Free space wave equation

Okamura-Hata & other prop. models

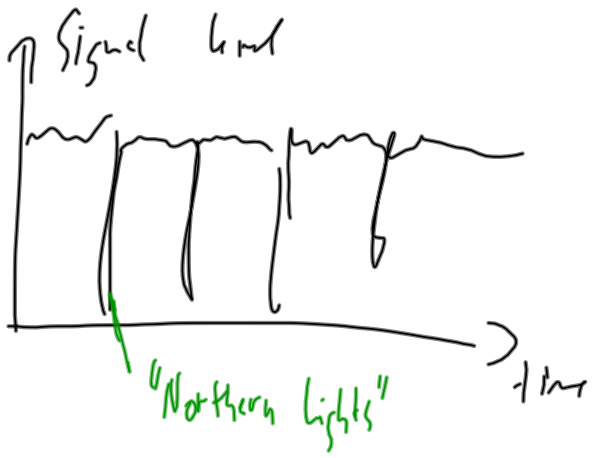
EIRP $\left[\frac{W}{m^2}\right]$

Total capacity of the link

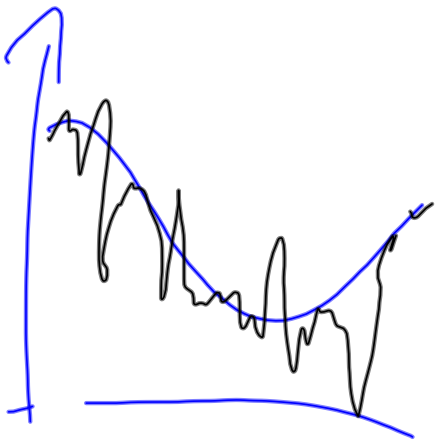
numbers (gain, 3dB opening angle) antennas

Roll-out of $\frac{2.4}{5}$ GHz Wi-fi

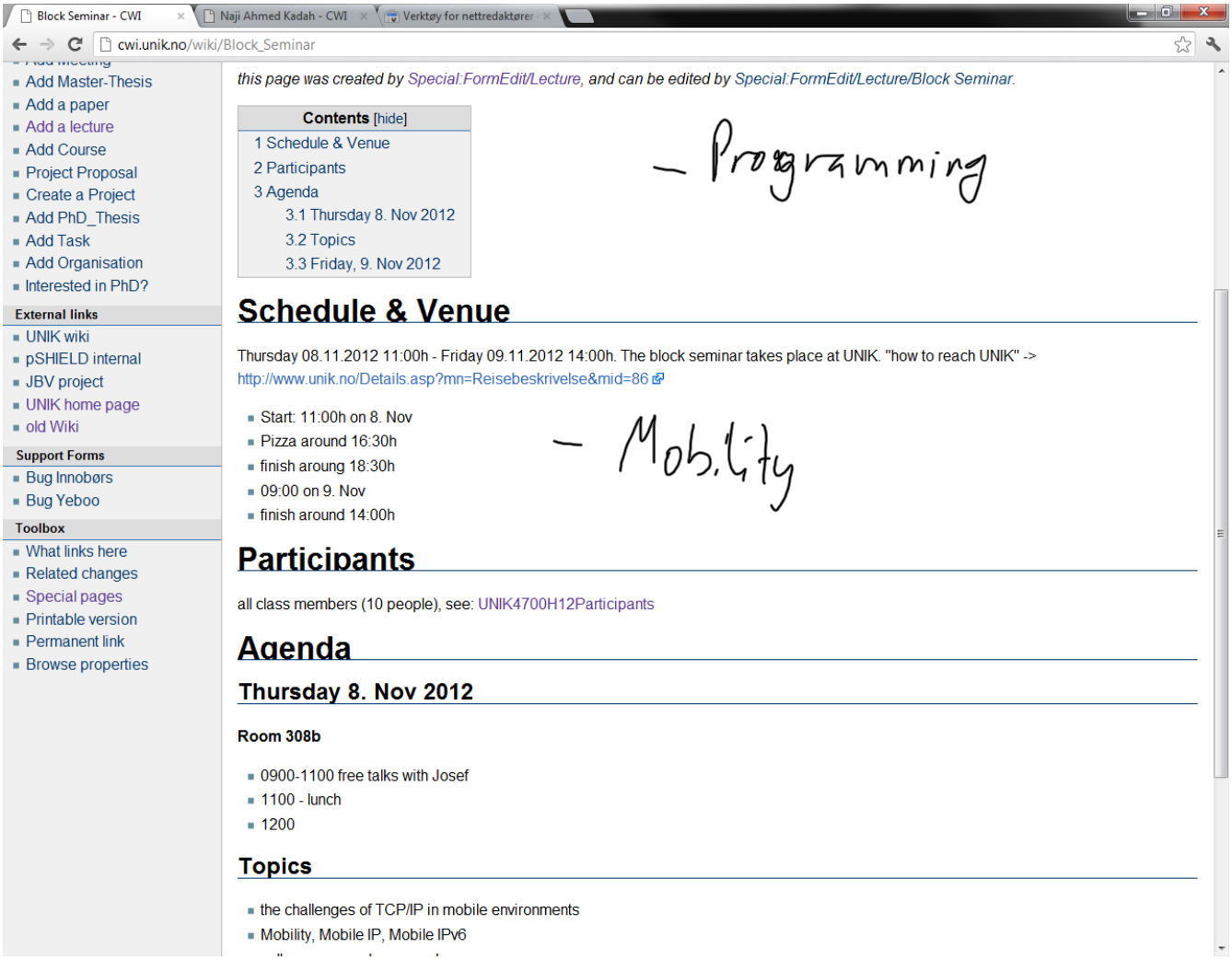
fast fading



slow



Stuchtur Block Seminar 11:00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Naji Ahmed Kadah - CWI
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Contents [hide]
1 Schedule & Venue
2 Participants
3 Agenda
3.1 Thursday 8. Nov 2012
3.2 Topics
3.3 Friday, 9. Nov 2012
- Programming
Schedule & Venue
Thursday 08.11.2012 11:00h - Friday 09.11.2012 14:00h. The block seminar takes place at UNIK. "how to reach UNIK" -> http://www.unik.no/Details.asp?mn=Reisebeskrivelse&mid=86
Start: 11:00h on 8. Nov
Pizza around 16:30h
finish aroung 18:30h
09:00 on 9. Nov
finish around 14:00h
- Mobility
Participants
all class members (10 people), see: UNIK4700H12Participants
Agenda
Thursday 8. Nov 2012
Room 308b
0900-1100 free talks with Josef
1100 - lunch
1200
Topics
the challenges of TCP/IP in mobile environments
Mobility, Mobile IP, Mobile IPv6

Programming

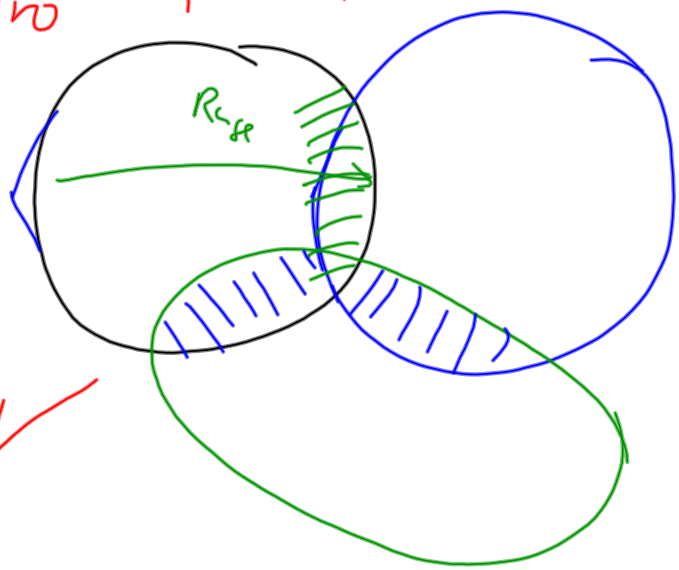
Matlab (Omnett++)

1) P_R including fading, ... formula

2) allocation ↳ mobile channel

[ ] Matlab intro formula

Cell size



3) Parameters for System ✓

4) Mobility

walking 3 km/h

Cycling 25 km/h

Car 60 km/h

..

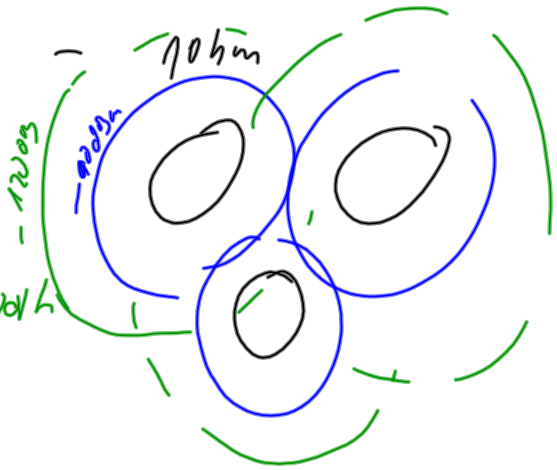
Car 120 km/h

5) Result time for handover

cell distance GSM – 70km

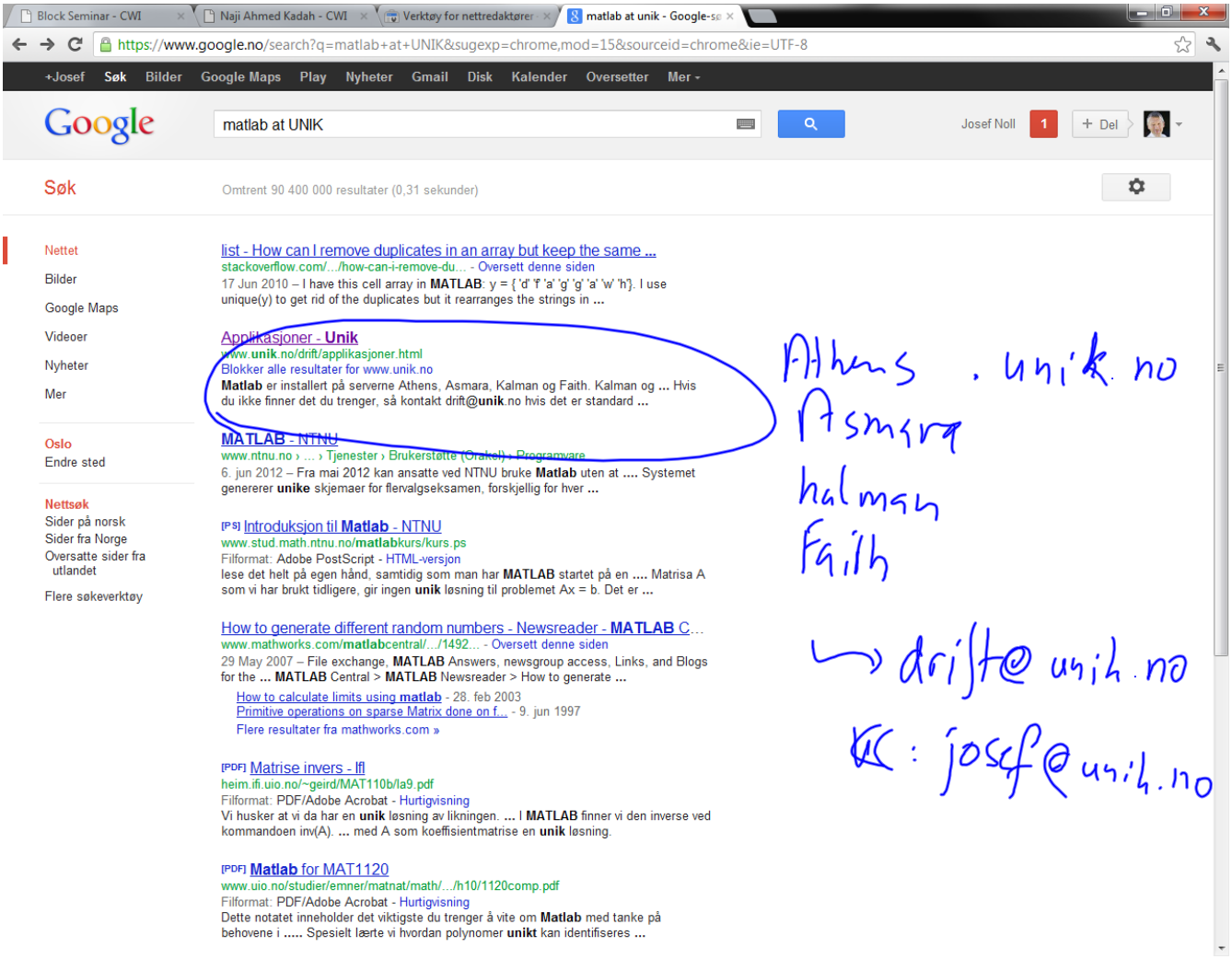
UMTS, (LTE)

Single frequency network



2.1 ... 2.15 GHz

Ch1 = 5MHz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Søk
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Nettet
Bilder
Google Maps
Videoer
Nyheter
Mer
Oslo
Endre sted
Nettsøk
Sider på norsk
Sider fra Norge
Oversatte sider fra utlandet
Flere søkeverktøy
list - How can I remove duplicates in an array but keep the same ...
stackoverflow.com/.../how-can-i-remove-du... - Oversett denne siden
17 Jun 2010 – I have this cell array in MATLAB: y = { 'd' 'f' 'a' 'g' 'g' 'a' 'w' 'h'}. I use unique(y) to get rid of the duplicates but it rearranges the strings in ...
Applikasjoner - Unik
www.unik.no/drift/applikasjoner.html
Blokker alle resultater for www.unik.no
Matlab er installert på serverne Athens, Asmara, Kalman og Faith. Kalman og ... Hvis du ikke finner det du trenger, så kontakt drift@unik.no hvis det er standard ...
MATLAB - NTNU
www.ntnu.no › ... › Tjenester › Brukerstøtte (Orakel) › Programvare
6. jun 2012 – Fra mai 2012 kan ansatte ved NTNU bruke Matlab uten at .... Systemet genererer unike skjemaer for flervalgseksamen, forskjellig for hver ...
[PS] Introduksjon til Matlab - NTNU
www.stud.math.ntnu.no/matlabkurs/kurs.ps
Filformat: Adobe PostScript - HTML-versjon
lese det helt på egen hånd, samtidig som man har MATLAB startet på en .... Matrisa A som vi har brukt tidligere, gir ingen unik løsning til problemet Ax = b. Det er ...
How to generate different random numbers - Newsreader - MATLAB C...
www.mathworks.com/matlabcentral/.../1492... - Oversett denne siden
29 May 2007 – File exchange, MATLAB Answers, newsgroup access, Links, and Blogs for the ... MATLAB Central > MATLAB Newsreader > How to generate ...
How to calculate limits using matlab - 28. feb 2003
Primitive operations on sparse Matrix done on f... - 9. jun 1997
Flere resultater fra mathworks.com »
[PDF] Matrise invers - Ifi
heim.ifi.uio.no/~geird/MAT110b/la9.pdf
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Vi husker at vi da har en unik løsning av likningen. ... I MATLAB finner vi den inverse ved kommandoen inv(A). ... med A som koeffisientmatrise en unik løsning.
[PDF] Matlab for MAT1120
www.uio.no/studier/emner/matnat/math/.../h10/1120comp.pdf
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Dette notatet inneholder det viktigste du trenger å vite om Matlab med tanke på behovene i ..... Spesielt lærte vi hvordan polynomer unikt kan identifiseres ...
Athens . unik. no
Asmara
kalman
Faith
↳ drift@unik.no
cc: josef@unik.no

other simulation

900 MHz
2 GHz
3.5 GHz

Berard: attenuation of equatorial rain forest

$L_{total} = L_{free\ space} + L_{forest} + L_{mobile\ channel\ statistics}$

Mobile channel . . . . . .

Free space attenuation ~60 ... 120 dB

$$P_r = P_T \cdot G_T \cdot G_R \cdot \left(\frac{\lambda}{4\pi r}\right)^2 \qquad \lambda = \frac{c}{f}$$

power	dB
10	10
100	20
1000	30
10000	40
1E12	120

$f = 2.45\,GHz \rightsquigarrow \lambda = \frac{30\,cm}{f\,[GHz]}$

$$= \frac{3\,m}{f\,[MHz]}$$

$$L = \left(\frac{4\pi\, d\,[m]\, f\,[\frac{1}{s}]}{c\,[\frac{m}{s}]}\right)^2$$

$$P_R[dB_m] = P_T[dB_m] + G_T + G_R - L\,[dB]$$

$$L = \left(\frac{4\pi\, d\,[m]\, f\,[\frac{1}{s}]}{c\,[\frac{m}{s}]}\right)^2$$

$$L[dB] = 10\log(\,)^2 = 20\log(\,)$$

$$L = 20 \log\left(\frac{4\pi d f}{c}\right)$$

$$c = 3E8 \frac{m}{s} \rightarrow 3E8 \frac{1E3\,m}{1E3} \frac{1E9}{1E9\,s} \left[km \cdot GHz\right]$$

1 km, 1 GHz

$$c = 3E8 \cdot \frac{1}{E3} \cdot \frac{1}{E9} = 3E{-}4 \left[km \cdot GHz\right]$$

$$L = 20 \log\left(\frac{4\pi}{3E{-}4} \left[km \cdot GHz\right] \frac{d}{[km]} \cdot \frac{f}{[GHz]}\right)$$

$$L = 20 \log\left(\frac{4\pi}{3} E4\right) + 20 \log \frac{d}{[km]} + 20 \log \frac{f}{[GHz]}$$

$$80 + 20 \log(4.\ldots)$$

$$0.6$$

1 km

$$L = 92 + 20 \cdot 0 + 0$$

1 km, 1 GHz $\rightarrow$ 92 dB

$$L = 92\,dB + 20\log\frac{d}{[km]} + 20\log\frac{f}{[GHz]}$$

92 dB ← f

1 km

1 GHz

$$L = 32\,dB + 20\log\frac{d}{[m]} + 20\log\frac{f}{[GHz]}$$

1 m

$20\log\frac{1\,m}{1\,km}$

1 GHz

$20\log 1E{-}3$

$$L = -28\,dB + 20\log\frac{d}{[m]} + 20\log\frac{f}{[MHz]}$$

$-60\,dB + 20\log 1$

FM ~ 100 MHz 10 km ~

$92 + 20 - 20 \sim 92\,dB$

$20\log\frac{1\,MHz}{1\,GHz}$

GSM 900 ~ 1 GHz 10 km

$-60\,dB \leftarrow 1E{-}3$

112 dB

UMTS ~ 2.1 GHz 1 km

$92 + 0 + 6 = 98\,dB$

Wifi 5 GHz 100 m

$92 - 20 + 14 = 86$

$20\log(5)$

$20 \log 1$ E-1 $= -20 + 20 \cancel{\log(1)}^{0}$

$= -20$

E3 $= 60$

E-5 $= -100$

$$P_r = P_t + G_t + G_R - 92\,dB - 20\log\left(\frac{d}{[km]}\,\frac{f}{[GHz]}\right)$$

GSM Base station

$= 10\log(25\,W) + 12\,dB + 3\,dB - 112\,dB\,(10\,km)$

$= 13\,dB$

$43\,dBm$

$f = 200\,kHz = 0{,}2\,MHz$

GSM ≙ 1 ⇝ UMTS 5 MHz factor: 25

Signal to noise ratio

Receiver sensitivity P_{Sens}

- Bandwidth — $N_{noise} = k\,T\,B$ (Boltzmann, Temp, Bandwidth)
- modulation gain ~3–10 dB
- fading margin ↳ 10–20 dB

$P_{Sens} = -85\,dBm$ ⇝ $P_R(GSM, 10\,km) = -54\,dBm$

receive Signal

10–20 dB · ↑ · ↑

$P_r > P_{Sens} + F_{fading} - F_{mod\,gain} + F_{Bandwidth}$

GSM $P_{sen} > -74\,dBm$ (1 ohm)

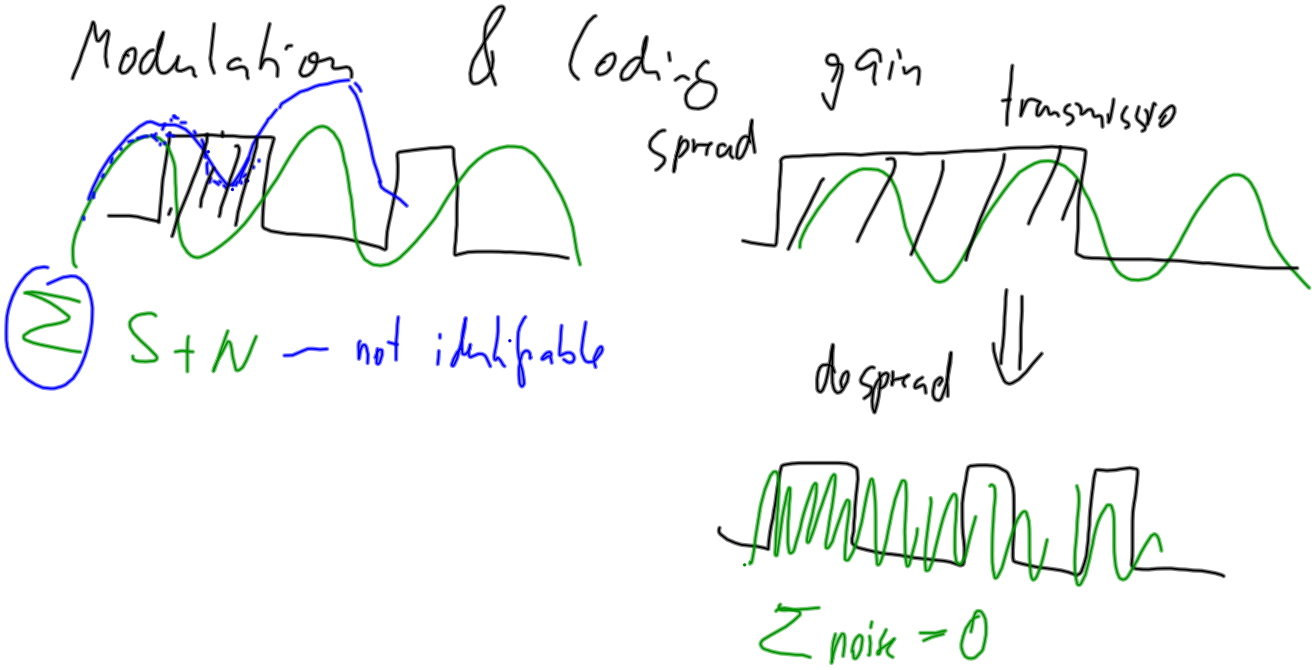
$P_{sen} \approx -105\,dBm$ → $\frac{300\,ohm}{20 \log \frac{d}{[km]}}$

30 dB

$\log d \sim 1.5$

$d = 10^{1.5}$

31


Modulation & Coding gain
spread
transmission
S+N – not identifiable
despread
Σ noise = 0