

1948: the birth date of modern telecommunications

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One place, one year: two major breakthroughs for telecommunications.

December 23, 1947, in Bell Labs. Laboratories (New Jersey, USA), the very first transistor, a point contact germanium device was invented by John Bardeen, William Shockley and Walter Brattain. The "PNP germanium transistor" operated as a speech amplifier with a power gain of 18 in that trial (Fig.1). In 1956 the three inventors were honored with the Nobel Prize in Physics "for their researches on semiconductors and their discovery of the transistor effect". It is the result of at least fifty years of researches in quantum physics and in the understanding of how the matter works in its most infinitesimal dimensions. The transistor is one of the most well known application (with the laser) of what is called the first quantum revolution.

Six months later, in July 1948, not so far from Bardeen and his friends, in an other building of the Bell Labs, a young mathematician, Claude Shannon, published a theory on *information* which bridges data, entropy, probality and transmission rates. This pionner work set the basis of today's digital communications with two majors theorems: one on source coding and one on channel coding. Both provide bounds on digital transmission capacities and a theoretical framework to convey information from a transmitter to a receiver.

By combining semiconductors and the transistor effect with the information theory, the third industrial revolution was born, that is the era of digital communications and the telecommunications world we are living with and in: all was there to set up hardware devices, network on chips, processors (Fig. 2) to support more and more complex algorithms to process, to code and to convey data faster and faster toward Shannon's limits.



Fig. 1 : The first transistor (left) and entropy diagrams from information theory (right)



Fig. 2 : processor with billons of transistors

W. H. Brattain, entry of 15 December 1947, laboratory notebook, case 38139-7. Bell Laboratories archives.
C. E. Shannon, A Mathematical Theory of Communication, <u>Bell System Technical Journal</u>, vol. 27, p. 379-423 and 623-656, July and October, 1948