Appendix: Numerical solutions to the exercises

This summary contains solutions to those exercise problems whose solutions can be represented as numerical values.

E.4.2.2-1: Topology of a digital LAN communication network

a)   Maximum transmission rate:

10 Mbit/s

b)   Maximum number of additional computers:

98

E.4.3.6.4.2-1: ISM-Band

a)   Mean wavelength (ISM band):

$\lambda_m = 1.2281 \cdot 10^{-1}$ **m = 12.28 cm**

b)   Free space loss FSL:

FSL = 80.20 dB.

c)   Power ration between sender S and receiver E:

$$\frac{P_S}{P_E} = 1.0472 \cdot 10^8$$

d)   Maximum achievable distance:

r = 218.77 m

e)   Underwater operation:

Half lenght: r = 0.9763 cm.
No, the absorption is too strong!

E.4.3.6.6-1: 5-GHz-Band

a)   Comparison of free space attenuation in the ISM band and 5 GHz band:

$\Delta A_F = 6.98$ dB

b)   Transmitting power difference:

$$\frac{P_{5\,GHz}}{P_{ISM}} = 4.99 \; .$$

E.4.4-1: Maximum data rate

a)   Maximum data rate („Classical telephony"):

6200 bit/s

b)   Maximum data rate (ISM band):

$1.58 \cdot 10^8$ bit/s

c)   Signal/Noise ratio:

S/N = 0.91

E.4.6-1: Optimization of an information transmission system

Optimum number of states per channel:

2.7183 (practically: 3)

E.5.5.5-1: Packet transfer time for a smallest possible and a largest possible data frame in a network based on Ethernet, Fast Ethernet and Gigabit Ethernet technology

E.5.5.5-2: Number of frames transmitted per second in each case (cases as in task A.5.5.5-1)?

```
E.5.5.5-1:
```

Parameter	Ethernet	Fast Ethernet Ethernet	Gigabit- Ethernet
Minimum frame length:			
$t_{Packet,\ min}$/s	$67.20 \cdot 10^{-6}$	$6.720 \cdot 10^{-6}$	$4.256 \cdot 10^{-6}$
Maximum frame length:			
$t_{Packet,\ max}$/s	$1230.4 \cdot 10^{-6}$	$123.0 \cdot 10^{-6}$	$12.304 \cdot 10^{-6}$

```
E.5.5.5-2:   Number of transferred frames per second:
```

Minimum frame length:	Ethernet	Fast Ethernet	Gigabit Ethernet
$\dfrac{N_{Packet}}{t} / \dfrac{1}{s}$	14 880	148 809	234 962
Maximum frame length:			
$\dfrac{N_{Packet}}{t} / \dfrac{1}{s}$	812	8 130	81 274

E.5.5.5-3: Relative bandwidth utilization

Minimum frame length:			
R_{min}	0.5476	0.5476	0.0865
Maximum frame length:			
R_{max}	0.9744	0.9756	0.9753

E.5.5.5-4: Throughputs in transcontinental computer network

```
4.1  S = 77.39 MBit/s (7.74 % utilization)

4.2  S = 456.19 Mbit/s (45.6 % utilization)
```

E.5.5.6.1-1: Mean throughput in the case of maximum efficiency in the Pure ALOHA process

G = 0.5

E.5.5.6.1-2: Maximum channel utilization at maximum efficiency in the Pure ALOHA process

S_{max} = 0.1839

E.5.5.6.2-1: Average throughput in the case of maximum efficiency in the Slotted ALOHA process

$G = 1$

E.5.5.6.2-2: Maximum channel utilization in case of maximum efficiency in the Slotted ALOHA process?

S_{max} = 0.3679

E.5.6-1: *CRC* checksum for a data frame

Transmitted frame: `11010111100`

E.5.10.2.3-1: Adjacency matrix

i/j		0	1	2	3	4	5
0		0	1	1	0	1	0
1		0	0	0	1	0	1
2		0	0	0	1	0	1
3		0	0	0	0	1	1
4		0	0	0	0	0	1
5		0	0	0	0	0	0