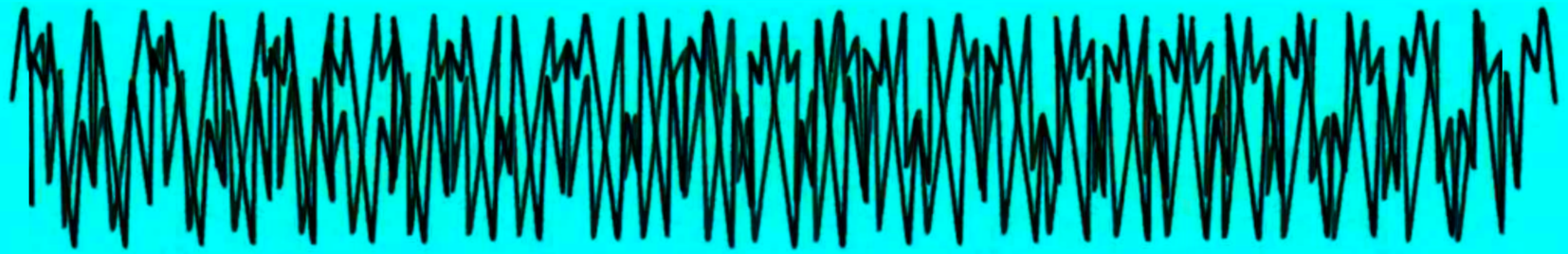
LORA / LORAWAN TUTORIAL 16

SNR Limit & Receiver Sensitivity

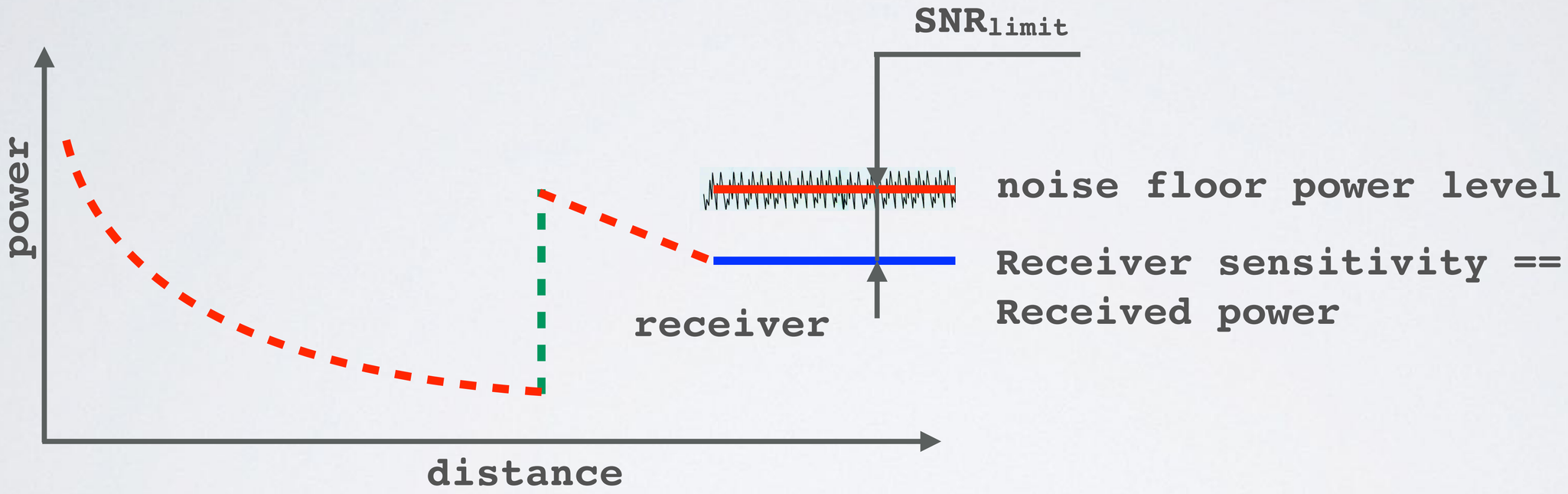


INTRO

- In this tutorial I will explain what an SNR limit is and how to calculate the receiver sensitivity.

SNR LIMIT

- For each spreading factor there is a SNR limit, if this limit is reached the receiver will not be able to demodulate the signal.



SNR LIMIT

- In the table below, the SNR limit can be found for each Spreading Factor:

Spreading Factor	chips/symbol	SNR limit (dB) [2]
7	128	-7.5
8	256	-10
9	512	-12.5
10	1024	-15
11	2048	-17.5
12	4096	-20

Note: If the SF increases by 1, the SNR_{limit} changes by -2.5 dB

RECEIVER SENSITIVITY

- To calculate the receiver sensitivity:

  $S = -174 + 10 \times \log_{10}(BW) + NF + SNR_{limit}$ [3]

  Receiver sensitivity (S) in dBm
  Bandwidth (BW) in Hz
  Receiver Noise Figure (NF) in dB
  NF is fixed for a given hardware implementation
  For LoRa end node transceiver chips SX1272 and SX1276 use NF = 6 dB [1]
  Signal-to-Noise limit (SNR_{limit}) in dB

- For example: BW=125kHz, NF=6dB [1]
  Lets calculate the receiver sensitivity for SF 7-12.
  Use the SNR_{limit} from the previous table.

RECEIVER SENSITIVITY

- SF=7: SNR_{limit}=-7.5dB

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S = -174 + 10xlog10(125000) + 6 -7.5 = -125 dBm
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SF=8: SNR_{limit}=-10dB

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S = -174 + 10xlog10(125000) + 6 -10 = -127 dBm
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SF=9: SNR_{limit}=-12.5dB

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S = -174 + 10xlog10(125000) + 6 -12.5 = -130 dBm
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SF=10: SNR_{limit}=-15dB

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S = -174 + 10xlog10(125000) + 6 -15 = -132 dBm
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SF=11: SNR_{limit}=-17.5dB

```
S = -174 + 10xlog10(125000) + 6 -17.5 = -135 dBm
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SF=12: SNR_{limit}=-20dB

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S = -174 + 10xlog10(125000) + 6 -20 = -137 dBm
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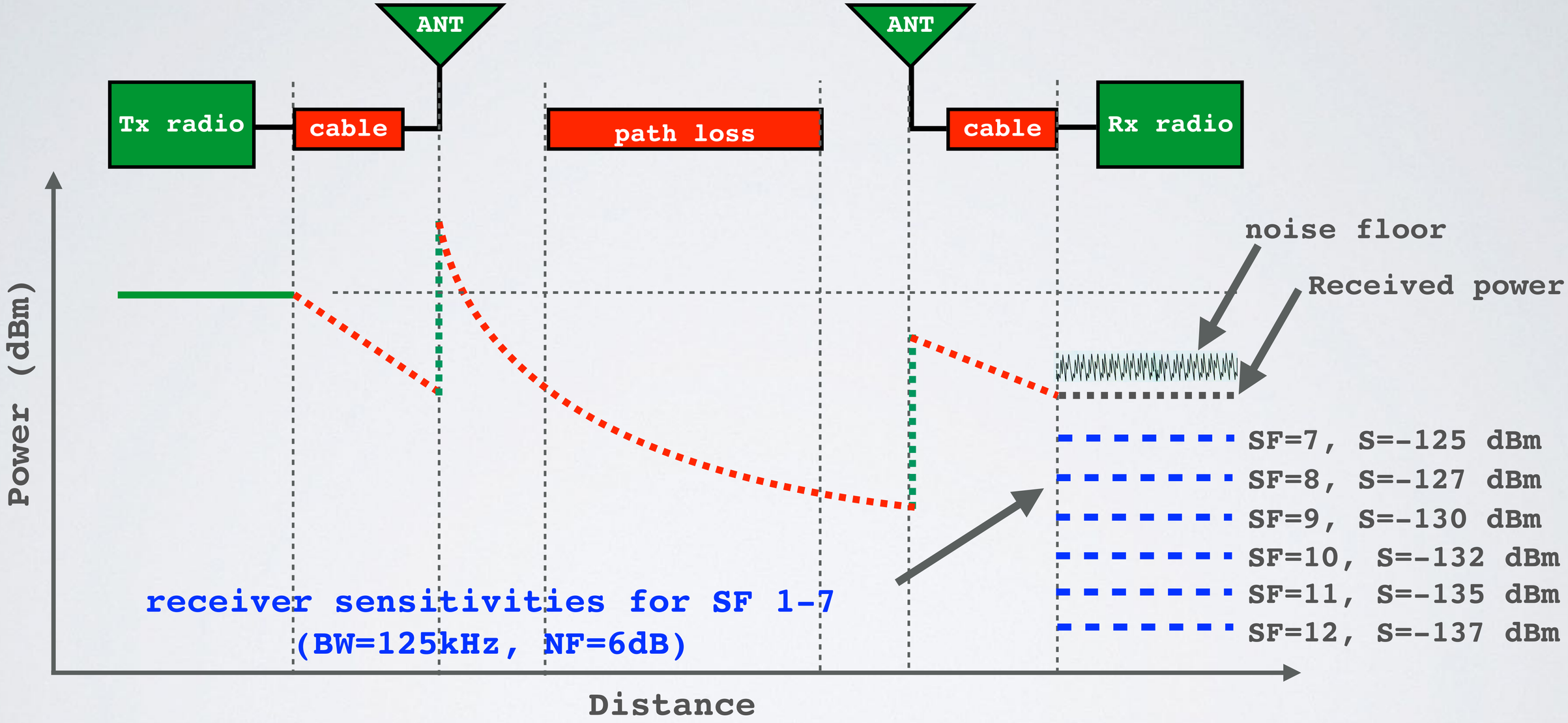
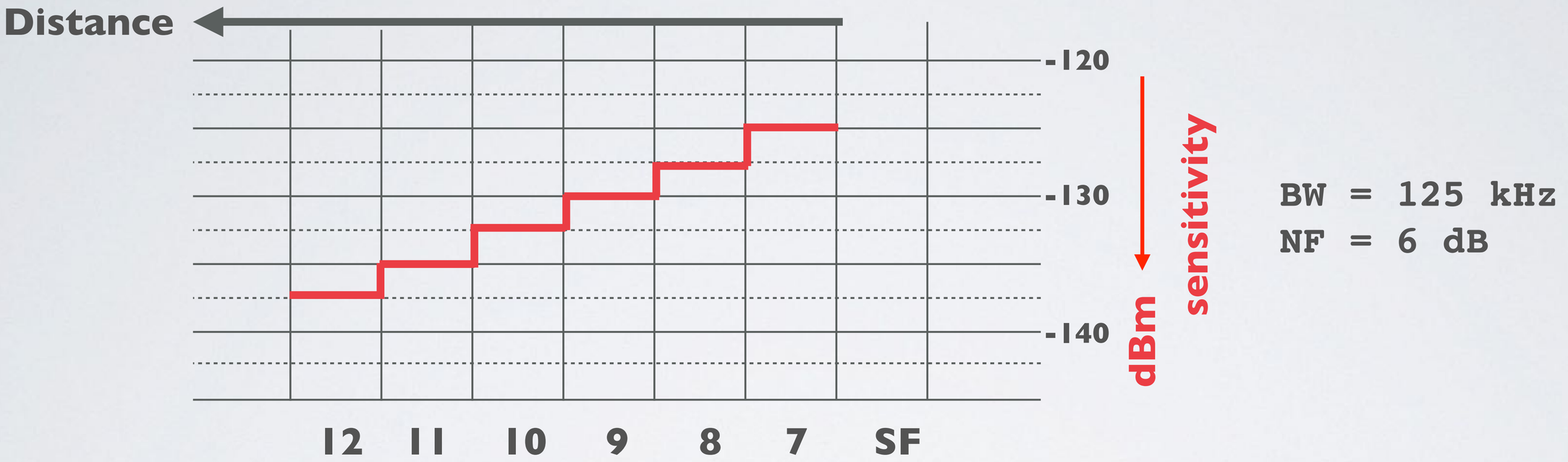
RECEIVER SENSITIVITY



RECEIVER SENSITIVITY



- If the distance between end node and gateway increases the signal gets weaker and therefore an increase spreading factor is needed for a lower receiver sensitivity to be able to demodulate the received signal. The Spreading Factor ranges from 7 when close to a gateway to 12 when far away from a gateway.