Shared Space Infrastructure

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ASMS Conference, Sitges, Feb 28, 2025

Viasat™

Viasat at a glance

$4.5B
FY24 combined revenue*

76
Countries around the world

90+
Offices around the world

40+ years
Enduring value

7k+
Global employees

21
Operational satellites in space

10
Satellites in development

2,500+
Patents

Note: *Combined revenue excluding catch-up litigation settlement

WHY SHARE SPACE INFRASTRUCTURE?

Scaling satellite networks sustainably

- **Sustainable use of finite resources**
  - Space is a commons: “difficult and costly to exclude potential users” and yields “finite flow of benefits”

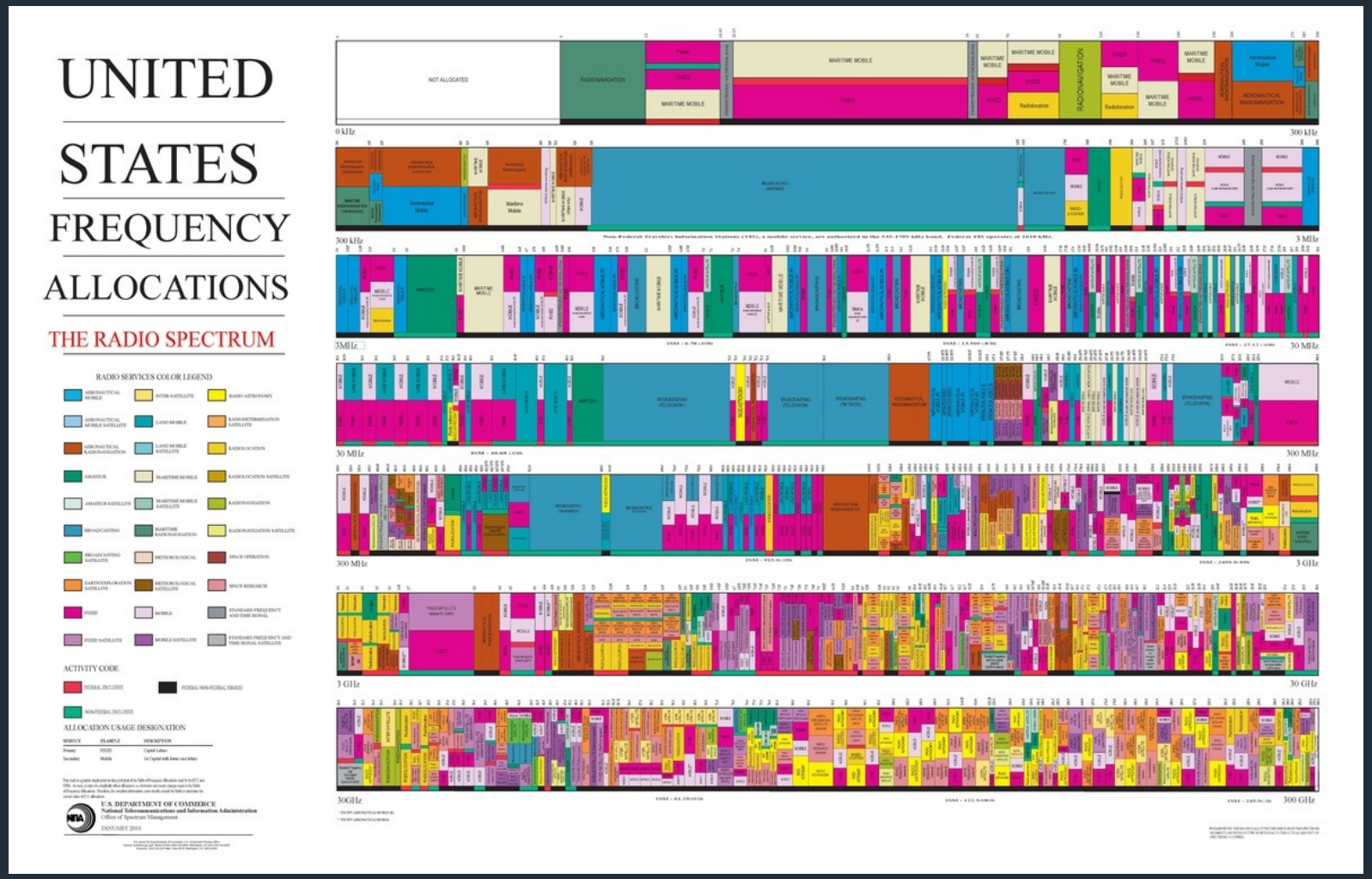
- **Efficient use of capital**
  - Create structures and mechanisms so that a large industry can develop and make collective investments of $$B

Scaling NTN sustainably

- **Efficient use of finite resources**

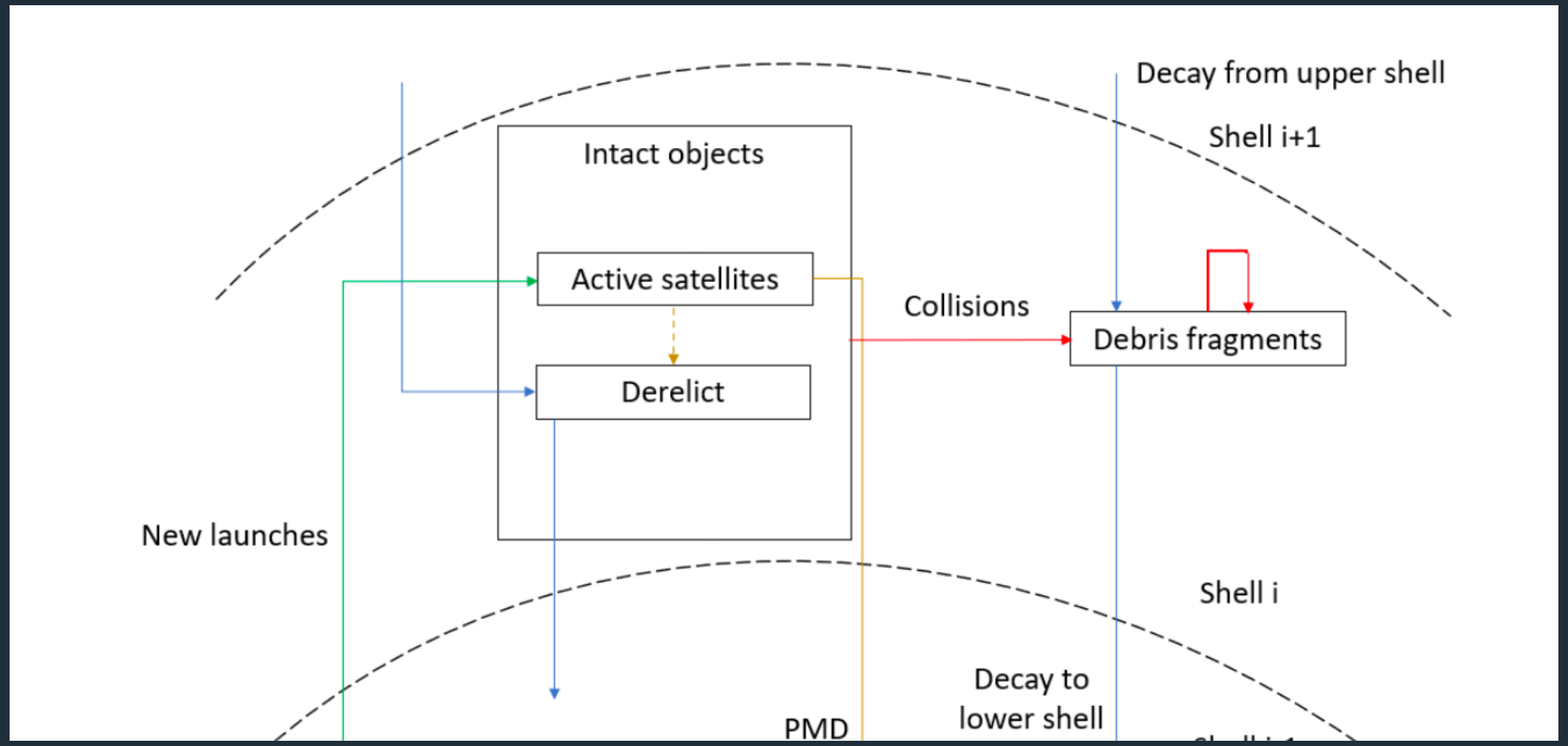
- Efficient use of capital
  - Create structures and mechanisms so that a large industry can develop and make collective investments of $$B

Problem 1: Spectrum is a finite resource: Channel capacity



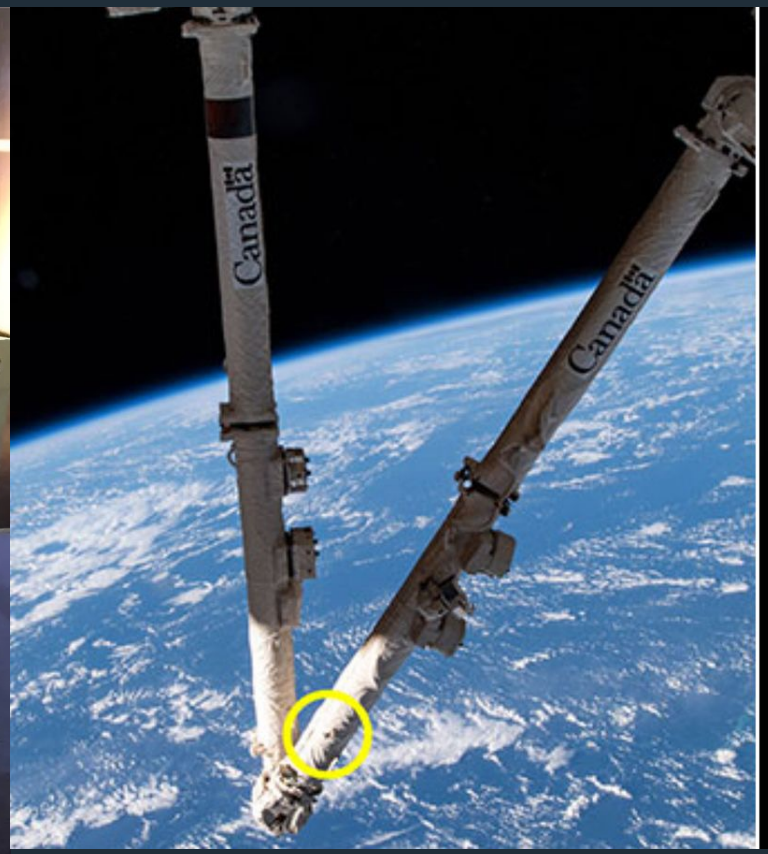
$$C = B \log (1 + S/N)$$

Problem 2: Orbits are a finite resource – Orbital capacity



Ref: D'Ambrosio, A et. al., The capacity of LEO computed using source-sink modeling, physics.space-ph 2022

Problem 2: Orbits are a finite resource – Debris impact

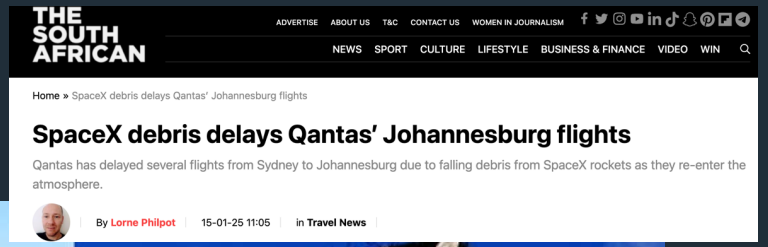


Problem 2: Orbits are a finite resource – Safe disposal?

Poland

Bahamas

Australia



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Home » SpaceX debris delays Qantas' Johannesburg flights

SpaceX debris delays Qantas' Johannesburg flights

Qantas has delayed several flights from Sydney to Johannesburg due to falling debris from SpaceX rockets as they re-enter the atmosphere.

By Lorne Philpot | 15-01-25 11:05 | in Travel News

Problem 2: Orbits are a finite resource -

Residual carrying capacity is a function of satellite mass, area, other parameters

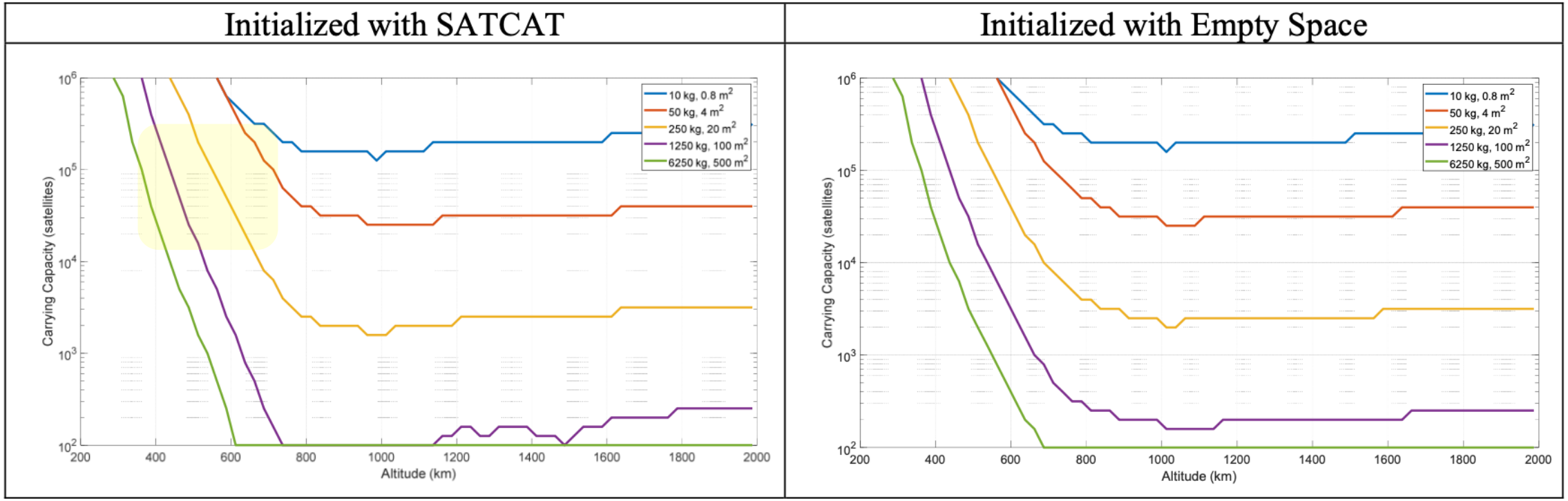
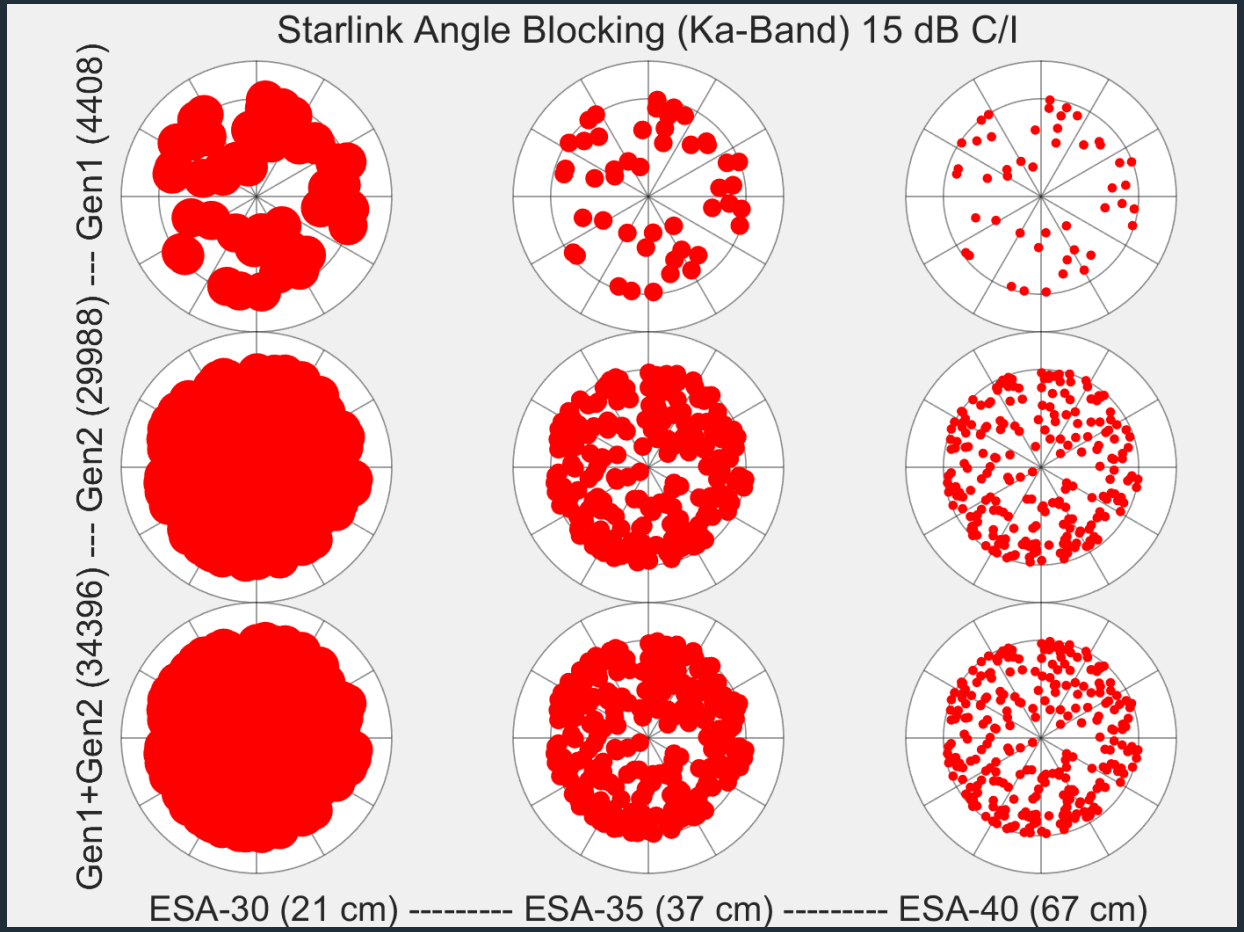


Fig. 10 – RCC Sensitivity to Satellite Mass (kg) with Constant A/M ($m^2 \cdot kg^{-1}$)

Ref: Sturza, M. et. al., LEO Capacity Modeling for sustainable design, AMOS Conference, 2022

Problem 3: Look Angles become limited with mega constellations



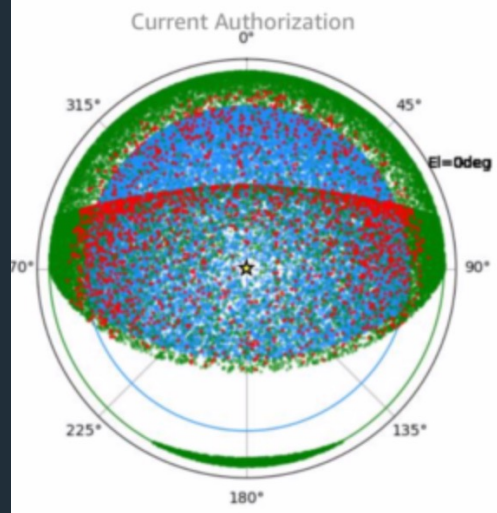
The 30, 35, and 40 are the nominal gains in dB corresponding to the diameters shown in the plots.

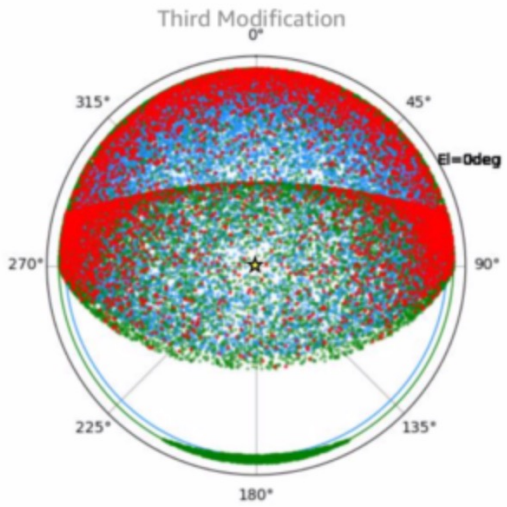
Ref: from USASAT-NGSO-3X ITU filing from USA for Starlink Gen2.

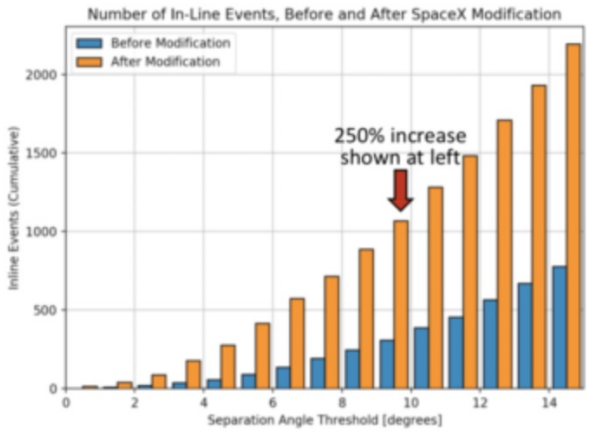
Problem 3: Look angles - cause in-line events

MOD #3 CAUSES SIGNIFICANTLY MORE IN-LINE EVENTS

(BETWEEN KUIPER AND ACTIVE SPACEX SATELLITES)







- ☆ Earth Station located at 40N
- SpaceX Satellite
- Unaffected Kuiper Satellite
- Affected Kuiper Satellite (i.e. Inside the interference cone of an active SpaceX satellite)

By reducing its minimum elevation to 25°, doubling the number of "active" satellites, and reducing its satellites' altitudes, the number of in-line interference events is increased by 250% in this case.

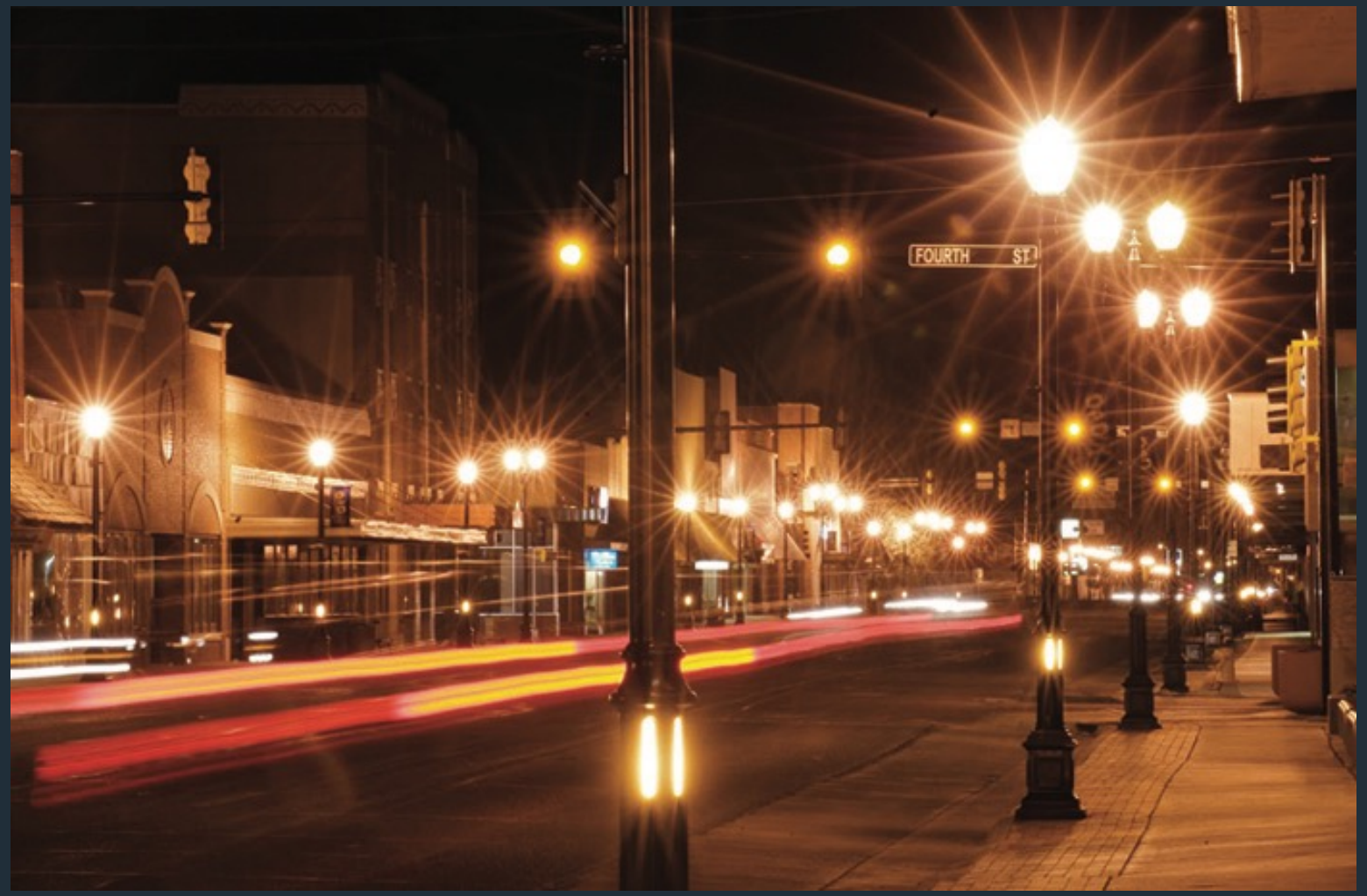
The increase in in-line events causes a significant interference problem and reduces the number of available Kuiper satellites.

Using the same separation angle threshold for before and after is a conservative assumption, as SpaceX's altitude reduction will increase the necessary separation angle.

Ref: https://wccftech.com/spacex-starlink-altitude-concession-system-change-amazon/

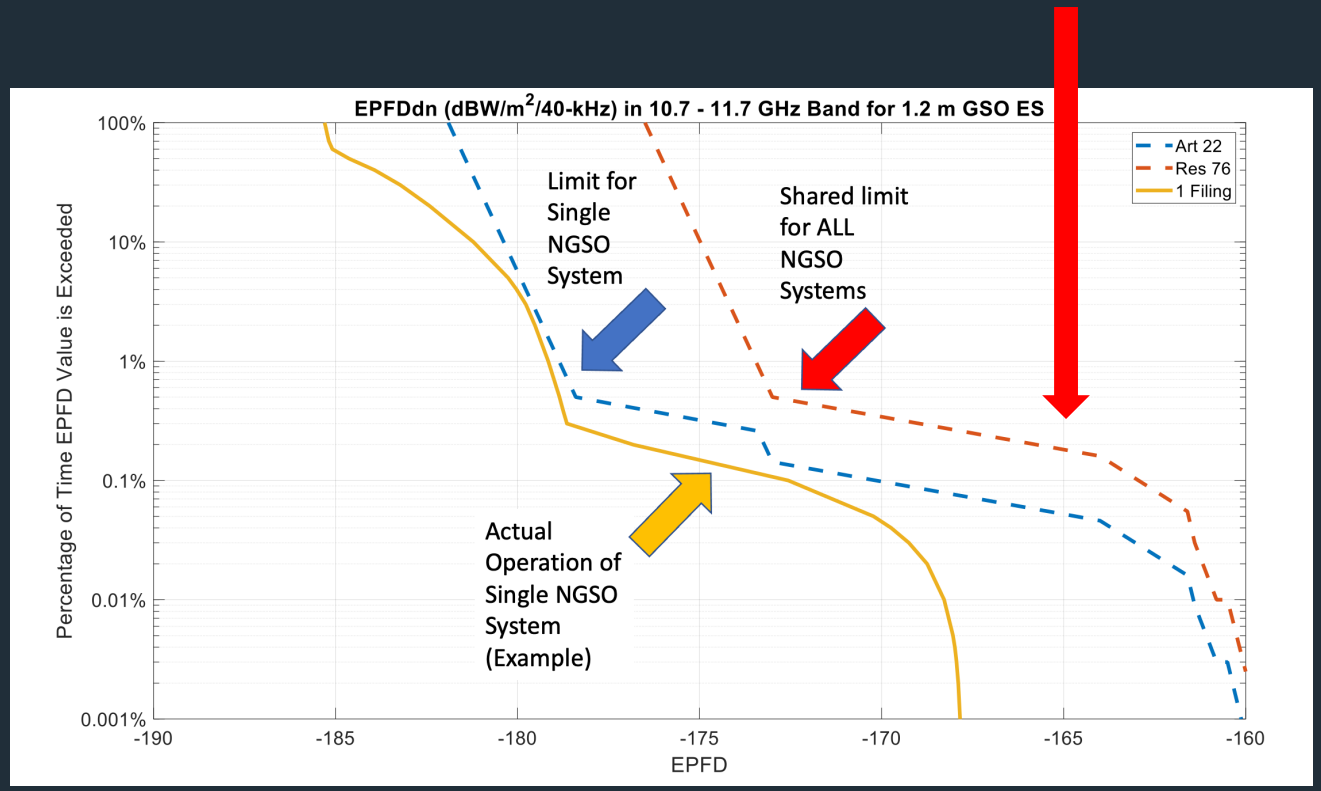
Problem 4: EPFD from LEOs can overwhelm GEOs

Analog - Distant starlight is overwhelmed by the collection of streetlights

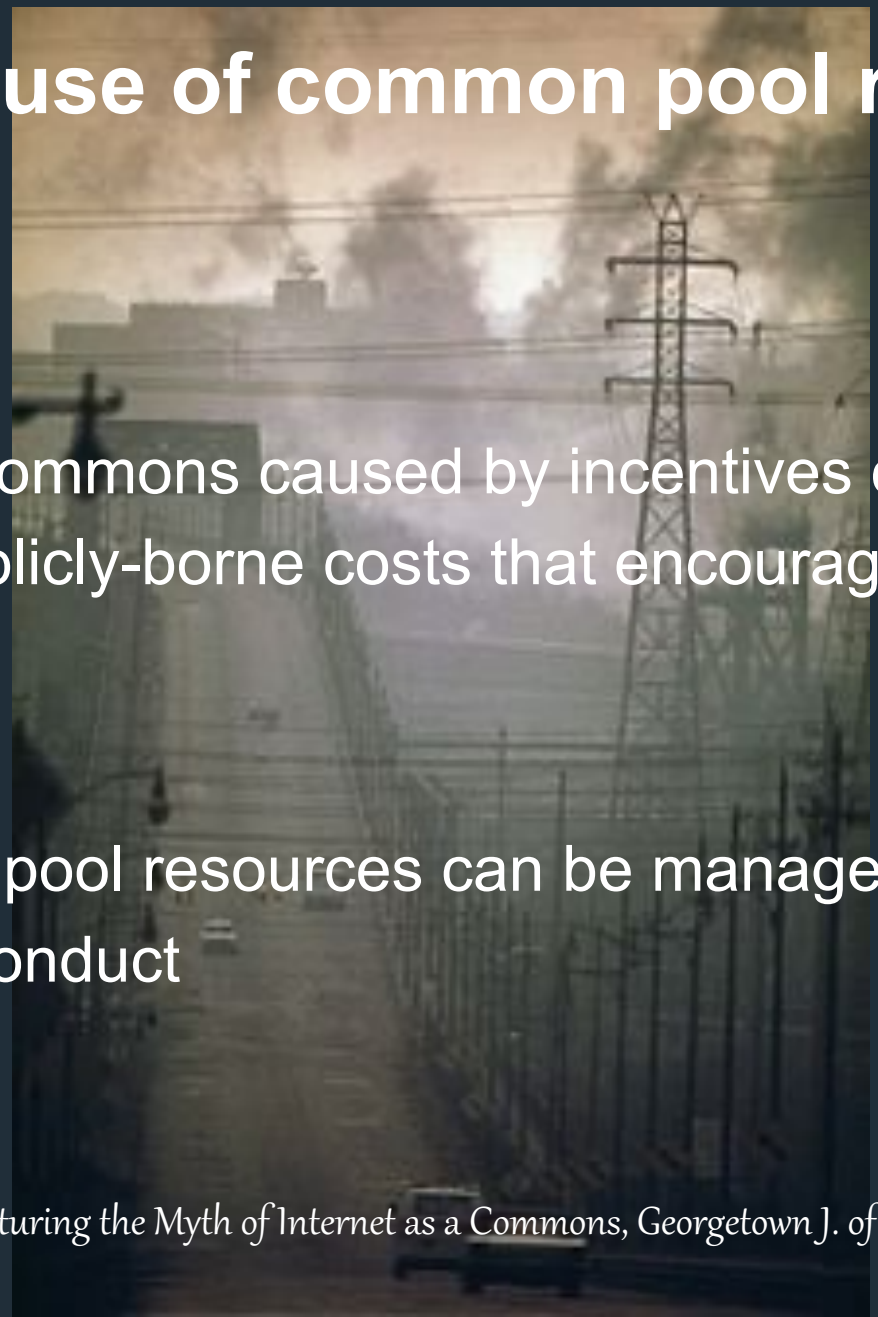


Problem 4: EPFD impact ... First come first served?

Two constellations together claim 86% of the EPFD allowance for ***all NGSOs in the world***



Mechanisms for use of common pool resources ?



Hardin: Destruction of commons caused by incentives created by privately-realized profits and publicly-borne costs that encourage a lack of restraint in consumption.

Ostrin: Maybe common pool resources can be managed better by creating and applying rules of conduct

Ref: Raymond, M, Puncturing the Myth of Internet as a Commons, Georgetown J. of Intl. Affairs, 2013

Scaling NTN sustainably

- Sustainable use of finite resources

- **Efficient use of capital**
  - Create structures and mechanisms so that a large industry can develop and make collective investments of $$B

Terrestrial infrastructure sharing

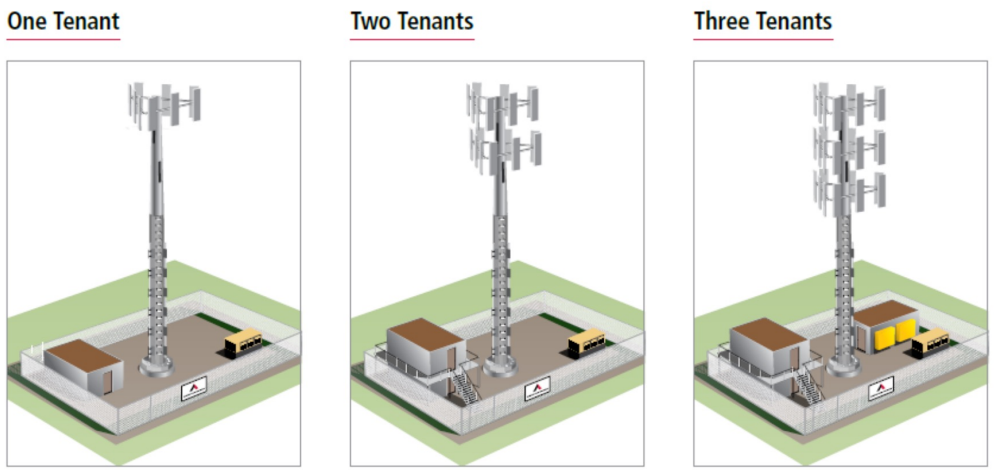
Successful model in terrestrial networks

- **Passive sharing**
  - Site sharing
  - Backhaul sharing
- **Active Sharing**
  - MORAN
  - MOCN
  - CN Sharing
- **Roaming**

Terrestrial and Space Tower Companies

Sharing infrastructure to manage costs

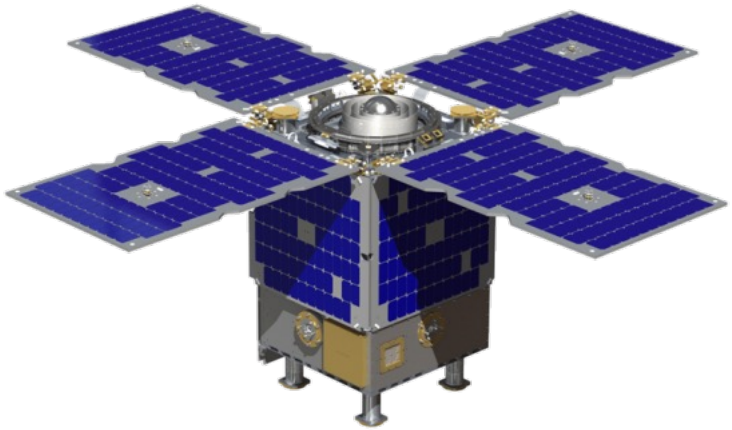
Revenue Growth: Tower Leasing



Adding additional tenants, equipment and upgrades yields additional revenue, while costs remain relatively flat

Source: American Tower Investor Q2, 2023

Shared space infrastructure?

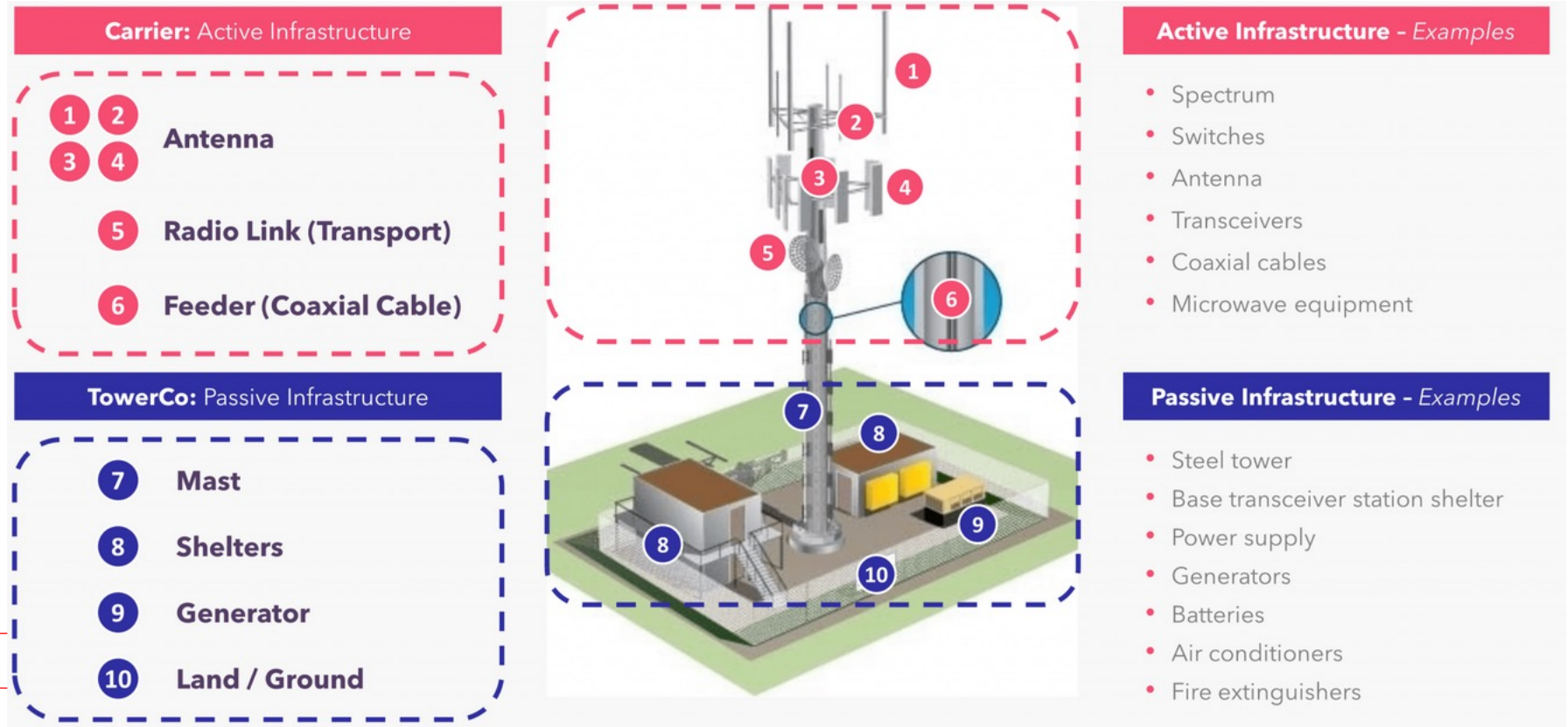


L-band tenant

S-band tenant

What does a TowerCo and Network Operator Own?

”Multi-Operator RAN” (MORAN) – like



Spectrum

Payload
(user-link)

Bus
(structure, power, thermal, feeder-link)

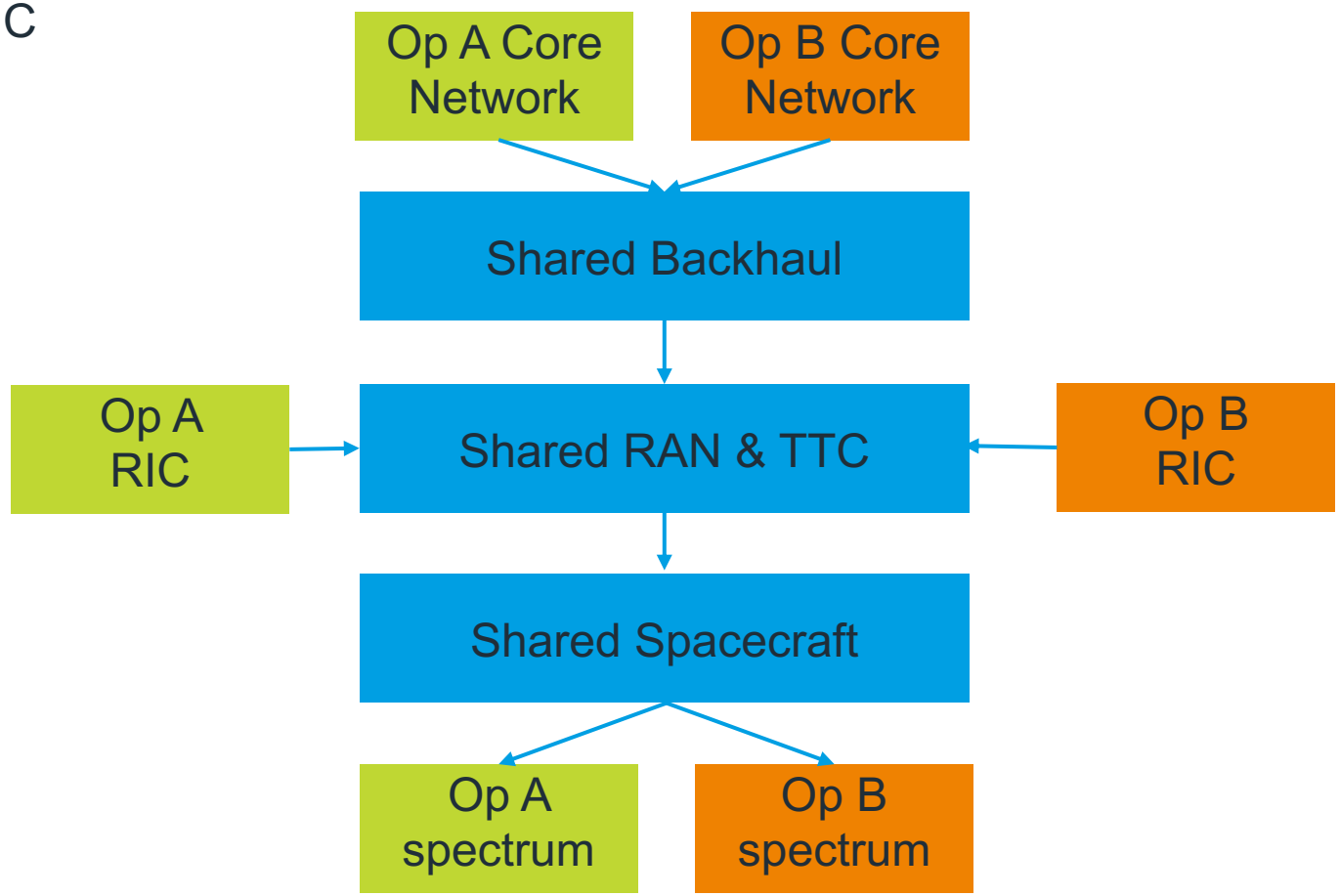
Orbital location

Blue is the space infrastructure equivalents

Source: Dgtl Infra, Real Estate 2.0

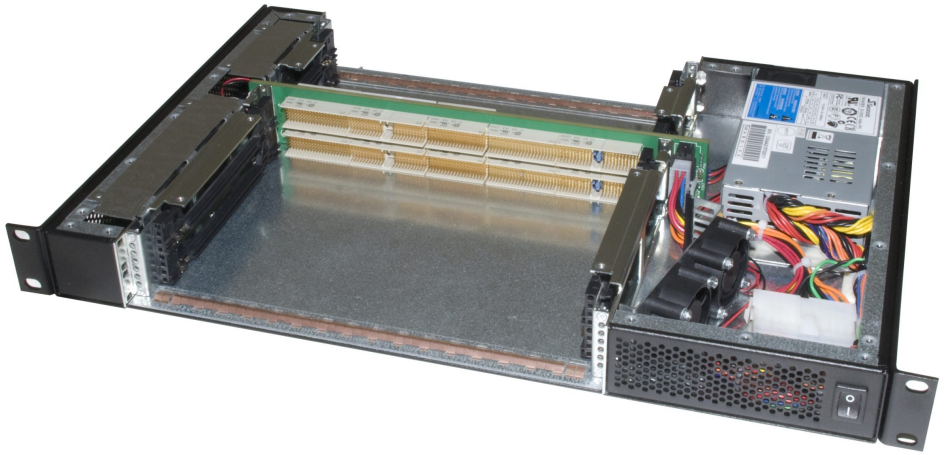
Infrastructure sharing

- Open RAN interfaces with RIC
- Slicing ?



Open ecosystem for satellites

Could PC industry serve as a model for individual satellites?

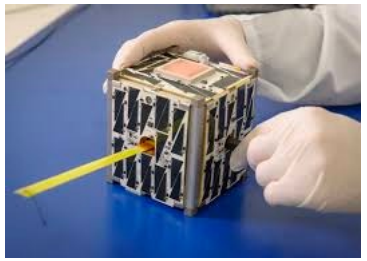


”Bus” provides power, cooling and motherboard,

:”Payloads” are PC cards with PCI interfaces

Example: “Standards” (open) for individual satellites

Cubesat (NASA)

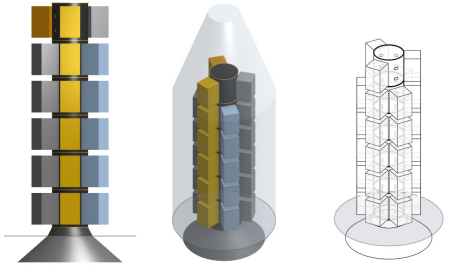


Bus??

- Structure
- Mechanisms
- Power
- Propulsion
- Guidance, Navigation & Control
- Flight computer/software
- Thermal
- Comms (TT&C)

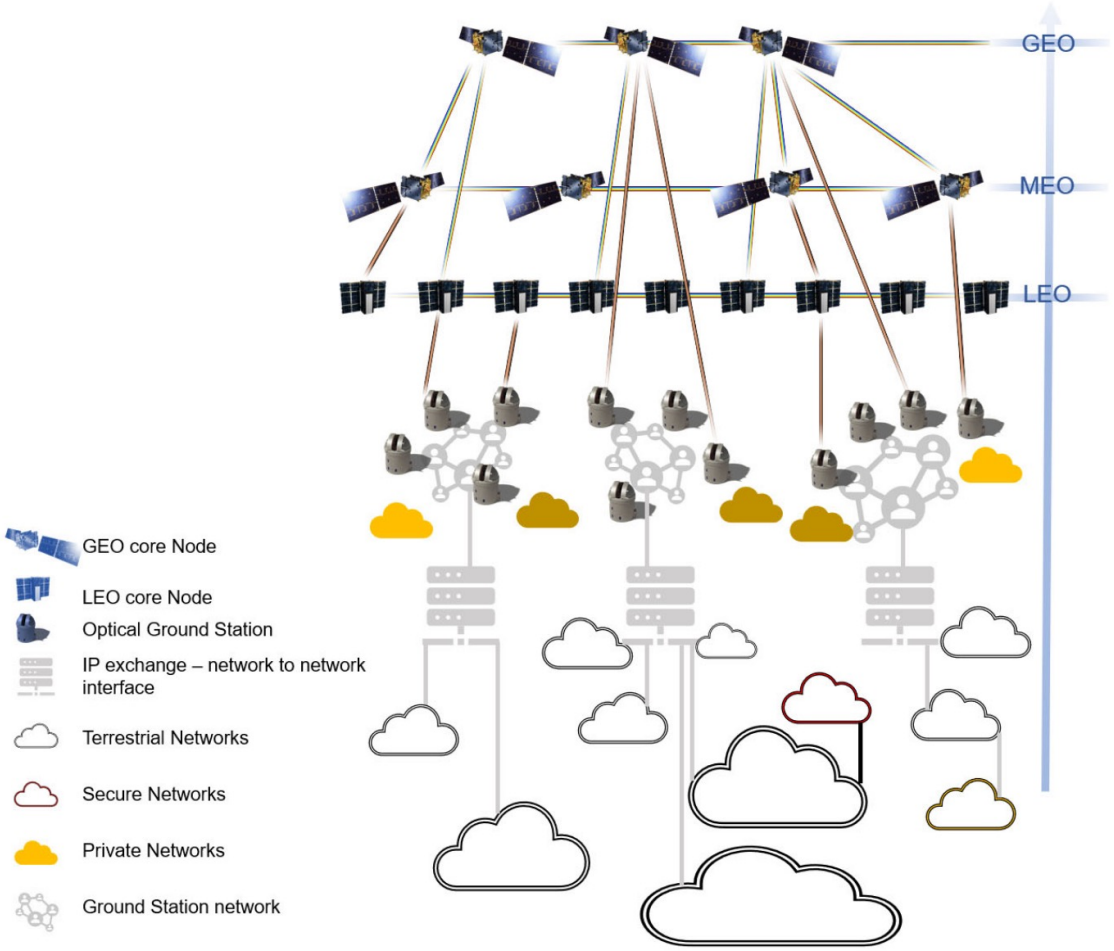
ESPA Ring (NASA)

Dispenser ??



“Pluggable” satellites in a constellation:
Using orbits efficiently

- **Ground-Space links**
  - Feeder links (to and from space); OGSL
  - User links (3GPP/NTN) (to and from space)
- **Intersatellite links**
  - SDA – OISL
  - ESTOL
- **Layer 2/3 networks in space?**
- Security needs to be a first-class citizen



Viasat

Summary

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