Internet usage analysis. There are no single sources that provide all of the data sets for any one country, nor are there any metric-specific data sources that address all the countries covered by this study. Moreover, data sources often only cover a single year, or a single project, and have not been repeated. Although more information has been available than for the Q4 2005 estimates produced in the previous iteration of the report, data sets have tended to lag the market by around a year. As a result, Analysys has been required to normalise the different data sets to ensure (as far as is possible) that they cover the same things, and to create some estimates to fill gaps in the data.

The following rules have been used for normalisation and estimation:

- where possible, we have only used sources that are underpinned by a programme of primary market research, and ideally we have only used market research results based on reasonable numbers of responses (always over 250 responses per country, often over 1000 responses per country)
- where no relevant survey data exists for a particular metric in any given country, we have left a gap rather than attempt to estimate a number through comparison with other markets
- we have used linear interpolation to fill small numbers of gaps (one or two missing points) in historical time series

- where historical data exists – but no recent data does (e.g. for Q2 2005) – we have estimated by extrapolation, using the following processes:
  - historical growth rates have been extrapolated forwards
  - the resulting outputs have been compared with
    - more complete data series for peer countries that historically have had a similar level of usage for that metric at an equivalent point in their development
    - reference indicators for the country (such as the recent growth of Internet usage and current levels of Internet penetration)
  - where appropriate, the initial linear extrapolation highlighted above has been adjusted following the comparison process

- where two data sources apparently contradict one another, we have investigated whether:
  - there are definitional differences (e.g. video download *versus* streaming TV and video over the Internet). If this is found to be the case, we have selected the data set that most closely matches the definition of the indicator included in this study. We have used an average score if the definitions of both data sets appear valid
  - there are sampling differences underlying the data set (e.g. the exclusion of certain age groups). In these cases we have used the data with the most comprehensive survey sample
  - there are computational/base differences (e.g. the results have been calculated as a proportion of population, all Internet users, regular Internet users, all households, etc.). In these cases, we have recalibrated the outputs

Due to the fact that the estimates have been created by pulling together results from a wide range of studies and surveys, it is not possible to express the expected accuracy of the results in terms of a percentage error margin. We have therefore devised a colour coding mechanism for the residential usage charts, which provides information about the quality of the underlying information. The colour coding scheme shows comparative confidence levels between different countries within a given indicator. Those with the highest confidence levels do not necessarily have a small margin for error, but they are those data points that we believe are the most reliable.

Colour coding on residential chart	*Comparative confidence*
Full colour bar on chart	Highest confidence: based on reliable series of historical data points or based on one or more reliable, reasonably current data points where available. Normalisation may have been required
Hashed bar on chart	Mid-range confidence: extrapolation or estimation based on a number of historical data points, possibly from different sources. Normalisation is most likely to have been required
Empty boxed bar on chart	Least confidence: substantial extrapolation has been required to estimate from old or sparse data, or performance has been estimated from similar countries

Exhibit 4.4: *Colour coding scheme used for residential charts [Source: Analysys]*

4.3 Results for business indicators

4.3.1 Sources used

An important source of data for the business indicators has been the survey responses underlying the *Business in the Information Age* study which have been aggregated together to a greater level of detail than that contained in the original study. This ensures a consistent set of historical data points for the years 2002 to 2004, on which to base estimates for Q4 2005 where sufficiently detailed new data was unavailable.

The sample sizes for the 2004 data of the *Business in the Information Age* study are as follows – with the exception of the chart for ecommerce revenue which has a separate sample size table in Section 4.3.6.

Country	*Broadband businesses*	*Narrowband businesses*
UK	1052	904
Ireland	195	141
France	193	146
Germany	191	71
Italy	216	89
Sweden	252	82
US	213	144
Canada	208	133
Japan	219	73
Australia	180	153
South Korea	302	10

Exhibit 4.5: *Sample sizes for business metrics [Source: Analysys]*

4.3.2 Broadband businesses ordering online

Definition

The percentage of all broadband businesses in a country that, in the last year, have ordered goods or services from their suppliers using the Internet (irrespective of whether payment was made over the Internet, or whether invoicing was managed separately).

Results and comments

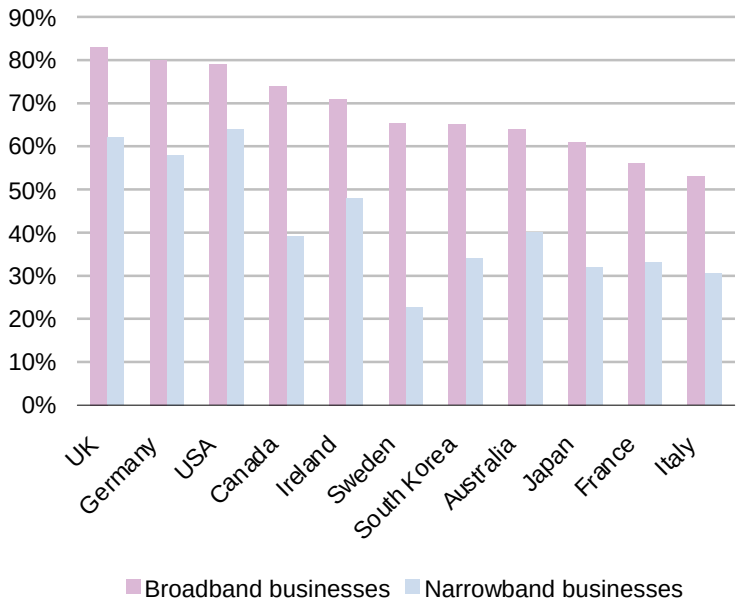

Exhibit 4.6
Percentage of broadband and narrowband businesses ordering online in the year ending December 2005 [Source: Analysys]

New, more recent data has become available and based on this, our previous estimates have been revised upwards. There has therefore been some changes in the ranking of the countries compared to the previous iteration of the report. The percentage of broadband businesses ordering online increased through 2005 and is estimated to be over 70% in Germany, Ireland, the UK and the USA, as illustrated in Exhibit 4.6 above. For all remaining countries, the metric is over 50%. As was the case for the previous iteration, Japan and South Korea remain towards the bottom of the ranking. One might expect that in countries with higher broadband penetration – such as Japan and South Korea – the broadband-using population would include a higher proportion of late broadband adopters (those that have only recently taken broadband). These late adopters might typically be reluctant to use their broadband connections for little more than emailing and Web browsing. This would mean that although a country has many broadband companies ordering online, that country has a low score when the indicator is expressed as a percentage of all broadband Internet users. France and Italy are also towards the bottom of the ranking and are poor performers on the ecommerce revenue indicators.

More recent data has now become available on the percentage of businesses ordering online, enabling us to improve on the Q2 2005 estimates (which were based largely on the *Business in the Information Age* study). Sources used include the Australian, Canadian and Irish national statistics agencies, the Japanese ministry and e-Business W@tch.[22] The new data does not distinguish between broadband and narrowband businesses, so historical information from the *Business in the Information Age* study was used to guide estimates for the difference in percentage of broadband and narrowband businesses ordering online.

4.3.3 Use of WLAN

Definition

The percentage of all broadband businesses in a country that, at the end of June 2005, have at least one private WLAN hotspot. This excludes businesses that merely allow their employees to make occasional use of public WLAN services.

22 An EU body set up to monitor business ecommerce in the EU.

Results and comments

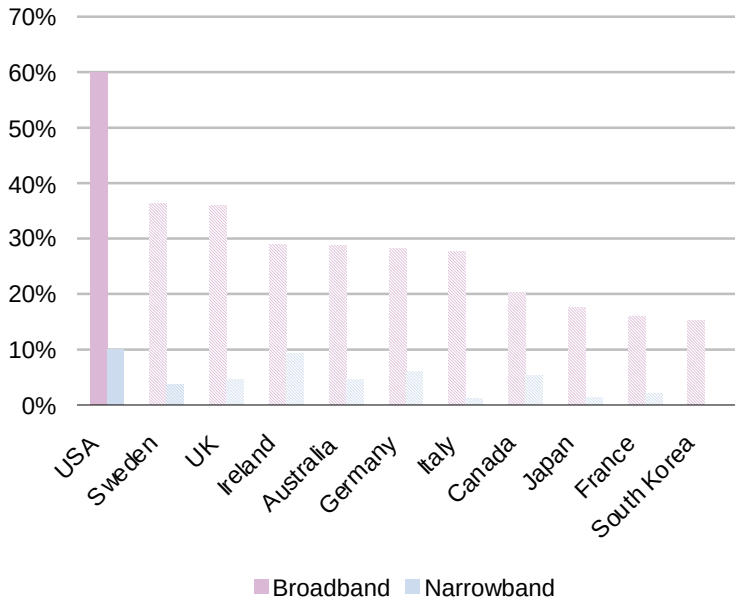

Exhibit 4.7: *Percentage of broadband and narrowband businesses with a WLAN in December 2005 [Source: Analysys]*

The percentage of broadband businesses with a WLAN hotspot has shown strong growth in the second half of 2005, in line with past growth trends. Japan, France and South Korea remain at the bottom of the ranking for the percentage of broadband businesses using private WLANs. Strong trend growth in Sweden and revised data for the USA have pushed these countries towards the top of the ranking, while weaker growth in Germany mean it has dropped down the ranking compared to Q2 2005.

This data is derived by projecting forward the source data from the *Business in the Information Age* study, adjusted where necessary according to the process explained earlier.

4.3.4 Use of VoIP

Definition

The percentage of all broadband businesses in the country that, at the year end, were using IP telephony services. The measure includes occasional use as well as use across a sub-set of company sites. It includes voice over broadband solutions delivered by public network

operators and also business site-to-site calling over the private corporate network. The measure excludes use of free PC-based software products that enable PC-to-PC calling.

Results and comments

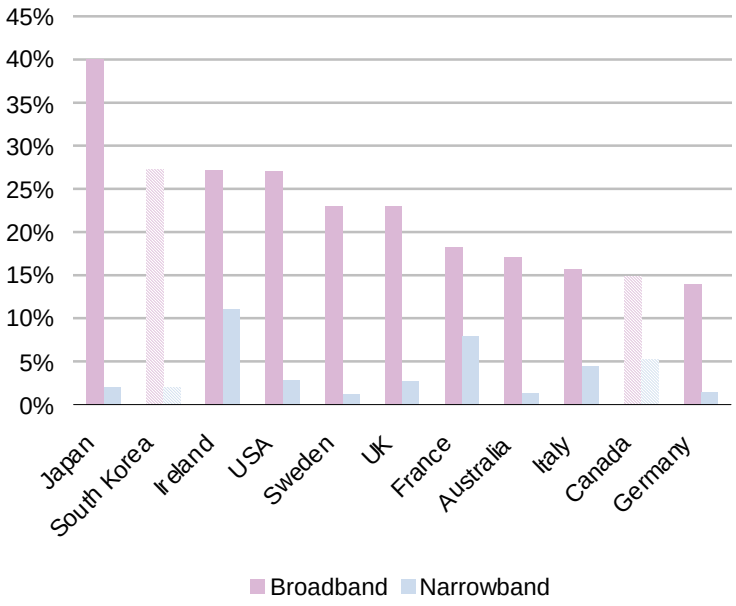

Exhibit 4.8: *Broadband and narrowband businesses using VoIP, December 2005 [Source: Analysys]*

Based on strong growth in consumer VoIP and strong growth in the percentage of broadband businesses using VoIP during the year to December 2004, the percentage of broadband businesses with VoIP has been predicted to have grown in most countries during 2005. This is supported by findings from detailed research conducted by Analysys on enterprise spending on VoIP. With Ireland experiencing rapid growth in broadband penetration, VoIP users as a percentage of all broadband businesses is predicted to have declined slightly due to a dilution effect, with new broadband adopters being less likely than existing broadband users to adopt VoIP. This pattern is in line with that experienced in other European countries at equivalent stages in their broadband adoption cycle. However, because broadband penetration in Ireland still remains relatively low, mass market broadband businesses in Ireland will still tend to be more technologically literate than, for example, mass market broadband businesses in the UK or Sweden, where overall take-up is much higher. This early adopter effect explains why Ireland still ranks highly in terms of VoIP usage amongst broadband enterprises.

The data for Japan and the USA has been revised upwards, with new data from third-party studies suggesting that previous estimates were too low. Japan and South Korea enjoy a

business base which is quick to take advantage of new technologies – this is a reflection of cultural attitudes towards the early adoption of emerging technologies.

Careful examination of data from Analysys's own detailed research into business VoIP for businesses employing over 20 people suggests an upward revision to the previous estimates for Germany and Sweden. Even in light of this, consistently low business VoIP take-up based on the *Business in the Information Age* study suggests Germany should remain at the bottom of the rankings.

This data is derived by projecting forward the source data from the *Business in the Information Age* study, adjusted where necessary according to the process explained earlier, including cross-referencing to a separate Analysys study.

4.3.5 Broadband businesses transacting with government online

Definition

The percentage of all broadband businesses in a country that have made online tax or other financial payments to public authorities within the last year. This measure excludes businesses that only make payments by BACS (bankers automated clearing system).

Results and comments

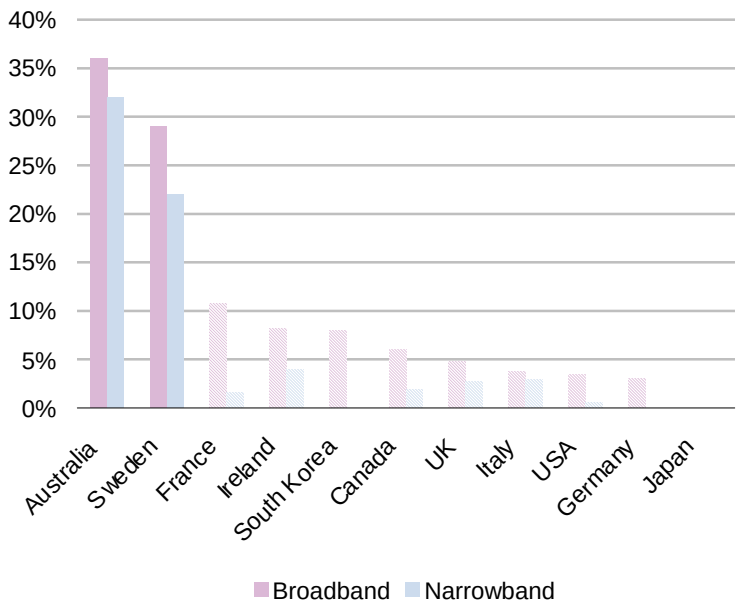

Exhibit 4.9: *Percentage of broadband and narrowband businesses making tax and other payments to public authorities over the Internet, December 2005 [Source: Analysys]*

Surprisingly, given the high level of broadband availability, Japan is ranked last in terms of businesses making payments to public authorities over the Internet, with none of the survey respondents (219 broadband, 73 narrowband) answering the question positively. It may be the case that the Japanese government does not have the processes in place to allow businesses to make such payments, although there may be the capability to submit tax forms without submitting an online payment.

On the other hand, broadband businesses in France, where ecommerce spend by residential users is low as a result of attitudes to personal credit card usage, appear to be amongst the most willing to pay their government online, in contrast to the narrowband picture. This may reflect a more structural difference in attitudes to online commerce between early adopters in France (broadband businesses) and those who are behind on the technology curve (narrowband businesses).

For most countries there is little change predicted between the end of 2004 and 2005, with a slight overall increase in the overall percentage of connected businesses transacting with government online. The data for Australia has been revised upwards based on new data from the Australian Bureau of Statistics. The estimate for Sweden has also been revised upwards based on new data from Statistics Sweden.

The majority of data points have been derived by projecting forward the source data from the *Business in the Information Age* study. Very little public domain information is available for this indicator.

4.3.6 Ecommerce revenue

Definition and explanation of metrics

For previous iterations of the report, the ecommerce revenue metric was based on the *Business in the Information Age* study and defined as follows:

- For all of a country's broadband businesses that take orders over the Internet, the average of the total annual value of orders received via the Internet expressed as a percentage of each entity's total annual order volume. This includes all orders irrespective of whether payment is made over the Internet, or invoiced separately.

However, very little new information has been published in this form, with new data only available for Australia, with the Australian Bureau of Statistics reporting that Internet income as a percentage of all income for businesses receiving orders via the Internet was 7.7% for 2004/5. This figure is significantly lower than the figures quoted from the *Business in the Information Age* study.

In the absence of more new data on this metric publishing estimates based almost entirely on the *Business in the Information Age* study would reveal little new information. However, a considerable amount of new data is available on related metrics. These are:

- For all of a country's connected (i.e. narrowband and broadband) businesses, the percentage of companies which sell goods and services over the Internet.

- For all enterprises employing 10 persons or more, the percentage of enterprises' total turnover from ecommerce over the past calendar year. Financial sector enterprises are not included. Ecommerce is defined as Internet ecommerce transactions conducted over IP-based networks. Goods and services are ordered over these networks, but payment and delivery may be conducted offline. This metric is based principally on data from Eurostat. It was also possible to make an

estimate of this data for Canada based on information from StatCan which reported that in 2004, Internet sales as a percentage of revenues represented less than 1% of total revenues.

Results and comments

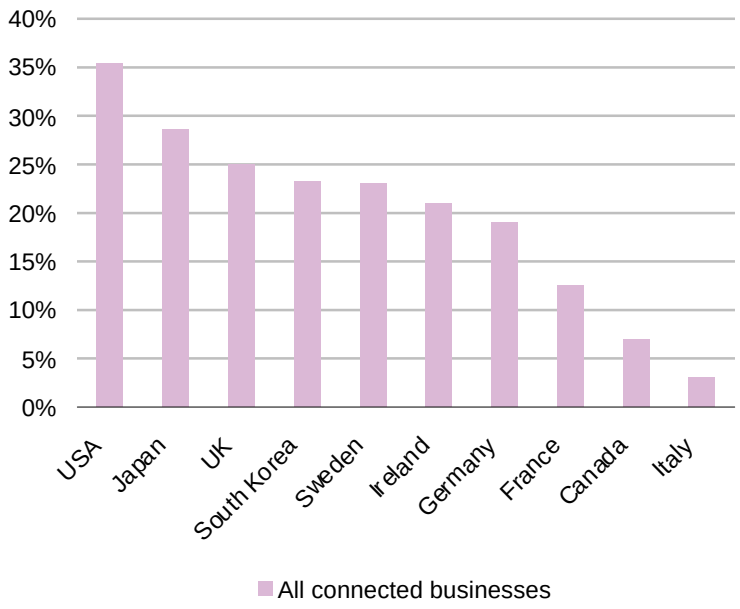

Exhibit 4.10:
Percentage selling goods and services online in the year to the end of December 2005 for all broadband and narrowband businesses
[Source: Analysys]

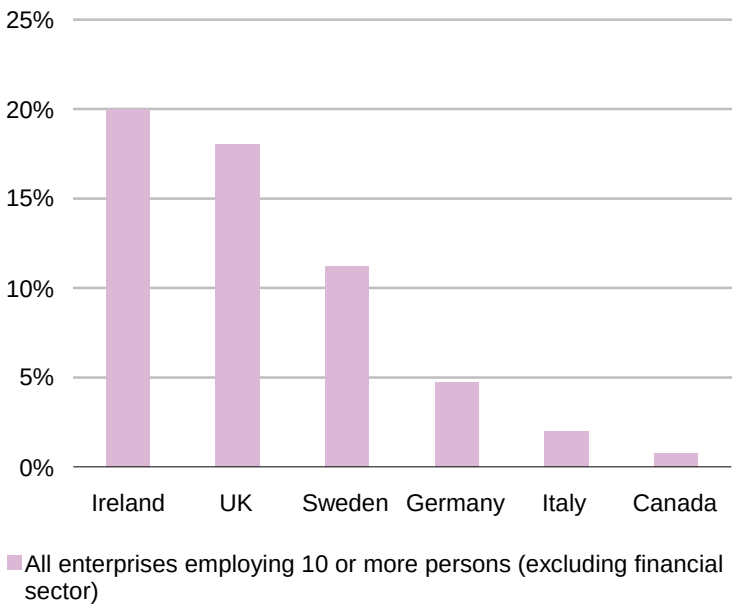

Exhibit 4.11: *Percentage of enterprises' revenues from ecommerce in the year to the end of December 2005 for all enterprises employing 10 or more persons and excluding the financial sector [Source: Analysys]*

These new estimates, based on sources including EU and national statistical bodies show that a significant proportion of businesses are now ordering online. In all countries bar Italy, over five percent of connected businesses receive orders online; in seven out of the ten countries for which estimates were made, over 15% of connected businesses received orders online. The data point for Italy is surprisingly low. It is possible that although the data for Italy is from the same source as that for many of the other European countries, the question was interpreted or asked differently in Italy. As such, this data point should be treated with caution.

For the five countries for which reliable data was available, there was a wide spread in the percentage of enterprises total turnover from ecommerce, suggesting that ecommerce has taken off strongly in some countries, but is still developing in others. For Italy and Canada, the low percentage of turnover from ecommerce correlates with a low percentage of businesses engaging in ecommerce. Germany, Ireland, Sweden and the UK all have a comparable percentage of businesses ordering online, suggesting that in the UK and Ireland, the biggest businesses represent a higher proportion of those receiving orders online.

These new data sets suggest ecommerce is a significant mechanism for receiving revenues, reinforcing the data gathered from the *Business in the Information Age* study of 2004.

4.4 Results for residential indicators

4.4.1 Downloading TV, video and movie clips

Definition

Exhibit 4.12 below shows the percentage of all people in a country that have downloaded one or more TV, video or movie clips over the Internet within the last year. It includes individuals irrespective of whether the content is paid for or whether it is available for free. The metric is expressed as a percentage of Internet users and as a percentage of the total national population.

Results and comments

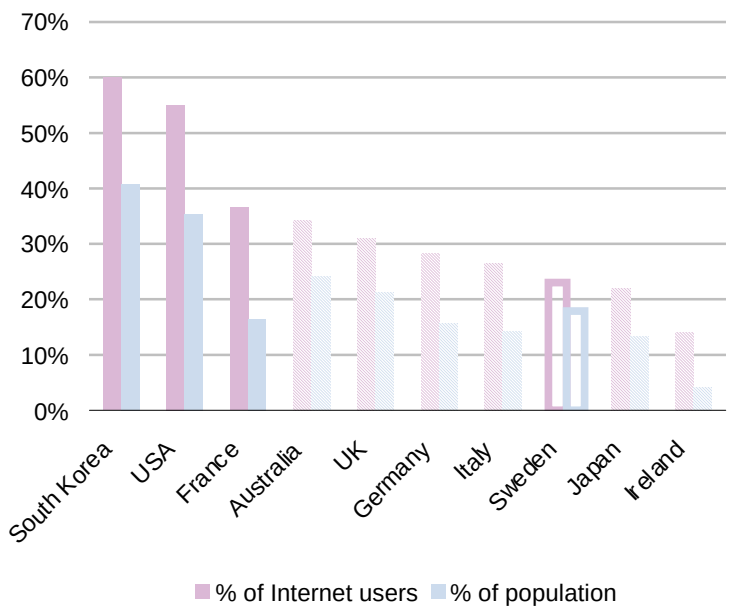

Exhibit 4.12:
TV, movie or video clip downloading, December, 2005
[Source: Analysys]

It initially appears surprising that, when measured as a percentage of Internet users, TV, movie or video clip downloading are low in Japan and Sweden in comparison with the other countries. As with other metrics, however, we believe that measuring usage amongst Internet users masks a saturation effect. We believe that those users who would download large volumes of movies and video clips form a core group within the early adopter segment. The Internet penetration in these two countries is high so many later adopters,

who use the Internet for more practical purposes such as sending emails and searching for goods and services, but who do not download movies and video clips, are reducing the countries' scores. This view is borne out by the fact that when plotted against percentage of population, these countries rank relatively more highly. There may also be other cultural reasons for these differences.

The data for the USA has been revised upwards significantly, based on data from ComScore, Park Associates and the online publishers association which suggests previous estimates were too low. The data for South Korea has been revised based on growth shown in survey data produced by the Korean Ministry. The most likely explanation for this is the very high levels of broadband penetration – over 25% per head of the population – the highest penetration rate of all countries in this study. In other countries, steady growth has been predicted with countries which have experienced rapid growth in broadband penetration estimated to have had stronger growth. However, these estimates should be treated with high levels of caution due to the lack of a single data source data allowing for reliable cross-country comparisons.

France scores highly in comparison with other countries. This may well be because the French broadband market is extremely competitive, with triple-play offerings becoming increasingly widespread. Indeed, France Telecom had 200 000 subscribers to *Maligne*, its IPTV offering, as of Q3 2005, while a further 142 000 paying subscribers took up Iliad's IPTV service. While this is only a very small proportion of Internet users and the population, it suggests that French consumers are likely to have a higher awareness and interest in downloading TV and video content and that appropriate infrastructure is being put in place to enable this.

It is possible that the difference between countries in this metric falls within the possible margin of error. Substantial normalisation was required to produce this metric and data for 2004 for Sweden was created by extrapolating from 2002 survey results. Our estimates could under-represent the popularity of movie clips downloading in the context of the growth of peer-to-peer file sharing.

Finally, Sweden, Japan and South Korea come top of the table of the next metric, online gaming, when usage is measured amongst Internet users. It is possible that in some cases TV and video clip downloading competes with gaming for leisure time amongst Internet users.

Sources used

A wide range of sources were used for this metric. These included national surveys commissioned by regulators and statistical offices into household use of the Internet, and published survey results from one-off surveys undertaken by commercial third-party information providers. Most data sources covered a single country, and they often measured slightly different service sets (e.g. inclusion of TV, or viewing of movies only), and slightly different periods of time (e.g. use in the last month *versus* use in the last year). Estimation was therefore required to normalise the results. A single source from the Motion Picture Association of America was informative – although its data only covered film downloads – as it did cover many countries covered by this study and was based on a survey conducted in 2004.

4.4.2 Use of online gaming

Definition

Percentage of all Internet users in a country that have played an online game during the last year. Games are defined in their broadest sense to include massive multi-player online games, multi-player online console or PC games. This definition excludes games that are downloaded and played offline, as well as online gambling.

Results and comments

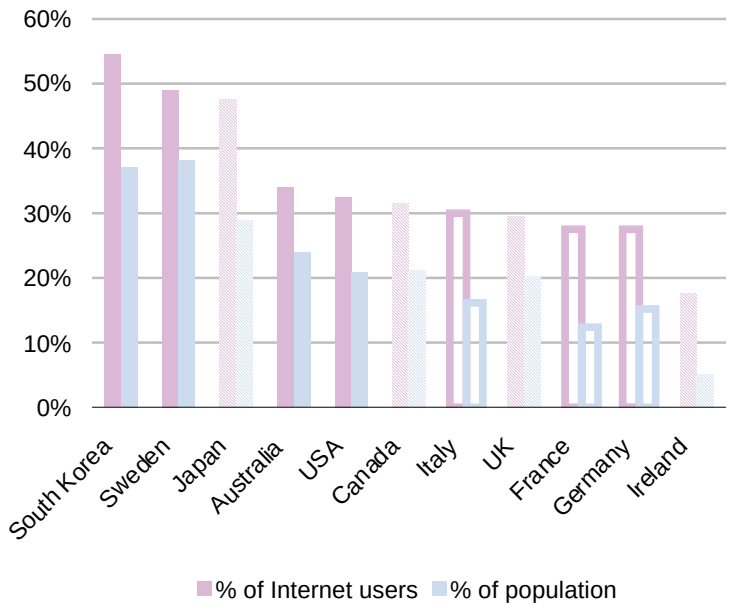

Exhibit 4.13: *Percentage of Internet users and population that play online games, December 2005 [Source: Analysys]*

South Korea has a very large online gaming market. This is reflected by the very high score, which appears in spite of the high levels of Internet usage in the country. In other words, late adopters are big gamers as well as early adopters. This is also true in Japan and Sweden. All three markets have high levels of broadband penetration, which is advantageous for serious online gamers. The lack of broadband penetration in Ireland could explain the low popularity of online gaming in that country.

Online gaming is estimated to have increased in most countries over the second half of 2005. Less growth is predicted for larger gaming markets where growth in broadband penetration is beginning to slow down, for example Japan and South Korea. Meanwhile, countries which have experienced rapid growth in broadband penetration per head of population, such as Ireland (which has grown from 3.2% to 6% during 2005), are estimated to have experienced a more rapid increase in online gaming.

Sources used

A wide range of sources were used to populate this metric. These included national surveys commissioned by regulators and statistical offices into household use of the Internet, as well as published survey results from one-off surveys undertaken by commercial third-party information providers. Most data sources covered a single country, and they often measured slightly different service sets (e.g. people who visited an online gaming site versus people who regularly play online games), and slightly different periods of time (e.g. use in the last three months versus use in the average week). Estimation was required to normalise the results.

4.4.3 Use of VoIP

Definition

Percentage of people in a country that, at the end of December 2005, were using *paid-for* VoIP services for personal purposes. The measure includes occasional use, use of an indirect access service for long-distance or international telephony, or use of a voice-over-broadband solution. The measure excludes use of free PC-based software products that enable PC-to-PC calling. It excludes use through work.

Results and comments

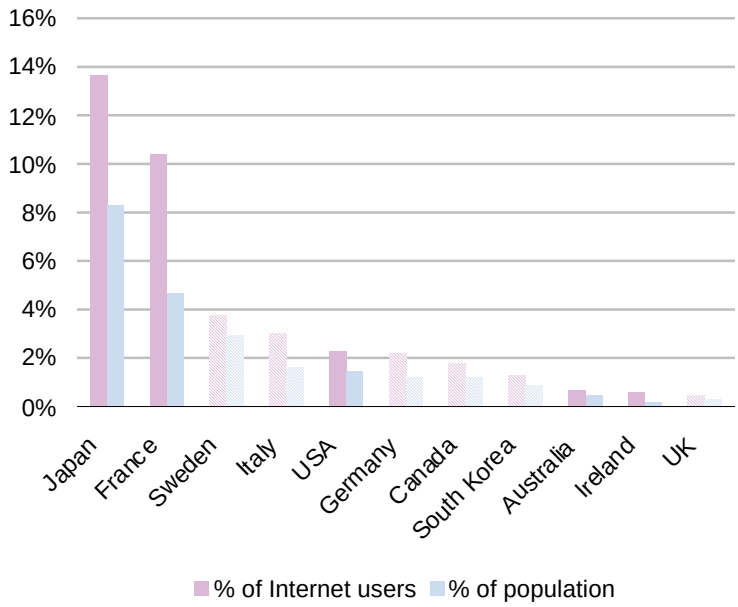

Exhibit 4.14: *Use of VoIP services by residential consumers, December 2005 [Source: Analysys]*

There has been very rapid growth in VoIP activity in many markets through 2005 with an overall increase in VoIP across the majority of countries in this study. VoIP penetration in France has shown a particularly marked increase (to over 10% of Internet users). This estimate is based on projecting Q3 2005 figures made available by ARCEP and is on the cautious side, with some evidence to suggest that France could have as many as 15% of Internet users using paid-for VoIP services.

In France, the local loop unbundlers such as Free (Iliad) have a comparatively large market share and offer direct-access VoIP packages without running the same risk of cannibalisation of revenues that France Telecom faces. Key players in the paid-for VoIP sector in France include France Telecom (which has responded to packages offered by unbundlers), Free, neuf telecom and Cegetel, Tiscali and Wengo. Meanwhile, in Italy, FastWeb, which had an estimated 714 000 customers by December 2005, offers VoIP as part of a bundled broadband package to all of its customers.

Japan remains the largest VoIP market (in terms of percentage take-up), although this gap is narrowing rapidly due to rapid growth in European and North American markets.

New data has become available for Australia which has led to a downward revision of the number of paid-for VoIP subscribers. This reflects the relatively low broadband penetration in

Australia as well as the relative popularity of free VoIP services. Also, there is some evidence that lower end, lower speed 256kbit/s broadband connections are relatively popular in Australia; given these lines are not best-suited to VoIP this may also be a factor in explaining low take-up.

Sources used

More data has now become available on consumer VoIP following growth in availability and popularity. Data now available includes a recent study of retail VoIP by Analysys Research, as well as data from PointTopic, regulatory bodies and VoIP providers. Analysys Research's study of retail VoIP uses estimates derived from operator data, press reports, information from regulators and Analysys's research into the development of the supply-side of each country market.

4.4.4 Ecommerce spend

Definition

Average annual consumer ecommerce spend per Internet user per country. The metric includes consumer spend on all types of products and services. It excludes business-to-business ecommerce spend. Spend is defined as the total value of goods and services ordered over the Internet, measured in GBP.

Results and comments

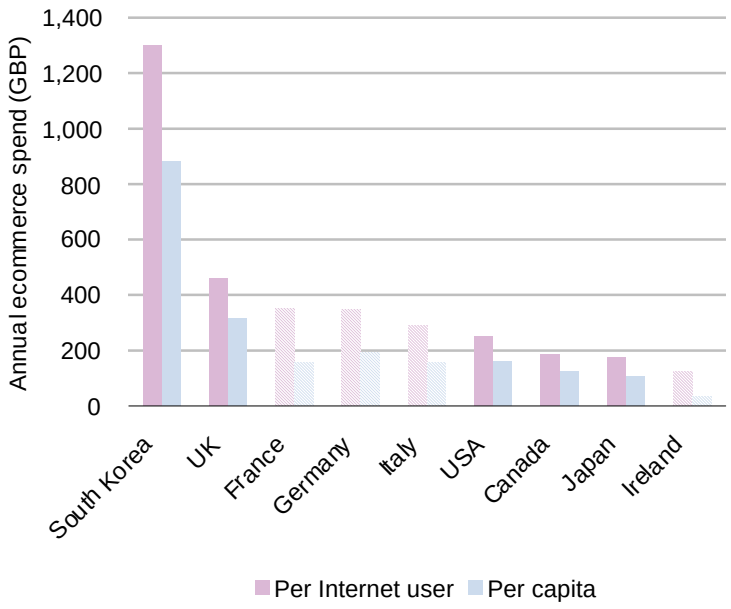

Exhibit 4.15:
Average annual ecommerce spend per Internet user and per capita, year ending December, 2005 [Source: Analysys]

South Korea has by far the highest spend per Internet user. The data point for South Korea has not been included previously due to concerns about the reliability of data, which seemed very high compared to other countries in the study. However, new data from the Korean National Statistics Office reinforces data available for the previous years, showing consumer ecommerce spend to have stabilised at approximately SKW7900 billion. High levels of ecommerce spend can be attributed to high broadband penetration, cultural attitudes to technology adoption and related high levels of media and game playing online which will help to boost ecommerce revenues.

The results also suggest that the UK is ahead of all other countries, except South Korea, in terms of spend per Internet user. There is evidence to suggest that there has been some dramatic recent growth in the UK's ecommerce market, and that 30% for 2004 and an annualised rate of 24% for the first half of 2005 may be conservative. A survey commissioned by Pipex found that, out of 500 people surveyed in the UK, 51% of men and 43% of women purchased goods online in March 2005, and that the average spend level in March (i.e. for one month only) was GBP127 per capita.

A possible explanation of the disparity between UK numbers and numbers for other countries could be the inclusion of travel purchases (i.e. flights and hotels) in the UK number, which are

not always included by other countries. Another difference could be the inclusion of transactional volumes on eBay (often excluded, or limited to eBay's retained revenue).

It is also possible, given the methodology used, that a recent worldwide boom in ecommerce has not been captured by our estimates. This will become clear when and if further data sets become available.

Sources used

We have predominantly used figures for business-to-ecommerce trade published by individual statistical bodies of the different countries (for example, the US Department of Commerce) and figures published by Eurobarometer, the programme of surveys of consumer behaviour run by the EU.

4.5 Trends analysis articles

4.5.1 Will increasing broadband speeds create consumer demand for online storage?

Data back-up and online storage

► *Current storage solutions*

In the past, the online remote storage market has been limited to unwieldy Web-based interfaces, FTP servers and virtual drives. Larger businesses have traditionally used magnetic tape drives for long-term data storage, with smaller businesses also using networked hard drives. Residential users have used similar devices, or have relied on CDs or DVDs to back up data

On-site storage for businesses is expensive – a large proportion of the costs involved in data back-up are due to the manpower required to support the process, while magnetic tapes as a storage medium can be unreliable, costly and do not fall in cost at the same rate as hard drive technology. Remote storage service provider U.S.DataTrust states that

"research shows that tape back-up fails to recover data as much as 50% of the time". On-site storage also brings with it the inherent risk to business continuity should a business site be hit by a significant natural disaster (a fire, for example, should the back-ups not be stored in a fireproof safe). It is for this reason that companies are increasingly looking to remote (or 'off-site') data storage for their back-up requirements. These sites generally have rigorous risk mitigation systems and policies in place covering, for example, security, environmental controls, and fire suppression systems. A 2004 survey conducted by vendor Imation revealed that 50% of SMEs did not have formal procedures in place to support the back-up of employees' laptops.

It has been conjectured in the press that as little as 2% of residential subscribers regularly back up their data. Residential users are also open to similar risks as businesses for on-site storage (e.g. theft, fire, hardware failure) although most of the data at risk is obviously of a more personal nature (photos, movies, music,…) than would be found in businesses. As a result, a number of services have emerged recently offering remote sharing and storing of data. Examples of such services include Xdrive, Streamload and numerous photo-sharing sites such as Flickr and Smugmug.

The reliance on on-site storage is changing, however, as improved storage technology and competition in the sector have reduced the price per megabyte of online storage, and increased availability/take-up of broadband, combined with higher bandwidths per customer, has improved the user experience and increased the addressable market. The drive towards Internet-based software applications and storage by Web 2.0[23] proponents such as Google and Microsoft has further increased consumer awareness and product availability. In the remainder of this article, we examine the falling costs of bandwidth and storage and consider how this affects the overall market for remote back-up and storage.

► *Data storage and bandwidth cost trends*

The cost of hard drive storage media has fallen over 100-fold in the last ten years, as shown in Exhibit 4.16. This has made it possible for remote storage operators to offer scalable storage capacity for minimal charge.

23 'Web 2.0' generally refers to services available on the Internet that facilitate collaboration and the communal sharing of information. By using Web-based applications, the Web 2.0 user experience is closer to that of desktop applications than to traditional static Web pages.

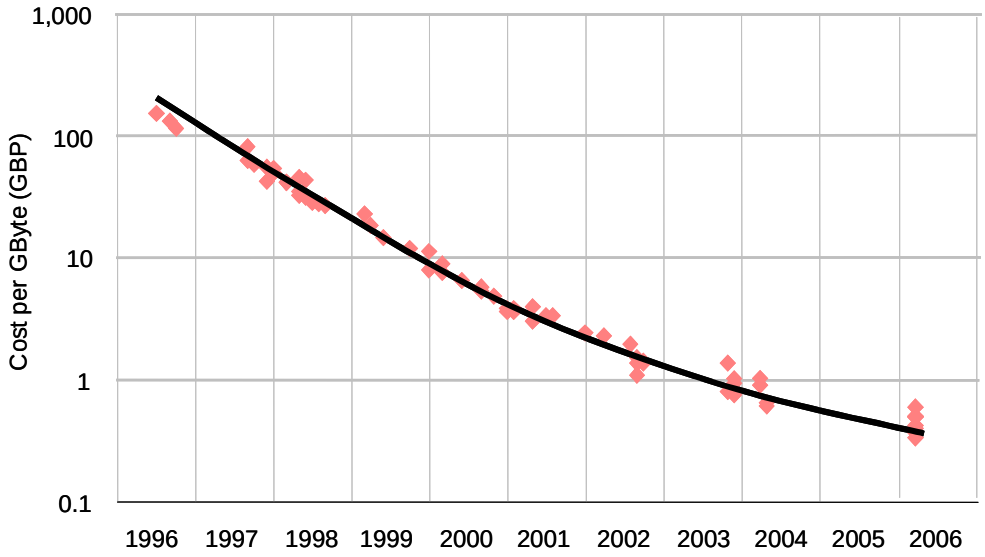

Exhibit 4.16: *Cost per Gbyte of hard drive-based storage, 1996-2006 [Source: http://www.alts.net/ns1625/winchest.html and Analysys, 2006]*

The trend in storage capacity follows Moore's Law (approximately halving every 18 months), and has therefore brought costs to a sufficiently low level that remote storage services may now be offered to the mass residential market, beyond networked servers, external/removable hard drives or DVD writers.

Likewise, higher broadband speeds both up and downstream are arriving across Europe and elsewhere, brought by ADSL2+ and the VDSL, VDSL2 and fibre networks that are currently in the process of planning and construction. The costs (to the end user) of data transmission are therefore also coming down, as shown in Exhibit 4.17, and the end-user experience of data storage services is improved by the decreases in transfer times that these new access technologies provide. However, the introduction of monthly usage caps by a number of ISPs (see Section 4.5.2) could increase the cost to the end user of taking such services and may hinder take-up. Present copper and coax technologies are still very asymmetric, and uploading is therefore best done in quiet times, e.g. overnight. This is fine for back-up services.

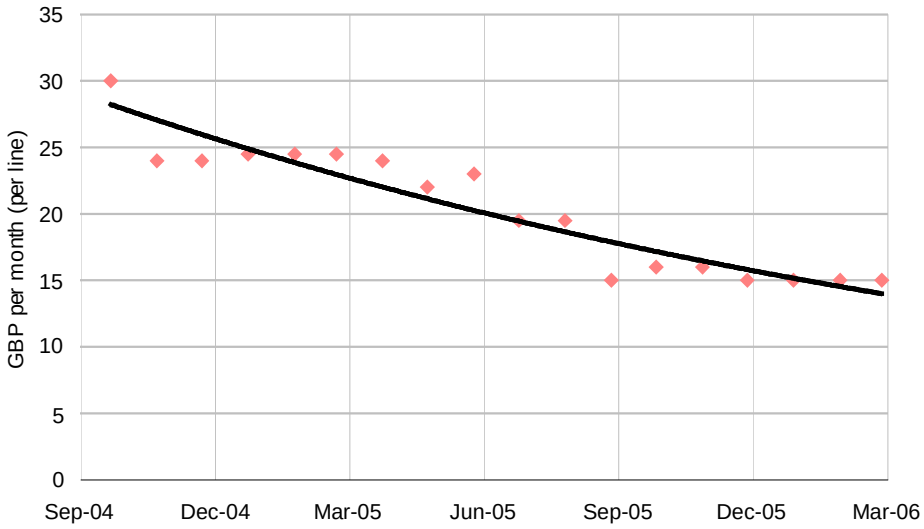

Exhibit 4.17: *Lowest price residential uncapped 1Mbit/s broadband connection in the UK, Sep 04 – Mar 06 [Source: Analysys, 2006]*

► *The next generation of remote storage*

Given the international nature of the Internet, remote back-up can theoretically be made from anywhere to anywhere. Consumer online storage services have evolved rapidly within the last 12 months, with many new service releases. However, clear brand leaders that can win the trust of the mass market have yet to emerge. This issue of trust is a significant one, following the US government's request to access individuals' search results from leading search engines. Indeed, it is unclear whether Google has maintained the trust of consumers following the ensuing increase in public exposure of the privacy issues at stake, and therefore whether its proposed GDrive online storage solution will achieve mass adoption. The ultimate goal of Google's GDrive service is to make all files accessible anywhere, on any platform, which in its sheer accessibility could make the service more vulnerable. Protection from both hackers and governments (or just general privacy issues) will therefore be high on the priority list of potential customers, who will demand strong encryption on all personal data.

With the falling price of offline and hard drive storage, is there a residential market for remote storage? The paradigm of remote storage is shifting away from that of simple storage to that of an enhanced 'virtual drive', providing a wider range of services, which therefore makes the service of higher value to the end user. Social software, or computer-mediated communication that results in the formation of online communities, has created sites/services such as Flickr and Facebook that allow (free) subscribers to share their photos with each other online. Similarly, premium services are arriving that offer the secure sharing of video, photos and even music[24] organised through attractive GUIs (Graphical User Interfaces). By offering storage services only for a more limited range of files, operators are able to offer a greater depth of services for those specific file types – such as Yahoo! photo services, which generates revenues through the sale of personalised calendars and photo books using the materials that the user has uploaded.

With the falling costs of storage, online presences such as Amazon, Google and the large email providers, such as Yahoo!, Microsoft, AOL, etc., already have the infrastructure and scalable storage in place to offer remote storage services. In March 2006, Amazon Web Services announced the development of Amazon S3, which charges USD0.15 per gigabyte of storage per month, and USD0.20 for every gigabyte of storage transferred (compared to the USD0.30–0.40 that Amazon.com retails blank DVD media for). However, while S3 may be indicative of the prices that operators will charge, the relative complexity of the service, targeted at software and Web developers, does not make the service conducive to a mass market service. With the advent of Microsoft Office Live, Microsoft's upcoming Web application-based office suite, the revenue potential of tying in online storage with online applications is significant – possibly leading to Google's vision of the online version of a file as 'the golden copy', with a user's hard drive acting simply as a cache.

Conclusion

Remote storage will become of interest to the mass market consumer only if it is simple, secure and sharable. By offering storage in a narrower field, such as for photographs, Web presences can offer a deeper array of services within this narrower range, and it is through these added value services that they will create revenue. However, basic remote storage

24 When available to only a very small closed user group, without the possibility of downloading their own copy to keep, this may possibly be construed as fair-use.

alone, such as an automated daily back-up of all files or, ultimately, a live 'mirror' of your PC's hard drive, is of interest to consumers as a simple way of allowing for recovery following, for example, the terminal failure of a hard drive. Such 'basic' services are unlikely to be charged at premium rates, but will probably be priced in proportion to the cost of data storage (which is falling) and maintenance. However, whether these data volume-heavy applications fit with the move to usage caps adopted by many ISPs remains to be seen.

As remote storage solutions and Web-based applications propagate, and the power of mobile handsets increases sufficiently that they may access the same data as desktop computers, a demand for universal access will make consumers desire a more complete remote storage solution, so that they might access data on remote devices more rapidly. File sizes (and image resolutions) are likely to continue to increase, affecting the time taken to back data up to a remote server, particularly if this server is on the other side of the world. This will therefore increase consumer demand for higher bandwidths and lower latency, and will therefore be a driving factor in the demand for next generation broadband services.

4.5.2 Usage capped broadband services

Increasing availability and take-up of high-speed broadband services are stimulating the development of new applications which are leading to rapid growth in the volume of traffic originating from content owners. For example:

- independent companies such as CinemaNow are offering video-on-demand (VoD) services where users can either stream or download films from online libraries

- the BBC has started offering past episodes of its TV programmes via the Internet as streamed content (albeit at a lower than broadcast quality), as well as live streaming of broadcast radio content. The BBC has also recently completed its iMP trial which allowed users to download programmes from the last seven days using peer-to-peer technology

- over one billion songs have been downloaded from iTunes worldwide since its launch a little over three years ago

- in the UK, Sky has introduced 'Sky by broadband' as a free offering for its satellite customers who subscribe to its sports or movies channels.

The trends seen here, in terms of increases in the amount of streaming/downloaded video and audio content that is available (either user generated or sourced from a content provider), will increase the demands placed upon ISPs' networks. Operators must either find ways to minimise pressure on network capacity or develop business models that provide increases in revenue sufficient to cover the costs of additional capacity.

As shown in Exhibit 4.18 below, there are a number of potential 'pinch points' in network capacity:

- **the access network** is limited by a number of factors depending on the technology used (e.g. DSL is limited by the form of xDSL used (ADSL, ADSL2+, VDSL,…) along with the physical length and quality of the copper line)
- **backhaul** (i.e. the connection between the local exchange and the ISP's core network) is limited by the amount of installed capacity, which is typically provisioned by an ISP based on the number of users, the headline speed of their product and the contention ratio[25] for each user's product. ISPs who own and operate much or all of their own infrastructure (e.g. BT, ntl and Telewest), in contrast to those who lease it from a network provider, will be less exposed to this. The majority of ISPs use a wholesale product from BT called IPStream – the backhaul product associated with this is called BT Central
- **IP transit/peering (i.e. connection to the Internet or other ISPs from an ISP's network)** is limited by the amount of capacity purchased. Connections to the Internet and other ISPs' networks are also possible through peering, where ISPs do not pay each other for interconnection.

25 The contention ratio is the number of users an ISP assumes share a set amount of bandwidth when calculating capacity requirements in its network. For example, a contention ratio of 50:1 on a 2Mbit/s service implies that each subscriber will have access to 41kbit/s (=2048/50) if every user on the network is using their service at the same time. Due to the highly variable ('peaky') nature of Web browsing and email, this is not an issue for most subscribers. However, if there were a move to more long duration levels of demand (such as downloading large files or streaming TV) the issue of concurrency will make this dimensioning assumption more apparent to end users.

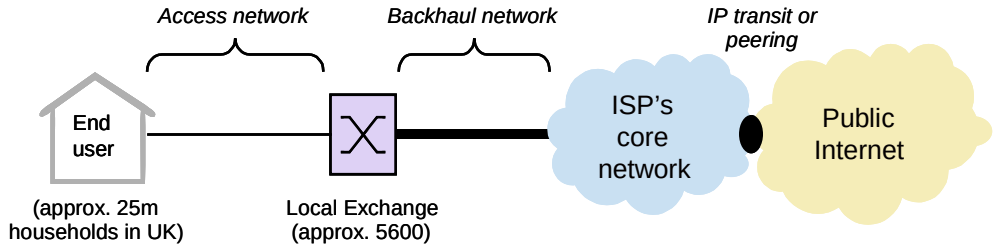

Exhibit 4.18: *Simplified network diagram for example ISP offering xDSL services [Source: Analysys, 2006]*

The backhaul network could potentially become more of a bottleneck than historically as traffic volumes increase and loading fluctuates less (making the effects of contention ratios more visible to the end user). Increasing backhaul capacity will either mean leasing extra capacity from other providers or making substantial investments in new infrastructure. One option for ISPs in this scenario is to move away from a flat-rate access-based pricing model to a volume-based pricing model. Such a charging scheme is attractive as it provides a way for operators to generate revenue proportionate to increased infrastructure costs and it may help to reduce traffic volumes by making users more aware of their volume consumption.

One volume-based pricing model currently in use in the UK and internationally is the adoption of 'usage caps', whereby subscribers pay a different monthly fee depending on the volume limit they want on their service. Usage over this cap is then either charged on a per GB basis or subscribers can be moved onto a higher cap product by the ISP if they regularly exceed their cap. A number of operators in the UK have already begun to adopt usage caps. For example, BT is currently offering two 2Mbit/s packages (one capped at 2GB per month for GBP17.99, and one capped at 6GB per month for GBP22.99, although, at the time of writing, these were soon due to increase to 'up to' 8Mbit/s services with the same caps) and two packages of 'up to' 8Mbit/s with download caps of 20 and 40GB priced at GBP26.99, and GBP29.99 respectively. Other operators offering capped packages targeted at residential customers include Wanadoo, ntl and Pipex, although this is by no means an exhaustive list.

Usage caps are becoming increasingly widespread, especially among the higher-speed packages that are now emerging. These higher speed services are often sold at comparable

prices to lower speed services. However, they place more demand on the backhaul network than lower speed services (even when contention ratios are taken into account) and enable the subscriber to receive higher quality (and therefore higher volume) content which may result in more extended peaks in demand per user than Web browsing and email. The pricing model for such services therefore shows a correlation between price and usage cap, as shown in Exhibit 4.19 below. Some operators continue to offer uncapped products, for example, Pipex charges GBP27.99 per month for its uncapped services, Telewest charges GBP35.00 per month for its uncapped 10Mbit/s service, while UKOnline offers uncapped packages charged at GBP24.99 for its 8Mbit/s service and GBP34.99 for its 22Mbit/s service (both these services are 'up to' the stated speeds depending on the line length and quality).

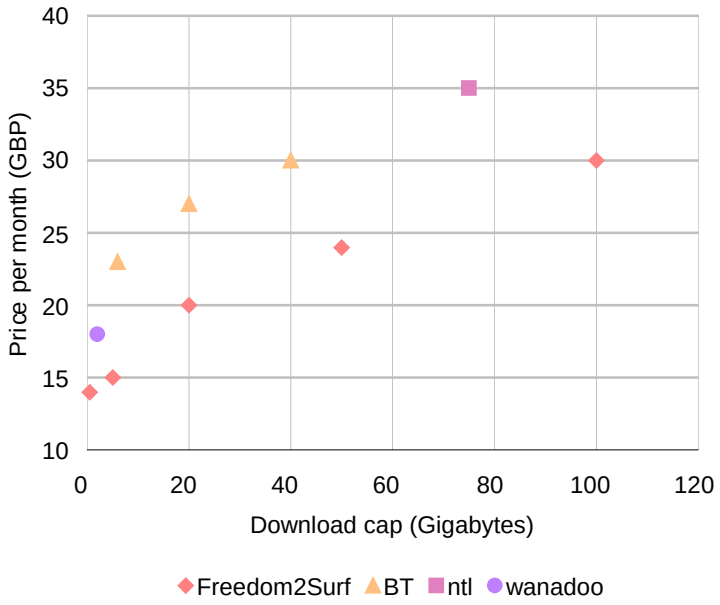

Exhibit 4.19: *Selection of usage capped services in the UK at 8 and 10Mbit/s: monthly charge versus download cap [Source: Analysys, 2006]*

It is notable that the smaller ISPs are more likely than the large providers to enforce tight usage caps. For example, in the UK, Virgin.net, Freedom2Surf and Advance Internet Services only offer packages with usage caps. This reflects the fact that these ISPs have a relatively small amount of network infrastructure of their own (if any) and are more reliant on wholesale services than other ISPs. This said, larger ISPs are also beginning to place usage caps on an increasing number of their products – for example, BT places usage caps on all of its residential broadband packages.

It is not just in the UK that operators are implementing volume-based pricing, but throughout Europe. In some countries, including Austria, Belgium, Germany, Ireland and Portugal, the majority of packages offered by the main ISPs are volume based.

Variants of the standard monthly usage caps are also beginning to emerge. For example in the UK, Freedom2Surf has offered packages which are capped except at off-peak time, which is classified as being between 1am and 6am. Meanwhile, in the Spanish market, France Telecom España offers unlimited off-peak usage combined with pay-as-you-go surfing at peak times. Telefónica de España has since followed France Telecom's example – it too now offers pay-as-you-go combined with free off-peak usage.

Overall, there is a clear trend towards volume-based pricing. In the UK, the introduction of capacity and usage-based charges on the BT Central backhaul product has been a key driver for innovation in residential tariffs. Improvements in broadband connection speeds are the other key factor driving the move towards volume-based charging. This trend may well stimulate developments in compression technologies as users try and find ways to reduce costs of downloading. More generally, it will be interesting to observe the impact of this charging model on ISPs, content providers and subscribers as a result of ever-growing download volumes.