Telecooperation Lab
Prof. Dr. Max Mühlhäuser

Telekooperation 1: Exercise WS15/16

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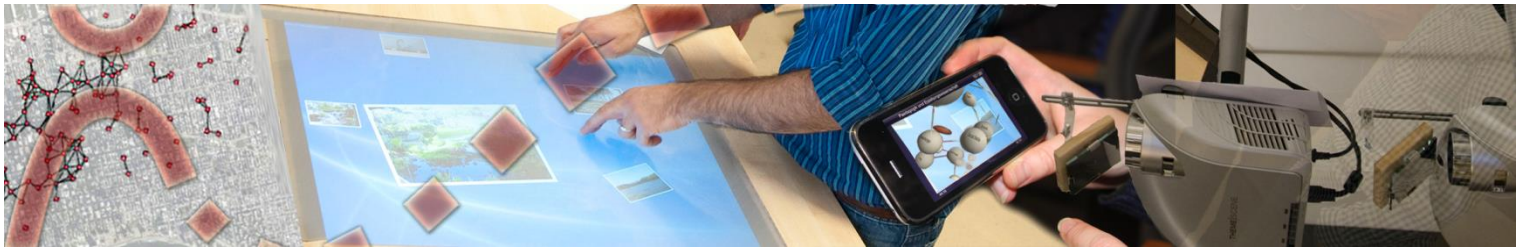

TK1 – EXERCISE 28.1.2016

- Solution 8th Exercise
- 9th Theory Exercise
- 5th Programming Exercise

Task 1

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- Mention (at least) **two criteria for the correctness in distributed systems**.
- Explain the criteria in one to two sentences and describe (at least) one example of the realization of the criterion.

Task 1

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- **Safety**
  - Properties are kept throughout computation and are always true
  - Ensure that a “bad thing” *cannot* happen, e.g. a deadlock
- **Liveness**
  - Guarantees progress computation
  - Ensure that a “good thing” *must* happen, e.g. termination

Task 2

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A client *C* wants to synchronize with a timeserver *S* in the intranet (assume an ideal minimum transmission delay of zero milliseconds). The runtime behavior of its messages (round-trip time) and the resulting timestamp of *S* are both stored by *C* in the following table:

Round-trip (ms)	Time (HH:MM:SS)
20	15:38:24.765
18	15:38:36.580
22	15:38:49.698

Refer to the algorithm by Christian to answer the following questions:

a) Which entry in the depicted table should *C* select to set its local clock?

b) How accurate is the time estimate of *C* in relation to *S*?

c) Which time should *C* set to its local clock?

Task 2

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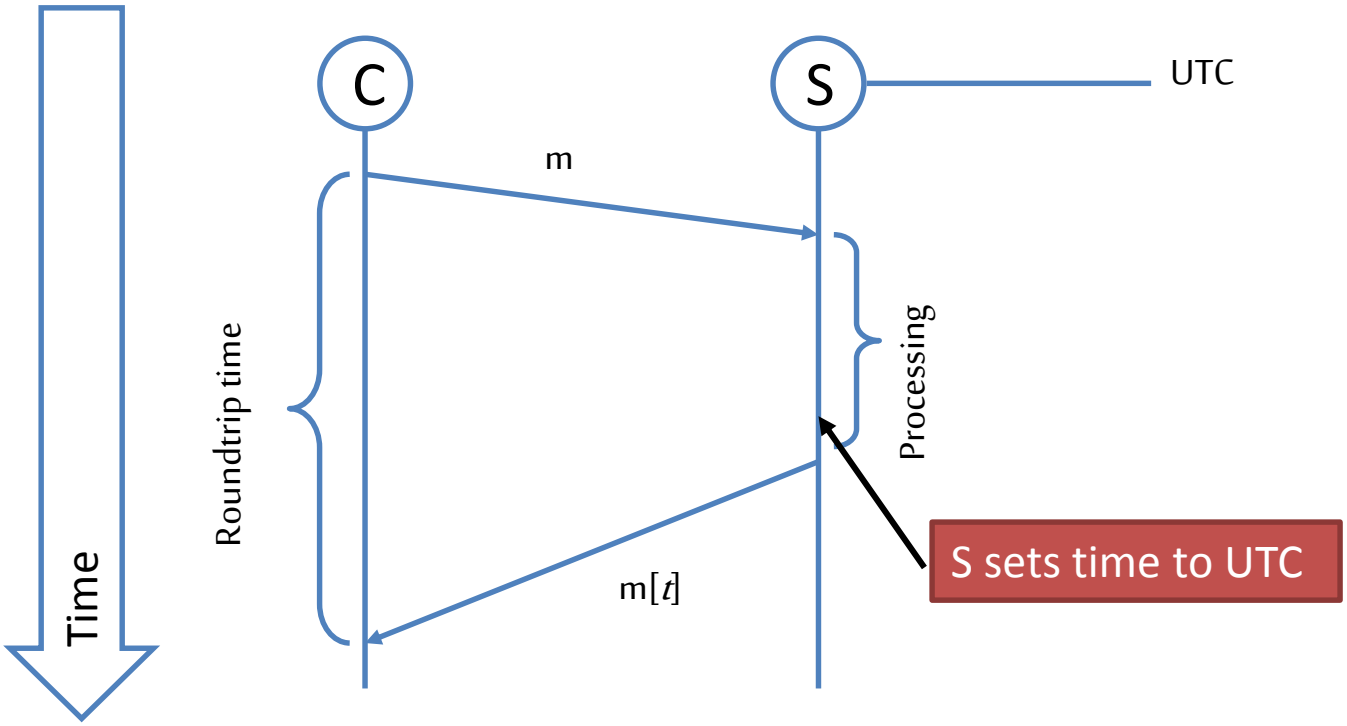
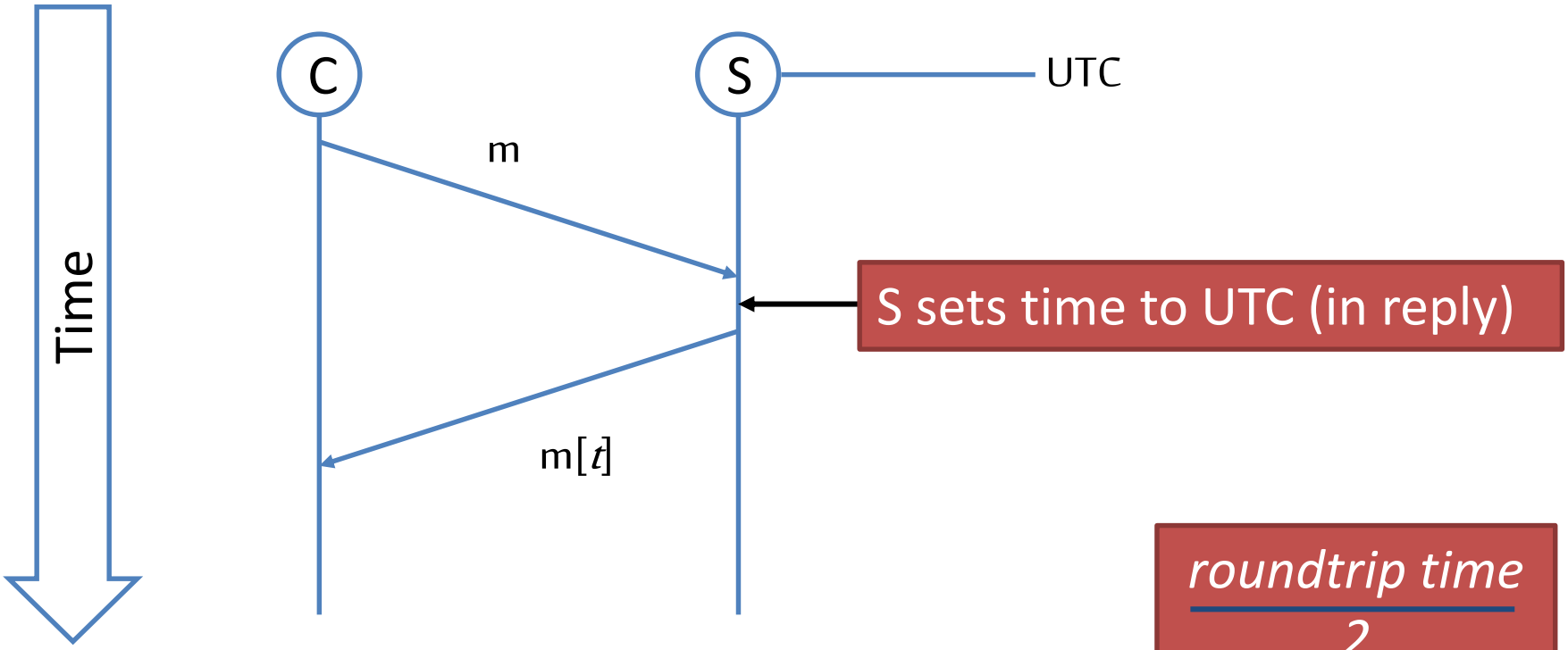
- General Situation



Task 2

Assumptions: only roundtrip time is known, m and m‘ take the same amount of transmission time and no processing time.



2.a: C chooses the entry with the smallest roundtrip time.

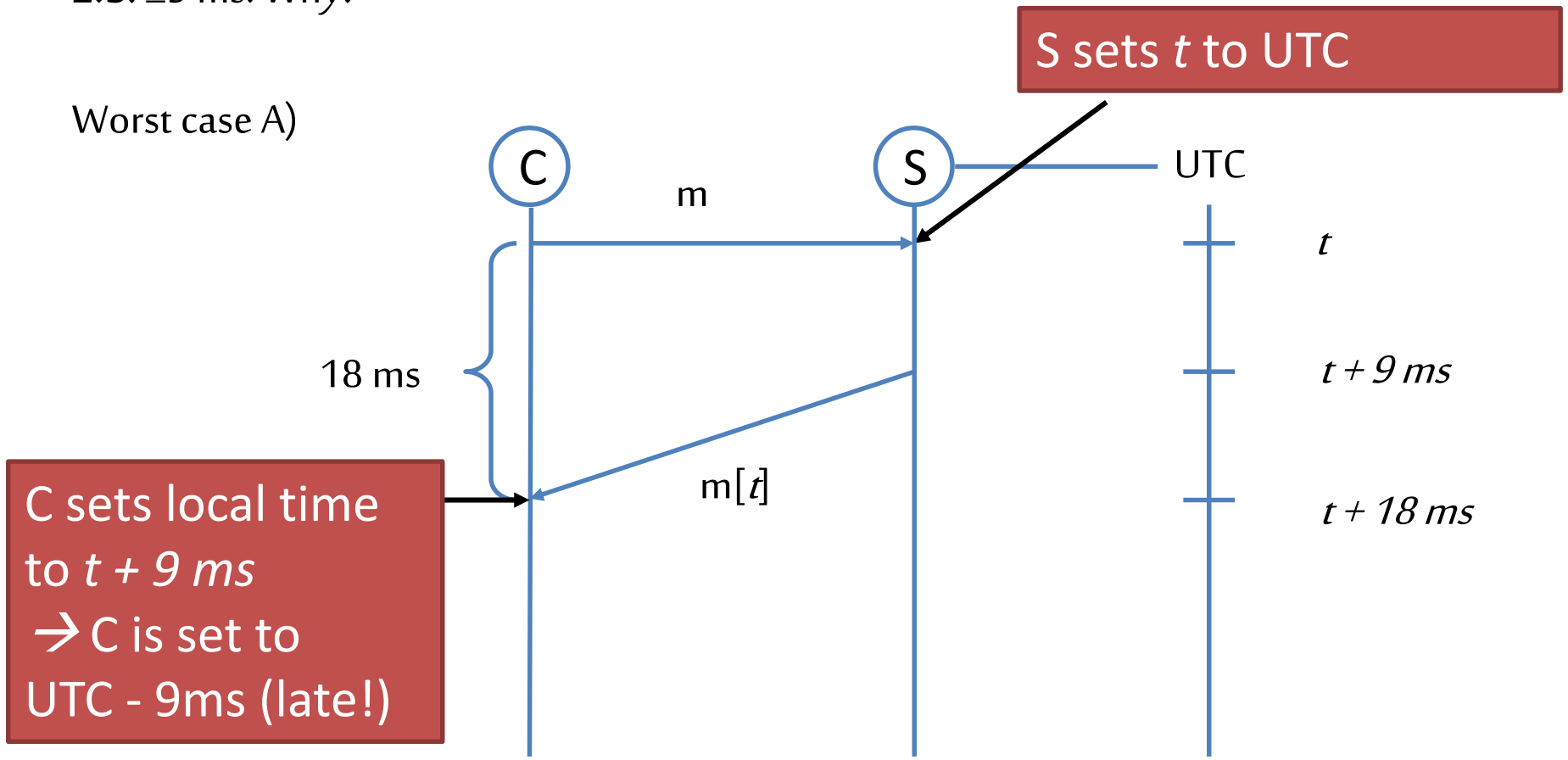
2.c: C sets local time to: 15:38:36.580 + 0.009s = 15:38:36.589

(18ms/2 = 9 ms = 0.009s)

Task 2

2.b: ±9 ms. Why?

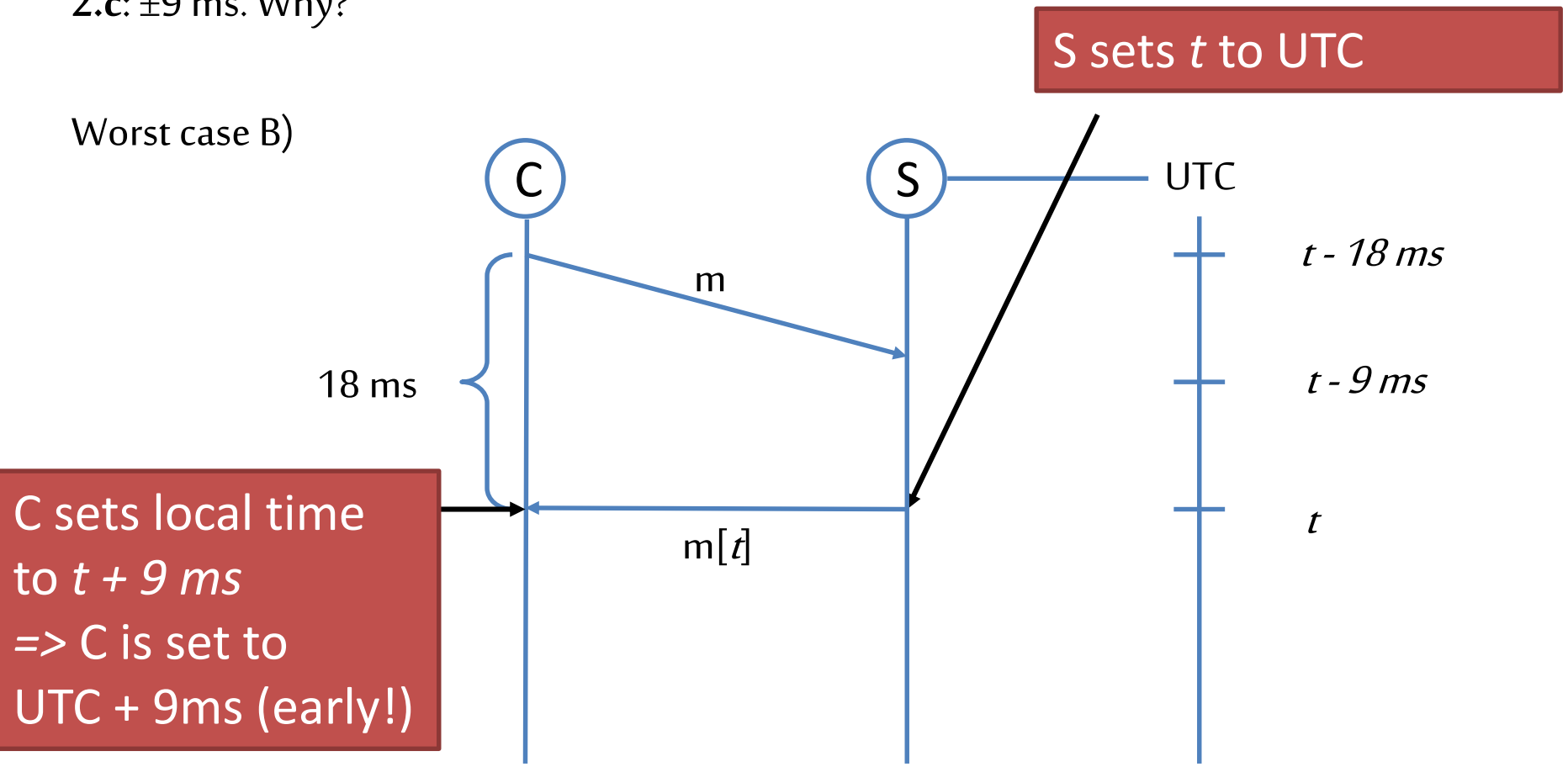
Worst case A)



Task 2

2.c: ±9 ms. Why?

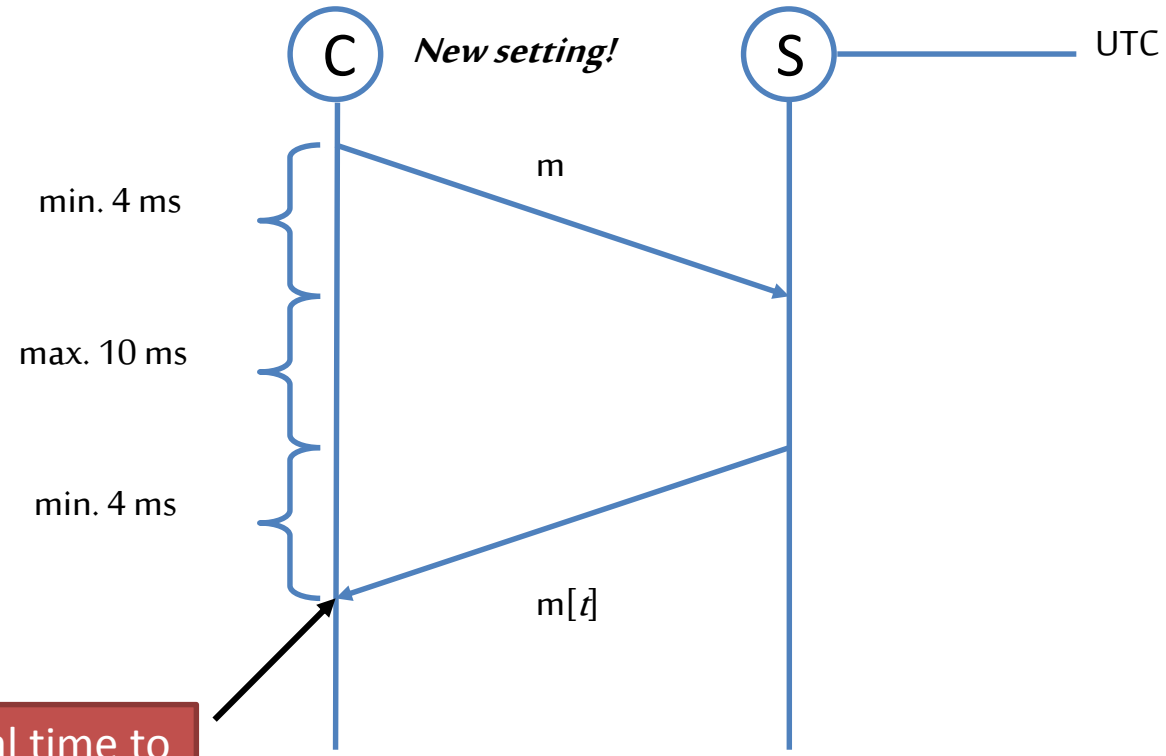
Worst case B)



Task 2

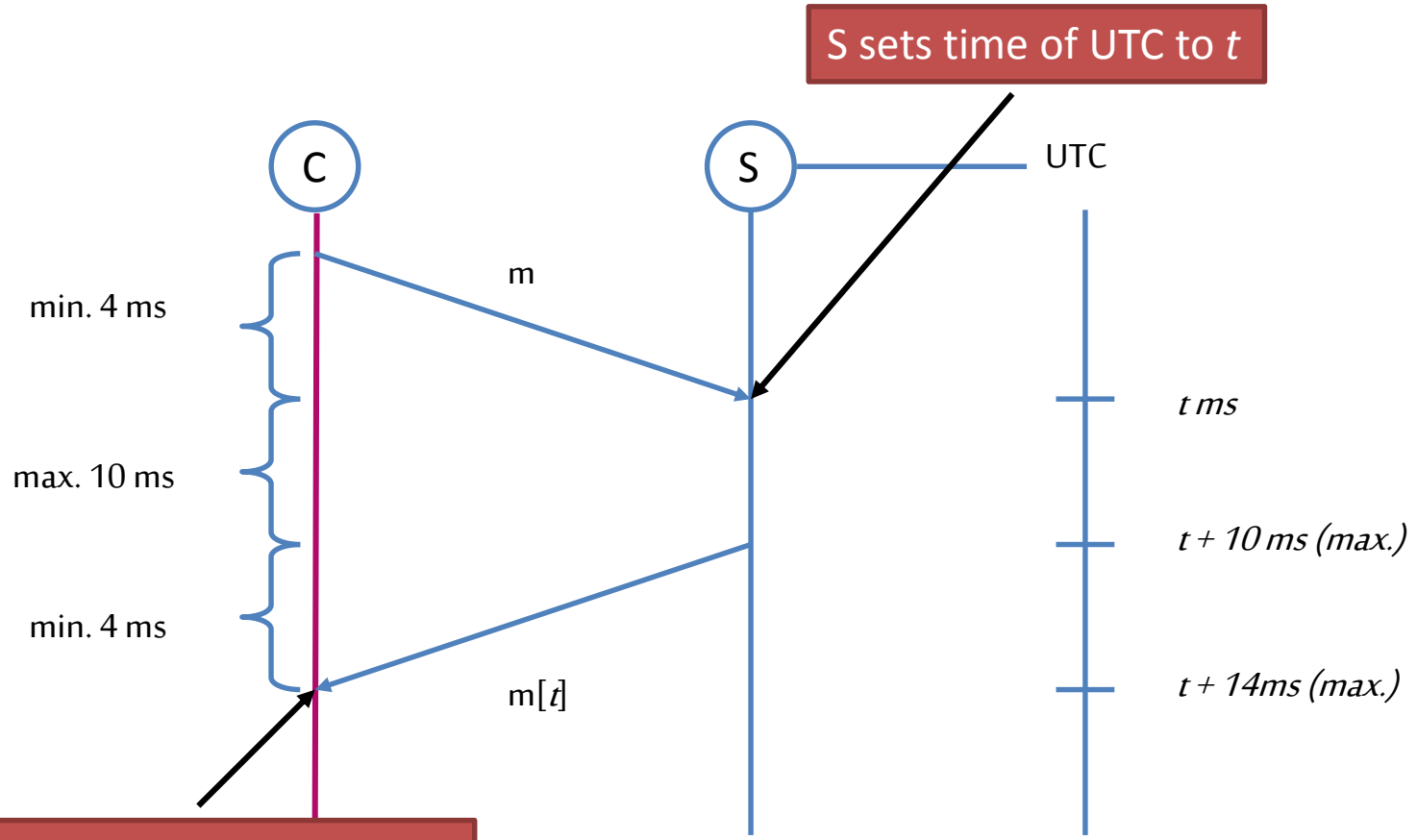
2.d: Only the precision of the estimation changes to ±**5 ms**

[roundtrip/2 - min = 18ms/2 – 4ms (cf. Coulouris)]



Task 2

Worst case A)

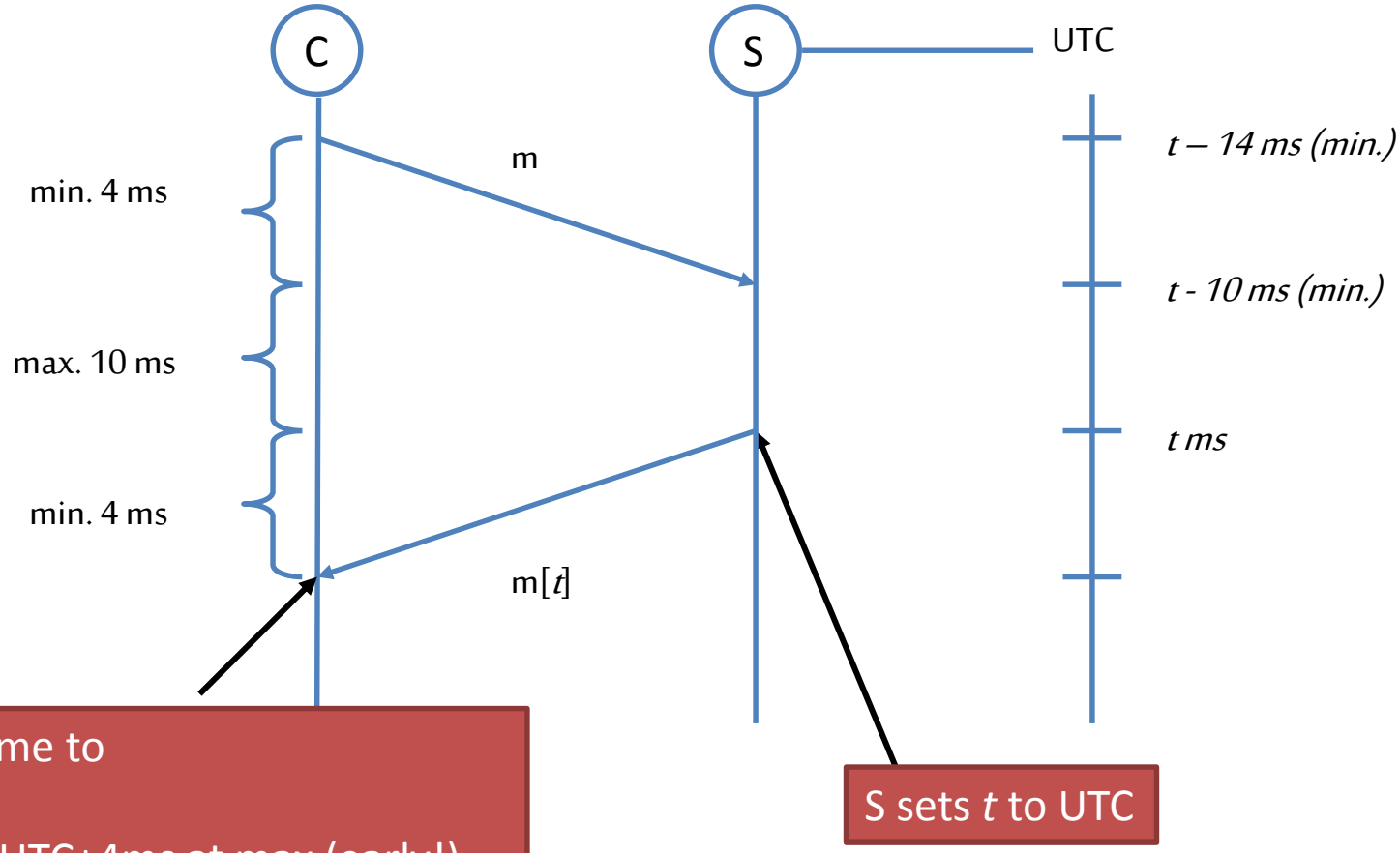


C sets local time to
t + 9 ms
→ C is set to UTC-4ms at max (late!)

Task 2

10.2.d: ±5 ms.

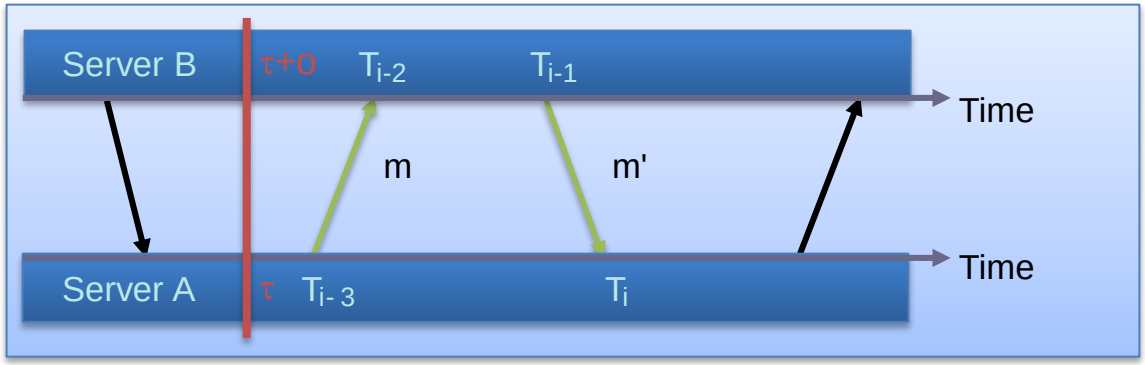
Worst case B)



C sets local time to
t + 9 ms
→ C is set to UTC+4ms at max (early!)

S sets *t* to UTC

Task 2



Cf. lecture:

- Delay: $d_i = t + t' = T_{i-2} - T_{i-3} + T_i - T_{i-1}$
- Offset: $o_i = ½ (T_{i-2} - T_{i-3} + T_{i-1} - T_i)$
- Accuracy of offset o is estimated by upper and lower bounds:
  $o_i - d_i/2 \leq o \leq o_i + d_i/2$

Values:

- T_{i-3} = 15:32:56.210
- T_{i-2} = 15:32:56.400
- T_{i-1} = 15:32:56.690
- T_i = 15:32:56.960

=> o_i = (15:32:56.400 - 15:32:56.210 + 15:32:56.690 - 15:32:56.960)/2 = -**0,040** s

=> d_i = (15:32:56.400 - 15:32:56.210 + 15:32:56.960- 15:32:56.690) = 0,460 s

=> **-0,040 s – 0,460s/2 < o < -0,040 s + 0,460s/2**