



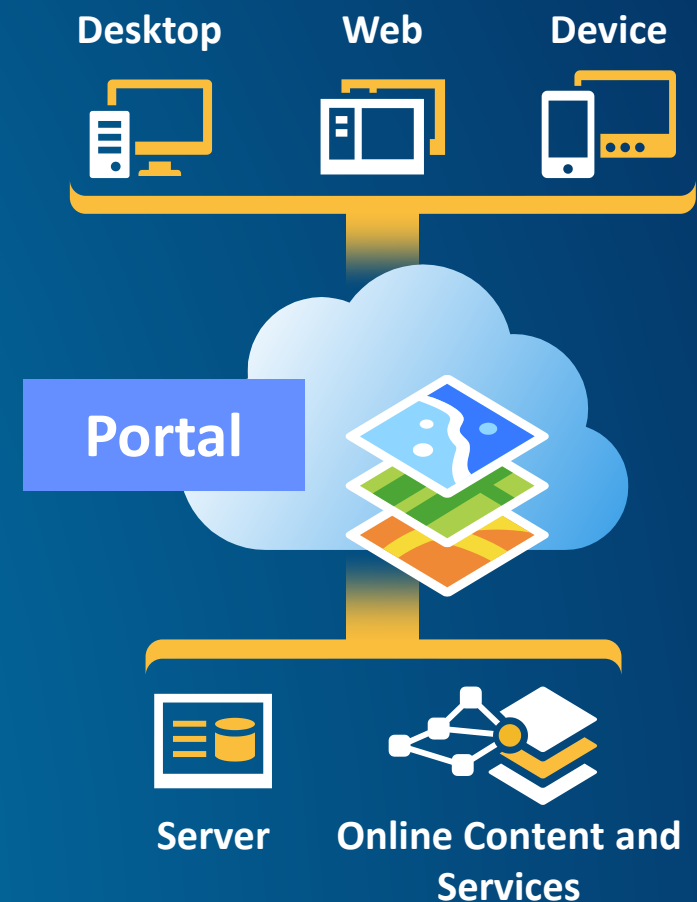
# An Overview of Geospatial Standards Support within the ArcGIS platform

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Satish Sankaran

# The ArcGIS Platform

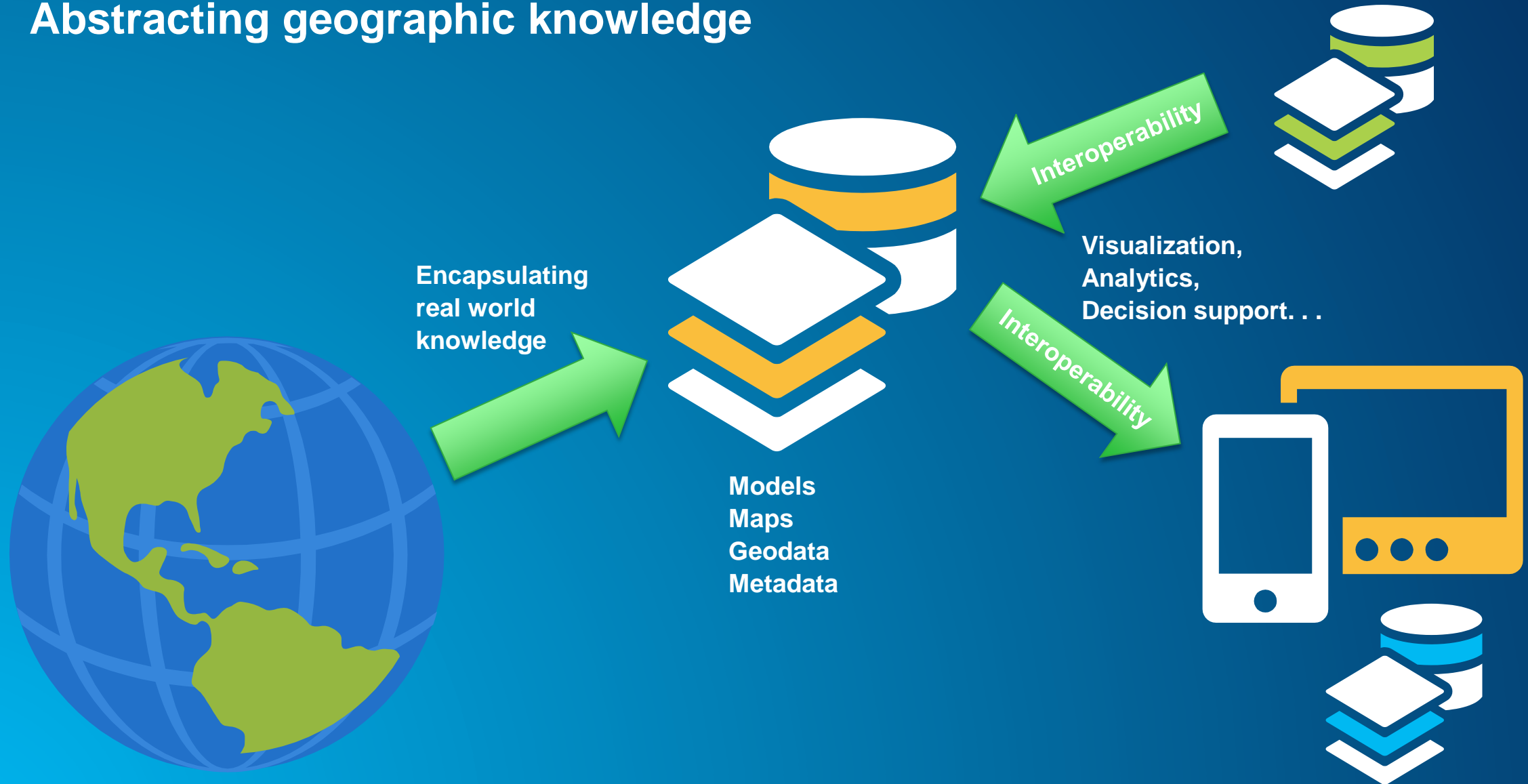
- **An Open & Interoperable Platform**
  - Supporting a thriving ecosystem of focused apps and applications.
- **A Standards Compliant Platform**
  - Supporting many relevant standards including those from ISO TC 211 and OGC.



# Agenda

- **Interoperability** – What, Why and How?
- **Standards** – There's a standard for that?
- **ArcGIS Technology** – Supporting Standards
- **Interoperability – A Recap:** Don't miss the forest for the trees !
- **Interoperability Initiatives** – Lessons learnt from Projects, Testbeds, ...

# Abstracting geographic knowledge



# GIS interoperability – exchanging and using geographic knowledge

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



Technical interoperability

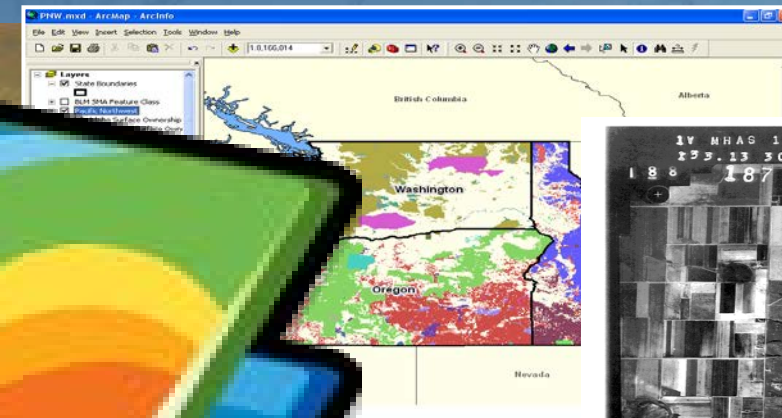
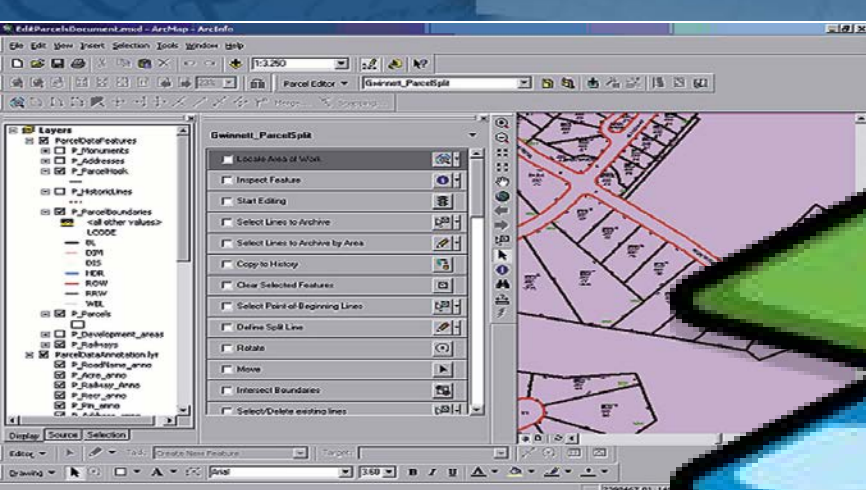


Semantic interoperability

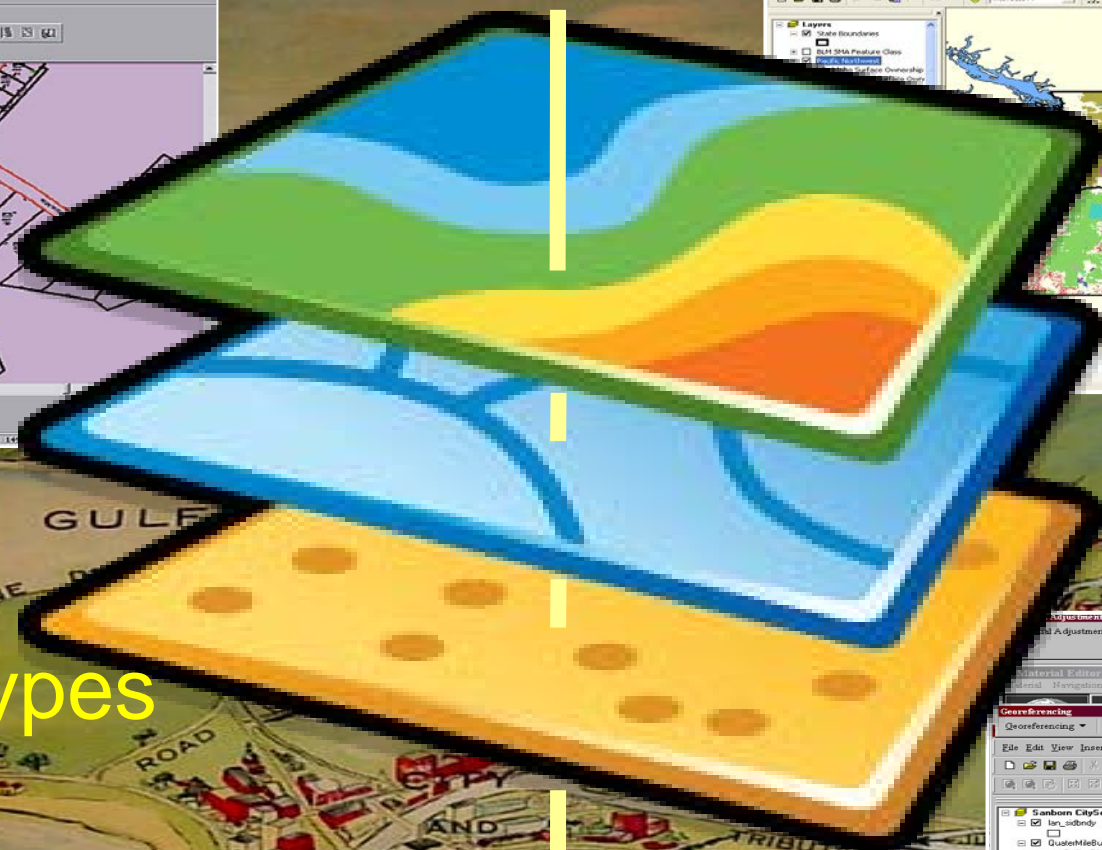
# Abstracting unlimited variety of features/phenomena



# GIS - merging diverse information



Diverse:  
information types  
formats  
location reference systems  
perspectives  
Distributed

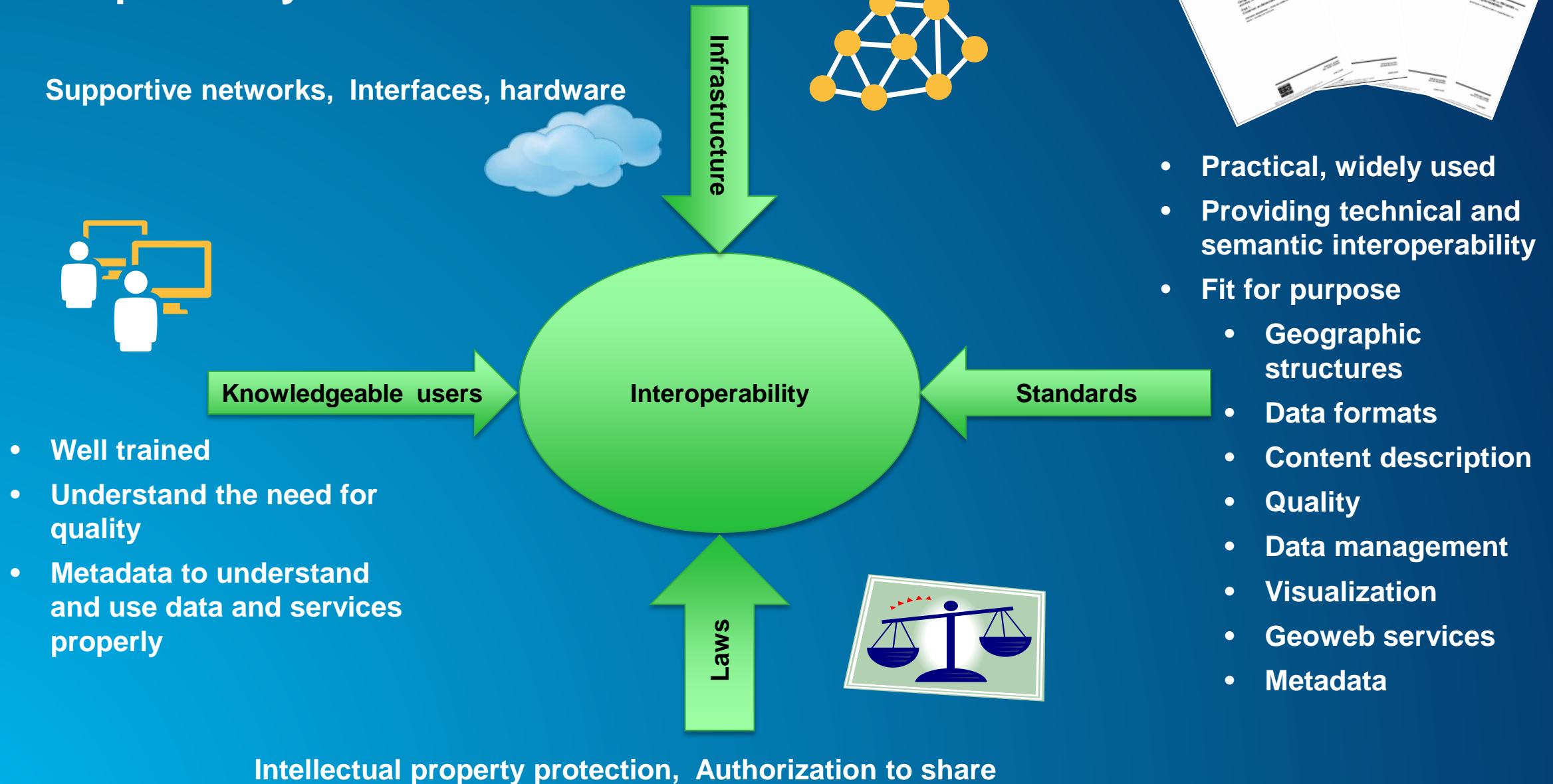


A screenshot of the ArcMap software interface showing a map of Los Angeles. The map is color-coded with various shades of blue, green, and yellow, representing different data layers. The 'Layers' panel on the left shows 'Sanborn CitySets(TM) Los Angeles, Ca' and 'Sanborn LA Boundry'. The 'Selected Attributes of Buildings' table is visible on the right.

FID	Shape	BLDNAME	BLDNUM	STPRE
7063	Polygon	WATT PLAZA NORTH TOWER	1875	CENTURY
6514	Polygon	NORTHROP GRUMMAN PLAZA II		CENTURY
6761	Polygon	NORTHROP GRUMMAN PLAZA II	1840	CENTURY
3803	Polygon	FRIARS CLUB	9900	SANTA MONICA
6898	Polygon	CENTURY PARK PLAZA	1891	CENTURY
0.00 - 0.25	Polygon	BEVERLY HILTON HOTEL	9872	WILSHIRE
0.25 - 0.50	Polygon	BEVERLY HILLS HIGH SCHOOL	241	MORENO
0.50 - 0.75	Polygon	BEVERLY HILLS CSC	9930	SANTA MONICA
0.75 - 1.00	Polygon		9915	SANTA MONICA
ca.edg	Line		9906	SANTA MONICA

Integrated by location

# Interoperability enablers





# Standards

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



# ESRI learns about and supports standards through active participation:

## Organizations

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



## Standards Development

- International Standards
- Regional Standards
- National Standards
- Information Community Standards

## Projects/Testbeds

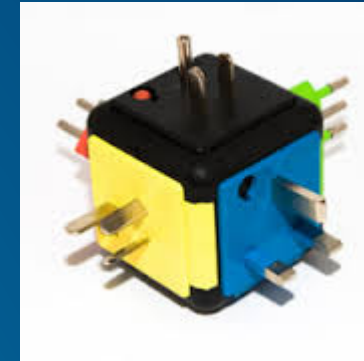
- OGC Web Services testbeds
- GEOSS
- INSPIRE
- NATO Core GIS



# 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+, DCPTType+)>
<!ELEMENT GetMap (Format+, DCPTType+)>
<!ELEMENT GetFeatureInfo (Format+, DCPTType+)>
```

## GML

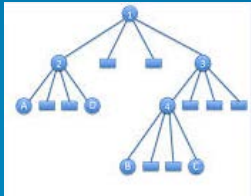
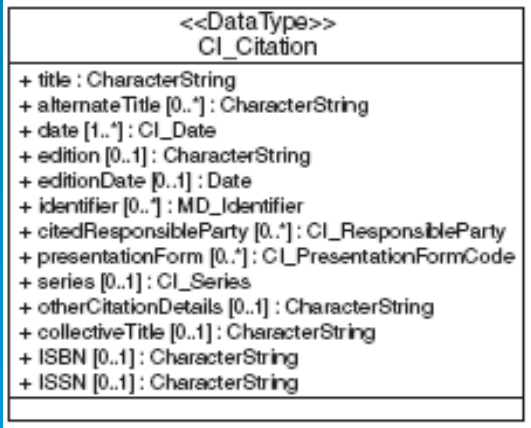
```
<complexType name="PointType">
  <complexContent>
    <extension base="gml:AbstractGeometricPrimitiveType">
      <sequence>
        <choice>
          <element ref="gml:pos" />
          <element ref="gml:coordinates" />
        </choice>
      </sequence>
    </extension>
  </complexContent>
</complexType>

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

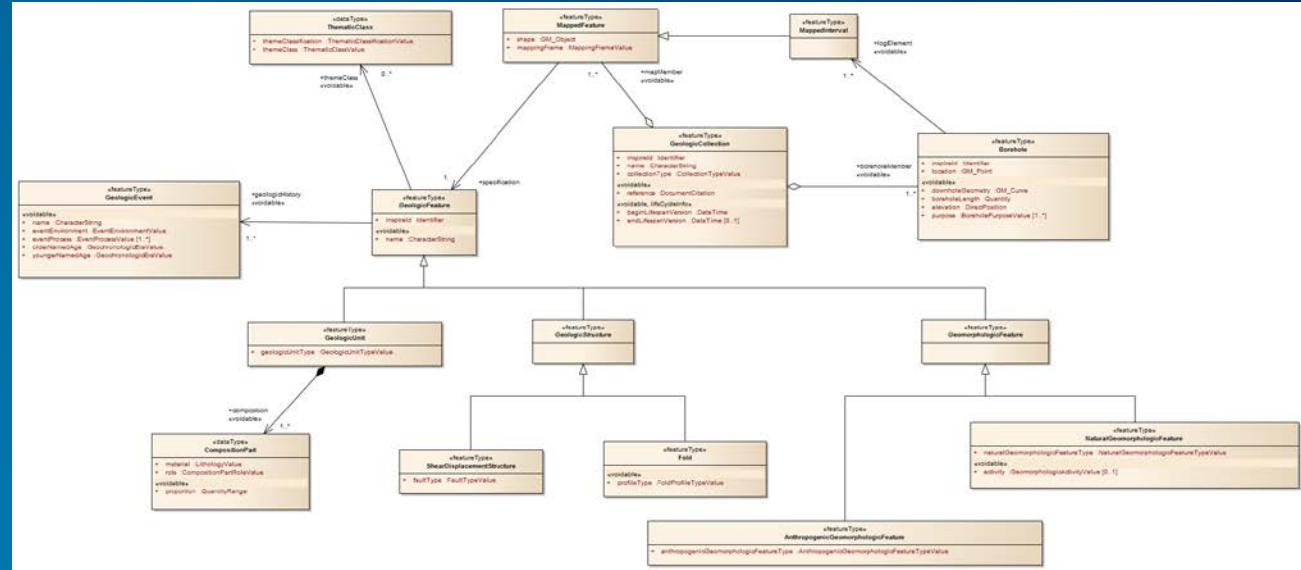
# Semantic Interoperability Standards

## ISO 19115 Metadata

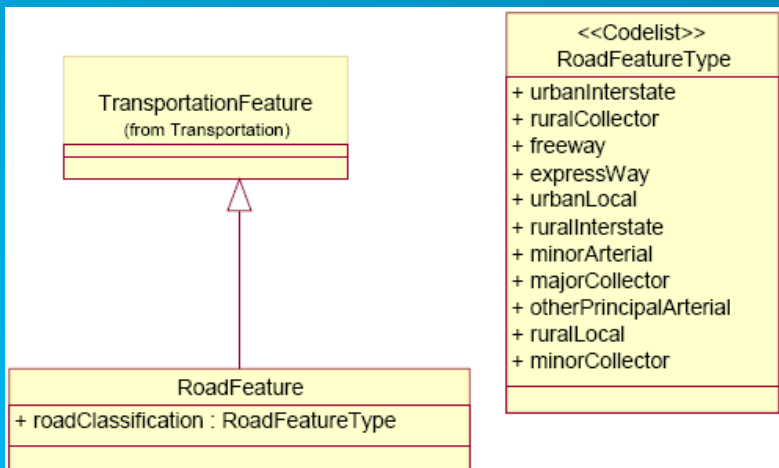
Title = name by which the resource is known



## INSPIRE Data specification on Geology



## FGDC Framework data models



## GML

```

- <element type="swe:QuantityPropertyType" name="boreholeLength" nillable="true">
  - <annotation>
    <documentation>-- Definition -- The distance along a borehole. -- Description -- This will be determined by the data provider (ie, "length" can have different sources, like drillers measurement, loggers measurement, survey).</documentation>
  </annotation>
</element>
- <element name="elevation" nillable="true">
  - <annotation>
    <documentation>-- Definition -- The vertical height above datum of the borehole collar. -- Description -- This is a compromise approach to supply elevation explicitly for location; this is to allow for software that cannot process 3-D GM_Point. Use null if elevation is unknown. Direct position shall have a dimension of 1, and CRS will be a "vertical" CRS (e.g. EPSG CRSs in the range 5600-5799).</documentation>
  </annotation>
  - <complexType>
    - <simpleContent>
      - <extension base="gml:DirectPositionType">
        <attribute type="gml:nilReasonType" name="nilReason"/>
      </extension>
    </simpleContent>
  </complexType>
</element>
    
```

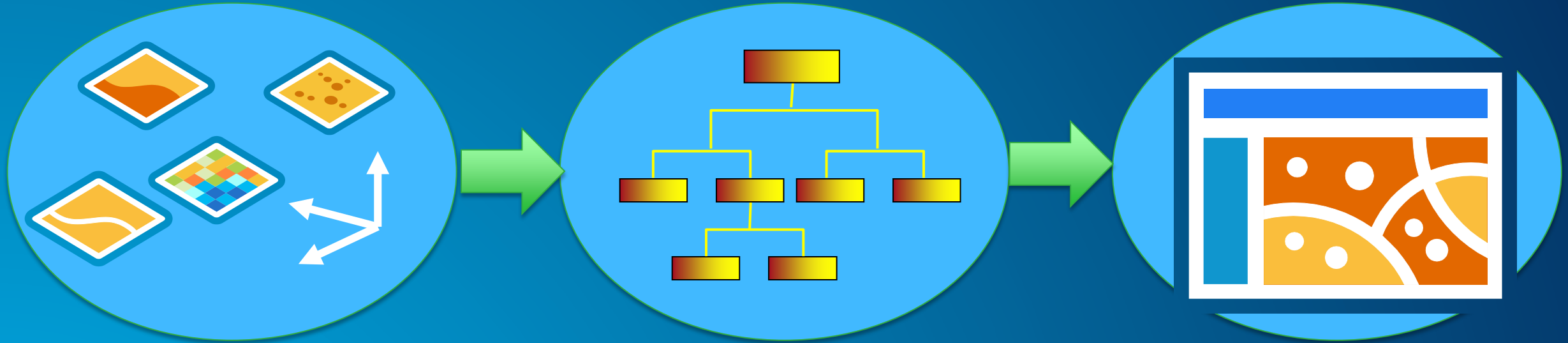
# GIS Standardization – functional areas

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



- 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







# 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>

# 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



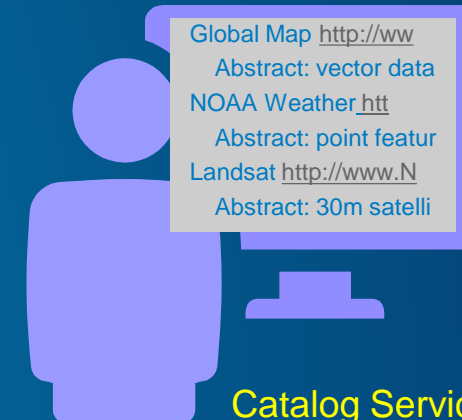
## Web Coverage Service

Imagery and gridded data publishing/processing service



## Web Processing Service

Interface for publishing geospatial algorithms, calculations or models



## Catalog Service-Web

Metadata publishing/search service

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

# ISO TC 211 Standards



ISO/TC 211  
Geographic information/Geomatics

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. **ARML 2.0**
2. **Cat: ebRIM App Profile: Earth Observation Products**
3. **Catalogue Service**
4. **CityGML**
5. **Coordinate Transformation**
6. **Filter Encoding**
7. **GML in JPEG 2000**
8. **GeoAPI**
9. **Geopackage**
10. **GeoSparql**
11. **Geography Markup Language**
12. **Geospatial eXtensible Access Control Markup Language (GeoXACML)**
13. **IndoorGML**
14. **KML**
15. **Location Services (OpenLS)**
16. **Moving Features**
17. **NetCDF**
18. **Observations and Measurements**
19. **Open GeoSMS**
20. **OpenMI**
21. **OpenSearch Geo**
22. **Ordering Services Framework for Earth Observation Products**
23. **OWS Context**
24. **PUCK**
25. **SWE Common Data Model**
26. **SWE Service Model**
27. **Sensor Model Language**
28. **Sensor Observation Service**
29. **Sensor Planning Service**
30. **Simple Features**
31. **Simple Features CORBA**
32. **Simple Features OLE/COM**
33. **Simple Features SQL**
34. **Styled Layer Descriptor**
35. **Symbology Encoding**
36. **Table Joining Service**
37. **WaterML**
38. **Web Coverage Processing Service**
39. **Web Coverage Service**
40. **Web Feature Service**
41. **Web Map Context**
42. **Web Map Service**
43. **Web Map Tile Service**
44. **Web Processing Service**
45. **Web Service Common**
46. **WKT CRS**

# W3C Standards

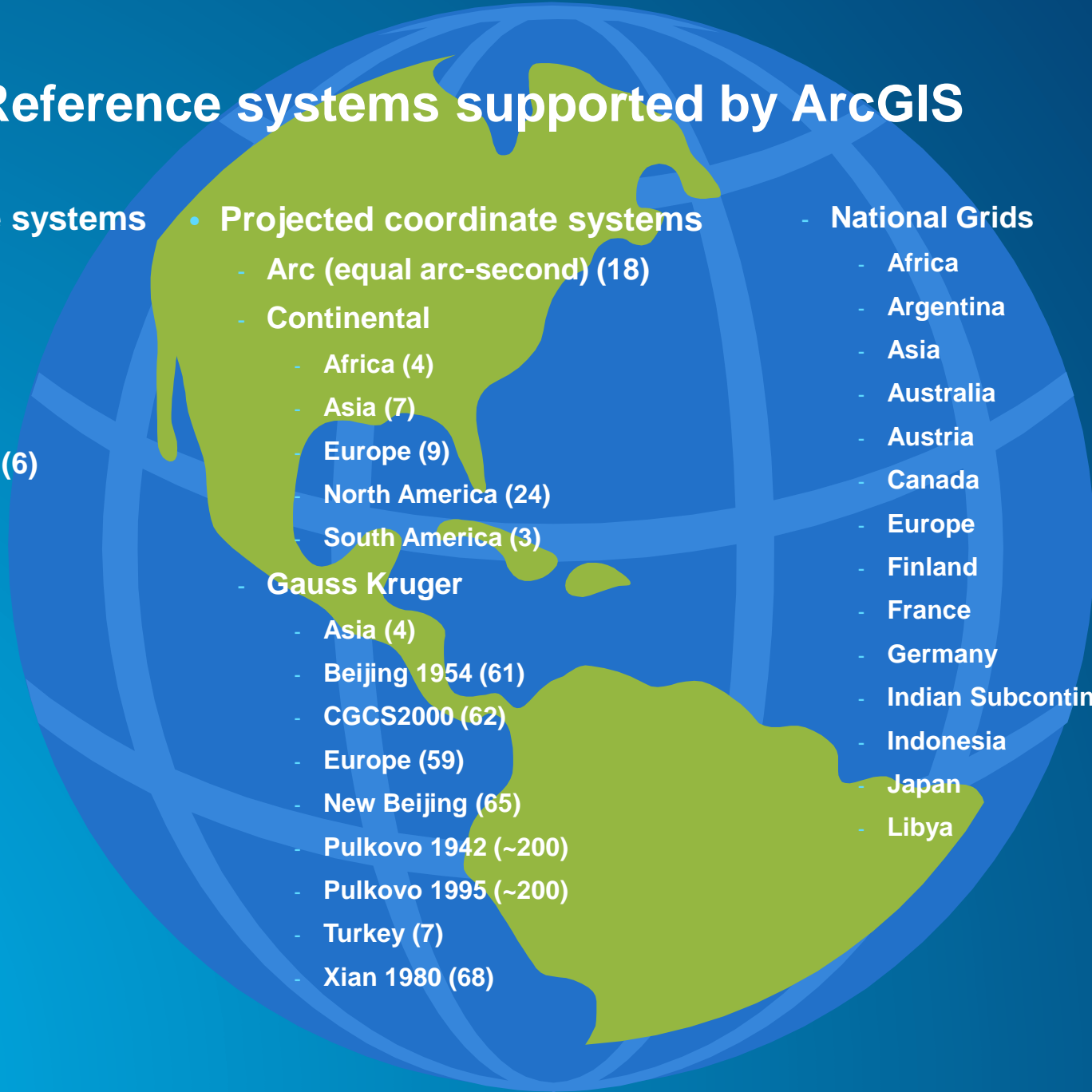


Accessibility (All)  
Accessible Rich Internet Applications (WAI-ARIA)  
Authoring Tool Accessibility Guidelines (ATAG)  
Best Practices for Authoring HTML  
CC/PP  
CSS  
Declarative Web Applications  
Device Description Repository  
DOM  
DOM events  
Efficient XML Interchange  
eGovernment  
Geospatial  
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)



[http://www.fgdc.gov/standards/fgdc-endorsed-external-standards/index\\_html](http://www.fgdc.gov/standards/fgdc-endorsed-external-standards/index_html)

- 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)



[http://www.fgdc.gov/standards/fgdc-endorsed-external-standards/index\\_html](http://www.fgdc.gov/standards/fgdc-endorsed-external-standards/index_html)

- ISO 6709 Standards 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
- 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	ISO 8601:2004	Representation of dates and times
BPCGM01.00	BIIF Profile for Computer Graphics Metafile	ISO/IEC 12087-5	Basic Image Interchange Format
BPJ2K01.10	BIIF Profile for JPEG 2000,	ISO/IEC 13818-1	Generic coding of moving pictures and associated audio information
CAT 2.0.2	Catalogue Service (CAT) Implementation Specification	ISO/IEC 13818-2	MPEG-2 Video
DGIWG FACC	DGIWG Feature and Attribute Coding Catalogue	ISO/IEC 13818-3	MPEG-2 Audio
GRIB WMO No. 306	Manual on Codes, International Codes,	ISO/IEC 15444-1:	JPEG 2000 image coding system: Edition 1
Ext. BUFR WMO	Manual on Codes, International Codes, Volume 1.2	ISO/IEC 15444-9	JPEG 2000 image coding system: Interactivity tools,
GeoTIFF Revision 1	GeoTIFF Format Specification,	ISO/IEC 8632-1	Computer Graphics - Metafile for the storage and transfer of picture description information - Functional specification,
GeoXACML GML2	Geospatial eXtensible Access Control Markup	ISO/IEC 8632-3	Computer Graphics - Metafile for the storage and transfer of picture description information - Binary encoding,
GeoXACML GML3	Geospatial eXtensible Access Control Markup Language	ISO/TS 19138:2006	Data quality measures
GML 3.1.1	Geography Markup Language Encoding Specification	ISO/TS 19139:2007	Metadata - XML schema implementation
IEC 80000-6:2008	Quantities and units - Part 6: Electromagnetism	ITU-R TF460-6	Standard-frequency and time-signal emissions
ISO 19107:2003	Spatial schema	ITU-T Rec. H.264	Advanced video coding for generic audiovisual service
ISO 19108:2002	Temporal schema	ITU-T T.81	Digital compression and coding of continuous-tone still images
ISO 19109:2005	Rules for application schema	Joint METOC	Joint METOC Broker Language
ISO 19110:2005	Methodology for feature cataloguing	JMBLv. 3.31	
ISO 19111:2007	Spatial referencing by coordinates	MIL-STD-188-198A	JPEG Image Compression for NITF
ISO 19112:2003	Spatial referencing by geographic identifiers	MIL-STD-188-199	Vector Quantization Decompression for NITF
ISO 19115-2:2009	Metadata - Part 2: Extensions for imagery and gridded data	MIL-STD-2401	DoD World Geodetic System 84 (WGS84)
ISO 19115:2003	Metadata, 8 May 2003, with Technical Corrigendum 1	MIL-STD-2407(1)	Interface Standard for Vector Product Format (VPF)
ISO 19119:2005	Services	MIL-STD-2411(2)	Raster Product Format; with Notice of Change,
ISO 19123:2005	Schema for coverage geometry and functions,	MIL-STD-2411-1	Registered Data Values For Raster Product Format
ISO 19126:2009	Feature concept dictionaries and registers,	MIL-STD-2411-2(1)	Raster Product Format Files into NITF
ISO 19135:2005	Procedures for item registration,	MIL-STD-2500C	National Imagery Transmission Format Standard
ISO 19136:2007	Geography Markup Language,	MISB 0102.9	Security Metadata Universal and Local Sets for Digital Motion Imagery
ISO 19142:2010	Web Feature Service,	MISB 0301.5, v1.5	Profile for Aerial Surveillance and Photogrammetry Applications
ISO 3166-1:2006	Part 1: Country codes,	MISB 0404	Compression for Infrared Motion Imagery
ISO 3166-2:2007	Part 2: Country subdivision code,	MISB 0601.5	UAS Datalink Local Metadata Set
ISO 6709:2008	Standard representation of geographic point location by	MISB 0604.2	Time Stamping and Transport of Compressed Motion Imagery and Metadata
w/Cor1:2009	coordinates	MISB 0807.10	KLV Metadata Dictionary
ISO 80000-1:2009	Quantities and units - Part 1: General	MISB 0902.1	Motion Imagery Sensor Minimum Metadata Set
ISO 80000-3:2006	Quantities and units - Part 3: Space and time	MISB STD 0107.1	Bit and Byte Order for Metadata in Motion Imagery Files and Streams
ISO 80000-4:2006	Quantities and units - Part 4: Mechanics	MISB STD 0403.3	Digital Representation for Infrared Motion Imagery
ISO 80000-7:2008	Quantities and units - Part 7: Light	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>

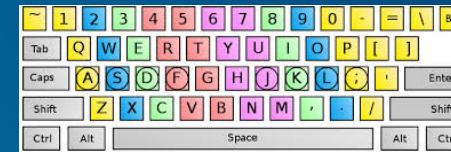
# DISR approved GEOINT Standards – mandated (2)



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

# Varieties of standards

- **De Jure** – by law, legally accepted, mandated by an organization, or nation usually endorsed by a standard development organization (SDO)  
ISO, W3C, OGC
- **De Facto** – in fact, whether with legal right or not
  - QWERTY keyboard, DOC, Adobe Flash, VHS
  - Early on - SVG, PDF, HTML, MP3, TIFF
- **Industry / Community** – serving a specific organization
  - Society of Automobile Engineers (SAE)
    - Sparkplug threads
  - International Hydrographic Organization (IHO)
    - S-4 Chart Specification



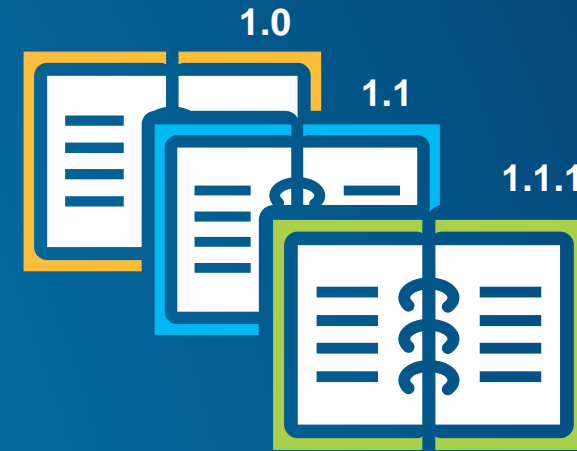


## Openly published geospatial De Facto standards

- Shapefiles
- KML (when it was openly published by Google)
- File Geodatabase API
- GeoServices REST API
- Open Street Map
- NetCDF (when it was openly published by unidata – UCAR/NCAR)
- GeoTIFF
- GDAL libraries

# Standards Evolve

- Bug fixes – change requests submitted
- Added functionality desired
- New technology available
- Refresh/new references/relationships
- New documentation style



# Implementing the latest version of each OGC standard

Hundreds of standards continually evolving

- **Why doesn't Esri immediately implement each new version when it is released?**
- **Considerations:**
  - A standard needs to reach a critical mass of adoption before it provides interoperability
  - Even though a new version becomes DeJure – the old version may remain most popular
  - New version may be buggy/untested
  - New version may have less functionality
  - Esri usually times new standards version support with ArcGIS releases
  - More convenient to wait for eminent releases of related standards

**Work with Esri – let us know your requirements  
Help us prioritize**

# Full list of Esri implementing, compliant, and reference implementations

The screenshot shows the OGC website interface. At the top, the OGC logo is displayed with the tagline "Making location count." and a navigation menu with items: Home, Standards, Programs, Participate, News & Events, About OGC, and Member Login. A search bar is located on the right side of the navigation menu. Below the navigation menu, the main content area is titled "Implementing Products". On the left side, there is a sidebar menu with the following items: Implementing, Registered Products, All Registered Products, Implementation Statistics, View By Specification, Compliant Products, Register Your Products, OGC Cookbooks, and Demonstrations. The main content area contains a search form with the following fields and options: Product Provider: ESRI, Specification: -, Compliant Products Only (checked), Reference Implementations, and Show All Products. Below the search form, a summary box states: "Found 1 organization with 104 products with 555 specification implementations, 163 of which are currently compliant, and 2 are reference implementations". At the bottom of the page, there is a footer with the text "Web Map Context Documents 1.0" and a user profile for "Sankaran, Satish" with the registration date "Registered: 2005-0".

OGC® Making location count.

Location Powers MWC2015 W3C/OGC YouTube What is the OGC?

Home Standards Programs Participate News & Events About OGC Member Login Search

## Implementing Products

Help

Register now or update your product listing.

Product Provider: ESRI Clear Search

Specification: -

Compliant Products Only  Reference Implementations Show All Products

Found 1 organization with 104 products with 555 specification implementations, 163 of which are currently compliant, and 2 are reference implementations

<http://www.opengeospatial.org/resource/products> Top ▲

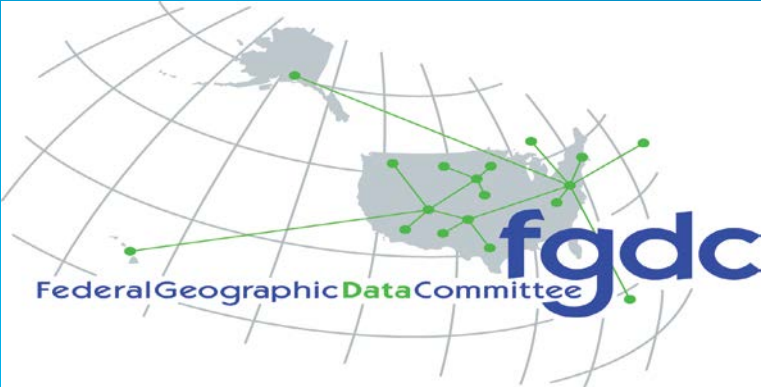
Sort on ESRI

Sankaran, Satish Registered: 2005-0

Web Map Context Documents 1.0

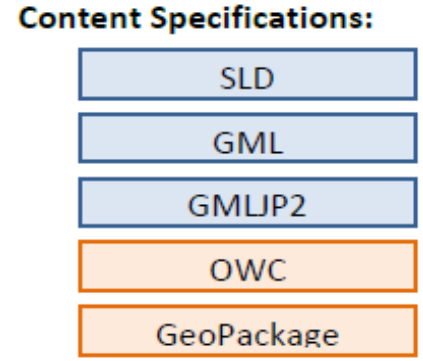
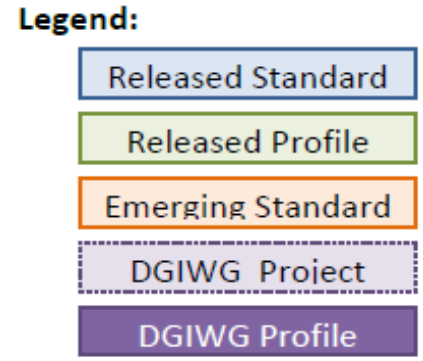
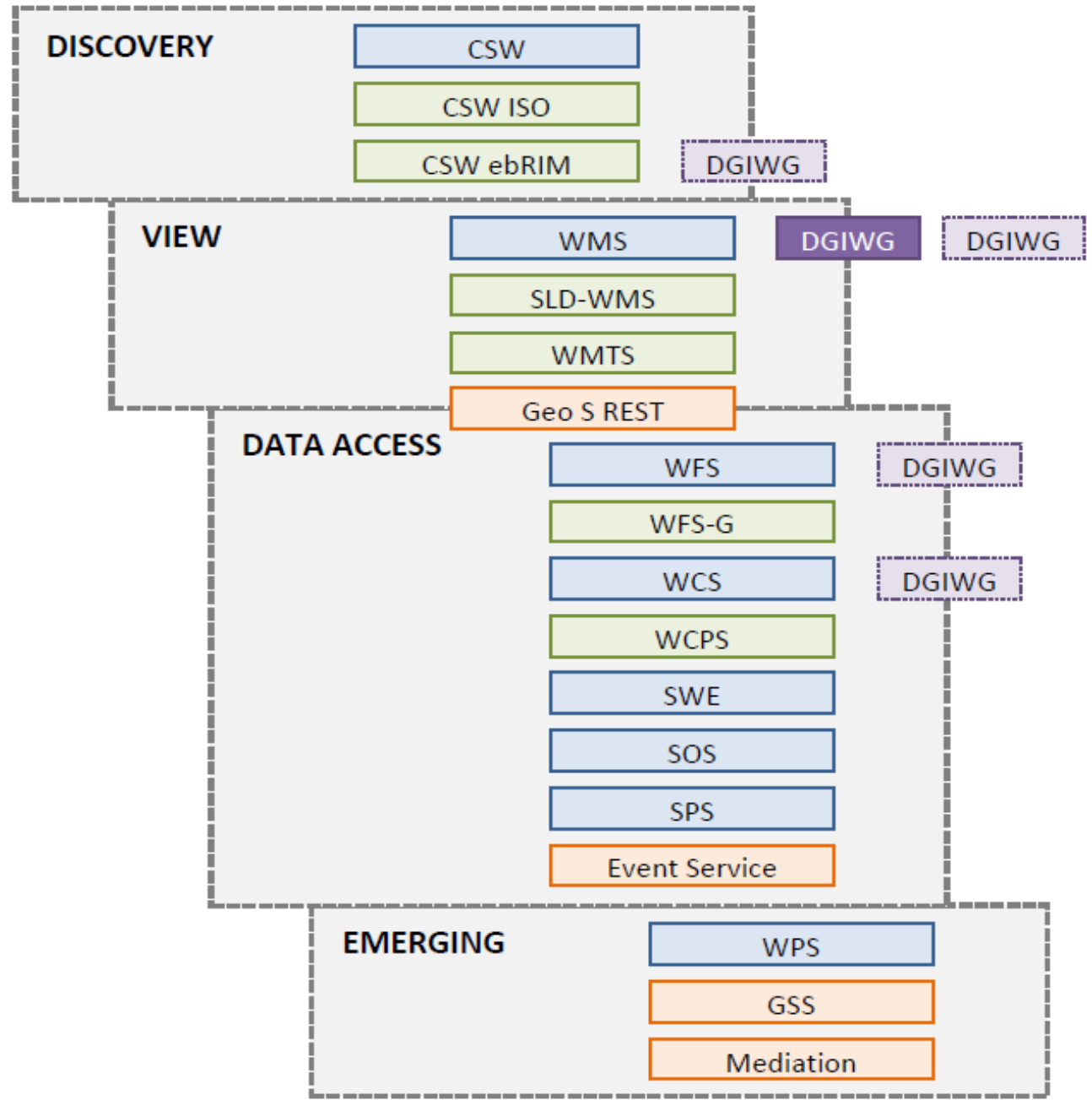
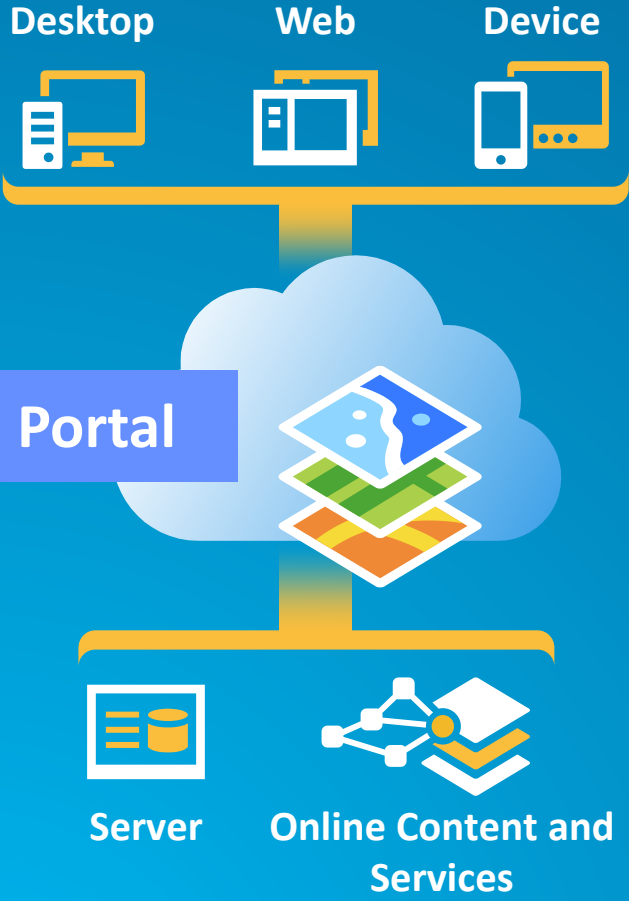


# ArcGIS Technology (supporting standards)





# ArcGIS - Platform



<http://ise.gov>

from ... Geospatial Interoperability Reference Architecture (GIRA)

# ArcGIS Platform Components

Portals  
(AGOL, Portal)  
  
Providing &  
Consuming

Developer Solutions  
(runtime, Javascript  
Api)  
  
Consuming

Server  
  
Providing

Desktop  
(ArcMap & PRO)  
  
Consuming

Apps  
  
Consuming

# Core Standards

Metadata  
(ISO, FGDC, ...)

Data  
(Geopackage,  
geoJSON, gml-  
JPEG 2000...)

Portrayal  
Standards

Services  
(wms, wfs, wcs,  
wps, sos, CSW, ...)

# OGC Support

## SERVER TECHNOLOGIES

### Server

Support WMS, WFS, WCS, WPS,  
WMTS, KML, SLD, FE

### ArcGIS Online / Portal

## CLIENT TECHNOLOGIES

### Desktop

wms, wcs,wfs kml oPeNDAP, gml,  
NetCDF, geopackage

### Runtime

Kml, wms, wmts

### ArcGIS Online / Portal

Register wms,kml services  
Webmap / mapviewer : Add wms,  
wmts, kml layers

### Javascript Web Api

wms, wmts, kml

# Standards Requirements – Across the platform ..... What we are hearing!

- **Online / Portal**
  - Register OGC services
  - Consume OGC services
  - Create hosted OGC services
  - Geopackage support
  - Allow analyses on OGC services
  - Support Discovery Standards – OGC CS-W, OpenSearch, DCAT
  - Managing Secured OGC Services
- **Metadata Support across the platform**
- **Federated searches across portals**
- **Server**
  - Improve existing OGC support (compliance, update to new version, new profiles)
- **Desktop (ArcMap / Pro)**
  - Consume OGC services
  - Geopackage support
- **Runtime and Apps**
  - Consume OGC services
  - Geopackage support
- **Javascript API**
  - Consume OGC services

# Standards Support

**portals**  
**(ArcGIS Online, Portal for ArcGIS)**

**Producing &  
Consuming**

- **Producing**

- **Hosted WMS service (2016)**
- **Hosted WFS Service (2016)**

- **Consuming**

- **WMS (support identify operation)**
- **WMTS**
- **WFS (2016) – Support as a first class layer type**
- **WCS**
- **GeoPackage**
- **KML**
- **Metadata Support (@ version 3.8)**

 Ongoing Work

 Planned Work

 Supported Today

# Standards Support

**Portals  
(Portal for ArcGIS)**

Producing &  
Consuming



Geoportal

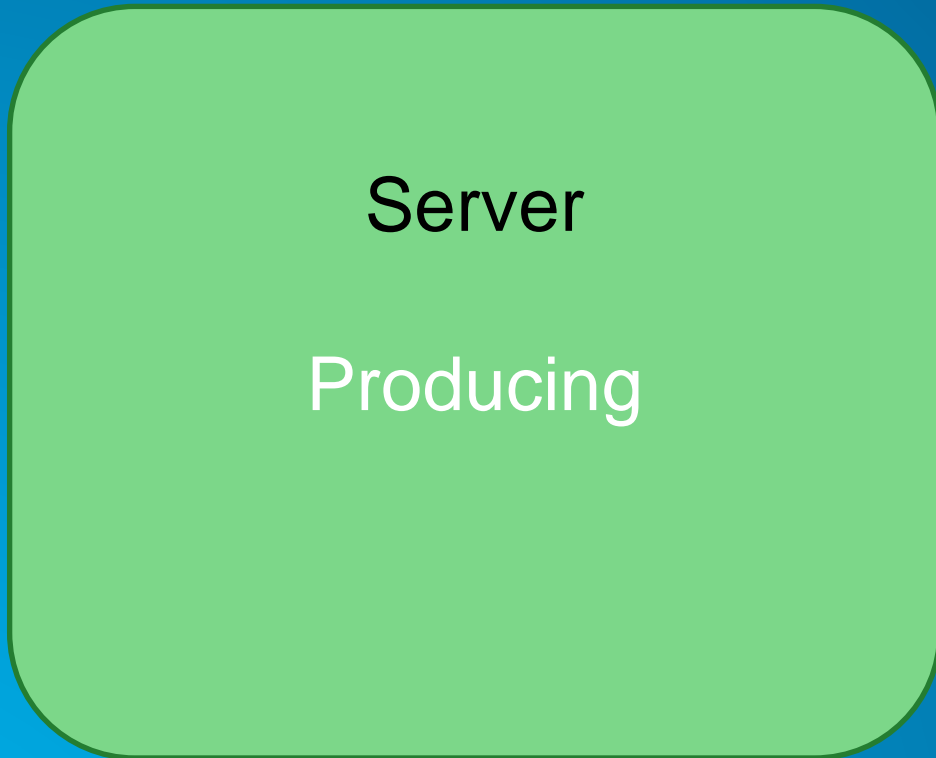
- **CS-W Support**
- **Federated Portals**
  - Federated Searches & Metadata Harvesting
- **Metadata Support ( Special Profiles)**

 Ongoing Work

 Planned Work

 Supported Today

# Standards Support



- **Server**
  - WMS
  - WFS (WFS-T)
  - WCS
  - WMTS
  - WPS
  - KML
  - **GeoJSON ( @ 10.4)**
  - **WPS 2.0**
  - **WCS – Met Ocean Profile**

 Ongoing Work

 Planned Work

 Supported Today

# Standards Support

Developer Solutions  
(Runtime, Javascript  
Api)

Consuming

- **Runtime**

- Wms
- Wmts
- GeoPackage
- **Wfs**

- **Javascript Api**

- WMS
- WMTS
- WFS ( @ version 3.1.4)

 Ongoing Work

 Planned Work

 Supported Today



# Standards Support

Apps  
Consuming

- Apps
  - WMS , WMTS , WFS, WCS, GeoPackage

 Ongoing Work

 Planned Work

 Supported Today

# Standards Support

Desktop  
(ArcMap & PRO)

Consuming

- **ArcMap**

- WMS , WMTS , GeoPackage, WCS, KML
- WFS
- **WFS-T (part of production mapping)**

- **PRO**

- **WMS , WMTS , GeoPackage, KML**
- **WFS /WFS-T**
- **WCS**

 Ongoing Work

 Planned Work

 Supported Today

# Standards Support

Desktop  
(PRO)  
Consuming

- PRO 1.1
  - WMS , WMTS , Geopackage, KML,
  - WFS (import –part of Data Interop)
- PRO 1.2
  - **WMS , WMTS , Geopackage, WFS**  
**/WFS-T**
- PRO (2016)
  - **WCS**

 Ongoing Work

 Planned Work

 Supported Today

## OGC / ISO standards support ( ArcGIS 10.3)

- WMS
  - + Style Layer Descriptor
  - + Filter Encoding Support
  - + Time Support
- WFS
  - + Transactions
  - + Filter Encoding Support
- WCS
  - +GeoTiff, NITF, HDF, JPEG, JPEG2000, PNG
- WMTS
  - + REST & KVP Encoding
- WPS
  - + Synchronous
  - + Asynchronous
  - + Data and Services as inputs
- CSW
  - + OGC Core
  - + ISO 19139
- Simple Features
- GML
- KML
- GeoPackage
  - +Vectors, Tiles
- Metadata
  - +ISO, FGDC, ...

<http://www.esri.com/library/whitepapers/pdfs/supported-ogc-iso-standards.pdf>

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

# User Scenarios

Organizations participating in SDI and Large Federal and Defense Infrastructures

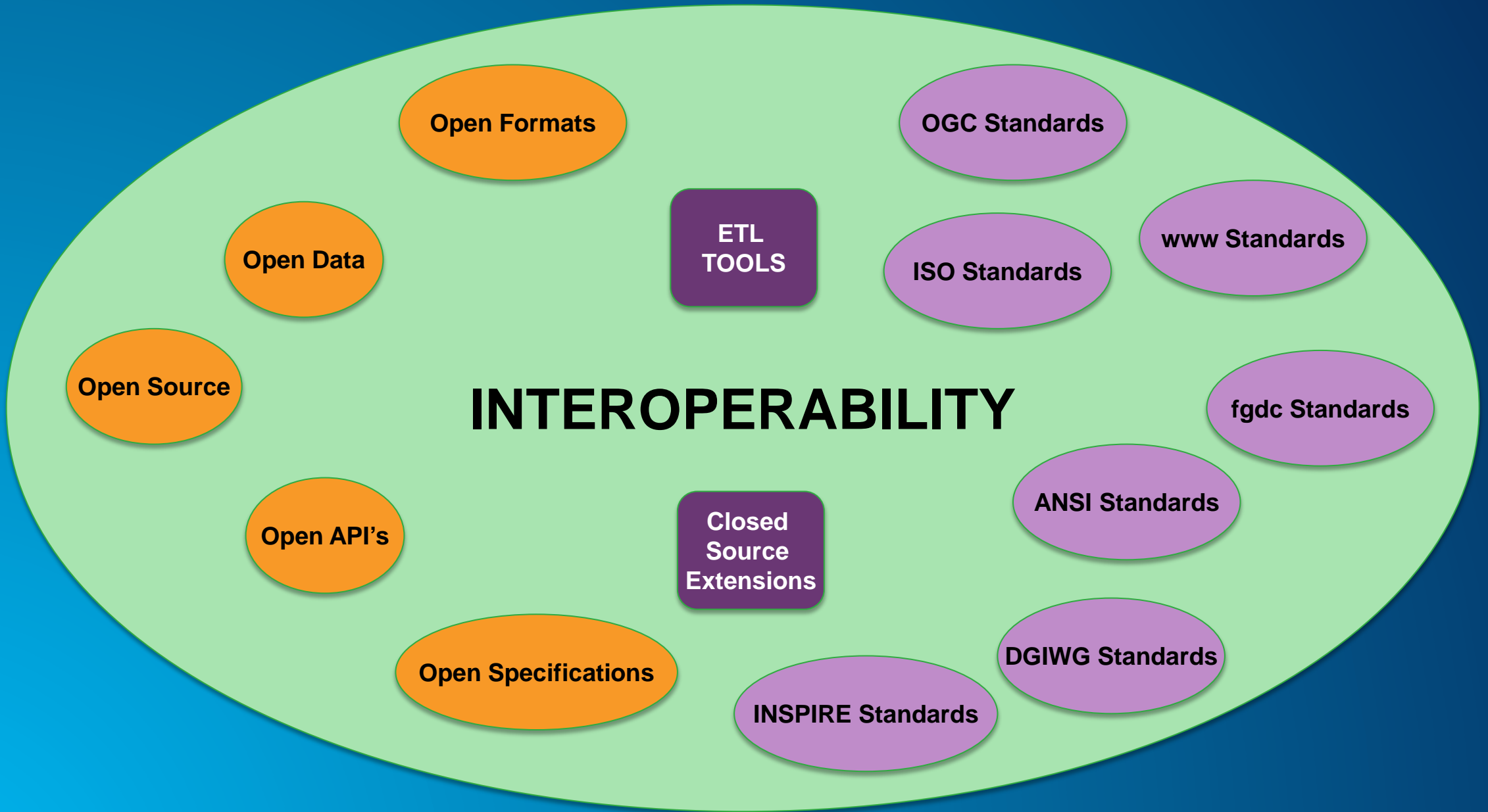
Help me satisfy my obligations (workflows) using mandated standards

Organizations participating in Opendata

Help me satisfy my obligations

Organizations participating in cross-domain, cross organizational workflows

Help my workflow. Help me work with my other stakeholders and business entities



**Achieving Interoperability**

# Explore **Open.**

(Hint, with Esri the possibilities are endless.)

<http://www.esri.com/software/open-site>



# Esri's Open Initiatives

Our strategy incorporates the many aspects of an open platform - **open code, open data, open formats, open content, and open community.**

- Centralized many of our Open Source Software projects via the Esri Github community
- GeoPortal – Esri's Open Source Platform for Collaboration & Sharing
- Openstreetmap Editor – Esri's OS Arcmap extension for editing OpenStreetMap Data
- Open-sourced a core geometry engine to enable developers to leverage the Hadoop Big Data platform.
- .....

..... **Join & Collaborate**



# Esri - Open Specifications

- **Shapefile**
- **File Geodatabase API**
- **Geoservices REST Specification**
- **Esri i3S specification** (<https://github.com/esri/i3s-spec>)

..... Advancing Interoperability

## .... Some Links to Esri's Open Source Libraries

- <https://github.com/Esri/geoservices-js>
- <https://github.com/Esri/Terraformer>
- <https://github.com/ajturner/geoservices-ruby>
- <http://dct-sci01.esri.com/OGCApps/OpenLayersApp>
- <https://github.com/kevinsigwart/EsriOpenLayersClient/>
- <https://github.com/Esri/esri-leaflet>
- <https://github.com/Esri/koop>
- <https://github.com/Esri/3d-cities-template/tree/master/Workflows/3DCityMaintenance/CityGML%20Tools>

<http://esri.github.io/>

# ArcGIS Open Data Platform

Open Data About Forums About ArcGIS

Explore **27,331 Open Datasets** from **2,149 Organizations** Worldwide

Search for data about

Featured Organizations Sharing Data

  HALIFAX   

<http://opendata.arcgis.com/>



Understanding our world.