MOBILE OVERTAKES FIXED:

IMPLICATIONS FOR POLICY AND REGULATION

This paper was prepared by Valerie Feldmann, Telecommunication Policy Consultant for the International Telecommunication Union (ITU) Strategy and Policy Unit (SPU). The paper, together with background resources on the topic, have been prepared in the framework of a research project on "mobile overtakes fixed". The project is part of ITU's New Initiatives Programme and under the project management of Lara Srivastava <lara.srivastava@itu.int>. Information on all activities carried out under the ITU New Initiatives Programme can be found at: http://www.itu.int/osg/spu/ni. The opinions expressed in this study are those of the author and do not necessarily reflect the views of the International Telecommunication Union or its membership.

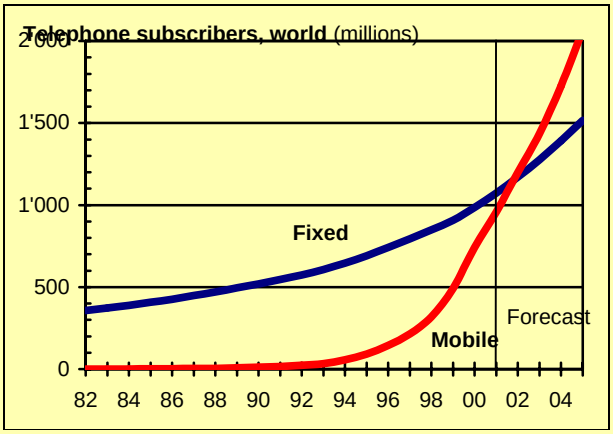
Table of Contents

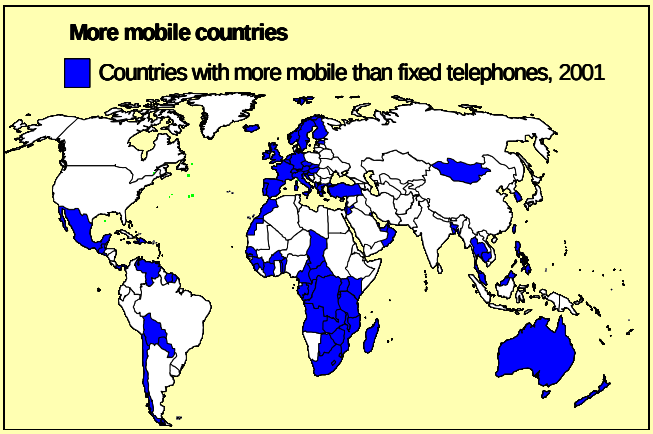
1 Introduction

The year 2002 marked an historic turning point in the history of telephony, for it was the year when mobile subscribers overtook fixed-line subscribers worldwide (see Figure 1). The rise of mobile telephony to overtake fixed has brought with it a huge number of implications, but perhaps the most significant impact is on access, both to basic telecommunication services, and to information and communication technologies (ICT), as a tool for economic and social development. It is also noteworthy that the phenomenon of the mobile cross-over has taken place across geographic criteria such as countries, regions, and continents, across socio-demographic criteria such as gender, income, or age, and across economic criteria such as price premium for mobile (micro) or GDP per capita (macro).

Figure 1: Mobile as the new global network

Mobile and fixed telephone subscribers worldwide, 1982 - 2005 and *Countries with more mobile than fixed telephone subscribers, 2001*





Note: In the upper chart, 1982-2001 is based on real data; 2002-05 on projections. In the lower chart, countries that are shaded had more mobile users than fixed lines, as at year-end 2001.

Source: ITU World Telecommunication Development Report, 2002; ITU World Telecommunication Indicators Database and ITU projections.

It is also significant that the greatest impact of mobile communications on access to telecommunication services—in other words, increasing the number of people who are in reach of a telephone connection of any kind—can be seen in developing countries. This is partly because cellular networks can be built faster than fixed-line networks and can cover geographically challenging areas. Mobile services have served to boost competition, and prepaid models have opened access to mobile cellular for those who would otherwise not qualify for telephone subscription plans.

In countries where mobile communications constitute the primary form of access, increased exchange of information on trade or health services is contributing to development goals; in countries where people commonly use both fixed-line and mobile communications, the personalized traits of the mobile phone are changing social interaction.

Increasingly, mobile is not only overtaking fixed, but also substituting for it: in such cases, users have a mobile phone only and have no fixed-line subscription. In developed countries, this may be through choice. In developing ones, it may be the only possibility for individuals to have their own phone. This has created a whole new set of paradigms for users, regulators and providers alike. It is important to note that while there may be a similar percentage of mobile-only users in countries as diverse as, for example, Finland and Uganda, the reasons for this development are clearly different for each of them, depending on whether they are developed or developing economies, and so are the implications.

This paper will first describe the development of mobile communications, the key drivers and inhibitors of growth, their benefits and cost, and the challenges that lie ahead with the migration to next-generation networks. It will investigate the changing roles of mobile and fixed-line communications with regard to substitution and complementation, how the changes can be measured, and what may be indicators for a

changing telecommunications paradigm. The subsequent sections will assess the implications for policy and regulation. As well as a discussion of different policy objectives, the issues of spectrum and numbering management, universal service policies, competition policy and interconnection for mobile communications, international roaming, pricing and billing models, privacy, consumer and data protection and regulatory reform will be considered. Finally, the possible future role of ITU in the changing ICT landscape will be discussed.

2 Trends in mobile communications

2.1 Drivers and inhibitors of growth

Mobile communications have seen unprecedented growth rates in recent years. In the early 1990s, a mobile phone was still perceived as an optional extra, or even as a luxury, and mobile communications were mainly targeted at business customers. But with the subsidization of handsets, the lowering of tariffs, and the introduction of prepaid models, mobile communications have developed into a mass market. Today, mobile services are sold like any other commodity at kiosks or retail outlets. The mobile phone may be the only access to telecommunication services in countries with a low fixed-line penetration. Elsewhere, it can be the preferred telecommunication service that offers ubiquitous access to personal communication services for roaming customers, or it is simply more convenient even for those who have the choice of using a fixed-line connection.

Throughout the mobile communications market lifecycle, different drivers and inhibitors of growth have interplayed. They are changing as the market is maturing. Wireless carriers have accelerated growth in a competitive landscape with cross-subsidizations of end-user devices and differentiated tariff systems. As saturation levels are getting closer, interconnection agreements at the wholesale level and pricing plans at the retail level may become the key inhibitors to further growth.

2.1.1 Competition, subsidization of handsets, and prepaid models

In the mobile market arena, a number of competing players have been offered licenses for operating a cellular network in almost all countries. The challenges of liberalization and privatisation of fixed-line markets that have historically been dominated by state-owned incumbents do not apply to mobile markets to the same extent. As a consequence, there has been very little regulation in the industry. Competition and market forces have fostered a rapid diffusion of mobile communications.

Box 1: Too much competition? Mobile handset subsidies in Korea

In the Korean mobile services market, competition was first introduced when Shinsegi Telecom joined the market incumbent Korea Mobile Telecom (renamed SK Telecom in 1997) in 1996. In October 1997, three new competitors were introduced into the market: KT Freetel, LG Telecom and Hansol PCS (later renamed as KTM). With the five competitors in the market, competition for subscribers was aggressive with generous handset subsidies being offered. At the end of 1998, the total value of handset subsidies totalled US$ 1.9 billion.

In February 1999, the "Korean National Parliamentary Hearing on the Economic Crisis", critically debated the policy of allowing five mobile service providers to compete in the confined domestic market. The excessive amounts of handset subsidies were highlighted as a possible risk to the continued financial viability of the companies. In April 1999, the Korean Ministry of Information and Communications decided to intervene to restrict handset subsidies to US$ 125 per subscriber and to ban obligatory subscription periods, largely in the aim of securing profitability and improving management among mobile service providers. The growth in mobile subscriptions fell for the two consecutive quarters following the effective date of the ban in June 2000.

A series of mergers and acquisitions during the same period have reduced the number of mobile service providers in Korea from five to three. In October 2002, the Korean operators were each given heavy penalties for continuing to subsidise handsets.

Source: ITU Competition Policy in Telecommunications Workshop Background Paper, 2002.

Mobile customers are willing to make an upfront investment for the mobile handset, very similar to investments in other information and communication technologies such as television sets or PCs. However, cross-subsidization through wireless carriers (see Box 1), the miniaturization and widespread availability of

handsets have led to a diffusion of mobile phones that exceeds that of fixed-line telephones, PCs and even TV sets.

In developed countries, prepaid plans have pushed mobile into a mass market. The rationale for wireless operators was to enlarge their customer bases as fast as they could in order to benefit from positive network externalities. Financial markets rewarded fast-growing customer bases that were expected to be turned into future mobile data customers and therefore revenue drivers. Prepaid mobile attracts young people with low budgets, parents who want to remain in control over their children's telephone expenses, or those who purchase a mobile phone for security reasons.

However, the biggest benefits of prepaid plans are unfolding in developing countries. In rural areas that have been inaccessible for fixed-line infrastructure or simply underserved, in countries where the waiting periods for a fixed-line connection are high and where the majority of the population does not have the credit-worthiness to qualify for a fixed-line connection, prepaid has significantly enhanced access to basic telecommunication services. In areas where not even public payphones are easily available, the mobile prepaid phone has effectively turned into a portable private payphone. Initiatives to provide mobile public payphones as part of licence conditions for mobile operators are being introduced in some national markets, for example in South Africa.

The social use of mobile tends to be valued highly even in low-income parts of the population. People with no steady or very low income value the availability of a communications device so much that they are spending a substantial amount of their disposable income on mobile. Typically, households spend about two per cent of their monthly expenses on communications.[1]

Economic and technological parameters have determined the initial growth of mobile. It is the social use of mobile communications that may evolve into the main driver in mature and saturated markets.

2.1.2 Interconnection and pricing models

Termination charges for fixed-to-mobile calls as well as for international roaming, which translate into high prices for customers, are a particular concern at the wholesale level. Mobile interconnection agreements have not been subject to regulation, although competition policy concerns have been addressed in this context. However, competition authorities, such as the Directorate General for Competition of the European Commission, are currently assessing potentials for dominant market power, excessive pricing and joint dominance of mobile operators with regard to termination charges.

In most countries across the world, termination on mobile networks is significantly more costly than termination on fixed networks. In fact, there is higher cost due to localizing the originating caller. Cost-based interconnection charges as demanded in the WTO Reference Paper[2] do not seem to apply in mobile markets. However, excessive interconnection charges can be cited as a serious inhibitor to future growth of national and international traffic in mobile networks.

High prices for mobile customers also inhibit further substitution of mobile for fixed and are an obstacle to increases of scale effects in average revenues per user (ARPU). Price sensitivity of consumers has led to shorter calls being made on mobile phones than over fixed lines, and a general cautiousness in the use of mobile phones. Experience from receiving party pays (RPP) regimes, e.g. in the United States, indicate that consumers are wary of switching their mobile phones on or using them at all when they fear overspending. These implications of price sensitivity counteract some of the benefits of mobile communications, such as ubiquitous availability, limit the growth potential of mobile traffic and—ultimately—stifle revenue growth.

Understandably then, whereas access to mobile communications in developing countries has grown tremendously, its actual use is limited by the high prices that are charged. Ironically, prepaid customers who are often at the lower end of the income scale pay higher prices for the use of their mobile phones than subscribers who can choose subscription and tariff plans that suit their communications behaviour best. In developed countries, a subsidization of subscriptions through prepaid may be appropriate. In developing countries however, such pricing plans inhibit further growth in traffic volume. Mobile operators' strategic approaches to pricing prepaid services may, therefore, inhibit an increase in bargaining power for interconnection agreements with national competitors and for international gateway access.

2.2 Benefits and cost of mobile communications

The benefits of mobile communications have come into effect on macro-, meso-, and micro-levels. Mobile markets, nationally and internationally, have benefited from the entry of a range of new players, from operators to equipment manufacturers and application service providers. Governments have benefited from revenues raised via auctioning scarce spectrum. Companies are re-engineering business processes along the value chain in order to realize efficiency gains through the use of mobile technology, and individuals enjoy ubiquitous always available ICT infrastructure that is gradually transforming public and private life.

However, high licensing costs have contributed to the debt load of mobile operators and to an overall downturn in the telecommunication industry; regulatory authorities are facing changes and challenges due to new regulatory approaches towards the mobile communications industry and its relation to fixed-line operators; an increase in mobile communications may lead to a decrease in investment into wired infrastructure; and consumers are raising concerns regarding health and environmental issues, including problems relating to social etiquette for the use of mobile phones in public places.

2.2.1 The perspective of the developing world: rural access

Rural access to telecommunications has always been a special concern in considerations with regard to the missing link as observed in the Maitland Report of 1984 and on narrowing the digital divide. In 2002, ITU's World Telecommunication Development Report[3] predicted that mobile communications would be the missing link, at least for basic access to telecommunications. Box 2 describes some of the benefits of mobile competition in the developing world, based on experience in Africa. In fact, developing countries have benefited over-proportionally from cellular infrastructure that is fast and comparatively cheap to install and to operate. Since it is still expensive for an individual to purchase a handset, new solutions are being developed such as mobile phone sharing in communities or new business developments around mobile payphone management.

Box 2: Access to basic telecommunication services in Africa

The benefits of mobile competition

One big door-opener to the development of access in Africa was undoubtedly the introduction of cellular telecommunications, which allowed private entrepreneurs onto the telecommunication scene for the first time. By 2001, more than 90 per cent of African countries had adopted cellular telecommunications compared to just 18 per cent in 1993.[4]

Research on the determinants of the diffusion of mobile telecommunications in Africa suggests that competition is the driving force behind the rapid mobile expansion in Africa, supported by network digitization. Research also tends to indicate that the presence of an incumbent-owned cellular operator has a negative effect. However, privatisation of the incumbent fixed-line cellular operator mitigates that effect. In Africa, about 44 per cent of cellular markets have a duopoly, only 26 per cent of the markets are monopolies. The tendency in Africa is to issue nationwide licences.[5]

Against the unsatisfactory background of telephone infrastructure in both fast-growing urban as well as rural areas, competition from mobile operators also brings benefits for the development of fixed-line infrastructure. In the case of Côte d'Ivoire, for example, fixed-line penetration increased in areas where the operator faced competition from mobile providers.[6] This is also consistent with findings from Senegal: fixed-line penetration increased in areas where the operator faced competition from a mobile provider. Here, granted fixed-line exclusivity to the incumbent operator may be questioned in the future.[7]

Source: ITU Research.

Wireless solutions from multi-access radio to cellular to fixed-wireless have advantages over wired solutions because of lower cost and the speed and ease of deployment. Laying cables, managing and maintaining them is not necessary to overcome the last mile problem, for instance. However, costs for wireless infrastructure can be underestimated when there are needs for special equipment such as towers or solar power systems, particularly in rural and remote areas. The decision on what wireless solution may be best to deploy is dependent on the distance from the customers to the main network (long distances may require satellite solutions) and the potential customer density.[8]

In rural areas where mobile is the only available alternative for telecommunication access, incentives for the roll-out of wired infrastructure decrease. Among the consequences may be a lack of Internet access

capabilities that may only be compensated for by installing VSATs. The provision of Internet services via satellite is a more expensive option that takes away some of the benefits of the cellular communications infrastructure.

2.2.2 The perspective of the developed world: alternative access and international roaming

In developed countries where most people have access to both a fixed-line telephone as well as a mobile phone, mobile communications have become an alternative to local and long-distance services. Calls increasingly bypass fixed networks. For example, in the United States, bulk pricing plans offered by wireless carriers and pricing plans that include calls from coast to coast lower barriers to the use of mobile phones as the main telephone access device. In markets that charge for local calls, mobile may also contribute to increasing competition in local markets.

Problems with patchy coverage and dropped calls have influenced customer satisfaction with mobile voice services. This still poses significant challenges even in urban areas. International roaming has been envisioned as one of the main benefits of mobile communications, but the benefits have not been fully unlocked owing to high charges and the significant cost still borne by customers.

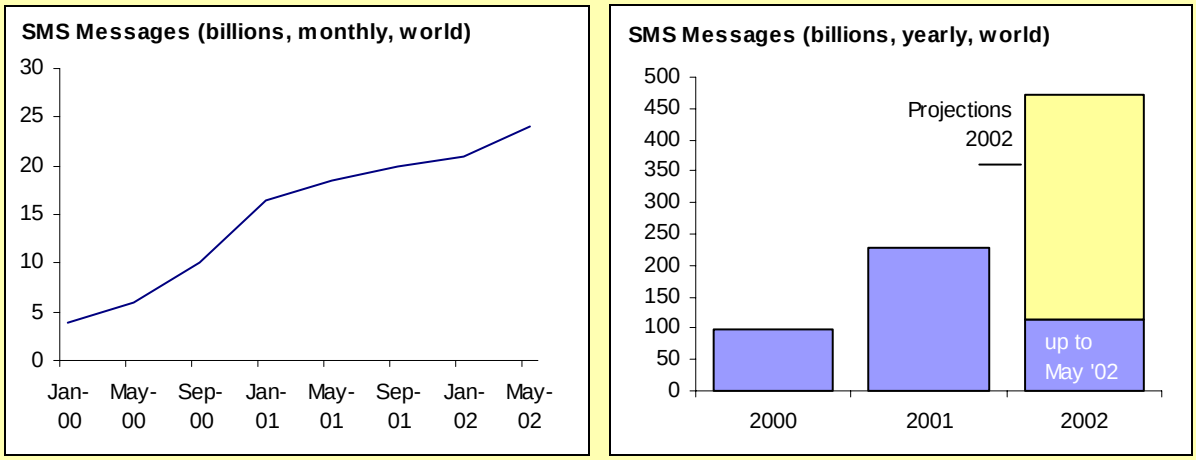
Health and environmental concerns are perceived to represent part of the social cost of mobile communications. The effects of electro-magnetic fields from antennas, base stations, and handsets, and their interaction with other electro-magnetic fields that surround us every day are still unclear.[9] Governments are dedicating funds to research on the effects of electro-magnetic fields in order to meet the concerns of their citizens. Some municipalities, in Germany for example, have been protesting against base stations installed on residential rooftops or hidden in church towers, and are prohibiting the installation of new base stations.

Recently, attention has been paid to growing waste problems with mobile phones that are not in use any more. The heavy subsidization of mobile phones has led to an inflation of the device. Mobile phones that are simply thrown away constitute toxic waste that is increasingly detrimental to the environment[10].

2.3 Migration to next-generation networks

The promise of a global standard that allows for international roaming, but particularly for innovative mobile data services has driven migration from current second-generation (2G) to third-generation (3G) networks. Neither is an easy task. Mobile data services have been introduced in 2G networks with short message service (SMS), which has caught on like wildfire in many parts of the world, and—paradoxically—may even have helped to delay migration to 3G data applications (see Figure 2).

Figure 2: Worldwide SMS growth
Billions of messages sent worldwide, monthly and yearly



Source: ITU Report Internet for a Mobile Generation, 2002; GSM Association.

2.3.1 From a pure voice model to a hybrid voice and data model of mobile communications

The concept of mobility has created economic and social value for voice services. Yet, for data services these values are assumed rather than demonstrated. The most experienced mobile data markets are in the Asia-Pacific region. In Japan and Korea, mobile data applications have been widely adopted (see the example of Korea in Figure 3). In Japan, many people are having their first experience with the Internet via the mobile phone. In Korea, 3G services are growing in popularity and have transformed the relation between voice-generated revenue and data-generated revenue.

However, in most regions of the world extensive mobile data usage has not yet been demonstrated. Entertainment services such as mobile gaming are among the most popular applications. However, location-based services that try to add value to data services—thanks to the fact that mobile communications allow roaming—are still in their early stages of development.

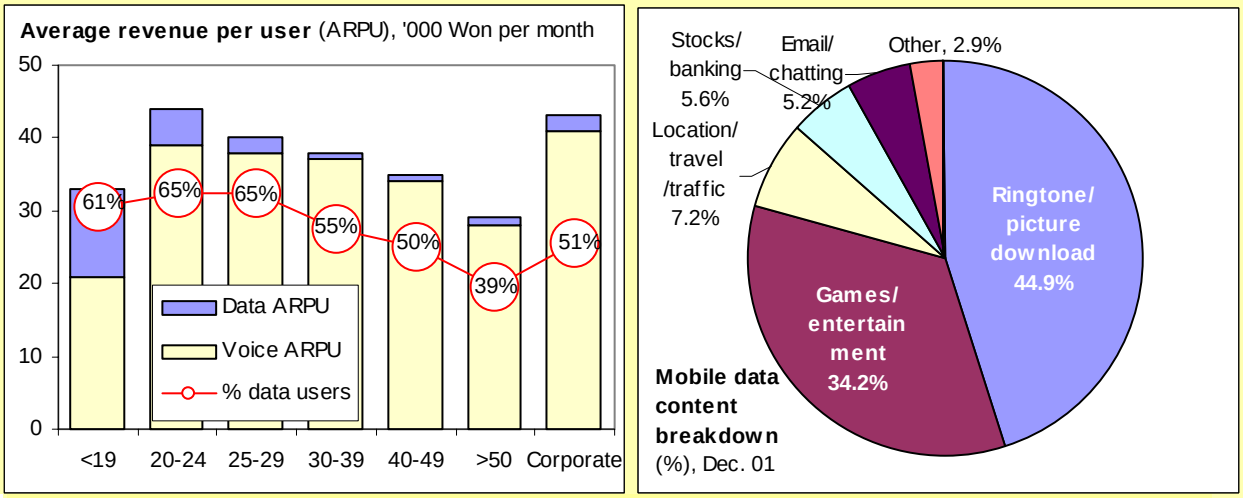
2.3.2 Challenges for mobile data communications

In its transition to increase the delivery of data services, switching technology has moved from circuit-switched to packet-switched, helping to make always-on services possible. However, various challenges remain such as the interconnection to IP networks, billing of services, or handset constraints such as battery power and low storage capabilities.

Among the technological drivers of the migration to next generation networks software radio is one of the emerging technologies that has important implications for the cost of building and operating networks. By moving radio functionality into software that has previously been implemented in hardware, software radio promises to change the economics of deploying and operating wireless networks, for example for implementing secondary spectrum usage models.[11]

However, technological challenges regarding the build-out and operation of 3G networks, lack of availability of 3G handsets, and lack of innovative data services contribute to the plethora of challenges associated with the migration to next-generation networks. So too do the high auction prices paid in some countries for 3G licences, that left some operators reeling financially.

Figure 3: Mobile data usage patterns in the Republic of Korea
Data from SK Telecom on average revenue per user (ARPU) by age group and breakdown of content use



Note: "Other" content, in right chart, includes news/sports (2.0%), e-books/education (0.6%) and e-lottery/shopping (0.3%).
Source: ITU Korea Case Study, 2002; SK Telecom.

Technological challenges also lie in network security, enhancing positioning technologies, e.g. for emergency communications, and in the interoperability of different 3G standards. Aggregation and pricing strategies, such as the question of volume- versus value-based pricing, pose economic challenges. Privacy and health concerns fall into the domain of social concerns, and are also presenting challenges. Among regulatory challenges are developments in spectrum policy, potential regulation of interconnection, the development of the numbering system that allows for mapping of telephone numbers into the Internet, known as ENUM[12], and ensuring open access to mobile data.

3 The changing roles of mobile and fixed-line communications

3.1 Substitution or complementarity?

Substitution of fixed-line services by mobile is a two-edged phenomenon. In countries that lack an extensive wired infrastructure, mobile 'substitution' is the result of a lack of supply. In other words, mobile communications are the only means of access to a telephone. Fixed-line services, e.g. for the provision of Internet services, may be adopted when they are available. However, in countries with wide coverage of fixed-line communications, mobile substitution is the result of demand-side substitution. In this case, the consumer perceives both forms of access with the same benefits and similar costs which allows for subjective substitutability capability.

It is interesting to note that, in other areas of ICTs, substitution is a very rare phenomenon. Television has not substituted for the radio, the Internet has not substituted for television. They are perceived as complementary services and they serve different needs in different situations. Yet, when a new technology is emerging, the roles of the existing technologies typically change; consumers also tend to divide their budget differently for ICT expenses.

Mobile and fixed-line communications can serve different needs in different situations as well (see Box 3). Moreover, the price premium for mobile services tends to inhibit mass substitution. This suggests that mobile and fixed remain complementary although their roles may change significantly. However, in markets such as Finland or the United States, customers are increasingly 'cutting their cords' and relying on mobile only. Where cable operators offer attractive conditions for the provision of broadband, the only reason for keeping a fixed-line connection may be for international long-distance services.

Box 3: Consumers' use of mobile telephony

Impact of mobiles on the use of fixed phones

In the United Kingdom, the national regulator Oftel's quarterly residential consumer survey conducted in February 2002 suggests that convenience remains the main reason for selecting mobiles rather than fixed phones. A quarter of customers said they use their mobile when their fixed phone is being used by someone else.

Mobile customers with Internet access at home tend to spend more on their monthly bill as their Internet usage increases, suggesting that some of these consumers may be using their mobile to make calls when their fixed phone line is connected to the Internet.

Source: Oftel, 2002.[13]

For a deeper analysis of the trends of fixed-mobile substitution, three different levels can be identified: the relationship of fixed to mobile in terms of subscribers, traffic, and revenue. Furthermore, since many of the benefits of fixed-lines lie in the provision of high-speed broadband services, the fixed-mobile relationship in data is also worth consideration. These points are discussed below.

3.1.1 Fixed-mobile relationship in subscribers

As outlined in chapter one, mobile subscribers outnumber fixed-line subscribers, and an increasing number of mobile-only households is emerging. In Finland, the socio-demographics of mobile-only users show that students or people from lower income classes are the most likely to decide to 'cut their cords'. Interesting trends have been revealed by surveys which show how mobile and fixed usage varies according to needs and uses of different subscriber categories (see Box 4).

Box 4: Fixed-mobile substitution user characteristics

Categories according to the combination of telephony services that users subscribed to

In March 2000, British Telecom released a report on fixed-mobile substitution based on a survey in February 2000 that analysed the substitution in lines and in calls. Within the report, users are divided into five categories, according to the combination of telephony services that they subscribe to. The key characteristics found in the survey are:

Single fixed-line users: Respondents without mobile, especially single fixed-line users, are disproportionately elderly or retired.

Multiple fixed-line users: Personal Internet usage is driving demand for multiple lines.

Single fixed and mobile users: In households with a single fixed-line and a mobile phone, the fixed line is used for Internet data traffic and encourages the migration of voice onto mobiles; mobile users are less likely than non-mobile users to answer a fixed line.

Multiple fixed and mobile users: Secondary fixed lines are associated with fax and Internet access.

Mobile-only users: The proportion of mobile-only respondents living in a single person household has increased; mobiles are becoming increasingly attractive to lower income groups; prepaid phones may be driving rapid growth in mobile use amongst the poorest social groups.

Source: Econ Report for BT, 2000.[14]

Research from the Republic of Korea suggests that a one per cent increase in the number of mobile phones results in a reduction of 0.1 to 0.2 per cent in new fixed connections and a 0.1 to 0.2 per cent increase in disconnections.[15] Mobile cellular has become the primary access network, but it does not necessarily mean that it is used more heavily than fixed-line.

3.1.2 Fixed-mobile relationship in traffic

Research also shows that mobile calls tend to be shorter than fixed-line calls. When mobile communications evolved into a mass market, a number of subscribers only decided to buy a mobile phone for security reasons or to use it passively to be available for incoming calls. However, mobile traffic has seen the highest growth

rates in national and international traffic over recent years (see Box 5). In the case of mobile-to-mobile calls, fixed networks are circumvented entirely.

Box 5: International traffic to and from mobile phones

Traffic analysis

International traffic contributes considerably to the average revenue per user (ARPU). The more international traffic is terminated to mobile handsets, the greater payments international carriers must make to mobile operators. As mobile-originated international traffic grows, mobile operators become more valuable customers of wholesale services.

In 2001, mobile-originated traffic grew from 14.5 per cent of total international traffic to 15.7 per cent, while mobile-terminated traffic rose from just over 18 per cent to 21 per cent. Over the past years, international mobile traffic has grown much faster than total international traffic, although the growth rates have slowed persistently, reflecting the development in mobile subscribership.

From 2000 to 2001, the volume of international traffic originated on mobile phones grew from 19.2 billion to 22.6 billion minutes. Europe accounts for the largest volume of any region with almost 14 billion minutes of international long-distance traffic originated on mobile handsets. Mobile-terminated traffic grew from 25.6 billion minutes to 34.2 billion minutes. Again, European users receive the bulk of mobile-terminated traffic with a 56 per cent share of the world's total.

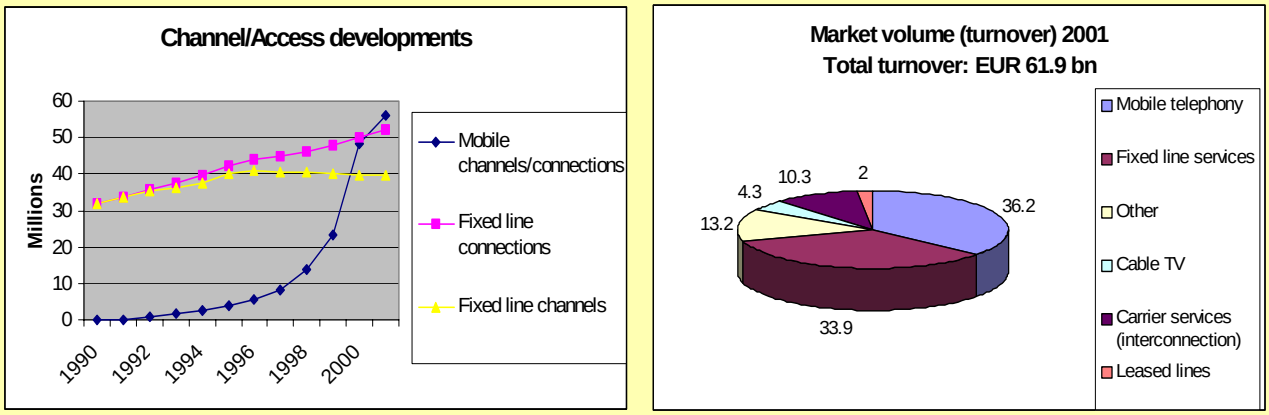
The increasing amount of mobile terminated traffic has made mobile termination costs a serious concern for international carriers, consumers, and national regulatory authorities (NRA). The high termination costs result in a significant differential between retail and wholesale prices for calls to mobile phones in comparison to calls to fixed networks. Wholesale rates can serve as a proxy to illustrate the economic effects of terminating international traffic on mobile networks. Mobile traffic contributes disproportionately to the total cost of termination. In Europe, for example, though mobile calls account for only 30 per cent of all incoming international traffic, they represent 67 per cent of the total cost for terminating international traffic.

Source: Telegeography, 2003.[16]

3.1.3 Fixed-mobile relationship in revenue

Mobile revenues are still lower than fixed revenues, but they are expected to overtake the latter by the end of 2004. This dimension of mobile overtakes fixed may become the most significant one. Once mobile operators create higher revenues than their fixed-line counterparts, their bargaining power, e.g. in interconnection negotiations, will increase substantially. Figure 4 shows the status of mobile and fixed turnover in Germany in 2001.

Figure 4: Mobile overtakes fixed in turnover
In Germany, mobile turnover exceeded that of fixed line services in 2001



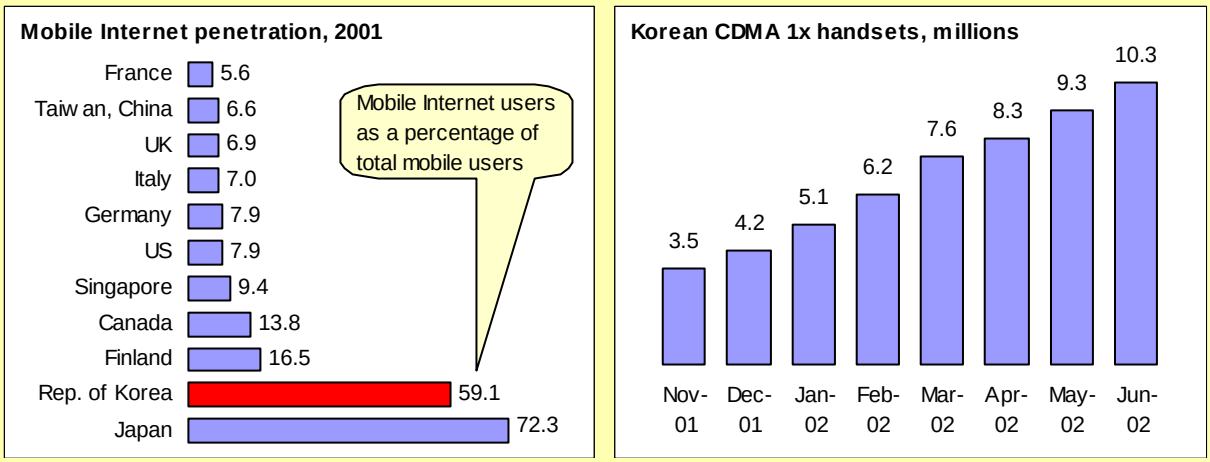
Source: RegTP, 2002.[17]

Mobile revenue had already overtaken Internet-generated revenue as early as the 1990s—a development that is key signal for providers of digital data services. Currently, the volume of Internet data traffic is a multiple

of the data traffic via mobile networks. However, mobile may develop a more important role concerning data revenue. The promotion of broadband access suggests that fixed-line delivered data, also in the form of wireless connectivity via wireless local area networks (WLAN), will further grow and carry the bulk of data traffic. However, the opportunities for mobile data lie in personalized data that adds value and unlocks payment reserves.

The volume of SMS sent between mobile phones, the Internet and mobile phones, and fixed-line telephones and mobile phones, has increased steadily until today. Although SMS are not clearly classified as either data or voice services, SMS revenue is typically categorised under data revenue. SMS in some cases substitute for voice calls, e.g. in the Philippines where the price of an SMS is less than that of a phone call. In Europe, many mobile content services are based on SMS, which suggests that SMS will likely remain an essential mobile data service.

Figure 5: Ahead of the pack
Mobile data usage in Korea, compared with other selected economies (left) and over time (right)



Note: The number of mobile data users equals the number of suitably-equipped handsets, because there are no subscription payments required for the CDMA 1x service.
Source: ITU Korea Case Study, 2002; MPHPT Japan (left), MIC Korea (right).

High illiteracy rates are one factor that may limit the use of mobile data in developing countries. This may be slightly counteracted by the fact that the availability of a device that enables access to the Internet while overcoming the lack of PCs or power supply can also be a boost for the production of relevant content, and for the development of educational development goals.

3.2 Indicators

The measurement of the fixed-mobile cross-over in all its dimensions—subscribers, traffic, and revenue—is an important task, but a difficult one. For instance, mobile phones correlate to individuals, who may possess one or more mobile phones, whereas fixed-line connections are related to households. What is even more difficult to capture in figures, is the fact that many users are using both options.

The actual definition of a mobile subscriber poses challenges due to a high percentage of pre-paid customers. This creates some distortions since there is no consistent agreement between mobile operators as to when prepaid customers are taken out of the statistics. Often, prepaid customers retain their status for three months after the expiration of their card and are still able to receive calls. The large number of prepaid customers and the fact that people tend to have more than one mobile phone may also contribute to the fact that, in Western European countries for example, mobile penetration is significantly higher than 100 per cent (see Box 6).

Regardless of all these challenges, indicators that describe the changing relationship between mobile and fixed-line communications are important for policy-makers to analyse sector developments, assess future trends and found strategic decisions on telecommunication policy.

Box 6: Mobile penetration beyond 100 per cent? Is it possible?

During 2002, the level of mobile penetration in Taiwan, China passed the figure of 100 per cent, meaning that there are more mobile phones than people. Hong Kong, China will probably pass that point soon, too. The theoretical saturation point ought to be around 85 – 90 per cent, assuming that some children are too young to have a mobile phone, some people (like prisoners) would not be allowed to own one, and a small minority of citizens would not choose to own one. Even allowing for extraneous factors, like tourism or migrant workers, there should be some sort of limit. But nevertheless, mobile phone ownership, even in the most advanced economies, continues to grow.

There seem to be several factors at play in economies like those of Taiwan, China, which seem to be surpassing the supposed saturation point:

- An individual user may own more than one mobile phone (e.g. one for home use and another for business);
- An individual user may own more than one mobile service account, especially in environments like Taiwan, China, where prepaid is popular;
- Mobile phone service providers may have different policies on when a prepaid account is no longer considered to be active. Thus, there may be some double counting of subscribers.

In the longer term, though, the "saturation" rate may prove to be illusory. In the future. families may own dozens of devices with mobile communicating ability built in. We are entering an era of pervasive computing and communications in which the majority of calls will be made from one machine to another. Mobile communicating devices will be used in a wide variety of fields, from healthcare, to personal security, to lifestyle convenience. Again, it is likely to be the Asia-Pacific region that will lead the way, as it is already doing in other aspects of the mobile Internet.

Source: ITU Asia-Pacific Telecommunications Indicators, 2002.

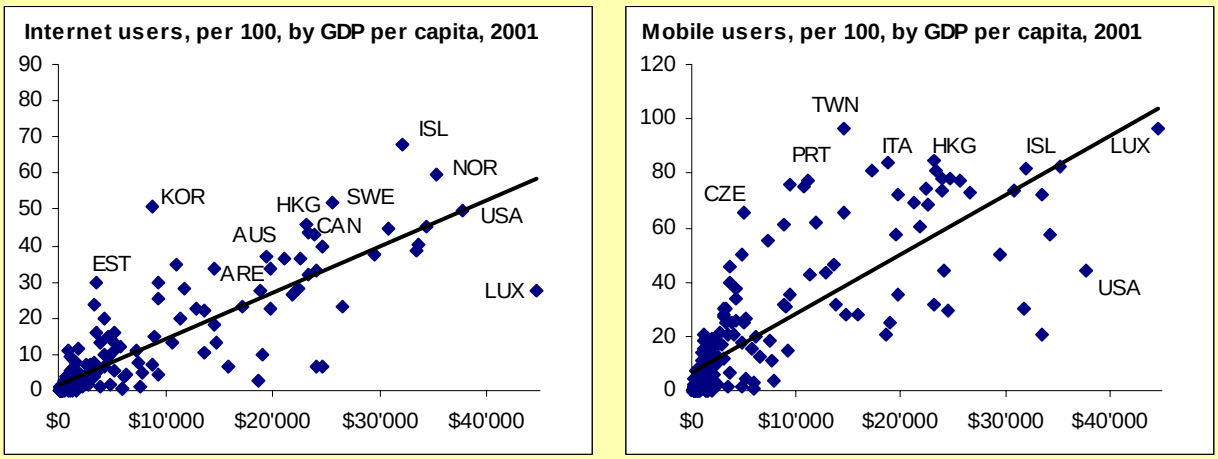
3.2.1 Basic indicators

Basic indicators used in ITU statistics include *total telephone subscribers* which refer to the sum of main telephone lines and cellular mobile subscribers; *cellular mobile telephone subscribers* which refer to users of portable telephones subscribing to an automatic public mobile telephone service using cellular technology that provides access to the PSTN; *cellular tariffs* which show the cost associated with connection (one time charge), monthly subscription (recurring fixed charge), and a three-minute local peak and off-peak call; *mobile communication revenue* that includes revenues from the provision of all types of mobile communications services such as cellular, private trunked radio, and radio paging; and a *mobile phone basket* is computed using the monthly subscription rate and 90 minutes of service which are comprised of 30 three-minute calls during peak hours.[18]

3.2.2 Indicator developments

The penetration of ICT services compared to the income level of the country as a whole may become one indicator to illustrate the extent of the digital divide between countries. Figure 7 shows Internet and mobile users per 100 people, according to GDP per capita.

Figure 7: Where does money make a difference?
Internet users and mobile users, by GDP per capita, 2001



Source: ITU Report Internet for a Mobile Generation, 2002.

Indicators that are capable of measuring community connectivity, i.e. access to mobile and fixed-line communications on a community level are gaining importance in the discussions around narrowing the digital divide. For mobile, for example, the number of mobile payphones available in villages, e.g. through the initiatives of micro-loan programmes, can be measured (see Box 8).

Box 8: Mobile payphones for rural access

Access to information and communication technologies is regarded as crucial to economic development because of three primary reasons: (1) they increase the efficiency and global competitiveness of a country as a whole; (2) they create new sources of income end employment for poor populations; and (3) they enable better delivery of public services such as health and education.[19]

Mobile payphones are a key access tool that can be shared and improve the connectivity of a village. The use of cellular phones as village mobile payphones has been demonstrated in many countries. An innovative example is the introduction of mobile payphones in Bangladesh, enabled by Grameen Bank's micro-loan programme. Grameen Phone's target is to install at least one fixed cellular phone in each of Bangladesh's 68,000 villages based on micro-loans to low-income market segments. Approximately 1,100 mobile village phones have been franchised to private operators that had to be female. However, such developments still only represent marginal rather than radical change. When telecommunications services are accessible, there is usually much more affordability among rural people to use these services.[20]

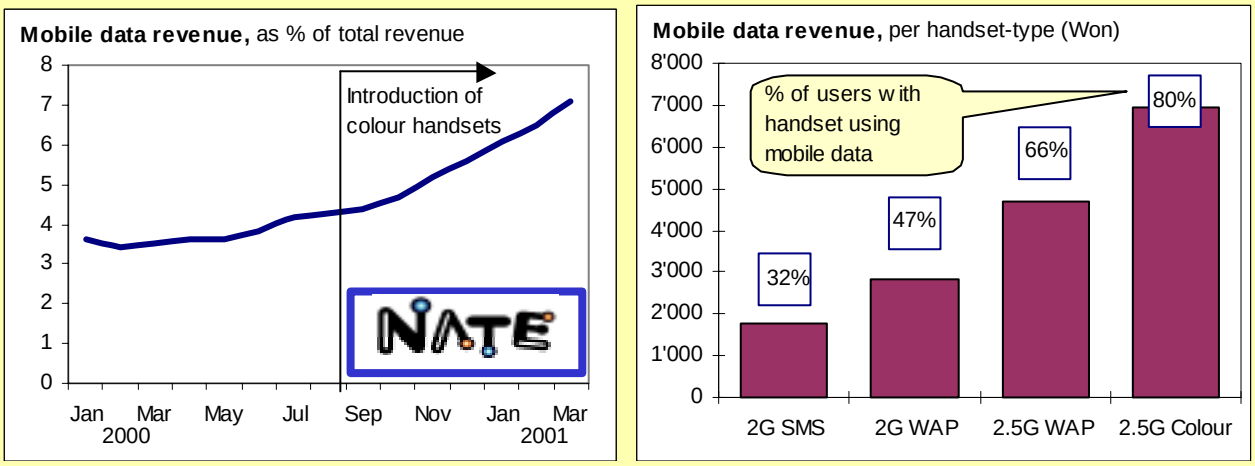
A survey in 1998 evaluated the Grameen Village Payphone Initiative. It showed that the extremely poor seem to use phones chiefly for economic purposes (54 per cent of all their calls). Another study in 2000 found that telephone usage was for financial matters with family such as remittances (42 per cent) and social calls to family and friends (44 per cent).[21]

In India, 3,000 village-based 'mobile payphones' operate as personal revenue-sharing businesses promoted by cellular operator Koshika Telecom. Other Indian cellular operators are also developing mobile payphone businesses. In other countries, such as Uganda and South Africa, cellular-based phone shops are in operation, some are franchised businesses, such as 'Mr. Phone' in South Africa. In Botswana, mobile operators are obliged to install 500 public phones each in rural areas.

Source: ITU Research.

Indicators that measure the use of mobile data are still rare due to lack of available or reliable data. Some Asia-Pacific regulatory authorities have, however, set a precedent that others could usefully follow in gathering and publishing such information (see Figure 8). For future measurements of the development of mobile communications, such indicators will, in any case, be increasingly important.

Figure 8: Growing the mobile data market
SK Telecom's revenue from mobile data, as a percentage of total data (Jan 2001 – March 2002) and by type of handset, March 2002 (in Korean Won)



Source: ITU Korea Case Study, 2002; SK Telecom.

3.3 Towards a new telecommunications paradigm?

The roles and functions of mobile and fixed-line telecommunications are changing and shaping a new order in the telecommunication industry. Mobile has already overtaken fixed in terms of subscribers, but may become more important in terms of traffic and revenue as well. This trend could imply that the bargaining power of industry players in a competitive landscape is shifting towards mobile operators.

This naturally has implications for fixed-line operators, who are now having to face competition from new entrants in local, national and international long-distance telecommunications and Internet markets, as well as substitution from their mobile counterparts. While many incumbent operators still have significant influence in mobile markets, a new balance between mobile and fixed will affect them. It will also affect the competing entrants, suppliers of equipment, and customers.

Liberalization, privatization, the widespread establishment of regulatory authorities and international agreements on telecommunication basic services (as established in the World Trade Organization Reference Paper) have significantly altered and developed the telecommunications industry in the past two decades. The introduction of competition in telecommunications has brought about a paradigm shift. With further developments of the fixed-mobile cross-over, the telecommunication paradigm may shift again. Policy makers and regulatory authorities are now confronted with addressing these changes; revising telecommunications policies; and assessing the need for regulatory intervention.

4 Implications for policy and regulatory objectives

4.1 Policy and regulatory objectives

The formulation of policy and regulatory objectives is a precondition for setting policies. In telecommunications, some of the widely accepted objectives are to:[22]

- promote universal access to basic telecommunication services;
- foster competitive markets to promote efficient supply of telecommunication services, good quality of service, advanced services and efficient pricing;
- prevent abuses of market power such as excessive pricing and anti-competitive behaviour by dominant firms;
- create a favorable climate to promote investment to expand telecommunication networks;
- promote public confidence in the telecommunication market through transparent regulatory and licensing processes;

- protect consumer rights, including privacy rights;
- promote increased telecommunications connectivity for all users through efficient interconnection arrangements;
- optimize use of scarce resources, such as the radio spectrum, numbers, and rights of way.

The changing environment does not actually alter these objectives *per se*, but it does entail changes in the means of achieving them. In an era of convergence and interchangeable technologies, some institutions, such as the European Commission for example, have changed their approach to reach these objectives to a technology-neutral regulatory approach.

It is notable that divergent opinions often do not concern the objectives but the means to reach them. The view that asymmetrical regulation as adopted for fixed-line telecommunications is not appropriate for mobile is widely accepted. However, there are differing opinions on the question of whether the mobile industry should be regulated at all. Some argue that there is sufficient competition to let market forces develop freely. Others argue that there is market failure and a rationale for regulatory intervention in mobile markets, for example at the wholesale level concerning fixed-to-mobile termination rates.

4.2 Absolute and relative relationship of fixed and mobile, and directions of growth

The fixed-mobile cross-over is a relative relationship. Absolute numbers can look quite different, even when the relative numbers are very similar. Two of the first countries where mobile overtook fixed, Cambodia (in 1993) and Finland (in 1998), are a good example as they present a similar relative ratio, but absolute teledensities that lie at opposite ends of the spectrum. Based even on this much information, policy and regulatory objectives will obviously have to be quite different for these countries, in spite of the fact that the same phenomenon has taken place in statistical terms.

Directions of growth are equally essential for the assessment of policies and regulations. In developing countries, the diffusion of cellular infrastructure may be an inhibitor to growth in the wireline infrastructure. This may not be desirable with regard to providing Internet access. Some regulators place conditions on mobile licences, such as the requirement that mobile operators build out fixed infrastructure as part of the licence conditions (see Box 9).

Box 9: Conditions for mobile licences

Lessons from rollout requirements

There are more and more examples where licences for mobile services have inbuilt rollout requirements. In the Philippines, mobile operators must provide fixed or semi-fixed wireless lines; in South Africa, mobile operators must provide public payphones; in Morocco, the second GSM licence included build-out requirements in rural areas.[23] The specificities of such requirements can be central to the results that are achieved. In the Philippines for example, the location for the roll-out targets were not specified, with the result that operators concentrated on areas and customers with high potential returns that may have attracted other investors as well. Conversely though, overly demanding fixed build-out obligations that are imposed on mobile operators in this manner may be counter-productive, possibly leading to unused capacity and inefficient use of spectrum.

Cellular operators are increasingly expanding their services to include fixed when, for example, focusing on the rollout of services to rural, remote, and low-income areas. Examples of this development can be found in Ghana (Western Wireless), Uganda (MTN), and Venezuela. When cellular operators get the option in their licences to provide fixed-wireless services within their operating areas this may allow them to serve rural areas at an incremental rather than at full cost. It may become one strategic direction in order to address the gap in urban and rural access in developing countries.[24]

Among lessons learned from previous regional concessions are: the benefits of packaging lucrative areas with higher-cost areas in order to attract investors to balance network expansion; technology neutrality of the services that are bundled under one licence; and preferential access to scarce resources such as the allocation of frequency spectrum free of charge in rural areas.[25]

Source: ITU Research.

In developed countries, mobile growth rates have been slowing down, but more interesting is a decrease in fixed lines in some countries. Fixed-line installations are subject to cycles, typically increasing when consumers request second lines, or when a lot of new businesses are emerging. From the business customer

point of view, this can change in times of economic slowdown or recession. However, a steady increase in mobile-only customers and a decrease in fixed-line customers will certainly have to play a part in policy and regulatory considerations.

4.3 Maturity of telecommunication markets and the effects on policy objectives

Experience has shown that emerging markets often develop best in a competitive environment that is characterized by very little regulatory intervention. Asymmetrical regulation can be applied in order to protect immature markets and give them the opportunity to evolve.

The maturity of the market affects such factors as market definitions and remedies for anti-competitive behaviour. In turn, market definitions influence the assessed level of maturity. In an intermodal comparison, mobile communication markets do not appear as mature when compared with their wireline counterparts. From an *intra*modal perspective however, 2G markets are highly mature compared to 3G markets.

For the remainder of this paper, implications the fixed-mobile cross-over based on policy and regulatory objectives will be analysed from three different perspectives: the relationship between governments and operators—and implications for spectrum policies, numbering management, as well as universal service policies; the relationship between operators and their implications for competition policy; and the relationship between operators and consumers and the implications for pricing and billing, privacy, and consumer and data protection.

5 Changes in government policies for mobile overtakes fixed

5.1 Spectrum management

Scarcity of spectrum has always affected competition in mobile communications because it limits the number of players that can operate in a given mobile market. Licences for the operation of a cellular network grant certain property rights. Recent proposals suggest sharing and trading of these property rights.

Licences can be awarded in different ways, including a process of relative comparison (“beauty contest”) or by auction. Conditions attached to licences ensure that certain universal service criteria are met. In developing countries, licence conditions for cellular networks often include conditions relating to rural access or fixed-line services.

Spectrum licences can cover certain regions of a country or allow for nationwide coverage. In countries as diverse as Chile, India, or the United States, regional licences have been inhibitors to providing a national footprint and to allow roaming for customers. In cases where the incumbent is the only provider with a national footprint, it is particularly difficult for the other operator to offer competitive services.

The notion of spectrum as a scarce resource is not undisputed. However, the issue of scarcity and associated issues are still the dominant rationale for governments’ spectrum management. Increasingly however, the benefits of unlicensed spectrum for wireless services are being perceived. The characteristics related to the provision of licensed services versus unlicensed connectivity, though, do not make for easy comparisons.

5.1.1 Diffusion of WLANs

Wireless local area networks (WLAN) are one way to provide wireless connectivity. A differentiated set of Institute of Electrical and Electronic Engineers (IEEE) standards has been developed in order to make use of unlicensed spectrum, e.g. in the 2.4 GHz and the 5.8 GHz frequency bands. One trend is clear: WLANs are spreading rapidly. They have developed from private WLAN on university campuses and office buildings, to include public WLANs (“hotspots”) in train stations, airport lounges, coffee shops and parks and free community networks that share their bandwidth in their respective neighbourhoods. WLAN Internet service providers can be any of the incumbent, fixed-line ISPs, mobile operators, or new businesses that act as intermediaries and aggregate WLAN connectivity. Even railway companies, banks, and retail stores are entering the WLAN ISP market, for example in Japan.

In the Asia-Pacific region in particular, a daily increase is occuring in WLAN hotspot announcements. In the United States, free community networks are reaching out to the wider population and are posing a threat to the business models of the providers, who calculate their charges for an individual rather than for a

community service. WLANs offer value to the user, and its unlicensed status allows for bottom-up rather than top-down innovation (see Box 10).

Box 10: Wi-Fi in Bhutan

Wireless connectivity for developing countries via WLANs

Wi-Fi, or Wireless Fidelity—local area networks using radio technologies based on the IEEE 802.11b or 802.11a standards—is generally thought of as a technology for mobile Internet users in developed economies. Wi-Fi is commonly perceived as wireless broadband for jet-setting business people, students and trendy dot-comers and hotspots are located in busy, urban places such as airports, college campuses and coffee shops. But Bhutan may prove this elitist image of Wi-Fi wrong. It is almost as though the predominant religion there, Bhuddism, extends even into communications: where "Gross Domestic Happiness" is as important as Gross Domestic Product: a source of delight for some, who appreciate the aspects of Wi-Fi that run counter to commercial and economic systems (Wi-Fi is often free, and typically operates in unlicensed frequencies). They have been helping Bhutan test the appropriateness of Wi-Fi technology in remote mountain villages.

Bhutan is probably one of the most difficult nations in the world to 'wire.' It is predominantly rural, with mostly mountainous terrain. Some 80 per cent of the population lives in around 6'000 villages—many without telephone service. The nation's telecom operator, Bhutan Telecom (BT), has been looking at alternative technologies for providing telephone service. Wi-Fi meets a number of BT's goals. It supports Internet Protocol (IP) that can both meet voice telephony needs (using Voice over Internet Protocol, VoIP), as well as data communications requirements. As BT notes, delay in implementing telephone service in rural areas "*may have been a godsend as recent technological developments may offer a much more cost-effective alternative for the provision of rural access.*[26] Another motive for moving to new technology is that manufacturers are discontinuing the Digital Radio Multiple Access Subscriber System (DRMASS) that BT has been using for rural telecommunications, and equipment will no longer be available.

A project in Bhutan has been exploring the feasibility of Wi-Fi for this mountain kingdom. It has a reasonably low cost at US$ 500 per access point and US$ 100 per client. There is also ample spectrum available in the kingdom. Results of a first pilot project were very promising. There was scarce radio interference and power requirements using solar and batteries were sufficient due to the lower energy requirements of the Wi-Fi equipment. There were, however, some incompatibility problems with circuit switched telephone equipment.[27] The pilot project has now been extended to 18 villages as part of US$ 300'000 project. Depending on the evaluation, the technology will be extended to more villages.[28]

Source: ITU Asia-Pacific Telecommunication Indicators, 2002.

One of the problems associated with WLANs is that interference problems and a lack of security are posing significant barriers to further development. Most governments around the world have not voted for the licensing of the unlicensed spectrum. On the contrary, regulatory authorities in countries such as France and Great Britain, as well as the Republic of Korea and Japan have announced their intention to free more spectrum[29]. In Hong Kong, China, the regulator Ofta announced the introduction of class licenses for WLAN providers in November 2002.

5.1.2 3G versus WLAN

Although 3G services are very different from the wireless connectivity provision of WLAN, the two wireless technologies are often compared. Stationary wireless Internet access may cannibalize potential future 3G revenues. Therefore, mobile operators and former incumbents such as Telstra in Australia, T-Mobile in the United States and Germany, or SingTel in Singapore have started to offer WLAN services themselves. They hope to win wireless data customers for 3G roaming services once these are in place.

Mobile data service delivery via 3G networks has certain quality of service obligations and roaming is feasible. In this context, the services offered via 3G networks may differ significantly from the WLAN services. However, the experiences with open wireless systems such as WLANs and with pricing in wired networks such as the Internet may lead to the prediction that open wireless networks will be more efficient in the foreseeable future.

5.1.3 Spectrum sharing models

Spectrum policy has traditionally 'parcelled' resources into frequency and space. An additional dimension for spectrum policy is time. Licensees can be allowed to dynamically rent certain spectrum bands when they

are not in use by other licensees. These secondary markets provide a mechanism for licensees to create and provide opportunities for new services in distinct slices of time.[30]

Box 11: Secondary spectrum markets

A model of business and regulatory challenges

The development of secondary markets is a market-based approach for the effective management of spectrum and the flexibility to respond to market forces and demands. In this model, licensees are able to trade unused spectrum capacity either by leasing it on a long-term basis or by selling spare capacity during off-peak periods. Facilitating the leasing of spectrum introduces economic incentives to develop efficient technologies, as licensees are able to sell the freed spectrum.

For 3G, secondary markets could allow more flexible management of property rights and lead the dynamic reallocation of spectrum rights to its most efficient and optimal use. For WiFi on the other hand, secondary markets could create property rights that are needed to manage QoS.

To increase the interchangeability of spectrum, spectrum trading contracts may need some extent of regulation. A new technology that will improve interchangeability is software defined radio which enables devices to use different frequency bands flexibly.

Regulatory issues in secondary spectrum markets include to allow for free entry and exit to the secondary markets; to ensure clearly defined rights to the spectrum for both buyers and sellers; to enhance the interchangeability of spectrum; to create competition among a large number of buyers and sellers; and to develop a mechanism to bring buyers and sellers together and facilitate the transaction with reasonable administrative costs and time delay.

Source: McKnight/Linsenmayer/Lehr, 2001.[31]

Spectrum sharing opportunities are not part of every awarded 3G licence. However, the economic benefits of spectrum sharing and trading, the potential for innovative market entrants, and the optimization of network capacities speak for the introduction of spectrum sharing and trading models. In Europe, the new telecommunication regulatory framework includes for the first time the option of trading radio spectrum and allows for the sharing of spectrum with non-licence holders. Furthermore, the Directive on Access and Interconnection explicitly mentions access to virtual network services.[32]

Another element in the spectrum debate is the emergence of mobile virtual network operators (MVNO), and various models of MVNO use of spectrum have been being discussed. MVNOs do not hold property rights for the spectrum they use. The actual use they make of the networks provided by the licence-holding mobile network operators range from minimum use of the networks facilities to strong dependency on them. In the latter case, the MVNO may be barely distinguishable from the actual mobile network operator. To differentiate themselves, MVNOs can use various methods to maintain and develop their own customer relations, either through tangible elements, such as the SIM card, or through branding or billing.

It is of course important to realize that MVNOs are not a homogeneous group. They can be categorized according to their technical composition as well as their market orientation.[33] MVNOs can maintain the radio access, network, call control, and service platform layer, or they may be active only at the call control and service platform layer. Depending on the assets MVNOs bring to their mobile data operations, they have been classified as telecom, media or brand MVNO models.

Despite the advantages that the presence of MVNOs can represent, there is nevertheless a prevailing scepticism on the part of 3G licence holders and regulators towards the MVNO model. This reticence is due in part to the expected negative incentive effects on investment in future networks such as 3G networks, combined with weaker infrastructure competition. These have to be weighed against the positive effects however, such as service innovation and competition in service provision. Indeed, the advantages of MVNO models may outweigh the disadvantages.

The critical question for regulators in establishing the regulation of access to the mobile operators' network, is whether it is appropriate to force licensed operators to disaggregate their networks in favour of other new entrants. For this, it is necessary to evaluate the essential character of the bottleneck for the development of competition in the mobile communication market, and the incentives for the deployment of mobile communication infrastructures. The mobile cellular bottleneck is different from, for example, cable networks or the local loop, because there are relatively high numbers of coexistent networks with similar characteristics such as capacity, services, or coverage.[34]

A further challenge for spectrum sharing is posed by peak time traffic. Here, trading models with differentiated price systems based on network demand may be an interesting avenue to pursue. But such models require sophisticated software to enhance network intelligence—the goal being to optimize network traffic real-time on demand.

5.2 Numbering management

While there is common awareness that spectrum is a scarce resource, it is often forgotten that so too are numbers. Mobile phones have increased the demand for numbers significantly, both for voice services as well as IP-enabled devices, and most countries have been obliged to restructure their numbering schemes in the wake of the mobile phone boom. Furthermore, rising demand for IP addresses is driving a shift to the new Internet protocol, called IPv6.

A further development is an endeavour to develop a system to map telephone numbers into the Internet domain name system. The enhancement of numbering and naming (ENUM) is the development of existing numbering plans that is intended to map a telephone number to a Uniform Resource Identifier (URI) in order to contact a resource associated with that number.[35] ENUM is a mechanism based on the Domain Name System (DNS) which maps E.164 telephone numbers onto a set of Uniform Resource Identifiers (URIs). The convergence of the PSTN and of telephony using IP has created opportunities for services bridging the two. However, ENUM raises serious issues concerning privacy.

Box 12: Options for numbering of SMS in Australia

Options for future numbering arrangements for SMS and MMS

Two main messaging systems are available on cellular mobile networks: short message service (SMS) and multimedia messaging service (MMS). Initially, text messages were sent exclusively between mobile phone subscribers. It is now possible for businesses to provide a range of value-added SMS services involving the provision of information or the participation in m-commerce applications. SMS can also be originated or terminated outside a mobile network. Meanwhile, MMS are complementing SMS. They have the ability to send messages comprising a combination of text, sound, still image, and video to MMS capable handsets. While both MMS and SMS are 'store and forward' systems which are not delivered in real time, one difference between them is that MMS use a network's traffic channel whereas SMS use the control channel, which has limited capacity to carry messages compared with a traffic channel.

The Australian Communication Authority (ACA) Telecommunications Numbering Plan of 1997 does not currently set aside specific number ranges for SMS. The definition of digital mobile services in the Numbering Plan covers both voice and SMS applications on numbers beginning with the prefix '04'. However, the Authority is now looking at possible ways to change these arrangements in view of growth and innovation in SMS applications and information-based services. Possible reasons include businesses wanting to offer services:

- where the price of the service is significantly higher than the standard charge for a SMS call;
- where certain numbers (such as easily memorable numbers) may have marketing value;
- on short numbers (e.g. 6- or 8-digits in length).

Options that have been identified by ACA to provide numbers for SMS include to:

- specify a distinct number range for use by SMS only;
- specify parts of the existing '04' range for use by SMS only;
- create a pool of very short memorable numbers for shared use by mobile carriers.

ACA is also considering whether a joint numbering system for both SMS and MMS should be available, or whether MMS should have separate numbering arrangements.

Source: ACA, 2002.[36]

A further scarcity of resources lies in the SMS numbering system for short numbers. In particular, numbers such as those preferred for commercial activities and that are easy to remember are in strong demand. Some regulatory authorities, such as those in Ireland or Australia (see Box 12), have addressed the issue of short numbers. Short numbers for SMS-based services need to be valid on all national mobile networks in order to be used for commercial reasons. A new kind of intermediary is emerging in this field to liaise between mobile operators and companies looking for innovative ways to relate to their customers, often selling them a package comprising both numbers and marketing services.

In its approach to the SMS numbering problem, the Irish Office of the Director of Telecommunications Regulation (ODTR) has developed a framework for value-added SMS services. Irish mobile network operators and various service providers proposed the development of a new range of short codes to allow both network operators and third party service providers equal access to the mobile market for the delivery of value-added SMS services. The short-code access system should be a five-digit system.[37] Currently, the short codes are directly usable only on and from mobile networks.

Value-added text messaging constitutes the use of SMS to provide a content service or product to the consumer, often incurring a premium charge related to the content. Mobile operators provide the transmission network, the billing mechanism and the established billing relationship with the customer. Value-added service providers may be the operators themselves or independent third parties. Premium text messages are often coupled with interactive 'instant responses'. In this context, the allocation of short codes is particularly useful. In Ireland, a two-stage approach will be used that will take enhanced messaging and 2.5G/3G into account in a second step in order to support the pace of implementation for 2G services.

5.3 Universal access policies

As described above, mobile communications are the primary service for basic telecommunications access in many developing countries in addition to the fact that the number of mobile-only customers in countries with very mature fixed-line and mobile markets is also rising. These developments are causing existing universal access policies to be reviewed.

Box 13: Defining universal service objectives

Defining universal service objectives usually involves a market test as well as economic and ultimately political assessment of the relative importance of the services to society as a whole. Such tests are generally based on the following criteria:

- the value of the service must have been demonstrated through the market and have been taken up by a substantial part of the population;
- people deprived of the service must be deemed to suffer serious economic and social disadvantages;
- the cost of extending the service beyond the market and the distribution of this burden across the population must be acceptable.

Universal service objectives vary with the level of network development. Most developing countries seek to achieve universal access through communal facilities. Countries with more extensive networks aim for at least telephone in every home.

As mobile services become more critical for national competitiveness, the question of including them into universal service policy becomes important: as market boundaries grow wider, reviewing universal service objectives has become increasingly necessary. In reality, mobile communications are close to meeting market test criteria for universal service.

Source: Wellenius, 2000.[38]

5.3.1 Access to mobile voice and data

Public telephone services are affected in two different ways. In countries with a high absolute mobile penetration, mobile communications often substitute for public payphones, which, as a result, may be reduced in the future. In countries where neither a mobile phone nor a public payphone is available for every individual, mobile public payphones are an alternative means of meeting universal access goals.

Data access capabilities can also be taken into consideration. Access to e-mail services has been included in many universal service policies in recent years. Access to the Internet may become a universal access goal in the future. However, the cost of Internet service delivery via different technological platforms such as satellite, cellular, or any fixed-line technology, needs to be taken into account. For this particular issue, the concept of universal Internet access even in the light of technology neutrality has strong economic limits.

Universal service funds typically collect funds from different sources and pay the universal service operators the eligible net cost of the service. Mobile operators need to be considered for all components of the universal service contribution with their growing importance in access, traffic, and revenue.

5.3.2 Shared ICT access

Rural access policies for developing countries have of necessity to consider such solutions as shared information and communication technology access, for example through telecenters. Among the advantages of mobile communications for these countries, is the strong mobilization of investment introduced by mobile telephony, but also the possibility of new sharing alternatives that go beyond the limitations of fixed lines.

5.3.2.1 Mobilizing investment for mobile voice and data access

It is the responsibility of governments to create a credible political and jurisdictional environment in order to attract investors. Where mobile communications have been promoted, this has opened up national markets to both domestic, and (to a greater extent) foreign companies.

In mobile communications markets in general, operators do not necessarily try to serve a national market as in the fixed-line telecommunications industry. Mobile operators try to create regional and/or global footprints. In this context, mobilizing foreign direct investment is an opportunity that can be very attractive for developing countries. Mobile operators have contributed to overcoming gaps in basic telecommunication services and may also become important for Internet access policies.

5.3.2.2 Regional initiatives for isolated and remote communities

Micro-loan programmes have been very beneficial for enhancing access to mobile phones in remote villages. Other initiatives may have a similar impact. Models for enhancing rural access could include a public lending library model for telecenters, where people have the opportunity to borrow a mobile phone when they need one. Another model may be a car-pool model for mobile phones, in which an assigned group of people share a mobile phone. Economic club theory suggests that the number of people in such a pool should be limited so as to maximize positive advantages and minimize negative externalities.

6 Changing the regulatory framework for the mobile and fixed business-to-business telecommunication market

6.1 Competition policy for mobile communications

Mobile markets are perceived to be very competitive. However, there may be indicators for excessive pricing and joint dominance in some regions, in Europe for example, and other abuses of dominant market positions, such as in the wireless ISP markets in the Asia-Pacific region.

Competition policy is gaining in importance for telecommunications. The analysis of potential abuses, e.g. for the assessment of termination charges, relies to a large extent on the market definitions. Lock-in policies that substantially lessen competition and consumer choice have been addressed through the introduction of mobile number portability and SIM-lock policies in some countries. However, in fixed-line telecommunications there are still more initiatives to enhance competition that are currently not widely available for mobile, such as carrier pre-selection.

Research on the competitive interaction among mobile telecommunications operators shows that the industry has strong features of a natural oligopoly where only a limited number of operators with different coverage can survive in equilibrium due to spectrum constraints.[39]

Mobile data markets are facing competition policy issues with walled-garden and exclusive rights approaches for mobile data platforms. This affects the selection, navigation, and the interface to the mobile customer. Open access to mobile platforms and content is an essential policy objective to increase competition and consumer choice.

International roaming is another difficult competition policy issues for mobile voice and data. Among the fraught areas are the fact that interconnection agreements include high termination charges that are passed on to the customers; there is no authority to whom customers can direct their complaints regarding problems occurring outside of the mobile operators' home country; for developing countries, mobile operators may not be able to have their own access to an international gateway and therefore have to pay excessive charges to the incumbent that provides access to international networks.

6.1.1 Definition of mobile markets

With the growing influence of competition policy in telecommunications, supply and demand side substitutability are becoming increasingly essential criteria. The scale and scope of the relevant market is important for further decisions on *ex-ante* and *ex-post* regulation.

Mobile communications can be defined as a separate market from fixed-line telecommunications although this notion may change when the demand side substitutability increases in the future. However, mobile operators can also be seen as dominant market players in their own networks. In this definition, each mobile operator is a monopolist in its own network—a situation which changes the rationale for regulatory intervention. It is also worth noting that mobile markets can be defined differently at the wholesale and at the retail level. The question also arises of how to define mobile data services, i.e. whether these constitute a single market, or if SMS or MMS constitute a market by themselves. Box 14 describes market definitions for mobile and fixed services in the United Kingdom.

Box 14: Oftel's view on market definitions for fixed and mobile services

Market definitions for fixed and mobile services, May 2002

Oftel's view on market definitions for fixed and mobile services state that fixed and mobile access constitute separate markets and that at current prices, fixed and mobile calls also constitute separate markets. High mobile termination rates significantly distort current retail prices which affect substitution between on-net mobile and fixed-mobile calls. Oftel also questions whether at competitive (i.e. cost-based) prices, substitution between some fixed and mobile call types would be such that it would be appropriate to regard them as part of the same market.

Mobile services: Mobile services have been defined as a single retail market for all outgoing calls including subscriptions, mobile-to-fixed, mobile to off-net, and mobile to on-net calls. Oftel considers that it may be possible to define different markets for different types of mobile calls. Because of the effect of calling party pays (CPP) and the fact that there are limited potential substitutes, Oftel concludes that there is a separate market for termination on each mobile network.

Fixed access: In contrast to the definition of mobile services, Oftel defines separate markets for fixed access and calls. Separate markets have also been defined for local calls, national calls, international calls by country pair, calls from fixed to mobile, and operator-assisted calls, and each of these markets has been separately defined for business and residential customers.

Fixed-mobile substitution: Oftel believes that fixed lines are unlikely to be close substitutes for mobile telephony services. Among the reasons for this conclusion are the existence of a price premium for calls to mobiles and the linkage of fixed lines to a place rather than a person. The scope for substitution between fixed and mobile calls may, however, vary by call type and depend on the pricing of mobile calls. Fixed-to-fixed calls are not a sufficient substitute for fixed-to-mobile calls. The substitution of fixed-to-mobile for mobile-to-mobile relies largely on relative prices; at current prices it appears that on-net mobile calls, fixed-to mobile calls and off-net calls are likely to constitute separate markets. At cost-based prices, fixed-to-mobile calls should be cheaper than mobile-to-mobile calls, however, prices are distorted by excessive termination charges. Many of the arguments also apply for mobile-to-fixed for fixed-to-fixed substitution.

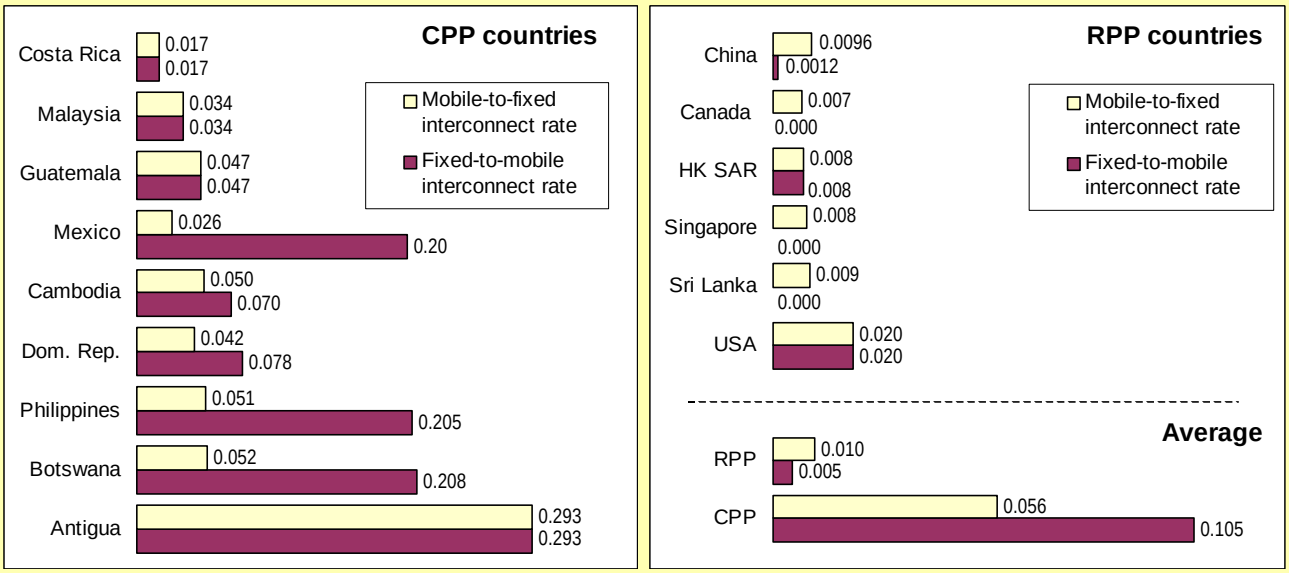
Source: Oftel, 2002.[40]

Even if the market is defined as a single network operator, it is unclear whether 3G calls should be included in the same market definition. Factors to be considered are market maturity, network integration, quality of service, speed of service delivery, licensing requirements, and the range of available applications.

6.1.2 Mobile termination

Fixed-mobile termination is creating challenges that have been known for a long time, but that have yet to be fully addressed. The challenges vary depending on various factors, for example on the regime used—either calling party pays (CPP), mobile party pays (MPP), or receiving party pays (RPP) (see Figure 9). Another aspect is that, in some developing countries, the market power exercised by incumbents can lead to significant distortions. For example, in India, under the original licence conditions fixed operators were not paying mobile operators for terminating calls on their networks. However, mobile operators had to compensate the state-owned incumbent for termination traffic.[41]

Figure 9: Interconnection rates in selected non-European countries
Calling Party Pays (CPP) vs. Receiving Party Pays (RPP). In US$ per minute.



Note: The average on the right hand side refers to the average of countries responding to the ITU survey as well as the European countries in Table 1.
Source: Fixed-Mobile Interconnection Workshop, 2001; ITU 2000 Regulatory Survey.

Mobile data and mobile messaging such as SMS or MMS pose new challenges to termination rates. Termination rates for SMS were only introduced into the market after it became obvious that SMS would be a growth market. Mobile operators have tested the price elasticities for messaging services and enjoy a significant amount of revenue from SMS termination.

As and when 3G operators enter the market, termination rates for voice and data in packet-switched networks will have to be defined. Currently, there is an absence of direct interconnection arrangements between mobile operators for GPRS-based services, while interconnection arrangements are developing between individual mobile operators and providers of GPRS roaming exchange (GRX) services. In a 3G environment, arrangements for the exchange of traffic will have to be re-negotiated due to different characteristics of 3G to those of 2.5G networks. Challenges for interconnection arrangements for 3G services include the lack of reliance on the CPP principle, the difficulty of easily differentiating applications, and the pulling of content-based services.[42]

A substantial part of mobile operators' revenues comes from subscribers who are not customers of the operator, such as fixed-line subscribers who make calls to mobile phones or customers from other mobile operators who make off-net calls. Some argue that each mobile operator has a virtual monopoly on terminating access with respect to its own customers. Therefore, mobile operators face far less competitive pressure with regard to the prices paid for mobile termination than for subscription or mobile-originated calls.[43] Taking into account the bottleneck aspect of the termination function, the adoption of proportionate remedies may be a good means to address the imbalances in relative bargaining power and the perceived market failure.

The introduction of competition in telecommunication markets has produced a large number of pre-selection service providers who offer competitive services in national long-distance and international calls. With the growing importance of mobile, more and more pre-selected carriers will want to offer fixed-to-mobile pre-selection. Therefore, they are likely to purchase mobile network termination services and expand this market for mobile operators. However, these new entrants among them do not usually have sufficient bargaining power to negotiate fair termination terms.

One negative traffic externality with regard to termination prices well above cost is 'tromboning'. Tromboning is also known as the refiling of domestic traffic. It occurs when new entrants in the fixed telecommunication market are confronted with the refusal of mobile operators to negotiate lower prices. In

this case, calls from a fixed network are taken to a foreign network and brought back for termination on a domestic mobile network to evade the high termination fees.

The degree of regulatory intervention varies, ranging from the establishment of best-practice guidelines for setting interconnection prices, e.g. in France, to direct mandates for cost-oriented pricing, e.g. in Sweden.[44] The variations in regulatory actions depend on the market definitions applied to mobile operators.

From an international point of view, the obligations to interconnect set out in the WTO Reference Paper require interconnection with a major supplier at any technically feasible point in the network under non-discriminatory terms and conditions. However, the matter of termination on mobile networks has never been tested before a WTO Disputes Panel.

6.1.3 Mobile number portability

Mobile number portability has been introduced in a range of countries, including in the European Union, and Australia[45]. It offers the customer an enhanced choice of providers and takes away one essential lock-in instrument of mobile operators. Mobile number portability has created some technological difficulties as well as disputes about who should carry which cost. But it also has implications for consumers. Still, mobile-to-mobile calls within one operators' network are a lot cheaper than to call into another operators' network. Number prefixes used to signal to consumers into what networks they were calling. Now, price information systems need to be developed to secure transparency of tariffs and security of estimated costs of mobile telephony (see Box 15).

Box 15: Benefits and costs of mobile number portability

Mobile number portability (MNP) gives customers the opportunity to change mobile service provider while keeping the same mobile telephone number. Technical and administrative challenges as well as cost effects and effects on the customers are crucial elements of MNP.

A lot of countries have implemented Signalling Relay Functions (SRF) which not only support the portability of voice, but also of data services. The time for validating a customers' application for MNP can be a crucial component in the administrative processes. From a competition policy standpoint, delays may prevent customers from applying for MNP. Hong Kong, China provides a positive example with a validation time of two days and a portability rate (amount of cumulative portability as a percentage of total mobile customers since the introduction of MNP) of 67 per cent.

The costs of MNP comprise system implementation costs, portability costs, and connection costs. The allocation of costs is currently subject to general agreements among carriers. The transparency of tariffs for consumers is an important issue that needs to be observed as more MNP will be taking place and consumer complaints may give further hints. The role for regulatory agencies may first be restricted to ensuring rapid implementation of MNP.

Source: Wik Consult, 2002.[46]

Portable numbers pose challenges for interconnection and the calculation of average interconnection charges in charge control regimes. For example, Oftel is investigating how mobile operators deal with ported numbers—the concern being that calls to ported numbers might fall outside of charge controls.[47]

6.1.4 Carrier pre-selection

Fixed-line networks allow enhanced choice for telephone users via pre-selection options. The introduction of these services has stirred competition and has driven down prices. Pre-selection for fixed-to-mobile calls has been included in a range of countries next to pre-selection of national long-distance and international calls. However, mobile operators do not allow for interconnection to competitive pre-selection providers. In the context of an increasing number of mobile-only customers this is an essential customer constraint.

Toll free numbers are a way of internalizing externalities in the fixed-line telecommunications industry. The caller can benefit from a call without bearing the cost. This service is not available on mobile phones, either. This may change when commercial enterprises discover mobile ad-hoc customer inquiries as a chance to influence purchase decisions at the point of sale.

6.1.5 Open access to wireless ISP markets

On a general level, competitiveness of Internet service providers is very high, although anti-competitive behaviour can be observed at the backbone provider level. In mobile communications, access to the mobile Internet is proprietary and not subject to competition. This exclusiveness concerns elements of the network architecture such as the protocols, the numbering, the browsing, and the software. It also concerns the interface to the customer; it influences navigation through the design of the portal; and it influences the selection of services through their placement and the number of clicks that a customer needs to get to them.

The issue of open access has played an important role in arguments against ISPs' walled garden services or the navigation and placement in the proprietary systems of Electronic Program Guides (EPG) in interactive television. In Japan, where mobile Internet access is adopted by a large share of the population, the Ministry of Public Management, Home Affairs, Post and Telecommunications (MPHPT) has started an investigation into the wireless ISP market. For example, the incumbent operator NTT DoCoMo is expected to present solutions to open its system for competitors (see Box 16).

Box 16: Opening up the networks in Japan

As at mid-2002, i-mode users could only access the Internet through DoCoMo's gateway. DoCoMo planned to open up its networks for i-mode to other ISPs in November 2002, while KDDI had already opened up its portal for EZweb in October 2001. Mobile Internet services were provided through closed networks owned and operated by carriers. The 3'000 plus i-mode official sites provide a wide array of services through DoCoMo's servers and networks. The operator came under serious scrutiny in 2001 regarding its closed content policy. It had planned to open its networks in March 2002, but brought the deadline forward to November 2002 after pressure from various industry players and Government. Soon, DoCoMo users will be able to use their own ISP to gain access to the Internet via their mobiles. The largest ISP in Japan, Nifty, is now preparing to launch its services through DoCoMo's gateway.

The Government took this a step further. The telecommunications ministry, MPHPT, had a report compiled in June 2001, recommending that content providers and ISPs jointly set up an organization to decide the criteria for selection of mobile sites. This was to replace the old system whereby mobile operators unilaterally decide which sites are "official" based on their own criteria, and bill users for access to these sites on the part of content providers. For instance, carriers would only release customer identification for official sites, and in return, collect content fees for content providers. Content providers have claimed that screening standards are non-transparent and that the treatment of official sites is discriminatory. The second recommendation is to encourage operators to collect charges for unofficial as well as official sites.

Source: ITU Report Internet for a Mobile Generation, 2002; MPHPT, Japan.

Although customers in some markets have the technical capability to change the default IP address in order to use the services of a mobile ISP other than the operator, this may not lead to greater consumer choice as making this change may be perceived as a complicated procedure. It is therefore relevant whether an operator pursues an 'open in', 'open out' or a 'walled garden' access strategy.[48]

A walled garden approach has been used in the development of GPRS. It has a private IPv4 addressing scheme and operates within a GPRS top-level domain. A 'network address translator' (NAT) serves as the bridge to the Internet. Mobile operators have the ability to use this closed approach as a means to charge ISPs for services such as providing IP addresses, location, or handset IDs of their customers.[49]

Next-generation instant messaging (IM) services, e.g. for mobile phones, have been subject to the merger condition of the AOL-Time Warner merger. The United States Federal Communications Commission (FCC) mandated interoperability for the future generations of AOL's popular IM service, based on the potential leveraging of merger assets together with current IM network effects into market power in next-generation IM services.[50]

6.2 International roaming

Roaming has been one of the biggest promises of mobile communications. A lot of the enthusiasm about developing 3G networks has been about the idea of global roaming capabilities. However, the evolution of different standards, difficulties with interoperability, and international interconnection agreements that increase prices for customers are working against the initial concept of global roaming.

Box 17: GSM Europe Code of Conduct for information on international roaming retail prices

Monitoring the Code of Conduct

In response to growing consumer demand for greater transparency in international roaming prices, the GSM Code of Conduct was published in July 2001[51]. It aims to provide greater consistency and clarity to the range of information available to consumers on roaming services. Consumers should be enabled to make better-informed decisions on how to use roaming services with regards to network choice, retail prices and other services.

In order to monitor the compliance of European operators with the Code of Conduct, an independent consultancy, Ovum, requested information on the measures taken, assess the home pages, and carried out random checks by making anonymous phone calls to operators' customer service departments.

The first year of monitoring shows that the monitoring process itself has played a significant part in increasing compliance from 38 per cent to almost 100 per cent on re-monitoring.

Source: Ovum, 2002.[52]

Emerging 'pushed' (as opposed to 'pulled') SMS services or other mobile data subscription services are a new challenge to international roaming. Within a country, a pushed data service may be time-sensitive, but it cannot adapt to different time zones. Moreover, a subscription charge could easily double or triple when international roaming charges are added on top of the price of the service.

A further consideration is that location-based services may only be available in the local language, which may be a drawback in a roaming situation. Also, international clearinghouses are needed to track the time, volume, and value of mobile data services while roaming across countries, time-zones, and standards.

6.2.1 Competition in standards

Inter-standard roaming has become a central issue in the development of truly global roaming. In addition to coordinating interface interoperability, harmonizing billing standards is a major component of inter-standard roaming.[53]

International roaming in countries with different standards requires a handset that can operate on all necessary frequency bands. Business customers in particular value tri-modal handsets that allow for continuous access to the communication infrastructure. The transfer of data across different standards is more difficult. For example, in the United States, SMS services used to be available only within an operators' network. In 2002, interoperability was introduced and has stimulated the use of SMS. Interoperability of different standards for international data services will be, thus, remain a challenge.

Over the next decade, different 3G standards will continue to compete. The provision of 3G mobile data services in Korea, where cdma2000 1x EV-DO is in place, is available a lot faster than data services in GSM networks that are migrated to UMTS networks, for example. Therefore, the choice of standard will have an influence on data use and data revenue.

6.2.2 Termination of international calls on mobile networks

International negotiations between fixed-line and mobile carriers on terms and conditions for carrying each other's customers' traffic over their networks are characterized by a 'co-opetition'- relationship. On a national level, fixed and mobile operators are competitors and this competition will become more fierce as more customers only subscribe to a mobile operator. On an international level however, fixed and mobile operators are cooperating in order to provide service to their customers. Co-opetition relates to the bargaining power, e.g. in negotiations on revenue sharing. In this context, it becomes important for the discussion of termination charges.

Revenue sharing agreements often reflect respective bargaining power. In the case of international termination pricing, mobile operators charge high termination fees to the disadvantage of the customers. Although the scale of international traffic to and from mobile networks has increased significantly, economies of scale are not reflected in termination prices. Bargaining power and revenue sharing agreements will also become important in the relationship between content provider and mobile operators. International mobile roaming will be an important issue for the roll-out of content and services with IMT-2000.

Wholesale prices for the completion of international calls to mobile cellular networks can be as much as 1500 per cent more expensive than calls to a fixed network in the same country.[54] Consequently, retail prices to foreign mobile networks can be higher by 10 to 30 cents EUR/US$ per minute. Mobile operators are also leveraging their domestic power in the call termination market into foreign markets for call origination. With the growing importance of mobile communications, other operators have no alternative but to connect.

Possible remedies in order to drive prices down to cost-orientation fall into two categories, an increase of competition in the market, e.g. through MVNOs, or a direct price regulation. The commitments to interconnection of the WTO GATS Reference Paper that suggests the principle of cost orientation needs to be applied to the termination of calls on cellular networks as well.

6.2.3 Origination of international calls from mobile networks

In developing countries, mobile operators are sometimes not allowed to operate their own international gateway. International calls from and to mobile phones have to be carried over the incumbent's network, heavy interconnection charges for that service. This dependency of mobile carriers is a distortion of competition that has not yet been addressed with determination. However, the percentage increase of international traffic that is being originated on or terminated on mobile networks demands more attention to that anti-competitive behaviour.

For example, Cambodia has some of the highest international traffic tariffs in the world. The Ministry of Posts and Telecommunications of Cambodia (MPTC) who owns respectively controls both international gateways earns 85 percent of its revenue from international phone calls. Mobile operators charge the MPTC's rate in addition to the mobile per minute call charge. The high cost of international calls turns users to other methods for communicating abroad, mainly relying on incoming international calls or VoIP.[55]

7 Policy and regulatory framework for providing customers with competitive mobile voice and data services

7.1 Pricing and billing for mobile communications

Mobile pricing for voice services has always been higher than fixed pricing due to the fact that mobile communications provide coverage rather than the connection to a certain location. The cost for terminating a call on a mobile network is higher because the call originator needs to be located. However, the current price premium for mobile communications is not grounded in higher cost of service provision. Interconnection is not cost-based either. Some costing approaches relating to data traffic delivery are discussed in Box 18.

In situations and environments where mobile communications have been perceived to be an additional or even a luxury service, these pricing structures have been appropriate. But as mobile has become a mass market, and an increasing number of people rely on mobile as their only means to basic telecommunication access, this notion is changing. In the United States, the introduction of bulk pricing plans has led to an increase in mobile-only customers. Mobile operators grant thousands of minutes per month for a fixed price. This enhances the customers' transparency in communication expenses and drives more traffic into the networks. With pricing plans that cover coast-to-coast calls as well, mobile carriers are now competing with national long-distance operators. However, patchy coverage and a high percentage of dropped calls are still counteracting the attractiveness of such pricing plans.

Box 18: Cost of delivering data traffic

Some economics of wireless mobile data

According to Qualcomm, it is useful to compare the economics of alternative technologies in terms of the network cost to deliver a megabyte of data traffic. The cost per megabyte in this approach reflects the network operating costs and the depreciation on capital investment required to design a network to support a given busy hour traffic load.

According to Qualcomm's calculations, cdma2000 1xEV shows the lowest cost in a high data traffic density environment with US$ 0.022 per megabyte against cdma2000 1x, WCDMA, and GPRS with the highest cost of US$ 0.415 per megabyte.

An alternative approach could be to consider the opportunity costs that arise when mobile operators turn voice into data traffic. However, retail prices are not cost-based and make an assessment and comparison of the cost from delivering data traffic impossible. For example, at the retail market level NTT DoCoMo's FOMA service is priced between US$ 1.5 and US$ 15 per megabyte based on its pricing of US$ 0.0002-0.002 per packet and 128 bytes per packet[56].

Mobile data volumes are expected to rise considerably. In this context, the economics of mobile data may reinforce the differences between the different standards for next-generation networks.

Source: Qualcomm, 2002[57]; ITU Research.

Billing of mobile data services on a national and international level, for roaming and the associated interconnection agreements are still challenging for mobile operators. Some providers are offering their data services for roaming for free to their customers until they have developed solutions to deal with the billing.

7.1.1 Pricing for prepaid

The economics of prepaid differ from subscription plans in two fundamental respects. On the one hand, the risk for operators is higher, because they cannot rely on a monthly revenue flow which increases the uncertainty of strategic planning. On the other hand, the cost of mobile operators is dominated by the cost for metering and billing and these services are less with prepaid customers.

Although it is an accepted economic fact that subscriptions are less expensive than services delivered at only one point in time, the pricing for prepaid mobile telephony services needs to be revisited. Particularly in developing countries, customers with a low income or without any income seem to cross-subsidize subscription customers. In countries where mobile communications is the primary telecommunications access, access to affordable prepaid services may become an addition to universal access policies. In this context, initial high prices to recover investment may not be a sufficient argument for keeping prices for prepaid at high levels.

The prepaid model is attractive to operators, because it exempts them from implementing billing systems that have a substantial overhead cost and they do not need systems to track unpaid duties. Against this background, higher prepaid margins offer potential for price reductions for the consumers. Operators who have installed prepaid models should be subject to further investigation if tariffs for prepaid plans have not come down. A potential lack of competitive pressure in the prepaid market may call for regulatory action.

Prepaid mobile service diffusion is facilitated by CPP regimes. Advocates of RPP on the other hand, counter that RPP tends to keep fixed-mobile interconnection charges in line with prices for other forms of interconnection.[58]

7.1.2 From circuit-switched to packet-switched models

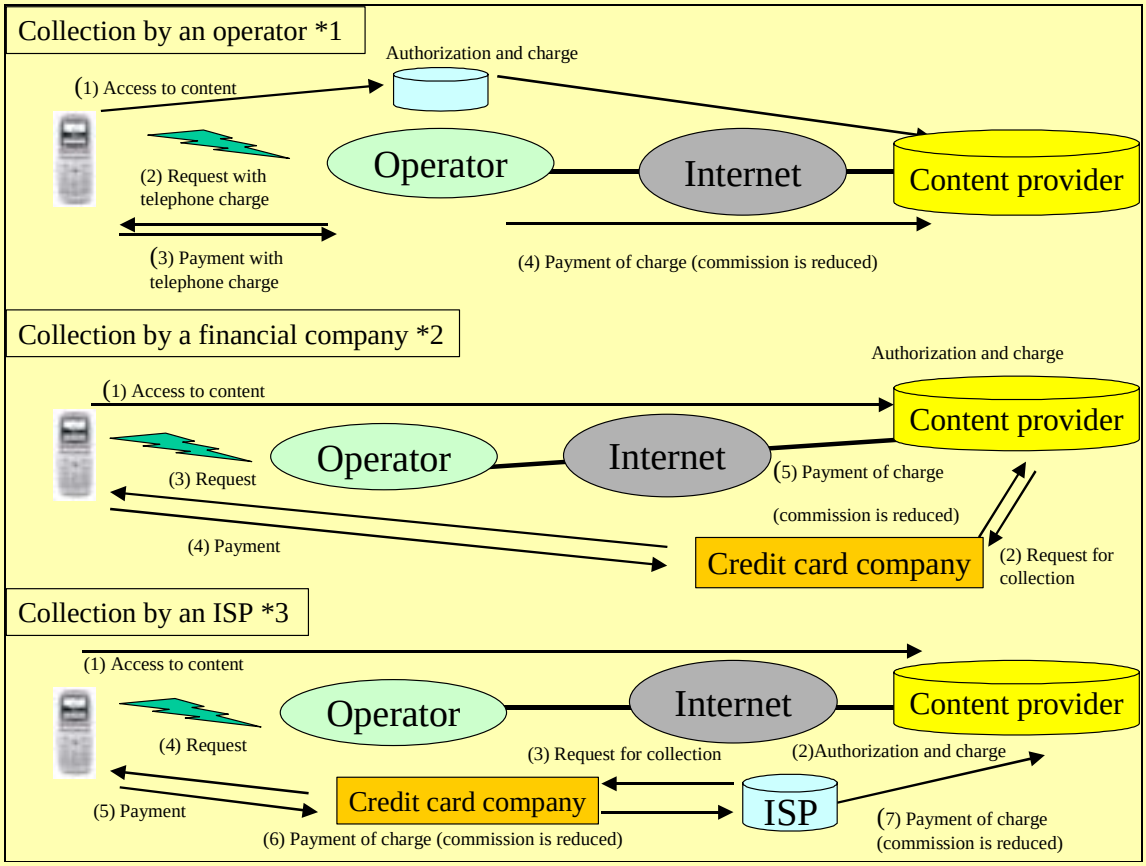
Two fundamentally different switching technologies are colliding and need interconnection in mobile communications. The interconnection of circuit switched and packet-switched networks require the development of a network architecture that can route next generation services across a series of interconnecting networks. The development of standards to facilitate the transmission across and between networks is as crucial as the interconnection and revenue sharing agreements.

Next-generation services promise to deliver text, pictures, audio and video content ubiquitously, on demand, and in real time. The realization of that vision is closely connected to the transition from circuit- to packet-

switched networks. However, numerous questions remain to be solved such as the issue of international clearinghouses. Korea and Japan are currently leading the endeavours on international clearinghouses.

Billing systems need to handle prepaid, post-paid, and passed-off to a third party data services, e.g. credit card issuers. Billing software for the backend and new trends such as m-wallets on the front end have to come together as well. Metering and billing service-specific IP streams is still an essential challenge to inter-network compensation. The critical elements of an IP traffic billing system are the mechanism for gathering customer usage data and the mediation software that processes the data and converts it into a billable record.

Figure 10: The payment chain: models for common billing
Content billing platforms for common billing



Note: *1: adopted typically by i-mode business model. This shows when a user accesses its 'official content'.
*2: in this case, a user inputs ID given by a credit card company, when he/she buys content.
*3: in this case, a user inputs ID given by an ISP, when he/she buys content.
In cases *2 and *3, not only credit card companies, but other financial institutions, such as banks, may be involved.
Source: ITU Report Internet for a Mobile Generation, 2002.

Over the next decade, the Internet's packet-switched protocols may provide a common global platform for almost all communications services. Therefore, there is great interest in new network-to-network payment schemes. Telecommunications operators receive significant payments from other networks in exchange for providing end-to-end service. In the Internet however, bilateral revenue sharing arrangements are uncommon. The prevailing Internet inter-network compensation models are peering, where no money is exchanged and transit where payments are one way. Figure 10 shows a number of models for common billing.

7.1.2.1 IPDR

Metering and measuring services in an environment with asymmetric traffic flows and different service classes such as voice, e-mail, web, or streaming goes beyond 'sender-keeps-all' accounting mechanisms. The Internet Protocol Detail Record (IPDR) aims at developing a charging, accounting, and cross-operator settlement scheme for IP-based networks.[59] It is one approach to capture the relevant metrics for a wide

range of IP-based service classes. Revenue sharing agreements that have been introduced between operators and content and service providers, e.g. by NTT DoCoMo, are a first step. However, when mobile data communication will gain in significance against fixed IP-based services, a sophisticated metering system will be essential for the creation of price-differentiated services that capture the best value for operators, companies, and customers.

7.1.2.2 IPv6

The mobile Internet requires that the chosen Internet protocol allows a high degree of scalability and efficient management. A new Internet protocol, called IPv6, provides a number of features that can be used for new generation mobile data services. The expected 'always on' paradigm has led to the Third-Generation Partnership Project's (3GPP) decision to mandate IPv6 for all new services. Within a 3GPP network, IP is used for two purposes: end user communication between mobile terminals and application hosts as well as the cellular infrastructure networking. Mobile operators need to make special considerations on addressing, security and mobility management to be able to reap the benefits of IPv6.[60]

The transition from the current Internet protocol, IPv4, to IPv6 will be beneficial for the development of mobile data services. The sufficient supply of IP addresses is a necessary pre-condition for IP-based mobile services. In this context, the development of mobile, particularly in the Asia-Pacific region, may be a driver for the faster implementation of IPv6.

7.2 Privacy and consumer and data protection

Privacy concerns in mobile communications increase with the availability of positioning technologies. They can be beneficial for emergency services. However, it is difficult to assess who should have access to this information, for what price and with whose approval (see Box 19). For commercial location-based services,

Box 19: Serious SPAM damage in Japan, and the countermeasures

NTT Docomo had initially given its 'i-mode' mobile handsets e-mail addresses as follows: '(phone number)@DoCoMo.ne.jp'. Spammers could send-users mail by generating random 8-digit e-mail addresses. As a result, in October 2001, DoCoMo users received some 950 million e-mails every day, of which about 800 million are returned to senders because of unknown addresses, putting a huge strain on its servers. Users of other operators also receive a lot of spam mail. In June 2002, operators received 140 thousand complaints about spam mail. Some complained that they receive hundreds of spam mails per day. Since July, Docomo has urged its subscribers to change to new addresses containing alphanumeric characters. Now, spammers have to introduce new systems to create random addresses including alphanumerics.

In November 2001, DoCoMo built a system to block e-mails sent to unknown addresses, whereby error messages are not returned to senders in order not to inform them of non-existent addresses. DoCoMo also won a temporary injunction in the city of Yokohama to bar the Web company Global Networks from sending randomly generated e-mail to addresses with the suffix '@DoCoMo.ne.jp'. In January 2002, it launched a service enabling users to designate a maximum of ten domain names from which they want to receive e-mails, and to block e-mail from others. Other operators have introduced similar systems. However, devious spammers have been able to get around this by sending spam mail using fake domains. In April 2002, DoCoMo upgraded its mail server to block such forged-domain spam mails.

The Government also provides countermeasures. In January 2002, METI (Ministry of Economy, Trade and Industry) obliged content providers to show 'mi-syoudaku-koukoku (non-agreed advertisement)' in the mail header, so that users can delete these mails without opening them. The MPHPT has also established a new law adopting the "opt-out" approach, prohibiting the sending of random bulk mail.

Source: ITU Report Internet for a Mobile Generation, 2002; NTT DoCoMo, http://www.nttDoCoMo.com/home.html; MPHPT, Japan, http://www.soumu.go.jp/.

the mobile operators who provide the positioning information will have a lot of new insights into their customers' preferences and daily lives. This affects the customers' privacy sphere as well as a need to protect that consumer information.

7.2.1 Emergency services

Initially, the emergence of location-based services was neither driven by revenue expectations nor by market demand, but by government regulation of emergency services.[61] Mobile operators have to supply emergency

call capabilities, but increasingly, governments mandate enhanced emergency services. Difficulties with the technological development of the positioning technologies have been a barrier to implementation.

In the European Union, determination of the location of 112 emergency calls is now technically feasible.[62] In the United States, the FCC has implemented additional regulatory measures to accelerate performance in terms of accuracy and service availability. For example, the FCC has mandated performance parameters that require operators to make significant additional infrastructure and handset investment.

Location identifying technologies, devices and services may have unintended consequences which, in a worst case scenario, would lead to the monitoring of everyday life. In this environment, data protection measures have to contribute to the goal of realizing public safety as well as emergency services. The EU Directive on universal service and users' rights relating to electronic communications networks and security (2002/22/EC)[63] specifies that in the case of emergency calls, rights for life and for health protection take precedence over rights for privacy and therefore, data processing may be used in some cases without the user's consent.

New ideas on the development of emergency services include the pushed delivery of emergency content, e.g. the floor plan of a building or the location of emergency exits. However, it is still unclear who would provide emergency content where, and who would cover the cost.

7.2.2 Location-based services

Location-based services (LBS) are unique to ICTs that allow for roaming. One can differentiate pulled and pushed LBSs. They promise to deliver a new quality of services, but they can equally well lead to an increase of spam. Mobile spam is even more objectionable than e-mail spam, because first the receiver expects a personal message and is more likely to open unsolicitated SMS or mobile mail and second because the users' attention is typically directed at another activity and not on the screen of a mobile phone. The disruptive nature of mobile messages that can be valued for interpersonal communications can turn out to become a nuisance in the case of pushed location-based services.

Location-based services in a commercial context are often developed to track people, (e.g. 'friend finders'), or to provide information about 'the nearest' restaurant, petrol station, or cash machine, for example. The implementation of these services depends on the legal requirements on consumer privacy and security of data.

One way of avoiding the drawbacks of LBS is to put an opt-in system in place. In that system, LBSs are only delivered upon the users' agreement. However, it may not be an effective means of protecting consumers from unsolicited mobile messages.

In Hong Kong, China, the six mobile network operators issued a code of practice that prohibits unsolicited promotional IOSMS, meaning promotional SMS, for which the recipient has not given his or her explicit prior consent. Operators agree to incorporate prohibition in the terms of contracts with customers and to take action against senders of unsolicited promotional SMS.[64]

In receiving party pays (RPP) regimes, a mobile subscriber is unlikely to be able to recover the cost of an unwanted call from a telemarketer. Negative externalities of telemarketing can be more easily internalized under calling party pays (CPP).

Privacy concerns regarding LBS can range from irritating abuse such as unsolicited advertisement, to serious abuse, such as firms enforcing performance measures on their employees, or even to dangerous abuses such as criminals determining the right time to break into a subscriber's house.[65]

7.3 Intellectual property rights in mobile data communications

In contrast to fixed-line telecommunications, intellectual property rights (IPR) for content are an essential element in mobile telecommunications. IPRs in mobile communications can be analysed with regard to exclusive rights that mobile operators acquire from content producers and licence holders, copyright protected data that mobile users can consume or download onto their mobile phones, and the potential file sharing of copyright protected mobile data over mobile peer-to-peer platforms.

Mobile operators use exclusive rights to content as a means for customer lock-in. For example, in the United States, Sprint PCS has signed exclusive agreements with mobile game producers in order to target a young

customer segment. Other mobile operators purchase mobile rights to sports events such as the Soccer World Championship or the Olympic Games. This business practice contradicts those public policy objectives that demand open access to content on all platforms.

The popularity of mobile data applications such as ring-tone and screensaver downloads has led to a wide range of licensing agreements. Disney, for example, is licensing its popular figures in many countries including Korea, Japan, and Taiwan, China. Peer-to-peer technologies are used in wireless communications predominantly for meshed networks. In mobile communications however, they can be built for file sharing and raise similar issues as for fixed Internet file sharing and IPR.

8 Regulatory reform

8.1 Technology-neutral regulation

The principle of technology neutrality requires that services can be regulated in a comparable manner, irrespective of their means of delivery. Regulation should be based upon consideration of the nature of the services provided to end-users.

Technology-neutral regulation is an option in mature telecommunication markets that indicates a probability of fixed-mobile substitution. When technologies reach a status where they are substitutable from the supply and demand side, regulation can be neutral to the technology that lies behind serving customer needs. In markets with low tele- and mobidensity, technology-neutral regulation may also be beneficial when, e.g., the means through which universal access policies are achieved are of little significance.

Fixed-line telecommunication markets have been regulated asymmetrically, whereas mobile telecommunication markets have been fairly unregulated or regulated symmetrically. The break with the differentiation in the two regimes of (a-)symmetric regulation can lead to some difficulties. Technology-neutral regulation also trades on specificity of its laws, remedies, and institutions. However, technological development needs to be reflected in the institutions that govern them. In this context, other countries may follow the lead of the European Union, which has introduced technology-neutral regulation in its new regulatory framework.

Technology-neutral regulation can be insufficient for different competition situations in different technological infrastructures. It also poses challenges for the requirements and user protection rules in telecommunications that, for example, do not apply for IP telephony. There still can be elements that may not allow services to be regulated equally.

8.2 Regulatory convergence

Regulatory issues affecting the Internet and the mobile Internet are no longer clearly attributable to a single regulatory authority. Telecommunication regulators, competition authorities and media regulatory authorities increasingly have to cooperate and to decide who has the responsibility and the competency in cases relevant to all of them. In fact, inconsistencies can result from the traditional separation of ICT and media industries. Instead of an institutional hierarchy, some argue in favour of a converged regulator that would deal with all aspects of the issues. Two different approaches have frequently been discussed, a converged ICT and media regulatory authority and a multi-sector regulatory authority (see Box 20).

Box 20: Two models for changing regulatory foundations

The design of next-generation regulation

Policy and regulatory frameworks have until recently been focused on the telecommunication industry. However, technologies are changing and markets and industries are realigning and evolving. Two approaches to the design of next-generation regulation have been widely discussed in recent times: regulation of ICT and media convergence as well as multi-sector utility regulation.

Regulatory scenarios for ICT and media convergence include merging infrastructure and content regulation with cross-sectoral regulations in both the infrastructure and the content layer; technology-neutral regulation across different infrastructure platforms and independent content regulation; and greater independency between the regulations of the communications and media infrastructures.[66]

Multisector regulation strives for improving the efficiency and effectiveness of regulation in order to become a catalyst for network and economic development. The rationale for multisector regulation lies in commonly regulating essential facilities with associated rights of ways. Common use of rights of way by different infrastructure sectors such as transport, telecoms, or energy may be a justification for multisector regulation. However, the upgrade of SIM cards to credit cards in mobile communications in some countries does not make a strong case for a single regulatory authority for telecoms and financial services.[67]

Although the set of development objectives is similar in both approaches, the problems, priorities and pathways to achieving them are quite different. Each country will need to assess the options in the context of its own policy framework and the structure of its regulation.

Source: World Dialogue on Regulation, 2002.

Joint regulation of infrastructure and content may prevent inconsistencies in regulation. However, the objectives for the regulation of content-based services such as plurality of voice, impartiality, diversity of content, or high quality of content[68], are very different from, for example, telecommunication regulatory objectives (see section 4 of this paper). A combined regulatory agency for conduits and content may also enhance the risk of political capture. For example, in the European Union, the scope of regulating electronic communications covers broadcasting as well as telecommunications and cable TV networks and services. Broadcasting content is, however, excluded.

Among the advantages of multi-sector regulation are the reduction of the risk of industry capture, or uniformity of regulation across sectors in issues such as tariffs, rights of way, and consumer protection. However, there are risks of inadequate use of rules that apply to only one of the sectors, or an inadequate depth of knowledge as a result of employing people that need to supervise many sectors.[69]

On the other hand, efficiency is one of the advantages of a converged regulator, and should be borne in mind. When different approaches to regulation merge into one regulatory authority, an important question is whether there will be more or less regulation and whether a converged regulator should aim at regulating more or less.

8.3 Challenges for effective regulation

Regulatory effectiveness is enhanced by measures that reduce the need for agency decisions, enhance regulatory credibility, and use resources efficiently.[70] These measures are different for developed, transitional, and developing economies. For example, regulators in transitional and developing economies have a greater need for practical assistance, and require more straightforward approaches to increase effectiveness.

The decisions on regulatory reform with respect to the fixed-mobile cross-over have to optimize the trade-off between benefits and costs that occur when changes are made in the institutional structure of the ICT and media industries. Efficiency gains through consolidating problems into one organization may be outweighed by the loss of specific knowledge and flexibilities to react to the differentiated needs of an industry.

For effective regulation of international mobile roaming, national regulators need to enforce cost-based principles on their home operators. Also, problems presented from abroad are not addressed by foreign administrations or regulators. As one option, NRAs could implement bilateral or multilateral agreements on international roaming charges and thereby help each other's citizens.[71]

9 Conclusion and future role for ITU

This paper set out with the observation that mobile has overtaken fixed in terms of numbers of subscribers, as well as the fact that access to mobile networks is becoming a new bottleneck in telecommunications. The relationship between mobile and fixed-line communications is a lot more complex though. As a consequence, there is a lot more potential for interesting, sometimes unexpected developments that will further change the roles and functions of wired and wireless technologies in people's lives.

The effects of the fixed-mobile cross-over are nonetheless significant and have implications for the design of future policies and regulation. Governments need to rethink their spectrum policies; the interconnection policies of a plethora of different networks is an essential precondition for future growth; and mobile operators need to take new responsibilities in order to provide their services in compliance with public policy goals while exploiting emerging technologies to effectively and efficiently improve their services and create new ones.

The implications for policy and regulation will continue to grow, as we move along the road towards a society that relies increasingly on wireless communications technologies across geopolitical and socio-demographic criteria.

ITU was the specialized agency for the telegraph in the nineteenth century, and it became the specialized agency for telecommunications in the twentieth century. The fixed-mobile cross-over and the new hybrid voice and data networks are doubtless a signal for ITU to enhance its perspective. ITU, with its work to date on the overlapping and converged areas of telecommunications, and other information and communication technologies, is ideally placed to evolve into a specialized agency for all ICTs, including, *inter alia*, the Internet and mobile communications.

The ITU, among other agencies, can also provide further assistance in closely monitoring the developments in ICT industries, conducting time series analyses, building indicators, and interpreting the data and its implications for policy and regulation. In this context, it has been of great value to all of its stakeholders. In bringing regulators, policy advisors and other decision-makers from developed, transitional, and developing countries together, ITU can provide a multilateral forum to discuss the challenges related to the transition from 2G to 3G networks, the integration of telephony and IP-based networks, and the provision of enhanced services to meet universal access and service goals.

The missing link may have been found. To fully unlock the potential that mobile communications offer, there are many more issues to be addressed. The workshop 'Mobile overtakes Fixed' under the New Initiative's Programme of ITU endeavours to provide a forum that will try to find answers, but perhaps more importantly, will attempt to raise awareness and pose new questions.

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