Wired Radio Broadcasting Technology in Britain: The Early Years

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Abstract—**The redistribution of public radio broadcasts through private cable networks was an important business in Britain from the late 1920s until after the Second World War. This paper presents some of the key stages in the development and use of this technology in Britain during this period. The contribution of P.P.Eckersley, former Chief Engineer of the BBC and one of the founders of the Rediffusion company is highlighted.**

Index Terms—**History, Broadcasting, Wire Communication**

I. Introduction

THE distribution of broadcast programmes through wire networks predates radio broadcasting [1]. In the 1880s and 1890s, a number of these services were introduced in both Europe and the USA. Some of these enabled subscribers to listen to musical and theatrical performances, while others broadcast news and entertainment on a daily schedule. The networks were based on the telephone technology of the time, and required listeners to use headphones. The two most often cited examples of this type of system are those of the Electrophone Company in London [2], and the Telefon Hiromondó "broadcast newspaper" in Budapest [3], [4]. The latter, set up by Tivadar Puszkás (an associate of Edison) in 1893 had thousands of subscibers and remained in operation until after the First World War [5].

Two years after the start of radio broadcasting in Britain, in 1924, the wire broadcasting idea was revived in a different form. Wire systems were now starting to be used for the redistribution or "rediffusion" of radio broadcasts. At first, these were very local affairs, but from these origins an entire industry grew. In fact the cable television industry can trace its roots to these early wired radio enterprises.

The most widely used method of distribution in the 1920s to 1940s period was audio baseband. However, in parallel with this were developed a number of carrier-based technologies, but not widely used in these early years. The development of these two methods, and of some of companies associated with them, will be outlined in the following two sections.

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This paper is concerned only with some of the technical aspects of wired radio in this period; some excellent accounts have been written about the commercial and regulatory environment in Britain [6]-[8].

II. Audio Distribution

A. A.W.Maton and his successors

The story of Wallace Maton's relay exchange is not a unique one[1], but is the one most well documented [9]. Maton owned a wireless shop and ran the cinema in the village of Hythe, near Southampton. He started his relay business in 1924.

In this period the number of listeners able to directly receive the new BBC broadcasts was small. A crystal set could be used near a transmitter, or for better results a battery-powered valve radio. Reception was not always reliable. Maton, like many others, experimented with extension loudspeakers attached to a radio set, first within his own house, and then for neighbours. Further experiments showed that he could extend the distance to half a mile or more, and also drive several loudspeakers in parallel. From this he built up a small business, by constructing a more powerful "wireless exchange" and charging his customers 1/6 (7.5p) per week. Overhead wires were used to link his exchange directly to the loudspeakers of the subscribers.

He obtained permission from the Post Office (who legally controlled all electrical communications) to operate his system provided all customers purchased a wireless licence. The number of subscribers never exceeded 150, but it remained in operation until 1941.

Maton was one of the early members of the Wireless Relay Services Association, formed in 1931[2]. This organisation, whose members where predominantly in the north of England, represented many small relay exchange operators. One of their main concerns was negotiation with the local authorities in the towns where they operated. Since distribution was mainly by overhead wires, wayleave permission was necessary. There was also resistance to the growth of relays from the young

[1] For example, in the Netherlands A.L.Bauling is credited with the invention of radio relay [10]

[2] It became the Relay Services Association, Ltd in 1932.

wireless trade. Subscribers to a relay service would be lost customers to the local wireless shop. (But in response to this threat, some relay services were set up by a local dealer).

Relay services were obliged to carry the BBC broadcasts, but were free to add additional foreign stations, some of which broadcast commercial programmes in English. To make programme selection possible, the audio distribution systems required additional wires and a selection switch at the subscriber's loudspeaker.

In the September 1932 issue of the Radio Relay Review, some advice on the marketing of radio relay was offered [11]:

- The users of older, low quality, radio receivers should be targeted.
- The relay service will always beat a cheap receiver for quality and number of stations. The receiver will also require repairs.
- The majority of houses have no electricity supply, and batteries are inconvenient and expensive
- Reception of foreign programmes is better than with a home receiver.

Electrical manufacturers developed lines of equipment for the equipping of relay installations. For example the Philips Type 3750 50-Watt Radio Relay Amplifier was designed to supply 250 subscribers, assuming 20% line losses [12]. (A typical parallel connected relay loudspeaker had an impedance of 10,000 Ω). Other manufacturers of relay exchange equipment advertising in the Radio Relay Review were GEC, Parmeko (Partidge & Lee), Tannoy, Nuvolian and STC. W T Henley and Siemens Brothers offered cables and interference suppressors. And since every customer required a loudspeaker a number of manufacturers developed products specifically for the relay market.

B. The Rediffusion Network of Companies

In an editorial in the Nov. 1933 issue of Radio Relay Review, the three types of relay company were identified [13]:

- Small companies with 300-400 subscribers, mainly non-members of the RSA.
- Those started by a wireless dealer or electrician, and which control substations in one large town or a group of small towns. Typically with 1-3,000 subscribers, these companies are the backbone of the Relay Services Association (RSA).
- Relay companies operating in large towns, with a board of directors, and a headquarters in London. The Rediffusion companies were the principal group of this type.

Generally there would only be a single company operating in each area, given that the right to operate was granted by the local authority (which was generally exclusive).

The parent of the Rediffusion Company was the relay operator Broadcast Relay Services which held concessions in a few area areas, including the city of Hull. The initial plan was to create a franchising company, which would design and manufacture the equipment and provide this to local Rediffusion companies set up to obtain relay concessions from local authorities. The Technical Director was Peter Eckersley[3], the first Chief Engineer of the BBC (1923-1929). Eckersley was forced to resign from the BBC over the matter of a divorce. (A full biography of Eckersley has been written by his son [14]).

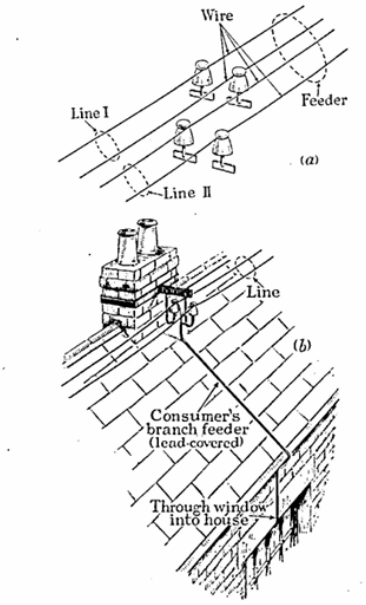

Fig. 1. Rooftop relay distribution cables (from [16])

Eckersley had always been an advocate of wired radio distribution, and had unsuccessfully campaigned for its use in the BBC network [15]. After leaving the BBC, amongst other activities he started research supported by the Dubilier Condenser Co.[4] in Acton (London) on high-frequency carrier systems for wired wireless application. He had hoped that he would be able to continue this work with Rediffusion, but the other directors preferred to deploy the existing audio distribution technology rather than invest in new development in a time of economic depression. Eckersley was bought out after a few months when STC joined as an investor. He continued to work as a consultant to Rediffusion, work which culminated in a comprehensive paper on the design of audio rediffusion systems read to the IEE in 1934 [16].

The total number of relay exchanges (Rediffusion and others) increased from 34 in 1929 to 390 in 1955, with subscriber numbers increasing from 9,000 to over a million

[3] Brother of T.H.Eckersley

[4] Dubilier had been granted patents on coin-operated wired radio systems in the USA several years previously.

[7]. While the the number of relay subscribers never amounted to more than a few percent of the total listening population, in some urban areas the majority of listeners received their broadcasts in this way.

III. CARRIER SYSTEMS

Audio distribution requires a separate pair of wires for every programme transmitted[5]. Carrier multiplexing was an established technology in telephone networks [17,18] and was also used by electric power companies for voice communication over power lines [19], both in Europe and the USA. It was natural that there would be attempts to apply it to wire broadcasting.

One such system was developed by Harold Holmes in St. Annes-on-Sea, Lancashire [9]. Holmes' first system, set up in 1927, was a single-programme audio distribution system using telephone lines leased from the Post Office. Each of the 400-500 subscribers was provided with a single-valve amplifier since high-power signals could not be transmitted through the telephone network. Holmes then went on to develop a dual-programme system, using a carrier frequency of around 100 kHz. The outline of his scheme is shown in Fig. 2. The radio receivers are shown as *a* and a^1. The output of a^1 is passed the modulator c. Each subscriber's terminal, A, can be switched between the two programmes using switch *z*. The ultimate version used was more complex, being described in a further 10 patents following the original one [20].

More than 1,000 subscribers were served by this system. Local redistribution stations each served up to 50 subscribers. Apart from the final links, all signals were distributed over Post Office telephone lines.

Eckersley was also an advocate of carrier systems for wire broadcasting, as mentioned in the previous section, but using the electricity mains as the distribution network. When Dubilier ended their support he found sponsorship from the British Insulated Cables Company [15] in Liverpool. After successful demonstrations he hoped that this method might be deployed in Britain. However, it was never legislatively permitted, largely due to objections from the BBC and the radio trade [6,7]. Eckersley continued to develop his system, together with partner R.E.H. Carpenter, finally reaching the stage of a trial deployment in Belgium, unfortunately cut short by the outbreak of war in 1939 [14]. (The assistant to Eckersley and Carpenter was G.B.Ringham, who joined Rediffusion at the start of the war and participated in the application of wired carrier systems to military radio training devices [22]).

[5] Unless phantom circuits are used: these seem never to have been widely used by relay companies.

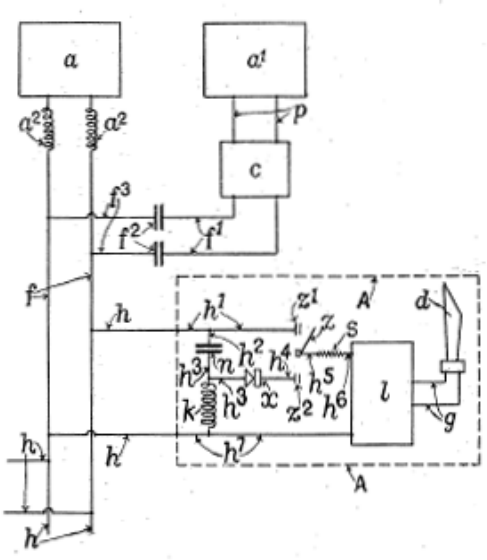

Fig. 2. Principle of the Holmes 2-programme distribution system (from [20])

IV. FURTHER DEVELOPMENT

Wired radio distribution continued in Britain into the 1950s, but the emphasis of development shifted to cable television.

Many of the developments up to the end of the 20th century and beyond were predicted by Eckersley, who will be permitted the last word [23]:

> *"In my book [15] I gave an account of a possible future and this envisaged a conductor (was it a coaxial cable?) which carried every kind of service offered by communication technology to the household. It was a conductor, not a radio link, so that this look into the future was based on my conviction that radio should only be used when a wire cannot be."*

APPENDIX – A NOTE ON TERMINOLOGY

The relevant British Standard [24] defines *wired broadcast* as "the distribution of sound programmes, or vision programmes, or both over a wire network to subscribers. *Broadcast relay* is defined as "the wired broadcast of radio broadcast programmes." Squier coined the term *wired wireless* for the transmission of radio frequency signals over cable [25]. *Wired radio* is an alternative term, and was also used by Squier as the name of the company he founded.

. REFERENCES

[1] P.Adorjan, "Wire-Broadcasting," *Journal of the Royal Society of Arts*, Aug. 31, 1945, pp. 511-522.

[2] D.Parsons, "Cable radio – Victorian style," *New Scientist*, 23/30 Dec. 1982, pp. 794-796.

[3] T.Puskas, "Fernsprecheinrichtung," Swiss Patent 6039, Dec. 10, 1892.

[4] J.Erdoess, "Le journal téléphonique de Budapest: L'ancêtre de la radio," *Radiodiffusion*, Oct. 1936, pp. 34-41.

[5] C.Marvin, *When Old Technologies Were New*. Oxford Univ. Press, 1988, pp. 222-231.

[6] R.H.Coase, *British Broadcasting: A Study in Monopoly*. London: Longmans, Green, 1950. (Chapter 4: "Wire Broadcasting")

[7] G.J.Davies, "Broadcasting: (5) Wire Relays," in: S.G.Sturmey, *The Economic Development of Radio*. London: Duckworth, 1958 (Chapter XII, pp 236-255)

[8] J.W.Welke, "Wired wireless: British relay exchanges in their formative Years," *Journal of Broadcasting*, Vol. 23, No. 2, pp. 167-178, Spring 1979.

[9] "Pioneers of relay," *Cable Television Engineering*, Vol. 11, No. 5, pp. 246-257, Aug. 1979.

[10] R.Drucker, "Radio relays in Holland," *Radio Relay Review*, No. 3, pp. 8,9, Nov. 1932.

[11] Letter on the marketing of relay servicers, *Radio Relay Review*, No. 2, Sept 1932.

[12] A.B.Calkin, "Philips radio relay amplifier, Type 3750," *Radio Relay Review*, No. 1, pp. 8,9, Aug. 1932.

[13] Editorial, *Radio Relay Review*, No. 14, p. 1, Nov. 1933

[14] Myles Eckersley, *Prospero's Wireless*, revised edition. Romsey: Myles Books, 1998.

[15] P.P.Eckersley, *The Power Behind the Microphone*. London: Jonanthan Cape, 1941.

[16] P.P.Eckersley, "Principles of audio-frequency wire broadcasting," *Journal of the IEE*, Vol. 75, pp. 333-353, 1934.

[17] M.D.Fagen (ed.), *A History of Engineering and Science in the Bell System: The Early Years (1975-1925)*. Bell Telephone Laboratories, 1975.

[18] M.Schwartz, "Origins of carrier multiplexing – Major George Owen Squier and AT&T," in *2004 IEEE Conference on the History of Electronics: CHE2004*, Bletchley Park, 2004.

[19] M.Schwartz, "Carrier-wave telephony over power lines – early history," in *2007 IEEE Conference on the History of Electric Power*, Newark, NJ, 2007, pp 244-254.

[20] H.C.Holmes, "Dual-programme wireless relay," *Radio Relay Review*, No. 2, pp 13-17, Sept. 1932.

[21] A.Warwick, J.Atkinson, H.C.Holmes, "Improvements in or relating to systems of distributing electrical signals," British Patent 319,984, Oct. 3, 1929 (application date: Nov. 16, 1928)

[22] M.Bolton, "Rediffusion and the Origins of the Training Simulation Industry in Britain." in *RAeS Conference: Flight Simulation 1929-2029: A Centennial Perspective*, London, May 2004, pp 4-1-4.8.

[23] P.P.Eckersley, "Broadcasting in densely populated areas: a comparison of methods and systems," *Proceedings of the Society of Relay Engineers*, Vol. 2, pp 17-31, 1949.

[24] *Supplement No. 1 (1964) to British Standard 204: 1960*. London: British Standards Institution.

[25] Paul Wilson Clark, "Major General George Owen Squier: Military Scientist," Ph.D dissertation, Case Western Reserve University, Jan. 1974.