

# History of Wireless Communication-An Evolution through Time & People

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**Abstract**— The article elaborates the development of wireless communication through electromagnetic waves from when it was first mathematically predicted to its experimental demonstrations by eminent scientists. Most noteworthy is the contribution from Sir Jagadish Chandra Bose who single handedly invented and designed wireless trans-receiver system which was first in its history. The use of millimeter waves by Sir J.C Bose in his instruments was also made for the first time.

**Index Terms**— Maxwell, Hertz, Tesla, J.C Bose, History of wireless, millimeter wave, mercury coherer, Galena crystal-diode detector.

## I. EARLY CONTRIBUTIONS

While testing the compliance of Ampere's circuital law with continuity equation, a British physicist, Sir James Clerk Maxwell, mathematically predicted the existence of electromagnetic waves [1] in the year 1864. It was a rare instance in the history of science when mathematical prediction preceded experimental verification. The modulation of electromagnetic waves with information led to what we know as wireless communication. Maxwell's contribution to the world of electromagnetism can be seen in his book [2].

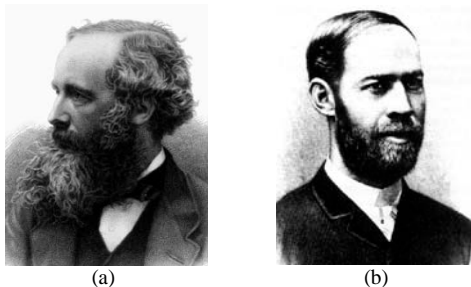


Fig. 1. (a) Sir James Clerk Maxwell. (b) Heinrich Hertz

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Article received in July 26, 2011. The author was inspired by the work of Prof. Tapan Sarkar & D.L Sengupta of Syracuse University who visited the department of Electronics and Electrical Communication Engineering, IIT Kharagpur, India, in 2003 and lectured on Sir J.C Bose's contribution towards microwave communication. The author, Pragnan Chakravorty, was then an M.Tech student at IIT Kharagpur.

After the death of Maxwell, a German physicist Heinrich Hertz showed experimentally, in 1888, the existence of electromagnetic waves in free space. Though Hertz experimentally established electromagnetic waves, the first ever wireless communication was done by Sir J.C Bose before Guglielmo Marconi [3]. His indigenous research in microwave and millimeter wave technology [4] [5], was also the first of its kind.

## II. COMMUNICATION OVER ELECTROMAGNETIC WAVES

### A. Demonstration held in Town Hall of Kolkata

In November 1894, in a public demonstration in Kolkata, J.C. Bose ignited gunpowder and rang a bell at a distance of over one mile using microwaves in wavelength of millimeter range. The demonstration was held in the Town Hall of Kolkata, in the presence of Sir William Mackenzie, the Lieutenant Governor, and Bose wrote in a Bengali essay, '*Adrisya Alok*' (Invisible Light), "The invisible light can easily pass through brick walls, buildings etc. Bose went to London on a lecture tour in 1896 and met Marconi an Italian inventor, who was conducting wireless experiments for the British post office. In an interview, Bose expressed disinterest in commercial telegraphy and suggested free use of his research work by others.

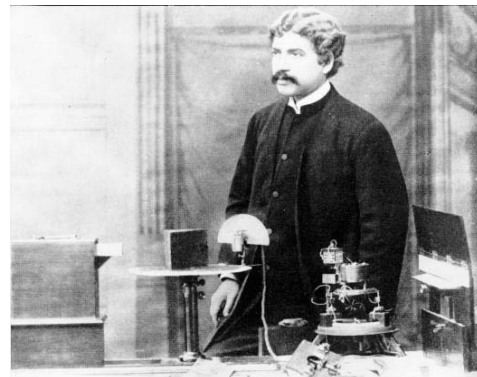


Fig. 2. Sir J.C. Bose with his Apparatus

### B. Poldhu Demonstration and the Patent Controversies

A scientist named Nikola Tesla, a Serbian, filed the first patent for radio in the year 1900. In December, 1901, Guglielmo Marconi used J.C. Bose's inventions to receive the radio signal in his first transatlantic radio communication over a distance of about 2000 miles from Poldhu, UK, to St. John's, Newfoundland. Marconi was celebrated worldwide for this achievement, but the fact that the radio patent was already registered by Tesla in 1900, as well as the fact the receiver was invented by Bose was not well known. Due to the incomprehensive nature of Tesla's work the radio patent was reissued to Marconi, he received the Nobel Prize for this achievement in the year 1909.

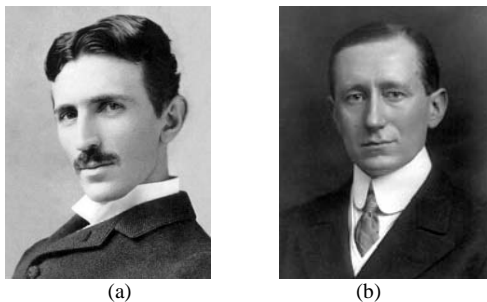


Fig. 3. (a) Nikola Tesla. (b) Guglielmo Marconi

The transmitter used by Marconi was designed by professor Fleming [6] and the mercury auto-coherer-receiver was invented by Sir J.C Bose [3]. Marconi's public demonstration came almost seven years after Bose's 1894 demonstration in Town Hall Kolkata. The radio patent remained a matter of controversy, during those years, between Marconi and Tesla.

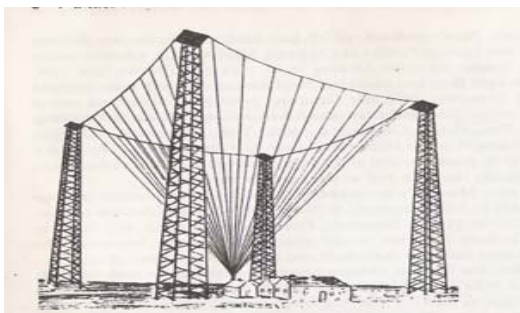


Fig. 4. Marconi's Poldhu Transmitter

### III. CONTRIBUTION OF BOSE IN MICROWAVE TECHNOLOGY

The most striking aspect of J.C Bose's coherer was the first use of millimeter waves in it. The use of millimeter waves was absent for almost fifty years after its first use. In 1904, J.C Bose got a patent on his solid state diode detector-using Galena Crystal. He was the first Indian to hold an US patent. His pioneering research in the field of microwave

components is well recognized by Lord Kelvin and Lord Rayleigh [4] [5].

### IV. CONCLUSION

Maxwell was a path setter with his contribution towards theoretical physics. In 1998 IEEE accepted J.C Bose as the inventor of mercury drop coherer used by Marconi. The precedence of Bose's demonstration of radio communication is also now well established.

### ACKNOWLEDGMENT

The contribution of Professor T.K Sarkar and Prof. D.L Sengupta, of Syracuse University, towards establishing and proclaiming the pioneering work of Sir J.C Bose is deeply appreciated. Most of the photographs included in this article have been taken from Wikipedia.

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