



# **Robust Global Geodesy Supply Chain**

**Zero Draft**

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# Overview and principles

- A robust global geodesy supply chain enables accurate and reliable satellite services. In particular, satellite services required by governments and the private sector to support critical infrastructure operations, economic growth and societal needs.
- To support the development of a shared vision, the co-authors have developed a zero draft reference architecture for a robust global geodesy supply chain. This **zero draft is intended as a starting point for discussion among countries, regions, and partners** when considering potential obligations, targets, or cooperative actions under any future international arrangement, whether legally binding or non-binding.
- The architecture described represents **one possible implementation model, designed to illustrate the scale, functional components, governance arrangements, and indicative resource requirements** needed to sustain a reliable global geodesy supply chain. The quantitative elements are illustrative and indicative, intended to inform discussion rather than prescribe uniform implementation across regions.



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# Overview and principles

- The model is based on a **global coordination and regional implementation approach**, recognising the principle of subsidiarity where countries retain sovereignty over national infrastructure, and regions coordinate, assure, and integrate contributions to meet collectively agreed objectives.
- Recognising significant disparities in technical capacity, infrastructure maturity, and financial resources across regions, implementation can follow differentiated pathways based on regional readiness. For example, regions beginning from lower baselines may implement in phases, with interim targets established through regional consultations and supported by capacity development mechanisms.



## REGIONAL GOVERNANCE

Membership of the regional committees could include representatives from government entities, satellite operators, space agencies, the scientific community, non-government organisations, the private sector, academia, Indigenous and Local Communities (ILC) and UN organizations.

Regional Committee - Africa

Regional Committee - Americas

Regional Committee – Arab States

Regional Committee – Asia and the Pacific

Regional Committee - Europe

Plenary (1 per year)  
(e.g. UN-GGIM, ICG, other)

Geodesy Executive Council

## GLOBAL GOVERNANCE

The decisions made in the Plenary set overall targets, strategy, and priorities.

The Geodesy Executive Council (EC) could be made up of selected representatives from the regional committees. The role of the EC is to manage the implementation of the of the decisions and targets decided in the Plenary.

**Secretariat**  
1 × Manager  
4 × Technical staff  
2 × Administrative staff

## REGIONAL OPERATIONS

**Robust Ground Observatory Network Targets**

**Robust Data Centre Target**  
1 x data centre

**Robust GNSS Analysis Centre Target**  
3 x GNSS analysis centres

**Robust Analysis Centre Targets**  
1 x GNSS analysis combination centre  
5 x VLBI correlation centres  
5 x SLR analysis centres  
3 x DORIS analysis centres  
3 x Gravity analysis centres

## GLOBAL OPERATIONS

Analysis and correlation centres could continue to be operated by current institutions participating as IAG Services, with the Secretariat coordinating to ensure adequate geographic distribution and redundancy, compliance with internationally agreed decisions and targets from the Plenary and Executive Committee.

# Part A: Architecture – Observatory station targets

## Globally

- At least 25 VLBI stations
- At least 25 SLR stations
- Aspire to at least five SLR and VLBI per region

## Regionally

- ~5 DORIS beacons
- ~25 GNSS CORS
- ~3 superconducting gravimeter stations
- ~10 absolute gravimeter stations

- The number of observatory stations are intended to:
  - Illustrate redundancy requirements for maintenance, upgrades, and outages.
  - Support geographic distribution needed for accurate and reliable geodetic products.



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# Part A: Architecture – Observatory station targets

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## Regionally

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- ~3 superconducting gravimeter stations
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- Each regional committee should work together to ensure operational and capital costs are available for the operation and maintenance of these observatory stations.
- Where possible, observing infrastructure should be collocated to support the mitigation of inter-system biases and improve product quality.
- Data from these observing stations should be shared with the data centre in the region.



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## Part A: Architecture – Data centres targets

- Each regional committee should aim to operate one data centre which collects, quality controls, archives and makes publicly available, the geodetic data from the global network of robust observing stations. The data centre could also host other data from the region.
- Each regional committee should work together to ensure the reliable operation of the data centre.
- Data centres should operate in accordance with internationally recognised good practice.



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# Part A: Architecture – Analysis and geodetic product targets

## Regionally supported

- Each regional committee should aim to operate ~3 GNSS analysis centres in the region.
- Each regional committee should work together to ensure operational and capital costs are available for the operation and maintenance of the ~3 GNSS analysis centres.

## Globally supported

- 1 GNSS analysis combination centre
- ~5 VLBI correlation centres
- ~5 SLR analysis centres
- ~3 DORIS analysis centres
- ~3 Gravity analysis centres
- 1 global geodetic product development centre



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## Part A: Architecture – Secretariat targets

A Secretariat should be established to support integration across regions and to coordinate functions that are most efficiently delivered at the global level. The estimated requirements for a Secretariat are:

- 1 × Manager
- 4 × Technical staff
- 2 × Administrative staff



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# Part A: Architecture – Secretariat targets

- The Secretariat would operate under decisions made by the Plenary and Executive Committee and would complement, not replace, existing scientific services and institutions.
- The Secretariat could operate as a co-located facility, distributed network, or virtual organisation, with staff provided through dedicated funding, institutional secondments, or both.
- Potential institutional arrangements include expansion of the UN-GGCE, expansion of the IAG Global Geodetic Observing System (GGOS), hosting by another relevant organisation, or establishment of an independent entity.



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## Part A: Architecture – Secretariat targets

- Indicative responsibilities of the Secretariat staff include:
  - Coordination of SLR, VLBI, DORIS analysis activities.
  - Coordination of GNSS Analysis Combination.
  - Coordination of the development of geodetic products.
  - Support to regions in meeting collectively agreed targets.
  - Coordination of capacity development activities.
  - Convene technical and coordination meetings.
  - Liaise with IAG Services, GGOS and other partners to ensure coherent planning, avoid duplication, and integrate scientific governance with operational coordination.
  - Establish and manage a Global Geodesy Fund which could be used to support regions to meet targets, undertake capacity development, or fund global analysis and geodetic product development activities.
  - Coordination of a yearly Plenary meeting and Executive Committee meetings.

## Part B: Implementation – regional responsibilities

- Each region (Africa, Americas, Arab States, Asia-Pacific, Europe) would collectively be responsible for coordinating: regional infrastructure and operations; regional governance and strategy; innovation and development; regional engagement and collaboration; capacity development and training; resource mobilisation and burden-sharing
- Regions may choose to meet these responsibilities through distributed national contributions, pooled funding mechanisms, hosting arrangements, or other cooperative models.
- Regional coordination of these responsibilities may be achieved through existing institutional arrangements, including UN-GGIM regional committees, or through purpose-designed regional bodies established for this mandate.
- The choice of governance structure depends fundamentally on whether participating parties assume legally binding obligations or voluntary commitments. Where binding regional obligations are agreed, the governance mechanism must provide legal certainty for cost-sharing arrangements, accountability for performance, and enforcement of commitments. Where participation remains voluntary, coordination bodies may operate with greater flexibility while supporting progressive strengthening of commitments over time.

## Part B: Implementation – global responsibilities

- To provide coordination, collaboration and oversight at a global level, a yearly Plenary meeting and Executive Council (EC) meeting is suggested. The Plenary meeting would be used to set targets, strategy, and priorities. The role of the EC is to manage the implementation of the decisions and targets decided in the Plenary.
- The EC and Plenary should have representatives from government entities, satellite operators, space agencies, the scientific community, non-government organisations, the private sector, academia, Indigenous and Local Communities (ILC) and UN organisations.
- The yearly Plenary and EC could be hosted in a variety of forms. One option for the EC is to have an expanded UN-GGIM Subcommittee on Geodesy with the inclusion of a broader number of representatives. The Plenary could be held in conjunction with the UN-GGIM Committee of Experts meetings in New York in August each year. Parties could also consider aligning with the UN Office of Outer Space Affairs (UNOOSA) and organising the Plenary meeting in the sidelines of the International Committee of GNSS (ICG) meetings.

## Part B: Implementation – global responsibilities

- Once targets are agreed to at a global level in the Plenary, regional committees could work together, with assistance of the Secretariat to ensure operational and capital costs are available for the operation and maintenance of the analysis centres.
- Options to operate the globally supported centres include:
  - Countries and partners perform the role based on in-kind contribution (i.e. status quo).
  - Countries and partners perform the role on a cost-recovery basis using money in the Global Geodesy Fund.
- Analysis and correlation centres should continue to be operated in accordance with current practices of the IAG Services.
- The Secretariat (with staff based in the expanded UN-GGCE, expanded IAG GGOS, or somewhere else) would help ensure adequate geographic distribution and redundancy, and compliance with internationally agreed decisions and targets from the Plenary and Executive Committee.

## Part B: Implementation – approach

- Regions could develop implementation roadmaps based on capacity assessments conducted in collaboration with the Secretariat.
- If regions lack the funding, equipment, or trained personnel to meet the robust targets they could explore burden-sharing solutions with the help of the Secretariat. This could include:
  - **Hosted services:** e.g. Member States A might operate a laser ranging station in Member State B.
  - **Shared infrastructure:** e.g. one region could share the cloud solution they have.
  - **Global Geodesy Fund:** An international trust fund could be established to receive and provide assistance to, developing regions to gradually build their own capabilities.
  - **Public-private partnerships:** This could include cloud hosting donations, commercial data-sharing agreements reducing observation costs, equipment-as-a-service models, and private sector secondments. Regions are encouraged to explore partnership models while maintaining data sovereignty and open access principles.
- No region will be expected to achieve reference targets without adequate financial and technical support mechanisms in place.

# Rough order or magnitude (ROM) costs

Category	Regional Rough Order of Magnitude cost (USD)	Global Rough Order of Magnitude cost (USD)	Notes
Very Long Baseline Interferometry (VLBI)	~8 M		5 stations per region that meet the International VLBI Service standards
Satellite Laser Ranging (SLR)	~8 M		5 stations per region that meet International SLR Service standards
DORIS Beacons	~2 M		5 stations per region that meet International DORIS Service standards
Global Navigation Satellite System (GNSS)	~2 M		25 stations per region that meet International GNSS Service standards
Data centre	~2 M		1 x data centre per region (which has access to all the data from the global robust reference network)
Regional GNSS analysis centres	~3 M		3 x GNSS analysis centres should be funded by the region
Global analysis and geodetic product development centres		~1 M	1 x GNSS analysis combination centre
		~5 M	~5 x VLBI correlation centres
		~5 M	~5 x SLR analysis centres
		~3 M	~3 x DORIS analysis centres
		~3 M	~3 x Gravity analysis centres
		~1 M	1 x global geodetic product development centre
<b>Subtotal</b>	<b>~25 M x 5 = ~125 M</b>	<b>~18 M</b>	
<b>Secretariat</b>		~1.5 M	1 x Manager 4 x <u>Technical</u> staff 2 x Administration staff
<b>Subtotal</b>		<b>~1.5 M</b>	
<b>Total</b>	<b>~125 M</b>	<b>~19.5 M</b>	<b>~144.5 M</b>

## Rough order of magnitude costs

- Of the ~US\$144.5 M needed for a robust global geodesy supply chain, it is estimated that the funding currently being allocated to the operation of the global geodesy supply chain to be between €60-90 M (~US\$70–106 M) per year worldwide - less than 0.05% of revenue generated from GNSS- and EO- services.
- This leaves a ~US\$40–70 M shortfall in the funding required to transition to a robust global geodesy supply chain predominantly in the areas of VLBI and SLR operations in the Southern Hemisphere, funding for global analysis and geodetic product development centres and the coordination functions provided by a Secretariat.

# Inclusion of scientific and space communities

- It is important that representatives from the following organisations and other relevant regional institutions have a role in the governance, operations and coordination at regional and global levels.
  - IAG Services will continue to:
    - Provide scientific coordination and quality standards
    - Operate as the primary technical-scientific governance bodies for their respective techniques
    - Conduct peer review and validation of analysis centre products
    - Maintain continuity of current data flows and product development
  - Space agencies (NASA, ESA, JAXA, Roscosmos, CNES, ISRO, etc.)
  - National mapping and geodetic agencies

# Private sector engagement and partnership models

- The private sector is both a critical user and potential contributor to a robust global geodesy supply chain. Engagement mechanisms could include:
  - Data and Infrastructure Partnerships: Commercial GNSS operators (e.g., providers of correction services) may contribute real-time data streams to regional data centres under data-sharing agreements.
  - Operational Support Agreements: Commercial EO providers may supply complementary datasets (InSAR, lidar) for deformation monitoring.
  - Cloud service providers may offer in-kind hosting for data, analysis and geodetic products development centres.
  - Making donations to the Global Geodesy Fund.
  - Technology vendors may provide equipment maintenance contracts, equipment-as-a-service models, or discounted hardware for capacity-building regions.
- Countries and partners could also explore public private partnerships.