



Wireless: The Latest Telecom Story. Seventh Revised Edition. Mohan Sundara Rajan. National Book Trust, India, Nehru Bhawan, 5 Institutional Area, Phase-II, Vasant Kunj, New Delhi 110 070. 2022. xii + 348 pages. Price: Rs 345.

In a professional career spanning more than five decades, the author of this book Mohan Sundara Rajan has published many popular science books covering the internet, space, atomic energy, etc. What is special about the book is that it is the seventh revised edition. When this book was first published in 1978, it was considered significant that in a rare gesture, the former Secretary General of the International Telecommunication Union (ITU), M. Milli, commended it as excellent and decided to review it in the *ITU Journal*. The revised edition deserves the same accolade.

The author has an inimitable way of presenting facts and stories around those facts engagingly. It makes the subject easy to comprehend for a beginner interested in knowing the basics. At the same time, it is valuable for a telecom practitioner/specialist to become aware of the current trends and their evolution. With the 5G services formally launched, this book is a timely guide to understanding the technology, including the Indian contributions.

Modern telecommunications began when electrical signals were used to carry coded messages. The Morse code was used in telegraphy in 1845 in the USA. A different system was introduced in India in 1855, which helped the British settle the 1857 uprising for independence.

Transmission of sound was the next innovation. An Italian migrant to the US, Antonio Meucci developed the first telephone in 1855. Unfortunately, he could not

get a permanent patent due to his illness. His wife sold the prototype for six dollars to meet the cost of medicines. Meucci developed another instrument, but did not have funds for a regular patent and sold it to a telegraph company. In 1876, Alexander Graham Bell filed for a patent for the device. The US Government initiated a case of fraud against Bell, but the case was postponed until Meucci died.

Even as different telephone models were developed, the technology to connect the instruments also developed. Coaxial cables carried several channels and enhanced the value of the telephone. In India too, the use of coaxial cables for telecommunications became popular after Independence.

Undersea cables initially carried telegraph messages (1858). In 1870, London and Bombay were linked by a submarine cable. By 1980, phone calls, computer data and telexes were operational between the US and Europe. Optical fibre cables soon followed. Today, India is well connected to the rest of the world by state-of-the-art undersea cables. Multinational technology companies own undersea cable links for carrying internet data worldwide.

The emergence of integrated circuits opened new windows in the electromagnetic spectrum first described by Maxwell (1864). When Hertz produced the first radio waves (1888), he pondered if they would be useful.

In the mid-1890s, J. C. Bose in Calcutta demonstrated his innovation – the first solid-state diode detector of wireless waves. It is unclear whether Marconi was aware of this when he received three telegraph dots in telegraphy denoting the letter ‘S’ across the Atlantic. Soon oscillators that could generate continuous high-frequency wireless waves and other innovations such as the vacuum tube paved the way to carrying speech and music. In the 1920s, the discovery of the ionosphere as a radio mirror opened up shortwave radio links.

In India, the Government’s Telecommunication Research Centre developed a 300-channel narrow-band microwave system in the 1960s and connected Calcutta and Asansol. It was a modest beginning; but the work soon morphed into a nationwide microwave network of telecommunications – thanks to Indian engineers whose work is often underplayed. Together with the coaxial cable network, subscriber trunk dialling (STD) became a nationwide service.

The advent of the space age took telecom links to a new orbit. Initial experiments with American and French satellites resulted in

the indigenous development of telecom links that operated from India’s domestic satellites. The provision of spot beams led to a wide range of services from banking to education. The Indian initiative resulted in using an extended C-band in the microwave spectrum for specific space links with ITU approval. After the introduction of colour television in India (notwithstanding several naysayers, including well-known scientists), the service took off quickly. Today, about 900 private television channels (in addition to Doordarshan channels) operate from various satellites serving the country. Thanks to Indian Space Research Organisation, India has its navigation satellites and is no longer dependent on foreign GPS systems. In recent times, software-determined flexible coverage from satellites has become possible. Deep space links have also been successfully used in Chandrayaan and Mangalyaan missions. India is positioned to avail itself of the emerging space links directly to cell phones provided by hundreds of small communication satellites in low earth orbit.

When Martin Cooper developed the first mobile phone in 1973, it weighed about a kilogram. Observers in his time could not have imagined that it would become small enough to fit into one’s pocket. It not only became smaller and thinner but morphed into a smartphone that provides a wide range of functions with facilities like camera, video, online reservations, payments and purchases, navigation, data search, e-mail, etc. India was second to none in taking



J. C. Bose, unsung hero of radio communications, ahead of Marconi in the field.

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advantage of the global mobile phone technologies: global system for mobile communications (GSM) and code division multiple access (CDMA).

The rise of the internet has had a profound impact on the role of the phone. Today smartphones connect to the internet for various services provided by thousands of applications. The cost of data in India is considerably lower than in other countries, and the use of data has increased remarkably over the years with the emergence of smartphones. Four generations of wireless technology have delivered new services.

The first generation of wireless cellular technology, 1G, was an analogue system (1981); 2G was digital for voice connections (1992); 3G (2001) supported mobile internet and multimedia content, and 4G provided mobile broadband, high-speed data and smartphone services (2012). The 5G technology, which has just taken off, promises 'an age of boundless connectivity and intelligent automation'. It envisages data speeds up to 20 Gbps with negligible delay. The speed of downloads can be 10 times that of 4G. Other features include enhanced mobile broadband and mission-critical functions. The innovations call for new technologies like software-defined networking and high-power microprocessors. India has made a unique value-added technology to expand 5G coverage in rural areas. Indian engineers have developed a new transmit waveform which increases the

cell range since approved by the ITU. Reliance Jio, a leading telecom service provider, in collaboration with Qualcomm (maker of the Snapdragon microprocessor) has announced that it will provide every town in India with 5G technology by the end of 2023. Other private service providers and the Government-owned BSNL are also poised to give 5G service.

All these developments have been narrated in the book in a cogent way. Starting with the invention of the telegraph and the telephone, the book explains the technologies embedded in underground and undersea cables. Then it recounts the growth of microwave systems, and their use in satellite communication and navigation. The narrative explains the GSM and CDMA technologies with remarkable clarity and analyses the impact of the internet on telecommunications and mobile phones, and the emergence of smartphones and multimedia services, including WhatsApp. The emergence of five generations of mobile phones is explained with special emphasis on the applications of 5G technology and Indian innovations that extend its use.

The succeeding chapters analyse the challenges faced in India in operating three generations of exchanges (including the 'struggle' with the cross-bar common control system). It is encouraging to read about the role of C-Dot, the indigenous electronic system, which has struggled to succeed. The demanding multimedia services on the

emerging next-generation network and other world trends (where software can change the frequency, modulation, and power output of hand-held phones anywhere and anytime) are then examined. In conclusion, the challenge of taking digital technologies to rural India is analysed.

The story of telecommunications with emphasis on Indian developments, often underplayed in the media, is rendered in a nontechnical and lucid language, easily accessible to lay readers. Though some of the technical details may not be needed in a popular account, the advanced technologies described would be useful to those in the telecom business, including start-ups, software developers and students. The book, illustrated with good graphics, and boxes would help enhance public understanding of a technology that is fast becoming a way of life. The work deserves the support of telecom service providers, State Governments and educational institutions, where it can be used as a primer on the subject. A welcome addition to the book is a selective and simplified glossary. The author and the National Book Trust have done a commendable job.

S. SAMPATHKUMAR

221, 2nd Main, 1st Cross,
Mahalakshmi Layout,
Bengaluru 560 086, India
e-mail: sasimpath@gmail.com