

EuroTelco Snapshot

Thinking about the data on data

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This short note pulls together a few recent data points and factoids which may be of interest to investors attempting to get to grips with the potential impacts of new bandwidth-intensive consumer services and content delivery mechanisms on the internet. Headline points are as follows:

- A variety of developments are driving higher bandwidth consumption – we believe these are, in order of magnitude: P2P file sharing, video search/upload/archiving sites, user generated content, mass gaming, and video IM.
- P2P traffic alone is staggering. Our analysis shows that the global monthly run rate for downloads of the top ten video titles alone at the end of March approached 49m, up 9% MoM in one month. At this rate, the run rate may cross 100m per month by December of this year.
- Internet traffic observable in the data from the Amsterdam Internet Exchange is consistent with this, growing at a compound rate of 7.4% per month over the past 15 months and crossing one Petabyte per day in February. Assuming this rate continues, daily traffic may double again by the end of this year, and then again by October 2007.
- We examine a number of drivers which may ensure that future growth accelerates considerably beyond current trend, and we interpret Level3's recent announcement of Transatlantic capacity increases as being indicative of more aggressive assumptions about growth.
- These developments underline our caution on mature market carriers, which we believe will undergo a painful and expensive process in meeting consumer expectations of true broadband, in preference for the enablers of this transformation.

[Prices as at 3 April 2006]

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Explosive bandwidth demand

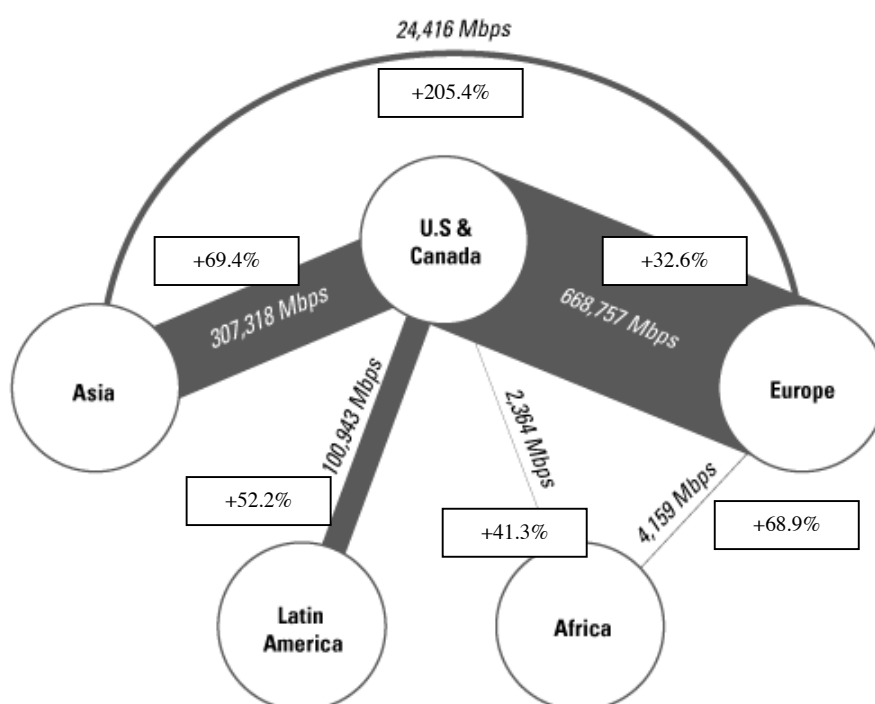
Don't underestimate the enablers

In our January *Global Telecom Monthly*, we identified a key criterion for inclusion in our model portfolio for the year – the theme of beneficiaries of the growth in edge-based applications and bandwidth consumption. This consideration lay behind the selection of Cisco, Akamai, Tandberg Television, and Alcatel, all of which have performed well year-to-date in dollar terms (+23.7%, +59.6%, +47.7%, and +28.3%, respectively). One name we seriously considered, but unfortunately avoided due to our view that it was too exposed to the commoditized portion of the market, was Level3, which is up 66.8% year-to-date, versus a mere 4.1% for the Nasdaq Composite. Interestingly, Level3 last week upgraded its OIBDA outlook for 2006 by just under 9%, citing (among other factors) a 2% increase in demand for every 1% decline in unit price for bandwidth. The company cited in particular the growth of video as a key future driver, saying that it expects internet video traffic to grow by 75% in 2006, mostly related to P2P file sharing. This short note attempts to pull together some recent data points and observations which may be of help to investors attempting to absorb the implications of this explosive growth in bandwidth consumption.

More undersea capacity being lit

In the Global Perspective section of February's *Global Telecom Monthly*, we discussed the agreement signed by Level3 Communications with Apollo Submarine Cable to purchase 300Gbps of additional capacity on its Transatlantic route. We noted that prior to this transaction Level3 had 480Gbps of lit Transatlantic capacity, of which 85% was being utilized. Even more strikingly, the company confirmed that its Transatlantic traffic had doubled in the past 12 months, and that the new deal with Apollo also included an option on a further 300Gbps of capacity. As at mid-2005, according to TeleGeography, capacity between North America and Europe totaled 653Gbps (+32.6% from 2004 levels) and accounted for 60% of global interregional internet traffic (total interregional activity grew by 45%, to over 1Tbps). Given that Level3's stated lit capacity of 408Gbps (i.e., 85% of 480Gbps lit) appears to have accounted for around 60% of total Transatlantic bandwidth utilization in H1 2005, we might be justified in taking its Transatlantic capacity expansion plans as a proxy for the growth in internet traffic as a whole. If this is valid, then the Level3/Apollo deal (assuming it exercises its option) leads us to the conclusion that we may witness an imminent near-trebling of traffic on the internet versus 2004 levels.

Interregional Internet Bandwidth, mid-2005 (with half-year growth rates)



Source: Daiwa, from TeleGeography/PriMetrica

And here's why...

While Level3's aggressive addition of capacity leads us to conclude that there is huge growth underway, what might be the real drivers of this growth? A few recent datapoints give us some clues:

Video already outstrips voice at MSN

Video IM - At the VON show in San Jose (where we presented), Blake Irving, head of instant messaging products at Microsoft revealed that MSN Messenger, with 26m concurrent users (over 3x that of Skype's peak usage level), had logged 1.1bn minutes of video chat in January. This exceeded the number of voice chat minutes on the platform by 300m, despite the fact that a much lower proportion of MSN users (only 9%) uses video in comparison to voice. Our experience with Skype's video service shows that bandwidth consumption is around ten times higher than for normal Skype voice calls (which consume around 40kbps up and down).

MMORPGs are bigger than you think

Mass gaming - We have yet to find any authoritative figures on massively multiplayer online role playing games (MMORPGs), though independent data from mid-2005 suggested around 10m players were subscribers of such games at that time. We think the figure may easily have doubled since then. Firstly, the largest MMORPG, *World of Warcraft*, has nearly trebled its subscriber base since then, to over 6m. Additionally, a study on gaming by the BBC in December 2005 determined that 22.7m Britons aged 11 - 65 play video games of some sort, and 8% of these engage in MMORPGs - this implies a number of something like 1.8m MMORPG players in the UK alone. With persistent virtual communities like Second Life (www.secondlife.com) and Hive7 (www.hive7.com) taking shape rapidly, and hosted gaming solutions such as ClubIT's G-cluster widening the range of online titles, online gaming should dramatically increase its bandwidth demands in coming years.

Uploading your life

Blogging, photosharing, and user generated content - When we published *EuroTelcorama 6* in February, 2005, blog-tracking company Technorati claimed to track 6.9m blogs. The site now tracks an astonishing 32m sites, and while this is impressive, it is by no means comprehensive, as Technorati does not track the tens of millions of users of Cyworld, SK Telecom's popular community, which has so far established itself in Korea, Japan, China and is poised to launch in the US. We think it is safe to assume that the global total of blogs could easily be double what Technorati figures suggest. In its traditional incarnation, blogging does not consume significant bandwidth, however, there is a growing tendency for bloggers to upload photos, videos, and audio podcasts to their sites. Related to this, photosharing sites have also generated massive upload traffic, with popular site Flickr! now hosting over 120m images and adding 500k images per day (based on our observations). Moreover, the growth of hosted sites for user generated audio and video distribution utilizing P2P, most prominently Prodigem (www.prodigem.com), is another development which we believe will contribute to significant bandwidth consumption in future.

YouTube if you want to

Video search and streaming - As we predicted in *EuroTelcorama No. 6*, video search and archiving sites from Google, Yahoo!, and others have indeed seen significant uptake in usage. A survey conducted in late 2005 by the Amsterdam Internet Exchange determined that video and audio streaming account for 14% of members' internet traffic, and is expected by member ISPs to be the highest area of growth in future. In the UK alone, internet monitoring specialist Hitwise observes that in early March, YouTube (www.youtube.com) accounted for over 0.4% of all web site visits, which is ahead of both Yahoo! and Google video sites, a feat made even more remarkable by the fact that YouTube started as a complete newcomer. While it is somewhat difficult to ascertain total viewing levels for these services, we note with interest that the most popular video on YouTube has been viewed over 7m times at this writing, up from 6.6m times just four days ago. It is also interesting to observe the apparent synergies between YouTube and social networking sites. Hitwise notes that 20% of YouTube traffic in the UK derives from such sites, with MySpace alone accounting for 7%. Indeed, increasingly such community sites straddle social networking, blogging, photosharing, video, instant messaging, and gaming, with the best example so far being Cyworld.

YouTube UK traffic share trends (all sites, weekly)

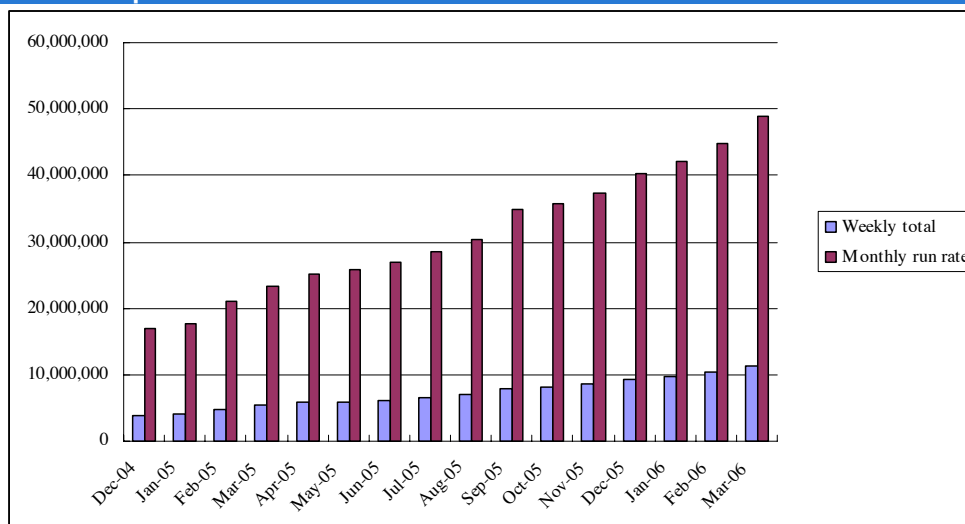


Source: Hitwise

File sharing is not by any means getting smaller

P2P file sharing – As it is by far the most significant consumer of bandwidth, we have tracked file sharing activity with interest for some time now, and the sheer growth in volume never fails to astound us. We have compiled data produced by P2P tracking firm Big Champagne, published via the P2Pnet (www.p2pnet.net) site since December 2004 up to the period ending 30 March 2006, to produce the graph below. It shows the weekly total downloads of the ten most popular titles (in blue), as well as our calculation of the monthly normalized run-rate of downloads implied by the weekly total (in red). This is calculated as follows: $[(\text{weekly total}/7 \text{ days}) \times 30.3 \text{ days}]$ (thus making each month equal in length). As can be seen from the trend, weekly downloads have increased by 187% over the past 15 months, from 3.9m at the end of December 2004, to 11.3m in the week ending 30 March 2006. This corresponds to a compound monthly growth rate of 7.3%, in line with the compound growth rate observed in the previous four months. Perhaps of more significance than downloads in any one week is the momentum exhibited in the normalized monthly run-rate trend. Based on the final week of March, this figure was up 9.2% MoM, to just under 49m downloads. At this rate, the run-rate of monthly downloads should exceed 100m by December of this year. Assuming an average file size of 1GB (this varies widely depending on format and encoding), such a volume would equate to 108m GB (otherwise stated as 103 Petabytes) per month. While much of this bandwidth may be localized (either on the same network or within the same country), and thus perhaps not fully captured by interregional or inter-carrier traffic flow statistics, it is nevertheless a significant volume – and it is essential to remember this is only the top ten video titles among millions of files of video, music, software, and gaming content available. (As an example, at this writing, The Pirate Bay, the popular BitTorrent aggregation site, alone shows 2.15m users online engaged in downloads of 139k files.)

Global top ten video downloads on P2P networks



Source: P2Pnet.net, from Big Champagne data

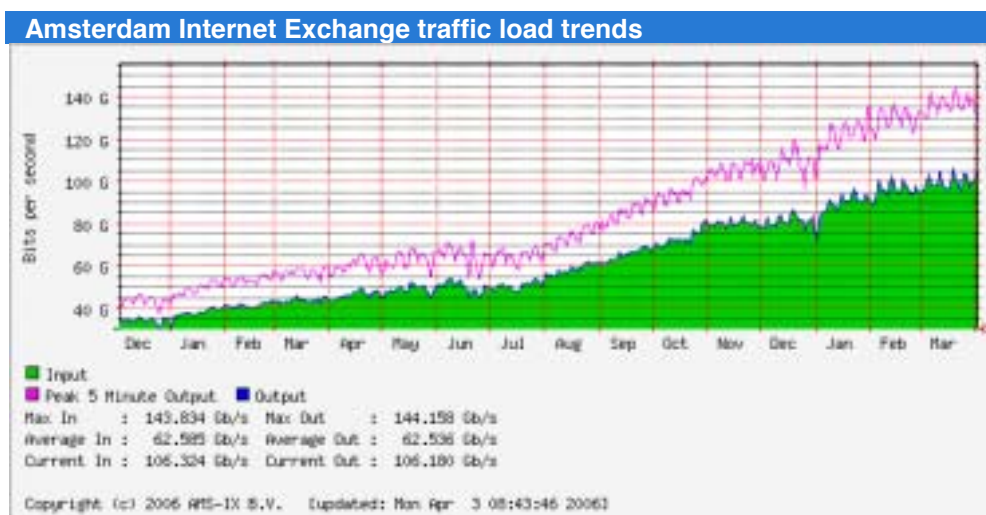
What's the real world view?

Q: Where's the evidence?
A: Amsterdam

To be sure, the demands placed on bandwidth supply by the variety of edge-based applications, and P2P in particular, appear to be huge. However, is there anywhere we can actually observe this and reality-check our views? Luckily, the Amsterdam Internet Exchange (www.ams-ix.net), the world's largest single peering point with 241 members, publishes statistics on a monthly basis, which give us a greater insight into what is happening in near real-time. The table below shows that month-on-month growth in average daily traffic has averaged 6.9% over the past 12 months, and average daily traffic surpassed one Petabyte for the first time in February. (Putting this in perspective, the figure on page 2 implies that total interregional traffic in mid-2005 equated to just under 12 Petabytes per day.) As at the end of March, average traffic per day on the exchange had grown by 190% since December 2004, a compound monthly rate of 7.4% over the past 15 months, which level is precisely in line with the P2P download observations cited above. One other interesting parallel with the P2P data is the sharp acceleration in activity from the August-September period in 2005, a fact which can be further confirmed by the traffic load data graph which follows.

Amsterdam Internet Exchange traffic statistics					
	Inbound (Terabytes per month)	Outbound (Terabytes per month)	Average Terabytes per day	Equivalent mp3 files (per day)	Equivalent feature length films (per day)
Sep-04	8,875	8,872	295.8	77,495,233	295,783
Oct-04	9,789	9,787	315.7	82,724,387	315,742
Nov-04	10,642	10,639	354.7	92,927,033	354,683
Dec-04	11,129	11,119	358.8	94,015,742	358,839
Jan-05	12,435	12,422	400.9	105,040,871	400,919
Feb-05	12,553	12,544	448.2	117,418,107	448,161
Mar-05	14,228	14,223	458.9	120,228,419	458,887
Apr-05	15,080	15,074	502.6	131,672,467	502,567
May-05	15,913	15,905	513.2	134,456,710	513,194
Jun-05	16,280	16,239	542.0	141,999,633	541,983
Jul-05	16,487	16,490	531.9	139,354,419	531,887
Aug-05	19,060	19,050	614.7	161,045,484	614,677
Sep-05	21,255	21,238	708.2	185,552,767	708,217
Oct-05	23,804	23,780	767.5	201,080,774	767,484
Nov-05	25,986	25,957	865.7	226,817,767	865,717
Dec-05	26,402	26,377	851.3	223,033,839	851,274
Jan-06	29,132	29,108	939.4	246,110,968	939,355
Feb-06	29,057	29,031	1037.3	271,768,857	1,037,286
Mar-06	32,292	32,263	1041.2	272,796,935	1,041,210

Source: Daiwa, from Amsterdam Internet Exchange data



Source: Amsterdam Internet Exchange

What's that in plain English?

We have endeavored to make this data more relevant to non-specialist readers by converting the daily figures from Amsterdam into equivalent mp3 files (assuming average file size of 4MB) and feature length movies (assuming an average file size of 1GB). As can be seen, the average daily traffic figure for March of just over 1PB per day equates to a staggering 273m mp3 files, or over 1m feature length films traversing the exchange every day (subject again to differences in file format and encoding). Clearly there is much more than just P2P file sharing traffic being exchanged by the Amsterdam Internet Exchange members, but research from monitoring specialists CacheLogic conducted in late 2004 (see *EuroTelcorama No. 6*, February 2005) concludes that perhaps as much as 70% of all IP traffic is related to P2P video exchange.

Where is it leading?

Whatever the precise breakdown of traffic flows among Amsterdam Internet Exchange members, we can make a few projections as to where things are heading based on current trends. If the currently observed growth trend of average daily traffic through the Amsterdam Internet Exchange (7.4% compound monthly growth since December 2004) continues steady, then daily traffic should cross the two Petabyte threshold in the December 2006/January 2007 timeframe, and double again to over four Petabytes by October 2007. However, there may be good reason to believe that growth rates will accelerate dramatically from here:

1. **More of the same** – Firstly, we expect that all the trends we have discussed above will intensify. Video IM/conferencing/collaboration applications will continue to gain traction from their relatively low levels of penetration, with eventual interoperability between user communities (Yahoo!/MSN and GoogleTalk/AIM) a key driver. Online communities will continue to expand, with more sophisticated integration of communication and content sharing tools requiring greater bandwidth. Gaming communities will expand, and online communities will increasingly incorporate elements of persistent virtual worlds with richer graphics. Self-distribution, upload/archiving sites, and streaming services will continue to expand significantly, the latest example being the In2TV service from AOL (www.aol.com/in2tv), which already features a full-screen, high quality viewing option for subscribers with compatible PCs. Also in their infancy now, we expect legal film download services employing P2P (such as those currently offered by Sky and the BBC) will proliferate. Most significantly, barring some miraculous breakthroughs in digital rights management technology or a wave of personal prosecutions of unprecedented proportions (millions of targets), we would not expect illegal file sharing growth to slow. Moreover, we must expect that a significant proportion of the expected wave of high-definition TV programming to come will find its way on to P2P networks, further exacerbating bandwidth demands stemming from file sharing.
2. **More of the same, but broader and faster** – It is important also to remember that changes in subscriber access technologies will have a significant effect on bandwidth demands.
 - a. Firstly, of the more than 2bn digital wireless subscribers in the world (according to the GSM Association), only 2.9% subscribed to a 3G system (W-CDMA or EV-DO) as at Q3 2005. As enhancements to data rates in these technologies appear, as 4G technologies such as TD-CDMA, Flash-OFDM, WiMAX and xMax see adoption, and most importantly, as data pricing falls, a significantly larger proportion of wireless users will be in a position to place increasing demands on the internet in a nomadic setting.
 - b. Secondly, both in the US and Europe, a number of major carriers are moving forward with plans to push fiber deeper into the local network, either in FTTC deployments by DSL and cable players, or in some cases fiber into the consumer premises. This will result in access speeds 10 – 50x the current representative levels of 1 – 4Mbps for end

users (excluding more advanced markets such as France), and further compound the effects cited in point one above. Ultimately, we believe even this level of connectivity will only provide a short-term cushion for carriers, who will eventually find themselves under pressure to take fiber directly into the home. Where this is already occurring, Japan, bandwidth utilization has increased dramatically. A study by Kenjiro Cho, et al, of the IJ Lab in late 2005, demonstrated that FTTH subscribers accounted for 86% of inbound traffic, and 75% of outbound traffic, in the ISPs under observation, despite being a smaller proportion of total broadband users than DSL subs, who only contributed 14% of inbound traffic and 25% of outbound. The researchers also observed that 82% of those classified as “heavy-hitters” (uploading more than 2.5GB per day) were fiber subscribers, and that fully 62% of residential traffic is user-to-user in nature.

3. **Something completely new** – With point 2b above as background, we think it likely that entirely new applications will take shape to make use of the higher bandwidths offered by true broadband. We know already that one motivation for municipally-backed FTTH projects in Europe, such as the Amsterdam example we have written on repeatedly, is to lower the cost of social service provision, particularly in the area of medical care for the elderly. With true broadband speeds of 100Mbps or more over symmetrical connections, we believe a wide range of health/safety monitoring and telemedicine applications will arise to meet this demand. Similarly, this level of connectivity would also greatly enhance the scope for tele-working and remote collaboration in knowledge industries, with an accompanying increase in bandwidth devoted to such activities. We also believe that what we today regard as “entertainment” has the scope to change dramatically in such an environment, to incorporate aspects of conferencing, document sharing, game playing, etc., all in a much more seamless manner than is currently the case with conventional broadcast television. All this points to significant increases in bandwidth consumption above those already envisaged.

Conclusions

This note is intended primarily as an examination of some key indicators and drivers of bandwidth consumption growth, rather than as a definitive analysis. There are many variables which could affect the implications for the sector, among them advancements in video compression, routing and optical multiplexing technologies, which could potentially moderate the impact of explosive consumption growth on infrastructure owners. Alternatively, we have highlighted areas of likely pressure and unforeseen demand growth which could exacerbate and accelerate developments. We concede that there is much more to the issue than simply the undersea capacity situation; however, we believe it is nevertheless an important indicator of trends overall. If, as we have observed, total interregional internet traffic was 12 Petabytes per day in mid-2005, up from an implied 8.3 Petabytes at end-2004, then growth is on the order of 100% per annum, consistent with comments from Level3 and what we have observed in the Amsterdam figures. Based on TeleGeography data from 2004, total lit capacity on submarine cables globally is in the neighborhood of 4.5Tbps, which we calculate implies total capacity of 47 Petabytes per day. Therefore, at current growth levels, all other things being equal, we probably have two years before any sort of critical congestion is in sight. However, we expect things will move faster, for the various reasons stated in this note, and we interpret Level3's dramatic capacity expansion announcement as an attempt to position itself for added flexibility in what may be a faster growth scenario.

Lit undersea cable capacity, 2004 (Gbps)	
Trans-Atlantic	2,338
Trans-Pacific	1,043
Intra-Asia	560
US - Latin America	518
Europe-Africa-Asia	61
Total	4,520

Source: Daiwa, from TeleGeography data

Back to picks and shovels

All this reinforces our view, embodied in our global portfolio, that we prefer to remain cautious on mature carriers, who we believe face a painful and costly period ahead in pacing consumer expectations for true broadband (ultimately being forced to go for full FTTH deployment). Our preference has been to play the proponents of applications-at-the-edge (Google, Yahoo!, Time-Warner, NewsCorp, Vivendi-Universal) – though, with the exception of VU, this has been less than a compelling success so far this year – as well as those who would benefit from being enablers (Alcatel, Cisco, Akamai, Tandberg Television) of this revolution. We hope the foregoing analysis goes some way towards clarifying our rationale for taking this view.

Bandwidth ready reckoner					
	bit	byte	Kilobyte	Megabyte	Gigabyte
bit	1	8	8,192	8,388,608	8,589,934,592
byte	8	1	1,024	1,048,576	1,073,741,824
Kilobyte	8,192	1,024	1	1,024	1,048,576
Megabyte	8,388,608	1,048,576	1,024	1	1,024
Gigabyte	8,589,934,592	1,073,741,824	1,048,576	1,024	1
Terabyte	8,796,093,022,208	1,099,511,627,776	1,073,741,824	1,048,576	1,024
Petabyte	9,007,199,254,740,990	1,125,899,906,842,620	1,099,511,627,776	1,073,741,824	1,048,576
Exabyte	9,223,372,036,854,780,000	1,152,921,504,606,850,000	1,125,899,906,842,620	1,099,511,627,776	1,073,741,824
Zettabyte	9,444,732,965,739,290,000,000	1,180,591,620,717,410,000,000	1,152,921,504,606,850,000	1,125,899,906,842,620	1,099,511,627,776

Source: www.t1shopper.com

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1 - expected to outperform by more than 15%, 2 - expected to outperform by between 5% and 15%, 3 - expected to deviate no more than plus or minus 5%, 4 - expected to underperform by between 5% and 15%, 5 - expected to underperform by more than 15%. All DIR recommendations are made on a 6 months basis. Our benchmark is the DJ STOXX 600 index.

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