



The bridge to possible

Securing Starlink Communications

Andrew Benhase, Federal Architect
@CyberSecOps, @ThreatCowboy

Cisco Webex App

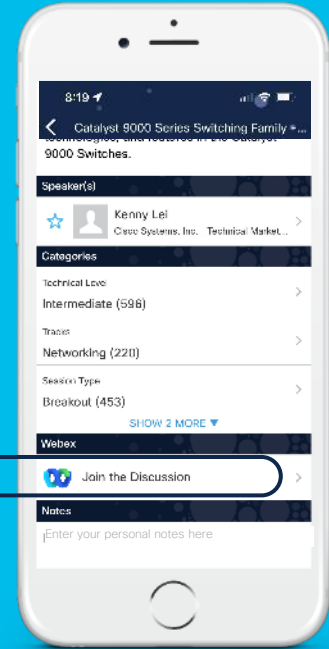
Questions?

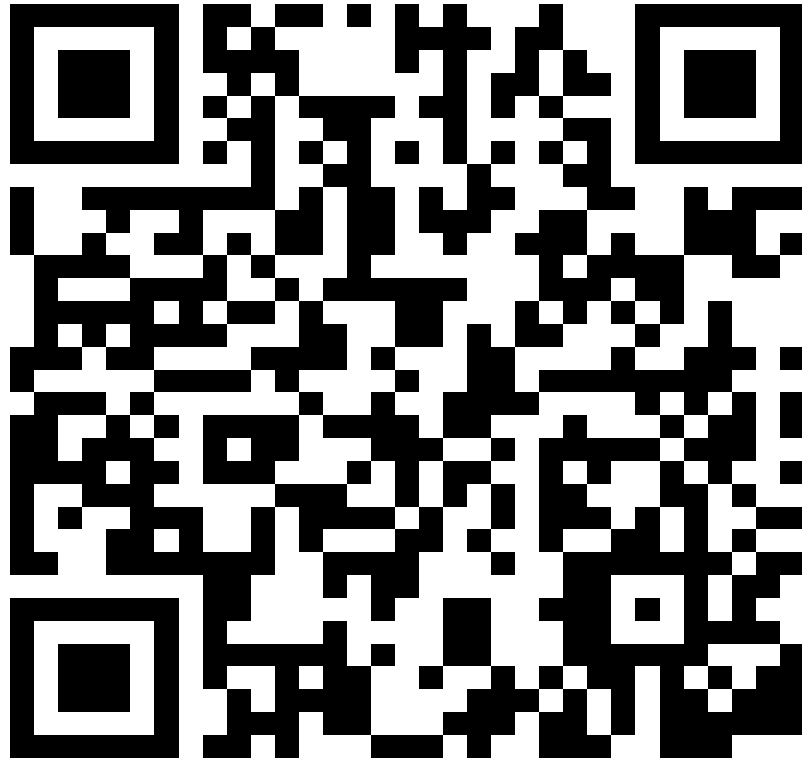
Use Cisco Webex App to chat with the speaker after the session

How

- 1 Find this session in the Cisco Live Mobile App
- 2 Click “Join the Discussion”
- 3 Install the Webex App or go directly to the Webex space
- 4 Enter messages/questions in the Webex space

Webex spaces will be moderated until February 24, 2023.





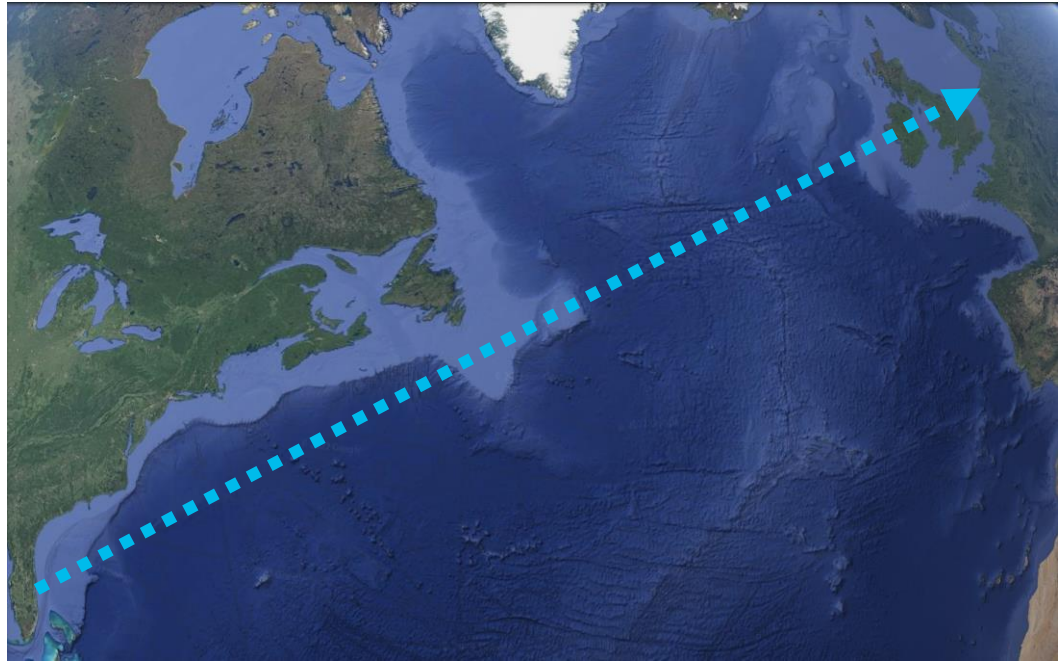
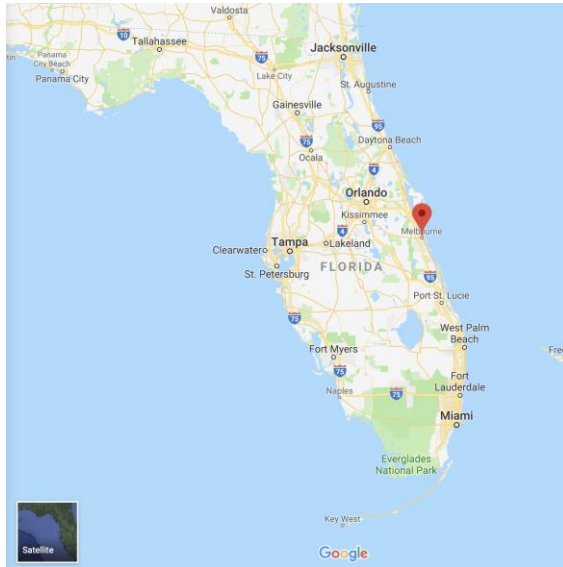
What I do here @cisco

- Federal Security Architect
- At Cisco >23 years, supporting US Federal Government
- 31 years primarily supporting US Defense, Civilian and Intelligence Communities
- Deep focus on defensive cyber operations, advanced encryption, making security work!
- My first Networkers was in 1995...
- <https://www.linkedin.com/in/andrewbenhase/>



@CyberSecOps
@ThreatCowboy
abenhase@cisco.com

From MLB to AMS





Space-X Heav



Agenda

- Orbital Mechanics 101
- What is Starlink today?
- How does Cisco work with Starlink?
- Securing Starlink
- Things you need to know

Latest News Updates



Latest News – @ CL EME

Starlink enters the African market with first launch in Nigeria



2 Feb 2023



Nigeria has become the first country in Africa to see a commercial launch of satellite broadband services by Starlink, the satellite internet business of SpaceX. The firm's Low Earth Orbit (LEO) satellites are designed to offer high speed, low latency broadband internet in remote and rural locations across the globe. The service is currently priced at NGN19,260 (USD41.8) per month, while hardware costs NGN268,584.

As [previously reported by TeleGeography's CommsUpdate](#), Starlink received licences to operate in Nigeria and Mozambique in May last year, marking the start of the company's expansion to Africa. The Nigerian Communications Commission (NCC) confirmed that Starlink received two licences – a ten-year international gateway licence and a five-year ISP



Center for Oldest Ice Exploration
@COLDEX_STC



Despite 30 knot winds at the Allan Hills, Antarctica, where ice cores up to 2,700,000 years old have been found, [@SpaceX](#) Starlink continues to give the [@NSF](#)-supported COLDEX team unprecedented connectivity! [@blueicehiggins](#) [@icy_pete](#)



USIceDrillingProgram and 6 others

3:06 PM · Dec 5, 2022

Latest News – @ CL EMEA

SECURED SATELLITE NETWORK FOR GOVERNMENT ENTITIES

Starshield leverages SpaceX's Starlink technology and launch capability to support national security efforts. While Starlink is designed for consumer and commercial use, Starshield is designed for government use, with an initial focus on three areas:



EARTH OBSERVATION

Starshield launches satellites with sensing payloads and delivers processed data directly to the user.



COMMUNICATIONS

Starshield provides assured global communications to government users with Starshield user equipment.



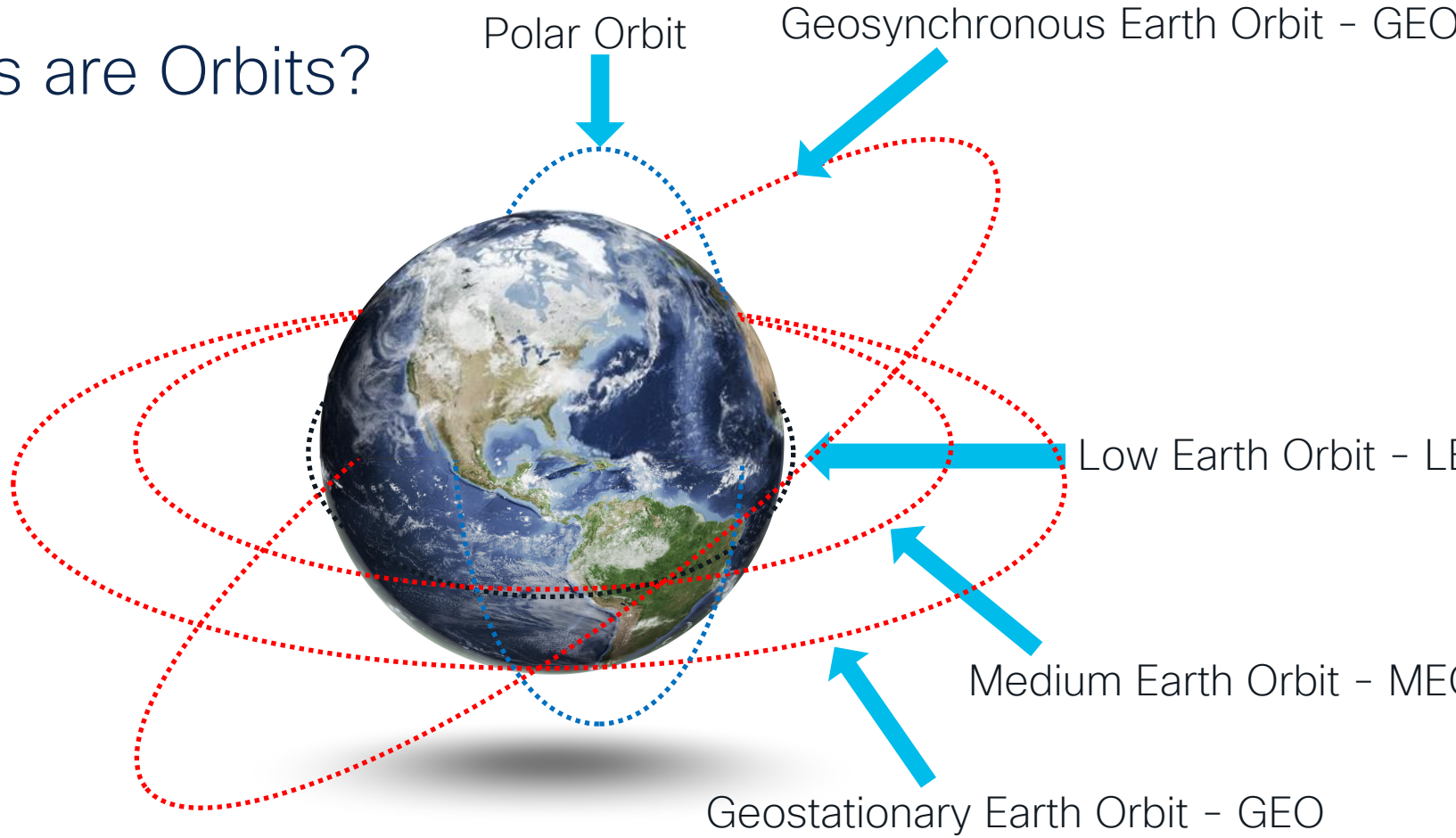
HOSTED PAYLOADS

Starshield builds satellite buses to support the most demanding customer payload missions.

Orbits are orbits right?



Orbits are Orbits?



Hey Andrew, this is CiscoLive....
Why do I need to know about
physics, orbits, altitudes and
latency?



Answer: Because this is an
Engineering discussion, not a
sales and marketing pitch 😊



Speed of Light in a Vacuum

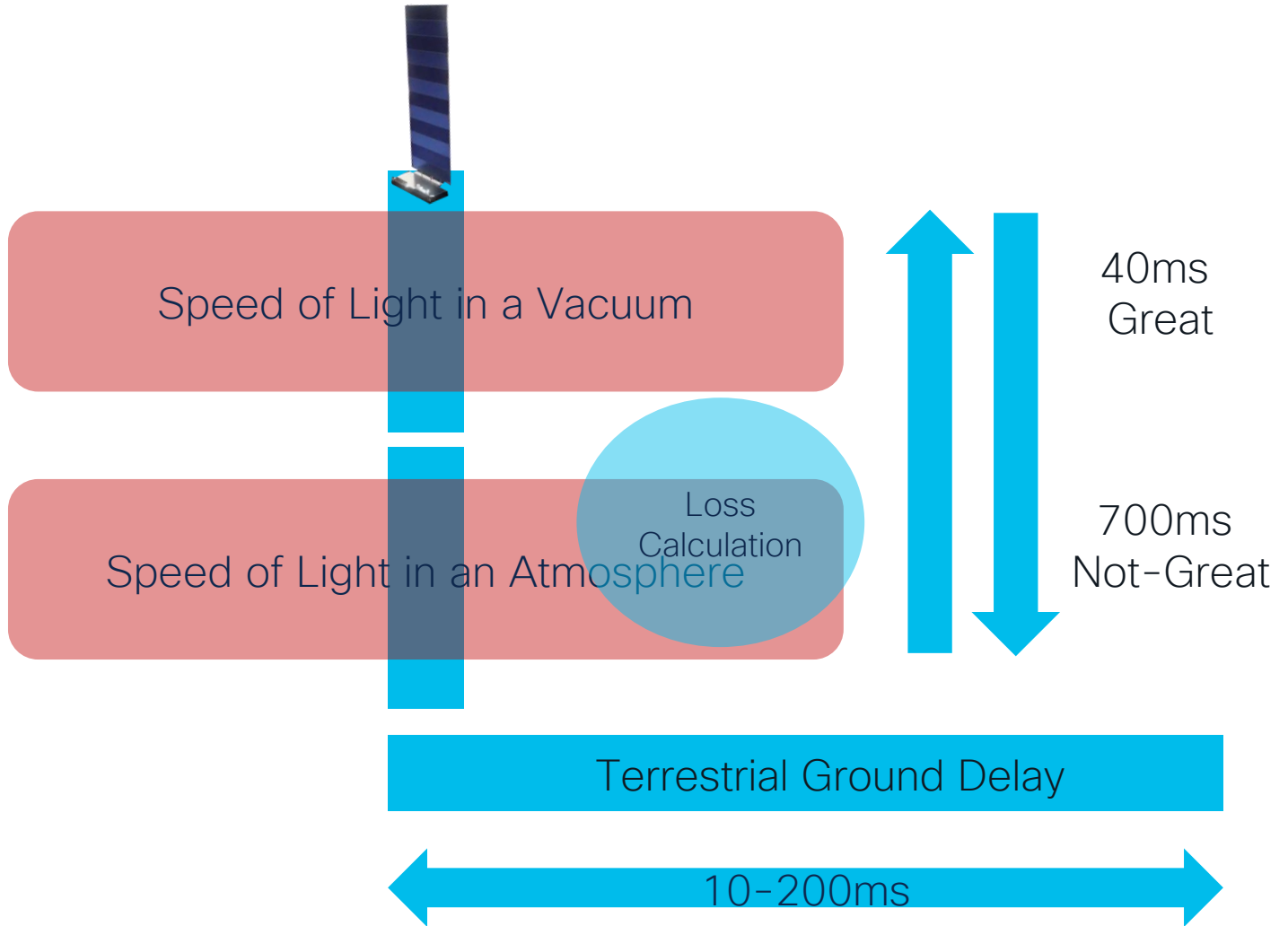
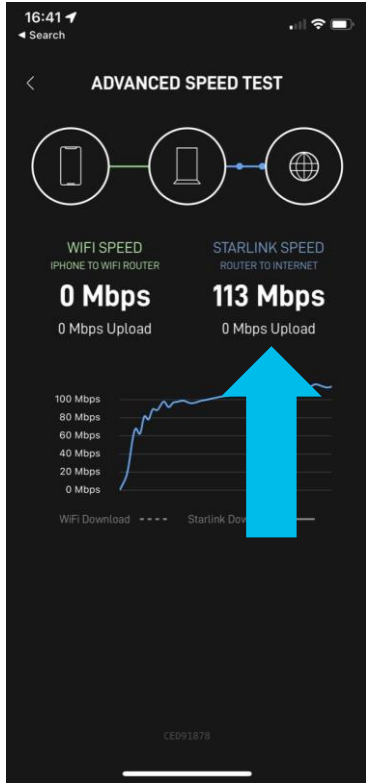
$$c = v\lambda$$

Light (Photons)

Frequency

Wavelength

300,000 km/s



Orbits and Networking

- LEO – 1000 kilometers and below
 - Starlink 540km (345 miles)
 - One way latency – ~12-25ms
 - RTT – ~25-50ms

- MEO – 8000 kilometers (5,000 miles)
 - ~RTT 350ms

- GEO – 36,000 kilometers (22,000 miles)
 - ~RTT 725ms



Happy Network
Zone



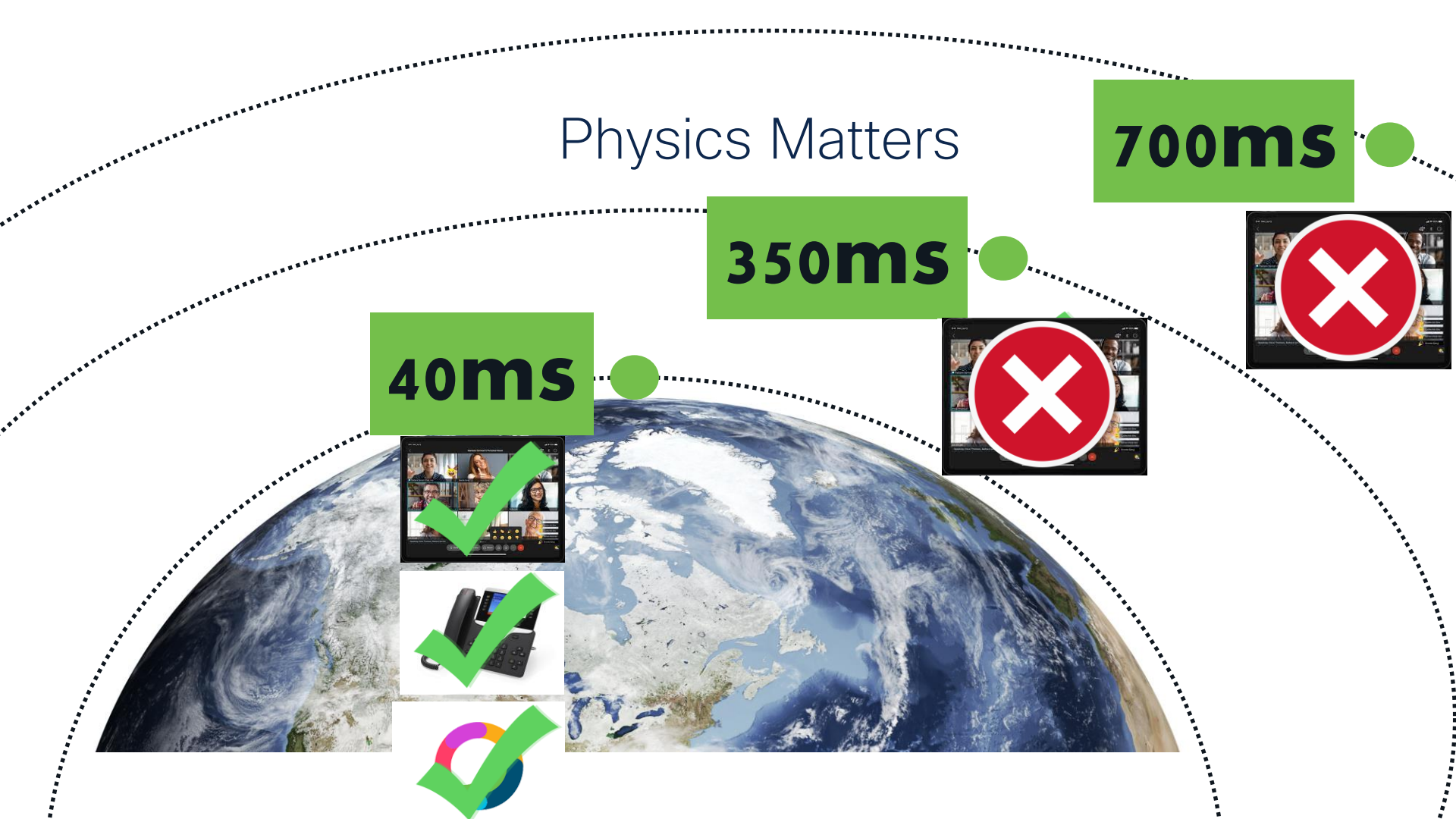
Sad Network Zone

Physics Matters

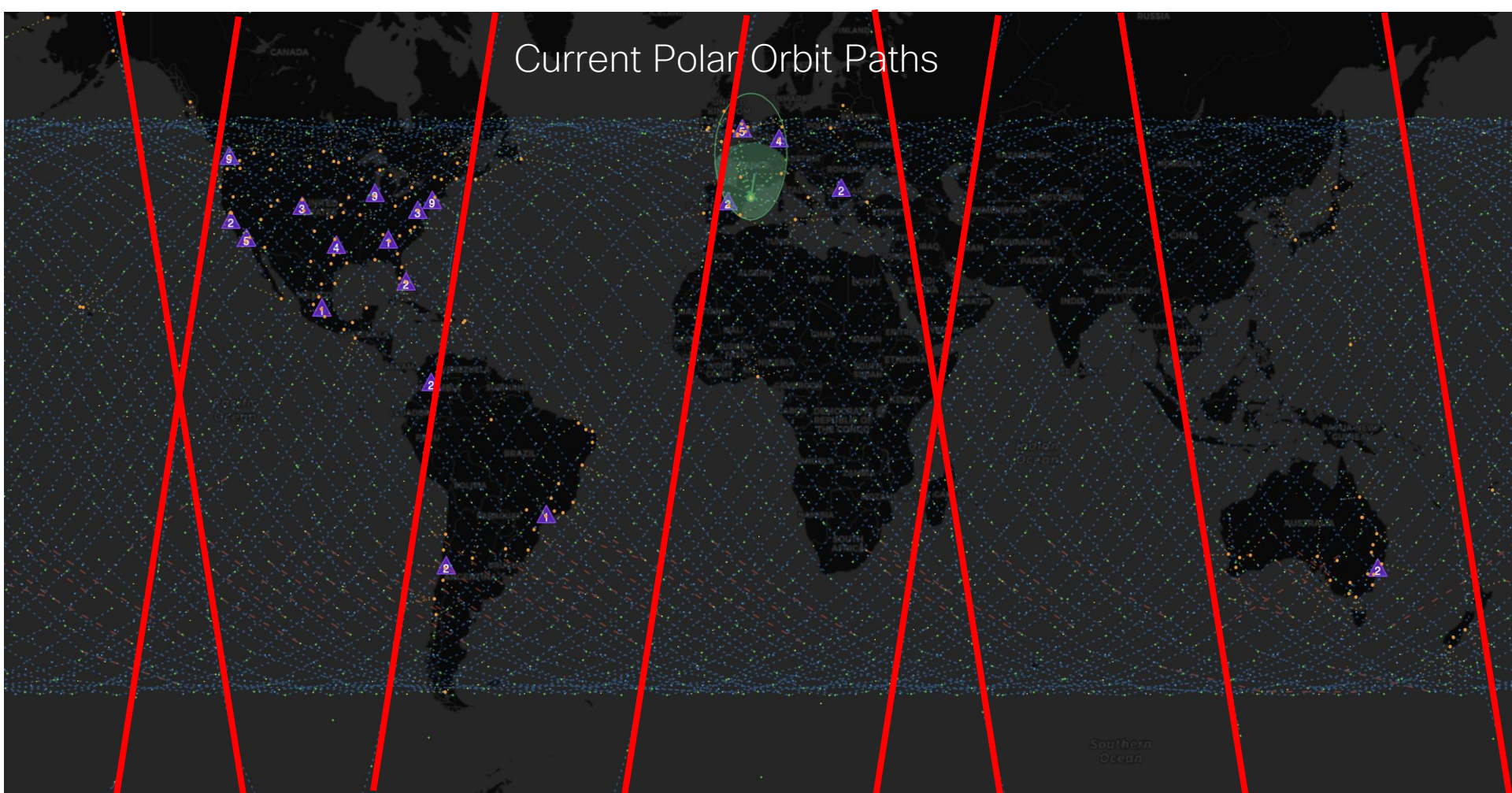
700ms

350ms

40ms



Current Polar Orbit Paths

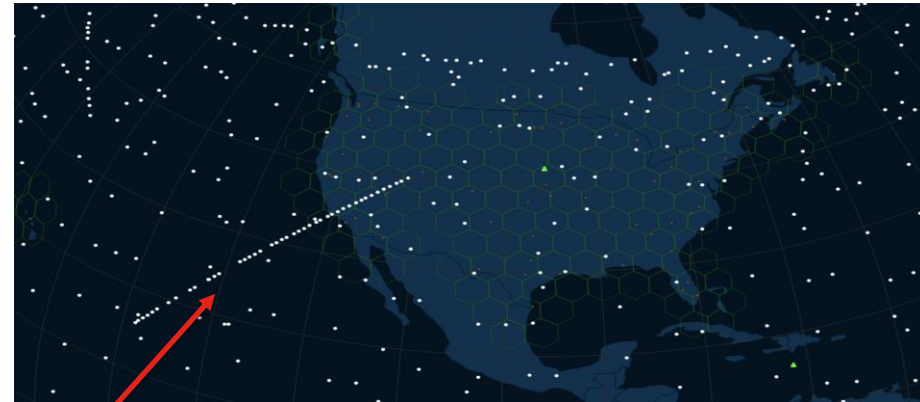
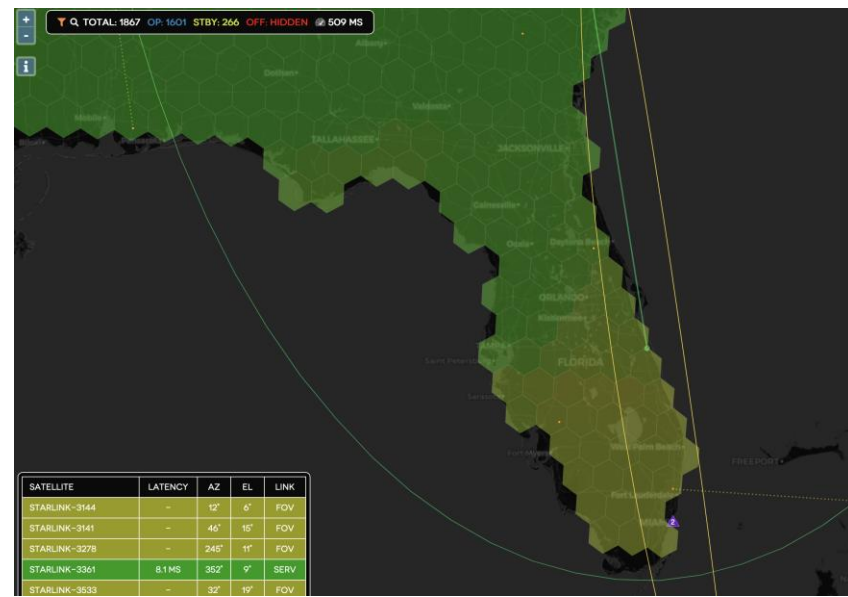
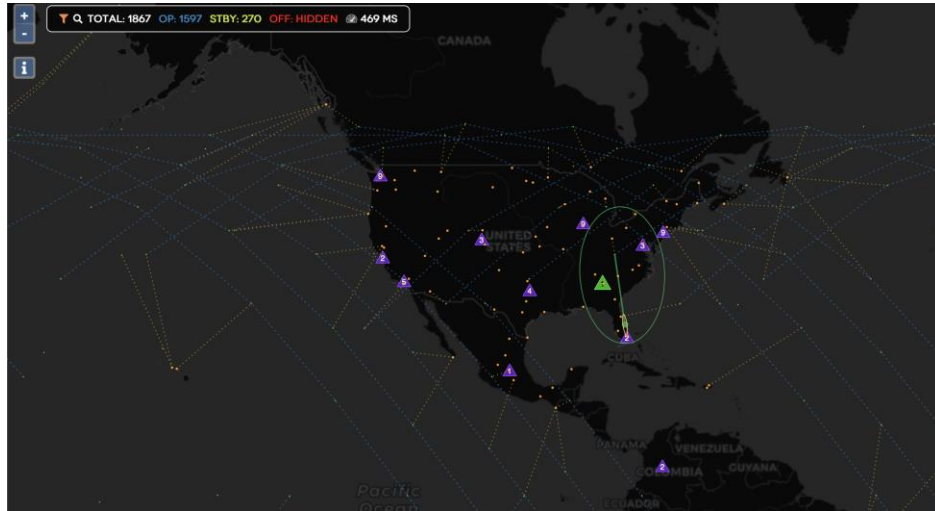


What is Starlink?



What is Starlink?

- A global satellite network in Low Earth Orbit currently consisting of ~3000 satellites*



*groups of 53 being launched on a regular basis

Disclaimer

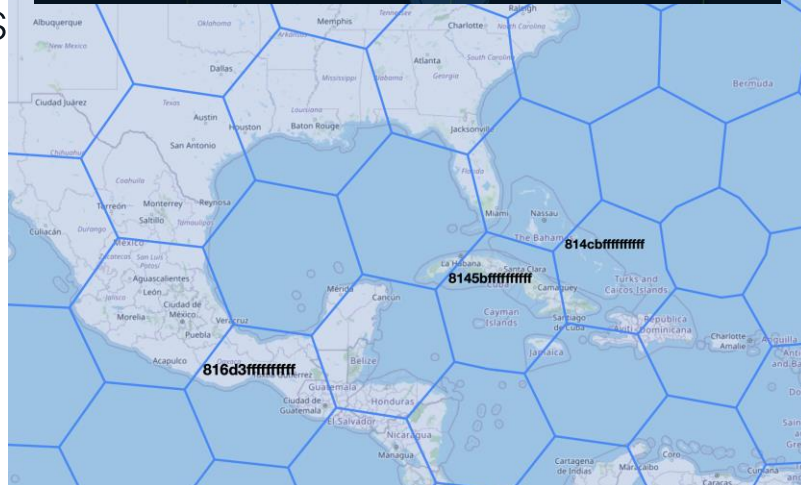
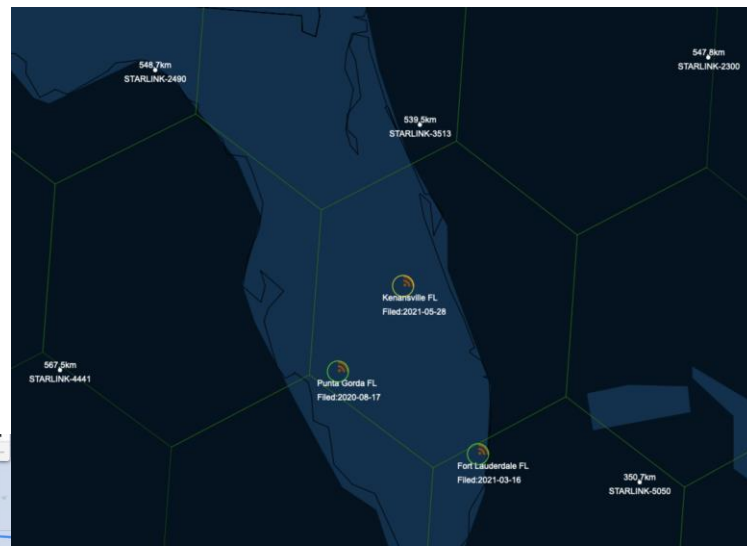
- **Starlink.sx**

Designed by Mike Puchol, who states this site is NOT affiliated with Starlink or SpaceX. Link is <https://starlink.sx/>

- It is an excellent website to help understand satellite movement, tracking and orbital mechanics
- Many of the screenshots are from starlink.sx simulation – it is not a Starlink sponsored tool – that said...orbital calculations are really just math...and positions are published
- These are assumptions based on collected knowledge, Starlink does not publish any of this information – for obvious reasons

H3 Geospatial Mapping

- H3 is a geospatial indexing system that partitions the world into hexagonal cells
- Each Hexagonal Grid is mapped into ~8000 hexagonal sections for each Satellite Radio Footprint
- Opensource Mapping System
 - <https://h3geo.org>



Basic Orbital Mechanics

- FCC Approval for 12,000 satellites
- Starlink Satellites operate in five primary defined orbital shells at between 550km-570km in altitude
 - First shell: 1,440 in a 550 km (341.8 mi) [altitude](#) shell at 53.0° inclination
 - Second shell: 1,440 in a 540 km (335.5 mi) shell at 53.2° inclination
 - Third shell: 720 in a 570 km (354.2 mi) shell at 70° inclination
 - Fourth shell: 336 in a 560 km (348.0 mi) shell at 97.6° inclination
 - Fifth shell: 172 satellites in a 560 km (348.0 mi) shell at 97.6° inclination

Satellite

- Each satellite features four antennas in Ku band, one for uplink, three for downlink
- Each antenna is capable of projecting eight beams in two polarizations (RHCP/LHCP), for a total 48 downlink beams and 16 uplink beams.
- The maximum bandwidth available to Starlink in Ku band is 8x 250 MHz channels in downlink (total 2 GHz), and 8x 62.5 MHz channels in uplink (total 500 MHz)
- Each Satellite nominally operates at 10Gbps capacity with future expansion to 20Gbps

Faced towards Ground



Credit: Starlink



Infrared “Space Lasers”

- 3 Beam Optical Head using Infrared Laser
- Same Orbital Plane Operation
- Theoretically could offload to parallel polar plane satellite



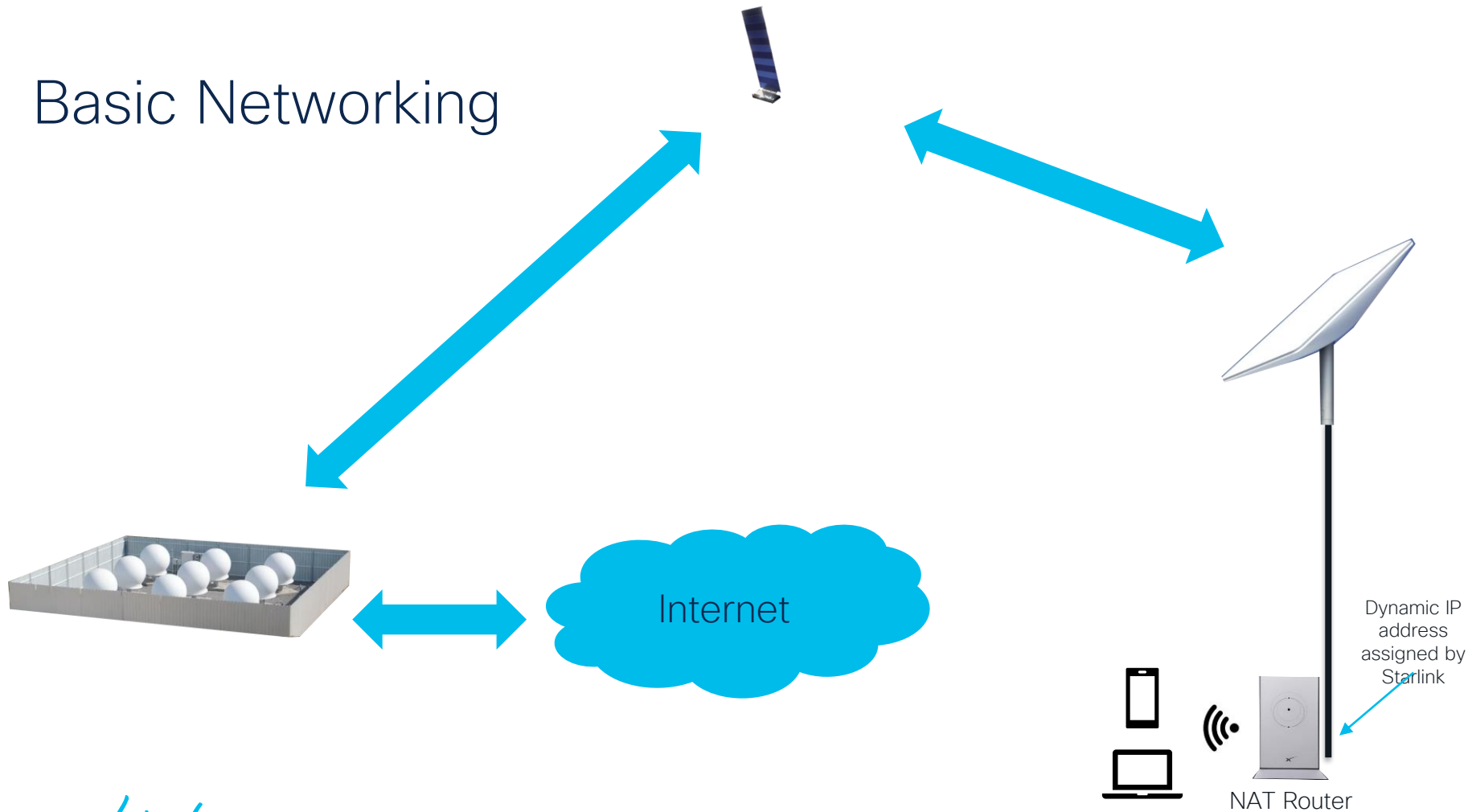
Credit: SpaceX/Starlink

Ground Station

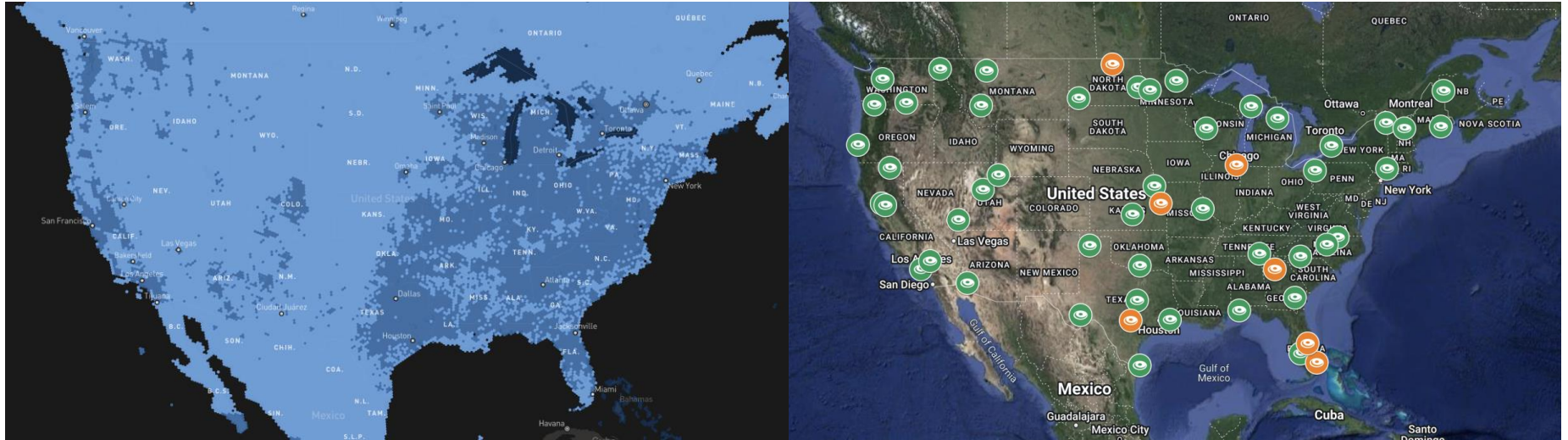
- Each gateway antenna has available a maximum of 4x 500 MHz channels (total 2 GHz) in uplink, and 5x 250 MHz channels (total 1.25 GHz) in downlink
- In this configuration – where 8 antennas are active – would be 10Ghz total active Down and 6Ghz Up per site
- Ground stations are positioned on top of existing Fiber Paths
- Each Parabolic Antenna can support 10Gbps x 2)
- So that's up to 1.6Tbps theoretical bandwidth for a site with 8 active



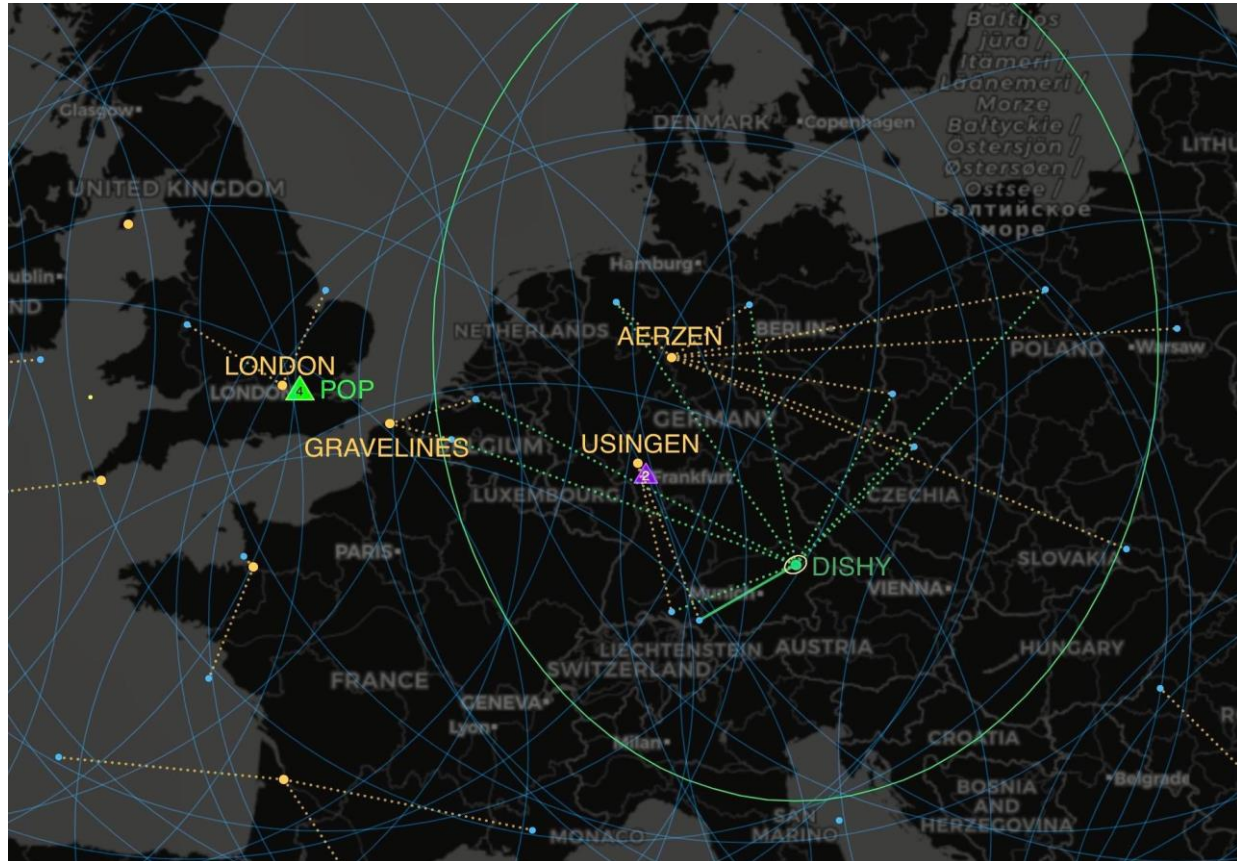
Basic Networking



US Gateway Locations



EMEA Gateway Locations

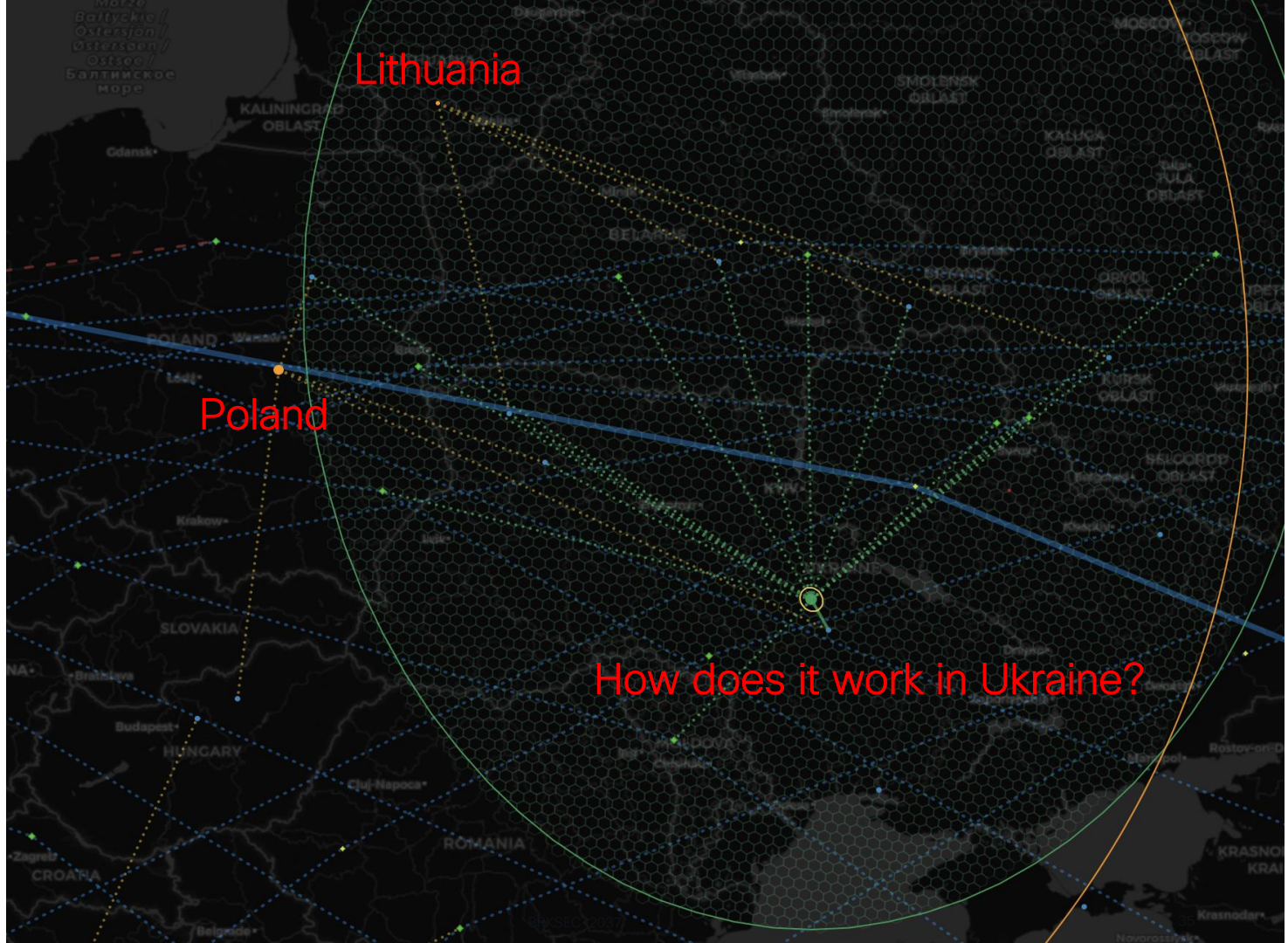


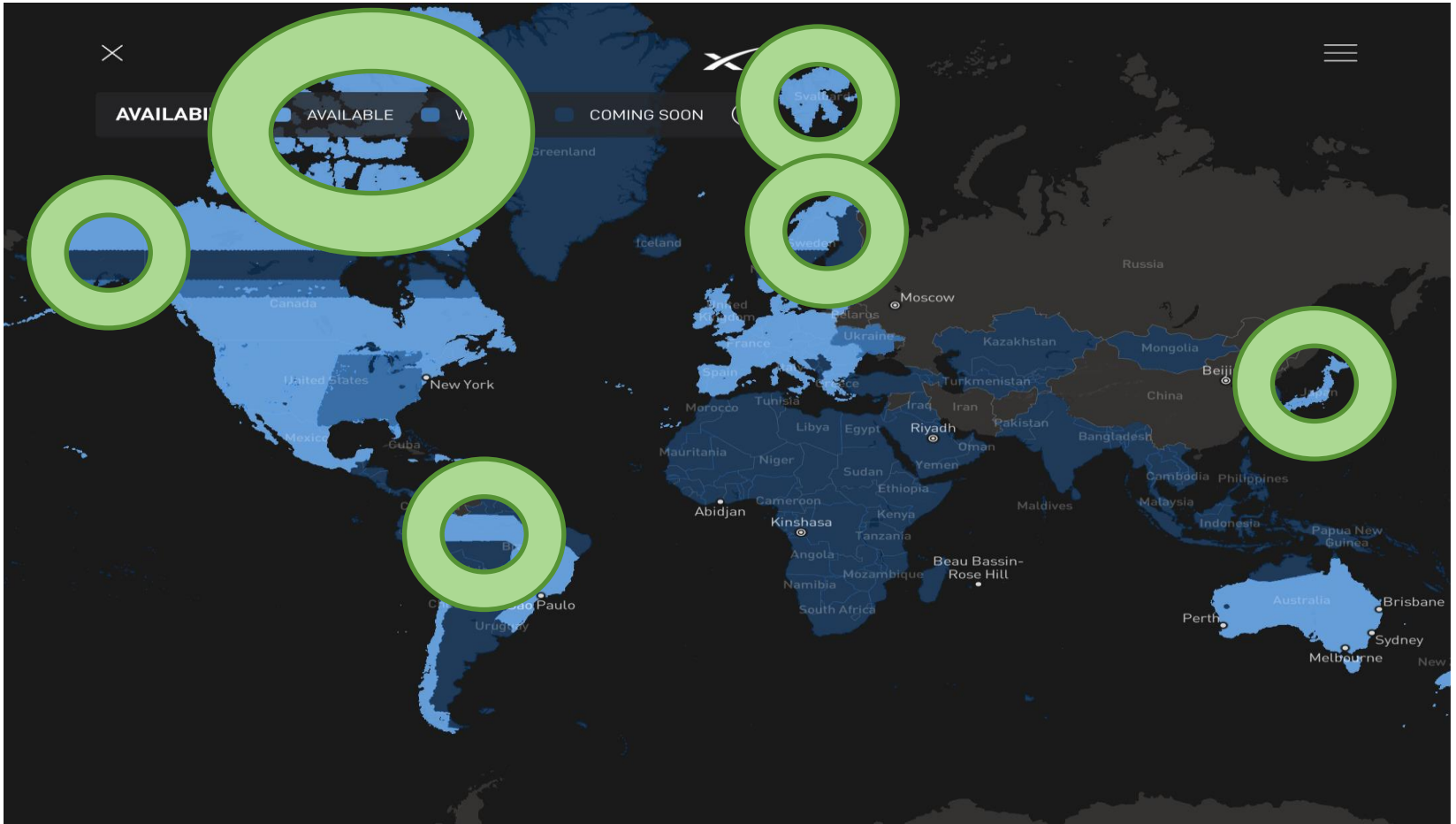
Radio Gateways

Lithuania
Poland

Internet Gateways

Frankfurt
London







STARLINK

RESIDENTIAL

BUSINESS

RV

MARITIME

AVIATION

IOT

AVAILABILITY



AVAILABLE



WAITLIST



COMING SOON



Things we know

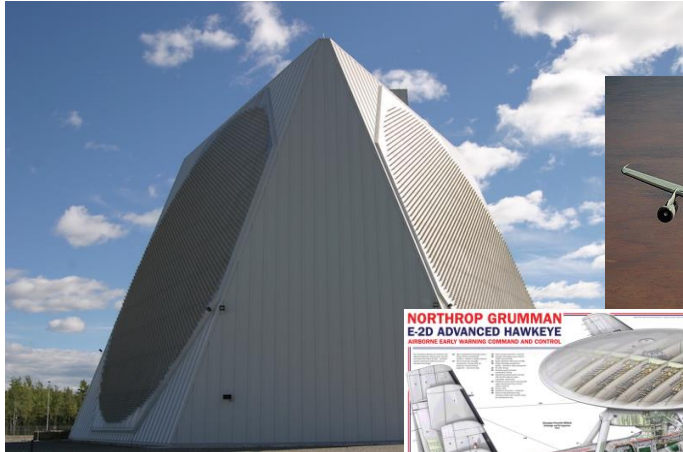
- Dense Orbital shells are extremely robust
- Frequency shifts can be simple software operations
- Receive only satellite arrays are critically important
- Low observability packages are important
- Low cost Software Defined Radios (SDRs) are being used for offensive hunt operations

Phased Array Antenna



Examples of Phased Arrays

- Space Observation Radar

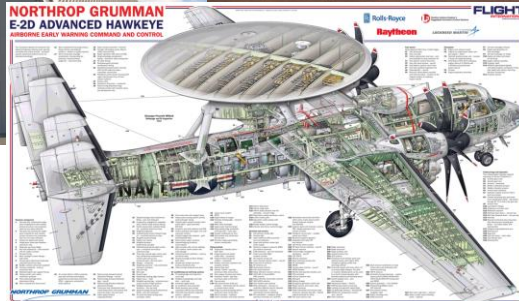


E-3 Sentry
AWACS



- AN-SPY-1 Phased Array

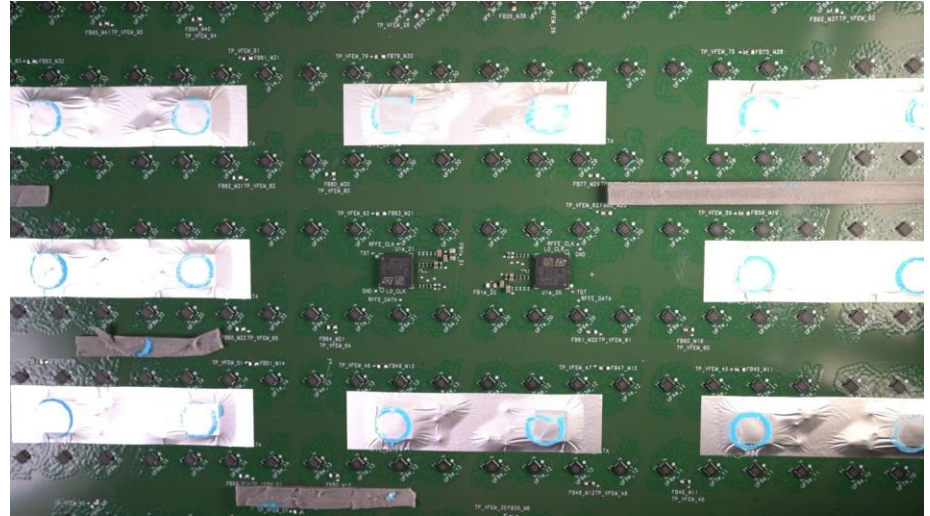
- AEGIS Deployed and Ashore



E-2D
Early Warning

How does Starlink work?

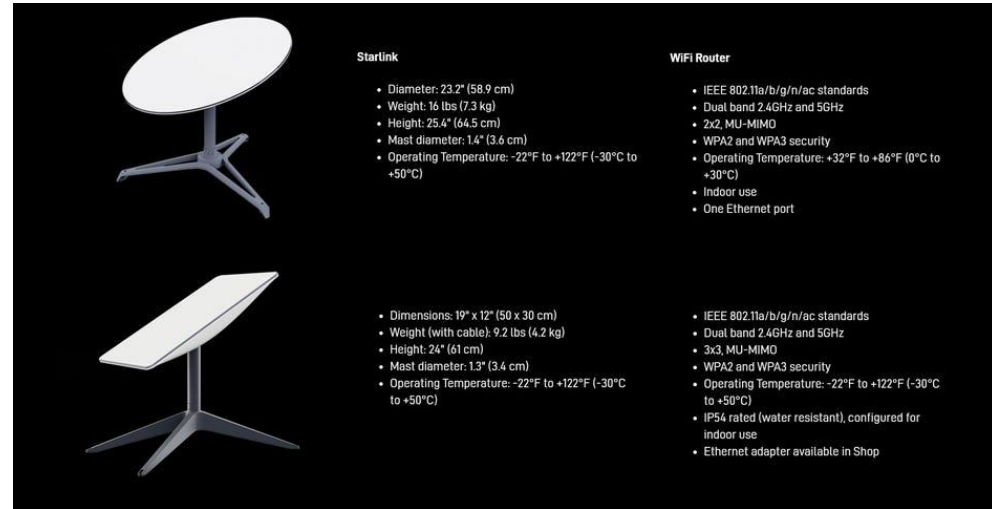
- Up / Down configuration
- Ground Terminal is a phased array antenna in one of two current configurations – Round (Gen1) or Rectangle (Gen2)
- Each array has hundreds of transceivers



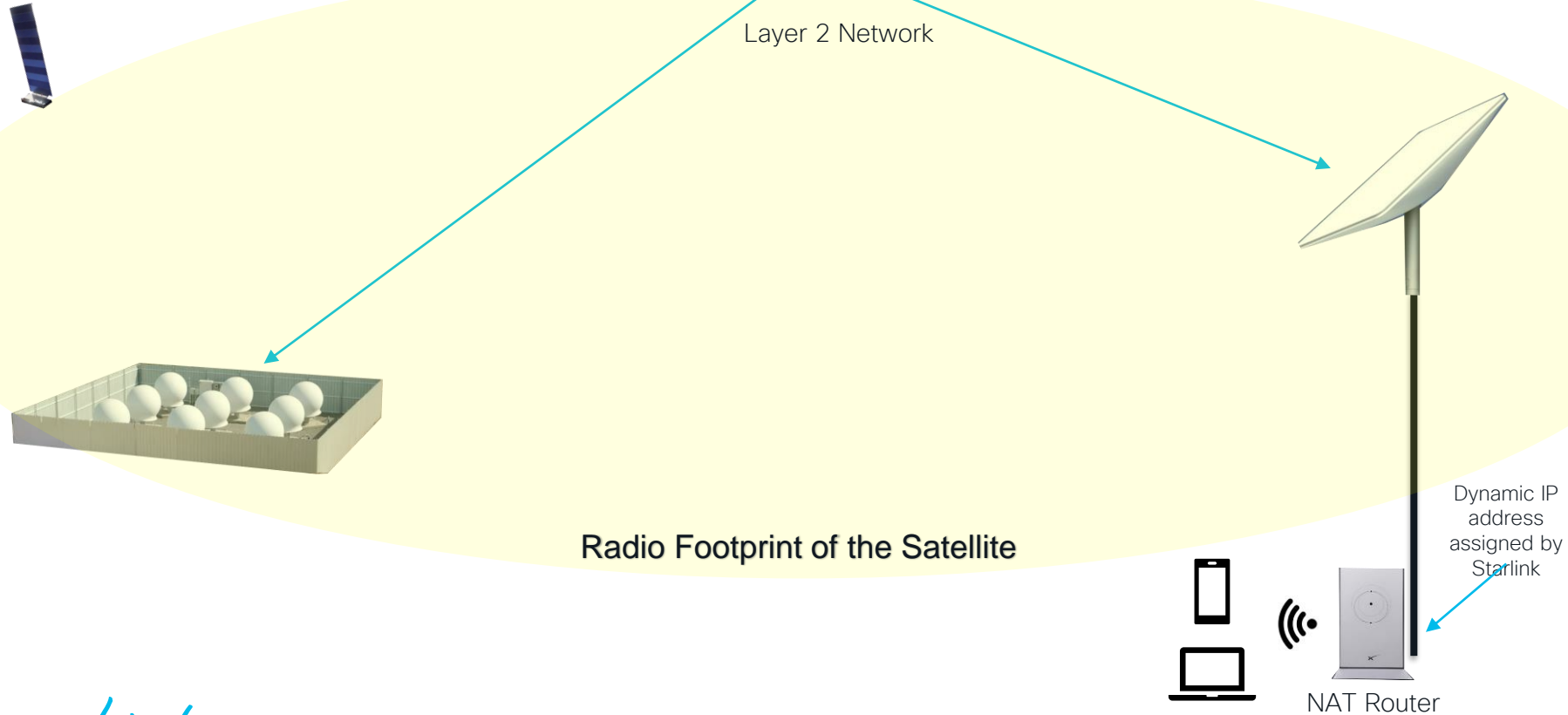
- [12-18 and 26.5-49 GHz bands](#)

Ground Terminal

- Phased Array Antenna
- Starlink Router (more on that later)
- Ethernet Cable with proprietary ends



Basic Networking



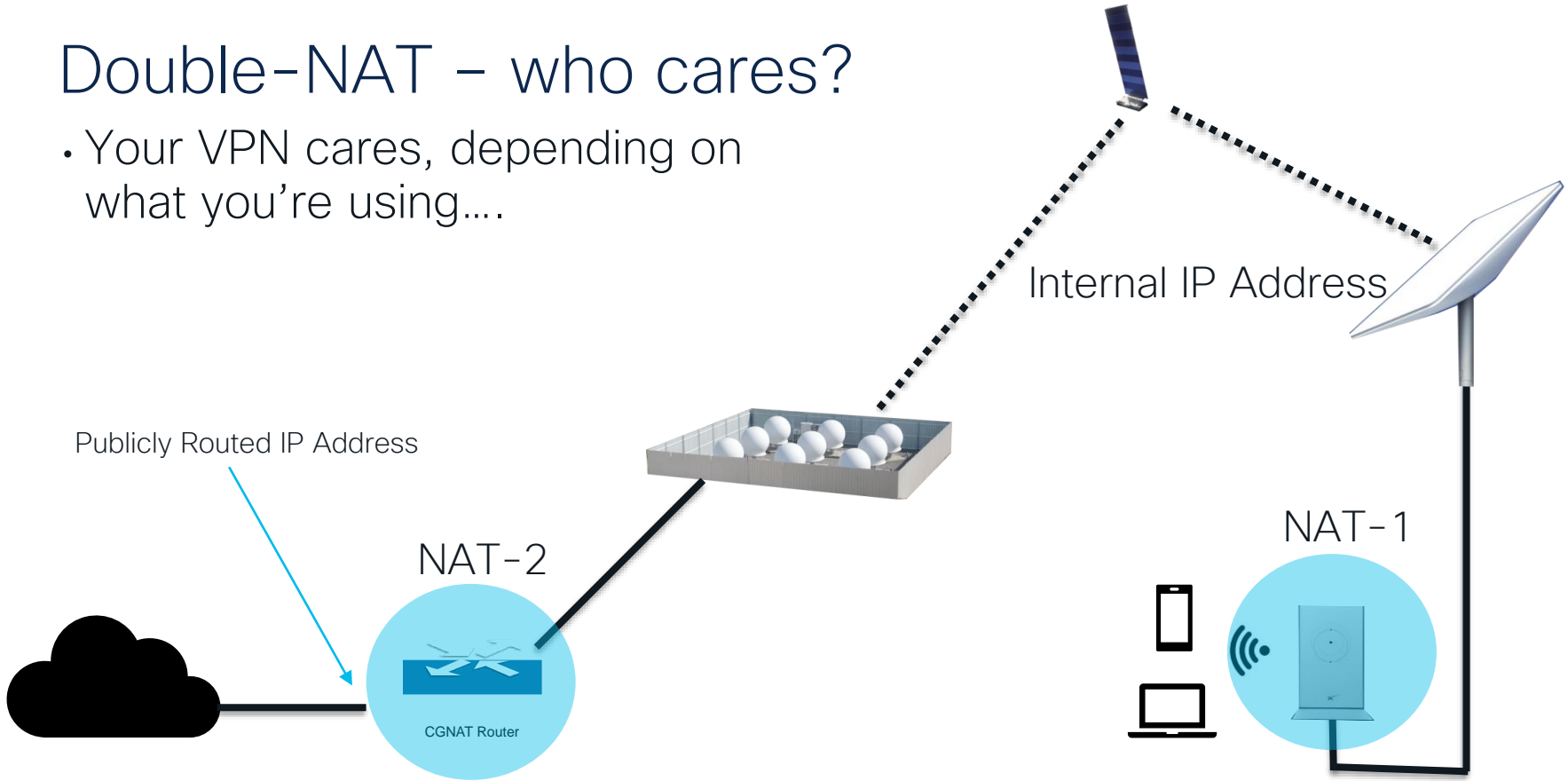
Starlink Router

- Micro Linux Router
- NAT Operations
- 60 second boot time
- 192.168.128.0 NAT Pool



Double-NAT – who cares?

- Your VPN cares, depending on what you're using....

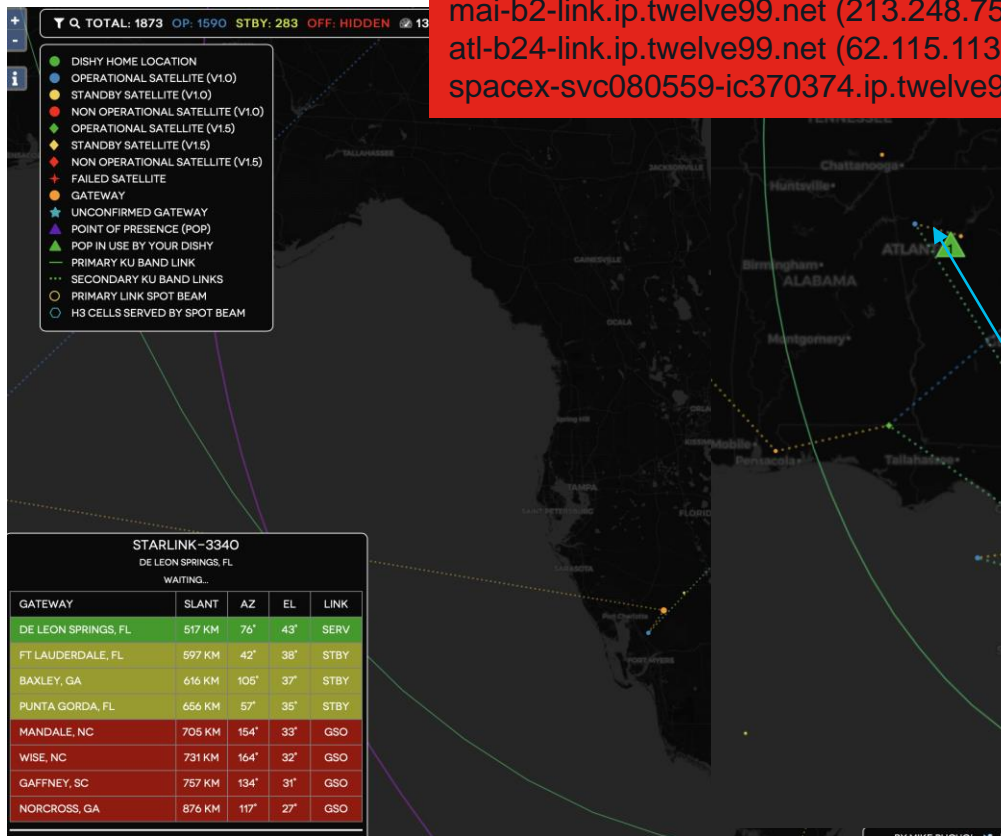


Things that Fix NAT Problems

- Static NAT configuration – impossible with Starlink and CG-NAT carriers
- GRE/IPSec+NAT-T Tunnels
- Straight NAT-T Tunnels
- IPv6
- TCP VPN Tunnels

How the network works

1 gi0-0-0-18.221.agr13.mia01.atlas.cogentco.com (66.28.3.217) 0.661 ms 0.727 ms 2 te0-5-0-1.ccr21.mia01.atlas.cogentco.com (154.54.6.57) 0.896 ms te0-0-0-11.ccr22.mia01.atlas.cogentco.com (154.54.31.229) 0.998 ms 3 be3087.ccr41.mia03.atlas.cogentco.com (154.54.88.234) 0.839 ms be3081.ccr41.mia03.atlas.cogentco.com (154.54.88.226) 0.843 ms 4 mai-b2-link.ip.twelve99.net (213.248.75.1) 0.606 ms 0.625 ms 5 atl-b24-link.ip.twelve99.net (62.115.113.48) 14.858 ms 14.762 ms 6 spacex-svc080559-ic370374.ip.twelve99-cust.net (62.115.146.55) 14.741 ms 14.796 ms



Summary

Country	United States
Domain	spacex.com
ASN	AS14593
Registry	arin
Hosted IPs	128
ID	NET-SUB-98-97-178-0

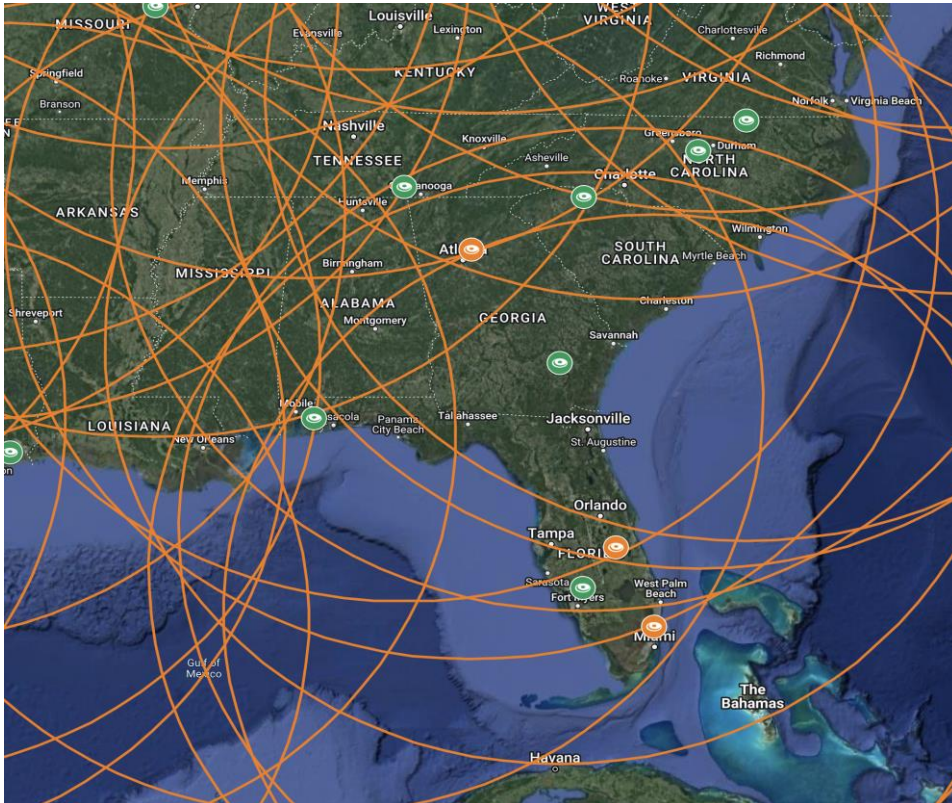
WHOIS Details

NetHandle:	NET-98-97-178-0-1
OrgID:	C08091088
Parent:	NET-98-97-128-0-1
NetName:	NET-SUB-98-97-178-0
NetRange:	98.97.178.0 - 98.97.178.255
NetType:	reassignment
OriginAS:	14593
RegDate:	2021-11-05


98.97.179.128/25

AS14593 · Space Exploration Technologies Corporation

How the network works



Summary

Country	 United States
Domain	spacex.com
ASN	AS14593
Registry	arin
Hosted IPs	128
ID	NET-SUB-98-97-178-0

WHOIS Details

NetHandle:	NET-98-97-178-0-1
OrgID:	C08091088
Parent:	NET-98-97-128-0-1
NetName:	NET-SUB-98-97-178-0
NetRange:	98.97.178.0 - 98.97.178.255
NetType:	reassignment
OriginAS:	14593
RegDate:	2021-11-05

Observations of the Starlink Network

- CGNAT Employed
- Array to Satellite to Ground Station are all Flat
- Appears that Ground to NAP is a series of Exit MPLS Networks
- Exit Routing is based on your specific Terminal
- *Network Configuration changes are frequent and unannounced
- Exit Path is currently static based on your Service Class
- Portability, Marine, RV, Aviation means that you can be placed in different exit VPNs, we assume dynamically

Network Static Exit Routes

In Florida, my array lands in Central Florida, but exits from the Atlanta Internet Gateway

Mobile Roaming still sends my traffic out of Atlanta, clearly tied to my Array_ID



Polar Orbits and “Space Lasers”

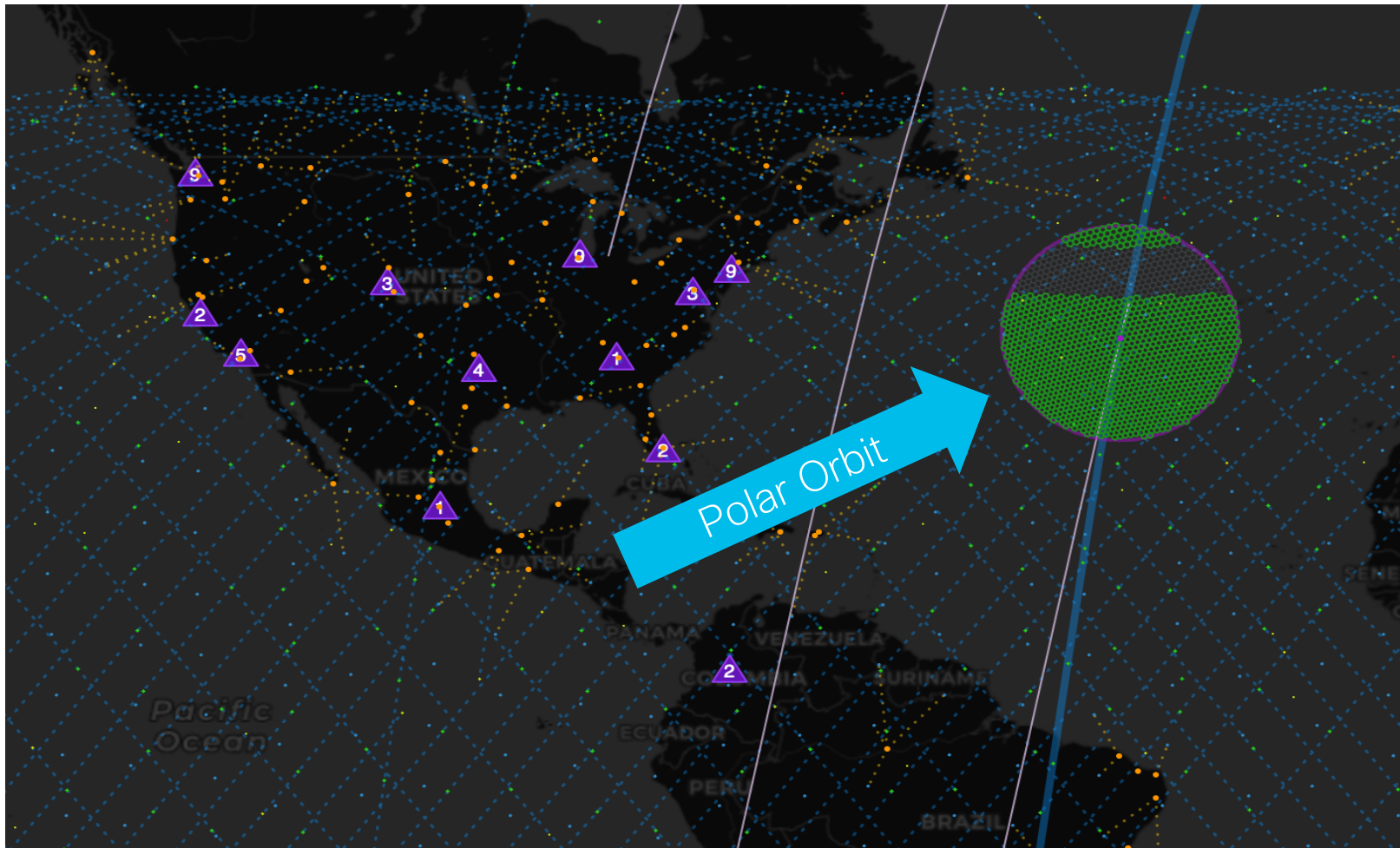


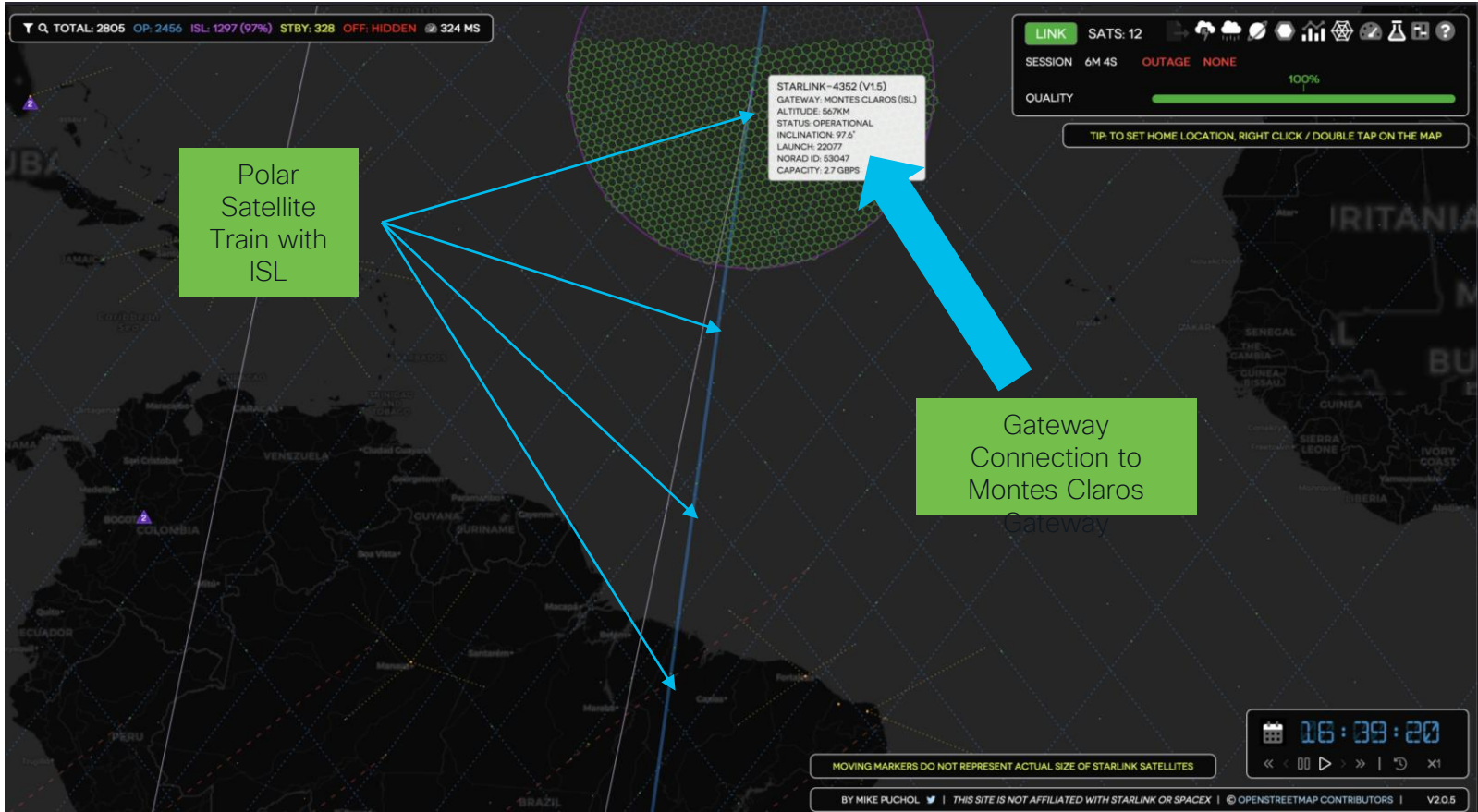
Satellite Truths and Myths

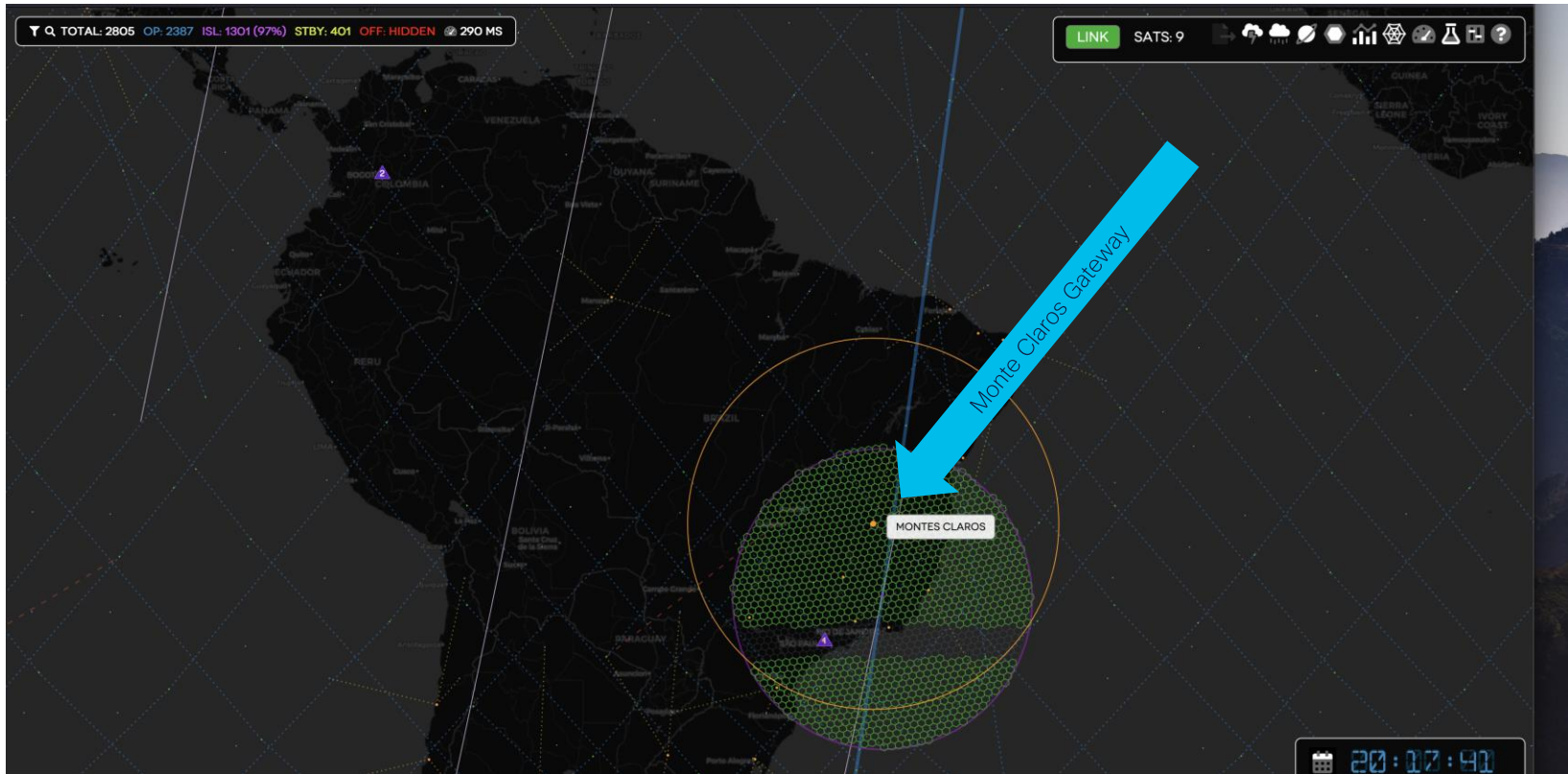
- All Starlink Satellites have “Lasers” – **FALSE**
- All Starlink Satellites can cross communicate to each other – **FALSE**
- Some Starlink Satellites have laser based optics that can point ahead of them to the next satellite – **TRUE**
- On-orbit Satellites can calculate multi-planar ephemeris to dynamically communicate to satellites in different orbits – **FALSE**

Polar Orbit Satellites and Free Space Optics

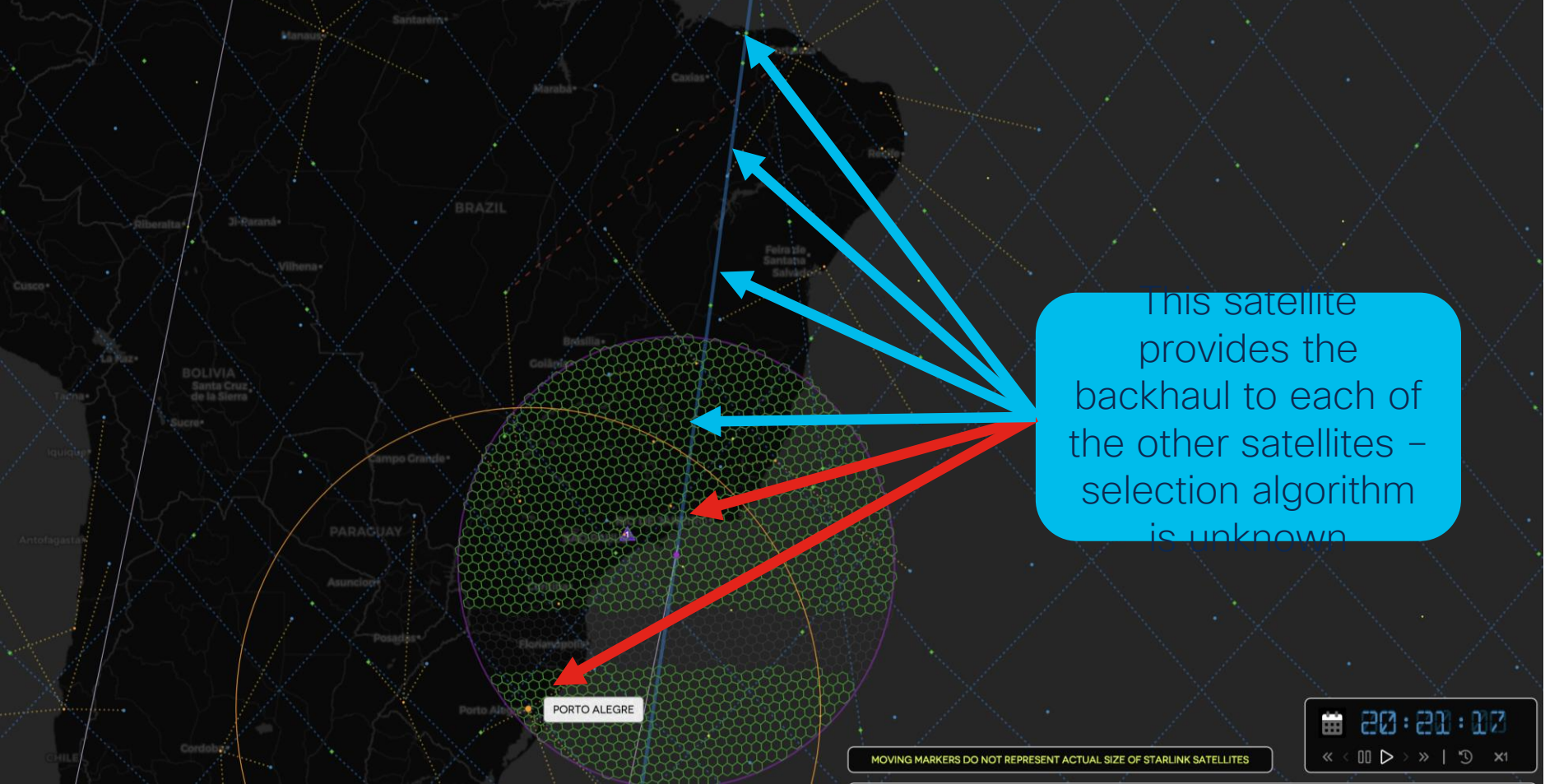
- Generation 1 Satellites are **Radio Only**
- Generation 1.5 and 2.0 Satellites are capable of Inter-Satellite Links (ISL)
- ISL Links work currently in a follow-me configuration
- A polar string of satellites provide hop to hop communications in single file
- Closest Radio Gateway provides the downlink for the chain of satellites
- Only use for satellites in polar orbits and where there is a Gateway connection
- **You may not pop-out onto the Internet in a country that you expect**
- **You may not come out in a country you want**



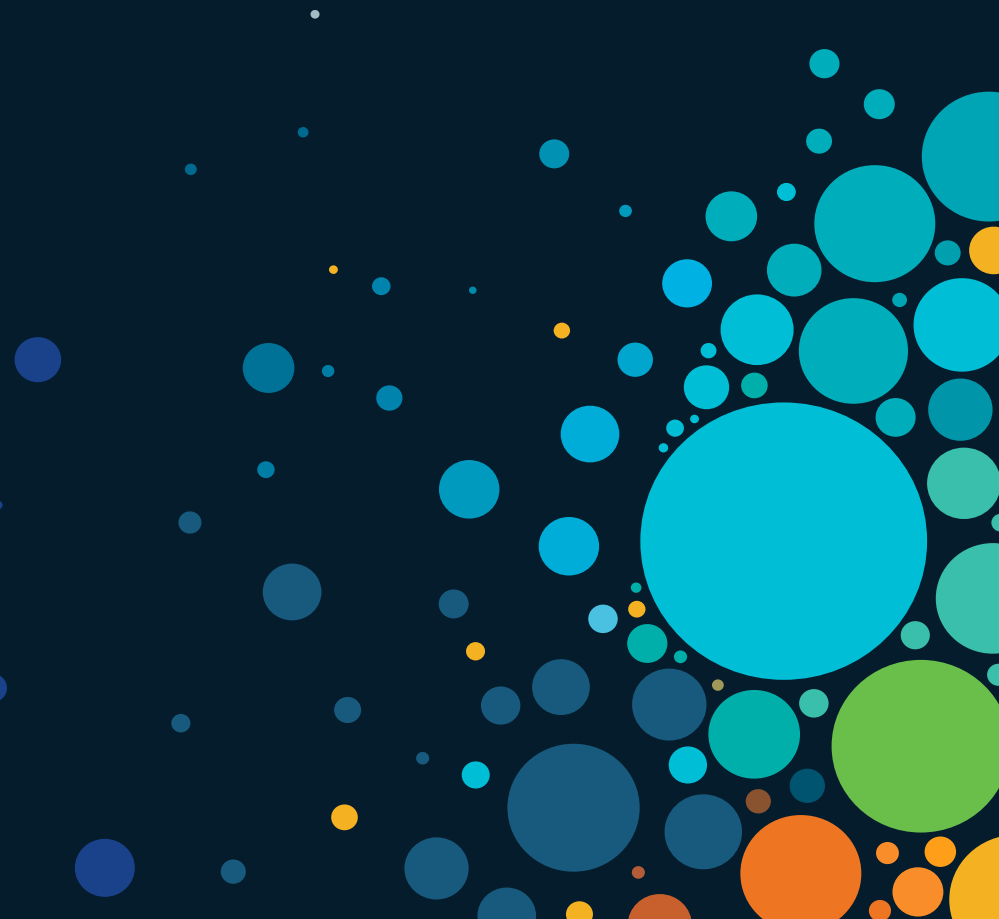


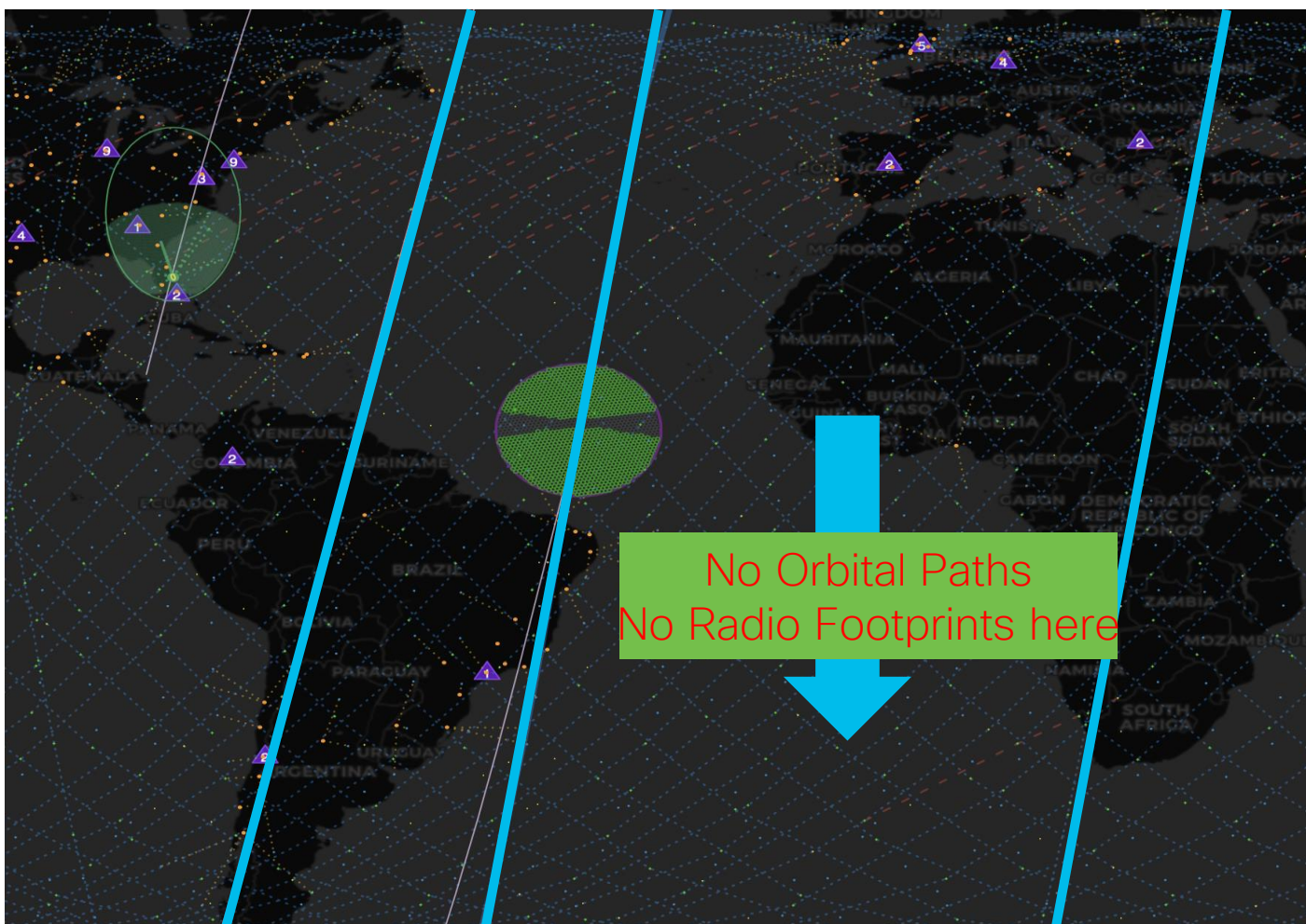


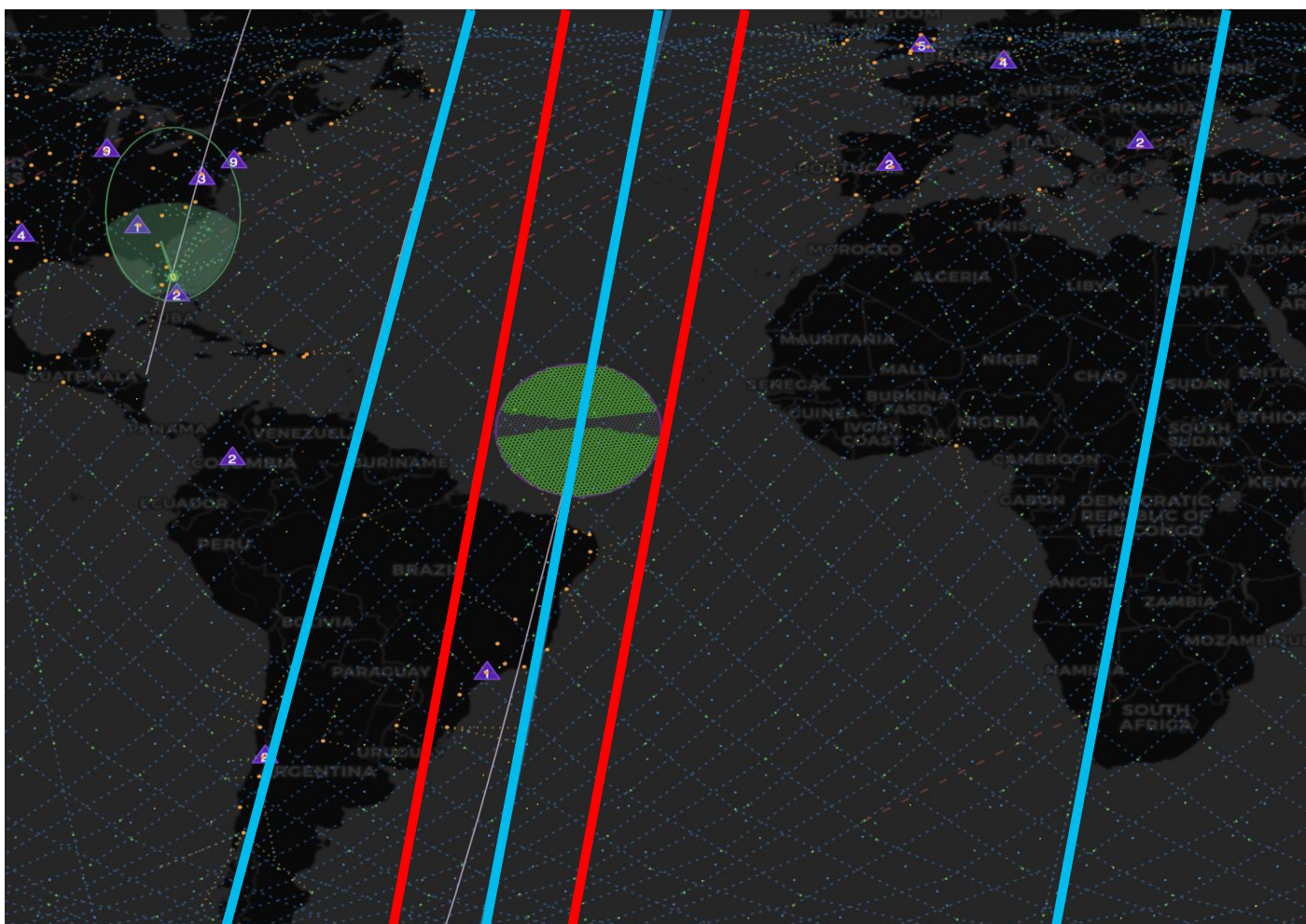


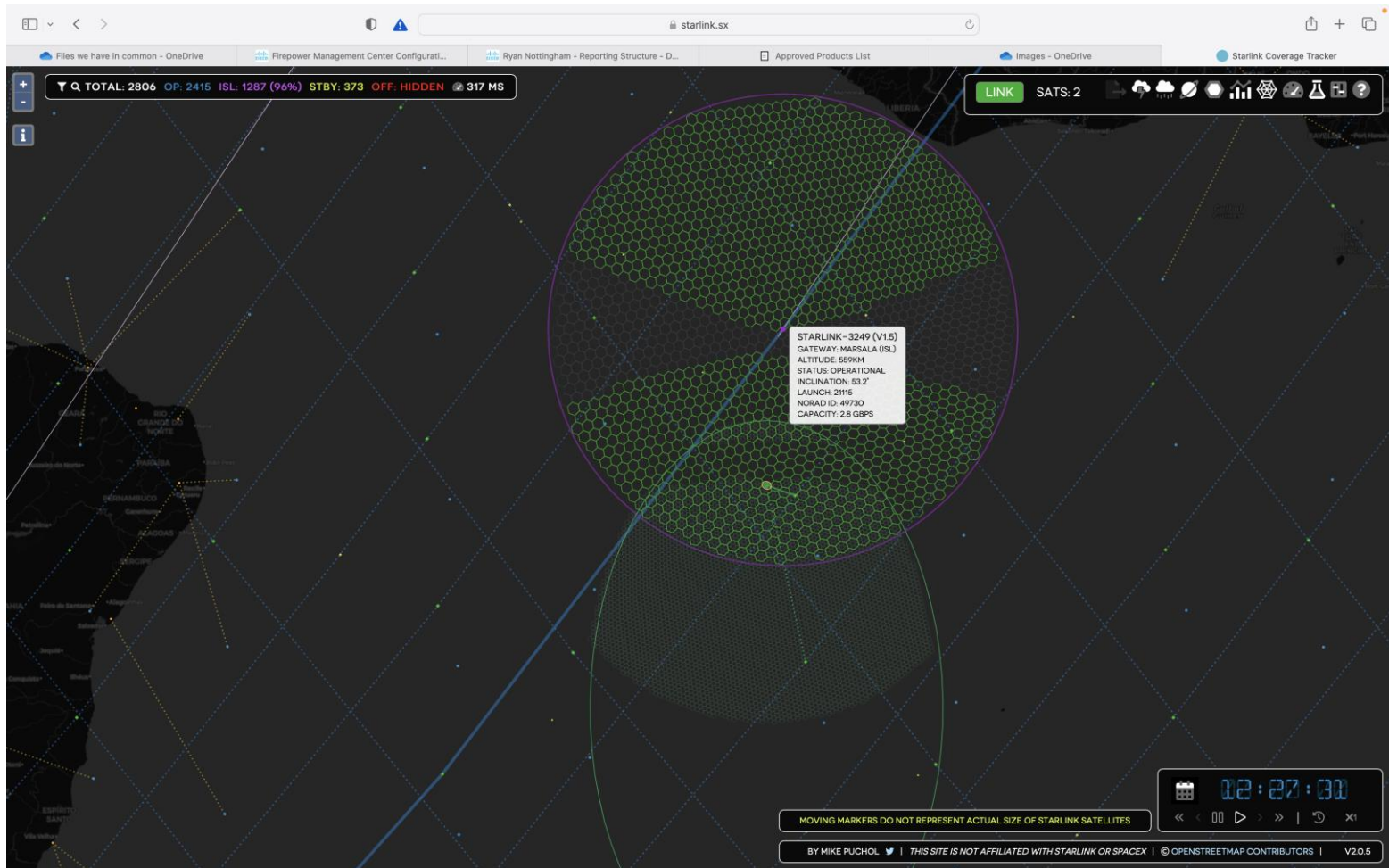


Challenges with Polar Orbits









Starlink Security

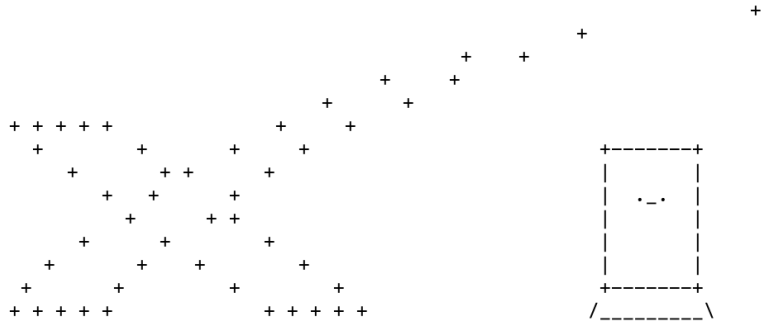


Starlink Security

There is no security other than what you bring yourself

BYOS – Bring Your Own Security

Starlink Router



```
-----  
When I was a kid, I wanted to be a WiFi router more than anything in the world.  
I stretched my arms out wide, and I hid in the corner. I tried to glue antennas  
to my head, I had ethernet cables, I had an LED indicator. Everybody knew me  
and was afraid of me. And one day, my dad said, "Bobby, you're 17. It's time to  
throw childish things aside," and I said, "OK, Pop." But he didn't really say  
that. He said, "Stop being a WiFi router and become a Dishy."
```

```
2022.19.0.mr13442
```




```
Router-010000000000000001F2F12
```

```
-----  
abenhase@192.168.1.1: Permission denied (publickey,keyboard-interactive).  
abenhase@ABENHASE-M-526H .ssh % █
```

- Nmap scan report for 192.168.1.1
- Host is up (0.0040s latency).
- Not shown: 994 filtered tcp ports (no-response)
- PORT STATE SERVICE
- 22/tcp open ssh
- 53/tcp open domain
- 80/tcp open http
- 9000/tcp open cslistener
- 9001/tcp open tor-orport
- 9002/tcp open dynamid

- Nmap done: 1 IP address (1 host up) scanned in 45.68 seconds

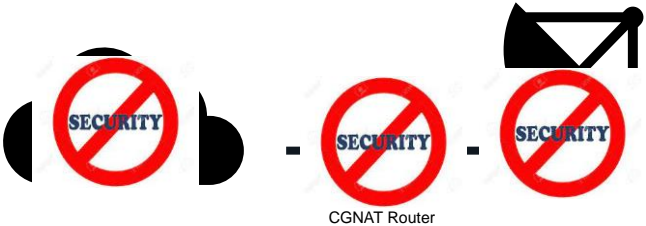
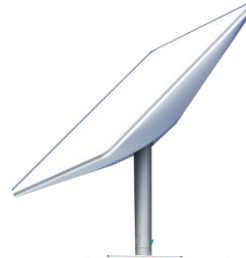
Things we know about Starlink Network

- Carrier Grade NAT (CGNAT) at the Internet Gateway
- IPv4 DHCP is assigned across the network
- IPv6 Prefix Delegation works on some Gateways
- Layer 2 network from terminal to ground to exit point (MPLS)
- Native IPSec will not work (CGNAT) 
- IPSec Encapsulation works – NAT-T (udp4500) 
- TLS VPNs work 
- There is NO local NAT configuration possible on the SL Router

Starlink Security Today

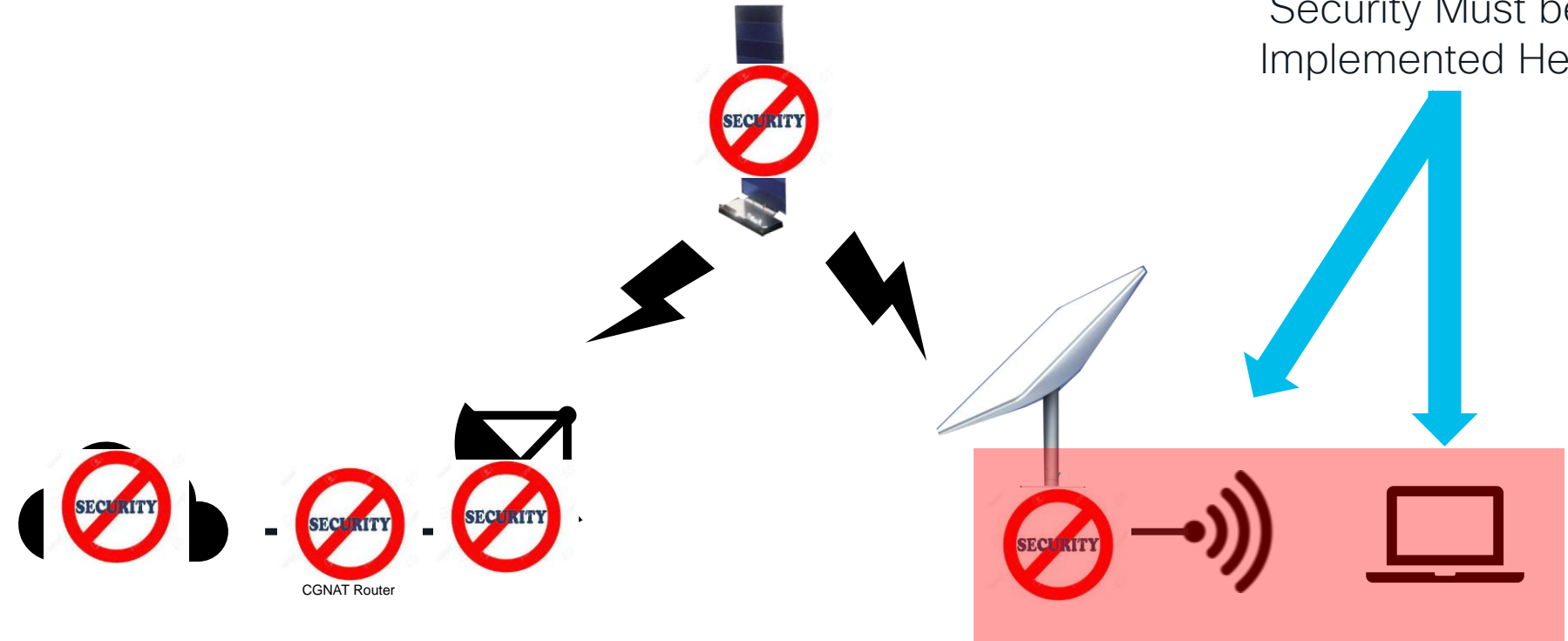


WPA2 Implemented here

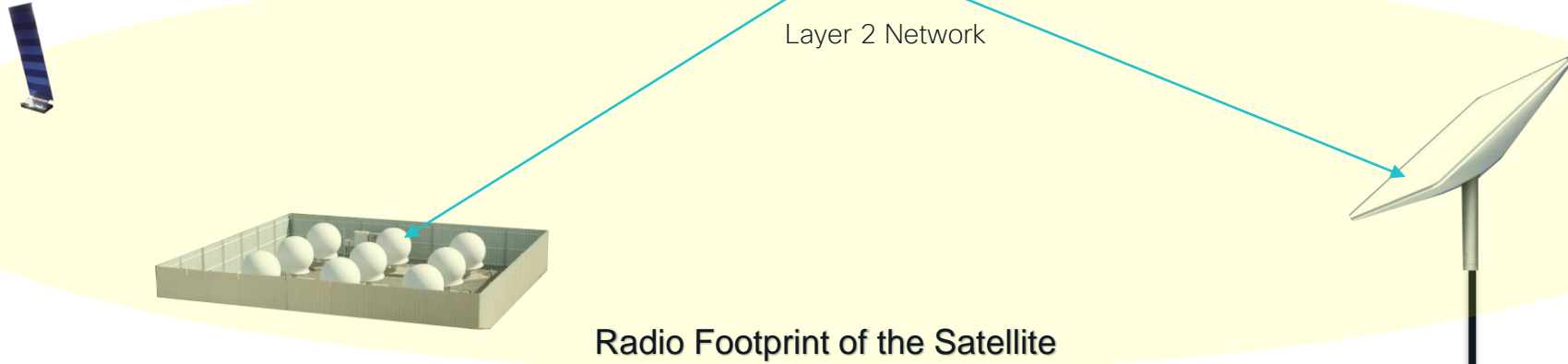


Starlink Security Today

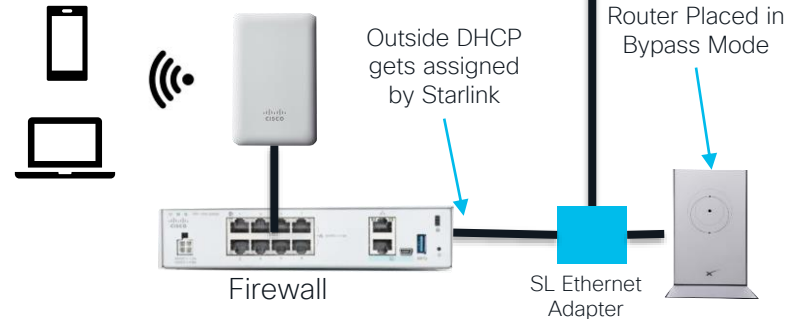
Security Must be Implemented Here



Advanced Networking

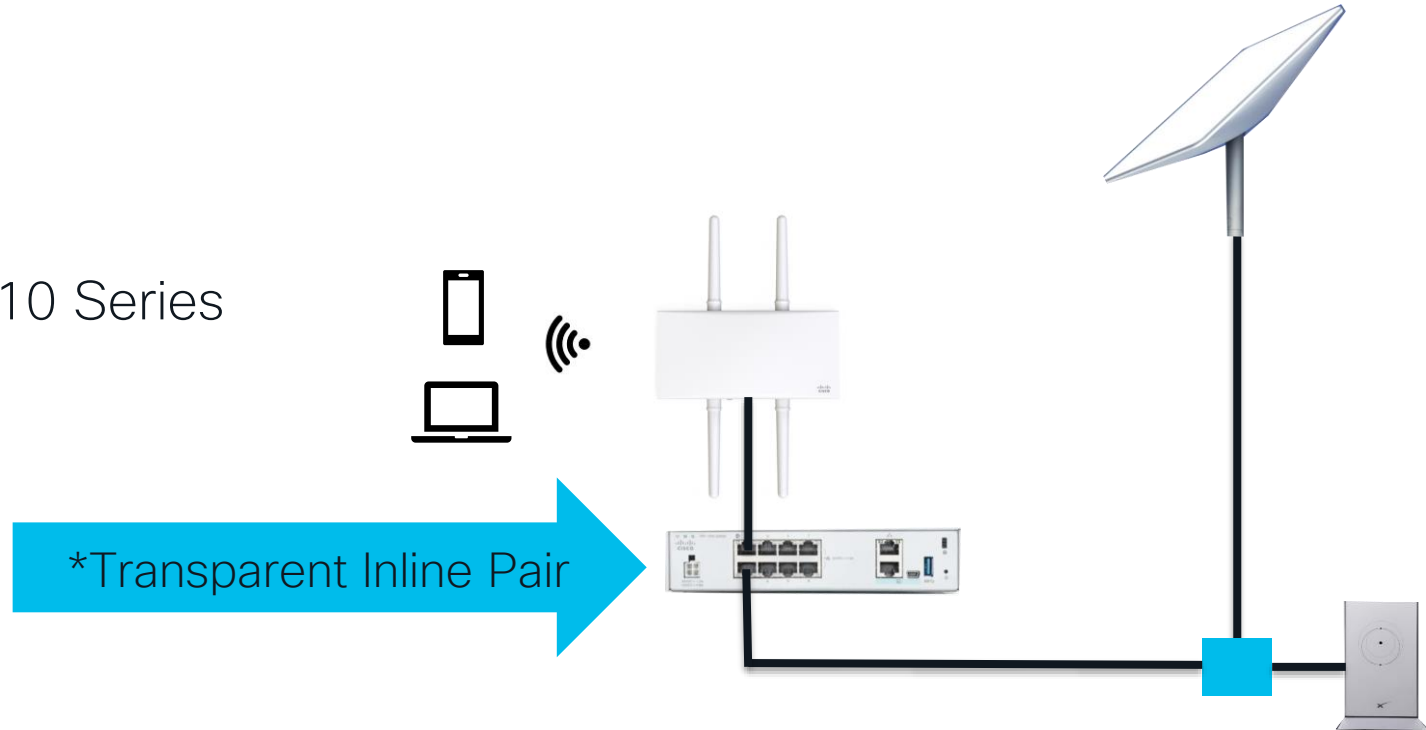


SL Router in Bypass Mode:
WIFI Gets disabled
Router is no longer locally accessible
Statistics are stored in SL Cloud
Array connects to SL Cloud and delivers updates



Meraki+Firepower Deployment

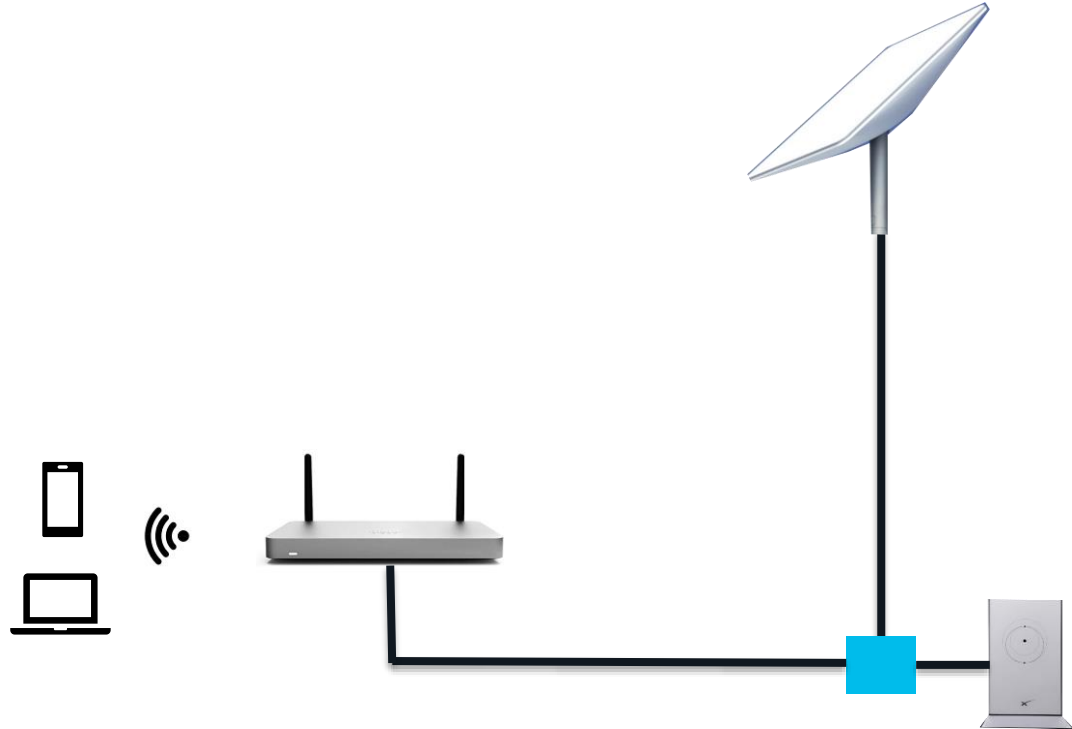
- MX Series
- MR Series
- Z3 Series
- Firepower 1010 Series



*Planned for FDM in 7.4 Release

Meraki MX/MR/Z3 Deployment

- MX Series
- MR Series
- Z3 Series



Native IPv6 Support on MX and MR Platforms

IPv6 Support on MX Security & SD-WAN Platforms [Core Fundamentals]

Last updated: Nov 12, 2022



Note: IPv6 is an ongoing cross-product initiative for Meraki as IPv4 addresses are being exhausted and with more hosts such as IoT devices requiring addressing, IPv6 provides a new structure to accommodate a larger number of hosts.

+ TABLE OF CONTENT

This article describes general information on IPv6 Support on MX Security & SD-WAN Platforms. For more information on compatible devices, please see our [IPv6 Device Compatibility](#) documentation.

Overview

- This document describes the IPv6 functionality and configuration available on the MX Security & SD-WAN Platforms. It will include information such as: supported MX and teleworker models, minimum firmware, and how to configure and use IPv6 on a network.



Note:

- MX cannot currently function in a native IPv6-only environment. It is recommended that dual-stack is implemented in order to leverage IPv6 functionality and management.
- High-availability (HA) and template deployments are not supported at this time.

Minimum Firmware

- MX 17.5+ firmware is required for IPv6 functionality on MX Security & SD-WAN Platforms.

Supported Models

- Z3, Z3C, MX64, MX64W, MX65, MX65W, MX67, MX67W, MX67C, MX68, MX68W, MX68CW, MX75, MX84, MX85, MX95, MX100, MX105, MX250, MX450.
- All current MX/Z models listed on our website [here](#).

Meraki is the simplest security option

The screenshot shows the Meraki dashboard interface. On the left is a dark navigation sidebar with the Meraki logo and menu items: ORGANIZATION (Cisco Florida), NETWORK (MX95 Firewall), Network-wide, Security & SD-WAN (highlighted), Insight, and Organization. The main content area has a search bar and a notification banner about new SM features. Below that is a yellow warning box: "Account recovery action needed. You are the only administrator for this organization. If you lose access, you will need to contact support to recover access. Add another administrator to ensure you can recover access." The main content is divided into three sections: "Threat protection" with "Advanced Malware Protection (AMP)" (Mode: Enabled), "Threat Grid" (Mode: Enabled), and "Intrusion detection and prevention" (Mode: Detection, Ruleset: Balanced). Each section includes instructions on how to add URLs, files, or rules to the respective allow lists.

The screenshot shows the "Configuration" page for WAN settings. At the top are tabs for Summary, Uplink, DHCP, IPv6 Prefixes, Location, and Tools. The "Uplink" tab is active. A large blue lightning bolt graphic points to the "WAN 1" section. The "General" section shows "PUBLIC IP" as "9...d2" and "customer.tagax1.pop.starlinkisp.net". The "WAN 1" section is a table with columns for TYPE, CONFIGURED AS, STATUS, IP ADDRESS, GATEWAY, and DNS. The table has three rows: IPv4 (Dynamic, Active, 192.168.1164), IPv6 (Auto (DHCP6), Active, fd5e:9a9e:c5bd:10::d0b), and IPv6 (fe80::7624:9fff:feaf:2f12, Not connected, fd5e:9a9e:c5t...). The "WAN 2" section is a table with columns for TYPE, CONFIGURED AS, STATUS, and IP ADDRESS. It has three rows: IPv4 (Dynamic, Not connected), IPv6 (Auto (Stateless), Not connected), and IPv6 (Not connected). Below the configuration is a "Live data" section with a legend for "Total" (blue) and "Download" (purple). The "Historical device data" section shows "Connectivity to 8.8.8.8" for the last day.

Meraki is the simplest IPv6 Deployment Option

- Takes the downstream Prefix Delegation
- Automatically deploys it to the downstream networks
- Clients will be assigned IPv6 address out of your assigned Prefix

Summary Uplink DHCP IPv6 Prefixes Location Tools

Delegated Prefixes

! WAN 2 is not connected. Prefixes assigned to this uplink won't be effective until the uplink becomes active. x

Search by prefix or source name Add new prefixes

No prefix info is available.

NAT Pool

WAN 1: fd5e:9a9e:c5bd:18::/96 ← /96 IPv6 Assigned Interface

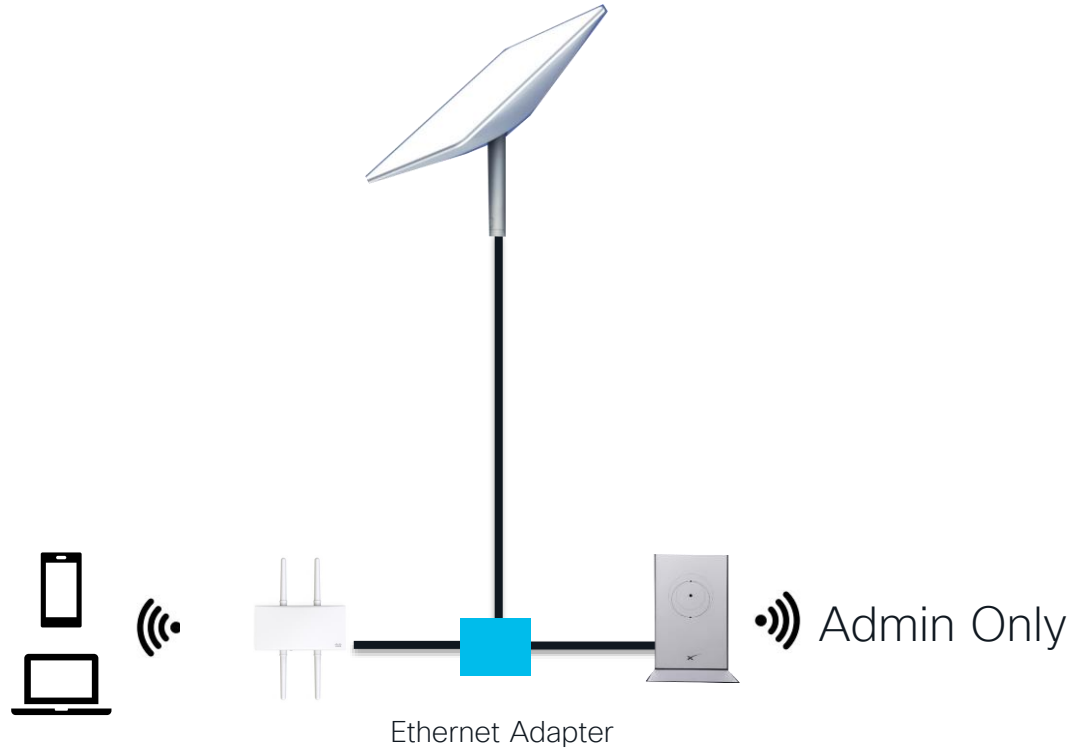
VLAN Assignments

Search by prefixes or VLAN name

VLAN ID	VLAN name	Subnet prefix	Origin	Delegated prefix	Prefix status
		fd5e:9a9e:c5bd:19::/64	WAN 1	fd5e:9a9e:c5bd:19::/64	Active

1 result

Keep it simple, don't overcomplicate things



Deployment Considerations

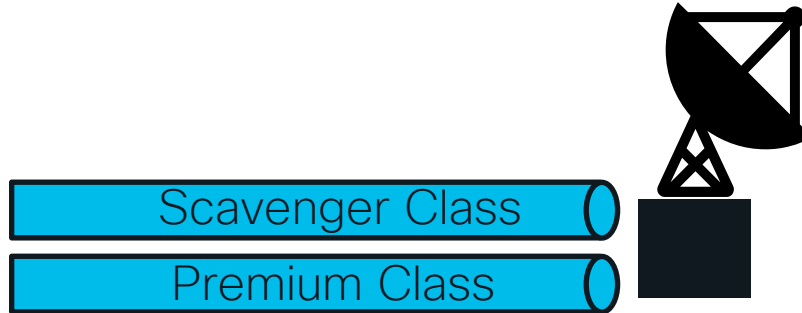
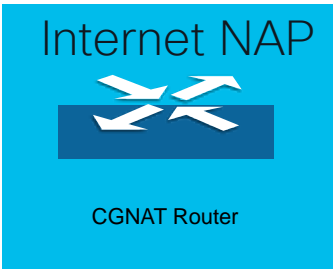


QoS Observations

- Terminals (arrays) are statically linked to what we believe to be MPLS VPNs with static exits to the Internet



Scavenger class QoS



Residential QoS

Deployment Considerations

- You will probably want a 150 foot cable
- You can make a 300+ foot cable easily by inserting Ethernet in the middle
 - Use High Quality watertight connectors



DATA USAGE 17 G 20 G

Service Type
RESIDENTIAL

Service Address
USA

ADD PORTABILITY >

CANCEL SERVICE >

Map Satellite

Treasure Ln

ADD PORTABILITY

For an additional monthly fee of **\$25.00**, you can move your Starlink to new locations within your continent to receive service anywhere Starlink provides active coverage. To see active coverage areas, please view the [Starlink Availability Map](#).

To learn more about Portability, visit our [FAQ](#).

ADD PORTABILITY

STARLINK	ROUTER	STATUS
KIT00215572	01000000000000000001F2F12	ACTIVE

Decisions

Service for this order is only guaranteed at this location.
\$110/mo for service and \$599 for hardware.

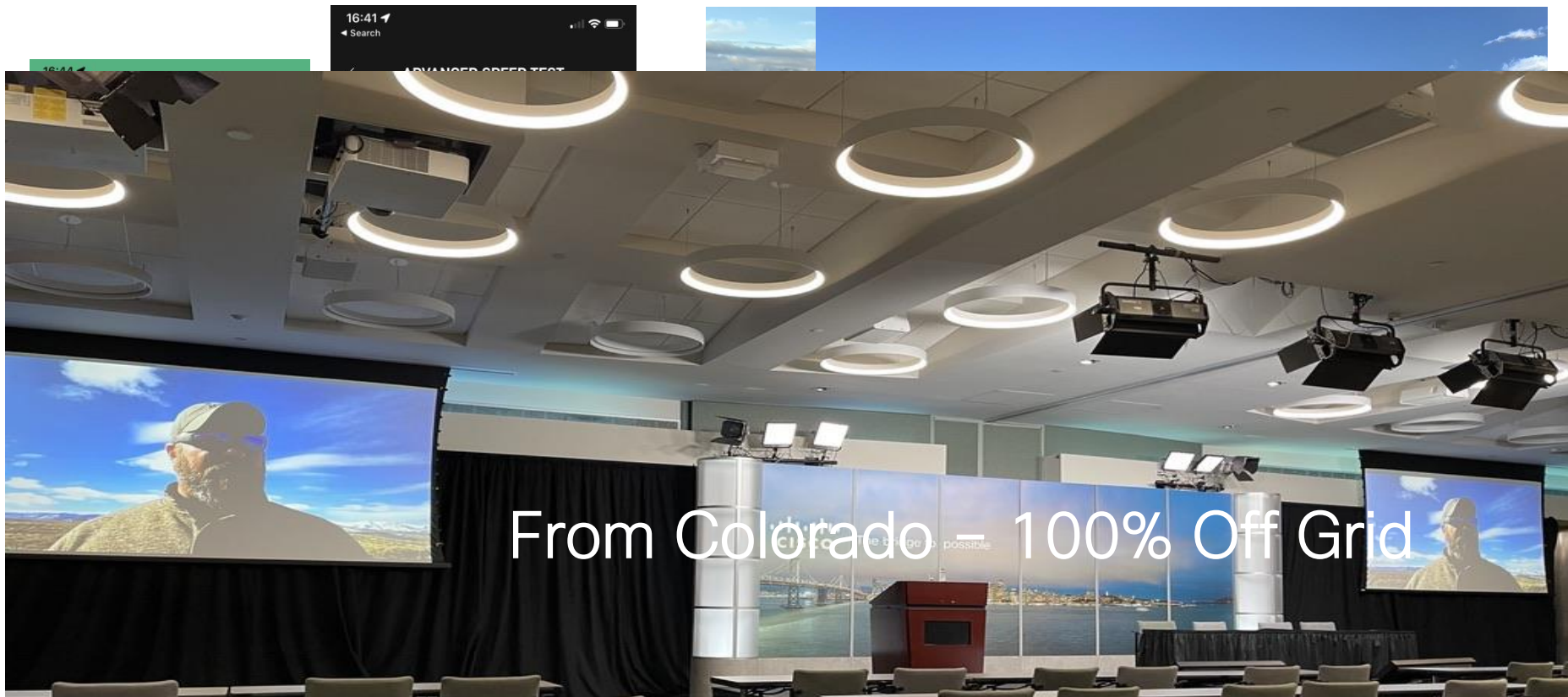
HARDWARE ⓘ

STANDARD \$599	HIGH PERF. \$2,500
----------------	--------------------

- “High Performance” is simply double the array
- They have a single GigE output – but have doubled the transceivers
- They are clearly creating a Service Class for High Performance users and doing traffic engineering to support it



‘I had a recent important meeting to attend but it conflicted with PTO....’



From Colorado - 100% Off Grid

HD Video Broadcast to San Jose

Austere Deployment Options

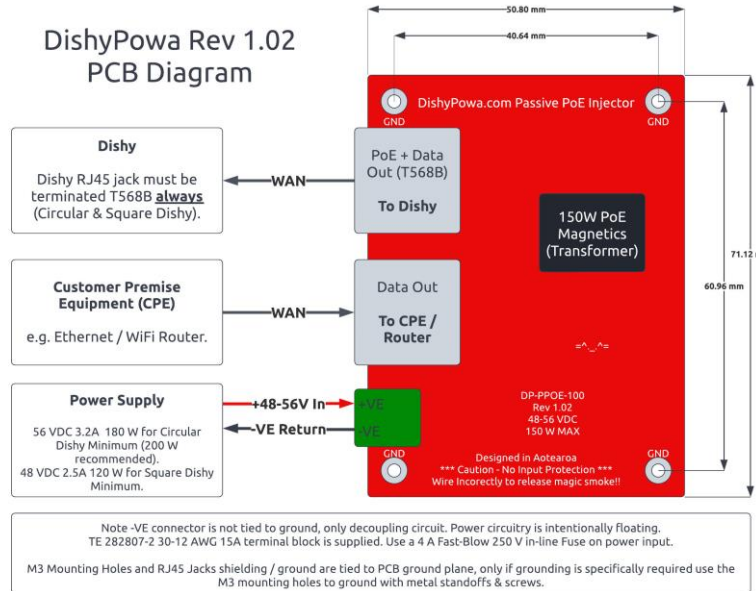


Disclaimer

I make 100% zero guarantees or warranty
you won't damage something....

Ditching the Starlink Router

- <https://dishypowa.com>
- 48-56V DC passive PoE injector
- Allows you to remove Starlink Router entirely
- Connect up BYOS options
- Needs 48v DC Power



Credit: dishypowa.com

Parts Needed



Roll over image to zoom in

📦 DC 12V Step Up to 48V Boost Converter 3A 144W DC Voltage Regulator Power Converter Adapter Waterproof Module Transformer for Golf Cart Club Car LED Light

Brand: Protooma
 ★★★★★ 26 ratings | 4 answered questions

\$17.99

FREE Returns

Get 40% off eligible products sold and shipped by Amazon when you pay with Discover rewards. Max discount \$50. Activation required. Limited-time offer. See terms.

Color: 12V to 48V 3A



Brand: Protooma
 Model Name: Boost Converter
 Color: 12V to 48V 3A
 Item Dimensions: 2 x 2 x 0.8 inches
 LxWxH
 Input Voltage: 12 Volts

About this item

- Input Voltage:DC 12V nominal; Voltage Range: 9-20V(12V); Output Voltage: DC 48V 3A 144W; Maximum Efficiency:≥95%; Ripple Wave: 50mV; Starting delay time:≤2s.
- Protection: Built in over-load, over-current, over-temperature and



📦 LiTime 12V 100Ah Lithium LiFePO4 Battery, Built-in 100A BMS, 4000-15000 Cycles, 10-year Lifetime, Perfect for RV, Solar, Backup Power, Off Grid Application, Boat, Trolling motor.

Brand: LiTime
 6 answered questions

\$299.99

Pay \$25.00/month for 12 months, interest-free upon approval for the Amazon Prime Rewards Visa Card

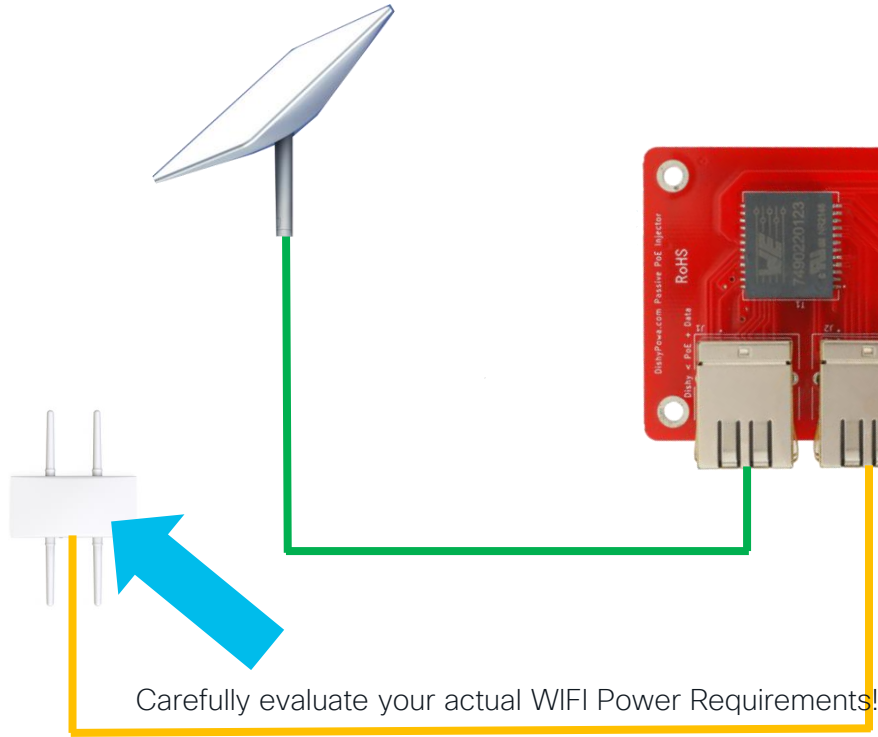
Size: 12V100Ah

12V50Ah \$179.98	12V100Ah \$299.99
12V100Ah Smart \$479.99	12V200Ah \$599.99
12V300Ah \$999.99	24V100Ah \$649.99
48V100Ah \$1,699.98	



Roll over image to zoom in

Wiring Diagram



100-200w Panel

MPPE Charge Controller

12volt DC
LiFePO4 Battery
- +

- 12volt-48v DC
+ DC Boost Converter

Minimum 120watts

SOLAR POWER





ADVANCED SPEED TEST



WIFI SPEED
IPHONE TO WIFI ROUTER
499 Mbps
388 Mbps Upload

STARLINK SPEED
ROUTER TO INTERNET
64 Mbps
4.4 Mbps Upload



WiFi Download - - - Starlink Download —

9F8E4566

NETWORK STATISTICS

Your Starlink just powered on. Network performance should stabilize after about 15 minutes.

UPTIME ⓘ

OUTAGES



Last 14 minutes:

- Possibly Obstructed 3s ⓘ
- Network Issue 8s ⓘ

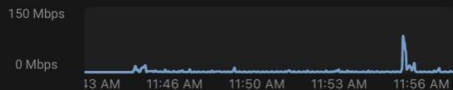
LATENCY ⓘ

Min: 0 ms Max: 1383 ms Last: 40 ms



THROUGHPUT ⓘ

SPEED TEST

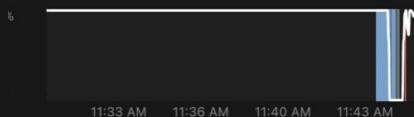


NETWORK STATISTICS

Your Starlink just powered on. Network performance should stabilize after about 15 minutes.

UPTIME ⓘ

OUTAGES

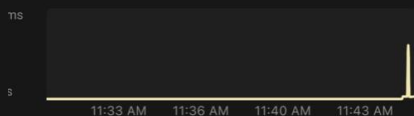


Last 2 minutes:

- Possibly Obstructed 3s ⓘ
- Network Issue 8s ⓘ

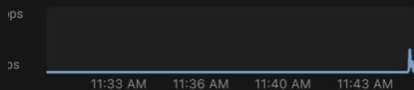
LATENCY ⓘ

Min: 0 ms Max: 1383 ms Last: 38 ms



THROUGHPUT ⓘ

SPEED TEST



Power off



72%



DC

AC

Power/Solar Conclusions

1

You will need more stored power than you think

2

You will need more solar power than you think

3

You will have to trial 24hr operation to be sure it works

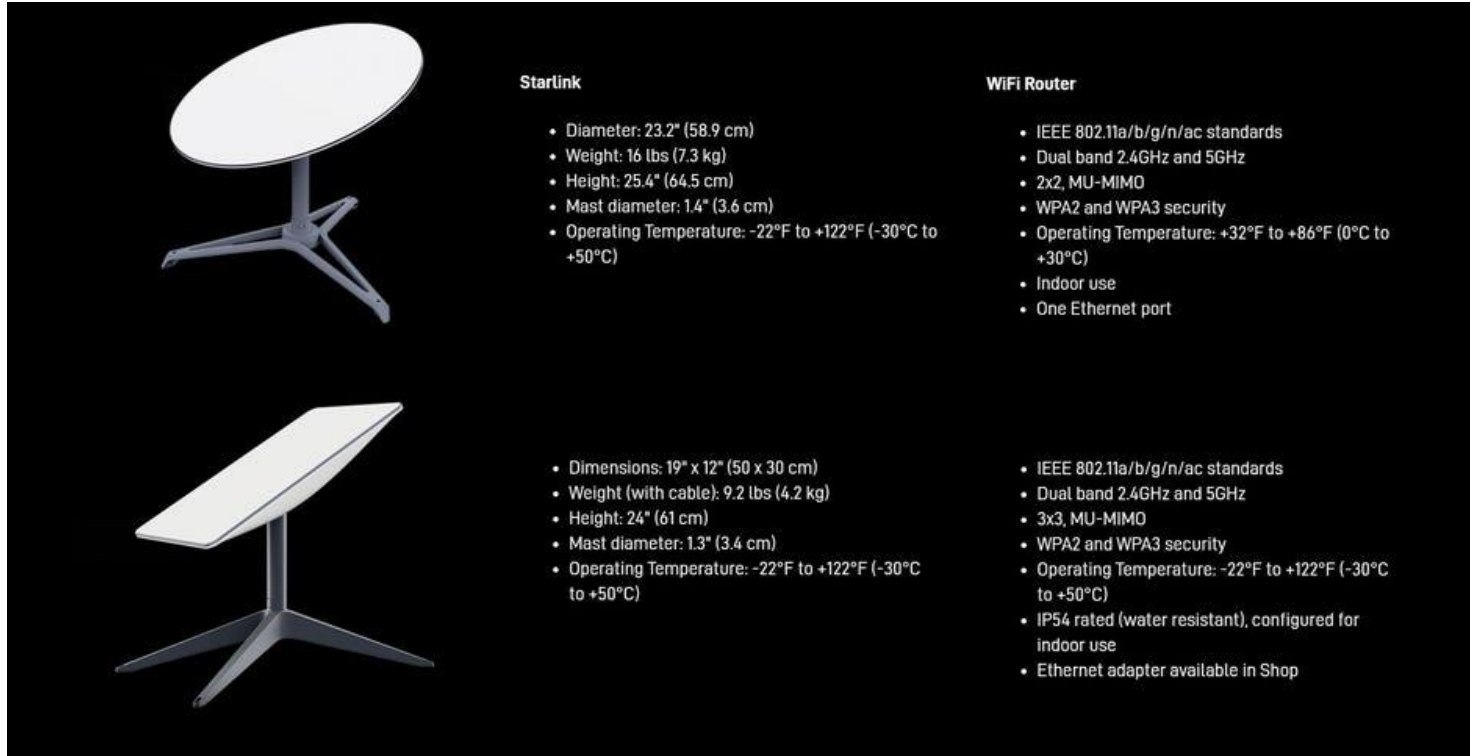
4



You will have to account for lack of full solar cycles

Electron Security



Gen 1 and Gen 2 Phased Arrays



	<p>Starlink</p> <ul style="list-style-type: none">• Diameter: 23.2" (58.9 cm)• Weight: 16 lbs (7.3 kg)• Height: 25.4" (64.5 cm)• Mast diameter: 1.4" (3.6 cm)• Operating Temperature: -22°F to +122°F (-30°C to +50°C)	<p>WiFi Router</p> <ul style="list-style-type: none">• IEEE 802.11a/b/g/n/ac standards• Dual band 2.4GHz and 5GHz• 2x2, MU-MIMO• WPA2 and WPA3 security• Operating Temperature: +32°F to +86°F (0°C to +30°C)• Indoor use• One Ethernet port
	<ul style="list-style-type: none">• Dimensions: 19" x 12" (50 x 30 cm)• Weight (with cable): 9.2 lbs (4.2 kg)• Height: 24" (61 cm)• Mast diameter: 1.3" (3.4 cm)• Operating Temperature: -22°F to +122°F (-30°C to +50°C)	<ul style="list-style-type: none">• IEEE 802.11a/b/g/n/ac standards• Dual band 2.4GHz and 5GHz• 3x3, MU-MIMO• WPA2 and WPA3 security• Operating Temperature: -22°F to +122°F (-30°C to +50°C)• IP54 rated (water resistant), configured for indoor use• Ethernet adapter available in Shop

How to properly ground your Starlink Array

- Grounding is very important
- A normal ground path will be direct to your equipment, which is an Ethernet adapter and Starlink Router
- Spike will travel to the closest ground – which if attached directly to the ground is great
- If not done properly, you could easily loose all equipment attached
- Insure that you have a proper ground path
- Take your time, employ thought and basic knowledge of physics

Re-Terminate your Starlink Cable

- Proprietary Connector to Router and Array must stay in place
- 568B Termination in the middle
- Use Shielded RJ45 connectors
- Remember the path – if a surge travels, where is it going?



Mounting Matters – Grounding Matters

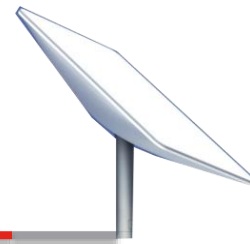


These ends have to stay on...



Starlink Connector

Twisted Pair Cat5/6 in the Middle



Starlink Connector

Cut the Cable

- Re-Terminated Starlink



- Stock 150 foot



Use Waterproof IP68 Connectors



Use Shielded RJ45 Connectors

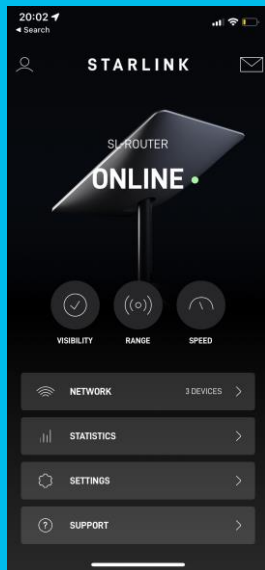
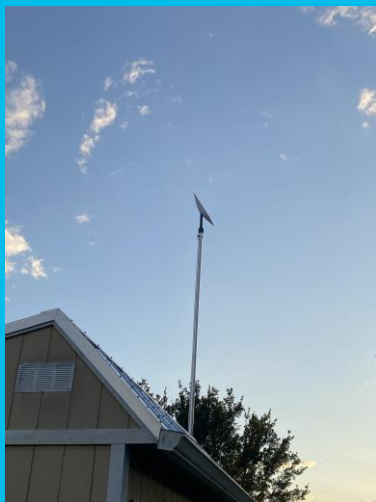


Leave Grounding Shield in Place
Terminate with Shield touch the connector

Ethernet Surge Suppression and Grounding Block

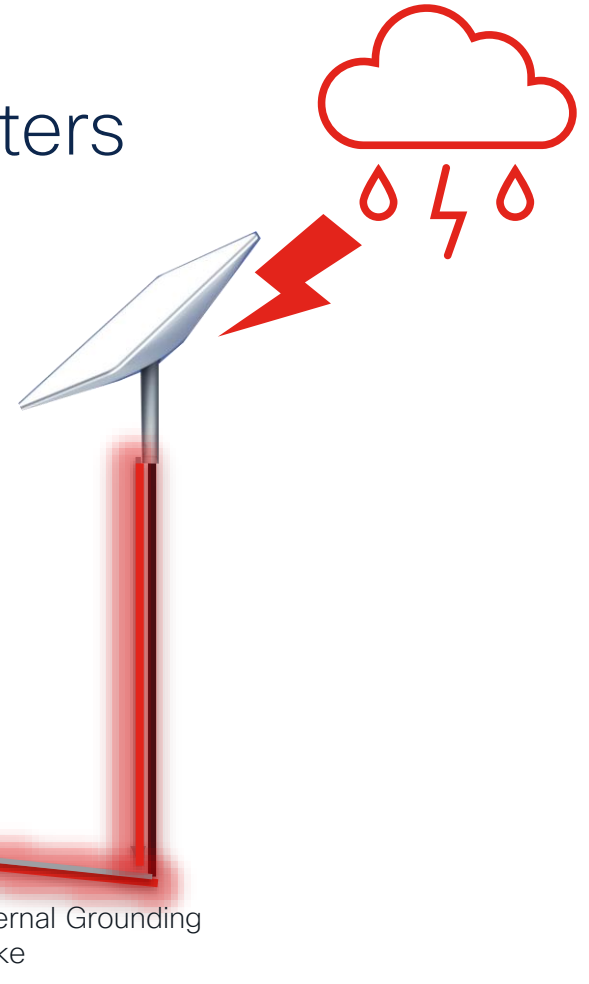
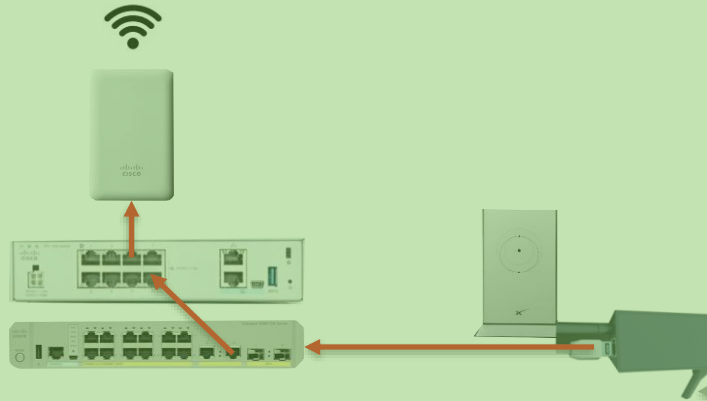


Proper Grounding



Mounting Matters – Grounding Matters

Protected Equipment



Debugging



Debugging at the CLI

```
abenhase@ABENHASE-M-526H starlink-grpc-tools-main % python3 poll_history.py | grep software_version
status: {'id': 'ut01000000-00000000-0008d16e', 'hardware_version': 'rev3_proto2', 'software_version': 'f562e306-0cd5-44c2-9058-9ab6800c4b50.utm.release',
to_first_nonempty_slot': 0.0, 'pop_ping_drop_rate': 0.0, 'downlink_throughput_bps': 1429922.125, 'uplink_throughput_bps': 270549.375, 'pop_ping_latency_ms':
currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 1.722228288650512
ise_floor': True}
status: {'id': 'ut01000000-00000000-0008d16e', 'hardware_version': 'rev3_proto2', 'software_version': 'f562e306-0cd5-44c2-9058-9ab6800c4b50.utm.release',
to_first_nonempty_slot': 0.0, 'pop_ping_drop_rate': 0.0, 'downlink_throughput_bps': 2350362.25, 'uplink_throughput_bps': 232783.875, 'pop_ping_latency_ms':
currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 1.747515082359314
e_floor': True}
status: {'id': 'ut01000000-00000000-0008d16e', 'hardware_version': 'rev3_proto2', 'software_version': 'f562e306-0cd5-44c2-9058-9ab6800c4b50.utm.release',
to_first_nonempty_slot': 0.0, 'pop_ping_drop_rate': 0.0, 'downlink_throughput_bps': 6270954.0, 'uplink_throughput_bps': 481732.59375, 'pop_ping_latency_ms':
currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 1.886579871177673
se_floor': True}
status: {'id': 'ut01000000-00000000-0008d16e', 'hardware_version': 'rev3_proto2', 'software_version': 'f562e306-0cd5-44c2-9058-9ab6800c4b50.utm.release',
to_first_nonempty_slot': 0.0, 'pop_ping_drop_rate': 0.0, 'downlink_throughput_bps': 836696.5625, 'uplink_throughput_bps': 155541.5625, 'pop_ping_latency_ms':
'currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 1.84504163265228
ise_floor': True}
status: {'id': 'ut01000000-00000000-0008d16e', 'hardware_version': 'rev3_proto2', 'software_version': 'f562e306-0cd5-44c2-9058-9ab6800c4b50.utm.release',
to_first_nonempty_slot': 0.0, 'pop_ping_drop_rate': 0.0, 'downlink_throughput_bps': 2781402.25, 'uplink_throughput_bps': 454972.9375, 'pop_ping_latency_ms':
'currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 1.78820550441741
oise_floor': True}
status: {'id': 'ut01000000-00000000-0008d16e', 'hardware_version': 'rev3_proto2', 'software_version': 'f562e306-0cd5-44c2-9058-9ab6800c4b50.utm.release',
to_first_nonempty_slot': 0.0, 'pop_ping_drop_rate': 0.0, 'downlink_throughput_bps': 2786863.25, 'uplink_throughput_bps': 344620.78125, 'pop_ping_latency_ms':
'currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 2.0890917778015
oise_floor': True}
status: {'id': 'ut01000000-00000000-0008d16e', 'hardware_version': 'rev3_proto2', 'software_version': 'f562e306-0cd5-44c2-9058-9ab6800c4b50.utm.release',
to_first_nonempty_slot': 0.0, 'pop_ping_drop_rate': 0.0, 'downlink_throughput_bps': 822544.9375, 'uplink_throughput_bps': 182125.0625, 'pop_ping_latency_ms':
bstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 2.058941125869751, 'directio
rue)}
status: {'id': 'ut01000000-00000000-0008d16e', 'hardware_version': 'rev3_proto2', 'software_version': 'f562e306-0cd5-44c2-9058-9ab6800c4b50.utm.release',
to_first_nonempty_slot': 0.0, 'pop_ping_drop_rate': 0.0, 'downlink_throughput_bps': 3287621.25, 'uplink_throughput_bps': 224588.203125, 'pop_ping_latency_ms':
'currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 2.2009549140930
oise_floor': True}
status: {'id': 'ut01000000-00000000-0008d16e', 'hardware_version': 'rev3_proto2', 'software_version': 'f562e306-0cd5-44c2-9058-9ab6800c4b50.utm.release',
to_first_nonempty_slot': 0.0, 'pop_ping_drop_rate': 0.0, 'downlink_throughput_bps': 9985874.0, 'uplink_throughput_bps': 485163.53125, 'pop_ping_latency_ms':
```

Docker Tools Repository

The screenshot shows the Docker Desktop interface. The top bar includes 'Docker Desktop', an 'Upgrade plan' button, a search bar with 'star' entered, and a user profile 'abenhase'. The left sidebar contains navigation options: Containers, Images, Volumes, Dev Environments (with a 'BETA' badge), Extensions (with a 'BETA' badge), and Add Extensions. The main content area is titled 'Images' and includes a 'Give feedback' link and a 'Learn more' link. Below this, there are tabs for 'LOCAL' and 'REMOTE REPOSITORIES'. A progress bar shows '5.09 GB / 7.27 GB in use' and '26 images'. A search bar with 'star' is present. A table lists Docker images with columns for Name, Tag, Status, Created, Size, and Actions. The table shows 8 items, including 'sponsianus/starlink-grpc-tools' and 'ghcr.io/sparky8512/starlink-grpc-tools'. The bottom status bar shows 'RAM 0.25GB', 'CPU 0.37%', 'Connected to Hub', and version 'v4.14.1'.

Images [Give feedback](#)

An image is a read-only template with instructions for creating a Docker container. [Learn more](#)

LOCAL REMOTE REPOSITORIES

5.09 GB / 7.27 GB in use 26 images Last refresh: 6 days ago ↻

star

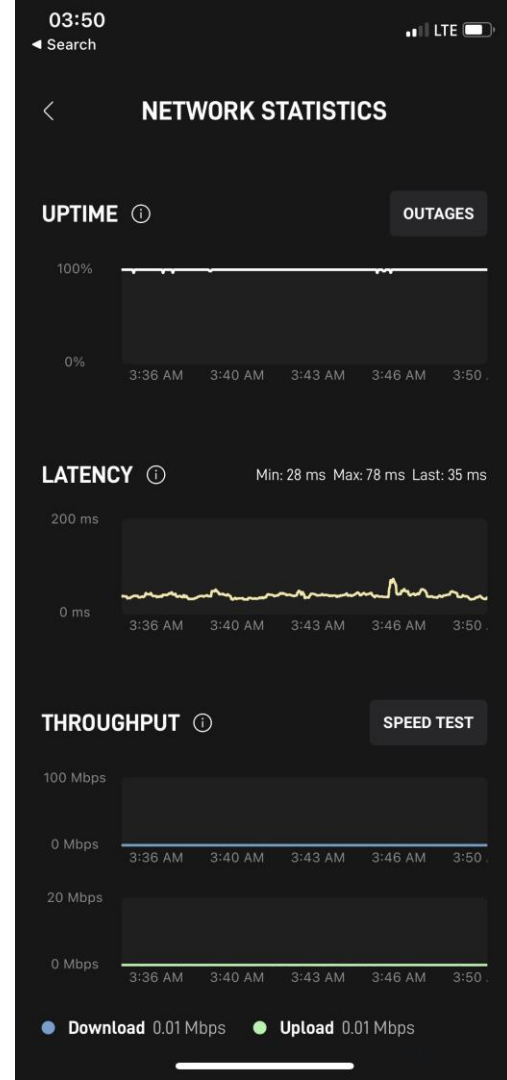
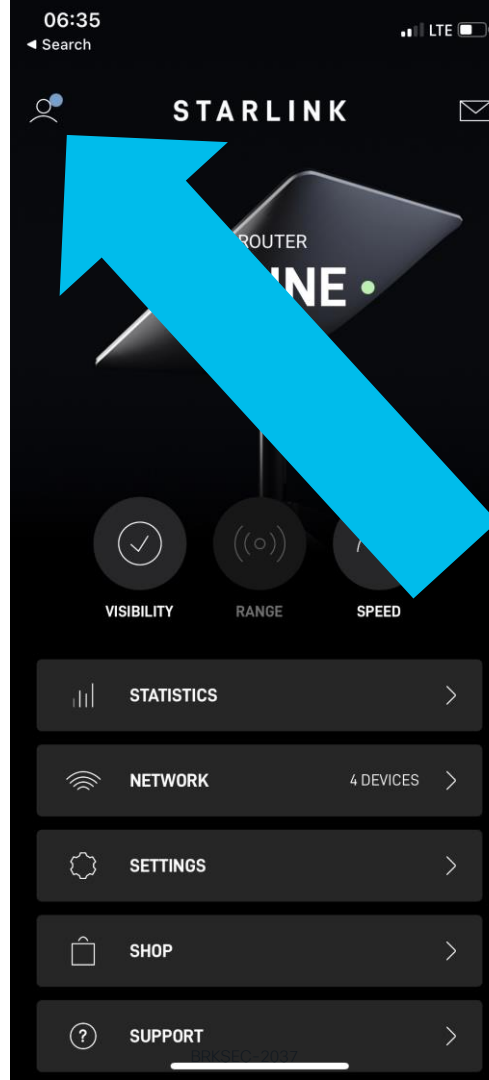
NAME	TAG	STATUS	CREATED	SIZE	ACTIONS
<input type="checkbox"/> sponsianus/starlink-grpc-tools 330f096f73b1	latest	In use	8 days ago	961.64 MB	▶ ⋮ 🗑️
<input type="checkbox"/> ghcr.io/sparky8512/starlink-grpc-tools 3221e3c4730e	latest	In use	26 days ago	960.32 MB	▶ ⋮ 🗑️
<input type="checkbox"/> sponsianus/starlink-grpc-tools 9385172f655f	<none>	In use (danglijr)	2 months ago	960.93 MB	▶ ⋮ 🗑️
<input type="checkbox"/> sysdigdan/starlink_exporter 5cf69d174bdb	latest	In use	7 months ago	13.63 MB	▶ ⋮ 🗑️
<input type="checkbox"/> ghcr.io/sparky8512/starlink-grpc-tools a90c66134558	<none>	In use (danglijr)	11 months ago	955.73 MB	▶ ⋮ 🗑️
<input type="checkbox"/> dbryanjohnson/starlink-monitor	latest	In use	12 months ago	305.88 MB	▶ ⋮ 🗑️

Showing 8 items

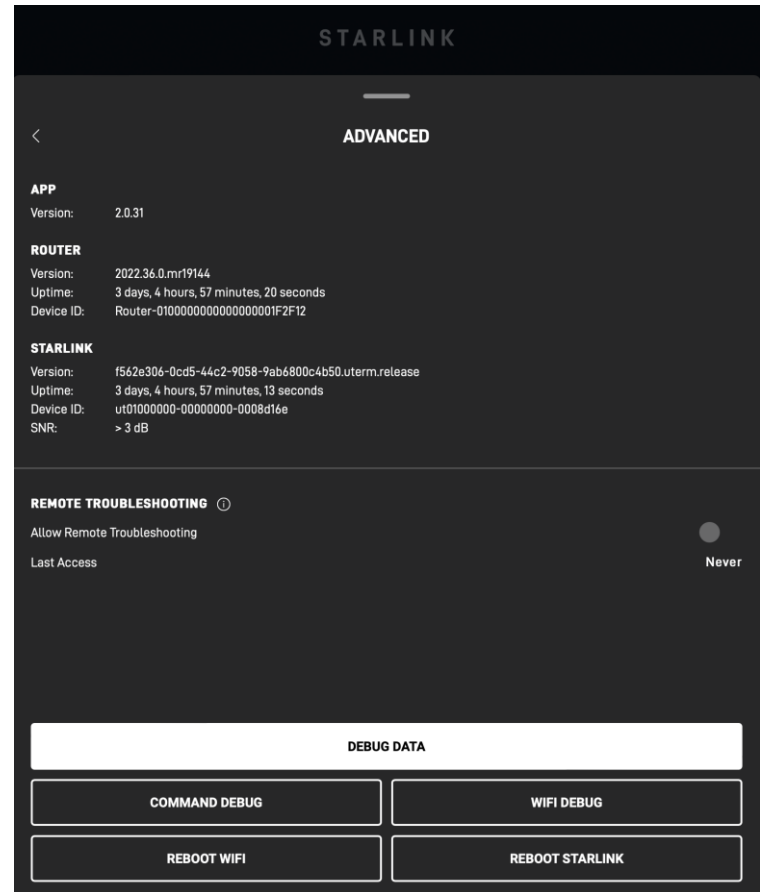
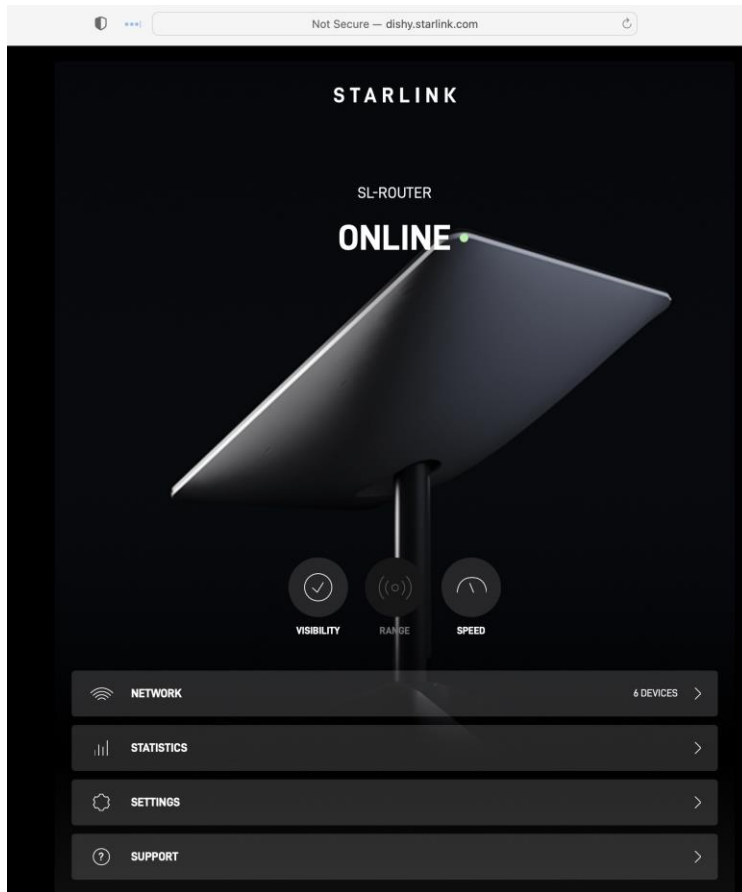
RAM 0.25GB CPU 0.37% Connected to Hub v4.14.1

Remote Connections

- Performance Data is stored in the Starlink Cloud
- Allows remote access to data statistics from your local network without being there



http://dishy.starlink.com



Starlink Debug

- . "dish": {
 - . • "reachable": true,
 - . • "service": "dish",
 - . • "cloud": false,
 - . • "features": {
 - . • "stowRequested": true,
 - . • "unstow": true
 - . • },
 - . • "timestamp": 1666895243,
 - . • "deviceInfo": {
 - . • "id": "ut01000000-00000000-0008d16e",
 - . •

```
"auth": {  
  "accessToken": "<len=848>",  
  "refreshToken": "<len=66>",  
  "accessTokenExpirationDate": "2022-10-  
27T18:39:21Z",  
  "idToken": "<len=723>",  
  "tokenType": "Bearer"
```

- . • "isDev": false,
- . • "bootcount": 129,
- . • "antiRollbackVersion": 0,
- . • "isHitl": false
- . • },
- . • "installPending": false,
- . • "isHeating": false,
- . • "powerSupplyThermalThrottle": false
- . • },
- . • "gpsStats": {

```
"gpsStats": {  
  "gpsValid": true,  
  "gpsSats": 16,
```



Please Fill Out The Survey!



Complete your Session Survey

- Please complete your session survey after each session. Your feedback is very important.
- Complete a minimum of 4 session surveys and the Overall Conference survey (open from Thursday) to receive your Cisco Live t-shirt.
- All surveys can be taken in the Cisco Events Mobile App or by logging in to the Session Catalog and clicking the "Attendee Dashboard" at <https://www.ciscolive.com/emea/learn/sessions/session-catalog.html>



Continue Your Education



Visit the Cisco Showcase for related demos.



Book your one-on-one Meet the Engineer meeting.



Attend any of the related sessions at the DevNet, Capture the Flag, and Walk-in Labs zones.



Visit the On-Demand Library for more sessions at ciscolive.com/on-demand.

Questions





The bridge to possible

Thank you

CISCO *Live!*

CISCO *Live!*

ALL IN