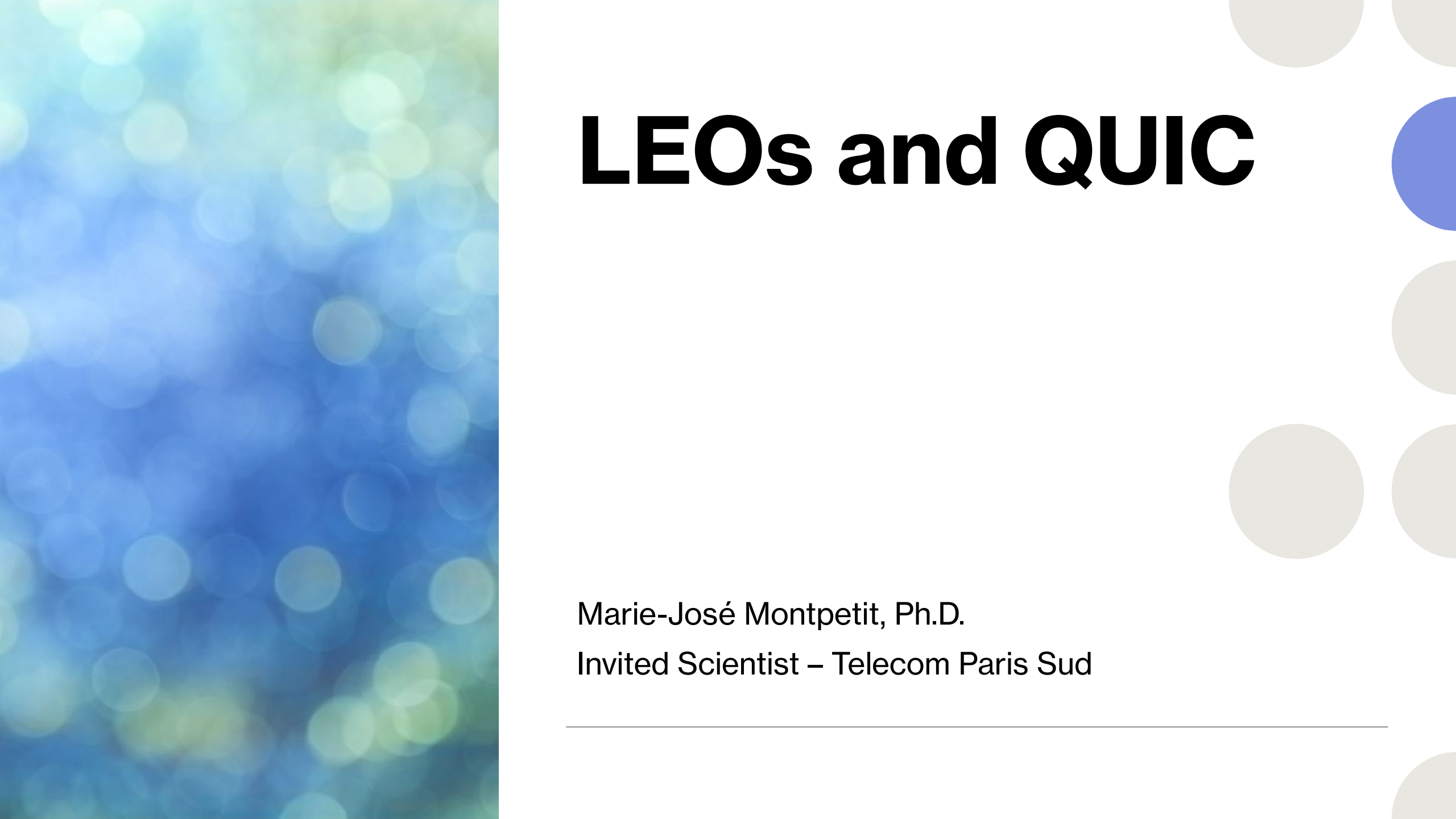




LEOs and QUIC

Marie-José Montpetit, Ph.D.

Invited Scientist – Telecom Paris Sud

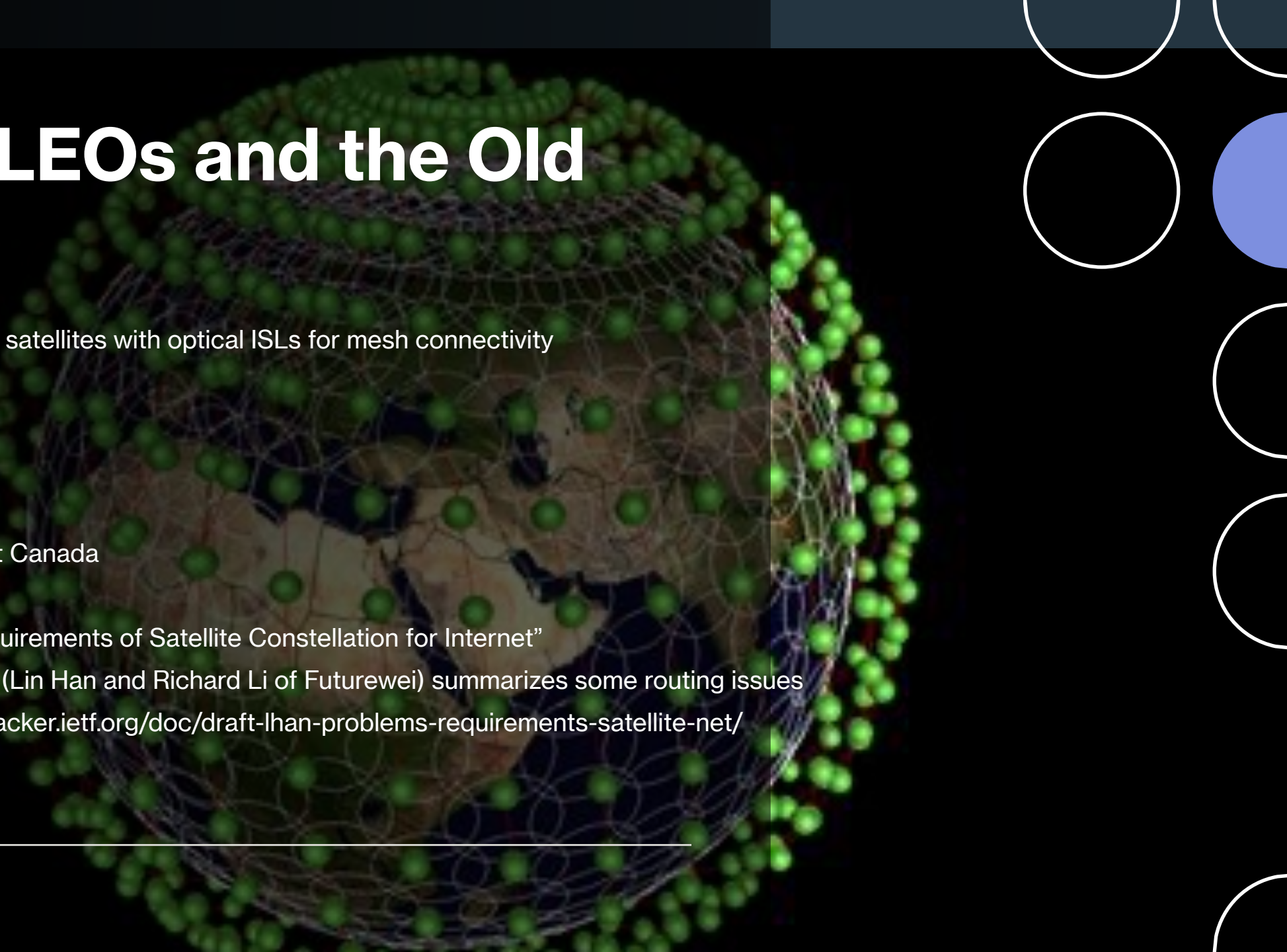
The new LEOs and the Old

- **The old**

- Teledesic
 - 750 then 288 satellites with optical ISLs for mesh connectivity

- **The new**

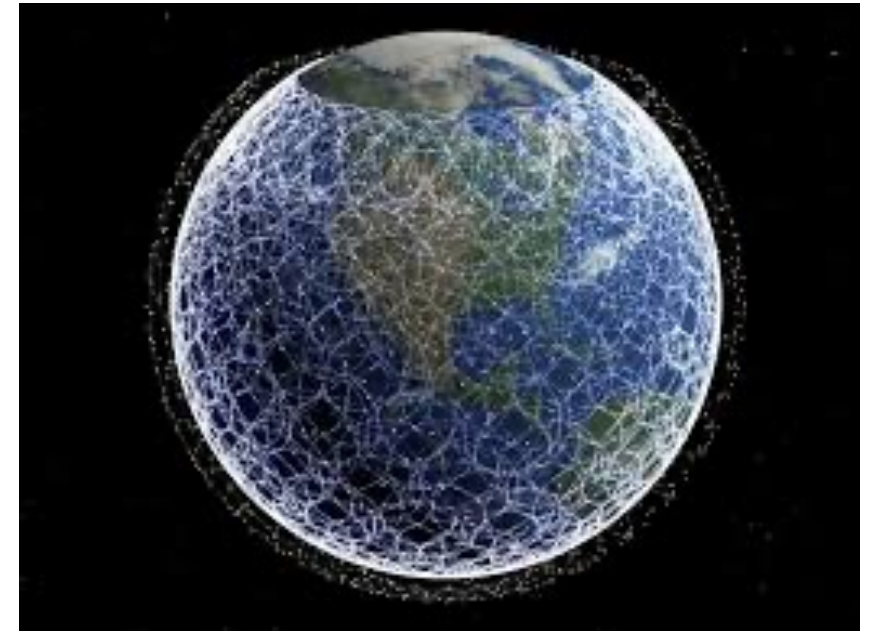
- Starlink/Space X
- Kuiper/Amazon
- OneWeb/Airbus
- Lightspeed/Telesat Canada
- Viasat? Samsung?
- “Problems and Requirements of Satellite Constellation for Internet”
 - Internet draft (Lin Han and Richard Li of Futurewei) summarizes some routing issues
 - <https://datatracker.ietf.org/doc/draft-lhan-problems-requirements-satellite-net/>



Focusing on Starlink

- Status

- Dense constellation of (currently planned) 4425 satellites
 - 1800 launched; partial service established
 - SpaceX has regulatory permission to operate 4,408 satellites at 550-km altitude for global coverage
 - No ISLs at least in the 1st generation
 - ISL added to the new generation (starting 2022) to avoid needing gateways in the arctic
 - Ku/Ka band
 - 24 orbital planes/53° inclined orbit
 - Speeds of up to 1 Gbit/s, with latencies between 25 and 35 ms
 - Currently 140,000 users at \$99/mo. (\$499 for the access point)
-



Connectivity Aspects

Access network

- Uplink established with one satellite that forwards the traffic to a gateway inside its footprint and onward to the Internet

Satellite diversity used to maintain the best connectivity in Ka band

- Changing satellites may mean changing gateway
 - New satellite may not be in the same orbital plane (at least before the constellation is complete)
- There are no ISLs to maintain the same GW
 - The ISLs may be turned on only at the arctic

LEOs do not have large delays but will have delay variations

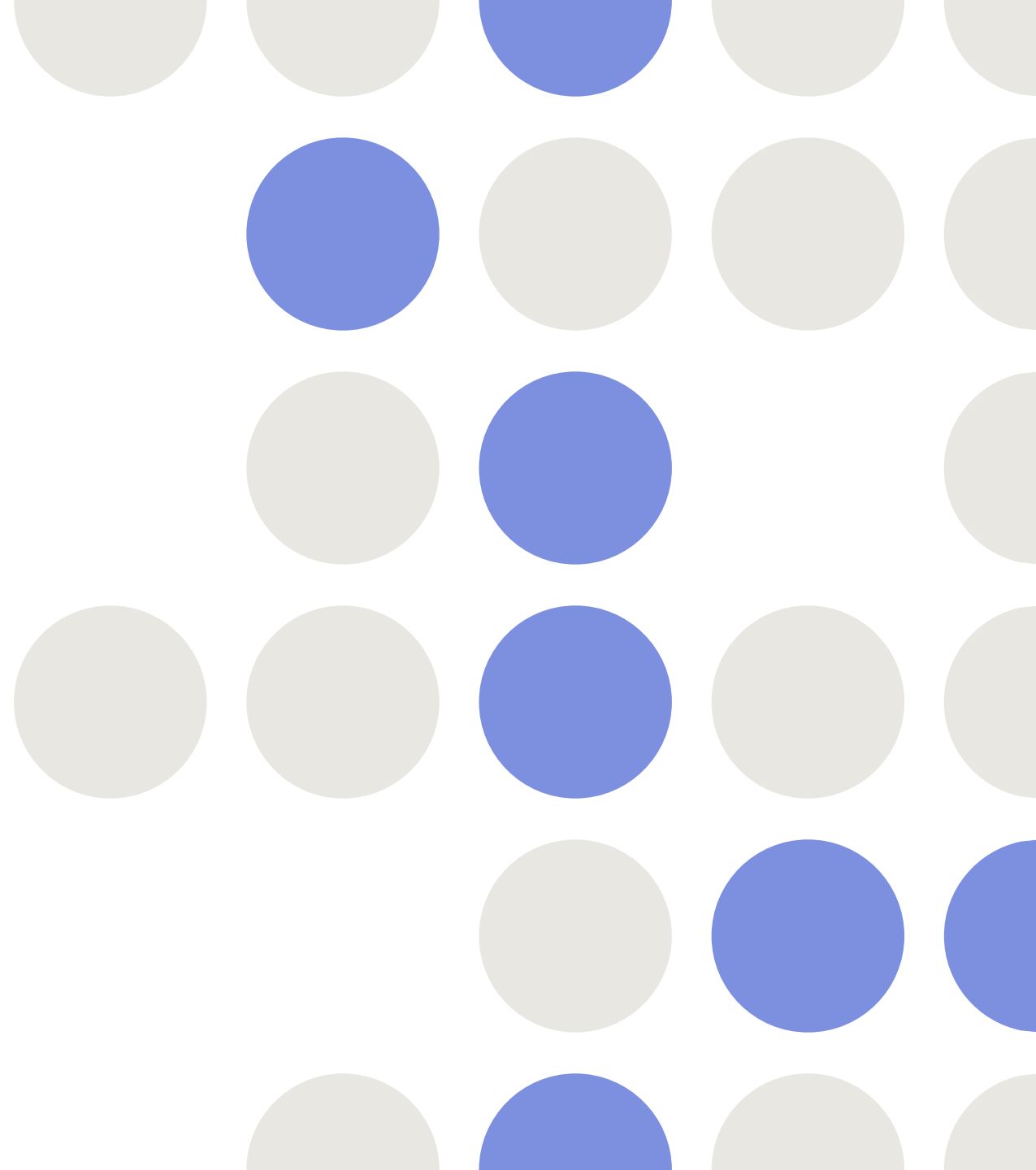
- Even with ISL the routing through the constellation incurs variations

Connection to the same satellite for 100-400 seconds

- Usually make-before-break for the handover

Impact on QUIC?

- No experiments as of yet (at least not public)
 - Some performance aspects
 - Multiple/changing gateways
 - Congestion control impacts
 - End to end connectivity aspects
 - Highlighted in the routing draft
 - ISL help keeping the end points constant
 - Impacts of delay variations
 - May or may not be an issue
 - FEC (or not)
 - LEO connectivity different from (or similar to) mobility
 - User is fixed, satellite moves (fast)
 - Lessons from 5G (discussed in the Han draft)
-



Some questions?

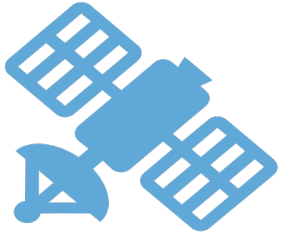


Use QUIC multipath and connection migration when connecting over a LEO?



Will there be enough users to justify specific LEO related changes to QUIC?

Next steps



IETF/IRTF

Plans for a broad-scope satellite tutorial that will include QUIC

The current IRTF draft concentrates on research opportunities mainly routing

- A QUIC specific draft?

Should a “QUIC over Satellite” Transport (sub)group be proposed?

- In the same breath as TCPsat of old
 - Both LEO/GEO impacts to be considered
-



Non-IETF/IRTF

Run experiments with the existing satellites

Specific ETOSAT discussions and activities



marie@mjmontpetit.com
