

Development of a Framework for Retrieval of Parameters of the Starlink Dish

Final talk for the IDP by

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Starlink 101

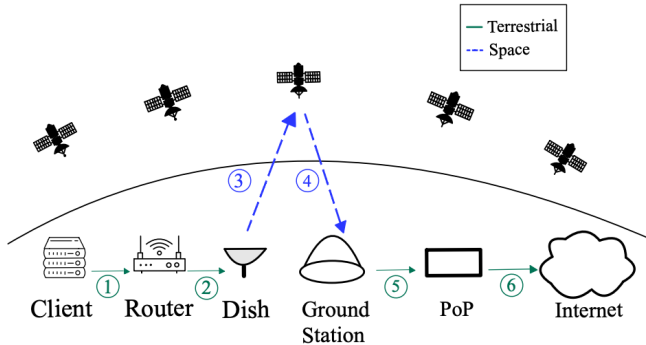


Figure 1: starlink in a nutshell (ignoring ISL), from [1]

Understanding routing decisions

- retrieved ip address blocks from major cloud providers (aws,azure,oracle), as we know their position ¹
- chose 5 geographically sparse targets around the globe (for aws: ap-northeast-2, us-east-1, ap-south-1, sa-east-1, me-south-1)
- tracerouted the targets over several days

¹ the fact we know the position doesn't really mean a traceroute to a certain address is really a traceroute to that geographic area

Understanding routing decisions

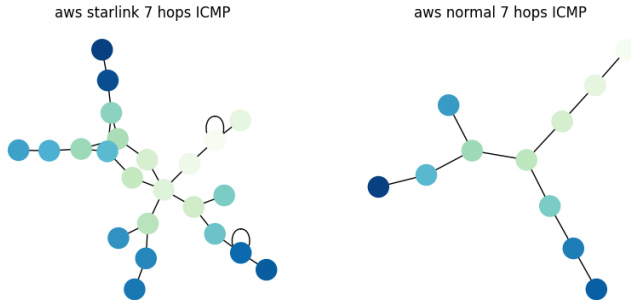


Figure 2: First 7 hops of traceroutes to 5 AWS datacenters using ICMP

Understanding routing decisions

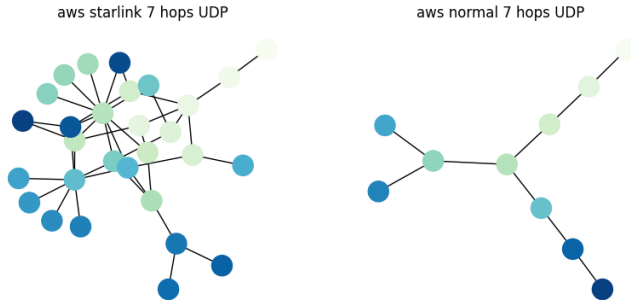


Figure 3: First 7 hops of traceroutes to 5 AWS datacenters using UDP

Understanding routing decisions

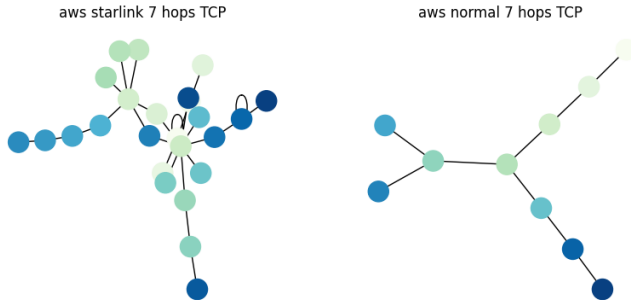


Figure 4: First 7 hops of traceroutes to 5 AWS datacenters using TCP

Measuring RTT changes when applying stress iperf

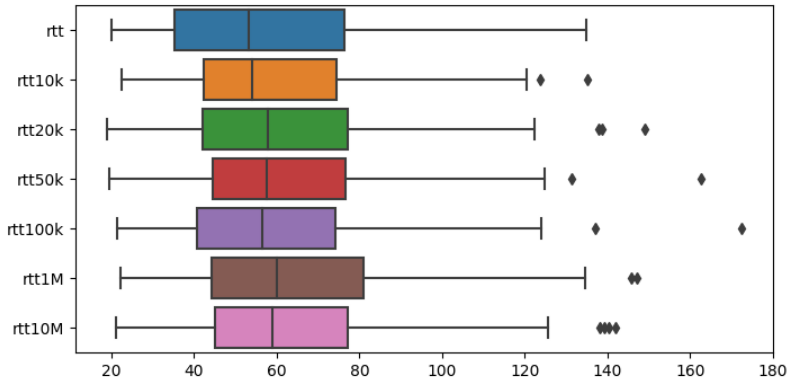


Figure 5: measuring RTT changes when applying stress iperf

Visualize Visible Satellites

- from celestrak.org we can download a list of Starlink's satellites TLEs
- A two-line element set (TLE) is a data format encoding a list of orbital elements of an Earth-orbiting object for a given point in time, the epoch. Using a suitable prediction formula, the state (position and velocity) at any point in the past or future can be estimated to some accuracy. (from wikipedia.org)

common.calculate_visible_satellites

```
def calculate_visible_satellites (...):  
    # ...  
    satellites = load.tle_file(stations_url)  
    observer = Topos(observer_latitude, observer_longitude, observer_elevation)  
    t = load.timescale().now()  
  
    # Calculate satellite positions  
    positions = [(sat, (sat - observer).at(t)) for sat in satellites]  
  
    # Filter visible satellites  
    visible_satellites = []  
    for sat, position in positions:  
        alt, az, distance = position.altaz()  
        # Satellite is above the horizon  
        if alt.degrees > 0 and distance.km < distance_km:  
            visible_satellites.append((sat, alt, az))  
  
    return visible_satellites
```

Listing 1: visualizing a single obstruction map

count of visible satellites across time

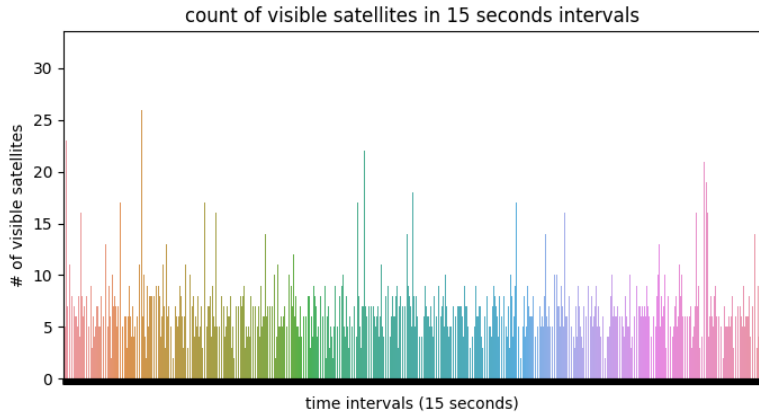


Figure 6: count of visible satellites across time

Visualizing Patterns in Visible Satellites

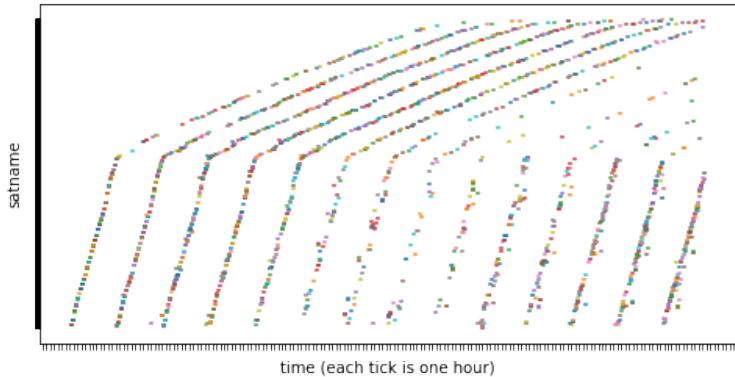


Figure 7: Visualizing patterns in visible satellites

the gRPC api

- the dish exposes a gRPC api with server reflection, "runtime construction of requests without having stub information precompiled into the client." ²
- 55 "methods" are available, most of them don't work, we have 2 categories of errors: Unimplemented, PermissionDenied and a couple of some other specific errors
- working methods: reboot, get_status, start_dish_self_test, get_history, get_device_info, dish_power_save, dish_get_config, get_obstruction_map
- to see all methods: <https://gist.github.com/rcastellotti/e20630366dfeaeada6cc2680f562f6ac>

² <https://github.com/grpc/grpc/blob/master/doc/server-reflection.md>

Next Actions

- investigate satellite handovers following the method described in [1] (we have a working script)
- try to correlate satellite handovers with sudden drops in bandwidth
- sneak peak: <https://youtu.be/PjfMPr20suw>

- [1] L. Izhikevich, M. Tran, K. Izhikevich, G. Akiwate, and Z. Durumeric. Democratizing leo satellite network measurement, 2023.