Passive Bistatic GeoSAR using Comsat transmissions:

- Low-cost geosynchronous radar

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Concept Introduction

Re-use reflections of suitable RF comsat transmissions for imaging

Many commercial communication satellites broadcast high bandwidth, high power RF signals

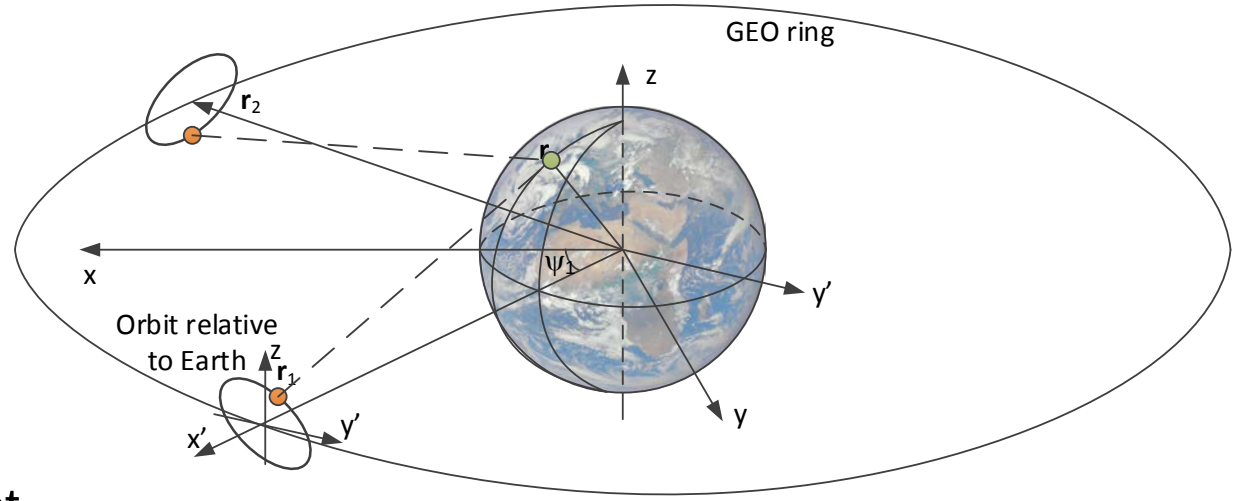
- These are similar to radar transmitters

We require a dedicated receiver:

- Record the reflected signals
- Correlate with the transmitted data (direct path)

Already demonstrated terrestrially

Challenge is achieving synchronisation and a useful SNR



Available Signals

Radar imaging requires bandwidth, power and low-ambiguity signal formats

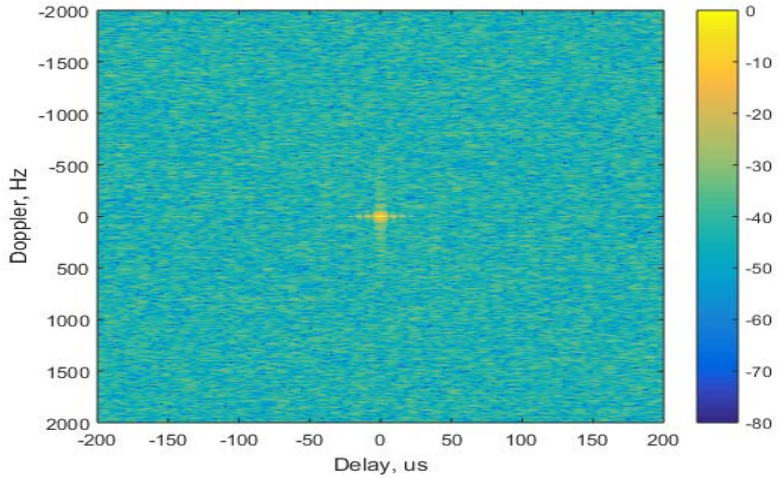
Candidate broadcast signals investigated from L-band to Ka-band

- The move to digital formats (e.g. DVB-S) is helpful
- L-band: Inmarsat data broadcasts
- Ku-band: satellite TV (and some data)
- Ka-band: data (and some TV)

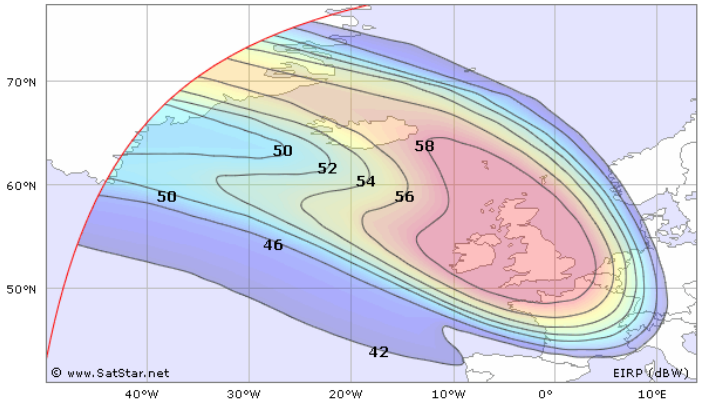
Digital TV signals

- Stable format with low ambiguities
- High power (for small consumer antennas)

Data signals often vary the packet format dynamically



Measured L-band range, Doppler ambiguity (above)



Astra 2E Ku-band TV signal power (as EIRP, dB) (left)

System Performance

Assessed spatial resolution and feasible SNR wrt applications

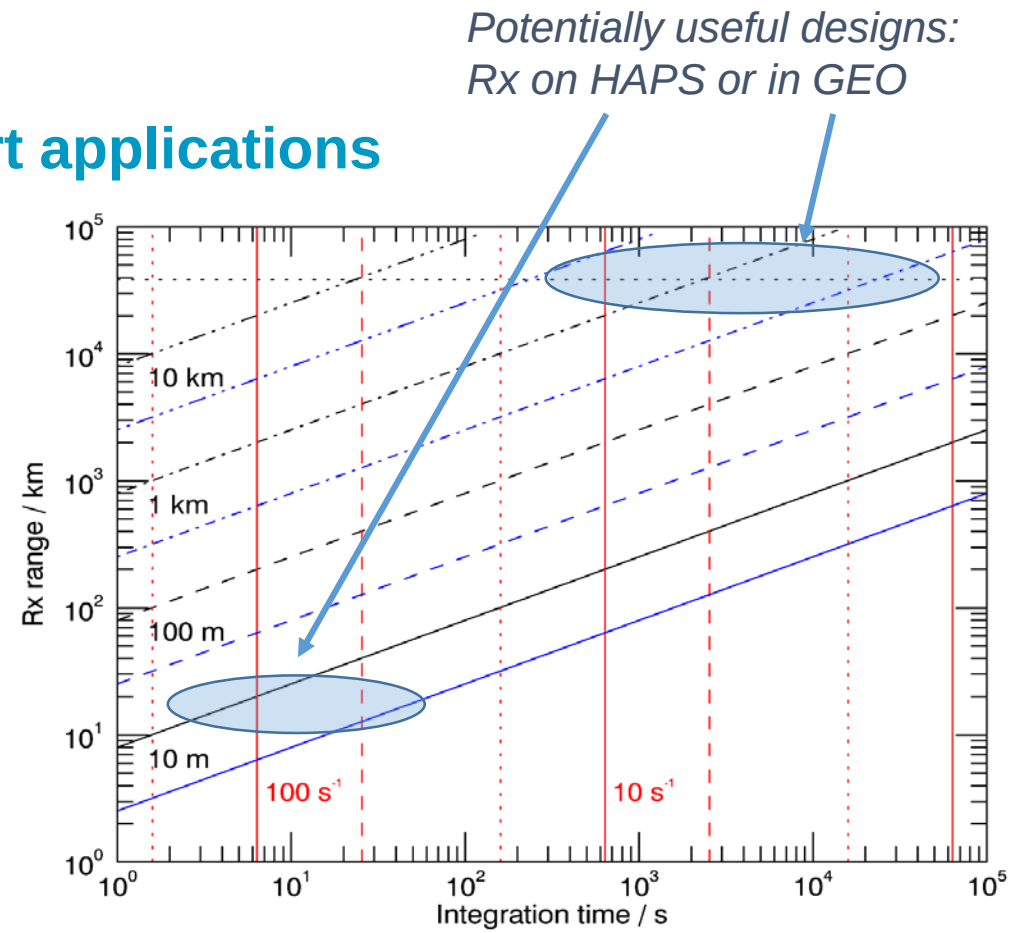
The bistatic geometry affects the spatial resolution:

- **Range resolution** is along the bisector between the directions to the transmitter and receiver
- Effective **azimuth resolution** direction varies over an orbit, depends on motion of Tx and Rx

Signal to Noise Ratio (SNR) is evaluated for candidate concepts (see chart) and limits useful spatial resolution to ~1 km

- Also consider azimuth ambiguity, resolution, etc.

Useful **applications** at ~1 km include atmospheric humidity for NWP and catchment scale soil moisture



System design overview *(SNR as a function of integration time and Rx slant range – for spatial resolution from 10 m to 10 km; overlay of implied orbit speed; for EIRP = 58 dB, 1 m² antennas, etc.)*

Conclusions

Passive Bistatic GeoSAR seems feasible, at ~1 km resolution

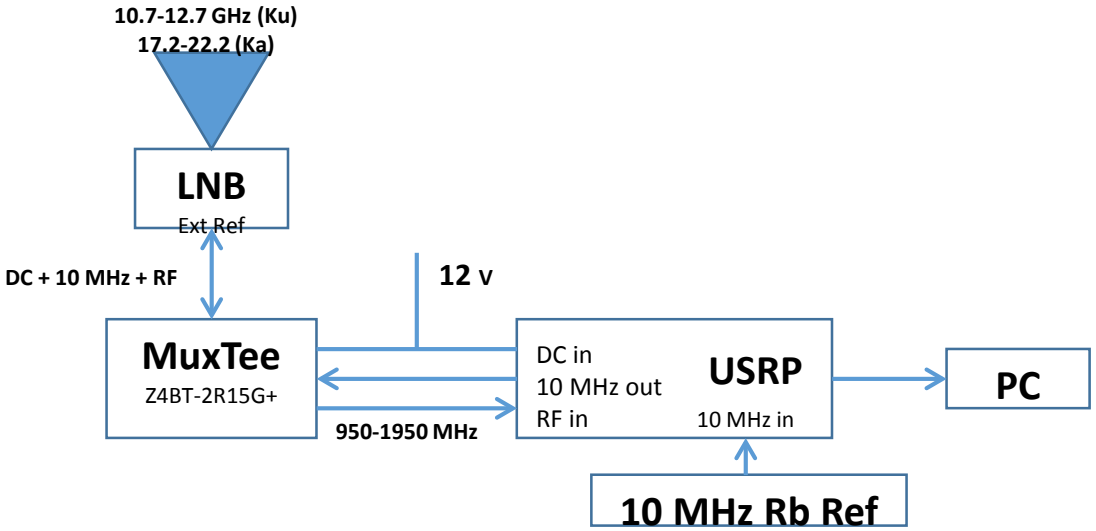
Both L and Ku-band seem feasible and worthy of further study

System synchronisation is a challenge – may require direct path signal recording at Rx

Outline development roadmap:

1. Roof-top hardware demonstrator for validation
2. Regional or HAPS demonstrator
3. On-orbit implementation

Cost as hosted payload ~ £-$-€ 10M



Top-level design for a hardware demonstrator to validate the concept and system models

Thank you for your attention

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