



## “Wire” vs “Wireless” Communication

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Though the integration of all modes of electrical communication is a practical *fait accompli* under the progress and aegis of the information theory, the fact remains that there is an undeniable and healthy competition between wire and wireless means in almost all communication fields. I would like to devote this editorial to some aspects of this technical feud, and to be allowed to present some personal technical *souvenirs* at this occasion.

I began my career on the radio side, and was at the start mainly concerned with military applications of the higher part of the radio frequency spectrum, which in 1920 we situated in a few hundreds of megacycles. We were quite enthused, of course, with the new technique, though at times we wondered whether General Ferrie, our boss, was not right when he would jokingly tell us that “had wireless communication come first, wire would have been considered a great improvement.”

Yet, things were achieved with “wireless” that wire could not do. I remember how thrilling it was for me to hear on the radio transatlantic tests between Rocky Point and New Southgate (London) the voice of a Bell Telephone Laboratories engineer, who had participated in the tests in England and had just sailed back to the United States. Wire had achieved transatlantic telegraphy in 1857, but wireless had entered the field in 1901, and radio-telephone was opened to the public in 1927. This was the long-wave circuit, soon to be supplemented by the short-wave circuits in 1928.

Is it not, therefore, somewhat of a shock to the radio engineer to have to acknowledge in 1954<sup>1</sup> that “no way has been found to provide (with short waves) day-to-day continuity and reliability comparable to that of good wire lines!” The wire communication engineers have fought back successfully in this case. In spite of enormous difficulties, a transatlantic telephone cable is being laid to link the United Kingdom, Canada, and the United States, and is scheduled to be completed in 1956.

Radio, however, which seems to have lost this round in the never-ending battle, has, meanwhile, invaded a well-guarded bailiwick of wire communication: the toll network of public telephone networks. This is a conquest of microwaves in a field where equal reliability of operation is necessary to compete. The Bell System in June, 1954 was providing more than five million telephone circuit miles by microwave radio.

This line-of-sight microwave communication has had an added incentive due to the need for TV transmission. It had the drawback of requiring optical line-of-sight between successive repeater stations. However, recent experimental work

has shown that, provided suitable power and antenna gain is utilized, microwaves can be sent over the horizon at 200 miles or more. At this distance radio would seem to compete favorably with an expensive submarine cable, and regain some of the ground lost on the longer transatlantic routes.

The guided propagation inside metallic pipes, the so-called waveguide, may change the picture in the future. Should the demand for more bandwidth increase, waveguides would give a means to obtain a tremendous capacity of radio and TV channels; and very high carrier frequencies would be used advantageously, because in one mode of propagation (TE<sub>01</sub>) they are less attenuated than lower frequencies, a fact established by both theory and experiment which came to light as a big surprise just before the Second World War broke out.

Thus, wire and wireless are pushing each other along the route of progress. It is tempting to conclude, as an old professor of mine, who used to advocate the 1) thesis, 2) antithesis, and 3) synthesis theme for any lecture or discourse, would have done. The development of communication is going on at such a rate that both methods have ample possibilities. In its annual report for 1954, the Federal Communications Commission starts by saying that its 20th anniversary saw the nation studded with 700,000 radio transmitters, 50 million telephones, and nearly 3.5 million channel miles of telegraph circuitry! Should this state of things be generalized to the whole planet, there would be need for all known communication means to provide the required facilities. In some cases wire would seem to be the better solution, as is the case for the local areas of public telephone networks. In other cases, radio is a must, as for mobile communication, air-to-ground and plane-to-plane transmission. In many cases, however, the fight is open, along the toll routes for telephone or television for example. Who could also predict with certainty which will win over the long international routes for TV transmission? I would like to repeat here the concluding words I used in a lecture on “New Advances in Guided Propagation,” which I gave last year at one of the Centennial Meetings of the Polytechnic Institute of Brooklyn: “Helped by a clearer understanding of the laws governing the transmission of information, it would seem safe to assume that wire and radio are henceforth indissolubly linked under a broader concept, which should lead some day to a rational organization of communications over our planet, as a prelude to more ambitious adventures outside of our earthly atmosphere.” We microwave engineers have plenty of work on our hands, and higher frequencies may still hold new wonders in reserve and ample ground for imaginative and profitable enterprise.

<sup>1</sup> M. J. Kelly, Sir Gordon Radley, G. W. Gilman, and R. J. Halsey, “A Transatlantic Telephone Cable,” *Proc. I.E.E.* (London), Part B, vol. 102, pp. 127-130; March, 1955.