WIKIPEDIA

History of mobile phones

The **history of mobile phones** covers mobile communication devices that connect wirelessly to the public switched telephone network.

While the transmission of speech by radio has a long history, the first devices that were wireless, mobile, and also capable of connecting to the standard telephone network are much more recent. The first such devices were barely portable compared to today's compact hand-held devices, and their use was clumsy.

Along with the process of developing a more portable technology, and a better interconnections system, drastic changes have taken place in both the networking of wireless communication and the prevalence of its use, with smartphones becoming common globally and a growing proportion of Internet access now done via mobile broadband.

A man talks on his mobile phone while standing near a conventional telephone box, which stands empty. Enabling technology for mobile phones was first developed in the 1940s but it was not until the mid 1980s that they became widely available. By 2011, it was estimated in the United Kingdom that more calls were made using mobile phones than wired devices.[1]

Contents

Further reading

Predecessors

Before the devices existed that are now referred to as mobile phones or cell phones, there were some precursors. In 1908, a Professor Albert Jahnke and the Oakland Transcontinental Aerial Telephone and Power Company claimed to have developed a wireless telephone. They were accused of fraud and the charge was then dropped, but they do not seem to have proceeded with production.[2] Beginning in 1918, the German railroad system tested wireless telephony on military trains between Berlin and Zossen.[3] In 1924, public trials started with telephone connection on trains between Berlin and Hamburg. In 1925, the company Zugtelephonie AG was founded to supply train telephony equipment and, in 1926, telephone service in trains of the Deutsche Reichsbahn and the German mail service on the route between Hamburg and Berlin was approved and offered to first-class travelers.[4]

Fiction anticipated the development of real world mobile telephones. In 1906, the English caricaturist Lewis Baumer published a cartoon in Punch magazine entitled "Forecasts for 1907" in which he showed a man and a woman in London's Hyde Park each separately engaged in gambling and dating on wireless telephony equipment.[5] Then, in 1926, the artist Karl Arnold created a visionary cartoon about the use of mobile phones in the street, in the picture "wireless telephony", published in the German satirical magazine Simplicissimus.[6]

Karl Arnold drawing of public use of mobile telephones

The Second World War made military use of radio telephony links. Hand-held radio transceivers have been available since the 1940s. Mobile telephones for automobiles became available from some telephone companies in the 1940s. Early devices were bulky, consumed high power, and the network supported only a few simultaneous conversations. Modern cellular networks allow automatic and pervasive use of mobile phones for voice and data communications.

In the United States, engineers from Bell Labs began work on a system to allow mobile users to place and receive telephone calls from automobiles, leading to the inauguration of mobile service on 17 June 1946 in St. Louis, Missouri. Shortly after, AT&T offered *Mobile Telephone Service*. A wide range of mostly incompatible mobile telephone services offered limited coverage area and only a few available channels in urban areas. The introduction of cellular technology, which allowed re-use of frequencies many times in small adjacent areas covered by relatively low powered transmitters, made widespread adoption of mobile telephones economically feasible.

In the USSR, Leonid Kupriyanovich, an engineer from Moscow, in 1957-1961 developed and presented a number of experimental pocket-sized communications radio. The weight of one model, presented in 1961, was only 70 g and could fit on a palm.[7][8] However, in the USSR the decision at first to develop the system of the automobile "Altai" phone was made.[9]

In 1965, Bulgarian company "Radioelektronika" presented on the Inforga-65 international exhibition in Moscow the mobile automatic phone combined with a base station. Solutions of this phone were based on a system developed by Leonid Kupriyanovich. One base station, connected to one telephone wire line, could serve up to 15 customers.[10]

The advances in mobile telephony can be traced in successive *generations* from the early "0G" services like MTS and its successor Improved Mobile Telephone Service, to first-generation (1G) analog cellular network, second-generation (2G) digital cellular networks, third-generation (3G) broadband data services to the state-of-the-art, fourth-generation (4G) native-IP networks.

Early services

MTS

In 1949, AT&T commercialized Mobile Telephone Service. From its start in St. Louis, Missouri, in 1946, AT&T introduced Mobile Telephone Service to one hundred towns and highway corridors by 1948. Mobile Telephone Service was a rarity with only 5,000 customers placing about 30,000 calls each week. Calls were set up manually by an operator and the user had to depress a button on the handset to talk and release the button to listen. The call subscriber equipment weighed about 80 pounds (36 kg)[11]

Subscriber growth and revenue generation were hampered by the constraints of the technology. Because only three radio channels were available, only three customers in any given city could make mobile telephone calls at one time.[12] Mobile Telephone Service was expensive, costing 15 USD per month, plus 0.30 to 0.40 USD per local call, equivalent to about 176 USD per month and 3.50 to 4.75 per call in 2012 USD.[11]

In the UK, there was also a vehicle-based system called "Post Office Radiophone Service,"[13] which was launched around the city of Manchester in 1959, and although it required callers to speak to an operator, it was possible to be put through to any subscriber in Great Britain. The service was extended to London in 1965 and other major cities in 1972.

IMTS

AT&T introduced the first major improvement to mobile telephony in 1965, giving the improved service the obvious name of **Improved Mobile Telephone Service**. IMTS used additional radio channels, allowing more simultaneous calls in a given geographic area, introduced customer dialing, eliminating manual call setup by an operator, and reduced the size and weight of the subscriber equipment.[11]

Despite the capacity improvement offered by IMTS, demand outstripped capacity. In agreement with state regulatory agencies, AT&T limited the service to just 40,000 customers system wide. In New York City, for example, 2,000 customers shared just 12 radio channels and typically had to wait 30 minutes to place a call.[11]

Radio Common Carrier

Radio Common Carrier[14] or **RCC** was a service introduced in the 1960s by independent telephone companies to compete against AT&T's IMTS. RCC systems used paired UHF 454/459 MHz and VHF 152/158 MHz frequencies near those used by IMTS. RCC based services were provided until the 1980s when cellular AMPS systems made RCC equipment obsolete.

A mobile radio telephone

Some RCC systems were designed to allow customers of adjacent carriers to use their facilities, but equipment used by RCCs did not allow the equivalent of modern "roaming" because technical standards were not uniform. For example, the phone of an Omaha, Nebraska–based RCC service would not be likely to work in Phoenix, Arizona. Roaming was not encouraged, in part, because there was no centralized industry billing database for RCCs. Signaling formats were not standardized. For example, some systems used two-tone sequential paging to alert a mobile of an incoming call. Other systems used DTMF. Some used *Secode 2805*, which transmitted an interrupted 2805 Hz tone (similar to IMTS signaling) to alert

mobiles of an offered call. Some radio equipment used with RCC systems was half-duplex, push-to-talk LOMO equipment such as Motorola hand-helds or RCA 700-series conventional two-way radios. Other vehicular equipment had telephone handsets and rotary dials or pushbutton pads, and operated full duplex like a conventional wired telephone. A few users had full-duplex briefcase telephones (radically advanced for their day)

At the end of RCC's existence, industry associations were working on a technical standard that would have allowed roaming, and some mobile users had multiple decoders to enable operation with more than one of the common signaling formats (600/1500, 2805, and Reach). Manual operation was often a fallback for RCC roamers.

Other services

In 1969 Penn Central Railroad equipped commuter trains along the 360 kilometres (220 mi) New York-Washington route with special pay phones that allowed passengers to place telephone calls while the train was moving. The system re-used six frequencies in the 450 MHz band in nine sites.[12]

In the UK, Channel Islands and elsewhere the "Rabbit" phone system was briefly used, being a hybrid of "cell" base stations and handsets. One major limitation was that you had to be less than 300 feet (closer with buildings) from a base due to power limitations on a portable device. [15] With modern technology a similar variant is being considered for Apple's new 4G "smart watch" so they can be used in large events in a broadly similar way to a femtocell.

European mobile radio networks

In Europe, several mutually incompatible mobile radio services were developed.

In 1966 Norway had a system called OLT which was manually controlled. Finland's ARP, launched in 1971, was also manual as was the Swedish MTD. All were replaced by the automatic NMT, (Nordic Mobile Telephone) system in the early 1980s.

In July 1971 Readycall was introduced in London by Burndept after obtaining a special concession to break the Post Office monopoly to allow selective calling to mobiles of calls from the public telephone system. This system was available to the public for a subscription of £16 month. A year later the service was extended to two other UK towns.[16]

West Germany had a network called A-Netz launched in 1952 as the country's first public commercial mobile phone network. In 1972 this was displaced by B-Netz which connected calls automatically.

The cellular concept

In December 1947, Douglas H. Ring and W. Rae Young, Bell Labs engineers, proposed hexagonal cells for mobile phones in vehicles.[17] At this stage, the technology to implement these ideas did not exist, nor had the frequencies been allocated. Two decades would pass before Richard H. Frenkiel, Joel S. Engel and Philip T. Porter of Bell Labs expanded the early proposals into a much more detailed system plan. It was Porter who first proposed that the cell towers use the now-familiar directional antennas to reduce interference and increase channel reuse (see picture at right)[18] Porter also invented the dial-then-send method used by all cell phones to reduce wasted channel time.

In all these early examples, a mobile phone had to stay within the coverage area serviced by one base station throughout the phone call, i.e. there was no continuity of service as the phones moved through several cell areas. The concepts of frequency reuse and handoff, as well as a number of other concepts that formed the basis of modern cell phone technology, were described in the late 1960s, in papers by Frenkiel and Porter. In 1970 Amos E. Joel, Jr., a Bell Labs engineer,[19] invented a "three-sided trunk circuit" to aid in the "call handoff" process from one cell to another. His patent

contained an early description of the Bell Labs cellular concept, but as switching systems became faster, such a circuit became unnecessary and was never implemented in a system.

A cellular telephone switching plan was described by Fluhr and Nussbaum in 1973,[20] and a cellular telephone data signaling system was described in hipatitas by Hachenburg et al.[21]

A multi-directional, cellular network antenna array ("cell tower")

Emergence of automated services

The first fully automated mobile phone system for vehicles was launched in Sweden in 1956. Named MTA (Mobiltelefonisystem A), it allowed calls to be made and received in the car using a rotary dial. The car phone could also be paged. Calls from the car were direct dial, whereas incoming calls required an operator to locate the nearest base station to the car. It was developed by Sture Laurén and other engineers at Televerket network operator. Ericsson provided the switchboard while Svenska Radioaktiebolaget (SRA) and Marconi provided the telephones and base station equipment. MTA phones consisted of vacuum tubes and relays, and weighed 40 kilograms (88 lb). In 1962, an upgraded version called *Mobile System B (MTB)* was introduced. This was a push-button telephone, and used transistors and DTMF signaling to improve its operational reliability. In 1971 the MTD version was launched, opening for several different brands of equipment and gaining commercial success.[22][23] The network remained open until 1983 and still had 600 customers when it closed.

In 1958 development began on a similar system for motorists in the USSR.[24] The "Altay" national civil mobile phone service was based on Soviet MRT-1327 standard. The main developers of the Altay system were the Voronezh Science Research Institute of Communications (VNIIS) and the State Specialized Project Institute (GSPI). In 1963 the service started in Moscow, and by 1970 was deployed in 30 cities across the USSR. Versions of the Altay system are still in use today as a trunking system in some parts of Russia.

In 1959 a private telephone company in Brewster, Kansas, USA, the S&T Telephone Company, (still in business today) with the use of Motorola Radio Telephone equipment and a private tower facility, offered to the public mobile telephone services in that local area of NW Kansas. This system was a direct dial up service through their local switchboard, and was installed in many private vehicles including grain combines, trucks, and automobiles. For some as yet unknown reason, the system, after being placed online and operated for a very brief time period, was shut down. The management of the company was immediately changed, and the fully operable system and related equipment was immediately dismantled in early 1960, not to be seen again.

In 1966, Bulgaria presented the pocket mobile automatic phone RAT-0,5 combined with a base station RATZ-10 (RATC-10) on Interorgtechnika-66 international exhibition. One base station, connected to one telephone wire line, could serve up to six customers ("Radio" magazine, 2, 1967; "Novosti dnya" newsreel, 37, 1966).

One of the first successful public commercial mobile phone networks was the ARP network in Finland, launched in 1971. Posthumously, ARP is sometimes viewed as a *zero generation* (0G) cellular network, being slightly above previous proprietary and limited coverage networks.

Handheld mobile phone

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.