

Cellular Systems and Standards: 3G W-CDMA, 4G LTE

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- Cellular Concept

- communication system $\left\{ \begin{array}{l} \text{wired/wireline} \\ \text{wireless} \end{array} \right.$

- communication system $\left\{ \begin{array}{l} \text{mobile} \\ \text{fixed} \end{array} \right.$

- mobile wireless communications $\left\{ \begin{array}{l} \text{Single transmitter covers all area.} \\ \text{A lot of transmitters cover the area.} \end{array} \right.$

- The cellular concept has revolutionized mobile wireless communications.
- frequency reuse factor ≤ 1

- Elements of a mobile telecommunication system
 - Core Network (CN): GSM core network used for GSM and W-CDMA, IS-41 core network used for cdmaOne and cdma2000. A CN connects access network to PSTN and the Internet.
 - Radio Access Network (RAN): GSM Access Network (GRAN), UMTS radio access network (UTRAN), the Long Term Evolution (LTE) RAN (E-UTRAN)
 - User Equipment (UE): mobile stations

- Elements of a RAN $\left\{ \begin{array}{l} \text{Base Station (BS)} \\ \text{Mobile Station (MS)} \\ \text{Relay Station (RS)} \end{array} \right.$

- $\left\{ \begin{array}{l} \text{BS} \rightarrow \text{MS: forward link or downlink} \\ \text{MS} \rightarrow \text{BS: reverse link or uplink} \end{array} \right.$

- Cellular Network Standards

- The n th generation standard for a cellular network is defined by radio access technology (RAT) or radio transmission technology (RTT) neither by carrier or clock frequency nor by chip-set technology.

- * 1G: Advanced Mobile Phone Systems (AMPS) $\leftarrow$ analog FM, FDM, FDMA, only for voice

- * 2G: Digital AMPS (D-AMPS), Global System for Mobile communications (GSM: originally Groupe Spécial Mobile) $\leftarrow$ TDM, TDMA, mainly for voice

* 2.5G: cdmaOne (CDMA: Code-Division Multiple-Access), originally IS-95 (Interim Standard 95) ← CDM, CDMA, mainly for voice

* 3G: W-CDMA (Wideband CDMA), cdma2000, etc. ← CDM, CDMA, mainly for voice

- cdmaOne and W-CDMA are both based on direct-sequence code-division multiple-access (DS-CDMA) scheme.
- DS-CDMA is a popularized term that is equivalent to ‘DS/SS technique applied to multiple access communications.’
- spread spectrum modulation
 - ⎧ direct-sequence spread-spectrum (DS/SS)
 - ⎨ frequency-hopping spread spectrum (FS/SS)

- * 4G: LTE (Long Term Evolution) $\leftarrow$ OFDM (Orthogonal FDM), OFDMA, mainly for data

- * B4G: Beyond 4G

- * 5G: under development

- From 4G, OFDM and its variants are mainly considered as RTT.

- Wi-Fi and Bluetooth

- Wi-Fi

- * IEEE: Institute of Electrical and Electronics Engineers
 - * IEEE802.11: a set of media access control (MAC) and physical layer (PHY) specifications for implementing wireless local area network (WLAN) computer communications
 - * IEEE802: the IEEE LAN/MAN Standards Committee (MAN: Metropolitan Area Network)
 - * Wi-Fi (commonly WiFi: Wireless Fidelity): any WLAN product based on the IEEE802.11 standards /ex/ 802.11, 802.11a, 11b, 11g, 11-2007, 11n, 11-2012, 11ac, 11ad, etc.

— Bluetooth

- * Bluetooth: a wireless technology standard for exchanging data over short distance and building personal area networks (PANs)
- * managed by the Bluetooth Special Interest Group (SIG)
- * The Scandinavian tenth-century king Harald Bluetooth united Danish tribes into a single kingdom. It was initially hoped that Bluetooth would do the same with communications standards.