CDMA - BASIC

Imagine a scenario where a sender and receiver using CDMA (Section 7.2.1 from the text) are exchanging data. Assume both the sender and receiver use a CDMA code of size 6, where M = -1, 1, -1, -1, -1, 1.

QUESTION 1 OF 2

Given the CDMA code above and the bit d=-1, what is the encoded output? Separate each value with a comma and no spaces

Answer

- $M = \{-1, 1, -1, -1, -1, 1\}$
- $|M| = 6$
- $d_1^1 = -1$
- $I = \{d_1^1\}$
- $Z_{1,1}^1 = d_1^1 \cdot c_1^1 = -1 \cdot -1 = 1$
- $Z_{1,2}^1 = d_1^1 \cdot c_2^1 = -1 \cdot 1 = -1$
- $Z_{1,3}^1 = \_\_\_ = -1 \cdot -1 = 1$
- $Z_{1,4}^1 = \_\_\_ = -1 \cdot -1 = 1$
- $Z_{1,4}^1 = \_\_\_ = -1 \cdot -1 = 1$
- $Z_{1,5}^1 = \_\_\_ = -1 \cdot 1 = -1$

$\sum_{s=1}^{6} d_i^s \cdot c_m^s \quad \forall i, m \in I, M$

QUESTION 2 OF 2

Given the CDMA code above and the output string: 1,-1,1,1,1,-1, what is the decoded bit value?

Answer

$d_i^s = \frac{1}{M} \cdot \left[\sum_{m=1}^{M} Z_{i,m}^* \cdot c_m^s\right]$

$I = \{1, -1, 1, 1, 1, -1\}$

$M = \{-1, 1, -1, -1, -1, 1\}$

- $d_1^1 = \frac{1}{6} \cdot 1 \cdot -1 + 1 \cdot -1 + -1 \cdot 1 + -1 \cdot 1 + -1 \cdot 1 + 1 \cdot -1$

$= \frac{-1-1-1-1-1-1}{6} = \frac{-6}{6} = \boxed{-1}$

CDMA: ADVANCED

CDMA - ADVANCED

This time, assume there are 2 senders whom interfere with eachother and that the interfering transmitted bit signals are additive. The value received at a receiver, however, is now the sum of the transmitted bits from all senders.

Assume that sender 1 has a CDMA code of (1, -1, 1, 1, -1, -1, -1, -1) and sender 2 has a CDMA code of (-1, 1, -1, 1, -1, -1, 1, -1) and their combined output is: (0, 0, 0, -2, 2, 2, 0, 2)

QUESTION 1 OF 2

Assuming you are receiver 1, what is the decoded bit? If it can't be done, answer with 'n/a'

-1

- $M^1 = \{1, -1, 1, 1, -1, -1, -1, -1\}$
- $d_1^1 = \frac{0\cdot 1 + 0\cdot -1 + 0\cdot 1 + -2\cdot 1 + 2\cdot -1 + 2\cdot -1 + 0\cdot -1 + 2\cdot -1}{8}$

$= \frac{0+0+0-2-2-2+0-2}{8} = -\frac{8}{8} = -1$

QUESTION 2 OF 2

Assuming you are receiver 2, what is the decoded bit? If it can't be done, answer with 'n/a'

Answer

$M^2 = \{-1, 1, -1, 1, -1, -1, 1, -1\}$

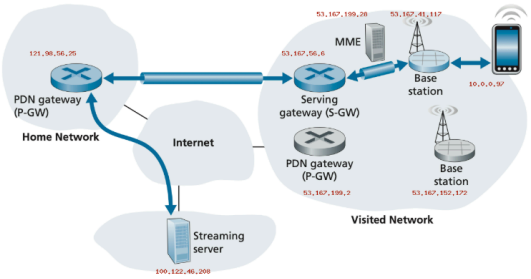
$d_1^2 = \frac{0+0+0+1\cdot -2 + -1\cdot 2 + -1\cdot 2 + 1\cdot 0 + -1\cdot 2}{8}$

$= \frac{0+0+0-2-2-2+0-2}{8} = \boxed{-\frac{8}{8} = -1}$

4G WIRELESS TUNNELLING

4G WIRELESS TUNNELING

In the graphic below, a mobile phone has a TCP connection with the streaming server using wireless 4G. Assume that both the mobile phone and the server use TCP port 3317 and any intermediary nodes that tunnel the datagrams use port 4144.



QUESTION 1 OF 30

What is the source IP address of the datagram sent from the mobile phone to the base station?

10.0.0.97

QUESTION 2 OF 30

What is the destination IP address of the datagram sent from the mobile phone to the base station?

100.122.46.208

QUESTION 3 OF 30

What is the transport-layer port number in the datagram sent from the mobile phone to the base station?

3317

QUESTION 4 OF 30

What transport-layer protocol is indicated in the datagram sent from the mobile phone to the base station?

TCP

QUESTION 5 OF 30

Is there an encapsulated datagram within the datagram sent from the mobile phone to the base station? Answer Yes or No

no

QUESTION 6 OF 30

What is the source IP address of the datagram sent from the base station to the serving gateway?

53.167.41.117

QUESTION 7 OF 30

What is the destination IP address of the datagram sent from the base station to the serving gateway?

53.167.56.6

QUESTION 8 OF 30

What is the transport-layer port number in the datagram sent from the base station to the serving gateway?

4144

QUESTION 9 OF 30

What transport-layer protocol is indicated in the datagram sent from the base station to the serving gateway?

UDP

QUESTION 10 OF 30

Is there an encapsulated datagram within the datagram sent from the base station to the serving gateway? Answer Yes or No

yes

QUESTION 11 OF 30

What is the source IP address of the encapsulated datagram?

10.0.0.97

QUESTION 12 OF 30

What is the destination IP address of the encapsulated datagram?

100.122.46.208

QUESTION 13 OF 30

What is the transport-layer port number in the encapsulated datagram?

3317

QUESTION 14 OF 30

What transport-layer protocol is indicated in the encapsulated datagram?

TCP

QUESTION 15 OF 30

What is the source IP address of the datagram sent from the serving gateway to the PDN gateway?

53.167.56.6

QUESTION 16 OF 30

What is the destination IP address of the datagram sent from the serving gateway to the PDN gateway?

121.98.56.25

QUESTION 17 OF 30

What is the transport-layer port number in the datagram sent from the serving gateway to the PDN gateway?

4144

QUESTION 18 OF 30

What transport-layer protocol is indicated in the datagram sent from the serving gateway to the PDN gateway?

UDP

QUESTION 19 OF 30

Is there an encapsulated datagram within the datagram sent from the serving gateway to the PDN gateway? Answer Yes or No

yes

QUESTION 20 OF 30

What is the source IP address of the encapsulated datagram?

10.0.0.97

QUESTION 21 OF 30

What is the destination IP address of the encapsulated datagram?

100.122.46.208

QUESTION 22 OF 30

What is the transport-layer port number in the encapsulated datagram?

3317

QUESTION 23 OF 30

What transport-layer protocol is indicated in the encapsulated datagram?

TCP

QUESTION 24 OF 30

What is the source IP address of the datagram sent from the PDN gateway to the server?

121.98.56.25

QUESTION 25 OF 30

What is the destination IP address of the datagram sent from the PDN gateway to the server?

100.122.46.208

QUESTION 26 OF 30

What is the transport-layer port number in the datagram sent from the PDN gateway to the server?

3317

QUESTION 27 OF 30

What transport-layer protocol is indicated in the datagram sent from the PDN gateway to the server?

TCP

QUESTION 28 OF 30

Is there an encapsulated datagram within the datagram sent from the PDN gateway to the server? Answer Yes or No

no

QUESTION 29 OF 30

Is data encrypted between the mobile phone and the base station? Answer Yes or No

yes

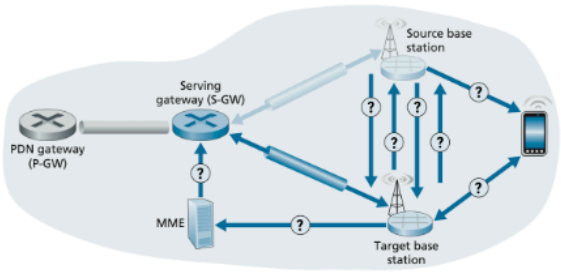
QUESTION 30 OF 30

Does the server know about any of the wireless tunneling? Answer Yes or No

no

4G WIRELESS HANDOVER

Consider the scenario, where a mobile phone connected to a base station (source) is streaming a video from the internet, and the mobile phone is going to switch to a closer base station (target) without interrupting their video stream. This process (called a handover) is shown in the diagram below.



Take a look at the statements below and put them in the correct order.

A. The current (source) base station selects the target base station, and sends a Handover Request message to the target base station.

B. The source base station receives the Handover Request Acknowledgement message and informs the mobile device of the target base station's identity and channel access information. At this point, the mobile device can begin send- ing/receiving datagrams to/from the new target base station. From the mobile device's point of view, handover is now complete! However, there is still a bit of work to be done within the network.

C. The target base station confirms back to the source base station that the tunnel has been reconfigured, allowing the source base station to release resources associated with that mobile device.

D. The target base station informs the MME that it (the target base station) will be the new base station servicing the mobile device. The MME, in turn, signals to the Serving Gateway and the target base station to reconfigure the Serving- Gateway-to-base-station tunnel to terminate at the target base station, rather than at the source base station.

E. The source base station will also stop forwarding datagrams to the mobile device and instead forward any tunneled datagrams it receives to the target base station, which will later forward these datagrams to the mobile device.

F. The target base station checks whether it has the resources to support the mobile device and its quality of service requirements. If so, it pre-allocates channel resources (e.g., time slots) on its radio access network and other resources for that device. This pre-allocation of resources frees the mobile device from having to go through the time-consuming base-station association protocol discussed earlier, allowing handover to be executed as fast as possible. The target base station replies to the source base station with a Handover Request Acknowledge message, containing all the information at the target base station that the mobile device will need to associate with the new base station.

G. At this point, the target base station can also begin delivering datagrams to the mobile device, including datagrams forwarded to the target base station by the source base station during handover, as well as datagrams newly arriving on the reconfigured tunnel from the Serving Gateway. It can also forward outgo- ing datagrams received from the mobile device into the tunnel to the Serving Gateway.

QUESTION 1 OF 7

Which lettered step (A-G) above corresponds to the first step in the handover process?

A

QUESTION 2 OF 7

Which lettered step (A-G) above corresponds to the second step in the handover process?

F

QUESTION 3 OF 7

Which lettered step (A-G) above corresponds to the third step in the handover process?

B

QUESTION 4 OF 7

Which lettered step (A-G) above corresponds to the fourth step in the handover process?

E

QUESTION 5 OF 7

Which lettered step (A-G) above corresponds to the fifth step in the handover process?

D

QUESTION 6 OF 7

Which lettered step (A-G) above corresponds to the sixth step in the handover process?

C

QUESTION 7 OF 7

Which lettered step (A-G) above corresponds to the seventh and final step in the handover process?

G