



# AST SpaceMobile

Transforming how the world connects -  
Satellite direct to existing handsets



NASDAQ: ASTS

USTTI Training Washington DC

[pnalikka@ast-science.com](mailto:pnalikka@ast-science.com)

Oct 2024 version

# Low-band: 5600+ cells across CONUS

## 01 — Presentation: Paul Nalikka VP, Africa

- | GEO, MEO, LEO/ Satellite Industry
- | D2C- NTN
- | AST SpaceMobile/ Technology Overview
- Broadband and UN SDGs



# Satellite Segments

A central illustration of Earth with three distinct satellite orbits. The innermost orbit is Low Earth Orbit (LEO), showing a cluster of small satellites. The middle orbit is Medium Earth Orbit (MEO), showing a few larger satellites. The outermost orbit is Geosynchronous Orbit (GSO), showing two large satellites. A yellow satellite in the LEO orbit is shown with a beam of light directed at the Earth's surface. The background is a dark space with some distant stars.

## Low Earth orbit (LEO)

satellites are closest to users (300-2000 km) but require 100s satellites for full coverage. Low latency (<100 ms).

## Geosynchronous (GSO)

satellite orbit (36,000 km) rotates at the same speed as the Earth's rotation. Three satellites can provide global coverage. 560 ms latency, which can support most applications.

## Medium Earth orbit (MEO)

satellites are located between LEO and GEO satellites at 8,000 to 22,000 km. 10-18 are required for continuous global coverage. Lower latency (150 ms).

# Types of Satellites in Context

Active satellites have increased 361% over 5 years (from 2,100 on December 31, 2018)

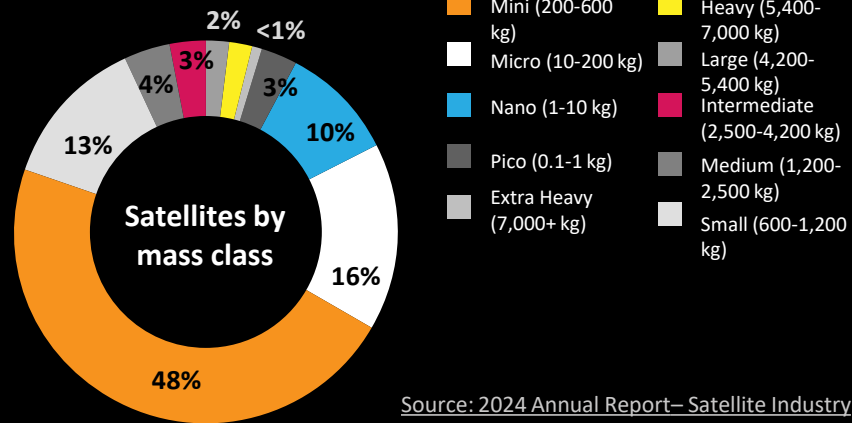
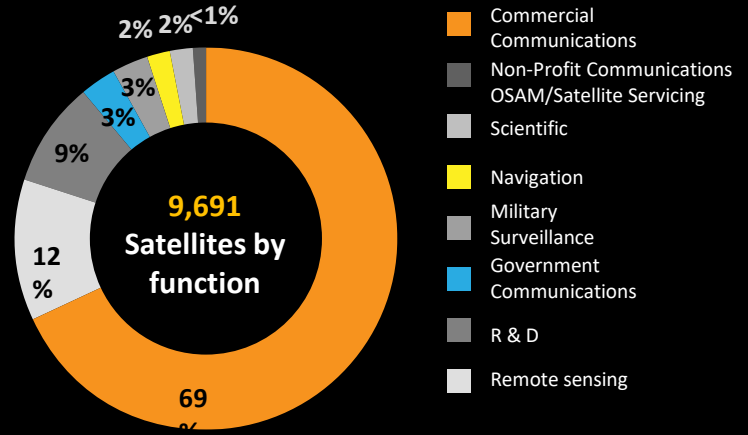
- Record breaking 8,000+ smallsats deployed since 2020 (satellites \$1,200kg)
- About 3,600 metric tons launched since 2019
- 625 active satellites in GEO (29 more than in 2022 mostly providing communications services)
- 9.066 active satellite in NGSO (2,346 more than in 2022)

9,691 satellites operated by entities headquartered in 87 countries (some in regional consortia).

- Since 1957 entities from 102 countries have deployed at least one satellite
- U.S. entities operate 6,500+ satellites, some in partnership with other nations

Estimated as of December 31, 2023

Includes satellites active and in orbit. Excludes defunct satellites



Source: 2024 Annual Report— Satellite Industry Association, Washington, D.C. ([sia.org](http://sia.org))

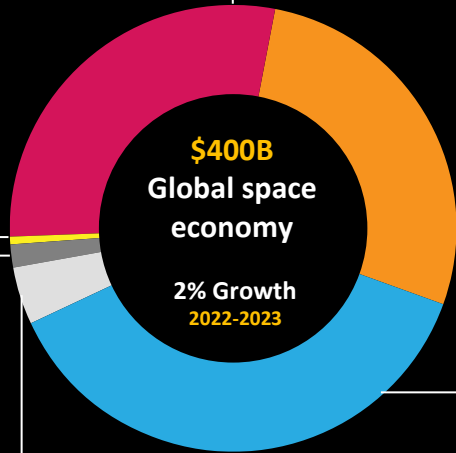
# Satellite Industry in Context

**Non-satellite space industry \$114B**  
 Including:  
 Government Space Budgets  
 Commercial Human Spaceflight

**\$300M+ Space Sustainability Activities**

**\$7.2B Launch Industry**

**\$17.2B Satellite Manufacturing**



\*Government space budgets include civil and military spending by 70 countries, ESA. Commercial human spaceflight includes commercial missions to ISS, suborbital and orbital flights

## Satellite services \$110.2B

### Telecommunications Remote sensing

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>  Television</li> <li>  Telephone</li> <li>  Broadband</li> <li>  Aviation</li> <li>  Maritime</li> <li>  Road and rail</li> <li>  National security</li> </ul> | <ul style="list-style-type: none"> <li>  Agriculture</li> <li>  Change detection</li> <li>  Disaster mitigation</li> <li>  Meteorology</li> <li>  Resources</li> <li>  Earth/Space science</li> <li>  National security</li> </ul> |
|--|--|

## Ground equipment \$150.4B

### Consumer equipment Network equipment

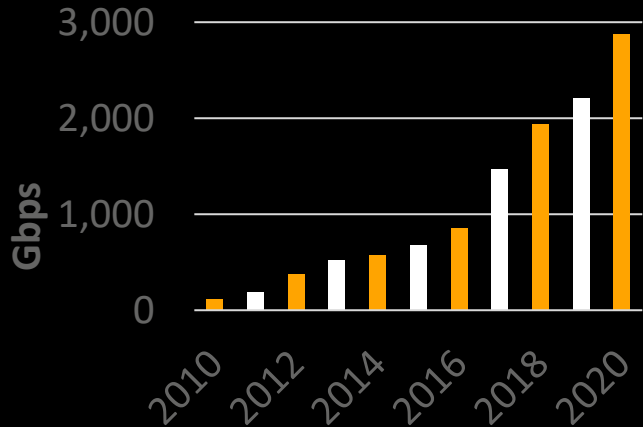
- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>  Sat TV, radio, and broadband equipment</li> <li>  GNSS stand-alone units &amp; in-vehicle systems</li> <li>  GNSS chipsets (beginning with the 2017 report)</li> </ul> | <ul style="list-style-type: none"> <li>  Gateways</li> <li>  VSATS</li> <li>  NOCS</li> <li>  SNG equipment</li> </ul> |
|---|--|

**\$285B**

**Satellite Industry (71% of Space Economy)**

Source: [2024 Annual Report— Satellite Industry Association, Washington, D.C. \(sia.org\)](#)

# NGSO's Cost Efficiencies



### As costs decrease:

- Launch costs
- Manufacturing costs
- Time to market

### Bits increase:

- Technology improvements
- Processing power

**Broadband:** User experience and price are competitive with wireline: ideal for hard-to-reach regions

**Mobility:** Provides broadband experience everywhere for passengers and crew

**Telco:** Extends networks, offloads congestion, and price competitive with microwave

**Enterprise:** In-office broadband experience in remote locations

# Today's Major Broadband and satellite providers 2023

Now, with the internet and personal mobility, the demand has skyrocketed at the same time the technology has developed and lowered in cost.

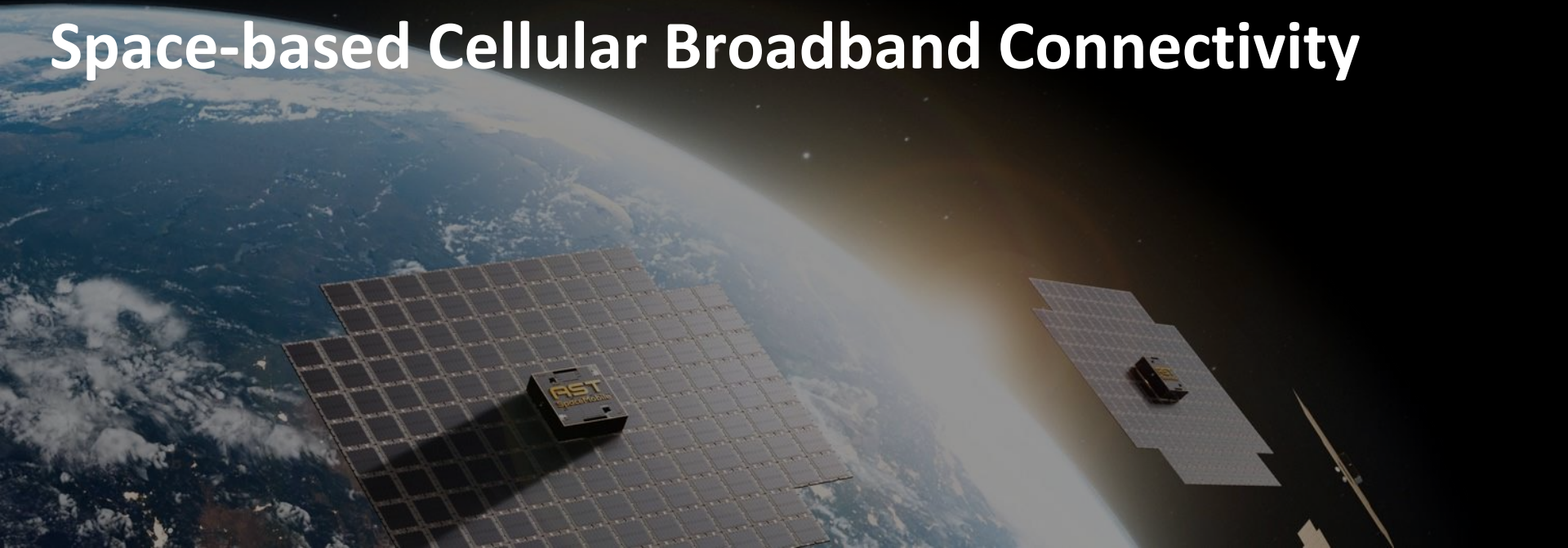
OPERATOR	SATELLITE SYSTEM (DEPLOYED)	SPECTRUM	TECHNOLOGY	OPERATIONAL	SERVICES
SpaceX (Starlink)	12000+ (3580)	Ku-band	Proprietary	Yes	Broadband
OneWeb	648 (542)	Ku-band	Proprietary	TBD	Broadband
Kuiper	3236 (0)	Ka band	Proprietary	Estimated 2024	Broadband
Galaxy Space	1000 (7)	Q/V spectrum	Proprietary	TBD	Broadband
Boeing	147 NGSO (1)	V band	Proprietary	TBD	TBD
Inmarsat	14 GEO (14)	TBD	Proprietary	TBD	Broadband to IoT
Telesat	188 (2)	C, Ku, Ka bands	Proprietary	TBD	Broadband
Echostar	10 GEO (10)	Ku, Ka, S bands	Proprietary	Yes	Broadband
HughesNet	3 GEO (2)	Ka band	Proprietary	Yes	Broadband
Viasat	4 GEO (4)	Ka band	Proprietary	Yes	Broadband

Source: <https://www.5gamericas.org/>



# Non-Terrestrial Networks (NTN)

Space-based Cellular Broadband Connectivity





# Satellite Innovation

## Strong market interest in connecting satellites directly to mobile phones and other devices

Consumer services including SOS emergency messaging, text

Eventually roaming voice and 5G data coverage

## 10+ satellite operators developing/deploying systems

Two providing limited initial services, including SOS messaging to specialized devices or specific geographies

Additional four have deployed satellites, for testing/demo

## Companies are pursuing a range of approaches

### Space segment

- Leveraging existing satellite networks
- Deploying new constellations tailored for direct-to-device service

### Spectrum

- Use already authorized satellite spectrum
- Add spectrum to satellites in partnership with terrestrial operators

### Device implementation

- Modify or develop new devices to utilize satellite frequencies
- Modify sats to utilize standard devices

## Key market drivers

Escalating from basic to more advanced services (e.g., text to voice calls, sending media, video streaming)

Customer willingness to pay and market penetration

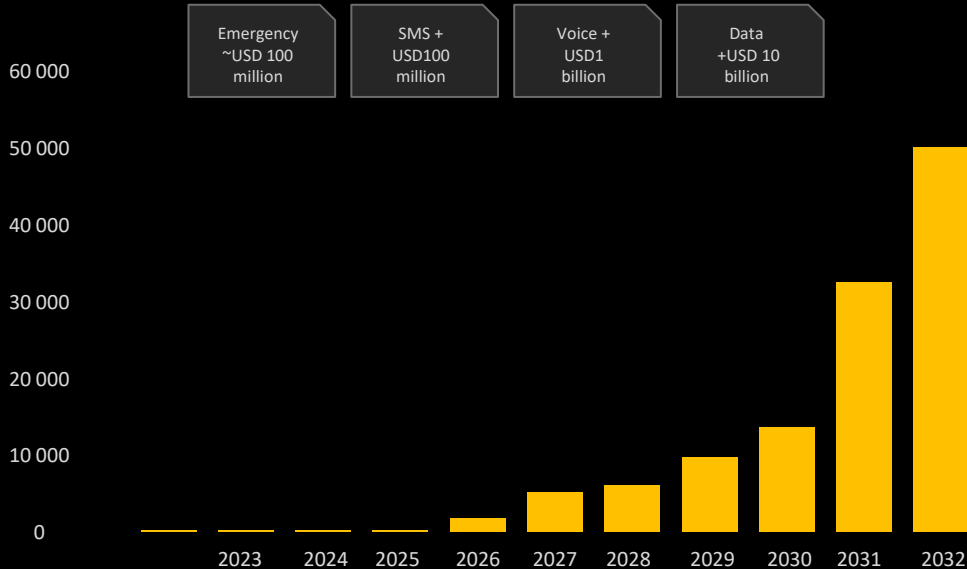
Mobile broadband company appetite

Spectrum allocation, potential interference with terrestrial networks

Integration of satellite signals into wireless standards

Wide-spread adoption of specialized hardware, including compatible chipsets

# D2C Global Revenues Projected



Source: NSR

D2C technology is advancing through four 'waves' of connectivity capabilities (emergency alerts, messaging, voice and data.)

- Current narrowband D2C systems support emergency alerts and SMS- Revenues projected < \$200m through 2032; Apple/Globalstar, Lynk, Viasat/Inmarsat, Skylo, Iridium
- More revenue opportunities are being unlocked as D2D capabilities mature with voice and wideband data services becoming commercially available to support emergency, voice, broadband data, IoT, data >\$10b through 2029; AST SpaceMobile and others

**Satellite D2D could generate USD137 billion in cumulative service revenue between 2022 and 2032**

Source: Analysis Mason





# Why NTN?

## LEO satellites disrupt space

- Launch cost reduced
- Satellite cost reduced
- Launch intervals reduced
- #satellites per launch increased
- End-to-end latency reduced
- Throughput increased

NTN applies to many use cases



 <b>TN backhaul</b>	 <b>Fixed wireless access</b>	 <b>Mobile users</b>	 <b>Internet of things</b>
High gain antennas, potentially in mmWave spectrum	Large antennas, no user mobility	Handheld devices, cars	Low-data rate services with long battery life target
<i>Examples:</i> AT&T - OneWeb KDDI - Starlink Verizon - Amazon	<i>Examples:</i> Starlink, Amazon, OneWeb, Eutelsat, Viasat	Pre-rel 17 sat tech: Apple Pre-rel 17 3GPP: AST, Lynk, Starlink	Eutelsat, Skylo and many, many others. 3GPP Rel 17,18, 19
		3GPP rel 17,18, 19	

# Space-based Cellular Broadband Connectivity Potential

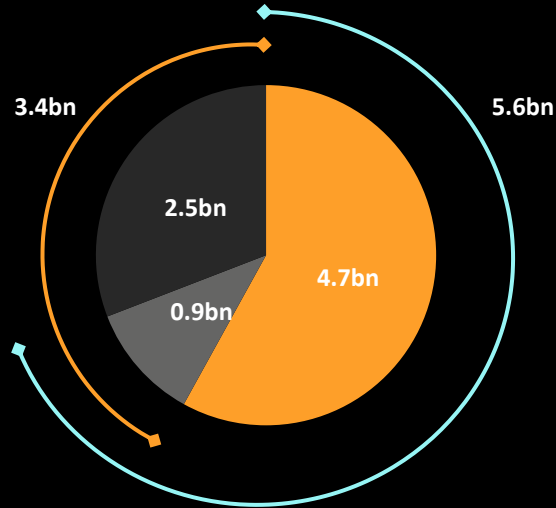
## 5.6 billion mobile phones and devices globally

Global Population  
– 8.1 billion



Global wireless services market generates over \$1.1 trillion in annual revenue, with a backdrop of evolving and imperfect networks

Source: GSMA Intelligence (data as of December 31, 2023).



- Cellular subscribers - broadband
- Cellular subscribers - no broadband
- Not a cellular subscriber

**5.6 BILLION UNIQUE CELLULAR SUBSCRIBERS**

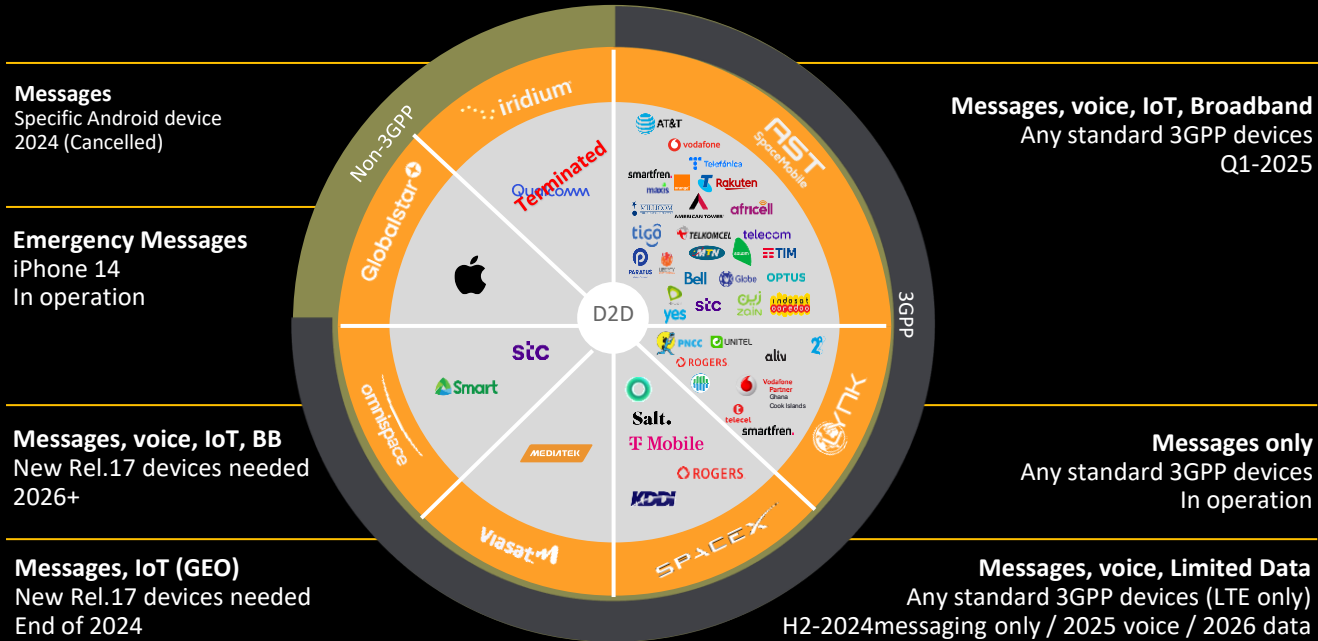
*move in and out of coverage as they live, work and travel*

**3.4 BILLION NOT SUBSCRIBED TO CELLULAR BROADBAND**

*0.4 billion have no coverage*

*3.0 billion usage gap*

# Space-based Connectivity Ecosystem




















# Major NTN IoT / D2C service providers

OPERATOR	SATELLITE SYSTEM (DEPLOYED)	SPECTRUM	TECHNOLOGY	OPERATIONAL	SERVICES
<b>AST</b> SpaceMobile	243 LEO (6) 60 to cover US	MNO spectrum	Proprietary – compatible	2024	Broadband, video, voice, messaging
<b>SpaceX</b>	2016 LEO (0)	MNO spectrum/ 2GHz MSS	Pre Rel-17 3GPP	2024	Messaging, speech, broadband
<b>Lynk</b>	5000 LEO (3)	MNO spectrum	Pre Rel-17 3GPP	2Q2023	Messaging, LDR (low-data rate)
<b>Satellite</b>	250 LEO (1)	2.0GHz MSS	Rel-17 NB-IoT (NB-NTN)	TBD	NB-IoT
<b>Iridium</b>	66 LEO	L-band	Proprietary	Yes	LDR/ Messaging
<b>Orbcomm</b>	31 LEO	137-150 MHz	Proprietary	Yes	Assets tracking
<b>GlobalStar</b>	24 LEO	L/S-band	Proprietary	Yes	Assets tracking
<b>Ligado</b>	1 GEO	L-band	Rel-17 NB-IoT (NB-NTN)	TBD	NB-IoT

Source: <https://www.5gamericas.org/>

# Traditional Satellite vs Space-based Cellular Broadband Connectivity

Existing satellite communications businesses have served the needs of narrow customer segments, but LEO's AST SpaceMobile will meet the needs of the mass market

	Direct satellite connections via specialized mobile phones	Indirect satellite connections via complex, expensive hardware		First and only direct satellite broadband to mobile phones
				
	Provider-specific satphones (~\$1K)	Provider-specific antennas mounted on planes, ships, vehicles, buildings (~\$1K-\$200K+)		Any standard mobile phone
Providers	  	Today	Coming	
		      	  	
Market size <sup>1</sup>	Those with narrowband service on satphones	Enterprise, maritime, aviation, government, residential		Mass market mobility and the unconnected



# AST SpaceMobile

Transforming how the world connects

Nasdaq **ASTS**



Use Only

# AST SpaceMobile

Building the first and only  
space-based cellular  
broadband network



## Coverage everywhere

Eliminates cellular coverage gaps and dropped connections



## Compatible with existing devices

Seamless service with no modifications required to consumer devices



## Cellular broadband

5G data rates with low latency and cellular-quality service levels



## MNOs engagement

Signed agreements with 40+ MNOs with 2+ billion existing subscribers



## Capital

Raised over \$1.2 billion to date to fund network build and technology with 3,400+ patent and patent-pending claims

# What is AST SpaceMobile?

AST SpaceMobile is building a new LEO satellite constellation to enable existing MNOs to provide mobile broadband coverage directly to standard mobile devices and smartphones



- | A space-based cell tower company that partners with nationally licensed MNOs to extend their existing terrestrial infrastructure
- | Aims to fill coverage gaps to connect the unconnected, reduce the digital divide, and plans to deliver affordable cellular broadband to 100% of the population and geography
- | AST SpaceMobile's customer is the MNO
- | With our solution, the MNO uses their already licensed spectrum in a self-interference management process
- | End users purchase the service from the MNO partner and use existing mobile devices
- | Supports cellular services at 2G, 4G and 5G speeds for any MNO
- | National MNOs continue to hold all domestic national regulatory responsibilities for mobile services
- | Flexible business model and affordable market-based pricing

## 2 Facilities in Texas



185,000 sq ft combined space



95% Vertically-integrated manufacturing



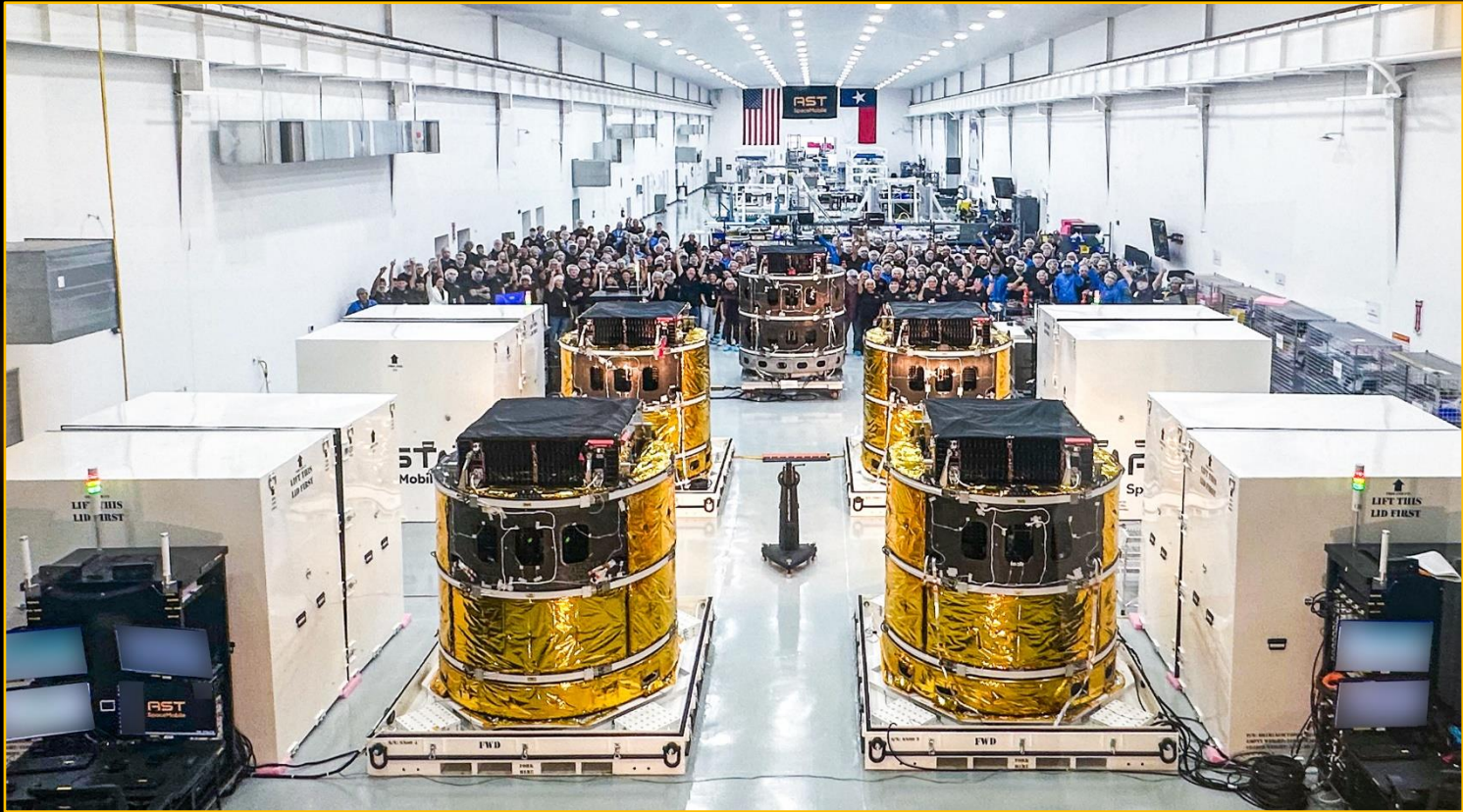
In-house production of key components, including AST5000 ASIC, a development effort that involved 150 person-years and \$45 million investment



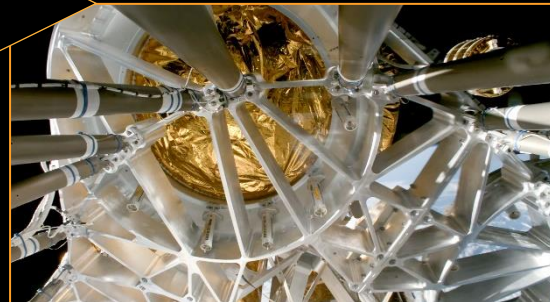
Drives performance, enables cost savings, rapid innovation, and market leadership





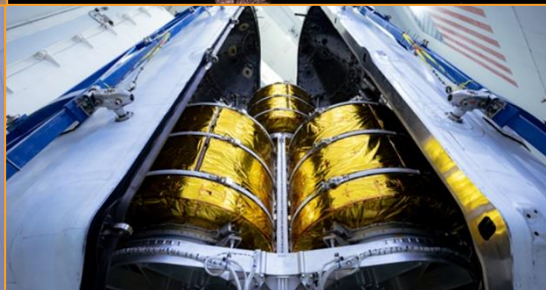


# Launch BlueBird 1 - 5





# Cape Canaveral September 2024





# First Five Commercial Satellites in Low Earth Orbit Unfolded



# Robust Network

## Leading MNOs as investors, partners and customers

When operational, AST SpaceMobile's service will be available to MNOs on a wholesale basis, with existing relationships spanning nearly every large country (excl. China and Russia)

- ▮ Leverages existing 5.5 billion mobile phones and devices
- ▮ Easy sign-up for cellular subscribers
- ▮ Super-wholesale revenue share model with MNOs
- ▮ Intended to drive new MNO partner revenue and reduced churn

**AST**  
SpaceMobile

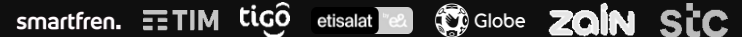
POTENTIAL COVERAGE



### STRATEGIC INVESTORS



### SELECT MNO PARTNERS



# Unique Market Differentiation

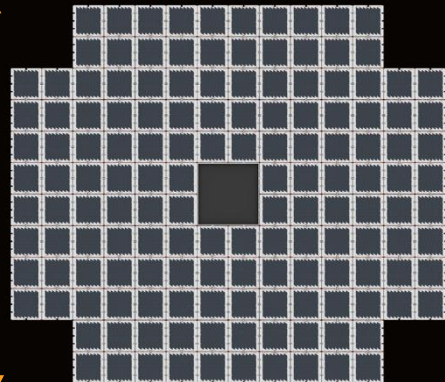
3,400 patents and patent pending claims



- Only pure play, low Earth orbit (LEO) broadband communications company that is publicly-traded
- Novel technology solution - largest phase array ever deployed in LEO – applicable to a 5.5 billion mobile phones and devices market, and its related \$1.1+ trillion TAM <sup>1</sup>
- Dual use - designed for both commercial and government applications
- Jointly going to market, not competing, with mobile network operators with hundreds of millions of subscribers
- Revenue share business model designed to allow users a seamless experience
- Raised 1.3+ billion to fund business operations and initial production satellites

# With The Largest-ever Phase Array In Low Earth Orbit (LEO)

BW3 and Block 1 BlueBird  
(10X BW3 Capacity)



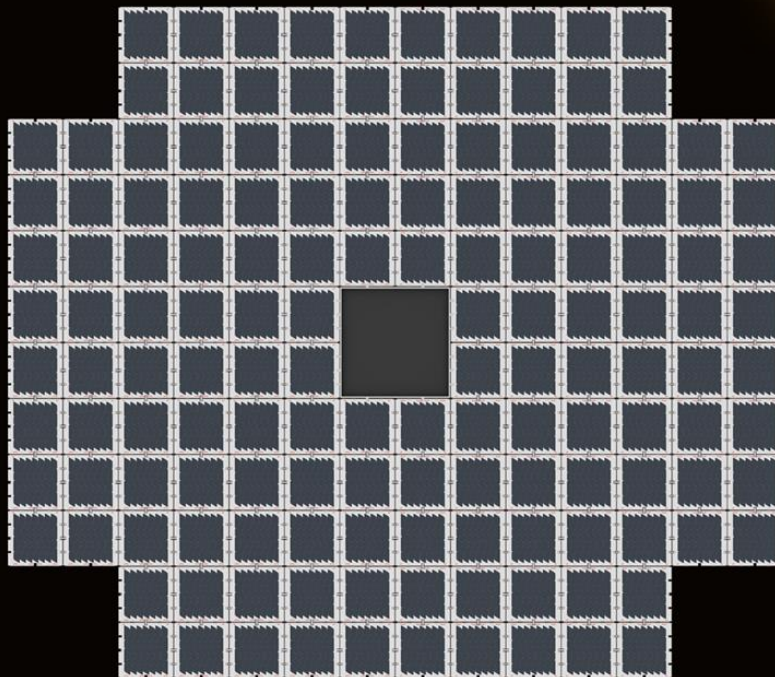
BMW 5



6 feet tall



Next Generation BlueBird  
100X BW3 Capacity





# History Made



connecting everyday smartphones directly from space using BlueWalker 3



September 2023

**5G voice calls**

**21 Mbps data rate**

*In a 5G first-ever, we demonstrated space-based 5G connectivity by placing a call from Maui, Hawaii, USA, to a Vodafone engineer in Madrid, Spain, using AT&T spectrum*



June 2023

**4G LTE voice calls**

**10 Mbps data rate**

*In a LTE first-ever, using AT&T spectrum, we again connected everyday smartphones to BlueWalker 3*



April 2023

**2G voice calls**

*The first voice call was made from the Midland, Texas area to Rakuten in Japan over AT&T spectrum using a Samsung Galaxy S22 smartphone*

# History Made

- | First 5 commercial satellites launched on target 12<sup>th</sup> September 2024 and unfolded by October 25<sup>th</sup>, each the largest-ever communications arrays to be deployed commercially in low Earth orbit
- | Expanded the AST SpaceMobile commercial ecosystem, adding Verizon as strategic investor and customer, joining AT&T in the U.S.
- | First 5 commercial satellites capable of U.S. nationwide non-continuous service with 5,600+ cells in premium low-band spectrum
- | ASIC chip expected to support up to 10x improvement of processing bandwidth per satellite
- | Initial Block 2 BlueBird planning and production of 17 satellites underway at AST SpaceMobile vertically-integrated Texas manufacturing facilities

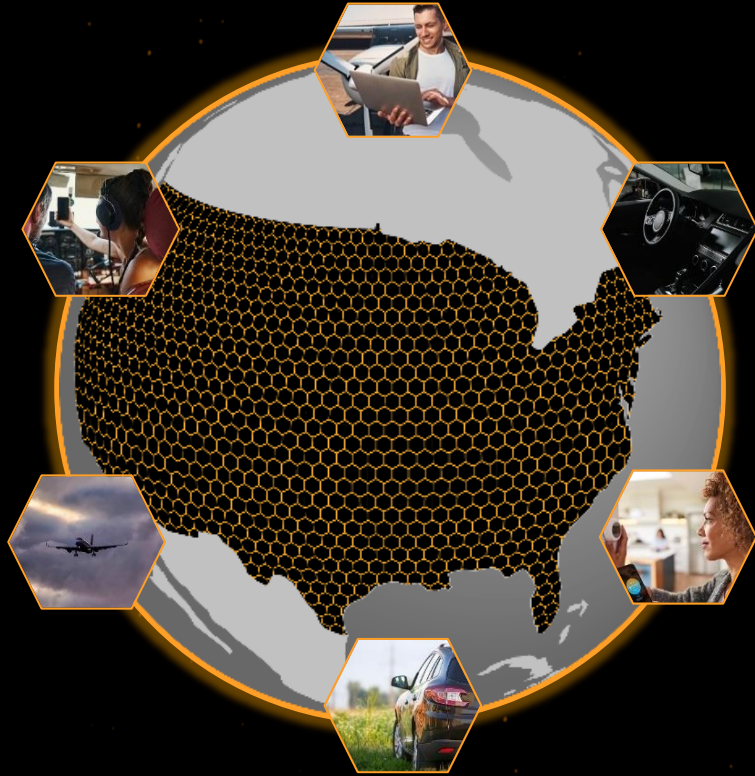






First 5 commercial satellites loaded into the Falcon 9 rocket



Satellites arriving at Cape Canaveral ahead of orbital launch

# US Coverage

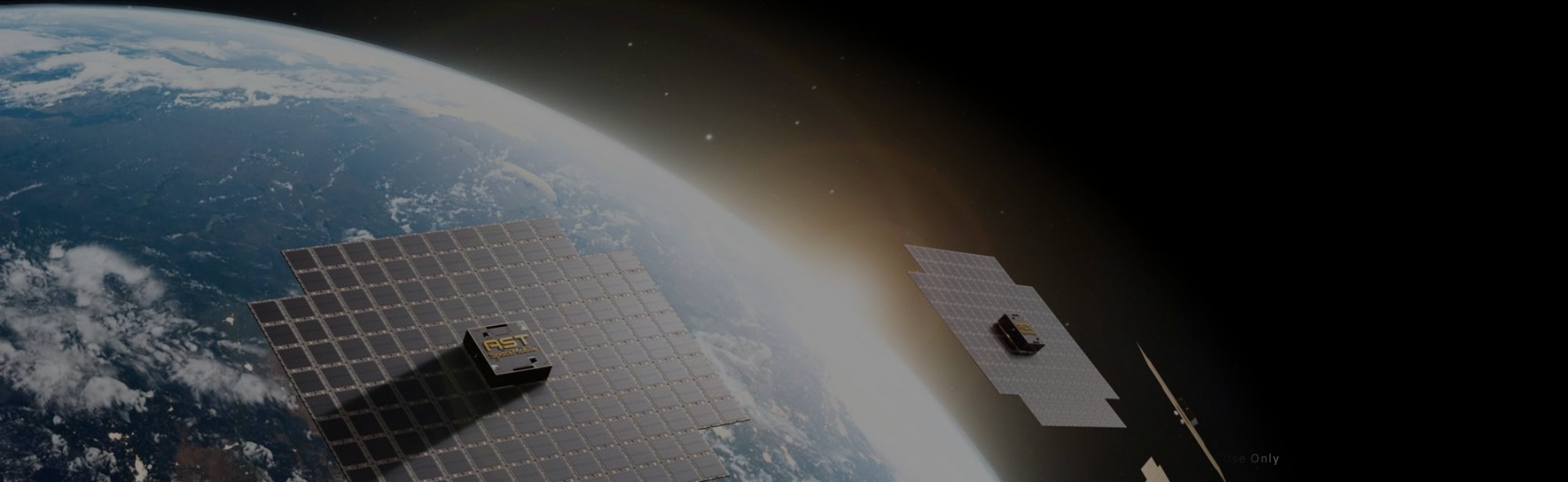


 <b>850 MHz</b> Premium Spectrum	 <b>5,500+</b> Cells
 <b>Target ~100%</b> Geographical Coverage	 <b>~70%</b> US Mobile Users





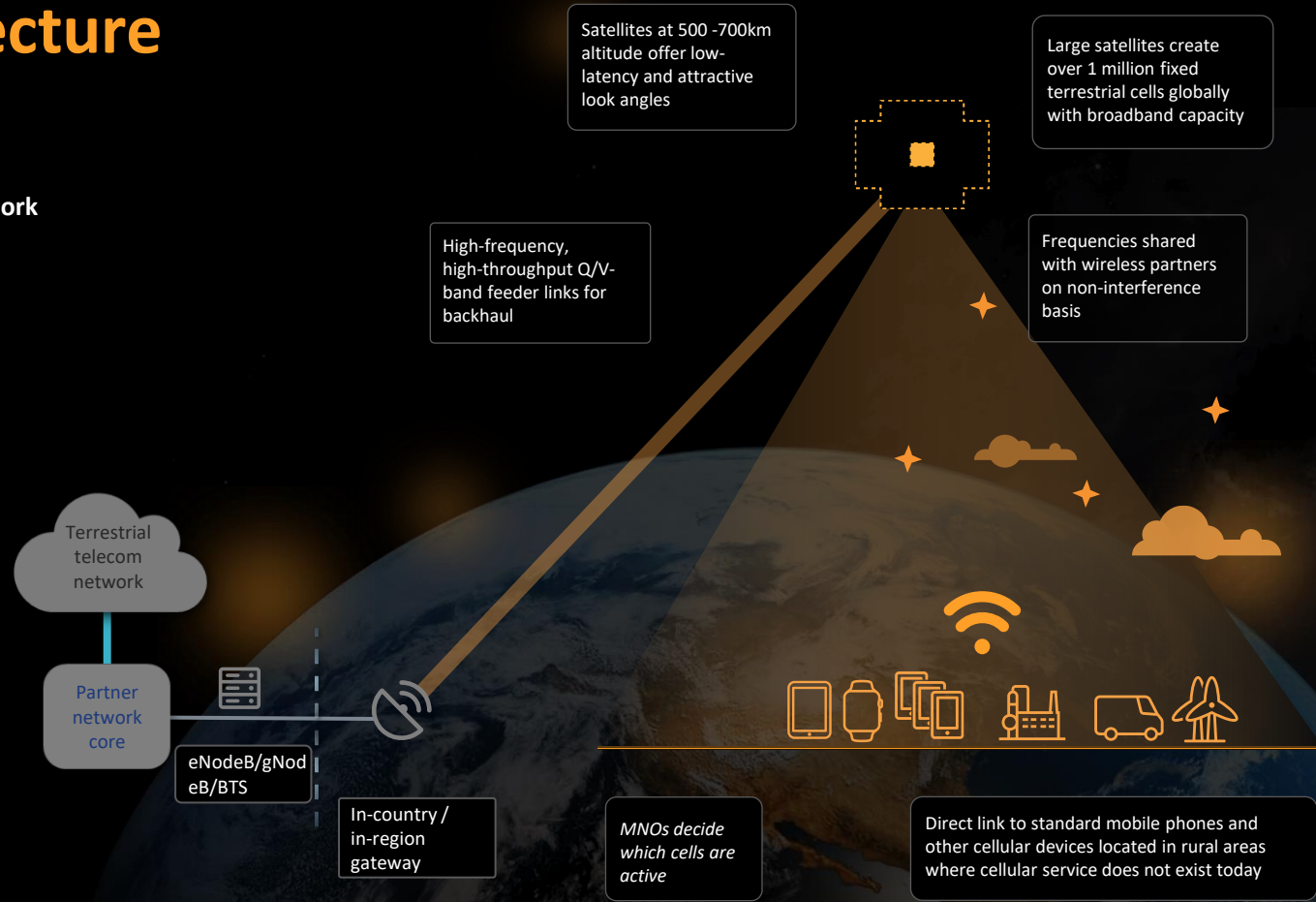
# Technology Overview



# Flexible Architecture

## Seamless integration to MNO Core Network

- Connect to unmodified standard user equipment (UE)



# Nationwide KSA Coverage with AST SpaceMobile Using the MNO's Licensed Spectrum



Map data according to gsm

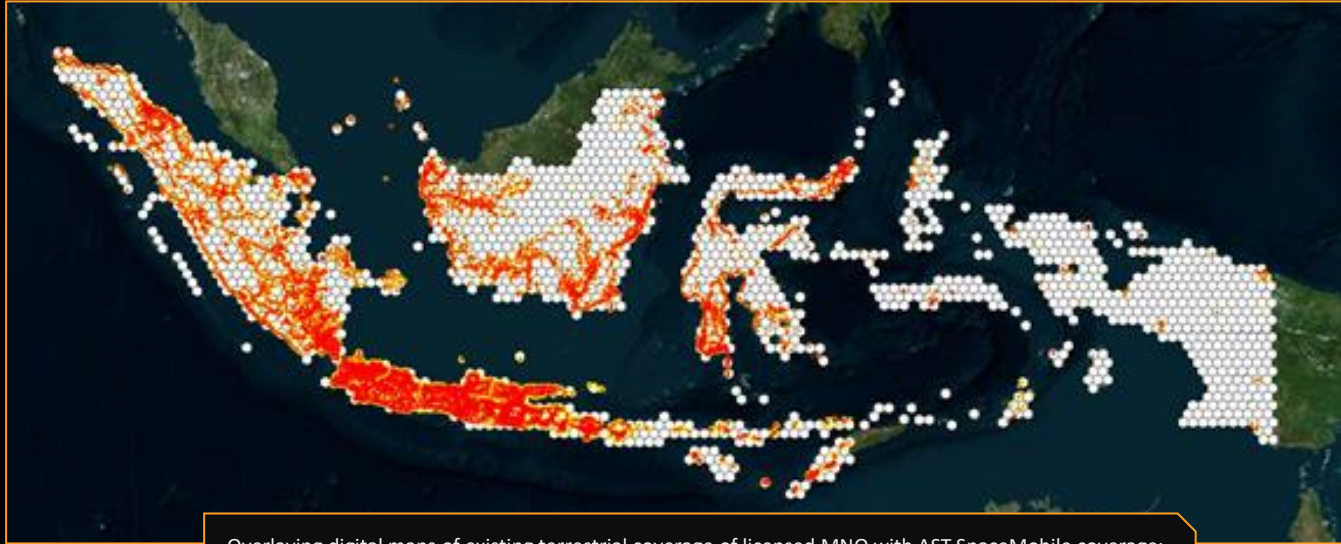


Sample SpaceMobile Cell Mapping



Countrywide 2G, 4G LTE and 5G coverage

# Sample Cell Mapping



Overlaying digital maps of existing terrestrial coverage of licensed MNO with AST SpaceMobile coverage; cell by cell evaluation what SpaceMobile cell to "switch on" and what to "switch-off" (RF interference management)



# Draft Commercial Products and Use Cases



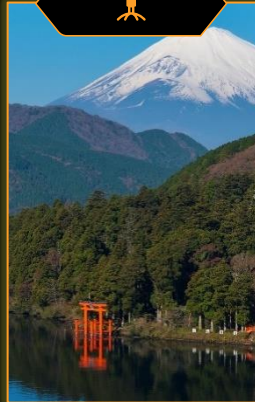
Space ad hoc



Space:  
'wherever You  
Go'



Disaster  
recovery: SOS  
broadband



Rural 5G  
coverage



IoT



Maritime



Ministry of  
Defense  
applications

# Regulatory Highlights

USA	ITU	Regulatory Authorizations
<ul style="list-style-type: none"><li data-bbox="88 352 504 547">14 March 2024 FCC formally adopts NPRM for Supplemental Coverage from Space (SCS) – will allow MNOs, AT&amp;T to offer spectrum use to AST to extend terrestrial coverage from Space</li><li data-bbox="88 590 504 680">2 August 2024, FCC granted V Band Market Access for Block 1 Satellites</li></ul>	<ul style="list-style-type: none"><li data-bbox="571 345 944 372">AST ITU filings to flag as USA</li><li data-bbox="571 412 1006 472">AST ITU filings previously done by NICTA in PNG</li><li data-bbox="571 513 996 540">Multiple ITU Filings for Q/V band</li></ul>	<p data-bbox="1174 350 1630 377">Received approvals in several countries.</p> <p data-bbox="1174 470 1599 530">Authorization processes underway in Multiple jurisdictions globally</p>

# Regulatory Issues

## Out Of Band Emissions OOBE

- FCC limit of -120 dBW/m<sup>2</sup>/MHz

## AST SpaceMobile meets and exceeds criterion due to:

- Phased Array design meets 3GPP most stringent requirement of 45 dB ACLR for formed beams \*\* key to meeting OOBE
- Supported by SSPA design/on board DPD
- Large antenna aperture size for sharp roll-off/low sidelobes
- High gain supporting high throughput with adequate CFR for SSPAs



# Satellite and mobile policy: Opportunities

## Social and Economic Benefits: Achieving the UN SDGs



# Social and Economic Benefits

the UN SDGs



## THE FACTS

- | In 2015 the UN set 17 Sustainable Development Goals, which were intended to be achieved by 2030
- | Progress has been made, but challenges remain - national governments and the wider international community now recognize that the world is not on track to deliver the 2030 Agenda for Sustainable Development
- | We urgently need to extend mobile connectivity to those who remain unconnected
- | The poorest and most vulnerable are disproportionately affected by remaining unconnected

- | An increase of 1 per cent in mobile broadband penetration yields a 0.15 per cent increase in GDP
- | Mobile broadband appears to have a larger economic impact than fixed broadband: a 1 per cent increase in mobile broadband penetration yields a 0.15 per cent increase in GDP, versus a 0.08 per cent increase when fixed\*

## THE SOLUTION

- | Embrace innovative communications technologies
- | Align national government policy and regulatory frameworks to accelerate realization of the UN's connectivity goals

# Getting Everyone Online

BROADBAND OPPORTUNITIES AND CHALLENGES



**Accelerated adoption of digital services, e-Gov, e-commerce, e-learning, e-medicine- Currently 5.4 billion people online :**

- Internet users grew by over 260 million users in 2023
- Global mobile connections to increase 10% by 2030
- Demand growth illustrated internet access is a necessity (not a luxury)



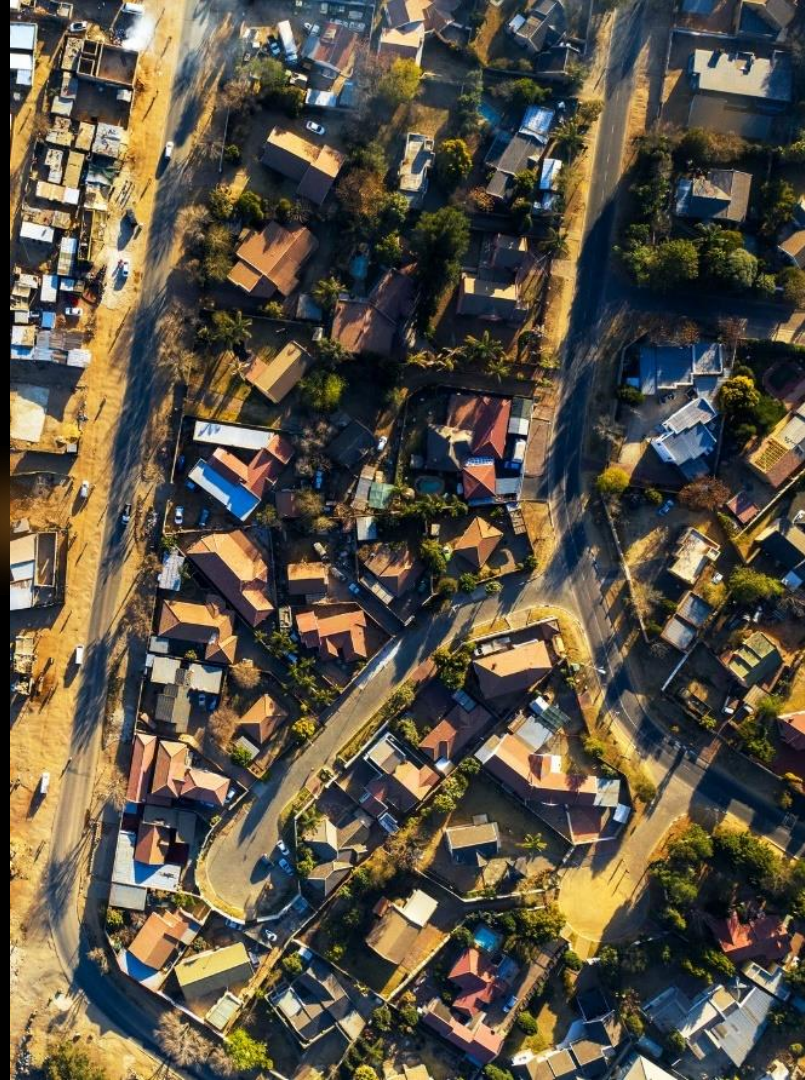
**Still a massive digital divide, with 2.6 billion people (1/3 of population) lacking broadband access:**

- 5% of worlds' population remains in a broadband coverage gap
- In 2023, Internet use was 93% in high-income countries, 55% in LMICs but just 35% in the LDCs
- Disparity in affordability of broadband in high-income countries and LDC's

# Connecting Rural Communities

What LEO satellite Broadband can Achieve

- | Affordable 2G and 4G LTE, 5G broadband wireless services nationwide
- | Broadband access for e- services: learning , telehealth, Govt services
- | Financial inclusion
- | Remote working
- | Reducing the digital divide and accelerating digital transformation



# Closing Remarks



LEOs offer opportunities for low latency broadband connectivities for unconnected communities, emergency responses, IoT, Comms on the move



Include LEOs Satellite Direct to Device technologies in your National Broadband connectivity Plans



Policy makers and Regulators will need to adopt new regulatory approaches to harvest the benefits of Satellite Direct to Device Technologies



## Trademarks and Trade Names

The information in this presentation and the oral statements made in connection therewith includes “forward-looking statements” that are not historical facts, and involve risks and uncertainties that could cause actual results of AST SpaceMobile to differ materially from those expected and projected. These forward-looking statements can be identified by the use of forward-looking terminology, including the words “believes,” “estimates,” “anticipates,” “expects,” “intends,” “plans,” “may,” “will,” “would,” “potential,” “projects,” “predicts,” “continue,” or “should,” or, in each case, their negative or other variations or comparable terminology.

These forward-looking statements involve significant risks and uncertainties that could cause the actual results to differ materially from the expected results. Most of these factors are outside AST SpaceMobile’s control and are difficult to predict. Factors that may cause such differences include, but are not limited to: (i) expectations regarding AST SpaceMobile’s strategies and future financial performance, including AST’s future business plans or objectives, expected functionality of the SpaceMobile Service, anticipated timing and level of deployment of satellites, anticipated demand and acceptance of mobile satellite services, prospective performance and commercial opportunities and competitors, the timing of obtaining regulatory approvals, ability to finance its research and development activities, commercial partnership acquisition and retention, products and services, pricing, marketing plans, operating expenses, market trends, revenues, liquidity, cash flows and uses of cash, capital expenditures, and AST’s ability to invest in growth initiatives; (ii) the negotiation of definitive agreements with mobile network operators relating to the SpaceMobile service that would supersede preliminary agreements and memoranda of understanding; (iii) the ability of AST SpaceMobile to grow and manage growth profitably and retain its key employees and AST SpaceMobile’s responses to actions of its competitors and its ability to effectively compete; (iv) changes in applicable laws or regulations; (v) the possibility that AST SpaceMobile may be adversely affected by other economic, business, and/or competitive factors; (vi) the outcome of any legal proceedings that may be instituted against AST SpaceMobile; and (vii) other risks and uncertainties indicated in the Company’s filings with the SEC, including those in the Risk Factors section of AST SpaceMobile’s Form 10-K filed with the SEC on March 31, 2022.

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The logo for AST SpaceMobile is set against a dark space background with a glowing orange arc. The text 'AST' is in white, and 'SpaceMobile' is in orange. The background features a dark blue/black sky with numerous small white stars and a prominent, bright orange arc that curves from the top center towards the bottom right corner.

**AST** SpaceMobile