

Satellite Broadband in the Asia Pacific

Panel Session

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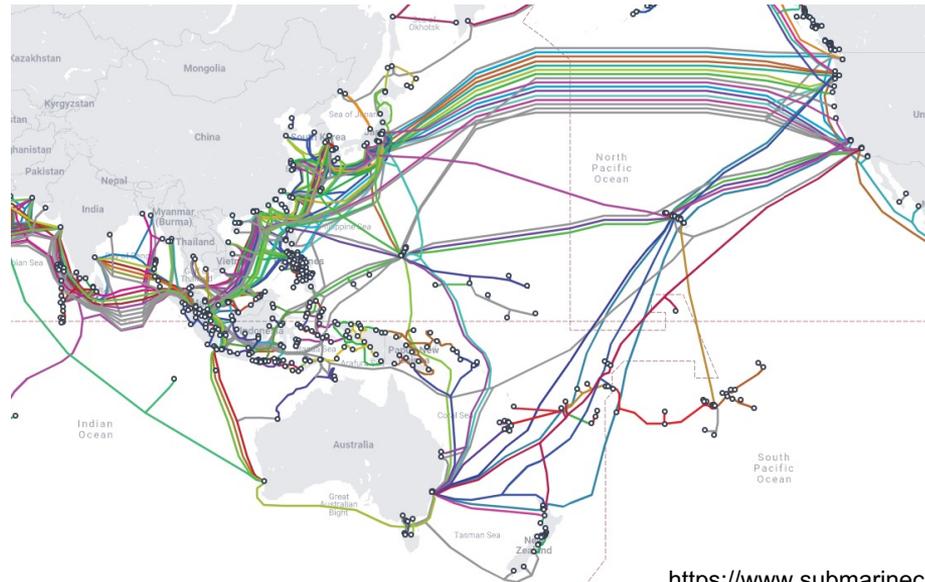
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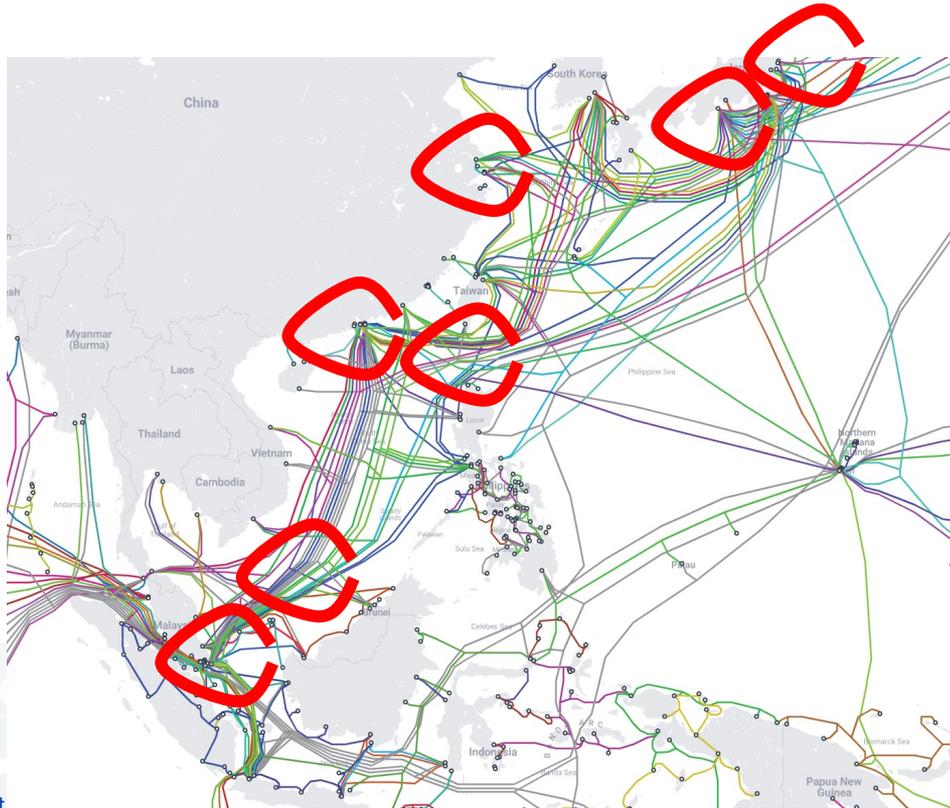


Why use Satellite services?

We have deployed so much undersea fibre in the past couple of decades! Why does the region need more capacity?



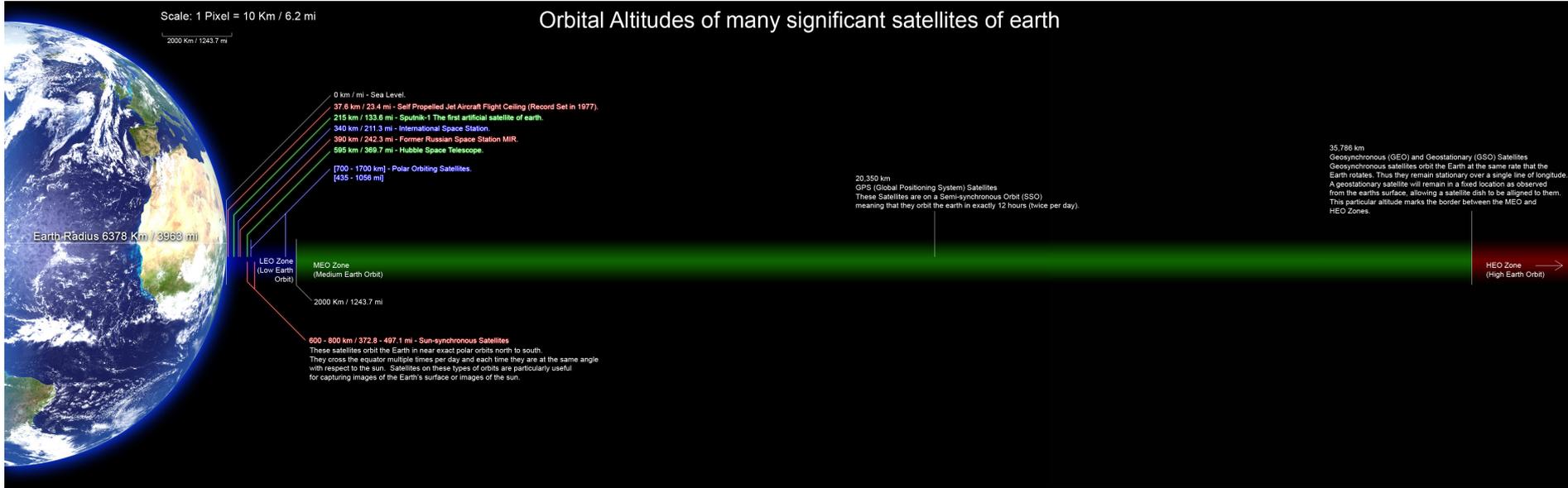
Submarine Route Choke Points



Hazards for submarine cables include:

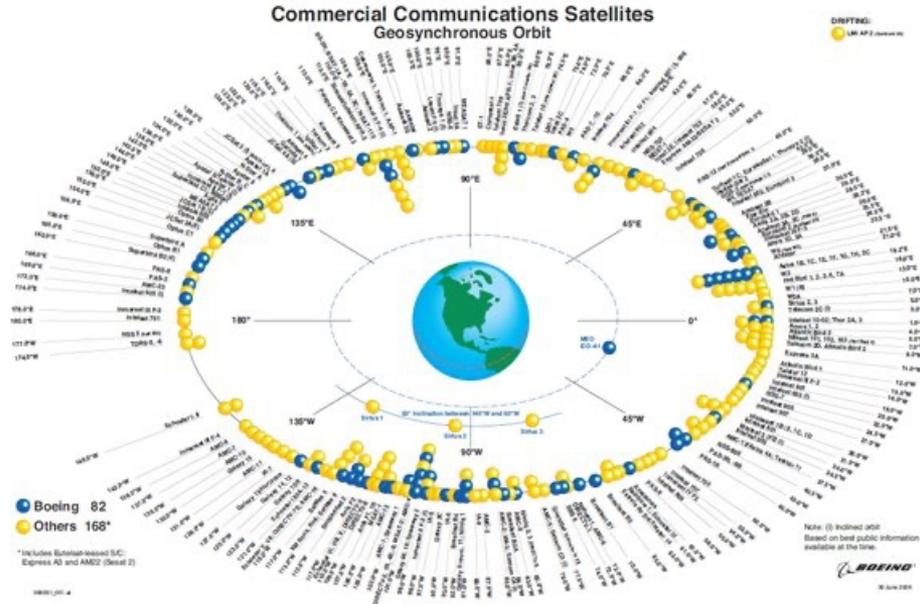
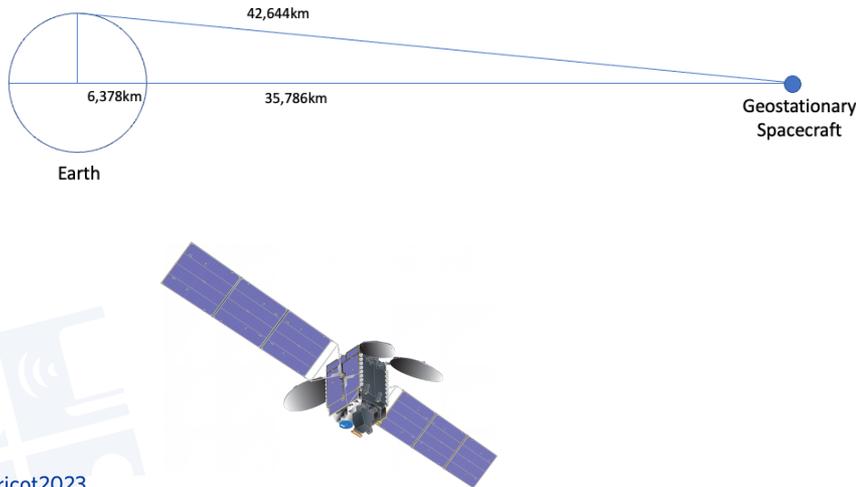
- Landings at busy port locations (Singapore, Hong Kong)
- Shallow water (South China Sea)
- Active Plate boundaries (Luzon Strait, Japan East Coast, Sunda Arc)
- Political Tensions (Hong Kong, Shanghai, South China Sea)

Satellites: GEOs and LEOs



Geostationary Earth Orbit

- At an altitude of 35,786km a satellite will orbit the earth with the same period as the earth's rotation – from the earth it will appear to be stationary in the sky



GEO Services

- Requires earth station investment
- Limited capacity
 - Limited orbital slots
 - Constrained frequency allocation
- High delay
 - Challenging for network use
- Remote Reach

Low Earth Orbit

Earth Radius 6378 Km / 3963 mi

- 0 km / mi - Sea Level.
- 37.6 km / 23.4 mi - Self Propelled Jet Aircraft Flight Ceiling (Record Set in 1977).
- 215 km / 133.6 mi - Sputnik-1 The first artificial satellite of earth.
- 340 km / 211.3 mi - International Space Station.
- 390 km / 242.3 mi - Former Russian Space Station MIR.
- 595 km / 369.7 mi - Hubble Space Telescope.
- [700 - 1700 km] - Polar Orbiting Satellites.
[435 - 1056 mi]

LEO Zone
(Low Earth Orbit)

MEO Zone
(Medium Earth Orbit)

2000 Km / 1243.7 mi

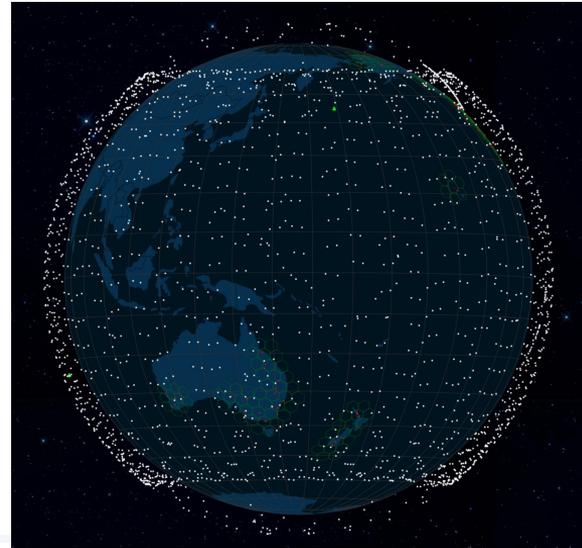
600 - 800 km / 372.8 - 497.1 mi - Sun-synchronous Satellites
These satellites orbit the Earth in near exact polar orbits north to south. They cross the equator multiple times per day and each time they are at the same angle with respect to the sun. Satellites on these types of orbits are particularly useful for capturing images of the Earth's surface or images of the sun.

Leo Services

- Historically high launch costs
 - This has changed significantly with SpaceX reusable launch vehicles
- High angular velocity, small footprint
 - Requires active tracking and inter-satellite handover
 - Requires a large constellation to provide continuous service
- Regulatory hurdles
 - Terrestrial licenses

LEO Constellations: Starlink

- 3,773 satellites, 3,129 in service (Planned total: 12,000)
- inclined orbit (53°), 550km
- Retail Services
- Satellite-to-Satellite coming with V2 satellites



LEO Constellations: Oneweb

- 542 operational satellites (planned total: 648)
- polar orbit, altitude: 1,200km, business and government clients



LEO Constellations: Project Kuiper (Amazon)

- Currently still in planning
- 3,276 planned satellites, altitude: 590km, 610km, 630km
- Planned retail services

Others

- China?
- Others?

LEOs

- It's a big money play, and without the ability to make head roads into high value service markets its probably an exercise with no prospect of a positive cash flow
 - Remember Iridium?
 - And Oneweb has already gone bankrupt once!
- Is this a niche market or a massive game changer for terrestrial access services?

Today's Panel

- Dan York, ISOC – overview of issues and concerns
- Mike Puchol, Africa Rural and Remote – challenging environments in Africa
- Debopam Bhattacharjee, Microsoft Research – model of satellite-to-satellite SDN routing
- Dr Ulrich Speidel, Univ Auckland – Pacific Experiences with satellite services

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