The Mobile Provide

Economic Impacts of Alternative Uses of the Digital Dividend

Public Report, September 2007

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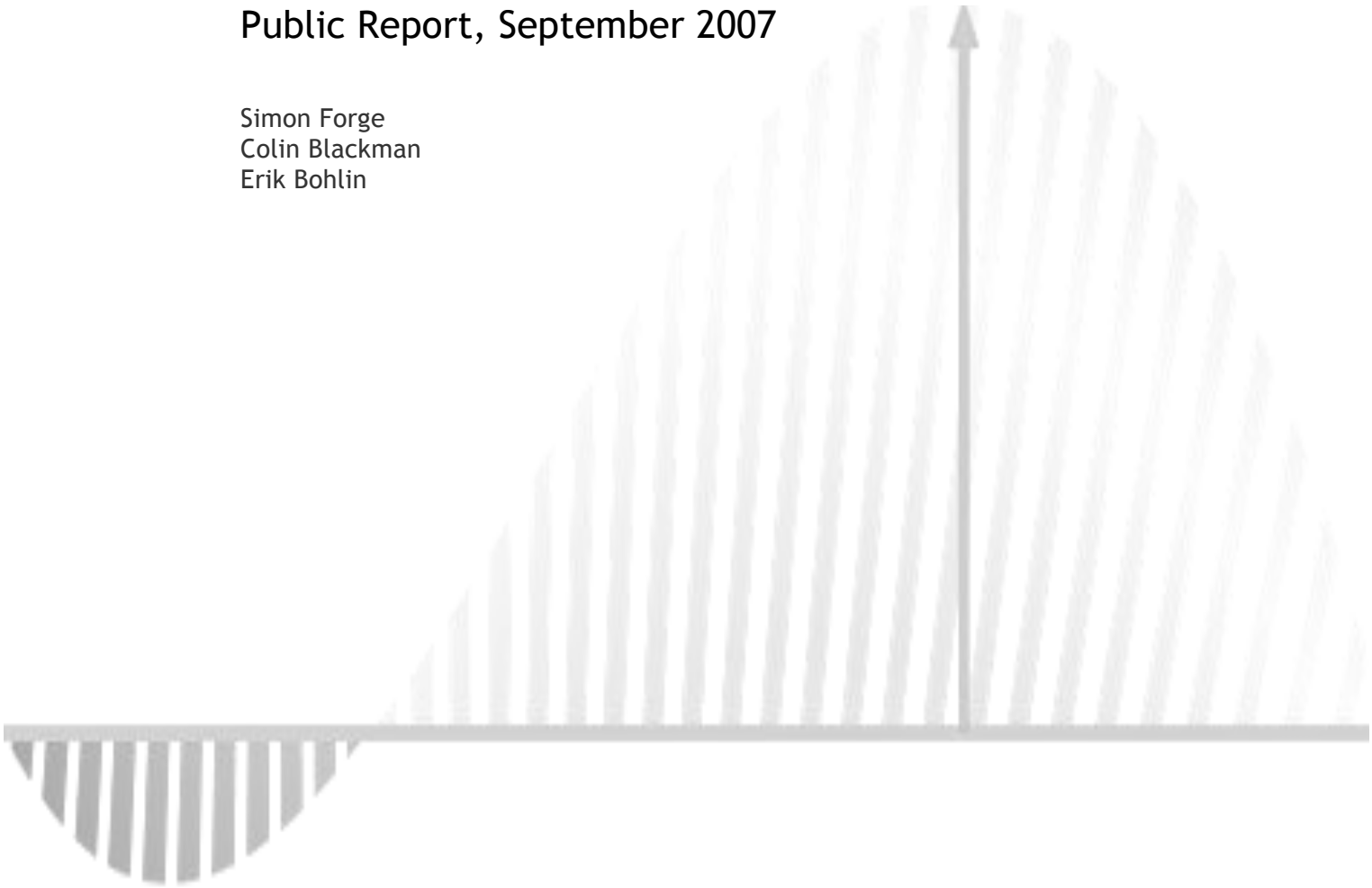

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The views expressed in this report are those of the authors and do not necessarily reflect those of Deutsche Telekom or T-Mobile International.

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Highlights from the study

The switchover from analogue to digital TV broadcasting in Europe could release significant spectrum in the UHF bands. Sometimes called the 'Digital Dividend', it offers a unique opportunity to meet new demands for services and to support the European agenda for innovation. Most importantly, it could have a significant impact on the EU economy, driving innovation, job growth, productivity and competitivity.

Economic analysis of the impacts of different uses of the spectrum is key to deciding how such spectrum should be used. The study has considered the economic factors involved in the Digital Dividend, from a micro- to a macro-economic European level. It delivers a framework for assessment of their impact and proposes how best to exploit the new spectrum for efficiency gains. The study compares the economic impacts of two different scenarios for allocating the Digital Dividend – 'Broadcast TV Rules', in which 70% of the dividend goes to TV broadcasting and 'The Mobile Bazaar, in which the mobile sector receives 60% of the freed spectrum. The results indicate:

- Investment in wireless communications could bring significant productivity gains throughout the European economy, resulting in faster GDP growth rates up to 2020. Approximations indicate that accumulated effects over the next decade or more might have a significant impact. Estimates of the accumulated effect indicate as much as an additional 0.6% GDP growth per year for the EU economy by 2020 in the mobile case when compared with broadcast TV. This cumulative effect would tend to increase with lower priced services.
- If we look at current performance as an indicator of future economic impact, we can see that the use of the Digital Dividend by the mobile sector could be much more advantageous for the EU. For instance:
    - The *economic output per MHz of bandwidth* is estimated at €168 million for mobile compared to €28 million for the digital TV case.
    - Direct economic effects in the EU (services, revenues, product sales etc) for *operators* are currently estimated to be €208 billion for mobile compared to €43 billion for broadcast TV. *Suppliers* presently directly benefit by sales of €87 billion in the mobile case v €30 billion for broadcast TV.
    - Indirect economic effects throughout the EU, such as user and producer surplus, are estimated at €165 billion for mobile against €95 billion produced by broadcast TV.
    - Investment in broadcast TV will not create nearly as much wealth or as many jobs as investment in mobile. Employment in the mobile sector is growing strongly and already outstrips employment in TV broadcasting, which is stagnating.
    - Spending by the mobile sector already stimulates 2.3 million jobs in other industries, a figure well in excess of the estimated 1.8 million resulting from TV sector spending.

Consequently, release of a major part of the Digital Dividend to broadcast DTV cannot be justified in economic terms. In contrast, the mobile sector can use the Digital Dividend to the benefit of Europe both economically and socially. In particular, allocating spectrum to enable wireless broadband could have a dramatic impact on bridging the Digital Divide by using the new spectrum to provide access for all across the EU's 27 Member States.

Objectives and scope of the study

This report briefly summarises the findings from an innovative research study[1] into the long-term impacts on the European economy of alternative uses of the radio spectrum released through the Digital Dividend. The study builds on a methodology developed by SCF Associates in several recent projects for the European Commission combining qualitative scenario building with quantitative economic forecasting. Our study and this brief report are structured as follows:

- First we explore the meaning of the Digital Dividend – its nature and possible uses for the spectrum that will be released.
- We then consider two scenarios – one in which most of the spectrum is allocated for broadcasting, the other in which most is used for cellular wireless – forecasting the major potential economic impacts for these two options.
- Finally, the report discusses the broad policy implications arising from the study's findings at a European level.

A unique opportunity for Europe

With the arrival of digital television (DTV), the proposed analogue switch off between 2010 and 2012 in the EU Member States presents a one-time opportunity for Europe. It has been called the 'Digital Dividend' since it will release significant segments of spectrum in the ultra high frequency (UHF) band. This is because:

- Today, nearly half of the lower part of the UHF band (200 MHz-1 GHz) is used to broadcast analogue television in many Member States, some 390 MHz – specifically the 470-862 MHz band.
- With DTV, all current analogue TV channels could be transmitted using only 25% – or less[2] - of the original spectrum, as illustrated below:

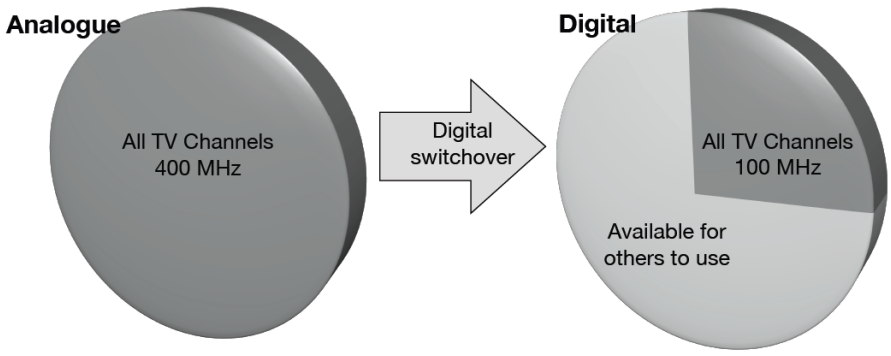

Figure 1. With digital switchover, current TV channels need much less spectrum

[1] The study was commissioned by Deutsche Telekom/T-Mobile and carried out by SCF Associates in May-September 2007. A separate Methodology Report describes the study's methodology, data sources and estimations in detail and is available from www.digitaldividend.eu.

[2] Ofcom's Digital Dividend Review, 2006, noted that the 368 MHz of UK analogue broadcasting could be carried in just 40 MHz.

Potential uses for released spectrum

There are many possible, and sometimes competing, uses for this valuable spectrum. Possible applications that have been proposed include:

Digital terrestrial television

- More standard definition channels and programming (eg local, special interest)
- Increased geographical coverage
- High definition TV
- Mobile/portable reception
- Data broadcasting

Licence exempt services and low-power wireless devices, eg for:

- Programme making and special events (PMSE), theatres, concerts, etc
- Instrument, scientific and medial applications
- Business networking, industrial sensor networks
- Home applications (networking, low-power devices)

Wireless communications and services, including:

- Cellular mobile
- Wireless hotspots
- Mobile multimedia, mobile TV
- Wireless broadband, especially for rural areas to bridge the 'Digital Divide'
- Private mobile radio

Releasing the spectrum to new users could offer new opportunities to Europe, eg:

Closing the digital divide: rural coverage for the EU with broadband at low cost has been the aim of industry and governments since the Lisbon agenda was first launched in 2000, to propel the EU towards a knowledge-based society. The Digital Dividend with its highly advantageous propagation characteristics (see next section) is exactly what is needed for low-cost broadband Europe's citizens. It can do far more than offer IPTV from the Web – it can stimulate the local economy with fast Internet access and also offer mobile broadband.

Health and elderly care applications: our aging population and the increasing costs of in-hospital care are a double burden on EU society. New solutions are essential that can combine better care but at lower cost. One solution is to provide more care at home. In fact the 'hospital in the home', or the less intensive elderly care through smart sheltered housing, can be effected using dedicated radio communications for monitoring vital signs of ill patients during recovery at home, as well as video surveillance. This approach would require a wide variety of broadband radio communications, from body area networks over a few metres, to home coverage networks, up to video relayed over several kilometres. Releasing the new spectrum could literally be a life-saver.

Flexible disaster recovery networks for global warming: again, in the area of vital applications for the new spectrum, our rapidly changing climate is bringing more frequent catastrophes. The effects of flooding, tornadoes, coastal erosion and other natural phenomena demand national and Europe-wide response networks. The frequencies should be appropriate for long-distance communications in poor weather (rain and wet foliage attenuation) but also for in-building rescue which needs propagation in ferro-concrete structures. Other countries (eg USA) are already reserving bands for new emergency services band in the Digital Dividend's UHF range, usually around 700 MHz, owing to these advantages.

The propagation characteristics of frequencies

Broadcast TV, much of which is still analogue in the EU, currently enjoys the major share of some prime spectrum.[3] The prime 200 MHz to 1 GHz spectrum band in one European Union Member State is used for terrestrial television (46%), military (26%), public mobile (9%), private business radio and other (7%), aeronautical/maritime (6%), emergency services (2%)with some 4% for digital radio, science and licence exempt applications.

This spectrum is very valuable, particularly to wireless operators, because of the propagation characteristics at these frequencies. They offer an optimal combination of range and data capacity. For example, at 3.5 GHz, the signal covers a reception radius, or cell size, of about 5 km while at 700 MHz it is about 10 km (see Figure 2).

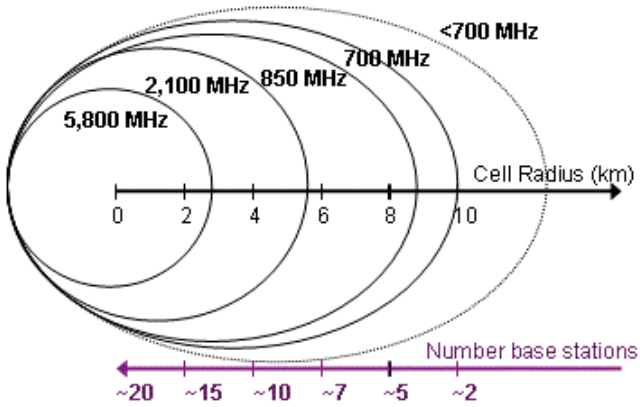

Figure 2.The propagation characteristics of spectrum

Source: BBC R&D.

In economic terms these features determine infrastructure cost. Better propagation means fewer base stations. Thus the network infrastructure investment (CAPEX) is nearly seven times higher if wireless operators have to use 3.5GHz compared to the larger cell sizes at 700 MHz, or even higher at the lower frequencies in the Digital Dividend (see Figure 3).

Moreover, improved propagation qualities also means better reception for mobile phones *inside buildings* – a factor that may hold back substitution of wireless for fixed-line communications in the future. Thus the UHF band has particularly valuable properties for wireless communications networks, using any generation of technology – whether it be 2G cellular, 2.5G, 3G or 4G or, as we look to the future, novel radio technologies such as WiMax or WiFi. As already indicated, it could also stimulate innovation in newer European radio technologies for emergency communications, health, elderly care and lower-cost communications.

[3] Note: In Europe the UHF band is conventionally divided into channels of 8MHz. Broadcast TV ranges from channel 21 at the bottom to channel 69 at the top – 470 to 862 MHz – some 392 MHz.

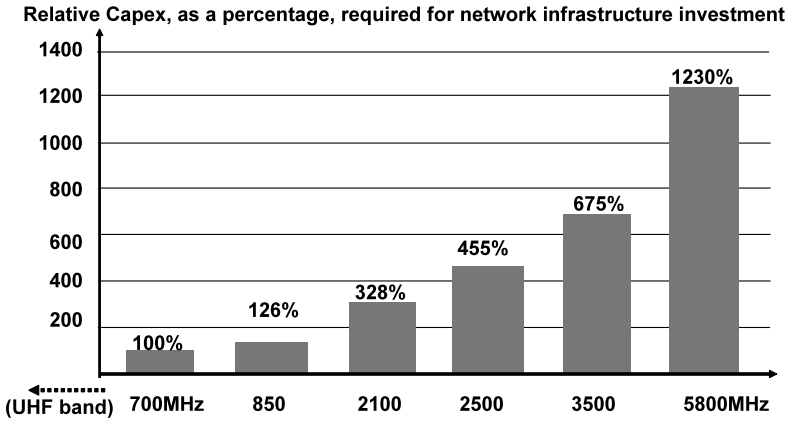

Figure 3. Lower frequencies reduce costs of infrastructure and communications

Source: BBC R&D.

Estimating the economics of the digital dividend

Translating the potential impacts of the propagation characteristics of the Digital Dividend into economic terms is a logical and metrical challenge. Like any kind of industrial development, the growth in industries producing information and communication technology (ICT) services and goods is thought to be important to the general growth of the economy in terms of their impacts on *other* sectors. But as many researchers have found, measuring the impact of any kind of ICT is difficult, owing to problems of identifying linkages between these economic inputs and their impacts.

Clearly the choice of appropriate parameters as indicators for measurement is one of the keys to the study. Our choices have been guided by several factors: by the desire to make a methodological advance in quantitative forecasting, by the literature on measuring impacts of ICTs, and by good practice in impact assessment in keeping with the concept of the SMART objectives[4] used in EC impact assessments. With this in mind we have constructed a quantitative approach for extrapolating from qualitative scenario building, using SCF Associates' previous experience in this domain. This quantitative approach is based on linking micro-economic factors to macro-economics via an intermediate level, that of a sector or social group, the meso-economic level.

We spent significant time in researching the availability of data to support possible parameters before deciding which were most proportionate to policy objectives. At the micro-economic level, we use parameters related to consumer behaviour. We collected data on consumer expenditures on communication and media, measured eg by mobile ARPU, TV and Internet/broadband spending as a percentage of total household expenditure on *e*-communications. At the meso-economic level, we considered growth indicators of media and wireless sub-sector-penetration in the EU27, eg the growth of wireless industries, penetration of TV receivers, TV and mobile sector revenues. Finally, the macro-economic parameters focus on European GDP and employment, measured by EU GDP growth rate, EU employment, and EU employment in services as a percentage of total employment. At each level, parameters were calculated for forward simulations over the period 2007 to 2020.

[4] SMART: Specific, Measurable, Accepted, Realistic and Time-depended objectives.

Exploring the options through two scenarios

We analysed the options for allocating the Digital Dividend by building two scenarios and modelling their impacts on the economy. The two scenarios created to contrast the allocation of the digital dividend are as follows:

Scenario	*Theme*
1. Broadcast Media Rules	Most of the dividend is used for additional digital terrestrial channels and HDTV
2. Mobile Bazaar	A significant proportion of the spectrum is released via a licensed spectrum regime for mobile communications services

We contrast the different amounts of spectrum from the Digital Dividend allocated within each scenario to the various applications in the illustrations below. Note that both scenarios allow for at least 15% of the released spectrum to be used for other purposes, such as military.

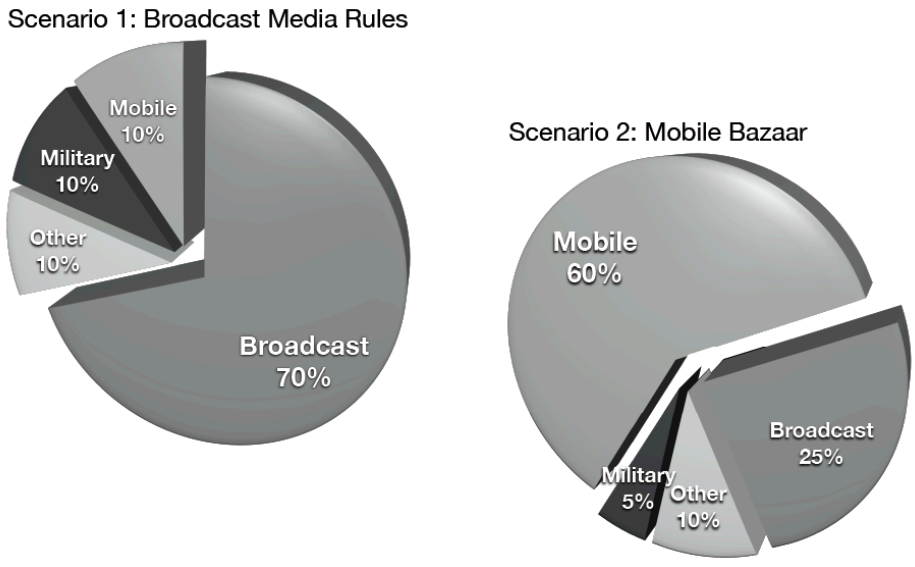

Figure 4. The two scenarios and the allocation of the Digital Dividend

The impact of the use of the Digital Dividend on the economy

The key finding of the study is that use of the Digital Dividend by the mobile sector is highly positive for the European economy over the next decade and more. By comparison, use of the released spectrum by broadcasting has much less impact on the economy. The difference in results arises mainly from the significant productivity gains throughout the EU economy, coming from the investment in wireless communications, and driving GDP growth rates higher. This is a cumulative effect over at least a decade, which accelerates with lower priced services (see Figure 5).

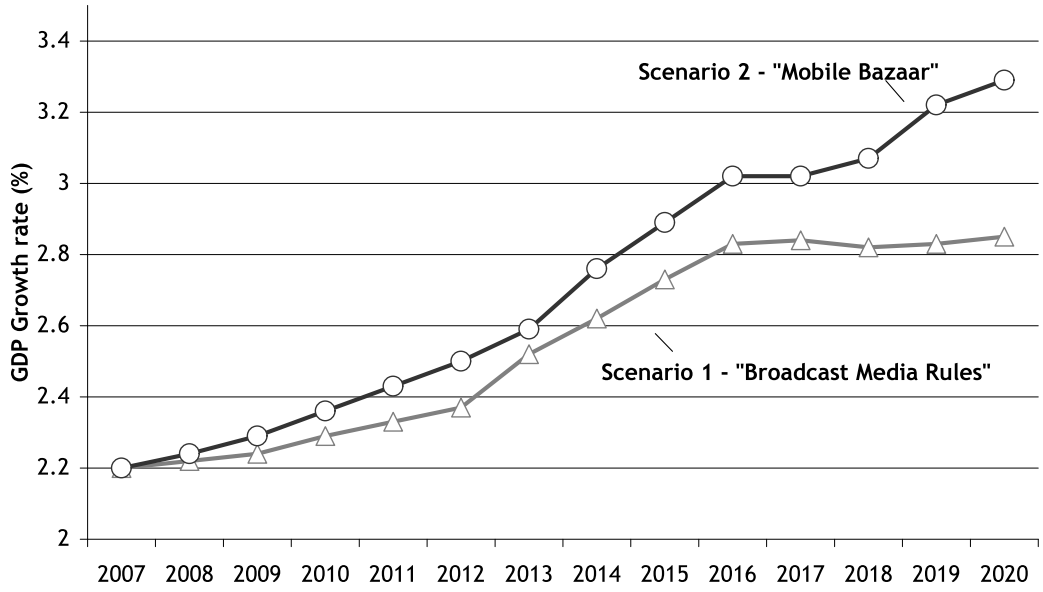

Figure 5. The impact of the two scenarios on Europe's GDP growth rate

Further results from scenario modelling show other positive impacts for Europe of allocating spectrum for wireless communication services. Total employment, the proportion employed in services (an indicator of knowledge-based work), and GDP per head are all more closely associated with mobile sector use of spectrum. The macro-economic impacts for the EU can be summarised as follows:

- Use of mobile provides major benefits for the EU economy, as measured in GDP growth, especially when its additional productivity factor is combined. After 2014 with cheaper services used more, the rate of growth of annual output takes off as voice prices fall with mobile VoIP introduced and progressive take-up to 2018/2019, when the effect starts to diminish.
- Overall employment is increased by mobile usage as the economy expands with extra productivity across all sectors, especially employment in the service sector.
- The differences in EU employment in services and thus the knowledge worker industries, as a percentage of the workforce, favour the mobile market scenario, as would be expected, indicating use of richer services, more types of usage and more minutes of use overall.
- GDP/head also is positively affected by increased mobile usage resulting from use of the radio spectrum.

The 'mobile provide'

Supplementary research was also conducted to validate these results, specifically by comparing the direct effects of the mobile industry in terms of industrial output and employment with those of TV broadcast media. In comparing the differences in impacts of the two scenarios – dominance by broadcast TV or mobile – the figure below shows that mobile spectrum allocation could generate more direct and indirect economic benefits as well as stimulating greater direct employment in the wireless sector. Furthermore, investment in mobile brings enormous indirect economic benefits through the economic stimulus of mobile enabled working, a primary economic difference between the two choices in driving the EU economy.

Mobile as an Economic Driver – the 'Mobile Provide'			
		Economic Significance for the EU	
		Mobile	**TV**
Direct	Operators – service provision, SCF projected time series estimate	€208 billion (2007)	€43 billion (2005)[1]
	Suppliers/distributors – hardware (handsets), software, networks, content, estimate base on 2004 data[2]	€87 billion (2007)	€30 billion (2006)
	Economic output per MHz at 900 MHz[3]	€168 million (2006)	€28 million (2005)
Indirect	Economic stimulus of mobile working, cumulative driving effect of mobile productivity to 2020[4]	0.6% GDP growth	Negligible
	Indirect stimulus to the economy by spend of direct impact revenues in other sectors: – User surplus, social and economic value, ie difference between what paid and prepared to pay – Producer surplus, ie difference between margins to stay in business and margins actually achieved	€165 billion (2007)[5]	€95 B[8]
Jobs	Employment in sector	0.5 million[6]	0.4 million[7]
	Employment stimulated by spend from sector	2.3 million[9]	1.8 million[10]

Table 1. Direct and indirect economic impacts on the EU economy

Sources: 1 Ofcom, 2006; 2 CEBR, 2004; 3 Vodafone/Ofcom, 2006; 4 Maliranta and Rouvinen, 2006; 5 Extrapolation from Mourik, 2003; 6 GSMA, 2004; 7 Cardona, 2002; 8 Estimate, Europe Economics, 2006; 9 Estimate, Ovum, 2004; 10 pro rata estimate.

Implications for Europe

Investment in mobile rather than media broadcasting through the Digital Dividend will be much more beneficial for the economy of Europe and clearly suggests the way forward:

- The contribution to productivity and GDP from investment in telecoms and especially mobile is much greater than anything else, as confirmed by a range of economic modelling studies.[5]

- GDP growth rate – cumulative effects means significantly higher rate of growth in GDP with mobile allocation by 2020. Similarly, the cumulative effect on average GDP per head across the European Union is significant.

- Jobs created – mobile investment means jobs in the mobile industry but more importantly more jobs in mobile user industries. The net impact is millions more additional jobs likely to be created by mobile compared with broadcasting over the next decade.

In comparison, the case for investment in broadcast TV through spectrum from the Digital Dividend is weak on economic grounds:

- Investment in broadcast TV will not create nearly as much wealth or as many jobs as investment in mobile (see Table 1).

- Even so, investment in mobile would not halt technological investment in display devices – consumer electronics would continue with mobile spectrum allocation - new mobile TV and IPTV might even drive display devices more, including programming and technology for:

    - TV products, media recorders and players (DVD, hard-disk, MP3 players, etc).
    - Network distribution.
    - Cable and satellite TV.

- In reality the broadcast paradigm of the past is becoming less and less relevant to the future. When distribution channels were limited a one-to-many model was the solution, but technology and society has moved on. A plethora of other platforms can now deliver content:

    - IPTV – over fixed xDSL or fibre to the home (FTTH).
    - Internet media downloads for non-IP TV from the Internet - and many fixed line operators are investing in next generation networks (NGN) with broadband capabilities.
    - Mobile TV – cellular channels or broadcast elements.
    - Wireless broadband, fixed and mobile.

The TV sector's argument in favour of using the released spectrum for HDTV is difficult to justify on economic grounds and even on consumer demand grounds:

- HDTV is already available through alternative platforms - broadband telecoms, cable TV and satellite, so demanding spectrum for making DTTV into HDTV is just a 'Me Too' play.

[5] See, for instance, studies by Waverman, Maliranta and Rouvinen, Brynjolfsson, Hardy, CEBR, NERA and Ovum.

- Consumer demand for better quality pictures has yet to be established. This is because consumers who currently receive free-to-air channels seem unwilling to pay for HDTV. If, however, TV viewers are willing to pay, then alternative platforms may be better placed to deliver. If they are not, we question whether taxpayers' money should be used to subsidise HDTV entertainment.

Conclusion

In conclusion, our study shows that the release of a major part of the Digital Dividend to broadcast DTV cannot be justified in economic terms or social terms.

In contrast, the mobile sector can use the Digital Dividend to the benefit of Europe both economically and socially. In particular, allocating spectrum to enable wireless broadband could have a dramatic impact on bridging the Digital Divide by using the new spectrum to provide access for all across the EU's 27 Member States. In short, the Digital Divide can be closed through the 'Mobile Provide'.

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A note on the study's methodology

The scenario approach: Scenario Construction for Forecasting

The study uses scenarios to build a qualitative picture of alternative futures. Scenarios are by nature *approximations of reality* – they simplify and extend the strongest features beyond what may happen to ensure that each scenario paints a picture that is vivid, clear and well distinguished and contrasts with other scenarios. There are many ways of building scenarios. Our approach (Scenario Construction for Forecasting –see Forge, Blackman and Bohlin 2006) is based on a formalisation of several of these, built up over some fifteen years of looking at future directions of market, high technology sectors and the economy. It consists of creating a key theme and its drivers, then working through assumptions and assertions and several further stages towards the full scenario.

Estimations using a quantitative economic approach: Micro-Meso-Macro

Our approach here is based on linking behaviour at the level of one firm or individual (micro-economic) to that of a social class or sector (meso-economic) to that of the EU economy (macro-economic). The scenario logic is then applied to projected time series at each level from the available data. The results presented here are indicative, no more. A more detailed Methodology Report may be obtained from www.digitaldividend.eu or by contacting the authors (simon.forge@whsmithnet.co.uk).

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