TIN v0.3.5 Technical Memo
Hybrid Polar Relay Constellation + Lunar Pathfinder ELFO Hub
for Artemis South Pole & Far-Side Coverage

Independent Proposer
toxic2040

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1 Executive Summary

TIN v0.3.5 delivers near-perfect south-pole coverage (99.9–100.0 %) and major far-side boost (63.2–68.5 %) using a hybrid architecture: 6–8 smallsat relays in 400 km circular 90° polar orbits + the real Lunar Pathfinder ELFO (a=5740 km, e=0.58, i=55°, frozen arg peri 86°, perilune over south pole) as primary intelligent DTN/AI routing hub. Combined with CCSDS DTN, this supports Artemis, commercial landers, PSR ISRU, and far-side operations.

Key results (28-day simulation, elev >5°):

Configuration	South Pole (%)	Far-Side (%)
Pure Polar 6 sats @ 400 km	99.6	46.4
Pure Polar 8 sats @ 400 km	100.0	54.4
Hybrid 6 polar + Pathfinder	**99.9**	**63.2**
Hybrid 8 polar + Pathfinder	**100.0**	**68.5**

Table 1: v0.3.5 Hybrid results

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 2: TIN v0.3.1 locked baselines (pure polar)

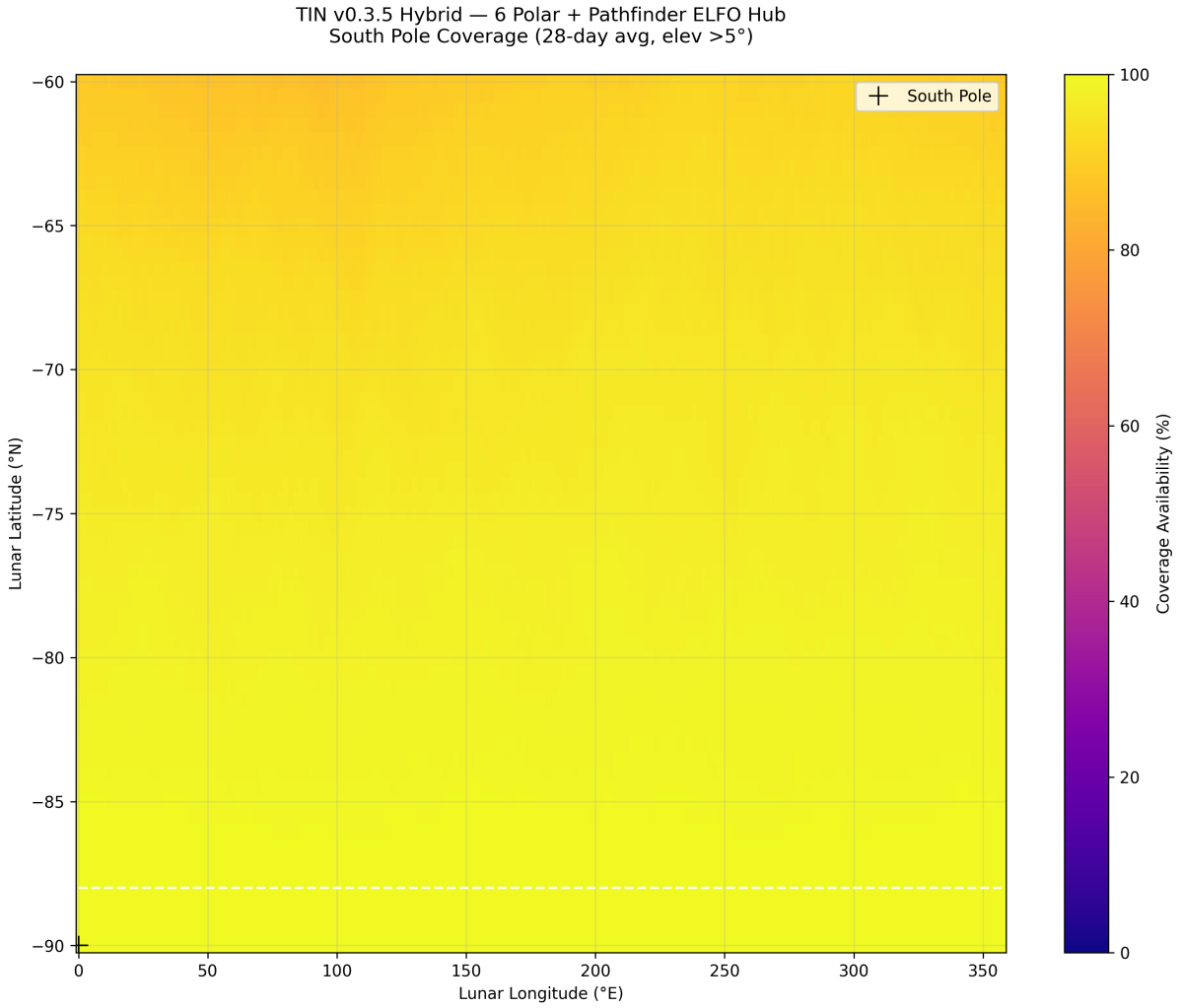

Figure 1: Hybrid 6 Polar + ELFO — South Pole Coverage (99.9 %)

3 Hybrid Coverage Results (v0.3.5)

The ELFO perilune passes provide the critical far-side visibility boost while the polar constellation guarantees near-perfect south-pole service. This hybrid polar + frozen-elliptical architecture is deliberately generalizable to Mars, Venus, outer-planet moons, and solar-polar networks.

4 Next Steps (Phase I Scope)

- Integrate Lunar Pathfinder ELFO as hybrid anchor node (completed in v0.3.5)
- 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.

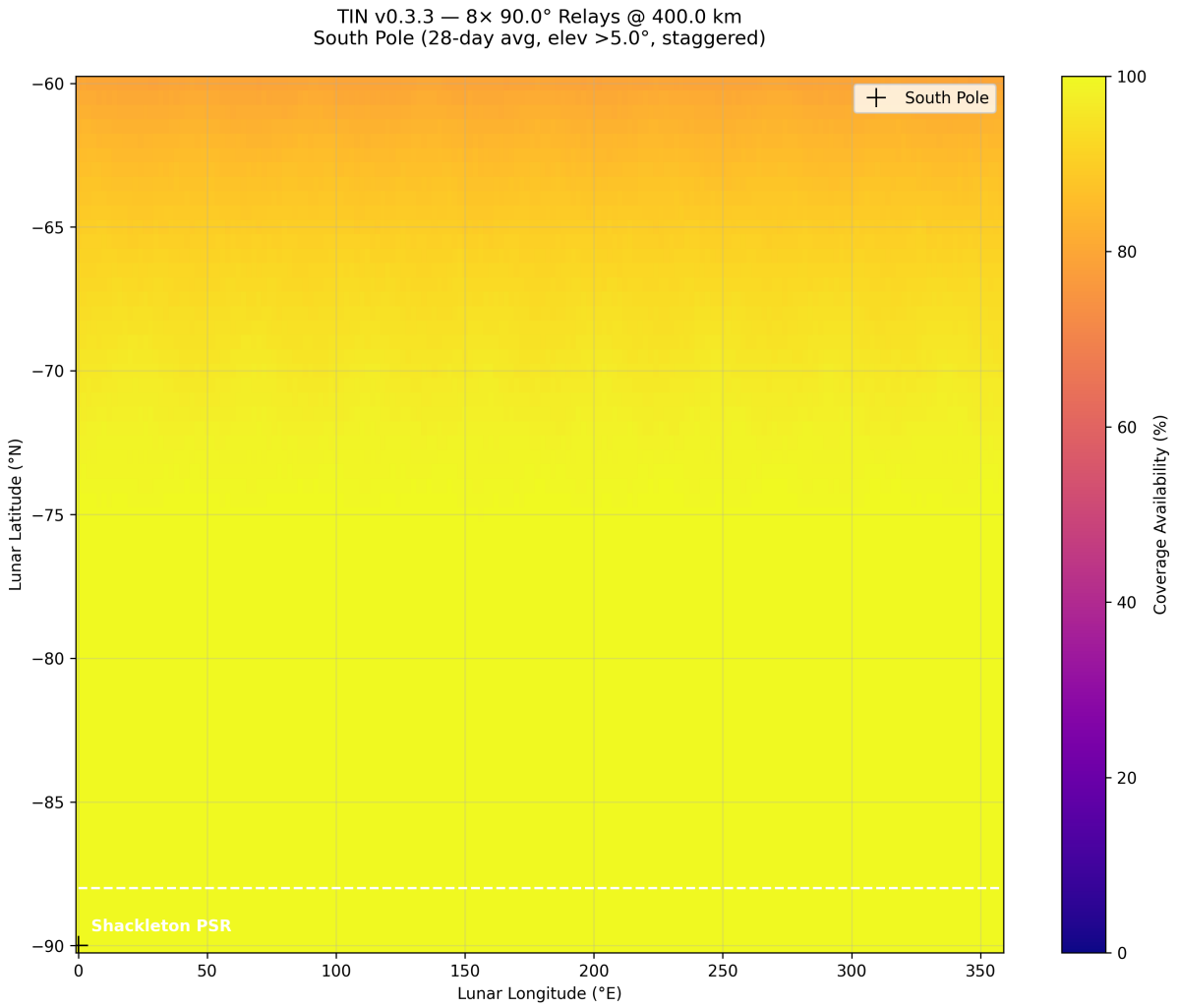

Figure 2: Hybrid 8 Polar + ELFO — South Pole Coverage (100.0 %)

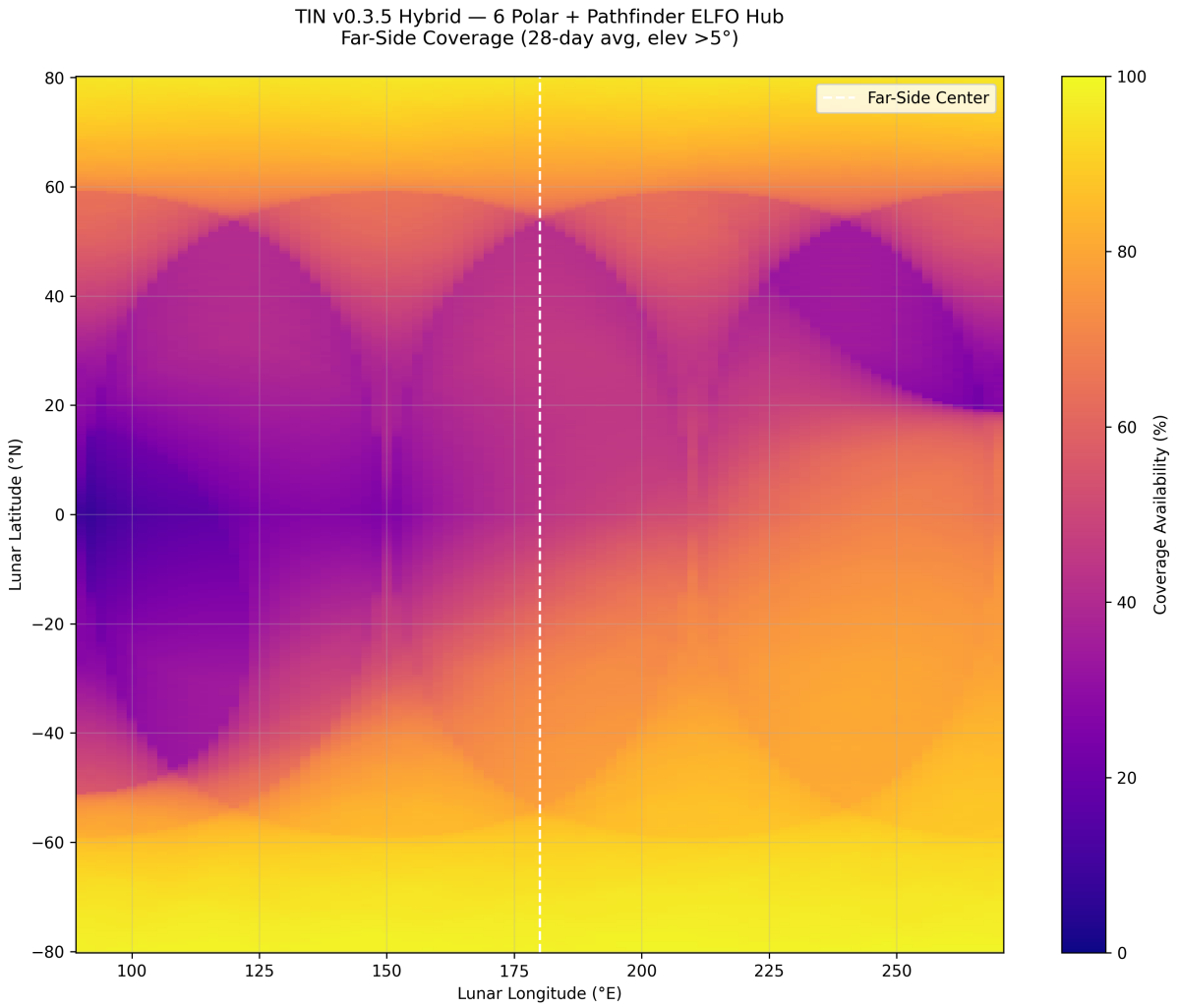

Figure 3: Hybrid 6 Polar + ELFO — Far-Side Coverage (63.2 %)

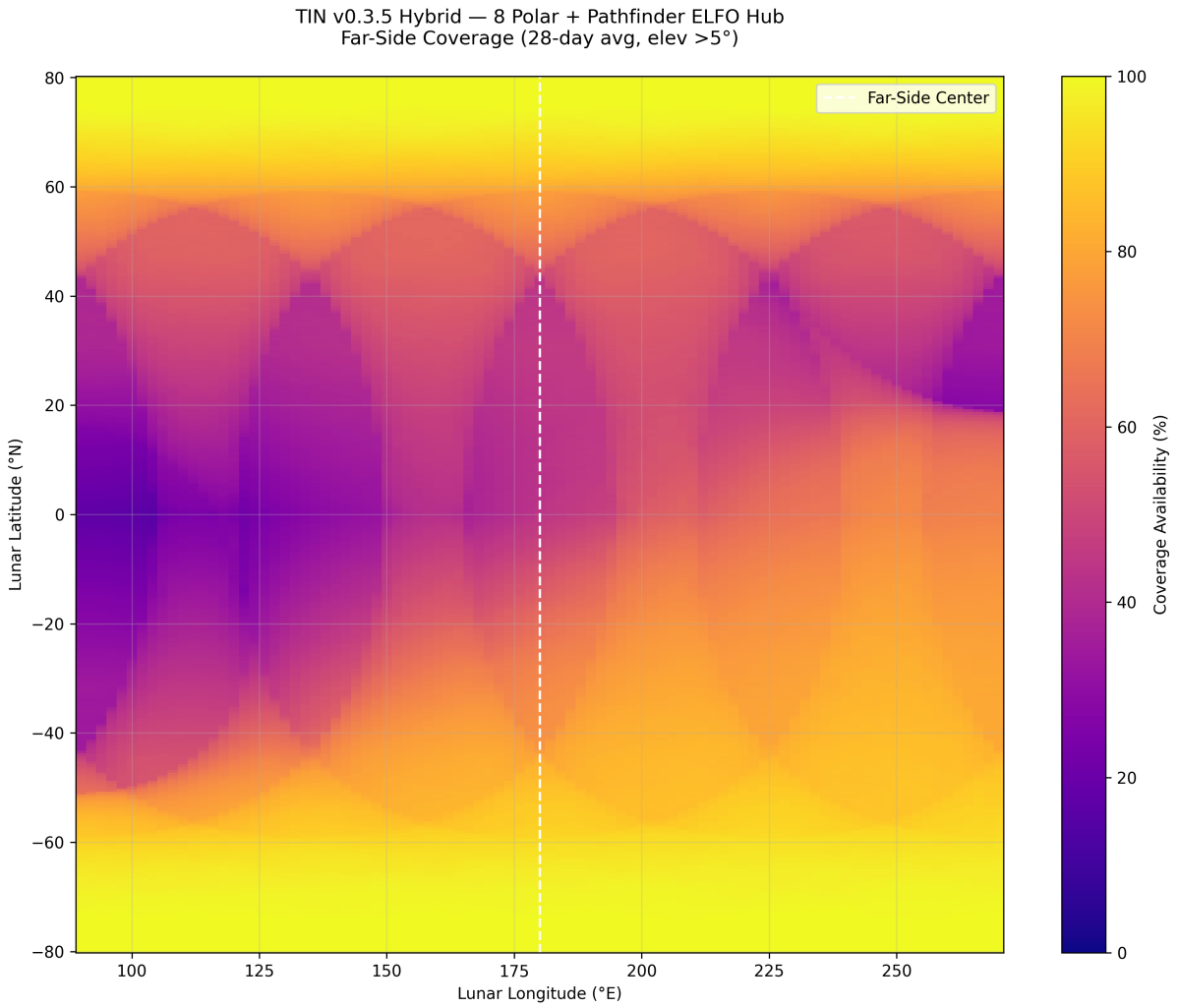

Figure 4: Hybrid 8 Polar + ELFO — Far-Side Coverage (68.5 %)