

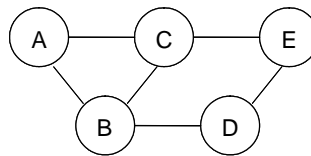
## Homework assignment 11: Wireless LANs

Due date: 2018-01-25

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### 1. Throughput in 802.11 networks

- Assume the topology below consisting of the nodes A, B, C, D and E.



This following list describes which nodes try to send data to which other nodes. Starting with a free channel, provide one timing diagram for each of the 3 transmission scenarios (i.e., node A or B or E starts transmitting first); assume RTS/CTS is used.

- (a)  $B \rightarrow D$  and  $E \rightarrow D$
  - (b)  $C \rightarrow B$  and  $E \rightarrow D$
  - (c)  $A \rightarrow B$  and  $C$
- Assume that in the previous scenario (a), station B wins the contention phase. For this case, calculate the overhead and effective data rate (so-called *goodput*) for the transmission of a single DLC data frame. Assume standard IEEE 802.11a parameters, in particular, a transmission rate of 6 Mbit/s for control frames and 12 Mbit/s for data frames of 1500 Bytes. Control frames are 20 Bytes (RTS), 14 Bytes (CTS), and 14 Bytes (ACK) in size. With IEEE 802.11a an SIFS is  $16 \mu\text{s}$  and a DIFS is  $34 \mu\text{s}$ .

2. Assume a WLAN BSS with one station far away from the access point and several other stations close to the access point. All terminals are backlogged, i.e., they always have data to send to the AP.

Explain why this one far away station severely limits the throughput achieved by the other stations. You might want to use equations.

Hint: Think about the fairness model of 802.11 and its rate adaptation capabilities.

3. Suppose there are two ISPs providing Wi-Fi access in a particular café, with each ISP operating its own AP and having its own IP address block. Further suppose that by accident, each ISP has configured its AP to operate over channel 11. (from: <http://vspclil-physicallayer.wikispaces.com/file/view/High+level+exercises.pdf>)
  - Will the 802.11 protocol completely break down in this situation? Discuss what happens when two stations, each associated with a different ISP, attempt to transmit at the same time.
  - Now suppose that one AP operates over channel I and the other over channel 11.