CTBTO PREPARATORY COMMISSION | preparatory commission for the comprehensive nuclear-test-ban treaty organization

REQUEST FOR EXPRESSION OF INTEREST

To: ALL BIDDERS

CTBTO Ref. No.: **2025-0081/ROTTE** SR
(PLEASE QUOTE ON ALL COMMUNICATIONS)

Tel. No.: +43 (1) 26030-6350
E-mail: procurement@ctbto.org

Date: 30 May 25

Subject: The Commission's Global Communications Infrastructure IV

Deadline for Submission: 30 Jun 25 ***Vienna Local Time:*** 17:00

The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (hereinafter referred to as the 'Commission') hereby invites you to submit a response that meets the requirements of the attached documents.

You are kindly requested to complete and return the acknowledgement form by email as soon as possible.

If you have any questions you should contact the email address indicated above.

Yours Sincerely,

Sally Alvarez de Schreiner
Chief, Procurement Services Section

CTBTO PREPARATORY COMMISSION | preparatory commission for the comprehensive nuclear-test-ban treaty organization

ACKNOWLEDGEMENT FORM

R-EOI No: 2025-0081 ***Title:*** Request for Expression of Interest (EoI) for the Commission's Global Communications Infrastructure IV	***Closing Date:*** 30 Jun 25 ***Vienna Local Time:*** 17:00

Procurement Staff: Rotte ***CTBTO Req. No.:*** 10027179

Please complete 'A' or 'B' or 'C'
and Return

WITHIN FIVE (5) DAYS

THE PREPARATORY COMMISSION FOR THE
COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION (CTBTO)

by email to
procurement@ctbto.org

A: We shall submit our response

Company Name: _____

By: _____ Contact Name: _____
(date)

Email/Tel: _____

B: We may submit and will advise

Company Name: _____

By: _____ Contact Name: _____
(date)

Email/Tel: _____

C: We will not submit a response for the following reason(s)

___ our current workload does not permit us to take on additional work at this time;
___ we do not have the required expertise for this specific project;
___ insufficient time to prepare a proper response;
___ other (please specify) _____

Company Name: _____

Contact Name: _____

Email/Tel: _____

INSTRUCTIONS FOR PREPARATION AND SUBMISSION OF EXPRESSIONS OF INTEREST

Ref.: R-EOI NO. 2025-0081/ROTTE

1. BACKGROUND

The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (the "Commission" or "CTBTO") with its headquarters in Vienna is the International Organization mandated to establish the global verification system foreseen under the Comprehensive Nuclear-Test-Ban Treaty (CTBT), which is the Treaty banning any nuclear weapon test explosion or any other nuclear explosions. The Treaty provides for a global verification regime, including a network of 321 stations worldwide, an International Data Centre with a communication system receiving data from/to the IMS Stations via the Global Communications Infrastructure (**GCI**) and on-site inspections to monitor compliance with the Treaty. More information about CTBTO can be found at www.ctbto.org.

The GCI plays a key role in securely transmitting IMS data and verification reports. It is designed to be cost-effective, highly available, and globally interconnected, linking IMS facilities with the IDC in Vienna and National Data Centres (NDCs) operated by Member States. This infrastructure ensures the reliable flow of data necessary to monitor nuclear test explosions. The GCI is therefore an essential component of the systems that make up the verification regime, which ensures the timely and secure transmission of IMS data and related products.

To operate GCI, the Commission has awarded contracts to contractors responsible for the operation and maintenance of the GCI communication links across the network. Since 1998, there have been 3 GCI contracts awarded, and the number of sites connected to the GCI network has grown to 273 sites to date under the third generation of the GCI (GCI III). This network also includes 10 independent subnetworks (ISN) and 6 communication links to the Antarctic, all operated by Member States, but connected to the GCI via interfaces operated and maintained by the GCI contractor. This network is designed to receive raw data from the 290+ active IMS stations and transmit raw data and data products to NDCs of Member States using a variety of technologies. Additionally, the GCI network provides the ability to operate and maintain stations remotely by allowing remote command and control by station operators. More details can be found in the Project Synopsis provided hereto as Annex B.

The contract for the next generation of the GCI (GCI IV) is planned for 2027/2028, henceforth the Commission is seeking market information in preparation for the next steps for the project.

2. REQUEST FOR EXPRESSION OF INTEREST (R-EOI)

(a) Suppliers are invited to express interest (EOI) in response to this R-EOI and as provided herein below. The market response to this R-EOI shall serve as a tool for the Commission to:

- Advance its knowledge of innovative technologies and solutions available in the market that could be employed for GCI IV. Generic, non-proprietary technical information obtained from EOIs may be considered in the development of the Commission's Terms of Reference for the solicitation for the GCI-IV;
- Identify potential sources of supply and prospective suppliers available in the market;
- Obtain and understand today's pricing structure and cost drivers of the required goods and services. No such information provided by suppliers in response to this R-EOI will serve as a commitment and/or be carried forward to any potential future solicitation(s).

(b) This R-EOI consists of the following documents:

- Letter of Invitation
- These Instructions for preparation and submission of EOIs and its annexes:
  A. Format and Content of the EOI - Response Table
  B. Project Synopsis

3. RESPONSE TO THE R-EOI

3.1. Content of the response

Interested qualified suppliers with relevant experience, technical and professional capability are invited to submit their EOI by providing a response to each of the queries included in the attached **Annex A "Format and Content of the EOI - Response Table**" based on the information provided in **Annex B "Project Synopsis"**, on the following:

(a) Company Information;
(b) Technical Information/Solutions;
(c) Indicative pricing structure and cost drivers.

The EOI may include any other relevant data and/or documentation in addition to what is requested in Annex A "Format and Content of the EOI - Response Table". Availably and/or potential preliminary design, available solutions or examples can be also provided, however, catalogues, marketing or commercial documentation should be avoided, unless intrinsically necessary for the supplier's response to this R-EOI.

Following the R-EOI closing date, the Commission reserves the right to request suppliers to provide any additional information or documentation and to verify the information provided in response to this R-EOI.

3.2. Submission of the EOI

The EOI shall be submitted in the English language and in electronic format to the email address:

procurement@ctbto.org

The subject of the email and the submission documents shall be clearly marked as:

"EOI 2025-0081/ROTTE - GCI IV"

The EOI must be received by the Commission as per above, no later than the date and time indicated in the Letter of Invitation.

4. SUPPLIERS' REQUESTS FOR CLARIFICATIONS

Suppliers' requests for clarifications must be in writing and submitted in the English language to procurement@ctbto.org with subject "R-EOI No. 2025-0081/ROTTE – Request for clarifications".

Questions raised by any supplier and related answers from the Commission will be sent to suppliers showing interest in responding to this R-EOI and posted on the websites of the Commission and of the United Nations Global Marketplace in the form of clarifications. The Commission will not disclose the name of the supplier(s) raising the question(s).

Except in the case of responding to a query from the Commission, no supplier shall contact the Commission on any matter relating to the EOI or this R-EOI after the R-EOI closing date.

5. ELIGIBLE GOODS AND SERVICES

The goods and services for this project shall have their origin in the States Signatories of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), the list of which is provided on the webpage: CTBTO States Signatories. For purposes of this paragraph, "the origin" means the place from where the materials, goods and from which the services are supplied.

6. GENERAL PROVISIONS

(a) This R-EOI does not constitute a solicitation and therefore is not a solicitation for quote, bid or proposal, nor does it form a commitment by a party in this R-EOI therefore, this R-EOI does not commit the Commission to proceed with a procurement process and/or contract as a result of this process.

(b) Any EOI submitted will be regarded as such for the purpose described herein above and not as an acceptance by the supplier of an offer made by the Commission.

(c) This R-EOI is not exclusive. The Commission reserves the right to approach suppliers and accept information through means other than this R-EOI. Any solicitation for this requirement that may be issued at a later stage will not be restricted to suppliers that respond to this R-EOI and replying to this R-EOI does not guarantee that a supplier will be approached by the Commission in the next steps of this procurement (if applicable) or otherwise.

(d) The Commission reserves the right to change or cancel this R-EOI or the requirement hereunder at any time during the R-EOI and/or solicitation process.

(e) The outcome of the Commission's considerations related to the EOIs received will not be disclosed to suppliers.

(f) Nothing herein or related hereto: (i) shall be deemed a waiver or any agreement to waive any of the privileges and immunities of the Commission, or (ii) shall be interpreted or applied in a manner inconsistent with such privileges and immunities.

(g) Suppliers shall adhere to the highest ethical standards including, if applicable, throughout any additional steps in the procurement process that may follow this R-EOI. Suppliers that wish to work with the Commission or already conduct business with the Commission are required to adhere to the UN Supplier Code of Conduct, which can be found at UN Supplier Code of Conduct. For more information, please refer to our website under https://www.ctbto.org/work-with-us/procurement.

(h) All costs and expenses incurred in relation to, or ensuing from, the preparation and/or submission of the EOI will exclusively be borne by the supplier. The submission of the EOI and a procurement selection process (if applicable) will not be subject to claims for financial compensation of any kind whatsoever.

(i) Any subsequent procurement activity, including any ensuing contract, will be subject to the Commission's General Conditions of Contract and qualification and eligibility assessment as may be provided for in such solicitation documents.

(j) All documentation and information contained in this R-EOI are proprietary to the Commission and shall not be duplicated, used or disclosed –in whole or in part- for any purpose other than to respond to this R-EOI or otherwise without prior written agreement of the Commission. |

ANNEX A: FORMAT AND CONTENT OF THE EXPRESSION OF INTEREST (EOI) RESPONSE TABLE

Ref.: R-EOI No. 2025-0081/ROTTE - Commission's Global Communications Infrastructure IV (GCI IV)

Item	Minimum Content	Response Included in the EOI		Response/Indicate the relevant section in your EOI
		YES	NO	
1 Executive Summary	• An overview of the response			
2 Experience, Resources and Project Management				
2.1 Corporate Profile and Values	• Background of company, yearly turnover, corporate structure and ownership, family tree of the company, size, location, number of years in the business of providing relevant services. • If a consortium, relationship between the members, including a clear definition of the roles; • Industry Standard certifications held; • Any other corporate information such as Environmental, Social and Governance initiatives and/or policies, etc..			
2.2 Corporate Experience	• Experience in managing and executing work of similar scope and complexity; • Experience in managing and executing work in the public sector, including Public International Organisations. • Experience in executing complex deployments in remote, logistically challenging, and potentially sensitive environments. This includes conducting on-site surveys, managing civil works as part of the migration plan, ensuring adherence to local site security protocols, obtaining access permits and liaising with relevant authorities, etc.			
2.3 Quality Management	A description of the Quality Management approach employed for these types of global network services; Relevant Quality Assurance certifications, if any.			
2.4 Risk Management	Risk management approach, in particular, of the major risks that may arise in performing these types of services and a description of how these risks could be managed. The EOI			

	should take into account the approach for risks identification, analysis, evaluation, monitoring and mitigation.
2.5 Project Management	Project Management approach and details about project management methodology used for such projects (e.g. PRINCE2 or equivalent), if available.
3 Qualifications of the Respondent	
3.1 Certifications	Availability of ISO 9000 certification or equivalent and any other certifications relevant to this industry.
4 Vendor Registration	Complete the Commission's Supplier Registration Form (https://www.ctbto.org/resources/for-researchers-experts/vendor/request-for-data)
5 Innovative technologies or designs available in the market	
5.1 High Level Understanding of the Project	A short description of the understanding of the requirements in the Project Synopsis. How do you understand this Project?
5.2 Technologies	A high-level outline of the technologies and solutions considered to most effectively address the described requirements; outline the benefits and drawbacks of each technology and their relevance to the GCI network. NOTE: Any global telecommunications service licensing considerations related to the technologies or solutions described are of particular interest to the Commission. Any past projects of the company showcasing the successful deployment of the technologies and solutions in a project of a similar magnitude. NOTE: The Commission is seeking any technology or solution allowing for scalability.
6 Technologies and Solutions	
6.1 Core Network	Description of available solutions and approach to designing and implementing a high-performance, high availability globally distributed core network that meets the Commission's stringent KPIs for connectivity and data transfer from/to the remote sites.

	NOTE: The Commission is seeking a design that may be able to support integration with the Commission's existing infrastructure described in the Project Synopsis. Details on how your company would integrate a Disaster Recovery (DR) site into the GCI network, including the deployment of core services, monitoring and support with the possibility of site activation and deactivation on Commission request. Available solutions to provide centrally managed, software-based secure connectivity solution that would enable remote devices to access the GCI network over the internet without a physical network infrastructure. Such solution should be easily deployable, remotely upgradable, support major operating systems and integration with leading cloud service providers.	
6.2 Remote Site Network	Describe available solutions tailored to the operational and environmental conditions specified, with emphasis on low power consumption systems and building autonomous power systems for sites with poor local power. NOTE: Such solutions should support IPv4 and IPv6, ensuring full routing capability within the private GCI network. Describe how such solution incorporates link and power redundancy through diverse and resilient communication paths and technologies to minimize single points of failure. Explain how your solution would incorporate agility and flexibility, with the ability to adjust the design based on Commission feedback or site-specific knowledge. NOTE: The solution should include secure integration of remote site to a disaster recovery (DR) site and enable operational continuity in the event of a core network disruption and should facilitate secure on-site communication and real-time problem resolution, potentially leveraging IP-based services over the GCI network. Hardware and infrastructure should account for environmental durability, including ruggedization, climate control requirements, and resilience against harsh conditions while maintaining performance and reliability.	
6.3 On-Demand Mobile/Portable and Test Network Services	Describe available solutions to provide mobile and portable communication systems for rapid deployment, including support for multiple communication link types, low power consumption	

	(AC/DC), and ruggedization for harsh environments. Solutions should be easily deployable, field-ready, and packaged for rapid shipment. Describe solutions able to deliver flexible broadband services on an on-demand basis, with activations ranging from several weeks to several months, and without long-term contractual obligations.	
6.4 Power Backup Systems and Energy Resilience at Remote Sites	Available solutions or possible approach for ensuring uninterrupted power supply at remote sites, including resilient power system design where applicable, backup power management, and surge protection. Preferably this should include information on the provision of alternative power solutions; such as hybrid systems, solar integration, or other context-appropriate options, aligned with the Commission's station power requirements. NOTE: The Commission is seeking a solution that should demonstrate energy efficiency and reliability during prolonged outages, incorporating technologies that optimize power usage and minimize equipment footprint. Solutions offering low-consumption, space-efficient solutions tailored to site-specific power profiles are desirable. Explain how to ensure input power stability through the deployment of power conditioning systems and describe the approach to real-time power monitoring, documentation of power system interconnections, and ongoing support to maintain operational continuity at the remote locations. Information on the approach for deployment of qualified field engineers capable of delivering both networking and electrical engineering services at designated sites.	
6.5 Network Management Systems	Describe a potential solution for the delivery of a comprehensive end-to-end Network Management System (NMS) that would support real-time monitoring, performance reporting, and incident resolution. NOTE: The system should monitor both the status and utilization of all network components, archive monitoring data for retrieval on request, and support periodic and Ad hoc performance reports aligned with SLA benchmarks. Detail how you would establish and manage a trouble ticketing system for all site and service-related activities, ensuring full transparency and operational handover through knowledge	

	transfer. The system must provide the Commission's GCI representatives with full access and include read-only API interfaces for both the NMS and ticketing platforms.	
6.6 Interface Provisioning and Maintenance for Specialized Networks	Describe your approach for network services provisioning for the different site types, including how you would ensure sufficient link capacity to support continuous data flows from the stations, remote maintenance, command and control. Explain your approach for provisioning, monitoring, supporting and maintaining secure interfaces with specialized network segments administered by third-party contractors, ensuring seamless integration with the GCI network. NOTE: Solutions should include provisions for real-time interface monitoring, responsive support, and coordination of maintenance and issue resolution with external stakeholders.	
6.7 Technology Refresh	Explain your approach to continuous technology refresh, including how you would monitor emerging technologies, ensure optimal service delivery, and assess and integrate new technologies into the existing GCI network without disruption.	
7 Operations		
7.1 Network Operations & Maintenance	Given the GCI availability requirements and the geographical distribution of the network, GCI installation spans all time zones, and as such requires permanent monitoring and support provisioning. Please outline what would be your approach to providing 24/7 Network Operations Center (NOC) services for the GCI network, including continuous monitoring, incident detection, and support for all stakeholders. Responsibilities would include maintaining an accessible monitoring system, daily incident reporting, field technician deployment, and coordination of on-site maintenance; as well as to ensure preventive maintenance, detailed service ticket logging, rapid issue resolution within agreed service levels, and adherence to a rigorous change management process approved by the Commission.	
7.2 Site Operations & Maintenance	Please explain what would be your approach to operating and maintaining the network, particularly in terms of Time-to-Restore-Service, and in light of the fact that the Commission does not have a physical presence at any of the remote sites.	
8 Service		
8.1 Capacity Building	Describe your approach towards capacity building for the technologies and services you would deploy in the GCI Network, including initial and hands-on training for Commission counterparts and designated entities, as well as provisions for refresher training following upgrades or at regular intervals.	

8.2 Logistics	Describe your logistics approach for equipment sourcing, personnel mobilization, rapid deployment of field technicians, and spare parts provisioning with minimal downtime, considering the variable complexity and the global distribution of the sites. Demonstrate experience in implementing similar large-scale logistics projects, accounting for equipment protection, physical security measures, insurance coverage and compliance with local regulations.	
8.3 Service Management	Describe your approach for service management that would meet the defined KPIs of the GCI Network, including ensuring communication link availability above 99.5%, packet loss below 1%, minimal disruption, low latency and guaranteed bandwidth to support IMS data timeliness and quality requirements, as described in the Project Synopsis. NOTE: The Commission is seeking a resilient, self-healing network design with an effective Quality-of-Service mechanism to prioritize traffic classes, including both verification and non-verification data. Describe your methodology for SLA monitoring, including the development of a performance reporting tool accessible to the Commission. This tool, operated by the Contractor and administered by the Commission, should calculate service levels using network monitoring and trouble ticket data based on a set of predefined rules. Describe your approach to change management focused on minimizing service impact, including for services delivered by subcontractors. NOTE: The Commission seeks a solution with end-to-end service accountability, including subcontracted elements.	

9 Service Transitioning and Migration	
9.1 Service Transitioning	Describe your proposed approach to service transitioning, including the development of a detailed migration plan in close coordination with the Commission and the current GCI contractor. The plan should ensure continuity of existing site operations, including IP addressing and service availability, with minimal disruption. Explain your logistics approach for the shipment and timely delivery of all required equipment and outline the asset management system you would implement to track deployed assets, including spare parts and stock replenishment within three weeks of use. Detail responsibilities regarding the acquisition, management, and renewal of communication and software licenses, ensuring compliance with local regulatory requirements.
9.2 Network Installation and Migration	Outline your high-level approach for the complete migration of all GCI sites, taking into account varied environmental conditions and site-specific constraints. NOTE: The approach should consider logistics, site access coordination, installation of GCI core and IMS components, testing, validation, and full operational readiness, with all activities finalized no later than the end of Q2 2028. Describe projects, if any, where your company migrated an operating network of a similar size and complexity and prepare your assessment of the challenges of migrating without impairing availability and reliability. Detail how you would coordinate travel and site access logistics in collaboration with GCI focal points and local station representatives. Confirm your ability to complete the network migration within the agreed timeline following final design approval. Describe your approach to provisioning, commissioning, and deploying communication links at each site, including the deployment of qualified field service technicians for on-site installation. Provide a logistics strategy that is adaptable to various site conditions and ensures seamless delivery and setup.
9.3 Decommissioning	Assessment of the challenges of decommissioning the communication links and removing and disposing of all associated equipment from the stations at the end of the service period.

10 Pricing Structure and Cost Drivers	
10.1 Pricing Structure and Cost Drivers	Provide information on the pricing structure and cost drivers of the required goods and services.

Annex B – Project Synopsis

Acronyms and Definitions

ARP – stands for Address Resolution Protocol.
CBS – Capacity Building System Server
CD 1.1 – Continuous Data Protocol version 1.1, developed by the Organization for IMS continuous data transmission.
CTBT or Treaty – Comprehensive Nuclear Test-Ban Treaty
CTBTO or Commission – Preparatory Commission for the Comprehensive Nuclear Test-Ban Treaty Organization
DR – Disaster recovery
FDSN – Tool to access and exchange waveform data, metadata and event parameters following the Federation and Digital Seismograph Network standard.
GCI – Global Communications Infrastructure
IDC – International Data Centre
IMS – International Monitoring System
IP – Internet Protocol
ISN – Independent Subnetwork
Kbps – Kilobits per second
KPI – Key Performance Indicators
LEO – Low Earth Orbit (satellites)
Member States – States Signatories to the CTBT
NDC – National Data Centre
OSI – On-site Inspection
POC – Point of Contact
Seedlink – Robust protocol developed for data transmission and intended for use on the Internet or private circuits that support Transmission Control Protocol/Internet Protocol (TCP/IP).
SG – Station Group
SLA – Service Level Agreement
SO – Station Operators
TCP/IP – Transmission Control Protocol/Internet Protocol
TWC – Tsunami Warning Centre
UPS – Uninterruptible Power Systems
VDMS – Verification Data and Products Messaging System developed by the Commission.
VPN – Virtual Private Network
VSAT – Very Small Aperture Terminal

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Project Synopsis

I- Background

The **Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO)** was established in 1996 with its headquarters in Vienna, Austria. As an interim organization, one of its objectives is to develop the verification regime of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) in preparation for the Treaty's entry into force. This mission strengthens the non-proliferation and disarmament architecture and contributes to broader efforts to enhance global security. More information about CTBTO can be found on www.ctbto.org.

To achieve this goal, the Commission is responsible for implementing a verification regime to monitor compliance with the Treaty. The regime includes an International Monitoring System (IMS), which, once fully operational, will consist of **337** monitoring stations and radionuclide laboratories across 89 countries. These stations will continuously collect and transmit data to the International Data Centre (IDC) in Vienna. Over 290 of these facilities are already functional and certified. The IDC serves as a central hub for processing and analyzing monitoring data, which is made available to CTBTO Member States.

The **CTBT** outlines specific requirements for data transmission and verification to ensure compliance. Article IV of the Treaty mandates an effective communication system for the **IMS**, emphasizing that IMS raw and processed data should be transmitted using the most direct and cost-effective means available. Article II of the Treaty further mandates to ensure the confidentiality of the information transmitted and the communication system needs to meet this requirement to protect confidential information (cf. Article II, paragraphs 6 & 7 of the CTBT).

II- The Global Communications Infrastructure and the Project objectives

1. GCI Network Overview

The **Global Communications Infrastructure (GCI)** plays a crucial role in securely transmitting IMS data and verification reports. It is designed to be cost-effective, highly available, and globally interconnected, linking IMS facilities with the **IDC** in Vienna and **National Data Centers (NDCs)** operated by Member States. This infrastructure ensures the reliable flow of data necessary to monitor nuclear test explosions.

The GCI is therefore an essential component of the systems that make up the verification regime, which ensures the timely and secure transmission of IMS data and related products. To operate this network, the Commission awards a contract of 10 years to a company responsible for all operations and maintenance of the communication links across the network. Since 1998, there have been 3 GCI contracts awarded and the number of sites connected to the GCI network has grown to **273** sites to date in the current GCI III contract. This network also includes **10** independent subnetworks (ISN) and **6** communication links to the Antarctic, all operated by Member States, but connected to the

GCI via interfaces operated and maintained by the GCI contractor. This network is designed to receive raw data from the **290+** active IMS stations and transmit raw data and data products to NDCs of Member States using a variety of technologies. Additionally, the GCI network provides the ability to operate and maintain stations remotely by allowing remote command and control by station operators. The GCI III contract ends on **30 June 2028**, hence the need to plan the transition of the network to the next GCI IV contract.

2. Project Scope and Objectives

The Commission's main objectives with this project are to **sustain a highly available, robust, secure and cost-effective GCI** and to **ensure the smooth transition to the next GCI IV contract**. It is also an opportunity to upgrade the network and align it to current and future operational needs while incorporating emerging technology deemed beneficial to the IMS network operations. Therefore, the following additional objectives are targeted:

- Reduce the GCI infrastructure footprint at IMS stations.
- Improve monitoring ability and remote command and control of IMS stations via the GCI.
- Document implementation of GCI infrastructure with the local power system and the IMS communications interface for future troubleshooting.
- Optimize power consumption, alignment and integration of GCI equipment into IMS facilities.
- Integrate disaster recovery in GCI network design.
- Enable provisioning on-demand transportable flexible mobile links for various use-cases. Incorporate emerging technologies (LEO, AI, and others as applicable) for a fault-tolerant reliable GCI IV.

III- The Commission and Operations

3. International Data Centre

The **IDC** is situated at the Commission's headquarters at the Vienna International Centre, Vienna, Austria. Data from all IMS stations is transmitted over the GCI network into the IDC, which serves as a central aggregation point for monitoring, further processing and analysis, and then disseminated outbound to Member States.

The IDC network is equipped with redundant symmetrical high-throughput (10Gbps) internet connections currently used to provide internet access to end-users sitting in the Commission's local area network and made accessible for establishing secured virtual private network (VPN) connections with the IMS stations. It offers a tested environment for deploying where test data senders and receivers similar to those found at IMS stations. This allows staff to run simulation and conduct research and development activities on various technologies.

The reliability and integrity of the data pipelines heavily depend on the quality and consistency of inputs from the GCI. As a critical upstream component, GCI feeds vital information into IDC system, which in turn enables analysts to process, analyse, and disseminate accurate and timely data to

Member States. Any issues or disruptions within GCI can have a ripple effect on the performance of the pipeline.

In the past the Commission experienced rare, but significant GCI outages with consequences for its operations. These issues not only impact the accuracy of the outputs but also affect the team's ability to meet SLAs and deliver insights to stakeholders. To improve Automatic Processing System operations, it would be beneficial to improve communication on planned disruptive maintenance; Enhance summary real-time monitoring and alerts for issues or anomalies; And have a clear channel of communication with the GCI team in case of issues, including outside of normal working hours.

NDCs are facilities operated by State Signatory responsible for receiving data and products from the IDC and/or forwarding measurement data from IMS stations hosted by the Member States. NDCs are typically government offices, military branches, or research institutions, amongst others. Their operational schedules vary from standard business hours to 24/7 staffed operations, and language requirements differ by country. The Commission currently provides GCI links as a service to **70 NDCs** and some others are connected to the network using alternate **cloud-based technologies**. Most NDCs primarily receive data, but some also send measurement data back to the IDC, influencing data traffic patterns. Not all countries have designated an NDC, and their number is expected to increase gradually. Changes in NDC designation or relocation might require adjustments to GCI connections. Additionally, several ongoing initiatives are designed to foster the establishment of NDCs to all Member States, which is likely to trigger a significant increase in the number of connections and bandwidth to NDCs during the contract period. In some cases, new NDCs are only equipped with a server provided by the Commission called **Capacity Building System Server (CBS)**, or with their **own equipment** or **cloud-based servers** running a standard operating system Image (currently Rocky Linux).

4. International Monitoring System

The IMS is a global network of stations that monitor the globe for nuclear test explosions. Many of these facilities are situated in remote, hard-to-access areas, including unmanned or uninhabited locations.

The IMS utilizes advanced monitoring technologies:

- **Seismic, hydroacoustic, and infrasound sensors** can record transient signals generated by underground, underwater, or atmospheric events. These signals are transmitted continuously to the IDC as digital waveforms or time-series data for further analysis, allowing timely event detection, localization, and further characterization.
- **Radionuclide monitoring** is designed to detect and identify radioactive particles and noble gases released from a nuclear explosion. It consists of 80 radionuclide stations and 16 laboratories worldwide. Data from all IMS radionuclide stations are transmitted in near real-time or periodically to the IDC for processing, analysis, and dissemination.

IMS facilities are owned by **individual Member States**, which designate a **station operator (SO)**. These operators may work under government agencies, military branches, research institutions,

academic organizations, or commercial entities. While some station operators hold contracts/agreements with the Commission, others cooperate without compensation under the obligation of their host country as a signatory of the Treaty. **Station operators** nominate GCI points of contact (POCs) for logistics and maintenance related activities. These POCs provide the best effort local information and facilitation to the contractor on GCI operations. However, they are not necessarily present at the IMS facility, making such stations unmanned. The **number and location** of IMS facilities are predetermined by the Treaty. However, facilities may be rebuilt or relocated, requiring adjustments to the **GCI**.

5. On-site Inspection

The OSI timelines require rapid deployment and seamless operational readiness, with inspectors required to reach the Point of Entry of the Inspected State Party not later than six days upon receipt of an OSI request. Given the need to ensure voice and data communication between the inspection team leadership and technical secretariat at the Point of Entry and after another 36 hours at the site of the Base of Operations in the Inspected State Party, the OSI team relies on robust, portable, secure, and real- or near-real time network connectivity with the CTBTO Technical Secretariat (Operations Support Centre). High-speed, secured and reliable communications with the possibility to encrypt transmitted data are essential for receiving i.e. daily information overviews from the Operations Support Centre, sending daily summary updates by the inspection team, submitting progress inspection report and preliminary finding document within Treaty mandated timelines. Conduct of an OSI may also require receiving any supporting data and information provided to the CTBTO Technical Secretariat through IDC or Operations Support Centre to the inspection team. To develop and validate the required capabilities, the OSI division conducts field tests and exercises in various Member States and requires on-demand portable communication systems, connecting them back to the GCI network and to the headquarters, the IDC and Operations Support Centre.

IV- Operations and Specifications

6. Data Transmission

Most IMS facilities have data senders, but some operate remotely via untrusted networks like terrestrial radio links or satellite links, or other media, which raises routing and security complexity and concerns. IMS data is transmitted continuously by using proprietary TCP/IP protocol, periodically via email, or on-demand through email or web-based methods. One of the key functions of the GCI network is to support **verification** data transfer, monitoring data acquisition, remote station operation with command-and-control ability, and remote maintenance including software upgrades. All traffic is classified as **inbound**, **outbound**, and **bidirectional**, relative to the IDC as the data aggregation point. The nominal traffic level ranges from **2** to **150 kbps** for data senders (inbound), and **20** to **650 kbps** for data receivers (outbound). These traffic levels are nominal and do not include bandwidth requirements for the remote command and control or maintenance. They are purely indicative and might vary depending on the situation. It is worth noting that, during link outages, data continues to be stored on the station servers and such data will be retransmitted to the IDC upon link restoration. Such data arriving with delay is called backfilled data. The backfilled data sent after the

link outages, potentially disrupting network performance and regular data transmission. Quality of service should ensure that real-time traffic has priority under such conditions over the backfilled data. Additionally, bandwidth provisioning should account for such situations and allow for a burst covering both real-time and backfilled data transmission. Around **32 gigabytes** of data is processed daily toward the IDC, while an even larger volume of data is sent to NDCs and other receiving entities.

The profile of data transmission from IMS stations to the IDC and from the IDC to the NDCs is summarized in the table below. It includes the list of tools used for data transmission and provides a high-level description of how they are used as well as the type of data they are transmitting. The following terms are defined to facilitate table reading.

Tools	**CD 1.1**	**Email**	**Seedlink**[1]	**FDSN**[2]	**VDMS**
Standard	CTBTO Owned	Public Standard	Public Standard	Public Standard	CTBTO Owned
Network	GCI | Internet	GCI | Internet	GCI only	GCI only	Internet
Authentication	No	Yes	No	No	Yes
Protocol	TCP	SMTP	TCP	HTTPS	SMTP | HTTPS
Data Type	Real-time	Periodical	Real-time	On-demand	Periodic & On-demand
Direction	Push	Push	Pull	Pull	Subscription
Use-case	Stations / NDCs	RN Stations	NDCs	NDCs	NDCs

Table: Protocols used for data transmission in the GCI network

Data Key Performance Indicators (KPIs)

To assess and monitor the operational status of IMS stations, multiple KPIs are calculated based on the availability, timeliness and quality of the data received at the IDC. The most constraining KPIs apply for stations that provide data, requiring at least 98% **data availability** and 97% **timely data availability** over a one-year period. Data is considered timely when it arrives within five minutes after it has been recorded or requested.

The GCI network should be designed to support the achievement of the above KPIs, making sure that the network service availability remains high and exceeds the data related KPIs, giving enough room in case of network failures.

7. Disaster Recovery Location

Disaster recovery (DR) is part of the resilience measures of the verification system, developed by the organization. This should be accounted for while proposing a design of the GCI network. A temporary DR location will be defined by the organization and shall be communicated to the next GCI contractor. However, an important consideration to be made is that the current DR site might be

[1] IRIS. (n.d.). *SeedLink - Data Management Center*. Available at: https://ds.iris.edu/ds/nodes/dmc/services/seedlink/.

[2] FDSN - FDSN Web Services and Data Formats. Available at: https://www.fdsn.org/services/

relocated anytime. Therefore, the GCI network design should be flexible to support a quick redeployment of the core services at any new location designated as DR site by the organization. System portability and flexibility are important considerations.

The design concept shall incorporate the ability for all remote stations, NDCs and laboratories to have at least a connection to the IDC DR site, allowing for all inbound and outbound traffic to be stream to/from the designated DR site on the Commission's demand and within a period of time from the loss of the main IDC location currently at the Vienna International Centre in Vienna, Austria. The timeframe for DR activation and deactivation will be communicated by the Commission at a later stage of the process.

8. Network Topology Classification

IMS network topology varies from one facility to another and may be grouped into five types as illustrated on the high-level network diagram in Attachment B:

- **Basic**: site with a single IMS station transmitting data directly to the IDC
- **Station Group (SG)**: site with multiple IMS stations transmitting simultaneous data from the site to the IDC.
- **Independent Subnetwork**: site aggregating traffic from multiple stations operated by the Member States, which data is connected to a hub operated by the Member States (in some cases the NDC), then transmitted to the IDC in Vienna using a secure circuit. The data volume and throughput of ISNs are generally much larger than those of single stations or station groups.
- **Special sites**: operated by, or in cooperation with, Member States or specialized institutions, and transmitting the data to a central hub from where data streams are transferred to the IDC. This is the case of links to locations such as Antarctica, Arctic region listed below:
    - A network managed by the US National Science Foundation that connects between Denver, USA and Antarctica.
    - A network managed by the Australian NDC that connects between Canberra, Australia and Antarctica.
    - A network managed by a German institute that connects between Bremerhaven, Germany and Antarctica.
- **Other sites**: Four other types of facilities connected to the GCI are described below. **Station operators**, appointed by Member States, manage IMS facilities and may require remote access via Internet VPN; **CTBTO contractors**, including universities and private firms, are granted temporary VPN access to station systems for the duration of their contractual engagement; **Tsunami Warning Centers (TWC)** in various countries receive continuous IMS data via VPN links for early warning purposes; and **Shared users** as third parties with equipment collocated at IMS sites.

9. GCI Points of Contact

The Commission does not maintain a physical presence at the remote GCI sites. It relies on the organization that owns or operates the facility in which a GCI link is installed to support its operation

and maintenance. Each organization designates one or more GCI Points of Contact (POC) who extend their support to the Commission and to the GCI contractor based on goodwill for a faster or more cost-effective response to some basic incidents at remote sites. They are the primary contact for site access or logistic coordination and should systematically be in the loop of any such activity coordination by the GCI contractor.

The Commission also relies on POCs to provide the following basic support at their respective sites, directed by the GCI contractor and in coordination with the Commission: conducting visual inspections, performing basic diagnostics and maintenance tasks, and handling simple actions like equipment reset and swaps.

It is important to note that the POC is not a communications technician and may not be familiar with the equipment used in the GCI nor possess the tools necessary to perform maintenance work. The POC can only perform actions that are very clearly described in the work instructions.

The POC is not necessarily present at the remote site. A POC of an unmanned remote site needs to travel to the remote site, limiting both the frequency of requests for support and the speed of response to a request.

The working hours of POCs range from a regular five-day week (either Mon.-Fri., or Sun.-Thurs.) to full 24x7 shift coverage, and are subject to national and organizational holidays. POCs have diverse language backgrounds and may not speak any of the Commission's official languages.

10. Mobile/portable Communication links

In addition to OSI field tests and exercises, there are scenarios where the Commission may require deploying rapid, mobile, and reliable communication systems on short notice. These include remote station command and control, temporary station deployment, Emergency Response activities, and more. Such services may be requested on-demand by the Commission and shall be readily available for shipping and possibly self-deployed by any designated personnel with minimal remote intervention from the contractor.

V- Challenges and Key considerations

The GCI project involves sites deployed in close to 100 countries across all continents and exposed to various challenges including natural and human related. Those challenges have been categorized, and key considerations summarized, to facilitate a general understanding of the operational situation.

11. Site Access, Remoteness & Security Considerations

The project involves sites with varying levels of accessibility, ranging from easily reachable urban locations to highly remote areas such as islands, mountains, deserts, caves, and national parks. Some sites require specialized transportation, including 4x4 vehicles, boats, or snowmobiles, and may be affected by extreme weather conditions like snow, ice, heavy rain, or strong winds. Additionally, many locations are isolated, potentially hundreds of kilometers from the nearest city or

infrastructure hub, posing logistical challenges such as long travel times, limited local support, and difficulty in sourcing replacement parts or getting technical assistance.

Certain sites also have strict security and access restrictions, requiring special permits, security clearances, and coordination with on-site personnel. Military bases, and other secured facilities may necessitate advanced approvals and escorted access. Some locations have a history of vandalism, demanding extra precautions for equipment protection.

12. Power Availability & Reliability

Many sites in this project face power reliability challenges, including chronic outages, unstable grid connections, and reliance on backup power solutions such as Uninterruptible Power Systems (UPS) or generators. Some locations are exposed to severe weather conditions, including frequent lightning and storms, which may further impact power stability.

13. Environmental and Site-Specific Conditions

Deployment sites may be exposed to extreme environmental factors, including but not limited to high humidity, excessive heat, heavy dust accumulation, heavy snow, and strong winds. Certain remote locations may also be at risk of flooding or seasonal weather extremes that can impact infrastructure stability. Some sites lack stable communication infrastructure. In such cases, field engineers or points of contact visiting the station have limited mobile phone network access, affecting their ability to communicate efficiently and providing timely feedback when troubleshooting issues or providing on-site support.

14. Logistics

The end-to-end logistic process related to GCI equipment packaging and shipping to IMS sites should be incorporated as a service for each of the sites and should remain the sole responsibility of the selected contractor. The GCI POCs responsible for logistic coordination may facilitate the coordination by providing site-specific information. Logistics should be factored in by the contractor. Background information on challenges and experience coordinating logistic activities at the various sites, as well as lessons learned and recommendations may be shared by the Commission, given the global distribution of the network and its complexity.

VI- Specifications and Requirements

15. Network Operations & Maintenance

The contractor shall be able to provide Network Operation Centre (NOC) service for the GCI network. The contractor shall establish and manage the service and trouble ticketing system to log all site and service-related activities. Knowledge transfer and full access to the ticketing system shall be provided to the Commission’s GCI representatives.

The contractor shall provide end-to-end service management, including monitoring, reporting, and problem resolution.

16. Network Services

The Commission expects to receive network services that include, but are not limited to, the following aspects:

Service Resilience: Ensure a fault-tolerant core and remote network design using diverse and redundant technologies, including non-terrestrial links.

Availability & Status Monitoring: Monitor the real-time status of all network components, link activations, traffic presence, and congestion indicators.

Performance & Throughput: Track data rates, throughput, and network capacity utilization at stations, remote ports, and the IDC.

Network Quality & Latency: Measure latency, delay, and packet loss across all GCI links and equipment to assess traffic reliability.

Security & Routing: Monitor routing and ARP tables, interface status, enforce access controls, and implement policy-based traffic segregation.

Service Quality & Compliance: Monitor VSAT signal quality, trigger QoS alarms, and manage service level agreements with a reporting system.

Hardware and Power Performance / Status: Monitor the health of network, satellite, and power systems, including uptime, errors, signal quality, and power metrics.

Spares Management: Track, test, and replenish spare parts inventory at all sites, linking usage to shipments and enabling Commission oversight.

17. Service Level

While delivering the network services across the GCI network, the Commission expects it to be delivered with emphasis on network availability, quality, support and security.

The following KPIs are to be considered while designing the service:

- A target availability of over 99.5% for all sites connected over the GCI network.
- Compliance with network metrics such as 1/1000 packet loss to remote sites and network latency lower than 1 second for packets travelling round-trip to the station from the IDC.
- Guaranteed bandwidth for verification data transmission (see section 6. Data Transmission above), considering that larger traffic volumes are required for outbound data transmission from the IDC to the NDCs, but the highest network quality is required for receiving lower data volumes from IMS stations into to the IDCs.
- An incident response time within 24h for issues affecting the core network and within 2 weeks for those of the remote sites.

- Used spares hardware replacement within **three weeks** and relocation/decommissioning requests to be completed within **three months**.

All critical network vulnerabilities or security compliance deviations must be resolved within sixty (60) calendar days of discovery or notification. SLA will be defined, monitored and reported to the Commission by the contractor, and shall serve as the basis for measuring compliance with all defined KPIs. Periodic reports issued by the contractor and reviewed by the Commission, shall form the basis for SLA enforcement through a penalty system in case of non-compliance.

Attachment A: IMS Network Map

Source: CTBTO Website. URL: https://www.ctbto.org/sites/default/files/2024-12/IMS%20Map_NOVEMBER_2024_Final_Web.pdf

Attachment B: Future GCI High-Level Network Diagram