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Inter-Satellite Links in Millimetre Waves

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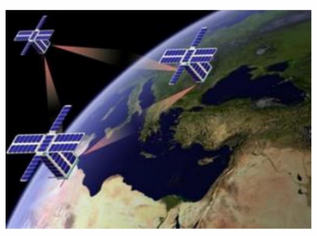
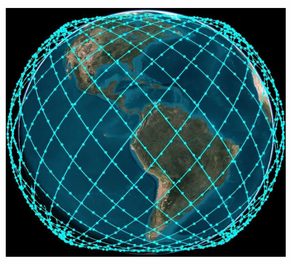
Introduction

- Satellite industry is now driven by high-performance, low cost small satellites flying in LEO Orbits.
- Earth observation and remote sensing applications are trending towards LEO orbits for reduced latency and improved accuracy.
- Inter-satellite communication is essential as LEO satellites do not have constant contact with ground stations.



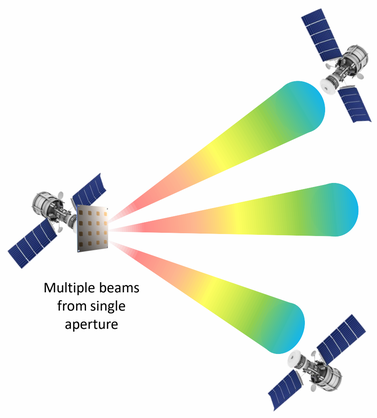
Satellite formation flying



Satellite constellation

Aims

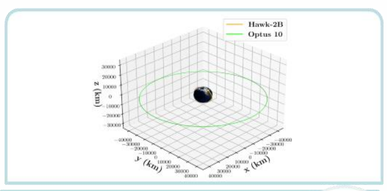
- Design a phased array antenna in millimetre wave frequencies (60 GHz).
- Develop beamforming techniques to create narrow beams and to steer beams electronically.
- Develop digital techniques to track beams.



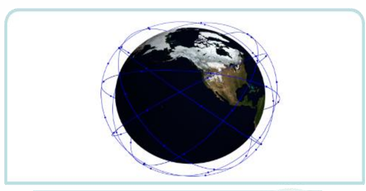
Methods

- Case study method- considered three inter-satellite links scenarios.

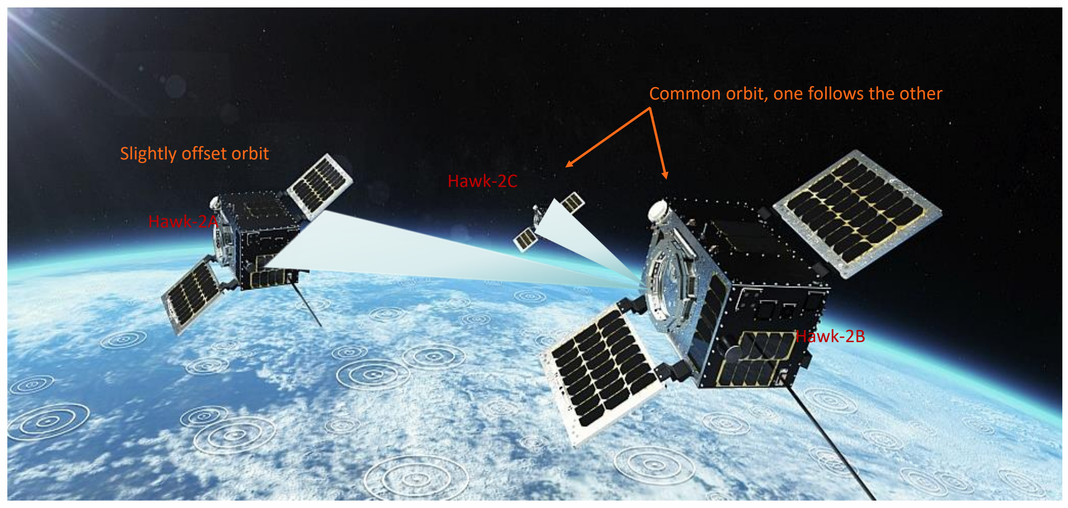
Inter-Satellite Links within a LEO satellite Cluster **1**



Link between LEO and GEO satellite **2**



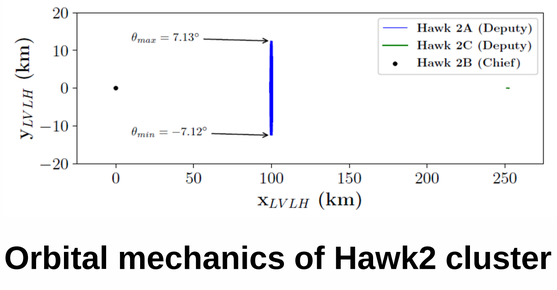
Indo-Pacific Connector **3**



Case Study: Hawkeye 360 Satellite Cluster (LEO)

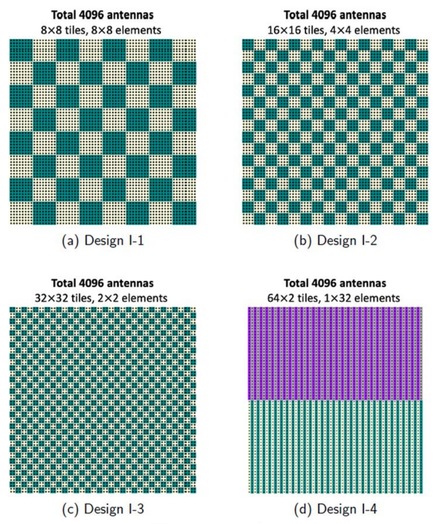
Results

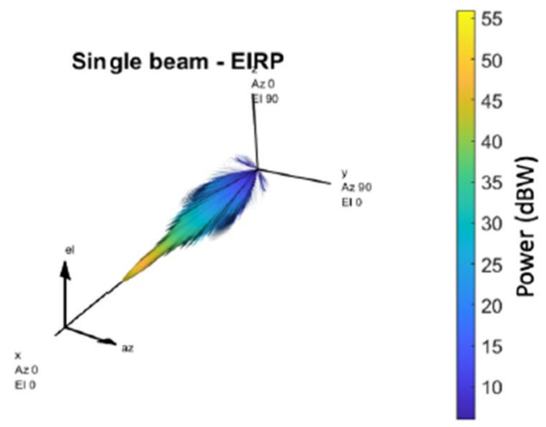
- Defining antenna design requirements.
  - Inter-satellite distance variations
  - Required beam steering range
  - Link budget analysis
  - Channel capacity analysis



Orbital mechanics of Hawk2 cluster

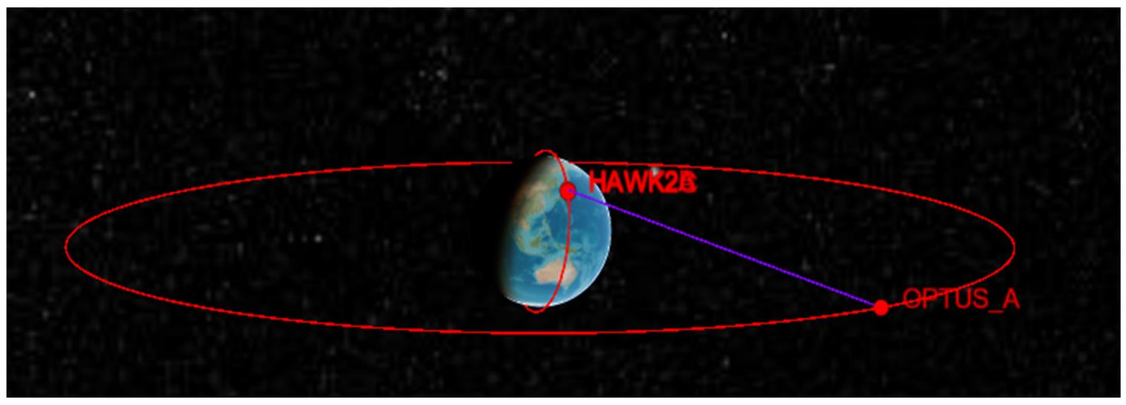
- Investigated multiple antenna designs.





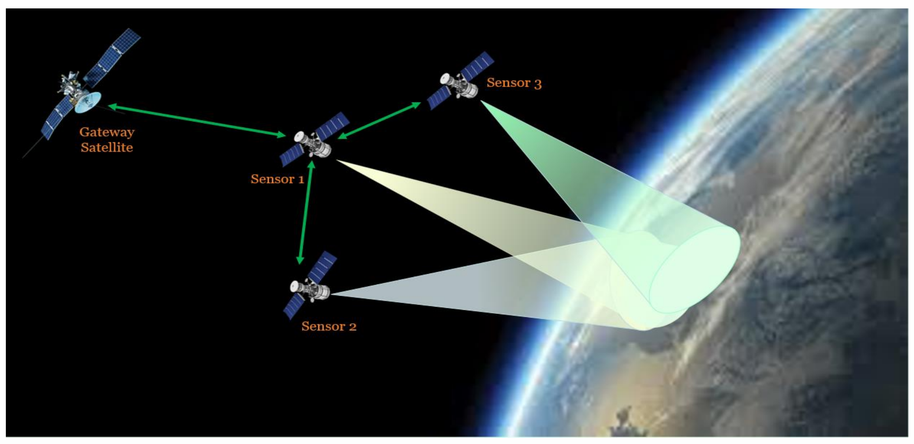
Example antenna design – 4096 elements

- Explored multiple beam tracking techniques (Simple Harmonic Motion Model, Clohessy-Wiltshire Model).
- Investigated techniques for satellite location estimate (TLE Fusion, Signal of opportunity).



Orbits of LEO satellite cluster and GEO satellite

Application: Earth Observation



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