Millimetre Wave Inter-Satellite Links

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SMARTSAT

COOPERATIVE RESEARCH CENTRE

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Project Partners

Australian Government
Department of Defence

SMARTSAT
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EM SOLUTIONS

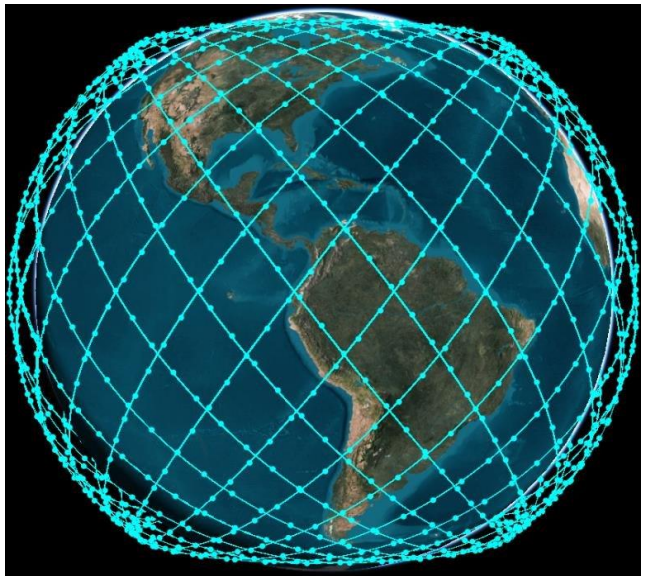
MACQUARIE University

UTS
UNIVERSITY OF TECHNOLOGY, SYDNEY

RMIT UNIVERSITY

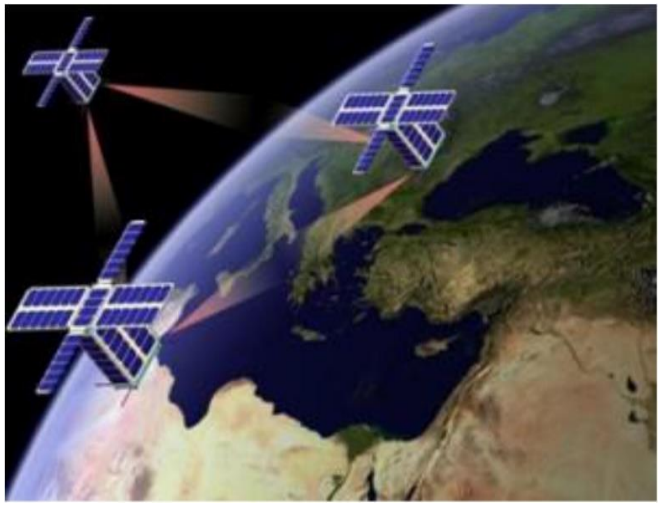
Motivation

- Satellite communications industry is now driven by high-performance, low-cost small (sometimes fractionated) satellite systems in LEO constellations
- LEO satellites do not have constant contact with ground stations.



Satellite constellation

- Accurate pointing and tracking
- Restrictive size, weight, and power requirements
- Simultaneous connectivity with multiple satellites



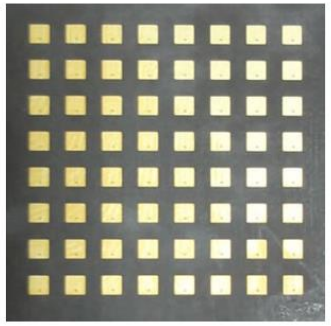
Satellite formation flying

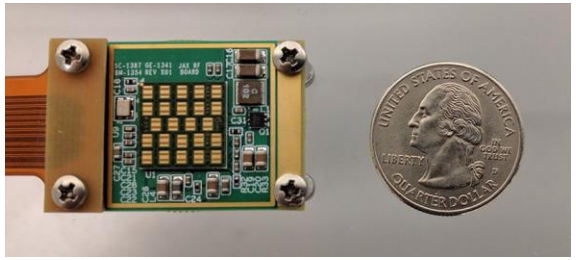
Why Millimetre Wave ISL?

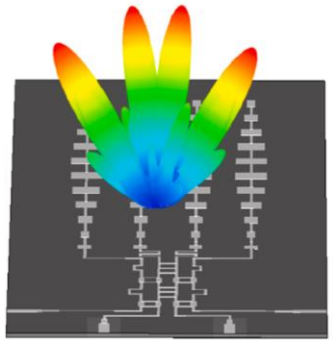
ITU Spectrum Allocation for ISL

57,000.00	58,200.00	1,200.00	EARTH-EXPL-SAT (passive),INTER-SAT,SPACE RESEARCH(passive)
59,000.00	59,300.00	300	EARTH-EXPL-SAT (passive),INTER-SAT,SPACE RESEARCH(passive)
59,300.00	64,000.00	4,700.00	INTER-SAT
64,000.00	65,000.00	1,000.00	INTER-SAT,RADIO ASTRONOMY
65,000.00	66,000.00	1,000.00	EARTH-EXPL-SAT,INTER-SAT,SPACE RESEARCH

- Beams are electronically steerable
- Small size (due to wavelength) and weight
- Multiple beams possible
- Allows for beam tracking
- Scalable and versatile
- Fails gracefully
- Space to space + atmospheric attenuation separates ground communication and ISL

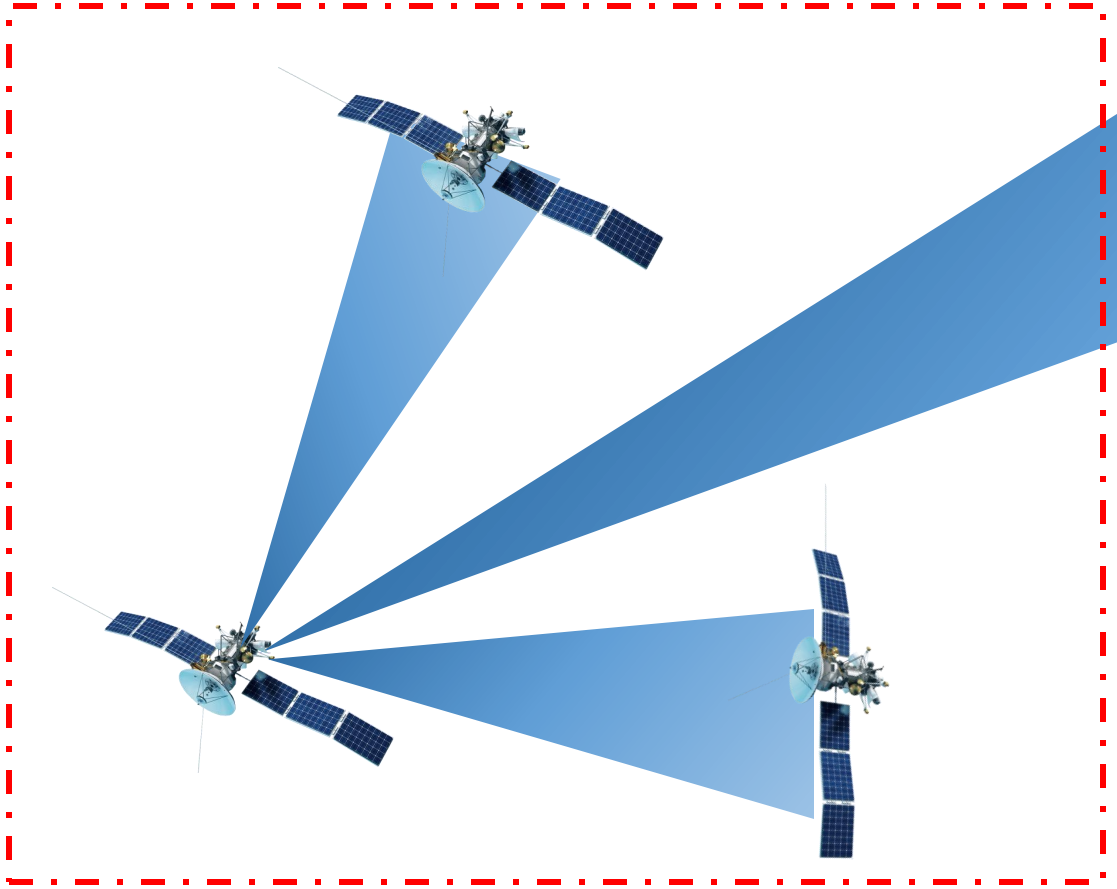






Project Focus

LEO Satellites (Hawkeye Formation)



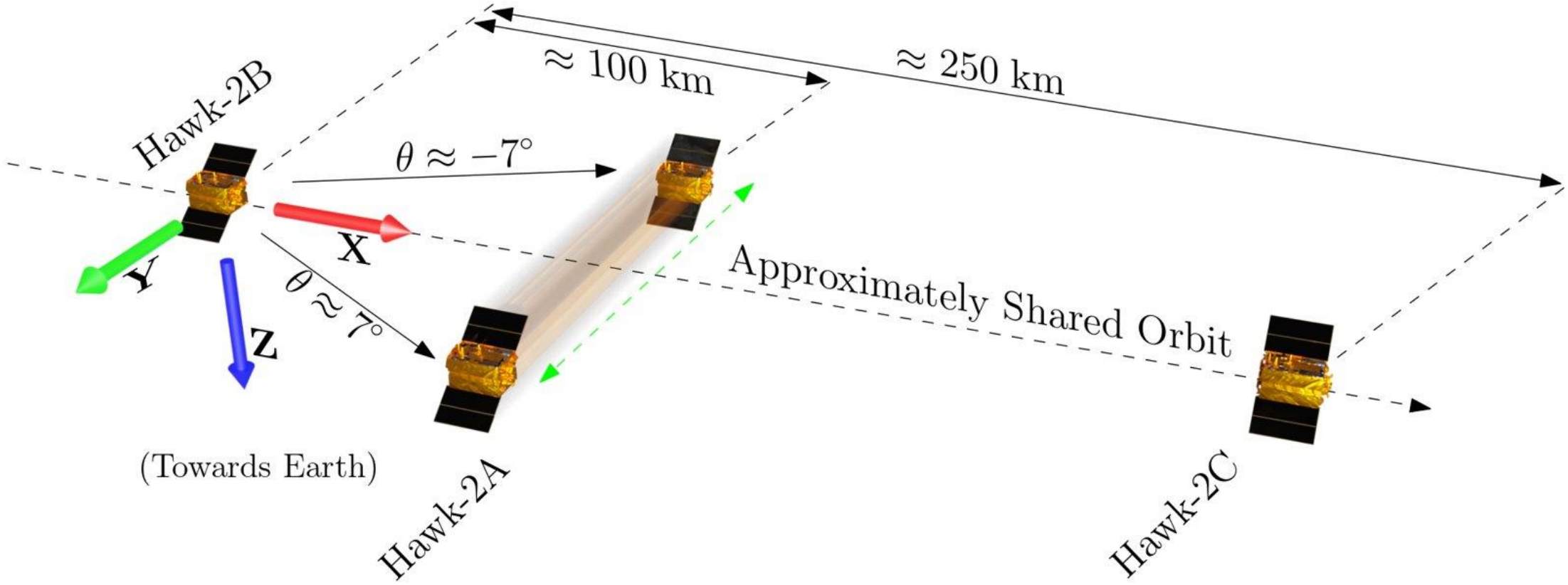
MEO/GEO Satellites
(Hawkeye Chief to Optus10)

Market Needs

- High Data rate links
- Low size and weight
- Security
- Adhere to regulations around interference systems (spectrum coordination)

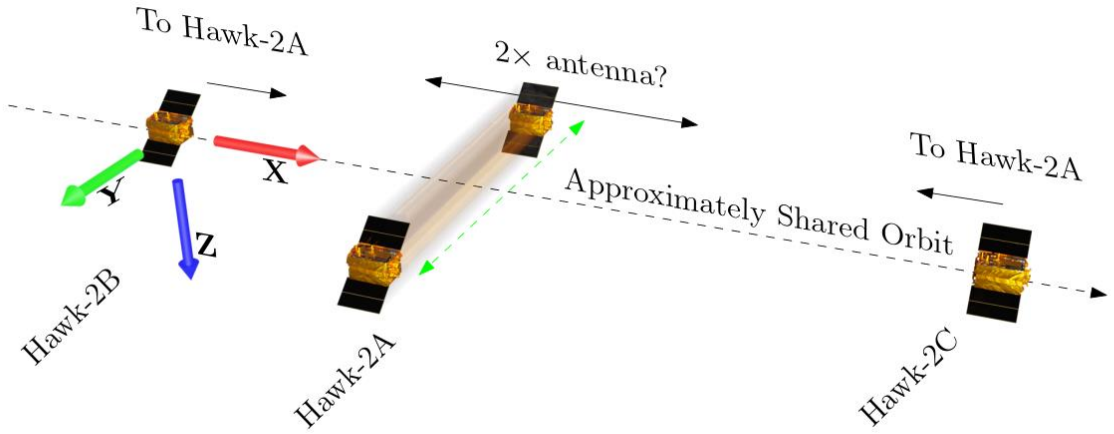
Hawkeye Case Study

- Beam steering required to both deputies
- Azimuth range to Hawk-2A varies over long time periods, but generally between +/-5 and +/- 8 degrees

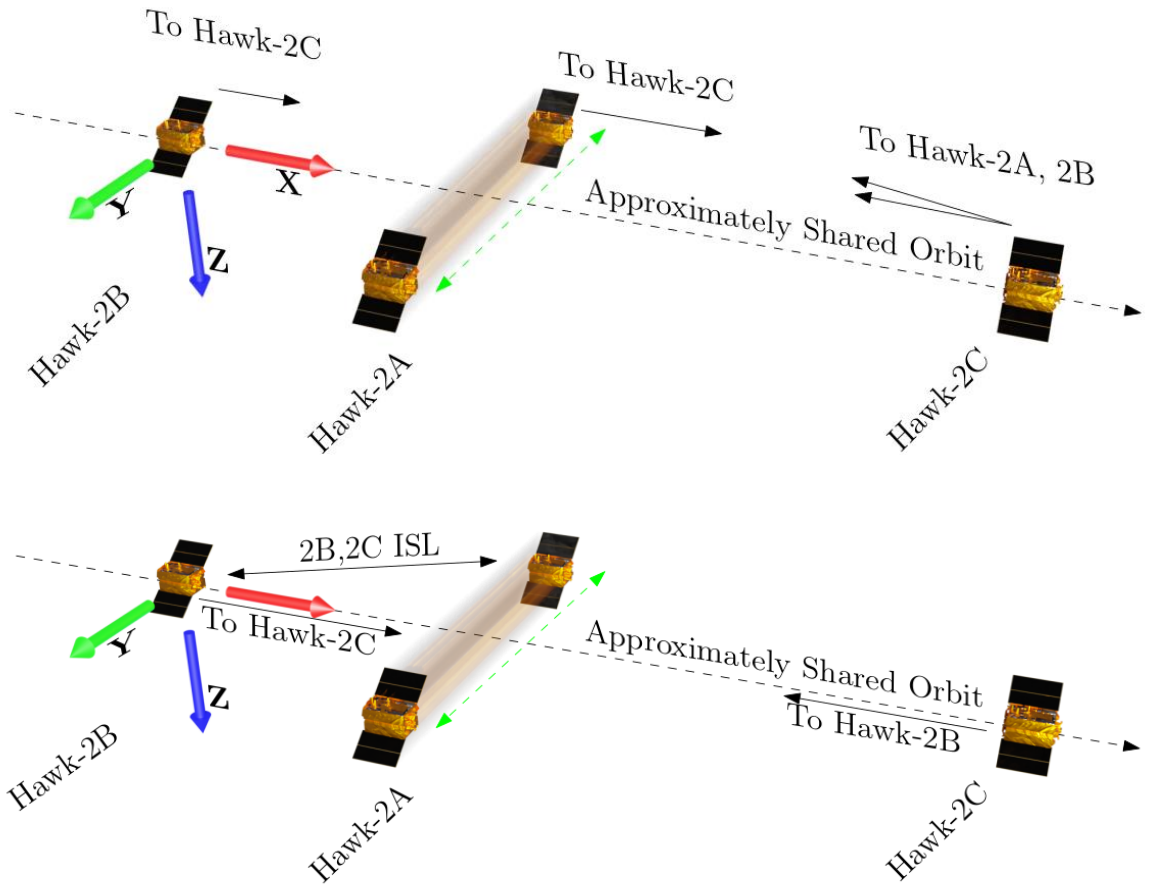


Antenna Mounting

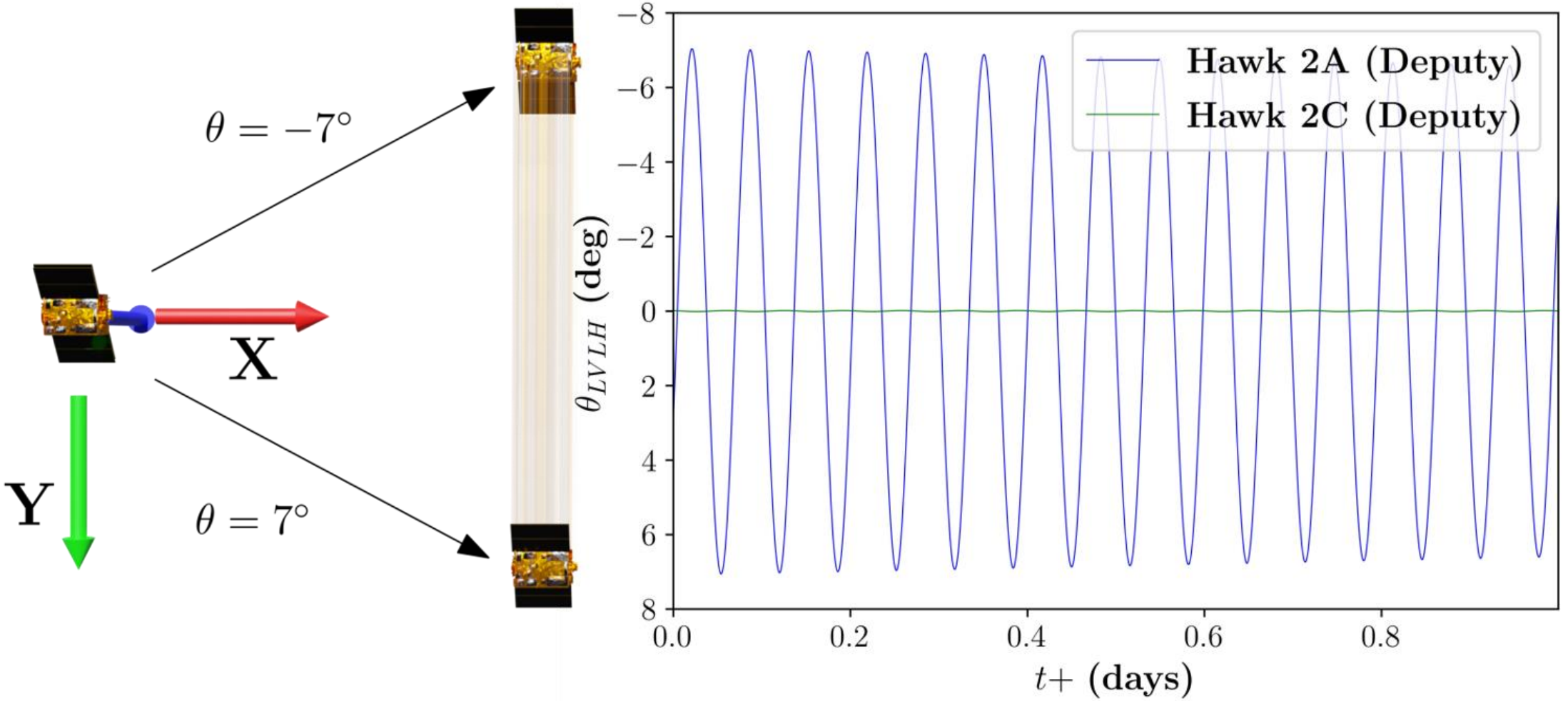
Dual Antenna, Single Beam, Hawk-2A



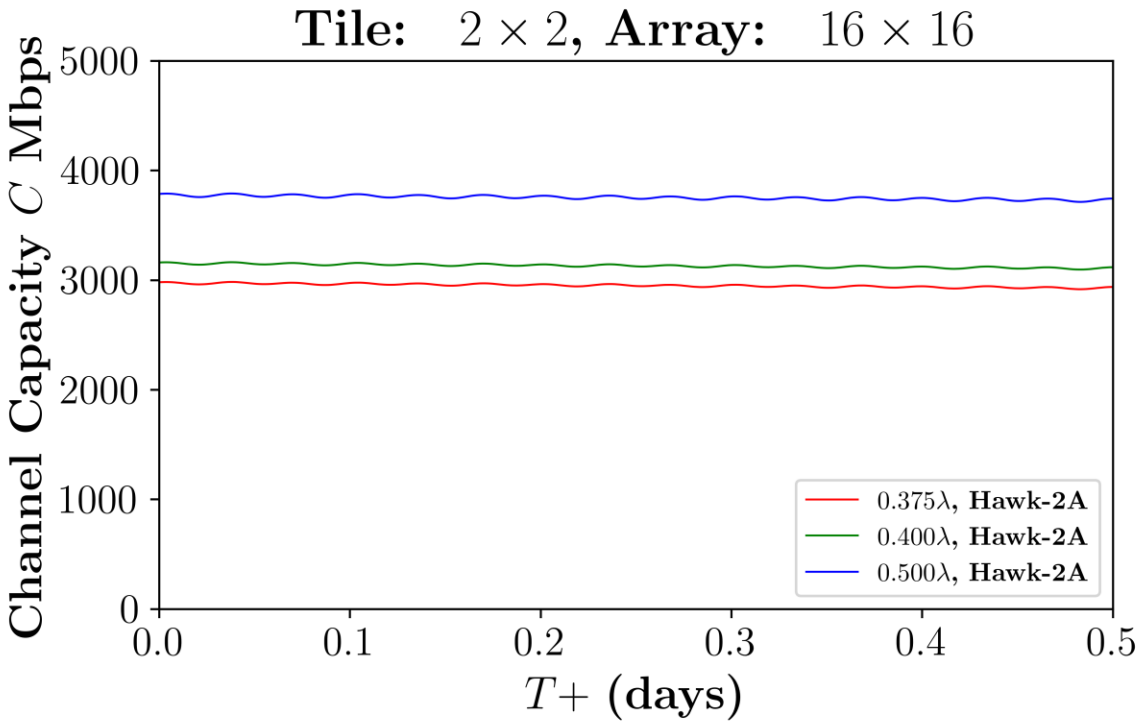
Dual Beam, Single Antenna, Hawk-2C

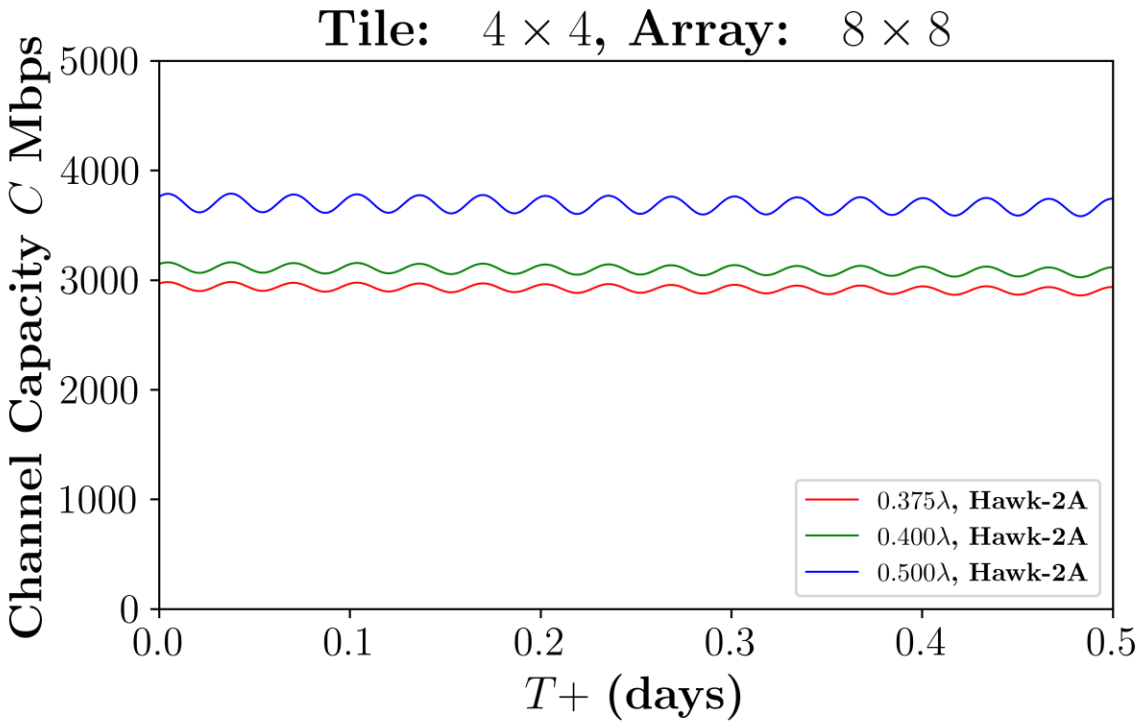


Implications on Tracking and Beamforming



Implications on Channel Capacity





B MHz	P_t W	G_t	G_r	λ	T	$\mathcal{L}_0$	d
500	25	$F(t)$	$F(t)$	≈ 5 mm	700 k	3 dB	$F(t)$

Q&A