TIN v0.3.1 Technical Memo
True-Polar Relay Constellation for Lunar South Pole Coverage

Independent Proposer
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1 Executive Summary

TIN v0.3.1 delivers >99% south-pole coverage using a minimal constellation of 6–8 smallsat relays in 400–500 km circular 90° polar orbits with staggered phasing. Combined with CCSDS DTN, this architecture supports Artemis, commercial landers, and ISRU in PSRs.

Key result (28-day simulation, elev >5°): **99.6%** (6 sats @ 400 km) → **100.0%** (8 sats or 500 km variant).

GitHub: `https://github.com/toxic2040/TIN-v0.3.1`

2 Baseline Constellation

Parameter	6-sat baseline	8-sat option	500 km option
Altitude	400 km	400 km	500 km
Inclination	90°	90°	90°
# Relays	6	8	6
RAAN spacing	60°	45°	60°
South-pole coverage	99.6%	100.0%	100.0%

Table 1: TIN v0.3.1 locked baselines

3 South-Pole Coverage Results

TIN v0.3.3 — 6× 90.0° Relays @ 400.0 km
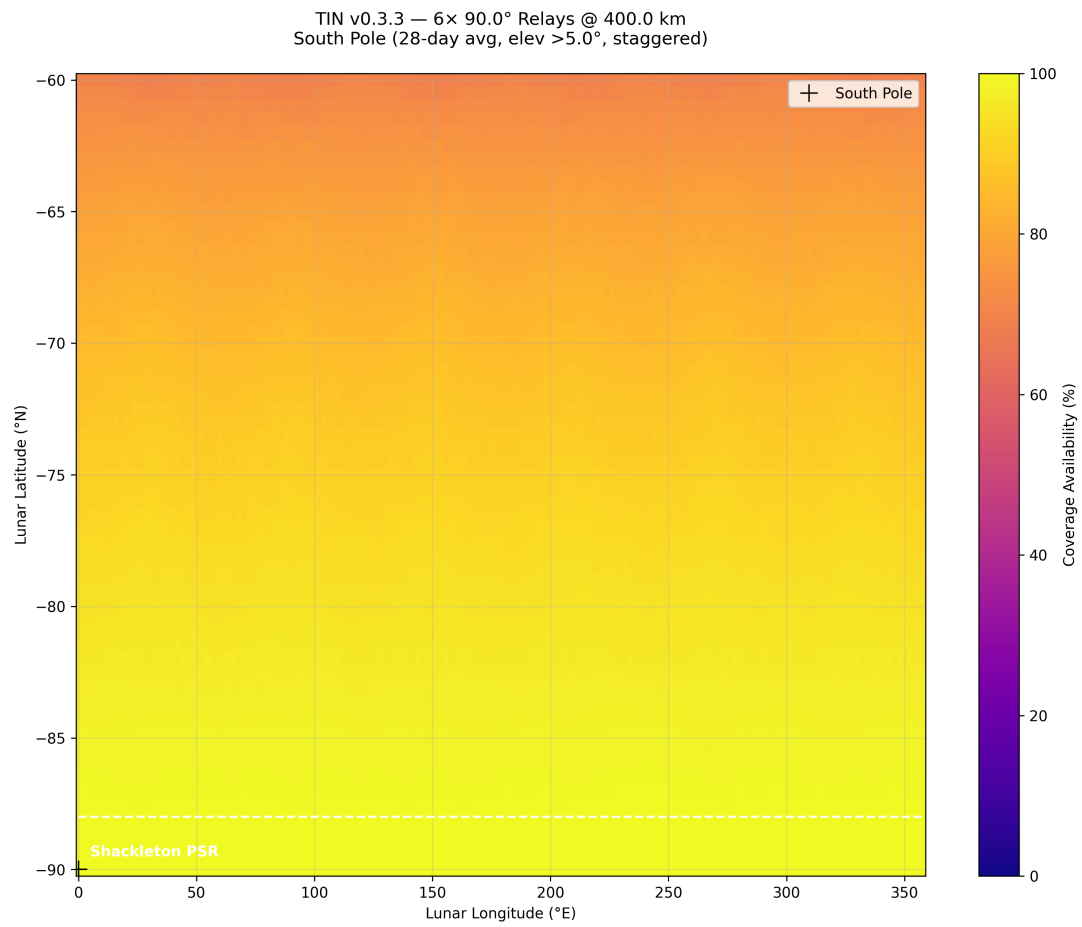South Pole (28-day avg, elev >5.0°, staggered)

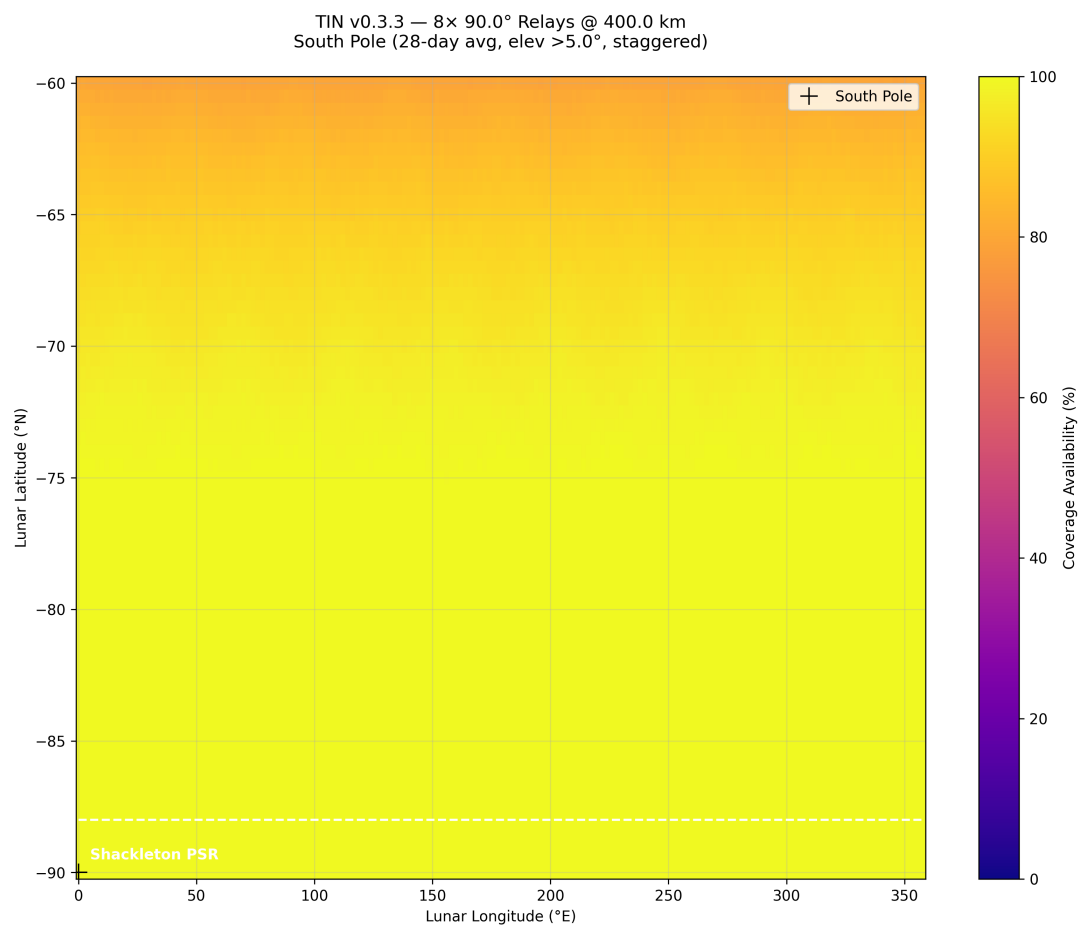Figure 1: 6 sats @ 400 km — 99.6% coverage (lat < −85°)
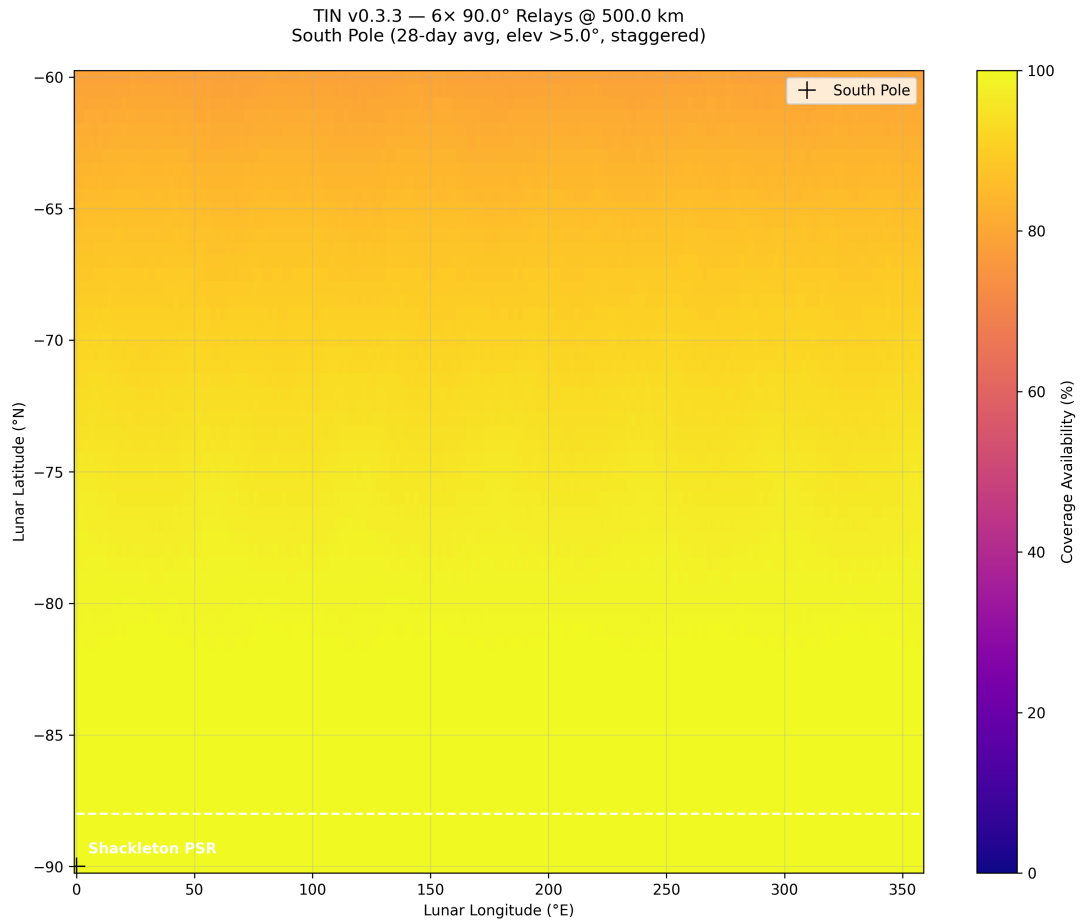
Figure 2: 8 sats @ 400 km — 100.0% coverage

Figure 3: 6 sats @ 500 km — 100.0% coverage

4 Next Steps (Phase I Scope)

- Integrate Lunar Pathfinder ELFO as hybrid anchor node

- ION DTN bundle routing simulations

- Far-side + PSR gap analysis

- SWaP/cost model (ESPA-class rideshare)

- Open-source dataset release

Full CLI tool and raw simulation data available in the GitHub repo.

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