**FFI** Forsvarets forskningsinstitutt
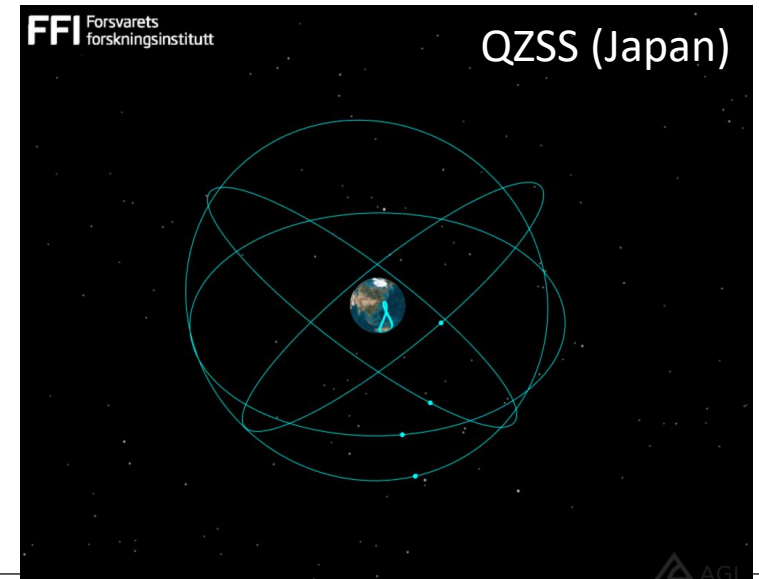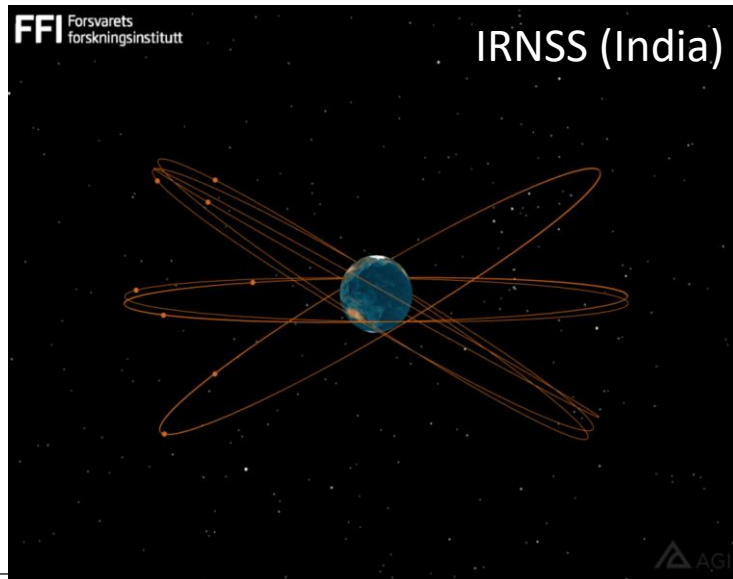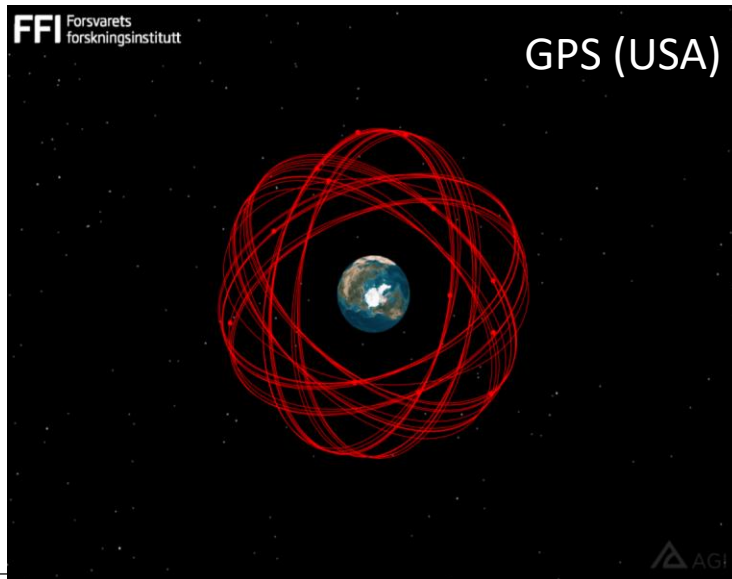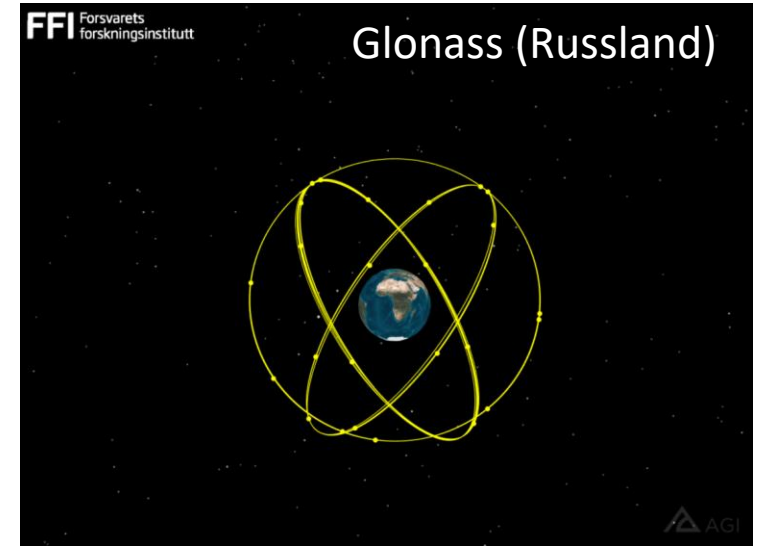
# Master Thesis at FFI

## GNSS anti-jamming antenna and SDR Spoofer

Tor Atle Solend
Anders Rødningsby

Foto: AdobeStock

# Global Navigation Satellite Systems (GNSS)



BeiDou (China)

Galileo (EU)

Glonass (Russland)

GPS (USA)

IRNSS (India)

QZSS (Japan)

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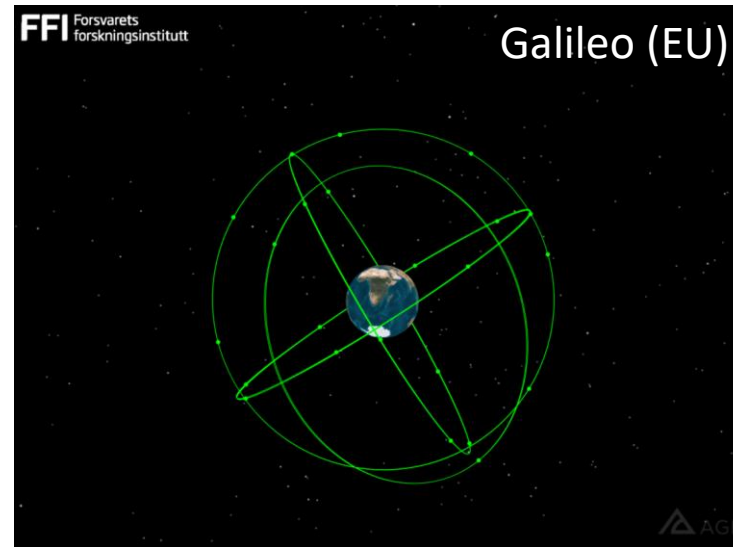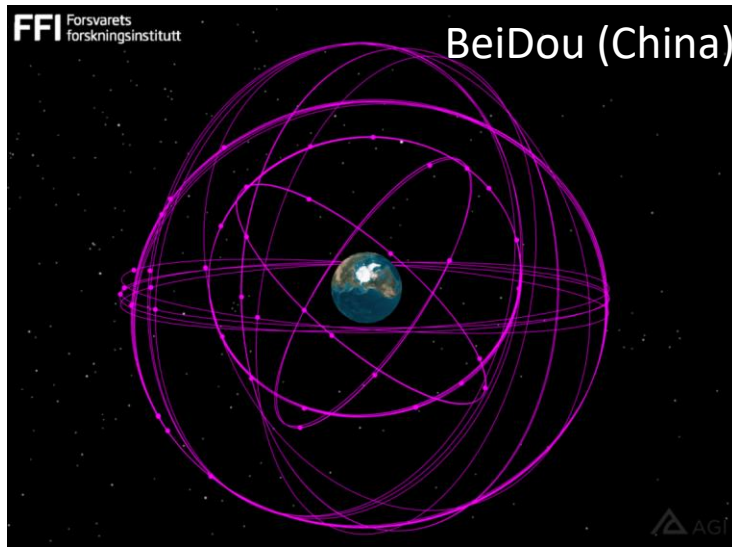
**GNSS:**

**GPS**
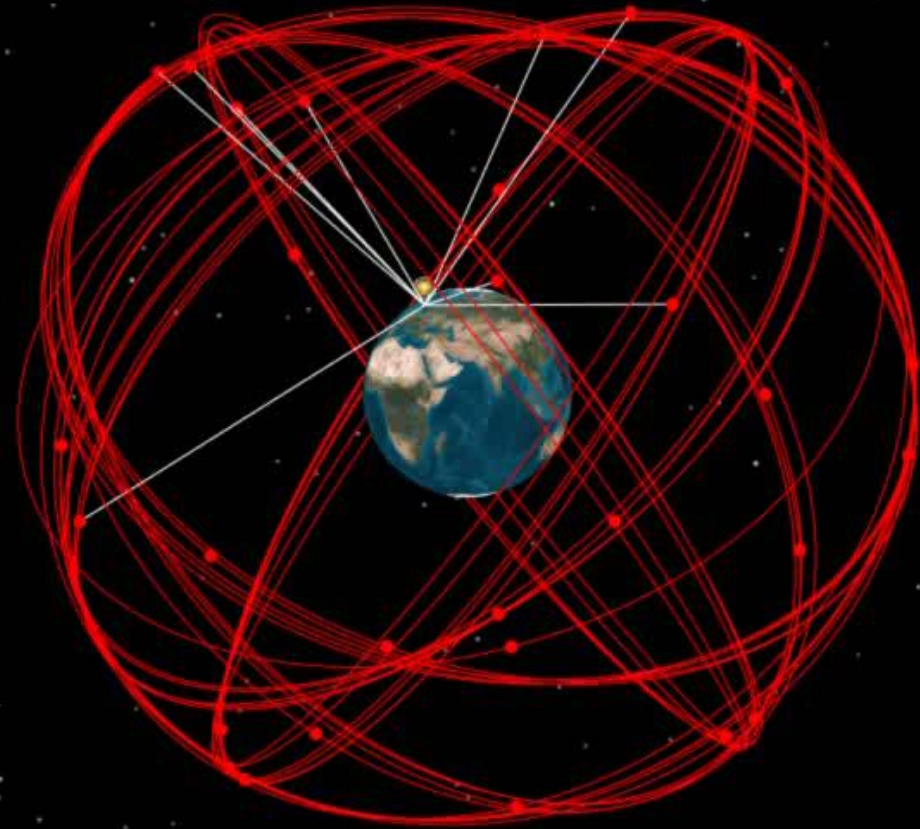
**RNSS:**

*GNSS:*

**GPS**

**GALILEO**

*RNSS:*
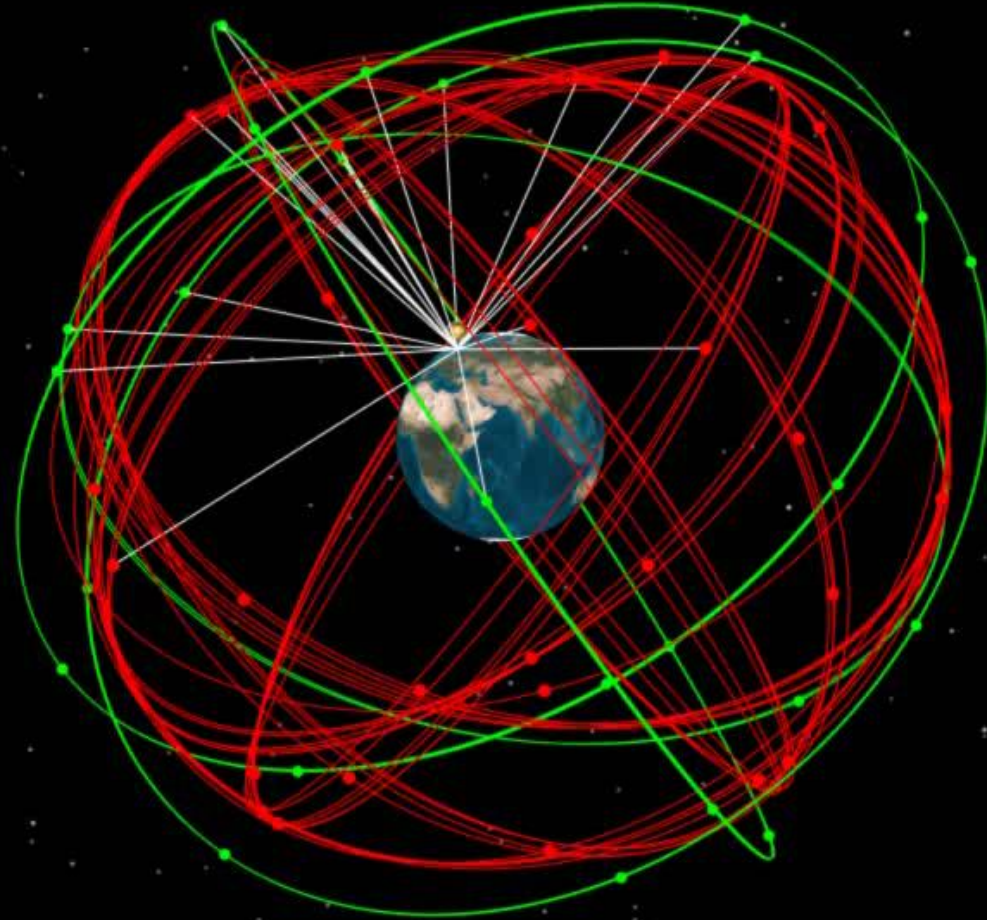
**GNSS:**
**GPS**
**GALILEO**
**GLONASS**

**RNSS:**
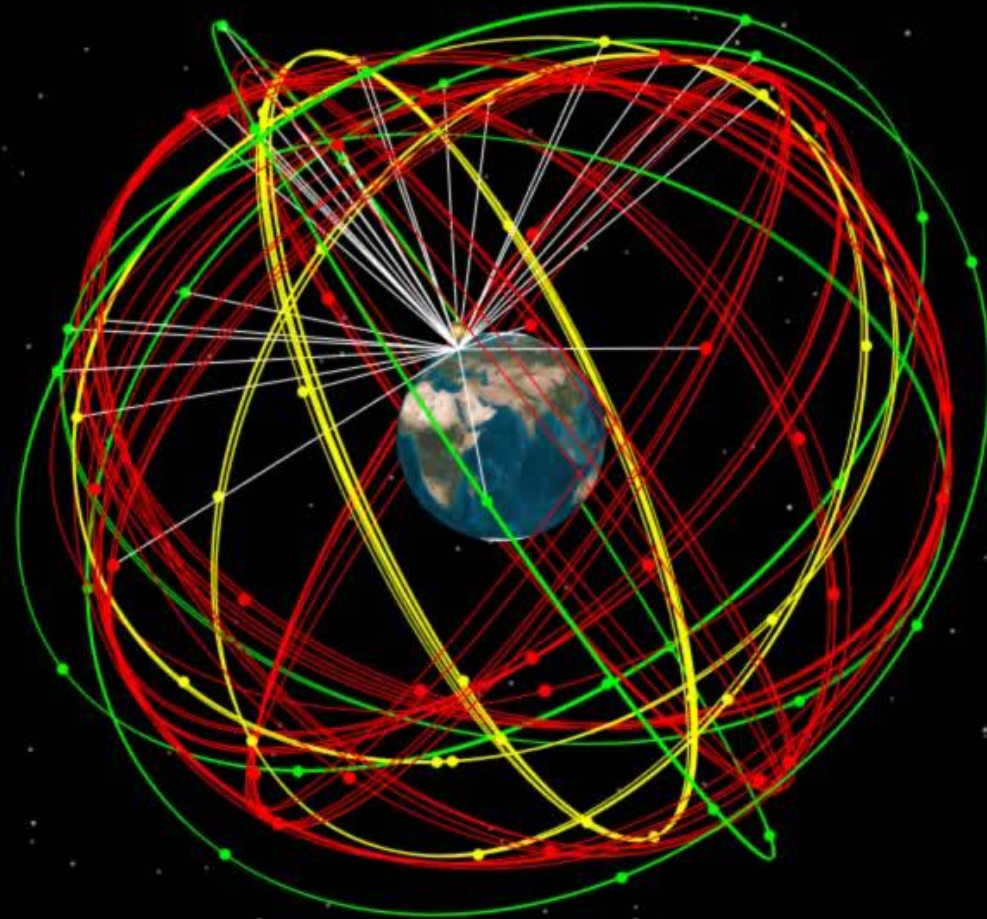
*GNSS:*
**GPS**
**GALILEO**
**GLONASS**
**BEIDOU**
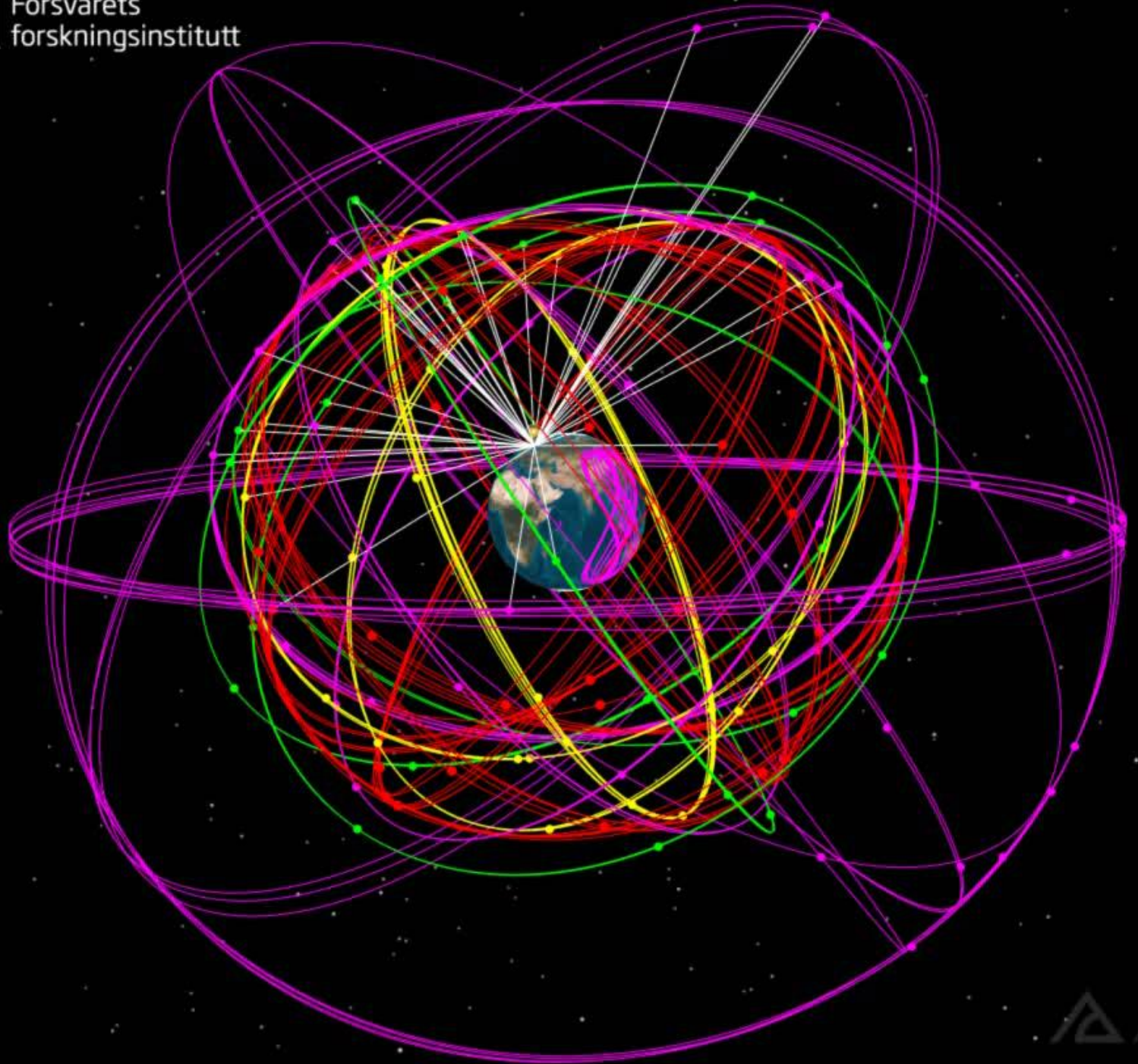
*RNSS:*
**BEIDOU***

**GNSS:**
**GPS**
**GALILEO**
**GLONASS**
**BEIDOU**

**RNSS:**
**BEIDOU***
**QZSS**
**IRNSS**

FFI

# Why is GNSS vulnerable?



20000 km

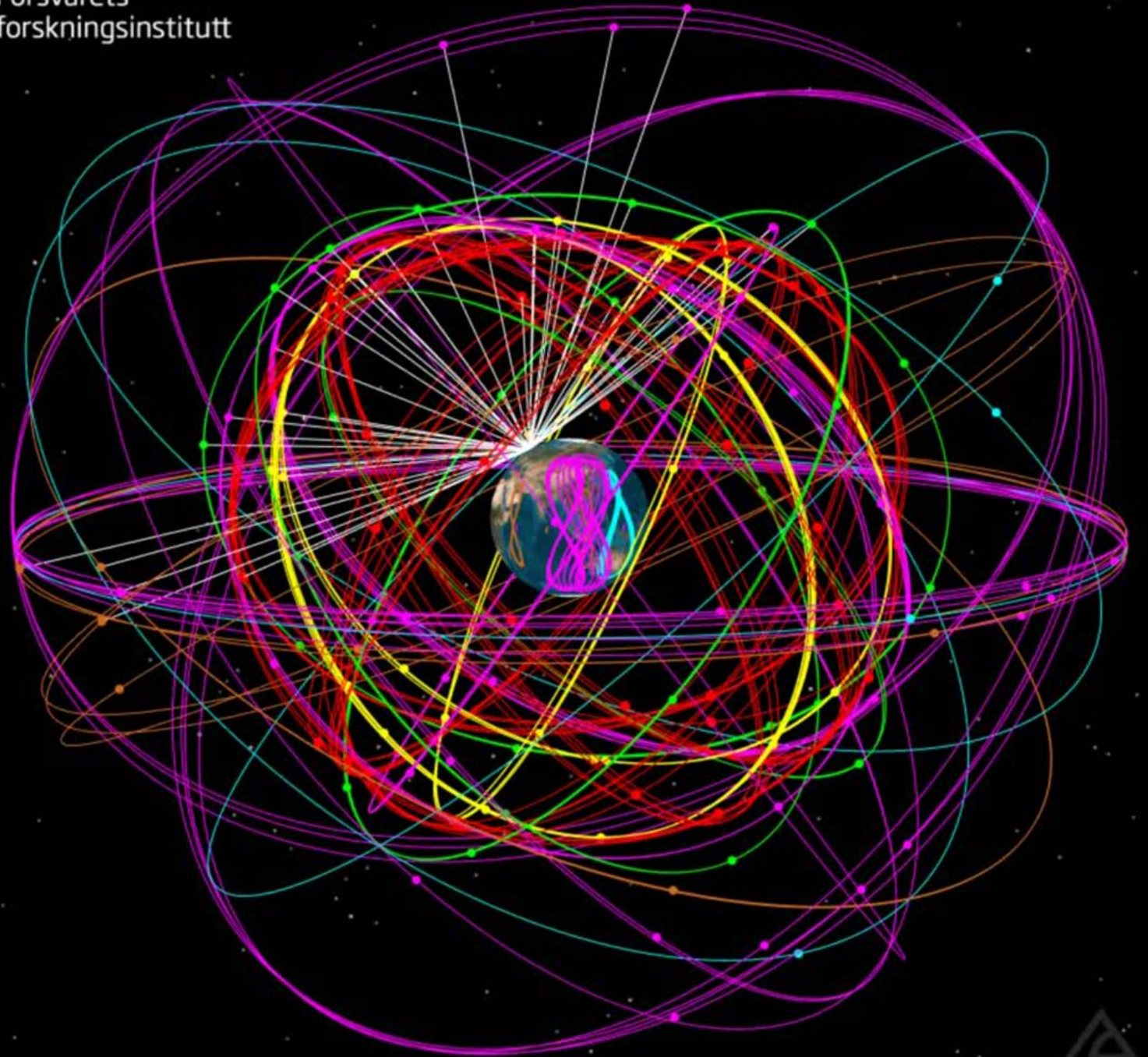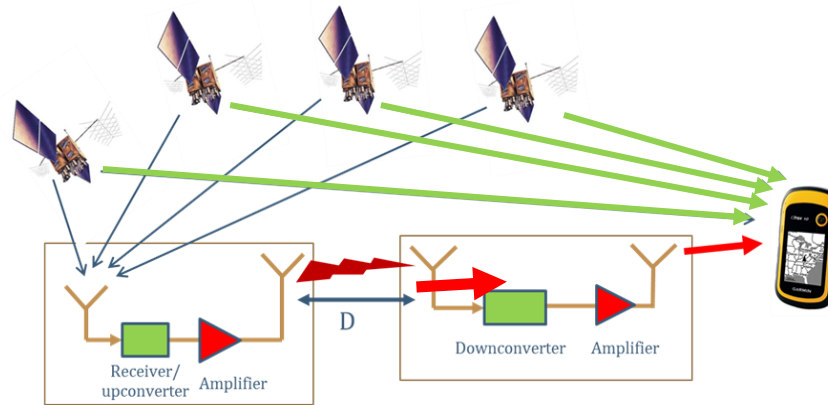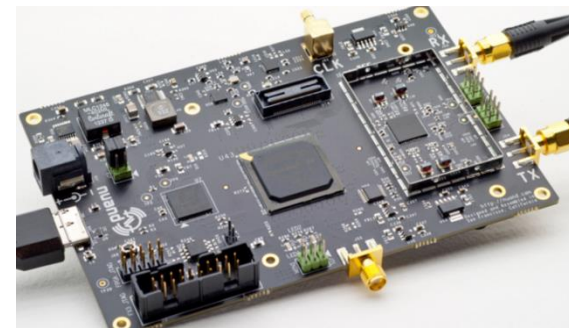~1 km

# Spoofing

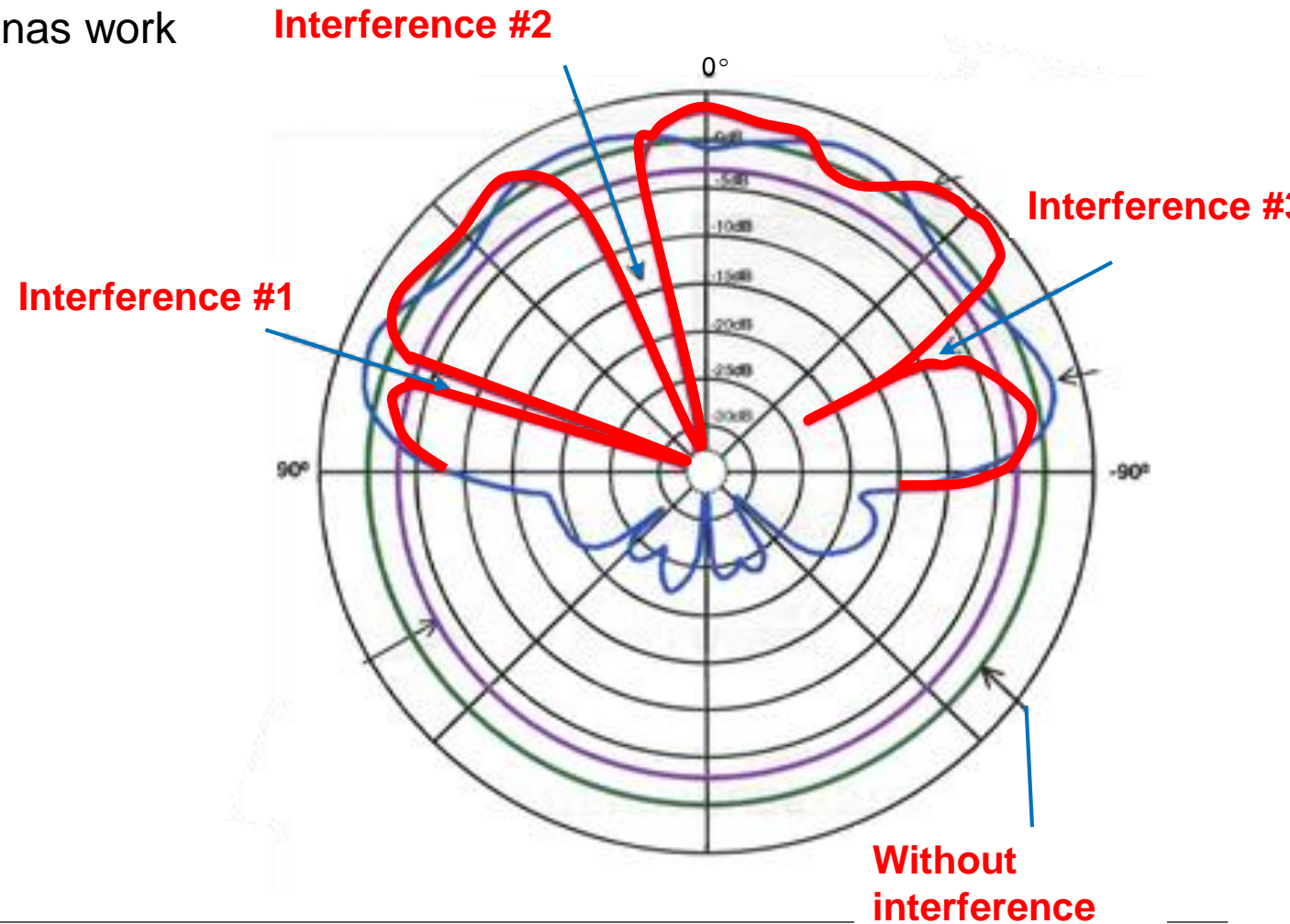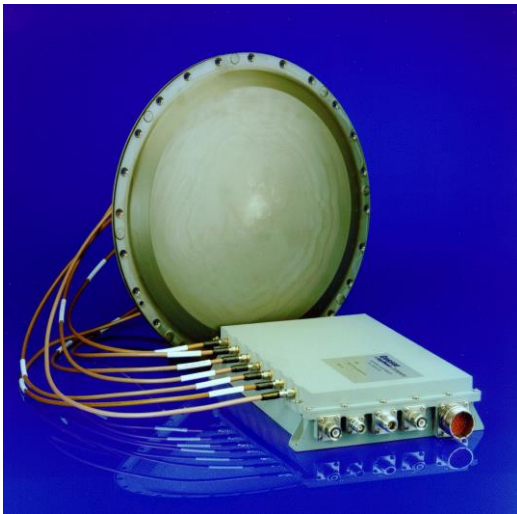Retransmitting «true» satellite signals



GNSS-simulator



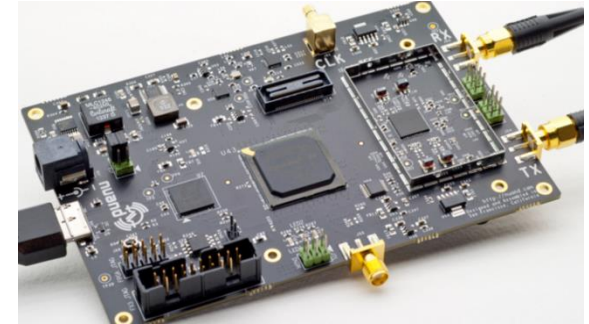Software Defined Radio (SDR)

# Anti-jam antenna simulator

- Analyse and understand how anti-jam antennas work

- Compare different nulling algorithms

- Develope an anti-jam antenna simulator

# GNSS spoofer

- Build your own GNSS spoofer based on SDRs
  → and become an expert in Pokemon GO☺

- Evaluate software available online

- Demonstrate enhanced functionality

- Can the spoofing signals be synchronized with real GNSS time

# Summary

- Simulate an anti-jamming antenna
- Build a GNSS-spoofer and demonstrate novel functionality


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    - Tor Atle Solend: t.a.solend@its.uio.no