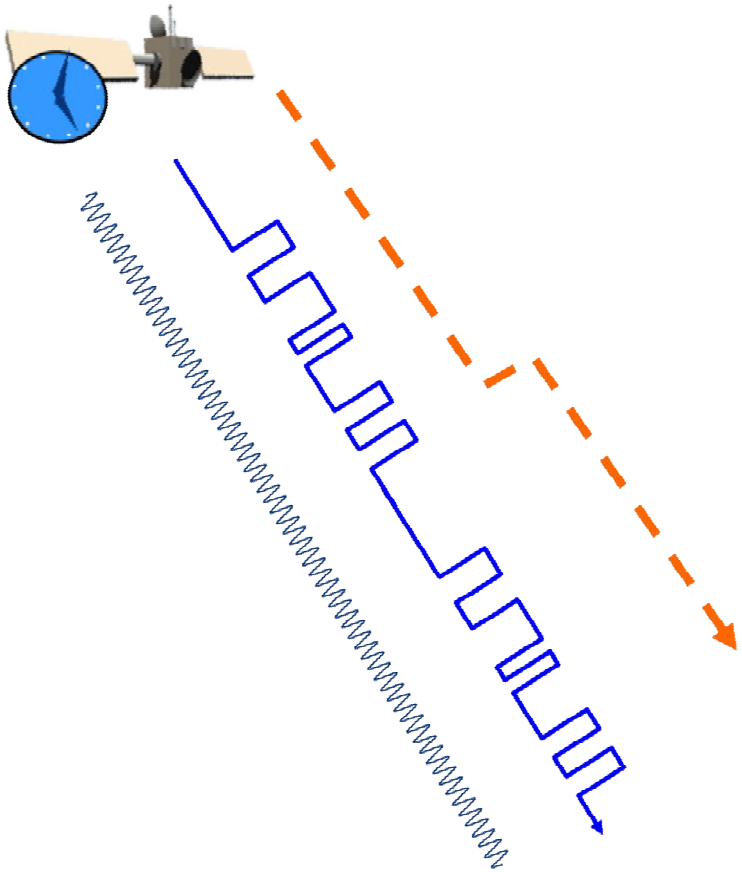
GNSS compared to terrestrial signals (why GNSS is vulnerable)

GNSS signal power



- radio waves disperse energy as they propagate
- satellites are more than 23,000km away
- signal emitted at about 30W
- signal strength proportional to: $^{1}/_{distance^{2}}$
- at 23,000 km, GNSS signal reduced by a factor of about 10^{18} !

- Imagine trying to see a lightbulb 23,000km away
- signal levels are below the natural background radiation

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Terrestrial signal powers

- mobile phone base station
  - typical transmit power,10-100W
  - signal power reduction depends on range
  - at 10km, signal power reduced by factor of 10^{11}
  - at 1km, reduced by 10^{9}

  compared to the GNSS signal (10^{18} reduction) it is over billion times stronger
- mobile phone, typical transmit power, 0.1-1Wconnected to a cell tower at 1km
  - typical signal reduction 10^{9}

  still over a million times stronger than the GNSS signal!

Expected receiver signal power levels

- GNSS receivers expect to receive and can operate at signal levels even below the natural background radiation level, the "noise floor"
- **GNSS receivers** need a minimum power level "−160dBW"
  - GNSS receivers designed to work at these low levels
  - provided they are not overloaded by other signals
- **Mobile phones** (eg GSM) expect a minimum "−104dBW"
  - almost a million times higher than GNSS
- this difference in expected signal receive levels makes GNSS reception vulnerable

[probably needs a comparative graphic, I can't find one]

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How do you avoid interference?

- If GNSS signals shared frequencies with mobile systems, they would be swamped by interference
- GNSS reception would not be possible
- To avoid such interference, the Radio Regulations separate different types of services (eg terrestrial mobile, satcoms, TV) into different frequency bands
  - eg mobile at 900MHz
  - TV at 600MHz
  - satcoms at 1650MHz
  - GNSS at 1575MHz