

Modern Wireless Communications – Why the Evolution from 2G to 4G?

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Wireless broadband access is the *only* solution to provide high-speed internet and data connections in many regions of the world. Cellular networks developed for supporting mobile users is increasingly seen as the bedrock of broadband access, with wireless LAN networks playing a supporting role, especially indoors.

Cellular mobile networks have evolved from 2G (TDMA based GSM with 200KHz bandwidth), to 3G (spread spectrum W-CDMA with 5MHz bandwidth), and currently to 4G (OFDM/OFDMA based LTE with 20MHz bandwidth). The key issue that we would like to address in our talks is: *Why did the bits-to-waveform mapping scheme change from TDMA to CDMA to OFDM when the bandwidth (and hence the bit-rate) of the wireless signal was increased?*

We motivate the reason for this evolution to OFDMA by focusing on four aspects of a modern cellular system: (a) Ability to handle time-of-flight differences between different mobile uplink signals connected to the base-station, (b) Complexity of the optimal receiver in multipath channels, (c) Ability to manage co-channel interference, and (d) Flexibility of resource allocation. We will interpret the above three mapping schemes using a “channel coding based framework” to show why OFDMA has become the scheme of choice for modern wireless communications. The five lectures will be done with minimal mathematics and notation, but will instead use simple figures, relevant properties of linear systems, and common sense, to bring home the main learnings.