

Non-Terrestrial Connectivity Solutions (NTCS)

This Amended and Restated Project Group Charter establishes the scope, intellectual property and copyright terms used to develop the materials identified in this Project Group. Only Participants whose Authorized Representative executes this Project Group Charter are permitted to participate in this Project Group in accordance with the TIP Bylaws.

TIP Board of Directors Approval Date: April 28, 2021

Term: The Project Group shall commence on the date this Charter is approved by the Board ("**Formation Date**") and shall terminate automatically one year from the Formation Date unless the TIP Board of Directors votes to extend the Term for a subsequent 1-year term. The TIP Board of Directors may extend the Term an unlimited number of times.

1. PROJECT GROUP NAME AND TYPE

NAME: Non-Terrestrial Connectivity Solutions

TYPE: Product Group

2. OBJECTIVES

This project group aims to collaboratively define non-terrestrial connectivity solutions that will result in lower total-cost of ownership for network operators and simplify the integration and interoperability of non-terrestrial connectivity platforms within or alongside terrestrial 3GPP networks. The project group will focus on developing solutions that mainstream support for non-terrestrial connectivity platforms within the 3GPP architecture, referencing emerging standards for non-terrestrial connectivity for 5G in Release 17, in order to leverage 5G's mass-market production, distribution, and software ecosystems.

3. PROJECT GROUP SCOPE

This project group aims to accelerate the development and deployment of open, disaggregated, multi-waveform 5G non-terrestrial connectivity solutions through the development of specific Deliverables as defined in Section 4.

The Deliverables will set forth the guidelines and requirements for implementing and testing products in connection with the Deliverables. This project group is not focused on developing interface specifications. Any change of Scope would require a recharter of this project group

The group intends to define, build, test, and support the issue of TIP badges for two solutions and their associated interfaces. The group's activities will include:

3.1 Solution: Network Backend for Non-Terrestrial Connectivity

The 5G Service Management & Orchestration (SMO) layer for 3GPP Release 17 based networks will need support for directing the physical link topology, routing, and radio resource management of non-terrestrial, mobile IAB networks that may include mechanically steered, highly-directional beams. This motivates the development of non-real-time and near-real-time Radio Intelligence Controller (RIC) implementations based on Temporospatial SDN to address new requirements:

- Some network resources (i.e., a millimeter wave beam) may be dynamically reconfigured to participate in a point-to-point backhaul link or to provide radio access coverage.
- The RIC will not be able to rely solely on empirical channel state information because it will not exist for hypothetical / candidate link direction vectors. A RIC that supports non-terrestrial connectivity must be able to leverage a digital twin representation of the wireless signal propagation environment in order to reason about hypothetical links.
- Space and time. While terrestrial nodes and geostationary satellites are both fixed in Earth's reference frame, HAPS, LEO, and MEO satellites are all constantly in motion relative to the Earth's frame. The slew times of directional apertures may be non-trivial and necessitate that a non-real-time RIC be able to utilize the digital twin to model and predict upcoming signal fades, geometric obstructions, or other constraints and reconfigure the access and backhaul networks to avoid user plane outages.
- The network may need to fall back to mobile ad-hoc network routing protocols for resilience to unpredictable mobility or link/weather outages.

The 5G Core Network will also need to support internetworking with untrusted, non-3GPP access networks, such as DVB and Link 16.

3.2 Interface(s): O-RAN and SDN for Non-Terrestrial Connectivity

We anticipate that O-RAN ALLIANCE interfaces (e.g., O1, A1, E2) and SDN interfaces (e.g., OpenFlow, P4), may need to evolve to support non-terrestrial connectivity use cases and requirements. This project group will define requirements to be referenced by collaborating organizations and participate in test & validation of revised interfaces.

3.3 Solution: Base Stations for Non-Terrestrial Connectivity

5G Non-Terrestrial Networking (NTN) in 3GPP Release 17 made Peak-to-Average Power Ratio (PAPR) and other enhancements intended to enable 5G NR waveforms to be used as the air interface to fixed wireless terminals or mobile UEs from HAPS, LEO, MEO, or GEO satellite platforms. The use cases and requirements of network operators may motivate 5G RAN vendors or open source projects to prioritize the implementation of subsets of the air interface.

Meanwhile, most High Altitude Platform Stations (HAPS) operate at low enough altitudes to also support direct-to-handset or direct-to-fixed-terminal connectivity from the stratosphere using the 4G air interface. Lab testing, plugfests, and field trials of 4G payloads, UEs, CPEs, and Non-Standalone (NSA) interoperability with the 5G Non-Terrestrial Service Management, Orchestration, and Core Network may also be pursued by the project group for this use case.

4. PROJECT GROUP ROADMAP AND DELIVERABLES

TIP may develop up to four types of Deliverables: Documents; Test Materials; Software; and in rare instances, Specifications. Intellectual Property Rights for each type of Deliverable are governed by a different policy or agreement, in each case approved by the TIP Board of Directors. The applicable policies or agreements are specified in the table below along with any procedures for approval and/or release of each Deliverable the Project Group intends to develop. All such policies and agreements may be found with TIP's Organizational Documents at: <https://telecominfraproject.com/organizational-documents/> unless otherwise identified **and attached** to this PG Charter. No Project Group may develop Software without forming a separate Project Group using the TIP Software Project Group Charter Template.

Deliverable	IPR Treatment	Approval Procedures
Use Cases	Document IPR Policy	Version(s) by consensus of the PG. Final approval by Technical Committee
Requirements Document(s)	Document IPR Policy	Version(s) by consensus of the PG. Final approval by Technical Committee

Test Materials (Test Scripts and Plans, Test Reports, Test Summaries, etc.)	Document IPR Policy	Versions by consensus of the PG or in the Lab or Field; final approval by the TC
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Contributions to Deliverables and any license to use the Deliverable upon its finalization are governed by TIP’s Organizational Documents which may be accessed [here](#). The IPR policies and agreements referenced below are TIP Organizational Documents unless otherwise specified and attached to this Charter.

Schedule and Milestones

Project Group Schedule and Milestones

Deliverable	Scope	Date
Use Cases Document	Non-Terrestrial Connectivity Use Cases	Q2 2021
Requirements Document	NTC Base Stations with 5G NTN Air Interface	Q3 2021
Requirements Document	NTC Base Stations with 4G Air Interface (for HAPS)	Q2 2022
Requirements Document	NTC Network Backend MVP	Q4 2021
Requirements Document	NTC Network Backend <> Base Station Interface	Q4 2021
Requirements Document	NTC Network Backend <> non-3GPP Internetworking	Q1 2022
Requirements Document	NTC Control & Management Interface	Q4 2021
CI Test Suite	NTC Base Stations > Northbound Interface	Q4 2022
CI Test Suite	NTC Network Backend > Southbound Interface	Q4 2022
CI Test Suite	NTC Network Backend N3iWF <> DVB Hub	Q2 2023
CI Test Suite	NTC Network Backend N3iWF <> Link 16	Q2 2023

The project group will work backwards from mid-2023 as a target date for field trials to plan the group’s proposed scope of work and deliverables. Proposed deliverables include:

Use Case Documents

Use case documents will capture operators' needs as an input to the product roadmap:

- Altitudes, orbital regimes (HAPS, LEO, MEO, GEO), and non-terrestrial terminals
- Regenerative vs. transparent (bent-pipe) payloads and inter-vehicle links
- Air interfaces (3GPP vs. non-3GPP) that must be supported for each use case
- Mechanically steered vs. electronically steered apertures and beam hopping
- Contested environments and security considerations

Requirements for Service Management, Orchestration, and Core Network

“Minimum viable” product requirements will be published by this workstream for a **network backend** that supports the service management & orchestration of 5G networks and 5G core network functions. This workstream will also develop the requirements for **non-3GPP access internetworking** with this network backend to support DVB and Link 16 air interfaces.

Requirements for Network Control & Management Interfaces

This workstream will develop **network control and management interface** requirements for non-terrestrial connectivity use cases. This requirements document may motivate changes to Open Core Network (OCN) orchestration; OpenRAN Radio Intelligence & Automation and associated O-RAN ALLIANCE interfaces, such as O1, A1, E2; NGFI for fronthaul; or SDN D-CPI interfaces, such as OpenFlow or P4.

Requirements for Base Stations

“Minimum viable” product requirements will also be published for:

- **4G eNB base stations** capable of interfacing with a non-terrestrial-connectivity-capable network backend (for altitudes <104 km)
- **5G gNB base stations** capable of providing the air interface for links to/from HAPS, LEO, MEO, or GEO satellite constellations based on the 5G NTN NR waveform. Some requirements may be conditional on the relevance of Integrated Access & Backhaul (IAB) to the use cases.
- **non-3GPP base stations** that interface directly with the network backend.

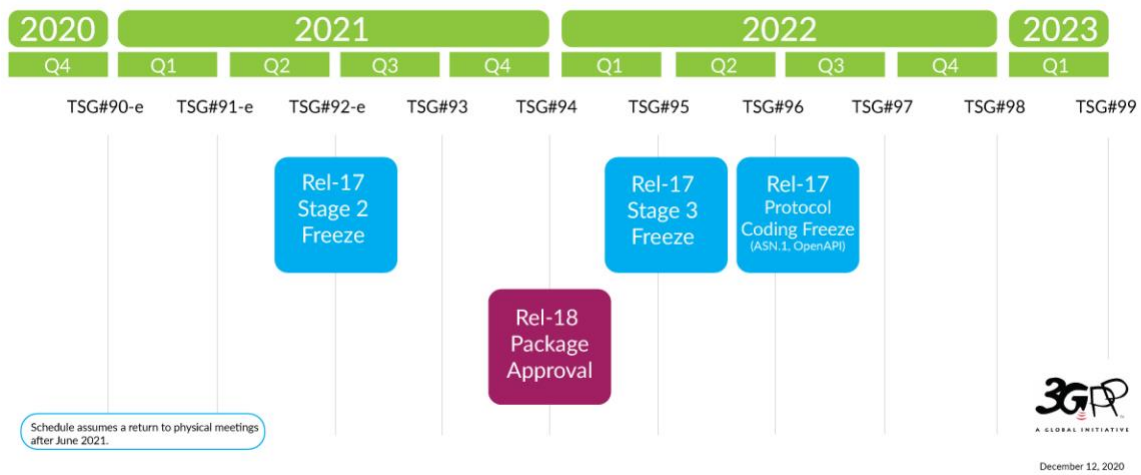
The project group would **translate requirements into system-level black box Continuous Integration tests** that can plug into their workflows and be run as a service against participants' solutions (e.g. via GitHub Actions). Some tests will be software-only tests, and other tests will run as Hardware-in-the-Loop (HWIL) tests hosted in TIP community labs.

The project group participants may also collaborate on contributions to open source software projects to accelerate development and integrate testing against requirements. The group will not develop any source code.

This project group is not focused on developing aerospace platforms. In addition, the project group is not focused on developing interface specifications. Any change of Scope would require a recharter of the project group.

Alignment to 3GPP Schedule for Release

The 3GPP schedule for 5G Release 17 calls for a freeze on functionality in June 2021, a protocol freeze in March 2022, and a ASN.1 + Open API coding freeze in June 2022. Given that the 5G Release 15 coding freeze (for NSA) occurred in March 2018, and the first commercial 5G Release 15 deployment occurred approximately one year later, it’s likely that this project will take until mid-2023 before we see real-world field trials and commercial deployments.



Source: <https://www.3gpp.org/release-17>
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5. FOR DELIVERABLES WHICH ARE SPECIFICATIONS*

___ Check if the PG is developing Specifications as defined in the TIP IPR Policy. All such Specifications must be listed in the table set forth in Section 4 and the IPR Treatment must reference this Section 5.

[If not checked, the remainder of Section 5 should be left blank]

PATENT LICENSING

The patent license for all Contributions, Draft Specifications, and Final Specifications within this Project Group shall be:

___ RAND License Option, as set forth in Section 5.2.1 of the Telecom Infra Project IPR Policy.

___ Royalty-free License Option, as set forth in Section 5.2.2 of the Telecom Infra Project IPR Policy.

FINAL SPECIFICATION COPYRIGHT LICENSING

Each PG Contributor as defined in the TIP IPR Policy agrees that to the extent that its Contributions are incorporated into the Final Specification it hereby grants TIP a copyright license in its included Contributions to release those included Contributions as incorporated into the Final Specification under the terms indicated below.

[Check one box]

- Option 1 as set forth in the TIP Supplemental Copyright Policy.
- Option 2 as set forth in the TIP Supplemental Copyright Policy.
- Creative Commons Copyright Attribution 4. See <http://creativecommons.org/licenses/by/4.0/legalcode>.
- Full Release of Copyright into the public domain.

**THIS SECTION 5 IS NOT APPLICABLE FOR ANY OTHER TYPE OF DELIVERABLE*

6. PROJECT GROUP LEADERSHIP

CHAIR AND CO-CHAIRS

- Jerome Soumagne, Inmarsat
- Alexander Geurtz, SES Networks

7. PARTICIPATION CRITERIA

Eligible to Sponsors and General Participants who have elected to be Full Participants and are in good standing.

A TIP Participant who wishes to participate in this PG must have its TIP Authorized Representative submit an application at <https://member.telecominfraproject.com/get-started>. The TIP Authorized Representative is the individual identified in the applicable Participant's General Participation Agreement.

No Participant shall be a participant of this PG until and unless TIP notifies the applicable Authorized Representative in writing that the application submitted by such Authorized Representative has been approved by TIP.

8. CHARTER UPDATE

This Project Group Charter will be updated to reflect any changes as set forth in the Project Group Charter Revision Policy which may be accessed at https://cdn.brandfolder.io/D8DI15S7/as/q7rnyo-fv487k-2j33tl/Project_Group_Charter_Revision_Policy_-_Telecom_Infra_Project.pdf.

9. COLLABORATION AND COOPERATION

The group will be structured and managed as a single Project Group, with the option to create additional sub work streams as appropriate to meet community needs.

EXTERNAL INDUSTRY COLLABORATION

The group will leverage existing 3GPP standards and collaborate with other projects and open source foundations, as appropriate, such as:

- European Space Agency
- HAPS Alliance
- Open Network Foundation
- OpenAirInterface Software Alliance
- Magma Core Foundation

INTERNAL TIP COLLABORATION

The NTCS project group will collaborate with other TIP project groups as necessary.

- TIP OpenRAN Project Group
 - The Non-Terrestrial Connectivity Solutions Project Group may reference the OpenRAN Project Group deliverables
 - The Non-Terrestrial Connectivity Solutions Project Group may offer requirements to the OpenRAN Project Group
- TIP Open Core Network (OCN) Project Group
 - The Non-Terrestrial Connectivity Solutions Project Group may reference OCN Project Group deliverables
 - The Non-Terrestrial Connectivity Solutions Project Group may offer requirements to the OCN Project Group

The project group may also review draft versions of requirements with other TIP project groups, as deemed appropriate and necessary by the co-chairs.

ACCEPTANCE

Contact Name

Contact Title

Email Address

Telephone Number (Include Country Code)

Company Name

Company Address, City, State, Country, Postal Code

Company Web Page URL

Primary services or products the company provides

Signature

Date

Signed by (print name)