Radiocomunication Systems

Introduction to Chapters 2 and 3

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Dpt. Communication Engineering
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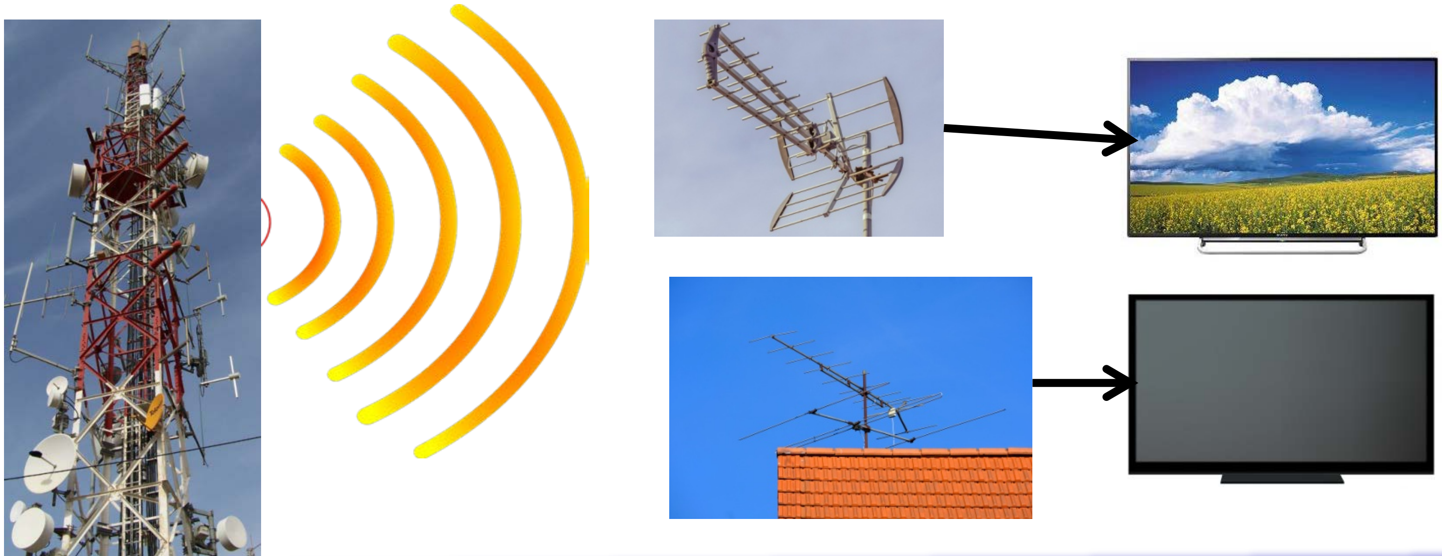
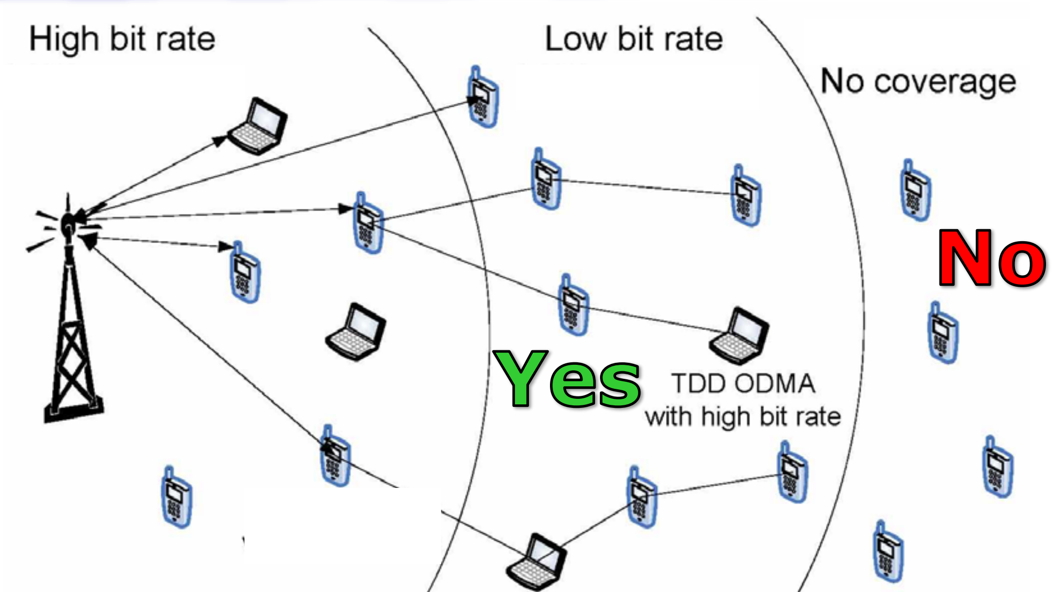


Yes

No



Why?

How far?

Coverage?

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Carrier to Noise Ratio

- This is the question:
  - **Will the C/N at the receiver be high enough to properly receive a radiocommunication service (television signal, mobile communication signal…)?**

1) C/N
  - In base band, SNR or S/N, Signal to Noise Ratio, is used.
  - In radiofrequency, signal is usually designed as Carrier and C/N, Carrier to Noise Ratio is used.

2) What does “high enough” mean? Which is the threshold value?

For an specific radiocommunication service or standard (for example DVB-T for terrestrial digital television) …

to provide an specific service to the users (for example, a high definition –HD– TV program),

a given data rate (information quantity per second) is required (for example, 8Mbps for a HDTV program, 4Mbps for a SDTV program, 128kbps for a typical mp3)

Carrier to Noise Ratio

Intuitively, the more bits per second are transmitted in the same bandwidth, the more difficult it will be to distinguish the bits. So, the required C/N will be higher.

For a radiocommunication service, each configuration requires a specific threshold value.

A radiocommunication service works if

C/N receiver> C/N threshold

C/N at the receiver can be calculated or measured

Calculus:

- N: noise power at the receiver in the bandwidth occupied by the signal
- C: signal or carrier power at the receiver

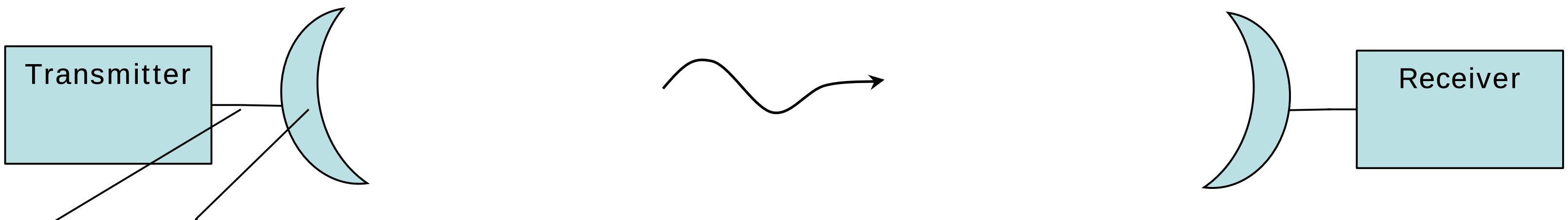
Carrier, C

Calculate C:

Transmitted power

Losses

Gains



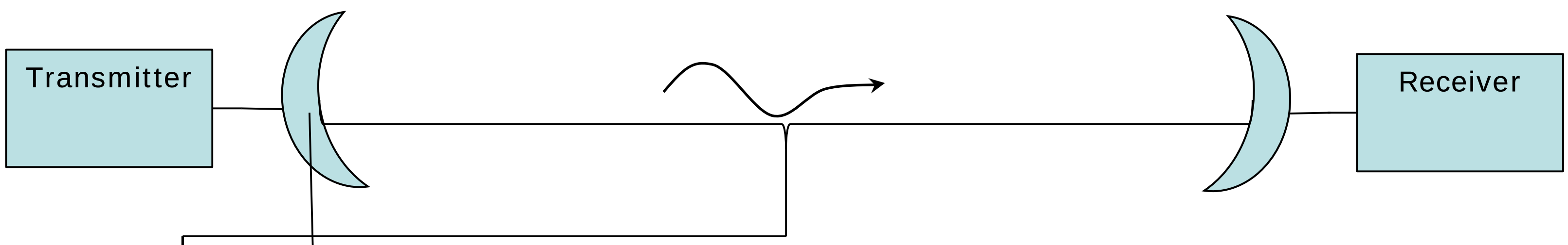
- Losses in the transmission site
  - Losses due to impedance mismatching between transmitter and antenna
  - Ohmic losses in the antenna (power dissipated as heat due to the electric currents in the wires of the antenna)

Independent losses

Nothing to do with each other!!!

Propagation path

- Losses in the propagation path



The antenna can focus the energy in one direction:

Energy is increased instead of lost

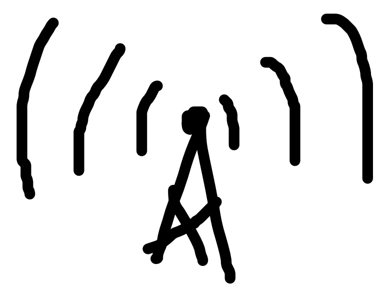
Energy is dispersed in all directions -> Free Space Propagation Losses

Not actual losses!!
Energy is spread out across a larger surface as we go further away from the transmitter.

The same power is used on all radius values!!

But there is not only stable air in the path…

Free space propagation losses: $L(FS) = 20\cdot\log\cdot\frac{4\cdot\square\cdot d}{\square}$



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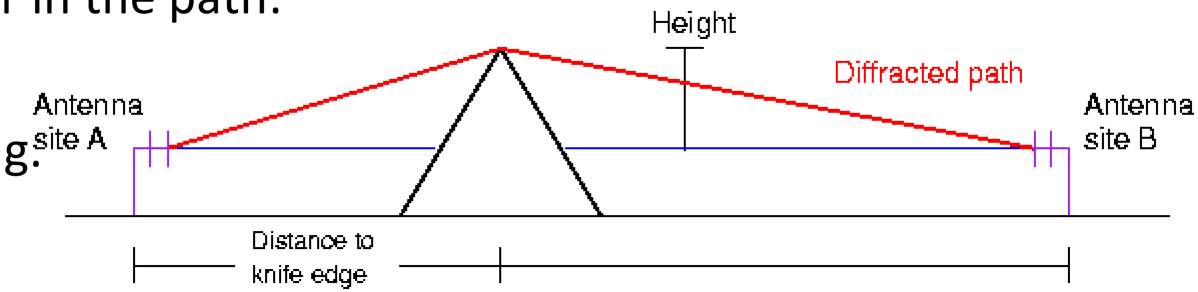
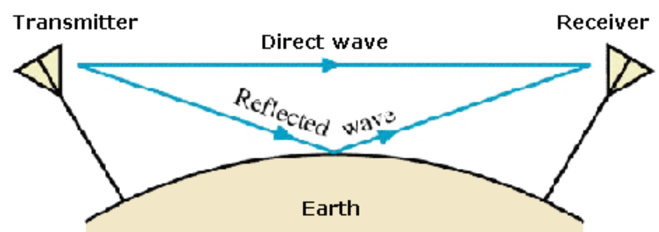
Propagation path

But there is not only stable air in the path:

- Diffraction: partial blocking.



- Reflection: two components.

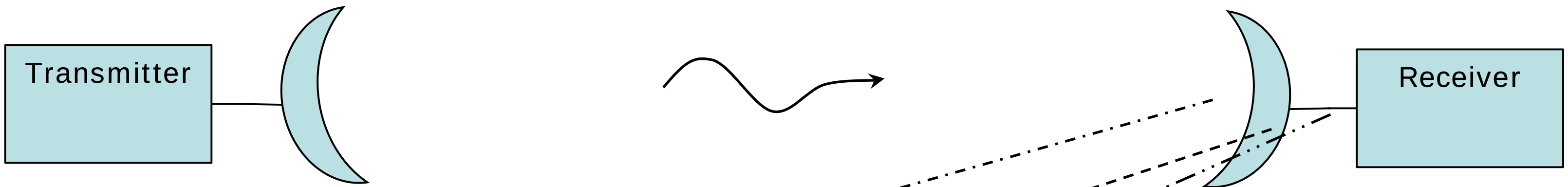


Space wave, comprising direct + reflected waves

- Tropospheric properties: refraction or path bending.
- Tropospheric elements:
  - Gases such as water vapor.
  - Rain and other meteors.
  - …

Reception site

- Losses in the reception site

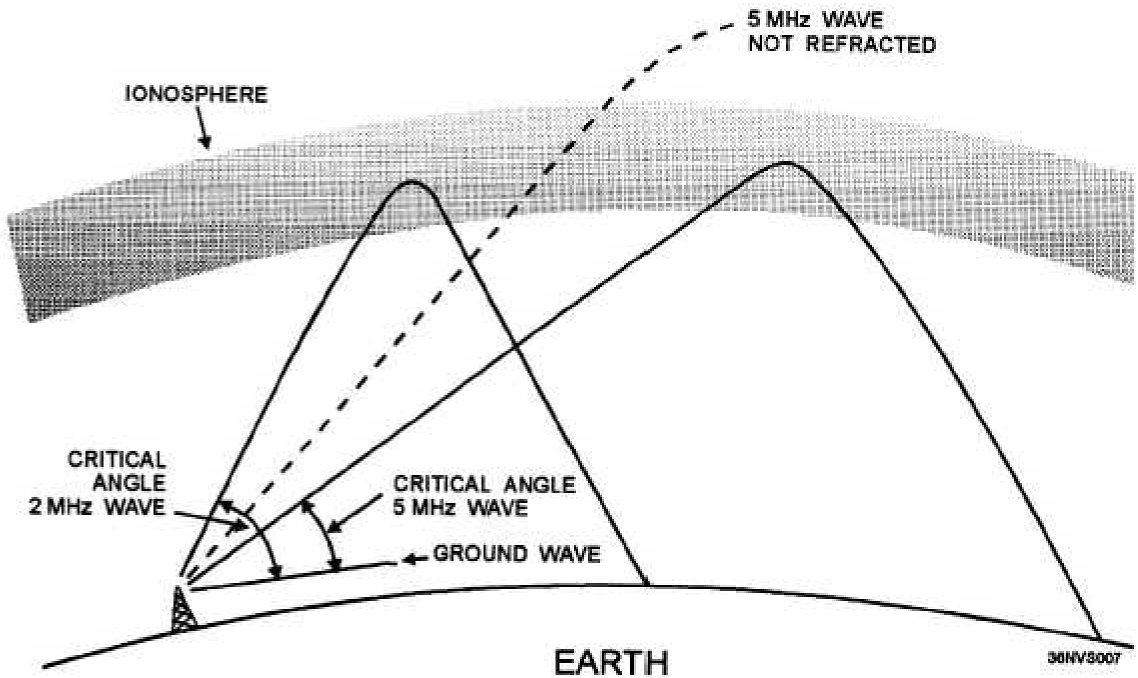


  - The antenna receives more energy from an specific direction.
    - Losses due to misalignment between transmission and reception antennas.
  - Ohmic losses in the antenna (power dissipated by currents in the antenna).
  - Losses due to impedance mismatching between antenna and receiver.
  - The receiver can include amplifiers (gain), cables (losses),… to be considered to calculate the power at the detector or receiver proper, C.

Propagation Mechanisms

In addition, for each frequency band, related to the wavelength size, different propagation mechanism can exist, besides the "space wave". For example:

- Propagation through the earth surface between 500 kHz and 1500 kHz
- Ionospheric (above the troposphere) refraction propagation (5 to 20 MHz)



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