The Magic of Radio - and Radar - and my own career

Nowadays we all accept the magic of radio without thinking much about it. It is everywhere - TV, digital radio, satellite broadcasting, mobile and cordless phones, WIFI, satnav, smart meters, Bluetooth, door-openers, remotely controlled street-lighting, radar speed-measurement ..... How would we cope if 'radio' suddenly stopped working? Let's go back 120 years to 1897, a key year in Marconi's experiments! That's when radio began.

But radio hasn't had it all its own way! In some roles radio has been pushed aside by new technologies.

I'm going to tell some of the story, in sections which mainly relate to phases in my own life.

1897 to 1932

Messages had been sent electrically using wires in about 1791 ***(the first was "si vous réussissez, vous serez bientôt couverts de gloire"***). The telegram service in this country started in about 1850 and telephones in the 1870s. By the 1920s both services were flourishing and people were beginning to be aware of radio following primitive use in WW1. It is said (probably unreliably) that Einstein was asked about radio and responded ***"...wire telegraph is a kind of very, very long cat. You pull his tail in New York and his head is meowing in Los Angeles. Do you understand this? And radio operates exactly the same way: you send signals here, they receive them there. The only difference is that there is no cat."***. (Obviously magic!)

1932 to 1952

I was born in 1932. By then the BBC had been established, and Broadcasting House was opened in that very year. I don't know whether there was a wireless set in our household then; radio was rapidly expanding and in that year over 4 million radio receiving licences were issued at a cost of 10 shillings. Many people still used 'crystal sets' since valve-radios were expensive. Indeed 10 years later the wartime 'utility' radios cost £12 3s 4d, the equivalent of over £500 today. But that was no good for us, since we didn't have electricity! We had a battery radio though. But oh no, not a set of today's small AA batteries. A 1940s 'portable' radio had a heavy set of batteries, a large 90 volt 'HT' battery, a 'grid-bias' battery, and a rechargeable 'accumulator' ,which the local bicycle shop recharged weekly.

The better radios had 3 bands - long-wave, medium-wave, and short-wave. The 'BBC Home Service' used medium-wave, and then in 1945 the 'Light Programme' was introduced on long-wave, followed by the 'Third Programme'. Short-wave was far more exotic, with distant stations, and very strange warbling noises. Actually short-wave was rather important for international communications - and quite important in my career.

In 1952 h.f.(high-frequency - short wave, bouncing off the ionosphere) was the most important way of communicating over long distances using morse and radio telegraphy as well as telephony. For telephony, quality and reliability were poor but there was no alternative at that time. There were not as yet any submarine telephone cables, and satellites did not yet exist.

Of course radio had by now spawned new technologies - first television, then radar , and radio navigation aids. (All 'magic' in their different ways!)

The last two were first applied during WW2, but rapidly adapted for commercial marine and air navigation Decca launched its first radar, the very successful 159 marine radar in 1949. And the Decca Navigator network was hugely important.

My degree (1949-1952) taught me nothing about radio as far as I can remember. A limited amount of electronics in the course was based on thermionic valves. The transistor had been invented in 1949, but was not yet commercially available.

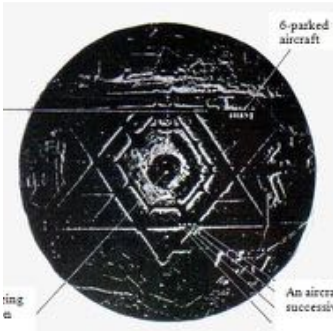
1952 to 1965

Then I became an R.A.F. Navigator, trained in Canada. Navigational methods were very 'traditional'; - dead-reckoning, optical drift-measurement, astro-navigation. When flying, our only radio-aids were the primitive 'radio-compass' direction-finder, and radio-range reception. And off-duty there was no thought of phoning home. Short calls, as well as being extremely expensive and poor quality, would have been tedious to arrange. But we didn't feel deprived; it was the norm.

It was much the same when I went to the U.S.A. in 1956. But change was imminent. Late in 1956, TAT1, the first transatlantic telephone cable, entered service, but the capacity was small and calls still had to be scheduled by collaborating operators. More cables followed throughout the world, but it would be more than 10 years before international direct dialling would be established. So in 1957, when we married in the U.S.A. , we just received transatlantic telegrams.

1957 was the year of Sputnik. And it was the year when we bought our first transistor radio. It was a year of contrasts. I'd returned to Decca Radar Research Laboratories (travelling by ocean-liner - the "Queen Mary"), My radar work at that time was technically challenging, and yet we still had yesterday's telephones, connected through manual exchanges and switchboards.

Radar had received huge impetus in WW2 and it soon became indispensable for marine navigation and air traffic control. But ground surveillance was much more difficult. Decca was a pioneer with the Airfield Surface Indicating Radar (ASMI) which was installed in the brand new control tower at Heathrow in about 1955. It was a very basic radar, but the resolving power was considerably enhanced by using millimeter-wave transmissions and very short pulses. Very soon afterwards the Royal Radar Establishment placed a contract for an experimental battlefield-surveillance radar and this used an ingenious high-speed scanning antenna. Decca called this radar 'Robert' and the name stuck with the Army. The original research project was masterminded by Robin Howell. Successful experiments led to a contract for 7 ruggedly engineered radars but by the time this contract was placed in about 1959, Robin Howell had left for an academic post at Brunel College/University, soon becoming Professor. So 'Robert' became my work for several years, including visits to Germany for trials. The radars were in Army service for a few years - but they were old technology, large and cumbersome and were retired early..



1965 to 1975

By 1965 I wanted to do new things and I made the (fortunate) move to the Royal Military College of Science at Shrivenham. It was a key year in many respects.

In 1965 radio and electronics were on the threshold of change, the start of accelerating changes. It was just being realised that digital computer technology was on the verge of great leaps forward in both speed and miniaturization. Signal processing was going to become digital with huge bonuses.

In 1965 the transistor had been available for over 10 years, with gradually improving capabilites, and integrated circuits just arriving; but valves would remain in production for many more years. Microprocessors were still to come.

In 1965 more and more international telephone traffic was moving onto submarine cables and the (then new) communications satellites. So the decline in h.f. radio telephony was under way.

In 1965 a third TV channel, BBC2, had just been launched, but TV was still black-and-white. That may sound incredible - but of course it is over half a century ago!

In 1965 the Post Office Tower was opened - the heart of the network of microwave radio links which carried vast numbers of telephone conversations and television signals.

At R.M.C.S. I had to learn about telecommunications in order to teach that, as well as radar. Fairly soon we began a working relationship with G.C.H.Q. and that became increasingly important to me.

In the 1960s GCHQ still controlled, or worked with, a large number of h.f. radio receiving stations, many quite small and left-over from the war. GCHQ itself had great technical knowledge of h.f. and close association with international and academic experts. Money was available. Three extremely large aerial systems were constructed at an old airfield at Blakehill Farm, near Cricklade, and used for experiments on direction-finding, over-the-horizon radar and target-location. New ideas were stemming from the availability of multi-channel receivers and computers.

A prominent feature at Blakehill was the all-wood 75 m. tower which accommodated a vertical antenna array. It was data from this tower which I started examining in about 1970, when I was still at R.M.C.S. Shrivenham. I devised computerised mathematical methods for "wavefront analysis". My involvement continued until 1975, and included a period in 1974/5 when I worked on detachment at GCHQ. I worked with Phillip Gething, who covered this work as part of his book "Wavefront Analysis and Super-resolution". This was a taste of things to come. Others in GCHQ and elsewhere developed far more advanced techniques for de-constructing wavefields, and medical tomography is one modern outcome.

1975 to 1991

In 1975 I transferred to GCHQ and moved onto different work, though still related to h.f. radio which was then still in widespread military and diplomatic use. International telephone services were now almost wholly carried by cables or by communications satellites.

By then minicomputers had become available - first from Honeywell, then DEC (PDP11), GEC (4080) and others. They became an important part of our h.f. radio systems right up until about 1986 when we built what was probably our last major h.f. system. By 1991 not much remained.

During this whole period GCHQ staff were doing pioneering work in electronics. In the early days 'Combi Units', an early form of integrated circuit, were devised. Later on, transputers, a form of high-performance microprocessor, were successfully used.

Around 1991

I retired in 1991. And that was coincidentally just about the time when a great many pieces were falling into place for today's digital world.

- G.S.M, the. Global Standard for Mobile Communications was first deployed in 1991, and has evolved ever since.

- The ARM6 processor was released in early 1992. It was a big leap forward. It and its successors became the heart of mobile phones - and a vast array of other 'intelligent' devices.

- The installation of fibre-optic cables was under way nationally and internationally in the early 1990s. They have largely displaced the use of microwave radio links (BT tower etc.) and Communications Satellites (Goonhilly, etc.)

- The first web page was served on the interent in 1991 and within two years would expand rapidly.

- Hand-held gps (satellite navigation) receivers were launched by Magellan, Garmin and Tomtom in 1991.

- NCR and ATT introduced 'Wavelan' in 1991 and that led to Wifi.

- British Satellite Broadcasting started TV transmissions (with the 'squariel') in 1991, and soon merged with Sky

- The Parliamentary Office of Science and Technology produced a briefing note in 1991 anticipating the introduction of terrestrial digital television..

- The BBC started digital radio broadcasting with test transmissions in 1990, prior to the full launch in 1995.

- Ericsson's began the development of the 'Bluetooth' short-link radio technology in 1989.

- The first DECT (Digital European Cordless Telecommunications) standard was finalised in 1992, and DECT cordless phones were soon available

26 years since I retired - what a long way we've travelled!