

One-Minute Introduction to mmWave Technology and Applications

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Miniature, low power/bit, multi-Gbps wireless connections at home and office will arrive shortly. What will you do with it?

I. WHAT IS MMWAVE?

MMWAVE (millimeter wave) technology is a next generation wireless technology that can provide up to multi-Gbps wireless connectivity for short distances between electronic devices. The data rate is expected to be 40-100 times faster than today's wireless LAN technologies, transmitting an entire DVD's data in roughly 15 seconds. This will be like having leading-edge wireline connectivity without worrying about cable connections.

II. HOW DOES IT WORK?

A critical component of this technology is the mmWave chip set. It allows transmitting signals wirelessly using a 60-GHz-band carrier frequency. This frequency range is almost 1,000 times higher than those used for FM radio. Since the carrier frequency is higher, more data can be sent in a given period of time, by modulating the carrier's amplitude, frequency, or phase.

In addition, reliable digital data transmission at multi-Gbps data rates cannot be achieved without sophisticated coding techniques. Such high data rates are not necessarily easy to achieve even with some of the wireline technologies available today. To make the things worse, wireless data transmissions are severely affected by various disturbances such as reflection, absorption, noise, etc., in free space. Therefore, the digital data need to be encoded

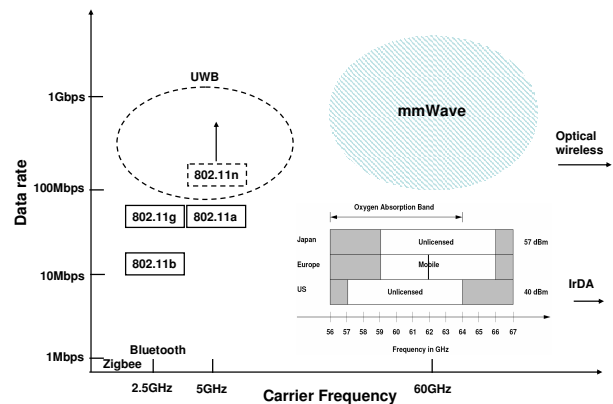


Fig. 1. Comparing mmWave and other wireless technologies. Both UWB and 802.11n use frequencies that are already heavily used.

and decoded appropriately at multi-Gbps data rates, such that efficient and robust transmission can be achieved.

III. WHY IS MMWAVE UNIQUE?

In wireless communications, the frequency is an essential resource. Fortunately, mmWave technology can exploit unregulated bandwidth that is available world-wide and with better efficiency and security than traditional wireless LAN frequencies such as 2.5 or 5 GHz. In addition, higher frequencies mean shorter wavelengths. As a result, the antenna systems can be millimeter size. Even arrays of antennas may be packaged within the area of a quarter for directionally transmitting and receiving radio signals.

On the other hand, since the carrier frequency is so high, expensive compound semiconductor technologies such as GaAs were the only choices, until IBM demonstrated that the chipsets can be manufactured with silicon-based technologies for

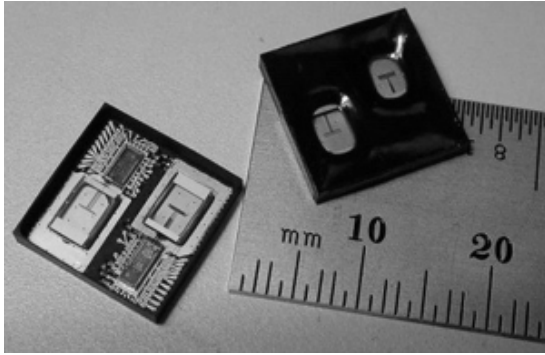


Fig. 2. IBM's mmWave transmitter and receiver chip. The chip set including antenna will become small and affordable.

lower costs, lower power per bit, and a smaller form factor than previously possible before. Soon, the technology will be ubiquitously embedded into various IT devices. Also, IBM's high-speed signal processing and coding techniques, such as error and packet recovery, enables efficient and robust digital data transmission for a small additional cost and power consumption.

IV. HOW CAN MMWAVE BE USED IN OUR LIVES?

Though the possibilities are endless, let us go through some near-future application scenarios.

First of all, this wireless technology can be widely used at home and office for applications such as multimedia contents downloads, HDTV streaming, and instant data replication. You could wirelessly download and synchronize iPod-like devices with music and videos in seconds, and send HDTV image wirelessly to a flat TV screen hanging on the wall. Or you could replicate multi-media presentation packages from your desktop to notebook more quickly. You do not need to find the right cable to use any more.

Second, since mmWave technology is more secure and does not interfere with other wireless technologies, it can be used where conventional wireless technologies cannot be used. For example, it can be applied to an in-flight entertainment distribution system that won't interfere with flight controls or navigation equipment.

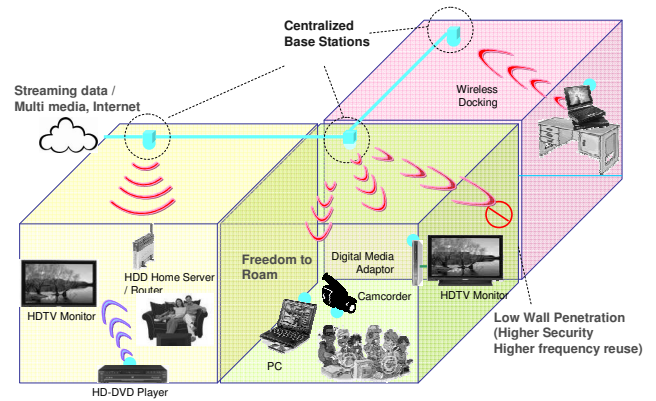


Fig. 3. Imagine your office and home become wire free space! Our mmWave technology will bring multi-Gbps wireless connectivity there.

Third, the technology will affect how multimedia information is distributed to end users. For example, you could instantly download rich multimedia content to your cellular phone just passing through a gate, an entrance, or in front of the product you are about to buy. You will enjoy TV shopping fun in front of real products.

Furthermore, mmWave technology allows transmitting a large amount of data across remotely-controlled miniature robots or vehicles without cable connections. So, for example, a team of these vehicles or robots can collectively search the real world and transmit real-time crisp images. This system could help find people for rescue in case of emergency or help find things at home.

Applications of mmWave technology to automobiles are also attractive.

V. CONCLUSION

We believe that this technology could significantly affect the way computers and electronic devices communicate each other. Human beings enjoy rich audio and visual communications naturally without being connected through cables and wires, so why not for computers, too!

References: For further info, please visit our website, <http://www.research.ibm.com/mmwave>.