Draft Policy ARIN-2026-1

Taking IP To Other Planets (TIPTOP)

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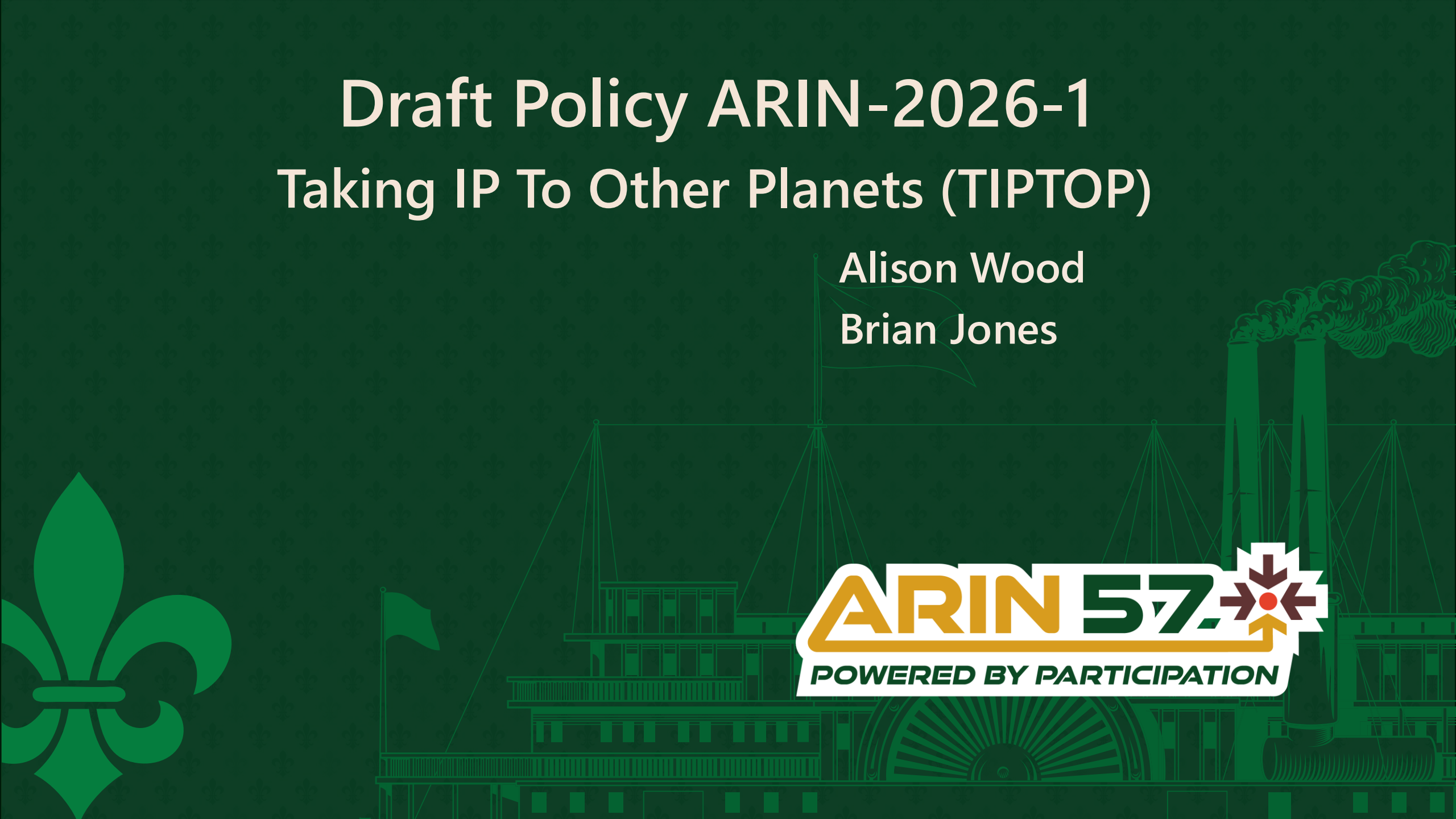

Problem Statement

Current Text (3 March 2026)

Organizations conducting space exploration missions are deploying IP-based networking infrastructure beyond Earth orbit, including on the Moon and in other deep-space environments. These networks currently utilize address space allocated independently from multiple RIRs, including ARIN.

As international missions expand and networks operated by multiple agencies interconnect to share communications infrastructure and provide operational redundancy, the use of unrelated terrestrial address allocations introduces routing scalability concerns. Existing allocations are not aligned with the topology of outer space communications networks, which may require the advertisement of numerous disaggregated prefixes when networks interconnect.

Problem Statement (cont.)

Outer space communications infrastructure is expected to develop around natural clusters near celestial bodies, with limited communication links between those regions. Addressing structures that reflect these topological boundaries could improve route aggregation and long-term routing scalability.

For the purposes of this policy, outer space includes the Moon and regions beyond Earth orbit, but excludes low Earth orbit (LEO) and geostationary Earth orbit (GEO).

Policy Statement

ARIN may allocate IPv4 and IPv6 address space to organizations operating IP networking infrastructure in outer space, including beyond Earth orbit and on the Moon. Allocations are intended to support interagency connectivity, operational redundancy, and scalable routing in emerging space networks.

Addressing structures should be organized hierarchically to reflect major celestial regions—such as the Moon, Earth–Moon Lagrange points, asteroid belt, and other planetary systems—enabling route aggregation where feasible. Participation in aggregation is voluntary, and organizations may advertise more specific prefixes when necessary.

This policy applies to government, research, and commercial space operators, and encourages coordination among agencies to facilitate efficient address usage and scalable routing for outer space networks.

Policy Statement (cont.)

Definitions (Add to NRPM Section 2)

2.xx Extra-Terrestrial Network (ETN) An ETN is defined as any IP-based networking infrastructure operating physically beyond the Geostationary Earth Orbit (GEO) arc, including but not limited to Lunar, Martian, or deep-space deployments.

Policy Statement (cont.)

IPv4 Policy (Add to NRPM Section 4)

4.11 IPv4 Allocations for Extra-Terrestrial Networks ARIN shall maintain a dedicated pool or specific registration guidelines for organizations operating ETNs to ensure routing scalability.

4.11.1 Eligibility: Applicants must demonstrate a direct operational requirement for networking infrastructure located beyond Earth's orbit. Eligible entities include government agencies, research institutions, and commercial operators.

4.11.2 Topological Hierarchy: To prevent global routing table exhaustion, allocations for ETNs should be issued from contiguous blocks where possible, designated by "Celestial Regions" (e.g., Luna, Mars, Lagrange Points).

4.11.3 Utilization Requirements: Standard utilization requirements (Section 4.2.4) apply, but ARIN may grant exceptions for high-latency "cold storage" nodes or orbital relay constellations where traditional "active host" pings are impractical for verification.

Policy Statement (cont.)

IPv6 Policy (Add to NRPM Section 6)

6.12 IPv6 Allocations for Extra-Terrestrial Networks Due to the vast distances and high-latency nature of deep-space communications, IPv6 is the preferred protocol for ETN deployments.

6.12.1 Minimum Allocation: The minimum allocation size for an ETN operator shall be a /48, or a size sufficient to allow for hierarchical subnetting per celestial body.

6.12.2 Planetary Aggregation: Organizations are encouraged to aggregate all prefixes within a specific gravity well or orbital system to a single aggregate route for advertisement back to Terrestrial Ground Stations (TGS).

6.12.3 Sparse Allocation: ARIN will employ sparse allocation techniques within the ETN block to allow for the future growth of lunar and planetary colonies without fragmenting the space.

Policy Statement (cont.)

Comments:

This is being proposed jointly with the IETF TIPTOP working group.

Please see https://datatracker.ietf.org/doc/draft-li-tiptop-address-space/ and https://datatracker.ietf.org/doc/draft-many-tiptop-ip-architecture/ for more details.

History

Action	Date
Proposal	3 March 2026
Draft Policy	24 March 2026

Staff and Legal Review

Staff Understanding: The Draft Policy seeks to establish provisions within the NRPM for the allocation of address space to organizations operating IP networking infrastructure beyond Earth orbit (Extraterrestrial Networks, or ETNs). The Draft Policy introduces definitions, eligibility criteria, and allocation practices intended to support routing scalability through hierarchical addressing aligned with celestial regions.

Staff and Legal Review (cont.)

Specifically, the Draft Policy calls for:

A. Establishment of a dedicated allocation pool or registration guidelines within ARIN for address space used by networks operating in outer space.

B. Introduction of new definitions and eligibility criteria for Extraterrestrial Networks (ETNs) within the NRPM.

C. Development of allocation practices intended to facilitate routing aggregation for deep-space networking environments, including hierarchical addressing aligned with celestial regions.

Staff and Legal Review (cont.)

Per discussion on ARIN-PPML, the Draft Policy appears primarily motivated by concerns regarding current operational practices among space agencies deploying deep-space networking infrastructure. In particular, the Draft Policy seeks to address current use of address space from existing allocations without coordination for long-term routing aggregation across shared deep-space communications infrastructure and to establish a coordinated addressing framework intended to improve routing scalability in such environments.

Staff and Legal Review (cont.)

The Draft Policy amends the NRPM directly and therefore falls within the procedural scope of ARIN's Policy Development Process (PDP). However, it raises several considerations related to clarity, implementability, and alignment with ARIN's role in the Internet number resource system.

Staff and Legal Review (cont.)

The Draft Policy seeks to improve routing aggregation through coordinated allocation practices for ETNs from dedicated, contiguous address blocks reserved for deep-space use. Without such address space, networks built using ad hoc IPv4 and IPv6 allocations would not support meaningful aggregation. Accordingly, the availability and source of dedicated address space are prerequisites for achieving the Draft Policy's stated objectives and should be clearly specified as an underlying assumption of the policy.

Staff and Legal Review (cont.)

The IETF could direct IANA to allocate dedicated address space for this purpose, including coordination with the RIR system for appropriate allocation and registry services for the relevant operational community (including, for example, interim administration by an existing RIR of registry and policy development functions until such time as the establishment of a distinct Internet number registry organization by that community).

Staff and Legal Review (cont.)

While ARIN served a “rest of world” role at the time of its formation (i.e., requests not handled specifically by RIPE NCC or APNIC were handled by ARIN), it is not clear that the ARIN Board would consider ARIN serving as the “default” registry for this purpose, even on an interim basis, to fall within the scope of ARIN’s current mission. If the Board were to determine that providing such services is compatible with ARIN’s mission (e.g., until such time as there is a deep-space Internet Number Registry organization), then ARIN could provide such services pursuant to policy recommended by the community and adopted by the Board. Such a determination would likely depend on both community sentiment and explicit acknowledgment by the other RIRs that such a role is acceptable.

Staff and Legal Review (cont.)

The Draft Policy, as written, presumes that these prerequisite conditions have already been satisfied, and these conditions should be clearly stated in the policy to provide a shared understanding of the circumstances under which the policy could be adopted: (a) that the IETF has determined that a dedicated address block is required; (b) that IANA has allocated appropriate IPv6 and/or IPv4 address space for this purpose and coordinated with the RIRs to provide operational registry services for that space; (c) that the ARIN Board of Trustees has determined that providing such services is consistent with ARIN's mission; and (d) that the other RIRs have concurred with ARIN serving in this capacity.

Staff and Legal Review (cont.)

Due to the complexity of this Draft Policy, active discussions, and necessary confirmations described above, a comprehensive staff review will be necessary once this Draft Policy is further developed.

Staff and Legal Review (cont.)

Implementable as Written?: No

Impact on ARIN Registry Operations and Services: n/a

Legal Review: At this preliminary stage, Legal has identified several areas for further consideration, including potential jurisdictional questions, coordination with other RIRs, and the source of IP resources. Additional clarity in definitions and alignment with the service region model will also be important. These observations are based on the Draft Policy in its current form, and a more comprehensive legal analysis may be provided if and when the Draft Policy is further developed.

Implementation Timeframe Estimate: n/a

Implementation Requirements: n/a

Policy Impact

Minimal impact to current terrestrial allocations

- The policy does not change existing IPv4 or IPv6 allocation practices on Earth.

Establishes a framework for extraterrestrial networking

- Introduces a policy basis for allocating IP resources for non-terrestrial use cases (e.g., lunar, deep space missions).
- Prevents ad hoc or inconsistent addressing practices across agencies and regions.

Improves aggregation and routing scalability

- Encourages topology-aligned addressing rather than agency-by-agency allocations from different RIRs.
- Reduces risk of future routing table sprawl as interplanetary networks interconnect.

Policy Impact

Promotes inter-RIR coordination

- Space missions can be multinational.
- TIPTOP implicitly pushes toward harmonization across RIRs, which could lead to future global policy coordination.

Limited immediate utilization

- Near-term demand is small and specialized (space agencies, contractors).
- No sudden depletion pressure on IPv4 or IPv6 pools.

Precedent-setting

- This is would be the first formal recognition of off-Earth use cases in RIR policy.

Community Feedback

- **Ad hoc allocations**: Agencies are currently selecting IP space for deep-space missions in an inconsistent manner, limiting aggregation and routing optimization.
- **Need for guidance:** A formal framework would provide structure for deep-space allocations while allowing flexibility in network design.
- **Aggregation & topology**: Provider-based allocations support aggregation, but shared topologies introduce complexity and uncertainty.
- **Low risk, potential benefit**: Dedicated deep-space addressing could improve aggregation even if topology assumptions evolve over time.

Community Feedback

Scope and coordination concerns:

- Some feedback suggests this may be better suited as a global policy (NRO NC) rather than ARIN acting independently.
- Others support ARIN proceeding via the bottom-up process, with inter-RIR coordination occurring.
- Authority considerations: Address allocations remain within the existing RIR/ASO framework, not external bodies.
- Establishing policy now could prevent fragmentation and support future multinational space networking.

Questions for the Community

Would aligning address allocations with celestial topology improve routing scalability for interconnecting space-based networks?

Do you see a risk of increased global routing table entries if extra-terrestrial networks continue using disaggregated terrestrial allocations?

What concerns would you want addressed before advancing this further in the Policy Development Process?

Are there any other risks that should be discussed?