

RAFT Technologies
a bit faster

Approaching HF Radio With Your Eyes Wide Open

Dr. Ehud Fishler, Head of Technology

ABOUT ME

Dr. Ehud Fishler

Head of Technology, Raft Technologies

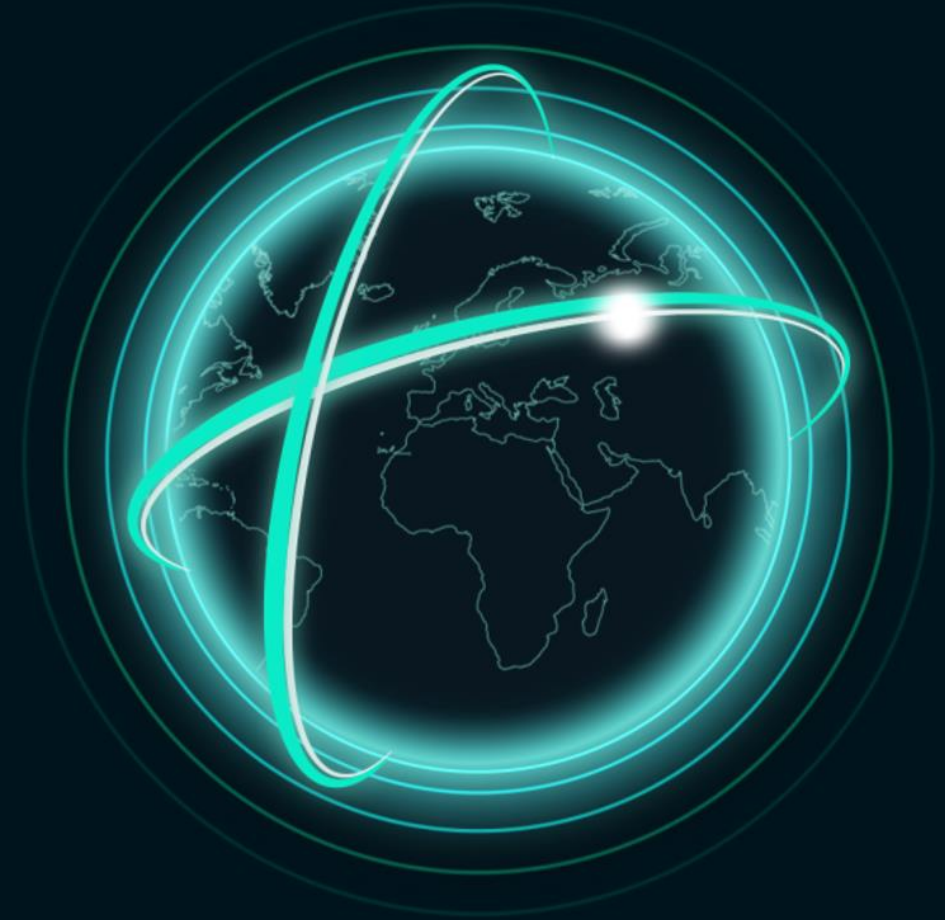
- More than 25 years of experience in RF, RADAR, and Communications
- Leads Raft's System & Algorithms groups since 2021
- The founder of:
 - “Mantissa”, a miniaturized radar device for HLS.
 - “Anachoic”, a smart helmet for two-wheelers.



HF-BASED ULTRA LOW LATENCY WIRELESS NETWORK

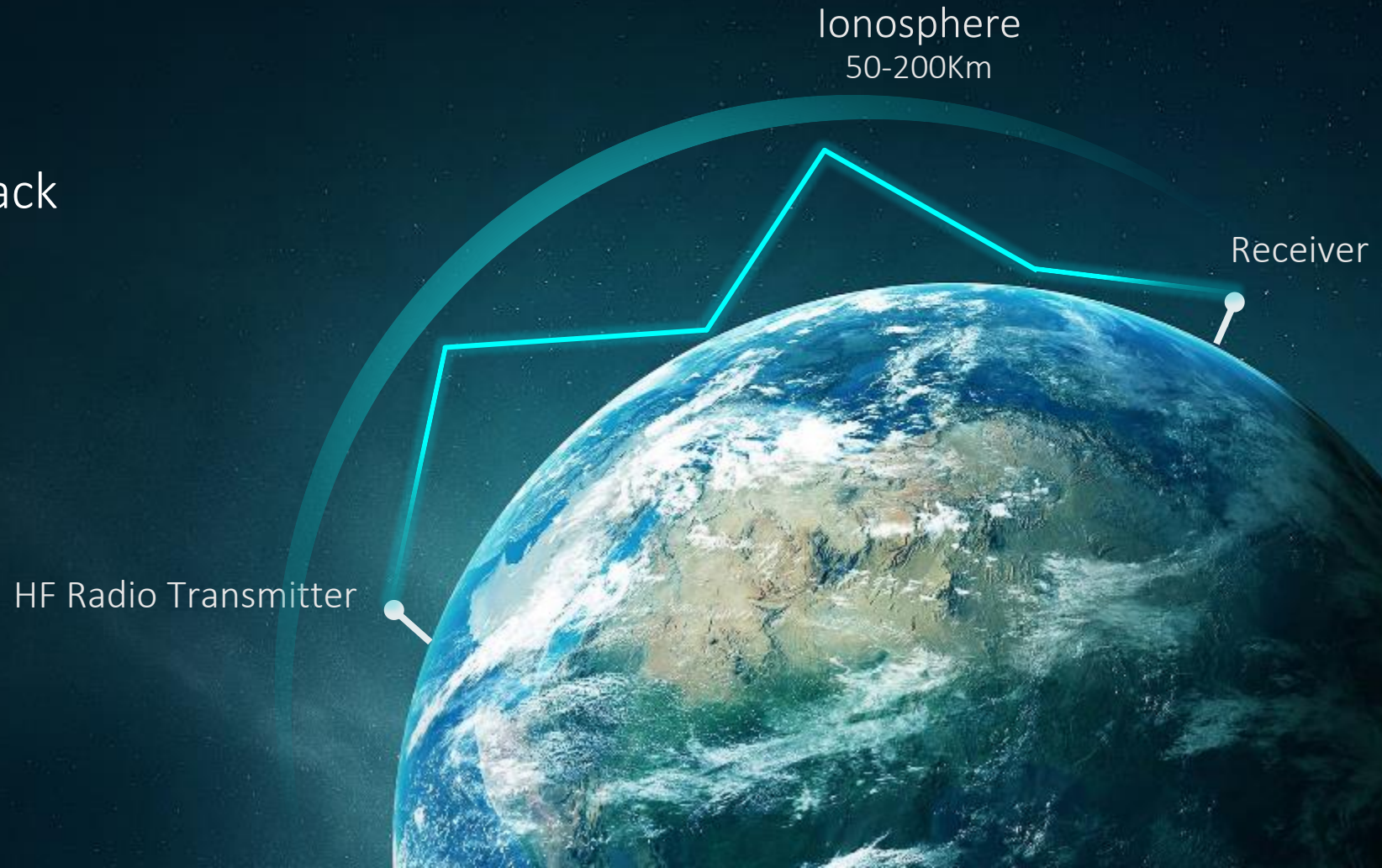
Let's talk about HF performance:

- What powers it?
- What performance can you expect?
- How far can we get (latency, distance, bitrate, uptime)?



SKYWAVES (HF / SHORTWAVE RADIO) TRAVEL LONG DISTANCES AT THE SPEED OF LIGHT

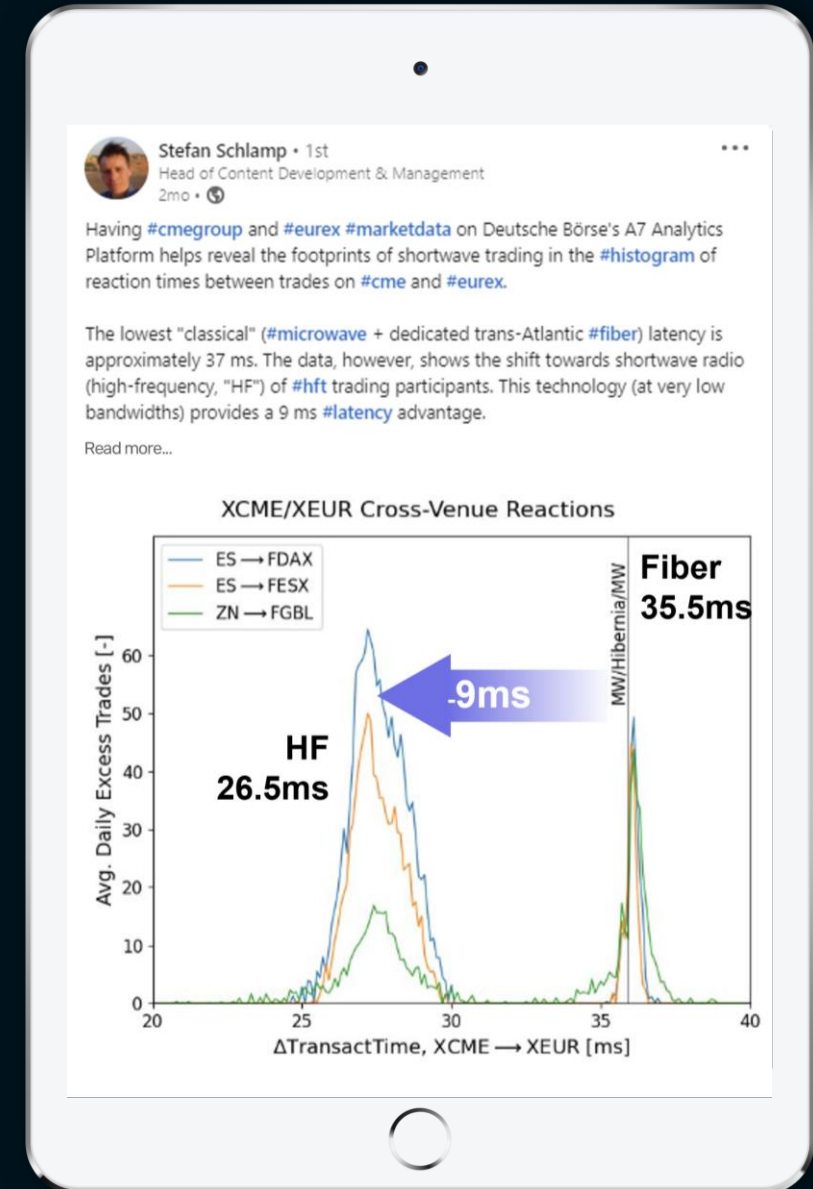
Skywaves propagate back
from the atmosphere,
acting as a mirror



HF ADOPTION HAS STARTED

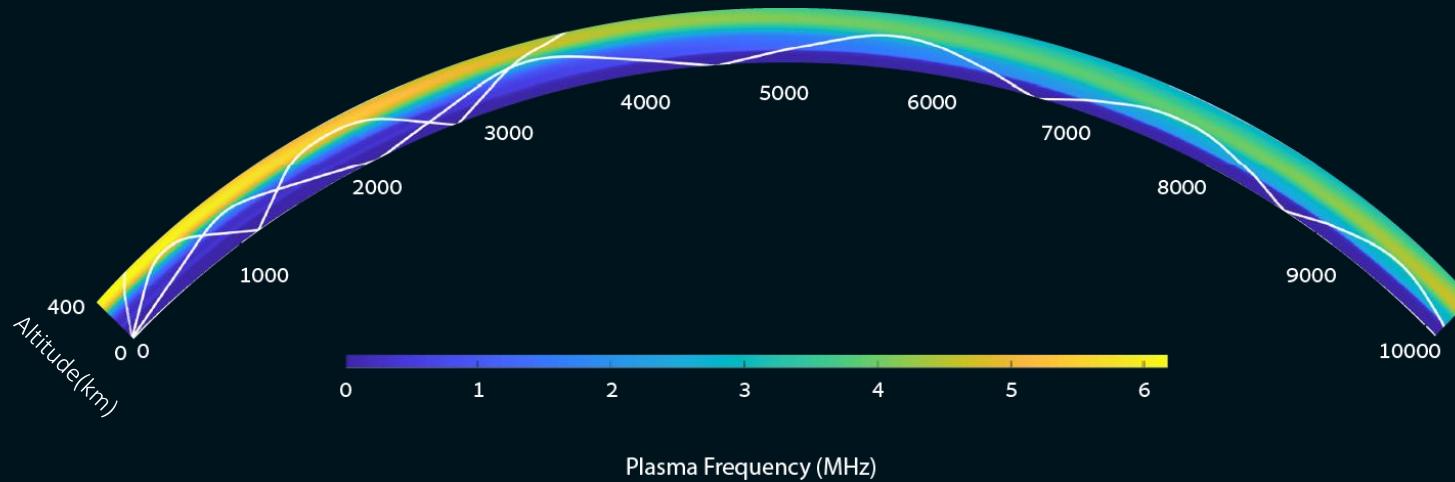
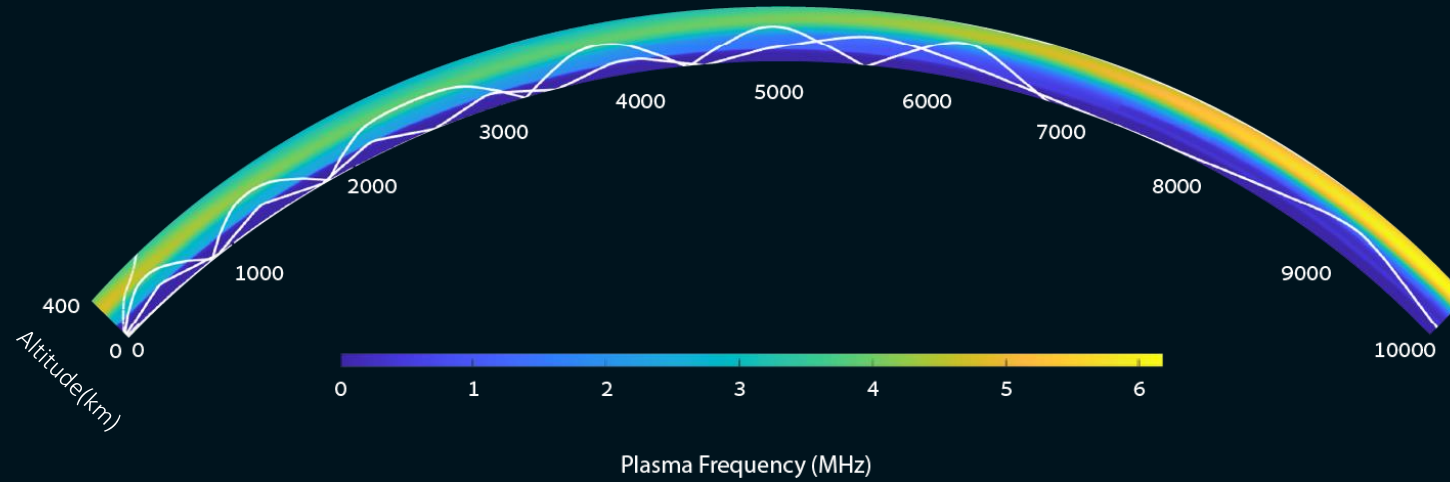
Deutsche Börse cross-correlation analysis

Showing trades in Frankfurt following trade events in Chicago



REFRACTIVE EFFECTS OF THE IONOSPHERE

Signals take different paths



CYCLES DEFINING HF SERVICE AVAILABILITY



Day-night
Cycle



Seasons
Cycle

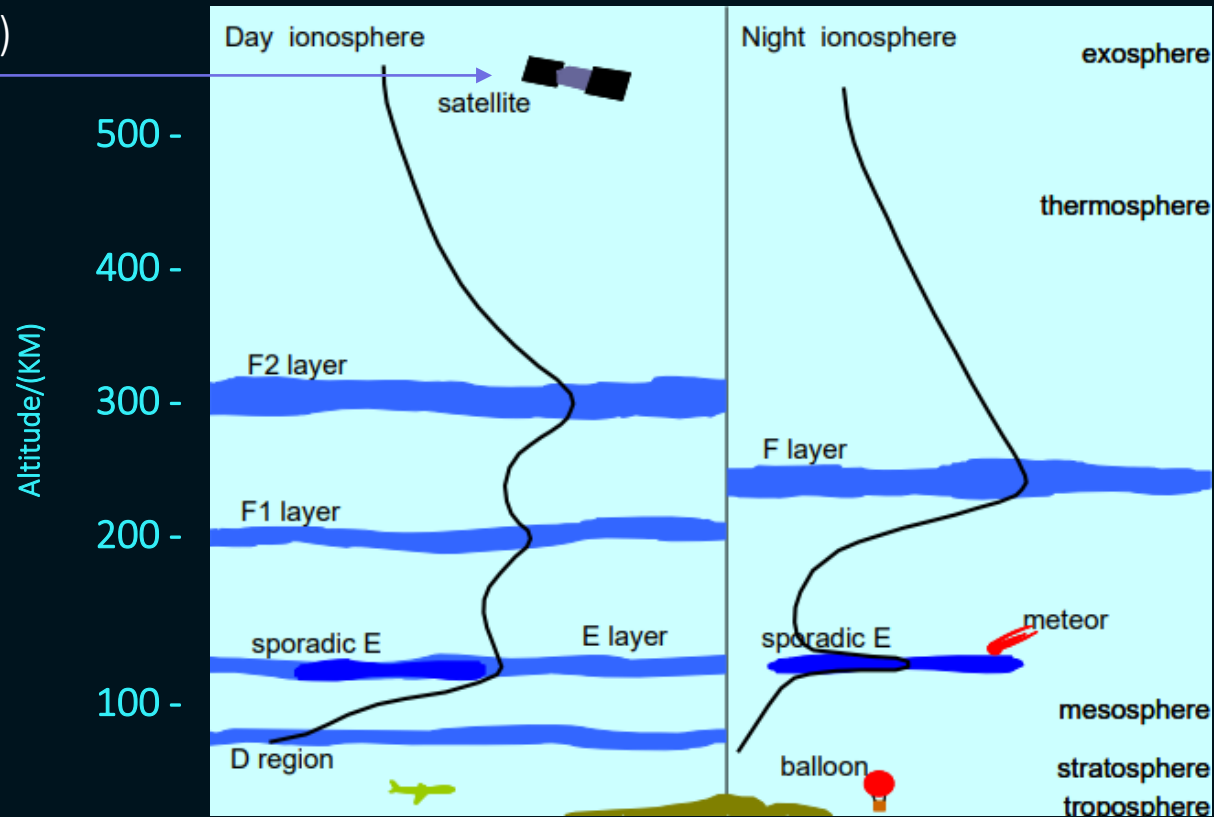


Solar
Cycle



DAY-NIGHT CYCLE IONOSPHERE LAYERS CHANGE

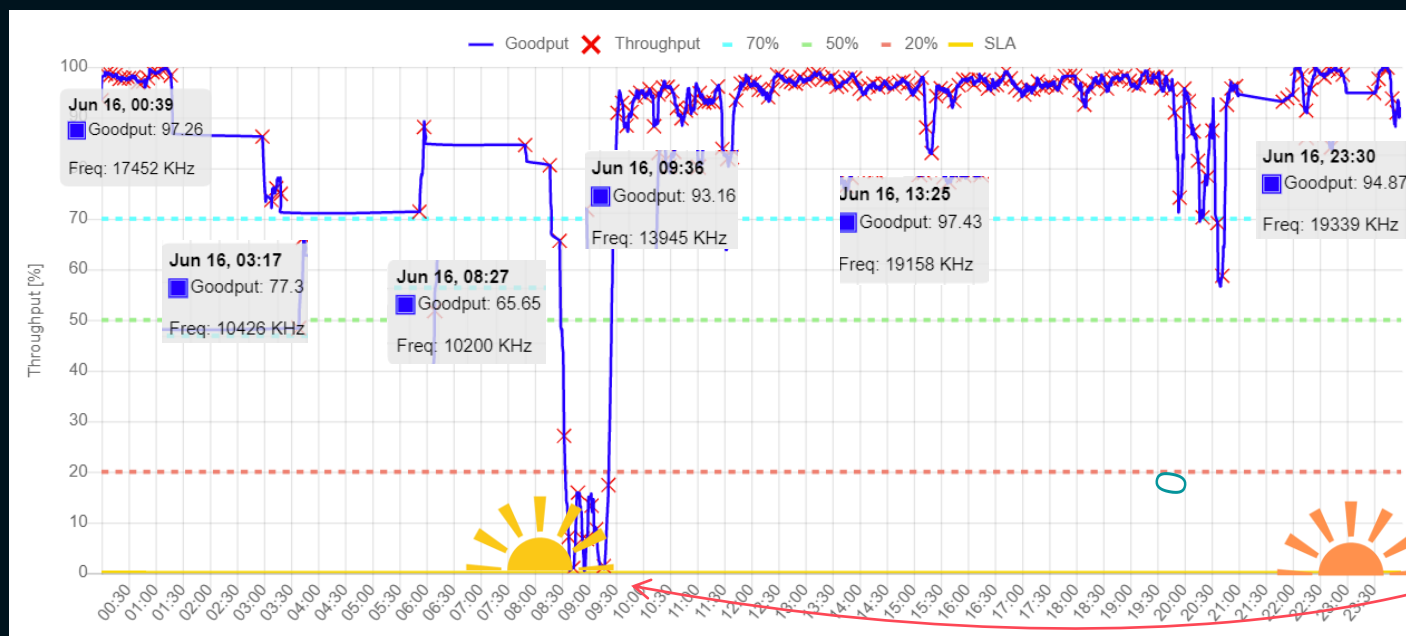
(LEOs are higher in the sky)



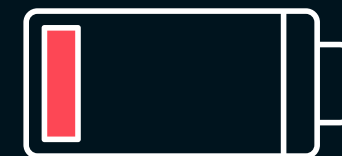


DAY-NIGHT CYCLE IONOSPHERE LAYERS CHANGE

Date: June 15, 2022



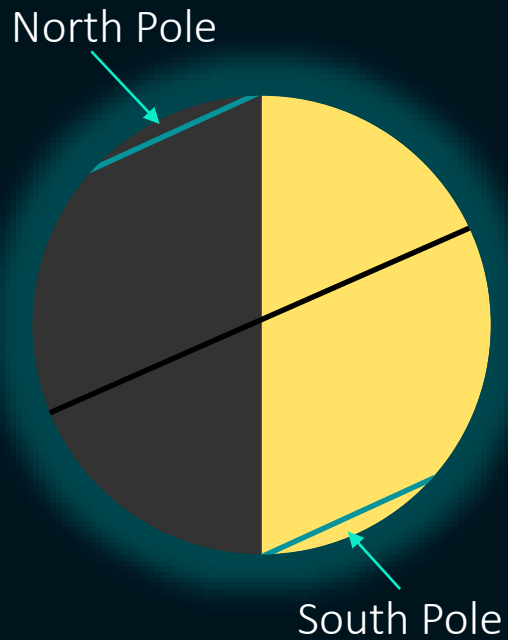
Just before dawn,
“battery drains out”



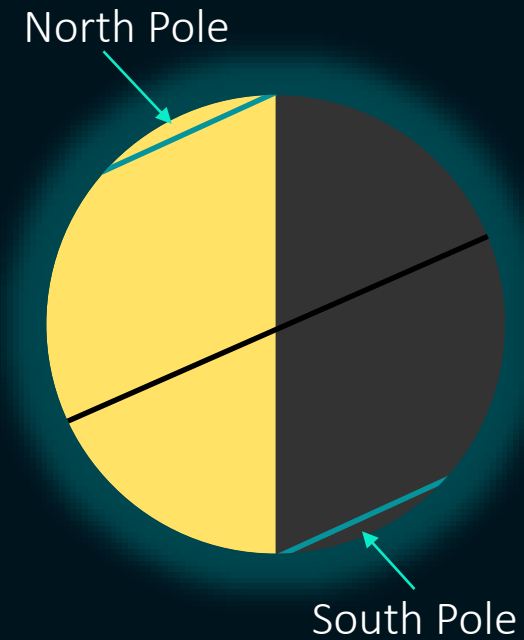


SEASONAL CYCLE DAYLIGHT HOURS CHANGE

The Earth Axial tilt ≈ 23 Degrees



December Solstice



June Solstice



SEASONAL CYCLE DAYLIGHT HOURS CHANGE



December

SUN



June



SEASONAL CYCLE DAYLIGHT HOURS CHANGE

Winter
day

Summer
day

UTC

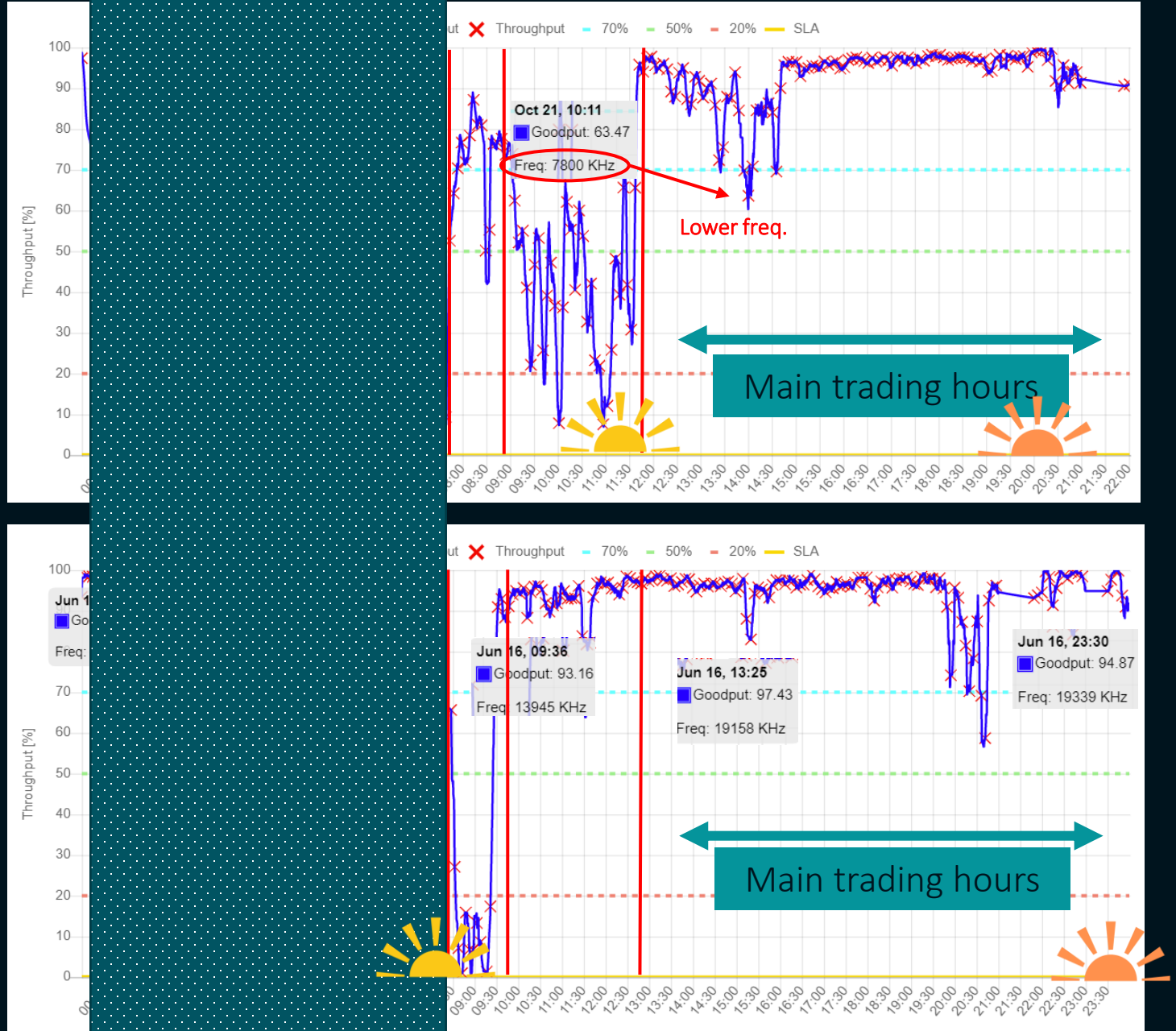




SEASONAL CYCLE DAYLIGHT HOURS CHANGE

Winter
day

Summer
day

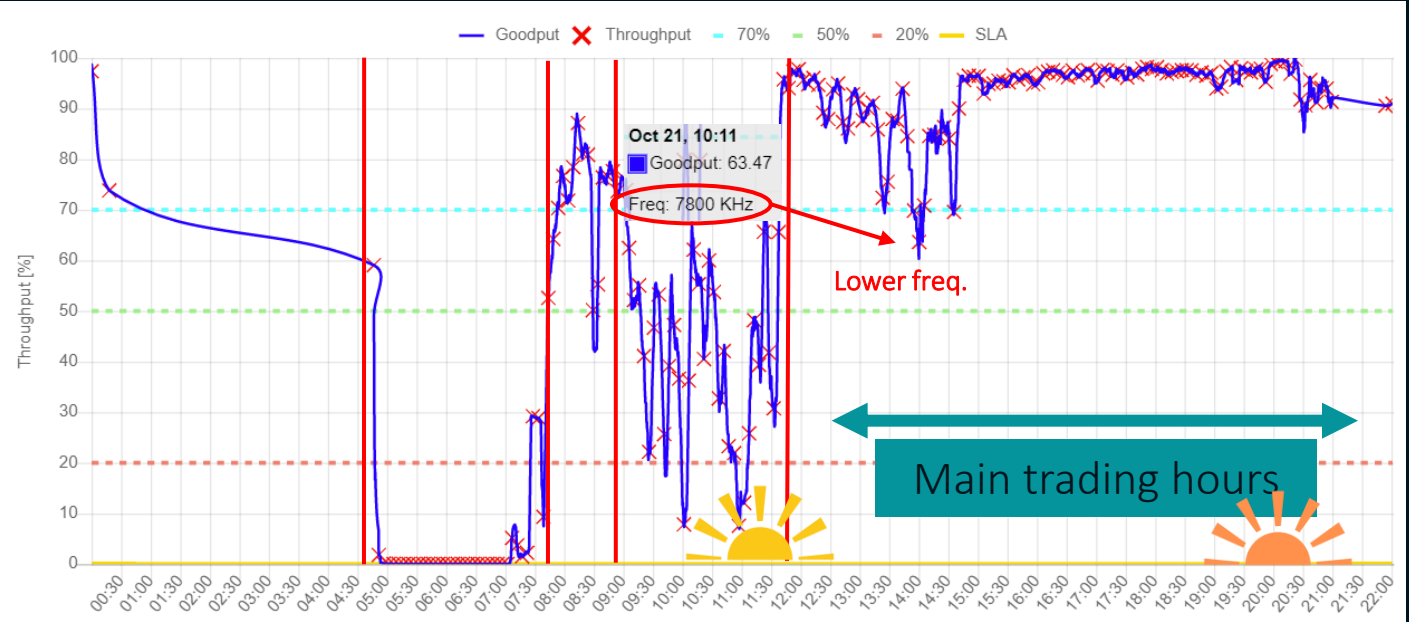


UTC

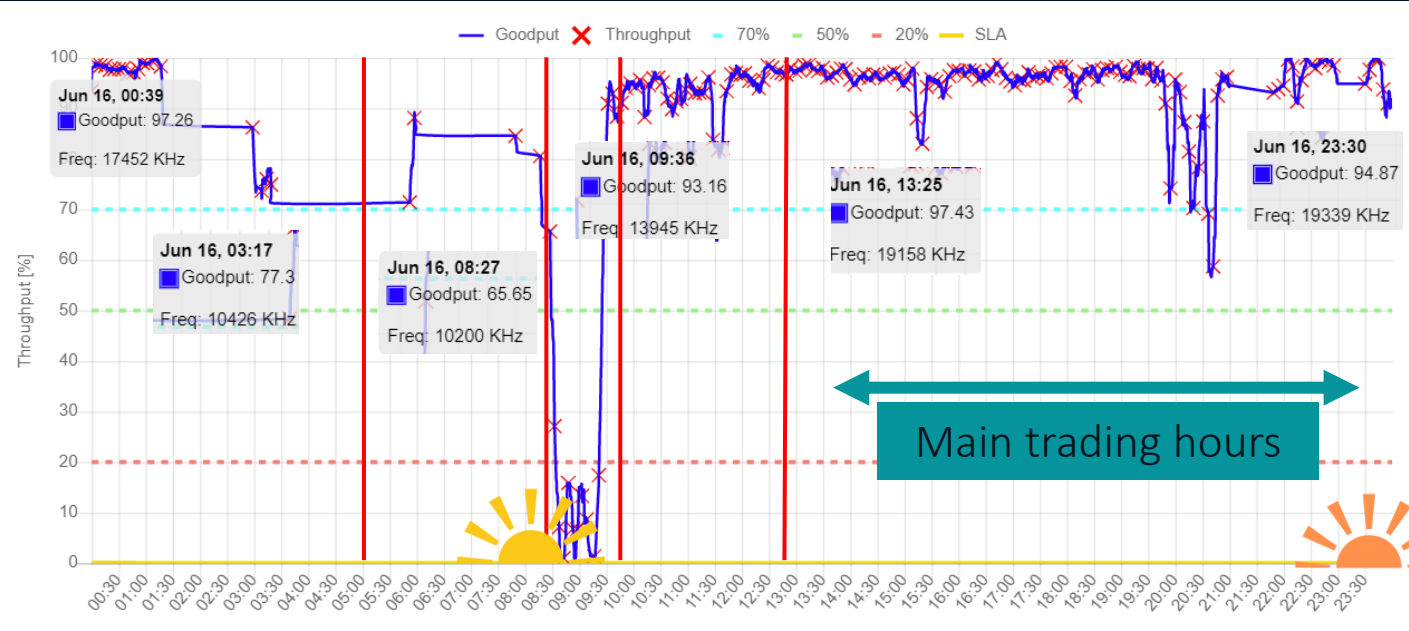


SEASONAL
CYCLE
DAYLIGHT
HOURS
CHANGE

Winter
day



Summer
day



UTC

Not STAC Benchmarks

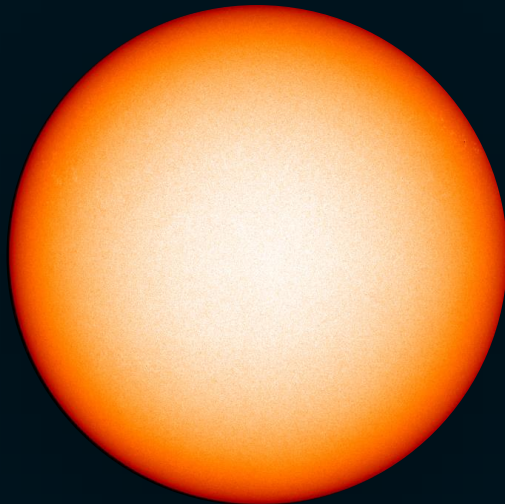
UTC-3h



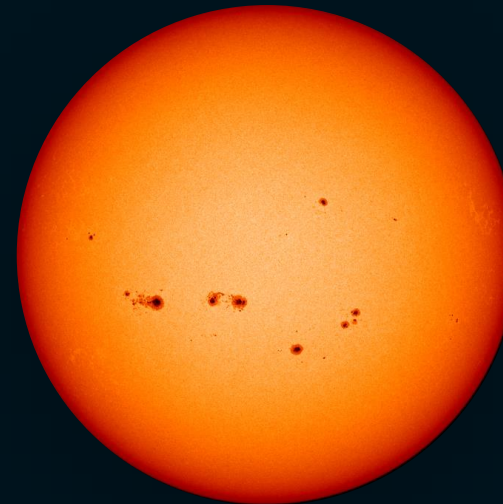
SOLAR CYCLE THE SUN'S MAGNETIC FIELD

Sunspots – the more the better

Solar Minimum



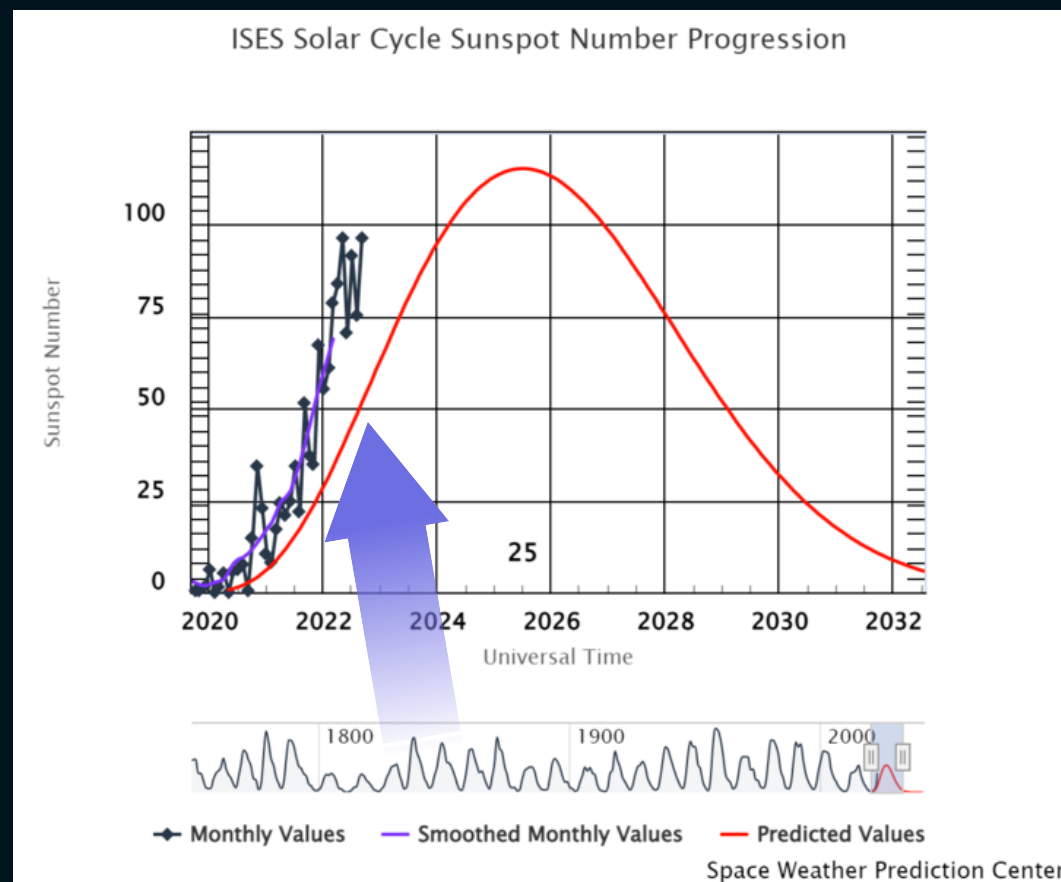
Solar Maximum





SOLAR CYCLE THE SUN'S MAGNETIC FIELD

There's a good tailwind for HF



WEATHER FORECASTS – IN SPACE, NOT ON EARTH

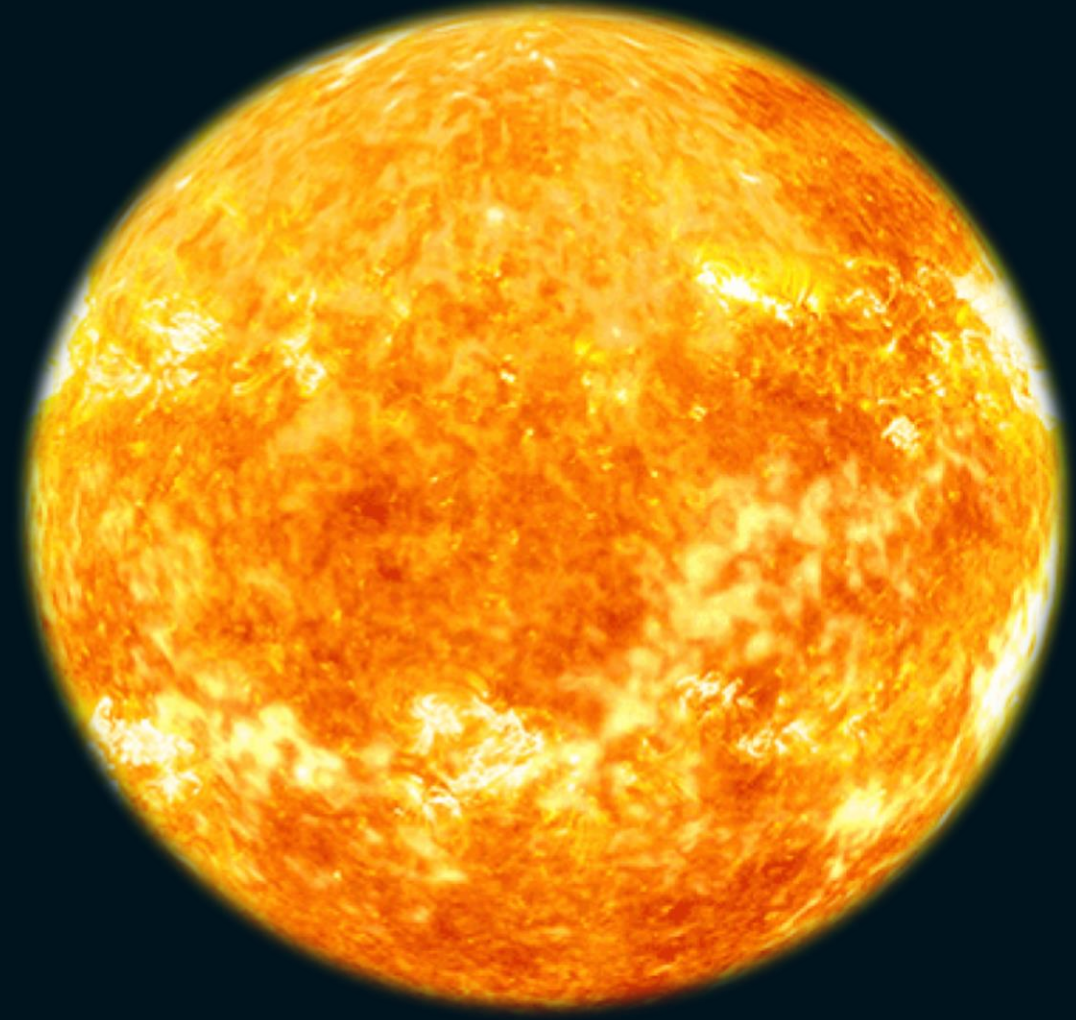
Positive

- Active Regions
- Sunspots

Negative

- Solar-Flux
- X-Rays

A master indicator: K-Index



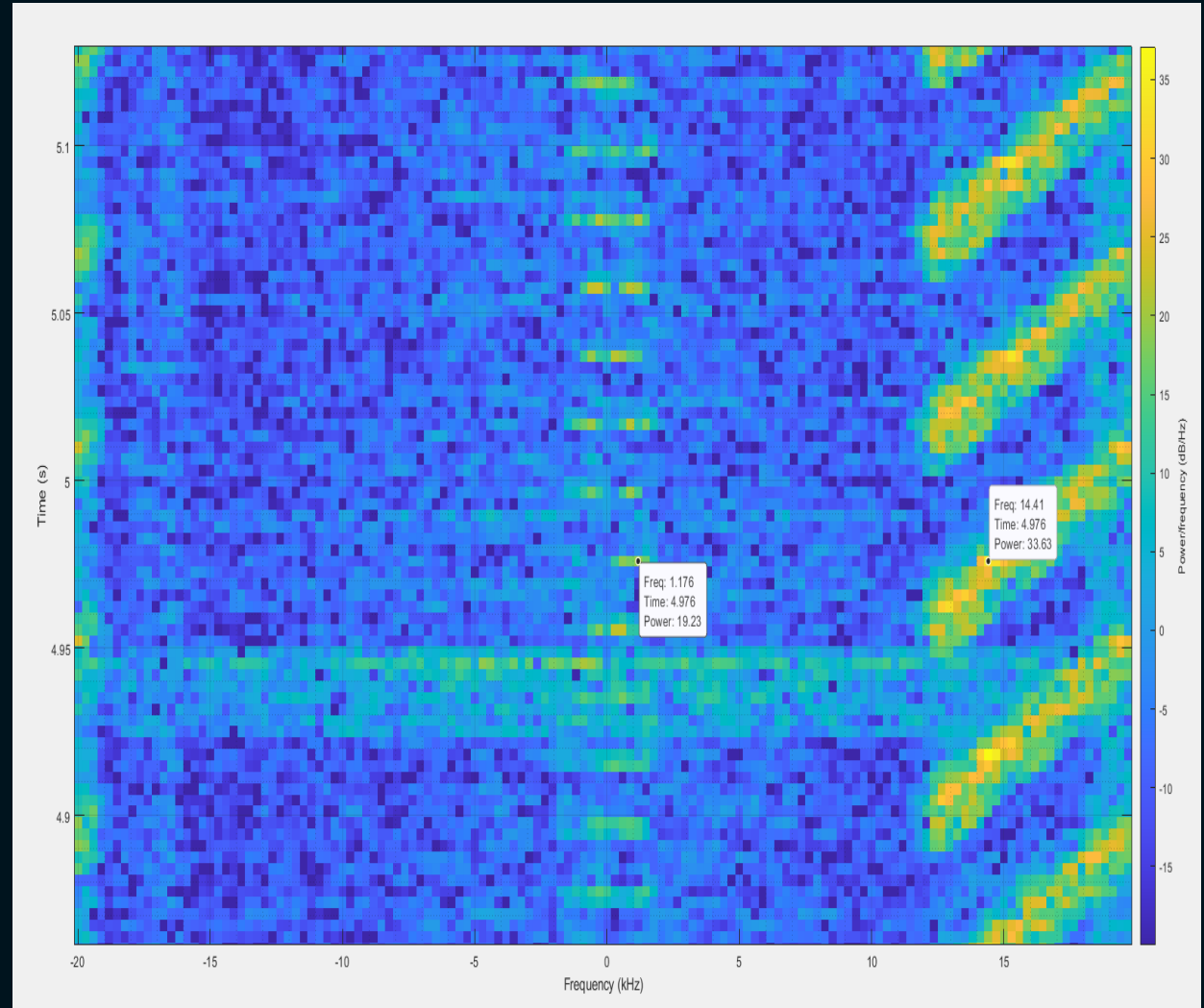
HF CHALLENGES RECEIVING A SIGNAL

Man-made noise

- Crowded spectrum
- Narrow-band noise
- Chirp-type noise

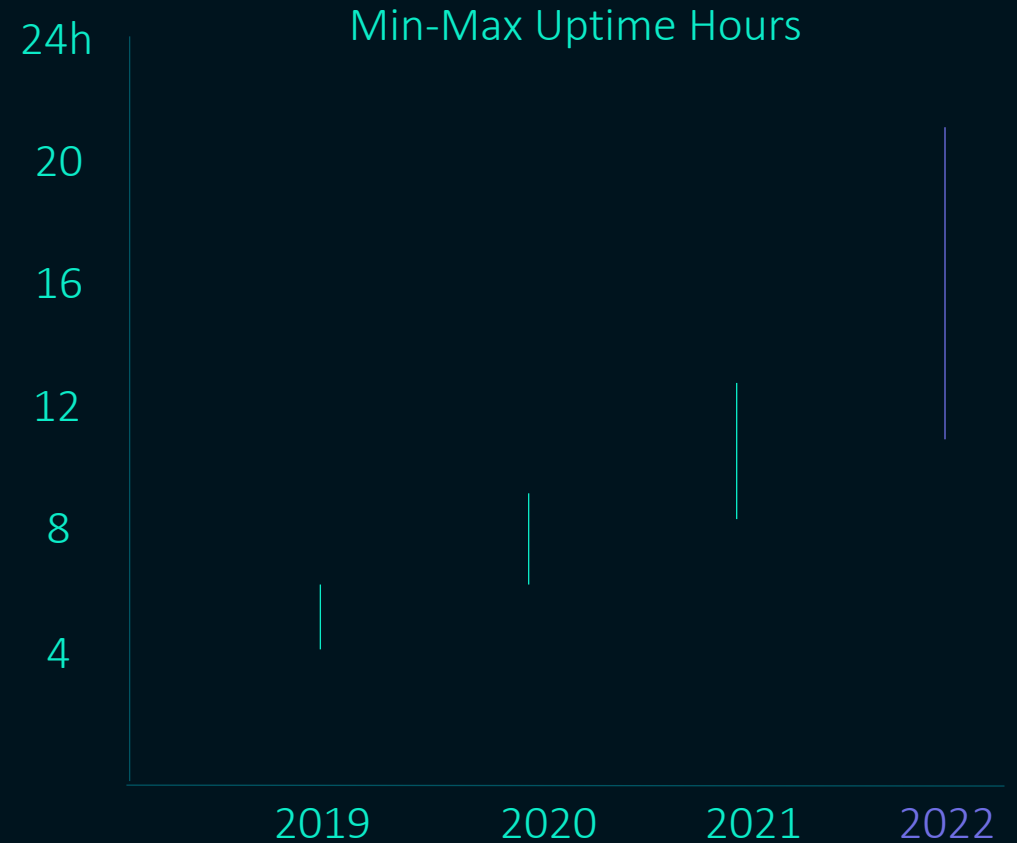
Your own “noise”

- Multipath
- Long path / 2nd time around

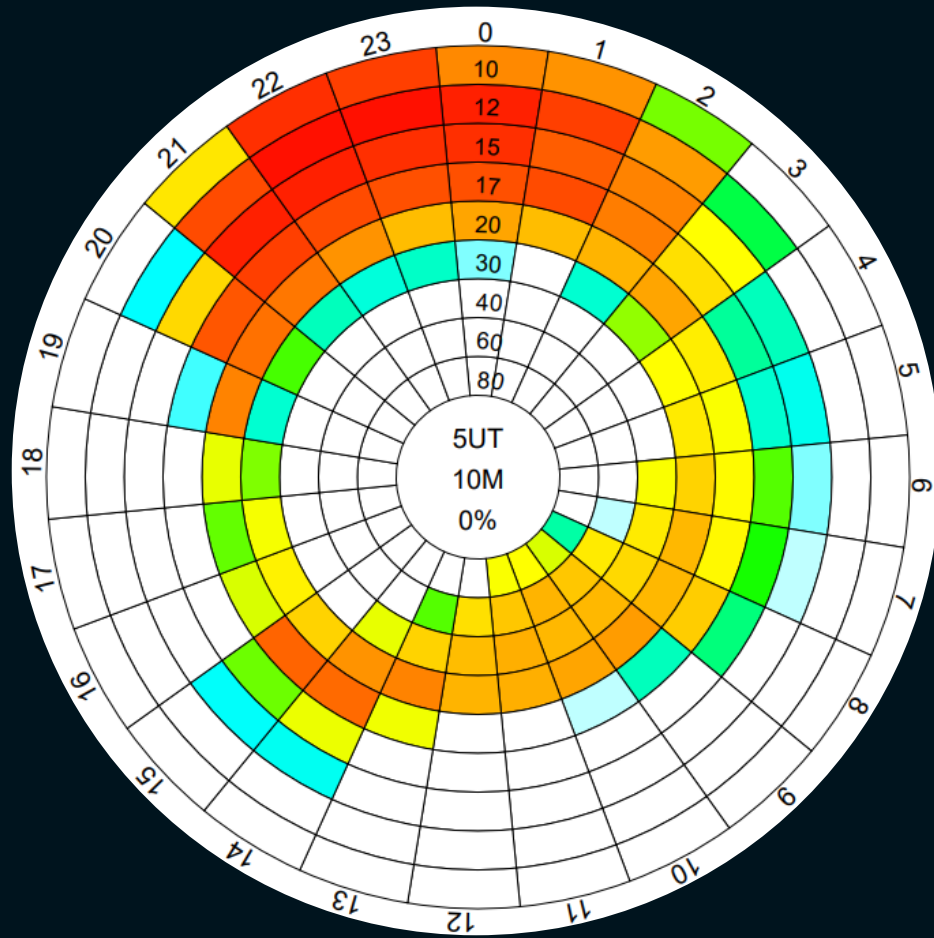


HF NETWORK KEY PERFORMANCE INDICATORS

Latency	●	HF delivers the shortest latency ever
Capacity	●	0.5-1.2 Kbps
Goodput	●	75-95%
Uptime	●	Near 24h, summertime cross-Atlantic
Error Rate	●	In the 10EXP-5 zone

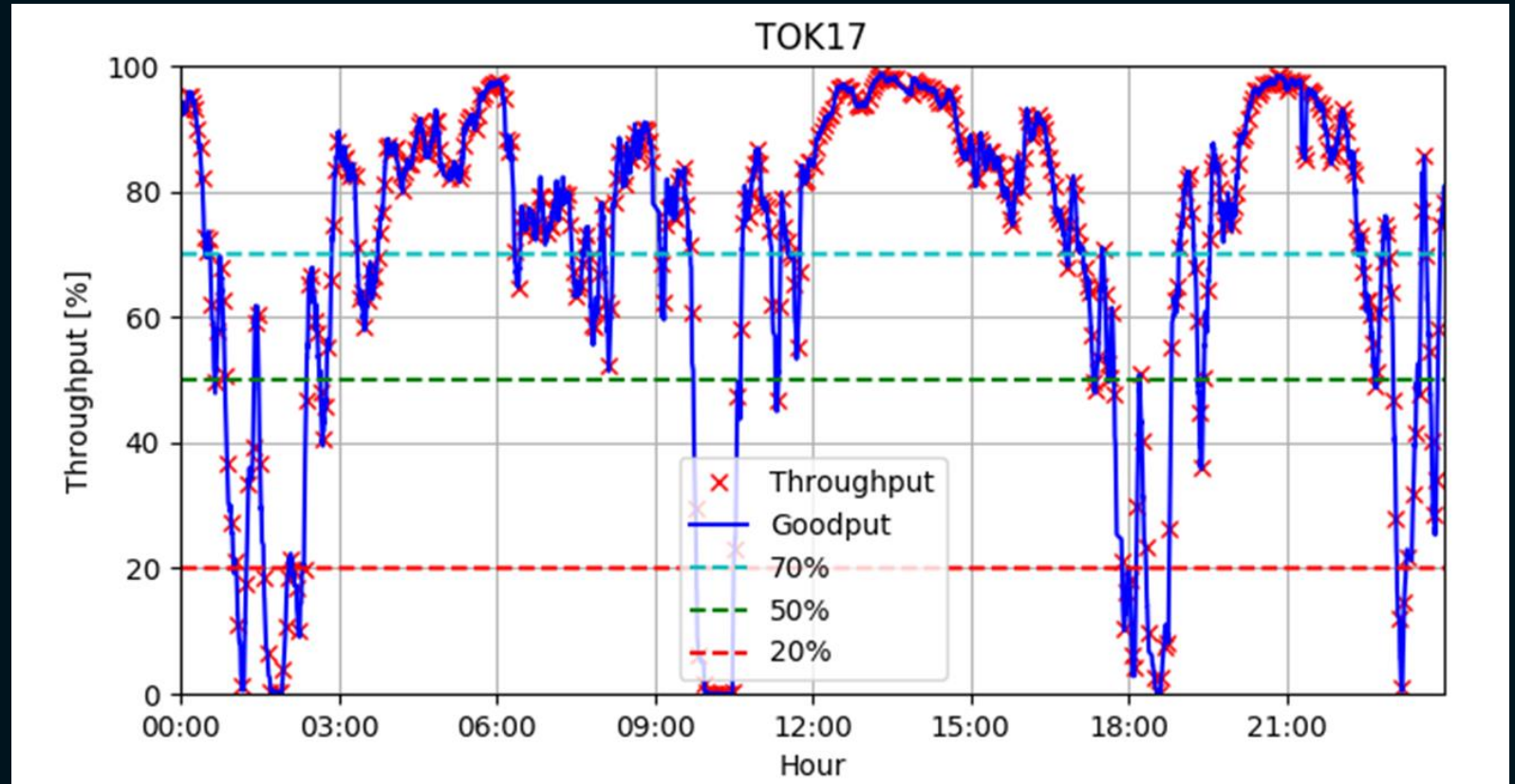


EXAMPLE: CHICAGO TO TOKYO LINK



EXAMPLE: CHICAGO TO TOKYO LINK

- Distance: 10,125 Km
- No repeater (!)
- End-to-end latency (colo to colo): below 50ms...



CONTINUOUS INCREASED PERFORMANCE



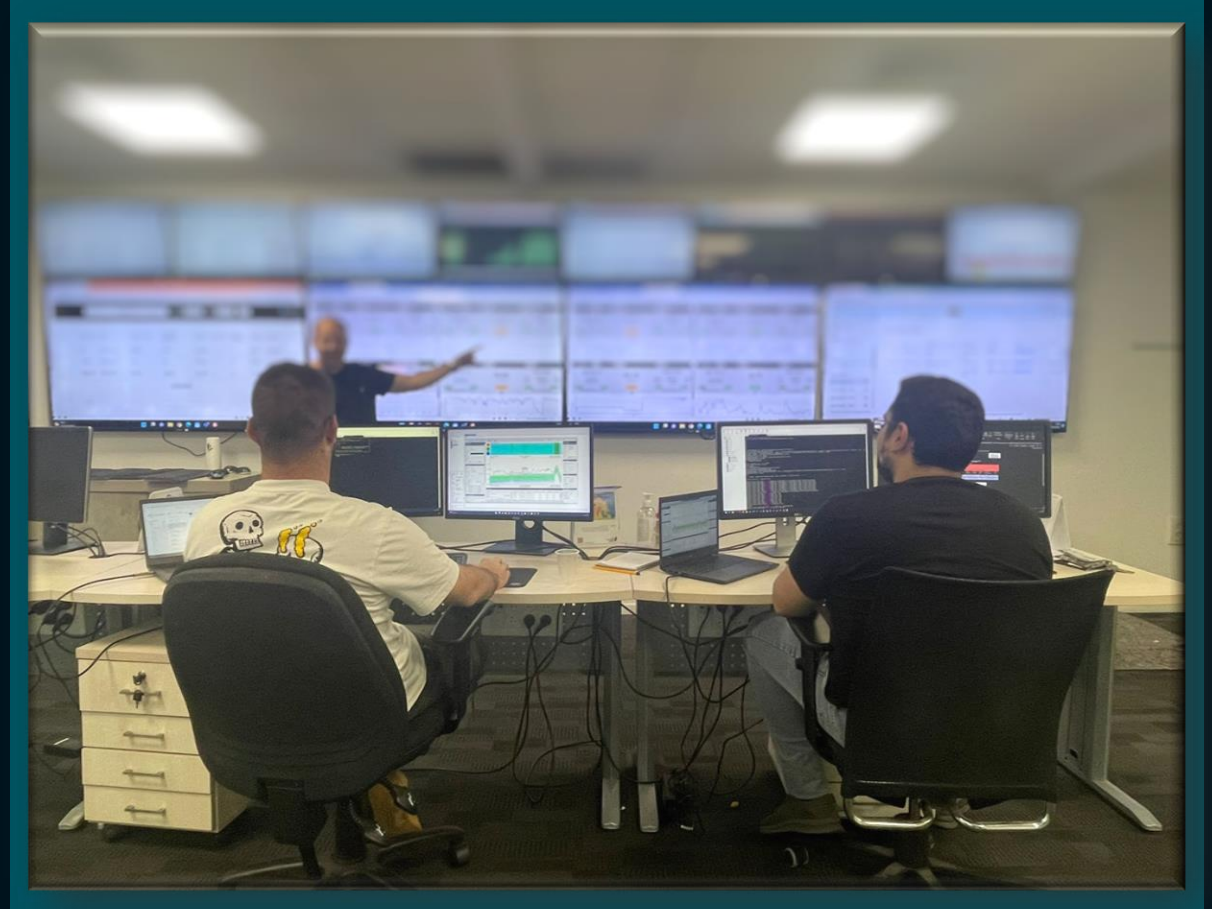
NOC

Developed procedures for link mgmt.



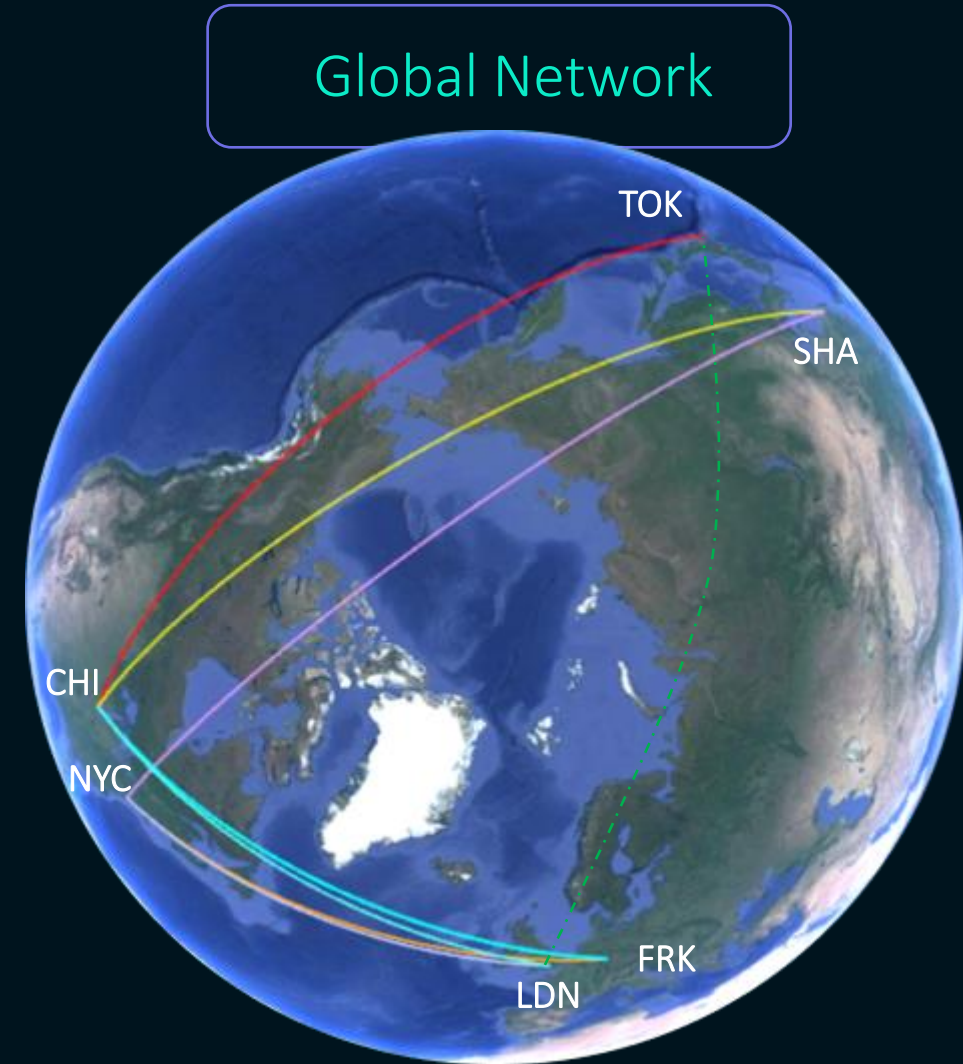
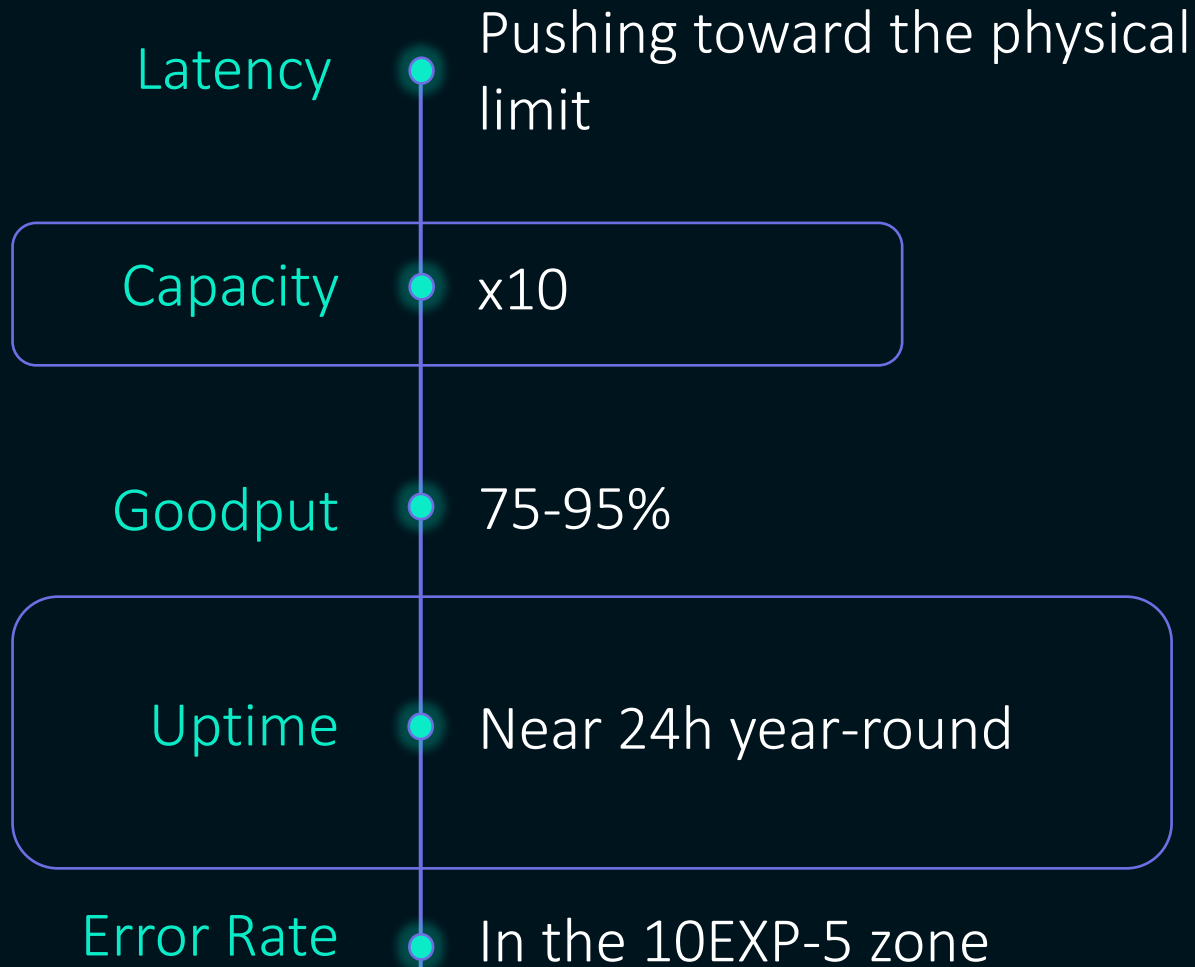
ANOC (Autonomous NOC)

AI-powered link monitoring and control

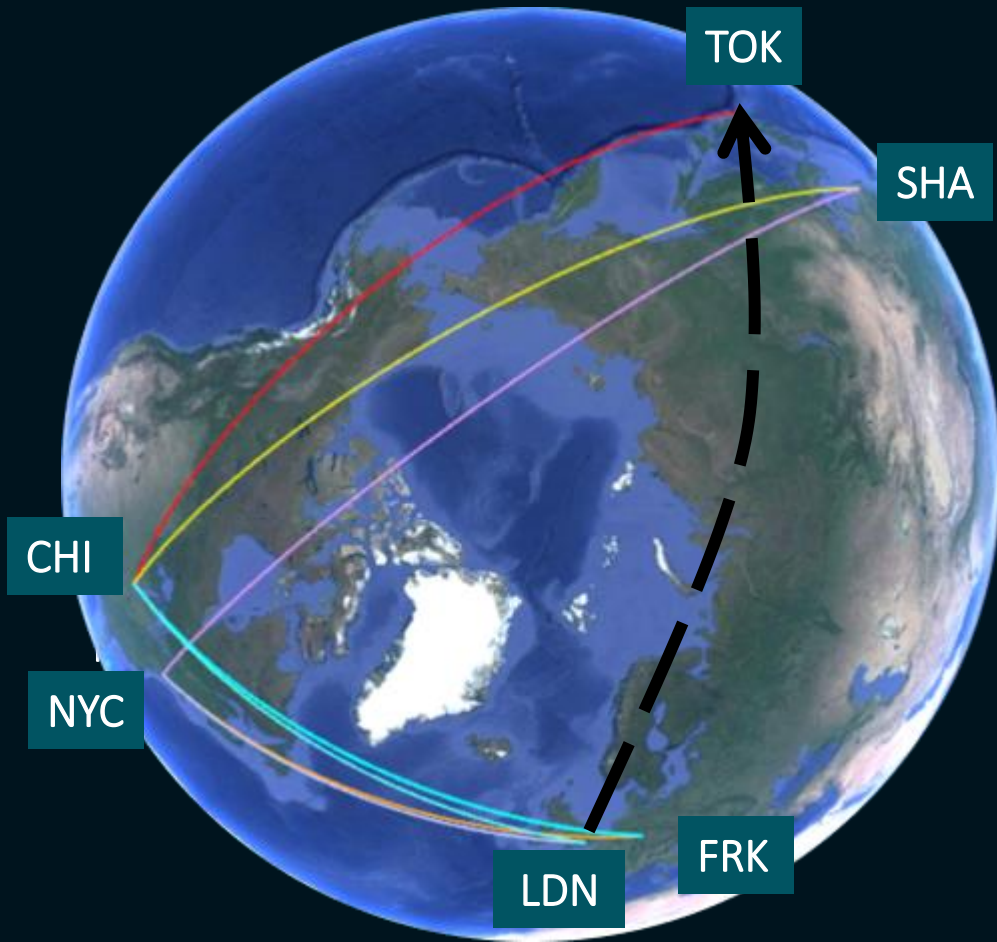


HF NETWORK KEY PERFORMANCE INDICATORS

Current focus



ONE MORE THING: A NEW LINK LDN-TOK



Best Fiber: 69ms

HF: <<50ms...

Completing FX
markets triangle

NYC-LDN-TOK

First come, first served,
limited availability

Q&A



Thank you!

“Any sufficiently advanced technology is indistinguishable from magic”

Arthur C. Clarke

RAFT *Technologies*

a bit faster