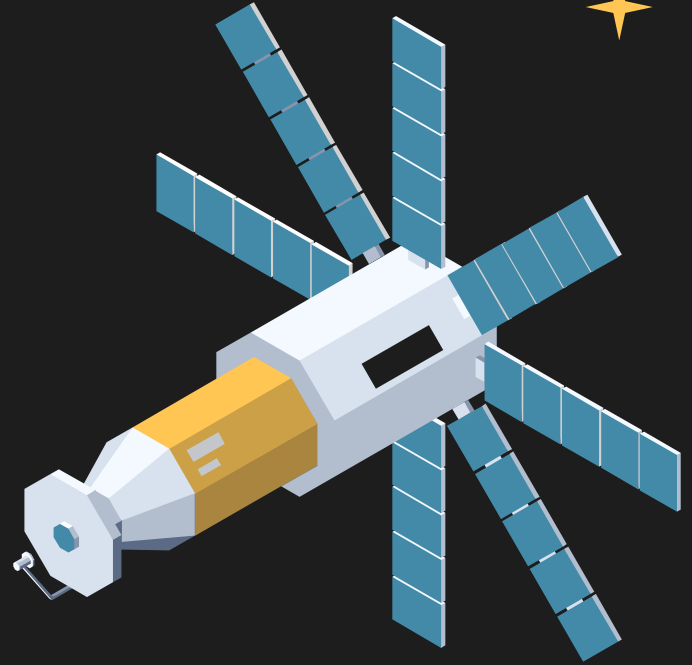


SPCE 402: Satellite Instrument

Ben - Starlink & Radios , the good the bad and the ugly



Motivation

In a chat a bit ago Yvette expressed how Starlink has been polluting scientific data.

I knew starlink wasn't all sunshine and rainbows

But I didn't know how bad it really was

So this first project is my attempt at finding out just how bad it is.

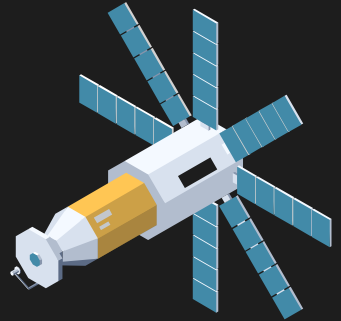


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We communicate A LOT



And it's a big World

Paper Messaging, slow postal
service,
delay after delay after delay



So we turned to the sky

Since July 26, 1963 with Satcom

3



When might I use this Technology?



Away from home

You may find yourself
living in a shotgun shack



Travelling

And you may find yourself
in another part of the
world



Driving

And you may find yourself
behind the wheel of a
large automobile



So you might ask yourself How did we get here?

Traditional land based communications
are prone to failure.
Used to be slow and frustrating
Are expensive to upgrade and continue
to distribute



Fiber optic Friday

So we turned to space
GeoStationary Satellites acted
like a big repeater, shouting
things back down to Earth with
little to no processing

This was cheap and worked !
(kinda)



The good Ol' Days

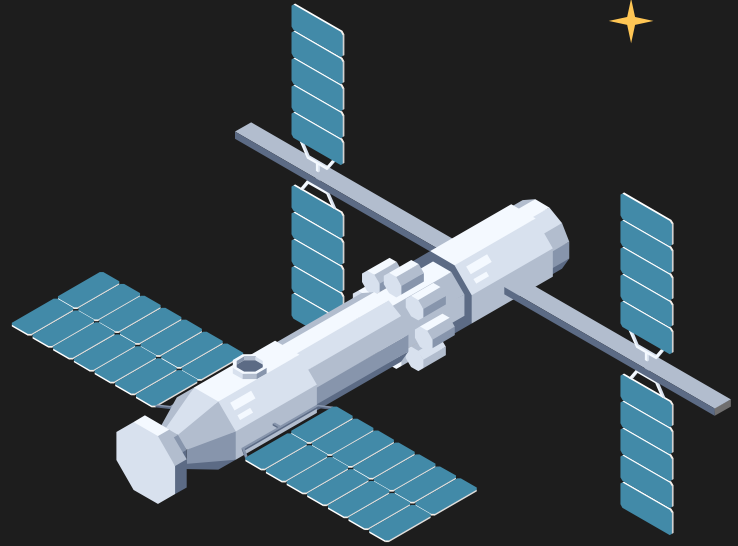
1 second round trip ? that's great !

- ★ Maybe for instructions
- ★ But try have a phone call with a 1 second delay
- ★ Might just struggle a little

In the world of engineering

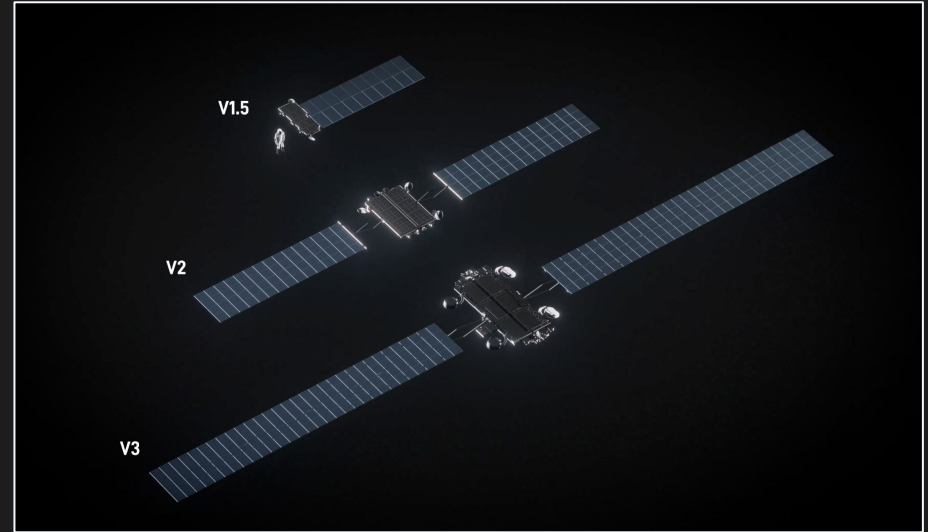
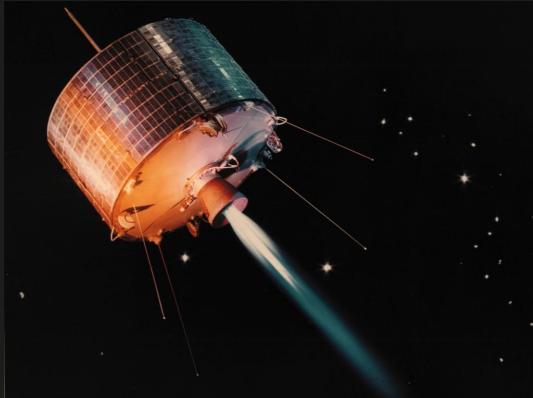
There is no such thing as being Cheap, Quick AND Good

So we had to adapt



Design Evolution

From the simple box with an antenna we started with,
We've moved towards pancake looking marvels of engineering.



Beam Geometry: GEO Bent-Pipe vs. LEO Phased-Array Downlink

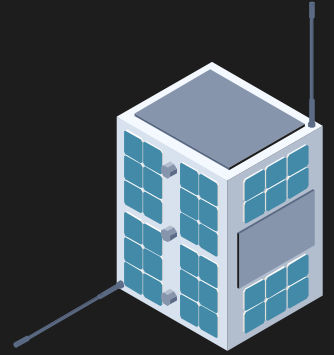
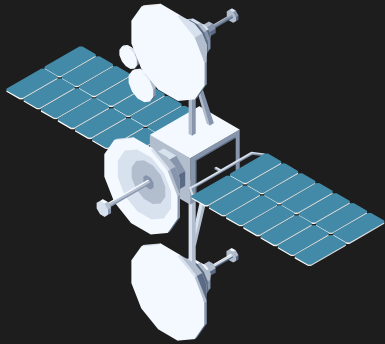


Fig. 1 — A bent-pipe GEO satellite illuminates one static footprint; a LEO phased array reforms several narrow, steerable beams every few microseconds.

But this beam forming isn't perfect...

Whoa!

But what's the problem?





~10 million x brighter

Than what LOFAR is looking for

32x

Worse with the second Generation



**We don't know what
G3 will do**



The ugly issue:



The 2024 follow-up (Bassa et al.) found the newer V2-mini satellites emit up to 32× stronger UEMR than the first generation...

So the problem is getting worse with each hardware refresh,

Right as the constellation is scaling into the tens of thousands.

Connecting remote communities is a real good thing,

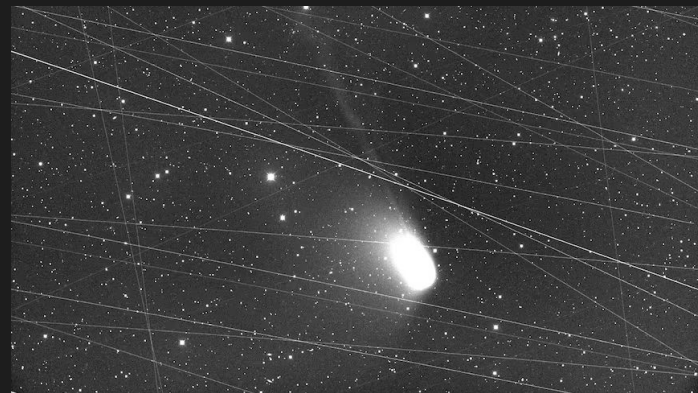
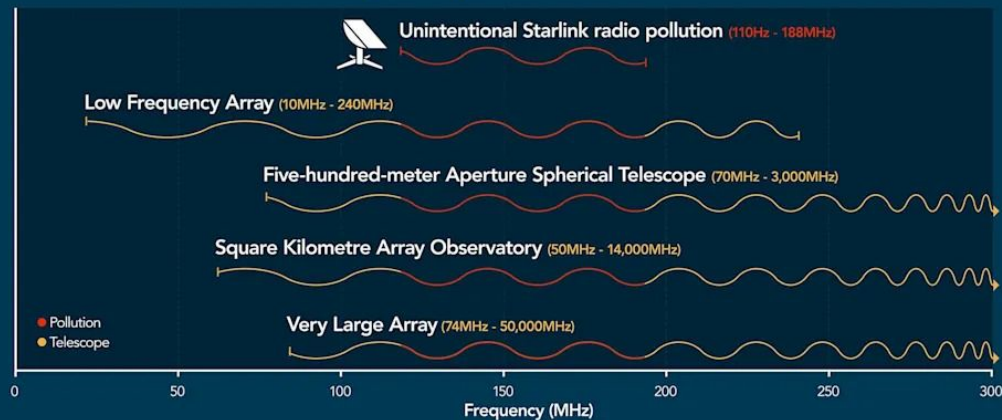
but it's not free

it's currently being paid for by a field (radio astronomy) that has no seat at the table and no mechanism to bill for it.



Overlap in Starlink radio pollution and radio astronomy frequencies

LIVESCIENCE



Rolando Ligustri took this early image of Comet C/2023 A3 (Tsuchinshan-ATLAS) on Aug. 1 from Italy, total of 20 minutes of exposure time. (Rolando Ligustri)

References



[1] F. Di Vruno, B. Winkel, C. G. Bassa, G. I. G. Józsa, M. A. Brentjens, A. Jessner, and S. Garrington, "Unintended electromagnetic radiation from Starlink satellites detected with LOFAR between 110 and 188 MHz," *Astronomy & Astrophysics*, vol. 676, A75, 2023.



[2] C. G. Bassa, F. Di Vruno, B. Winkel, G. I. G. Józsa, M. A. Brentjens, A. Jessner, and S. Garrington, "Bright unintended electromagnetic radiation from second-generation Starlink satellites," *Astronomy & Astrophysics*, vol. 689, L10, 2024.



[3] X. Zhang, P. Zarka, C. Viou, et al., "Broadband polarized radio emission detected from Starlink satellites below 100 MHz with NenuFAR," *Astronomy & Astrophysics*, vol. 698, A244, 2025.



[4] F. H. Wainscott, "The Syncom III Launch," NASA Goddard Space Flight Center, Greenbelt, MD, USA, NASA Tech. Note TN D-3377, 1966.



[5] S. Marek, "GEO Satellite Internet From HughesNet and Viasat Can't Compete With LEO Starlink in Speed or Latency," *IEEE ComSoc Technology Blog*, Jul. 18, 2025. [Online]. Available: <https://techblog.comsoc.org/2025/07/18/geo-satellite-internet-from-hughes-net-and-viasat-cant-competite-with-leo-starlink-in-speed-or-latency/>



Thanks!

Do you have any questions?

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