

IAG/FIG Commission 5/ICG Technical Seminar

Reference Frame in Practice

Rome, Italy 4–5 May 2012



Activities of International Standards Organization (ISO) TC211 and TC172 with respect to Geodetic References

Session 2.4 Standards and Traceability of a Terrestrial Reference Frame/GNSS

Larry D. Hothem

ISO/TC211 Liaison Representative to FIG and IAG

Member, US national body for geospatial data and information standards

USGS, Reston, Virginia USA

Sponsors:



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- **Overview - ISO Technical Committee 211 (TC211), Geographic Information/Geomatics**
- **TC211 work related to Geodesy and Geodetic References**
 - 19111, 19127, **Geodetic Registry Network, Geodetic References (NWIP)**, 6709
- **TC211: other work of interest to geodesists and surveyors**
 - 19130 and 19159: remote sensors, e.g. Optical, LiDAR, etc.
- **ISO TC172, Special Committee 6 (SC 6), Geodetic and Surveying Instruments**

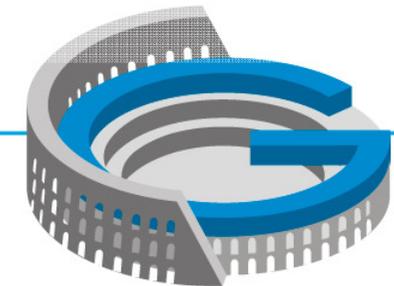
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International
Organization for
Standardization

ISO/TC 211 Geographic information/Geomatics



The ISO/TC 211

Geographic information/Geomatics

(2012-02)

*... building the foundation of the geospatial
infrastructure, brick by brick ...*



The goal of ISO/TC 211

... is to develop a family of international standards that will

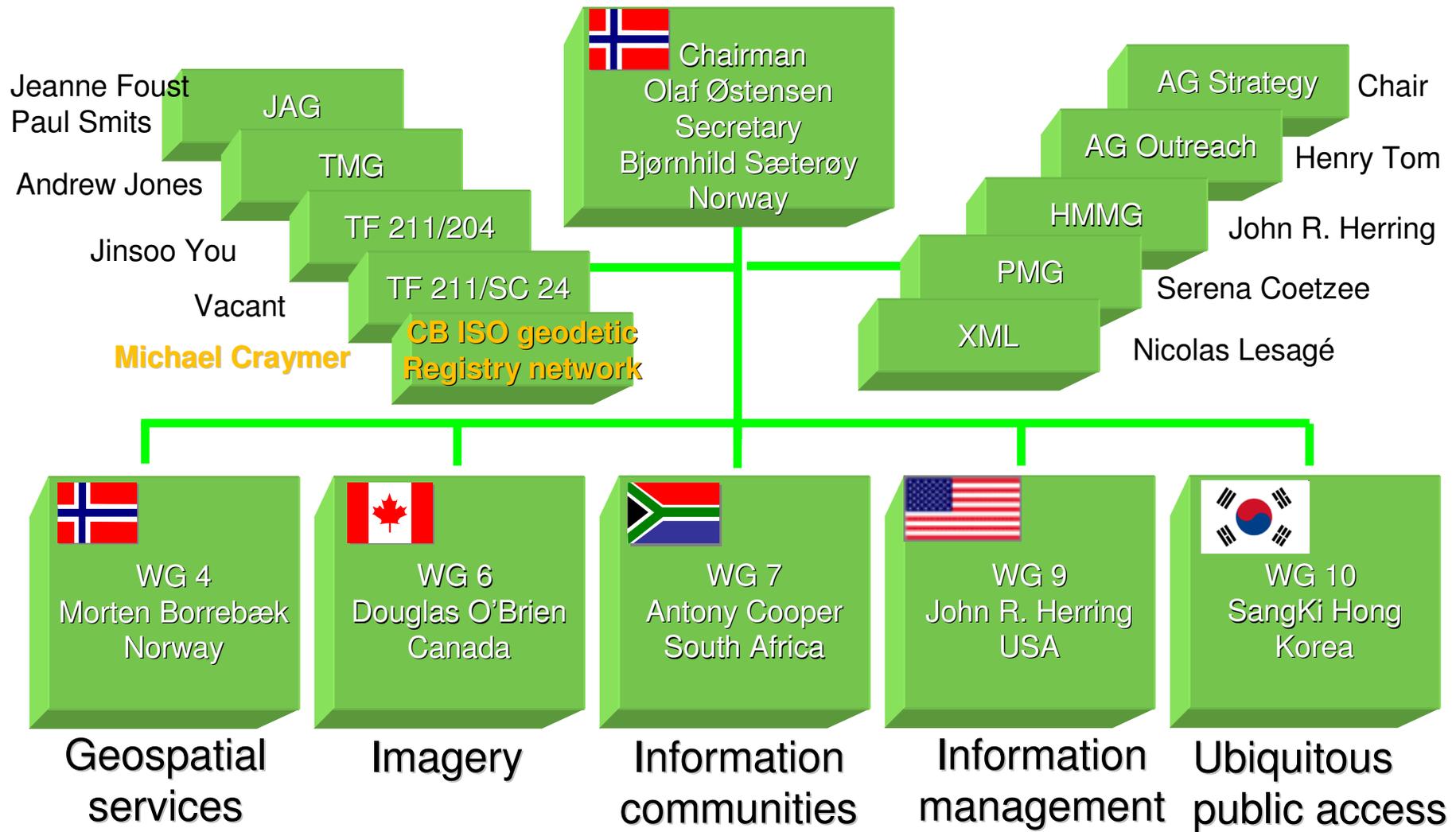
- support the understanding and usage of geographic information
- increase the **availability, access, integration, and sharing of geographic information, enable interoperability** of geospatially enabled computer systems
- contribute to a unified approach to addressing global ecological and humanitarian problems
- ease the **establishment of geospatial infrastructures on local, regional and global level**
- contribute to sustainable development



Scope of ISO/TC 211

- Standardization in the field of digital geographic information.
- This work aims to establish a structured set of standards for information **concerning objects or phenomena that are directly or indirectly associated with a location relative to the Earth.**
- These standards may specify, for geographic information, methods, tools and services for data management (including definition and description), acquiring, processing, analyzing, accessing, presenting and transferring such data in digital/electronic form between different users, systems and locations.
- This work shall link to appropriate standards for information technology and data where possible, and provide a framework for the development of sector-specific applications using geographic data.

ISO/TC 211 organization



Active permanent (P) members - 33 countries

Australia

Austria

Belgium

Canada

China

Czech Rep.

Denmark

Ecuador

Finland

France

Germany

Hungary

Italy

Japan

Rep. of Korea

Lithuania

Malaysia

Morocco

Netherlands

New Zealand

Norway

Peru

Portugal

Russian Federation

Saudi Arabia

Serbia

South Africa

Spain

Sweden

Switzerland

Thailand

United Kingdom

United States of
America



Observing (O) members - - 31

Argentina

Bahrain

Brunei Darussalam

Colombia

Croatia

Cuba

Estonia

Greece

Hong Kong

Iceland

India

Indonesia

Isl. Rep. of Iran

Ireland

Israel

Jamaica

Kenya

Mauritius

Oman

Pakistan

Philippines

Poland

Romania

Slovakia

Slovenia

Swaziland

Tanzania

Turkey

Ukraine

Uruguay

Zimbabwe



External liaisons, 1 of 2

- CEOS, Committee on Earth Observation Satellites
- DGIWG, Defence Geospatial Information Working Group
- Energistics
- ESA, European Space Agency
- EuroGeographics
- EuroSDR, European Spatial Data Research
- **FIG, International Federation of Surveyors**
- GSDI, Global Spatial Data Infrastructure
- **IAG, International Association of Geodesy**
- **ICA**, International Cartographic Association
- ICAO, International Civil Aviation Organization
- IEEE Geoscience and Remote Sensing Society
- IHB, International Hydrographic Bureau
- ISCGM, International Steering Committee for Global Mapping
- **ISPRS**, International Society for Photogrammetry and Remote Sensing
- JRC, Joint Research Centre, European Commission
- OASIS, Organization for the Advancement of Structured Information Standards
- OGC, Open Geospatial Consortium, Inc.
- OGP, International Association of Oil and Gas Producers
- OMG, Object Management Group



External liaisons, 2 of 2

- PAIGH, Panamerican Institute of Geography and History
- PCGIAP, The Permanent Committee on GIS Infrastructure for Asia and the Pacific
- PC IDEA, Permanent Committee on Spatial Data Infrastructure for the Americas
- **SCAR, Scientific Committee on Antarctic Research**
- UN Economic Commission for Africa
- UN Economic Commission for Europe, Statistical Division
- UNGEGN, United Nations Group of Experts on Geographical Names
- UNGIWG, United Nations Geographic Information Working Group
- UN FAO, Food & Agriculture Organization of the United Nations
- UPU, Universal Postal Union
- WMO, World Meteorological Organization
- CEN/TC 287, Geographic information
- CEN/ISSS Workshop on Metadata for Multimedia Information - Dublin Core
- CEN/TC 278, Road Transport and Traffic Telematics



Internal liaisons



- ISO/IEC JTC 1/SC 24 Computer graphics and image processing
- ISO/IEC JTC 1/SC 31 Automatic identification and data capture techniques
- ISO/IEC JTC 1/SC 32 Data Management and Interchange
- ISO/IEC JTC 1/SC 36 Information technology for learning, education and training
- ISO/IEC JTC 1/WG 7 Sensor networks
- ISO/TC 20 /SC 13 Space data and information transfer systems
- ISO/TC 59/SC 13 Organization of information about construction works
- ISO/TC 69 – Applications of statistical methods
- ISO/TC 154 Processes, data elements and documents in commerce, industry and administration
- ISO/TC 171 Document management application
- **ISO/TC 172/SC 6 Geodetic and surveying instruments**
- ISO/TC 184/SC 4 Industrial data and global manufacturing languages
- ISO/TC 204 Transport Information and Control Systems
- ISO/TC 207 Environmental management
- ISO/TC 241 Project Committee: Road-Traffic Safety Management System
- SCIT, The ISO Steering Committee for Image Technology



ISO/TC 211 Publications (1)

- **ISO 6709:2008 – Standard representation of geographic point location by coordinates**
- **ISO 19101:2002 – Reference model** (under revision)
- **ISO 19101-2:2008 – Reference model – Part 2: Imagery**
- **ISO/TS 19103:2005 – Conceptual schema language** (under revision)
- **ISO/TS 19104:2008 – Terminology**
- **ISO 19105:2000 – Conformance and testing**
- **ISO 19106:2004 – Profiles**
- **ISO 19107:2003 – Spatial schema**
- **ISO 19108:2002 – Temporal schema**
- **ISO 19109:2005 – Rules for application schema** (under revision)
- **ISO 19110:2005 – Feature cataloguing methodology** (under revision)
- **ISO 19111:2007 – Spatial referencing by coordinates**
- **ISO 19111-2:2009 – Spatial referencing by coordinates – Part 2: Extension for parametric values**
- **ISO 19112:2003 – Spatial referencing by geographic identifiers**
- **ISO 19113:2003 – Quality principles** (under revision)
- **ISO 19114:2003 – Quality evaluation procedures** (under revision)
- **ISO 19115:2003 – Metadata** (under revision)
- **ISO 19115-2:2008 – Metadata – Part 2: Extensions for imagery and gridded data**
- **ISO 19116:2004 – Positioning services**
- **ISO 19117:2005 – Portrayal** (under revision)
- **ISO 19118:2011 – Encoding**
- **ISO 19119:2005 – Services** (under revision)
- **ISO/TR 19120:2001 – Functional standards**
- **ISO/TR 19121:2000 – Imagery and gridded data**

ISO/TC 211 Publications (2)

- ISO/TR 19122:2004 – Qualification and certification of personnel
- ISO 19123:2005 – Schema for coverage geometry and functions
- ISO 19125-1:2004 – Simple feature access – Part 1: Common architecture
- ISO 19125-2:2004 – Simple feature access – Part 2: SQL Option
- ISO/TS 19126:2009 – Feature concept dictionaries and registers
- **ISO/TS 19127:2005 – Geodetic codes and parameters**
- ISO 19128:2005 – Web Map Server Interface
- ISO/TS 19129:2009 – Imagery, gridded and coverage data framework
- ISO/TS 19130:2010 – Imagery sensor models for geopositioning
- ISO 19131:2007 – Data product specification
- ISO 19132:2007 – Location-based services – Reference model
- ISO 19133:2005 – Location-based services – Tracking and navigation
- ISO 19134:2007 – Location-based services – Multimodal routing and navigation
- **ISO 19135:2005 – Procedures for item registration** (under revision)
- ISO 19136:2007 – Geography Markup Language (GML)
- ISO 19137:2007 – Core profile of the spatial schema
- ISO/TS 19138:2006 – Data quality measures (under revision)
- ISO/TS 19139:2007 – Metadata – XML schema implementation
- ISO 19141:2008 – Schema for moving features
- ISO 19142:2010 – Web Feature Service
- ISO 19143:2010 – Filter encoding
- ISO 19144-1:2009 – Classification systems – Part 1: Classification system structure
- ISO 19146: 2010 – Cross-domain vocabularies
- ISO 19149:2011 – Rights expression language for geographic information – GeoREL
- ISO 19156:2011 – Observation and measurements

ISO/TC 211 Projects (1)

Colour legend: DIS, FDIS

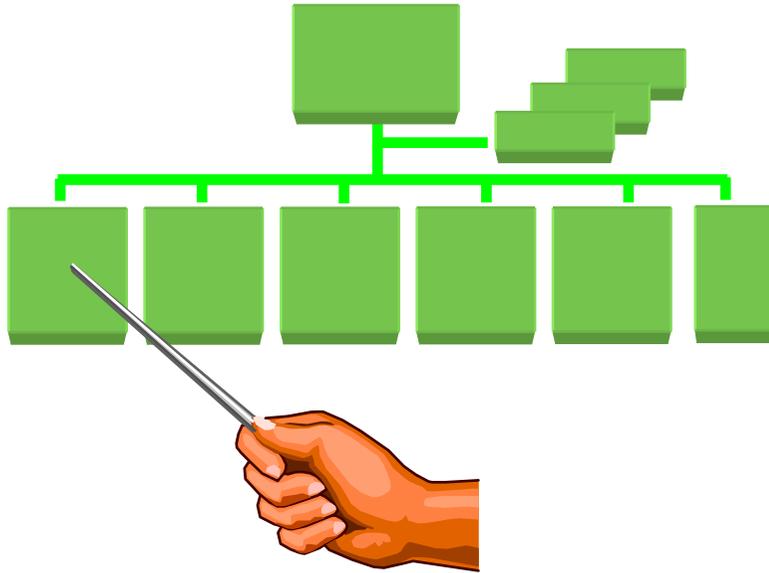
- ISO 19101-1 – Reference model – Part 1: Fundamentals (revision, ready for DIS)
- ISO 19103 – Conceptual Schema language (revision)
- ISO 19109 – Rules for application schema (revision)
- ISO 19110 – Methodology for feature cataloguing (revision)
- **ISO 19115-1 – Metadata – Part 1: Fundamentals** (revision)
- **ISO 19117 – Portrayal (revision)** (Ready for FDIS)
- ISO 19119 – Services (revision)
- **ISO/TS 19130-2 – Imagery sensor models for ge positioning – Part 2: SAR, InSAR, Lidar and Sonar**
- **ISO 19135-1 - Procedures for item registration** - Part 1: xxx (revision)
- **ISO/TS 19135-2 – Procedures for item registration** - Part 2: XML Schema Implementation (ready for publication)
- ISO/TS 19139-2 – Metadata - XML Schema Implementation - Part 2 : Extensions for imagery and gridded data
- **ISO 19144-2 – Classification Systems – Part 2: Land Cover Classification System LCCS** (Ready for FDIS)
- **ISO 19145 – Registry of representations of geographic point location** (Ready for FDIS)

ISO/TC 211 Projects (2)

Colour legend: DIS, FDIS

- ISO 19147 – Location-Based Services - Transfer Nodes
- ISO 19148 – Linear Referencing (ready for publication)
- ISO 19150-1 – Ontology – Part 1: Framework
- ISO 19150-2 – Ontology – Part 2: Rules for developing ontologies in the Web Ontology Language (OWL)
- ISO 19152 – Land Administration Domain Model (LADM) (Ready for FDIS)
- ISO 19153 – Geospatial Digital Rights Management Reference Model (GeoDRM RM)
- ISO 19154 – Ubiquitous public access – Reference model
- ISO 19155 – Place Identifier (PI) Architecture (Ready for FDIS)
- ISO 19157 – Data quality (revision of ISO 19113:2003, ISO 19114:2003 and ISO/TC 19138:2006)
- ISO/TS 19158 – Quality assurance of data supply (Ready for publication)
- **ISO/TS 19159-1 – Calibration and validation of remote sensing imagery sensors and data – Part 1: Optical sensors**
- ISO 19160 – Addressing

WG 4 - Geospatial services

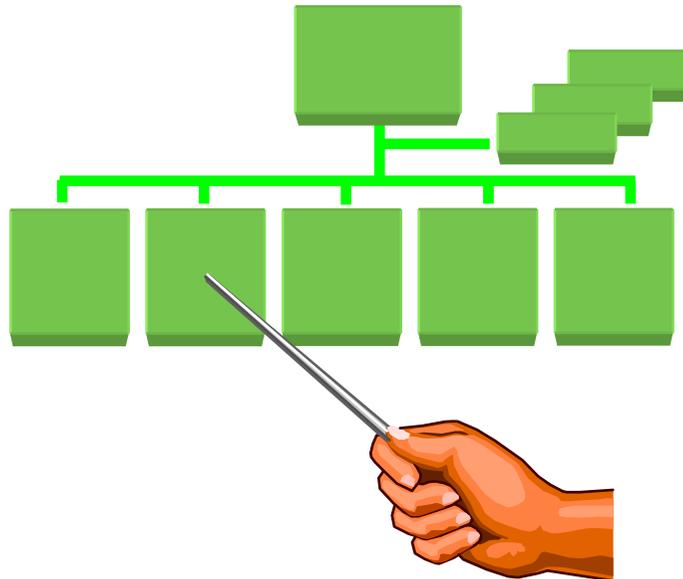


WG 4

Morten Borrebæk
Norway

- ISO 19103 – Conceptual schema language
- ISO 19117 – Portrayal (revision)
- ISO 19119 – Services

WG 6 - Imagery



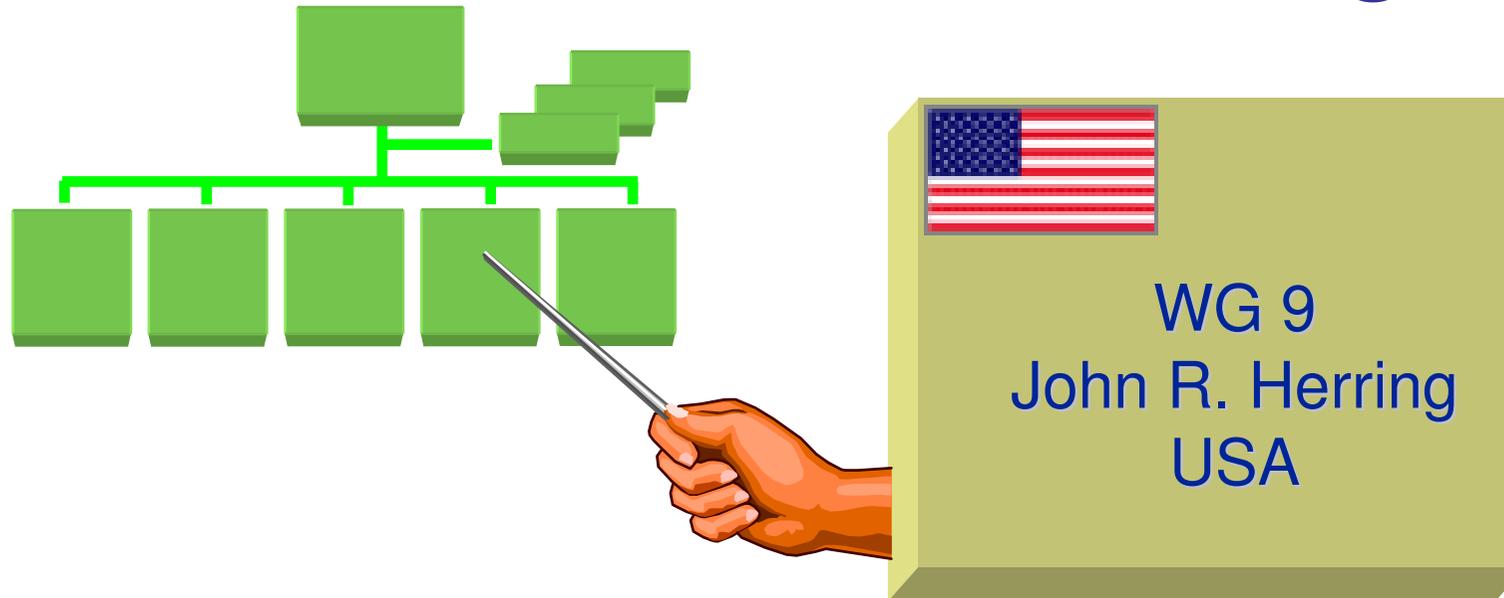
- ISO/TS 19130-2 – Imagery sensor models for geopositioning – Part 2: SAR/InSAR, Lidar, and Sonar
- ISO/TS 19139-2 – Metadata – XML Schema Implementation – Part 2 : Extensions for imagery and gridded data
- ISO/TS 19159-1 – Calibration and validation of remote sensing imagery sensors – Part 1: Optical sensors

WG 7 – Information communities



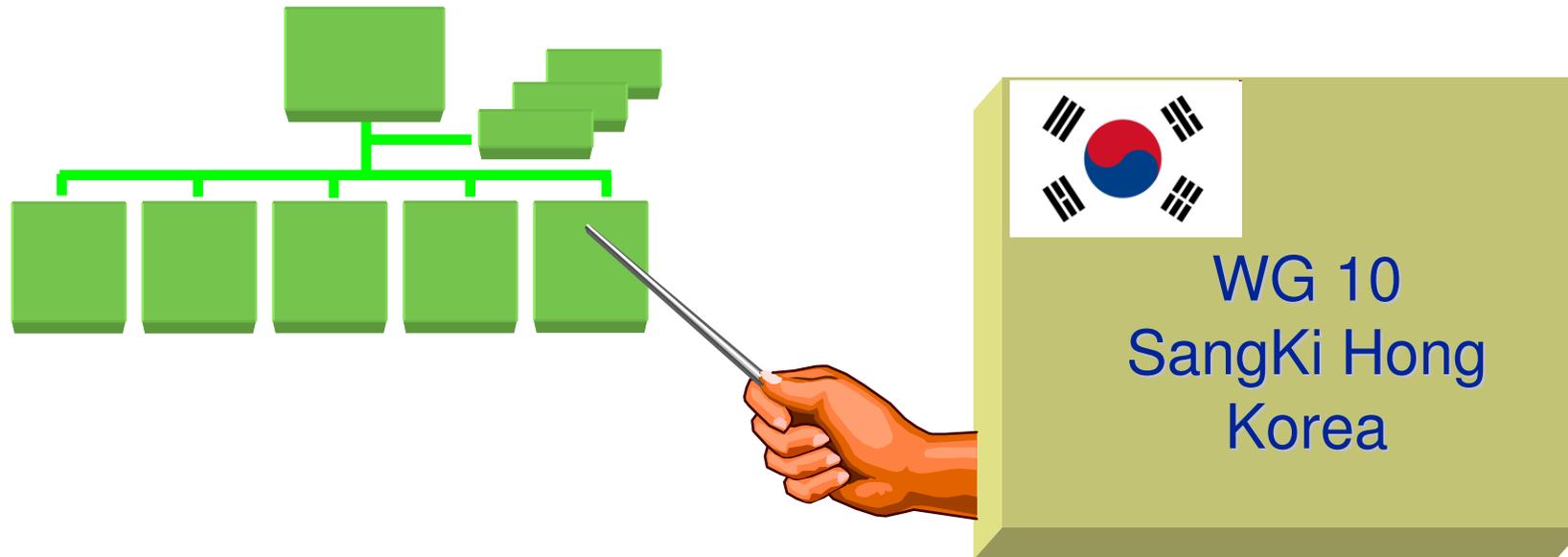
- ISO 19110 – Methodology for feature cataloguing (revision)
- ISO 19115-1 – Metadata – Part 1: Fundamentals (revision)
- ISO 19144-2 – Classification Systems – Part 2: Land Cover Classification System LCCS
- ISO/TS 19150-1 – Ontology – Part 1: Framework
- ISO 19150-2 – Ontology – Part 2: Rules for developing ontologies in the Web Ontology Language (OWL)
- ISO 19152 – Land Administration Domain Model (LADM)
- ISO 19160 – Addressing

WG 9 – Information management



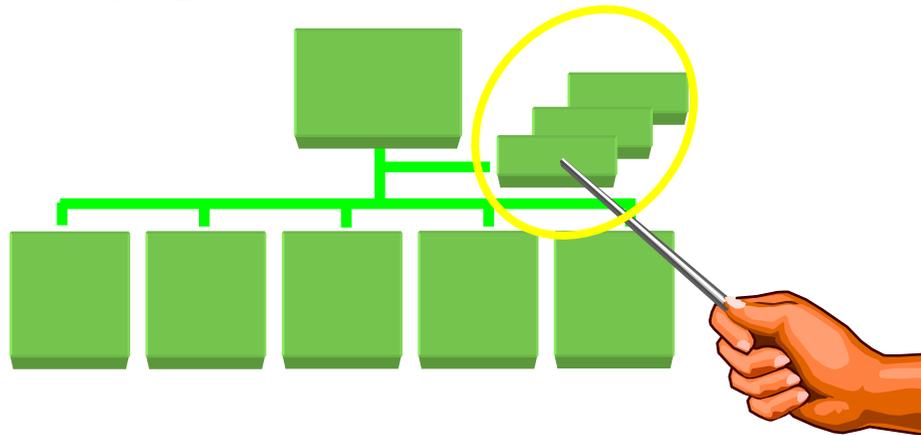
- ISO 19109 – Rules for application schema (revision)
- ISO 19135-1 – Procedures for item registration – Part 1: XXX
- ISO/TS 19135-2 – Procedures for item registration – Part 2: XML Schema Implementation
- ISO 19145 – Registry of representations of geographic point location
- ISO 19153 – Geospatial Digital Rights Management Reference Model (GeoDRM RM)
- ISO 19157 – Data Quality
- ISO 19158 – Quality assurance of data suppliers

WG 10 – Ubiquitous public access



- ISO 19147 – Transfer nodes
- ISO 19148 – Linear Referencing System
- ISO 19154 – Ubiquitous public access - Reference model
- ISO 19155 – Place Identifier (PI) Architecture

Additional Groups



- Advisory group on strategy
- HMMG – Harmonized Model Maintenance Group
- TMG – Terminology maintenance group
- PMG – Programme Maintenance Group
- XML MG – XML Maintenance Group
- Advisory group on outreach
- ***Control body for the ISO Geodetic Registry Network***
- JAG – ISO/TC 211 / OGC Joint Advisory Group
- ISO/TC 211 / TC 204 task force
- ISO/TC 211 - ISO/IEC JTC 1/SC 24 task force
- Ad hoc group on linked data

ISO/TC 211 statistics

As of 2012-01-01

TC211 established in 1994

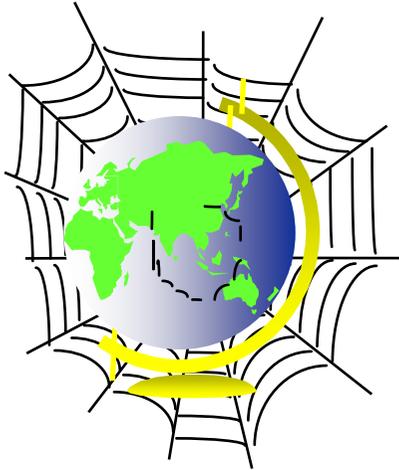
- 49 International Standards or Technical Specifications/ Reports
- 25 projects under development with about 250 nominated subject matter experts
- 33 Participating members
- 31 Observing members
- More than 1500 persons involved internationally since 1994
- More than 900 have attended one or more plenaries
- 33 plenary meetings have been convened in 20 different countries on 5 continents

NOTE: Figures are approximate and vary over time

ISO/TC 211 web-site

You will find updated information on
ISO/TC 211 at:

<http://www.isotc211.org>



containing:

- Organization
- Scope and work programme
- Resolutions
- Document register
- Calendar
- News and information
- Presentations (slides)
- List of events

TC211 work involving Geodetic and Reference Frame related standards

- è 6709 – Standard representation of geographic point location by coordinates
- è 19111 - Spatial Referencing by Coordinates
- è 19116 - Positioning Services
- è 19127 - Geodetic Codes and Parameters
 - è TC211 Geodetic Registry Network
 - è 19135 - Procedures for Item Registration
- è NWIP - Geodetic References
- è 19104 – Terminology, Symbols and Abbreviations



19111 - Spatial referencing by coordinates (1)

- | Positions on or near the Earth's surface that can be described by systems of spatial referencing.

- | Two basic position types:
 - í those using coordinates
 - í those based on geographic identifiers
 - u For example, postal addresses, administrative areas, road distance and offset
 - u Defined in ISO 19112 - Geographic information - Spatial referencing by geographic identifiers

19111 - Spatial referencing by coordinates (2)

Contents

Introduction	
Coordinate reference system	
Kind of coordinate reference system.....	
Single coordinate reference system	
Compound coordinate reference system	
Datum	
Types of datums.....	
Datum description.....	
Prime meridian	
Ellipsoid	
Coordinate system.....	
Coordinate operation – coordinate conversion and coordinate transformation .	
General.....	
Coordinate conversion (including map projection)	
Coordinate transformation.....	
Concatenated coordinate operation	

19111 - Spatial referencing by coordinates (3)

- | Standard describes elements necessary to fully define:
 - í various types of 1-, 2- and 3-dimensional coordinate reference systems
 - í coordinate reference system that is applicable to geographic information
- | Includes optional data fields to allow for inclusion of non-essential coordinate reference system information
- | Provides for description of a coordinate transformation and conversion

19111 - Spatial referencing by coordinates (4)

Examples of Figures found in the 19111 Standard

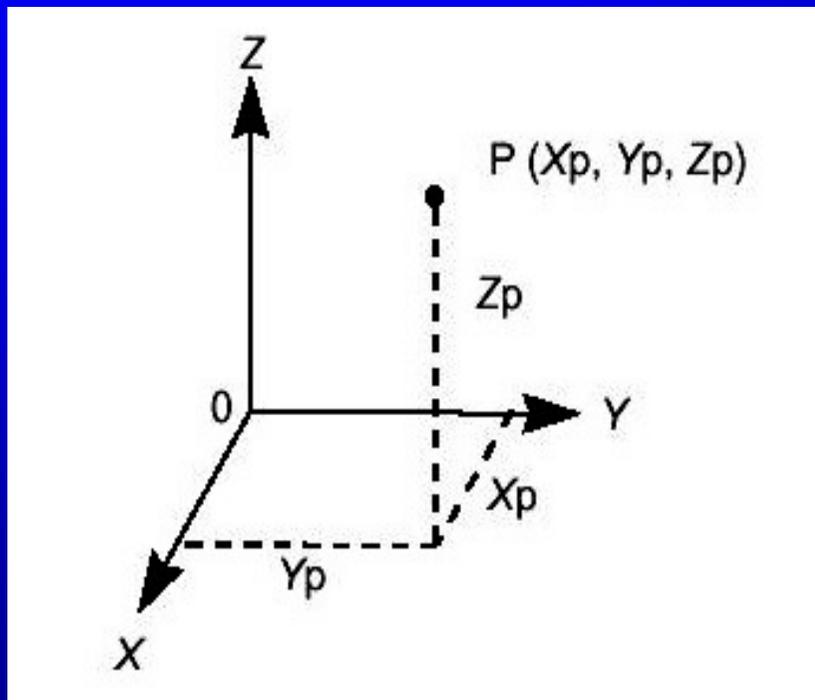


Figure D.2 - Cartesian coordinates

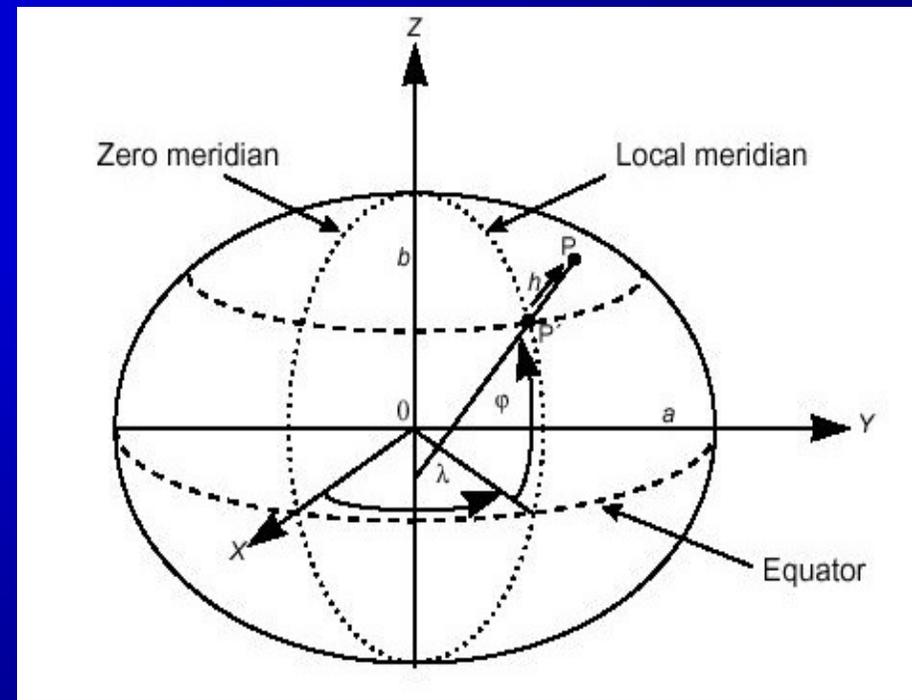


Figure D.3 - Cartesian coordinates and ellipsoidal coordinates

19111 - Spatial referencing by coordinates (5)

Examples of Figures found in the 19111 Standard

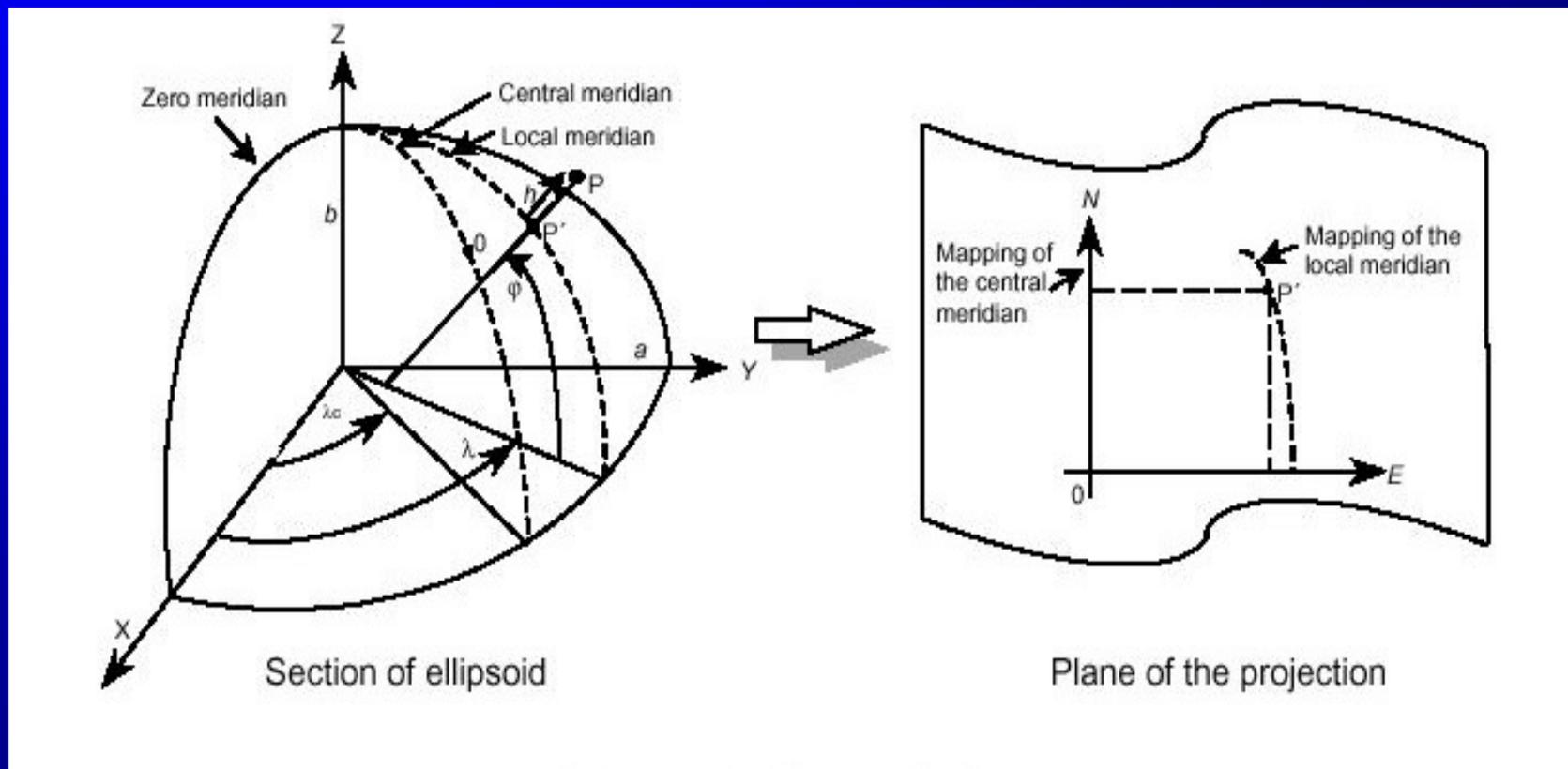


Figure D.4 - Map projection

19111 - Spatial referencing by coordinates (4)

Examples of Figures found in the 19111 Standard

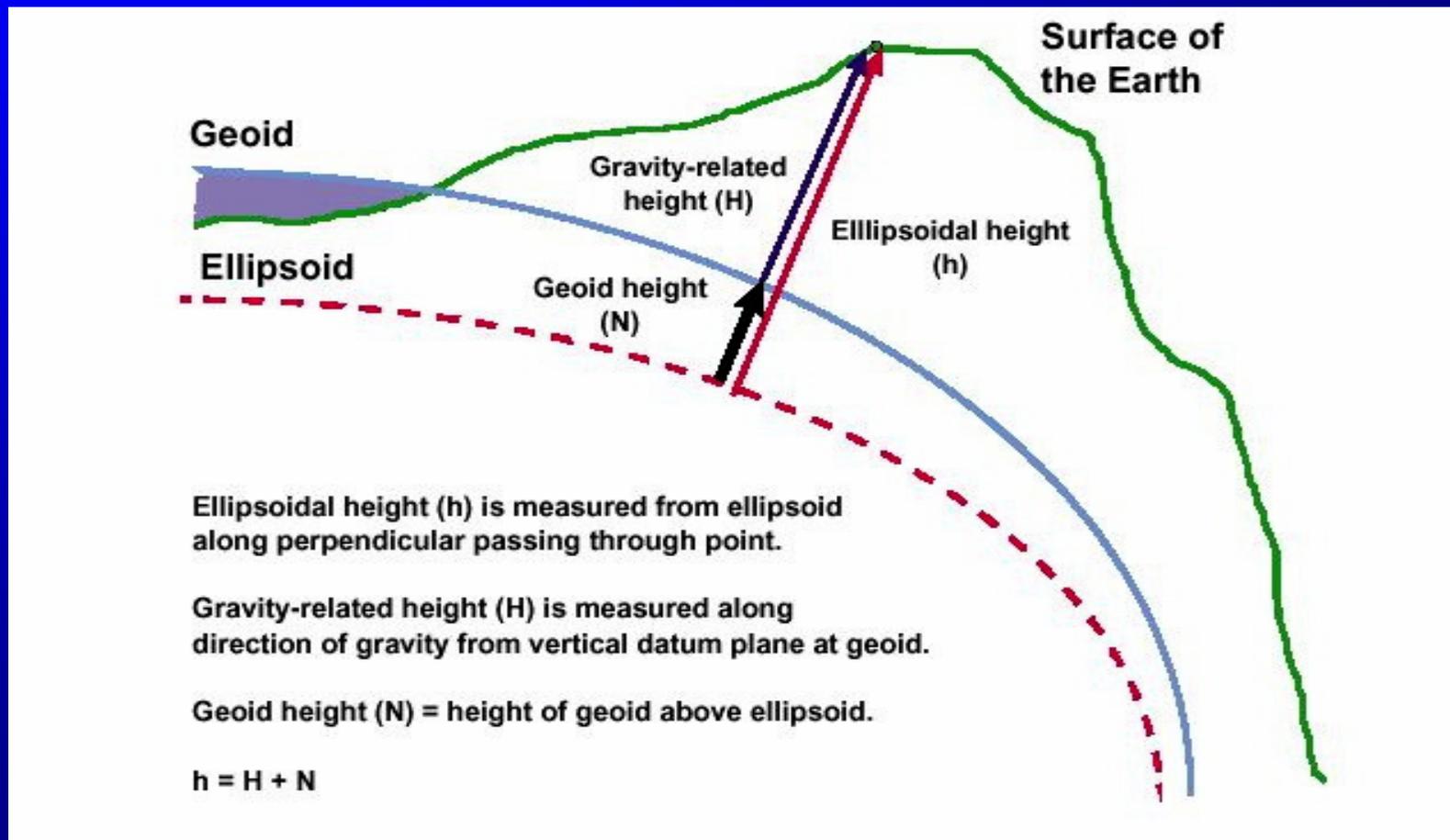
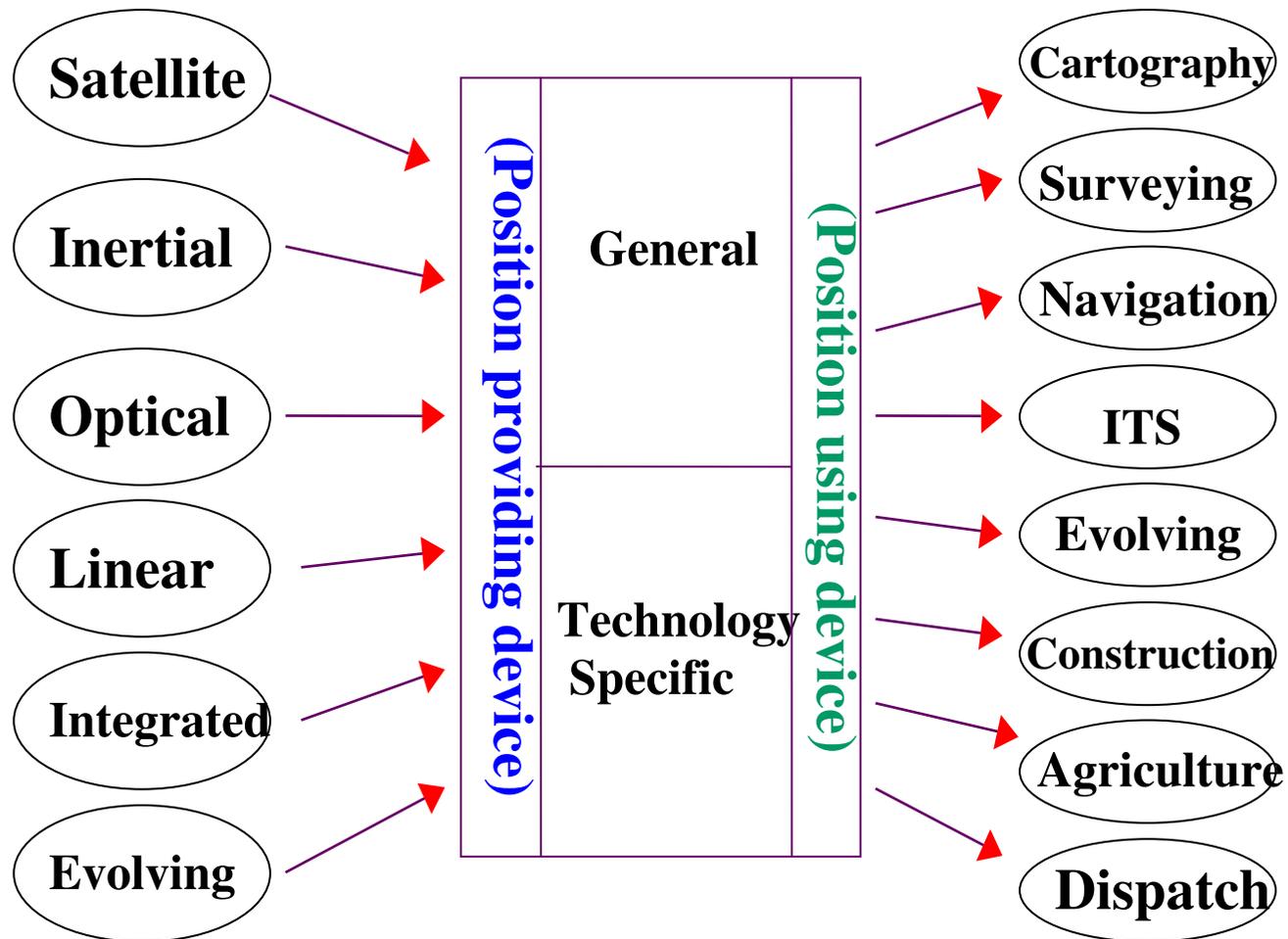


Figure D.5 - Ellipsoidal and gravity-related heights

19116 - Positioning services Connects Positioning Technology to Users

Positioning Technologies

Geographic Information Users



19127 - Geodetic codes and parameters

- | Provides for creation and maintenance of a publicly available **registry of geodetic codes and parameters** that are **in compliance with ISO 19111**

- | **Guidance on applicability and appropriate use**

- | Provides **guidance for**
 - í **submission** of proposals for additions to the registry,
 - í **validation** of proposals,
 - í **inclusion of new data** in the registry,
 - í **maintenance** of the registry, and
 - í for **registry control bodies**.



International
Association of
Geodesy



TC211 Geodetic Registry Network and the Control Body

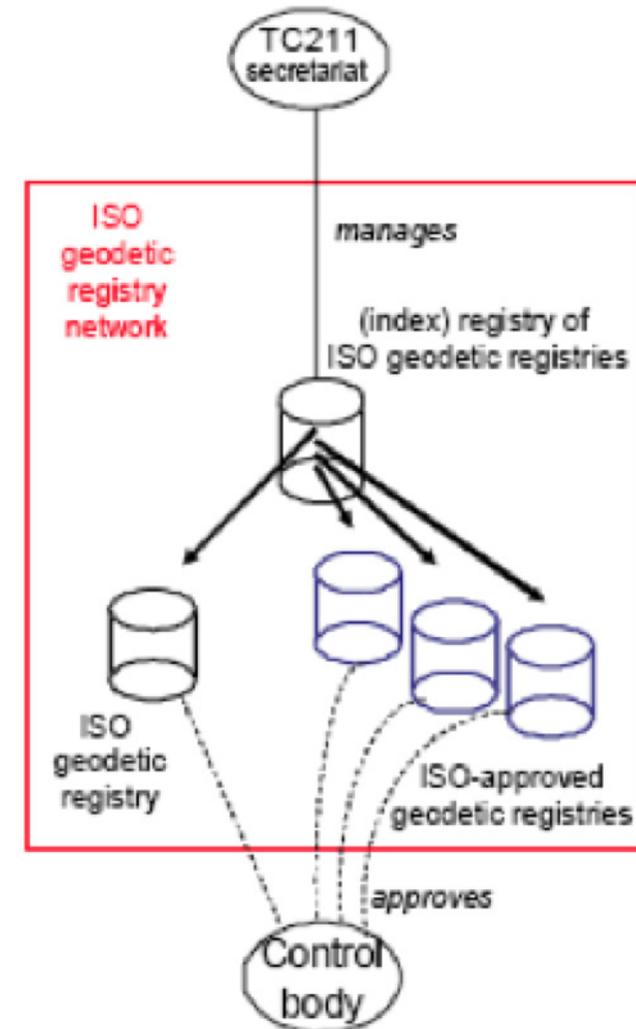
Invited Lead: IAG/GGOS

Mike Craymer (Chair)

Larry Hothem (Vice-Chair)

Geodetic Register Network

- **Geodetic Register Network**
- **Three components:**
 - Register of ISO-approved registers
 - ISO geodetic register
 - ISO-approved external registers
- **Control Body (CB)**
 - Approves content of ISO register & ISO-compliant parts of external registers



CB Terms of Reference (TR)



- **Defines**
 - Membership
 - Responsibilities
 - Process for approving register content
 - Reporting
- **Adopted 2010-12-10**
- **Key control component of the TR**
 - *Control Body decisions shall be made by consensus.*
 - *In the event that a consensus is not possible, decision may be made by two thirds (2/3) voting majority of members. **A minimum of 3 votes is required.***

Current Membership (11)

- Dr. Mike Craymer (Chair, IAG/Canada)
- Mr. Larry Hothem (Vice-Chair, IAG/USA)
- Dr. Eid M. Almotairi (Saudi Arabia)
- Dr. Piergiorgio Cipriano (Italy)
- Mr. Bruno Garayt (France)
- Dr. Lassi Lehto (Finland)
- Mr. Roger Lott (United Kingdom & OGP)
- Dr. Wolfgang Dick (Germany)
- Mr. Matsusaka Shigeru (Japan)
- Mr. Scott Spaunhorst (USA)
- Mr. Richard Wonnacott (South Africa)

Pending liaison representatives

- DGIWG (point of contact: Stefan Storb)el)
- FIG (point of contact: Mikael Lilje)
- IHO (point of contact: Tony Pharoah)



Geodetic Register Requirements



- **Address**
 - Register management
 - Register content
 - Register access
- **Comments on draft requirements document will be discussed at meeting of the Control Body next month in France**
 - Next TC211 meetings and plenary: 4-8 June 2012, Toulouse, France

Geodetic Registry Network



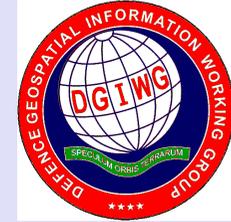
- **Implementation**

- TC 211 – Standards Norway is committed to:
 - Implement registry management software
 - Manage register

- **Planning for registry management software**

- **RegManTool**: in use by DGIWG (Defense Geospatial Information Working Group)
- Follows ISO 19135:2005 registration procedures
- Pending work: incorporate 19111 CRS schema
- License for ISO TC211
- Test with data planned next month in Toulouse

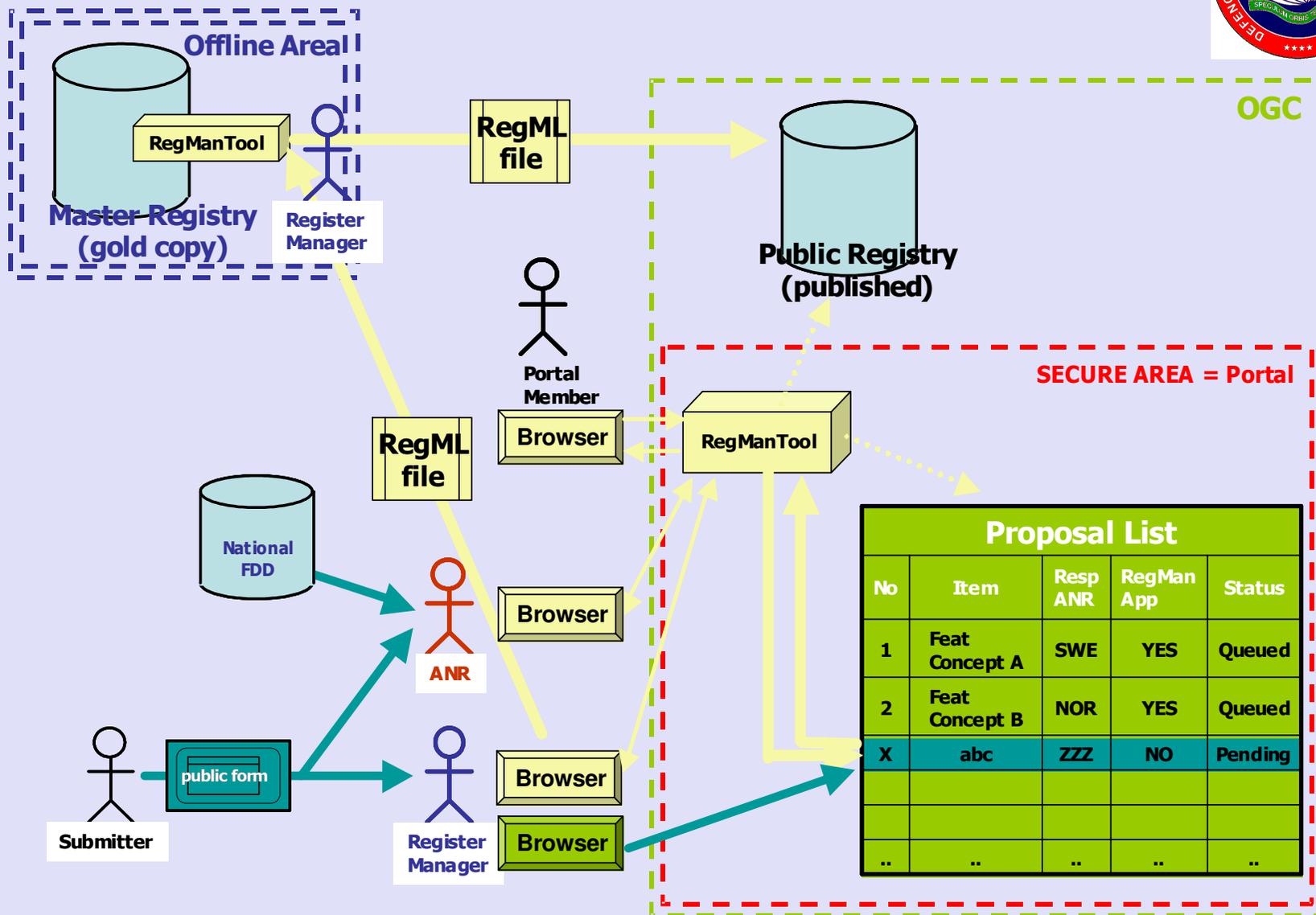
RegManTool Procedures for Item registration



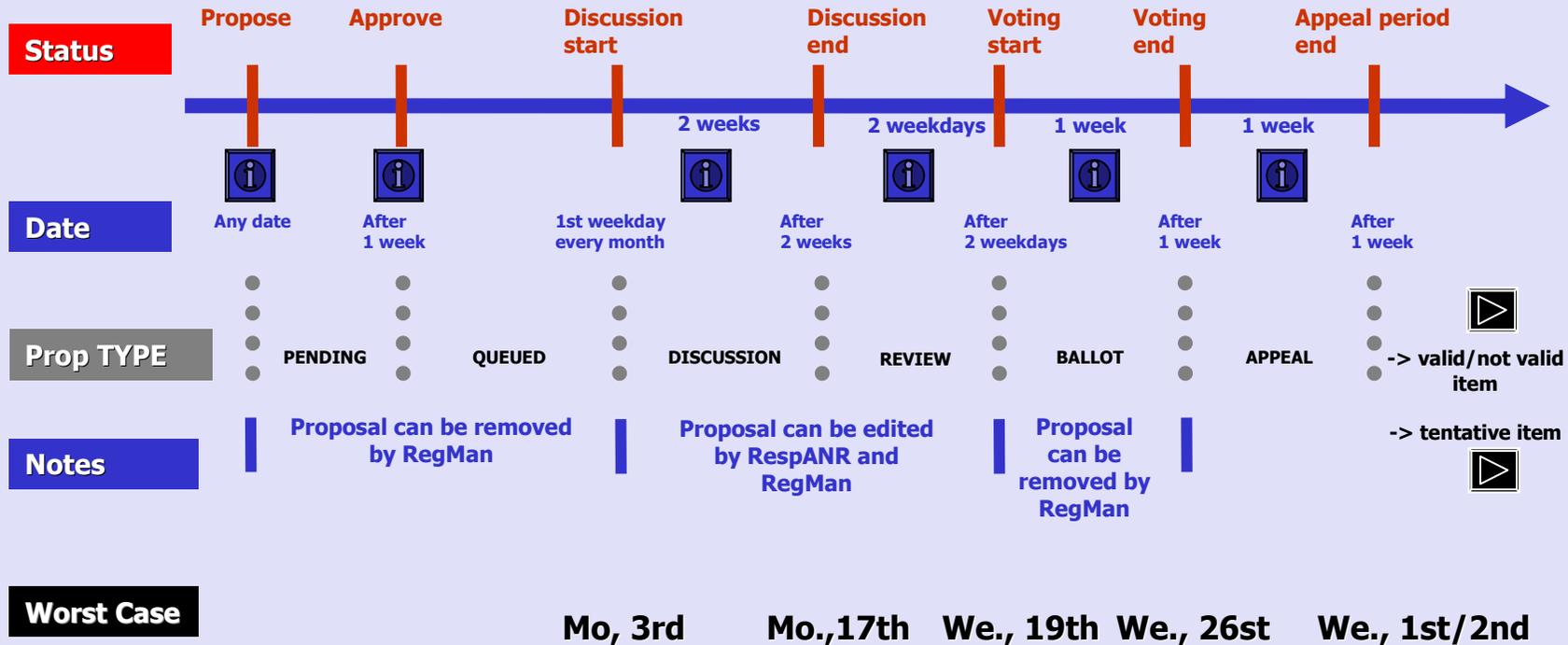
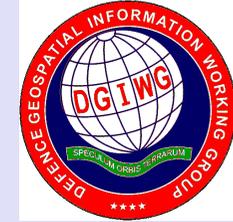
Roles – as defined in ISO 19135 - - Procedures for Item Registration (2005)

- **Registry Manager:** Person or Organization responsible for management of the information system providing the contained registers.
- **Register Owner:** Organization that establishes a register.
- **Register Manager:** Organization to which management of a register has been delegated by the Register Owner.
- **Submitting Organization:** Organization authorized by a register owner to propose changes to the content of a register.
- **Control Body:** A group of technical experts that makes decisions regarding the content of a register.
- **Register User:** Person or organization with access to one or more registers.

RegManTool Procedures for Item registration



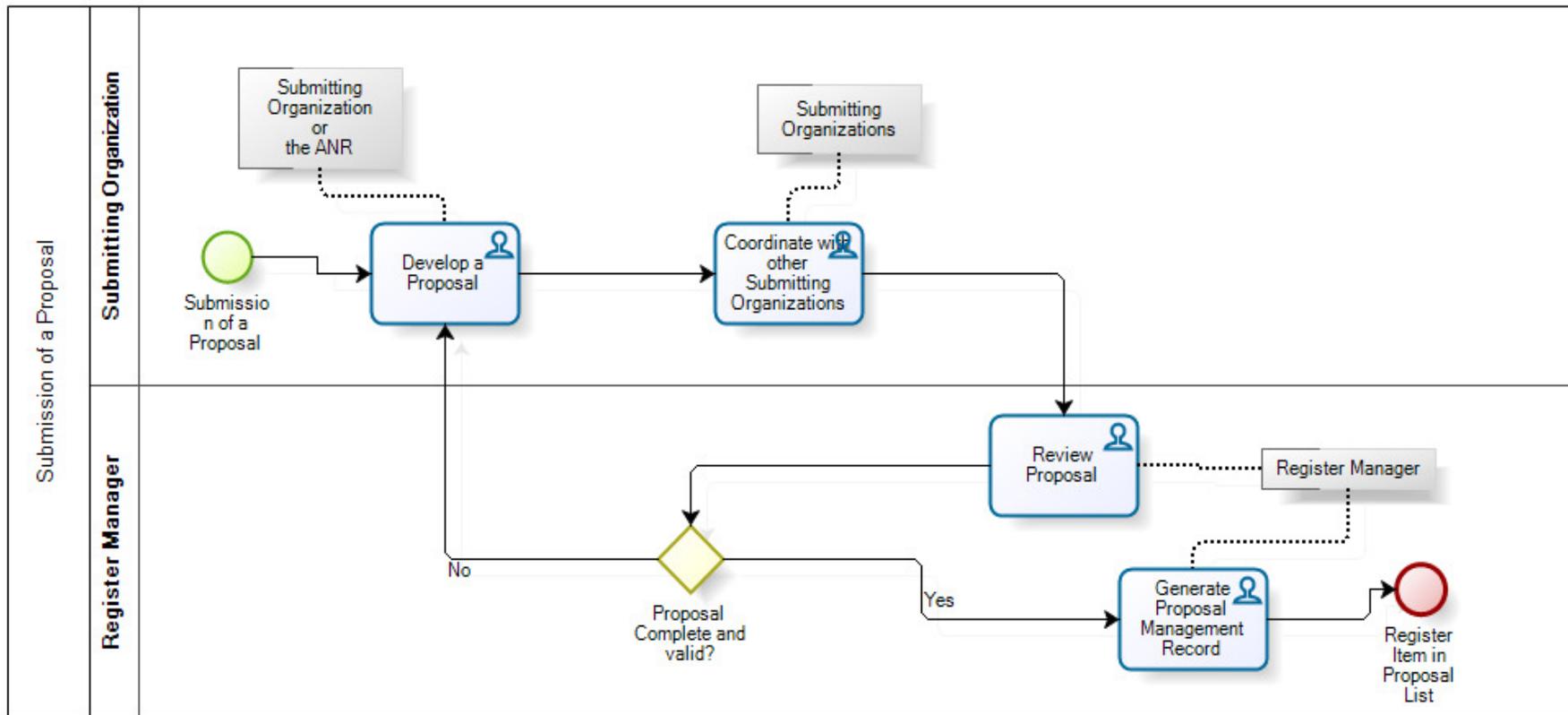
RegManTool Procedures for Item registration



Lifecycle Procedures – ISO/TC211 19135



Submission of a Proposal





International
Organization for
Standardization

ISO/TC 211 Geographic information/Geomatics



International
Association of
Geodesy



New Work Item Proposal

ISO Standardization for ITRS and geodetic references

Claude Boucher

MEDDTL, France

ITRS within IAG

- **The International Terrestrial Reference System (ITRS) was defined in 1988 by the International Earth Rotation and Reference System Service (IERS) and made available through its primary realizations (ITRF solutions) developed by IERS**
- **The geoscience international scientific community formally adopted ITRS in 2007 (IUGG resolution, Perugia 2007)**
- **The IAG services, in particular IGS, express their products in ITRS by using directly ITRF solutions.**
- **Regional networks (NSRS, EUREF, AFREF...) are also realizations of ITRS for a specific region or geographical area.**

ITRS use in practice today

- **The Global Navigation Satellite System (GNSS) community provides more and more services closely linked or even directly expressed in ITRS.**
 - GPS and Galileo standard services are in such a case (ITRS explicitly mentioned in the US-EU agreement which implies that TRF information for WGS84 used by GPS is recognized as a particular realization of ITRS)
 - The GNSS community (providers and users) is coordinated by an **International Committee for GNSS (ICG)**
 - Within ICG, a Working Group established in 2008 on Geodetic References
- **For a variety of reasons, several other system designations are adopted in addition to ITRS in regulations or standards, by various communities:**
 - WGS84 for cartography (IAC), civil aviation (ICAO), hydrography (IHO)
 - ETRS89 in Europe for EUREF, EuroGeographics and INSPIRE

IAG WG on ITRS and ISO standards

- IAG, through its GGOS program, established a Working group on ITRS and ISO standard in 2008
- WG chaired by C Boucher
 - 2009, recommended development of an ISO based standard for ITRS

Membership of the GGOS Working Group on an ITRS Standard

Function	Name	Affiliation
Chair	Claude Boucher	IGN, France
President, IAG Commission 1; Member, GGOS Steering Committee	Zuheir Altamimi	IGN, France
Member, GGOS Steering Committee	Felicitas Arias	BIPM, France
Member	Mike Craymer	NRCAN, Canada
Member, ISO TC 201	L. Hothem	USGS, USA
Member, ISO TC 201	Johannes Ihde	USGS, USA
Member, GGOS Steering Committee	Steve Kenyon	NGA, USA
Vice-Chair, GGOS Steering Committee	Ruth E. Neilan	JPL, Pasadena, USA
Vice-Chair, GGOS Steering Committee	Hans-Peter Plag	University of Nevada, Reno, USA
Member, GGOS Steering Committee	Bernd Richter	IERS, BKG, Germany
Chair, GGOS Steering Committee	Markus Rothacher	ETHZ, Switzerland

Other Standardization activities in Geodesy

- Various activities can be mentioned as examples
 - RINEX format for GNSS data
 - SINEX format for data analysis results
 - DOMES numbering system for ground station id
 - IERS Conventions
- Multiple domains
 - Data information
 - Concepts and models
 - Products
- Need to adopt a strategy: IAG, IAU, FIG, IHO...

Proposed strategy

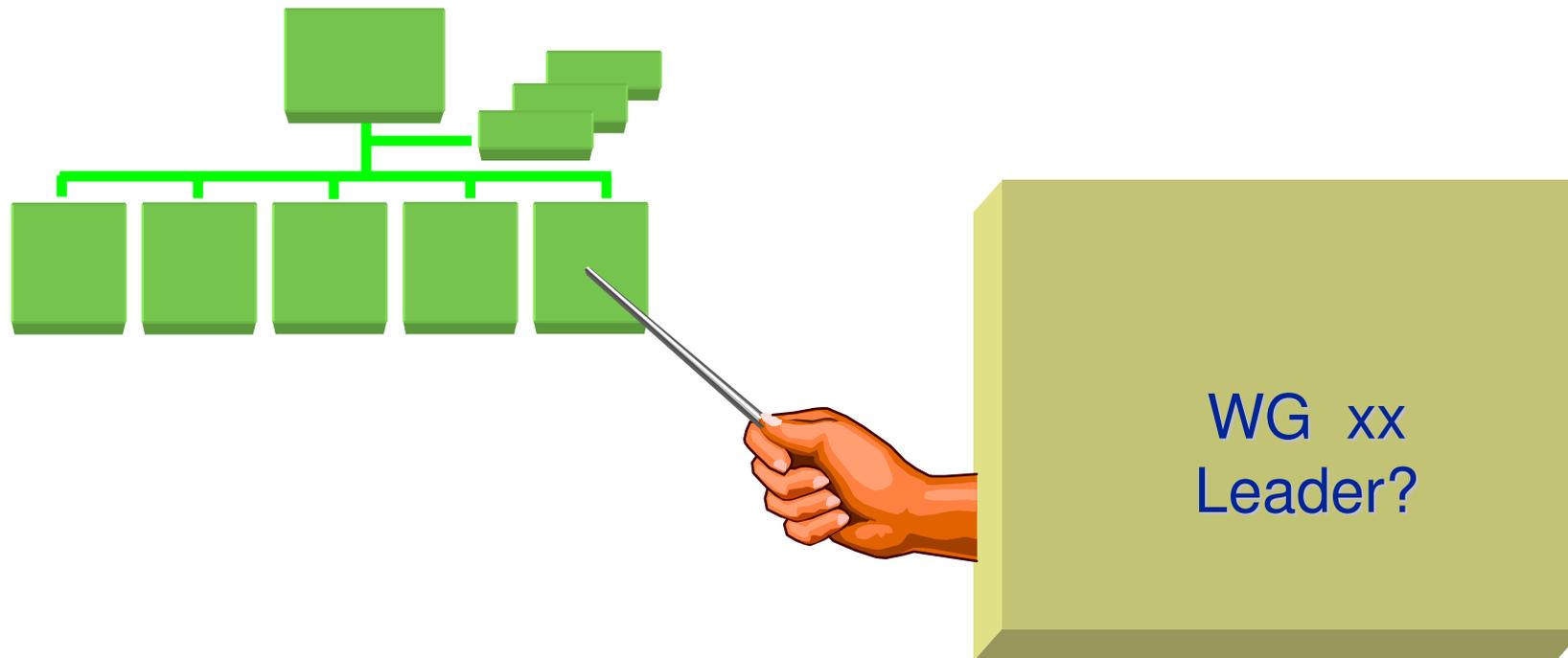
- **France has submit to ISO/TC211 the proposal of an ISO standard on ITRS**
 - Funded by MEDDTL, French ministry in charge of geographical information
 - Following IAG WG recommendations
 - Ensuring the support of the various communities, in particular geographical information, space and metrology

Activity may lead to identifiable structure on geodetic references within TC 211

- **Concept:** create within TC211 a permanent structure dealing with geodetic references
- **Activities**
 - Develop an ISO **standard related to ITRS**
 - **Maintain existing standards** such as 19111 –Spatial Referencing by Coordinates
 - Follow technically the **Geodetic Registry Network Control Body activities**
 - **Develop other appropriate standards** – for example:
 - vertical and height references
 - gravity references

Possible development:

WG xx – Geodetic References



TC211 External Liaisons Support

- For a viable indentifiable structure for geodetic references within TC211, **critically important will be active support of external liaisons to TC211:**
 - IAG, IAU, BIPM, ICAO, IHO, FIG, ICA, ICG, etc.

19104 – Terminology

Terms, Symbols and Abbreviations

- | **Harmonization of all specific terms, symbols, and abbreviations that relate to the family of ISO 19100 standards, other ISO standards, and other international references.**
- | **Open access to document**

IAG/FIG Commission 5/ICG Technical Seminar

Reference Frame in Practice

Rome, Italy 4–5 May 2012



THANK YOU

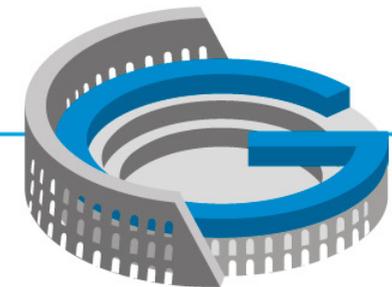
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Reference Frame in Practice

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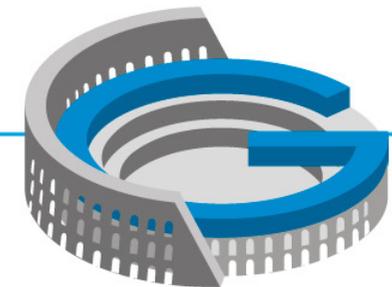
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TC 172/SC 6 - Geodetic and surveying instruments Optics and optical instruments

Standards and projects under direct responsibility of TC 172/SC 6

- Geodetic and surveying instruments
- Ancillary devices for geodetic instruments:
 - Part 1: Invar levelling
- Field procedures for testing geodetic and surveying instruments:
 - Part 4: Electro-optical distance meters (EDM measurements to reflectors)
 - Part 5: Total stations
 - Part 6: Rotating lasers

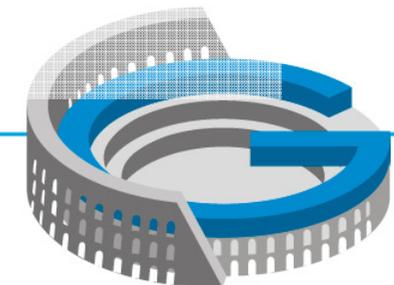
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TC 172/SC 6 - Geodetic and surveying instruments

- Participating countries: 9
- Observing countries: 10

Secretariat:

- [Switzerland \(SNV\)](#)

Participating Countries

- [China \(SAC\)](#)
- [Germany \(DIN\)](#)
- [Japan \(JISC\)](#)
- [Korea, Republic of \(KATS\)](#)
- [Russian Federation \(GOST R\)](#)
- [Spain \(AENOR\)](#)
- [Sweden \(SIS\)](#)
- [USA \(ANSI\)](#)

Observing Countries

- [Austria \(ASI\)](#)
- [Czech Republic \(UNMZ\)](#)
- [France \(AFNOR\)](#)
- [Hong Kong, China \(ITCHKSAR\)](#) *(Correspondent member)*
- [Hungary \(MSZT\)](#)
- [India \(BIS\)](#)
- [Poland \(PKN\)](#)
- [Romania \(ASRO\)](#)
- [Slovakia \(SUTN\)](#)
- [United Kingdom \(BSI\)](#)

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Project of TC172/SC6 related to GNSS

Adopted in 2007: ISO 17123-8:2007

Field procedures for testing geodetic and surveying instruments

GNSS field measurements systems in real-time kinematic (RTK)

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