GIS interoperability – exchanging and using geographic knowledge

Interoperability:
the ability of two or more systems or
components to <u>exchange</u> information and to <u>use</u>
*the information that has been exchanged ***

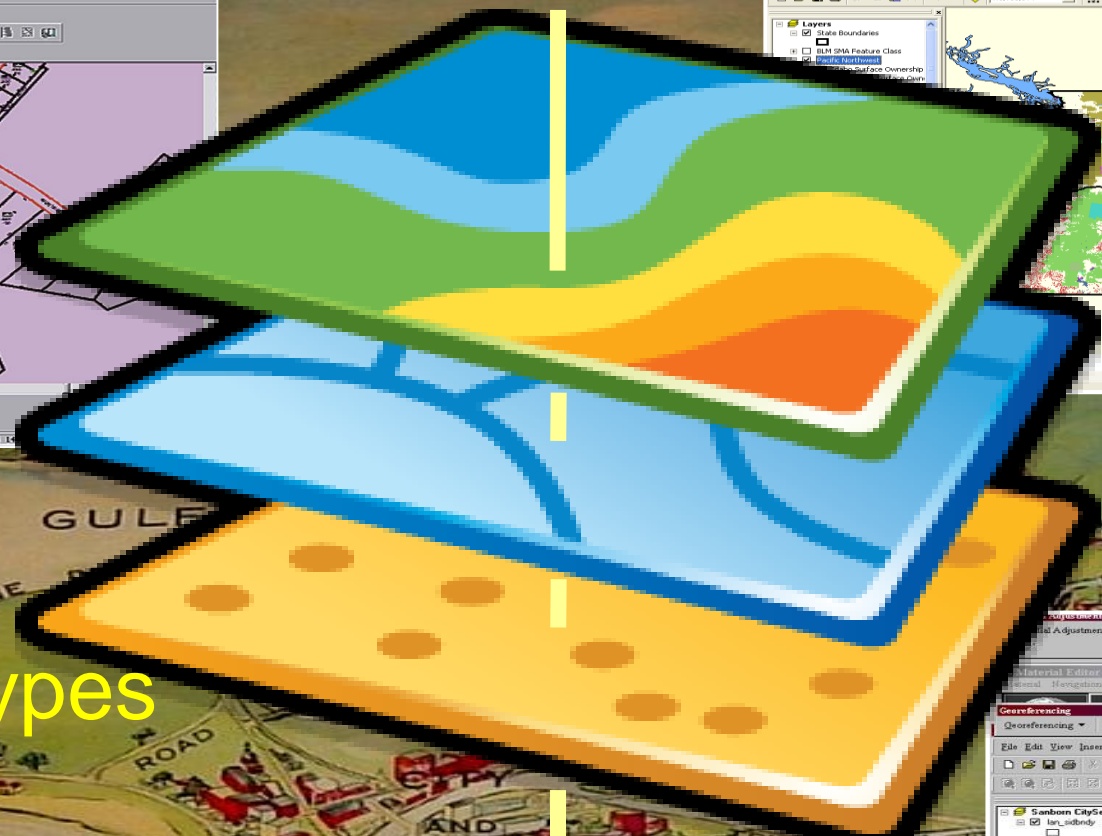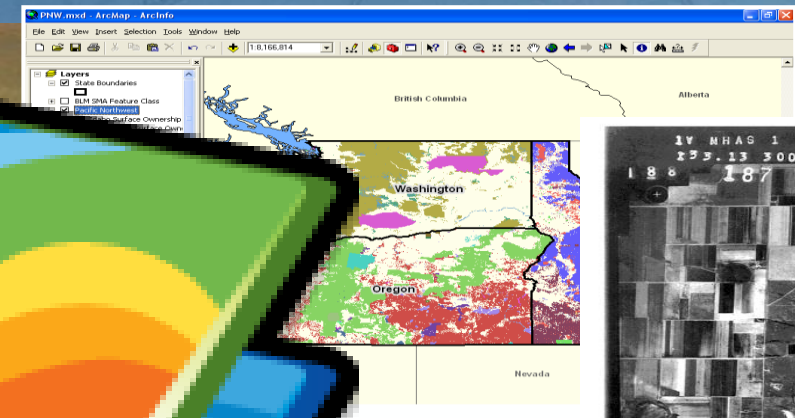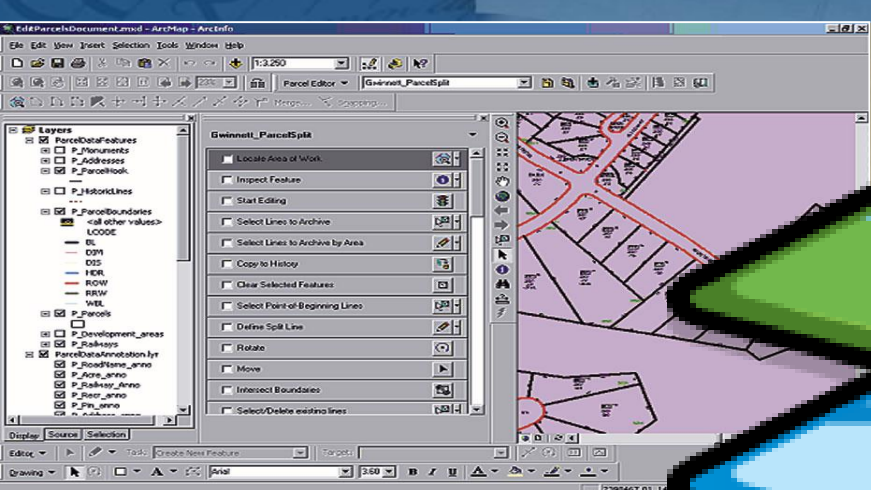Technical interoperability

‹Plant›

Semantic interoperability

* IEE

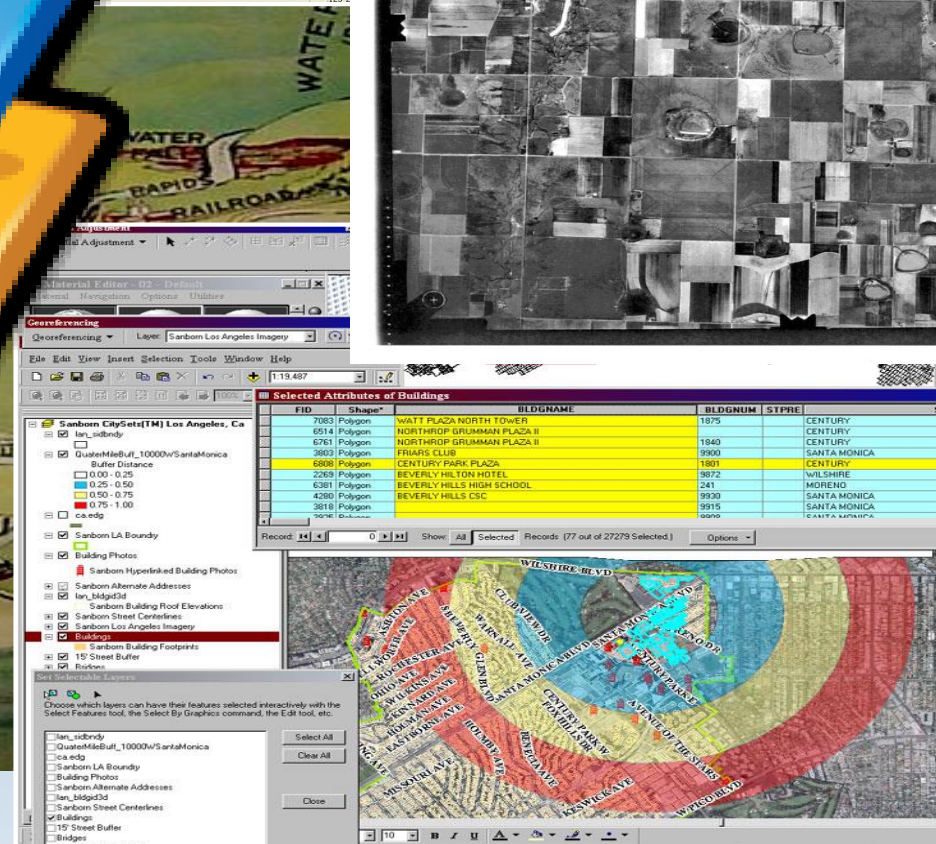# Abstracting unlimited variety of features/phenomena

GIS - merging diverse information

Diverse:
   information types
   formats
   location reference systems
   perspectives
Distributed

Integrated by location

Interoperability enablers

Supportive networks, Interfaces, hardware

Infrastructure

Knowledgeable users → **Interoperability** ← **Standards**

- **Well trained**
- **Understand the need for quality**
- **Metadata to understand and use data and services properly**

Laws

Intellectual property protection, Authorization to share

- **Practical, widely used**
- **Providing technical and semantic interoperability**
- **Fit for purpose**
  - **Geographic structures**
  - **Data formats**
  - **Content description**
  - **Quality**
  - **Data management**
  - **Visualization**
  - **Geoweb services**
  - **Metadata**

ESRI learns about and supports standards through active participation:

Organizations
– ISO TC 211
– OGC
– ANSI/INCITS –L1
– CEN
– Global Map
– GSDI
– DGIWG
– IHO
– GWG

Implementations
– IT/industry standards
– GIS standards

Standards Development
– International Standards
– Regional Standards
– National Standards
– Information Community Standards

Projects/Testbeds
– OGC Web Services testbeds
– GEOSS
– INSPIRE
– NATO Core GIS

Standards

- **An agreement between a provider and a consumer**
  a reference document enabling interoperability
- **Standards Development Organizations (SDOs)**

**ISO TC211
Abstract Models,
Content, Vocabulary.**

**Software
Interfaces:
Instantiations
based on ISO and
W3C standards**

**XML/XSD, HTML,
XSLT, URI. . .**

Domain   **Infrastructure**

Technical interoperability standards

```
<xs:complexType name="MD_Resolution_Type">
    <xs:choice>
        <xs:element name="equivalentScale"
type="gmd:MD_RepresentativeFraction_PropertyType"/>
        <xs:element name="distance"
type="gco:Distance_PropertyType"/>
    </xs:choice>
</xs:complexType>
```

ISO 19139 Metadata XML Schema

WMS

```
<!ELEMENT GetCapabilities (Format+, DCPType+)>
<!ELEMENT GetMap (Format+, DCPType+)>
<!ELEMENT GetFeatureInfo (Format+, DCPType+)>
```

GML

```
<complexType name="PointType">
    <complexContent>
        <extension base="gml:AbstractGeometricPrimitiveType">
            <sequence>
                <choice>
                    <element ref="gml:pos" />
                    <element ref="gml:coordinates" />
                </choice>
            </sequence>
        </extension>
    </complexContent>
</complexType>

<element name="Point" type="gml:PointType" substitutionGroup="gml:AbstractGeometricPrimitive" />
```

Organizations in which ESRI participates to establish Technical Interoperability

ISO/TC 211
Geographic information/Geomatics

example: ISO 19128, 19139

OGC

example: WMS, WFS, GML
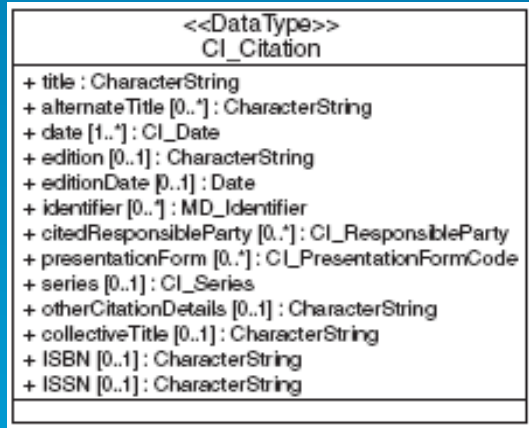
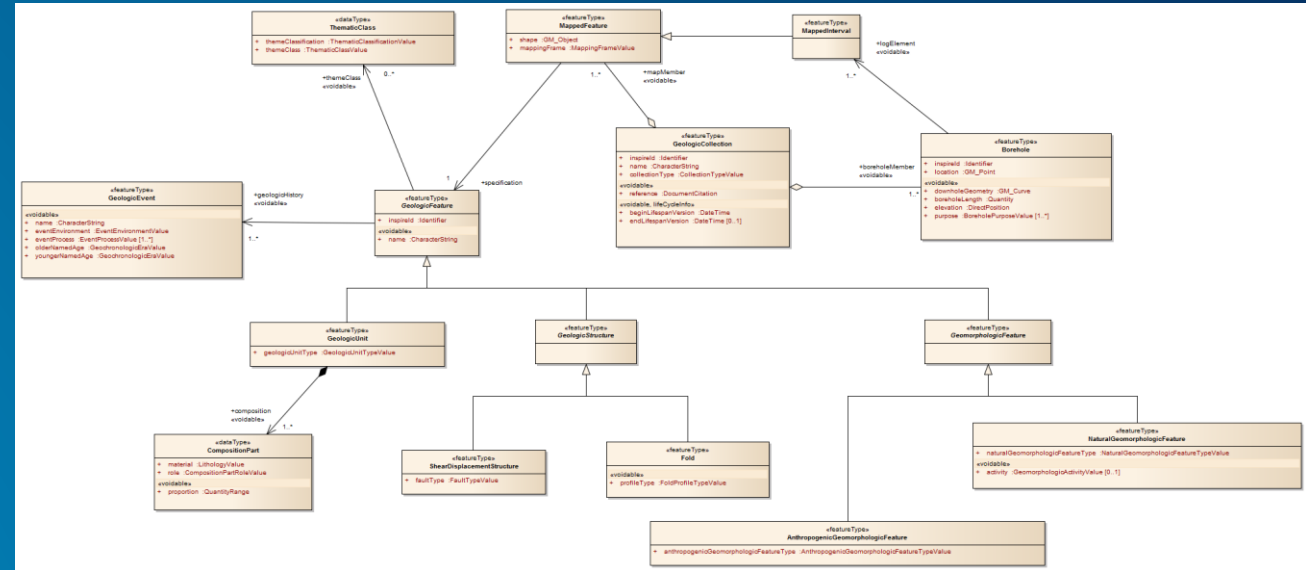W3C WORLD WIDE WEB consortium

example: XML, URI, HTML5

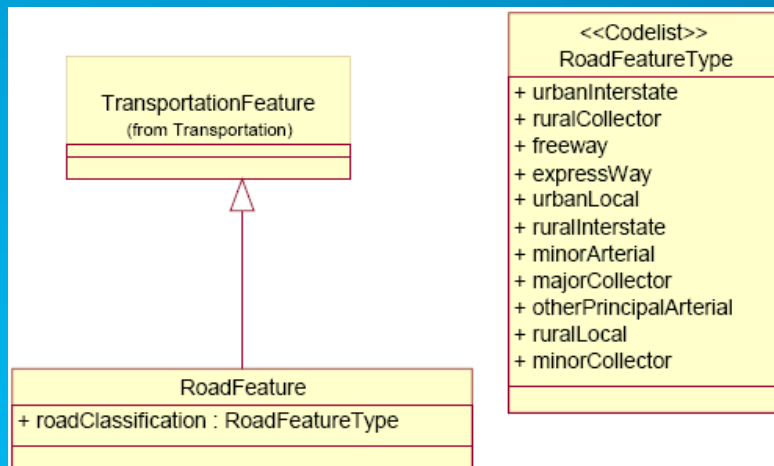# Semantic Interoperability Standards

ISO 19115 Metadata

Title = name by which the resource is known

INSPIRE Data specification on Geology

FGDC Framework data models

GML

Organizations in which ESRI participates to establish Semantic Interoperability

example: ISO 19157 Data quality, 19110 Feature Catalogue Methodology

example: Point Symbology for Emergency Management, NAP

example: INSPIRE Metadata Implementing Rules and Data Specifications

example: FGDC Framework Themes, Content Standard for Digital Geospatial Metadata

GIS Standardization – functional areas

1. **Basic Geographic Structures** (semantic interoperability)
   - ISO Spatial Schema, Coverages, Coordinate Ref Systems standards

2. **Content description** (semantic interoperability)
   - FACC, SDSFIE, Standardized Data Models
   - Feature Catalogs, Metadata

3. **Data Management** (semantic and technical)
   - OGC Simple Features

4. **Data Formats** (technical interoperability)
   - VPF, OGC GML

5. **Visualization** (semantic and technical)
   - SLD, MIL-STD 2525

6. **GeoWeb Services** (technical interoperability)
   - OGC Catalog, Web Services, HTTP

Putting it all together
Using standard's functional areas to provide geographic knowledge
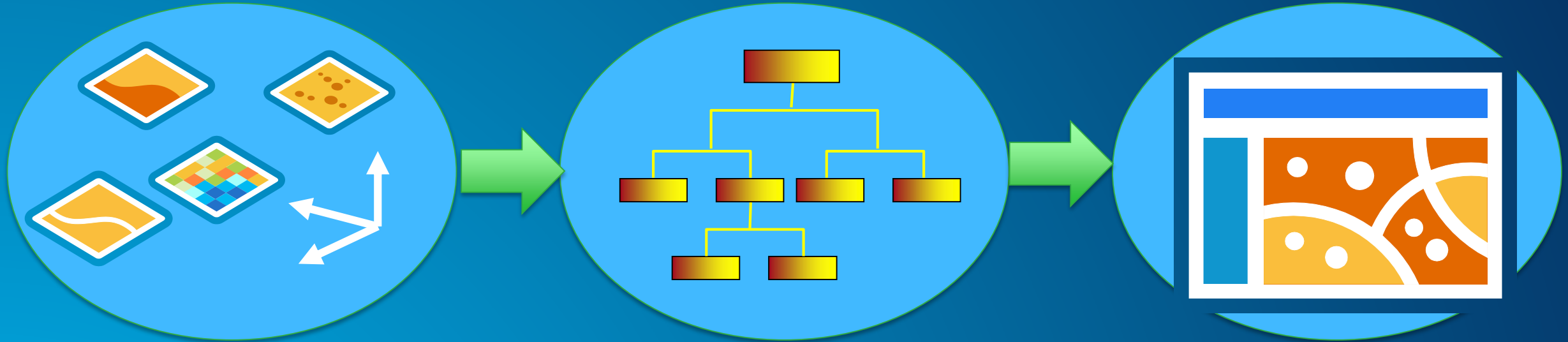
Basic Geographic Structure

Examples:
ISO 19107 Spatial Schemas
ISO 19111 Spatial referencing by coordinates
ISO 19123 Schema for coverage geometry
and functions

Content Description

Examples:
ISO 19109 Rules for Application Schemas
ISO 19110 Feature Catalog
ISO 19115 Metadata
ISO 19144 Classification Systems

**Data Management
Data Format
Visualization
Web services**

Examples:
GML, WMS, WCS
WFS, MIL-STD 2525

ISO TC 211Participation

- ESRI provides leadership role in ISO TC 211 Standards Development:
  - Project lead on many ISO Standards
  - Provide technical experts on many Work Item project teams
  - Provide support for ISO TC 211 standards outreach
  - Meeting sponsorship

ISO TC 211 Standards examples

ISO 19107 Spatial schema
     Conceptual schemata for describing, representing and manipulating the spatial characteristics of geographic features

ISO 19111 Spatial referencing by coordinates
     Defines the conceptual schema for spatial reference systems. The data required to define 1, 2, and 3-dimensional systems

ISO 19115 Metadata
     Schema for describing geographic information and services
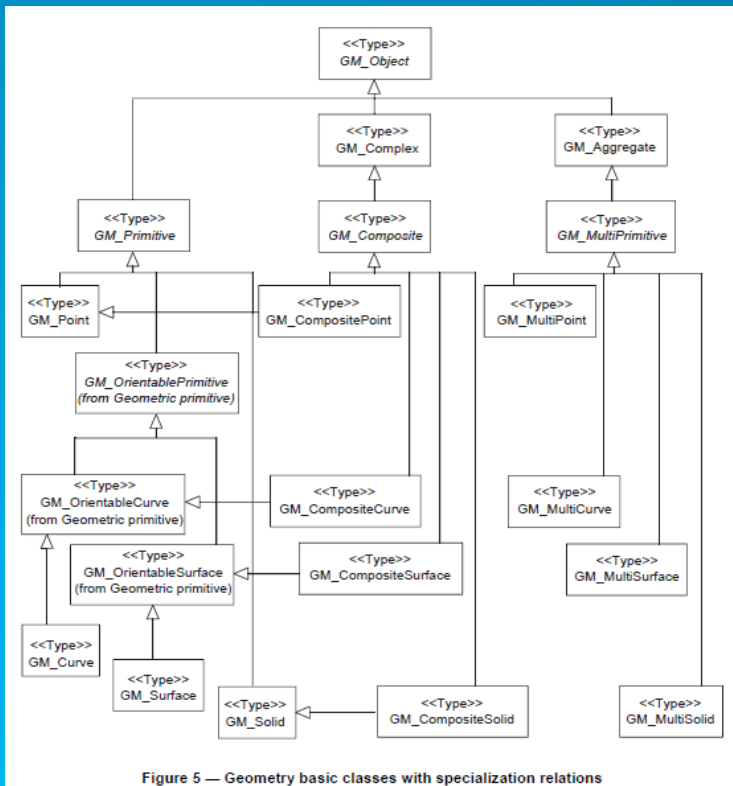
Figure 5 — Geometry basic classes with specialization relations
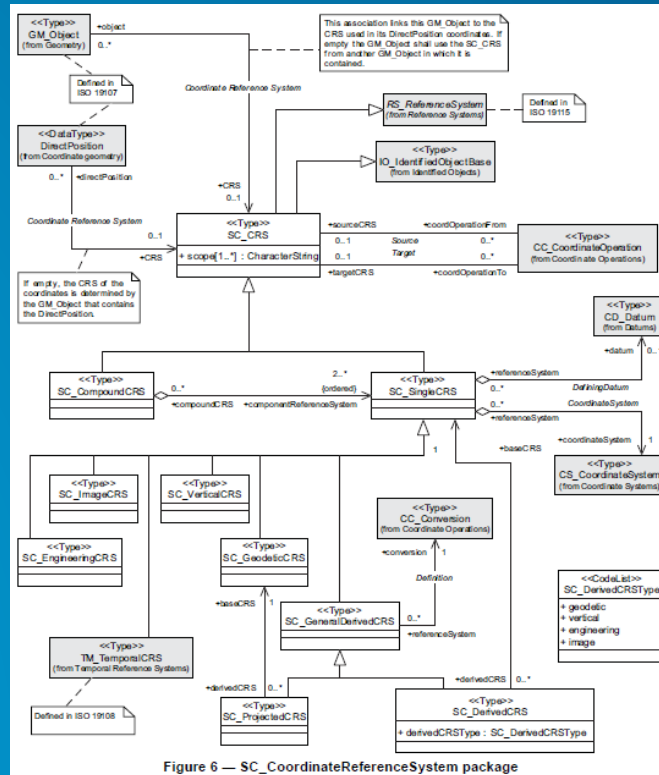
Figure 6 — SC_CoordinateReferenceSystem package
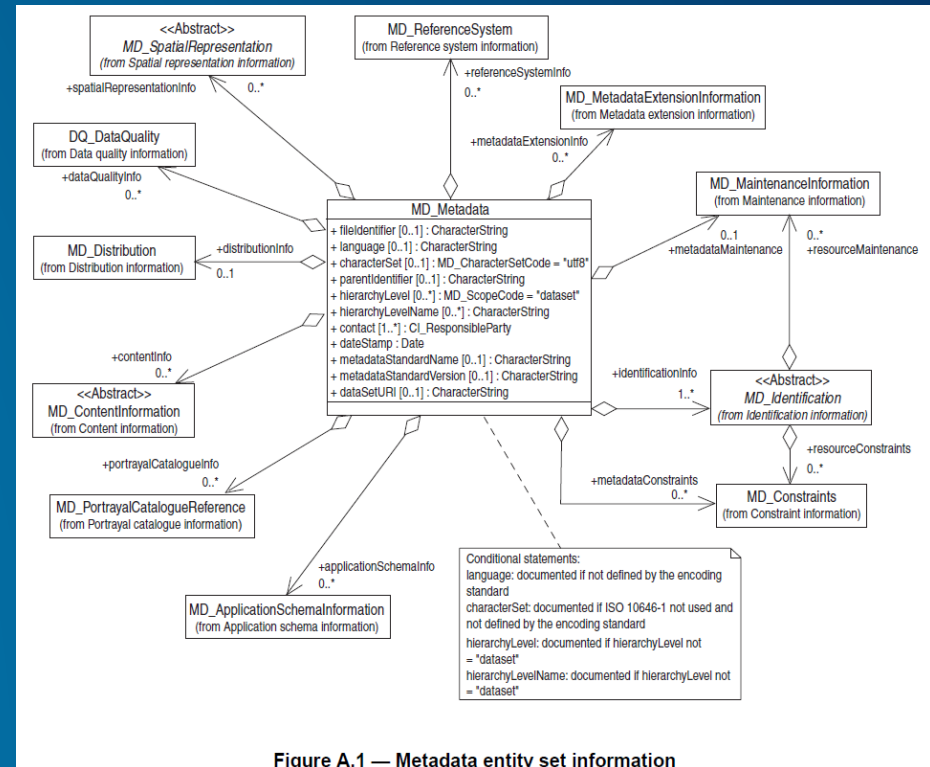
Figure A.1 — Metadata entity set information

ESRI serves many roles within OGC

Board of Directors

Architecture Board

Planning Committee

Technical Committee

Lead several Standards and Domain Working Groups

Joint Advisory Group to ISO TC211

OGC Forums

Testbeds & Plugfests

Testing & Compliancy

Outreach Program

Financial Support

160+ Compliant past and present products

http://www.opengeospatial.org/resource/products/compliant#ESRI

Closing Plenary

Hosted and Sponsored by
esri

83rd OGC Technical Committee
Redlands, CA USA
Carl Reed
January 17, 2013

OGC Web Services examples

Web Map Service
Geospatial "picture" publishing/viewing service

Web Map Tile Service
static base maps where the bounding box and scales have been constrained to discrete **tiles**
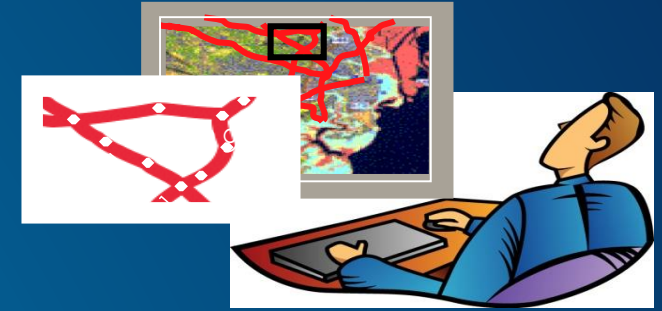
Web Feature Service
Geospatial feature publishing/streaming service

Web Coverage Service
Imagery and gridded data publishing/processing service
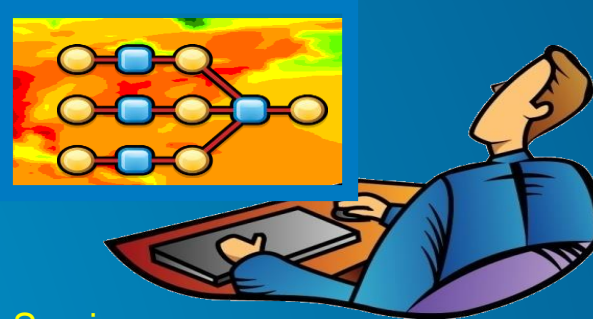
Web Processing Service
Interface for publishing geospatial algorithms, calculations or models

Global Map http://ww
   Abstract: vector data
NOAA Weather htt
   Abstract: point featur
Landsat http://www.N
   Abstract: 30m satelli

Catalog Service-Web
Metadata publishing/search service

ISO TC 211 Standards

6709:2008 - Standard representation of latitude, longitude and altitude for geographic point locations
19101:2002 - Reference model Part 1: Fundamentals
19101-2:2008 - Reference model - Part 2: Imagery
19103:2005 - Conceptual schema language
19104:2008 - Terminology
19105:2000 - Conformance and testing
19106:2004 - Profiles
19107:2003 - Spatial schema
19108:2002 - Temporal schema
19109:2005 - Rules for applicaiton schema
19110:2005 - Methodology for feature cataloguing
19111:2007 - Spatial referencing by coordinates
19111-2:2009 - Extension for parametric value
19112:2003 - Spatial referencing by geographic identifiers
19113:2002 - Quality principles
19114:2003 - Quality evaluation procedures
19115:2003 - Metadata
19115-2:2009 - Extension for imagery and gridded data
19116:2004 - Positioning services
19117:2005 - Portrayal
19118:2005 - Encoding
19119:2005 - Services
19120:2001 - Functional standards
19121:2000 - Imagery and gridded data
19122:2004 - Qualifications and Certification of personnel
19123:2005 - Schema for coverage geometry and functions
19124 - Imagery and gridded data components
19125-1:2004 - Simple feature access - Part 1: Common architecture
19125-2:2004 - SQL option
19126:2009 - Profile - FACC Data Dictionary
19127:2005 - Geodetic codes and parameters
19128:2005 - Web Map server interface
19129:2009 - Imagery, gridded and coverage data framework

19130:2010 -Sensor and data models for imagery and gridded data
19130-2 - SAR, InSAR, Lidar and Sonar
19131:2007 - Data product specifications
19132:2007 - Location based services - Reference model
19133:2005 - Location based services - Tracking and navigation
19134:2007 - Multimodal location based services for routing and navigation
19135:2005 - Procedures for registration of geographical information items
19135-2 - XML Schema Implementation
19136:2007 - Geography Markup Language
19137:2007 - Core profile of the spatial schema
19138:2006 - Data quality measures
19139:2007 - Metadata - XML schema implementation
19141:2008 - Schema for moving features
19142:2010 - Web Feature Service
19143:2010 - Filter encoding
19144-1:2009 - Classification Systems – Part 1: Classification system structure
19144-2 - Land Cover Meta Language (LCML)
19145 - Registry of representations of geographic point location
19146:2010 - Cross-domain vocabulary
19147 - Transfer nodes
19148 - Linear referencing
19149 - Rights expression language for geographic information
19150-1 - Ontology - Part 1: Framework
19150-2 - Ontology - Part 2: Rules for developing OWL
19148 - Linear referencing
19152 - Land Administration Domain Model (LADM)
19153 - Geospatial Digital Rights Management Reference Model
19154 - Ubiquitous public access - Reference model
19155 - Place Identifier (PI) Architecture
19156 - Observations and measurements
19157 - Data quality
19158 - Quality assurance of data supply
19159 - Calibration and validation of remote sensing imagery sensors and data
19160 - Addressing

OGC Standards

1. Cat: ebRIM App Profile: Earth Observation Products
2. Catalogue Service
3. CityGML
4. Coordinate Transformation
5. Filter Encoding
6. GML in JPEG 2000
7. GeoAPI
8. Geopackage
9. GeoSparql
10. Geography Markup Language
11. Geospatial eXtensible Access Control Markup Language (GeoXACML)
12. IndoorGML
13. KML
14. Location Services (OpenLS)
15. NetCDF
16. Observations and Measurements
17. Open GeoSMS
18. OpenMI
19. OpenSearch Geo
20. Ordering Services Framework for Earth Observation Products
21. OWS Context
22. PUCK
23. SWE Common Data Model
24. SWE Service Model
25. Sensor Model Language
26. Sensor Observation Service
27. Sensor Planning Service
28. Simple Features
29. Simple Features CORBA
30. Simple Features OLE/COM
31. Simple Features SQL
32. Styled Layer Descriptor
33. Symbology Encoding
34. Table Joining Service
35. WaterML
36. Web Coverage Processing Service
37. Web Coverage Service
38. Web Feature Service
39. Web Map Context
40. Web Map Service
41. Web Map Tile Service
42. Web Processing Service
43. Web Service Common

W3C Standards

Accessibility (All)
Accessible Rich Internet Applications (WAI-ARIA)
Authoring Tool Accessibility Guidelines (ATAG)
Best Practices for Authoring HTML
CC/PP
CSS
Declarative Web Applications
Device Description Repository
DOM
DOM events
Efficient XML Interchange
eGovernment
Geospatial
Government Linked Data
Graphics
GRDDL
HTML
HTTP
InkML
Internationalization (All)
Internationalization of Web Architecture
Internationalization of Web Design and Applications
Internationalization of XML
Javascript APIs
Linked Data
MathML
Media Access
Mobile Web Applications
Mobile Web Authoring

Multimodal Web Applications
OWL Web Ontology Language
P3P
PICS
PNG
POWDER
Provenance
Quality Assurance (QA) Framework
RDB2RDF
RDF
RDF Relationship to Other Formats
RDF vocabularies
RDFa
RIF Rule Interchange Format
Security for User Agents
Security for Web Applications
Semantic Annotation for WSDL and XML Schema
Service Modeling Language (SML)
SKOS
SMIL
SOAP
SPARQL
Stylesheets in XML
SVG
SVG Tiny
Timed Text
User Agent Accessibility Guidelines (UAAG)
Voice
Web Architecture

Web Content Accessibility Guidelines (WCAG)
Web Fonts
Web Performance
Web Services Addressing
Web Services Policy
Web Services Resource Access
WebCGM
Widgets
WSDL
XForms
XHTML For Mobile
XHTML Modularization
XInclude
XKMS
XLink
XML
XML Base
XML Canonicalization
XML Design Techniques
XML Encryption
XML Pipeline (XProc)
XML Schema
XML Signature
XML-binary Optimized Packaging
xml:id
XPath
XPointer
XQuery
XSL-FO
XSLT

Coordinate Reference systems supported by ArcGIS

- **Geographic coordinate systems**
  - **Africa (93)**
  - **Antarctica (6)**
  - **Asia (97)**
  - **Atlantic Ocean (30)**
  - **Australia/New Zealand (6)**
  - **Caribbean (22)**
  - **Europe (92)**
  - **Indian Ocean (9)**
  - **North America (34)**
  - **Pacific Ocean (56)**
  - **Solar System (9)**
  - **South America (39)**
  - **Spheroid-based (47)**
  - **World (17)**

- **Projected coordinate systems**
  - **Arc (equal arc-second) (18)**
  - **Continental**
    - **Africa (4)**
    - **Asia (7)**
    - **Europe (9)**
    - **North America (24)**
    - **South America (3)**
  - **Gauss Kruger**
    - **Asia (4)**
    - **Beijing 1954 (61)**
    - **CGCS2000 (62)**
    - **Europe (59)**
    - **New Beijing (65)**
    - **Pulkovo 1942 (~200)**
    - **Pulkovo 1995 (~200)**
    - **Turkey (7)**
    - **Xian 1980 (68)**

- **National Grids**
  - **Africa**
  - **Argentina**
  - **Asia**
  - **Australia**
  - **Austria**
  - **Canada**
  - **Europe**
  - **Finland**
  - **France**
  - **Germany**
  - **Indian Subcontinent**
  - **Indonesia**
  - **Japan**
  - **Libya**

- **Malaysia and Singapore**
- **New Zealand**
- **North America**
- **Norway**
- **Oceans**
- **South Africa**
- **South America**
- **South Korea**
- **Sweden**
- **Turkey**
- **Polar**
- **State Plane**
- **State Systems**
- **UTM**
- **World**
- **World (Sphere-based)**

FGDC endorsed External Standards (1)

- **GeoTIFF Revision 1.0**
- **Hierarchical Data Format V 5.0**
- **Codes for Identification of Hydrologic Units in the U.S. and the Caribbean (Outlying) Areas . . .**
- **Codes for the Identification of Counties and Equivalent Areas of the United States . . .**
- **Codes for the Identification of the States and Equivalent Areas within the United States, Puerto Rico, and the Insular Areas**
- **Identifying Attributes for Named Physical and Cultural Geographic Features (Except Roads and Highways) of the United States . . .**
- **North American Profile of ISO 19115:2003 - Geographic information - Metadata (NAP - Metadata)**
- **Codes for the Identification of Metropolitan and Micropolitan Statistical Areas and Related Statistical Areas of the United States and Puerto Rico**
- **Codes for the Identification of Congressional Districts and Equivalent Areas of the United States . . .**
- **ISO 19107 - Spatial schema**
- **ISO 19108 - Temporal schema w/Corrigendum 1**
- **ISO 19110 - Methodology for Feature Cataloguing**
- **ISO 19111 - Spatial referencing by coordinates + extension for parametric values**
- **ISO 19112 - Spatial referencing by geographic identifiers**

- ISO 19115 - Metadata + Corrigendum 1
- ISO 19115 - Metadata - Part 2: Extensions for imagery and gridded data
- **ISO 19118 - Encoding**
- **ISO 19119 – Services + Amd 1**
- **ISO 19123 - Schema for coverage geometry and functions**
- **ISO 19132 - Location Based Services - Reference model**
- **ISO 19133 - Location Based Services - Tracking and navigation**
- **ISO 19134 - Location Based Services - Multimodal routing and navigation**
- **ISO 19135 - Procedures for registration of geographical information items**
- **ISO 19141 - Schema for moving features**
- **ISO 19109 - Rules for application schema**
- **ISO 19127 - Geodetic codes and parameters**
- **ISO 19131 - Data product specifications + Amendment 1**
- **ISO 19136 - Geographic Markup Language**
- **ISO 19144 -- Classification Systems -- Part 1: Classification system structure**
- **ISO 3166 - Codes for the Representation of Names Of Countries and their Subdivisions**

FGDC endorsed External Standards (2)

- ISO 6709Standards representation of geographic point locations by coordinates w/Corrigendum 1
- ISO/IEC 13818 -2: MPEG 2 - video
- ISO/IEC 13818-3: MPEG 2 - audio
- ISO/IEC 15444-1: JPEG 2000
- ISO/IEC IS 10918-1 : JPEG
- ISO 19103 - Conceptual schema language
- ISO 19104 - Terminology
- ISO 19138 -- Data quality measures
- ISO 19139 -- Metadata -- XML schema implementation
- NetCDF (Network Common Data Form)
- Web Feature Service Implementation Specification, version 1.1.0 with Corrigendum 1
- Filter Encoding Implementation Specification, version 1.1
- Web Map Context (WMC) Documents Implementation Specification, Version 1.1.0 w/Corrigendum 1
- Web Processing Service, Version: 1.0.0 w/ Corrigendum
- Symbology Encoding Implementation Specification, version 1.1.0
- Styled Layer Descriptor profile of the Web Map Service Implementation Specification, version 1.1.0
- Sensor Observation Service Interface Standard, version 1.0.0

- Location Services: Tracking Service Interface Standard
- Web Map Service Implementation Specification, Version 1.3.0
- SensorML Encoding Standard v 1.0 w/Schema Corrigendum 1 (1.01)
- Catalogue Service (CAT) Implementation Specification (2.0.2) + Corrigendum for OpenGIS Implementation Specification 07-006: Catalogue Services, Version 2.0.2
- Catalogue Services Specification 2.0.2 - ISO Metadata Application Profile
- Web Map Tile Service Implementation Standard, version 1.0.0
- Web Coverage Service (WCS) Implementation Standard, version 1.1.2 w/Corrigendum 2
- Location Services (OpenLS): Core Services, version 1.2
- OGC KML 2.2 – Abstract Test Suite (1.0.0)
- KML, version 2.2.0
- Location Services (OpenLS): Part 6-Navigation Service
- Location Services: Tracking Service Interface Standard
- Sensor Planning Service Implementation Specification, version 1.0.0
- Tagged Image File Format (TIFF)
- Unified Model Language (UML)2.2
- GENC Ed.1 Geopolitical Entities, Names, and Codes Standard, Edition 1.0
- ISO 19156 Observation and Measurements
- OGC WaterML 2.0 Part 1 – Time series
- Time-Space-Position Information (TSPI), Version 2.0

DISR approved GEOINT Standards – mandated (1)

AIXM 5.1	Aeronautical Information Exchange Model
BPCGM01.00	BIIF Profile for Computer Graphics Metafile
BPJ2K01.10	BIIF Profile for JPEG 2000,
CAT 2.0.2	Catalogue Service (CAT) Implementation Specification
DGIWG FACC	DGIWG Feature and Attribute Coding Catalogue
GRIB WMO No. 306	Manual on Codes, International Codes,
Ext. BUFR WMO	Manual on Codes, International Codes, Volume 1.2
GeoTIFF Revision 1	GeoTIFF Format Specification,
GeoXACML GML2	Geospatial eXtensible Access Control Markup
GeoXACML GML3	Geospatial eXtensible Access Control Markup Language
GML 3.1.1	Geography Markup Language Encoding Specification
IEC 80000-6:2008	Quantities and units - Part 6: Electromagnetism
ISO 19107:2003	Spatial schema
ISO 19108:2002	Temporal schema
ISO 19109:2005	Rules for application schema
ISO 19110:2005	Methodology for feature cataloguing
ISO 19111:2007	Spatial referencing by coordinates
ISO 19112:2003	Spatial referencing by geographic identifiers
ISO 19115-2:2009	Metadata - Part 2: Extensions for imagery and gridded data
ISO 19115:2003	Metadata, 8 May 2003, with Technical Corrigendum 1
ISO 19119:2005	Services
ISO 19123:2005	Schema for coverage geometry and functions,
ISO 19126:2009	Feature concept dictionaries and registers,
ISO 19135:2005	Procedures for item registration,
ISO 19136:2007	Geography Markup Language,
ISO 19142:2010	Web Feature Service,
ISO 3166-1:2006	Part 1: Country codes,
ISO 3166-2:2007	Part 2: Country subdivision code,
ISO 6709:2008 w/Cor1:2009	Standard representation of geographic point location by coordinates
ISO 80000-1:2009	Quantities and units - Part 1: General
ISO 80000-3:2006	Quantities and units - Part 3: Space and time
ISO 80000-4:2006	Quantities and units - Part 4: Mechanics
ISO 80000-7:2008	Quantities and units - Part 7: Light

ISO 8601:2004	Representation of dates and times
ISO/IEC 12087-5	Basic Image Interchange Format
ISO/IEC 13818-1	Generic coding of moving pictures and associated audio information
ISO/IEC 13818-2	MPEG-2 Video
ISO/IEC 13818-3	MPEG-2 Audio
ISO/IEC 15444-1:	JPEG 2000 image coding system: Edition 1
ISO/IEC 15444-9	JPEG 2000 image coding system: Interactivity tools,
ISO/IEC 8632-1	Computer Graphics - Metafile for the storage and transfer of picture description information - Functional specification,
ISO/IEC 8632-3	Computer Graphics - Metafile for the storage and transfer of picture description information - Binary encoding,
ISO/TS 19138:2006	Data quality measures
ISO/TS 19139:2007	Metadata - XML schema implementation
ITU-R TF460-6	Standard-frequency and time-signal emissions
ITU-T Rec. H.264	Advanced video coding for generic audiovisual service
ITU-T T.81	Digital compression and coding of continuous-tone still images
Joint METOC JMBLv. 3.31	Joint METOC Broker Language
MIL-STD-188-198A	JPEG Image Compression for NITF
MIL-STD-188-199	Vector Quantization Decompression for NITF
MIL-STD-2401	DoD World Geodetic System 84 (WGS84)
MIL-STD-2407(1)	Interface Standard for Vector Product Format (VPF)
MIL-STD-2411(2)	Raster Product Format; with Notice of Change,
MIL-STD-2411-1	Registered Data Values For Raster Product Format
MIL-STD-2411-2(1)	Raster Product Format Files into NITF
MIL-STD-2500C	National Imagery Transmission Format Standard
MISB 0102.9	Security Metadata Universal and Local Sets for Digital Motion Imagery
MISB 0301.5, v1.5	Profile for Aerial Surveillance and Photogrammetry Applications
MISB 0404	Compression for Infrared Motion Imagery
MISB 0601.5	UAS Datalink Local Metadata Set
MISB 0604.2	Time Stamping and Transport of Compressed Motion Imagery and Metadata
MISB 0807.10	KLV Metadata Dictionary
MISB 0902.1	Motion Imagery Sensor Minimum Metadata Set
MISB STD 0107.1	Bit and Byte Order for Metadata in Motion Imagery Files and Streams
MISB STD 0403.3	Digital Representation for Infrared Motion Imagery
MISB STD 0603.1	Common Time Reference for Digital Motion Imagery
MISB STD 0605.3	Inserting Time Stamps and Metadata in High Definition Uncompressed Video

https://nsgreg.nga.mil/DISR-approved.jsp

DISR approved GEOINT Standards – mandated (2)

Standard	Description
MISB STD 0903.3	Video Moving Target Indicator and Track Metadata
MISP v6.4	Motion Imagery Standards Profile
NGA.IP.0001_2.0	Implementation Profile for GeoTIFF
NGA.IP.0002_1.0	High Resolution Elevation (HRE) Products,
NGA.IP.0003_1.0	NITF Implementation Profile for LiDAR Systems
NGA.IP.0006_1.0	NITF Implementation Profile for Tactical Hyperspectral Imagery
NGA.STND.0012-1_2.1	NSG Metadata Foundation (NMF) - Part 1: Conceptual Schema
NGA.STND.0012-2_1.0	NSG Metadata Foundation (NMF) - Part 2: Quality Metadata,
NGA.STND.0012-3_1.0.0	NSG Metadata Foundation (NMF) - Part 3: Metadata for Imagery and Gridded Data
NGA.STND.0015_3.1	Display Performance Standard, Version 3.1
NGA.STND.0016_2.1	Softcopy Exploitation Facility Standard, Version 2.1
NGA.STND.0017_3.0.1	Community Sensor Model (CSM) Technical Requirements Document
NGA.STND.0018_2.1	NSG Metadata Implementation Specification (NMIS) XML Exchange Schema
NGA.STND.0020_5.0	NSG Feature Data Dictionary (NFDD), Version 5.0
NGA.STND.0021_5.0	NSG Entity Catalog (NEC), Version 5.0
NGA.STND.0022_5.0	NSG Application Schema (NAS) - Part 1: Platform Independent Model, Version 5.0
NGA.STND.0024-1_1.0	Sensor Independent Complex Data (SICD) Design & Implementation Description Document
NGA.STND.0024-2_1.0	SICD, File Format Description Document
NGA.STND.0024-3_1.0	SICD Image Projections Description Document
NGA.STND.0025-1_1.0	SIDD Design and Implementation Description Document
NGA.STND.0025-2_1.0	Sensor Independent Derived Data (SIDD) NITF File Format Description Document, Version 1.0
NGA.STND.0025-3_1.0	Sensor Independent Derived Data (SIDD) GeoTIFF File Format Description Document
NGA.STND.0026_5.0	NSG Topographic Data Store (TDS) Content Specification, Version 5.0
NGA.STND.0033_1.0	Geopolitical Entities, Names, and Codes (GENC) Standard, Edition 1.0
NGA.STND.0034_4.1.26	Joint OPIR Logical Data Model (JODM) Version 4.1.26
OCL v2.2	Object Constraint Language (OCL), Version 2.2
OGC GML sfp v2.0 w/Cor	Geography Markup Language (GML) simple features profile,
OGC KML 2.2.0	OGC KML, Version 2.2.0
OGC SensorML v1.0.0	OpenGIS Sensor Model Language (SensorML)
OGC SLD 1.1.0	Styled Layer Descriptor
OGC WCS 1.1.2	Web Coverage Service (WCS) Implementation Standard
OpenGIS Filter 1.1	Filter Encoding Implementation Specification, Version 1.1.0
OpenGIS SOS 1.0	Sensor Observation Service Implementation Specification,
Rec. BT.601-6 (01/07)	Studio encoding parameters of digital television for standard 4:3 and 16:9 aspect ratios,
SDSFIE 3.0 Gold	Spatial Data Standards for Facilities, Infrastructure, and Environment,
SE 1.1.0	Symbology Encoding Implementation Specification, Version: 1.1.0
SMPTE 336M-2007	Data Encoding Protocol Using Key-Length-Value,
SMPTE 377M-1-2009	Material Exchange Format (MXF) - File Format Specification
SPS 1.0	Sensor Planning Service Implementation Specification
STANAG 3809	Digital Terrain Elevation Data (DTED) Exchange Format
STANAG 4559	NATO Standard ISR Library Interface, Edition 3
STANAG 4607	NATO Ground Moving Target Indicator Format (GMTIF), Edition 3
STANAG 7098 Edition 2	Compressed ARC Digitized Raster Graphics (CADRG)
STANAG 7099 Edition 2	Controlled Image Base (CIB), 26 November 2004
STANAG 7172 (Ed.2)	Use of Geomagnetic Models
STANAG 7194 Edition 1	NATO Imagery Interpretability Rating Scale (NIIRS)
STDI-0001 v1.3/CN3	National Support Data Extensions (SDE) for the NITF
STDI-0002-1_4.0	Controlled Extensions (CE) for NITF Tagged Record Extensions
STDI-0002-2_1.0	The Compendium of Controlled Extensions (CE) for NITF
STDI-0006, 23 July 2008	National Imagery Transmission Format (NITF)
T3D v6.4r1	Tasked Target Text Data v6.4r1
TIFF Revision 6.0	TIFF, Revision 6.0, Adobe Systems Inc.
U.S. DoD IP 1.1	Motion Imagery for Situational Awareness
U.S. DoD USIP 1.1	Line of Sight Transmission of Motion Imagery for Battlespace Awareness
U.S. DoD USIP 1.2:2012	Beyond Line-of-Sight Transmission of Sensor Data for Battle Space Awareness
UML 2.2	Unified Modeling Language (UML) Superstructure
WFS 1.1	Web Feature Service
WMC 1.1	Web Map Context
WMS 1.3	Web Map Service
WMTS v1.0.0	Web Map Tile Service Implementation Standard
WPS 1.0	Web Processing Service

https://nsgreg.nga.mil/DISR-approved.jsp

Standards for Geospatial Information

- **The bad news – whew, a lot of standards**
  - Many organizations feel their needs are special
  - Politically feel the need for an exclusive approach
  - As a broad based GIS provider Esri is involved a larger number than most
- **The good news**
  - There is overlap!
  - Some standards are foundations for others
  - Esri doesn't need to implement all
  - Some are mainstream IT standards
  - Esri is very active in getting SDOs to work together
  - Interoperability is working ☺

Full list of Esri implementing, compliant, and reference implementations

http://www.opengeospatial.org/resource/products
Sort on ESRI

Interoperability across ArcGIS

Desktop Web Device

Application Layer

ArcGIS Online Portal

Integration Layer
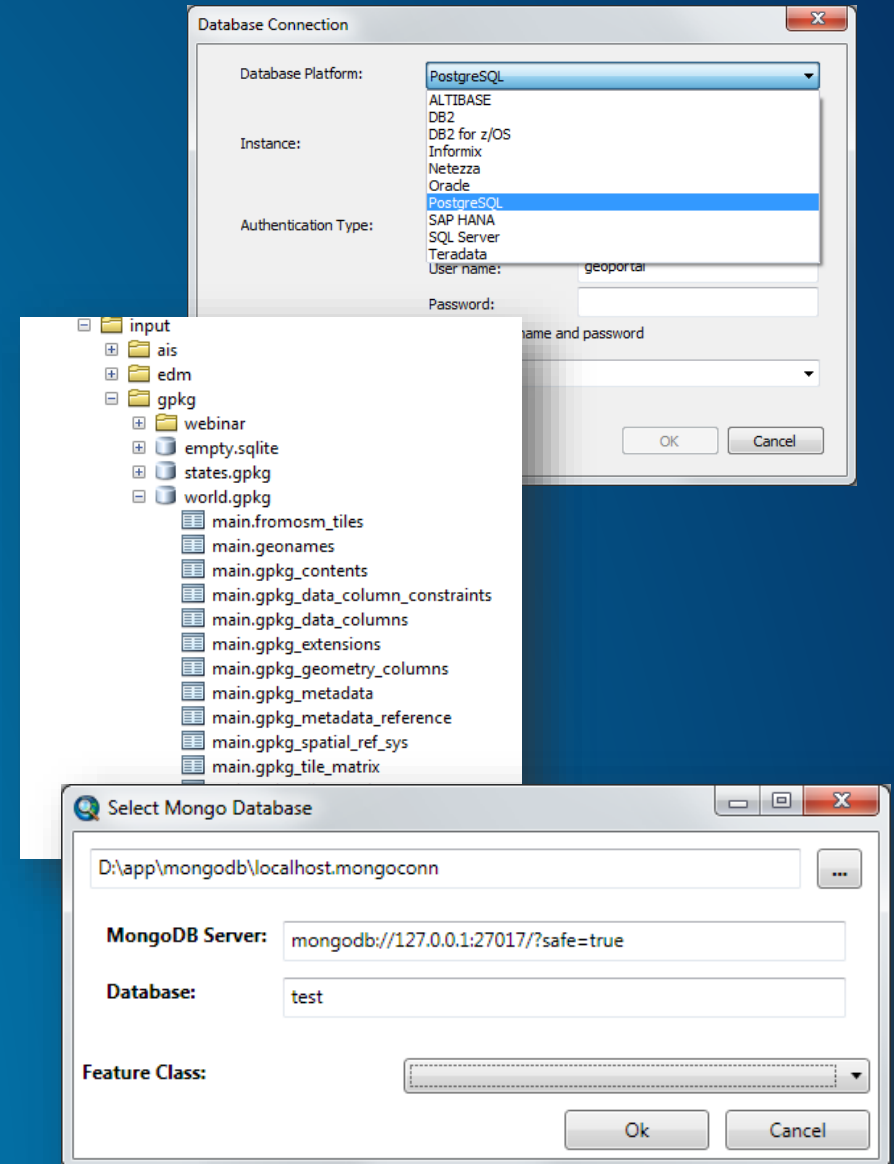
Server

Online Content and Services
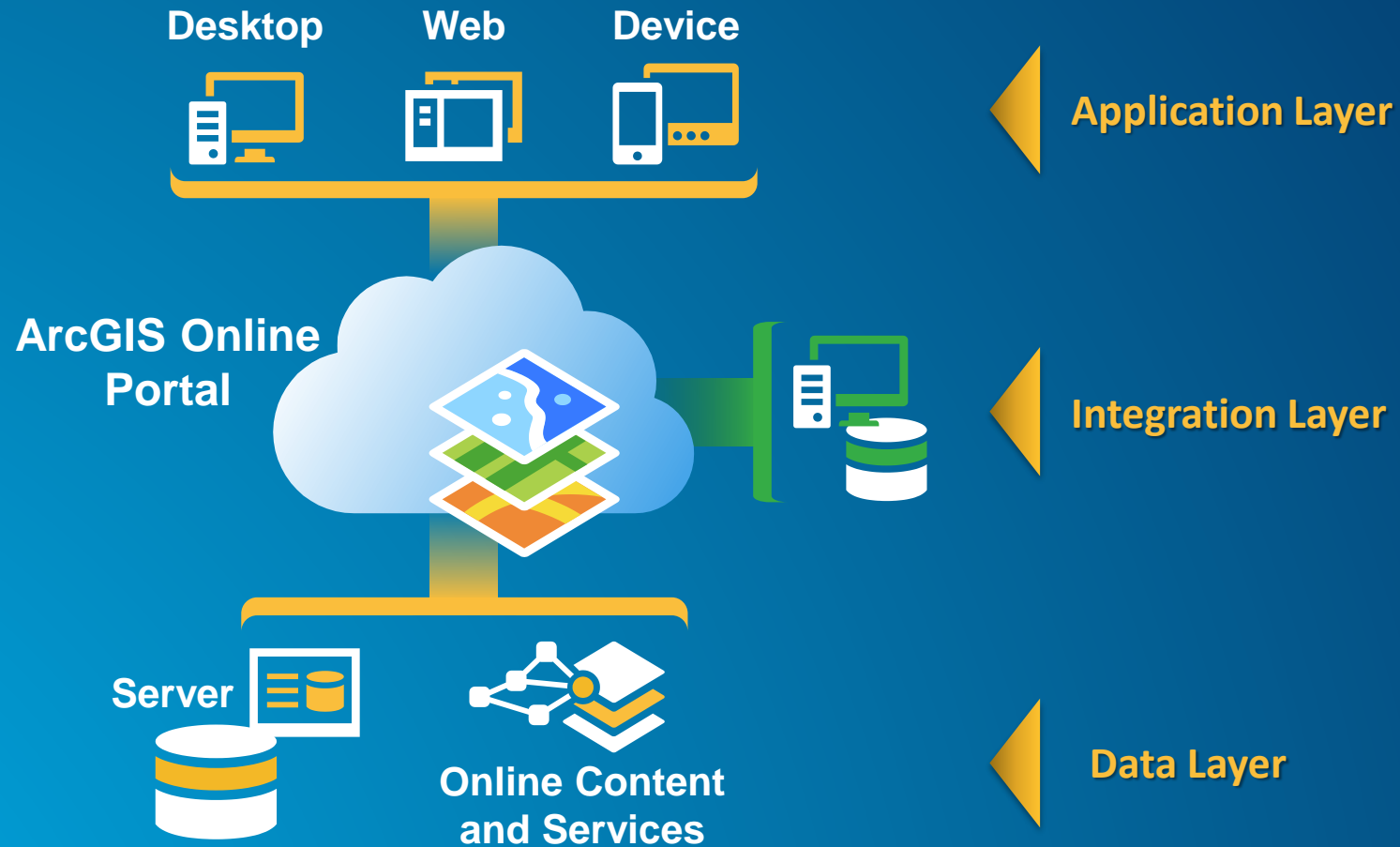
Data Layer

Interoperability across ArcGIS | @martenhogeweg

Data Layer
Exchange, Manage, Analyze

- **Shapefile, Geopackage, SQLite**

- **Relational Databases**

- **BIG Data Sources – Hadoop, SAP HANA, Teradata**

- **Multi-dimensional data – netCDF, GRIB, HDF**

- **Plug-in Data Sources – MongoDB**

- **Focus: Datasets**

Integration Layer
Enterprise GIS Platform

- **Extract Transform Load (ETL) using Python**
- **Data Interoperability Extension**
- **GeoEvent Extension Adapters**
- **OGC WMS, WMTS, WFS, WFS-T, WCS, WPS**
- **Partner Solutions:**
  - **OSIsoft (realtime data, internet of things)**
  - **SAP (enterprise resource management, geoanalytics)**
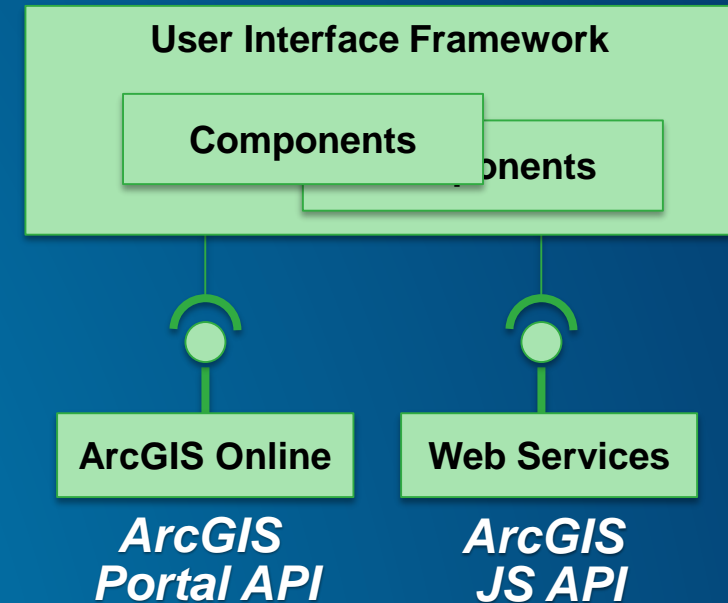 - **…**
- **Focus: Web Services**

Select and configure capabilities

- ☑ Mapping (always enabled)
- ☑ WMS
- ☐ Schematics
- ☐ Network Analysis
- ☐ WFS
- ☐ WCS
- ☐ Feature Access
- ☐ Mobile Data Access
- ☑ KML
- ☐ Maritime Chart Server

Application Layer

- **ArcGIS Apps for**
  - Android, iOS, Windows, …
- **ArcGIS CMS Modules**
  - Drupal, WordPress, SharePoint, Kentico, TYPO3, …
- **ArcGIS API for …**
- **Focus: Webmaps**

Understanding our world.