Karlsruher Institut für Technologie

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Communication Systems and Protocols

Exercise 2

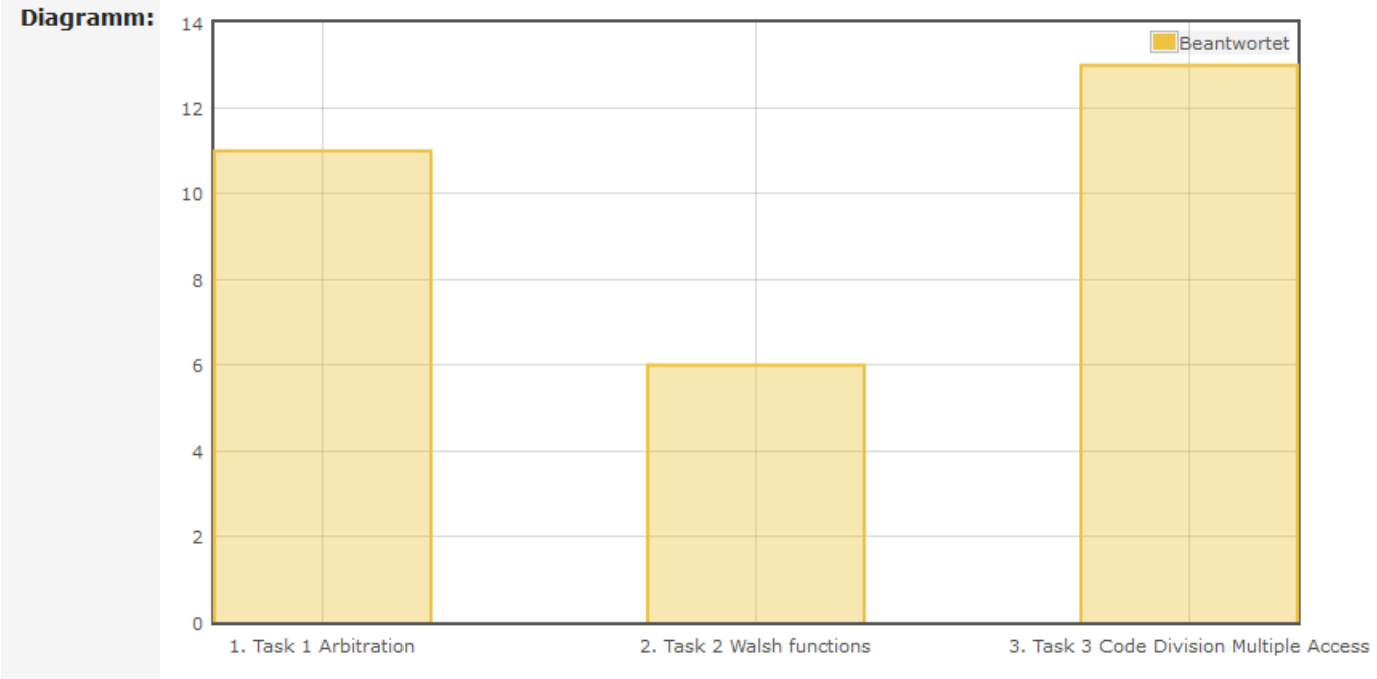
Schedule CSP

Monday: 09:45 – 11:15 (MTI)	Thursday: 09:45 – 11:15 (EAS)
18.04.2016 – Lecture 1	21.04.2016 – Lecture 2
25.04.2016 – Lecture 3	
02.05.2016 – Lecture 4	05.05.2016 – Ascension Day
09.05.2016 – Lecture 5	12.05.2016 – Exercise 1
16.05.2016 – Pentecost week	19.05.2016 – Pentecost week
23.05.2016 – Lecture 6	26.05.2016 – Corpus Christi
30.05.2016 – Exercise 2	02.06.2016 – Lecture 7
06.06.2016 – Exercise 3	
13.06.2016 – Lecture 8	16.06.2016 – Exercise 4
20.06.2016 – Lecture 9	
27.06.2016 – Exercise 5	30.06.2016 – Lecture 10
04.07.2016 – Lecture 11	
11.07.2016 – Lecture 12	14.07.2016 – Exercise 6
18.07.2016 – Exercise 7	21.07.2016 – Question time

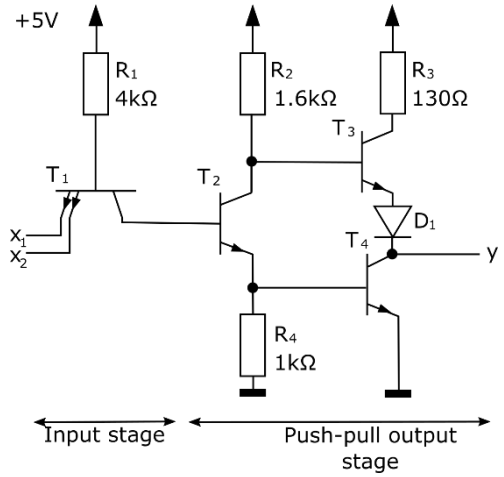
Monday, 25.07.2016: CSP - EXAMINATION

Results of the survey

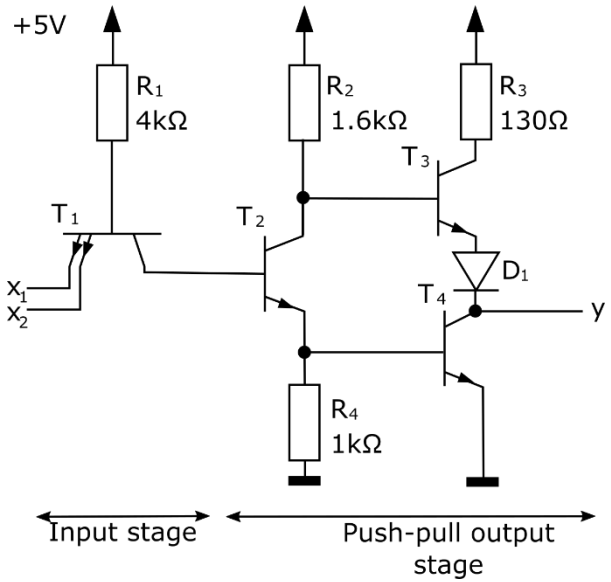
- Arbitration and CDMA



Task 3.1: TTL logic



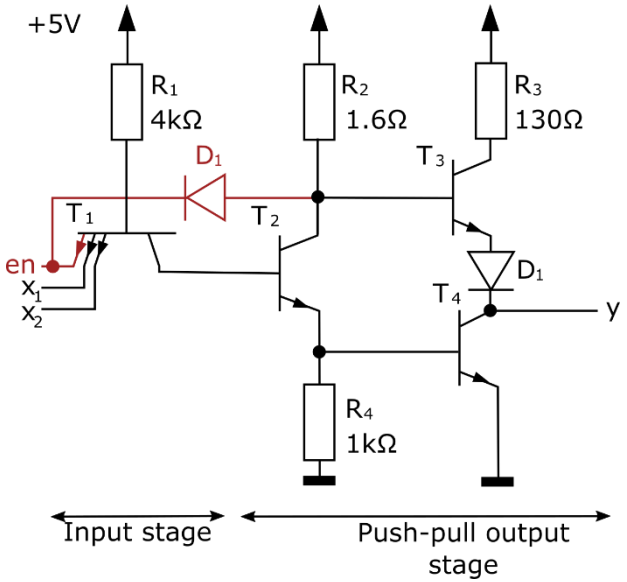
Task 3.1 solution



x_1	x_2	T_1	T_2	T_3	T_4	y
0	0	conducts	blocks	conducts	blocks	H
0	1	conducts	blocks	conducts	blocks	H
1	0	conducts	blocks	conducts	blocks	H
1	1	blocks	conducts	blocks	conducts	L

Task 3.1 solution

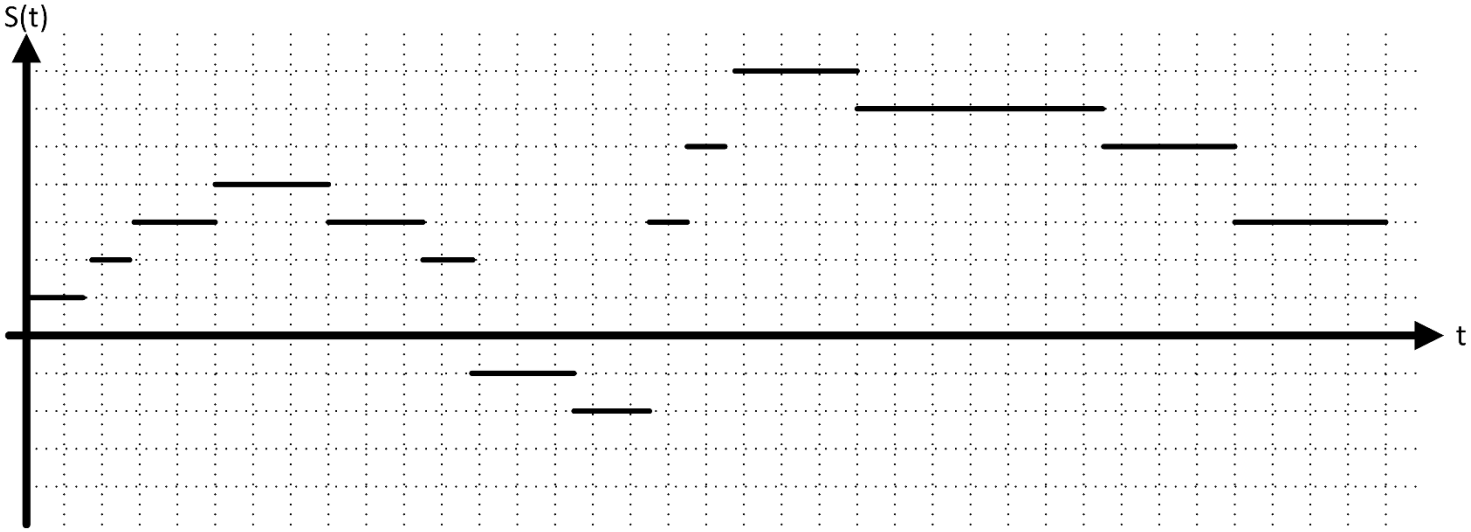
- T1 needs an enable input
  - En=LOW -> T_4 and T_3 are blocked , y is high-resistance (Z)
- A diode in reserve direction is needed



en	x_1	x_2	y
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0
0	-	-	Z

Task 3.4 A) : Channel capacity

Task 3.5: Signal Conversion



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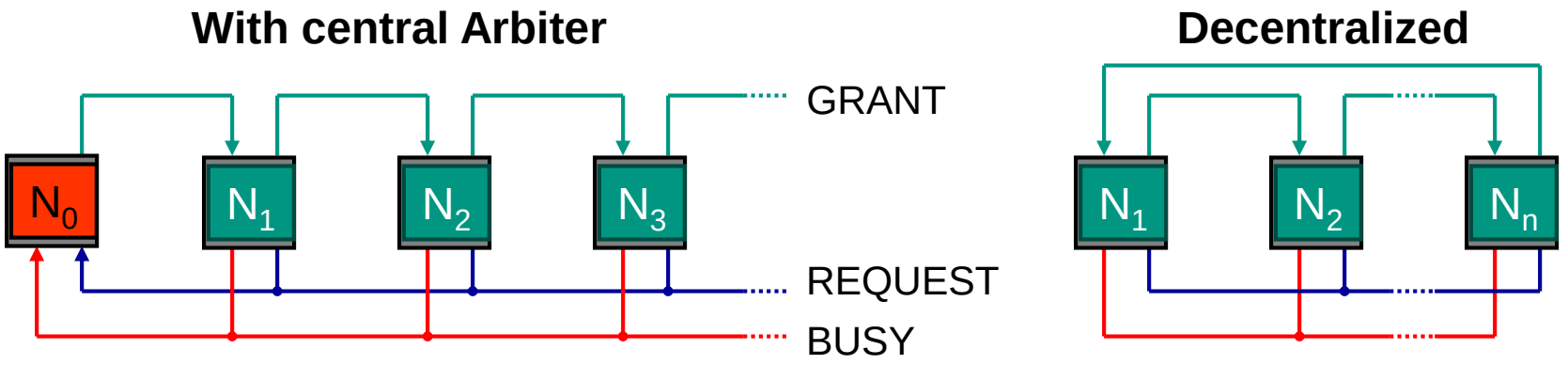
Daisy-Chain

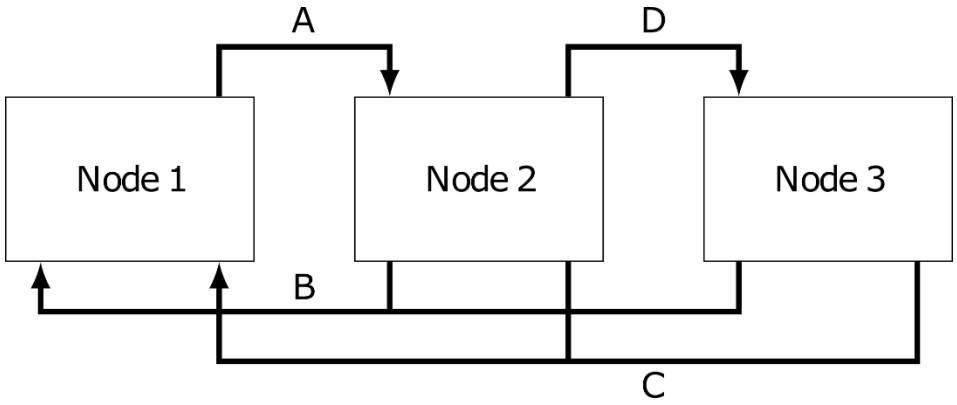


- All nodes that are “ready-to-send” activate the *REQUEST*-line
- If a node N_i receives the *GRANT*-signal it can take over the control of the bus
  - If N_i has data to send, N_i activates the *BUSY*-line and keeps the *GRANT*-signal
  - If N_i has no data to send, it passes the *GRANT*-signal to the next node N_{i+1}
- Centralized: One central arbiter N_0. Chain always starts with N_0.
- Decentralized: Chain always starts with the node that was the last bus master
- Properties:
  - relatively slow
  - easy extensions (scalable)
  - low hardware footprint

→ Centralized daisy-chaining unfair, as priorities are fixed by the wiring

Task 1: Arbitration

A)+B)



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Spreading codes

- Spreading functions have to be orthogonal (orthogonal means that the inner product of two functions equals to 0)

- Walsh code
  - Start with a logic “0” as element a_{11} of a 2x2 matrix
  - The element a_{11} is repeated at position a_{12} and a_{21}
  - At position a_{22} the inverse of a_{11} is inserted

$$\begin{matrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{matrix}$$

- Walsh functions for sender nodes
  - Substitution in resulting matrix
  - Zeros with +1
  - Ones with -1

Task 2: Code Division Multiple Access

A)+B)

Node	Code							
0								
1								
2								
3								
4								
5								
6								
7								

Node	Sender function							
0								
1								
2								
3								
4								
5								
6								
7								

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Data transmission with CDMA

- Multiple nodes want to send data at the same time using the same frequency band
  - Every node has a unique spreading code assigned to it
- Every bit to be send is encoded with the spreading code assigned to the corresponding sender
  - Transmission of „0“: Spreading sequence is send as is
  - Transmission of „1“: Spreading sequence is inverted
- Spreading sequences of all nodes are superimposed and form **one** signal on the media
  - Attention: The signal on the media is now multi-valued and not binary any more!

Task 2: Code Division Multiple Access

C)

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

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Reception with CDMA

- On receiver side the transmitted signal is correlated with the Walsh function that has been assigned to the node
- As the Walsh functions of the other nodes are orthogonal, only the signal that is meant for the receiver is filtered
  - If the result of the correlation is +8, a “0” has been send
  - If the result of the correlation is -8, a “1” has been send
- For real data transmission a decision based on the exact value is not possible any more because of interferences and other disturbances that distort the signal. Therefore the signal has to be within in a predefined interval to be interpreted as “1” or “0”.

Task 2: Code Division Multiple Access

D)

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

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