



## Research that changes the way we live

# Mobile Telephony



- *Marconi filed the world's first patent for wireless telegraphy*
- *The UK pioneered competition in mobile services, leading to the creation of the world's largest mobile phone company*
- *Research programmes have resulted in new generations of mobile technology to cope with exponential market growth*

### What is it?

Given that most people in the developed world now have a personal mobile telephone, this may well seem a superfluous question, since it is now clearly a small battery powered telephone that can make and receive calls by radio almost everywhere. But only 20 years ago this was not the case.

Trials of the first cellular networks began in the early 1980's, and in 1982 the UK government invited submissions for a license to operate a second UK network to compete with a subsidiary of the newly privatised British Telecom. This competition was won by a consortium led by Racal Electronics, which later became Vodafone. Both companies launched their first services in 1985, but at that time mobile telephones were only installed in cars as they were heavy and needed substantial battery power. The first portable phones arrived soon after, although initially their price was high enough to deter almost everyone. Despite this, the market grew rapidly, prices fell quickly and the highly competitive UK market became one of the most dynamic in the world.

These early phones used analogue technology, but for historic and political reasons, most countries chose to develop and introduce their own standard, often championed by local industry. Consequently, by 1990 Europe alone had six incompatible analogue standards, with many others around the world. So few customers could use their phone outside their own country, and few markets enjoyed the benefit of any substantial volume production to help drive costs down and encourage consumers.

Fortunately, in 1982 work had started to develop a second generation Pan-European digital standard, which became known as GSM. Endorsement by the EEC in 1987 resulted in launches in most EU countries from 1991 onwards, with the result that international roaming became possible. At last, the common technology meant that real volume production became possible, prices dropped substantially and customer adoption rates soared. Today more than 1.5 billion people in over 200 countries use a GSM mobile phone, making it by far the world's most successful mobile technology.

### The science

The single most important idea behind the explosive growth in mobile telephony was arguably the cellular principle of frequency re-use, attributed to D H Ring at Bell Laboratories in 1947. Until then, radio transmissions used the highest possible mast heights and powers to achieve maximum range. However, frequency spectrum is a scarce and finite resource.

The cellular concept argued that, at least for urban environments, both the power levels and base station antenna heights should be as low as possible so that the same frequencies could be reused many times, even within one city. However, to achieve continuous communication on the move, calls must be able to be passed from one base station to the next. It was to be another 30 years before advances in semiconductor and computing technology were to make this possible in practice.

Today's mobile telephone undoubtedly contains more advanced technologies than any other personal item. Many research initiatives over the last 30 years have contributed, with the DTI & SERC's Alvey and LINK Personal Communications Programmes being perhaps the most significant within the UK. At a European level, UK participants have also been very active in RACE, Esprit and Eureka projects.



*An early portable cellular telephone (1986)*

## Mobile Telephony timeline

1896	Marconi patents wireless telegraphy
1897	Marconi achieves wireless transmissions over 10 miles & opens first wireless factory in Chelmsford
1921	Mobile radio adopted by Detroit police
1947	Cellular concept first proposed by Ring at Bell labs
1978	First cellular trial by AT&T in Chicago
1981	Nordic Mobile telephone service commenced
1982	UK competition for a second cellular license won by Racal Millicom (later to become Vodafone) First meeting held to discuss a new digital cellular standard for Europe SERC Specially Promoted Programme in Radio Communications Systems research established
1983	UK 1 <sup>st</sup> generation TACS analogue standard specified, based on US AMPS Alvey Programme in communications research commenced
1984	Motorola launch first handheld AMPS cellular phone
1985	Vodafone & Cellnet launch first UK cellular services
1987	EEC commit to a common Pan-European digital standard (GSM ) LINK Personal Communications Programme established
1991	First GSM services launched with international roaming
1996	UK TACS analogue networks closed
1999	Vodafone merges with AirTouch
2000	Vodafone acquires Mannesmann AG, to become the world's largest mobile phone company
2003	First 3G services launched

## The future

As the internet revolution gathered pace, there has been an increasing demand for higher speed mobile data and internet access. GSM networks are now introducing EDGE (Enhanced Data rates for GSM Evolution) technology to triple current data rates, but it has become clear that a third generation of mobile technology would be required to keep pace with developments in fixed broadband access networks.

This time, the GSM standards bodies collaborated with others globally to develop the 3G standard which is now being introduced as an evolutionary step in most major GSM markets. And already 3G is being further enhanced to provide even faster data rates with HSDPA (high speed downlink packet access).

Unsurprisingly, work has also commenced to define and develop a fourth generation of technology, but there is as yet no real consensus of what 4G will actually be, or when it will become available. But we can be reasonably certain that it will offer greater spectrum efficiency, even higher data rates and a wider range of services.

The latest phones now include still and movie cameras, video telephony, personal organisers, music players, Email clients and web browsers. They have become both affordable and indispensable to many of us as we go about our daily lives. But, as with other high technology consumer items, most of us never fully exploit the potential of these tiny miracles of highly sophisticated engineering.

