UMTS Forum Report 44

Mobile traffic forecasts 2010-2020 report



January 2011





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Foreword

About the UMTS Forum

Mobile broadband¹ is changing the way the world communicates. The UMTS Forum helps all players in this dynamic new value chain understand and profit from the opportunities of 3G/UMTS networks and their Long Term Evolution (4G/LTE).

The UMTS Forum participates actively in the work of the ITU, ETSI, and 3GPP, EC and CEPT as well as other technical and commercial organisations globally. It contributes to the timely licensing and deployment of mobile broadband globally through regular dialogue with regulators and responses to public consultations. A strong promotional voice is maintained via a high-profile presence at conferences, seminars and workshops as well as regular briefings to the media, analyst and other stakeholders.

Membership of the UMTS Forum draws together everyone with an interest in mobile broadband, including network operators, regulators and the manufacturers of network infrastructure and terminal equipment. Since its launch in 1996, The UMTS Forum has been supporting the interests of its membership with a range of studies, reports and other outputs.

Principal focus areas include markets trends, mobile broadband services and applications, key growth markets, spectrum, regulation, technology and implementation. While centred around the promotion of 3GPP technologies and their long-term roadmap, the studies of the Forum nevertheless embrace a range of complementary mobile and wireless access technologies that can deliver broadband multimedia and the personal internet.

About this report

The report from the UMTS Forum provides forecasts for the next decade, i.e. from 2010 to 2020², on the evolution of penetration rates, voice and data traffic on mobile networks, on the services that are expected to be used and, finally, on the evolution of the use of these services.

Mobile Traffic Forecasts 2010–2020 was authored for the UMTS Forum by IDATE who reviewed the forecasts presented in the UMTS Forum report N°37 "Magic Mobile Future 2010–2020" (published in 2005) and presents new forecasts taking into account the market trends and market drivers as they have evolved since 2005. The report subsequently covers:

1- The identification of the main trends and drivers that will shape the world of 2010-2020 including mobile data traffic with specific examples of growing number of mobile devices such as tablets, dongles, smartphones, connected devices and M2M.



- 2- The development of a mobile market model for the evolution of mobile traffic and services with potential future services, taking into account segmented categories of devices using mobile networks
- 3- Detailed global traffic forecasts including for a Representative Western European country of around 50 million inhabitants in 2010

In addition to providing updated forecasts to our members and readers, the immediate purpose of this report is to assist both CEPT/ECC and the ITU process (IMT.UPDATE) related to long term (2010–2020) mobile traffic forecasts as well as penetration rates of voice and data traffic on mobile networks, to the services that are expected to be used and finally, to the evolution of the usage of these services. Therefore these results should be used in the preparation of the next World Radiocommunication Conferences (2012 and 2015), in the spirit of determining continued smooth operations of IMT broadband networks in this time frame.

Our special thanks go to the team at IDATE for their extensive work, in particular to Frédéric Pujol. I would also like to thank the UMTS Forum Spectrum Aspects Group and Project Team colleagues for their dedication in the preparation and direction of this report: Cengiz Evci, Rauno Ruismäki, Lasse Wieweg, Guillaume Lebrun and others who were partially involved.

Jean-Pierre Bienaimé

Chairman

January 2011

¹ By "Mobile Broadband", the UMTS Forum refers to subscriptions and devices using technologies that can offer 3G bitrates (or higher, such as HSPA, HSPA+ and LTE). In this context, GSM and GPRS are not considered as Mobile Broadband technologies

² Projections are also given for 2025



Executive summary

This report³ provides forecasts for the next decade, i.e. from 2010 to 2020⁴, on the evolution of penetration rates, of voice and data traffic on mobile networks, on the services that are expected to be used and, finally, on the evolution of the use of these services.

Methodology

This study reviews the forecasts presented in the UMTS Forum report N°37 "Magic Mobile Future 2010– 2020" (published in 2005) and presents new forecasts taking into account the market trends and market drivers since 2005.

• Step 1: trends and drivers of mobile traffic

Mobile traffic trends and factors driving change were reviewed. In the report, we analyse the main developments in the mobile sector: penetration rates, 3G growth, mobile Internet penetration, device evolution, supply-side changes, demand for voice and non-voice services, evolution and impact of the LTE ecosystem, impact of alternative wireless standards, and the new drivers for mobile traffic in the 2010 environment. We also highlight the latest developments in messaging, M2M, social networking, P2P and video services.

Step 2: review of the 2005 scenarios

The scenarios established in 2005 were revised to reflect the weight of data traffic compared with voice traffic. We consider that scenario 2 ("balanced, broad-based growth") represents the most plausible development for mobile communications for 2010-2020. This scenario was used for the traffic forecasts presented in this report.

• Step 3: mobile traffic forecasts

A market model for the evolution of mobile traffic has been developed to help create a picture of how the mobile market is likely to evolve. It takes into account the various categories of devices using mobile networks: low-end smartphones, mid-range smartphones, high-end smartphones, dongles⁵, connected devices and M2M devices.

Main trends and drivers

Major drivers and trends that will shape the world of 2011-2020 have been identified:

- The analysis of economic trends does not reveal any significant differences with the one contained in the 2005 report. It is used in our model to forecast mobile subscription growth worldwide.
- Mobile voice was overtaken by mobile data at the end of 2009. Data was the number 1 service category at the beginning of 2010 in terms of traffic generated on mobile networks. Mobile voice traffic growth should remain limited compared to the explosive growth in data traffic from 2010 to 2020.
- Data traffic already reaches very high figures for mobile broadband⁶ subscribers as shown in the table below:

³ The UMTS Forum commissioned this report from IDATE.

⁴ Projections are also given for 2025

⁵ We refer to "dongles" for the type of usage rather than the physical device: today, dongles are external devices which add connectivity to portable computers. In the future, this functionality will be more frequently integrated within portable computers. By "Mobile Broadband", the UMTS Forum refers to subscriptions and devices using technologies that can offer 3G bitrates (or higher, such as HSPA, HSPA+ and LTE). In this context, GSM and GPRS are not considered as Mobile Broadband technologies

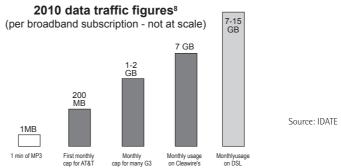


Daily mobile broadband data per subscription in different countries

Country	Time	Mobile Broadband Traffic per Day
Sweden	2009	61 MB/subscriber (average of private and corporate
Finland	2H2009	61 MB/subscription
Denmark	2H2009	43 MB/subscription
Austria	Q42009	42 MB/subscription
Ireland	Q12010	42 MB/customer (average btw business and residential)
Iceland	2H2009	31 MB
Slovak	n/a	15 MB/subscriber
Germany	2009	4.8 MB/UMTS user (as a response to Q2)
Netherlands	2H2009	2.5 MB/connection
Malta	10/2010	0.5 MB/subscriber

Source: ECC PT1

- Currently mobile data traffic drastically reaches very high figures for mobile broadband subscribers. In November 2010, one Scandinavian operator indicated that the average 3G smart phone user consumed 375 MB/month of data. The average 3G broadband user consumed 5 GB/month, largely through HSPA-data cards. But the average LTE consumer (all data cards) used 14 GB 15 GB/month of data. In the USA, one operator announced an average of 7 GB per month of data for a base of 2 million subscribers in July 2010.
- Growing number of mobile devices such as tablets, dongles, smartphones and connected devices are being used.
- Application stores have changed the mobile value chain and new players have joined the market.
- The LTE ecosystem is developing rapidly as LTE took off in 2010 and LTE Advanced is planned for 2015 according to time to market expectations.
- In 2010, the machine-to-machine (M2M) market already represents 53 million modules. M2M will continue to grow significantly. However in the future, the main contribution for mobile traffic will come from other devices.
- Small cells⁷ and Femtocells are becoming the solutions of choice for increasing network capacity. Wi-Fi offloading also plays a critical role for many operators.



^{7:} Small cells is a generic term that refers to low RF power cellular base stations dedicated to increasing the capacity and/or coverage of the mobile networks for short communication ranges (typically less than 200m) in urban environment or in rural areas (typically less than 1 km). They are deployed as a complement to the existing network based on macro cells

^{8: 1}minute of MP3 corresponds to the size of an audio file for 1 minute of music with MP3 coding



- Social networking has become very important for mobile users and now represents new consumption patterns and generates significant traffic
- Video has become increasingly important and is the N°1 source of data traffic. TV content provision by Internet also generates data traffic on mobile networks

Mobile traffic forecasts 2010-2020 based on this study

As a conclusion, total worldwide mobile traffic⁹ will reach more than 127 Exabytes (EB) in 2020, representing an x33 increase compared with 2010 figure. In 2020, we forecast that Asia will represent 34.3% of total world mobile traffic, Europe 22% and Americas 21.4%.

Total mobile traffic (EB per year) 140.00 120.00 fearly traffic in EB 100.00 Europe 80.00 Americas Asia 60.00 Rest of the world World 40.00 20.00 2010 2015 2020

For a representative Western European country of 50 million people, there will be more than 85 million subscriptions in 2020.

Source: IDATE

Population and subscriptions- Representative Western European country

Representative Western European Country	2010	2015	2020
Population (million)	50,0	50,2	50,2
Subscriptions (million)	62,6	73,5	85,4

Source: IDATE

⁹ Traffic forecasts represent the uplink and downlink traffic for voice and data transported on mobile networks using licensed spectrum and include the traffic managed by Femtocells. The forecasts presented in this report do not take into account Wi-Fi offloading and RFID traffic or any other traffic on unlicensed frequency bands
Traffic units used in the report are as follows:

¹ Gigabyte = 1,000 Megabytes

¹ Terabyte = 1,000 Gigabytes

¹ Petabyte = 1,000 Terabytes = 1,000,000 Gigabytes

¹ Exabyte = 1,000 Petabytes = 1,000,000 Terabyte



From 2010 to 2020, total daily mobile traffic in the representative Western European country¹⁰ will grow 67 times from 186 Terabytes (TB) to 12540 TB.

Total daily mobile traffic - Representative Western European country

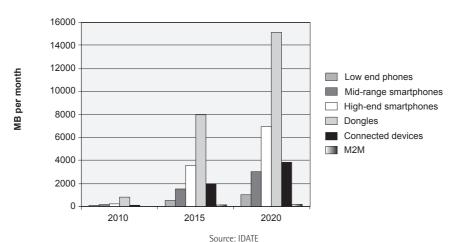
Total daily mobile traffic	2010	2015	2020
Representative Western European country (TB per day)	186	5,098	12,540

Source: IDATE

- Significantly, at least 80% of the traffic volume remains generated by users, leading
 to large variations of the total mobile traffic both in terms of time and space
 variations of traffic.
- Future mobile networks must be designed to cope with such variation of traffic and uneven traffic distribution, while at the same time maintaining a permanent and extensive geographical coverage in order to provide continuity of service to customers
- These opposite constraints are some of the most significant future challenges for operators.

Monthly traffic per device (representative Western European country)

Representative Western European Country



In 2020, daily traffic per Mobile Broadband¹¹ subscription in the representative Western European country will stand at 294 Megabytes (MB) and at 503 MB for dongles.

¹⁰ A Representative Western European country is considered as a country with 50 million population in 2010 and 50.2 million in 2020 with 62.6 million subscriptions in 2010 and 85.4 million subscriptions in 2020, respectively.

¹¹ According to the model used in this report, users of Mobile Broadband (MBB) subscriptions with high-end smartphones and dongles will represent 31% of the subscriptions in 2020 and 63% of the mobile traffic



Daily mobile traffic per Mobile Broadband & dongle subscriptions - Representative Western European Country

Daily mobile traffic per subscription	2010	2015	2020
Mobile Broadband (MB per day)	10	155	294
Dongles (MB per day)	26,7	265	503

Source: IDATE

Finally, we anticipate total worldwide mobile traffic of 351 EB in 2025 representing a 174% increase compared to 2020.

Traffic units used in the report are as follows:

- 1 Gigabyte = 1,000 Megabytes
- 1 Terabyte = 1,000 Gigabytes
- 1 Petabyte = 1,000 Terabytes = 1,000,000 Gigabytes
- 1 Exabyte = 1,000 Petabytes = 1,000,000 Terabyte

Table 1: Network capacity units12

Kilobyte	КВ	10 ³
Megabyte	MB	10 ⁶
Gigabyte	GB	10 ⁶
Terabyte	TB	10 ¹²
Petabyte	РВ	10 ¹⁵
Exabyte	EB	10 ¹⁸

Source: IDATE

¹²: Figures presented here are approximate values (1 KB is 1024 bytes or 8096 bits or 2¹⁰ in binary usage). Using the traditional binary interpretation, a terabyte would be 1,099,511,627,776 bytes.



1. Introduction and methodology

This study reviews and updates the forecasts presented in the UMTS Forum report N°37 "Magic Mobile Future 2010-2020".

In the figure below, we present the detailed methodology used for the traffic model employed in this update:

The report is structured as follows:

- Demographics & economic trends
- Analysis of the 2005 key findings
- Main trends for the mobile sector in 2010
- Analysis of the drivers
- Mobile services evolution
- Observed data traffic
- Traffic forecasts
- Scenarios

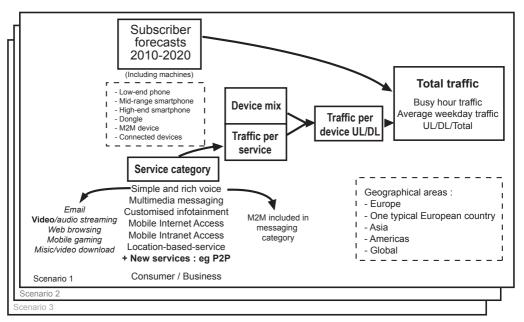


Figure 1: Traffic model

Subscriber forecasts come from IDATE's database and will be extended to the 2015–2020 period. Both subscribers and M2M forecasts will be detailed.



2. Demographics & economic trends

2.1. World Demographics

World population is projected to increase from 6.1 billion in 2000 to 7.7 billion in

2020 (an increase about 1.6 billion over 20 years). However, the population growth rate has slowed from 1.5% in 1995 to a current annual rate of 1.18%. According to United Nations, the growth rate will be 0.9% by 2020. 95% of the increase comes from developing countries and especially from Asia and Africa regions. India significantly contributes to this growth with more than 17 million new inhabitants per year.

In some advanced countries, population is forecasted to decline because of insignificant growth in birth-rates and no planned immigration in countries such as in Japan and Italy. Among the developed countries, USA, Canada, Australia, and New Zealand will maintain population growth, and provide the highest population growth-rates (around 0.7-0.9%)

In the less developed countries, a CAGR (Compound Annual Growth Rate) of 1.33% is forecasted between 2000 and 2020 (vs 0.30% in more developed economies). In India, the population will grow from 1.04 billion to more than 1.37 billion in 2020, adding more than 230.million inhabitants during this period. While in China, we will see a net addition of 164 million inhabitants to reach a global population of 1.43 billion in 2020. However, in Africa, some countries will see their population increases slowing due to the high rates of AIDS. This will be evident in South Africa for instance with a population growth rate at 1.38% in 2000 falling to 0.37% in 2020.

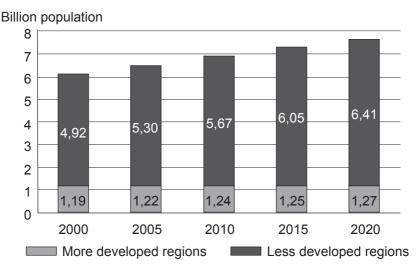


Figure 2: World population

Source: UN, 2008



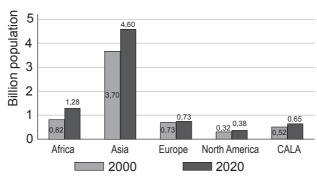


Figure 3: World population by region

Source: UN, 2008

2.2. Urbanisation level

Urbanisation is steadily increasing with more than 50% world population living in cities today. In 2020, it is expected that this number will reach 55%. Moreover, the number of people living in mega-cities (more than 10 million inhabitants) will double to more than 400 million

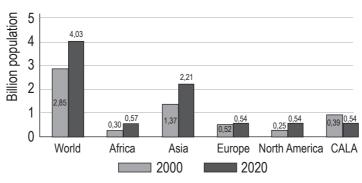


Figure 4: World urban population by region

Source: UN, 2007

2.3. Economic trends

The global economy is seeing signs of a recovery in 2010, albeit a weak one. According to the World Bank, annual real GDP growth will reach 3.3% this year, 3.3% in 2011 and 3.5% in 2012.

For the time being, this growth is driven by developing economies and especially BRIC countries accounting for real annual GDP growth of between 7.5% and 8.7% for 2010. However, rest of the world is lagging behind; the annual GDP will be much lower with 2.3% for the same period, and has been much more seriously impacted by the global financial crisis in 2008 and 2009.



When going into further detail, USA is the world's largest economy in 2010, followed by China, which represents 13.3% of the world total GDP. USA share in world GDP has declined from 23.7% in 2000 to 20.2% in 2010, evidencing the severe impact of the financial crisis. In Japan, the economy is shrinking, according to IMF, as annual real GDP fell by 5.2% over 2009. The country has been heavily impact by global financial turmoil. The European Union countries have also been heavily impacted by the economic slowdown, which is underlined by rising unemployment.

Developing economies are catching up with the large economy countries with the entry of developing countries like Russia and Brazil into the top ten biggest economies in 2010. They have all fared well during the global economic recession.

Chinese share in world GDP has increased from 7.1% in 2000 to 13.3% in 2010 and India has become the world's fourth largest economy in 2010.

Moreover, based on IMF and the United Nations forecasts, most developing economies in the top ten largest economies will be ranked higher than high income countries by 2020. Indeed, it is forecasted that China will be the world's largest economy accounting for more than 20.7% of global GDP. US will be relegated to second place and followed by India, which will have overtaken Japan. Russia will overtake Germany, and Brazil both the UK and France, while Mexico will rank higher than Italy.

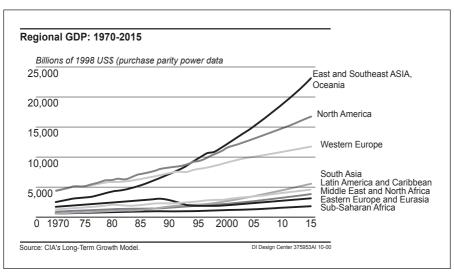
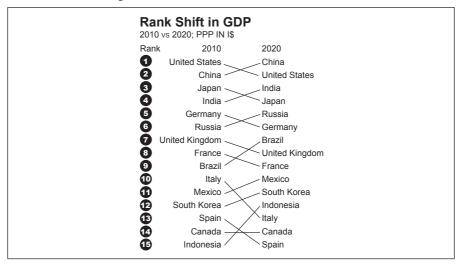


Figure 5: GDP trends per region, 1970-2015, USD

Source: NIC, 2000



Figure 6: Rank shift in GDP, 2010 and 2020, USD



Source: Euromonitor International (from IMF, UN...), 2010

The analysis of these economic trends is used in our model in order to anticipate mobile subscriptions growth worldwide.

From the perspective of reaching the poor with ICTs, mobile telephony offers particularly great potential. In practically all low-income countries, wireless is more prevalent than fixed telephone line infrastructure. This applies especially to rural areas. There are ample signs that the use of mobile phones in developing nations has expanded from voice to text messaging and more advanced data applications.

BAN Ki-moon, Secretary-General, United Nations says in preface¹³: "We are witnessing a new dawn in the way new technologies can make a difference, even in the most remote places. The diffusion of some ICTs – especially mobile phones– has improved dramatically, including in regions where many of the world's poor live and work. This translates into new micro-enterprises in different sectors, new services and new ways to market produce and other goods."

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¹³ UN Report: http://www.unctad.org/en/docs/ier2010_embargo2010_en.pdf



3. Analysis of the 2005 key findings

During the 2005–2010 period, mobile networks saw an explosion of data traffic. We present in the table below our vision of the evolution of the anticipated 2005 key findings:

Figure 7: 2005 key findings - traffic forecasts 2010-2020

2005 key findings	2010 analysis
Traffic will increase by a factor of 23: From 2012 to 2020, total daily traffic in the Representative Western European country will grow from 250 TB to approx. 5,750 TB. This significant growth is due to the increasing number of available services using photos, videos which will lead to the exchange of higher data volumes	From 2012 to 2020, total daily traffic in the Representative Western European country will grow from 711 TB to approx. 12,540 TB
Internet access will be the driver: Mobile Internet access (consumer segment) and mobile Intranet/ Extranet access (business segment) will benefit from higher use frequency and larger file sizes. Mobile Internet access subscriber base will grow significantly. In 2020, voice will be overtaken in terms of volume (TB) by Mobile Intranet/Extranet access which currently generates the highest traffic volumes	Voice was overtaken by data at the end of 2009. Voice traffic growth should remain limited compared to traffic growth from 2010 to 2020 The application stores have changed the mobile value chain and new players are now part of the game
Voice will remain the predominant service: In 2012, voice (simple and rich) will still be the N° 1 service category in terms of daily traffic volumes. Simple voice duration will remain flat in both consumer and business segments. However, total call duration will be higher in 2020 than in 2012 thanks to the increase of rich voice and VoIP calls	Data is the n°1 service category at the beginning of 2010 in terms of traffic generated on mobile networks
Relations between people will expand: P2P communications (such as MMS) traffic volumes will grow from 2012 to 2020 thanks to the migration from text based MMS to photo/video based MMS and thanks to the increasing number of M2M file transfers.	In 2010, M2M already represent 53 million modules. M2M will continue to grow significantly
More personalised services – from entertainment to life coaching: In 2020, customised infotainment subscriptions base will be slightly higher than in 2012 but traffic volumes will increase steadily thanks to a higher use of services	Entertainment continues to generate most of the data traffic growth with video representing the bulk of the consumption
A world under individuals' own control via sensors and location based services: Location-based services daily traffic will grow thanks to both subscriber growth and frequency of use growth	Location-based services are becoming a utility as capabilities are integrated into smartphones. Services are often offered for free



4. Main trends

The main trends identified in 2005 are commented in the tables below:

Table 2: Main trends (1/2)

Technology trends that will shape future mobile devices and networks	UMTS Forum report N°40	2010 situation
Key drivers that will shape the world of 2010-2020	 The key drivers will be: more urban and elderly population labour-force evolution will lead to new needs for communication privacy and education are identified as social trends the ICT environment booming everywhere; dramatic growth in Asia 	No significant change compared to 2005 forecasts
Key technology trends	Mobile devices will benefit from major breakthroughs expected to occur in the next decade: technology developments in areas such as semiconductors, nanotechnology, processing power and storage capacity will enable the emergence of smaller, increasingly complex and intelligent devices. However, battery power technology will only improve in terms of power to weight ratios, rather than any generational improvements. Many networking technologies will be available to enable true ubiquitous mobile access: many technologies will become available that provide different wireless solutions (e.g. wireless sensor networks, "enhanced 36") and networking protocols will connect users to the best available network.	Mobile devices: tablets, dongles, Smartphones and connected devices proliferate LTE take-off and LTE Advanced planned for 2015 Small cells and Femtocells are becoming the favoured solutions to increase network capacity Network sharing is developing



Table 3: Main trends (2/2)

TS Forum report N° 40	2010 situation
iniaturisation will permit wireless tag, con and sensor node take-off and ld enable the number of connected nts, products and machines to exceed number of connected people (billions units in a year). This will generate a host new services: homes will be "sensorised" n remote monitoring and control over igerator inventory, environmental controls parental control of content	M2M is taking off
bile devices will enable the transmission of lth information to a server maintained by vidual or healthcare providers for analysis. maniche-market in 2010, adoption expand to routine monitoring and histicated analysis by 2020	e-health is gaining momentum
ure technologies such as wireless beacons likely to provide highly accurate location ormation (a few cm)	Geolocation facilities (GPS,compass) included in many devices
the next decade, the technologies required initiating the transaction, the mobile asaction authentication and payment onciliation will be available	M-Payment is taking-off (already widespread in Japan and in many African countries)
bile technology will be in place to meet sumers' demand for rich digital content time, anywhere and over any channel	Social networking has become very important for mobile users and now represents new usage and generates significant traffic
user will have access to entertainment dia wherever and whenever desired, and have increasing ability to customise their n entertainment experience	Video has become increasingly important and is the N°1 source of data traffic. TV content provision by Internet also generates data traffic on mobile networks
bile technologies like virtual private works (VPNs) or M2M services will enable increased blurring of home and work life. rking hours are likely to become more ible as a result	No significant change
vernment will encourage the adoption of nnology by proactively using technology lisseminate information and provide vices	M-Government applications are being adopted
s would be a second step in the talisation of education that was decided many governments	M-education is quite high on the priority list of many governments
	iaturisation will permit wireless tag, con and sensor node take-off and ld enable the number of connected nts, products and machines to exceed number of connected people (billions nits in a year). This will generate a host ew services: homes will be "sensorised" nemote monitoring and control over igerator inventory, environmental controls parental control of content oile devices will enable the transmission of lth information to a server maintained by vidual or healthcare providers for analysis. In a niche-market in 2010, adoption expand to routine monitoring and nisticated analysis by 2020 are technologies such as wireless beacons likely to provide highly accurate location irmation (a few cm). The next decade, the technologies required initiating the transaction, the mobile isaction authentication and payment onciliation will be available. The provide highly accurate to meet sumers' demand for rich digital content time, anywhere and over any channel user will have access to entertainment dia wherever and whenever desired, and have increasing ability to customise their in entertainment experience.



5. Analysis of the drivers

5.1. 2007 drivers update

The mobile sector drivers identified in UMTS Forum report 41 are summarised in the table below. We comment on their importance and any observed changes in the 2010 context:

Table 4: Mobile traffic drivers

2007 Drivers	2007 Impact ¹⁴	2007 Uncertainty ¹⁵	2010
Device evolution – e.g. usability, functionality, capacity and battery life	2	3	Significant evolution as evidenced by smartphones and tablets
Level of fixed-mobile substitution	5	4	More complementarities than substitution (attractiveness of dongles)
Supply side change – e.g. consolidation and entry of new players	2	2	Consolidation in the UK and in the USA. New entrants in the TDD field (India, Japan, Europe, Russia)
Availability of spectrum for LTE services	5	2	Digital Dividend and 2.6 GHz band becoming available
Level of demand for non- voice services requiring higher performance networks	5	5	High demand for video services, emails, VPN, Internet access
Evolution of LTE ecosystem	5	2	Rapid development
Impact of alternative wireless standards (e.g. WIMAX and proprietary BB FWA)	4	4	Low impact
Actual LTE network performance	4	3	As expected
LTE standard convergence of UMTS and CDMA2000 evolution	3	4	LTE chosen by HSPA and CDMA2000 operators
Global macroeconomic environment	2	2	Mixed (see section 2.)
Demographic trends	3	1	No significant change (see section 2.)
Investor willingness to finance new network rollout	4	3	Limited
Timing for LTE network and device availability	4	3	On track

Legend: significant change compared with 2007

no significant change

Source: UMTS Forum report N° 41 and IDATE

In the following sections, we discuss in detail the 2005–2010 evolution for each of these drivers and provide our own estimates and forecasts.

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¹⁴ 5 corresponds to very strong uncertainty and impact (the corresponding driver was subject to strong uncertainty in 2007), 1 to very low uncertainty and impact (e.g. Demographic trends are know with a good level of detail 10 years in advance)
¹⁵: same as ²



2008 2009 2010 2011

5.2. Mobile sector evolution

5.2.1. Mobile penetration rates (actual results and forecasts)

Mobile penetration rates: 2007 forecasts for mobile subscriber numbers in 2020 have already been exceeded!

Exhibit 4.2 shows the forecast growth in global mobile subscribers detween 2008 and 2015

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Table 5: 2007 penetration rates forecasts

Source: UMTS Forum report N°41 (from year 2007)

2012 2013

2014 2015

Source: UMTS Forum & IPTS

1990

2005

Source: IPTS

2010 2015

2020

At mid-2010, there were already more than 5 billion mobile users worldwide (excluding the M2M market). 2020 forecasts show that mobile penetration should reach 119% of the population (excluding the M2M market).

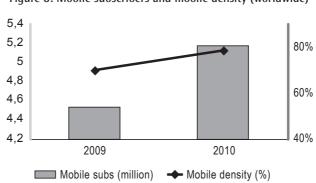


Figure 8: Mobile subscribers and mobile density (worldwide)

Source: IDATE



Table 6: Mobile users' forecasts (excluding M2M – the dates refer to end of corresponding years)

Global Base (million)	2010	2015	2020
Europe	1,014	1,151	1,242
Americas	898	1,109	1,302
Asia	2,570	3,780	4,764
Rest of the world	794	1,238	1,730
World	5,275	7,278	9,038

Please refer to section 8.1.1 for more details on the user forecasts.

5.2.2. 3G growth

One obvious condition required for the mobile broadband16 take off is a favourable environment, and most importantly a suitable network infrastructure. Although mobile Internet started with the emergence of EDGE devices, which made browsing the Web more comfortable, the provision of adequate connection speeds was and remains crucial for a satisfactory browsing experience.

The latest technology to be deployed by operators is 3G+ or 3.5G (e.g. HSPA/HSPA+), which is gradually supplanting 3G (e.g. WCDMA). 3.5G encompasses technologies with theoretical connection speed ranging between 3.6 Mbps and 42 Mbps, which is close to DSL-type wired networks. HSPA+ is the latest version of HSPA and some operators started deploying it in 2009. Although still considere as 3.5G, it offers considerably faster connection speeds.

3G and 3G+ coverage has increased over recent years but is heterogeneous, depending on the country. Indeed, the first areas with mobile broadband coverage (3G and 3G+) were cities where the density of population is highest. Other areas are now being covered and refarming enable operators to use the 900 MHz band, which offers larger cell radius than the 2.1 GHz band. The Digital Dividend17 will also bring additional resources when LTE starts to takes off.

100% 75% 3G Ratio 50% 25% 0% 2006 2007 2008 2009 2010 2011 2012 2013 -□-Germany - Spain France → Italy -≭-UK - USA - Japan

Figure 9: Nationwide distribution of 3G subscribers

Distribution of 3G/3G+ handsets

Currently, more than 30% of all mobile phones in the world are 3G-ready. According to IDATE, sales should reach 623 million units in 2012 thanks to continued 3G deployments in countries such as China and India. By 2012, 48% of handsets will be 3G-ready.

¹⁶ By "Mobile Broadband", the UMTS Forum refers to subscriptions and devices using technologies that can offer 3G bitrates (or higher, such as HSPA, HSPA+ and LTE). In this context, GSM and GPRS are not considered as Mobile Broadband technologies

in : The Digital Dividend is the additional spectrum that is becoming available for new wireless and TV services as a result of the switchover from analogue to digital TV



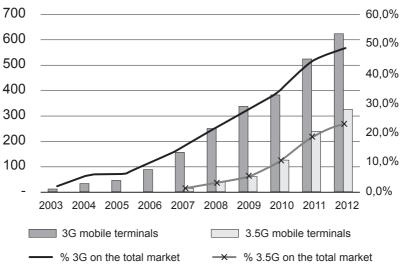


Figure 10: Sales forecasts for 3G18 and 3.5G terminals (million units)

With 3.5G networks emerging on the global scene, the volume of compatible handset sales started to take off in the third quarter of 2007. According to IDATE estimates, 37 million units were sold in 2008 which represents 3.1% of all handsets, and up from 1.2% in 2007.

5.2.3. Mobile Internet penetration

Following early developments in Japan and South Korea, the market of mobile Internet finally took off in 2007. There are now 95 million mobile Internet users in Europe and 55 million mobile Internet users in USA in 2009.

The higher take-up of smartphones, which are tailor-made for mobile Internet experience, is also a key driving force in the significant development of the mobile Internet market.

Most mobile Internet services are extensions of the PC-based Web and much focus on entertainment. Many stakeholders are now offering applications through commercial application stores.

By 2014, it is expected that mobile Internet users will reach 232 million in Europe and 117 million in USA, which would represent respectively penetration rates of 33% and 37%.

^{18 &}quot;3G" corresponds to HSDPA and 3G+ or 3.5G corresponds to HSPA and HSPA+



160 nternet mobile users (million) 140 120 100 80 60 40 20 0 2007 2008 2009 2010 2011 2012 2013 2014 France USA Germany Spain Italy UK Japan South Korea

Figure 11: Mobile Internet users, million, 2007-2014

90 % Internet mobile users 80 70 60 50 40 30 20 10 2007 2009 2008 2010 2011 2012 2013 2014 France Germany Spain Italy **USA** South Korea Japan

Figure 12: Mobile Internet penetration,%, 2007-2014

Source: IDATE

5.2.4. Huge growth potential for mobile broadband

At the end of 2010, fixed Internet penetration should reach 23% of the world population¹⁹. At the same date, mobile will reach a 77%²⁰ penetration level worldwide. With mobile broadband becoming widely available, mobile networks already represent the first access means to the Internet in developing countries. This potential is likely to increase in the future as mobile networks continue to offer higher speeds and capacity. According to Ericsson, there will be close to 3.5 billion mobile broadband users in 2015. Our model gives similar figures with an estimate of 3.2 billion mobile broadband subscribers in 2015 and 4.3 billion in 2020.

^{19 2010} estimate, source: www.internetworldstats.com

²⁰ Source: IDATE



5.3. Device evolution

Device evolution is one of the key enablers of the data traffic explosion on mobile networks:

- A significant step forward in technology was evidenced by the explosive growth of the smartphone segment.
- There is also fierce competition between Operating Systems of smartphones
- Dongle take-up is boosted by low prices
- Connected devices: tablets should also heavily impact mobile data traffic. In
 October 2010, Gartner forecast tablets at 19.5 million units in 2010 and 54.8 million
 units in 2011. Other new devices include portable game players, portable media
 players, digital cameras, digital photo frames, HDTVs, GPS devices ...
- M2M: M2M traffic is expected to explode in the coming years with the rise in the number of M2M devices available, and it is also expected that new M2M applications such as video surveillance will increase the average traffic per unit

The amount of smartphones in the market will significantly impact the development of the mobile broadband. Whilst smartphones are not must-haves for the mobile Internet, they are certainly the most suited device to satisfy high-quality user-experience expectations which users are used to in fixed/cable environment.

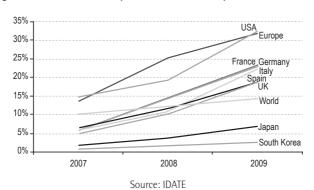


Figure 13: Share of smartphones in mobile shipments, 2007–2009

- For every country and region, the share of smartphones in mobile shipments has been steadily increasing since 2007
- In Japan and South Korea, purchase of smartphones remains low. The mobile market is already very advanced in these two countries, where "traditional" mobile phones already have very high specifications with well-established ecosystems.
- On the other hand, USA and EU27 leads shipments for smartphones. USA made a big leap in smartphone penetration in 2008, followed by EU27 in 2009.
- There are no big discrepancies between the countries of the EU5²¹, and smartphone penetration remains similar between the USA and Japan/South Korea.

²¹ Germany, United Kingdom, Italy, France and Spain



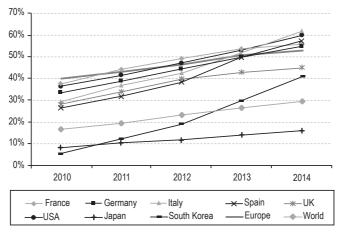


Figure 14: Share of smartphones in mobile shipments, 2010-2014 forecast

- On country, region, and worldwide scales, IDATE forecasts that the share of smartphones shipped will continue to increase through 2014.
- In Japan, the share of smartphones will remain low due to its distinctive closed ecosystem with local handset vendors, who create many high-end "traditional" phones which are comparable to smartphones.
- Whilst South Korea, like Japan, has currently low smartphone penetration, Korean handset vendors are starting to enter the smartphone market (both nationally and internationally), and thus smartphone shares will increase.
- The US and Europe will see a continuing rise in smartphone mobile-market share, with some countries approaching 60% or more.
- Worldwide, smartphone shipments should reach 30% by 2014.

Recent developments

During the last two years, improvements have been made to the mobile Internet user experience. Some particular components have become standard on most advanced smartphones and are gradually penetrating the rest of the market. They do not relate to processing power but to usage and broader services enabled on mobile devices. Here is a review of those components.

Accelerometers can now be found on most smartphones. Those components enable
the device to determine the inclination of the screen and then accurately adapt the
display mode (either landscape or portrait). This is the main use of this component
in mobile devices but other applications are possible. Most notably the
accelerometer has been used in games to interact with the environment. Turning
the phone to the right, for instance, makes your character or engine go to the right.
Accelerometers can also be used to detect shocks and trigger a specific action. For
instance shaking the device makes the mobile browser reload the page displayed.



- Multitouch screens: Touch screens have been around a while in the industry but
 they could only register and manage one point of contact. With multitouch
 technology users' interactions have been multiplied. Pinching the screen, for
 instance, can allow the user to zoom in or out in a very intuitive manner. The use
 of several fingers enables a variety of gestures; this seems an attractive alternative
 to pointers such as a mouse, which are not found on mobile devices.
 Multitouch capacity is often related to capacitive touchscreens but very precise
 multitouch resistive touchscreens have also been demonstrated and are used in
 entry level smartphones.
- GPS is now very common in mobile phones and not only in the most advanced one.
 This is not the only location technology but surely the most precise and most effective, when combined with other technologies such as cellular or WiFi triangulation. Turn-by-turn navigation is one very commonly enabled application, but contextual localisation enables the device to propose and adapt different services depending on where you are located. Access to the GPS chip was previously limited to native applications, but HTML 5 will allow Web Browsers, and consequently Web Apps, to access the GPS chip through standardised geolocation API.
- Compass: More recently, compasses or magnetometers have been included in smartphones to enhance location-based services. A compass notably enables the user to know exactly in which direction he is heading. GPS in fact can determine this only if the device is moving while a compass can do so very precisely even at a standstill. More importantly, a compass used in combination with GPS enables applications such as basic Augmented Reality
- NFC/RFID: Not many improvements have been made in this field and the
 penetration of this technology is still limited to countries in Asia and more
 specifically Japan. The implementation of the NFC chip inside the SIM card could
 help increase NFC penetration as it would enable more phones to benefit from this
 technology. In Japan, Softbank has also been testing the integration of NFC services
 through a sticker, which embeds the NFC component.

5.4. Fixed-mobile substitution

Today, there is more complementarity between fixed and mobile than fixed-mobile substitution. 3G dongles which provide connectivity enhance the attractiveness and the usefulness of personal computer for people on the move. This type of usage is more a complement than a substitute to the fixed line.

Fixed-mobile substitution is significant in a limited number of markets such as Austria or Sweden. This can be explained by the attractiveness of dongles, competitive prices for "unlimited" data packages and speeds offered by 3G+ networks.



Austria 1900 +7% 3167 3 000 2739 33% 2010 2 000 1690 900 1252 1 000 0 -100 2006 2007 2008 2005 2009 ☐ DSL 2H06 1H07 2H07 1H08 2H08 1H09 2H09 FTTH Cable modem Mobile BB Fixed BB Mobile Broadband Other fixed broadband Sweden 4255 3 000 4 000 3601 +4% 2960 3 000 2432 2 000 2 000 1871 +80% 1 000 1 000 n 2005 2006 2007 2008 2009 ■ DSL Cable modem 2H06 1H07 2H07 1H08 2H08 1H09 2H08 ■ FTTH Other fixed Broadband Mobile BB Fixed BB ■ Mobile broadband
■Other fixed Broadband

Figure 15: Broadband growth in Austria and Sweden

Source: NRAs and IDATE

5.5. Supply side change

Consolidation between mobile operators took place in some countries:

- In the UK: Orange and T-Mobile merged in 2010
- In the USA: Sprint and Nextel merged and the market is now effectively dominated by four main operators

A limited number of new entrants:

- New 3G operators (eMobile-Japan in 2007, Free Mobile-France in 2011 ...)
- Some new entrants in the 2.6 GHz band in Europe
- New entrants with the BWA (Broadband Wireless Access) licenses in India and Clearwire in the USA

Operators considering network sharing keeping control of the costs ...



Another trend is network sharing: the latest technological and regulatory developments are conducive to the adoption of network sharing practices. As operators (prepare to) install LTE networks they have the opportunity to maximise on the benefits of network sharing by opting for common planning and rollout from the outset and thus reduce their network costs. These sharing agreements are subject to regulatory approval. This has led to a significant increase in infrastructure-sharing agreements between operators, which has been the case particularly in radio site sharing because the construction of additional cellular towers is very CAPEX-hungry and network sharing can reduce noticeably network construction expenditure as well as operational costs. For MNOs wishing to reduce their costs, the actual potential cost reduction depends on the extent to which the MNO's network is shared (passive/active) and on the number of sites decommissioned. Assuming the case of a greenfield network with 100% of sites shared, savings will be somewhere between 11% and 20% of total network costs.

5.6. Demand for non-voice services

Please see section 6.4 for more details.

5.7. Evolution of the LTE ecosystem

TeliaSonera, LTE world premiere

On December 14, 2009, TeliaSonera rolled out the first worldwide commercial LTE network. It uses the 3GPP Release 8 which was frozen at the end of 2008²² (Release 9 stage 3 was frozen in December 2009, Release 9 stage 2 in June 2009 and Release 9 stage 1 in December 2008, Release 10 stage 1 is still being reviewed at the time of writing; it was expected to be frozen in March 2010).

The rollout initially covers Oslo, Norway and Stockholm, Sweden, and is limited even within the boundaries of these cities. The Samsung GT3710 (a USB LTE-only dongle) is the first commercial device enabling LTE technology. Initial speed tests showed 42.78 Mbps downlink, and 5.3 Mbps uplink, with 37ms latency. February 2010 results (Oslo network) showed peak rates of close to 100 Mbps at 20 MHz bandwidth with delays of 20 to 25 ms.

At the moment it has a few thousand users, but growth is being hindered by the low availability of LTE dongles. Multi-mode dongles were available in June 2010.

Several players set to follow late 2010

A few players have confirmed their plans to launch LTE by the end of the year 2010. The majority of the aggressive LTE deployment comes from CDMA operators. Verizon Wireless of USA, the jointventure company between Tele2/Telenor in Sweden and NTT DoCoMo in Japan are expected to launch LTE by the end of 2010. Verizon Wireless is clearly in a hurry to deploy their LTE network. MetroPCS launched a LTE network with coverage limited to Las Vegas and Dallas in September 2010.

²² After "freezing", a Release can have no further additional functions added. However, detailed protocol specifications (stage 3) may not yet be complete.



2009 2011 2012 TeliaSonera döcomo 3GPP WCDMA TELE2 Operators TELECOM & T - Mobile 8 TD-SCDMA KTF Bell KDDi 3GPP2 TELUS CDMA metro PCS operators

Figure 16: Major operator LTE commercial deployment schedule

Many more LTE launches scheduled for 2011 onwards

Some players seem to be more cautious about deploying LTE. For instance, Vodafone has not made any big announcements on their LTE deployment plans. T-Mobile is not in any particular hurry and AT&T Wireless CEO Stephenson reported that AT&T is "not in a tremendous hurry to deploy the nextgeneration network".

A number of big-name MNOs have also been very quiet about their deployment plans, which leads us to believe that they are also taking their time (Telecom Italia, Telefonica). They have however confirmed that, post HSPA, LTE is the logical next technological step. They are still committed to deploying LTE and have started to trial the technology in limited areas.

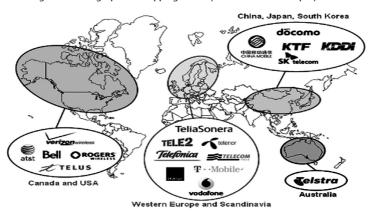


Figure 17: Geographical mapping of early LTE commercial deployment

Source: IDATE, based on operator announcements

Driven by the rapidly growing demand from their customers for data services, mobile operators worldwide are accelerating the deployment of LTE. At mid-2010, a minimum of 9 frequency bands are being used for LTE tests:



Table 7: Spectrum used for LTE tests and deployments

Country	Operator	Frequency band	technology	Status	
China	China Mobile	2.3 GHz	LTE TDD	Tests	
France	Bouygues Telecom	1800 MHz	LTE TDD	Tests	
Finland	Elisa	1800 MHz and 2.6 GHz	LTE TDD	Tests	
Germany	Vodafone	800 MHz LTE TDD		Tests	
Japan	DoCoMo	2.1 GHz	LTE TDD	Deployment	
Japan	DoCoMo, KDDI, Softbank Mobile	1.5 GHz LTE TDD		Tests	
Japan	E-Mobile	1.7 GHz	LTE TDD	Tests	
Norway	TeliaSonera	2.6 GHz	LTE TDD	Commercial	
Sweden	Net4Mobility	900 MHz and 2.6 GHz LTE TDD		Tests	
Sweden	TeliaSonera	2.6 GHz LTE TDD Cor		Commercial (12/2009)	
USA	Verizon Wireless	700 MHz	LTE TDD	Deployment	
USA	MetroPCS	AWS (1.7/2.1 GHz)	LTE TDD	Commercial (09/2010)	
USA	Cox	AWS (1.7/2.1 GHz) and 700MHz LTE TDD Tests		Tests	
USA	AT&T	700 MHz	LTE TDD	Tests	

LTE market forecasts

We based our forecasts on estimated commercial launches of LTE services in 5 distinct regions/countries, i.e. the USA, the EU5 plus Scandinavia, Japan, South Korea and China. As they all have very specific market conditions, which affect LTE adoption, we present the latest news on this theme in each sub-section.

We estimate that LTE services will not be launched before end 2011–2012 in EU5 and China and notbefore end 2010–2011 in the USA, Japan and South Korea. We took into account recent commercial launches in Scandinavia.

India, which announced 3G and 4G spectrum auctions in April 2010, cannot be disregarded because of its huge population. IDATE thinks LTE adoption in India could be driven by TD-LTE if BWA spectrum can be used for this technology.

The following figure provides a global picture of regional forecasts detailed below. As at end 2015, we expect 13% of the subscriber base to be accessing LTE networks with discrepancies depending on countries. More specifically, LTE subscribers should increase during the 2012-2015 period from 27 million to close to 300 million at end 2015 (EU5+Scandinavia, Japan, South Korea, China, USA).



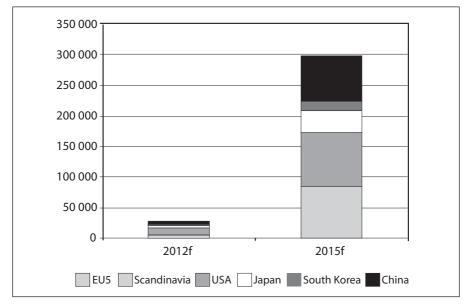


Figure 18: LTE market forecasts

5.8. Impact of alternative wireless standards

Alternative wireless standards have a low impact on the mobile ecosystem:

- Mobile WiMAX has an impact in the USA where it is likely to impact Verizon's strategy in terms of LTE deployment. On the long term, Clearwire and other Mobile WiMAX operators might choose to switch to TD-LTE.
- In developing countries, WiMAX technology is mainly used as a substitute for fixed networks.
- No other FWA/BWA technology

5.9. Current LTE network performance

Early LTE networks are delivering on forecasted performance levels. Based upon the field trials performed by many operators worldwide and the commercial launch of TeliaSonera in Sweden and Norway, it is now possible to have a good picture of the performances of LTE networks. In the following table, we differentiate between peak rates (the maximum data rates measured), the average data rates and the cell-edge (the limit of the coverage of a cell where data rates are lowest).

Data rates depend upon the channel width used, the antennas, the number of users in the cell... In the table below, we present examples of data rates based on public figures given by the operators:



Table 8: LTE data rates

Operator	Network	Channel	MIMO	Downlink data rates	Uplink data rates	Latency (response time)
Cox USA	Trial	5 MHz	2x2	Peak 28 Mbps, 17 Mbps at mid-cell and 8 Mbps at cell edge		
Net4mobility Sweden	Trial			86.9 Mbps max.	19.82 Mbps max.	22 ms
Orange France	Trial	10 MHz	2x2	Peak: 57 Mbps Average data rate: 25-30 Mbps	Peak: 17 Mbps	20 ms
02 UK	Trial	20 MHz	2x2	Peak: 50 Mbps		
Telecom Italia	Trial	20 MHz	2x2	Peak: 135 Mbps	Peak: 135 Mbps	
TeliaSonera Sweden	Commercial	10 MHz	2x2	Peak: 35 Mbps Average data rate: 15 Mbps.	Peak: 5 Mbps (15 to 25) Average: 4.45 Mbps	28 ms
		20 MHz		Peak 80-90 Mbps. 32 Mbps median, 34.2 average		
TeliaSonera Norway	Commercial	20 MHz	2x2	100 Mbps connectivity with 95% reliability. 5 to 10 Mbps average. cell edge, max. 10–20 Mbps		
Verizon Wireless USA	Trial		2x2	Peak: between 40 Mbps and 50 Mbps	Peak: 20Mbps to 25 Mbps	

5.10. LTE standard convergence of UMTS and CDMA2000 evolution

CDMA2000 operators are choosing LTE as the way forward:

- The main CDMA2000 operators have announced their commitment for LTE: Verizon Wireless in the US, KDDI in Japan, operators in Canada, Australia, New Zealand
- SprintNextel chose Mobile WiMAX but could switch to LTE in the coming years
- Standardisation work for CDMA 2000 evolution is limited

5.11. Investor willingness to finance new network rollout

Investor willingness to finance new network rollout is quite limited as only a small number of new entrants have emerged:

Partly financed by Harbinger Capital Partners (for 2.9 billion USD), the network, called LightSquared, is an open wireless broadband network with a combination of SkyTerra's satellite assets and Nokia Siemens Networks' LTE infrastructure. The investment company has announced its plans to build a hybrid LTE-satellite mobile network to provide nationwide coverage. By 2015, the LTE network will cover 92% of US mobile users by installing 40 000 base stations. Satellite coverage will increase population penetration to 100%.



Geostationary
Satellites

Satellite

Gateway

PSTN/
PDN

L-Band Cell
Sites

Figure 19: Hybrid Terrestrial /satellite wireless network

Source: DailyWireless

 Qualcomm invested in 2.3 GHz spectrum in India, aiming at demonstrating LTE technology and creating LTE infrastructure and device ecosystem. Qualcomm's goal is to attract one or more experienced 3G HSPA and/or EV-DO operator partners into the venture for construction of an LTE network and then to exit the venture.

However, it is expected that incumbent mobile operators will be able to deploy LTE networks without any significant increase in their CAPEX.

TeliaSonera LTE deployment will be achieved progressively, rather than through a

large-scale roll-out, by deploying SingleRAN base stations. The mobile operator plans to roll out first LTE networks to cover urban areas including 25 largest municipalities in Sweden and 4 cities in Norway. It already launched the first commercial LTE services in the world last December 2009 in the central city areas of Stockholm and Oslo. For this initial deployment, in terms of investment, TeliaSonera did not expect any significant rise in spending due to LTE. According to the company, the impact of its investments in the new networks on the overall spending on equipment should be small. TeliaSonera expects to spend 500 million SEK (47 million EUR) in LTE for 2010 while its mobile CAPEX declined in 2009 reaching a total of 3.9 billion SEK (370 millions EUR).



Decline in investments in GSM Continued espenses for UMTS LTE networks duild-out in Sweden and Norway billion SEK 3 0 2009 2006 2010 estimated Purchase of 4G licences ¹LTE LTE trials Launch Capex - Total LTE initial deployment Capex - Sweden and Norway

Figure 20: TeliaSonera Capex evolution 2006-2010

Source: IDATE

5.12. Timing for LTE network and device availability Network development

LTE development is on track for the FDD (Frequency Division Duplex) version with commercial deployments already available. The TDD version is currently undergoing tests.

Table 9: Geographical coverage for early LTE and Mobile WiMAX deployments

Country	Network	Operator	Type of deployment
Japan	LTE FDD	NTT DoCoMo	Plans to cover 50% of the population from 20 000 base stations
Norway	LTE FDD	Telia Sonera	The commercial network was launched at the end of the year 2009 in Oslo. The network was launched with approximately 200 base stations in the city centre
Sweden	LTE FDD	Telia Sonera	The commercial network was launched at the end of the year 2009 in Stockholm. Telia Sonera expects to extend its LTE coverage to several Swedish cities: Lund, Västeras, Göteborg, Malmö, Uppsala och Linköping during Q2-Q3 2010. Plans are later on to cover 25 additional municipal cities in Sweden by 2011.
USA	LTE FDD	AT&T	key markets during 2011
USA		Clearwire	Clearwire plans to launch WIMAX 13 to markets in 2010.This plan should include Los Angeles, Miami, New York City, Houston, Boston, Washington, D.C., Kansas City, Denver, Minneapolis, the San Francisco Bay Area, St Louis and Salt Lake City. It should concern 120 million people
USA	LTE FDD	Cox	Plans to cover 25 million pops
USA	LTE FDD	Verizon Wireless	Verizon Wireless announced that it aims at covering 48 states as well as Hawaii. By end of 2010 LTE will be launched into 25 to 30 markets covering approximately 100 million people. The network will be extended in the years to come to cover current 3G footprint by 2013, i.e., around 285 million people. It plans to install 1 000 base stations by the end of 2010.

Source: IDATE



Device availability

TeliaSonera started commercial LTE service in Sweden using single standard LTE dongles in December 2009. They were replaced by dual-standard LTE-HSPA dongles in June 2010. The first LTE smartphones appeared in September 2010 for MetroPCS (USA) with limited volumes (the Samsung Craft or SCH-r900 with a 624 MHz processor, 128 MB of RAM, a 3.2-inch display and the Windows Mobile 6.1 operating system). Large scale provision of LTE smartphones is expected in 2011.

5.13. New drivers in the 2010 environment

Compared with the 2005 context, the most important changes are due to the adoption of the smartphones and changes in the mobile value chain. The success of the mobile broadband is leading to mobile networks saturation. New drivers taken into account in this study are the following:

- Mobile video counts for most of mobile data traffic growth
- Mobile networks saturation
- The smartphones and connected devices will fuel data growth
- Femtocells impact: Femtocells bring additional capacity and coverage in indoor environment
- M2M units and traffic growth
- Changes in the value chain: the arrival of Internet and PC players in the mobile sector

5.13.1. Trends in mobile data pricing

Two heavyweight operators, Verizon Wireless and NTT DoCoMo, plan to launch their commercial LTE service in 04 2010

Verizon Wireless - USA

Verizon Wireless dominates LTE deployment in the US as it was one of the first telcos to commit to LTE. It announced its deployment plans in February 2009. Verizon Wireless offers its 3G network CDMA 1xEV-DO Rev.A, hence its LTE deployment is its first based on the GSM/HSPA family of technologies. Verizon Wireless has adopted an aggressive approach because it aims to immediately begin leveraging on a global scale by quickly adopting a dominant global standard. It plans to launch the nation's first LTE network in up to 30 markets by the end of 2010 and cover virtually all of its current nationwide 3G areas by the end of 2013.



Table 10: Mobile data tariffs (Verizon Wireless and the other operators in the US-October 2010)

Operator	Device	Monthly cost	Network	Data cap	Overage cost
Verizon	Dongle	USD 39.99	3G	250MB	USD 0.1 per MB
		USD 59.99		5GB	USD 0.05 per MB
	Smartphone	USD 15		150 MB	USD 0.05 per MB
		USD 30		Unlimited	USD 0.05 per MB
AT&T	Dongle	USD 35	3G	200MB	USD 0.1 per MB
		USD 60		5GB	USD 0.05 per MB
	Smartphone	USD 15		200MB	USD 15 for additional 200MB
		USD 25		2GB	USD 10 for additional 1GB
Sprint Nextel	Dongle	USD 59.99	3G	5GB	USD 0.05 per MB
		USD 59.99		Unlimited	
			3G	5G	USD 0.05 per MB
Clearwire	Dongle	USD 40	4G (DL 6Mbps /UL 1Mbps)	Unlimited	
		USD 55	4G	Unlimited	
			3G	5G	USD 0.05 per MB

Source: IDATE

In the US, Sprint Nextel and Clearwire have already launched WiMAX service as "4G". Clearwire offers unlimited "4G" usage at a cost of USD 40 per month and when bundled with 3G is priced at USD 55 per month. Sprint Nextel offers unlimited "4G" usage bundled with its 3G and the monthly fee is USD 59.99 which is same as 3G alone. Verizon offers its 3G at a cost of USD 59.99 offering the same conditions as Sprint Nextel. The price level of "4G" would be around USD 50 whether the tariff includes 3G or not.

Verizon offers its prepaid 3G tariffs which are 15 USD per day for 100MB, 30 USD per 7 days for 300MB, 50 USD per 30 days for 1GB and 80USD per 30 days for 5GB. Meanwhile, Clearwire's Rover offers its prepaid tariffs which include unlimited usage at a cost of 5 USD per day, 20 USD per week and 50 USD per month.

For early growth, Verizon Wireless will have to aggressively price its offers on the market place.

DoCoMo - Japan

As one of the early LTE adopters in the world, NTT DoCoMo plans to launch its LTE service called "Xi" in December 2010, which is based on 3G/LTE dual mode devices. It has expanded LTE areas using an overlay approach to existing 3G areas. The service will begin in Tokyo, Osaka and Nagoya where there is heavy demand for high speed access. Downlink speeds reached 37.5Mbps (75Mbps in some areas) at service launch. The first target is data device usage. It aims to accommodate growing packet traffic and to achieve growth by boosting data ARPU. It intends to maintain its competitive advantage by taking measures against traffic growth resulting from the expanded uptake of smartphones and PC data devices.



Table 11: Mobile data tariffs (NTT DoCoMo and the other operators in Japan - October 2010)

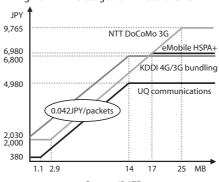
Operator	Device	Monthly cost	Network	Data cap	Overage cost
DoCoMo	Dongle	JPY 2,000-9,765	3G	Unlimited	-
KDDI	Dongle	JPY 2,205-5,985	3G	Unlimited	-
		JPY 2,030-6,800	3G/WiMAX (DL 40Mbps/ UL 10Mbps)	Unlimited	-
eMobile	Dongle	JPY 6,980	HSPA+(DL 21Mbps/UL 5.8Mbps)	Unlimited	-
		JPY2,000-6,980		Unlimited	-
		JPY 5,980	3G	Unlimited	-
				Unlimited	-
UQ Communications	Dongle	JPY 380 - 4,980	Mobile WiMax (DL 40Mbps /UL10Mbps	Unlimited	-
		JPY 4,480		Unlimited	-

Source: IDATE

In Japan, UQ communications offers a service, which is much faster than 3G, and eMobile (a 3G operator), offers HSPA+. Those two operators offer a simple one-fee flat-rate tariff. UQ communications offers unlimited WiMAX usage at a cost of JPY 4,480 and eMobile provides unlimited HSPA+ usage at a cost of JPY 6,980.

They also offer a two-staged unlimited tariff which is a common tariff allowing for a low entry barrier in Japan. Taking the example of NTT DoCoMo, an initial monthly fee of JPY 2,000 is charged for up to 2.9MB, after which JPY 0.042 per packet (128 bytes) is charged up to the maximum JPY 9,765 for 25MB.

Figure 21: Two-staged unlimited data tariff



Source: IDATE

eMobile differentiates HSPA+ from its 3G. The tariffs are 1,000 JPY higher than for 3G. KDDI also offers a bundled "4G" service which is provided by UQ Communications with its 3G offer. It sets a price that is almost 1,000 JPY more expensive than its 3G alone.

NTT DoCoMo plans to offer 3G/LTE dual mode devices from the beginning of commercial service. Considering the convenience of users, LTE tariff would be bundled with 3G or proposed as an option where the 3G plan can be easily added. NTT DoCoMo's 3G data tariff is a little bit more expensive than the other operators'.



Even if it has the advantage of being an early LTE adopter, its price difference with the other operators may hinder its LTE growth. eMobile plans to launch its DC-HSDPA in October. It announced it reached a download speed of 40Mbps in the test.

Pricing structure

In June, AT&T introduced tiered pricing for its smartphone data offers. It used to charge \$30 per month for unlimited use and now offers prices of \$15 per month for 200MB or \$25 per month for 2GB, both of which provide for extra charges should the user go over the data cap. O2 in the UK also changed its smartphone tariffs from unlimited to "tiered" pricing.

atat O. Tariff plans Unlimited pricing Introduction of tiered pricing Content based pricing? Applications App stores launch App stores growth 1000 Terminals iPhone TeliaSonera I TF Networks HSPA LTE-Advanced Mobile traffic 2008 2010 2015 Source: IDATE

Figure 22: Enablers of mobile traffic and tariff plans

Meanwhile, the other pricing strategy is prepaid tariffs. Virgin Mobile USA using the Sprint Nextel network replaced its USD 20, USD 40 and USD 60 tiered plans by a prepaid offer on August 25th. The prepaid offer includes unlimited usage for a month at a cost of USD 40. Verizon Wireless announced it will introduce prepaid tariffs for smartphone data plan from September 28th. The tariff includes unlimited 3G usage at a monthly cost of USD 30. There is, however, a data cap with their 3G dongle tariff offer.

In Japan, NTT DoCoMo, KDDI and SoftBank have offered tiered dongle data tariffs. NTT DoCoMo has 1.07 million data subscribers and tiered plan subscribers accounted for 40 percent in June 2010. Regarding prepaid tariffs, only two operators (eMobile and UQ communications) propose them, and are mainly charged for data communication services. Both operators' plans offer unlimited data usage for a certain period.

As data traffic is growing at a very rapid pace, operators have to manage network operating costs, thus the adoption of tiered pricing strategies. Prepaid tariffs, which set data caps, can also be seen as tiered pricing. Regarding LTE deployment, most operators intend to reinforce their network capacity. Now most set a data cap on 3G tariff, although Mobile WiMAX offers do not have a data cap. Whether operators adopt datacap for LTE pricing and how high the data cap is, will have a strong bearing on LTE deployment.



5.13.2. Evolutions in the mobile value chain

IDATE has identified five main sections in the mobile Internet value chain: contents and applications, application store, connectivity, mobile OS and the mobile terminal. Of these, the "application store" component is a significant change to the mobile value chain; it did not exist (at least significantly) until the arrival of the App Store by Apple. The mobile OS is also worthy of interest, as the arrival of Google Android in this area has opened it up considerably.

Mobile terminal

The role of the smartphone is increasingly important for the mobile internet as these devices are specifically designed to optimize such usage.

Mobile OS

The importance of mobile OS has changed considerably with smartphones. The operating system is now at the heart of the system layer within the mobile phone, and is a vital interface between the applications and the mobile terminal.

Connectivity

This is perhaps the one area which has changed the least and is unlikely to change very much in the future. After all, it is only the mobile telcos which can provide the connectivity for mobile Internet. Potentially there are other technologies such as WiFi which could replace mobile operators by offering the connection. In practice, however, WiFI-coverage will always remain "patchy" and true mobility will not be achieved. From a business sense, MVNOs could potentially enter the WiFi-field but in any case they would still have to rely on the MNOs to provide the physical connectivity, and MVNOs targeting mobile Internet users are scarce.

Application store

This is the part of the chain that has received most of the limelight in recent times and has seen the arrival of new entrants, due to the arrival of Apple App Store. Players from all over the mobile ecosystem have latched onto this part of the chain. It is worth noting that a similar model – although not exactly the same – has in fact existed in Japan since the early 2000s; there, developers could create their own applications and make them available through operator portals as "unofficial sites". Currently this part of the chain is being hotly competed, with many big players from handset vendors, Internet giants and mobile telcos alike entering the fray.

Contents and applications

With all the talk of application stores and the tens of thousands of developers and their applications, it is easy to forget that in fact all the main players offer their own applications too. For example, Apple iTunes is available on the iPhone, and in fact at the initial launch of the App Store, developer applications which threatened to cannibalise iTunes were not accepted onto the store (although this stance appears to be changing). Internet giants too are also present; Google, for example, whilst offering the Android Market Place for developer applications also offers their own mobile version of Google services. All the same, it is crystal clear that this part of the chain is now highly innovative and easily accessible to any startup with ideas for mobile applications.



Application Contents & Mobile Connectivity Mobile OS applications store terminal 105 Device Vendors SYMBIAN ovi NOKIA ovi MeeGo Google Google mobile Internet Giants msn^M Windows Phone 7 Microsoft m@pera[] 賞ドコモマーケット 着ドコモマーケット döcomo Mobile Telco's

Figure 23: Value chain and positioning of major players

Note: The figure does not represent every service within the chain, but rather shows which players are active within the chains

Source: IDATE

5.13.3. Competition structure

Handset vendors

Some handset vendors have centred their strategy on the mobile handset, but perhaps more importantly these players now also run their own operating systems to go with the handset. Furthermore, they have own application stores and provide content for the handset. Put simply, the handset vendors provide every piece of the value chain except for mobile connectivity.

Internet giants

The Internet giants have been traditionally active in the mobile ecosystem as content and service providers. Services which became popular in the fixed environment, most notably applications such as instant messaging and social networking, were then offered in the mobile environment under the same brand name. The notable change came with the introduction of the Android OS by Google. Furthermore, Google has also introduced their application store, Android Market Place, with the same revenue-sharing model as Apple. Concerning other players, Microsoft is active in contents and application provision. It also has its own application store and develops mobile OS.

Mobile telcos

The telcos are first and foremost present in the connectivity part of the chain, since that is their core business. Operators do not want to become simple connectivity providers (often referred to as becoming a "bit pipe"), and the emergence of application stores have put further pressure on operators, who were already feeling the heat from the Internet giants and their well-established contents.



5.13.4. M-commerce: waiting for take-off

M-commerce (or mobile commerce) remains a fledgling industry, which is mainly the result of persistent technological drawbacks (how to display an entire store online), payment constraints (beyond a few Euros for which there are systems such as SMS+) and slow take-up.

M-commerce could develop when existing e-commerce sites become available in mobile versions and when new sites are launched in mobile formats, based on the same business models of sales commissions, comprising variable revenues derived from sales and/or fixed revenues.

We may also see m-commerce develop through new mobile services for on-site buying: mobile phones used as a payment method (virtual wallet, credit card) or as an assistant (for looking up information, checking prices). Revenues collected from pay-by-mobile services will be on the same scale as other payment systems. All sectors could offer or take advantage of these new mobile commerce services. However, this requires the players to work resolutely to create the appropriate banking structure.

The number of mobile payment users worldwide is estimated to have totalled 73.4 million in 2009, up 70.4 percent from 2008 when there were 43.1 million users. This figure is expected to exceed 190 million in 2012 (source: Gartner).

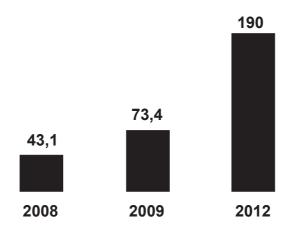


Figure 24: Number of mobile payment users worldwide (in millions)

Source: Gartner



6. Mobile services evolution

6.1. Voice traffic

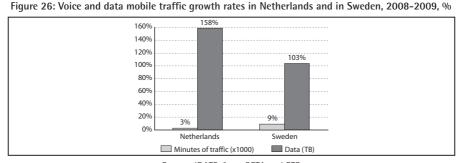
6.1.1. Mobile voice traffic will have a limited growth

Mobile voice traffic continued to grow in 2009 but at a lower pace with an annual increase of around 5% when compared to global traffic (growth rate between 100 and 150%). While mobile call minutes is increasing slightly or flattening in many countries, the number of voice minutes per user for a local-call in USA decreased from 2.27 minutes in 2008 to 1.81 in 2009, according to CTIA.

2500 2000 1500 Minutes per Year 1000 500 0 2003 2005 2002 2004 2006 2007 2008 2009 ----Sweden --- Norway =Finland = = Denmark =

Figure 25: Mobile call per subscription per year

Source: Nordic countries regulators



Source: IDATE, from OPTA and PTS

Voice traffic was overtaken by data traffic in the mobile networks at the end of 2009 when the global amount of traffic was around 280 TB/month according to telecom industry players.

It is inevitable that mobile VoIP will be adopted on mass scale in the next ten years and will trigger increases in the mobile voice traffic. This is mainly due to attractive pricing of international calls. However, mobile VoIP take-off depends on each country's characteristics (competitiveness of the mobile market, roaming pricing, trend for unlimited data plans, and mobile operators' acceptance of mobile VoIP applications). The two figures below illustrated the different trends between four developed countries in terms of mobile VoIP adoption, showing that between 8.4% and 17.5% mobile subscribers will use VoIP.

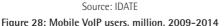


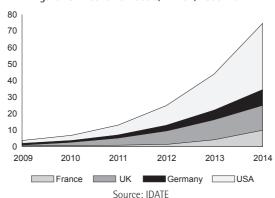
When considering the low capacity consumption of a mobile VoIP call – a Skype voice call minute consumes on average 0.5 MB – the traffic from Voice over IP communication will have little impact on the amount of capacity consumed in the mobile networks.

Mobile voice traffic growth will remain flat until 2020 and its contribution to global traffic is expected to be marginal.

20% 18% 16% 14% 12% 10% 8% 4% 2% 0% 2009 2010 2011 2012 2013 France - UK Germany ----- USA

Figure 27: Percentage of mobile VoIP users over total mobile subscribers, 2009-2014





6.1.2. HD (High Definition) Voice will challenge VoIP

Recent improvements in circuit-switched voice means high-quality voice services are now being offered by mobile operators. The idea here is to use high definition codecs (Wideband Adaptive Multi-Rate) for "crystal clear" mobile calls, thus reducing background noise. Technically, the bandwidth for speech used is wider; 50-7000 Hz instead of the traditional narrowband – 300-3400 Hz. This enables significant improvement in sound quality and intelligibility over current voice calls. By doing so both attenuation and distortion that inherently exist during encoding of unvoiced sounds of conventional telephonic speech are reduced and consequently both intelligibility and quality of unvoiced sounds are improved significantly.



Given the quality offered with HD by Voice, some specific categories of users are targeted like business people and travellers for clear calls in public transport situations (buses, trains ...). Thus, it is expected that assuming that HD Voice is adopted, mobile calls should be longer which should offset the current trend of limited growth.

Handsets manufacturers, e.g. -Nokia (X6, E5, N5230), Sony Ericsson and Samsung (OmniPro), are committed to Mobile Voice HD and all of them are supporting the WB-AMR codec.

From the operators' side, Orange UK is the first to introduce "HD voice" service across its 3G network nationwide following a trial conducted during summer 2010. It is anticipated that other operators will follow suit mainly in advanced markets in coming years. According to the industry, more than 400 million mobile users will use mobile HD Voice by 2015.

6.2. Messaging

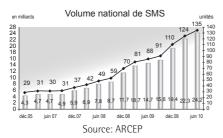
6.2.1. SMS, small traffic-consumer application

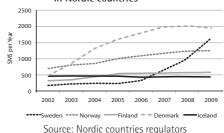
Mobile messaging traffic volume continued to show strong growth on a global basis in 2009 and will continue to increase in the coming years driven by strong SMS adoption despite the increasing use of social networking sites and IM accessible from phones. The growth can be observed e.g. in France where text messaging volume doubled in 2009 and in UK with a 25% volume growth for the same period.

Within the global mobile traffic, the weight of mobile messaging is irrelevant. According to Cisco, mobile messaging represented less than 0.1% in 2009 mobile traffic.

Figure 29: SMS volume in France

Figure 30: Annual average of SMS sent per subscription in Nordic countries





6.2.2. MMS, limited adoption

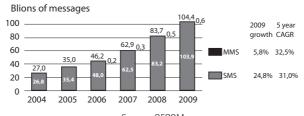
Multimedia messaging offers text with pictures, video and/or audio files. Unlike for successful SMS take-up, MMS has not been widely adopted. It is estimated by industry players and regulators that MMS accounted for 2% to 3% of mobile messaging in 2009.

MMS has not yet taken off, because of disincentive factors concerning interoperability (issues on mobile networks or handsets not supporting MMS) and pricing (in USA, MMS reception is still charged by some carriers). Moreover, it is now more common to send a picture/video/audio as an email attachment or to share it through any social website rather than sending a MMS.

The best scenario for MMS adoption is in countries with high mobile penetration (like in some Asian countries) where MMS can be the support for any entertainment updates, movie trailers...



Figure 31: Messaging volume in the UK



Source: OFCOM

Table 12: MMS usage in the UK

UK	2009
3G subscribers	25.5 million (+39% yoy)
MMS	0.5 billion (+5.8% yoy)

Source: OFCOM

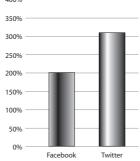
6.2.3. Social networking

Since 2006, social networks have seen ever-intensifying usage explosion, huge traffic growth and a greater portion of online time devoted to these sites. Social networking has made it to the masses particularly on the fixed networks. Almost 70% of Internet users worldwide visited a social network in July 2009. Out of the 770 million people who logged onto an online community that month (up 18% compared to the previous year), almost half went on Facebook.

On the mobile networks, social networking is experiencing a surging popularity akin to that seen on the fixed networks and is for the time being among the fastest growing mobile applications. According to Allot, Facebook increased its traffic consumption by 200% during the 1H2010 while Twitter grew by 310% in the meantime. This growth can be explained by easy access to such services through smartphones but also the ability to access the services at any time: users with mobile Facebook applications installed on their smartphones are twice as active as the average Facebook user. In April 2010, it is estimated that more than 75% of smartphone users accessed social network sites. When considering the whole mobile market, this number is much lower with an estimation of 20% of all mobile users accessing social networking sites.

In the future it is expected that social networking applications will continue to drive mobile data consumption.

Figure 32: Social networking growth applications, 1H2010



Source: Allot



Also, the impact of social network applications on mobile network traffic is increasing. For example in UK, half of mobile web traffic is from Facebook use. In addition, the recent Facebook zero have been especially designed for mobile device usage, which is a very light version of the site with no content (image, video). It has already been integrated by more than 50 operators, and is certainly a good starting point in developing countries.

On another hand, the integration of location-based functions with social networks can lead to a hungry application on mobile networks.

6.3. The impact of M2M (Machine-to-Machine) traffic

By end 2010, the M2M market represents 53 million modules worldwide. This market is growing very quickly within the wireless field. Overall growth for the next four years should top 33% per year for cellular modules, reaching 165 million in 2014. In 2014, M2M SIM cards will probably represent 2.5% of total SIM cards (human and machine) and over 8.1% of total SIM cards in Europe.

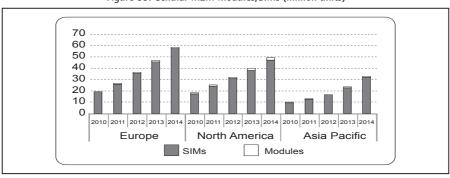
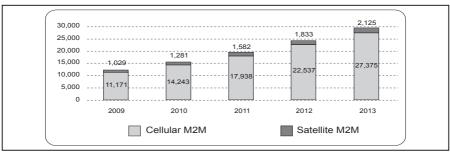


Figure 33: Cellular M2M Modules/SIMs (million units)

Source: IDATE, 2010





Source: IDATE, 2010

The growth of the wireless M2M market has been mainly sustained by a few major vertical markets such as fleet management, industrial asset management, point of sales, and security. Healthcare is the next and most promising market, but there is no discernible rush to enter it.



According to specialists, M2M for security is already a mature market (in Japan, approximately 400,000 M2M modules have been rolled out nationwide in order to carry out age verification for all cigarette purchasing machines to combat under-age smoking). Fleet management is also an advanced market in terms of M2M usage used by logistics companies and the retail industry to monitor their trucks and shipping. M2M has also a great potential in the energy domain thanks to the commitment of national governments and industries to deploy smart metering solutions: 40 million smart meters are planned to be deployed in USA by 2015, 33 million in France by 2017, 170 million in China by 2015.

Moreover, consumer electronics is gaining traction in the M2M space driven by the success of connected e-readers, connected Portable Navigation Devices, photo frames and speed camera prevention systems. The arrival of new consumer electronics has had a great impact on M2M growth in general and in module sales growth particularly. As they address the mass market, consumer electronics will dominate in volume terms in the near future. Automotive applications, especially with expected e-call service, should be a key driver in the M2M market where we can imagine SIM cards embedded within vehicles. Driven by consumer electronics, we expect the market to grow at a very rapid pace as shown in the IDATE forecasts.

In terms of traffic, the M2M share will depend on related applications. For instance, in the future, smart utility meters dedicated to equip homes consume some hundreds of KB while surveillance video monitoring should use tens of MB.

6.4. Mobile Internet use

The range of applications used by mobile Internet users is widening and differs from one country to the next.

According to Nielsen, email became the N°1 application in 2010 followed by social networking. Last year, portal applications were the most popular in the USA accounting for 45.2 million visitors followed by email with 33 million users (as of February 2009).

U.S. Mobile Internet Time by Category: May 2010 Share of mobile Share of mobile Internet Time based Internet Time based RANK Mobile Sector on total time at an on average time spent at a individual site-level* category-level** 38.50% E-Mail 41.60% Social Networking 10.70% 10.50% **News & Current Events** 7.20% 4.40% Search 6.30% 7.10% 5 Portals 4.60% 11.60% 6 Entertainment 4.30% 3.30% 7 Sports 4.10% 2.30% 8 Music 4.00% 3.10% 9 Videos/Movies** 3.00% 2.00%

Table 13: Internet mobile top applications in the USA

Source: The Nielsen Company

Weather

*The original share of time analysis was based on the average time spent at a category-level **The Videos/Movies category refers to time spent on video-specific (e.g., YouTube, Yahoo! Videos, Hulu) and movie-related websites (e.g., IMDB, Blockbuster and Netflix) only, It is not a measure of video streaming or inclusive of video streaming on non-video-specific or movie-specific websites (e.g., streamed video on sports or news sites).

2.80%

2.80%

**New Analysis

Source: Nielsen, May 2010



Table 14: Fastest growing content categories (USA)

Fastest-Growing Content Ca 3 Month Avg. Ending Apr. 20 2009 Total U.S. Age 13+ Source: comScore MobiLer	10 vs. 3 Mo			Fastest-Growing Content Ca 3 Month Avg. Ending Apr. 20 2009 Total U.S. Age 13+ Source: com Score MobiLer	10 vs. 3 Mo		
Total Audience (000)				Total Audi	ence (000)	000)	
Application Access Category	Арг-2009	Арг-2010	% Change	Browser Access Category	Арг-2009	Арг-2010	% Change
Total Audience: 13+ yrs old	232,000	234,000	1	Total Audience: 13+ yrs old	232,000	234,000	1
Used application (except native games)	54,414	69,639	28	Used browser	55,503	72,872	31
Social Networking	4,270	14,518	240	Social Networking	15,708	29,835	90
News	4,148	9,292	124	Bank Accounts	7,801	13,154	69
Sports Information	3,598	7,672	113	General Reference	7,246	12,084	67
	-	<u> </u>		Sports Information	14,033	21,549	54
Bank Accounts	2,340	4,974	113	Search	23,266	34,912	50
Weather	8,557	18,063	111	Stock Trading	3,214	4,817	50
Movie Information	3,296	6,359	93	Online Retail	4,968	7,326	47
Maps	8,708	16,773	93	News	17,957	26,003	45
Online Retail	1,416	2,701	91	Movie Information	10,295	14,895	45
Photo or Video Sharing Service	3,131	5,950	90	Classifieds	7,039	10,181	45
Search	5,434	10,315	90				

Source: comScore

In Japan, e-mail was still the main application used in 2009 within mobile Internet applications. Entertainment applications are popular with 28% of mobile subscribers watching TV on mobile, 28% playing games and 19% using the mobile as a music player.

Table 15: Internet mobile top applications (Japan)

Applications	% Mobile subscribers usage
Email	91.7%
Internet search	46.7%
Download ringtones	29.7%
Watch TV	28.0%
Gaming	25.7%
Download song	19.3%
Music player	18.8%
GPS and location information	17.0%

Source: CIAJ, 2008



Table 16: Applications on mobile Internet (Japan)

Applications	2009	2008
Email	54.5%	54.5%
Buying goods/services	30.1%	30.1%
Digital contents	29.4%	21.8%
Email magazines	17.4%	15.3%
Access personal web/blogs	16.2%	16.3%
Maps	14.1%	14.0%
Access corporate web/blogs	13.8%	13.6%
BBS/chat (look only)	5.9%	6.1%
Quiz	5.9%	5.5%
Upload videos	5.5%	n/a
Answer surveys	5.3%	4.8%
Auctions	4.9%	5.3%
Online games	4.8%	4.2%
BBS/chat (participate)	3.2%	3.8%
Social networking	3.0%	3.0%
Banking	2.8%	3.0%
Own blog	2.5%	2.1%

Source: MIC 2009

Other elements on Mobile Internet use are provided in section 9.3 of this report.

6.5. The role of dongles in the data traffic explosion

In addition to the popularity of smartphones, the take-up of the 3G data cards with affordable flat rate data subscriptions is another explanation for the fast take off in mobile data traffic. Indeed, laptops with dongles generate 450 times more traffic than handsets. With the first offers introduced in 2008, Finland is the leader among advanced countries in terms of laptops with embedded 3G/HSPA modules. Today (1H2010) almost 90% of Finnish mobile data traffic comes from dongles connected to laptops.

Another piece of equipment that should contribute to the growth in traffic is the Tablet PC, assuming that shipments will increase significantly in the future when embedded 3G connection technology, like with the current Galaxy Tab by Samsung, will become more commonplace. According to PC manufacturers, tablet PC will be a new way of computing. The tablet PC has high growth potential within the PC industry; some estimates predict a six fold increase by 2014.



6.6. The importance of peer-to-peer (P2P) traffic

Like in fixed broadband networks, P2P applications generate a significant share of traffic in mobile networks with the large-scale use of file sharing applications. This is mainly due to the democratisation of media files transferring. According to Cisco, P2P represents 17.1% of global traffic, the second largest mobile traffic consuming application.

Regarding geographical distribution, the figure 38 presented by Ericsson shows that the average share of P2P file sharing accounts for 18.4% of mobile broadband traffic in Western Europe in 2009. This figure is in line with Allot distribution assuming that 17% is the weight in Europe; 18% in Americas and 23% in APAC region.

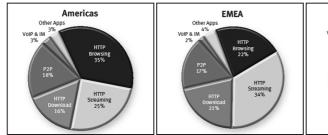
10,8% 9,5% 9,1% 8,2% 7,8% 2009 2010 2011 2012 2013 2014

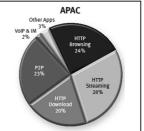
Figure 35: P2P contribution in mobile broadband traffic

Source: IDATE based on Cisco, 2010

Figure 36: P2P weight in the mobile broadband traffic in Americas, EMEA and APAC

Americas EMEA APAC





Source: Allot Mobile trends, 2009

However, on a global basis, P2P application is still growing but according to Cisco, P2P share of overall mobile traffic is forecasted to decline in the years to come and will only represent 7.8% of the traffic by 2014.

6.7. The dramatic growth of video traffic

6.7.1. Various forms of video

Mobile video generally refers to real time entertainment consumption of video streaming, generic Flash video and other various webcasts. Today, YouTube and Flash generate the bulk of video watching on mobile devices.

However video sharing has also emerged as a new way to consume audiovisual content, and has particularly been adopted by fixed Internet users. For many viewers, consuming a video no longer just means watching it, but also sharing it with their community, commenting on it, blogging about it, tagging it, etc. This is why the online video market is largely dominated by community-based sites.



Most notable video sharing platforms based on user generated content (UGC) are YouTube, Dailymotion and Myspace. According to Sandvine, these services are becoming mainstream for mobile users.

Moreover, uploading videos on its social networking profile is becoming also a way to share video. Hence, community networks (with obviously Facebook at the head) are now video viewing sites in their own right.

Catch-up TV is also a way to watch video. It is a professional content made available for a limited period just after the broadcast diffusion. The content is generally focused on TV series and TV specific programs. However, few services are for the time being available on mobile devices.

Mobile TV

Generally speaking, TV refers to video applications as TV content and is mostly accessible through downloading or streaming. If we consider TV on mobile as strictly speaking a live TV service offered by mobile network operators this usage would appear to be rather insignificant despite the many offerings. However, for specific events like the World Cup, audiences can be exceptionally higher than for everyday usage.

In the figure below is provided the top 10 TV channels for mobile TV usage for Orange customers in UK.

Mobile TV & Video Top 10 TV channels for mobile TV usage: Sky Sports One (24%) 6. Sky at the Races (4%) 2. Sky Sports Two (14%) 7. Channel 4 (4%) ITV 1 (14%) 8. Kerrang! (3%) 4. My Movies (11%) 9. Cartoon Network (3%) 5. Sky Sports Xtra (7%) 10. Eurosport 1 (2%)

Figure 37: Orange UK Top 10 TV channels, in April 2010

Source: Orange UK

6.7.2. Video traffic growth

When talking about video content, it covers all kind of TV content, however it is distinguished in shortform videos (professional and UGC) and medium/long-form videos. On mobile devices, for the time being, a short clip is the adequate form of viewing videos. Generally found on web portals or on specialized video portals, they are generally related to sports highlights, music (TV clips), movie trailers, humour, news, video game trailers...

Video content is mainly watched on PC via dongles. Today, the relatively decline of P2P traffic in the overall Internet traffic is mainly the result of the shift from P2P file sharing to video streaming websites. Indeed, the sharp increase in real-time video consumption first experienced in the fixed market can now be observed on the mobile networks, which is heavily impacting mobile traffic volumes.

Both streaming and file sharing are the heaviest traffic usages and represent more than 50% of all traffic in 2009 in Western Europe and generating the highest growth rates (close to 100% growth for HTTP streaming).



According to YouTube, mobile viewing content grew by 160 percent in 2009 and that strong growth was also expected in 2010.

For the coming years, video will be responsible for most mobile data traffic growth through streaming or downloading with a CAGR exceeding 100% between 2009 and 2014.

Other (17.2%)E-mail (1.5%) Software updates (2.5%)File-sharing (18.4%)**Browsing** (24.2%)File-sharing and streaming

Figure 38: Data traffic distribution in WCDMA networks in Western Europe

Source: Ericsson, 2009

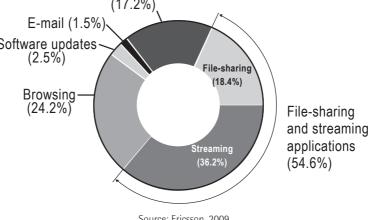


Figure 39: Top applications growth, 2H2009

Application Growth 100% 80% 60% 40% 20% 0% HTTP HTTP HTTP P2P Volp & IM Other Browsing Streaming Download Apps

Source: Allot Mobile trends, 2009



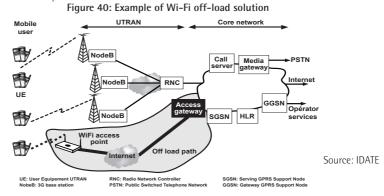
6.8. Re-routing traffic through WiFi system

6.8.1. Principles

WiFi systems, sometimes present in homes, are an additional way for routing traffic from mobile devices. WiFi systems use unlicensed spectrum in the 2.4 GHz and the 5 GHz bands, may be used to re-route the traffic from the mobile operators' cellular spectrum.

A WiFi capacity in smartphones is a practical feature for both mobile operators and mobile subscribers.

The main drawback here is that mobile operators are not able to manage the quality of service on the Wi-Fi system.



Many mobile operators are considering using Wi-Fi as an additional route to increase their total network capacity.

6.8.2. Statistics

USA

102010: 32 million AT&T customers had Wi-Fi access included with their smartphones, high speed internet and 3G LaptopConnect plans. 69 % of Wi-Fi connections were made from smartphones and integrated devices, up from 35% a year ago in the first quarter of 2009. AT&T also indicated that its customers made 85.5 million connections to the Internet in 2009 using AT&T's Wi-Fi network (20 000 hotspots), four times the number of Wi-Fi connections made in 2008.

HK

Fifty percent of people in the UK have a smartphone with Wi-Fi and use it everyday. Of these, 40% say they use Wi-Fi because it's faster for accessing the Net, while 50% use it because it's easier. (Oct 2010; Source: YouGov and Kineto)

Orange had already investigated the option, and estimates that Wi-Fi offload could reduce traffic over the mobile infrastructure by around 30%.

iPass (Aug 2010)

Smartphone users typically prefer Wi-Fi because of the speed at which they can interact and respond. In the recent Mobile Workforce Report, iPass found that nearly half of workers use Wi-Fi on their smartphones, 31.8%because it is faster than 3G, yet only 15.6 %because it is cheaper.



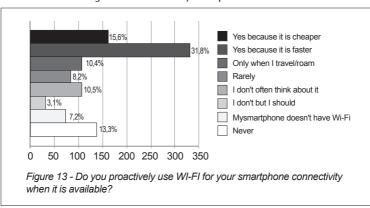


Figure 41: Wi-Fi use by smartphone owners²³

Source: iPass

6.8.3. WeFi

In August 2010, the hotspot location service WeFi released figures on smartphone owners' use of hotspots. With the recent increase in WiFi-enabled smartphones, WeFi's report shows an uptick in smartphone data consumption, much of it by users on the Android platform. However, the data is limited by the absence of a major player in the smartphone arena.

With a population base of over 5 million users, and a database of 60 million hotspots globally, the statistics below show big changes in Wi-Fi usage. Fifty percent of all Android devices analyzed consumed more than 500 MB of data per month each through Wi-Fi hotspots

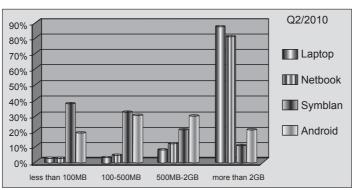


Figure 42: Wifi Data Usage by platforms

Source: WeFi

²³ Survey with the following users distribution: 54% North America, 30% Europe, 10% APAC, 6% RoW



7. Observed data traffic

Traffic units used in the report are as follows:

1 Gigabyte = 1,000 Megabytes

1 Terabyte = 1,000 Gigabytes

1 Petabyte = 1,000 Terabytes = 1,000,000 Gigabytes

1 Exabyte = 1,000 Petabytes = 1,000,000 Terabyte

Table 17: Network capacity units²⁴

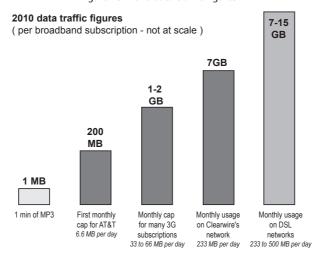
	. ,	
Kilobyte	kB	10³
Megabyte	MB	10 ⁶
Gigabyte	GB	10 ⁹
Terabyte	TB	1012
Petabyte	PB	10 ¹⁵
Exabyte	EB	10 ¹⁸

Source: IDATE

7.1. Data growth differs from country to country: observed traffic

In most countries, data volume transferred over mobile networks increased very significantly between 2006 and 2010.

Figure 43: 2010 data traffic figures²⁵



Source: IDATE

 $^{^{24}}$: Figures presented here are approximate values (1 kB is 1024 bytes or 8096 bits or 2^{10} in binary usage). Using the traditional binary interpretation, a terabyte would be 1,099,511,627,776 bytes.

^{25: 1}min of MP3 corresponds to the size of an audio file for 1 minute of music with MP3 coding



ECC PT1 gathered detailed traffic information from various European countries in early 2010. This survey shows very significant differences between countries. It should be noted that the figures in the figure below correspond to traffic per inhabitant.

350 **Traffic in TB per million inhabitants** 300 250 -Estonia -Denmark 200 -Finland 150 ★—Germany 100 Iceland 50 -Ireland -Austria 0

Figure 44: Mobile data traffic evolution (TB per million inhabitants per month) in some European countries

Source: ECC PT1

22.02.2008

Date

10.10.2006

06.07.2009

18.17.2010

Sweden

28,05,2005

14.01.2004

Finland and Sweden have the same pattern in terms of mobile data traffic growth. The two countries have the highest consumption rates in the figure below with the most significant growth rates in 2008. Surprisingly, Austria adopted mobile broadband earlier (in mid-2005) and has experienced steady growth. Estonia (where FTTH penetration is high) has seen little growth in data traffic.

Table 18: Daily mobile broadband data per subscription in different countries

Country	Time	Mobile Broadband Traffic per Day
Sweden	2009	61 MB/subscriber (average of private and corporate)
Finland	2H2009	61 MB/subscription
Denmark	2H2009	43 MB/subscription
Austria	Q42009	42 MB/subscription
Ireland	Q12010	42 MB/customer (average btw business and residential)
Iceland	2H2009	31 MB
Slovak	n/a	15 MB/subscriber
Germany	2009	4.8 MB/UMTS user (as a response to Q2)
Netherlands	2H2009	2.5 MB/connection
Malta	10/2010	0.5 MB/subscriber

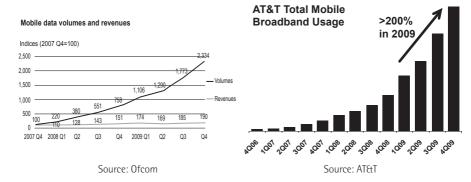
Source: ECC PT1

In the UK, according to the local regulator, data traffic has grown very guickly: estimated at more than 2,200% between 2007 and 2009) Over in the United States, ATEtT is reporting 5,000% growth over the last three years.



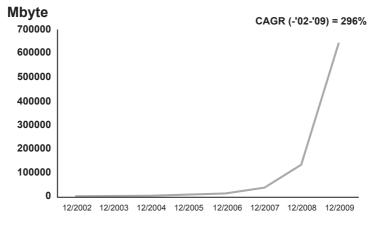
Figure 45: UK mobile data traffic growth

Figure 46: AT&T traffic evolution



Monthly mobile data usage in Hong Kong surged to 640 TB in December 2009, representing 5 times the traffic during the same period in 2008.

Figure 47: Mobile data traffic evolution in Hong Kong

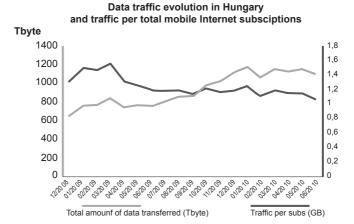


Source: Ofta, 2002-2009

Data traffic in Hungary shows very high consumption per mobile broadband subscriber with an average close to 1 GB per month.



Figure 48: Data traffic volume in Hungary, December 2008-June 2010



Source: National Communications Authority

Vodafone anticipated that data traffic will double each year based on experience acquired between 2008 and 2010:

Data traffic in Europe (petabytes)

81.8

40.8

18.8

2008 2009 2010

Figure 49: Vodafone data traffic volume in Europe, 2008-2010

Source: Vodafone

02 in Ireland also forecasts strong data traffic growth for the coming years as depicted here:



Figure 50: 02 data traffic volume in Ireland, 2009-2012

Source: 02 Ireland

7.2. Daily traffic distribution

This section will briefly detail daily network traffic utilization in Europe and North America. In Europe, peak and off-peak periods are clearly differentiated when compared with American traffic consumption patterns with peak hour traffic over 70% higher than for off peak times. Also worth noting is that file sharing traffic is stable throughout the day, even during the evening.

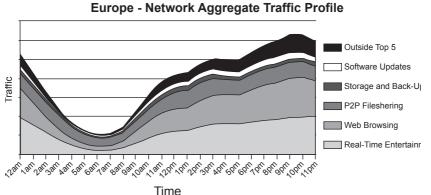


Figure 51: Daily traffic consumption in Europe

Figure 6 - Europe - Network Aggregate Traffic Profile

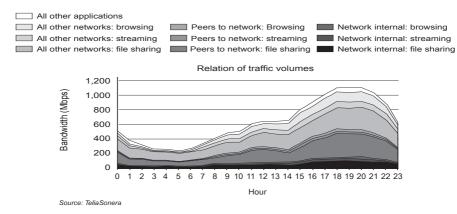
Source: Sandvine

For TeliaSonera in Sweden, mobile data traffic shows a significant peak between 5:00 pm and 10:00 pm:



Figure 52: TeliaSonera daily traffic consumption

Fig.12: TeliaSonera, traffic mix over a given day



Source: Teliasonera

Total traffic consumption in North America is quite constant, and each application category consumes nearly the same proportion of traffic over the day except for web browsing and real time entertainment, which explodes during the evening.

Figure 53: Daily traffic consumption in North America

Europe - Network Aggregate Traffic Profile

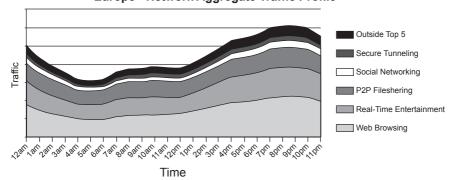


Figure 8 - North America - Network Aggregate Traffic Profile

Source: Sandvine



7.3. Geographical traffic distribution

The geographical breakdown of the traffic is commercially sensitive for operators as it has a direct impact on network deployment strategies. Therefore, it is difficult to obtain precise data on the geographical repartition of the traffic.

The services on mobile network, which were introduced in Section 6, can be clearly differentiated between:

- User generated traffic (voice, messaging, social networking, mobile internet, video),
- Traffic not generated by users (machine to machine), M2M traffic is currently negligible and is expected to remain very low in the coming years, as further discussed in Section 8.
- Peer-to-peer (P2P) traffic, which is more difficult to classify as it can be user generated but can sometimes but run as a background application, therefore not requiring human interaction for long periods of time. P2P traffic represents around 20% of the traffic on mobile networks as discussed in Section 6.

As a result, it is clear that a minimum 80% of the traffic is generated through users' interaction and therefore heavily related to the geographical repartition of users.

Users are very unevenly distributed in geographical areas. For example, as highlighted in the Figure below, 80% of the French population lives on less than 20% of the geographical area.

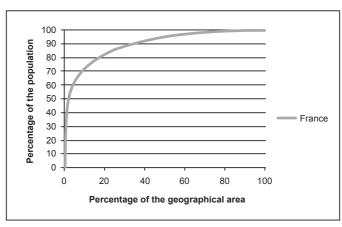


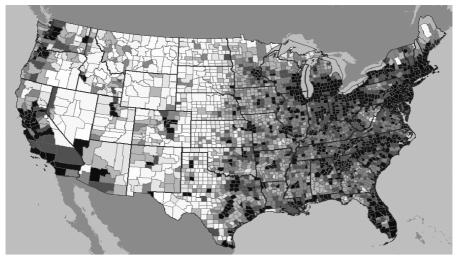
Figure 54: Population distribution in France

Source: Insee

Such an uneven distribution is very common and is usually displayed as a population density map (see Figure below).



Figure 55: 2000 U.S. population density in persons per sq. mile (contiguous U.S. only). Averaged on a percounty basis



Legend, light to dark (white to dark blue):
0-1 (white) 1-4 (yellow) 5-9 (yellow-green) 10-24 (green) 25-49 (teal) 50-99 (dark teal)
100-249 (blue) 250-66,995 (dark blue)
Source: http://www.learnnc.org/lp/multimedia/14566

The concentration of the population in specific geographical areas implies that the mobile traffic, too, is heavily concentrated in some specific areas. The coverage map provided by AT&T shows great similarities with density of population:

6-12-09 to 9-4-09 3G CHANCES

Coverage last updated on: 9-04-09,
Majo depicts an approximation of coverage.

Figure 56: AT&T coverage map

Source: AT&T



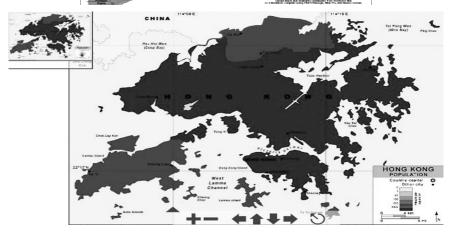
New York City and Hong Kong density maps show examples of population density in very large cities:

NEW YORK CITY 2000

TOTAL POPULATION

Committee of the co

Figure 57: New York City and Hong Kong density of poprlation maps



Furthermore, the population density is not constant through time but varies significantly. Rural, residential and commercial/industrial areas all have different intraday traffic distribution. For example, traffic in commercial areas is likely to increase during business hours. Specific locations such as stadium would display extreme traffic during event with very limited traffic outside of these events.

Though it is clear that the vast majority of the mobile traffic occurs in selected areas, mobile operators must also maintain geographical coverage to ensure continuity of service. In conclusion, it should be underlined that the mobile traffic display very significant variation in space and in time, creating a requirement for operators to dimension their network in any given location for the peak demand that can occur in any specific area while ensuring a continuous and significant geographical coverage for the continuity of service.



7.4. Traffic growth driven by data services

Data traffic over mobile networks continues to grow at a tremendous pace and now accounts for the majority of traffic on cellular networks. According to Ericsson, 225 PB of data were transferred (upload and download) per month around the globe, along with 155 PB per month of voice on mobile networks in 2Q 2010. This is in line with Cisco estimates (220 PB of data per month in 2010.

7.4.1. Industry sources

This trend is expected to continue into the future with data traffic representing 30 to 40 times the traffic used by voice services by 2014, and 100 times by 2020. Forecasts do vary somewhat from player to player, however.

Total UL+DL Monthly Traffic (GSM. WCDMA & CDMA)

250000

Speech

Packet

150000

2208 Q3 08 Q4 08 Q1 09 Q2 09 Q3 09 Q4 09 Q2 10 Q2 10

Time

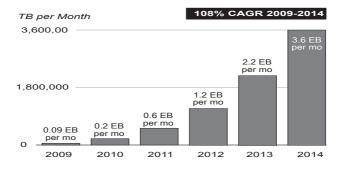
Figure 58: Voice and data traffic evolution from 2Q2008 to 2Q2010

Source: Ericsson, 2009

Some predict mobile voice and data traffic will reach 2 EB per month by 2014 while others estimate that for data transfers alone, traffic will be somewhere in the region of 3.6 EB for the same period.

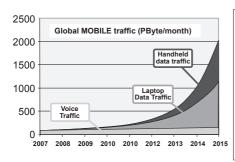


Figure 59: Mobile data traffic transferred per month, 2009-2014



Source: Cisco VNI Mobile, 2010

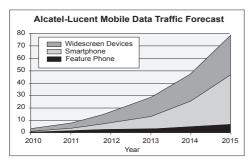
Figure 60: Mobile traffic evolution from equipment vendors' perspectives



MOBILE DATA TRAFFIC FORECAST SUBSCRIBER DATA TRAFFIC IN MOBILE ACCESS NETWORKS 50 40 **Annual Traffic Growth 100%** 35 Yearly Exabytes 30 20 10 2009 2010 2012 2013 2014 2015

Source: Ericsson, 2010

Source: Nokia Siemens Networks, 2009



30x Growth in Global Aggregate
Mobile Traffic
31% CAGR MBB Subscribers
41% SmartPhones in 2012

Source ALU: November 2010



NokiaSiemens Networks' forecasts for mobile data card traffic show monthly traffic of 3 GB in 2015, up from 1GB in 2010.

7.4.2. Forecasts for the United States

Traffic forecasts for the US show an expected traffic of more than 40 EB in 2014:

Figure 61: Mobile data traffic growth (US)

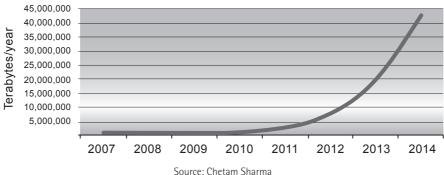
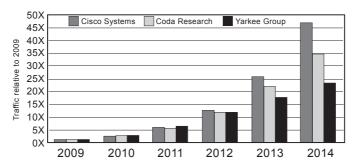


Figure 62: mobile data traffic in North America

Forecasted mobile data traffic in North America



Source: Cisco, Coda Research, Yankee Group

S

In November 2010, Swedish mobile operator Telia indicated that the average 3G smartphone user consumed 375 MB/month of data. The average 3G broadband user consumed 5 GB/month, largely through data cards. But the average LTE consumer (all data cards) used 14 GB – 15 GB/month of data.

In the USA, Clearwire announced an average of 7 GB per month of data for a base of 2 million subscribers in July 2010.



8. Updated mobile traffic forecasts

As a conclusion, traffic forecasts presented in this section correspond to the following:

- Traffic forecasts presented in this section represent the uplink and downlink traffic for voice and data
- The traffic taken into account is the traffic transported on mobile networks using licensed spectrum
- Wi-Fi offloading is not taken into account²⁶ 27.
- The forecasts include the traffic managed by Femtocells.
- The forecasts presented in this report do not take into account RFID traffic or any other traffic on unlicensed frequency bands.

8.1. Main hypothesis

8.1.1. Global mobile device market

The mobile global device market in our 2010 assumptions differ from those presented in report no. 37: our 2010 assumptions lead us to predict a 119% penetration rate in 2020 (excluding M2M). Asia-Pacific will still be home to the largest share of total mobile subscriptions in 2020 with Americas taking the number 2 position ahead of Europe.

Table 19: Mobile forecasts (excluding M2M)

Global Base (million)	2010	2015	2020
Europe	1 014	1 151	1 242
Americas	898	1 109	1 302
Asia	2 570	3 780	4 764
Rest of the world	794	1 238	1 730
World	5 275	7 278	9 038

Source: IDATE

With M2M subscriptions, the total number of subscriptions comes close to 10 billion. M2M devices are expected to represent 6.7% of the subscriptions in 2020

Table 20: Mobile forecasts (including M2M)

Global Base (million)	2010	2015	2020
Europe	1 033	1 222	1 427
Americas	915	1 166	1 437
Asia	2 579	3 825	4 957
Rest of the world	801	1 276	1 863
World	5 328	7 490	9 684

Source: IDATE

²⁶ In the USA, AT&T indicated that its mobile customers made 85.5 million connections to the Internet in 2009 using AT&TS Wi-Fi network (20 000 hotspots), four times the number of Wi-Fi connections made in 2008. According to some industry sources, the traffic offloaded on Wi-Fi networks could represent up to 20% of the mobile traffic in 2015.

²⁷ Wi-Fi or any type of traffic offloading on unlicensed spectrum relates, by essence, to stationary wireless broadband access. It implies some usage restrictions/limitations on the quality, mobility and security of the service.

As such, Wi-Fi is a 'second choice' solution to a primary mobile broadband access. The two access methods (mobile broadband and stationary wireless broadband) are complementary, not competing. There will always be applications that work reasonably well in best effort, while many others will need 0.65.

This Report clearly focuses on mobile broadband - that is, not stationary wireless broadband - and therefore Wi-Fi traffic was excluded from this Report.



8.1.2. Worldwide device mix

Our hypothesis regarding device mix take into account the growing share for midrange and high-end smartphones, bringing low-end phones' share down below the 20% mark in 2020.

90.0% 80.0% 70.0% 60.0% Low end phones ——Mid-range smartphones 50.0% -X-Donales 40.0% 30.0% -M2M 20.0% 10.0% 0.0% 2010 2015 2020 Source: IDATE

Figure 63: Worldwide device mix

According to our hypothesis, high-end smartphones will represent a little bit more than 20% of the total devices in 2010. Low-end phones will see their share falling from 76.6% in 2010 to 17.2% in 2020.

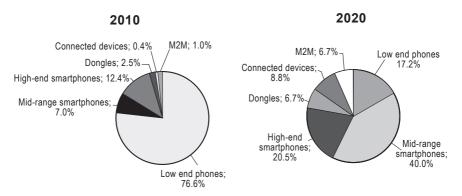


Figure 64: Worldwide device mix in 2010 and 2020

Source: IDATE



8.1.3. Traffic mix

The hypothesis used in our model for the traffic per devices are based upon the data gathered on observed traffic values (section 7 of this report) and on additional research for various mobile operators and countries.

Traffic distribution by service

Peer-to-peer (P2P) mobile traffic is not included in the following distribution as it was considered to represent an access scheme rather than a service. P2P mobile traffic can be used to carry video or audio content which fall into the "infotainment" category, but can also be used to download other content such as software.

Location-basedservice; 4%

Mobile Intranet
Access; 6%

Mobile Internet
Access; 11%

Multimedia
messaging; 10%

Customised
infotainment; 59%

Figure 65: Worlwide distribution of traffic by service - 2020

Monthly traffic per device

The monthly traffic per device is expressed in MB and represents the addition of uplink and downlink traffic. High-end smartphones will represent monthly traffic close to 2GB while traffic for dongles is expected to reach 4.8 GB per month.

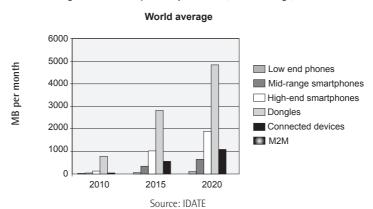


Figure 66: Monthly traffic per device (World average)

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It should be noted that these figures represent an average for all countries combined, and that they will be much higher in the most mature markets.

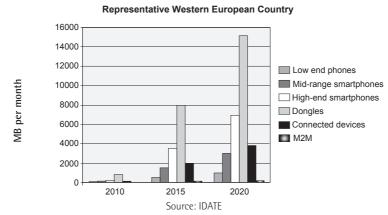
Table 21: Monthly traffic per device (MB - World average)

MB per month	2010	2015	2020
Low end phones	26	73	119
Mid-range smartphones	44	338	665
High-end smartphones	140	1,020	1,020
Dongles	775	2,813	4,850
Connected devices	48	568	1,088
M2M	1	6	10

Source: IDATE

In the representative European country, in year 2020, having a population of 50 million and subscriptions of more than 85 million, the total amount of traffic generated by the many smartphones reaching 6.9 GB in average, is more significant than the 15 GB generated by the dongles, for the reason that the dongles are fewer in numbers.

Figure 67: Monthly traffic per device (representative Western European country)



In our hypothesis, the traffic generated by dongles in 2020 is similar to the traffic generated today by a fixed connection on Digital Subscriber Lines or CATV/Cable TV networks.

Table 22: Monthly traffic per device (MB – representative Western European Country)

MB per month	2010	2015	2020
Low end phones	30	510	990
Mid-range smartphones	100	1,538	3,025
High-end smartphones	250	3,550	6,900
Dongles	800	7,950	15,100
Connected devices	50	1,950	3,850
M2M	1	91	180

Source: IDATE



8.2. Worldwide mobile traffic

Total mobile traffic will reach more than 127 EB in 2020, representing an x33 increase over 2010.

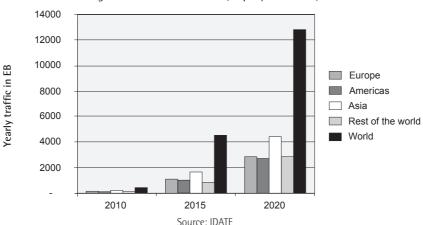
Table 23: Total mobile traffic (EB per year - World)

	2010	2015	2020
Europe	1.03	10.88	28.15
Americas	0.78	9.84	27.33
Asia	1.65	16.31	43.85
Rest of the world	0.41	8.22	28.48
World	3.86	45.25	127.82

Source: IDATE

In 2020, we forecast that Asia will represent 34.3% of total world mobile traffic, Europe 22% and Americas 21.4%.

Figure 68: Total mobile traffic (EB per year - World)



8.3. Representative Western European Country Subscriptions

For a representative Western European country of 50 million people, there will be more than 85 million subscriptions in 2020.

Table 24: Population and subscriptions- Representative Western European Country

Representative Western European Country	2010	2015	2020
Population (million)	50.0	50.2	50.2
Subscriptions (million)	62.6	73.5	85.4

Source: IDATE



Total mobile traffic

The total mobile traffic in a representative Western European country will rise from 1,860 PB in 2015 to 4,580 PB in 2020.

Table 25: Total mobile traffic per year- Representative Western European Country

Total mobile traffic	2010	2015	2020
Representative Western European Country (EB per year)	0.07	1.86	4.58
Representative Western European Country (PB per year)	70	1,860	4,580

Daily traffic

From 2010 to 2020, total daily mobile traffic in the representative Western European country will grow from 186 TB to 12,540 TB.

Table 26: Total daily mobile traffic - Representative Western European Country

Total daily mobile traffic	2010	2015	2020
Representative Western European Country (TB per day)	186	5,098	12,540

Source: IDATE

Daily traffic per subscription

Daily traffic per Mobile Broadband (MBB)²⁸ subscription is expected to reach 294 MB per day in 2020. This figure represents an average over the devices generating the most important share of the traffic on mobile networks (high-end smartphones and dongles).

Table 27: Daily mobile traffic per Mobile Broadband & dongle subscriptions - Representative Western European Country

Daily mobile traffic per subscription	2010	2015	2020
Mobile Broadband (MB per day)	10	155	294
Dongles (MB per day)	26.7	265	503

Source: IDATE

Busy hour traffic

As explained in section 9.2, the busy hour carries 10% of the daily traffic. In 2020, the busy hour traffic per MBB subscription will be 29.4 MB.

Table 28: Busy hour traffic - Representative Western European Country - 1/2

Busy hour traffic	2010	2015	2020
Total country (TB)	18.6	510	1.254

Source: IDATE

Table 29: Busy hour traffic - Representative Western European Country - 2/2

Busy hour traffic	2010	2015	2020
Per Mobile Broadband subscription (MB)	1	15.5	29.4
Per dongle (MB)	2.6	26.5	50.3

Source: IDATE

According to the model used in this report, users of Mobile Broadband (MBB) subscriptions with high-end smartphones and dongles will represent 31% of the subscriptions in 2020 and 63% of the mobile traffic



8.4. Differences with previous UMTS Forum market study

In UMTS Forum previous market study from year 2005, the used forecast model was different so results are not one-to-one comparable. Also, in the modelled representative European country, the amount of subscriptions, were substantially different. As explained in section 3, 4 and 5 in this study, trends and drivers have changed between now and year 2005, and therefore, the model and approach is different in this study.

8.5. Conclusion on mobile traffic forecast

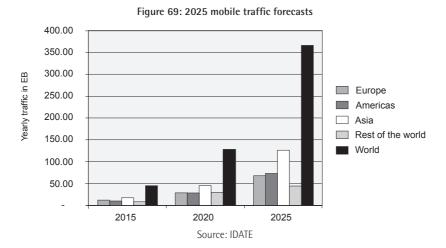
Mobile traffic will increase by a factor of 33 (worldwide) and 67²⁹ (representative Western European country): from 2010 to 2020, total worldwide traffic will grow from 3.86 EB to 127.8 EB. For a representative European country, total daily traffic will grow from 186 TB to 12,540 TB. This growth will come from the combination of a higher number of subscriptions and the importance of video traffic.

The traffic will be dominated by video, i.e. user related content. As a result, the traffic will continue to be unevenly distributed with a significant unbalance between busy and non busy hours, along with very large variations across the different parts of the globe. Traffic is likely to vary parallel to peaks in population density, coupled with the peak of leisure time.

8.6. Trends beyond 2020: 2025 forecasts

Disclaimer: these 2025 forecasts are presented here in order to show mobile traffic trends but the model for this study was designed for 2010–2020. There is even more uncertainty as far as mobile traffic is concerned for 2020–2025, this forecast should be considered as "informative" only.

We anticipate total mobile traffic of more than 350 EB in 2025 (worldwide) representing a 174% increase compared to 2020. Daily traffic per MBB subscription in the representative Western European country will stand at 452 MB by that point in time.



29: figures correspond to the different assumptions for traffic per device which are higher in the representative European country



9. Annex

9.1. Scenarios

We adapted the 2005 scenarios as included in the table below to take into account observed changes and anticipated developments for the 2010-2020 period.

9.1.1. 2005 scenarios

A modelling framework was then developed to produce three different but plausible scenarios that represent the possible outcomes for the future of mobile communications. These are summarised below:

Table 30: 2005 scenarios and 2010 comments

2005 scenarios	2010 comments
Scenario 1: Low price, voice-dominated growth A pessimistic scenario that describes the mobile industry evolving into bigger volumes rather than enhanced capabilities. Voice increases in volume but revenues diminish, and are not offset by new revenue streams resulting from the adoption of new applications. Overall, communications industry revenues decline as all pricing levels continue to fall.	Low price, limited data services adoption Average ARPU is likely to decline but overall revenues should continue to grow thanks to the arrival of new devices (tablets, M2M, connected devices) Data already accounts for over 50% of all traffic on mobile networks and the current growth is likely to last for the 10 coming years.
Scenario 2: Balanced, broad-based growth – Mobile networks deliver compelling new services such as anytime, anywhere streaming video customised to the needs of users. Businesses comprehensively integrate mobile within their operational practices. Other communications industry service providers are effectively converged into mobile-led companies, whilst content and application providers find a healthy, growing market place.	Balanced, broad-based growth Mobile video is responsible for most of mobile data traffic growth The smartphones and connected devices will fuel data growth M2M traffic could explode with over50 billion devices in use in 5 years. LTE will boost capacity LTE Advanced will enable new business models from 2015 on
Scenario 3: Pervasive data-driven growth – Adhoc broadband wireless networks, with many services that are virtually free in urban areas, start to take up a significant share of the traffic. Traffic volumes increase as the access costs fall sharply. Users have many ways to get online, though seamless experiences are not guaranteed. The larger mobile networks ensure complementary coverage on a national level to these ad-hoc networks.	Pervasive data-driven growth No change to this disruptive scenario Source: UMTS Forum & IDATE

9.1.2. Modifications of the 2005 scenarios: new scenarios proposal

In order to take into account changes observed on the mobile environment, we propose to modify the three scenarios and to adopt the following:

	2005 scenarios	2010 scenarios
Scenario 1	Low price, voice-dominated growth	Low price, limited data services adoption
Scenario 2	Balanced, broad-based growth	Balanced, broad-based growth (50 bn devices in 2020)
Scenario 3	Pervasive data-driven growth	No change to this scenario



Scenario 1: low price, limited data services adoption Key drivers

This scenario is a pessimistic one in which the mobile industry will be able to manage bigger volumes rather than offer enhanced capabilities. Data increases in terms of volume but voice revenues diminish and are not compensated for by an increase in data ARPU. There is no massive adoption of data traffic based services. Such a scenario results from the transition to all-IP networks and the proliferation of IP compatible technologies that provide very low priced wireless VoIP-based solutions, without compensatory growth in new mobile data service revenues. There is no significant development of new services. Value is captured by terminal manufacturers and Internet giants. Overall, mobile operators' revenues decline as all pricing levels continue to fall.

Regulation is slow to react or support incumbents in creating a fairer competitive landscape. Significant tensions among policy makers, and between competing industry camps, result in a struggle, which will damage brands, and lead to prescriptive regulatory reactions. These tensions hinder the harmonisation of spectrum policy across regions, and make it more difficult for manufacturers to plan for or achieve significant scale economies.

Data traffic, fuelled by video consumption, grows too quickly in large cities and creates more and more congestion. Quality of services and user experience are not satisfactory; which leads to lower ARPU for operators. Traffic management policies implemented by mobile operators only satisfy business users who can pay an add-on to their subscription in order to obtain a satisfactory service for their traffic.

The fragmentation of the Operating Systems and application stores for smartphones will make it more difficult for users wishing to keep their applications when switching OS. This slows the global development of the market.

Discussion of variables

Political plane

This scenario is favoured by stagnation in the general economy. The rise of regional regulatory and policy authorities causes the regulatory agenda to be primarily concerned with normalising intraregional policies. As a result, policy does not keep pace with technological changes or the dynamics created by increasingly global competition, such as the requirement for harmonised global spectrum allocations. This impacts LTE with a significant fragmentation of frequency bands leading to higher chipset and terminal costs. Unregulated alternatives gain strength as incumbents are disadvantaged by rigid prescriptions on issues such as terminating call pricing, quality of service, coverag requirements, and consumers' "bill of rights". Uncertainty in the Net Neutrality debate has a negative impact on the market with a lack of coherence between geographical areas. Frustration grows and defensive or self-interested attempts by firms to "play the system" only result in policy backlash, hindering investment, innovation and expansion e.g. into regulated broadcast markets.

Social plane

Only a small portion of mobile subscribers adopts wireless data applications with the development of the smartphone segment, but a significant part of the market refuse to pay add-ons for data packages.



But the appetite for paid content emerges only in small niches. Mass adoption is hindered by the market's satisfaction with existing and well established alternatives for Internet access and video entertainment. No killer application emerges, other than VoIP, to stimulate broad growth in wireless volumes. Consumer mistrust resulting from the industry's never ending struggles with regulators, and the fragmentation of existing offerings, also curbs growth. Because the industry is on the defensive, it is slow to provide a comprehensive response to consumer concerns about spam, health and privacy, and business concerns about security and interoperability.

Technology plane

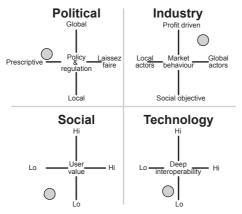
The take-off of LTE is slowed by spectrum fragmentation and inadequate supply of chipsets whereas LTE-Advanced is delayed as Patents and Intellectual Property Rights become a battleground. Network saturation worsens and leads to customer dissatisfaction. Robust adoption of VoIP drives the market to uniformly low pricing for all mobile access services. Incumbents resist new standards as a defensive stance to address their constrained position. New entrants who do emerge, and use innovative technologies actively, avoid depending on incumbents to complement their service offerings, for fear of being drawn into a legal and regulatory morass. Interoperability between offerings results and no offering is able to meet the most robust market requirements for availability and quality.

Industry plane

Fragmentation in spectrum, application stores and operating systems slows down development. The industry becomes increasingly balkanised but concentrated, as slow growth triggers consolidations, and competing camps emerge depending on their support for new technologies and standards. Intense rivalries manifest themselves in price wars and an inability to solve difficult problems such as digital rights management, user-defined preferences, spectrum reuse and resale, and VoIP quality of service. With poor prospects of adequate returns, capital investment withers. Providers cannot afford to pursue "socially motivated" objectives.

Discussion of variables

Figure 70: Relative influence of variables on scenario outcomes (scenario 1)30



^{30:} In economics, laissez-faire describes an environment in which transactions between private parties are free from state intervention, including restrictive regulations, taxes, tariffs and enforced monopolies (source: Wikipedia)



Impacts and implications

• Users – Consumers:

Users benefit from falling voice prices, and are able to consume as much wireless content and data services as they wish to. However, the experience is of poor quality, mainly due to network congestion. Consumers are primarily price driven.

Users – Business:

Low voice pricing is a clear benefit to businesses, which actively replace embedded landlines with wireless solutions. However, business users find that service providers are often unwilling to tailor service offerings, invest in augmented network availability, assure quality of service, or develop security solutions. Interoperability with new alternative wireless access methodologies (provided by new entrants) is not provided, and causes most businesses to rely heavily on unlicensed wireless alternatives for their local data applications.

Government:

Without wide adoption of data services, initiatives to take advantage of wireless e-government solutions are blocked. Since vendor costs are high due to the presence of many competing standards and solutions, there is little ability or will to fund penetration into marginal markets.

Mobile operators:

Mobile operators are under extreme financial stress as the losses on voice revenues are not offset by rising data revenues. VoIP becomes "free" and cannot be blocked by the operators due to regulatory pressures. Investment and innovation are not affordable. New entrants often face strong resistance from incumbents, who rely on brand loyalty and protect their position through aggressive price moves. To the extent that incumbent players cannot attain the cost structure necessary to avoid bankruptcies, political authorities may force crossborder and other managed consolidations as a survival tactic. In the most extreme cases, in order to preserve ubiquitous wireless access, some national governments choose to nationalise the "wireless pipe" and force a clear separation of content and application provision from underlying licensed wireless transport.

Manufacturers:

Financial stress reaches this sector, as operator capital investment dries up, and device replacement cycles are not fuelled by new applications. The large penetration opportunities in Asia are not spread broadly amongst potential suppliers, but captured primarily by domestic firms.

Content and Applications Providers:

Although content is not broadly consumed, in those segments where content matters the market is "hit" driven. Content creators retain a relatively large share of revenue as a result and also because mobile operators cannot transform themselves (for reasons of affordability, regulation and skill) into "hit makers" or effective marketers.



Today

Diminished

Manufacturers Mobile operators Content / applications

Figure 71: Changing influence and role of industry participants 2020 (scenario 1)

Scenario 2: balanced, broad-based growth Key drivers

Mobile networks deliver an enhanced user experience thanks to a successful transition to LTE and LTE-Advanced. The take-off of TD-LTE translates into additional capacity and introduces more competition in the market place. Traffic volumes continue to grow at a very rapid pace and connected device (tablets, game consoles...) and M2M connections explode. Femtocells and Wi-Fi networks enable offload from the mobile networks and enable very high data rates broadband connections leading to a sharp fall in access costs. Additional spectrum becomes available in higher frequency bands and allows operators to meet traffic requirements. Networks deliver compelling new services such as anytime, anywhere streaming video customised to the needs of users. Businesses comprehensively integrate mobile technology and services within their operational practices. Other communications industry service providers are effectively converged into mobile-led companies. Content and application providers find a healthy, growing market place and enjoy solid growth in their revenues.

Consumers readily adopt mobile access opportunities as mobile terminals get bigger screens, higher quality audio and video, as laptops replace desktops, as wireless voice availability becomes truly ubiquitous and of high quality, and as personal video devices complement televisions. The steady progression of consumer demand, and the emergence of global consumer expectations, enables firms that dominate different aspects of the value chain to retain and confidently expand their positions. With the helpful guidance of government policy makers, open standards, roaming capabilities are enhanced and managed competitive entry helps to maintain a stable environment for service provider investment. Innovation amongst firms and developers creates growth-oriented pressure. Competitors differentiate propositions on the basis of applications, content and quality. Mobile industry succeeds in creating fundamental solutions to address difficult communications industry issues around trusted multimedia environments, micro-billing, and appropriate content. The industry is also able to invest in pan-industry solutions that enable a high degree of seamless application performance, user-defined quality, and personalisation. Mobile activities also generate higher profitability in the overall industry, helped by robust content revenue sharing, revenue producing interconnection arrangements, and disciplined pricing.



As a result, mobile becomes the centre of an industry convergence at both the platform and mobile operator level. The mobile industry maintains a proactive stance with policy makers, and is a willing partner in efforts made to support affordability and adoption. Convergence between mobile and broadcasting is successful from a technology point of view and traffic migrates accordingly.

Political plane

Spectrum harmonisation and uniform standards are reached thanks to converged industry policy frameworks built as a result of the positive collaboration between regulators, policy makers and industry actors. The pace of convergence-driven consolidation occupies the agenda, and increasingly authorities perceive that the available service choices, and innovation, can adequately meet consumer needs. As a result policymakers take a cautious stance in the promotion new competitive alternatives, although new technology enables such entries. The dominant players navigate the policy arena well, find self-policing solutions to meet regulatory authority expectations.

Social plane

Connected devices and tablets provide benefits to the users of mobile networks. Adoption of wireless PANs and LANs at home and work takes off. Innovative mobile applications find an eager audience; global consumer expectation emerges for continued innovation and choice. The industry is proactive in addressing many of the potential concerns that plagued the Internet's early rise, and mobile access world is seen by consumers as a trusted environment.

Technology plane

LTE impose itself as the dominant mobile technology and its LTE-Advanced evolution offers even more capacity and higher speeds to the market place. Adherence to open standards increasingly marks the industry's approach to new technology deployments, and the big players might stimulate that approach. This enables early and effective efforts to ensure interoperability at all levels. One critical achievement is the adoption of robust and standard micro-billing capability for usage-based mobile applications and internet working between different access methods. Interoperability is improving between Operating Systems for smartphones. Smartphones represent 80% of the sales in 2020 and have become very cheap.

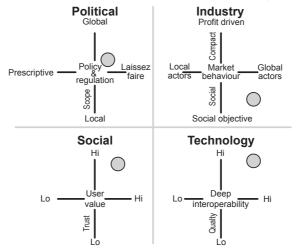
Industry plane

Cooperation and coordination best define the largest players' behaviour as they actively guide investment away from proprietary solutions. Intellectual property rights are not a battleground. The industry succeeds in establishing wireless-originated infrastructure platforms as the de facto converged standard across the entire communications industry. Where new technology and spectrum create a compelling alternative for wireless access, existing providers typically co-opt the alternative by building it into a comprehensive proposition. An open approach toward intellectual property leads to a robust level of new investment and application innovation amongst smaller players and start-ups. Larger players continue to expand horizontally and globally, and significant consolidation occurs within the industry as the distinction between fixed and mobiles disappear for operators and manufacturers of access devices, infrastructure and software. Long-term capital investments are made with relative confidence.



Discussion of variables

Figure 72: Relative influence of variables on scenario outcomes (scenario 2)



Impacts and implications

• Users – Consumers:

Consumer applications are proposed by many actors: mobile operators, terminal manufacturers, Internet giants. The users benefit from a very large number of attractive, low-price applications for smartphones and tablets. Content is increasingly created to serve the mobile market. Consumers interact intensively with their mobile devices and services, coming to see them as a robust tool, companion, and stimulus to creativity. Mobile medical monitoring is one example of an application that consumers embrace.

• Users - Business:

Significantly, the banking industry embraces mobile payment methods including transaction microbilling and as a result mobile commerce enjoys broad adoption. The stability, interoperability and quality of mobile communications encourage several industries to fully integrate mobile solutions into their way of doing business – supply chain management, information exchange, distribution, billing and customer management.

Government:

The relative stability and cohesiveness of the market and its underlying standards mean that governments are able to plan and successfully implement e-government initiatives on a broad scale. Tax payments, voting, administrative automation and delivery of services are all facilitated by converged, interoperable and trusted communications infrastructures. Mobile communication is at the heart of this new way of providing government services.



• Mobile operators:

Competition for the provision of applications is fierce but operators find a way to attract users to their application stores. Although VoIP puts continuing pressure on voice revenues and margins, mobile operators grow their way out is via the robust adoption of data applications by consumers and business, and usage-based pricing. Service providers integrate alternative means of access as part of a complementary total solution, but work with vendors to assure the continued dominance of traditional access methods. Mobile becomes the centrepiece of integrated propositions, including significant application and content packages.

Manufacturers:

Mobile operators pilot a measured rollout of new capabilities and infrastructures, but this is balanced by the great opportunities created by obsolescence and the convergence of platforms. Device manufacturers face competition from the entire consumer electronics industry as consumers segment their mobile device buying along application lines – be it music, video, voice, messaging, games, productivity, creativity, information retrieval – as manufacturing costs fall.

Content and Applications Providers:

Application stores flourish and applications can be downloaded on all type of terminals. Mobile operators install the most popular applications on low cost smartphones. Many propositions become content-led, and robust micro-billing capability means that adequate revenue sharing supports the financial health of content providers.

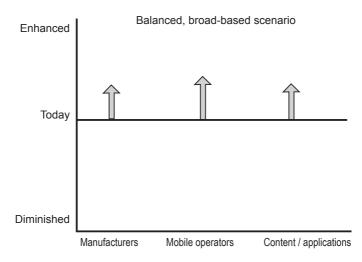


Figure 73: Changing influence and role of industry participants 2020 (scenario 2)



Scenario 3: pervasive data-driven growth

Key drivers

This scenario is characterized by the development of multiple access networks favoured by the maturity of dynamic and adaptive networks which help to optimize the use of spectrum in highly populated areas. Prices fall rapidly, with commodity-like pricing a constant risk. The rapid deployment of complementing networks, technologies beyond 3G, plus connected LANs and PANs means that the user has multiple ways of connecting, although seamless experiences are not guaranteed and consumers must cope with several options. However there is a need to ensure complementary coverage for these dynamic and adaptive networks with the larger mobile networks on a national basis.

Manufacturers adopt aggressive "leapfrog" strategies, using opportunistic partnerships and sourcing arrangements that employ proprietary end-to-end solutions. Many manufacturers, consumer/content brands and enterprises become virtual service providers in order to secure end-user markets for their core products. In the drive for quick scale economies, firms aggressively court – and deploy capability to – previously underserved markets around the globe, in highly populated areas. Mobile operators find this to be an attractive avenue of growth. Incumbent mobile operators are ultimately unable to compete within their existing cost structures. Regulatory influence is diminished. The market (customer segments, propositions and providers) initially fragments to an extraordinary and chaotic degree – fed by a proliferation of access options, content propositions and device types. Use of wireless explodes, including peer-to-peer content applications using ad hoc networks and pirated content. By 2020 service providers will have to begin consolidating again, led by global consumer brands that have expertise in managing customers using several generations of technology and propositions.

Political plane

Manufacturers seek to gain market share through proprietary standards, providers and price levels through an aggressive leapfrog strategy which promotes: much lower deployment costs with attractive prices for customers, proprietary end-to-end solutions, and access to and re-purposing of virtually any content at significant savings compared to the original distribution source. Device technologies and consumer behaviour (peer-to-peer creation and piracy of content) make the industry almost "ungovernable." Initially, some policy officials' will adopt an increasingly hands-off approach, satisfied that competition will meet customer needs. However, over time many regulators will begin to find the market excessively unstable, which is not in the public interest, and push for more rationale market developments. Some regions mandate an accelerated and standardised ubiquitous network rollout technologies beyond 3G as a defensive industrial policy to address market instability. Spectrum harmonisation suffers as a result of this uncoordinated and inconsistent approach and limited economies of scale can be achieved for equipment production.

Social plane

The ubiquitous availability of low-cost content increases the number of peer-to-peer content applications and "co-production" on top of an already rich market for video entertainment. In highly populated areas, wireless becomes a great enabler of virtual work and social patterns despite poor quality. Consumer markets and propositions become segmented along new lines according to emerging preferences for cost, quality and features. Some providers offer content ratings and protection as an example.



Technology plane

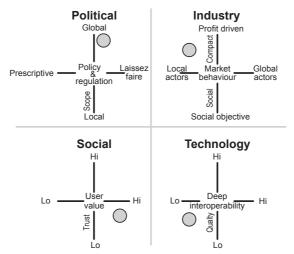
The fracturing of dominant standards reintroduces interoperability challenges, and leads to emerging "virtual islands" of providers and users that adopt lower cost "leapfrog" end-to-end solutions. Since cost and speed to market are the dominant drivers, the quality and security offered often fail to meet customer requirements. Widespread ad hoc or mesh network deployments are one of the "leapfrog" tactics of low-cost manufacturers and service providers, and "bottoms-up" creation of such networks becomes widespread.

Industry plane

The drive for market share based on low cost strategies puts many firms under significant strain, and those that do not rapidly reduce costs are consolidated. As firms radically restructure and focus on their core strengths, networks of specialised low-cost providers emerge to defend markets and expand globally. Market shares shift rapidly and alliances form based on opportunistic behaviour. Utilities, cable television firms, municipalities, consumer lifestyle brands and automobile manufacturers all develop wireless propositions. Capital investment decisions face shorter payback requirements.

Discussion of variables

Figure 74: Relative influence of variables on scenario outcomes (scenario 3)



Impacts and implications

Users – Consumers:

An increase in peer-to-peer content, user-created content, and quickly changing propositions characterize this scenario. Users are able to find offers that meet their essential needs, often at very low cost. Basic devices are very inexpensive, but capabilities can be limited and differ from device to device. Certain market segments churn aggressively to take advantage of the latest offers. Subscriptions grow rapidly as previously unserved markets become economic for service providers. Many of the subscriptions are for voice only or simple messaging applications in highly populated areas of some currently under-served markets.



Users – Business:

Businesses are able to find providers who can offer a tailored mix of applications and features to suit their needs but at the price of poor quality. Machine-to-machine applications grow rapidly. The low cost of devices also encourages businesses to distribute application specific wireless devices to customers as a way of locking them in, and lowering the cost of customer management, information exchange and distribution. The indirect benefit is increased wireless adoption.

Government:

In some developing economies, the relatively low cost of deploying infrastructure and devices that are voice-only, messaging-only, or otherwise application specific, allows modest subsidies. Governments, development authorities, foundations and micro-lending institutions may choose to subsidize the distribution of devices to encourage connectivity, and to provide incentives to deploy networks more broadly. Some developed economies could undertake similar efforts such as e-government, but on a more localized or application-specific basis.

Mobile operators:

Vendors directly sell low cost end-to-end solutions to consumers, businesses, communities of interest and virtual mobile operators. To preserve revenues, existing network operators pursue wholesale provision of backbone and core infrastructure services to emerging and virtual mobile operators. The proliferation of wireless networks, including coalitions of local unregulated access providers, and the incentive to switch providers created by low cost intelligent devices, means that existing service providers cannot afford broad infrastructure upgrades or other long term investments and find it ultimately impossible to compete on the basis of: their legacy networks, today's cost structures and profitability models.

Manufacturers:

Manufacturers drive the overall market, but those who cannot operate at extremely high speeds, with clear focus and at low costs are left behind. Restructuring is an imperative for existing players. Quickly assembled and disassembled global supply chains and distribution networks enable effective exploitation of new application opportunities and developing markets. Many manufacturers develop their services into virtual service provision, or partner with global consumer brands to provide turnkey service offerings, including content sourcing.

Content and Applications Providers:

Digital rights management is a battleground in this scenario. Immense volumes of high bandwidth content are consumed and shared in this scenario. However, some service providers avoid industrial frameworks and provide compelling, pirated content at low price. Large content brands react by pursuing multi-pronged distribution, packaging and pricing strategies.



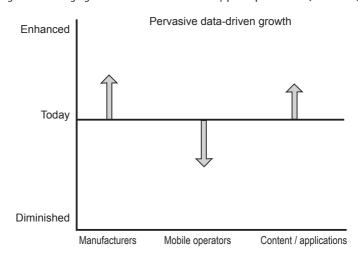


Figure 75: Changing influence and role of industry participants 2020 (scenario 3)

Selection of the preferred scenario

We consider that scenario 2 ("balanced, broad based growth") represents the most plausible development of mobile communications for the years 2010–2020. Scenarios 1 and 3 are disruptive scenarios, and were considered to provide a fuller picture of opportunities and risks for the industry.

9.2. Busy-hour assumptions

The measure of traffic that is used in the calculations is busy-hour volume, as it is important, from an MNO's perspective, for quality of service (QoS) that the MNO's network can still function effectively in periods of peak traffic volume.

The Magic mobile future study used a multiplying factor to provide traffic forecasts in this measure. The average factor used is 7.15%, which is lower than is typically used for cellular networks: 10–15%. However, since this study concerns traffic forecasts up until 2020, it may be appropriate to use a lower busy-hour assumption. This is due to the fact that in the future there will be more services that will generate traffic outside of the busy hour (e.g. M2M services), or services that are amenable to delays in arrival of traffic (e.g. email). The FMS study, meanwhile, only provides daily traffic rates.

In order to accommodate this difference, the traffic that we insert into the model is converted into the equivalent of daily traffic – in the case of the Magic mobile future forecast – and the busy-hour assumption is then incorporated inside the model. Two scenarios of 7.5% and 10% are used for this busy-hour factor, with 7.5% used in our base cases.

The hypothesis used for our 2010–2020 forecasts is 10% in the representative European country because we consider that voice traffic will represent less than 10% of total traffic in 2020 and that the traffic pattern will change compared to previous figures.



9.3. Mobile Internet use

Table 31: Mobile Internet use

Select Mobile Behaviors in Japan, United States and EU5 (UK, DE, FR, ES and IT) June 2010
Total Mobile Audience Age 13

Total Mobile	Total Mobile Audience Age 13				
	Percent	t of Total Mobile Au	udience		
	Japan	United States	Europe		
Total Audience: 13+ yrs old	100.0%	100.0%	100.0%		
Used connected media (Browsed, Accessed Applications or Downloaded Content)	75.2%	43.7%	38.5%		
Used browser	59.3%	34.0%	25.8%		
Used application	42.3%	31.1%	24.9%		
Messaging Usage					
Sent text message to another phone	40.1%	66.8%	81.7%		
Used major instant messaging service	3.3%	17.2%	12.6%		
Used email (work or personal)	54.0%	27.9%	18.8%		
Social Media/Entertainment					
Accessed Social Networking Site or Blog	17.0%	21.3%	14.7%		
Listened to music on mobile phone	12.5%	13.9%	24.2%		
Took photos	63.0%	50.6%	56.8%		
Captured video	15.4%	19.2%	25.8%		
Watched TV and/or video on mobile phone	22.0%	4.8%	5.4%		
Played games	16.3%	22.5%	24.1%		
Financial Information					
Accessed bank accounts	8.0%	9.4%	7.1%		
Accessed financial news or stock quotes	16.1%	10.0%	7.2%		
Retail/Travel					
Accessed online retail	7.2%	5.5%	4.1%		
Accessed classifieds	4.2%	6.6%	4.2%		
Accessed travel service	3.3%	4.7%	4.1%		
Other					
Accessed maps	15.7%	16.0%	10.8%		
Accessed traffic reports	12.6%	8.2%	5.9%		
Accessed weather	34.1%	22.3%	13.7%		

Source: comScore MobiLens



9.4. Data Traffic: AT&T

Table 32: Data usage for a Laptop/notebook user

Data usage for a laptop/notebook user

DATA USAGE FOR A LAPTOP/NOTEBOOK USER									
Emails sent/received (no attachments) per day	20 emails	40 emails	70 emails	100 emails	150 emails	200 emails	300 emails	400 emails	500 emails
Your Estimated Monthly Usage	0.02GB	0.04GB	0.07GB	0.10GB	0.15GB	0.21GB	0.31GB	0.41GB	0.51GB
Emails with photo attachments per day	10 emails	30 emails	50 emails	70 emails	100 emails	120 emails	150 emails	170 emails	200 emails
Your Estimated Monthly Usage	0.29GB	0.88GB	1.46GB	2.05GB	2.93GB	3.52GB	4.39GB	4.98GB	5.86GB
Emails sent/received (with attachments) per day	20 emails	40 emails	70 emails	100 emails	150 emails	200 emails	300 emails	400 emails	500 emails
Your Estimated Monthly Usage	0.17GB	0.34GB	0.59GB	0.85GB	1.27GB	1.70GB	2.55GB	3.40GB	4.25GB
Songs Downloaded	1 song	2 songs	3 songs	4 songs	5 songs	6 songs	7 songs	8 songs	9 songs
Your Estimated Monthly Usage	0.12GB	0.23GB	0.35GB	0.47GB	0.59GB	0.70GB	0.82GB	0.94GB	1.17GB
Web Pages Viewed per day	10 pages	20 pages	50 pages	100 pages	150 pages	200 pages	300 pages	400 pages	500 pages
Your Estimated Monthly Usage	0.09GB	0.18GB	0.44GB	0.88GB	1.32GB	1.76GB	2.64GB	3.52GB	4.39GB
Applications/Games/Songs downloaded per day	1 app	2 app	3 арр	4 app	5 app	6 app	7 app	8 app	9 app
Your Estimated Monthly Usage	0.44GB	0.88GB	1.32GB	1.76GB	2.20GB	2.64GB	3.08GB	3.52GB	3.96GB
Social Media Posts with Photos Uploaded per day	10 posts	20 posts	50 posts	100 posts	150 posts	200 posts	300 posts	400 posts	500 posts
Your Estimated Monthly Usage	0.14GB	0.29GB	0.72GB	1.44GB	2.15GB	2.87GB	4.31	5.74	7.18GB
Minutes of Streaming Video per day	1 minute	5 minutes	10 minutes	15 minutes	20 minutes	30 minutes	40 minutes	50 minutes	60 minutes
Your Estimated Monthly Usage	0.09GB	0.44GB	0.88GB	1.32GB	1.76GB	2.64GB	3.52GB	4.39GB	5.27GB
TOTAL	1.36GB	3.28GB	5.38GB	8.87GB	12.32GB	16.04GB	17.23GB	26.9GB	32.59GB

Source: AT&T Usage per month for smartphone users, 4Gcounts Quarterly Report - June 2010.

Table 33: Data usage for a smartphone user

Data usage for a smartphone user

DATA USAGE FOR A SMARTPHONE USER									
Emails sent/received (no attachments) per day	20 emails	40 emails	70 emails	100 emails	150 emails	200 emails	300 emails	400 emails	500 emails
Your Estimated Monthly Usage	0.01GB	0.02GB	0.04GB	0.06GB	0.09GB	0.12GB	0.18GB	0.23GB	0.29GB
Emails with photo attachments per day	10 emails	30 emails	50	70	100	125	150	170	200
Your Estimated Monthly Usage	0.10GB	0.30GB	0.50GB	0.70GB	1.00GB	1.25GB	1.50GB	1.70GB	2GB
Emails sent/received (with attachments) per day	20 emails	40 emails	70 emails	100 emails	150 emails	200 emails	300 emails	400 emails	500 emails
Your Estimated Monthly Usage	0.08GB	0.34GB	0.59GB	0.85GB	1.27GB	1.70GB	2.55GB	3.40GB	4.25GB
Hours of Streaming Music per day	0.5 hours	1 hour	2 hours	4 hours	6 hours	8 hours	10 hours	12 hours	14 hours
Your Estimated Monthly Usage	0.43GB	0.86GB	1.72GB	3.45GB	5.17GB	6.89GB	8.61GB	9.47GB	10.32GB
Web Pages Viewed per day	10 pages	20 pages	50 pages	100 pages	150 pages	200 pages	300 pages	400 pages	500 pages
Your Estimated Monthly Usage	0.05GB	0.11GB	0.26GB	0.53GB	0.79GB	1.05GB	1.58GB	2.11GB	2.64GB
Applications/Games/Songs downloaded per day	1 app	2 app	3 арр	4 app	5 app	6 app	7 app	8 app	9 app
Your Estimated Monthly Usage	0.12GB	0.23GB	0.35GB	0.47GB	0.59GB	0.70GB	0.82GB	0.94GB	1.05GB
Social Media Posts with Photos Uploaded per day	10 posts	20 posts	50 posts	100 posts	150 posts	200 posts	300 posts	400 posts	500 posts
Your Estimated Monthly Usage	0.14GB	0.29GB	0.72GB	1.44GB	2.15GB	2.87GB	4.31GB	5.74GB	7.18GB
Minutes of Streaming Video per day	1 minute	5 minutes	10 minutes	15 minutes	20 minutes	30 minutes	40 minutes	50 minutes	60 minutes
Your Estimated Monthly Usage	0.06GB	0.29GB	0.57GB	0.86GB	1.14GB	1.71GB	2.29GB	2.86GB	3.45GB
TOTAL	1GB	2.44GB	4.3GB	8.36GB	12.2GB	16.30GB	21.84GB	26.45	31.2GB

Source: AT&T Usage per month for smartphone users, 4Gcounts Quarterly Report - June 2010.



9.5. Bibliography

- UMTS Forum, 3G offered traffic characteristics, Report No. 33, November 2003
- UMTS Forum, Magic Mobile Future, Report No. 37, April 2005
- UMTS Forum, Market potential for 3G LTE, Report No. 41, July 2007
- ECC PT1(10)163, Summary of responses to CEPT questionnaire on mobile broadband
- IDATE, M2M, market report, 2010
- IDATE, Mobile networks saturation, market report, 2010
- IDATE, Mobile Internet, market report, 2010
- IDATE, Is LTE taking-off?, market report, 2010
- Cisco, VNI (Visual Network Index), 2010
- Sandvine, 2010 Mobile Internet Phenomena Report
- Allot, Mobile trends, global mobile broadband traffic report, 2010
- NokiaSiemens Networks, mobile broadband business aspects, January 2010
- Ericsson, technology update on LTE, telebriefing, September 2010
- Ericsson, North American Industry Analyst Forum 2009
- National Communications Authority, Hungary, Flash Report on Mobile Internet, April 2009
- FCC, Mobile broadband: the benefits of additional spectrum, October 2010
- IPTS, the demand for future mobile communications markets and services in Europe, 2005
- Rysavy Research, mobile broadband capacity constraints, February 2010
- GSMA, analyst conference mobile broadband, October 2009
- FierceWireless, Mobile video traffic: alleviating the capacity crunch, July 2010