The Introduction of FM Sound Broadcasting in Britain

Prof. Anthony C Davies
Visiting Professor, Kingston University,
Kingston-upon-Thames, Surrey
and
Emeritus Professor, King’s College, University of London.

I am an electronics engineer, NOT a professional historian - but I am now part of history since the subject of my paper is part of my personal experience!

Some British History

⇒ Pioneering introduction of TV
The world’s first high-definition broadcast TV service

began in 1936 from Alexandra Palace
(405 line standard).

This was well ahead of all the "competition"
(USA and Germany)

⇒ Alexandra Palace now
Photos: ACD, April 2005
Some British History
- Pioneering introduction of TV in **1936** from Alexandra Palace

**But ……**
- Very late introduction of broadcast VHF/FM sound service.

began in **1955**, long after USA, Germany, and others.

It started with little enthusiasm, regarded by authorities as “an unwelcome complication” compared to LW/MW AM

Why so late? How was the introduction done? What happened subsequently? What if a difference choice?

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**Frequency Modulation: concepts and (mis)understanding**

First proposals for FM were ~**1900**:
- hope for a reduction in bandwidth compared to AM !!!!!
- many misconceptions, led to rejection of FM by many experts

**Edwin Armstrong** (USA) – in **1936** – demonstrated conclusively the real advantages of FM for broadcasting and showed how to implement the Transmitters and Receivers

Armstrong’s controversial life and contributions, and tragic suicide, have been well documented already.

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**Edwin H Armstrong** (USA):

- RCA antenna tower 1923
- 1938: antenna for Armstrong’s Experimental FM sound transmissions in USA (W2XMN transmitter)

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**European broadcasting environment, 1930-1950**

A few high-power National broadcasting stations – typically state-controlled content

A few (unlicensed or discouraged) high-power commercial stations transmitting across National boundaries
(e.g. Radio Luxembourg, LW, then 208m from 1950)

**USA broadcasting environment, 1930-1950**

Many low-power Local broadcasting stations, licensed nationally (by FCC) but content linked to advertising

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**UK Post World War II broadcasting environment, 1945-1950**

Unacceptable levels of interference on LW/MW (especially sky-wave reception from Continental Europe after dark, and LW interference from unsuppressed electrical motors, thermostats, etc.)

Lack of channels for development of broadcasting (geographical frequency re-use not easy because of high-power transmitters)

A need to develop VHF sound broadcasting seemed evident - but ……… should it be AM or FM or something else?

economy was ‘in recovery’ from war, so finance not readily available (either for TX or RX development and manufacture).
1945: BBC Engineering Department began tests to decide the relative merits of AM, FM for VHF use

1951: BBC began comparative test transmissions from Wrotham, Kent, using a transmitter built in 1949
(a) conventional AM
(b) wideband FM
(c) AML (= AM with an impulse-noise limiter in a wide-band receiver)

January 1954:
Report of TV Advisory Committee (established by British Government in 1935 to oversee TV development)

Recommended the use of FM (by a narrow margin) – apparently with little enthusiasm.
Includes 6-page minority report (by C.O. Stanley, owner of Pye Company):
“….VHF broadcasting has been a failure in practically every country …..”
He advocated narrow band AM

1956

Three transmitter outputs combined into a single antenna
Three air-blast cooled valves:
1.5kW tetrode
2kW triode
9 kW triode; (grounded-grid)
2.5 kV to stages 1 and 2
9 kV to stage 3
Filament Heater (V3):
625W at 5V
Wenvoe, Wales (Glenfo, Cymru)

More complex terrain, and need to provide services in English and Welsh.

Present day coverage

FM Receiver availability in 1955:

Initially, many imports came from Continental Europe, since VHF/FM was introduced in Germany at the end of WW II (because insufficient channels were offered on LW/MW).

Do-it-yourself Home Construction kits for ‘FM Tuners’ were popular – most used CV138 (EF91, Z77) h.f. pentode valves.

Such F.M. Tuners typically needed 250 V dc and 6.3 V ac for the valves, and an audio power amplifier and loudspeaker.

Commercial (ready-made) FM Tuner from DYNATRON

Photo: BBC Research Dept

Typical quality radio receiver at time of introduction of VHF/FM service in Britain

Philips model 643A with piano-key band-selector and rotatable ferrite antenna for LW/MW and ‘magic eye’ tuning indicator

www.thevalvepage.com/radios/philips/643a/p643a.htm

No printed circuits.

No transistors.

Vinyl long-playing 33 rpm and extended-play 45rpm records had recently been introduced in Britain, and created public interest in ‘better quality’ sound – and perhaps prepared the way for more appreciation of FM broadcasting.

Bang & Olufsen 507LP, 1952

www.beoworld.co.uk/vintage/507lp.htm

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Transistors suitable for high frequency or high power were not commercially available for a few years.

\[ h_e \approx 100 \]
\[ f_T \approx 70 \text{ MHz} \]
\[ I_c \leq 10 \text{ mA} \]

**OC170**: became available for IF amplifiers at 10.7 MHz

**GET 110**: became available for audio output stages: two in push pull could provide ONE WATT !!
Early AM/FM all-transistor portable (for USA/Canada market)

Later developments

1966: Regular Stereo Broadcasts commenced in UK (cf. USA start in 1961)

1981: Start of the introduction of higher transmitter powers and mixed-polarisation transmission to improve reception by portable radios and vehicle radios

Recognition that there would be no further development of AM, and that FM would be the predominant method for Sound Broadcasting.

Later developments

1996: ‘BBC Transmission’ was ‘privatised’:

Most responsibilities taken over by Castle Transmission International (now ‘Crown Castle International’)

BBC Research Department still exists

Now: BBC transmits FM sound from 200 UK sites with powers from 4 W to 250 kW
Shared-services sites

Low-power FM transmitter (500W)
(Purin Hill, Fife)
(Mike Smith website: mds975.co.uk)

Transmitter mast erected in mid 1980s
(photo, ACD, January 2005)
at
Wenvoe, Wales (Glenfô, Cymru)

What if Britain had rejected FM in 1955?

Suppose VHF/AM had been chosen instead.
1. Out-of-line with the rest of the world
2. VHF/AM sound was used in the British 405 line TV standard from 1936. The transmissions were effectively superceded by the introduction of PAL (with FM sound) in 1964, but transmissions continued until 1985
3. Quality and S/N ratio might have been adequate

BUT
No Capture Effect with AM, so far fewer high-power transmitters would have been possible, and much less frequency re-use

What about the Future

After FM ....... ?
1. DAB (digital audio broadcasting); use of coded OFDM
2. Broadband Internet Streaming Radio
3. ........... ?? ??

Quotation from 1963:
"... a change may be made to such techniques as Pulse Code Modulation, which have theoretically even better signal/noise properties."

Thank you for your attention

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Prof. Anthony C Davies
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