

UiO : **Universitetet i Oslo**

UNIK4700: L1 Introduction

Building mobile and wireless Networks



Josef Noll

Co Founder and Visionary at Basic
Internet Foundation

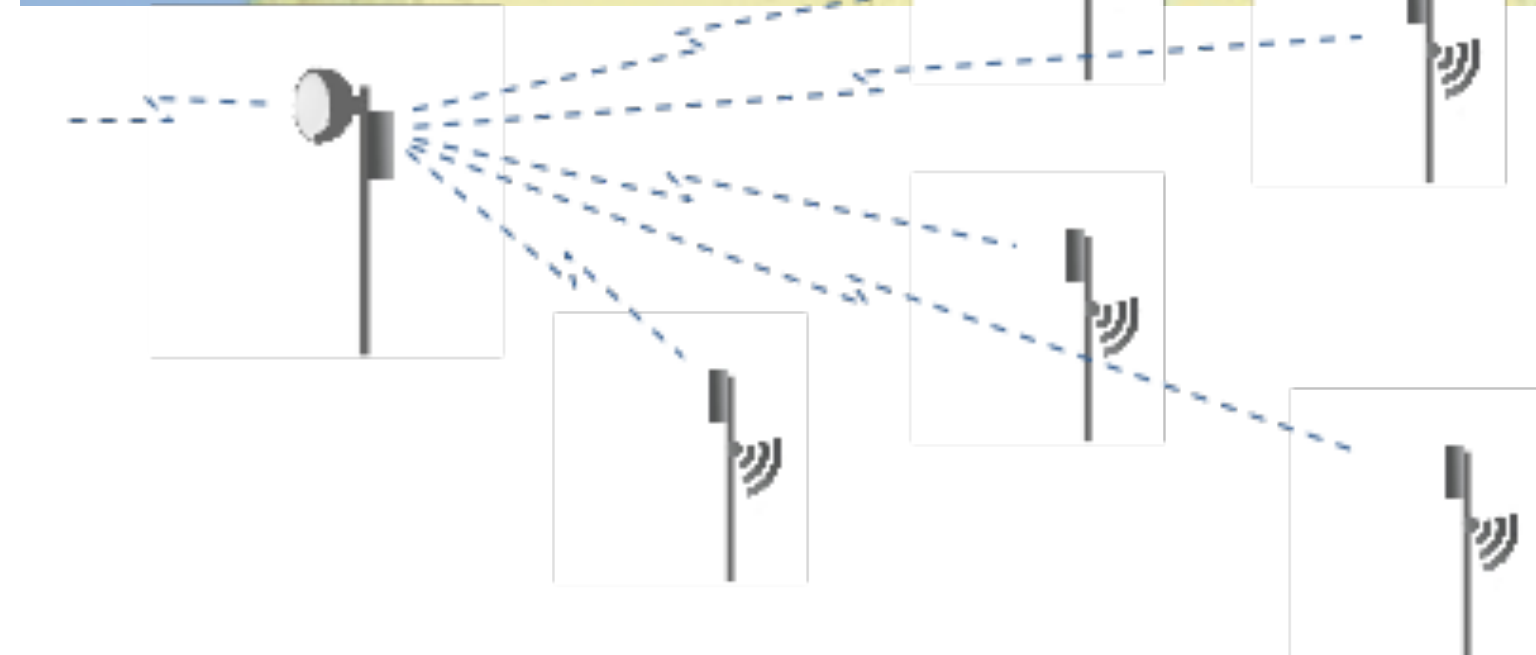
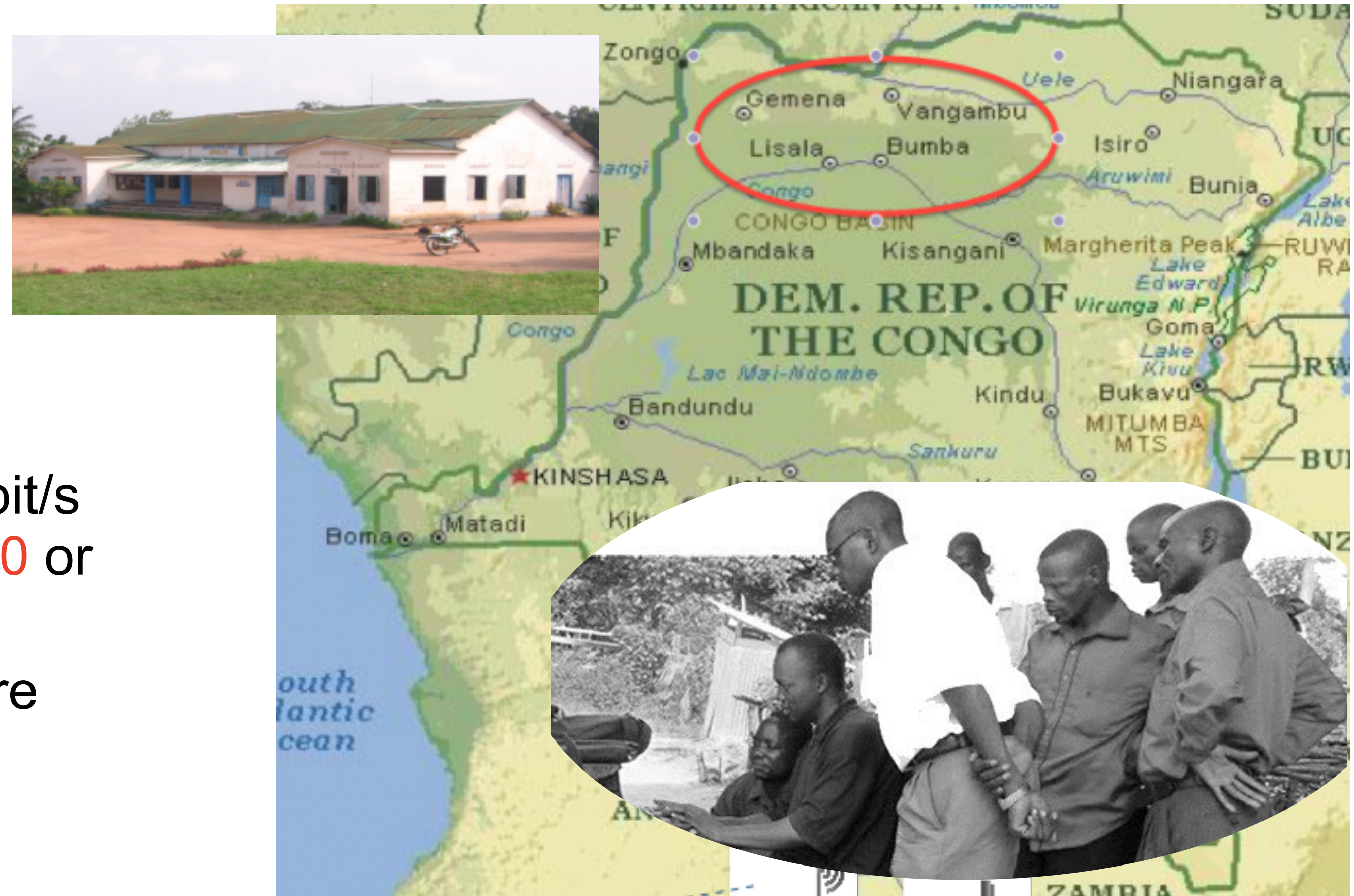
Prof. at University Graduate Studies
(UNIK), University of Oslo (UiO)

Head of Research at Movation AS
Norway



Background/Challenges

- Internet provision to various parts of DRC
 - operations since 2011
- Connection to a.o. University of Lisala
- Experiences from Internet provision
 - Expensive access: 2000 US\$/month for 1 Mbit/s
Note: 80 Mbit/s for 66 US\$ (NO), factor: **2.420** or **0.04%**
 - Requirement for self-sustainable infrastructure
- Developed network infrastructure
 - low-cost establishment of local hot-spots
 - remote core infrastructure (in Norway)



based on experiences from Internet history at UiO/
UNIK

Internet is a basic human right

- Is Internet access and online freedom of expression a basic human right?
- “All people should be allowed to connect to and express themselves freely on the Internet.”



- The United Nations’ Human Rights Council unanimously backed that notion in a resolution on **5 July 2012**. All 47 members of the Human Rights Council including China and Cuba signed the resolution.

United Nations Sustainable Development Goals



1 NO POVERTY 	2 ZERO HUNGER 	3 GOOD HEALTH AND WELL-BEING 	4 QUALITY EDUCATION 	5 GENDER EQUALITY 	6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY 	8 DECENT WORK AND ECONOMIC GROWTH 	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 	10 REDUCED INEQUALITIES 	11 SUSTAINABLE CITIES AND COMMUNITIES 	12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION 	14 LIFE BELOW WATER 	15 LIFE ON LAND 	16 PEACE AND JUSTICE STRONG INSTITUTIONS 	17 PARTNERSHIPS FOR THE GOALS 	 THE GLOBAL GOALS For Sustainable Development

Connectivity & Affordability

- Mobile driven development,
 - ➔ Revenue-driven
- **Affordability** (costs of data)
- industrial perspective
 - ➔ Industry4.0, Internet of Things
- **Novel Approach** required



The Unconnected Market Landscape

Unique Mobile Internet Users

Population 15+ (bn)	Total
Developed World	0.9
Developing World	4.3
Total	5.2

BMI	NMI	Unconnected	Total
0.6	0.1	0.3	
1.0	0.8	2.5	3.3
1.6	0.9	2.8	

Penetration 15+ (%)	Total
Developed World	100%
Developing World	100%
Total	100%

BMI	NMI	Unconnected	Total
64%	31%	27%	
23%	18%	59%	77%
30%	47%	53%	

Source: GSMA Intelligence; figures reflect position at end of 2014
 BMI = Broadband Mobile Internet (3G/4G); NMI = Narrowband Mobile Internet (<3G)

77% don't have decent access

[Source: GSMA, Nov2015]

The need for an Information-Internet (**InfoInternet**)



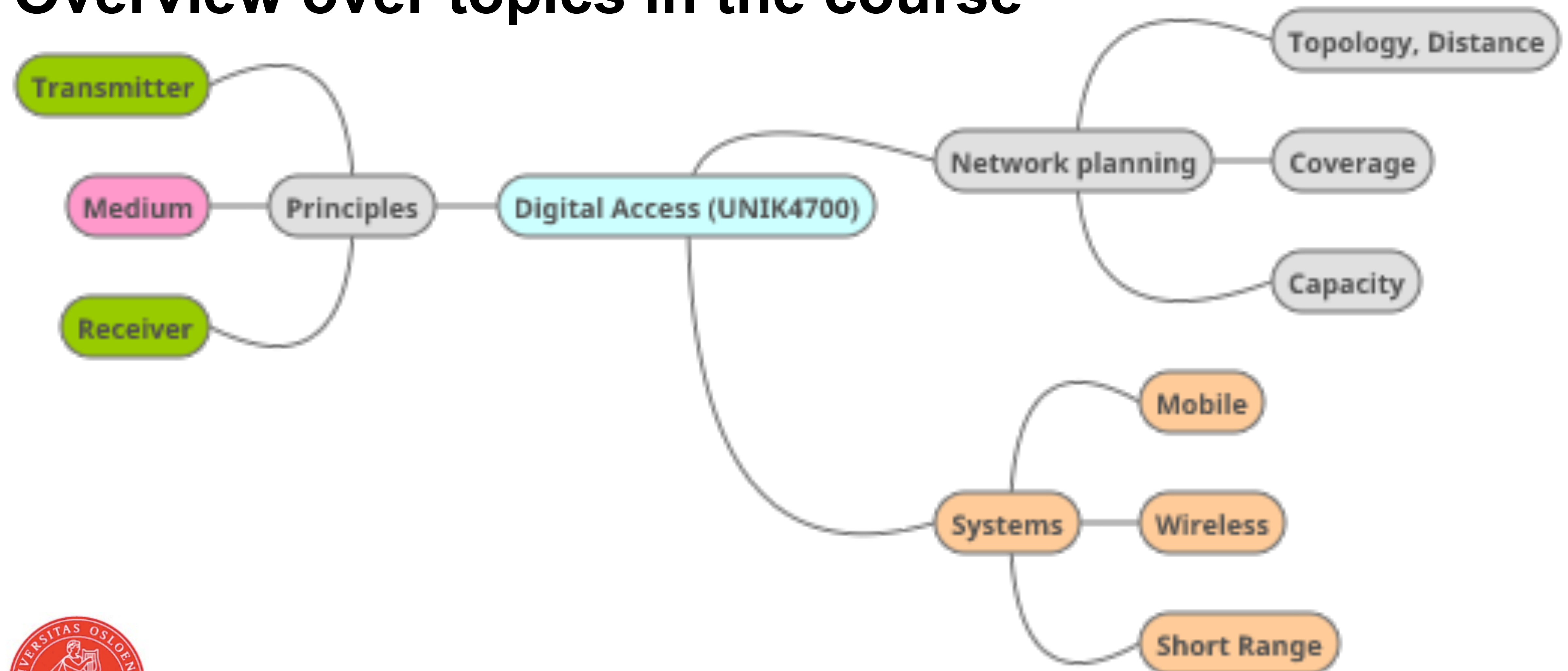
Partnership for digital inclusion	
Telecom	InfoInternet
revenue-driven	non-profit
targeting leveraged creation	targeting no- and limited use
voice & mobile broadband	compressed text & pictures
subscription based (SIM)	free access & voucher
mobile network: coverage & capacity	Wifi-spots: health-/community centres, schools
operator cost model	target: 0.5 US\$/month
operator roll-out	NGO & community roll-out



[Source: GSMA, Nov2015]

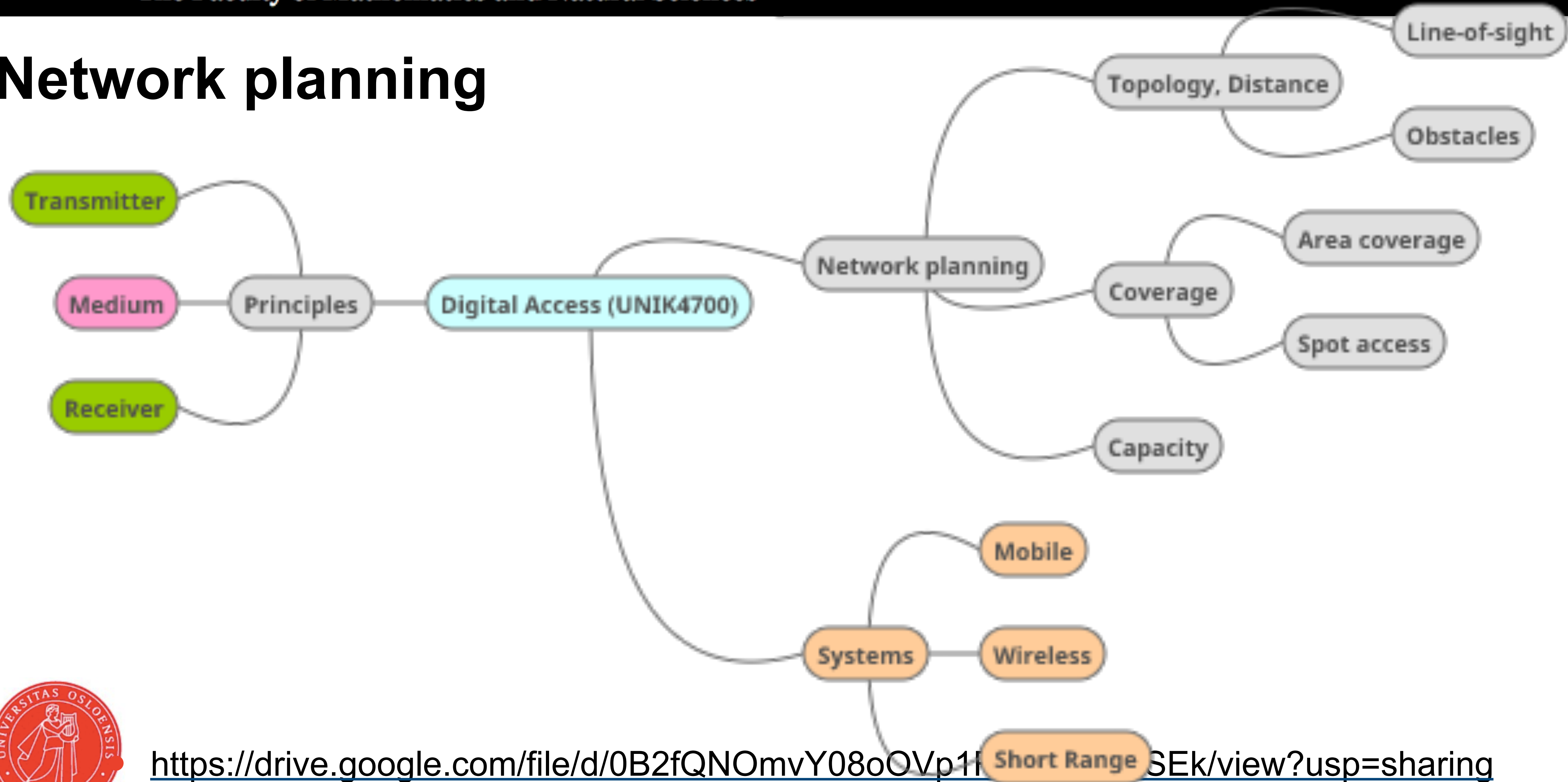


Overview over topics in the course



<https://drive.google.com/file/d/0B2fQNOmvY08oOVp1RXVJaFNkSEk/view?usp=sharing>

Network planning



<https://drive.google.com/file/d/0B2fQNOmvY08oOVp1fSEk/view?usp=sharing>

Transmission parameters



- Isotropic antenna = point source: $G_s = 0\text{dB}$
- Hertz Dipol = Short dipol: $G_s = 1,5 = 1,76\text{dB}$
- $\lambda/2$ -Dipol: $G_s \approx 1,64 = 2,15\text{dB}$

$$D_{rad} = \frac{4\pi F_{max}(\theta, \varphi)}{\int_0^{2\pi} \int_0^\pi F(\theta, \varphi) \sin(\theta) d\theta d\varphi}$$

Gain

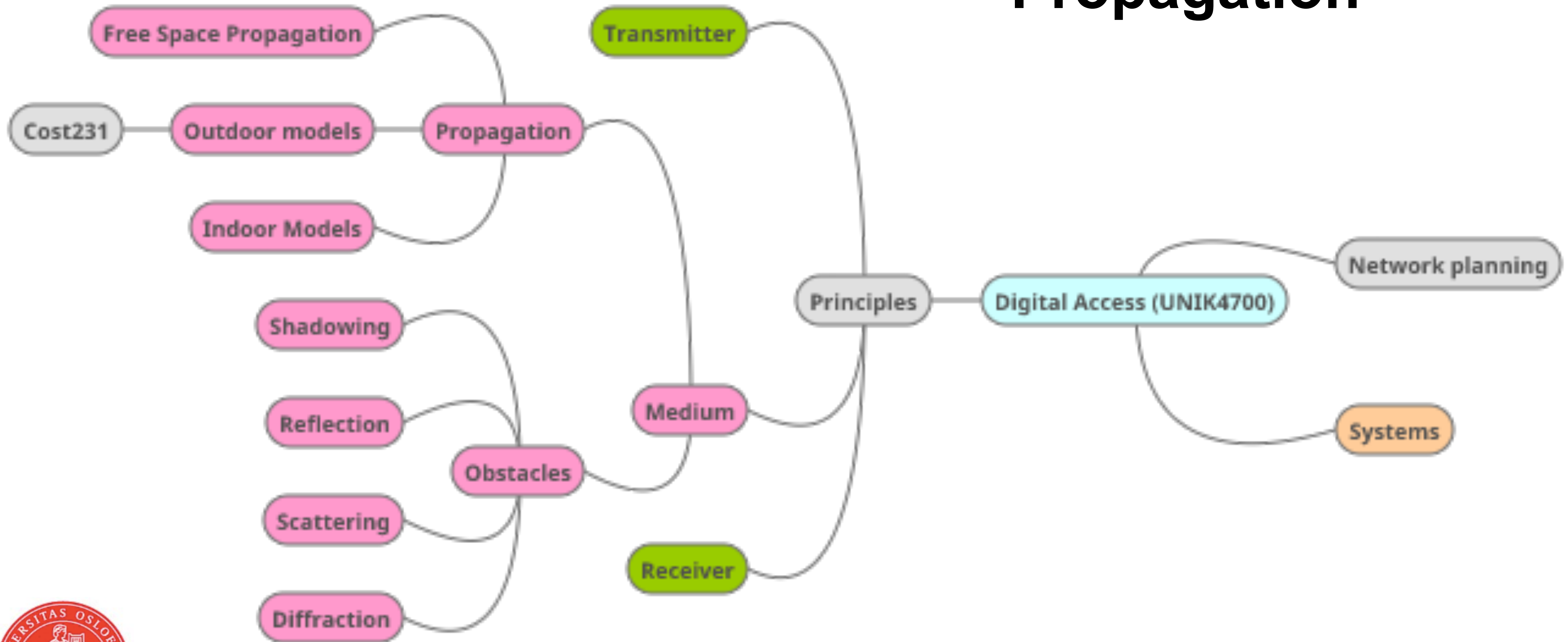
Antenna

Directivity



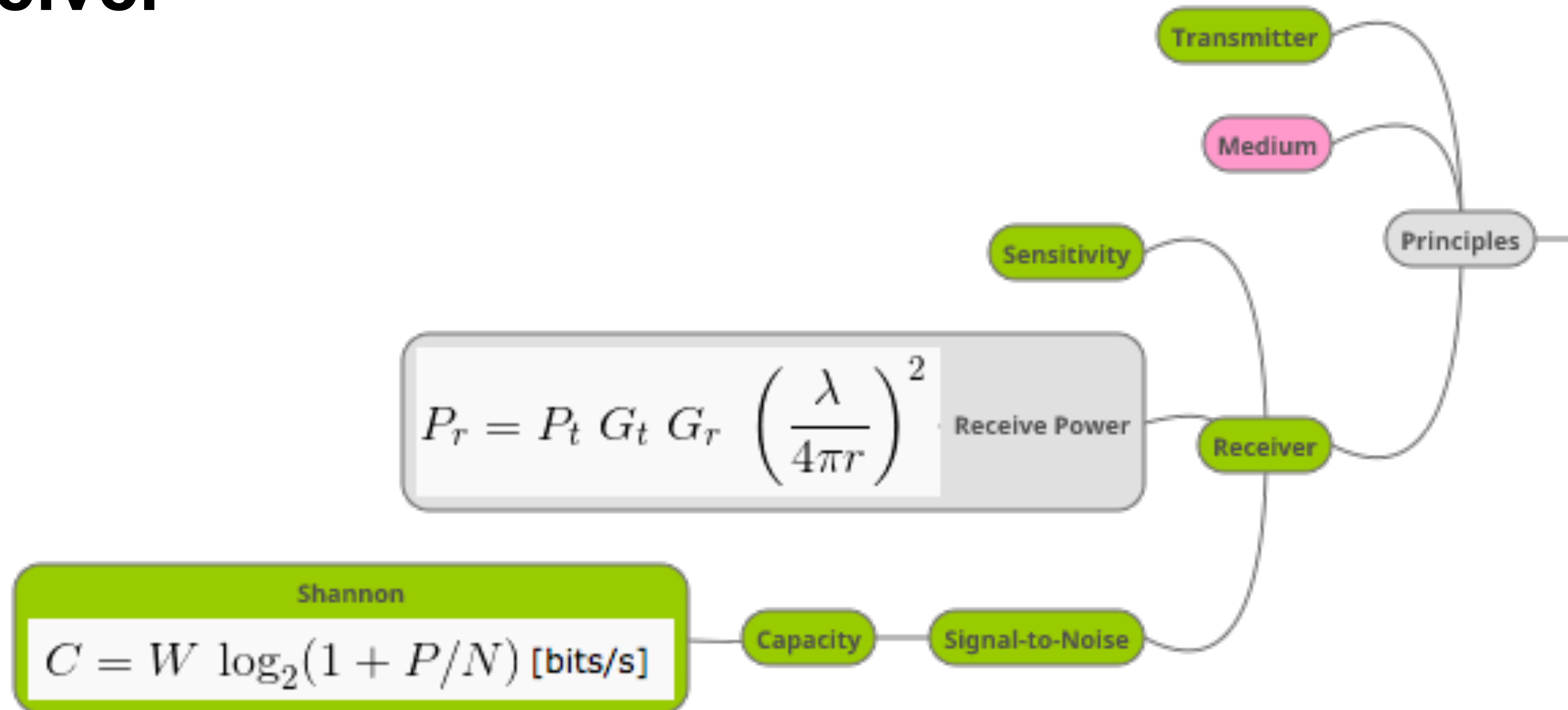
<https://drive.google.com/file/d/0B2fQNOmvY08oOVp1RXVJaFNkSEk/view?usp=sharing>

Propagation



<https://drive.google.com/file/d/0B2fQNOmvY08oOVp1RXVJaFNkSEk/view?usp=sharing>

Receiver



Mobile and Wireless Systems

