



Oliveira, M.; Portela, P. & Santos, L.A. (eds.) (2012)
ECREA Radio Research Section Congress: 'Radio Evolution: technology, contents, audiences'
September, 14-16, 2011, Braga, University of Minho: Communication and Society Research Centre
ISBN 978-989-97244-9-5

Radio and Technologies. Ideas for research

ROGÉRIO SANTOS

Portuguese Catholic University
rogeriosantos@netcabo.ptl

Abstract:

From a historical point of view, this paper aims at putting into perspective the evolution of radio technology. Radio was the first electronic network, and for its better understanding, this paper reflects on the concepts of remediation, improvement, succession, simultaneity and interchangeability. From the magnetic register to an electronic medium, radio is here taken as a medium that still count in cultural and social terms.

Keywords: radio, technology, history

Introduction

In the present text, I seek to reflect on some transformations which occurred in the history of radio, from concepts such as improvement (Friedel, 2007), network and law of suppression of radical potential (Winston, 1998), and remediation (Bolter and Grusin, 2000). To Friedel (2007: 4), the nature of technological change means: "Much of the truly interesting part of the story of Western technology told from this perspective lies in the changing means by which improvements become less likely to be ephemeral and more likely to be sustained over time and distributed over space". An improvement is neither ephemeral nor contingent but part of a sustained series of changes and this is the direction I intend to follow.

Winston (1998) proposes an idea of network which I seize upon and develop. For him, the network, in the modern sense, dates from the electric technologies such as Morse's telegraph, which is governed by the point-to-point principle, and Bell's telephone (1876), which right after involved the notion of telephone switchboard, a set of knots where many interlinked lines came to and left from in a multilinear path. Electronic technology came into the network with the radio (1920s) and with television (end of the 1940s). Hence, network means not just the physical connection between electrical points but also broadcasting, with a tendency to mean a group of persons, provided they have the necessary equipment, but with no need to know one another. In a sort of complementarity to that perspective, Smith (1993) considers the increase of the interaction and convergence of text and image machines at the end of the 20th century. According to him, that trend started a century earlier, when photography, cinema and the phonograph appeared. Smith sets differences between transportation and communication: if the former facilitated mobility and suburbanization in the 20th century, the latter exercised power in the change of the construction of the city's image, culture and events turned into news. Smith conveniently distinguishes transportation and communication and evaluates the differences within the latter, especially the several media. A lot of work has been done on communication, but an interesting line of investigation has been developed in transportation (Bissel, 2009; Packer, 2006; Urry, 2010; Vannini, 2009; Santos, 2011).

Predominant research in the media accepts the idea of the new as a way of overcoming the old: digital technologies such as the internet and virtual reality establish a divorce from the former medium; the recent medium radically suppresses the old medium. Bolter and Grusin (2000) put such an approach into question and offer a theory of mediation. For them, in the digital age, the new media find a new cultural significance because they pay homage to and renew former media, such as perspective painting with regard to photography, film and television. This process of renovation is called remediation, in which former media renew themselves in relation to older means: photography remediated painting, film remediated photography and television remediated film, vaudeville theatre, and the radio. From reading Bolter and Grusin (2000), I come to the conclusion that there is room for an epistemological rupture as well as a cultural reform, in which the new forms see themselves in the old ones, just as the first automobile looked like the carriage, the first television entertainment programmes copied success formats from the radio and the first internet newspapers were similar to paper newspapers.

The present text is the result of my personal experience as a radio listener, namely FM radio in the last four decades of the 20th century, and of empirical knowledge in the construction and repair of receiving equipment between the end of the 1960s and the beginning of the following decade, as well as my experience as a writer of radio history (Santos, 2005, 2010). In addition to this introduction, the chapter has four other parts, the following on development structures, in which I write about magnetic registering as record and memory. In the third, I write about a scientist, Edwin Armstrong, whose visionary capacity marked the evolution of radio, and its relation with other media. The last two parts deal with the massification and miniaturization of receiving equipment, associating technological efforts with the radio audiences and with the way amateurs socially seize the equipment.

Media development structures: succession and simultaneity

For Smith (1993), social and family structures reorganise themselves taking into account the new media and the array of apparatuses they create. Cinema in the 1920s and the 1930s, and the television from the 1950s onwards, redirected the home as family centre. Nowadays, the numerous apparatuses (which include computer, games console and mobile phone) divide the family and re-individualise it, encouraging a new domestic micro-consumerism. To this I call *succession* (or history) of media, not in the perspective of technological determinism but considering social uses, personal biographies and economic interests. The stories of magnetic record and of FM creation and expansion, which I present further on, are good examples. Smith (1993) draws attention to the fact that technological evolution is concentrated in interactions and dependencies of a social, artistic, technical and intellectual order. Marconi's work with the radio occurred at the same moment the Lumière brothers were working with cinema; Zworikyn was working on the basic principles of television (cathode ray tube) in the same decade as Méliès' most important activity. To this, I call media *simultaneity*, where there seems to be a common social and cultural aspiration.

Assuming the role of media historian and sociologist, my goal is to find the main structures of media development. In the radio, I detect four fundamental elements, some of a more historic nature and others of a more sociological scope: 1) since 1947, with the miniaturization brought about by the transistor, 2) from 1950, with the massification of media products (such as recorder tape), 3) impact introduced by transportation and mobility (car, airplane), 4) the articulation of elements for building industrial objects such as mechanization, uniformity and interchangeability (Friedel, 2007: 322-328).

In the interests of time and research, here I confine myself to the topics of massification of media products and the miniaturization brought about by the transistor, as well as to a historical reflection on magnetic registering and the inventions of Edwin Armstrong. On recording and its techniques, I follow Winston (1998), who particularly highlighted the record, film, sound recorder and video recorder. Sound and image recording enables the repetition of programmes, which represents availability in terms of transmission, beyond live transmission. Other authors name this distinction as *stock* and *flux* production (Flichy; Miège), being the former the one that can

be stored and aired at any time (film, radio serial, documentary). Dayan and Katz analysed another form, the *media event*, with preparation (announcement of its production) and long television transmission (royal wedding, music concert, Olympic Games). In this case, previous recording is included in the flow of live transmission.

The history of magnetic registering comprises names that are not known in the public domain, such as Oberlin Smith, Valdemar Poulsen and Fritz Pfleumer (Daniel, Mee and Clark, 1998), and which illustrate the concept of *improvement* by Friedel (2007). Oberlin Smith invented magnetic recording in 1878, after visiting Thomas Edison's laboratory and seeing his phonograph. On the one hand, Valdemar Poulsen, a Danish who was recruited as a telephone engineer in Copenhagen, became interested in magnetic registering, for he felt frustrated by the fact that it was impossible for telephone users to leave a message when no one answered. His magnetic recorder dates from 1898. On the other hand, Fritz Pfleumer, an Austrian inventor living in Germany, was able to invent a cheap recording system with cigarette paper based on bronze powder. Interested in magnetic recording, his first magnetic tape was a strip of paper with particles of pulverized iron. Even without knowing one another personally, these men knew directly or indirectly of the others' experiments, which shows a circulation of information and a technological maturity in central Europe and links to the United States. There is an almost simultaneous knowledge of these technological discoveries.

AEG, the German group, showed an interest in Fritz Pfleumer's invention and a contract with him in 1932 was signed. Eduard Schüller, who developed the magnetic head, a fundamental element in recording, and Friedrich Matthias, a chemical engineer who produced a celluloid tape, joined both Pfleumer team. At the Berlin's Exhibition, during the summer of 1935, AEG's model of recorder (magnetophone) was a big sensation: visitors were surprised when listening to their voices registered. Two and a half years later, AEG, together with BASF, produced an equipment for commercial sale, at a price of 1350 Marks (the average salary of an experienced technician was about 250 Marks) (Daniel, Mee and Clark, 1998). It should be noted that Germany lived under the Nazi regime. During the Second World War, the factory where sound recorders were produced was completely destroyed (1943). With the end of the war, since the Allied Commission invalidated German patents and copyright, AEG, BASF and Agfa did not receive any benefits from the growth of inventions linked to magnetic recording, contrary to what happened with American and European undertakings (such as EMI) and even Japanese (Sony, Matsushita-Panasonic and Toshiba).

Throughout the history of magnetic recording we can detect three main periods. The time when inventors acted in isolation and had a main activity that was different from their invention was followed by a time when researchers worked in big corporations and formed multidisciplinary teams and then by another time when, for several reasons (transfer of technology, copies, cessation of copyright, piracy), technologies became public domain and apparatuses were made by those undertakings which presented better functions or lower prices. If, on the one hand, the era of technical reproducibility (Benjamin) enables democratic access to works through copies, the ease with which a digital file can be copied turns out to be a problem for content producers.

Magnetic recording, first, and optical, after, can be looked at in the sense of Bolter and Grusin (2000), *remediation*. A recording is a way of registering a reality that becomes eternal, since the event is perpetuated and retransmitted (or reset) at any moment. This phenomenon was already happening since photography, which was intended to be a very objective and neutral memory of reality, in the sense of *immediacy* (visual representation that makes the viewer forget about the presence of the medium, as in the case of the cinematographic screen, and which moves or excites us while the images "run" on the screen, as if they were "reality"). Recording is also used in the sense of a record of the history of Man, of its events and technologies.

Remediation occurs in two levels, of which the most sophisticated is magnetic recording. For example, theatre plays through the radio. Before recorders, radio dramas were aired live, with the chances of showing the flaws of live representation. Radio drama is not and is the theatre. It is not because there is no physical and live audience, but it is because there is representation. With sound recording, it is possible to transmit plays that were

recorded a long time before. The example of Eduardo Street, the already deceased director of radio dramas, whose plays were aired at Antena 2 throughout 2010-2011, shows this double possibility.

Radio

I have great esteem for Edwin Howard Armstrong (1890-1954), an American engineer and inventor of three electronic circuits that were fundamental in the history of radio: regenerative or feedback circuit (1912), super-heterodyne (1918) and the FM system (1933) (Sterling and Keith, 2008). That is why I dedicate some attention to his career and examine it. From the reading that I have done, I come to the conclusion that the first, the regenerative circuit, was an apparatus with defective technology (noises of static electricity). For example, a receiver beside another one induced noises that were difficult to control. With the introduction of improvements it became much sought after and sold quite well.

In 1917, young Armstrong became a university professor at Columbia University. The following year he went to France with the American armed forces. As a captain, he developed the super-heterodyne circuit. Seen at a distance of almost a century, it is an easy and logical circuit, of three to four stages (from detection and oscillation to amplification) of electronic valves. The better sound quality and the elimination of many feedback noises turned it into a dominant model in terms of AM radios (amplitude modulation). During my youth, at the end of the 1960s, my closeness with the radio made me build or repair apparatuses with that technology. Without knowing it at the time, I owed a lot to improvements brought about by Armstrong. I worked with electronic valves, when equipment working as transistors gained market position, with the resulting revolution in uses and functionalities. While electronic valve (or lamp) radio, plugged to the electric current, was a fixed set, which took a central position in the home, later replaced by television, transistor and battery radios enabled mobility, making it possible to listen to the radio (telephony) anywhere: on the street, at the beach, in public transportation, still with loudspeakers before the mainstreaming of headphones, implemented by the use of the walkman (Sony), an apparatus that was more appropriate for listening to music tapes than radio programmes (and latter replaced by mp3s).

When Armstrong returned to New York with a rank of major, a title he always used, he sold his radio circuits to RCA and became its largest single shareholder. RCA, then one of the biggest radio corporations, was run by David Sarnoff, who accepted Armstrong's proposal for more experimentation of FM receivers. FM (modulated frequency) is a type of modulation that indelibly marked the history of radio. To me, radio means FM, given the cultural context in which I lived my adolescence and as a young adult. FM was thought and developed by Edwin Armstrong at a time when AM prevailed. At the end of 1933, the 85th floor of the Empire State Building was reserved for him, but later Sarnoff retreated because he feared that FM was completely different from AM. That situation could bring business back to a starting position (Sterling and Keith, 2008). In 1935 Armstrong engaged with Carmine R. "Randy" Runyon to transmit in 110 MHz. The superior quality of music transmission pleased a lot of people. But, since there were no FM programmes to justify the acquisition of receivers and the sale of receivers didn't enable the creation of programmes and their commercialization, the process was not launched. In our time, that would happen with DAB (Digital Audio Broadcasting).

In trying to understand Edwin Armstrong's path – as it could have been done with Thomas Edison –, one gets the precise idea of the *improvement* as Friedel (2007) presented it. The scientist designed successive radio reception circuits and tried to eliminate faults in its functioning. After the design came the patents and the effort of commercialisation (the super-heterodyne through RCA, the FM receiver through General Electrics). There was a central core (the succession of stages in the circuit, the use of parts as electronic valves and condensers, dial and amplification) and the understanding of adding good reception (sound quality improved with stereophony) to a popular or elitist programming, depending on the target audiences: classical music in the initial FM, top 40 in American AM, radio drama and talk-shows, which, later on, also became popular on television.

Armstrong's life also illustrates Winston's *law of suppression of radical potential* (1998). The British author seeks to illustrate that the most advanced technological ideas don't always prevail, due to vested interests. Winston (1998: 13) uses the metaphors of the brake and the accelerator to explain his theory, which in turn explains the constraint in view of the latest development while the inventors, with prototypes and business projects, have to concentrate on one objective. Sarnoff's refusal to develop FM, which he himself recognised as revolutionary technology, had to do with the fear that such technology might be a threat to the system already installed (AM), while, on the other hand, a promising new medium was emerging, television, forcing investments in the latter. This made Armstrong seek other entrepreneurs that would understand him and forge partnerships for the transmission of programmes.

The radio had, from the very beginning, a special relation with music, first through live programmes and then the record. The advertising of musicians, good sound reproduction (electronic) and the updating of music broadcast on the radio made these two media inherently linked. There was a circulation between the two media: the radio advertised a record or singer, who became famous with live interviews. In the American case, RCA (industry and radio stations) on buying Victor (the record company that owned the brand "His Master's Voice") further developed this linkage. But the relation was unequal, since the record industry has no conditions to resist the competition from the radio (Winston, 1998: 84). In the case of the United Kingdom, there were efforts to use copyright to limit the radio's access to records, but to no avail. The relationship between the radio and cinema should also be noted: the radio advertised films and interviewed film stars. Differently, the press refused to read news on the radio based on the former. That happened in several countries, including Portugal. The first editing department in a radio, with journalists producing news reports, was formed during the 1960s, at Rádio Clube Português, although Emissora Nacional already produced news outside their studios with Fernando Pessa, a radio announcer, at the end of the 1930s.

Massification and miniaturization

Massification and miniaturization are two different elements although they are interlinked in radio reception and occur at well-determined times, even though developments occur throughout long periods.

Massification emerged right in the 1930s in the United States when radio plants take the place of amateurs who produced their own equipment and when listening to the radio goes from an individual to a collective experience (such as a football match at Rossio, in Lisbon, at the end of the 1920s) or with the whole family. In Portugal, massification occurs later, dating from around the 1940s and 1950s. Massification means better AM transmitters throughout the country and varied programming and with different broadcasters. On the other hand, purchasing power is necessary, because radios sets are expensive. In advertising done during the 1930s, it was obvious that only the upper-middle class and the upper class could buy such apparatuses. The values associated with advertising of the several brands are also geared to high culture. On the other hand, in a country with a long political dictatorship, a rather unattractive conservatism of form and content was imposed. Throughout the decades of the 1930s and 1940s radio prices fell, so it was easier to purchase them and also there were many stores that sold them on instalments. The radio, after its first few years, lost its aura of "educator" and became an "entertainer", gaining popularity especially those broadcasting stations that had a programme that was closer to the listeners' tastes.

The radio had two big advantages when compared to the press. On the one hand, it does not demand literacy, thus being understood by everyone, as long as it expresses itself in the national language and with music also sang in the same language. On the other hand, beside an initial investment (the purchase of the radio) and the electricity used, the radio doesn't cost any more money and reaches everywhere, working at any moment and can be shared simultaneously by a group of listeners.

The radio sets of the 1950s became smaller, although they were still equipped with electronic valves. With the application of the new technologies, such as the transistor, which replaced the valve, and small supply batteries, in the middle of that decade and even more in the 1960s, the size of receivers shrank substantially. Some of them were small enough to be held in one hand. The mobility of this equipment with new technologies made its use much simpler, bringing a new wave of massification. From then on, it was frequent to have a fixed radio at home and a transistor radio to be carried. The same phenomenon would occur with computers, with a desktop one at home and a portable one to be carried by the person, to work outside the home.

Transistor receivers came equipped with a loudspeaker. It was usual to see pedestrians with their small radios stuck to their ear to listen better to the programmes. Also, some of the programmes, transmitted for example at lunch time, made listeners carry their radios turned on. In 1974, a very popular soap opera was listened to in those portable radios: *Simplesmente Maria* (Santos, 2010).

Amateurs and technologies

The new transportation technologies that emerged at the end of the 19th century (bicycle, automobile) created a new class of social players, the amateurs, who had, by personal experience and from sharing with other amateurs, the capacity to repair and improve equipment (Friedel, 2007: 398). The emergence of the radio caused the same wave of enthusiasm, with knowledge acquired namely through popular technical publications. The amateur remained, throughout the 20th century, an important element in terms of innovation and change. Communications mechanisms built with the amateur in mind – magazines, centres and associations – were fundamental elements in the culture of improvement. Knowledge linked to the radio and the automobile, for example, became a men's affair. More to the end of the 20th century, the line between amateur and specialist became more blurred, especially in technologies linked to micro-electronics such as computer software and the internet, with amateurs spending endless hours searching for knowledge and updates.

The amateur produced two lines of approach: those who became specialists and professionals and those who spent time on it as a hobby, keeping a line separating them from the professional activity. Many of those who promoted the radio learned from the everyday difficulties that would come up. Thus, they belonged to a generation of practical people, almost with no time for theory, which was later fed by the faculties of engineering. Technical schools appeared at the end of the 1950s to eliminate shortcomings in technical knowledge at an intermediate professional level. The amateur who saw the activity only as a hobby could regress in terms of allocation of resources (time, financial, technical). In Portugal, the first entrepreneurs of radio stations abandoned radio broadcasting after a period of time, such as Abílio Nunes dos Santos Júnior (CT1AA station), who was active from 1924 to 1938 (Santos, 2005).

Linked to the amateur, the concept of fan emerges, an individual with a special preference for a project and who dedicates a substantial part of his life to knowing more and defending a project or brand. Besides the characteristics of the amateur, the fan shows passion in participating in the construction or reformulation of objects and is motivated to be part of initiatives to make known those objects of which he is a fan. He does not become a professional but has a specialization that is close to that of an expert. Amateur workmanship of electronic parts and circuits, before equipment was produced industrially, the preparation of transmission and reception antennas, the creation of programmes that range from telegraphy, radio broadcasting and the radio during the first years as a means of communication (Santos, 2005) and the publication of articles in magazines, for example, stressed the role of the amateur fan.

The fan is close to a distinct category which I will now present: the consumer. In the research that I have made on the first few years in the history of radio (Santos, 2005), I analysed the role of the consumer, whose main characteristic is being a listener of a programme geared for the general public. The listener can be a dilettante (good taste, specialized taste) or can be looking only for entertainment in music or any other programme. As

different audiences are formed through massification, the offer of programmes was altered and enlarged, creating specialized radio stations. Today, niche programming is more evident, replacing the more generalist offer. If initially the music that was transmitted had a classical repertoire, massification represented the popularization of the music listened to, with special emphasis on urban and popular music, shows (with no single standard) and record requests and talks related to contests. The consumer is already different from the amateur, for he is not a specialist and does not try to know the technical details of the equipment neither does he read science magazines.

Research on radio reception done at the end of the 1940s (Field and Lazarsfeld, 1946; Lazarsfeld and Kendall, 1979) indicated that listening to the radio was a feminine activity during the day, such as married women, while men listened to the radio at night, due to their professional activities. Seen from today, these conclusions have the stamp of its time: for example, women went into the workforce and, because of that, are not a different audience from that of men. But there is still a distinction between young adult consumers and older ones, such as in cinema. It is easy to understand the fact that cinema fans belong to the younger generation – adolescents and young adults have less personal and social responsibilities and more “free evenings”. Since young people are developing intellectual goals, a free evening can be spent at the cinema or another activity. Going to the cinema means the possibility of establishing fundamental personal contacts. What I wish to underline here are the constants and the structures throughout the decades and the methodologies of the survey, of which Lazarsfeld was a pioneer. When Lazarsfeld started his radio project, in 1937, he conceived it around four themes: radio and reading, music, news, politics (Scannell, 2007: 14).

Parallel to the concepts of amateur, fan and consumer, there has also been work done on the concept of hacker. This one takes two perspectives, that of the youth who enters into a sophisticated system and reveals safety fragilities and that of the specialist who develops systems and contributes to the improvement of a project or product. The second meaning was the first one to be created, while the first has acquired negative connotations, criminal action and is punished by law. The hacker is, like the other categories, someone who specialises, who knows the elements that are parts of a process and shares knowledge. The hacker, if included in a group albeit anonymous, follows his own code of ethics: the greater the difficulty to be overcome the more he will be admired by his peers. There is, then, a sense of pride in this illegal activity, which defies the canon.

Conclusions

My study was based on the radio as a means of communication, the technologies that supported it throughout the 20th century and its social and cultural improvements. Radio was the first electronic network, and for its better understanding I worked the concepts of remediation, improvement, succession, simultaneity and interchangeability. I looked for examples in the history of the radio and the media, such as magnetic registering and transformation of electronic circuits, to render the evolution of the medium more comprehensive. Massification and miniaturization of equipment and different specialised users (amateur, fan, hacker) were also elements of research.

The key issue of my research is technology. The use of a technology is not neutral, but based on the social use and private interests of corporations and official bodies and on the existing correlation of forces. Sometimes, there is pressure to keep a technology, other times successive experiments (from prototypes to launching products onto the market) lead to experiments and consumption in different directions. Other times, old ideas are recovered, because there is a more adequate knowledge and a renewed interest in the matter. The role of individuals, corporations, and countries, and exchange and technological knowledge follow paths not previously trodden but are able to follow expectations or old dreams.

Bibliography

- Bissel, David (2009). "Moving with others: the sociality of the railway journey". In [Phillip Vannini](#) *The Cultures of Alternative Mobilities. Routes less travelled*. Surrey and Burlington, VT: Ashgate
- Deuze, Mark (ed.) (2011). *Managing media work*. Los Angeles: Sage
- Field, Harry, and Paul Lazarsfeld (1946). *The People Look at Radio*. Chapel Hill: University of North Carolina Press
- Küng-Shankleman, Lucy (2000). *Inside the BBC and CNN - Managing media organisations*. Londres e Nova Iorque: Routledge
- Küng, Lucy (2008). *Strategic management in the media. Theory to practice*. Los Angeles, Londres, Nova Deli e Singapura: Sage
- Küng, Lucy (2011). "Managing strategy and maximizing innovation in media organizations". In Mark Deuze (ed.) *Managing media work*. Los Angeles: Sage
- Lazarsfeld, Paul, and Patricia Kendall (1948/1979). *Radio Listening in America. The People Look at Radio – Again*. Nova Iorque: Arno Press
- Mitchell, Caroline, Brian Lister and Tony O’Shea (2009). *Managing Radio*. Sedgefield: Sound Concepts
- Packer, Jeremy (2006). "Rethinking dependency: new relations of transportation and communication". In Jeremy Packer and Craig Robertson (eds.) *Thinking with James Carey. Essays on communications, transportation, history*. New York: Peter Lang
- Scannell, Paddy (2007). *Media and communication*. Los Angeles, London, New Delhi and Singapore: Sage
- Sterling, Christopher H., and Michael C. Keith (2008). *Sounds of change. A history of FM Broadcasting in America*. The University of North Carolina Press: Chapel Hill
- Santos, Rogério (2011). *Media, transportation, and society – reflections on their transformations*. Paper presented at Ottawa 6th Annual Communication Graduate Caucus (CGC) "Neglected Media" Conference in March 2011
- Santos, Rogério (2010). *Do jornalismo aos media. Estudos sobre a realidade portuguesa*. Lisboa: Universidade Católica Editora
- Santos, Rogério (2005). *As vozes da rádio, 1924-1939*. Lisboa: Caminho
- Urry, [John](#) (2007/2010). *Mobilities*. Cambridge, Oxford and Malden, MA: Polity
- Vannini, [Phillip](#) (2009). *The Cultures of Alternative Mobilities. Routes less travelled*. Surrey and Burlington, VT: Ashgate