Section 3:

About the ILRS

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Mission of the ILRS

The International Laser Ranging Service (ILRS) organizes and coordinates Satellite Laser Ranging (SLR) and Lunar Laser Ranging (LLR) to support programs in geodetic, geophysical, and lunar research, as well as space science and engineering activities, and provides the International Earth Rotation and Reference Systems Service (IERS) with products important to the maintenance of an accurate International Terrestrial Reference Frame (ITRF). This reference frame provides the stability through which systematic measurements of the Earth can be made over thousands of kilometers, decades of time, and evolution of measurement technology. The Service provides precision ephemerides to support active Earth sensing missions and missions with optical receivers. The ILRS is one of the technique services of the International Association of Geodesy (IAG).

Role of the ILRS

The International Laser Ranging Service (ILRS):

- coordinates activities for the international network of SLR stations;
- develops the standards and specifications necessary for product consistency;
- develops the priorities and tracking strategies required to maximize network efficiency;
- collects, merges, analyzes, archives and distributes satellite and lunar laser ranging data to satisfy user needs;
- provides quality control and engineering diagnostics to the global network;
- works with new satellite missions in the design and building of retroreflector targets to maximize data quality and quantity;
- works with science programs to optimize data yield; and
- encourages the application of new technologies to enhance the quality, quantity, and cost effectiveness of its data products.

ILRS Organization

The ILRS organization, as shown in Figure 3-1, consists of the components required to address the goals of the service; the components include: Observing Stations, Operations Centers, Data Centers, Analysis Centers, a Central Bureau, and a Governing Board. Organizations participating in these components collaborate at all levels within the service to ensure efficient operations and consistent and timely delivery of data and derived products to a global user community.

- The Laser Tracking Network included of 43 SLR stations during the 2016-2019 period; providing ranging data on an hourly basis; four of these stations also provided Lunar Laser Ranging data;
- Two Operations Centers collected and verified the satellite data and provided the stations with sustaining engineering, communications links, and other support;

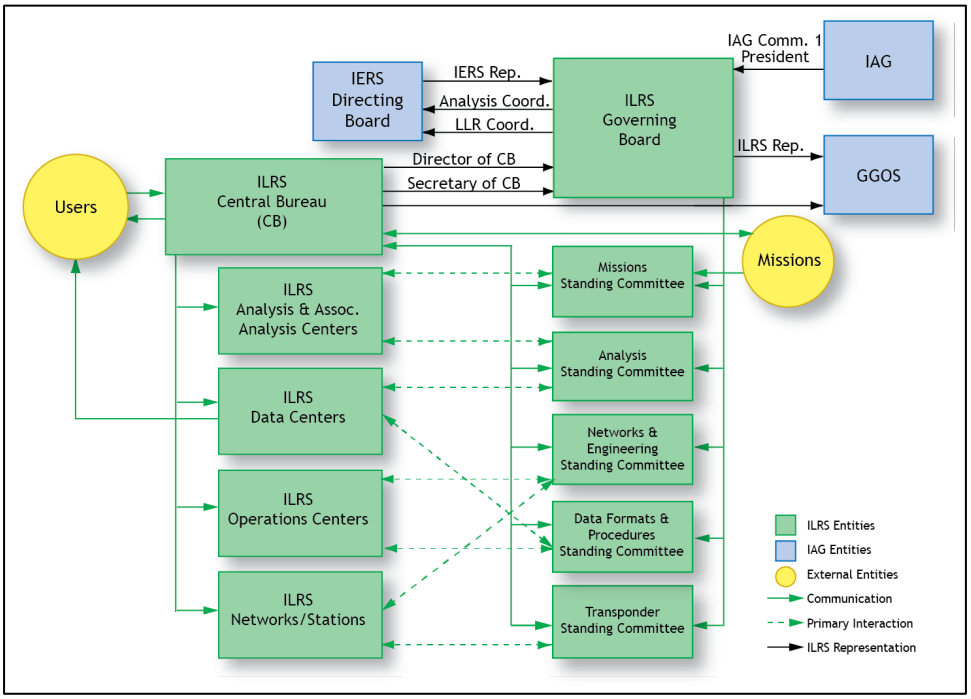
- Two Global Data Centers received and archived data and supporting information from the Operations Centers and provided these data to the Analysis Centers; and received and archived ILRS scientific data products from the Analysis Centers for availability to the user community;
- Two Combination Centers prepared the ILRS weekly data product, seven SLR Analysis Centers provided the input solutions to the Combination Centers for the data product process, twenty Associate Analysis Centers provided specialized SLR products to the users community and provided a second level of data quality assurance in the network; and six Lunar Analysis Centers provided lunar data products;
- Five ILRS Standing Committees (SCs) supplied technical expertise on special topics and areas and helped formulate ILRS policy; additional Study Groups (SGs) and Boards gave more focused attention on future ILRS activities or problem areas. The current Standing Committees, Study Groups, and Boards and their roles are:
  - Analysis SC – Developed, maintained, and coordinated the submission of the suite of standard ILRS products; provides feedback on the performance of the ILRS network.
  - Data Formats and Procedures SC – Developed, maintained, and reviewed standard procedures for generation and reporting of SLR data.
  - Missions SC – Reviewed and provided recommendations on applications submitted by missions requesting laser tracking and the priority for this support.
  - Networks and Engineering SC – Provided technical expertise in station performance analysis and coordinates engineering improvements across the global SLR network; communicated with both analysts and stations in data quality and quantity improvements.
  - Transponder SC – Provided advice, evaluation, and coordination on support of transponder and missions with in-orbit optical receivers for space geodesy and other scientific applications.
  - Space Debris SG – Served as an interface between the ILRS and agencies interested in space debris awareness as well as a forum to provide assistance, consultation, and help with hardware, software, and procedures to stations expanding their capabilities to use laser ranging for tracking space debris objects.
  - Quality Control Board – Addressed SLR systems biases and other data issues to help improve the quality of ILRS data and derived products.
- A Central Bureau provided the daily coordination and management of ILRS activities including communications and information transfer, monitoring and promoting compliance with ILRS network standards, monitoring network operations and quality assurance, determining satellite-tracking priorities, maintaining documentation and databases, and organizing meetings and workshops;
- A Governing Board supplied the general direction of the ILRS, defining official ILRS policy and products, developing standards and procedures, and interacting with other services and organizations.

Interactions with External Organizations

As shown in Figure 3-1, the ILRS cooperates extensively with other international organizations, serving on their governing bodies, etc.; current relationships include:

- International Association of Geodesy (IAG)
  - Representation on IAG Executive Committee
  - A representative from IAG Commission 1 serving on ILRS Governing Board

- International Earth Rotation and Reference Systems Service (IERS)
  - ILRS Technique Center Representatives on the IERS Directing Board
    - ILRS ASC Chair/AC Representative from ILRS Governing Board, and
    - Lunar Representative from ILRS Governing Board
  - A representative from IERS serving on the ILRS Governing Board
- Global Geodetic Observing System (GGOS)



- Network: 40+ stations
- Data Centers:
  - 2 Operations Centers
  - 2 Data Archive Centers
- Analysis Centers:
  - 7 Analysis Centers
  - 2 Combination Centers
  - 21 Associate Analysis Centers
  - 6 Lunar Analysis Centers
- Standing Committees: 5
- Central Bureau: 25+ members
- Governing Board: 18 members
- Membership
  - Associates: 400+
  - Organizations: 110+
  - Countries: 30+
  - Correspondents: 200+
- Supporting:
  - Users: 1000's
  - Missions: 110+

Figure 3-1. The components of the ILRS and their relationships with external groups.

Recent Updates to the ILRS Organization

The ILRS, like other services within the IAG, is guided by its Terms of Reference (ToR) which details the vision, objectives, structure, and operation, and specifies the data and products provided by the service to ensure consistency over time. In 2016, the ILRS Governing Board approved changes to its Terms of Reference to reflect changes in its organization and service activities. In particular, two additional At-Large members were added to the Board. At the direction of the IAG, working groups transitioned to standing committees; this change was also added to the ToR. Other updates included clarification of some processes and terminology in the document, updates to the Governing Board election process, and an update to the schedules for issuing official ILRS products. The updated ToR was approved by the ILRS Governing Board and accepted by the IAG in late 2016; the document is available on the ILRS website at: *https://ilrs.cddis.eosdis.nasa.gov/about/termsofref.html*

Governing Board elections are held every two years; recent elections were held to form the Board for the 2015-2016, 2017-2018, and 2019-2020 terms. During the 2017-2018 election, the Board was expanded to 18 members following the updates to the ToR. According to this new procedure, two additional members are nominated and elected by the ILRS Governing Board following its bi-annual elections. These new positions were added to the board to provide additional skills, organizational representation, geographic representation, or knowledge of use to the Board in carrying out its duties. The ILRS Governing Board membership during 2015-2019 is given in Table 3-1 below.

Table 3-1. ILRS Governing Board (2015-2020)

James Bennett

Affiliation: EOS Space Systems Pty. Ltd., Australia

Position: WPLTN Network Representative (2016-2020)

Carey Noll

Affiliation: NASA Goddard Space Flight Center, USA

Position: Ex-Officio, Secretary, ILRS Central Bureau (2015-2020)

Geoff Blewitt

Affiliation: University of Nevada, USA

Position: Ex-Officio, Representative of IAG Commission 1 (2015-2016)

Toshimichi Otsubo

Affiliation: Hitotsubashi University, Japan

Position: WPLTN Network Representative (2015-2018)
At-Large Representative Governing Board Chair (2019-2020)

Giuseppe Bianco

Affiliation: Agenzia Spaciale Italiana (ASI), Italy

Position: EUROLAS Network Representative (2015-2019)
Governing Board Chair (2015-2018)

Erricos Pavlis

Affiliation: Joint Center for Earth Systems Technology (JCET) and Goddard Space Flight Center (GSFC), USA

Position: Analysis Center Representative (2015-2020)

Ludwig Combrinck

Affiliation: Hartebeesthoek Radio Astronomy Observatory (HartRAO), South Africa

Position: LLR Representative (2015-2016)

Michael Pearlman

Affiliation: Harvard-Smithsonian Center for Astrophysics (CfA), USA

Position: Ex-Officio, Director, ILRS Central Bureau (2015-2020)

Table 3-1. ILRS Governing Board (2015-2020), continued

Urs Hugentobler

Affiliation: Technical University of Munich, Germany

Position: Ex-Officio, Representative of IAG Commission 1 (2017-2020)

Ulrich Schreiber

Affiliation: Technical University of Munich, Germany

Position: At Large Representative (2015-2018)
Appointed At-Large Representative (2019-2020)

Georg Kirchner

Affiliation: Austrian Academy of Sciences, Austria

Position: At Large Representative (2015-2019)

Christian Schwatke

Affiliation: Deutsches Geodätisches Forschungsinstitut-Technische Universität München (DGFI-TUM), Germany

Position: Data Center Representative (2017-2020)

Vincencia Luceri

Affiliation: e-GEOS S.p.A., Italy

Position: Analysis Center Representative (2015-2020)

Andrey Sokolov

Affiliation RPC PSI, Russia

Position: Governing Board Appointed At-Large Representative (2017-2018)

David McCormick

Affiliation: NASA Goddard Space Flight Center, USA

Position: NASA Network Representative (2015-2016)

Krzysztof Sośnica

Affiliation: Inst. of Geodesy and Geoinformatics, Wroclaw University of Environmental and Life Sciences, Poland

Position: Governing Board Appointed At-Large Representative (2019-2020)

Table 3-1. ILRS Governing Board (2015-2020), continued

	**Jan McGarry** **Affiliation:** NASA Goddard Space Flight Center, USA **Position:** NASA Network Representative (2015-2019)	**Daniela Thaller** **Affiliation:** Bundesamt für Kartographie und Geodäsie (BKG), Germany **Position:** IERS Representative to ILRS (2015-2020)	
	**Stephen Merkowitz** **Affiliation:** NASA Goddard Space Flight Center, USA **Position:** NASA Network Representative (2017-2020)	**Jean-Marie Torre** **Affiliation:** Observatoire de la Côte d'Azur, Geoazur, France **Position:** LLR Representative (2018-2020)	
	**Jürgen Müller** **Affiliation:** U. of Hannover/Institut für Erdmessung (IFE), Germany **Position:** LLR Representative (2015-2018)	**Matthew Wilkinson** **Affiliation:** Natural Environment Research Council (NERC) Space Geodesy Facility (NSGF), UK **Position:** At-Large Representative (2017-2020)	
	**Horst Müller** **Affiliation:** Deutsches Geodätisches Forschungsinstitut-Technische Universität München (DGFI-TUM), Germany **Position:** Data Center Representative (2015-2016)	**Zhang Zhongping** **Affiliation:** Shanghai Astronomical Observatory (SHAO), China **Position:** Governing Board Appointed At-Large Representative (2017-2018) WPLTN Representative (2019-2020)	

Future Activities

Over the next two years we expect some of the SLR systems in process to come online, increasing the SLR geographic coverage (see Section 8). We also expect to see enhanced performance from systems now being updated. We will also try to work with some of the poorly performing stations to increase their productivity, with the realization that some may be operating under conditions with severe limitations.

In general, the legacy SLR systems are expensive to build, and in many cases, expensive to operate. The implementation of new technologies and automation is providing operational cost saving and enhanced capability. As new stations are fielded and current stations are upgraded and replaced, the cost of SLR operations should decrease. In general, the SLR community needs to examine further options for building less expensive systems that offer increased productivity.

With its new Quality Control Board (QCB) and other operational activities, the ILRS has made important strides in improving its data quality. We need to continue to stress this area in working toward reliable mm quality data products.

It would be advantageous for the ILRS to improve its connections with the other services and IAG entities. This past few years we worked closely with the IGS and ICG to develop a tracking strategy for GNSS that will better address the needs of a broad spectrum of users. In planning our first Laser Ranging School (held prior to the 2019 ILRS Technical Workshop in Stuttgart, Germany), we benefitted greatly from the IVS experience. We will continue to encourage ILRS members to connect with other services and ILRS entities and invite members of other such entities to a closer relationship with the ILRS.