Wireless Networking : Solution to Homework #1

1. Suppose that three CDMA users A, B and C are simultaneously transmitting 0 bits, each using the CDMA sequence in the figure above. What is the resulting chip sequence?

   **Answer:**

   \[
   \begin{align*}
   \tilde{A} &= (+1 +1 +1 -1 +1 -1 -1) \\
   \tilde{B} &= (+1 -1 +1 -1 -1 +1 +1 +1) \\
   \tilde{C} &= (+1 +1 +1 -1 -1 -1 +1 +1) \\
   S &= \tilde{A} + \tilde{B} + \tilde{C} = (+3 +1 -1 -1 -1 +1 +1 +1)
   \end{align*}
   \]

2. A CDMA receiver gets the following chips: (-1 +1 -3 +1 -1 -3 +1 +1). Assuming the chip sequence in the figure above, which stations transmitted and which bits did each one send?

   **Answer:**

   \[
   \begin{align*}
   S \cdot A &= (+1 -1 +3 +1 -1 +3 +1 +1)/8 = 1 \\
   S \cdot B &= (+1 -1 -3 -1 -1 -3 +1 -1)/8 = -1 \\
   S \cdot C &= (+1 +1 +3 +1 -1 -3 +1 -1)/8 = 0 \\
   S \cdot D &= (+1 +1 +3 -1 +1 +3 +1 -1)/8 = 1
   \end{align*}
   \]

   So station A transmits 1, station B transmits -1, station C transmits nothing and station D transmits 1.

3. How can you reduce the guard times in TDMA? The guard band in FDMA?

   **Answer:**

   The guard times can be reduced by improving the synchronization of the system such that stations transmit in their assigned time slot without interfering the signals in neighboring slots.
4. Give at least an example of wireless networks that are single-hop/multi-hop, and infrastructure-based/infrastructure-less (4 examples in total).

<table>
<thead>
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<th>Infrastructure Based</th>
<th>Infrastructure-less</th>
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<tr>
<td>Single hop</td>
<td>Cellular System</td>
<td>WLAN in ad hoc mode, sensor network</td>
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<tr>
<td>Multi hop</td>
<td>Mesh Network</td>
<td>MANET, VANET</td>
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5. When the power of a base station doubles, how does the range of the cell change?

**Answer:**

The cell range does not change. The communication between mobile station and base station require both downlink and uplink working, so the cell range is the determined by the intersection of downlink and uplink range. The cell coverage cannot be improved by only expanding the downlink range without increasing the uplink range.

6. When the chip-sequence of a CDMA transmission doubles in length, how does the bandwidth of the transmitted signal change?

**Answer:**

The bandwidth also doubles.