(Not yet quite) Proposed

SPACE RG

Systems and Protocol Adaptations for Circumstellar Environments Research Group

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Side meeting 2025-07-23 (Madrid)

https://github.com/irtf-spacerg

Note Well

This is a reminder of IETF policies in effect on various topics such as patents or code of conduct. It is only meant to point you in the right direction. Exceptions may apply. The IETF's patent policy and the definition of an IETF "contribution" and "participation" are set forth in BCP 79; please read it carefully. As a reminder:

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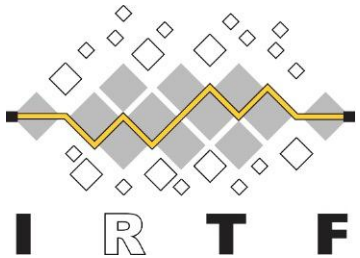
Definitive information is in the documents listed below and other IETF BCPs. For advice, please talk to WG chairs or ADs:

- BCP 9 (Internet Standards Process)
- BCP 25 (Anti-Harassment Procedures)
- BCP 78 (Copyright)
- https://www.ietf.org/privacy-policy/(Privacy Policy)
- BCP 25 (Working Group processes)
- BCP 54 (Code of Conduct)
- BCP 79 (Patents, Participation)



Agenda

- **Agenda and Overview [Juan]** (10 min)
- **Short talks for background** (1 hour)
  - **[Joan Adrià Ruiz de Azúa]** (i2Cat, Spain - 15 min)
    "NTN developments and contributions: from design principles towards in-field demonstrations"
  - **[Andreas Schmidt]** (Saarland University, Germany - 15 min)
    "Computers in Orbit: Green and Efficient?"
  - **[Rick Taylor]** (Aalyria, UK - 15 min)
    "Challenges in Deep Space Networking"
  - **[Michael Menth]** (Tübingen University, Germany - 15 min)
    "Inter-Satellite Routing with Resource-Constraint Forwarding Nodes"
- **New Charter Bashing [all]** (20 min)

Overview

- **Goal**: Investigate **architecture**, **protocol**, **management** and **operational** aspects of "**Aerospace Networks**" (HAPS, LEO, MEO, GEO, Cislunar, Deep-Space).
  - **Characteristics**: Mobility, environment, cost, interoperability.
  - **Challenges**: Fragmented, proprietary, non-standardized, regulatory.
- **Communities**: **Internal IETF/IRTF Groups** and **External Stakeholders**.
- **Contributions**: Technical focus.
  - **Evaluation**: Systematize tools, metrics, and best practices for assessing aerospace networks.
  - **Optimization**: Investigate models and algorithms to improve aerospace network performance.
  - **Systemic**: Explore architectures and interfaces to inform interoperable aerospace protocols.
- **Outcome**: Research **artifacts** (e.g., white papers, datasets, metrics) and **tools** (e.g., scripts, testbed interfaces like LEOscope). *No protocol specifications*.

Charter Bashing

- **Goal**: Investigate **architecture**, **protocol**, **management** and **operational** aspects of several categories of "**Aerospace Networks**".
- **Aerospace Networks**: Nodes in HAPS, LEO, MEO, GEO, Cislunar, Deep-Space.

Characteristics

🚀 **Mobility & Topology Dynamics**

High-speed movement, predictable and opportunistic links, frequent topology partitions.

🔋 **Environmental & Resource Constraints**

Atmospheric disturbances, limited energy, thermal variability, constrained onboard resources.

💸 **Cost & Lifecycle Limitations**

Expensive to deploy, difficult to upgrade, long service lives, robust-by-design constraints.

🧩 **Interoperability Across Domains**

Multi-operator coordination, heterogeneous platforms, administrative boundaries.

Charter Bashing

- **Goal**: Investigate **architecture**, **protocol**, **management** and **operational** aspects of several categories of "**Aerospace Networks**".
- **Aerospace Networks**: Nodes in HAPS, LEO, MEO, GEO, Cislunar, Deep-Space.

Challenges

🌪️ **Solutions remains fragmented and domain-specific.**
Research efforts are dispersed across disciplines, from aerospace to Internet

🔒 **Isolated and handled manually or through proprietary mechanisms.**
Treated as black boxes for the time being.

🚫 **Not engaged in standardization or interoperability efforts.**
Standards development is similarly split across bodies like CCSDS, 3GPP, and IETF

🏛️ **Exposed to emerging political/regulatory questions.**
Governance, sovereignty, and global impact issues are surfacing.

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- **Relevant Communities**: To address these challenges, SPACE RG will engage with:

🏠 Internal IETF/IRTF Groups

DTN WG (Delay-Tolerant Networking),

TIPTOP WG (Cislunar and deep space),

TVR WG (Time-Variant Routing),

PANRG (Path-Aware Networking),

SUSTAIN RG (Sustainability and the Internet),

(Others under formation such as **T4SAT**)

🌍 External Stakeholders

Academia (SIGCOMM, SIGMOBILE, etc.),

Industry (Operators, integrators, vendors),

CCSDS (Consultative Committee for Space Data Systems),

3GPP (NTN-focused working groups),

IPNSIG (Interplanetary Internet SIG).

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- **Initial Contributions**: Technical focus:
  - 🧪 **Evaluation**: Systematizing techniques for **simulation, emulation, and in-orbit testing**. This includes surveying existing *toolchains*, identifying *metrics*, and compiling *best practices*.
    - Based on existing aerospace networks as measurable artifacts or simulations.
    - **Goal**: Assess aerospace networks.
  - ⚙️ **Optimization**: Investigating the **design and optimization**. This includes mathematical *modeling*, *algorithmic* approaches, and *ML* for *scheduling*, *data handling*, and *conops*.
    - Based on hypothetical aerospace networks due to lack of access to operative systems.
    - **Goal**: Improve aerospace network performance
  - 🏛️ **Systemic**: Exploring **architectural models, interfaces, and software paradigms**. This includes *control-plane design*, *data handling*, and *interoperability*.
    - Based on the multiple efforts across IETF WGs, IRTF RGs and external actors.
    - **Goal**: Inform protocols and applications to other IETF WGs and IRTF RGs.

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- **Expected Outputs**:
  - ✅ **Research Artifacts:** These will include white **papers**, Internet-Drafts, living documents (e.g., Wikis), curated **datasets**, configuration parameters, and evaluation **metrics**.
  - ✅ **Tools Artifacts:** These will include **tools** and **scripts** for simulation and measurement, interface with community **testbeds**, and support platforms such as LEOscope.
- **Non-Expected Outputs**:
  - ❌ **Protocol specifications**: While SPACE RG may explore ideas that imply protocol adaptations, it will not propose changes to existing IETF protocols.
- **Other Areas**:
  - 🌐 **Interoperability**: SPACE RG will also look at local interconnectivity obligations, global interoperability, and whether mechanisms like BGP for space should emerge.
  - 🌎 **Externalities**: SPACE RG will also look at growing concerns about impacts on radio astronomy, sovereignty, and sustainability.

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Discussion Notes

https://hedgedoc.cit.tum.de/d2MAWJu0T22un9hMCvuIdA