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**European Spectrum Management: Successes,  
Failures & Lessons**

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## ***Introduction***

The European Union (EU) has long held the creation of an information society, latterly a single European information space, as a policy objective.<sup>1</sup> The liberalisation of markets has played an important role in the achievement of this goal, a process that will require many more years. Spectrum management has been important to allow the introduction of new market players, new services and new technologies. Consequently, it must continue to be managed in ways that support the achievement of these goals.<sup>2</sup>

Spectrum policy within the EU has involved global decisions made by the World (Administrative) Radio Conference of the International Telecommunication Union (ITU) and regional decisions by the *Conférence Européenne des Administrations des Postes et des Télécommunications* (CEPT) encompassing all European countries, then are assignments by the member states to individual operators. The EU institutions play two roles, firstly in coordinating the position of the member states to be taken at CEPT and ITU meetings, secondly in adopting measures that are binding on member states in the implementation of the decisions taken.

The GSM markets that were created in the 1990s contained deep and enduring flaws that have not yet been and cannot be eliminated for many years to come.<sup>3</sup> The information asymmetry between operators and customers, the low levels of competition, the high degrees of market concentration and the culture of embittered resistance to regulation have severely handicapped the efforts to achieve effective competition. The failure by the public authorities to anticipate excessive pricing allowed operators to set their own Mobile Termination Rates (MTRs), which will have taken almost two decades to reduce to cost. The high charges for international mobile roaming have proved remarkably resistant to intervention by the public authorities. Despite geographic consolidation amongst the operators, services are purely national in scope.

The problems include the creation of a small group of overweening operators that dominate policy discussions. There are also the death or the crippling of a range of other services including ERMES, TETRA and GMPCS, plus significant damage to and delay in the adoption of UMTS and WiMAX, then the divisions over mobile multimedia. Europe has seen a failure to deliver the wireless Internet.

This paper reviews the overall aims of information society policy and spectrum management. There is then an analysis of the development of GSM markets, followed by the absorption of PCS into the latter. The story of digital paging is then briefly set out. The development of digital public mobile radio is then explained. The preparation for UMTS is described, with a brief analysis of the auctions and beauty contests. The status of mobile multimedia is then described, followed by conclusions.

## ***Policy and design***

The management of spectrum, whether by command and control or by market forces serves broader policy goals, primarily of delivering the information society and through that the Lisbon agenda of jobs and growth. The primary framework for this is the creation of the single market, supported by policies for competition, spectrum and for research and development.

Despite its best endeavours, the role of the EC in spectrum remains modest, it can encourage and identify best practice, but member states have consistently refused to allow it increased control. In 1990, the Council agreed to improve coordination on the use of frequencies.<sup>4</sup> The EC then tried to push this further with a communication.<sup>5</sup> In the 1999 Review there was considerable discussion about further harmonisation of spectrum, especially following the British and German 3G auctions. The result was the adoption of a spectrum decision and the creation of two bodies to coordinate decision making, the Radio Spectrum Committee (RSC) and Radio Spectrum Policy Group (RSPG).<sup>6</sup>

In 1984, the Council of Ministers adopted a recommendation to ensure the harmonised introduction of any future telecommunications service. Member states bound themselves to:

1. consult each other, preferably in the framework of CEPT, before they introduce any new service, notably between Member States, with a view to establishing common guidelines so that the necessary innovation takes place under conditions compatible with harmonization;
2. ensure that all new services that are introduced from 1985 onwards are introduced on the basis of a common harmonized approach, notably with regard to services between Member States, so that compatible services are offered throughout Europe, taking into account the progress of work in CEPT, CEN/Cenelec, CCITT and ISO;<sup>7</sup>

The introduction of competition onto mobile markets has faced the active resistance of the incumbent fixed and also the established mobile operators. The European Commission, by its Directive 96/2/EC, forced member states to create equal conditions for all licensed players on the GSM markets, though implementation took several years.

Despite some measure of rivalry amongst the operators, primarily to acquire customers, the markets for call origination and access have been very highly concentrated (see table 1). While in most countries the market concentration continues to decline gently, the values remain a cause for concern. A policy priority has to be the introduction of additional operators.

**Table 1** *Herfindahl-Hirschman Index for mobile access markets*

	UK	IT	LT	AT	PL	EE	HU	ES	BE	FR	IE	LU	MT	SK	SI	CY
1999	2488	4304		3758				4304	5082	3829	5050	5208				
2005	2402	3353	3354	3381	3413	3581	3622	3664	3674	3794	4145	4374	5008	5072	5925	8698

Source: EC implementation reports.

On mobile termination markets there is an absolute monopoly making price regulation the only solution, even if implementation has been painfully slow.

An obvious risk of linking such highly concentrated markets to the provision of other services is of leverage of power between markets. If, say, mobile television were to be linked to GSM or to UMTS then mobile operators could easily use their power on those markets to distort the new market, even to preclude competition. A pro-competitive policy would ensure that while bundling of those services was possible at the retail level, it did not permit the leverage of such power to distort new markets. There are also risks from the creation of walled gardens that would impair and distort the distribution of content over these services.

There has been massive trading in the shares of mobile network operators. While this is not trading in spectrum *per se*, it is clear that operators can enter and exit markets by partial shareholdings or by acquisitions.

There were two waves of consolidation in Europe in the late 1990s and again in the mid-2000s, with extensive acquisitions by Vodafone, France Telecom and Telefónica de España. These were subject to conventional merger control that eliminated any overlapping interests on national markets. This was repeated elsewhere, for example, when operators based in the USA withdrew from Latin America, Telefónica de España acquired their interests. Similarly, Dennis O'Brien formerly of Esat Digifone, acquired the AT&T Wireless interests in the Caribbean for Digicel. In Africa there have many exchanges of shares and ownership, leading up to the massive MTN acquisition of Investcom for US\$ 5.5 billions.

Despite the impression that all mobile services are regulated, there have been important areas that have been entirely unregulated. Operators have been able to "upgrade" their GSM networks to offer GPRS and EDGE with no commitments to governments on the coverage or the data speeds to be offered. Indeed, they have not made any commitments to their customers, beyond a few, not entirely plausible, headline download speeds, of up to 500 kbits/second. The experience depends on network loading and contention ratios. Business users of data services expect to be offered, as they are on fixed networks, Service Level Agreements (SLAs) indicating guaranteed access, throughput and other measures of reliability. A similar story is being repeated with 3.5G where operators offer HSDPA and HSUPA with, in very general terms, speeds of "up to" 3.6Mbits/s.

The mobile operators tried to sell Wireless Access Protocol (WAP) to consumers only to prove that they could kill it from an overdose of techno-hype. Some operators tried to import i-mode from Japan, with very little success, not least because they demanded so much money from content producers in return for very few customers. It is not clear that the operators have learned the lesson of these failures.

The promises of the mobile Internet and the wireless information society remain just that and there are no signs that they will be delivered in a consistent way for a mass market. There is insufficient competition to drive the MNOs to deliver any significant services using 2.5, 3 or 3.5 G technologies. Moreover, they have deployed considerable political influence to deny, to delay and to degrade rivals who might use WiMAX and alternatives to compete. They have also sought to claim as their own the right to deliver mobile television and to avoid it having a separate identity with which they might have to compete.

There is a significant contrast between Europe and the position adopted in Japan and South Korea. There the policy model is the Ubiquitous Network Society (UNS) in which customers are to be offered: anywhere, any time, any network, any service. This could have created immensely complicated negotiations over access and interconnection, with the probability of having to introduce complex and uncertain regulations.<sup>8</sup> Instead, the governments have simplified the problem by allowing operators access to all types of infrastructure: fixed, cellular and hot spots.

Spectrum management in Europe has been a strange mix of incomplete competition, delayed regulation to mitigate earlier mistakes and enduring support for operators.

## ***The success of GSM***

The ITU WARC in 1979 allocated 862-960 MHz for use for the “mobile service” in Region 1 (Africa and Europe).<sup>9</sup> Then in 1982, the CEPT designated parts of that band for land and maritime mobile services, subsequently revising this in 1988 and 1990 to allocate 890-915 MHz and 935-960 MHz for use for GSM.<sup>10</sup> This was based on the desirability of harmonised frequency allocations throughout Europe and the intention of some countries to introduce GSM services in the near future. In 1989, the CEPT adopted a recommendation on frequency planning and coordination for GSM in border areas.<sup>11</sup>

Manufacturers and operators pushed policy-makers for more, presenting the “shortage” of spectrum as being an acute problem. Additional spectrum meant the operators had to build fewer base stations, reducing the cost of their networks and, potentially, the cost to users. However, it also meant closing the market to entry by additional rivals, removing the prospect of competition that would have driven down prices. A decision was adopted in 1994 to give a wider 900 MHz band for GSM.<sup>12</sup>

The Council of Ministers agreed that member states would ensure an initial assignment of spectrum to operators by 1 January 1991, in the 905-914 and 950-959 MHz frequency bands. This was invariably to the PTT and sometimes also to a second operator. The aim was to promote the “only means of contacting users on the move” and because second generation mobile was to be truly pan-European mobile communications.<sup>13</sup> As quickly as possible the whole of the 890-915 and 935-960 MHz bands were to be made available to operator(s). Specifications for the service were set out in a Council Recommendation.<sup>14</sup> The annex did not identify the transmission mode, leaving that to the GSM group of the CEPT, but gave detailed technical requirements. It also required the service “to be sufficiently flexible to facilitate the introduction of new services related to ISDN”, what was to become General Packet Radio Service (GPRS).

Articles 14 to 16 of the EC Treaty set out the goal of completion of the single market, making its achievement a duty on the Commission.<sup>15</sup> The adoption of a common technical standard for mobile telephony, by creating cross-border supply of equipment and services, was seen as contributing to that goal. The common technical standard also supported industry policy goals. Procurement under the GSM MoU was to “encourage a strong competitive European industrial manufacturing base”.<sup>16</sup> It was easier for the MoU signatories to take such a position than the EU, which was subject to WTO commitments.

The attraction of a common standard was that equipment, both handsets and base stations, could be built for several countries. This was to allow competition and economies of scale, which would make the system cheaper for users and thus increase its likely popularity. International mobile roaming, required tighter harmonisation to ensure handsets would work on foreign networks, the resolution of licensing problems for users of handsets from foreign countries and over-coming significant objections from security services.<sup>17</sup>

Based on Article 86 of the EC Treaty, the Commission issued the Mobile Directive 96/2/EC.<sup>18</sup> This obliged member states to remove any exclusive or special rights in respect of licences for mobile services. It allowed licensed operators to construct their own infrastructure and removed any obligation that they be required to use that provided by the fixed incumbent operator or to transit through the fixed incumbent. The EC brought actions against member states for failing to implement the directive. The European Court of Justice found against Greece, which had not

licensed a second operator. It also ensured that in Austria economically equivalent terms were imposed on the competitors and the incumbent. The EC made formal finding against the treatment of the second operators in Spain<sup>19</sup> and also in Italy.<sup>20</sup>

Following an EC proposal in 1993 the Council initiated a review of mobile telecommunications.<sup>21</sup> The result was a wide-ranging green paper, setting out the measures considered necessary to ensure that markets might become competitive and the operators freed to build networks, to interconnect and to make offers to customers. It noted that:

Mobility has a particular significance in the broader context of the European Union. On the one hand, mobility is at the very heart of the objective of the Union for the free movement of goods, people, services, and capital. On the other hand, the prospect of European-wide advanced mobile communications services, will support the commercial success of these services on the mass market.

With the pan-European digital mobile system, GSM, the European Union has established a world-leading technology in this key area of the future global communications market. The Union must now build on this success.<sup>22</sup>

As GSM services developed, the operators were assigned separate and distinct number ranges to which they gradually attached Mobile Termination Rates (MTRs), especially after the EC forced member states to allow them to interconnect. This was based on the naïve belief that the incumbent operators were obstructing them and without consideration of the market power of the mobile operators themselves. There was a brief period of tromboning traffic where some incumbent operators continued to offer a way to avoid high MTRs.<sup>23</sup> A long war has since been fought by regulators to reduce MTRs towards cost oriented prices.

### ***The absorption of PCS***

The Council of Ministers in 1990 adopted a resolution on outstanding issues for mobile telecommunications, including the mutual recognition of GSM terminals and data protection measures. The further expansion of GSM markets was envisaged through the use of the PCS or DCS 1800 band, to create new mass markets and through the promotion of GSM in Central and Eastern Europe. In particular, the Recommendation encouraged the setting up of inter-operator agreements to support international roaming service.<sup>24</sup>

The countries of the former Warsaw Pact had used the GSM band for military applications that initially could not be replaced, forcing reliance on NMT in the 450 MHz band. Gradually, these were moved and GSM services introduced. The DCS 1800 band was already available for assignment for mobile voice telephony.

A Commission communication of 23 November 1994 had established that DCS 1800 was to be treated as part of the GSM system.<sup>25</sup> It later gave the technical specifications.<sup>26</sup>

A CEPT decision in 1995, based on an assignment made at ITU WARC 1992, set out the arrangements for use of the 1710-1880 MHz band for Digital Communications Systems (DCS).<sup>27</sup> It was undertaken:

In order for Europe to keep up with the pace of cellular mobile and to strengthen its good position in the terrestrial mobile market, it is necessary to provide an adequate environment for further development of cellular mobile systems driven by market forces. With an ERC Decision on DCS 1800 a clear sign on the development of public mobile communications in Europe has been given and another step forward in European mobility has been taken.<sup>28</sup>

The Mobile Directive 96/2/EC required member states to open up the licensing of the 1900 MHz band for GSM.<sup>29</sup> Member states were to give preference to the use of pan-European standards including GSM and DCS 1800, in order to allow cross-border provision of mobile communications. This was intended to ensure competition by increasing the number of GSM operators to three or more.

In many markets the use of 1800 MHz improved competition within the GSM market, but it equally avoided competition from a different type of service, notably CDMA. Instead of being a distinct service with its own characteristics and business models, DCS was absorbed into the GSM leviathan. It allowed cross-border market entry for some of the existing players. While some new players entered the market, most quietly left, being bought out by other operators.

### *The containment of GMPCS*

An ITU World Telecommunication Policy Forum in 1996 discussed the development of Global Mobile Personal Communications Services (GMPCS).<sup>30</sup> Following this, a Memorandum of Understanding (MOU) established for type approval of terminals, licensing of terminals, marking of terminals, customs arrangements, access to traffic data and review of these.<sup>31</sup>

Services were developed by two consortia from the USA, Iridium and Globalstar, which launched Low Earth Orbit (LEO) satellites in order to provide global mobile services. However, the proponents of the schemes underestimated the adoption of GSM and especially the expansion of international mobile roaming. Both had to seek Chapter 11 bankruptcy from which they emerged with quite different business plans and with much narrower service offerings.

The EC had first addressed the issue of LEO systems in a communication of 1993, when it saw a significant market.<sup>32</sup> It also identified a risk of monopolisation of the spectrum by the USA. The Council adopted a resolution that year, pressing for action.<sup>33</sup> It was followed in 1994 by a further resolution.<sup>34</sup> Then in 1995 the EC argued a compelling need for action to ensure that the European industries had a chance to develop services with this technology.<sup>35</sup> In 1997, a decision was taken with the creation of a one-stop shop procedure for licensing.<sup>36</sup> It was proposed to extend this from 2000 until 2003.<sup>37</sup> The attempt to create the one-stop shop for satellite services failed due to a distinct lack of enthusiasm from the member states.<sup>38</sup> This confirmed their concern to keep spectrum control at the national level.

The EC produced a detailed action plan on the role of satellites in the information society.<sup>39</sup> Then in 1999, the EC argued that satellite communications should be brought into the mainstream regulatory policy on telecommunications.<sup>40</sup>

A second area where the EU felt it was at a disadvantage to the USA was that it lacked a Global Positioning System (GPS). The solution, after long delays and some uncertainty, was to be Galileo, a European GPS, free from American control.<sup>41</sup>

## ***The untimely death of ERMES***

The European Radio Messaging System (ERMES) was to be a second generation and digital pan-European paging system, allowing alphanumeric and tone messages. The intention was to use harmonised spectrum to allow the free circulation of pagers and thus to create a common market for manufacturers and, with international roaming agreements amongst the operators, for customers. In the event, it was to be killed by GSM, especially the inadvertent opening of the Short Messaging Service (SMS) to customers, which was to be adopted with such very great enthusiasm. With many of the potential ERMES customers already carrying GSM handsets when ERMES services were launched, the demand was very much less than forecast.

In 1990, the Council adopted Directive 90/544/EEC which, in the spirit of Recommendation 84/549/EEC, set out to harmonise second generation radio paging across Europe.<sup>42</sup> Prior to this the frequencies used in paging systems varied widely, the devices were incompatible and the markets for services and equipment were national. The frequencies to be used for ERMES had been identified by CEPT with the band divided into 25 kHz channels.<sup>43</sup> Specifications for terminals had also been devised.<sup>44</sup> Since not all of the band would be available in all member states, frequency hopping was specified. The technical standards were developed by ETSI.<sup>45</sup>

The signalling rate of 6.25 kbit/s was much higher than previous technologies, the messages could be longer and the network could support more subscribers per channel. Calls to ERMES could use the Calling Party Pays (CPP) principle, allowing a range of business models and could be made to individuals or to groups. The pagers themselves were smaller, lighter and had better features, with longer lasting batteries.

The EC adopted a recommendation that called on member states to introduce an ERMES service by 31 December 1992.<sup>46</sup> The geographical coverage was to be extended progressively to 25% population coverage by 1994, 50% by 1995 and 80% by 1997. Consideration was to be given to providing character sets for all eleven official languages.

Market research by the EC had identified a clear need for ERMES, suggesting that there would be 13 million users by 2000. While it estimated that only 5% of these users would require international roaming, this was considered sufficient to justify a pan-European system that would be a standard for the industry. By comparison, there were almost 200 million GSM customers in the EU-15 in 2000, rising to 350 millions in 2005, of whom 147 millions were using international mobile roaming.

In 1994 the CEPT European Radiocommunications Committee adopted a Decision designating 169.4125 - 169.8125 MHz for use for ERMES.<sup>47</sup> Then, the EC adopted a decision specifying the use of the ETSI standards for ERMES.<sup>48</sup>

It was only in 1996 with Directive 96/2/EC that the Commission forced member states to remove special rights from incumbent operators and to require competition in paging services. The EC also obliged member states to give preference to pan-European standards, including ERMES, to allow the development of trans-national services.<sup>49</sup>

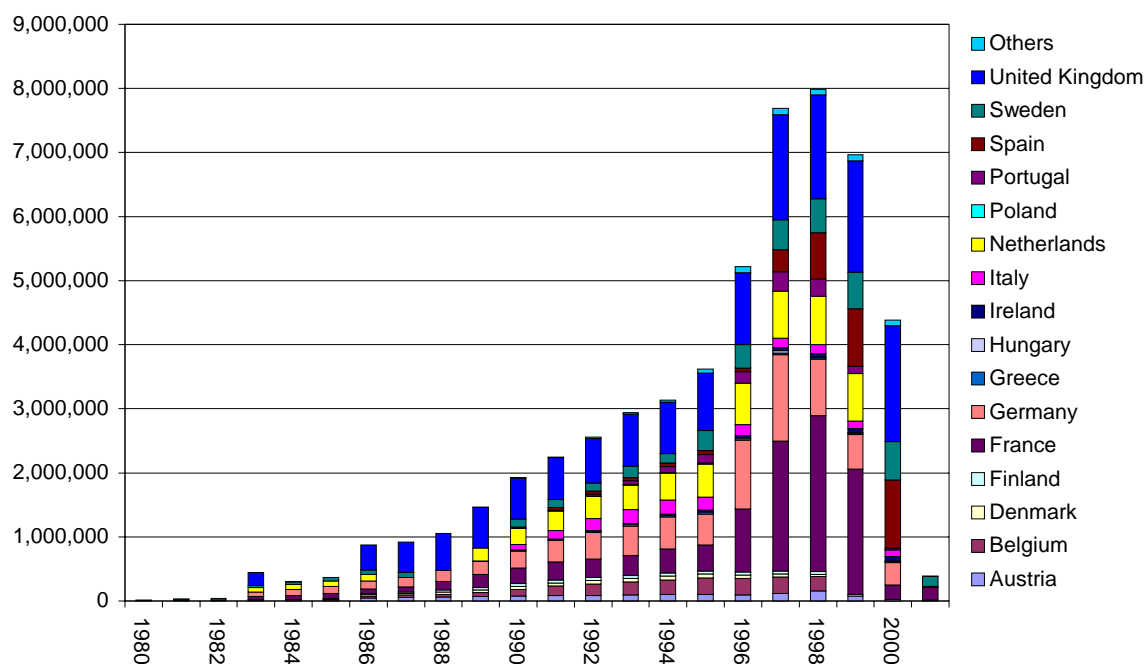
The Federal Ministry in Germany elected to auction the available channels of ERMES spectrum. WiK considered this an innovative and efficient mechanism, despite there only being three



bidders for twelve channels. The parties selected the different characteristics of the channels on offer. The auction raised a total of DM 1,874,000.<sup>50</sup>

The use of pagers continued to grow through the 1990s, indeed while small in absolute numbers compared to GSM, there was clearly demand for the service (see figure 1). It then appears to fall quite precipitously at the end of the decade. This seems to have been a mixture of countries ceasing to report the statistics, in effect exaggerating the fall, and customers responding to offers from mobile operators to switch to GSM.

**Figure 1** The rise and fall of radio-paging in the European Union



Source: ITU telecommunication statistics database.

The EC held a consultation in 1999 on its Green Paper on Spectrum.<sup>51</sup> In its response, Swissphone, a manufacturer of ERMES pagers, made criticisms of the additional cost of the multi-frequency facility and of administrative delays, especially in Germany and the UK.<sup>52</sup> Others had noted the perennial problem of the handsets being late and expensive.

In 2002, the Radio Spectrum Committee (RSC) invited comments from member states on the future of the ERMES spectrum.<sup>53</sup> The following year, the EC gave a mandate to CEPT to review “future possible applications” for the ERMES spectrum, since use had “severely diminished” to a point where in some member states the band was not being used at all.<sup>54</sup> Late in 2004 the CEPT reported on the options: hearing aids, social alarms, tracking or tracing systems, meter reading systems, paging and PMR systems.<sup>55</sup>

There was a complex and superficially circular set of liaison statements, mandates and reports between the CEPT and the EU. The Electronic Communications Committee (ECC) asked the EC to consider withdrawal of Directive 90/544/EEC concerning harmonised spectrum for ERMES. The ECC indicated it would withdraw its own Decision (94)02, once new applications for the band had been agreed. The ECC report accepted the demise of ERMES.<sup>56</sup> The EC stressed the

need for applications that required harmonisation.<sup>57</sup> Then, finally, there was a compromise on the downgrading of ERMES to one of a set of possible applications in the band.<sup>58</sup>

In early 2005, the ECC revoked the ERMES spectrum assignment, because in most CEPT countries the allocated band was no longer being used.<sup>59</sup> Then in mid-2005, having received a positive opinion from the Radio Spectrum Committee, the EC adopted a proposal to repeal Directive 90/655/EEC. Finally, in December 2005 a decision was adopted that re-assigned the spectrum in line with the CEPT proposals.<sup>60</sup>

Thus ended the ERMES project after fifteen years. However, there was never a full autopsy or inquest, leaving the causes of death only very incompletely understood.

### ***The truncation of TETRA***

EU countries had a range of national Private Mobile Radio (PMR) and Public Access Mobile Radio (PAMR) services, though as with other first generation radio services these varied greatly in frequencies and technologies. Again, the EC sought to achieve a transition to a harmonised pan-European second generation service, using standards developed by ETSI.<sup>61</sup> Deployment was supported by the Tetra Memorandum of Understanding (MoU).<sup>62</sup>

The TETRA project began in 1989 as Mobile Digital Trunked Radio System (MDTRS), later renamed as Trans European Trunked RAdio (TETRA), then Europe was dropped from the name to increase its appeal, TErrestrial Trunked RAdio. The air interface was specified in 1995 and the first service became operational in 1997. Release 2, with a range of additional services, was approved by in 2000. The EC adopted a decision on handsets for the emergency services.<sup>63</sup>

The ERC designated 410-430 MHz and/or 870-876/915-921 MHz as being the preferred bands for TETRA and, if not available, 450-470 MHz and 385-390/395-399.9 MHz for the introduction of TETRA for civil use. The CEPT assigned 380-383 MHz and 390-393 MHz for use by the emergency services.<sup>64</sup>

TETRA was, almost from the outset, in the shadow of GSM. Many of the civilian applications could be handled more cheaply with GSM and companies faced the challenge of persuading employees who already carried a GSM handset to carry a bulkier TETRA device or a dual-mode handset. In large measure the technology mirrored GSM, with the counterparts of SMS and GPRS. While it had clear advantages, in encryption and in coverage, both inside buildings and in rural areas, it struggled commercially. Dolphin, one of the leading commercial operators, went bankrupt.

### ***The third generation***

In 1997, the EC adopted a communication on the wireless information society.<sup>65</sup> This raised the question of whether it was the “right moment” to develop a strategy for the introduction of Universal Mobile Telecommunications Service (UMTS). The answer was in the affirmative, with the EC setting out policies for its adoption in order that Europe and the operators might remain at the “forefront of mobile technology”.

The EC adopted a communication in preparation for ITU WRC 1997, to support the allocation of spectrum for UMTS.<sup>66</sup> The first decision by CEPT on UMTS was also taken in 1997.<sup>67</sup> Then in 1999 it was agreed to assign part of the 1900 MHz band for UMTS.<sup>68</sup> This was subsequently extended in 2000 so that the bands 1900, 2100 and 2170 MHz bands could be used for UMTS.<sup>69</sup> In 2005 the CEPT designated 2500-2690 MHz for use for UMTS.<sup>70</sup>

In order to coordinate the introduction of UMTS, the EC proposed a decision in 1998.<sup>71</sup> This was subject to consultation with manufacturers and operators, then a common position was adopted by the Council.<sup>72</sup> Finally, the European Parliament, the Council of Ministers and the European Commission agreed, at the end of 1998, on the Decision.<sup>73</sup> The aim was to facilitate:

... the rapid introduction of compatible UMTS networks and services in the Community on the basis of internal market principles and in accordance with commercial demand by means of co-ordination of national licensing regimes.

Member states bound themselves to take the measures necessary to allow the harmonised provision of the UMTS services on their territories no later than 1 January 2002 and to have a licensing system in place by 1 January 2000. This meant they had to accelerate licensing and to provide for UMTS, but not necessarily to ensure that it was provided. In doing so they had to conform to the CEPT frequency bands and to the ETSI technical standards.

There was a bare minimalism in recognition of trans-national markets. The member states were to support roaming between licensed operators, in effect keeping it as a special right, but doing nothing to resolve the problems identified by DG Competition. There was no serious consideration of licences for multi-country spectrum.

The only technology to be used was to be UMTS, though sometimes this was conjoined with IMT2000, allowing the possibility that cdma2000 or TD-SCDMA might be used. This was despite the absence of an upgrade path from GSM. It was to be “slash and burn” for the digital age, with very little being carried forward. In particular, it required many new base stations and also new handsets, which have invariably been delivered late by the manufacturers. The implication was that money was not a problem.

There was a presumption of demand for 3G services, with a stress on Location-Based Services (LBS), though this was to be overtaken by the image of Games Gambling and Girls. There was very little concern about the upstream markets that were need to develop services.

Beyond some references to the principles of competition law and to Directive 96/2/EC, there was little consideration of the established problems. No efforts were made to ensure that 3G avoided the failings of 2G. While there was an urgency to deploy, it was to keep up with other parts of the world, rather than from a fear of 4G or alternative technologies.

### ***Auctions, beauty contests and trading***

The idea of auctioning public goods is not new, the United Kingdom auctioned positions in the army until the middle of the nineteenth century. The mismanagement of the Crimean War saw this abandoned in favour of a more meritocratic approach, if not a beauty contest.

In the USA, the application of auctions to radio spectrum was authorised by the Omnibus Budget Reconciliation Act of 1993.<sup>74</sup> Experience of this approach quickly showed some problems in their design, including signalling and collusion amongst bidders.<sup>75</sup>

However, it was in Europe and in particular in Germany and the United Kingdom that the full horrors of auctions were discovered. Linking the sale of spectrum to volatile and irrational financial markets caused a positive feedback loop driving up prices. Some operators subsequently tried to argue that there was “implicit” Value Added Tax (VAT) in the fees paid and that this could be reclaimed. The EU courts have rejected this argument.<sup>76</sup>

At the time of UMTS licensing, the member states retained full authority over the assignment of spectrum and took quite divergent paths, in which some conducted auctions and others beauty contests. A post-mortem was conducted by McKinsey & Company on behalf of the European Commission.<sup>77</sup> However, it was limited to the views of manufacturers, operators and regulators, excluding users and independent content or service providers. The focus was on what had gone wrong for the operators rather than for the Lisbon agenda and the wireless information society. There was a one-day public hearing and a series of comments by operators, manufacturers and industry associations, with considerable interest in reduction of the commitments into which the operators had entered.

It was not only auctions that could be botched. The third licence for GSM in the Republic of Ireland was issued by a beauty contest to Meteor. Orange, a loser in the contest, appealed in the High Court, delaying the introduction of service by Meteor by eighteen months.

The European Commission had a study undertaken by consultants on secondary trading of spectrum.<sup>78</sup> This recommended that the EC should move ahead on spectrum trading and liberalisation, in the narrow sense of being allowed to change the use of spectrum through binding EU measures. It suggested that many details could be devolved to member states. Competition law, including the Merger Regulation, were considered sufficient to ensure trading did not adversely affect the level of competition.

The report was the subject of a “public” consultation which generated a wide range of responses from the industry and member states.<sup>79</sup> Even the EC conceded that there was no consensus on this, with stiff resistance from several member states. The EC proposed a framework to facilitate trading in the 2006 Review.<sup>80</sup>

There appear to be two views in the EC positions on spectrum. That it should be made technology neutral or liberalised from specific applications and that new spectrum should be obtained from the ITU for specific applications. This apparent confusion may lead to a pre-emption of new spectrum by existing spectrum users and the exclusion of potential new users which would have serious effects on competition on the wireless Internet access markets.

To permit trading of spectrum amongst players on markets that are, at best, highly concentrated risks trouble. While it may benefit licensed operators, it seems extraordinarily unlikely to make the markets more competitive. Given long-standing concern about tacit collusion, trading will simply add to the obscurity. It seems an improbable way for a new entrant to acquire spectrum and more likely a means for existing players to acquire new applications. There has been no serious analysis of the likely effects on competition or new market entry of spectrum trading.

### ***Additional spectrum bands***

For all that the 3GSM operators claimed that they wish to see market forces applied to the auctioning of spectrum and its subsequent trading, they refuse to forebear from lobbying and pleading at any opportunity, showing fear and loathing of alternative technologies. The possibility of additional spectrum bands that might be used to compete with UMTS has resulted in a number of positions from the operators which are nakedly political and obstructionist. They have sought to delay the release of spectrum and to constrain its use or to tie its use to their services. In doing so they have sought to pre-empt competition on the market.

The EU finds itself in the difficult position of having several spectrum bands that require to be (re-)designated for use and where past errors have to be recognised. The ERMES spectrum has been reassigned, but that leaves the so-called UMTS expansion band around 2.5GHz and the 2.0 and 2.1 GHz bands. Ultimately, the 900 MHz and 1800 MHz bands which are specified for GSM, need to be made technologically neutral, allowing use of a range of technologies. In reality, the only conceivable change is the switch to UMTS, which the operators cannot make while they claim they need the 2.5 GHz band, because of a spectrum shortage. There has been some public discussion of this possibility.

In June 2005, the EC conducted a public consultation on what it termed, Wireless Access Platforms for Electronic Communications Services (WAPECS).<sup>81</sup> The responses were somewhat varied, with limited agreement except, almost inevitably, amongst the group of broadcasters and the group of mobile operators, both seeking to protect their vested interests. The complex and politically difficult transition from analogue to digital broadcasting and the extent to which broadcasting could be sheltered as public service, technically a Service of General Economic Interest (SGEI), were raised but without agreement.

The development of digital mobile television has shown that one lesson from GSM has been lost, namely the need for economies of scale across the EU for a single technology. This was made clear at the EC workshop in February 2006 where there were a series of highly complex and mutually incompatible and contradictory proposals.<sup>82</sup> Different parties proposed Digital Audio Broadcast (DAB), Digital Multimedia Broadcast (DMB) and Digital Video Broadcast (DVB-H) but without any way in which the EU might make a selection or any hope that a consensus might be achieved. There appeared no obvious policy mechanism for the EC to bring the issue to a conclusion.

At the instigation of the 3GSM operators, DG Competition undertook a sector inquiry into the question of their access to certain types of content, in particular sports clips and broadcasts. However, the result while improving the level of knowledge of the EC offered little for the operators.<sup>83</sup> The reverse argument could be applied, with a dominant oligopoly of mobile operators seeking to charge excessive rates to carry premium sports content and also moving to block the broadcasters from alternative technologies.

The EC published a report by consultants on the assignment of spectrum and the information made available to current and potential users.<sup>84</sup> It then held a workshop on collective or shared use of spectrum in April 2006.<sup>85</sup> This set out the work of the consultants and raised issues for debate within the sector, including improvements to the classes of use and the opening of more spectrum. In parallel to this, there was a study by the JRC on the future requirements for spectrum, this set out some rather speculative ideas about the requirements for 4G.<sup>86</sup>

There is little common ground among the various protagonists. Some favour the use of only market forces, others want certain public services to be separated. The member states are clearly extremely reluctant to give up their powers to the EC.

### ***Conclusion***

The myth of the success of GSM has hung over or intruded upon every administrative and commercial decision about spectrum or wireless services taken in Europe in the last fifteen or twenty years, for good or for ill.

GSM has caused the death of ERMES, the fatal wounding of TETRA and the reduction of GMPCS to a tiny niche. It also turned the 3G auctions into a re-enactment of the Charge of the Light Brigade.<sup>87</sup> Yet, perhaps the most damaging decision was the least noticed, the conversion of the 1800 MHz spectrum to GSM and with it the loss of the prospect of competition between technologies. Thereafter, anything that was “mobile” was to be sucked into what has since become known as “3GSM”; it was to be part of the leviathan. Competition was to be contained within one model, controlled by the “mobile” operators.

The GSM markets remain severely flawed, despite massive regulatory intervention that is destined to continue for many years. The lessons of such errors have not been taken into account in more recent spectrum assignment exercises. A notable example is that the mobile termination rates for 3G networks are already being regulated and in a few months will be joined by regulation of 3G voice roaming rates. New services come with old bottlenecks.

The very limited successes, so far, of HSCSD, GPRS, WAP, EDGE, UMTS, HSDPA, HSUPA, DxB and WiMAX, together with the enduring abuses associated with GSM make clear that the market structures are not fit for purpose. New services on these networks cannot be taken up quickly and deployed on the market. In particular, third parties struggle to find routes to their customers over cellular data networks faced with walled gardens and the inability to negotiate reasonable rates for access from the mobile operators.

The EC and the member states have been too prescriptive, too slow to change and have created markets that are too heavily concentrated and too nationalistic. The level of harmonisation achieved is very modest and its achievement is so precarious that the work cannot be undone for many years. The operators have assumed that, like GSM, they would have years to deploy and modify service offerings and prices. Neither group has adjusted to an accelerated pace of technological change.

In all of the new services there is a significant and sometimes massive information asymmetry between customers and operators. The operators know what they selling, but convey only a few technological headlines to their potential customers. Even pricing is a problem, with the likely costs to users being impossible to predict. Business customers will not easily be persuaded to adopt a service without being able to make an accurate budget. There are no data on the quality of service of individual operators, especially on data speeds where the operators talk about “up to” rather than average or peak loads. This leaves the customer to make a pseudo-random choice amongst competitors, with high switching costs in the event of a mistake.

The failure to deliver the single European wireless information space is very disappointing. There are a few Canadian electronic mail devices and some limited use of IEEE 802.11, but the rest is a mix of national services that are still not widely used. There is a large market for ringtones. Cameras on mobile phones are extensively used, but more to upload video clips onto MySpace or YouTube rather than to be send as an MMS.

Much of the fuss about auctions and secondary trading has been addressed at the wrong problem. Their proponents are looking at a degree of granularity one order of magnitude more detailed than the significant issues. They are troubled by mere shadows of the problems, what Plato termed idols of the cave.<sup>88</sup>

The only certainty is of enduring and seemingly accelerating change. Thus the necessity and priority must be for market structures with sufficient competition to generate, to absorb and to profit from succeeding waves of technological change or opportunity. The real issues concern market design, the introduction of trans-national services and the admission of innovative market players.

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