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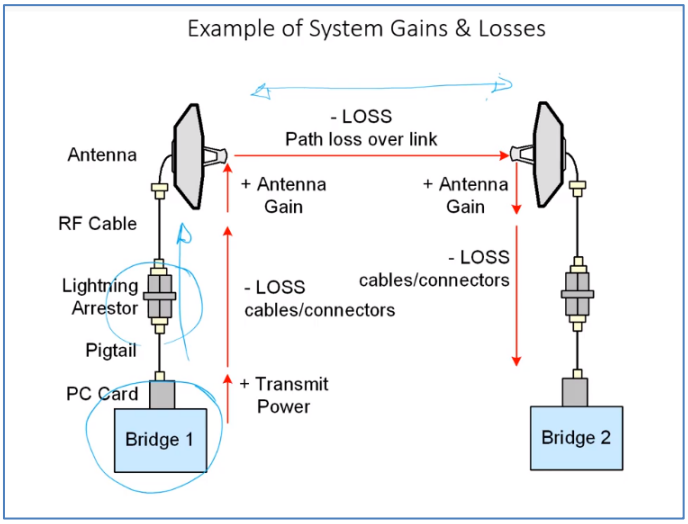
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Recommended external support materials for exercises from subject KEI/ANT

The following external materials expand the knowledge of antennas and their use in radio communication systems and serve as a supplement to broaden the overview of the issues discussed in the course KEI/ANT with an overlap into the course KEI/RAS (Radio electronic systems).

Link budget calculation – Dr Graham Sexton (https://www.youtube.com/watch?v=aNOuN6LMtow)

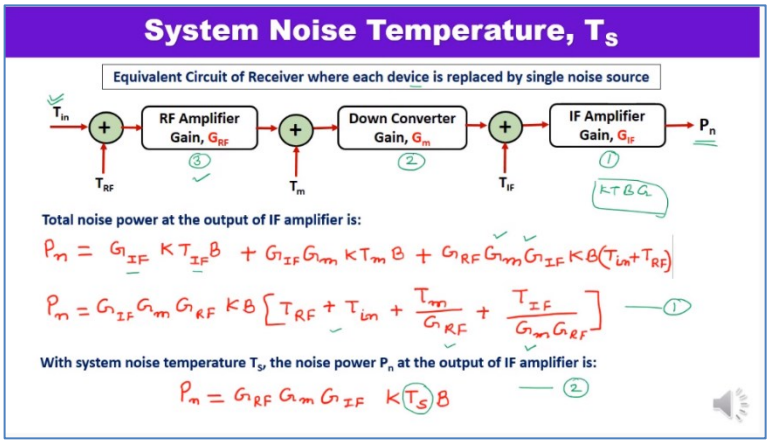
Abstract – This YouTube lesson gives you a brief introduction to the simplified link budget calculation between two radio equipment in 2.4 GHz and also 5 GHz frequency bands. Calculations take into account the gains of antennas, transmitted power, receiver sensitivity, free space loss (attenuation by the communication distance) and some additional losses (in cables, connectors). At the end, it also discusses several neglected issues in presented calculations like Fresnel zone encroachment, radio frequency interferences, restrictions for mounting antennas, route cable to the roof, etc.



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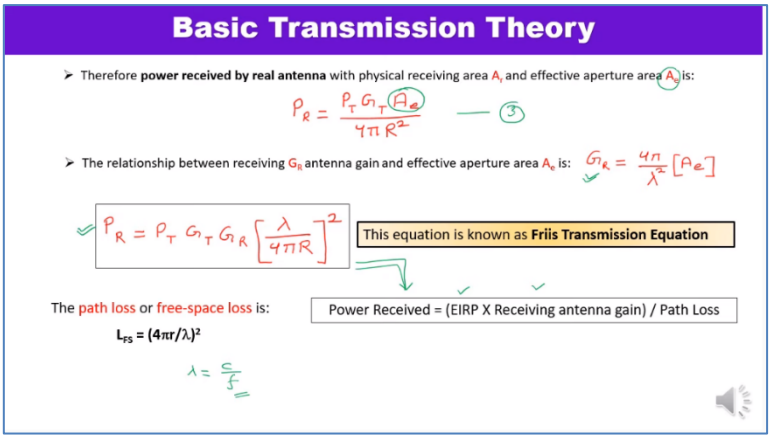
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System noise temperature – Dr Sapna Katiyar (https://www.youtube.com/watch?v=OCiMzOAjJUo)



Abstract – This YouTube lesson gives you a brief introduction to the system noise temperature and its influence to more realistic link budget calculations covering also received noise issue. Calculations take into account the cascade of block at the receiver side and their noise properties. The lesson shows you the importance of a high-quality low noise amplifier and low-loss cables at the beginning of receiver chains to achieve a low system noise temperature.

Introduction to communication satellite link design – Dr Sapna Katiyar (https://www.youtube.com/watch?v=WoRWjZpKj1w)



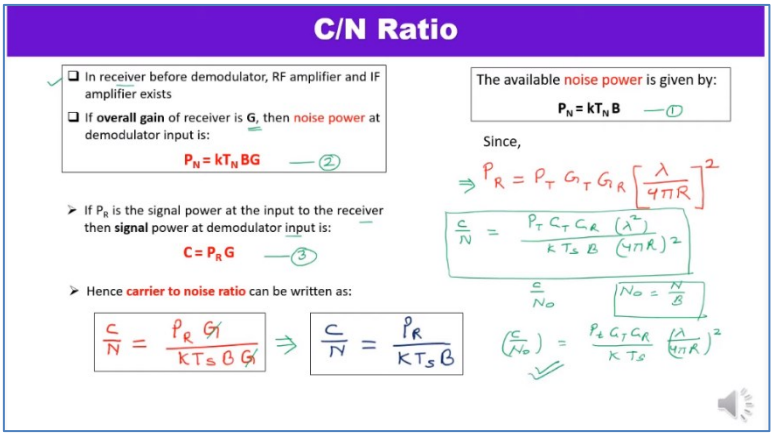
Abstract – This YouTube lesson gives you a brief introduction to the simplified link budget calculation between satellite and ground station. It introduces also relation between antenna gain and antenna effective aperture. Calculations take into account also some additional losses related to satellite communication (transmit and receive antenna polarization mismatch, antenna pointing error, attenuation in gasses of atmosphere, etc).

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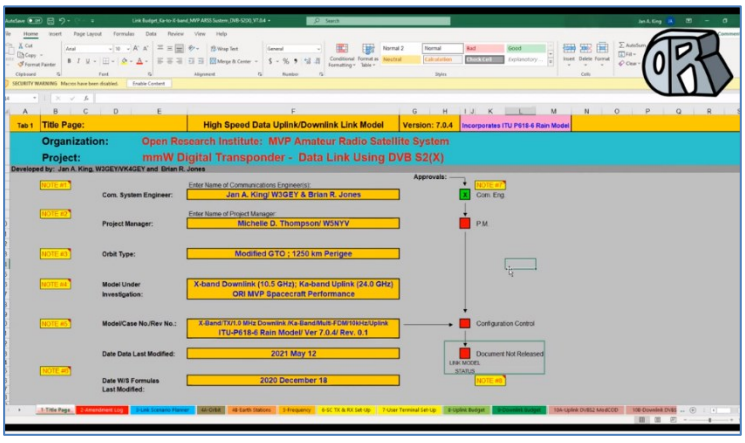
Noise power, C/N and G/T ratio – Dr Sapna Katiyar (https://www.youtube.com/watch?v=p99iiNwHMlk)

Abstract – This YouTube lesson gives you a brief introduction to the complete calculation of received signal quality in satellite communication system. It introduces also quality indicator of the ground stations (G/T ratio). The lesson shows you the importance of high-gain antenna, high-quality low-noise amplifier and low-loss cables at the beginning of receiver chains to achieve a good performance of the ground station to receive weak signal of satellites.



Link budget walkthrough – Jan King (https://www.youtube.com/watch?v=sClk7Kd_rQI)

Abstract – This YouTube lesson gives you a deep walk through the complete calculation of satellite link budget via Jan King budget calculator spreadsheet. This spreadsheet also contains a basic models and parameters of antennas used on the satellite side as well as on the ground station side. Complete calculations give you an estimation of link margin and bit error rate with entered parameters of communication system and selected modulations and forward error correction.

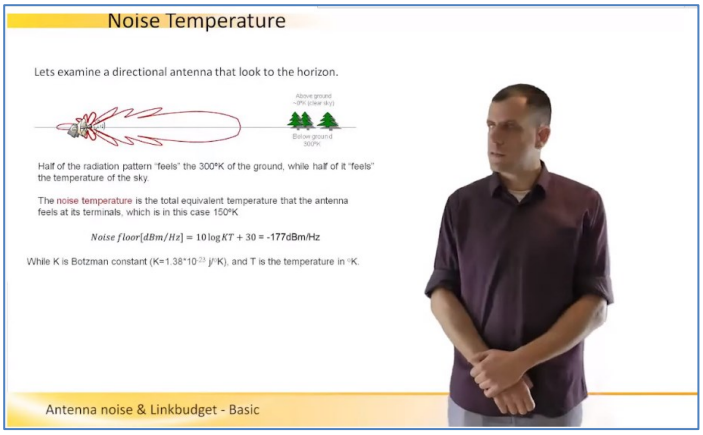


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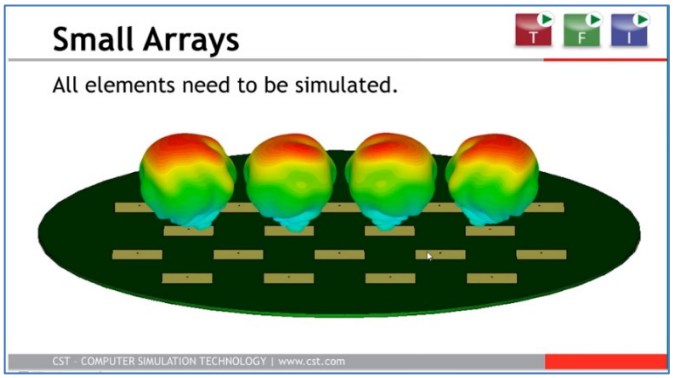
Antenna noise and Link budget – Yuval Tsur (https://www.youtube.com/watch?v=RL4hySEL8f0)

Abstract – This YouTube lesson gives you a brief introduction to the antenna noise temperature including practical example of antenna pointed toward the horizon and the same antenna elevated. There are also mentioned near field, far field, Fresnel zone, free space loss terms and link budget equation. At the end, the lesson also discusses atmospheric losses and their frequency dependency at higher frequency bands.



Simulation enabled 5G antenna design – Ian Wood (https://www.youtube.com/watch?v=sRYyw_rfvyg)

Abstract – This YouTube lesson from CST gives you a deep preview into the design of antenna array for 5G networks. The lesson discusses the use of Antenna Magus to synthesize and rapidly design array elements and initial array layouts, using the link between Antenna Magus and CST STUDIO SUITE to quickly create these designs in 3D. This is supplemented by additional phased array design tools within CST STUDIO SUITE. Next, the solvers and high-performance computing techniques available in CST STUDIO SUITE will be shown, in order to demonstrate how a 3D EM simulation of the full mobile device can be carried out efficiently.



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Other recommended sources of information

- Tutorial to antenna and antenna array design with Matlab and Antenna toolbox
  https://www.youtube.com/watch?v=st2YISG9VrQ

- Tutorial to antenna and antenna array design with CST software
  https://www.youtube.com/watch?v=tezDLU4uO90

- Tutorial to antenna and antenna array design with RFPro software
  https://www.youtube.com/watch?v=7lsdM34y9_E

- Tutorial to massive MIMO antenna array for 5G network
  https://www.youtube.com/watch?v=qjqYRHYLoWo

- Tutorial to antenna beamforming
  https://www.youtube.com/watch?v=A1n5Hhwtz78

- Tutorial to antenna gain and directivity
  https://www.youtube.com/watch?v=YHd5K-zIUT4

- Phased array beamforming Workshop
  https://www.youtube.com/watch?v=0hnWfTvETcU

- Intro to basics of antenna arrays (playlist)
  https://www.youtube.com/playlist?list=PL2fRCJxWQiS8ec8tZLz72fLp7WM7nep-w

- Example antenna types (playlist)
  https://www.youtube.com/playlist?list=PL2fRCJxWQiS9UJVbMFRNNObUGZ8xgclIk

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