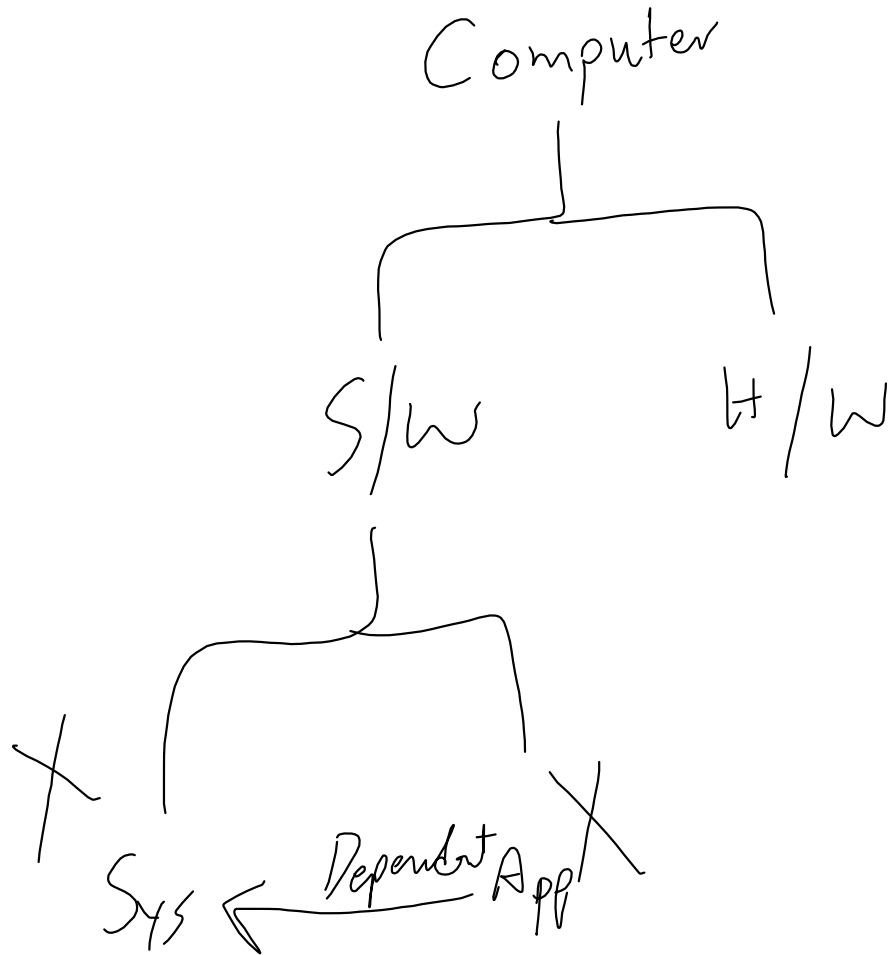
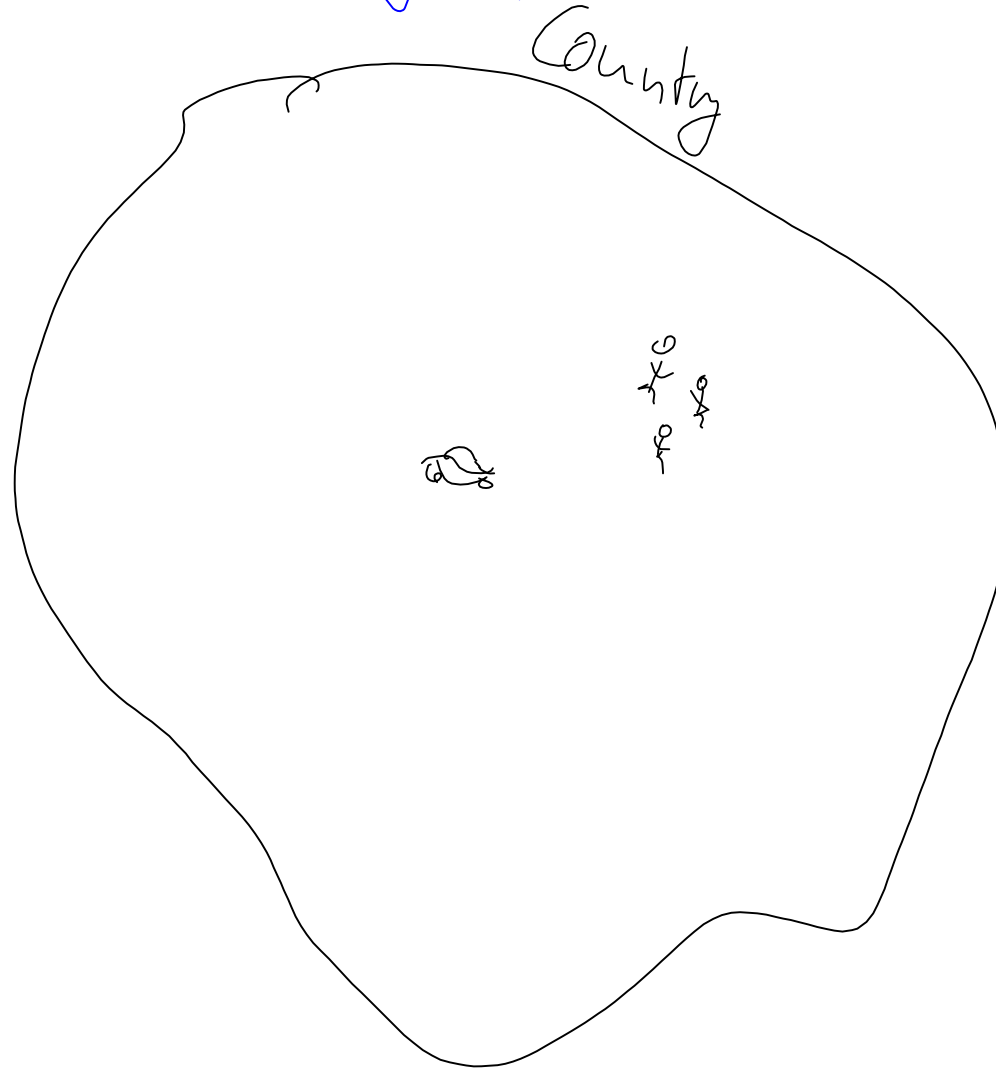
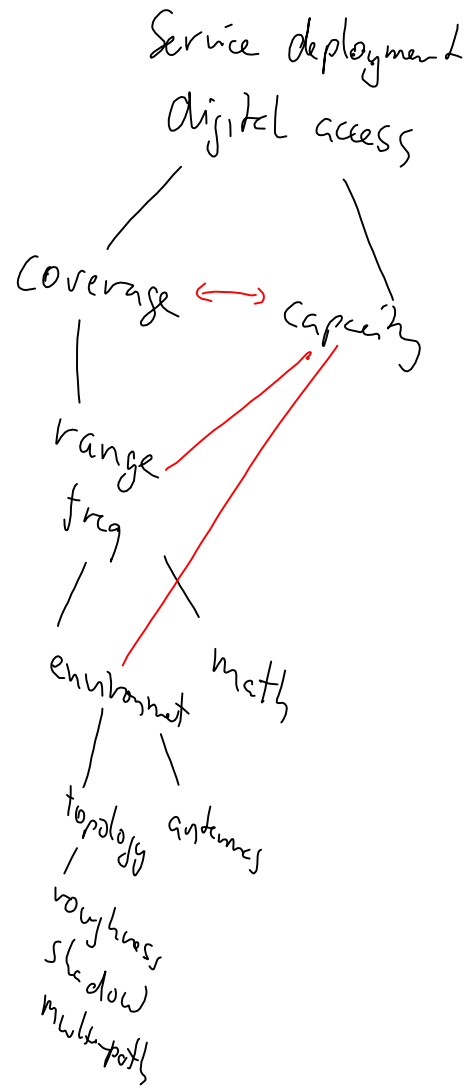


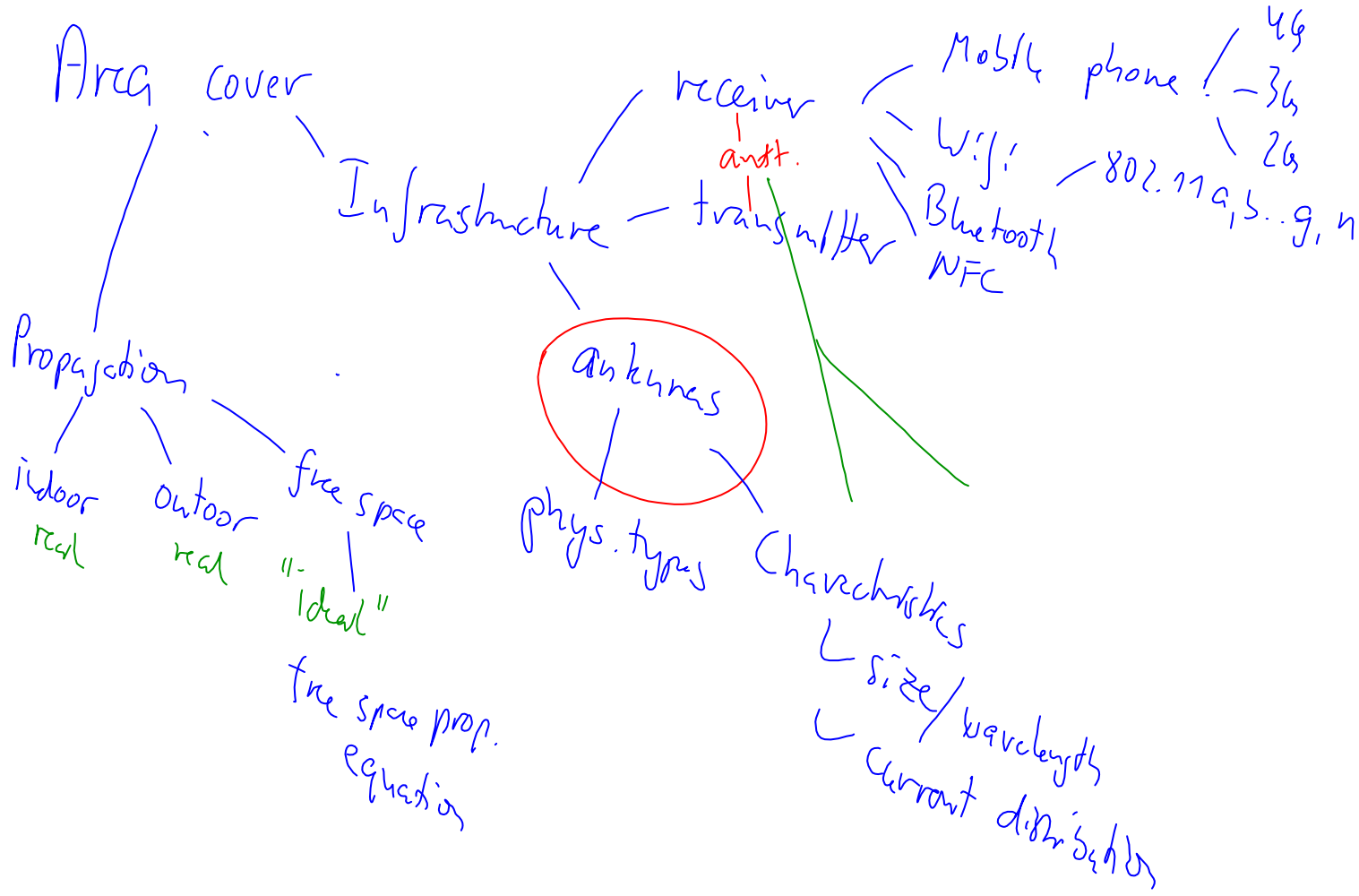
Example of structure



Challenge of structuring information (radio)

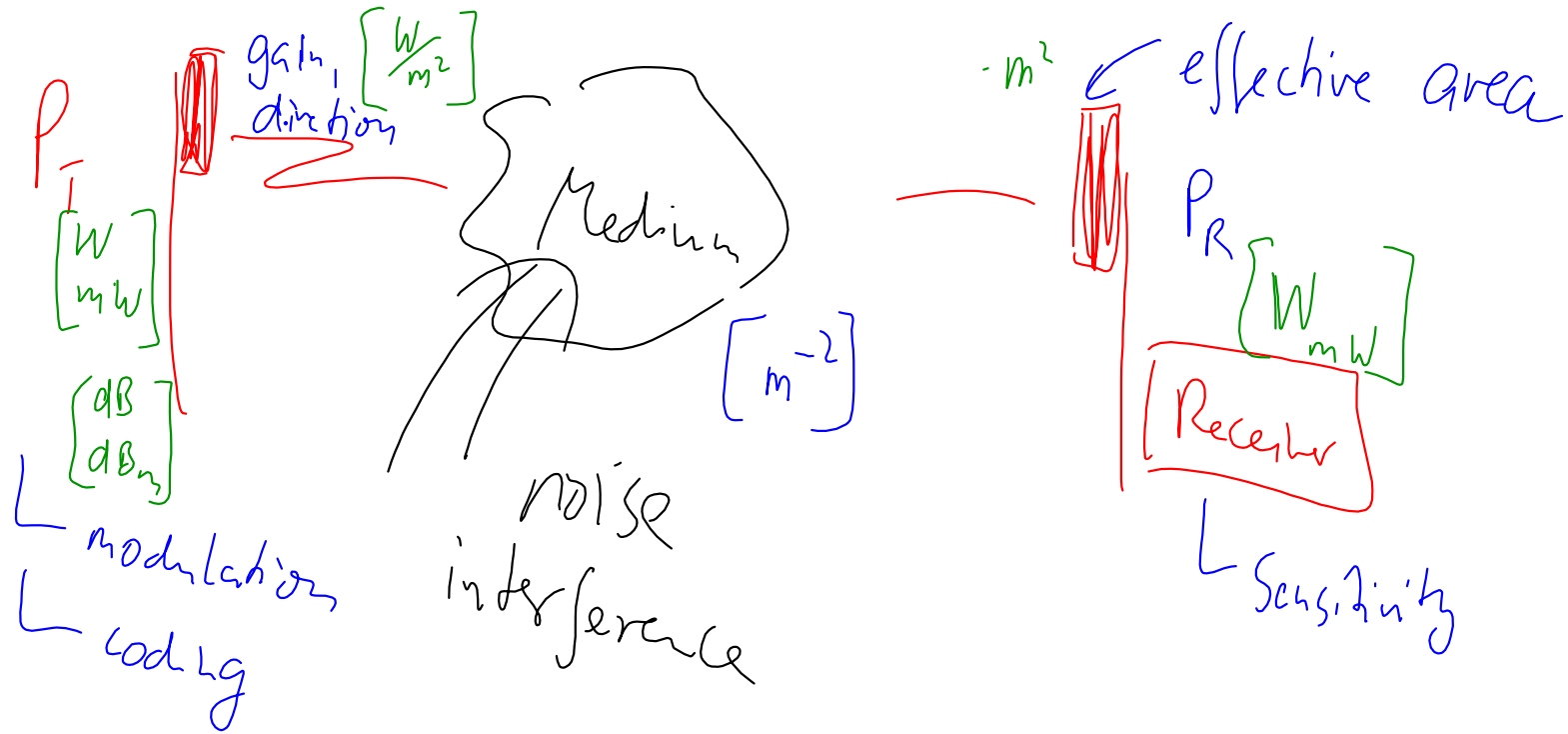


Structured Representation of Propagation



TASK SORT

Explaining Propagation between Sender and Receiver



Comparison

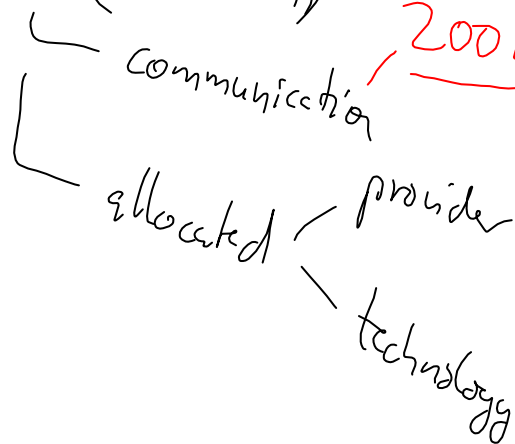
	1G	2G	3G	4G	5G
Period	1980 – 1990	1990 – 2000	2000 – 2010	2010 – (2020)	(2020 - 2030)
Bandwidth	150/900MHz <i>techn. comm channel 30kHz</i>	900MHz <i>25MHz</i> 200kHz	100MHz <i>60MHz (3-4 operators)</i> 3.8MHz (5MHz)	100MHz	1000x BW pr unit area
Frequency	Analog signal (30 KHz) <i>150, 450, 900</i>	1.8GHz (digital) <i>900MHz</i>	1.6 – 2.0 GHz <i>2.1GHz</i>	2 – 8 GHz <i>EU: 900, 1800, 2100, 2600</i>	3 – 300 GHz
Data rate	2kbps	64kbps <i>data</i> 9.6kbps (16.4kbps)	144kbps – 2Mbps <i>750kbps</i> 2Mbps	100Mbps – 1Gbps	1Gbps <
Characteristic	First wireless communication	Digital <i>8x 730kbps</i>	Digital broadband, increased speed	High speed, all IP	
Technology	Analog cellular	Digital cellular (GSM) <i>CDMA IS95</i>	CDMA, UMTS, EDGE, WCDMA	LTE, WiFi, N1MAX	WWWW

Security
Lack of security data
flexibility
cell breathing coverage capacity
flexible BW
2, 5, 10, 20, 40, 80 MHz
traffic mix
9.6kbps (16.4kbps)
CDMA IS95
(CDMA 2000)

Communication Technology

frequency

BW (bandwidth)

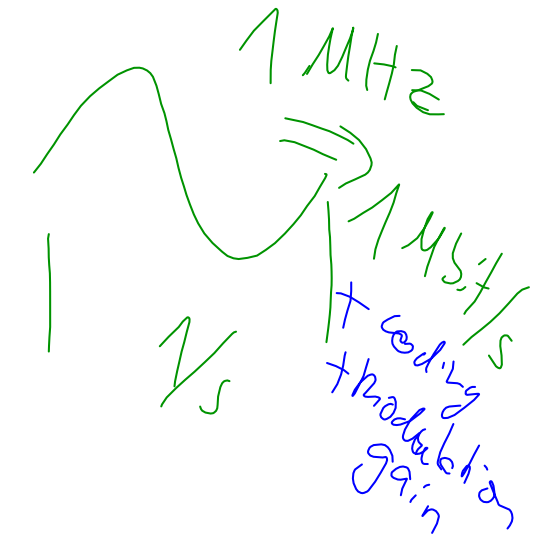


9.6 kbps
 (11.4 kbps) $\times 8 \approx 130 \text{ kbit/s}$
 $200 \text{ kHz} = 50 \text{ channels}$
 8 time slots

3Prov:
 +70
 +70 MHz
 +5
 GSM
 25 MHz
 @ 800 MHz

Mob \rightarrow BS
 GSM 890-915
 25 MHz

198 kbit/s EDGE



Discrepancy of 5G wishlist

- here, costs of access through satellite

2000 us\$/month \uparrow 1 Mbit/s
x50

100,000 us\$

10,000 us\$/month \uparrow 50 Mbit/s