



# DIGITAL OUTLOOK

Auditorium, MCMC Tower 1 | 29 October 2024 [ SERIES 2024 ]  
Cyberjaya | 8:30am - 1:30pm

## ORBITING INNOVATIONS:

Unveiling the Future of Satellite Communications



Windsor  
Place  
Consulting

## Exploring the Value of LEOs including D2D Connectivity

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*Cyberjaya*

29 October 2024

# Agenda

The Agenda for today's presentation is the following:

1. Introduction
2. Background on space economy and orbital launches
3. Exploring LEOs and D2D issues
4. Use of satellite D2D for emergency services
5. Concluding remarks
6. Epilogue: 6G Non-terrestrial networks (NTN) project

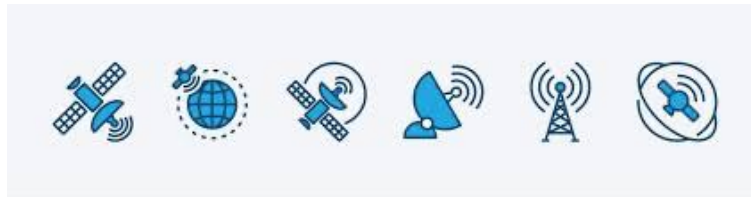


# 1. Introduction– LEOs in context (1)

Beyond the traditional use of GEO (and low earth orbit (LEO)) satellite services for disaster response and recovery and redundancy utilising GEOs and LEO satellite connectivity to improve backhaul capacity and coverage in both the under and unserved areas of the country is increasingly become very viable. LEOs in particular become increasingly important as they offer low-latency, high-speed internet connectivity.

Such connectivity can be used in at least three ways – namely to:

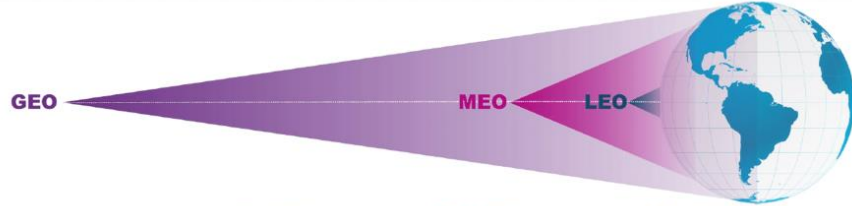
- i. Single site connectivity to say a community centre or school with Wi-Fi;
- ii. Use of the GEO/LEO satellite to provide backhaul connectivity for a terrestrial cellular base station; and
- iii. Individual mobile connectivity via the use of **non-terrestrial networks (NTNs)/ Supplemental Coverage from Space (SCS)/Direct to Device (D2D)** services especially for remote locations (eg islands) and for emergency situations



# 1. Introduction– GEO, MEO and LEO satellites (2)

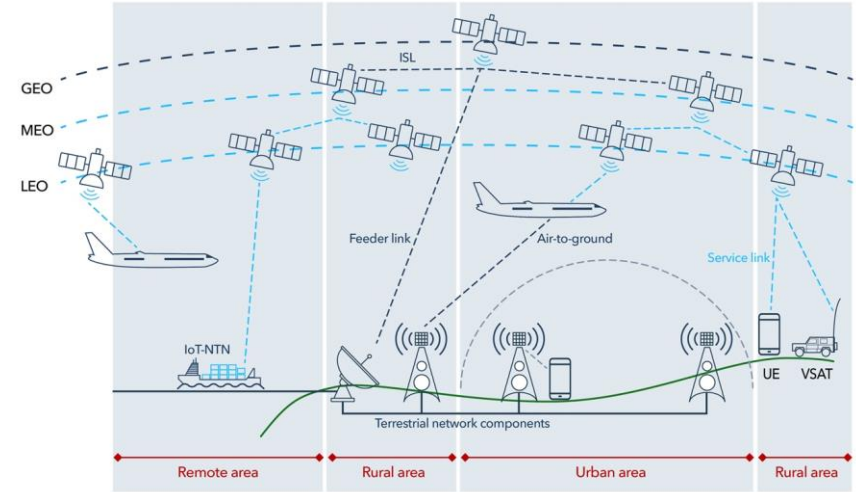


## GEO, MEO and LEO Satellites



	<b>GEO (~36,000 km)</b>	<b>MEO (~8,000 km)</b>	<b>LEO (~1,000 km)</b>
<b>Latency</b>	Medium (~700 m/s)	Low (~150 m/s)	Very low (~50 m/s)
<b>Network size for global services</b>	3 satellites (99% coverage)	6 satellites (96% coverage)	Thousands of satellites (100% coverage)
<b>Data gateways required</b>	Few, fixed	Several, flexible	Numerous, local
<b>Technology readiness level</b>	Proven, deployable technology	Proven, deployable technology	Technology still in development for satellite internet
<b>Cost to deploy network</b>	\$1 - 1½bn	Approx. \$1½bn	\$5 - 15bn
<b>Satellite design life (replacement cycle)</b>	15 years	12 years	5 - 7 years

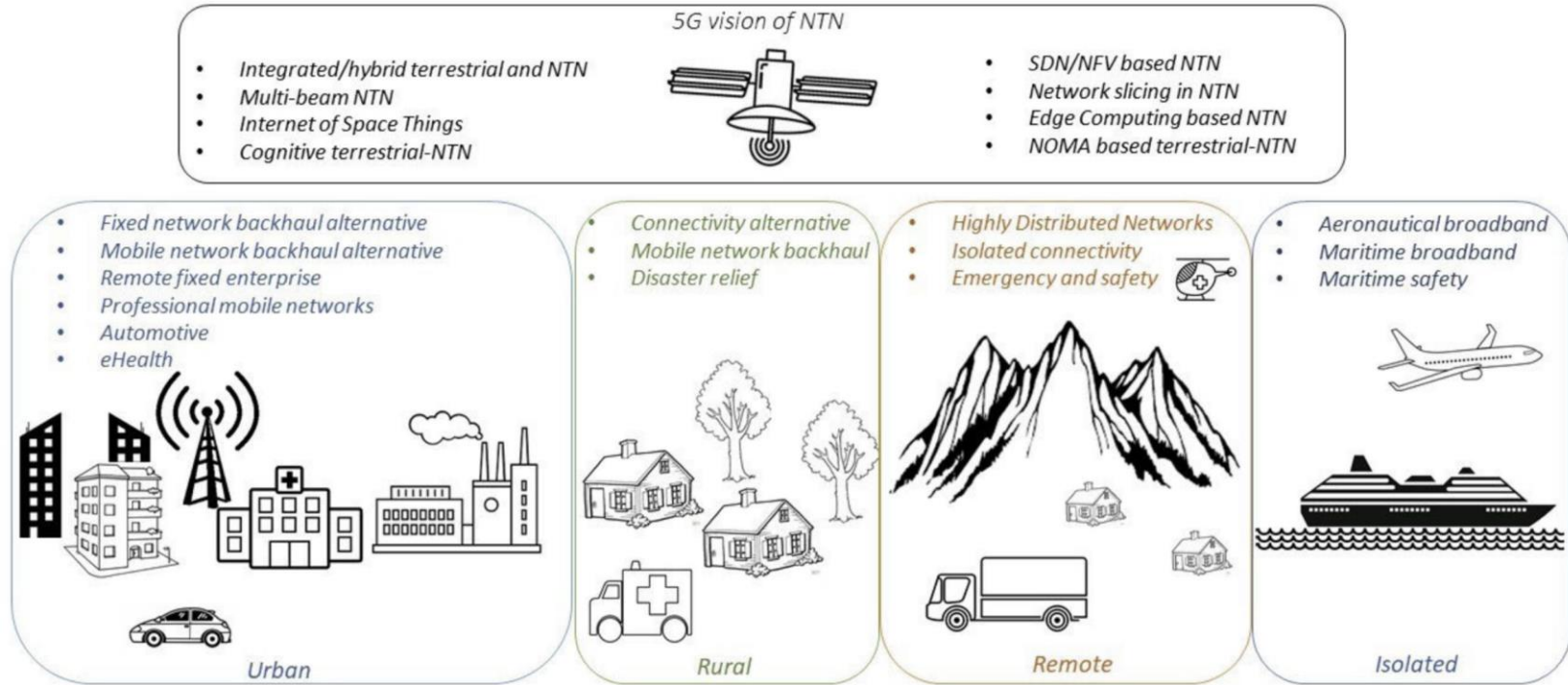
www.dgtlinfra.com



Satellite types have a range of different uses and use different spectrum bands from 1-40 GHz. Most of the LEOs are from Starlink/Space X. Keep in mind that Starlink D2D offering uses different satellites than their current Gen 1/2 Satellites. They use a 350 km orbit rather than 525 km. Currently Starlink – >6,400 satellites in operation and Starlink D2D >100 satellites, AST Bluemobile 5 satellites, Globalstar 25 satellites

# 1. Introduction on SCS/Satellite direct-to-device (D2D) market size (3)

- 5G Vision of use cases



Source: IEEE Non-Terrestrial Networks in 5G & Beyond: A Survey (Figure 1)

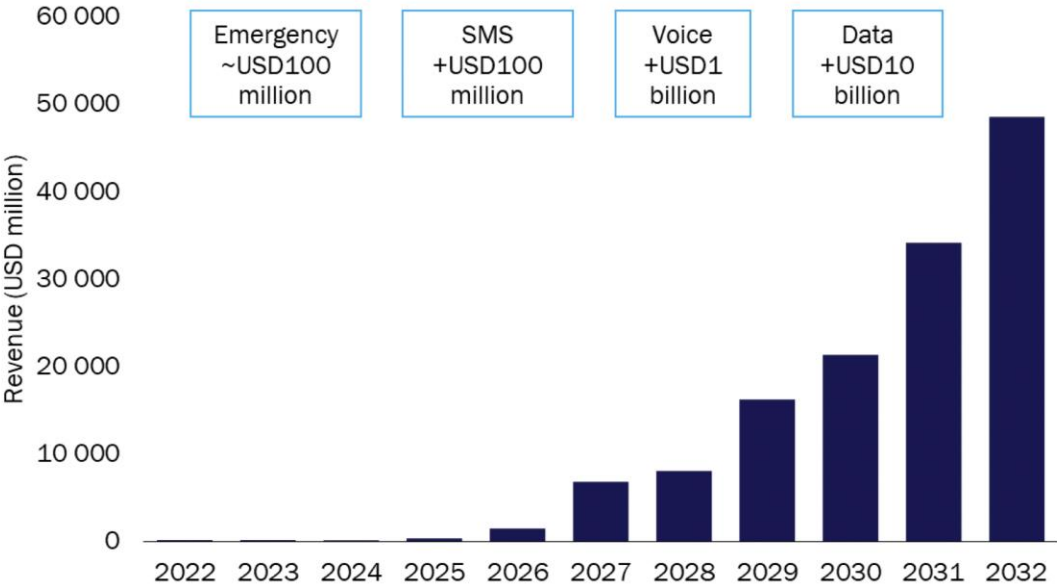
# 1. Introduction on SCS/Satellite direct-to-device (D2D) market size (4)

- Individual mobile connectivity via the use of non-terrestrial networks (NTNs)/ Supplemental Coverage from Space (SCS) or Direct to Device (D2D) services
- Satellite direct-to-device (D2D) is one of the most exciting areas of the space industry.
- Satellite D2D could generate USD137 billion in cumulative service revenue between 2022 and 2032 (Analysys Mason)

## Satellite service revenue



Satellite D2D service revenue, worldwide, 2022-2032



Source: NSR

Source: Analysys Mason, *Satellite direct-to-device technology needs to evolve through four phases before reaching its full potential*, March 2024

# 1. Introduction - Importance of Global Standards (5)

- Standards is crucial to unlock the revenue opportunity.
- 3GPP Release 17 has opened the door for advancing D2D technologies by including non-terrestrial networks. Although Release 17 mainly focuses on narrowband capabilities of 5G non-terrestrial networks, it is expected that Release 18 will enhance and expand standards for voice and data applications over satellites.

## Transition to Standards-Compliant Solutions

- Some companies are moving away from proprietary solutions in favour of standards-compliant ones.
  - SpaceX ceased Swarm IoT device sales, in favour of standards-based IoT solutions;
  - Iridium, after its unsuccessful partnership with Qualcomm, is taking a standards-based approach to D2D satellite services.

## 2. Background on space economy and orbital launches (1)

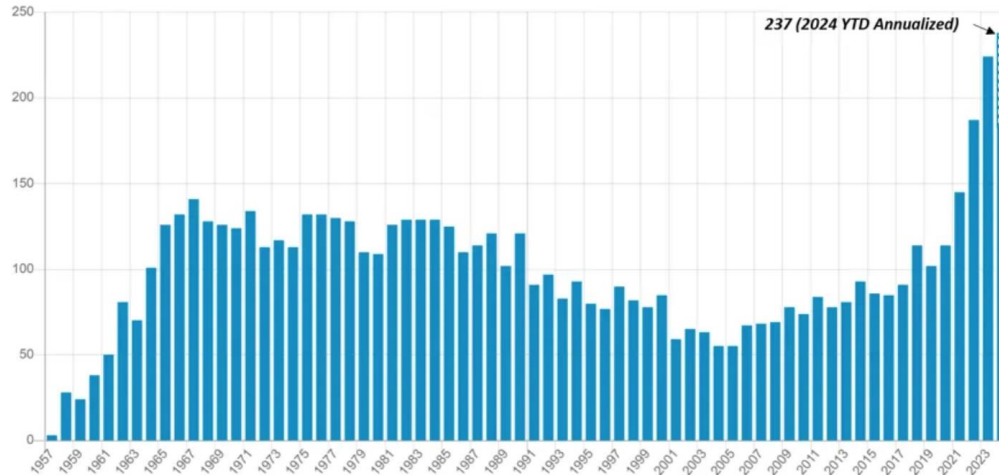
- The space economy is rapidly growing and evolving alongside the transformation of the space sector, integrating more deeply into society and the economy.
- Today's advanced space infrastructure supports new services and applications in fields like meteorology, energy, telecommunications, transport, and aviation, generating significant economic and social benefits.
- Private companies like SpaceX have drastically lowered the cost of launching into orbit, unlocking new commercial and technical possibilities.



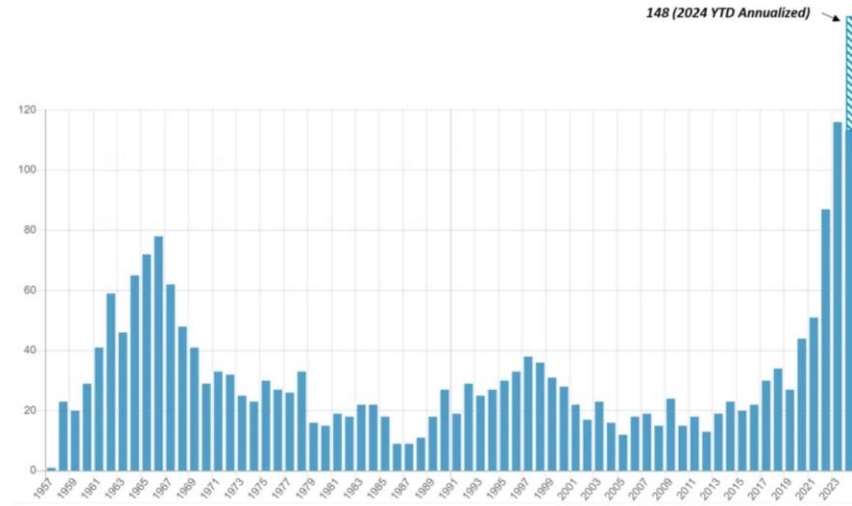
## 2. Background for space economy and orbital launches (2)

- In 2021 global orbital launches broke records from 1967, and by October 2024, 237 missions are expected, with an average of one launch every 1.5 days. The U.S. (113 launches) and China (45) dominate, making up 86% of all missions in 2024. U.S. launches alone have increased fivefold in the past six years, while Russia's activity has declined.

Global Orbital Launches by Year

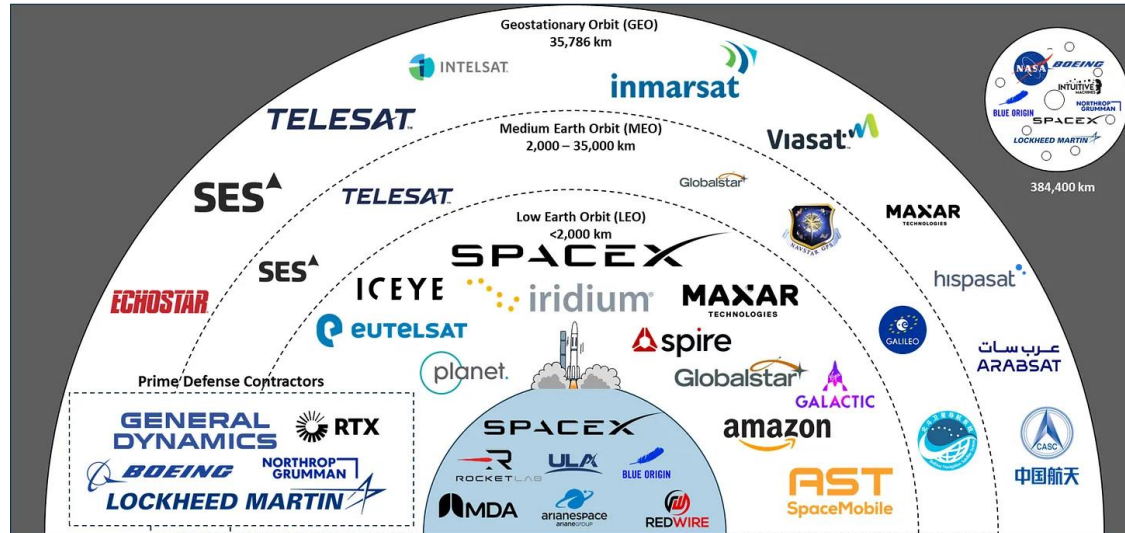


United States Orbital Launches by Year



## 2. Background for space economy and orbital launches (3)

- Advances in rocket technology especially the development of partially reusable rockets, have significantly lowered launch costs, driving the second space age.
- Traditional companies, often tied to government and defence, have lost market share to more innovative players like SpaceX, and to a lesser extent, Rocket Lab, Blue Origin, and Relativity Space. These cost reductions have allowed a wider range of satellite providers to affordably place technology into orbit, expanding opportunities for space-based applications.



# 3. Exploring LEOs and D2D issues

## Possible approaches to satellite D2D from a spectrum perspective

**Approach 1:** MSS frequencies in L and S bands are used. A satellite communication module with a corresponding frequency is installed into smartphone to directly connect the mobile phone to a satellite.

- Typically GEO satellite in this case.

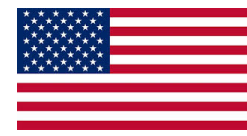
**Approach 2:** Satellite operators work with terrestrial mobile operators to adopt IMT frequencies.

- Typically LEO satellite in this case – for example, SpaceX uses this approach
- There might be interference from the satellite D2D to the terrestrial IMT network, which is yet to be studied. That's scope of the WRC-27 AI 1.13.

**Approach 3:** 3GPP defines NTN bands, including n255 (1.6 GHz) and n256 (2.0 GHz) frequencies in R17, and R18 defines n254 (1.6 GHz/2.4 GHz).

- GSOA supports such approach.

## 3. Regulatory Developments in the USA (2)



In February 2024, the FCC established a new regulatory framework to facilitate innovative collaborations between satellite operators and wireless providers. In March 2024, the FCC adopted its **Supplemental Coverage From Space (SCS) framework**.

### SCS Framework

- The framework will enable partnerships between MNOs and satellite providers to provide non-terrestrial coverage in areas without terrestrial mobile coverage, especially in remote, unserved, and underserved areas. It would increase the availability of emergency communications.
- The FCC's new SCS rules authorize communications from satellites networks to mobile devices (i.e., Mobile Satellite Services or MSS) in the following spectrum bands: 600 MHz (614–652 MHz and 663–698 MHz) 700 MHz (698–769 MHz, 775–799 MHz, and 805–806 MHz) 800 MHz (824–849 MHz and 869–894 MHz)

### 3. Satellite D2D perspective - Developments in the USA (3)



#### **SpaceX pushes FCC to review spectrum sharing between satellite types arguing**

- Existing ITU rules are outdated (adopted in 2000) unnecessarily restrict the operation of non-geostationary satellite systems.
- The existing rules protect radio spectrum access for geostationary satellites at the expense of low-Earth orbiting satellites, like those for Starlink. However, there no question that satellite filings to the ITU by LEO providers have not been gamed in their filings (eg split etc)
- At WRC-23 the FCC said: “there is a need to ensure efficient use of co-frequency spectrum resources” for these systems, noting that the limits were “derived taking into account only a short-term protection criterion.”

#### **AT&T and Verizon urge FCC to reject SpaceX’s plan to offer cellular services with T-Mobile**

- SpaceX and T-Mobile plan to offer Supplemental Coverage from Space for T-Mobile's cellular network using SpaceX satellites.
- However, AT&T and Verizon argue SpaceX’s plan will cause harmful interference to terrestrial mobile networks.

# 3. Satellite D2D perspective - Developments in the USA (4)



## Starlink and T-Mobile

- In 2022, T-Mobile announced plans to establish a new network that will use Starlink's satellites to broadcast using T-Mobile's mid-band spectrum across the country. This satellite-to-cellular service aims to deliver nearly complete coverage in areas where customers have a clear view of the sky.
- **How?**
  1. T-Mobile leases 800 MHz spectrum to Echostar to support Dish Network's rural 5G rollout in the U.S.
  2. Echostar leases 30 MHz of S-band MSS spectrum to SpaceX for its global Starlink Direct-to-Device (D2D) service.
  3. Starlink offers D2D airtime to T-Mobile, potentially including Deutsche Telekom, on a global scale.



### 3. Satellite D2D perspective - Developments in the USA (5)



#### Starlink and T-mobile

- In 2024, T-Mobile explained that its SCS arrangement with SpaceX contemplates that the terrestrial and satellite networks will operate independently.
- At least one commentator argues that Starlink will offer a distinct service to T-Mobile users, featuring its own application, billing, and support. The satellite and terrestrial networks will function independently, and only select devices with compatible PCS G block modems will be supported.
- Others express concern that T-Mobile's strategy may overlook the risk of Starlink establishing direct relationships with their customers. They suggest that once Starlink connects with T-Mobile users, it could upsell its fixed wireless internet, potentially replacing T-Mobile's 5G Home Internet.



Refer to <https://t.co/TGm0HkT3o1> and [https://x.com/no\\_privacy/status/1841478562710172081/photo/1](https://x.com/no_privacy/status/1841478562710172081/photo/1)



### 3. Satellite D2D perspective - Developments in the USA (6)



#### Spectrum sale

- [UScellular is selling](#) some of its spectrum assets to Verizon for USD1 billion, which includes 850 MHz, PCS, and AWS airwaves. Verizon's spectrum purchase from UScellular involves acquiring 663 million MHz POPs of 850 MHz spectrum, 19 million MHz POPs of PCS licenses, and 11 million MHz POPs of AWS airwaves, all for a total of \$1 billion.
- UScellular has made agreements with two other mobile network operators to sell 12 million MHz POPs of spectrum in the CBRS, C-Band, and 700 MHz B/C Block bands. The identities of the buyers and the terms of the deals have not been revealed. The finalization of these sales is dependent on UScellular's planned transaction to sell its wireless operations and spectrum assets to T-Mobile.

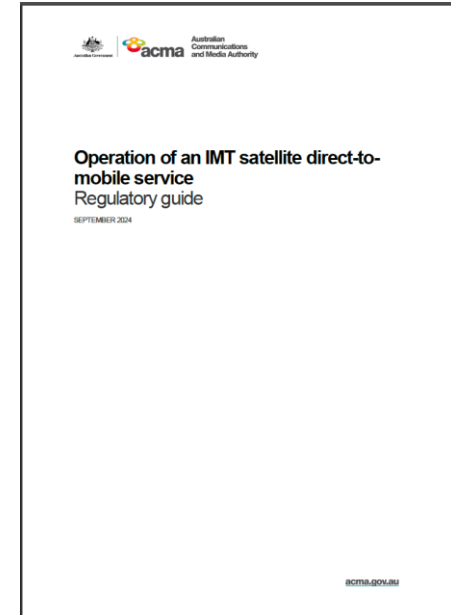


# 3. Regulation in Australia: ACMA Guideline on satellite D2D (7)



## Operation of an IMT satellite direct-to-mobile service: Regulatory Guide

- In September 2024, the Australian Communications and Media Authority has confirmed that International Mobile Telecommunications (IMT)-based satellite direct-to-mobile services can be operated under Australia-wide spectrum licences without the need for further approval from the regulator.
- The guideline establish regulations for the operation of satellite direct-to-mobile services, covering both MSS (Mobile Satellite Service) and IMT (International Mobile Telecommunications) satellites. They also outline the regulatory framework for spectrum licensing in this area.



# 4. Use of satellite D2D for emergency services (1)

First, key use of D2D is going to be for first responders (eg police, bomba, ambulance etc).


In the USA announcement from FirstNet/AT&T on partnering with AST Spacemobile. Unsure where Malaysian first responders are at with PPDR Broadband?

## AT&T 3Q2024 EARNINGS & HIGHLIGHTS

Growing the right way as more customers choose AT&T


 <b>\$5.1B</b> free cash flow*	 <b>403K</b> postpaid phone net adds, with Mobility service revenue growth of <b>4%</b> year over year	 <b>226K</b> AT&T Fiber net adds, with fiber revenue growth of <b>16.7%</b>
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Keeping people connected in more ways



AT&T and AST SpaceMobile took a step forward in building a space-based cellular network to connect everyday smartphones with AST SpaceMobile's launch of **five commercial satellites**

Serving customers world-class 5G and fiber is a winning combination

Expected industry-leading postpaid phone churn of <b>0.78%</b>	Ookla® named AT&T Fiber America's fastest internet in the nation¹
 <b>34%</b> faster than the nearest competitor	

Leading in converged connectivity. About **4 out of 10** AT&T Fiber customers also select AT&T wireless



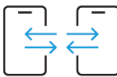



### BY THE NUMBERS

The **only** dedicated communications platform in the country that brings first responders:







-  **Always-on, 24x7** priority and preemption across voice and data communications
-  A **physically separate network core fully dedicated to public safety**
-  **Government oversight and accountability from the FirstNet Authority**

Updated 10/23/24  
¹As of Q3 2024  
²Since the start of the FirstNet Build

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<b>6.4M+</b> FirstNet connections¹ 	<b>29K+</b> Public safety agencies and organizations subscribed 
 <b>200+</b> apps in the FirstNet App Catalog	 <b>865+</b> FirstNet Ready® devices

## AMERICA'S PUBLIC SAFETY NETWORK

<b>2.97M+</b> Square miles of coverage 	<b>250K+</b> Square miles more than commercial networks 
<b>180+</b> Dedicated assets, including Flying COWs® and CRDs™  	<b>64%</b> Increase in Tribal Land coverage* 
	<b>2250+</b> Solutions triaged and deployed this year 

\*Free call flow is a non-GAAP metric. For reconciliations, please see the Investor Relations website. ¹Based on analysis by Ookla® of Speedtest mobile® data. ²Speed Score, Consistency score and average Consumer Rating for Q1-Q2 2024. Ookla trademarks used under license and registered with permission.

# 4. Use of satellite D2D for emergency services (2)

Second use is utilising D2D for emergency texting. This was tested tested in the USA in September 2024 – used IMT spectrum for signalling and then in the recent USA hurricanes SpaceX’s cellular Starlink service delivered "hundreds of thousands" of text messages to help hurricane victims, according to T-Mobile's CEO.



NETWORK PRESS RELEASE

## T-Mobile Conducts the First Ever Wireless Emergency Alert Via Satellite

September 11, 2024

*T-Mobile Starlink satellite-to-smartphone technology to bring critical emergency alerts to 500,000+ square miles of land currently unreachable with earth-based cell towers*

*Emergency alerts will work for everyone – even Verizon, AT&T and other wireless provider customers will receive critical emergency alerts*

Same with Apple and iPhone use of Globalstar satellites for SMS etc . Free service for first 2 years but has been extended

### No signal? There’s a satellite for that.

When you don’t have cell service or Wi-Fi, iPhone 16 Pro can **connect you to a satellite**, so you can stay in touch or get the assistance you need.

**Messages via satellite** lets you send and receive messages and Tapbacks when you’re off the grid, right from the Messages app. Your iPhone will help you connect to a satellite, so you can text over iMessage or SMS.<sup>8</sup>



**Roadside Assistance via satellite** can get you help for things like a flat tire or a dead car battery. iPhone will connect you with a roadside assistance provider, who can dispatch help to your exact location — even if you’re off the grid.<sup>10</sup>

## 5. Concluding Remarks (1)

- Firstly, wish to strongly state that the **capability of the satellite D2D is not comparable with the terrestrial IMT network in terms of capacity, delay, affordability etc.** And is it never likely to be! There is a lot of hype/fake news about this....
  - As such Governments and Regulators need to continue to encourage and facilitate MNOs to deploy the terrestrial IMT network. So need to consider USO implications
  - Starlink Broadband (ie not D2D) has maybe 4 million customers of which 400K are in Australia
- Secondly, in addition, **Governments/regulators do need consider aspects** including: the regulatory impact, competition impact, cross border interference, data security, and economic impact to the terrestrial MNOs. Governments who charge high fees for spectrum or auction IMT spectrum need to consider implications of use if LEOs can utilize the IMT spectrum



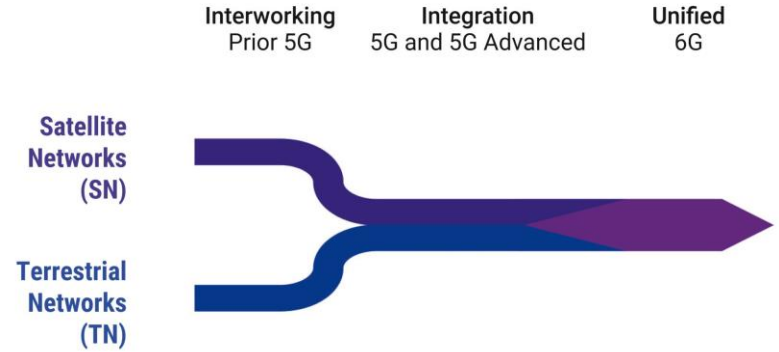
## 5. Concluding Comments (2)

- Finally, what is **optimal approach to spectrum for these services?** – an optimal approach should be to use separated spectrum for satellite D2D (not to use the IMT spectrum) but is this possible, is there sufficient spectrum? Does it materially affected device costs and hence affordability? Will it be different for emergency services versus broadband?
- Satellites **enhance rather than replace** traditional networks ie they are complementary. They serve as a crucial solution to address coverage gaps in rural and remote areas where terrestrial infrastructure is insufficient.



# 6. Epilogue: 6G Non-terrestrial networks (NTN) project (1)

- The Non-Terrestrial Network will enhance existing Terrestrial Networks (TN), improving mobile connectivity, especially in underserved areas. 6G NTN is an SNS JU project focused on developing and validating the key technical, regulatory, and standardization elements needed to integrate terrestrial and non-terrestrial networks (NTN) into 6G.
- 6G-NTN will design a revolutionary 3D network infrastructure for 6G, integrating terrestrial and non-terrestrial networks to deliver widespread coverage, ultra-low latency, and high data rates. This concept also aims to provide highly accurate and reliable location services.



## 6. Epilogue: 6G Non-terrestrial networks (NTN) project (2)

According to recent comments the plan is that:



- NTN should be a core part of 6G, with seamless integration into terrestrial networks. Key sectors for NTN in 6G: utilities, agriculture, and government.
- In consumer market, 7.5% of mobile users and 5% of new cars are expected to be NTN-capable.
- 6G-NTN is working on developing 5G/6G and NTN convergence. There is a need to improve the coexistence between NTN and terrestrial spectrum
- NTN infrastructure should be multi-tenant, allowing multiple operators to share the same network to access the satellite components.
- Future Goals include AI/ML-driven spectrum sharing, reducing costs and carbon footprint, improving positioning, and strengthening security.

# **Thank you**

**I would be pleased to answer any questions you might have**

**....**

**Additional slides**

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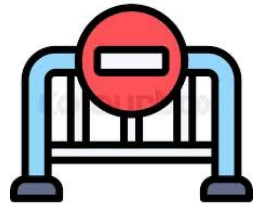
# Space Competition issues (1)



SPACEX

## Space X as a monopolisation case

- **SpaceX's dominant position in the space transportation market:** In 2023, it secured \$3.1 billion in federal contracts, almost matching its competitors combined. With 96 successful launches compared to only seven from all other companies, SpaceX accounts for over 93% of orbital launches. Musk claims the company delivered 80% of the world's space cargo, indicating strong dominance and barriers to entry in the industry.
- Entry barriers in the space launch industry include:
  - **High Fixed Costs:** Launching a rocket can require upwards of \$100 million.
  - **Long Development Times:** Rocket development typically takes three to five years, with delays common (e.g., Blue Origin's first orbital launch).
  - **Strategic Launch Schedules:** SpaceX's dominance allows it to set timelines and prices, forcing other agencies and operators to align their plans with its capabilities.



# Space Competition issues (2)



SPACEX

## SpaceX as a monopolisation case

- **SpaceX's ride-sharing program might be predatory:** Their estimated incremental costs per launch could be as low as \$25 million, while their average revenue per launch has fallen to about \$22.5 million. This discrepancy suggests that SpaceX may be operating at a loss to undercut competitors. Industry reports indicate that SpaceX's low pricing tactics have pressured smaller launch companies, hindering their growth and potentially violating antitrust principles due to the exclusionary impact on rivals.
- **SpaceX's contracts with customers seem to be exclusionary:** SpaceX may engage in anticompetitive practices through exclusionary clauses in contracts with customers, including government agencies and satellite firms. Reports indicate that SpaceX has imposed restrictions, such as a "right of first refusal," which allows them to match any competing offers. This can stifle competition, as rivals may hesitate to bid if they know SpaceX can easily undercut them.

# Space Competition issues (3)

## Regulator's focus on competition

- In September 2024, FCC Chair Jessica Rosenworcel expressed a desire for increased competition against SpaceX's Starlink satellite internet service. Starlink currently operates about two-thirds of active satellites, having launched roughly 7,000 since 2018.
- At a conference, Rosenworcel emphasized that monopolies harm the economy and called for more companies to enter the space sector to foster innovation and create new satellite constellations.

