

The Cisco Live! logo, featuring the word "CISCO" in a dark blue, sans-serif font, followed by "Live!" in a dark blue, cursive script font.

CISCO *Live!*

The text "Let's go" in a large, dark blue, sans-serif font, positioned to the left of a bright, multi-colored sunburst graphic that radiates from the right side of the image.

Let's go

#CiscoLiveAPJC



The bridge to possible

Starlink Security Advanced

Andrew Benhase – Federal Architect
@CyberSecOps
BRKSEC-2037

CISCO *Live!*

#CiscoLiveAPJC



“Reconciliation”- Dustin Koa Art

Cisco Webex App

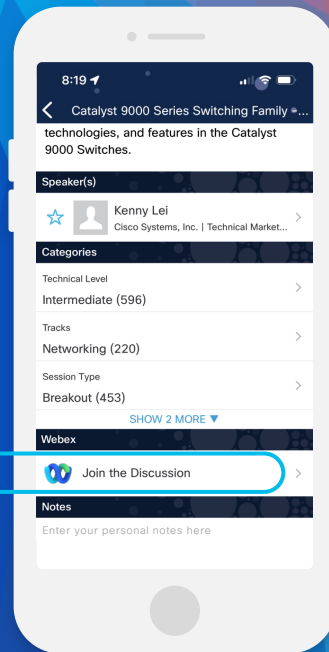
Questions?

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 by the speaker until December 22, 2023.



<https://ciscolive.ciscoevents.com/ciscolivebot/#BRKSEC-2037>

BRKSEC-2037 CL Room

BRKSEC-2037: Securing Starlink Internet Services ☆

Messages

People (11)

Content

Meetings

+

Apps

Meet

☆ You Monday, 12:05 PM

Welcome folks, looking forward to discussions here in this space

This starts the "BRKSEC-2037: Securing Starlink Internet Services" space, created by CL Melbourne 2023. Sunday, 2:54 PM

CL Melbourne 2023 added 7 people to this space. ✓

Monday • 12/4/23

 You Monday, 12:05 PM 

Welcome folks, looking forward to discussions here in this space

You pinned a message. Monday, 12:05 PM

Yesterday • 12/5/23

CL Melbourne 2023 added 2 people to this space. ✓

Today

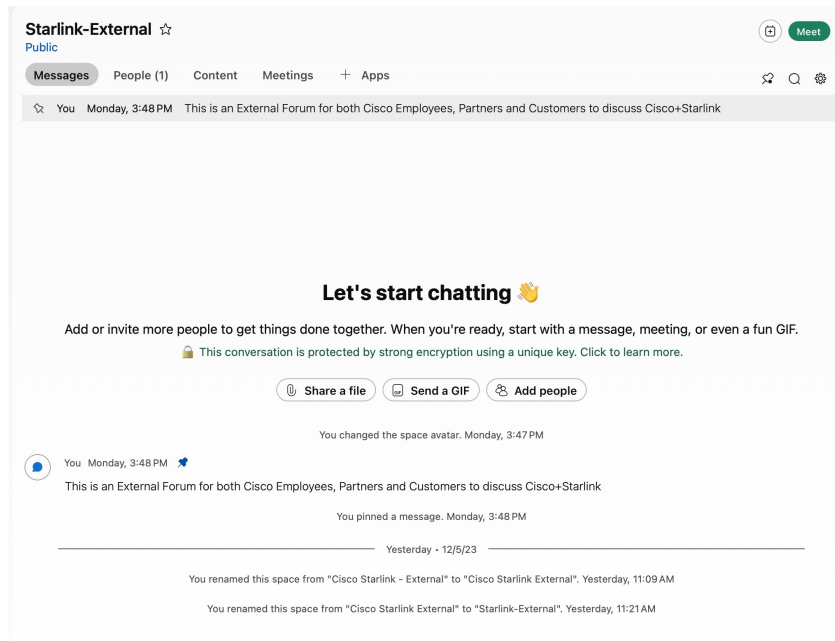
CL Melbourne 2023 added Sanam Mehta to this space. 12:58 AM

Seen by    

Cisco Starlink – External Teams Space

webexteams://im?space=740fe050-925f-11ee-bb7e-295d996ede61

Ready and Waiting for you
to join!



Agenda

- Catch up on current events
- What is Starlink
- Starlink Security
- Deployment Models
- SDWAN
- Conclusion

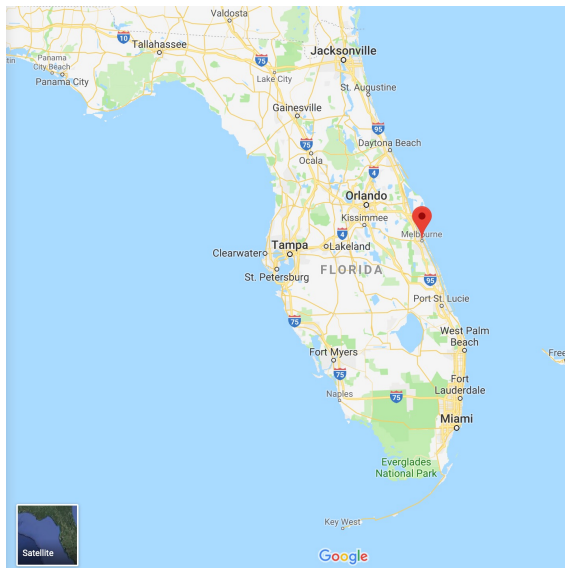
What I do here @cisco

- Federal Security Architect
- At Cisco >24 years, supporting US Federal Government
- 32 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 MEL



Latest News Updates (since last year)



plane will be better than their
connection at their house





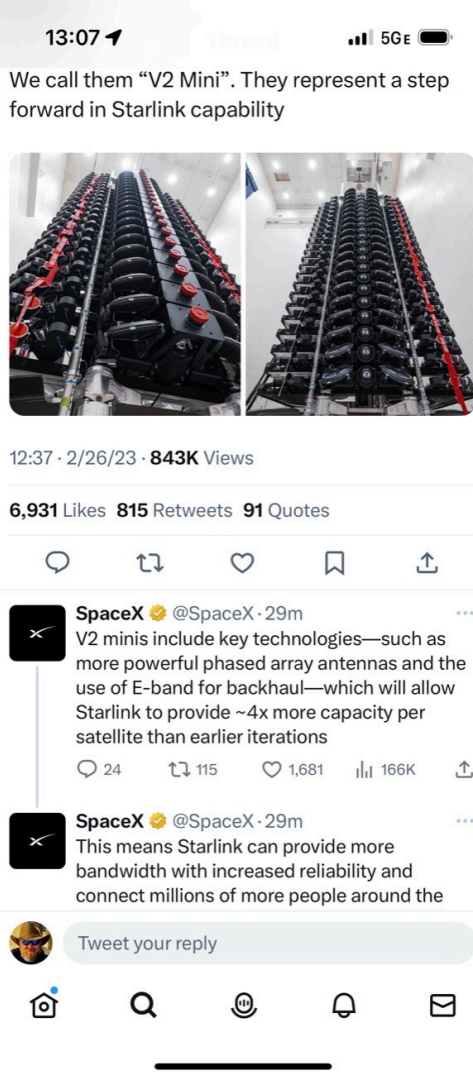


SpaceX Announces a Starship Version Two is in the Works

By Jack Kuhr November 28, 2023

[X](#) [in](#) [f](#) [🔗](#) [✉](#)





13:07

5G E

We call them “V2 Mini”. They represent a step forward in Starlink capability



12:37 · 2/26/23 · 843K Views

6,931 Likes 815 Retweets 91 Quotes



SpaceX @SpaceX · 29m
V2 minis include key technologies—such as more powerful phased array antennas and the use of E-band for backhaul—which will allow Starlink to provide ~4x more capacity per satellite than earlier iterations
24 115 1,681 166K

SpaceX @SpaceX · 29m
This means Starlink can provide more bandwidth with increased reliability and connect millions of more people around the



Tweet your reply



Services Changes – Public IP

PRIORITY - 1TB

High-speed, priority service for businesses and other high demand users at one location. Includes public IP and priority support. After using Priority data, continue receiving unlimited Standard data.

\$250.00 /Month (\$174.89 Due Today)

ACTIVATE ON PRIORITY - 1TB

PRIORITY - 2TB

High-speed, priority service for businesses and other high demand users at one location. Includes public IP and priority support. After using Priority data, continue receiving unlimited Standard data.

\$500.00 /Month (\$349.79 Due Today)

ACTIVATE ON PRIORITY - 2TB

PRIORITY - 6TB

High-speed, priority service for businesses and other high demand users at one location. Includes public IP and priority support. After using Priority data, continue receiving unlimited Standard data.

\$1,500.00 /Month (\$1,049.36 Due Today)

ACTIVATE ON PRIORITY - 6TB

STARLINK



You're Invited!

Enjoy an opportunity to experience the next generation Starlink!

The next generation Starlink is slimmer and more portable, with a more elegant design than its predecessor. This Starlink Kit also includes our Gen 3 router with improved range and speeds.

The cost of the Starlink Standard kit is **\$599** + Tax and Shipping.

EARLY ACCESS SPECIAL OFFER:

Enjoy your first month of service on us!*

ORDER NOW



Cats love Starlink



How do you keep up?

Starlink Federal Room (SL-OSINT)

Starlink Federal

Messages People (64) Content Meetings + Apps

+ Add people

Andrew Benhase

Active

Adnan Sadiq

In a meeting

Austin McDaniel

Active

Brandon Adkins

Out of Office until 5/23/23, 4:00 AM • P...

BT

Brent Taylor

Brian Bessette

Active

Candice Olson

Active

Chris Ahrens

In a meeting

Chris Johnson

Do Not Disturb until 5/30/23, 10:00 AM

Craig Hill

Out of Office until Friday, 7:00 PM

Darrel Beach

Active 50 minutes ago

Darren Norris

In a meeting

David Caren

Active

David McBrayer

In a calendar meeting

David Prall

Active 1 hour ago

Don Rogers

Active 50 minutes ago

BRKSEC-2037: Securing Starlink Internet Services ☆

Messages People (8) Content Meetings + Apps

You 12:05 PM Welcome folks, looking forward to discussions here in this space

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Seen by





Starlink - SpaceX Satellite Internet Constellation

r/Starlink

Joined



Posts

Wiki

FAQ

Discord

Threads



Create Post



Hot



New



Top



161



PINNED BY MODERATORS

Posted by u/TimTri MOD | Beta Tester 2 years ago



r/Starlink Availability, Questions & General Discussion

2.7k Comments Share Save ...



299



Posted by u/Show_me_the_dV 2 months ago



Starlink now available in every active cell on earth!

166 Comments Share Save ...



Posted by u/ziptested 4 hours ago

About Community

r/Starlink is for news, media, and discussions related to Starlink, the SpaceX satellite internet constellation. This is a fan-run Subreddit. For official news and to sign up for service, visit starlink.com

Created Dec 15, 2008

181k

Members

254

Online

Top 1%

Ranked by Size

Create Post

PREVIEW



cyber_worrier

Whats happening with Kuiper?

First Kuiper Launch



December 2 2023



Additional capacity will supplement existing launch contracts to support Project Kuiper's satellite deployment schedule.

Amazon has signed a contract with SpaceX for three Falcon 9 launches to support deployment plans for Project Kuiper, Amazon's low Earth orbit (LEO) satellite broadband network. Project Kuiper satellites were designed from the start to accommodate multiple launch providers and vehicles, allowing us to reduce schedule risk and move faster in our mission to connect unserved and underserved communities around the world. Our [earlier](#)

Whats happening with OneWeb?

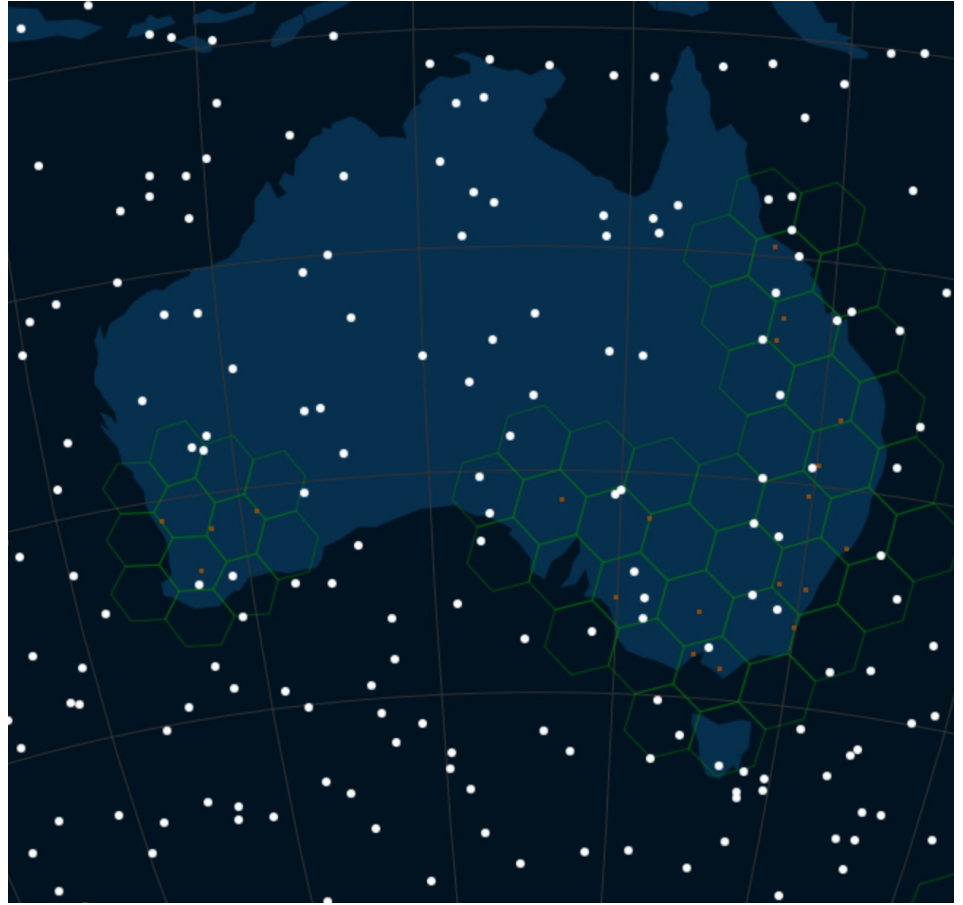
OneWeb- catering towards Enterprise

- Polar Orbits
- Higher Orbit
- >600 satellites in orbit
- Broad Coverage over Australia
- Focused towards Enterprise Networking

What really is Starlink?

Starlink Australia

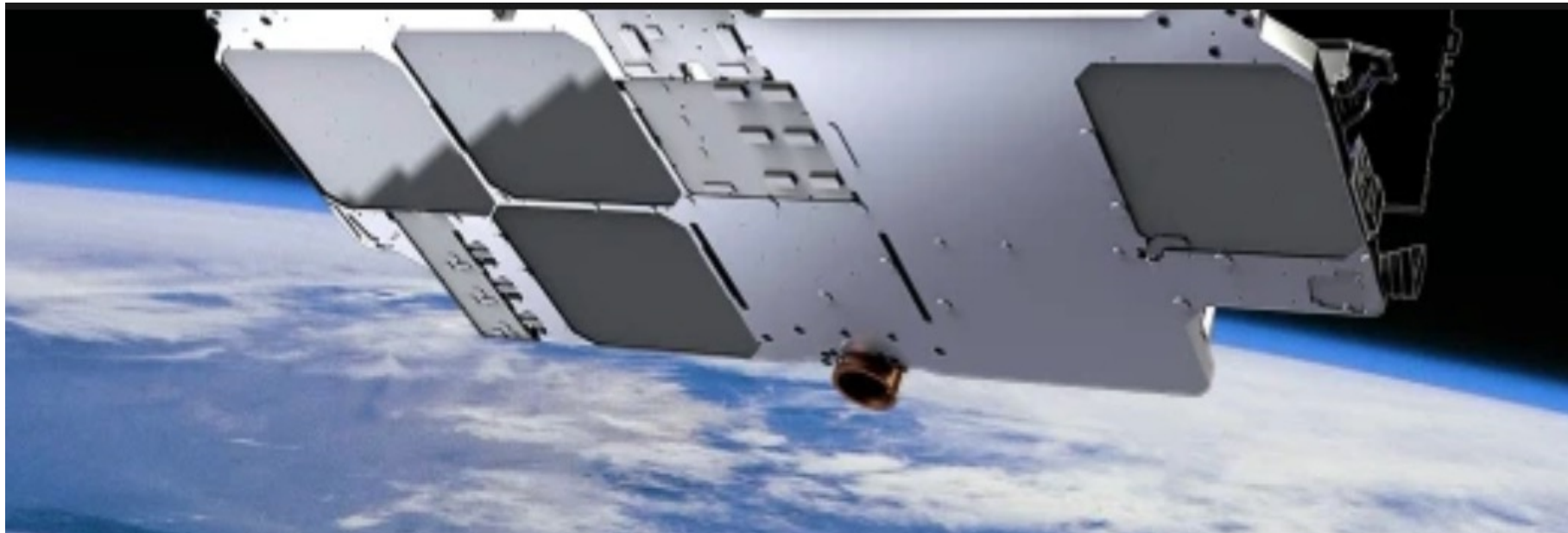
- Estimation of pathing using currently published ephemeris
- Broad coverage of urban areas
- Rural areas would be serviced by polar orbits
- Coverage in remote area may be inconsistent



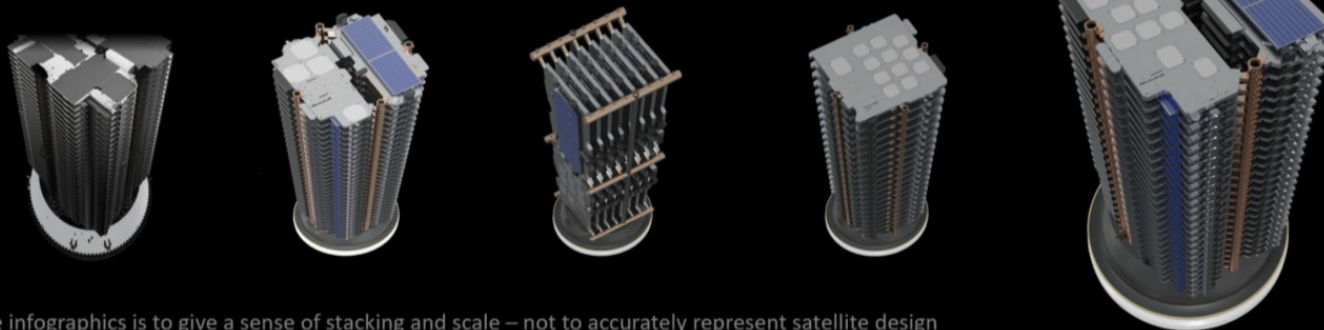
Satellite v1.5

- 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



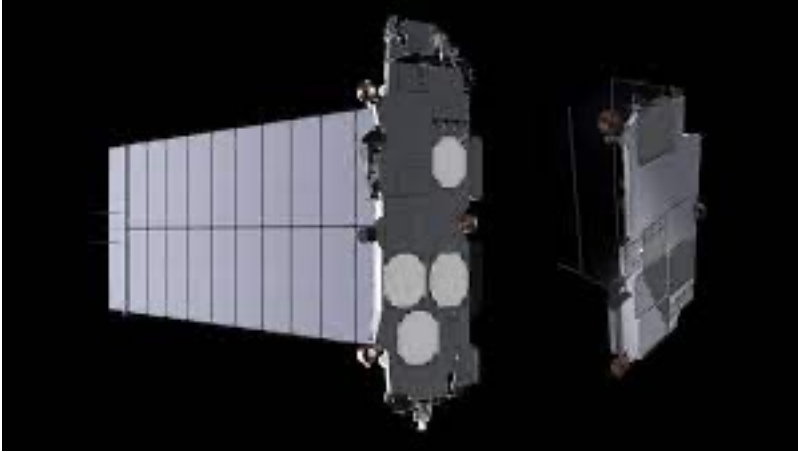
Credit: Starlink



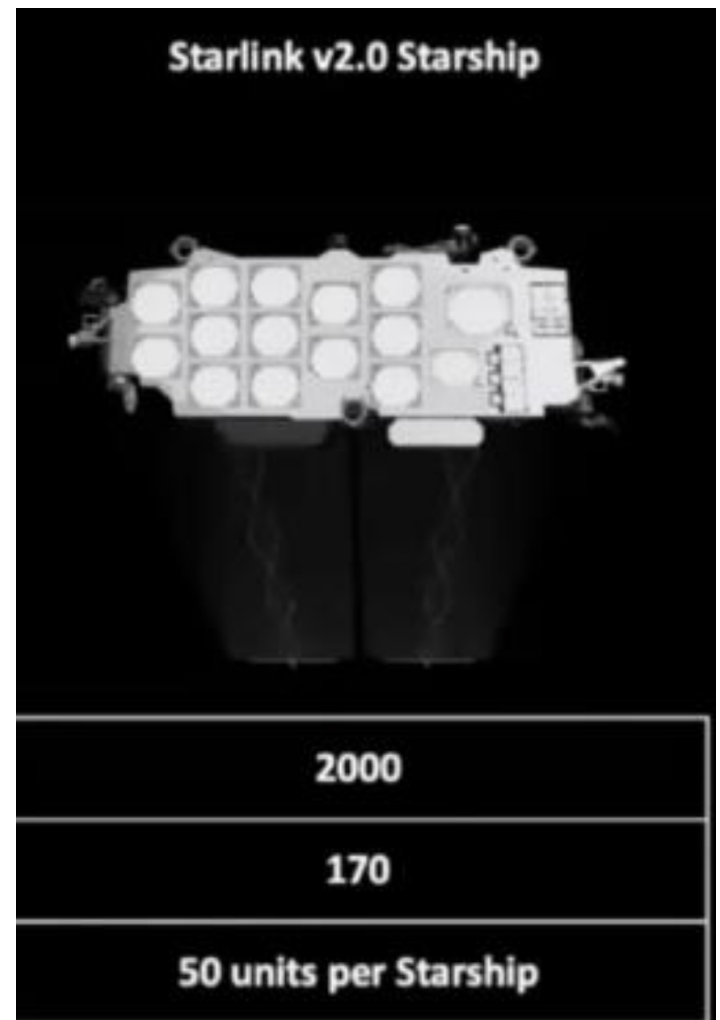
The goal of these infographics is to give a sense of stacking and scale – not to accurately represent satellite design

Assumptions	Designation	Starlink V1.5	Starlink V2 F9-1	Starlink V2 F9-2	Starlink V2 mini	Starlink V2 Starship
	Status	Launched	FCC filing – may not realize	FCC filing – may not realize	Launched	FCC filing
	Mass kg	306	303	800	800	2000
	Gbps / sat	15	18	70	60	170
	Launch	60 units per Falcon 9	60 units per Falcon 9	16 units per Falcon 9	21 units per Falcon 9	50 units per Starship
	Tbps / launch	0.9	1.1	1.1	1.3	8.5
	m\$ / launch	Sats 18 + launch 30 = 48m\$	Sats 18 + launch 30 = 48m\$	Sats 11 + launch 30 = 41m\$	Sats 15 + launch 30 = 45m\$	Sats 60 + launch 15 = 75m\$
	\$ / Mbps	53	45	37	35	9

V2.0 Satellite



V1.5 Satellite



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

Infrared “Space Lasers”

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



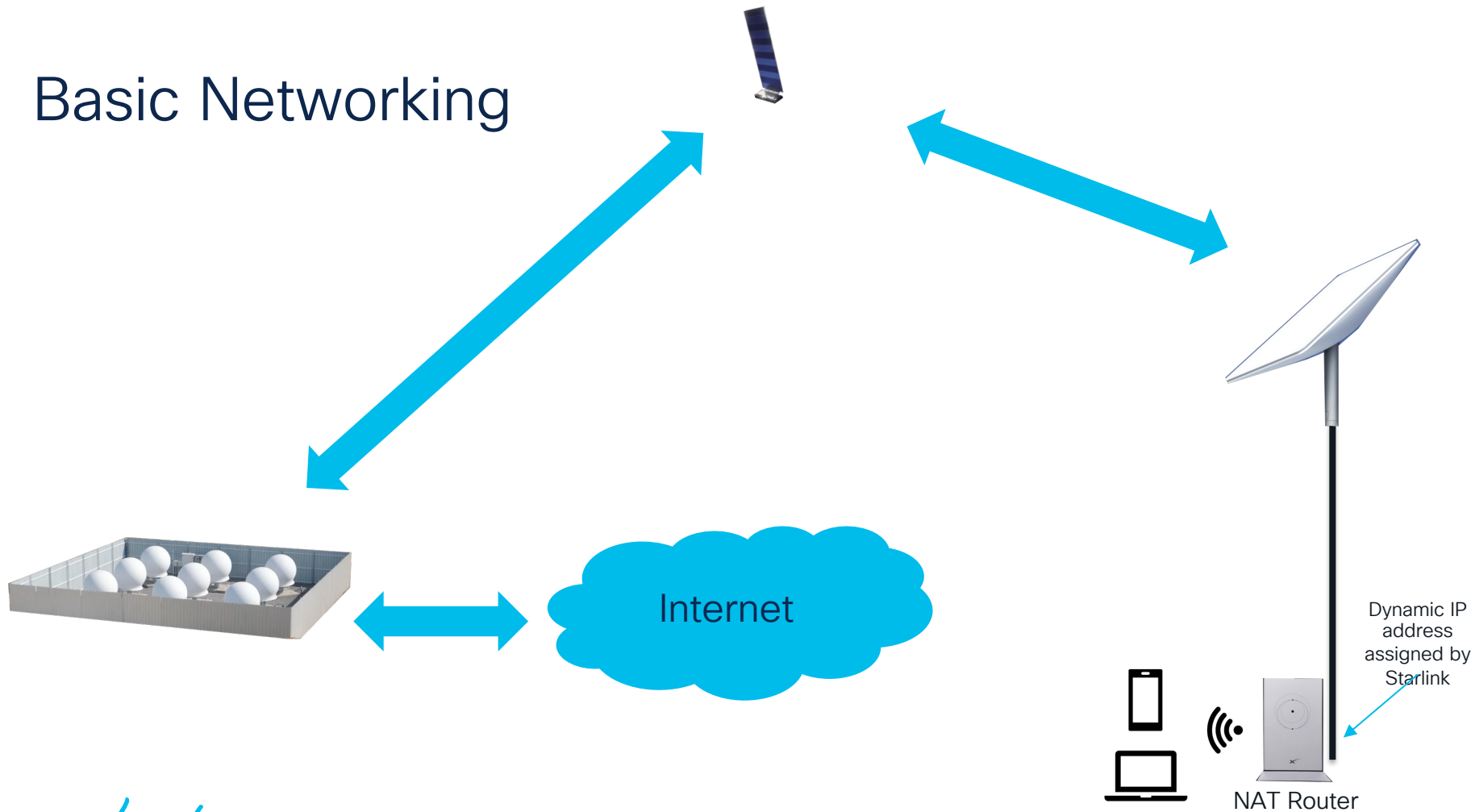
Credit: SpaceX/Starlink

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



List of Australian Starlink Ground Stations

Cataby, WA
Merredin, WA
South West of Coolgardie, WA
Wagin, WA
Ki Ki, SA
Pimba, SA
Broken Hill, NSW
Boorowa, NSW
Calrossie, NSW
Canyonleigh, NSW
Cobargo, NSW
Springbrook Creek, NSW
Tea Gardens, NSW
Ki Ki, SA
Anankie, VIC
Koonwarra, VIC
Torrumbarry, VIC
West of Emerald, QLD
Toonpan, QLD
Warra, QLD
Willows, QLD
Bulla Bulling, WA

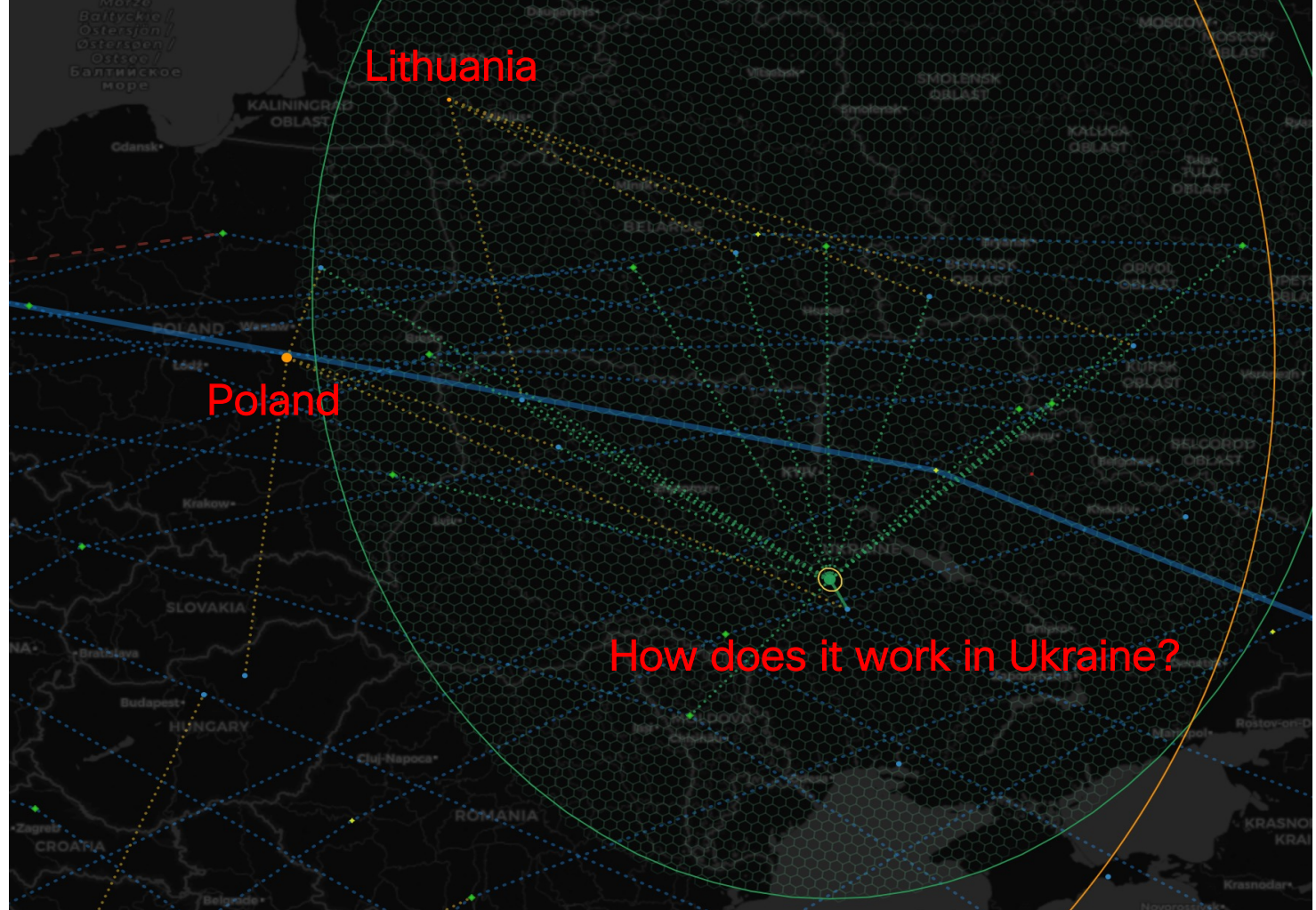


Radio Gateways

Lithuania
Poland

Internet Gateways

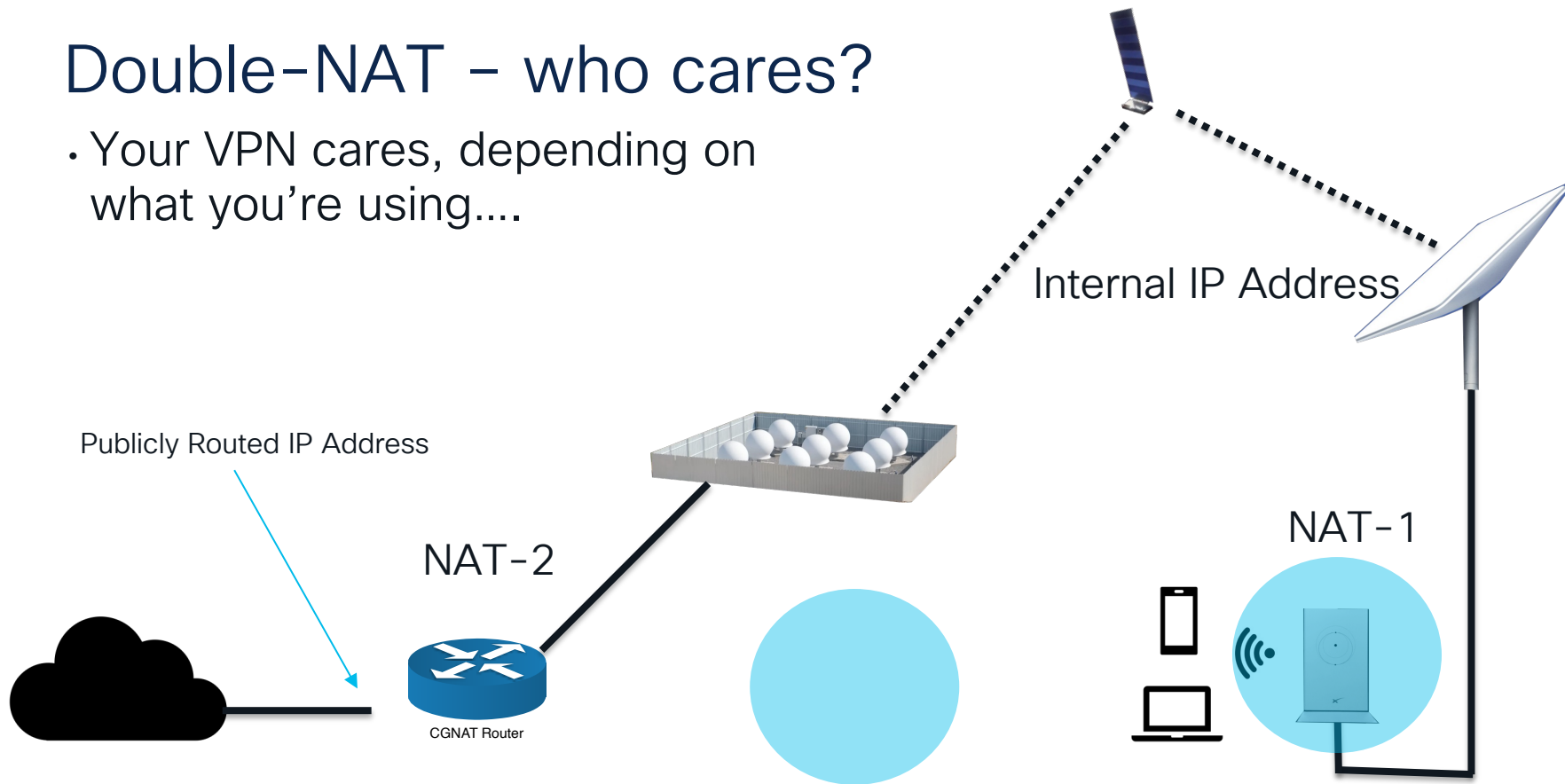
Frankfurt
London



Double/Triple NAT

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**** (maybe)
- TCP VPN Tunnels

Polar Orbits and “Space Lasers”

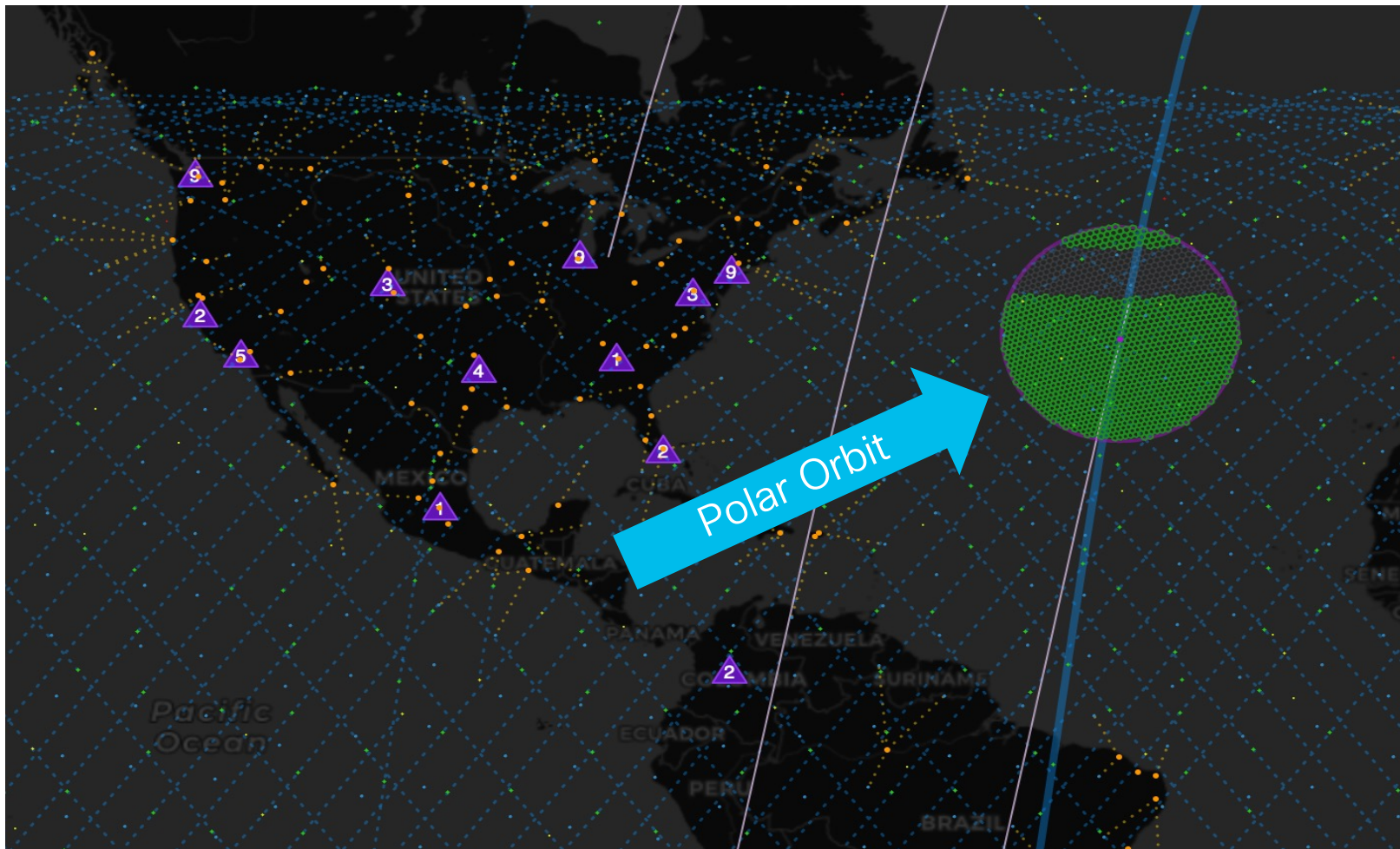
Satellite Truths and Myths

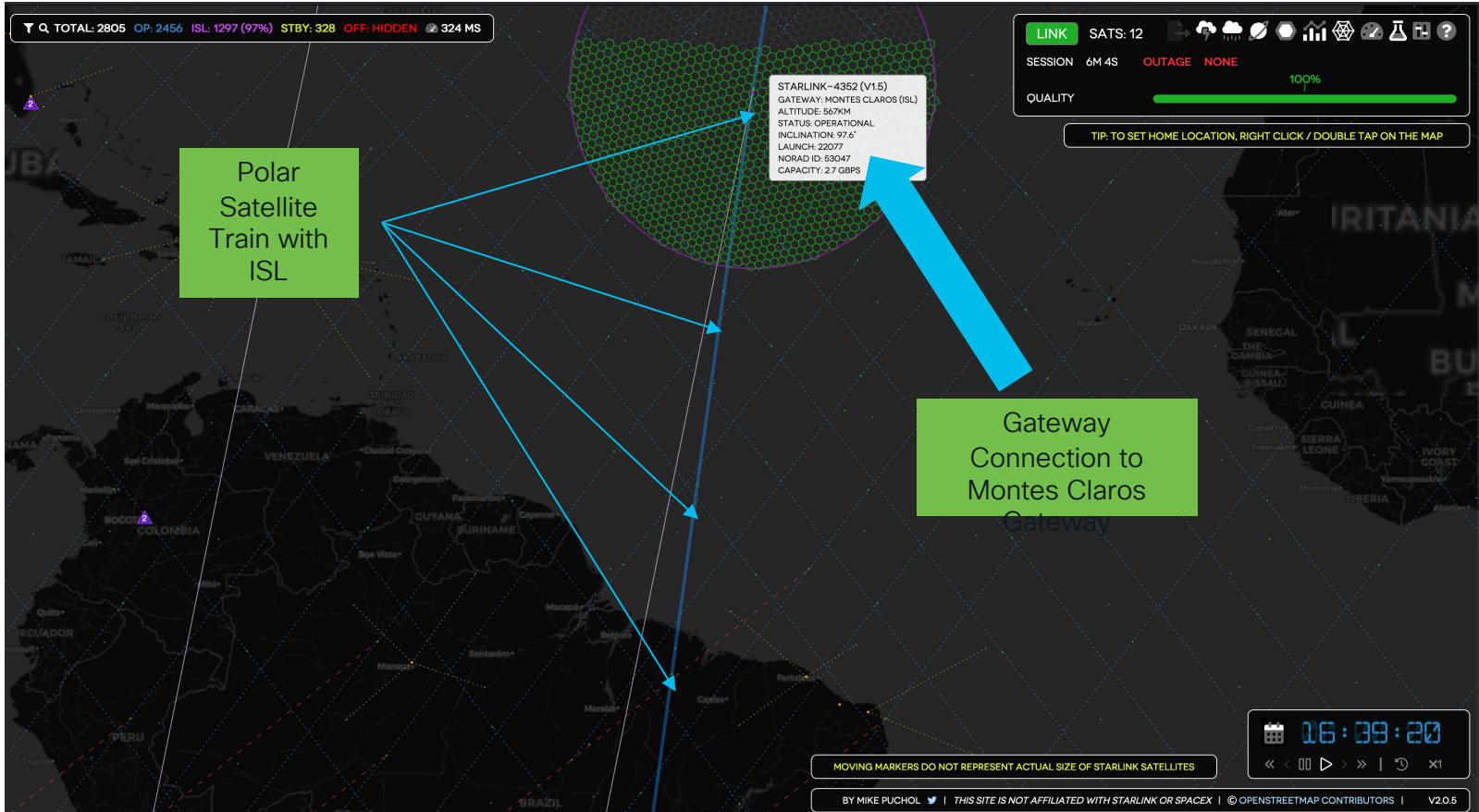
- All Starlink Satellites have “Lasers” – **FALSE**
- All Starlink Satellites can cross communicate to each other – **FALSE**
- Some Starlink Satellites have laser based optics that can point ahead of them to the next satellite – **TRUE**
- On-orbit Satellites can calculate multi-planar ephemeris to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

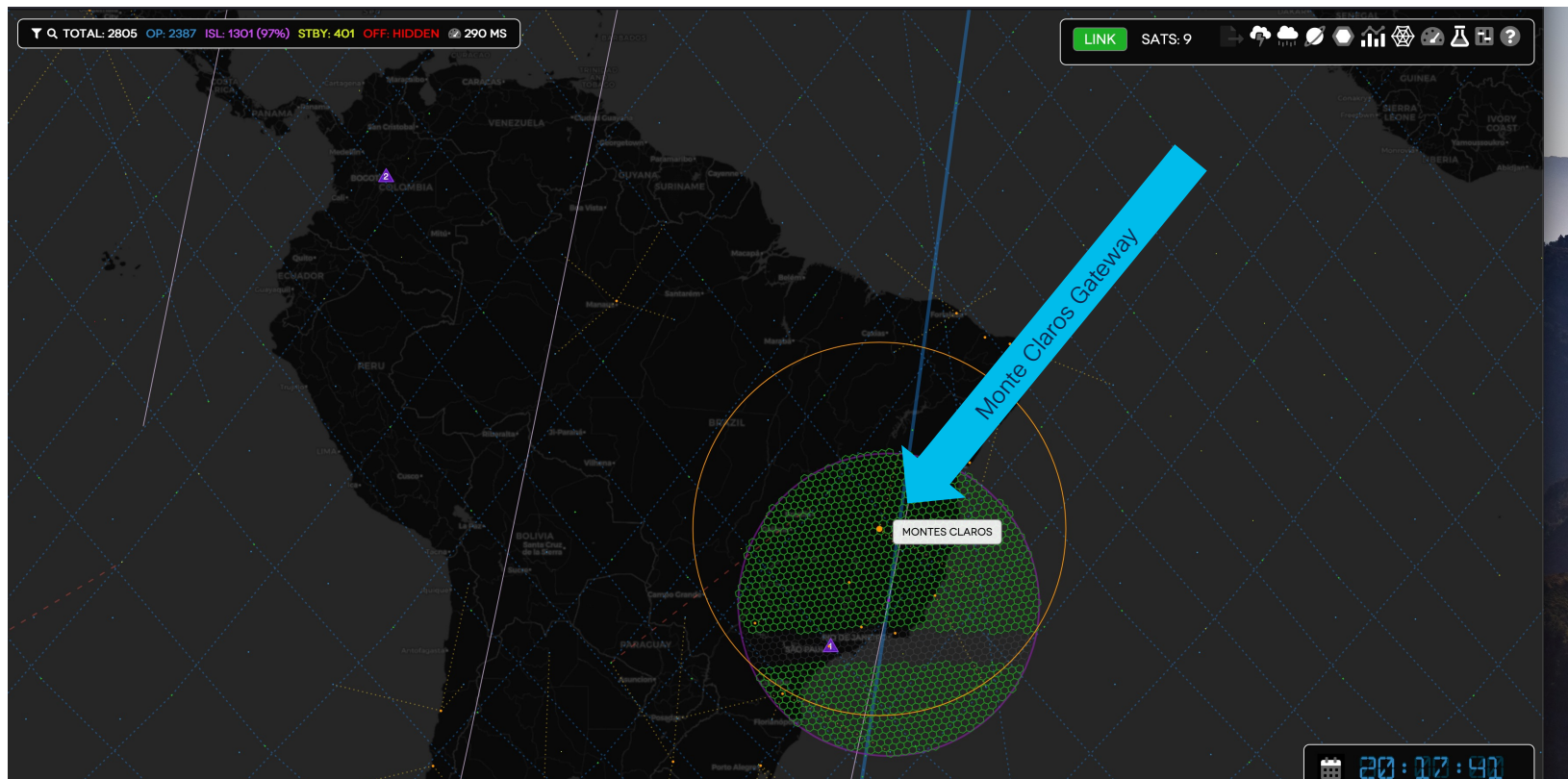
Polar Orbit Satellites and Free Space Optics

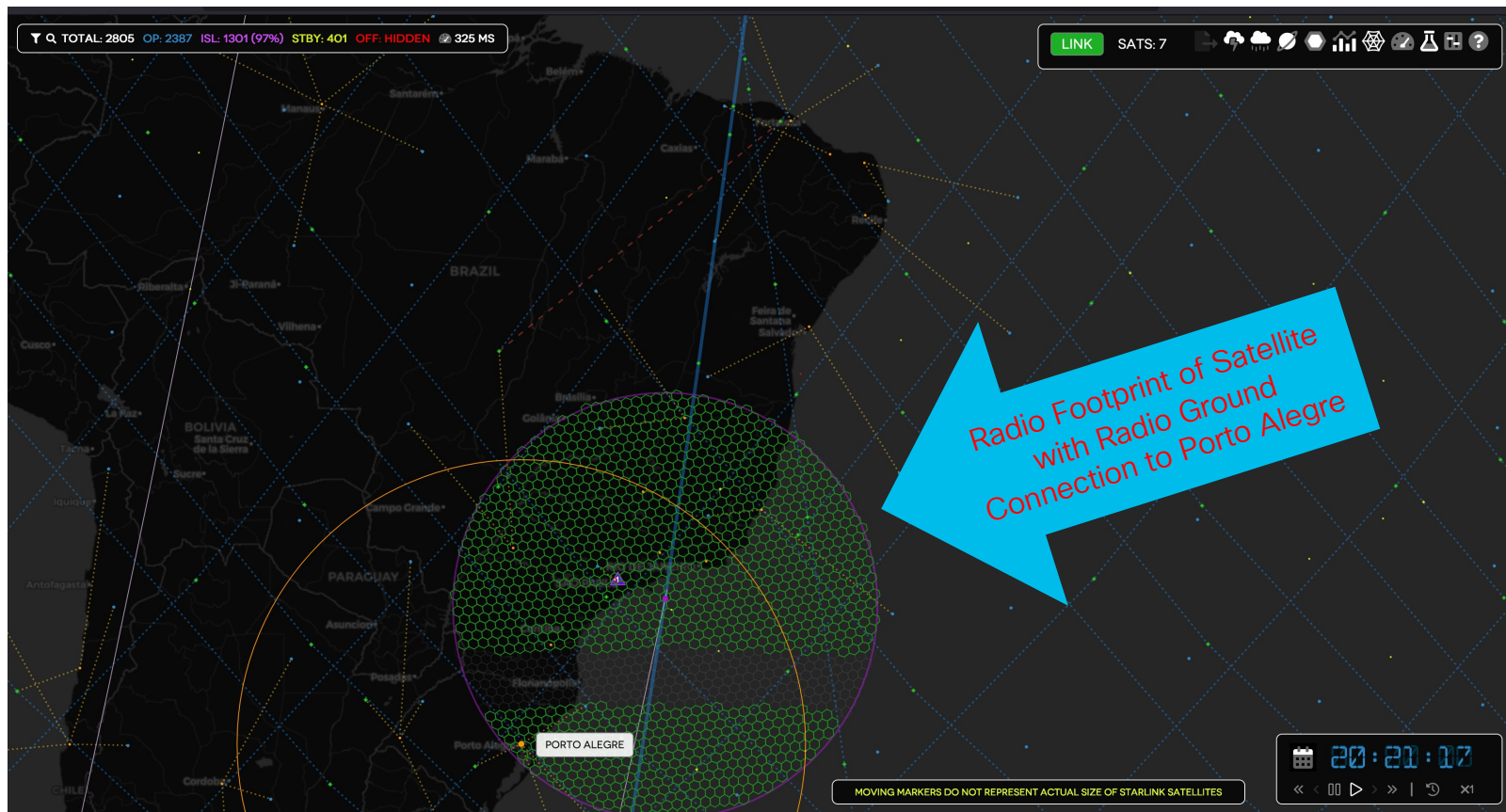
- Generation 1 Satellites are **Radio Only**
- Generation 1.5 and 2.0 Satellites are capable of Inter-Satellite Links (ISL)
- ISL Links work currently in a follow-me configuration
- A polar string of satellites provide hop to hop communications in single file
- Closest Radio Gateway provides the downlink 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**

Space Lasers fix my networking issues

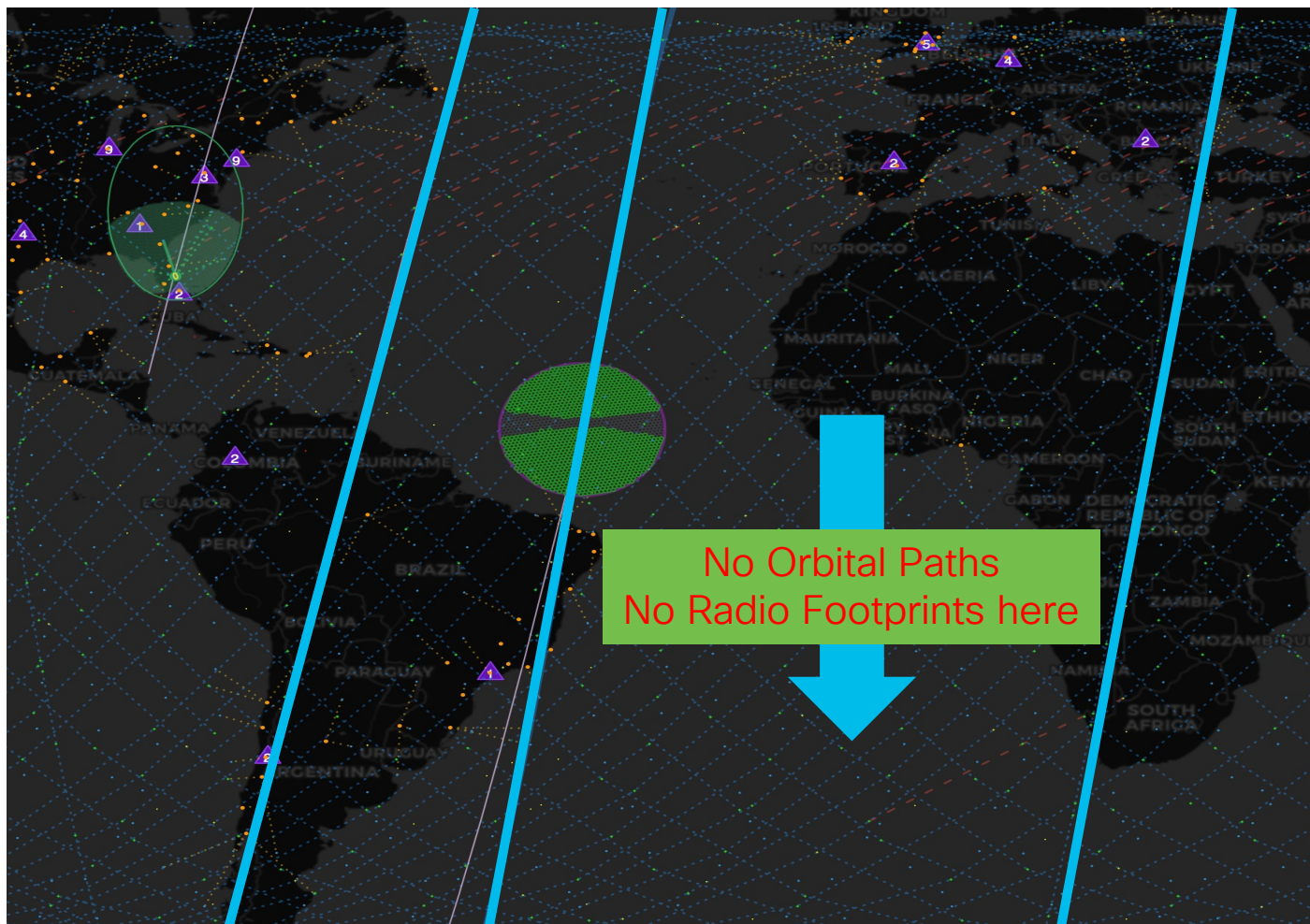


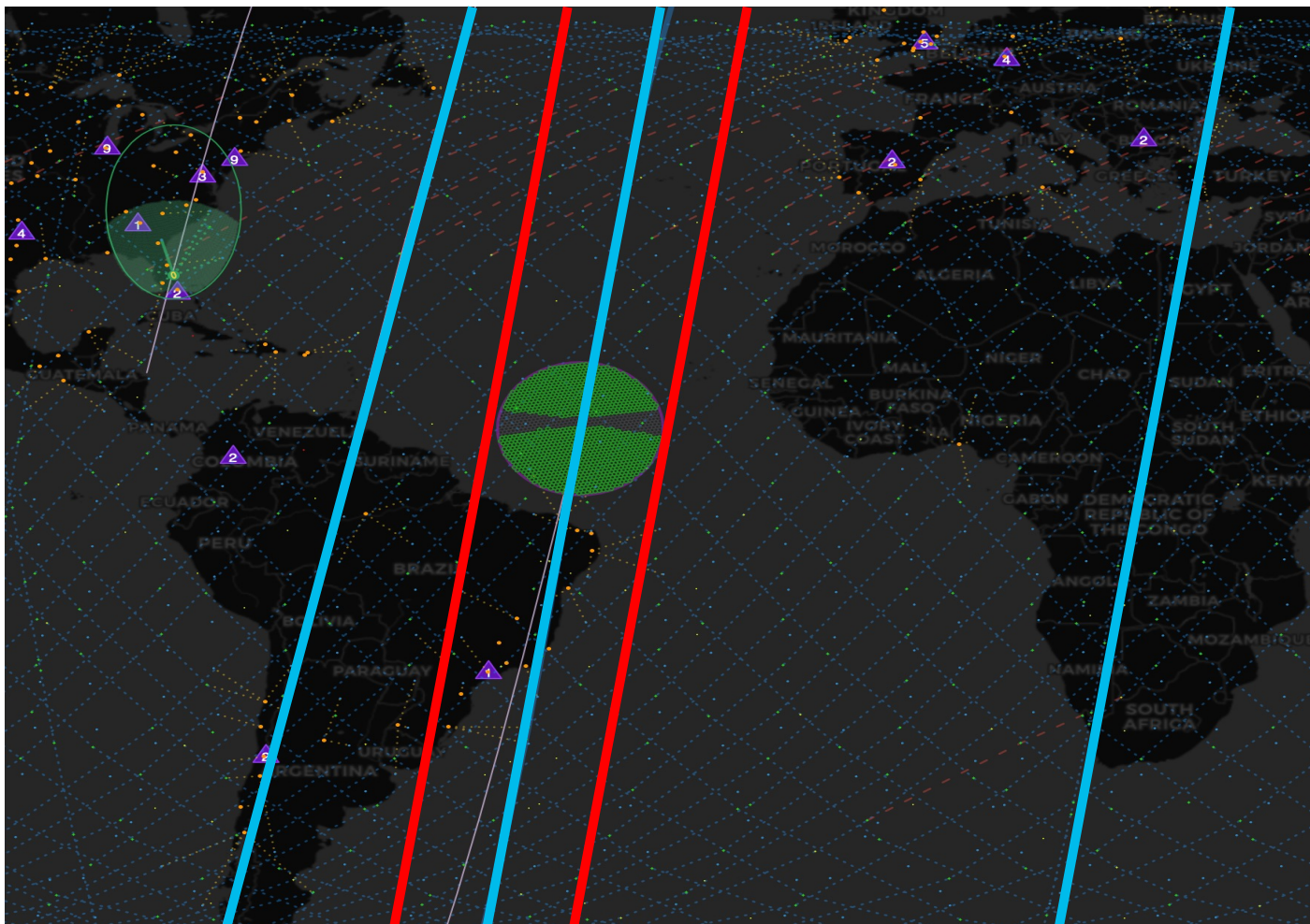


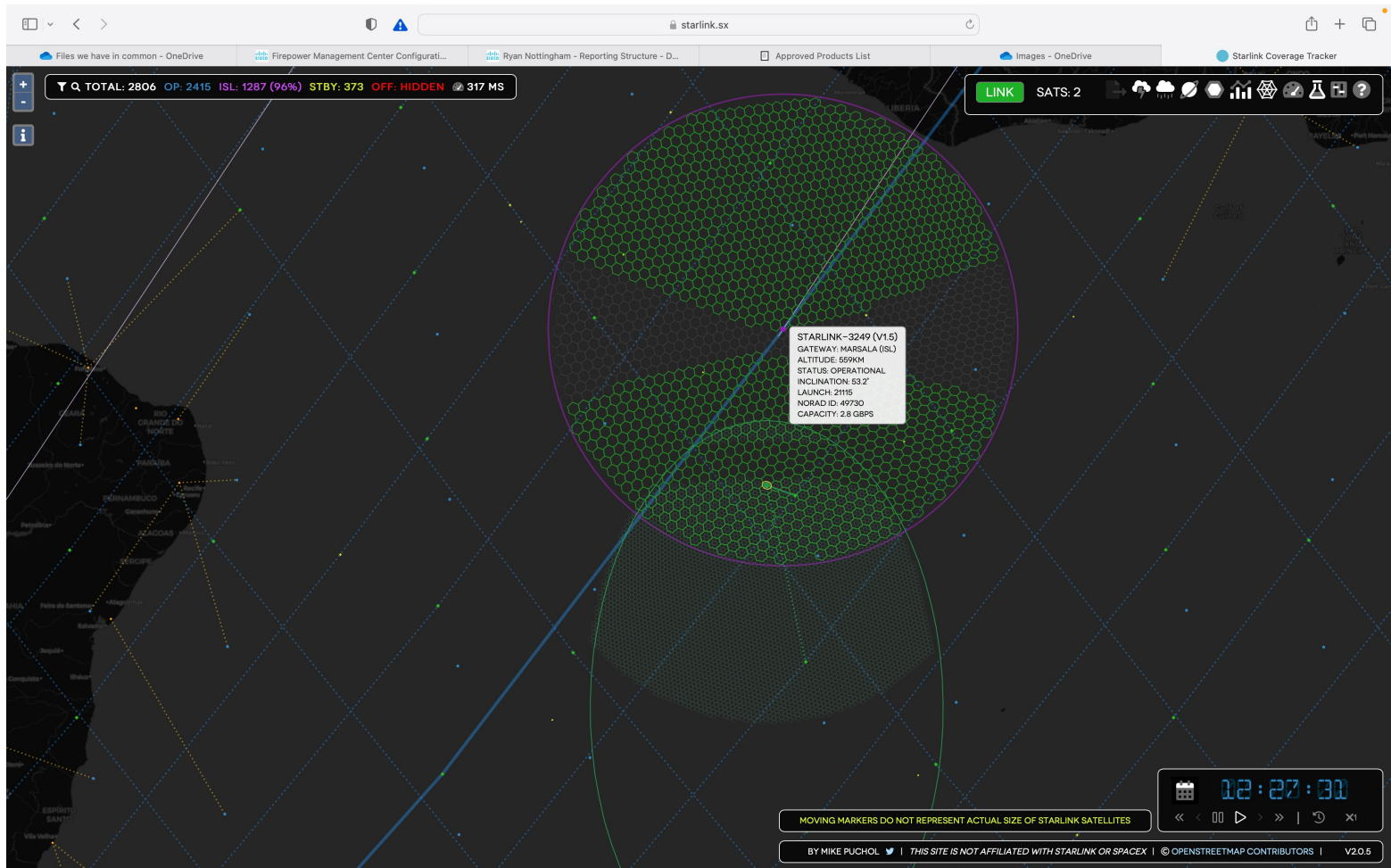




Challenges with Polar Orbits

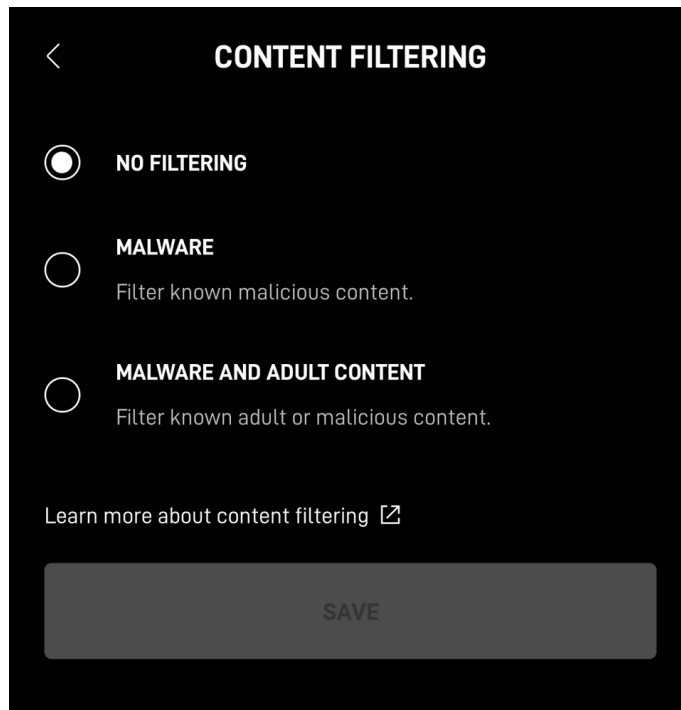






Starlink Security

Sum Total of available Security



< **CONTENT FILTERING**

☒ **NO FILTERING**

☐ **MALWARE**
Filter known malicious content.

☐ **MALWARE AND ADULT CONTENT**
Filter known adult or malicious content.

[Learn more about content filtering](#)

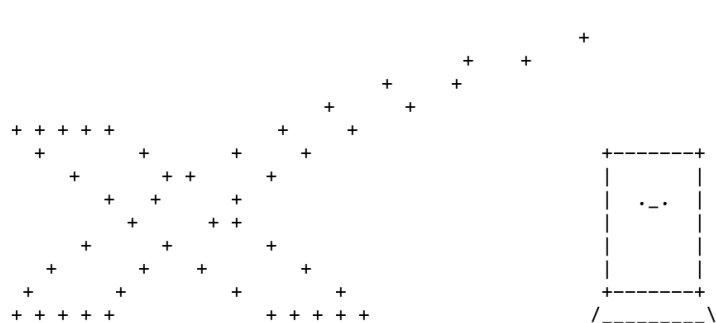
SAVE

Starlink Security

BYOS – Bring Your Own Security

There is “very limited” security other than what you bring yourself

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

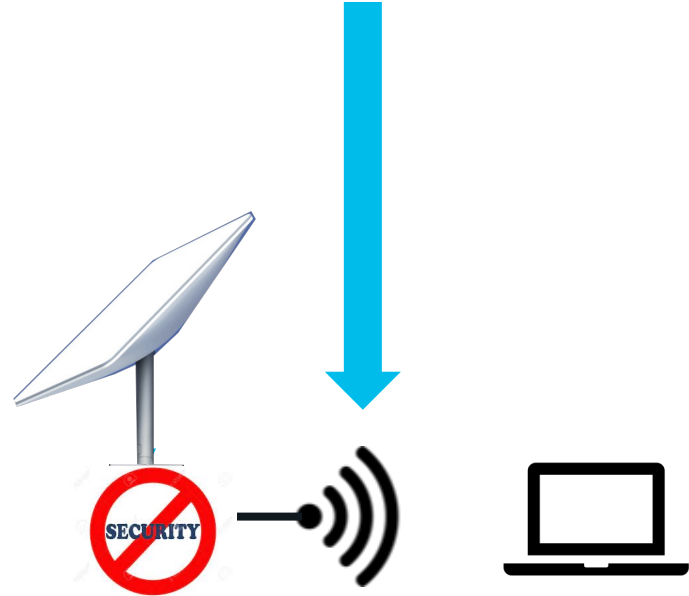
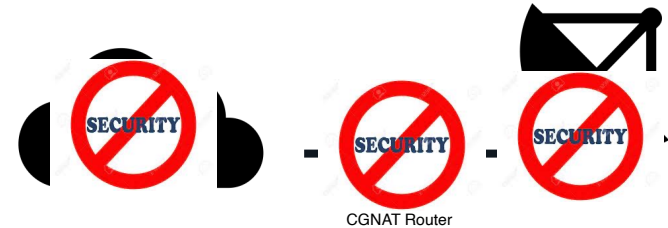
Things we know about Starlink Network

- 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

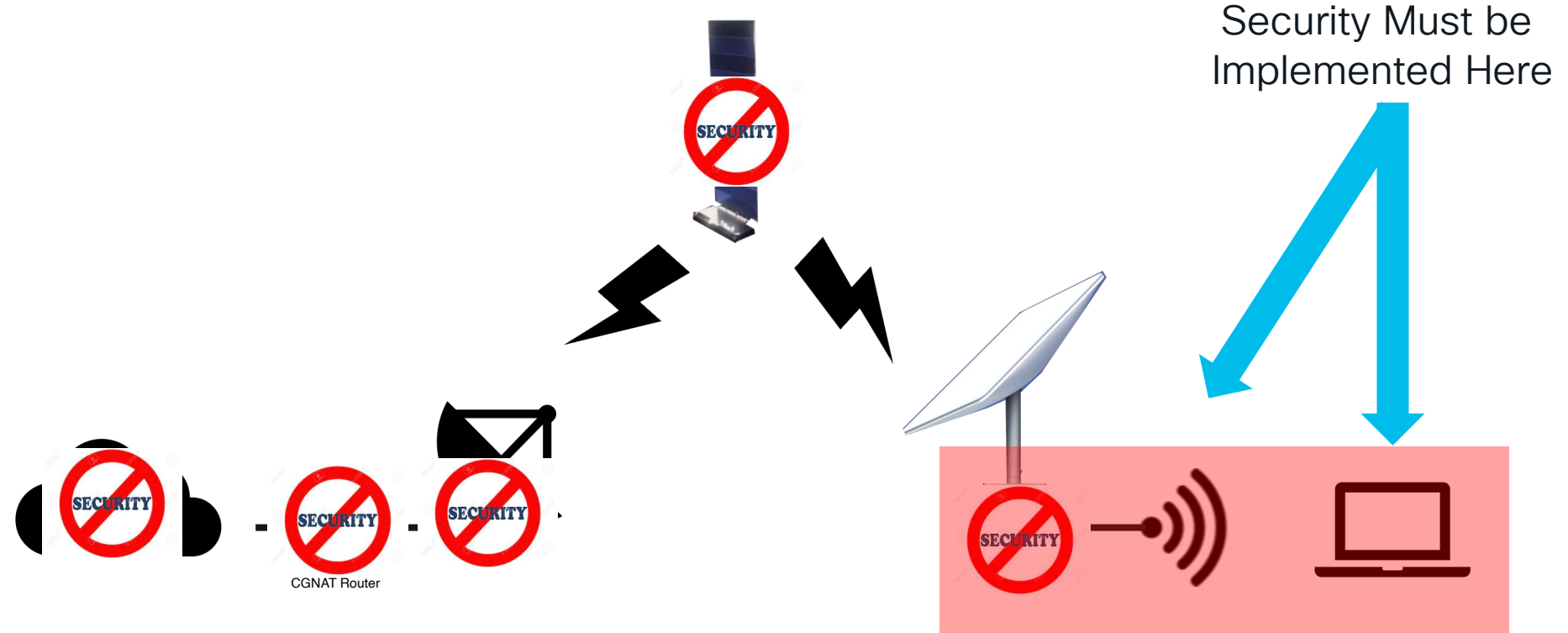
Starlink Security Today



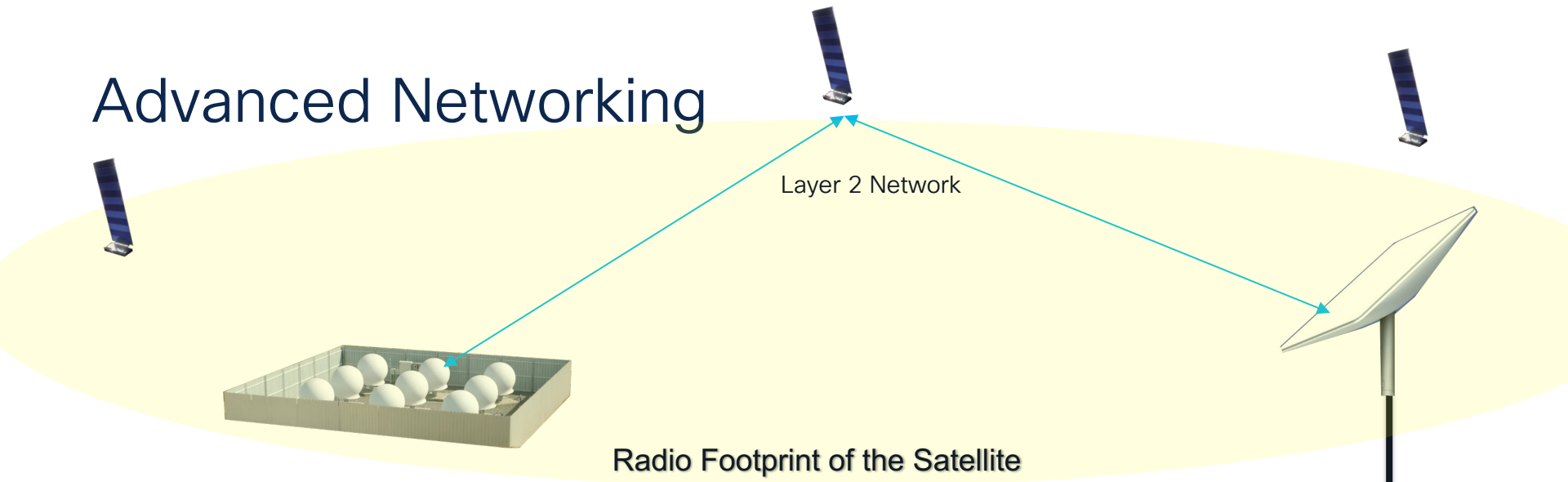
WPA2 Implemented here



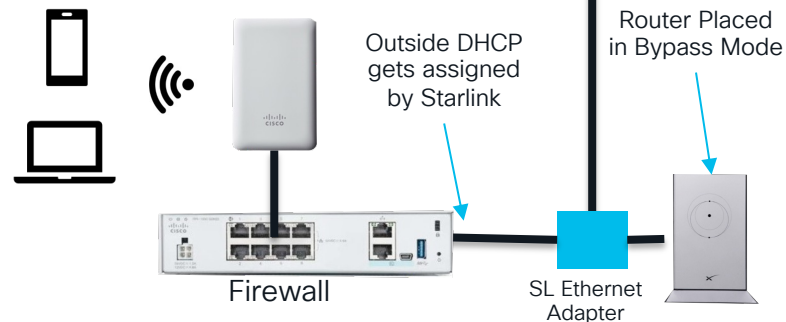
Starlink Security Today



Advanced Networking



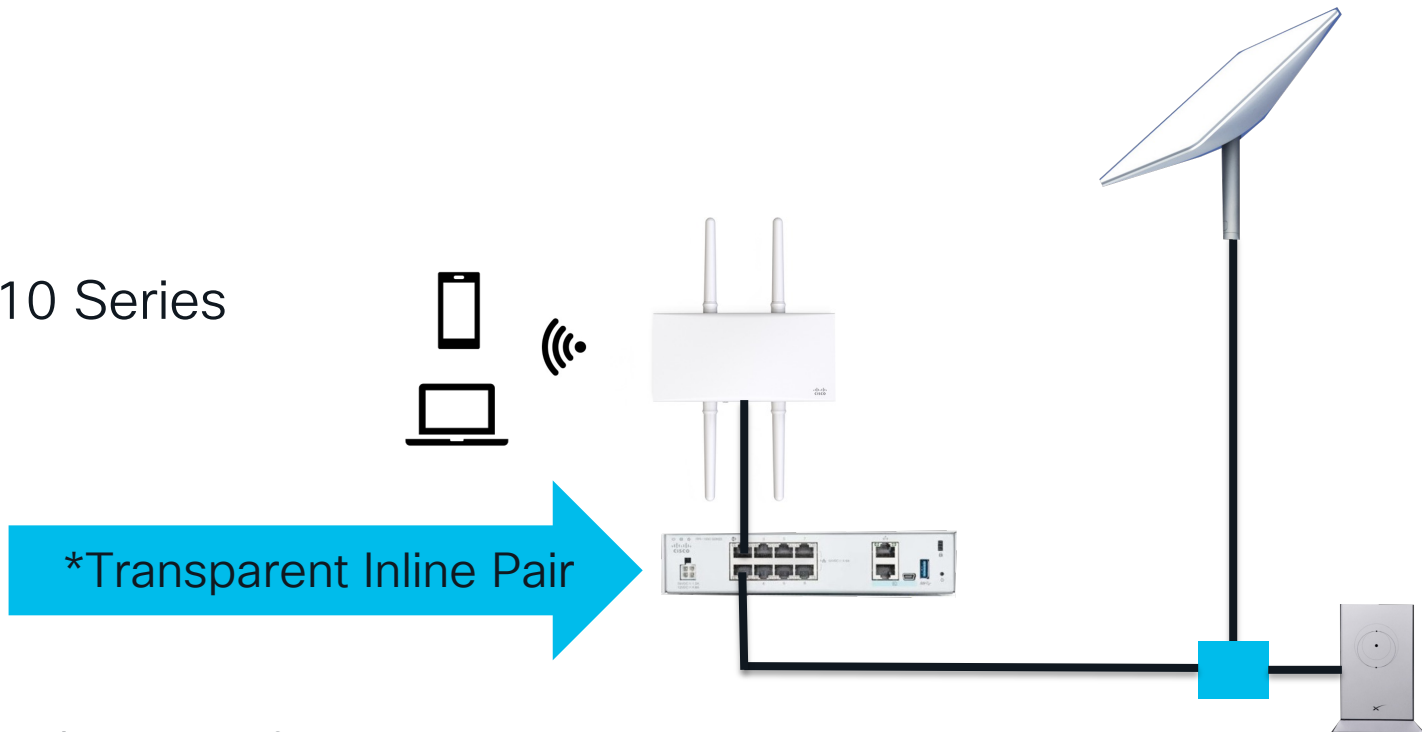
SL Router in Bypass Mode:
WIFI Gets disabled
Router is no longer locally accessible
Statistics are stored in SL Cloud
Array connects to SL Cloud and delivers updates



Cisco Security + Starlink

Meraki+Firepower Deployment

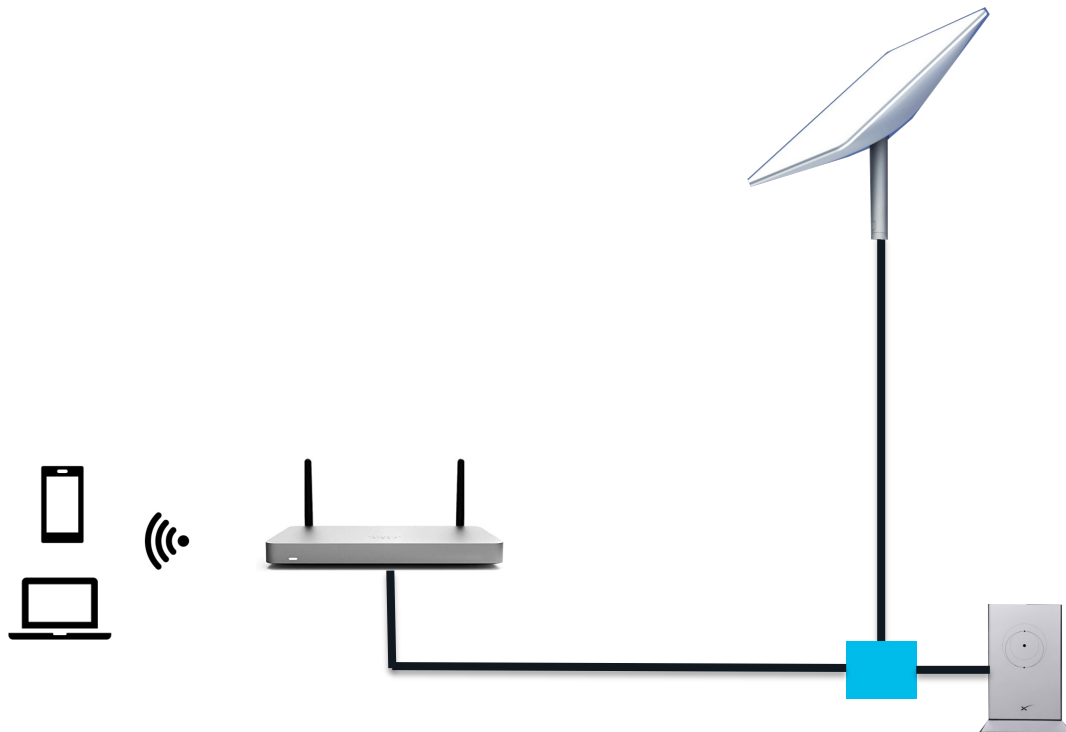
- MX Series
- MR Series
- Z3 Series
- Firepower 1010 Series



*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 Cisco Meraki dashboard. On the left is a dark sidebar with the Meraki logo and navigation links: ORGANIZATION, Cisco Florida, NETWORK, MX95 Firewall, Network-wide, Security & SD-WAN (highlighted), Insight, and Organization. The main area has a search bar and a notification banner about new SM features. Below this is a yellow warning box about account recovery. The 'Threat protection' section is expanded, showing 'Advanced Malware Protection (AMP)' with 'Mode' set to 'Enabled'. It also shows 'Threat Grid' and 'Intrusion detection and prevention' sections, all with 'Mode' set to 'Enabled'.

The screenshot shows the 'Configuration' tab in the Meraki dashboard. A large blue lightning bolt icon points to the 'WAN 1' section. The 'General' tab is selected, showing 'PUBLIC IP' and 'WAN 1' settings. The 'WAN 1' section has a table with columns for TYPE, CONFIGURED AS, STATUS, IP ADDRESS, GATEWAY, and DNS. The table shows settings for IPv4 and IPv6. The 'Live data' section is also visible, showing 'Uplink traffic' and 'Historical device data'.

TYPE	CONFIGURED AS	STATUS	IP ADDRESS	GATEWAY	DNS
IPv4	Dynamic	Active	192.168.1.164	192.168.1.1	192.168.1.1
IPv6	Auto (DHCP6)	Active	fd5e:9a9e:c5bd:10::d0b	fe80::7624:9fff:feaf:2f12	fd5e:9a9e:c5bd:10::d0b

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

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

/64 Deployed Network

/96 IPv6 Assigned Interface

Actual Working Things

Global Overview

Organization
Cisco Florida

Network
MX95 Firewall

Network-wide

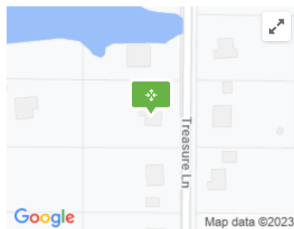
Security & SD-WAN

Insight

Organization

Starlink-MX95

MX95 a8:46:9d:3c:b6:d2



ADDRESS
5840 Treasure Lane, Grant, Florida 32949

WARM SPARE

Configure warm spare

WAN 1

98.97.181.203

Active

2605:59c8:6087:3a10::d0b

Active

WAN 2

HOSTNAME
grant-florida-rckhqznmqc.dynamic-
m.com

SERIAL NUMBER
Q2XN-CRBC-3HG5

TAGS

NOTES

Configurat

General

PUBLIC IP

WAN 1

TYPE

CONFIGURED AS

PREVIOUS STATU

IP ADDRESS

GATEWAY

DNS

WAN 2

TYPE

CONFIGURED AS

STATUS

Live data

Uplink traffic

1 b/s
0.75 b/s
0.5 b/s
0.25 b/s
0 b/s



Dashboard

SFC Protect

Network

Advanced

AP

System

Status

Apply Changes

General

Logout

WAN Connection Status

Independent from Priority

Starlink	Connected via Starlink	192.168.1.21
1 Verizon-Cisco	Connected to Verizon LTE-A	100.103.182.178
2 WAN-WIFI	Connected to GigE-Spectrum	192.168.1.108

Priority 1 (Highest)

1 WIFI-WAN 2.4Ghz	Scanning...	(No IP Address)
-------------------	-------------	-----------------

Priority 2

2 T-Mobile	No Device Detected	(No IP Address)
------------	--------------------	-----------------

Priority 3

Drag desired (Priority 3) connections here

Disabled

VLAN WAN 1	Disabled	(No IP Address)
------------	----------	-----------------

LAN Interface

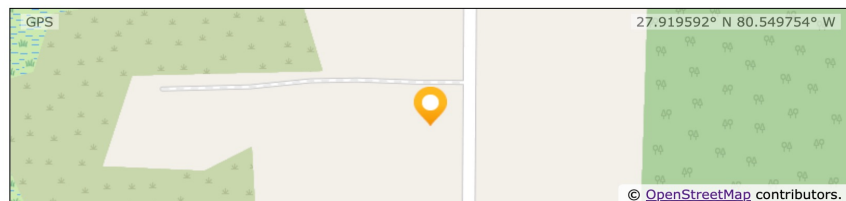
Router IP Address: 192.168.50.1

Wi-Fi AP

2.4 GHz 5 GHz	Pepwa (United ...	2.4 GHz 5 GHz	Pepwa (United ...	2.4 GHz 5 GHz	Pepwa (United ...	2.4 GHz 5 GHz	Pepwa-WIFI
---------------	-------------------	---------------	-------------------	---------------	-------------------	---------------	------------

SpeedFusion Connect Protect

SFC-ATL	Established
SFC-CHI	Established
SFC-MIA	Established
Data usage allowance: 1003.20 GB (Expiry date: Apr 11, 2024)	



Device Information

Model: Peplink MAX Transit Duo Pro



WAN Connection Status		
Independent from Priority		
Starlink	Connected via Starlink	192.168.1.21
1 Verizon-Cisco	Connected to Verizon LTE-A	100.103.182.178
2 WAN-WIFI	Connected to GigE-Spectrum	192.168.1.108

Makes forwarding decision based on API feedback

Priority 1 (Highest)

1 WIFI-WAN 2

Priority 2

2 T-Mobile

Priority 3

Disabled

VLAN WAN 1

IPv6

Enabled

DNS over HTTPS

Enabled

WAN Quality Monitor

Auto

Synergy Controller

Disabled

Starlink

Enabled WAN Connection(s):
Starlink

What Is My IP?

My Public IPv4: 98.97.18.37

CG-NAT IP

My Public IPv6: 2605:59c8:2103:7310:654e:1122:4a82:e20a

My IP Location: New York City, NY US

My ISP: SpaceX Services Inc.

Actually does API lookups

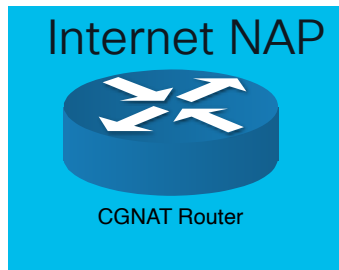
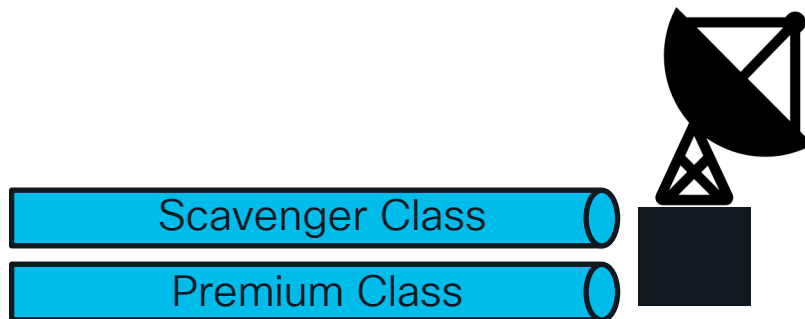
Deployment Considerations

QoS Observations

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

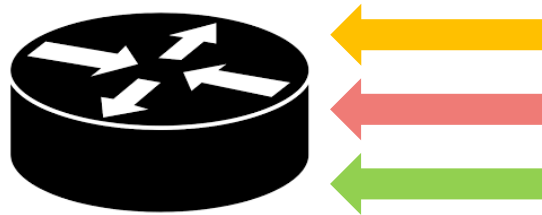
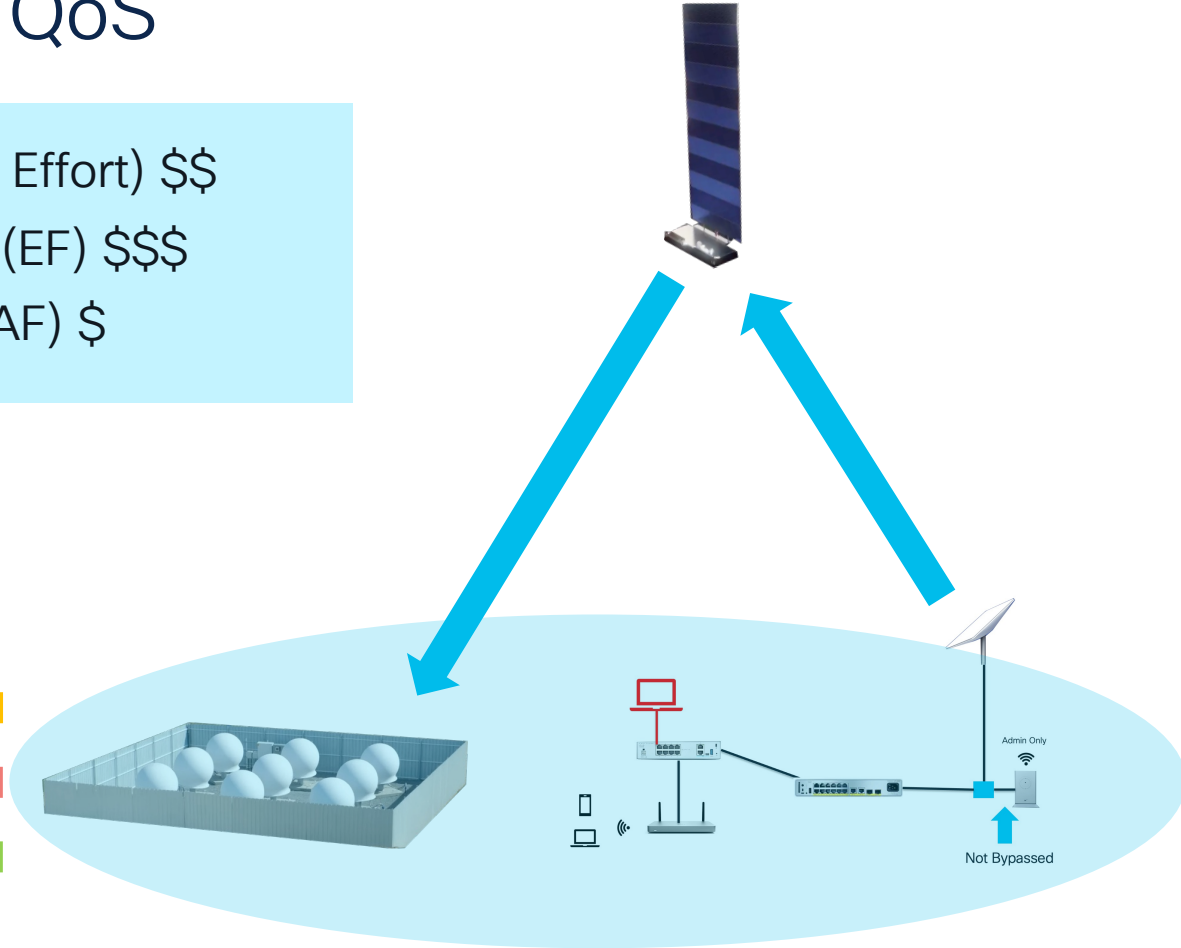


Scavenger class QoS



Residential QoS

- ← Mobile (Best Effort) \$\$
- ← Priority Data (EF) \$\$\$
- ← Residential (AF) \$

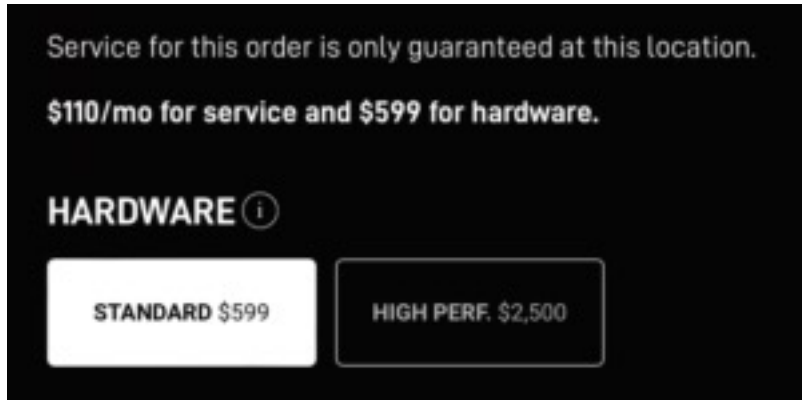


Deployment Considerations

- 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



Decisions



- “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

High Performance Terminal Considerations

HP Wires are 22AWG!

HP pin / Pot / Dish Wire Color / RJ-45 pin &
Color using 568B standard

A1 + Green 1 Orange/White

A2 + Yellow 2 Orange

A3 + Blue 3 Green/White

A4 + White 6 Green

B1 - Orange 7 Brown/White

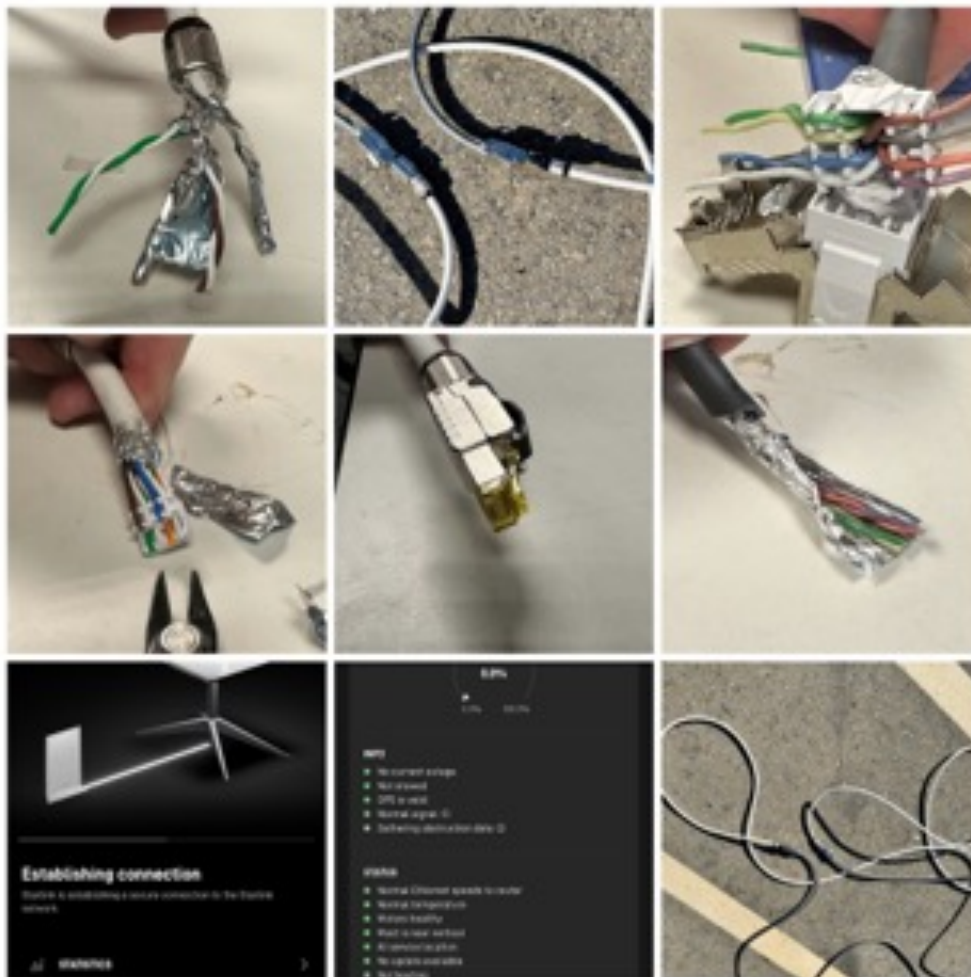
B2 - Purple 8 Brown

B3 - Brown 5 Blue/White

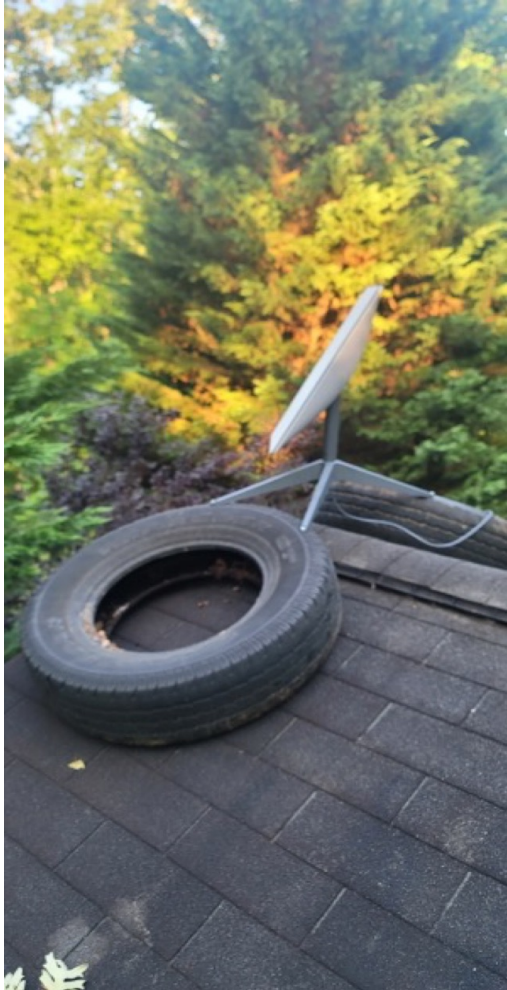
B4 - Gray 4 Blue

B5 × Shield / Shell

CAT8 22AWG STP RJ45



Austere Deployment Options

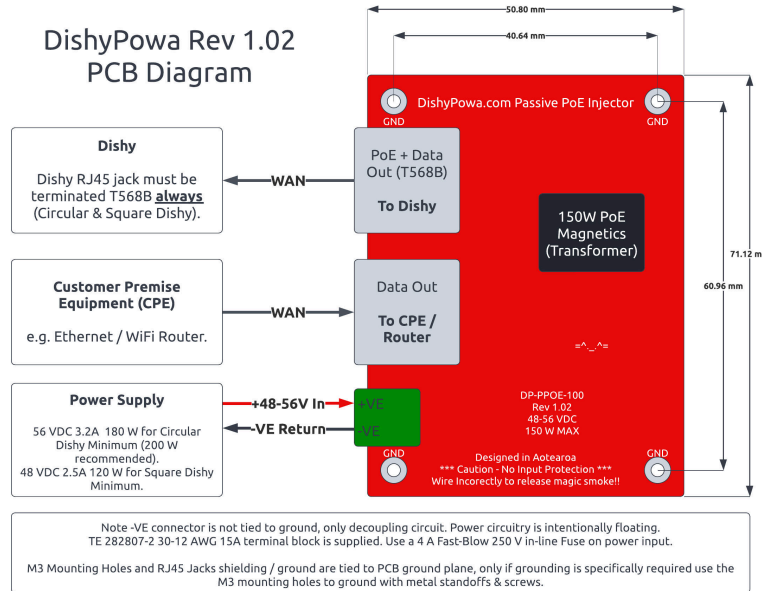


Disclaimer

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



Roll over image to zoom in

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

Carefully evaluate your actual WIFI Power Requirements!

12volt DC
LiFePO4 Battery

12volt-48v DC
DC Boost Converter

Minimum 120watts

Dishy Dualie Products

Filter: Availability ▾



Dishy Dualie DC Power Supply

\$148.00 AUD



Dishy Dualie DC Enclosure

\$68.00 AUD

Cisco Crisis Response Deployment to Maui

- Requested to support Maui First Responders with Internet access
- Cisco Employees dispatched with High Performance Terminals
- Setup instant Internet access



SOLAR POWER (last year)



ADVANCED SPEED TEST



WIFI SPEED

IPHONE TO WIFI ROUTER

499 Mbps

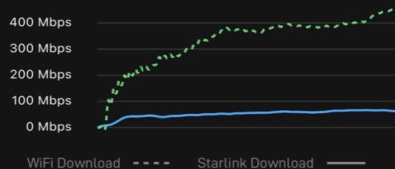
388 Mbps Upload

STARLINK SPEED

ROUTER TO INTERNET

64 Mbps

4.4 Mbps Upload

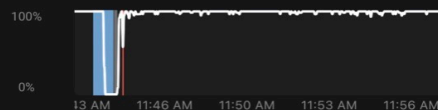


NETWORK STATISTICS

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

UPTIME ①

OUTAGES



Last 14 minutes:

- Possibly Obstructed 3s ①
- Network Issue 8s ①

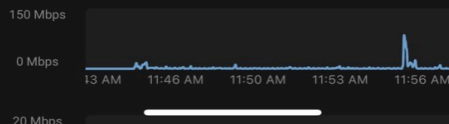
LATENCY ①

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



THROUGHPUT ①

SPEED TEST

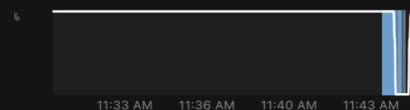


NETWORK STATISTICS

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

UPTIME ①

OUTAGES

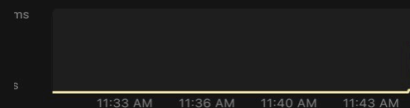


Last 2 minutes:

- Possibly Obstructed 3s ①
- Network Issue 8s ①

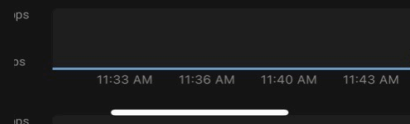
LATENCY ①

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



THROUGHPUT ①

SPEED TEST



EB3A2226002144201



Power off



72%



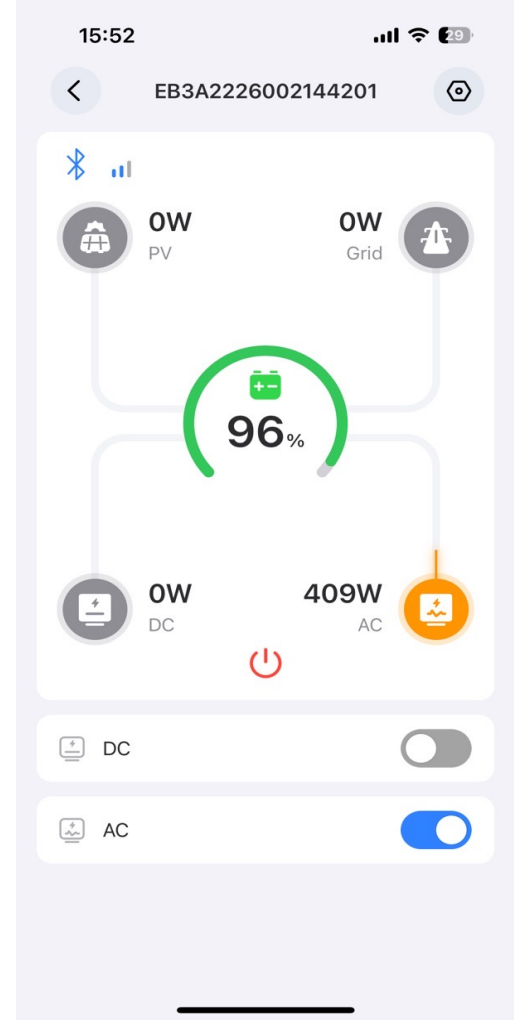
DC



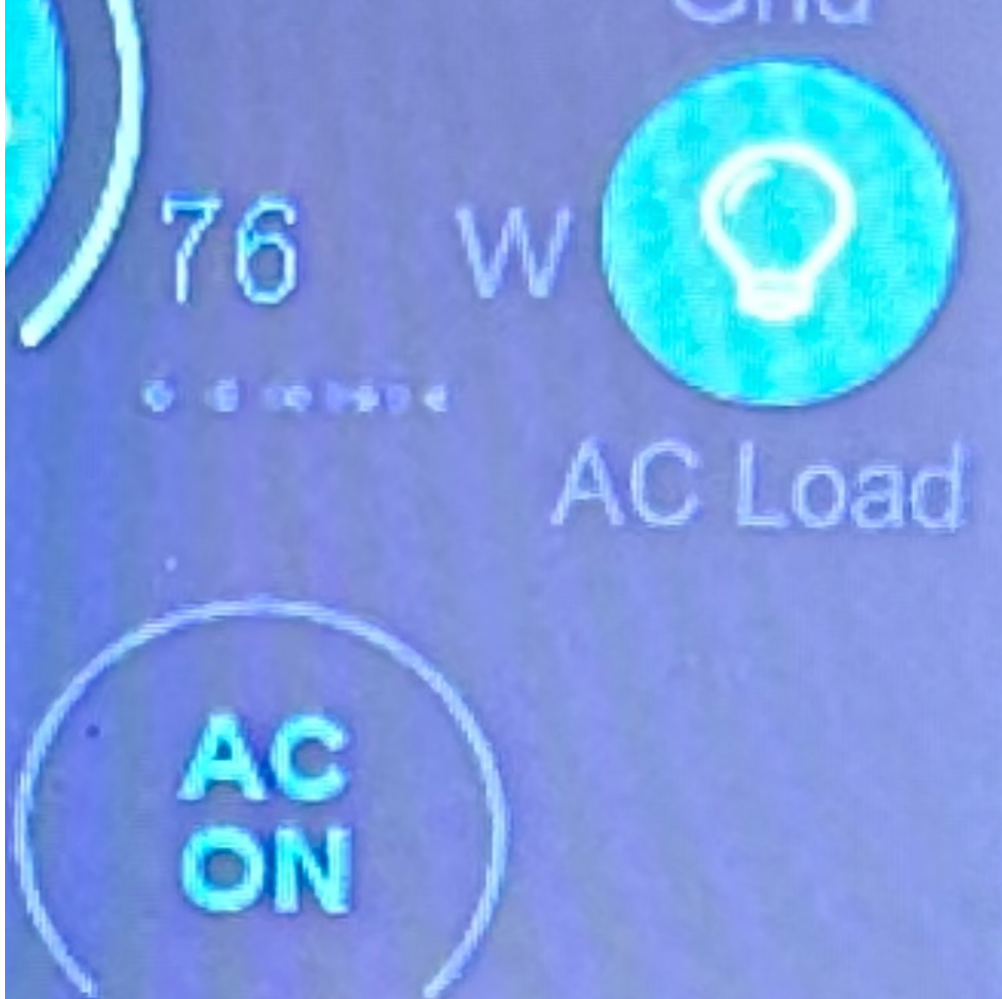
AC



SOLAR POWER (this year)







Power/Solar Conclusions (from last year)

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

Updated Solar Guidance

- Minimum 1000Wh between solar cycles
- Gen 2 dish consumes between 430-50watts consistently
- 200watts of solar panel will reliably recharge 800Wh in 4-5 hours of direct sun
- 24 hour remote operation is completely achievable

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': 2370549.375, 'pop_ping_latency_ms': 4
currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 1.7222282886505127
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': 4
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': 1
currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 1.8865798711776733
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': 1
currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 1.845041632652282
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': 1
currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 1.788205504417419
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': 1
currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 2.08909177780151
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': 1
bstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 2.058941125869751, 'direction
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': 1
currently_obstructed': False, 'seconds_obstructed': None, 'obstruction_duration': None, 'obstruction_interval': None, 'direction_azimuth': 2.20095491409301
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': 1
```

Docker Tools Repository

Docker Desktop Upgrade plan Search K ⚙️ abenhase

Images [Give feedback](#) [Learn more](#)

An image is a read-only template with instructions for creating a Docker container.

LOCAL REMOTE REPOSITORIES

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

star

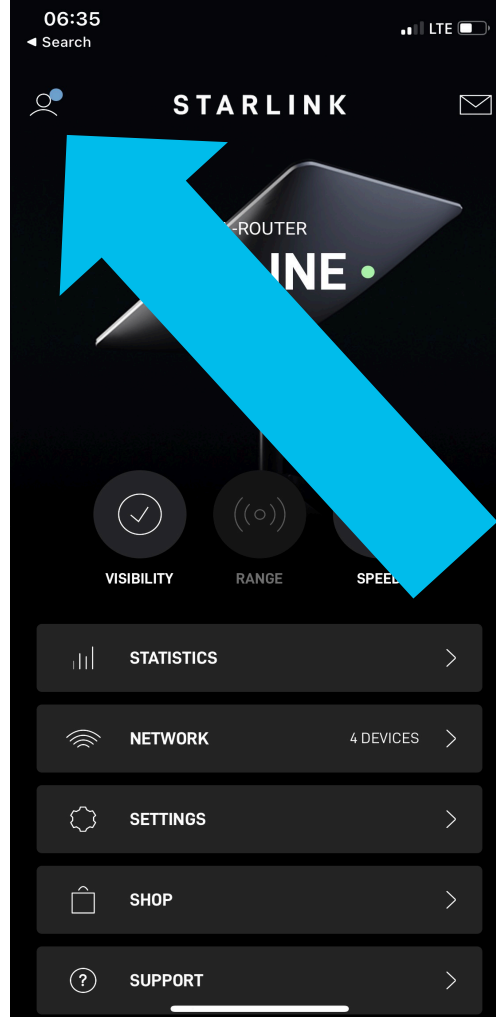
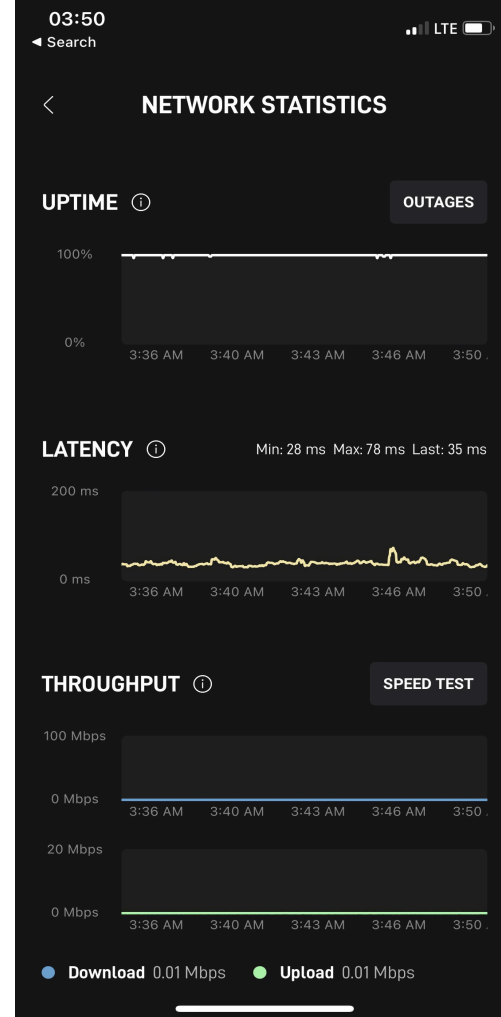
☐	NAME	TAG	STATUS	CREATED	SIZE	ACTIONS
☐	sponsianus/starlink-grpc-tools 330f096f73b1	latest	In use	8 days ago	961.64 MB	▶ ⋮ 🗑️
☐	ghcr.io/sparky8512/starlink-grpc-tools 3221e3c4730e	latest	In use	26 days ago	960.32 MB	▶ ⋮ 🗑️
☐	sponsianus/starlink-grpc-tools 9385172f655f	<none>	In use (dangling)	2 months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

Showing 8 items

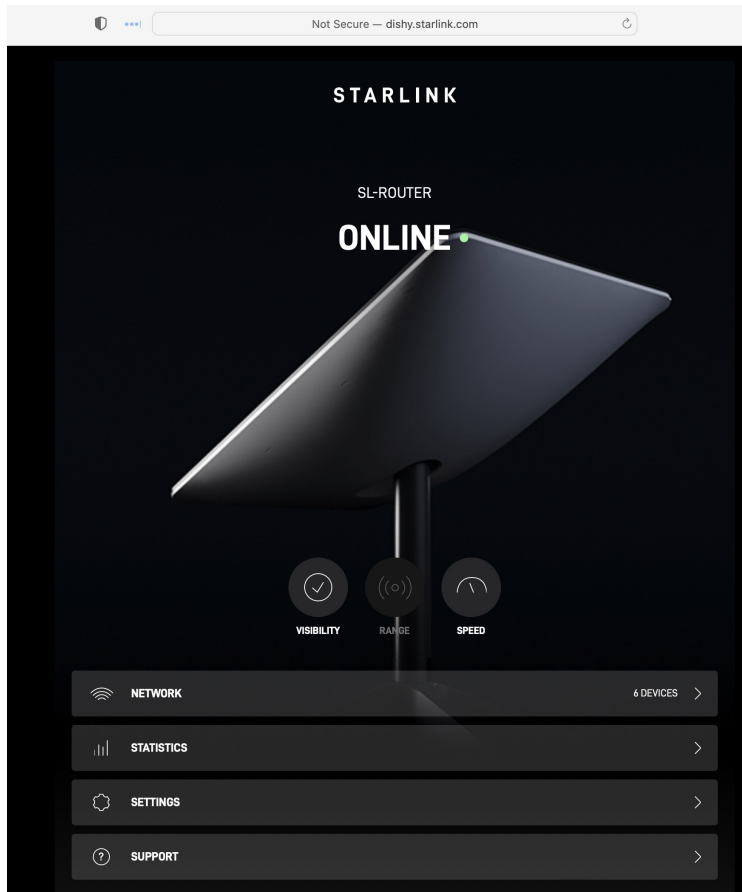
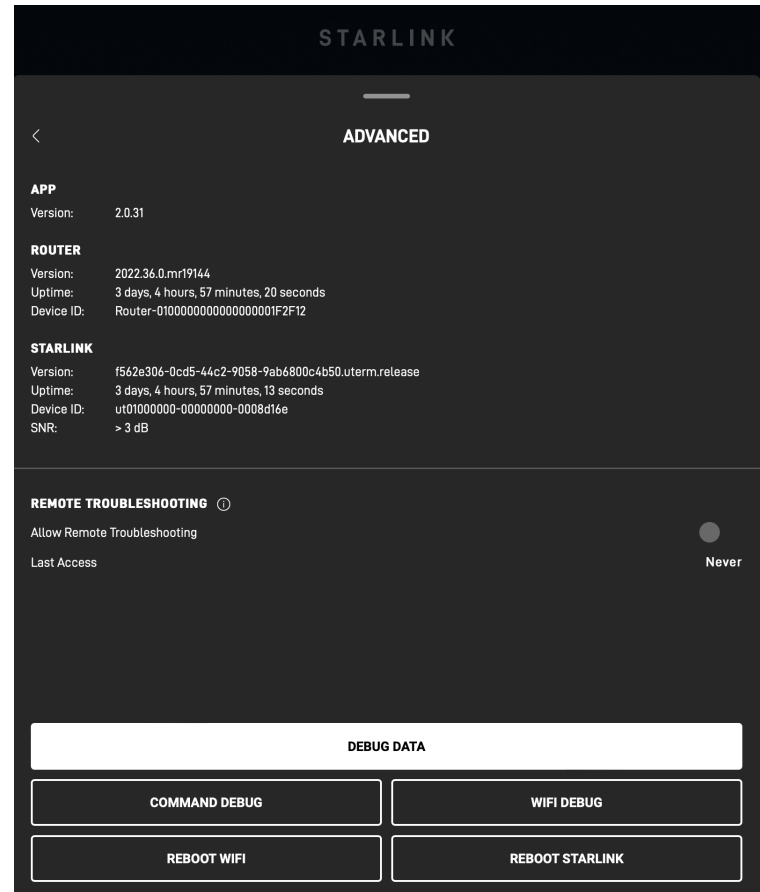
RAM 0.25GB CPU 0.37% Connected to Hub v4.14.1

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,
```

Should you leave your SL Router WIFI Enabled?

- The short answer is yes – primarily for local debug reasons
- Just don't use it for actual production users
 - It is not secured
 - It is not configurable
 - It is not a Firewall
 - It is a very poor performing Access Point

BYOS – Bring Your Own Security

What do you have
running?



What is running now?

- Meraki MX95 (IPv4 and IPv6)
- Meraki MX65 (IPv4 and IPv6)
- Peplink MAX Transit Duo Pro (IPv4)

Meraki Starlink

Health

UPLINKS



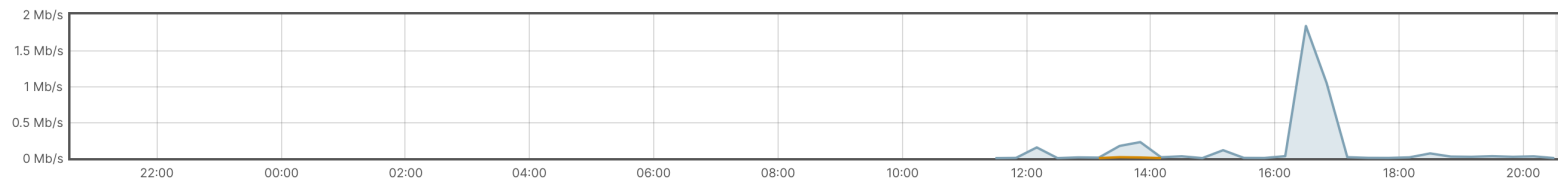
WAN APPLIANCES



Clients

all ▾ for the last day ▾

573 MB (↓ 528.9 MB, ↑ 44.1 MB)



Policy ▾

Search... ▾

6 clients

Add client

☐	Status	Description	Last seen ▲	Usage	Client type, OS	IPv4 address	IPv6 address
☐		027092e3-8692-42c2-a0bc-4302f88fe1c3	Nov 30 13:51	3.2 MB	Other	192.168.128.102	2605:59c8:6087:3a10:842e:e72:4cdb:2d87
☐		ABENHASE-M-526H	Nov 30 14:02	53.2 MB	Other	192.168.50.181	fd11:1f5a:8f9a:16:cc9:3f77:d78a:c6a4
☐		Blink-Mini	Nov 30 14:02	100 KB	Other	192.168.50.4	
☐		Blink-Mini	Nov 30 14:02	95 KB	Other	192.168.50.3	
☐		10:56:ca:84:bb:e0	Nov 30 16:45	9 KB	Other	192.168.50.1	
☐		ABENHASE-M-C02F	Nov 30 20:36	517.1 MB	Other	192.168.128.99	fd11:1f5a:8f9a:15:1cc8:8925:33c8:21fc

Threat protection

Changes saved. ✕

Advanced Malware Protection (AMP)

Mode ⓘ

Enabled ⚙

Allow list URLs ⓘ

There are no URLs on the Allow list.

[Add a URL to the Allow list](#)

Allow list files

There are no files on the Allow list.

[Add a file to the Allow list](#)

Intrusion detection and prevention

Mode ⓘ

Detection ⚙

Ruleset ⓘ

Balanced ⚙

Allow list rules ⓘ

There are no IDS rules on the Allow list.

[Add an IDS rule to Allow list](#)

Trusted Traffic Exclusions

To increase network performance, select traffic categories and IP addresses or subnets to bypass when AMP or IDS/IPS is enabled.

Trusted Applications ⓘ



Streaming & entertainment

Amazon Video, Google Services, Hulu, Netflix, Pandora Radio,...

[View all](#)



Software updates

Adobe Updates, Apple Updates, Google Updates, Microsoft ...

[View all](#)



Collaboration

Cisco Collaboration, MS Teams, RTP, SCCP, SIP, Skinny Call ...

[View all](#)



Online storage

Box, Dropbox, Google Workspace, Microsoft OneDrive, iCloud

[View all](#)

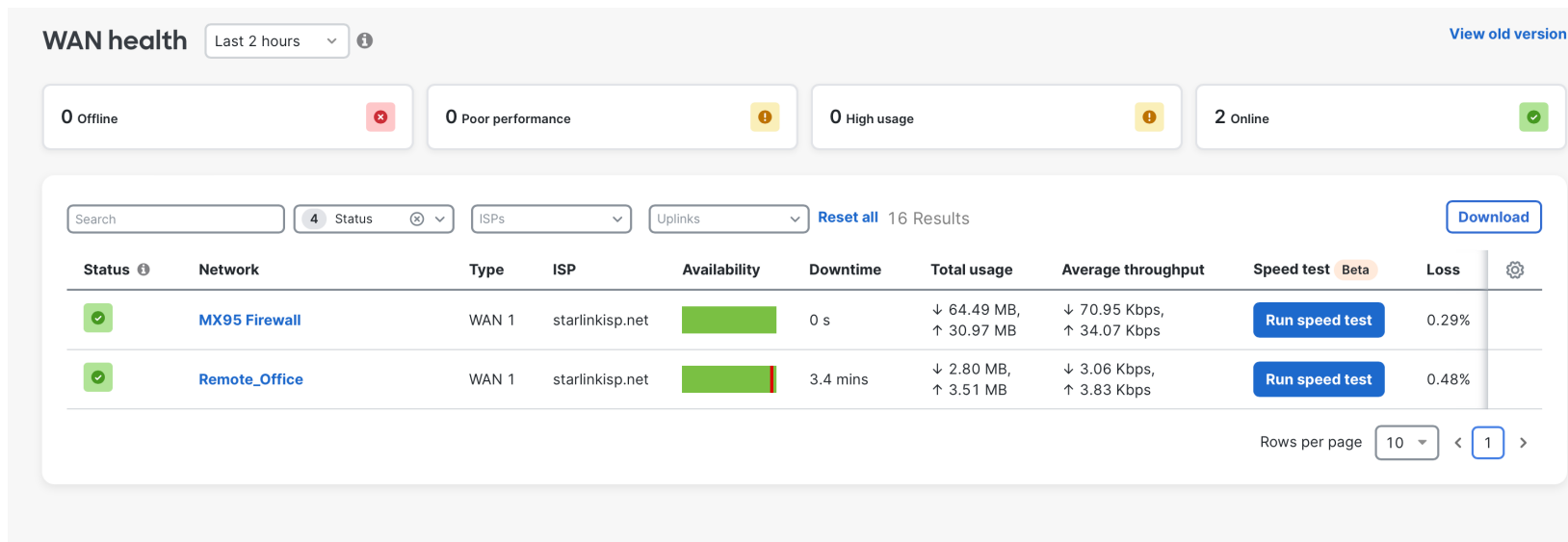


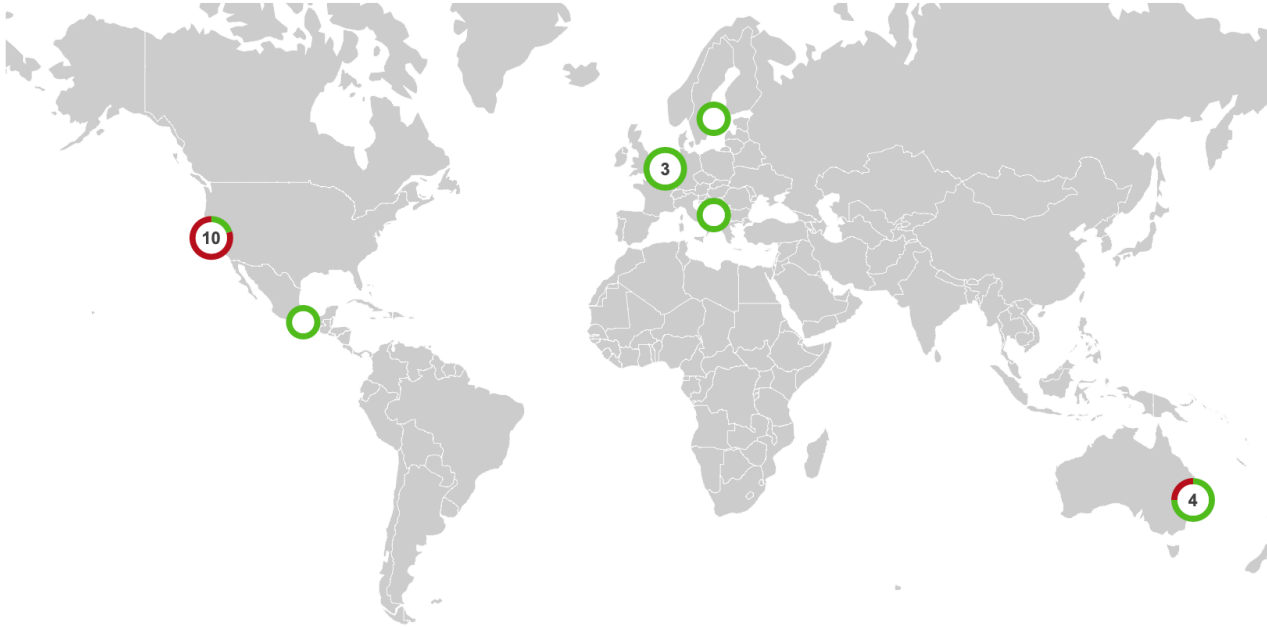
Business critical applications

AWS, Atlassian, Azure, Concur, Google Workspace, Jira, Log...

[View all](#)

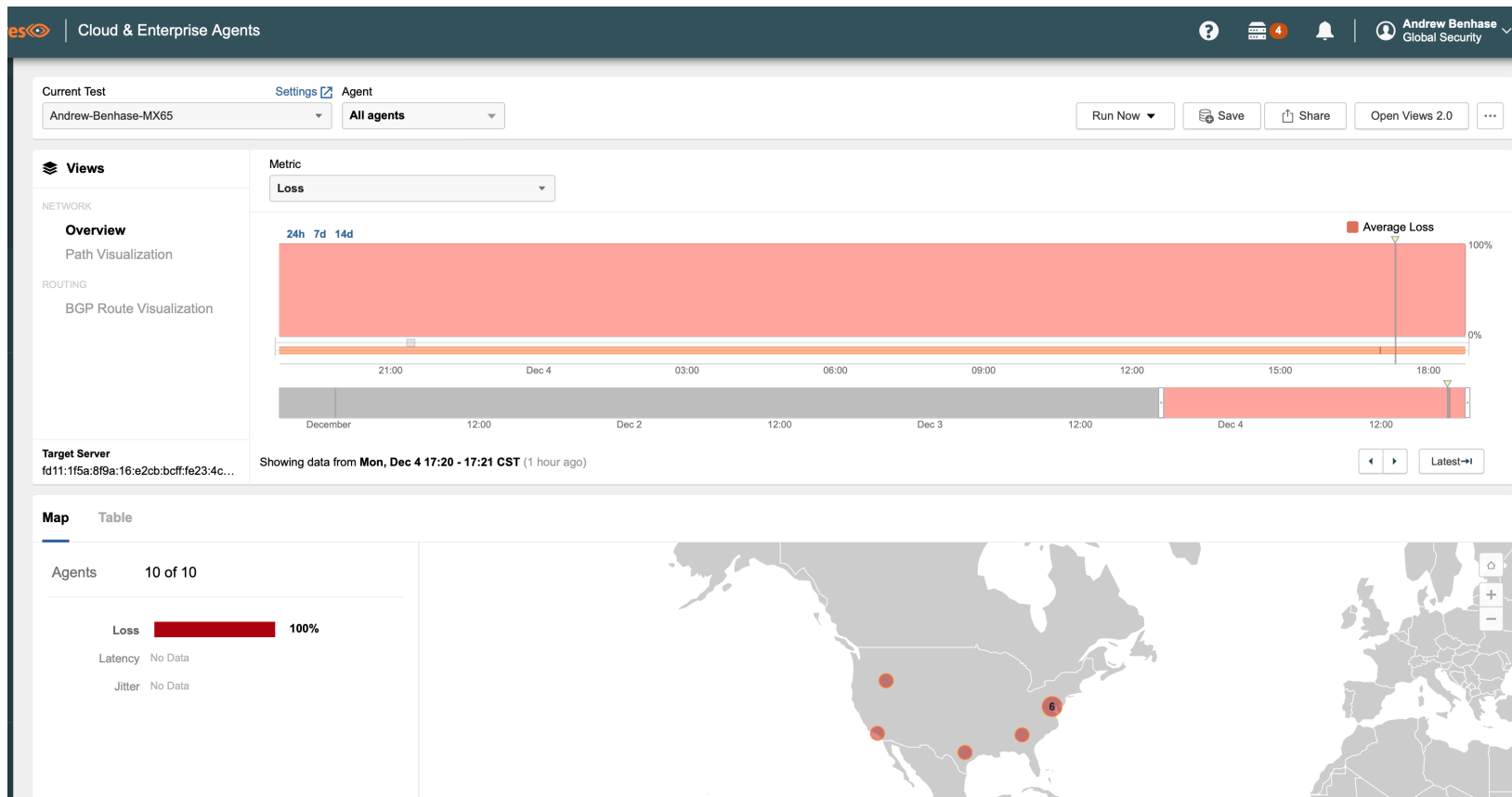
WAN Health using 1keye





Agent based Reporting for Thousand Eyes running Starlink across the Globe

Agent to ICMP IPv6 not working



IPv6 PD Renew Every 5 Minutes

Event log

Client: Before: (EST)

Event type include: Event type ignore:

[Reset filters](#)

Download as ▾

[« newer](#) [older »](#)

Time (EST) ▾	Client	Category	Event type	Details
Nov 30 21:48:52		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 600, ValidLifetime: 1200 more »
Nov 30 21:48:52		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 600, ValidLifetime: 1200 more »
Nov 30 21:43:53		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 599, ValidLifetime: 1199 more »
Nov 30 21:43:53		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 599, ValidLifetime: 1199 more »
Nov 30 21:38:54		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 598, ValidLifetime: 1198 more »
Nov 30 21:38:54		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 598, ValidLifetime: 1198 more »
Nov 30 21:33:55		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 597, ValidLifetime: 1197 more »
Nov 30 21:33:55		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 597, ValidLifetime: 1197 more »
Nov 30 21:28:57		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 595, ValidLifetime: 1195 more »
Nov 30 21:28:57		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 595, ValidLifetime: 1195 more »
Nov 30 21:24:01		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 590, ValidLifetime: 1190 more »
Nov 30 21:24:01		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 590, ValidLifetime: 1190 more »
Nov 30 21:19:11		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 581, ValidLifetime: 1181 more »
Nov 30 21:19:11		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 581, ValidLifetime: 1181 more »
Nov 30 21:14:30		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 562, ValidLifetime: 1162 more »
Nov 30 21:14:30		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 562, ValidLifetime: 1162 more »
Nov 30 21:10:06		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 526, ValidLifetime: 1126 more »
Nov 30 21:10:06		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 526, ValidLifetime: 1126 more »
Nov 30 21:06:21		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 449, ValidLifetime: 1049 more »
Nov 30 21:06:21		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 449, ValidLifetime: 1049 more »
Nov 30 21:03:51		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 300, ValidLifetime: 900 more »
Nov 30 21:03:51		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 300, ValidLifetime: 900 more »
Nov 30 20:58:52		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 599, ValidLifetime: 1199 more »
Nov 30 20:58:52		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 599, ValidLifetime: 1199 more »
Nov 30 20:53:52		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 599, ValidLifetime: 1199 more »
Nov 30 20:53:52		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 599, ValidLifetime: 1199 more »
Nov 30 20:48:51		DHCPv6	DHCPv6-NA Renew successful	Address: 2605:59c8:6087:3a10::d0b, PreferredLifetime: 600, ValidLifetime: 1200 more »
Nov 30 20:48:51		DHCPv6	DHCPv6-PD Renew successful	Prefix: 2605:59c8:6087:3a14::/62, PreferredLifetime: 600, ValidLifetime: 1200 more »

SDWAN

Devices



Devices

Certificates

Licensing

FILTERED BY

Reachable · Up x

SUMMARY

> Health

▼ Reachable

☒ Up☐ Down

> Control Status

> Cloud Provider

Device Group All

Devices (5)

[Export](#) As of: Dec 06, 2023 01:04 PM 

Hostname	Device Model	Site Name	System IP	Health 	Reachability	vSmart Control 	BFD	TLOC	Up Since	CPU Load	Action
IR1833-tom	IR1833	SITE_206202	172.16.20.1			2 / 2	6 / 6	1 / 1	Dec 04, 2023 07:08 AM	<div><div></div></div> 33.93%	...
StarlinkPOC-1121X	C1121X-8P	SITE_303303	172.16.250.200			2 / 2	6 / 6	1 / 1	Nov 15, 2023 06:43 AM	<div><div></div></div> 6.24%	...
Starlink-WASH-8300-1	C8300-1N1S-4T2X	SITE_303302	172.16.250.199			2 / 2	5 / 6	1 / 1	Dec 02, 2023 04:30 AM	<div><div></div></div> 11.97%	...
C8300-RTP6-SL-1	C8300-1N1S-6T	SITE_206250	172.16.1.1			4 / 4	6 / 8	2 / 2	Nov 16, 2023 08:23 AM	<div><div></div></div> 8.22%	...
C8300-RTP6-SL-2	C8300-1N1S-6T	SITE_206250	172.16.1.2			2 / 4	3 / 4	1 / 2	Nov 15, 2023 04:26 AM	<div><div></div></div> 8.25%	...

Things we know

- CG-NAT is a reality for all Residential and Mobile Plans
- High Performance Array is allocated a public IP address
- This is NOT a static IP address!
 - DHCP 5 minute renewal

Catalyst SD-WAN Controllers
On Premise in DC or Cloud
Hosted

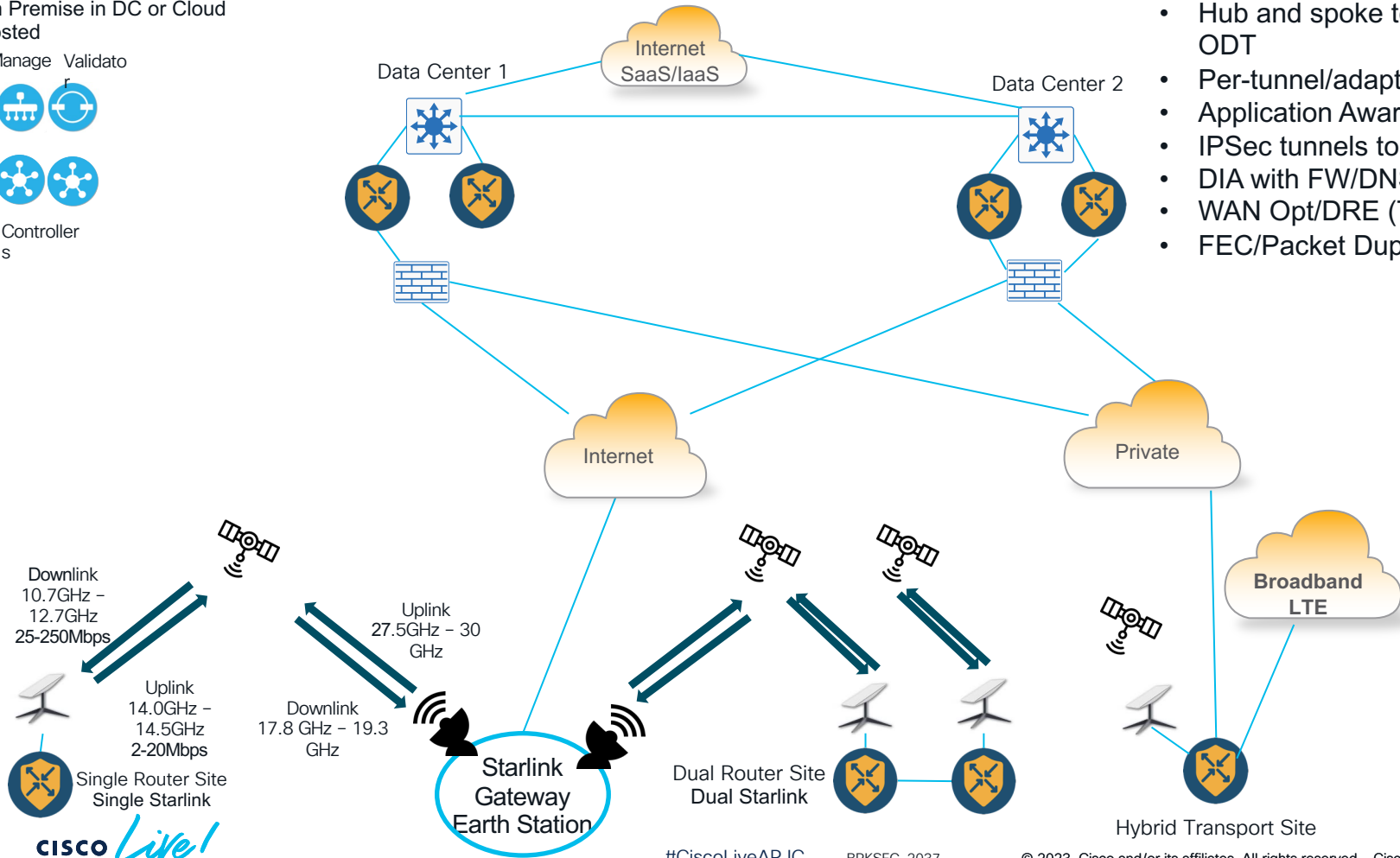
Manage Validator



Controller
s

Starlink Reference Architecture

- SD-WAN version 17.x
- Hub and spoke topology with ODT
- Per-tunnel/adaptive QoS
- Application Aware Routing
- IPSec tunnels to SIG
- DIA with FW/DNS-Sec
- WAN Opt/DRE (TBD)
- FEC/Packet Dup (TBD)



CISCO *Live!*

WAN Edge List

WAN Edge List (10)

Search Table

Upload WAN Edge List	Export Bootstrap Configuration	Sync Smart Account	Add PAYG WAN Edges		
Chassis Number	Site Name	Hostname	Tags	Config Locked	Managed By
C1121X-8P-FGL2624L51Q	SITE_303303	StarlinkPOC-1121X	Add Tag	No	Unmanaged
C8300-1N1S-4T2X-FLM272112RA	SITE_206202	C8300-TOM-SL	Add Tag	Yes	Template Starlink-8300-1N1S-4T2X-Tom-Zs
C8300-1N1S-4T2X-FLM272112R8	SITE_303302	Starlink-WASH-8300-1	Add Tag	Yes	Template Starlink-8300-1N1S-4T2X-Tom-Zs
ISR1100-6G-FGL2347L5EX	-	-	Add Tag	No	Unmanaged
C8500L-8S4X-FLX26030880	SITE_300	Router	Add Tag	Yes	Template 8500L-RTP6-Hub1
C1101-4PLTEP-FGL2321113A	-	-	Add Tag	No	Unmanaged
C1101-4PLTEPWB-FGL232613MD	-	-	Add Tag	No	Unmanaged
IR1833-K9-FCW2711Y52G	SITE_206202	IR1833-tom	Add Tag	No	Unmanaged
C8300-1N1S-6T-FLM272112HR	SITE_206250	C8300-RTP6-SL-1	Add Tag	Yes	Template Starlink-8300-1N1S-6T-TLOCEXT
C8300-1N1S-6T-FLM272112J0	SITE_206250	C8300-RTP6-SL-2	Add Tag	Yes	Template Starlink-8300-1N1S-6T-TLOCEXT

Running Configuration

Host: C8300-RTP6-SL-1(169.254.12.83)
Site ID: 206250
Device Model: C8300-1N1S-6T

```
system
gps-location latitude 35.89
gps-location longitude -78.0
device-groups STARLINK1
system-ip 172.16.1.1
overlay-id 1
site-id 206250
port-offset 0
control-session-pps 300
admin-tech-on-failure
sp-organization-name "mt-vmanage-demo - 627179"
organization-name "mt-vmanage-demo - 627179-spacex"
port-hop
track-transport
track-default-gateway
```

SD WAN Configuration

```
interface GigabitEthernet0/0/0
description Ethernet to Starlink LEO satellite
no shutdown
arp timeout 1200
ip address dhcp client-id GigabitEthernet0/0/0
no ip redirects
ip tcp adjust-mss 1360
ip dhcp client default-router distance 1
ip mtu 1500
ip nat outside
load-interval 30
mtu 1500
negotiation auto
```

```
interface Tunnel100201
no shutdown
ip unnumbered GigabitEthernet0/0/0
no ip clear-dont-fragment
ip mtu 1400
tunnel source GigabitEthernet0/0/0
tunnel destination dynamic
tunnel mode ipsec ipv4
tunnel protection ipsec profile if-ipsec201-ipsec-profile
tunnel vrf multiplexing
tunnel route-via GigabitEthernet0/0/0 mandatory
exit
interface Tunnel100202
no shutdown
ip unnumbered GigabitEthernet0/0/0
no ip clear-dont-fragment
ip mtu 1400
tunnel source GigabitEthernet0/0/0
tunnel destination dynamic
tunnel mode ipsec ipv4
tunnel protection ipsec profile if-ipsec202-ipsec-profile
tunnel vrf multiplexing
tunnel route-via GigabitEthernet0/0/0 mandatory
exit
```

Crypto Configuration

```
crypto ikev2 policy policy1-global
proposal p1-global
!
crypto ikev2 profile if-ipsec201-ikev2-profile
no config-exchange request
dpd 60 10 on-demand
dynamic
lifetime 14400
!
crypto ikev2 profile if-ipsec202-ikev2-profile
no config-exchange request
dpd 60 10 on-demand
dynamic
lifetime 14400
!
crypto ikev2 proposal p1-global
encryption aes-cbc-128 aes-cbc-256
group 14 15 16 19 20 21
integrity sha1 sha256 sha384 sha512
```

```
crypto ipsec transform-set if-ipsec201-ikev2-transform esp-null esp-sha-
hmac
mode tunnel
!
crypto ipsec transform-set if-ipsec202-ikev2-transform esp-null esp-sha-
hmac
mode tunnel
!
crypto ipsec profile if-ipsec201-ipsec-profile
set ikev2-profile if-ipsec201-ikev2-profile
set transform-set if-ipsec201-ikev2-transform
set security-association lifetime kilobytes disable
set security-association lifetime seconds 3600
set security-association replay window-size 1024
!
crypto ipsec profile if-ipsec202-ipsec-profile
set ikev2-profile if-ipsec202-ikev2-profile
set transform-set if-ipsec202-ikev2-transform
set security-association lifetime kilobytes disable
set security-association lifetime seconds 3600
set security-association replay window-size 1024
```

Design optimizations for LEO Satellite Transport

Reducing SD-WAN control plane traffic on Satellite links

Problems

LEO satellite have low transmit speeds (2-20 Mbps up) relative to download speeds of 25-220 Mbps down). SD-WAN control traffic can consume a high proportion of this bandwidth in heavily meshed topologies with default timers. This includes:

- BFD probes over each IPsec tunnel (2.2 Kbps per SD-WAN tunnel)
- OMP hellos and updates to/from Catalyst controllers (up to 80 Kbps)
- Statistics upload to the Catalyst Manager (up to 1.2 Mbps)

Control traffic is automatically mapped to Q0 on the WAN edge, which can contend with user realtime traffic also in Q0 resulting in drops and instability

Solutions

- Dynamic OnDemand tunnel design (reduces # of BFD sessions)
 - BFD low bandwidth link
 - Last-resort-circuit in cases where Starlink is for backup
 - vManage connection preference 1
 - Administration Settings for Statistics – disable some, all or vAnalytics only?
 - QoS design with Adaptive QoS and 2-level policer / Split LLQ
-

Tunnel Optimizations for low bandwidth links

Low bandwidth link: Reduces BFD overhead by 50% per tunnel

Last-Resort-Circuit: No tunnel or traffic unless all other transports down

vManage connection preference 1: Prefer terrestrial (if available) over Satellite for vManage control connections to reduce overhead of statistics publishing.

OMP Hello tuning: Reduce Hello-interval to further optimize bandwidth

```
sdwan
```

```
interface GigabitEthernet 0/1/0
Description connected to Starlink
tunnel-interface
encapsulation ipsec weight 1
no border
color
```

```
no last-resort-circuit
```

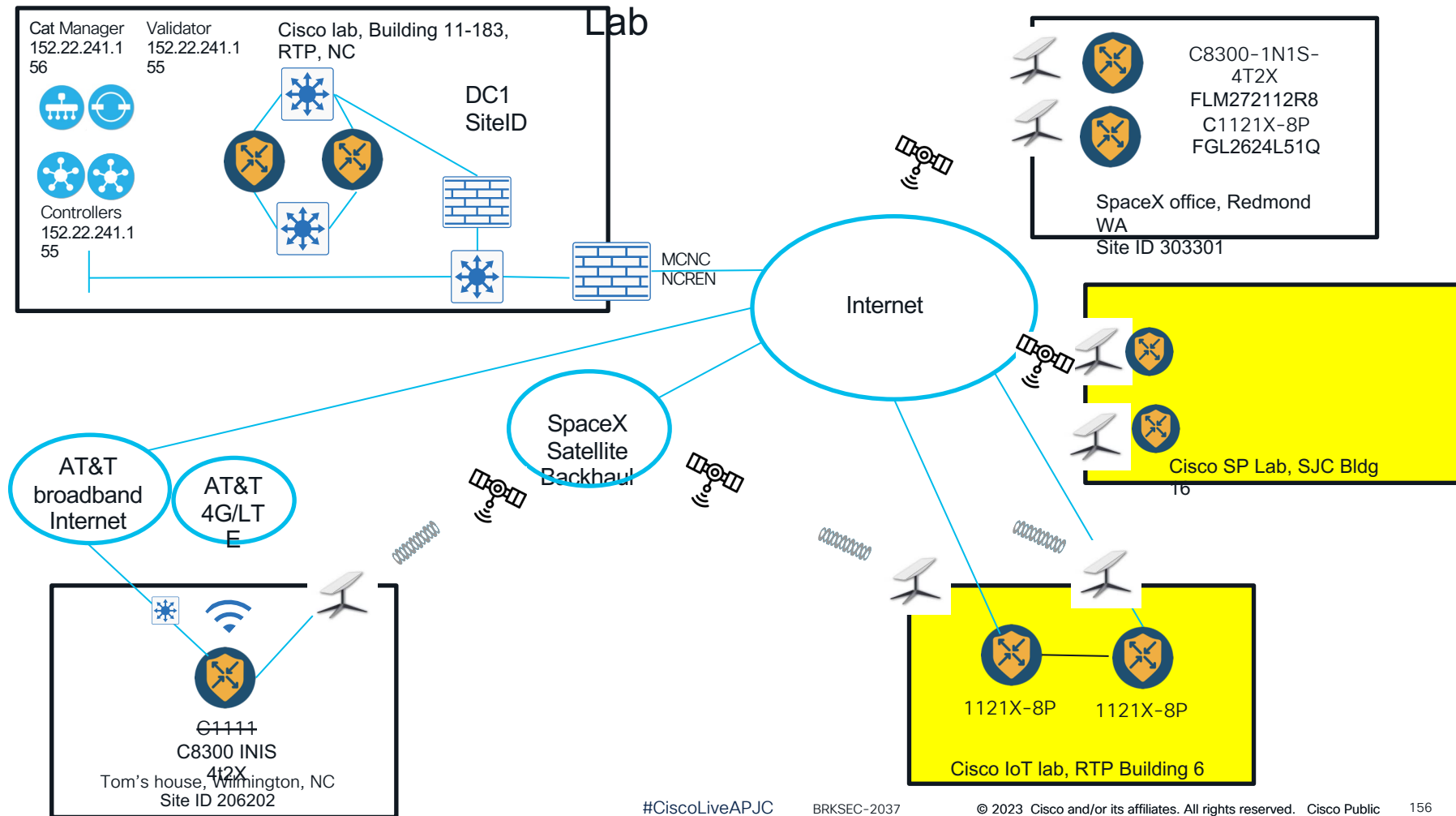
```
low-bandwidth-link
```

```
hello-interval 6000
```

```
hello-tolerance 600
```

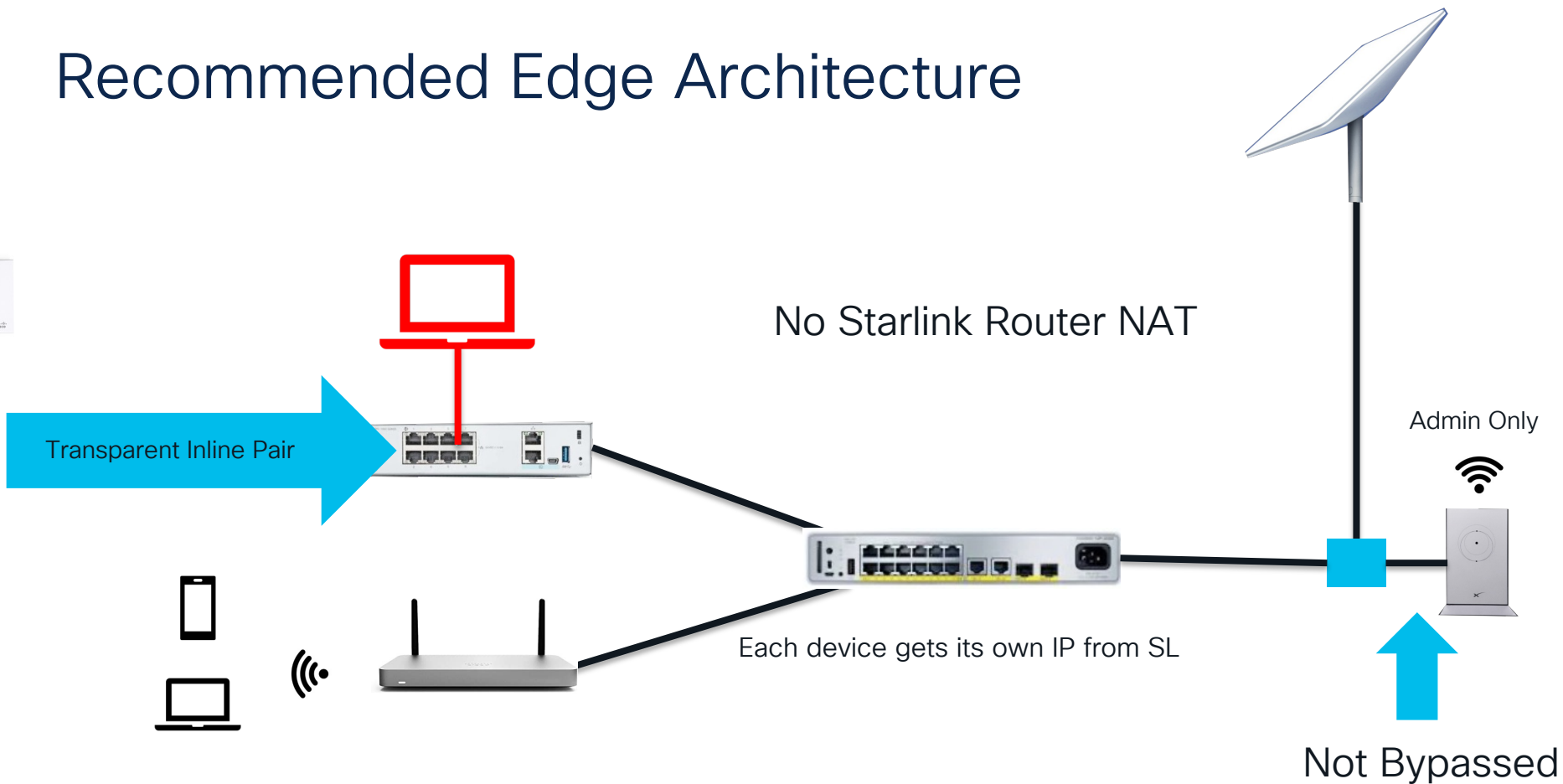
```
vmanage-connection-preference 1
```

Validation

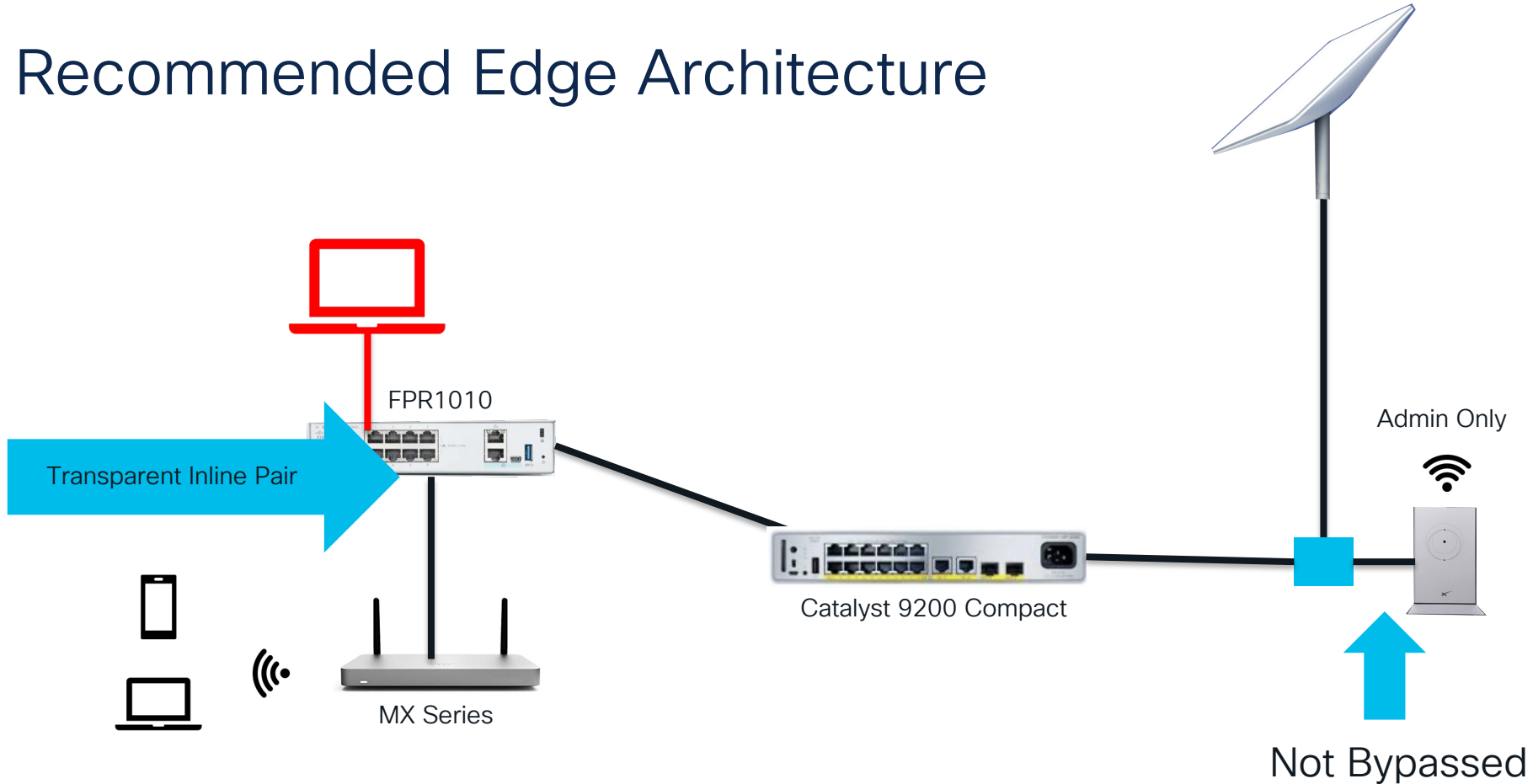


Ground/Space Architectures

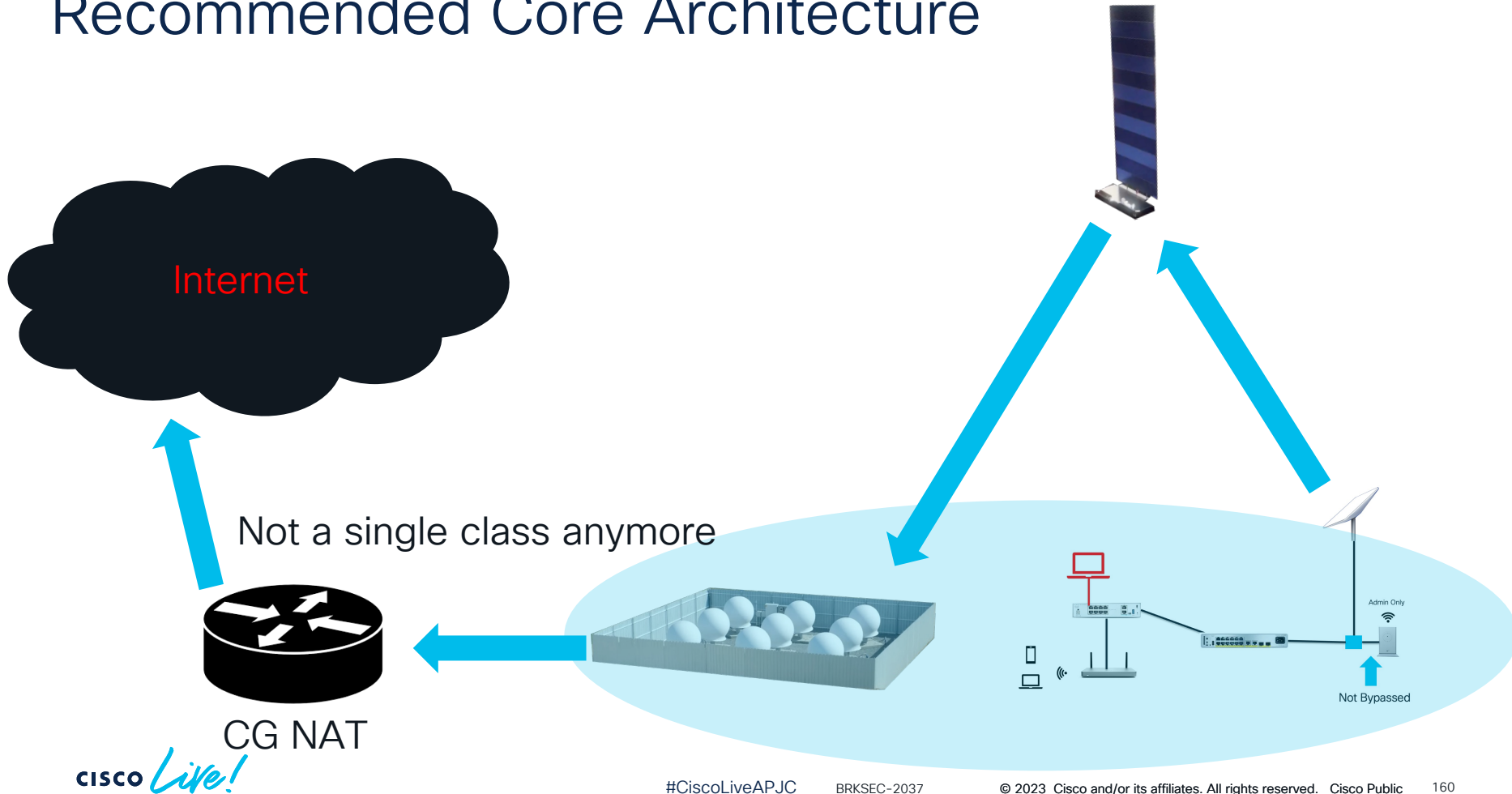
Recommended Edge Architecture



Recommended Edge Architecture

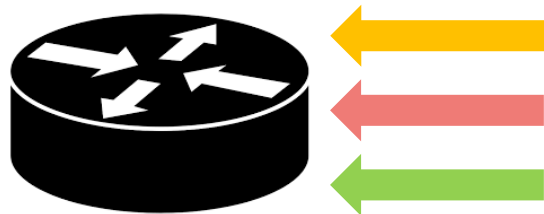
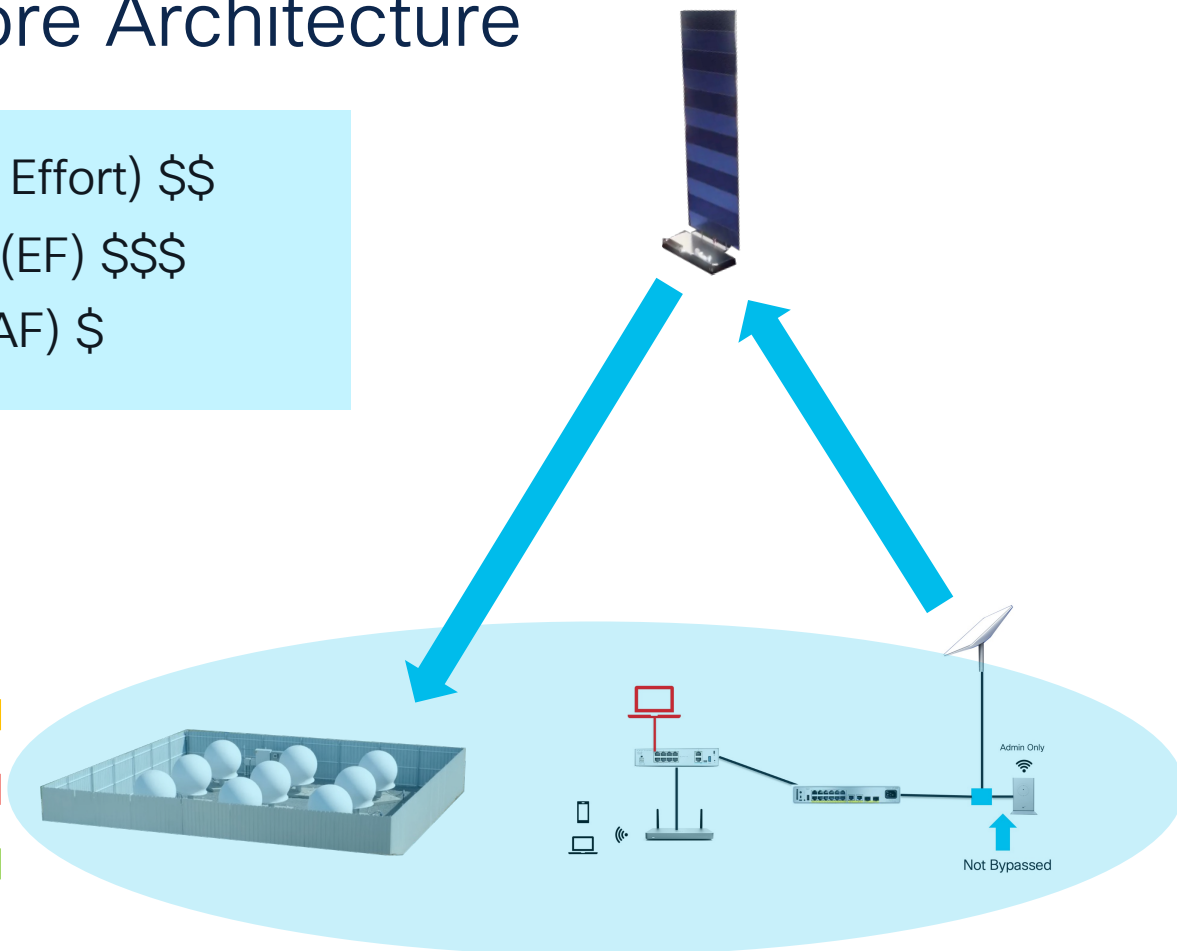


Recommended Core Architecture

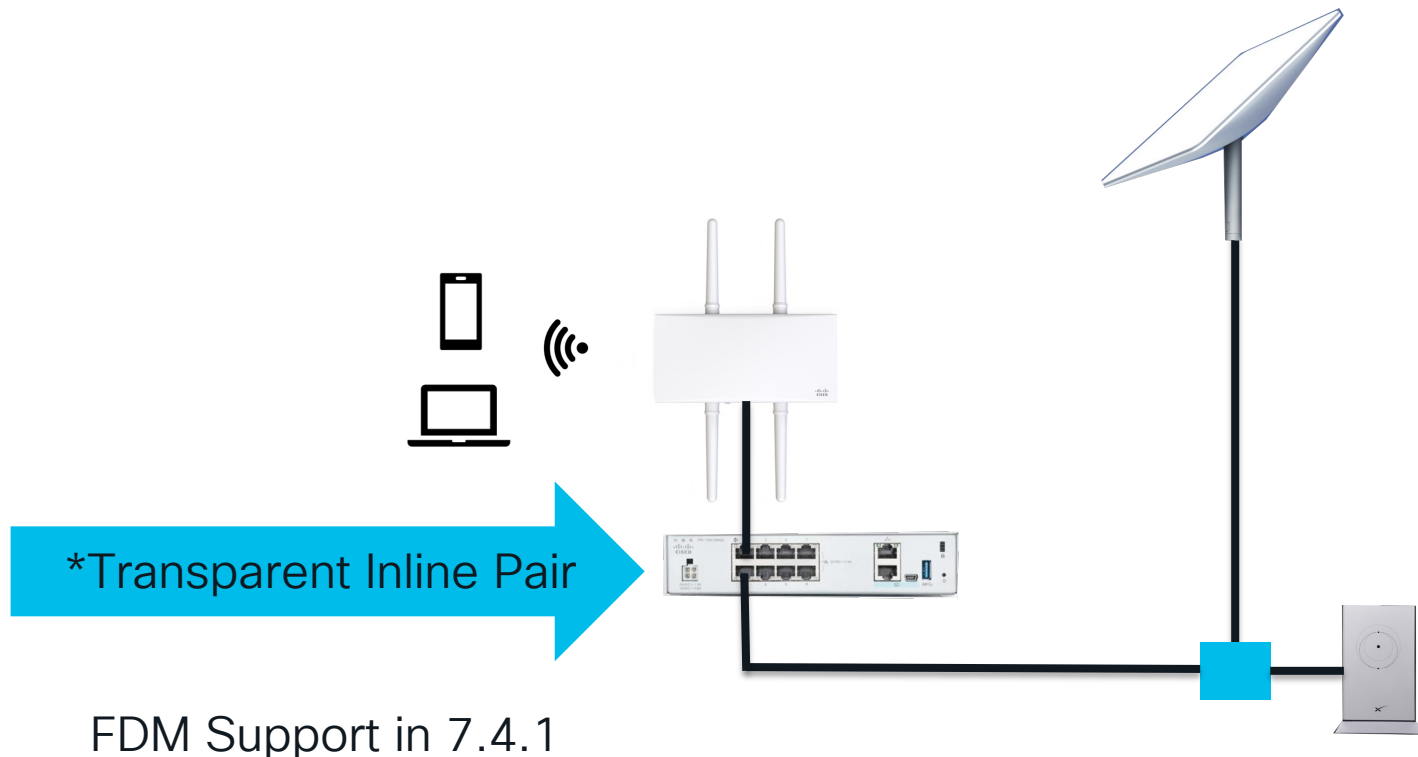


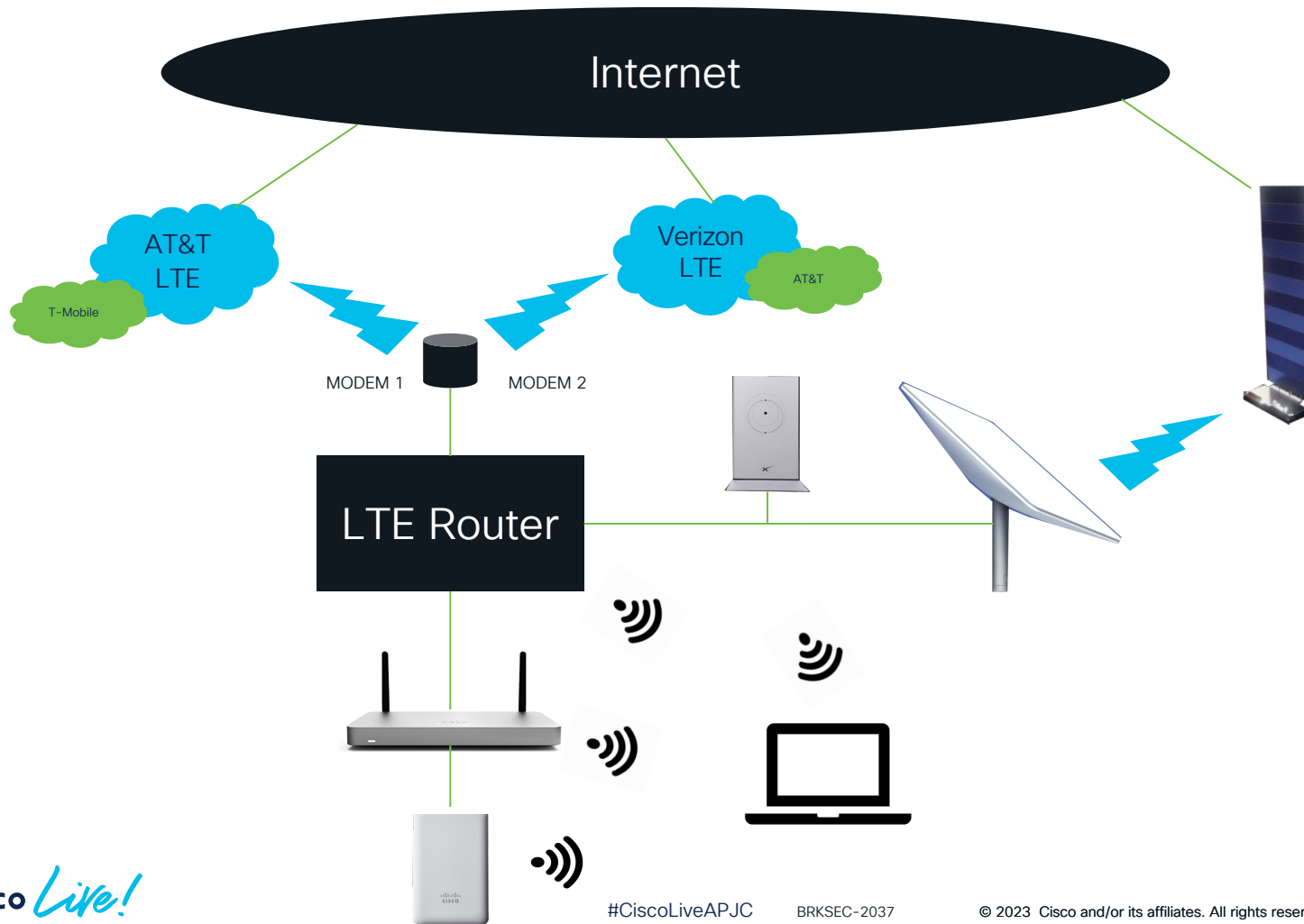
Recommended Core Architecture

- ← Mobile (Best Effort) \$\$
- ← Priority Data (EF) \$\$\$
- ← Residential (AF) \$

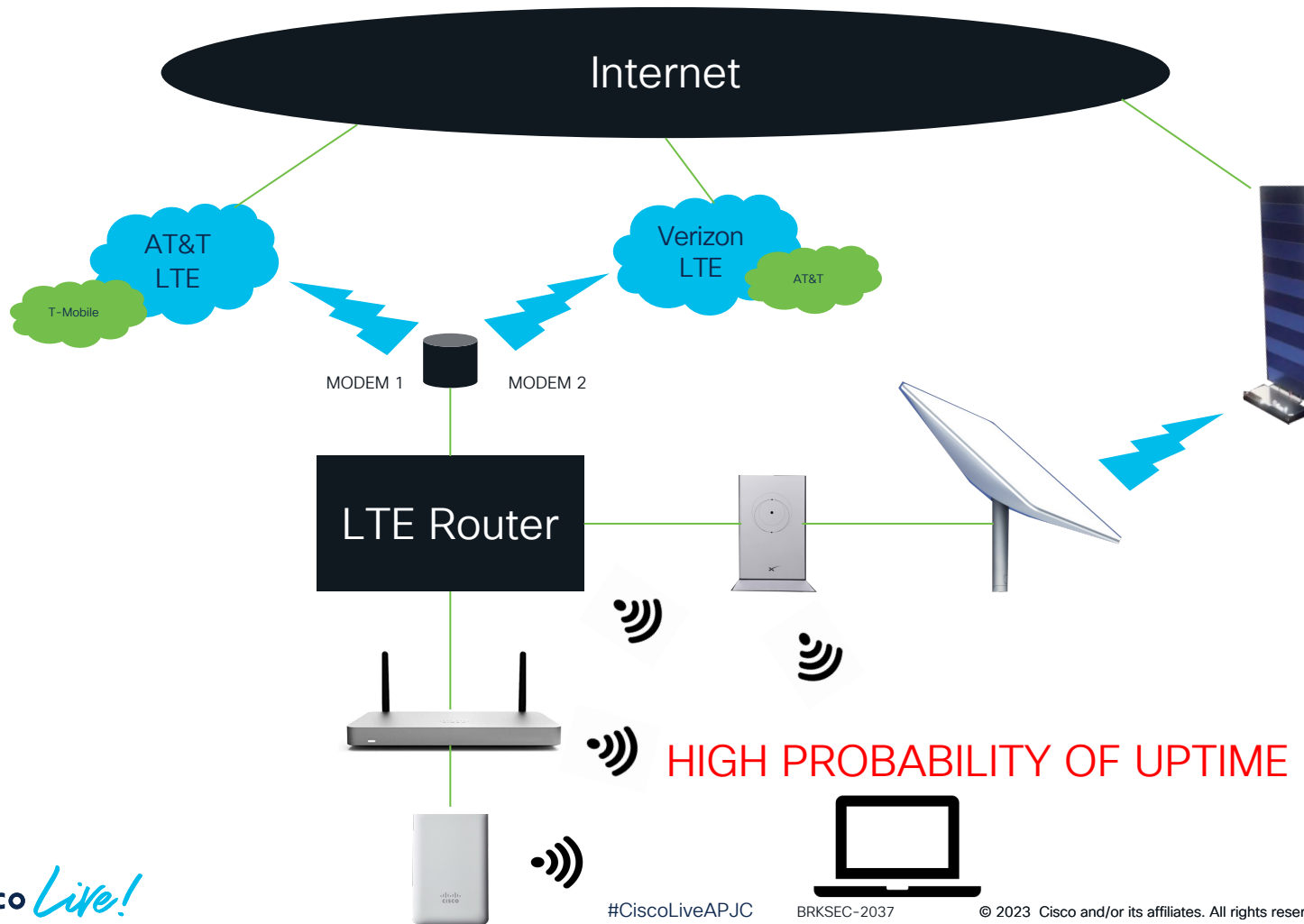


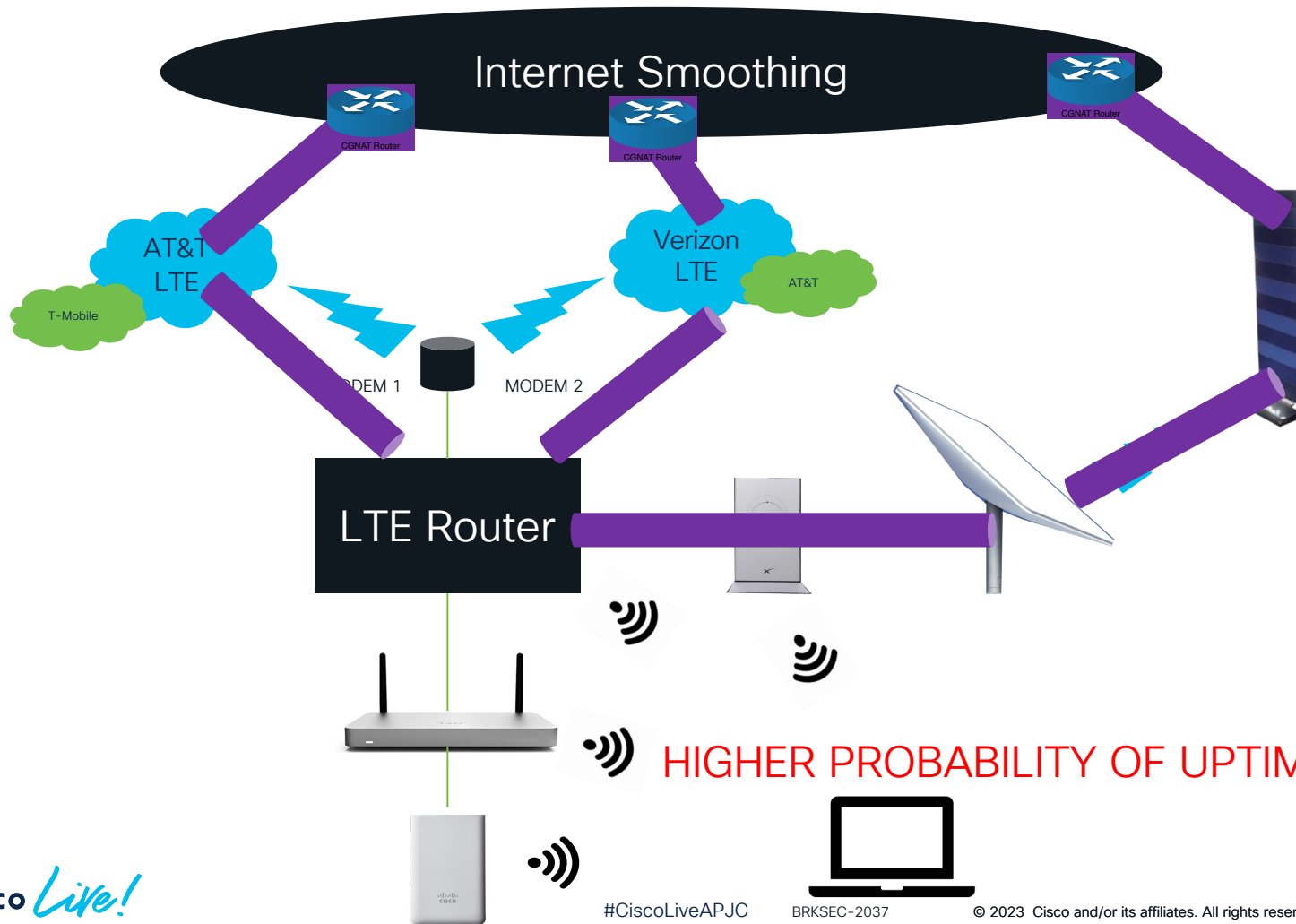
Recommended Architecture





Highest Probability of Netowrk Uptime

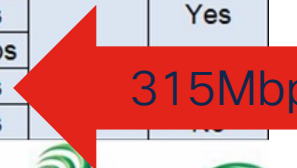




LTE Cat 7/14 or 5G Cat 20 Modem?

- Great question – do you think you can find a consistent basis?
- If not, I would opt for LTE based
- With WAN Smoothing technology, the performance impacts are largely minimized

Downlink			Uplink				
DL UE Categor	Max data rate in Mbps	DL MIMO	DL UE Categor	Max data rate in Mbps	64QAM Support	256QAM Support	
M1	~1 Mbps	1	M1	~3 Mbps	No	No	
M2	~ 4 Mbps		M2	~7 Mbps			
0	~1 Mbps		0	~0 Mbps			
1bits	~10 Mbps		1bits	~5 Mbps			
4	~150 Mbps	2	3	~50 Mbps	Yes		
6	~300 Mbps	2 or 4	5	~75 Mbps			
7	~300 Mbps		7	~100 Mbps	No		
9	~450 Mbps		8	~1500 Mbps			
10	~450 Mbps		13	~150 Mbps			
11	~600 Mbps		14	~9500 Mbps			
12	~600 Mbps		15	~220 Mbps			
13	~390 Mbps		16	~100 Mbps	No	Yes	
14	~3900 Mbps	8	17	~2100 Mbps			
15	~800 Mbps	2 or 4	18	~210 Mbps			
16	~1050 Mbps		19	~13500 Mbps			
17	~25000 Mbps	8	20	~315 Mbps	No	Yes	
18	~1200 Mbps	2,4 or 8	21	~300 Mbps			
19	~1600 Mbps						
20	~2000 Mbps	2 or 4					
21	~1400 Mbps						



When Starlink goes down for 20 minutes





Please Fill Out The Survey!





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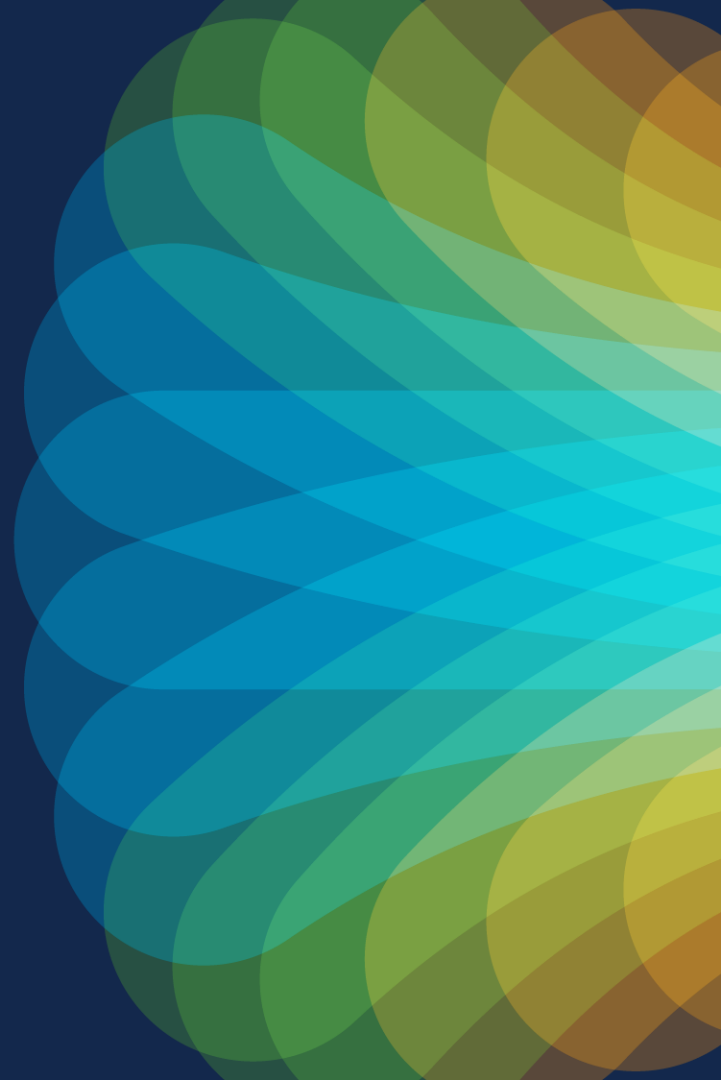


The bridge to possible

Thank you



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The background features a vibrant, multi-colored abstract design. On the left, there are horizontal, wavy bands of color in shades of red, orange, yellow, and green. On the right, a bright white light source emits a series of colorful rays in shades of blue, green, and yellow, creating a sunburst effect.

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Local Launch Pictures from Melbourne (Florida)







