

LENS: A LEO Satellite Network Measurement Dataset

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Introduction to the LENS dataset

- Low-Earth-Orbit (LEO) satellite network measurement dataset
- **13** Starlink dishes
- **7** Point-of-Presence (Seattle, New York, Chicago, Denver, Frankfurt, Lagos, Dallas)
- **3** continents (North America, Europe and Africa)
- Various hardware versions, sky obstruction ratios and service tiers
- First long-term measurement of inter-satellite links (ISLs) and community gateway
- High precision continuous data collection since 2023/11

Starlink dishes and locations









	Dish ID	Location	Hardware Version	БКУ	Time
				Obstruction	Obstruction
				Ratio (%)	Ratio (%)
	victoria_active_1	Victoria, BC, CA	rev3_proto2	0.264	0.002
	victoria_active_2	Victoria, BC, CA	rev3_proto2	0	0
	victoria_inactive	Victoria, BC, CA	rev3_proto2	0	0
	vancouver	Vancouver, BC, CA	rev2_proto3	4.564	0.097
	seattle	Seattle, WA, USA	rev3_proto2	10.198	0.801
	seattle_hp	Seattle, WA, USA	hp1_proto1	0.257	0.059
	ottawa	Ottawa, ON, CA	rev3_proto2	13.961	0.449
	iowa	Iowa City, IA, USA	rev1_pre_production	0.516	0
	denver	Denver, CO, USA	rev3_proto2	0.071	0.027
	louvain	Louvain, Belgium	rev3_proto2	0.027	0
	seychelles	Seychelles	rev3_proto2	0.646	0.022
	alaska	Anchorage, AK, USA	rev3_proto2	0.029	0.006
	dallas	Oxford, MS, USA	rev3_proto2	15.979	3.914

Obstruction map of dishes



1	PoP	Service Tier	
	Seattle	Standard	
	Seattle	Mobile	
	Seattle	Inactive Mobile, Roam	
	Seattle	Standard	
	Seattle	Standard	
	Seattle	Priority	
	New York	Standard	
	Chicago	Standard	
	Denver	Mobile, Roam	
	Frankfurt	Standard	
	Lagos / Frankfurt	Mobile, Roam	
Seattle		Mobile	
	Dallas	Inactive Standard	

Figure 2: Side-by-side dishes' obstruction maps



Figure 3: Side-by-side dishes' latency performance

Red: Obstruction

Measurement methodologies

"Inside-out"

- **R**ound-**t**rip-**t**ime (RTT) from dish to PoP
- **O**ne-**w**ay **d**elay (OWD) (Uplink/Downlink) from dish to cloud VPS close to PoP
- Including dishes without active service subscriptions (inactive dishes) and a dish utilizing ISLs

"Outside-in"

- RTT from cloud VPS to dishes with public IP addresses
- Including Starlink's first community gateway in Unalaska, AK, USA, and dishes in Africa utilizing ISLs

Use cases

- Trace-driven simulation/emulation for optimizing application performance, including VoD and live video streaming, cloud gaming, etc.
- Jinwei Zhao, Jianping Pan, Low-Latency Live Video Streaming over a Low-Earth-Orbit Satellite Network with DASH, MMSys'24, https://doi.org/10.1145/3625468.3647616



Figure 4: ISLs performance in Seychelles over time in CDF



Figure 5: ISLs performance at different locations

White: Unobstructed

Interested?

- Check out links to our monthly dataset lacksquaresnapshots on GitHub
- Already own a Starlink dish or have access to other LEO ISPs (OneWeb)? Consider hosting a RIPE Atlas probe, or join a community testbed



Figure 6: Active dish RTT in CDF

Figure 7: Inactive dish RTT in CDF

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Dataset available: https://github.com/clarkzjw/LENS