Tutorial 2 - SS2016
Communication Systems and Protocols

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Task 1: Arbitration

A) A system using centralized daisy-chaining is shown in figure 1.1. An exemplary arbitration cycle of the system is shown in figure 1.2. Assign the correct signals of figure 1.1 to the signals shown in the diagram below (figure 1.2). Justify your choice of assignment with a few sentences. What node is sending data at which point in time? Complete the diagram (figure 1.2) accordingly.

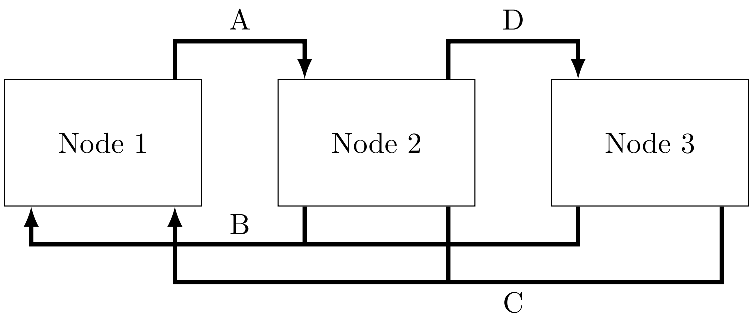

Figure 1.1: Centralized Daisy-chain

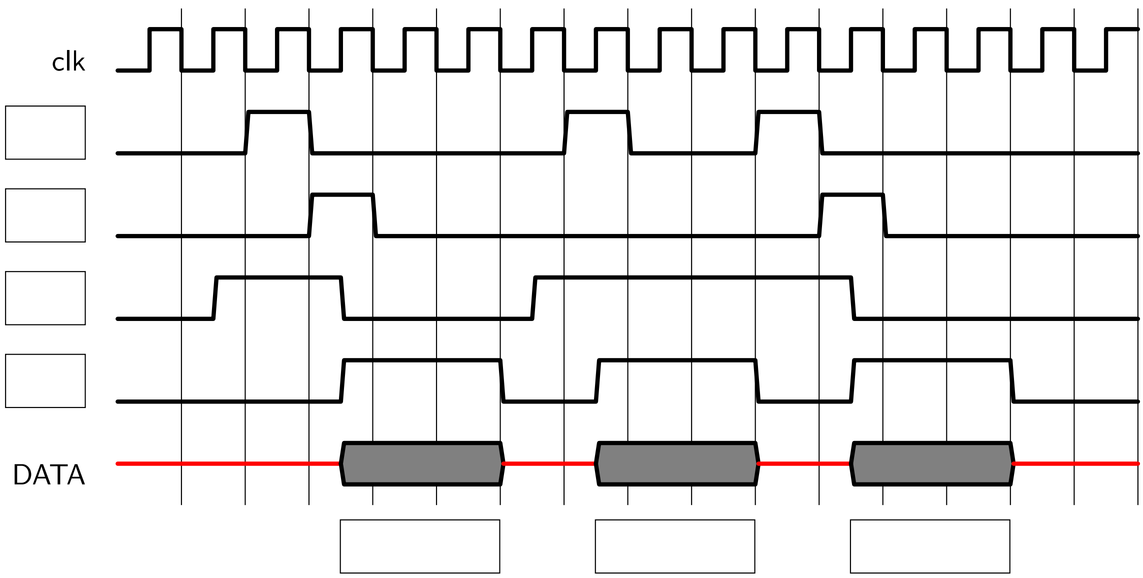

Figure 1.2: Signal flow for Daisy-chain

B) In the decentralized Daisy-chain shown in figure 1.3 a scheduling should be done. The different nodes will set a request at the times given in table 1.1. Only after successful transmission the nodes will remove their request. The sending of the data always needs exactly one time step. This includes token passing and the time needed for the arbitration. Complete Table 1.2 according to the specified arbitration scheme.

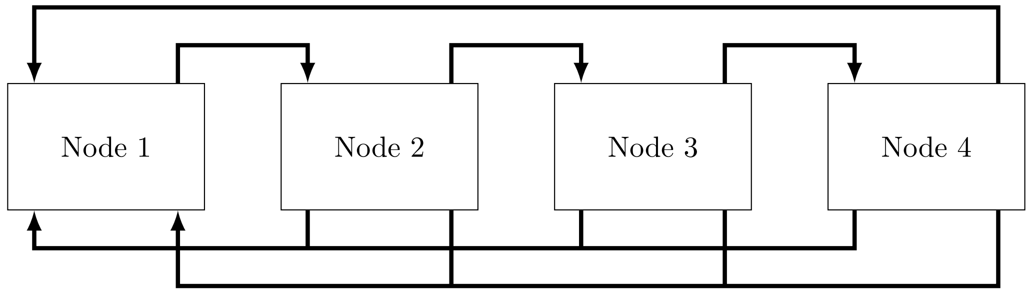

Figure 1.3: Decentralized Daisy-chain

time	Nodes that assert a sending request signal
t_1	Node 2 and Node 3
t_2	Node 1
t_3	Node 0
t_4	Node 0 and Node 1

Table 1.1: Time of sending nodes

time	Sending Node
t_0	Node 0
t_1	
t_2	
t_3	
t_4	
t_5	
t_6	

Table 1.2: Solution of Daisy-chain scheduling

Task 2: Walsh functions

A) Table 2.1 shows the functions of several sender nodes. Show that these functions fulfill the requirements and can be used to transmit data using CDMA.

Sender node	Function
A	$(+1,+1,-1,-1,+1,+1,-1,-1)$
B	$(+1,+1,+1,+1,-1,+1,-1,+1)$
C	$(+1,+1,-1,-1,-1,-1,+1,+1)$

Table 2.1: Functions for sender nodes

B) An additional node D should also be able to send data at the same time. Find another function for node D and show that your function is valid.

C) Table 2.2 shows the walsh code for a system with four different senders. Only three instead of four senders want to send data. Calculate the resulting signal on the media.

Sender node	Function	Data
A	$(+1,+1,+1,+1)$	"1"
B	$(+1,-1,+1,-1)$	"0"
C	$(+1,+1,-1,-1)$	"0"
D	$(+1,-1,-1,+1)$	-

Table 2.2: Walshcode for four sender nodes

D) Calculate the bit value that the receiver will detect for node D.

E) Assume there is not an analog signal on the media, but a positive and negative value. Calculate the bit value that the receiver will detect for node A and node D.

Task 3: Code Division Multiple Access (CDMA)

A) The transmission scheme "Code Division Multiple Access" uses so called spreading codes to separate different transmissions. One group of functions that can be used for this purpose, are the Walsh functions. The CDMA scheme shall be used for simultaneous transmission of eight different messages. Derive the required Walsh functions and give them in binary notation.

B) The CDMA scheme shall be used for simultaneous transmission of eight different messages. Derive the required Walsh functions and give them in binary notation.

C) For the simultaneous transmission of three messages, the Walsh function calculated in this task shall be used. The eight bit given in Table 3.1 shall be encoded each using one of the Walsh functions mentioned above. They are the transmitted simultaneously. The Walsh function is to be inverted when a '1' is to be transmitted and remains unchanged for a '0' to be send. Give the resulting signal on the media. Make use of the given scheme.

The following Signal has been received from a transmission using the Walsh functions from this task.

+2.1 +1.9 +1.4 +2.0 -1.7 +5.3 -2.1 -1.9

As corruptions might happen during transmission, the receiver has a tolerance band for the detection of "1" and "0". All values differing up to ± 0.5 from the ideal value will still be accepted as "1" and "0".

Node	Data	Signal							
0	"0"								
3	"1"								
6	"0"								
Signal on media									

Table 3.1: transmission with CDMA

D) Calculate the bit value that the receiver will detect for node 1 and node 5.