The View from Above: Geolocation and Starlink

Geoff Huston, APNiC

Where are you?

- "Where" depends what you are trying to achieve:
  - Lat/Long coords are overkill if you just want to place an IP address into a country, but are great if you want to dispatch emergency services to a precise physical location
  - Political coordinates are used for enforcing national regulatory controls, but may not be so good if you want to make the "best" server selection in a CDN context
  - Network topology coordinates (origin AS, adjacent AS) are sometimes useful if you want to optimize service performance
  - And of course there are mobility issues
    - If you change location, do you change IP addresses?

Where are you?

- "you" is also variable:
  - Is it the human end user of a service?
  - Is it a device? Even if it's a shared device?
  - Can "you" have multiple devices? In multiple locations? It is still a single "you" or multiple instances of "you"?
  - Is it a service subscription?
  - And of course there are mobility issues
    - Is "you" relative to a network provider, and when you change providers do you change identity?

For me, it started as a simple question

- Can I calculate the market share of retail Internet Service Providers in every economy?

- And by "market share" I mean "user population"

The tools of the trade

- For country- level geolocation I use the ISO 3166 list of recognized countries and their two-letter alpha code

- And I'm trying to map every IPv4 and IPv6 address to a CC code corresponding to the assumed geo location of the device that has this IP address

- I use a mix of Maxmind and IPinfo to assemble a database of IP address prefix to CC code

And then there is Starlink

- Conventionally with "bent-pipe" LEO systems the end user and the ground station are typically closely located (within ~600km or so)

- Starlink may use inter-satellite 100Gbps laser connections to relay packets across satellites, when the Dishy user and the associated ground station are distant from each other
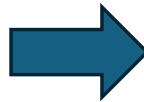

Satellite Train

550km
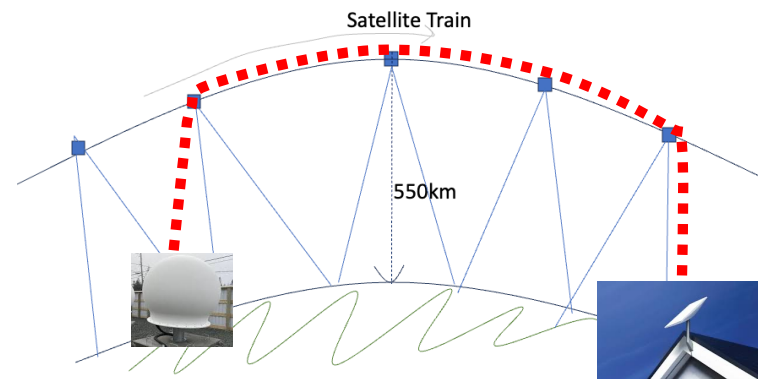
What is "location" for a satellite service?

- Where the user is located?

- Where the gateway earth station is located?

- Where the satellite operator is registered or licensed?

Starlink Geolocation

https://geoip.starlinkisp.net/ ➡️

These are notional "user" locations

But the city code is confusing/unclear

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14.1.64.0/24,PH,PH-00,Manila,
14.1.65.0/24,PH,PH-00,Manila,
14.1.66.0/24,PH,PH-00,Manila,
14.1.67.0/24,PH,PH-00,Manila,
14.1.72.0/24,AU,AU-VIC,Melbourne,
14.1.73.0/24,AU,AU-VIC,Melbourne,
14.1.74.0/24,AU,AU-TAS,Hobart,
14.1.75.0/24,AU,AU-TAS,Hobart,
14.1.78.0/24,LK,LK-1,Colombo,
14.1.79.0/24,LK,LK-1,Colombo,
14.1.82.0/24,AU,AU-NSW,Sydney,
14.1.83.0/24,AU,AU-NSW,Sydney,
14.1.84.0/24,AU,AU-NSW,Sydney,
14.1.85.0/24,AU,AU-NSW,Sydney,
14.1.86.0/24,AU,AU-NSW,Sydney,
14.1.87.0/24,AU,AU-NSW,Sydney,
14.1.94.0/24,AU,AU-VIC,Melbourne,
14.1.95.0/24,AU,AU-VIC,Melbourne,
65.181.0.0/24,AU,AU-QLD,Brisbane,
65.181.1.0/24,AU,AU-QLD,Brisbane,
65.181.2.0/24,AU,AU-QLD,Brisbane,
65.181.3.0/24,AU,AU-QLD,Brisbane,
65.181.4.0/24,JP,JP-13,Tokyo,
65.181.5.0/24,JP,JP-13,Tokyo,
65.181.6.0/24,JP,JP-13,Tokyo,
65.181.7.0/24,JP,JP-13,Tokyo,
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What does this map *mean*?

- It's NOT the location of the ground station
  - It's not the terminating point of the terrestrial path to the user

- It looks like its the notional location of the Starlink subscriber
  - But the city code is pretty misleading, as in many cases Starlink is a rural/remote solution

- If you buy a roaming package does this map apply to where you purchased the package or where you are right now?
  - If it's the latter how does Starlink handle IP address reassignment?
  - And what happens for aircraft and/or ships?

Is this list "accurate"?

- That's hard to tell!
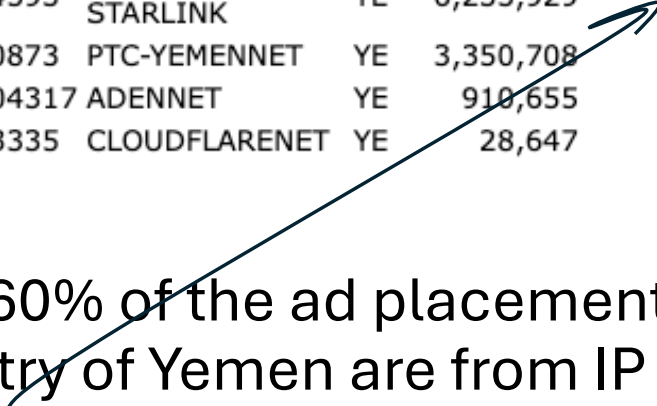- But when I plug this into my "market share" data I get some results that are challenging to accept

Visible ASNS: Custimer Populations (Est.)

Date: 22/09/2025

Rank	ASN	AS Name	CC	Users (est.)	% of country	% of Internet	Samples
1	AS14593	SPACEX-STARLINK	YE	6,233,929	59.22	0.14	321,186
2	AS30873	PTC-YEMENNET	YE	3,350,708	31.83	0.08	172,636
3	AS204317	ADENNET	YE	910,655	8.65	0.02	46,919
4	AS13335	CLOUDFLARENET	YE	28,647	0.27	0.01	1,467

Really?

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- Over a 60 day interval, 60% of the ad placements that are geolocated to the country of Yemen are from IP addresses that geo-locate to Yemen!
- Starlink is a globally priced service, and the GDP per capita in Yemen is USD 752, which would suggest that a service that costs ~USD 50 per month is simply unaffordable for many Yemenis

Starlink Issues

How do Starlink treat ships at sea in terms of geolocation?

- There are no maritime geolocation codes in the Starlink geo files, and all of our ad placements into AS14593 locate into (land) countries

- It's possible that shipping in the Red Sea could account for a part of the anomaly, BUT there are only 60 - vessels a day going through the Suez Canal, which is just nowhere near enough
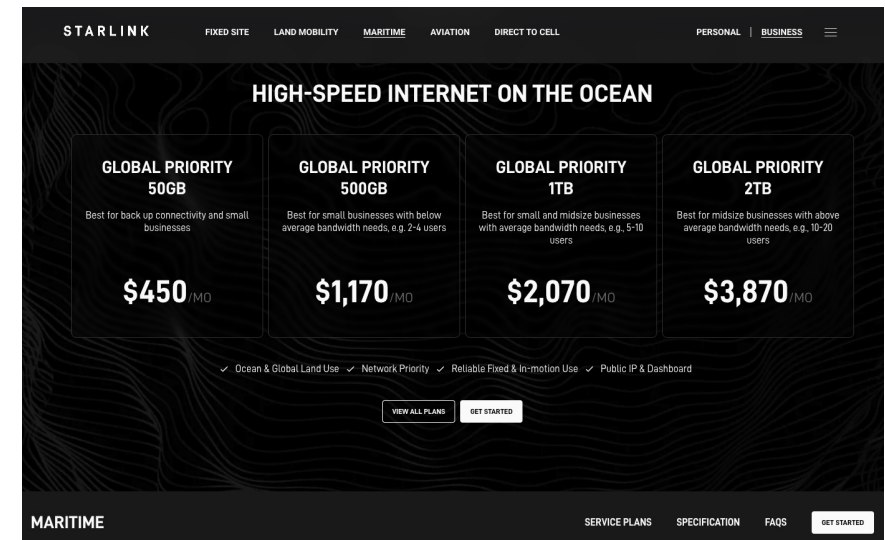
Starlink Roaming "Leakage"

Starlink Roaming "Leakage"

- Starlink is not authorized for use in Saudi Arabia, Egypt or Ethopia, including roaming use
  - The Starlink service can work, but Starlink may block the service for Dishy units located in these places
- Is the high use level in Yemen due to users in neighbouring countries purchasing a roaming service in Yemen (which geolocates to Yemen) and using the Dishy back home?
  - Yes, Starlink assert that they may cut off the service when the unit roams to locations where its use is unauthorized, but what they say they will do, and what they actually do may differ
  - At the same time, there are reports of Starlink performing geo-blocking when ships enter territorial waters.

Starlink "reselling"

- There are Starlink Community Gateways , but the cost is high
- You CAN resell access to Starlink in the form of a community Wi-Fi local hotspot
- Is the extremely high Yemen use level a result of widespread community "pooling" of Starlink services?

It's not just Yemen

CC	Cover?	Ads	Est. Users	% Users	CC Name
SJ	Y	726	0	100%	Svalbard and Jan Mayen Islands
BL	Y	620	6,008	98%	Saint Barthelemy
TV	Y	7,980	5,799	92%	Tuvalu
KI	Y	42,234	1,7955	81%	Kiribati
PN	Y	16	19	72%	Pitcairn
YE	Y	321,673	6,256,291	59%	Yemen
NR	Y	6,864	4,071	56%	Nauru
CK	Y	16,220	4,802	50%	Cook Islands
MH	Y	7,857	7,805	34%	Marshall Islands
SS	Y	60,296	369,566	32%	South Sudan
MF	Y	1,412	4,468	24%	Saint Martin
VU	Y	214	22,423	22%	Vanuatu
NE	Y	140,318	1,076,585	21%	Niger
SD	N	348,986	3,517,776	19%	Sudan
TD	Y	78,690	292,985	17%	Chad
ZW	Y	311,093	801,754	15%	Zimbabwe
SB	Y	9,916	14,946	14%	Solomon Islands
MM	N	237,004	2,899,276	14%	Myanmar
FM	Y	9,824	6,164	14%	Micronesia
MG	Y	67,755	612,408	12%	Madagascar
TO	Y	4,881	5,304	11%	Tonga

Table 1 – Countries where Starlink attribution is greater than 10%

There are 21 countries where the use of Starlink services appears to be more than 10% of the domestic population

Including two countries where Starlink claims that the service is unavailable in that country, yet the Starlink Geo map lists these countries, and ads are presented to users on these IP addresses

What about ships and aircraft?

- The Tokyo Convention for aircraft says that once an international flight is airborne, the laws of the country of registration of the aircraft apply to the aircraft

- This is the similar for ships at sea, with the UN Convention of the Law of the Sea (UNCLOS), but UNCLOS applies only in international waters

- Does this imply that geo country attribution for either ships or aircraft should revert to the country of registration once the craft is out of any national territory?

Thanks!