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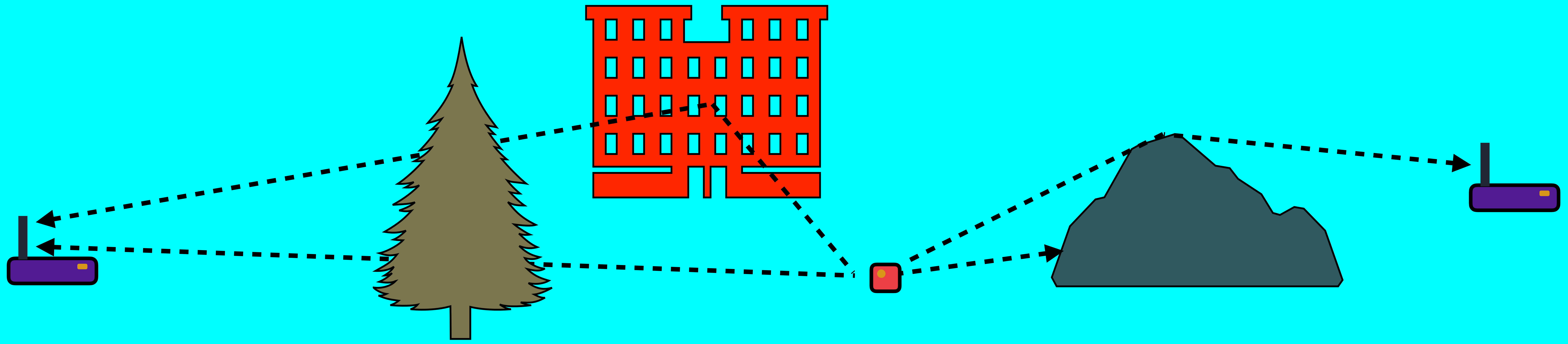
LORA / LORAWAN TUTORIAL 6

Radio Propagation & Free Space Loss



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INTRO

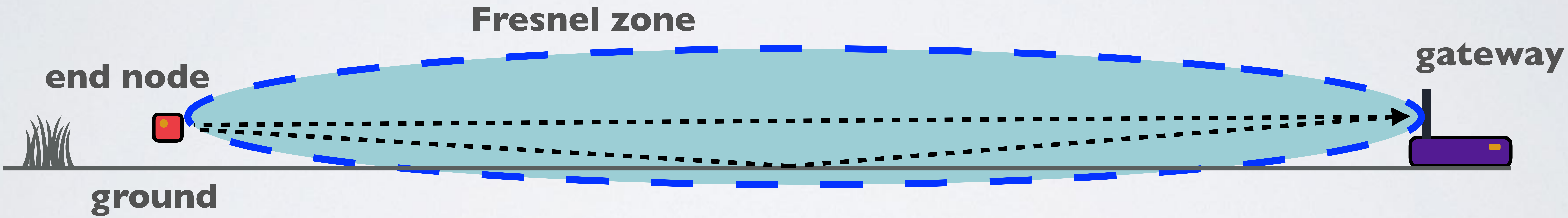
- In this tutorial I will explain what radio propagation and free space loss are.

PROPAGATION

- Propagation is the way how radio waves travels thru free space (also known as medium). The way how these waves travels may impact its signal strength.
  - Line-of-sight propagation
    The radio waves travels directly from sender to receiver without any obstacles.
    If the distance between sender and receiver gets larger, the signal will get weaker.
    This loss is known as Free Space loss.

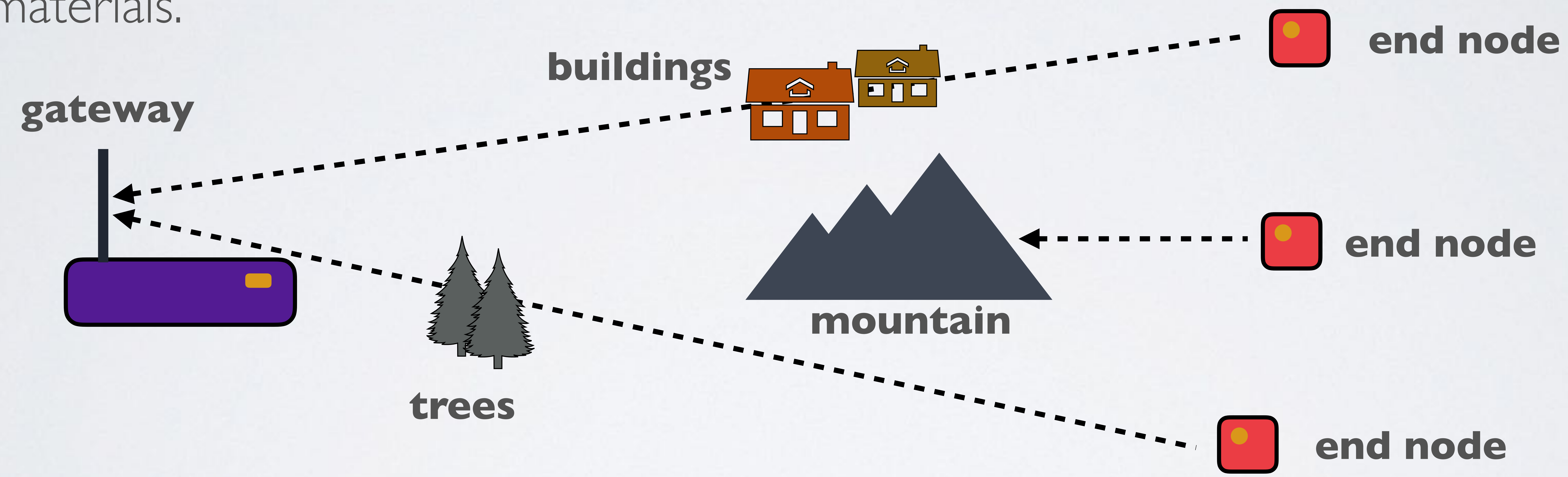
PROPAGATION

- If there are obstacles **near** its path (within the Fresnel zone), the radio waves reflecting off those objects may arrive out of phase with the signals that travel directly and reduce the power of the received signal.



PROPAGATION

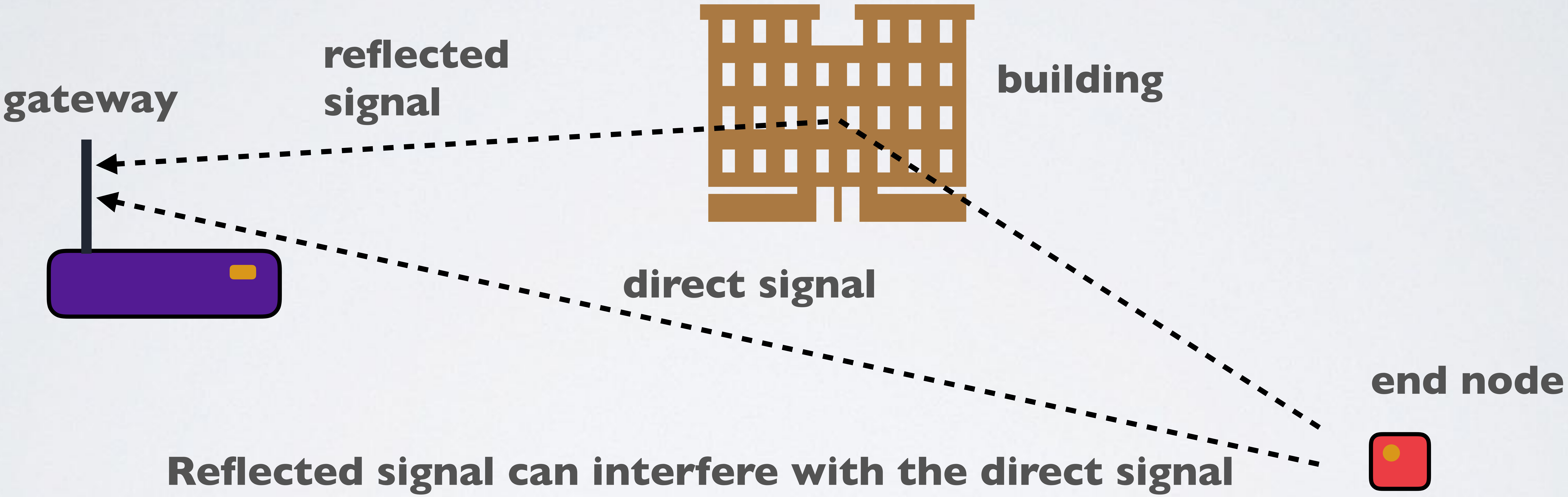
- Propagation thru obstacles
  Radio waves may penetrate thru obstacles that appear in its path.
  Radio waves loses strength if it travels thru obstacles made of more conductive materials.



Buildings are made of more conductive materials which weakens the signal more compared to trees. A mountain blocks the signal completely.

PROPAGATION

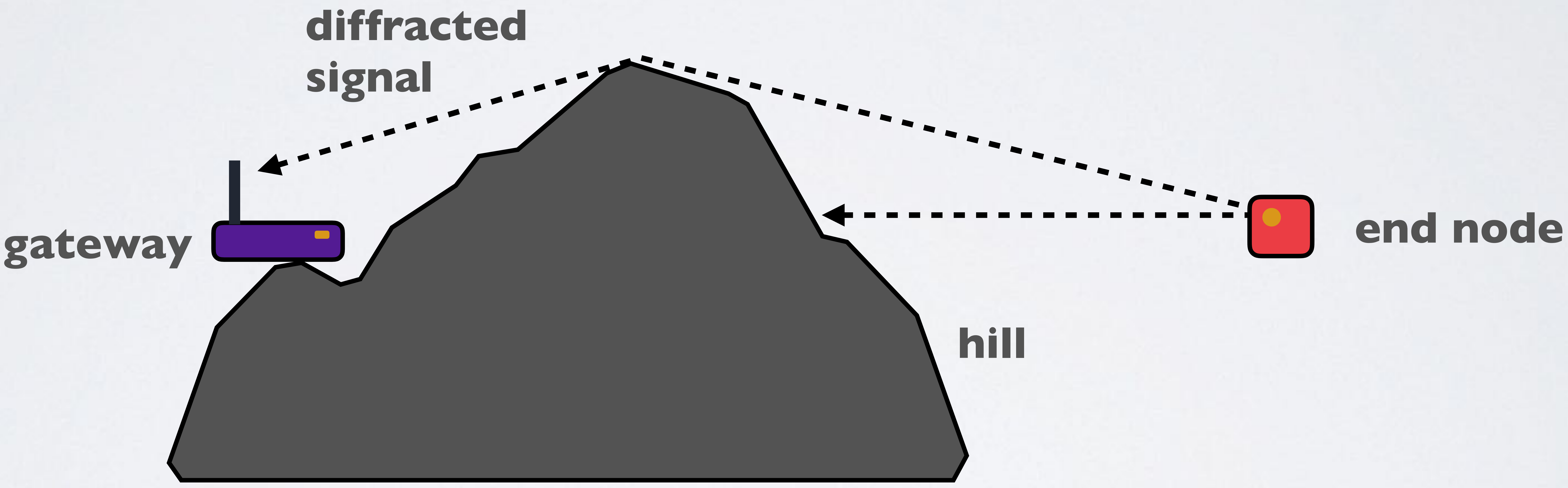
- Propagation thru reflection
  Radio waves can be reflected by buildings which interfere with its direct signal.



Reflected signal can interfere with the direct signal

PROPAGATION

- Propagation thru diffraction
  Diffraction is where radio waves are bent around sharp edges. A signal from a transmitter may be received by the gateway even though it may be "shaded" by a large obstacle.



Gateway receives the diffracted signal but not the direct signal

PROPAGATION

- There are more types of propagations which impact the signal strength but the ones explained in this video:
  - Line-of-sight propagation
  - Propagation thru obstacles
  - Propagation thru reflection
  - Propagation thru diffraction

  are the important ones.

FREE SPACE LOSS

- The free space loss can be calculated as follow:

  $L_{fs} = 32.45 + 20x\log(D) + 20x\log(f)$

  L_{fs} = Free space loss in dB
  D = Distance between end node and gateway in km
  f = frequency in MHz

- For example: f=868MHz

  D=0.01 km, L_{fs}=32.45+20xlog(0.01)+20xlog(868) = 51 dB
  D=0.05 km, L_{fs}=32.45+20xlog(0.05)+20xlog(868) = 65 dB
  D=0.10 km, L_{fs}=32.45+20xlog(0.10)+20xlog(868) = 71 dB
  D=0.50 km, L_{fs}=32.45+20xlog(0.50)+20xlog(868) = 85 dB
  D=1.00 km, L_{fs}=32.45+20xlog(1.00)+20xlog(868) = 91 dB