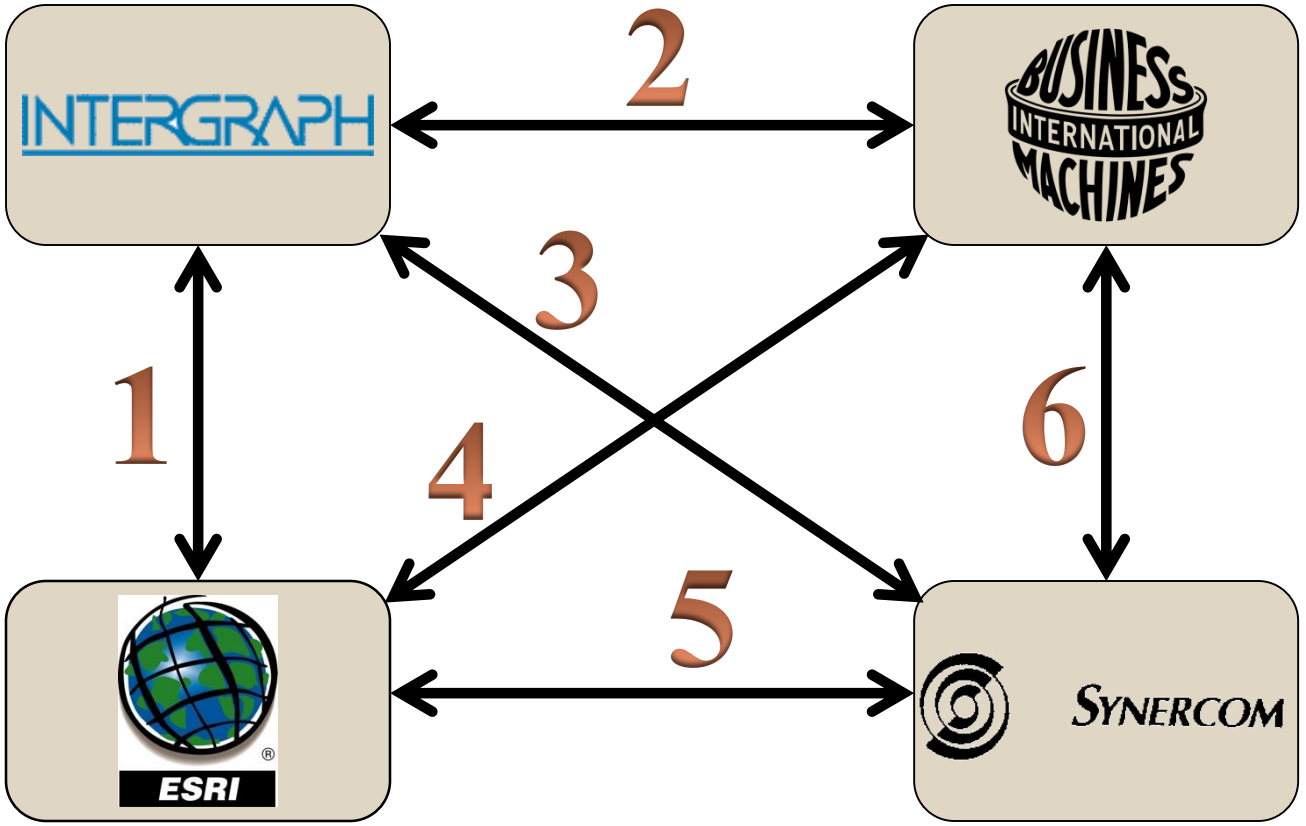
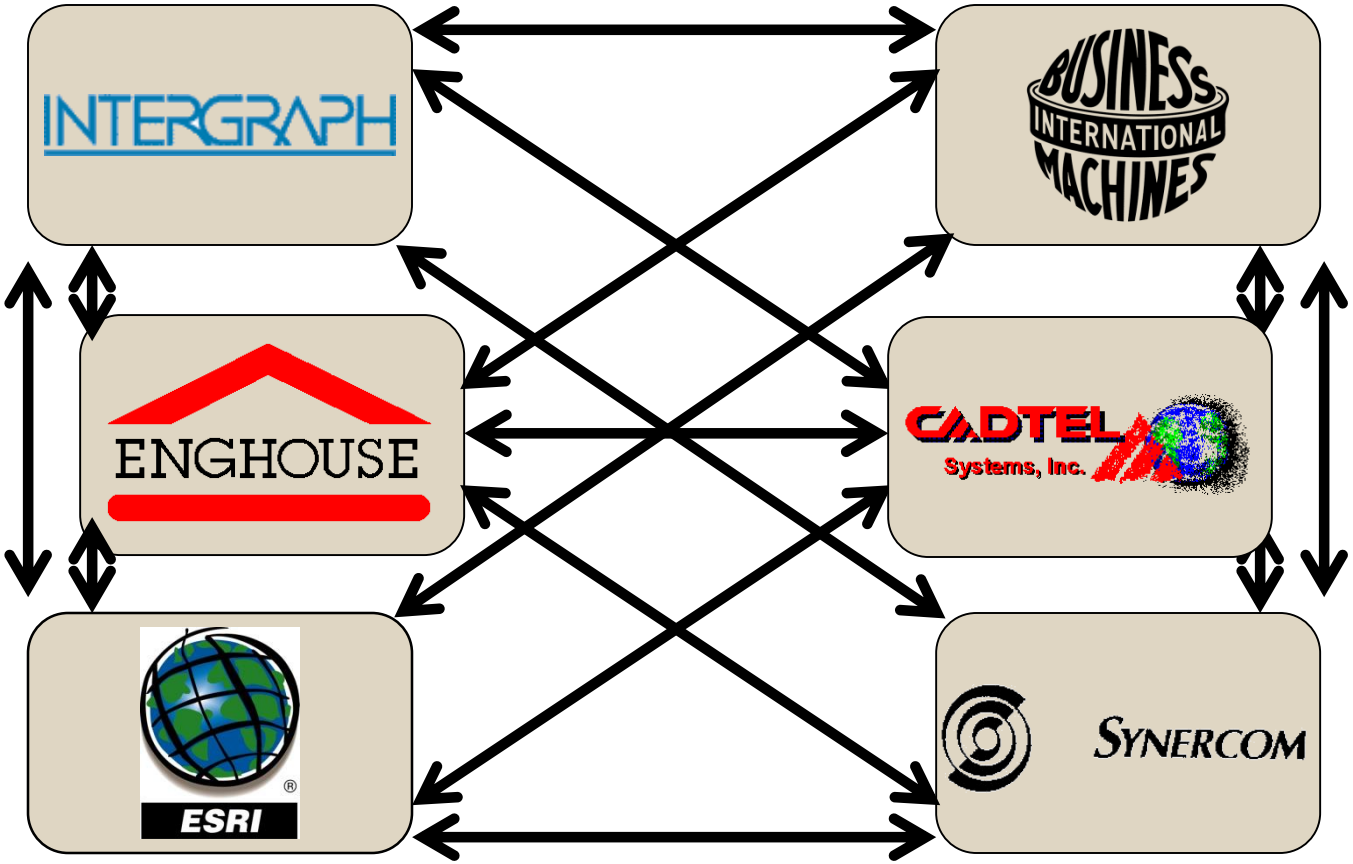
Sharing Geospatial Data

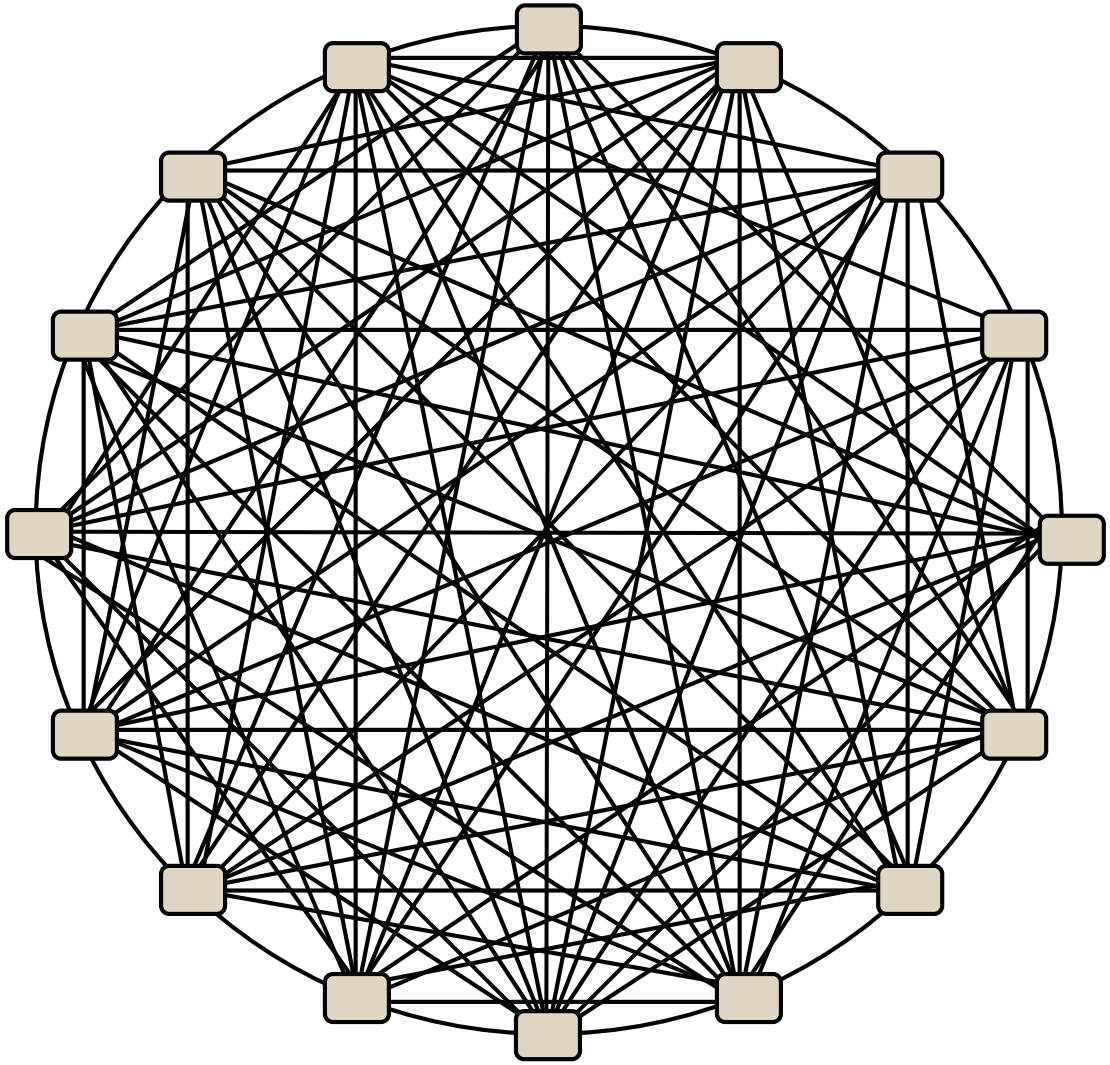
Chicago Aerial Survey, 1984



What about New Platforms? With 6 Vendors, 15 Translators



With 16 Platforms (or Databases), 120 Translators!



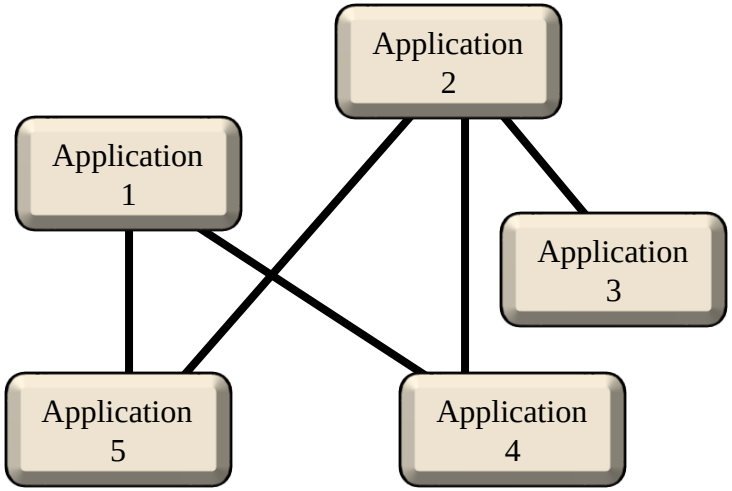
Enterprise Architecture: Theory and Practice

- "*The process of translating business vision and strategy into effective enterprise change by creating, communicating and improving the key requirements, principles and models that describe the enterprise's future state and enable its evolution.*" (Gartner)
- In practice, three major considerations:
  - Infrastructure
  - Governance
  - Data

Data

- Enterprise information: diverse content that is consistently shared across multiple business processes and capabilities
- Means of access to data must be defined and created
- “Traditional” approach to data access
  - Point-point modeling

Traditional Data Access



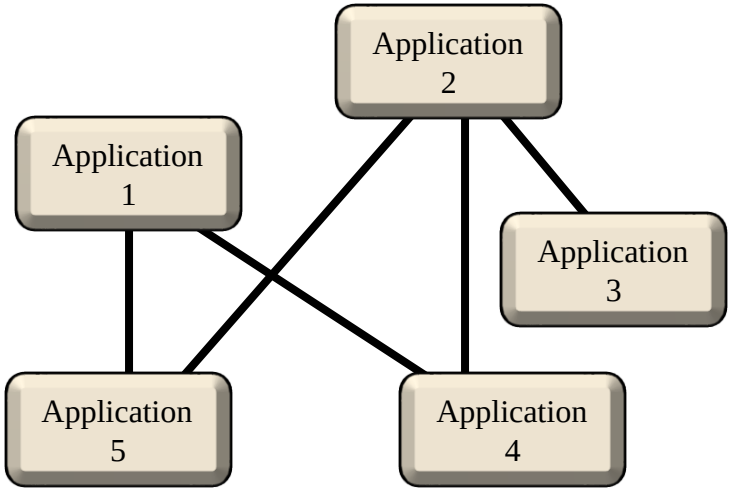
Point-to-Point Mapping

$c = (n(n-1))/2$

Data

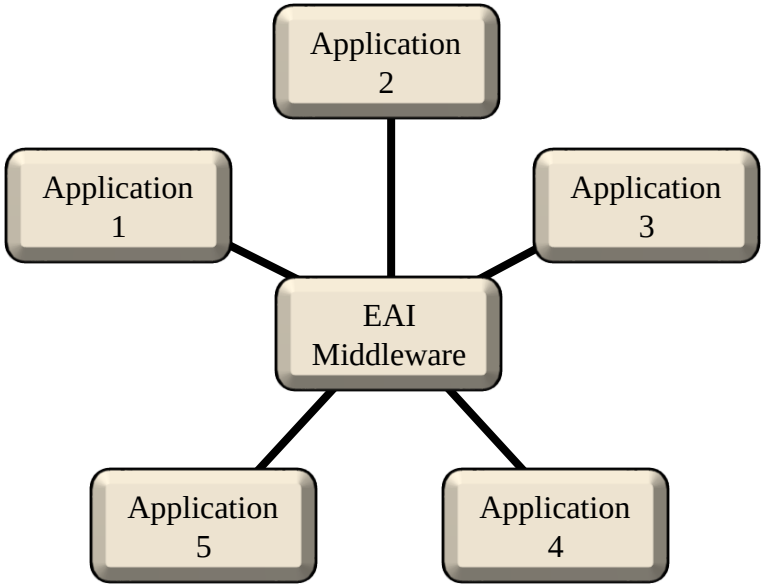
- Enterprise information: diverse content that is consistently shared across multiple business processes and capabilities
- Means of access to data must be defined and created
- "Traditional" approach to data integration
  - Point-point modeling
- Alternative approach
  - Enterprise Application Integration (EAI) using a standard, canonical model to enable multiple systems to exchange data

Data Access Via Middleware



Point-to-Point Mapping

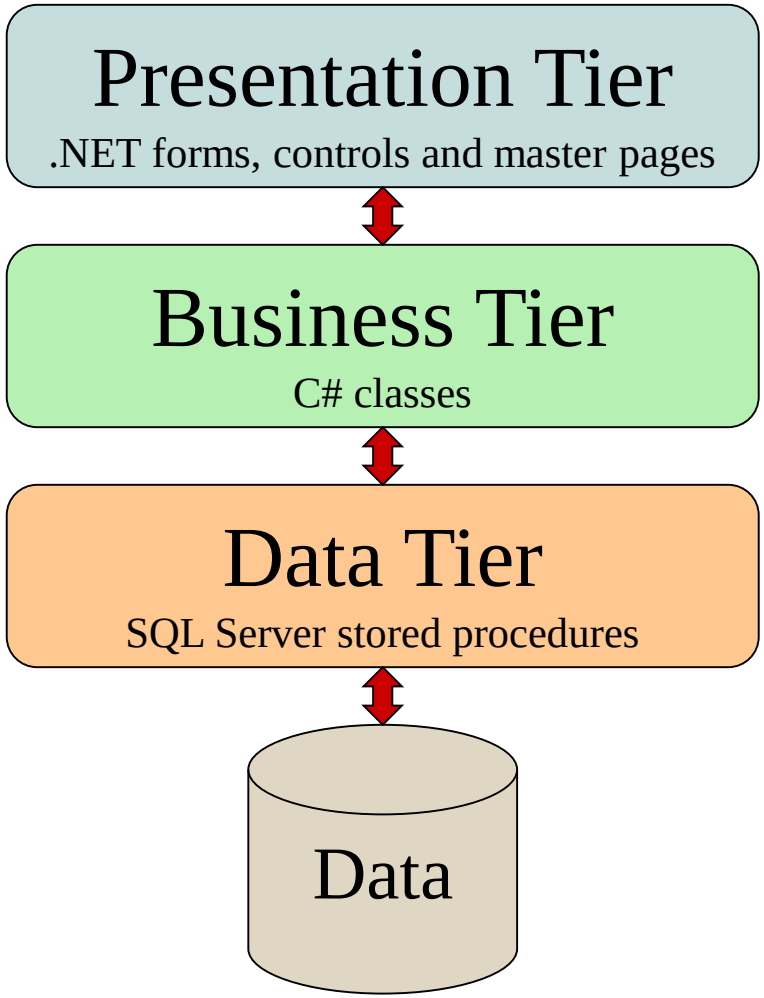
c = (n(n-1))/2

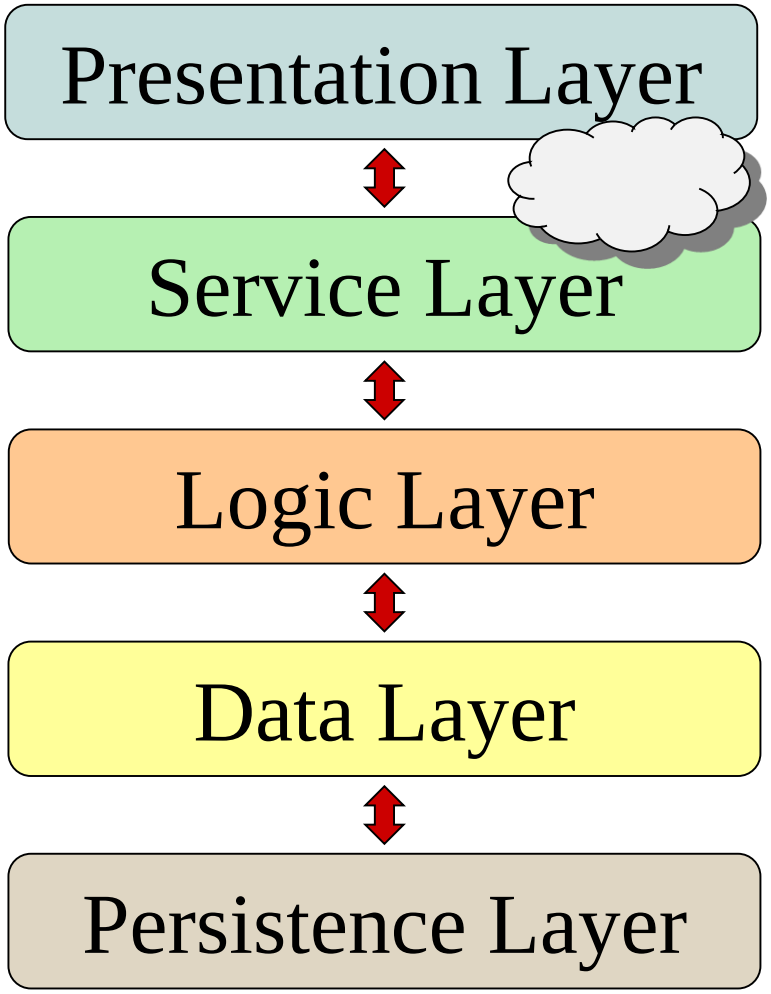


Canonical Model Mapping

c = 2n

N-Tier Architecture Examples





Canonical Modeling

- “Interoperability by design” (Gartner)
- “A model which is in the simplest form possible based on a standard, common view within a given context” (Wikipedia)
- Knowledge base for data exchange with a shared vocabulary

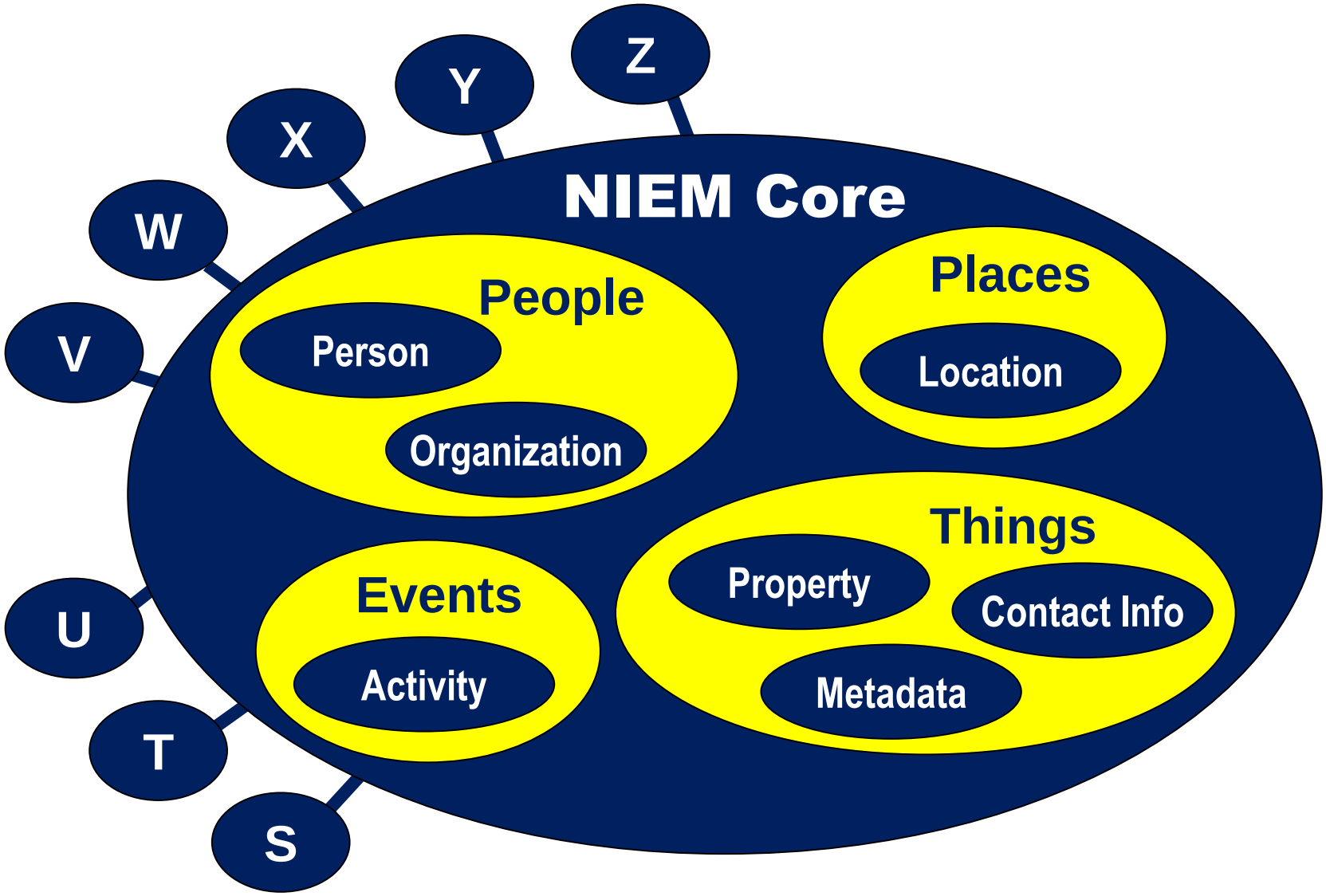
Easiest Path to a Canonical Model

- Use an existing sector-focused model
  - Health: HL7 International
  - Automotive Retail: STAR
  - Insurance: ACORD
  - Defense: DoDAF
  - Retail: ARTS
  - Government: **NIEM**

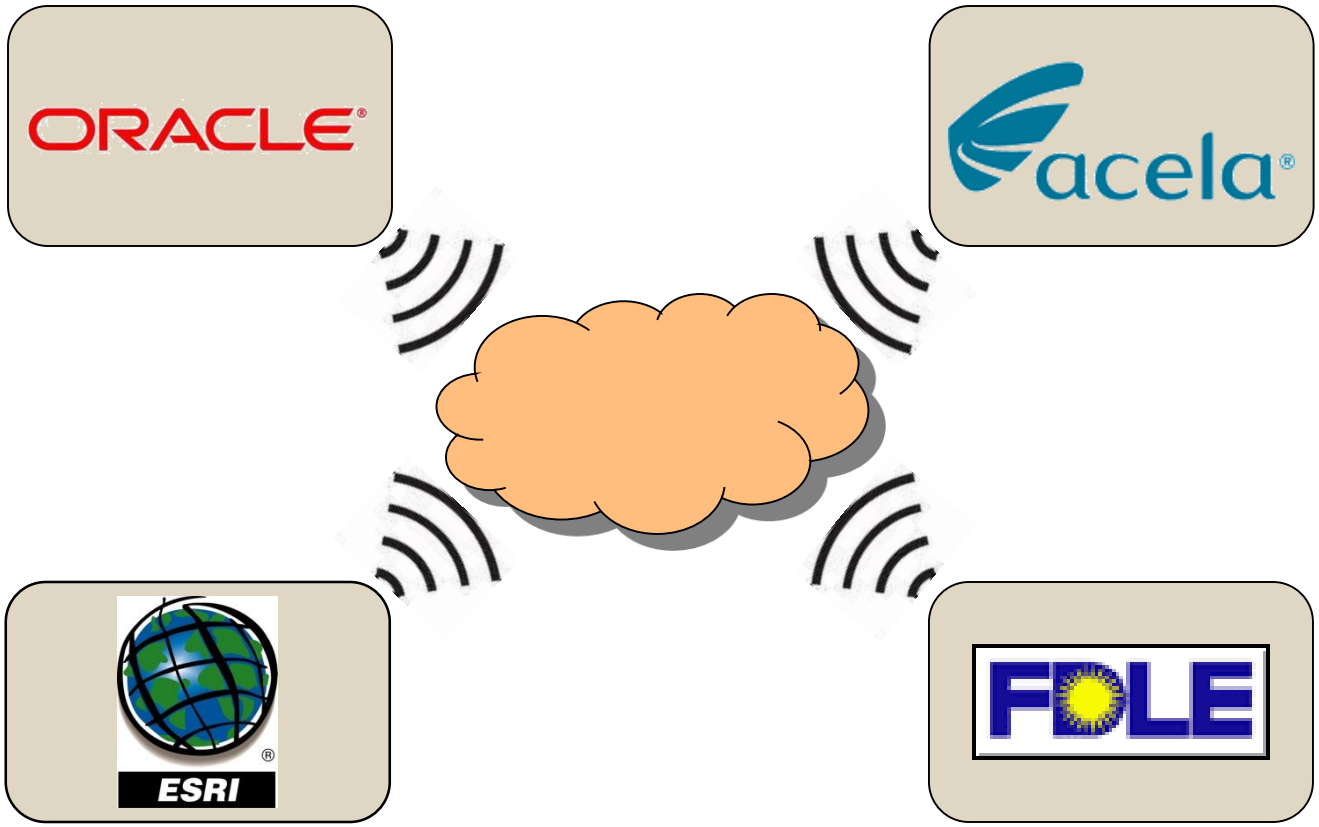
    National Information Exchange Model



NIEM Overview

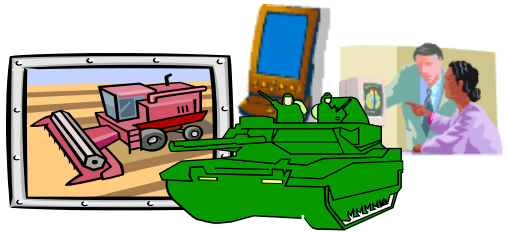


Data Access Via Web Services



NSDI Components - Technology

Geospatial Interoperability: Services Viewpoint



User Applications

Clients

Access to transformed data

Service Chaining

Geoprocessing Services

Metadata search and retrieval

Middleware

Catalogs

Metadata update

Direct data access

Services

Content Repositories

Features

Coverages

Other data

What is a Spatial Data Infrastructure (SDI)?

- Basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general
  - Technology: hardware, software, networks and databases
  - Policies and institutions: governance, data privacy and security, data sharing, cost recovery
  - People: training, cooperation, outreach and professional development

Metadata

- “Data about data”
- Standardized form of metadata published in June 1994 by the Federal Geographic Data Committee (FGDC)

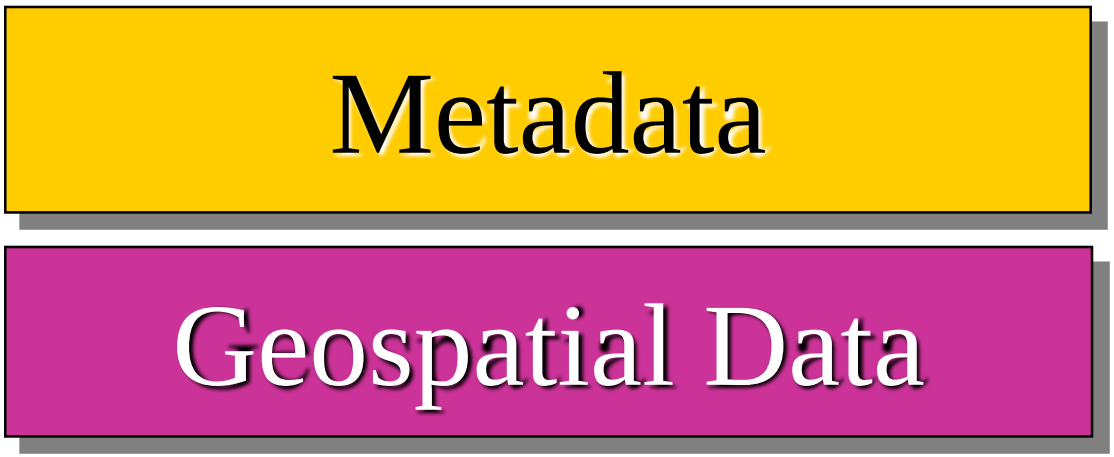
Metadata

Metadata

- Provides documentation of existing internal geospatial data resources within an organization (e.g., an inventory)
- Permits structured search and comparison of held spatial data by others (e.g., a catalog)
- Provides end-users with adequate information to use data in an appropriate context (e.g., documentation)

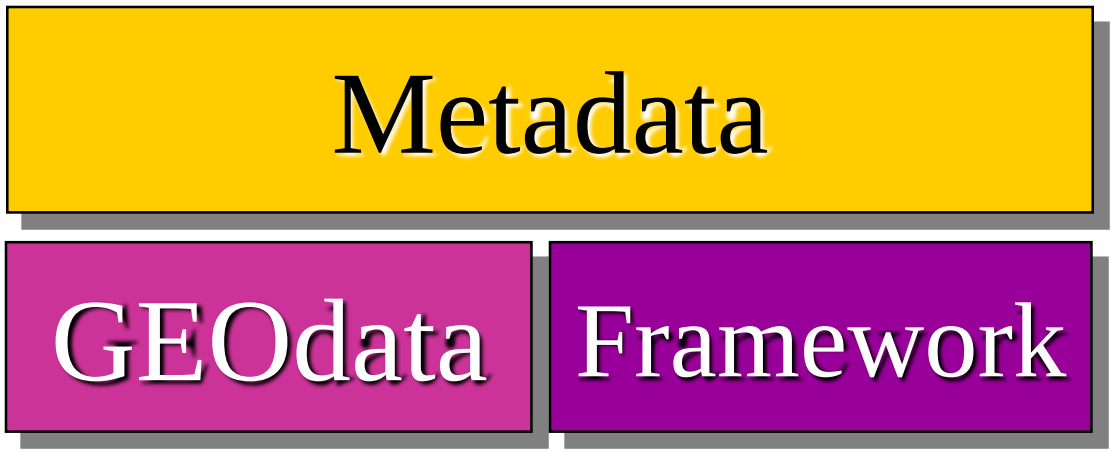
Geospatial Data

- Metadata describes existing data holdings for order, retrieval or local use
- Metadata should be used to describe all types of data (“truth in labeling”)



Framework

- Special-use thematic layers are built and described as available geospatial data
- Common data layers are defined in a *Framework* component

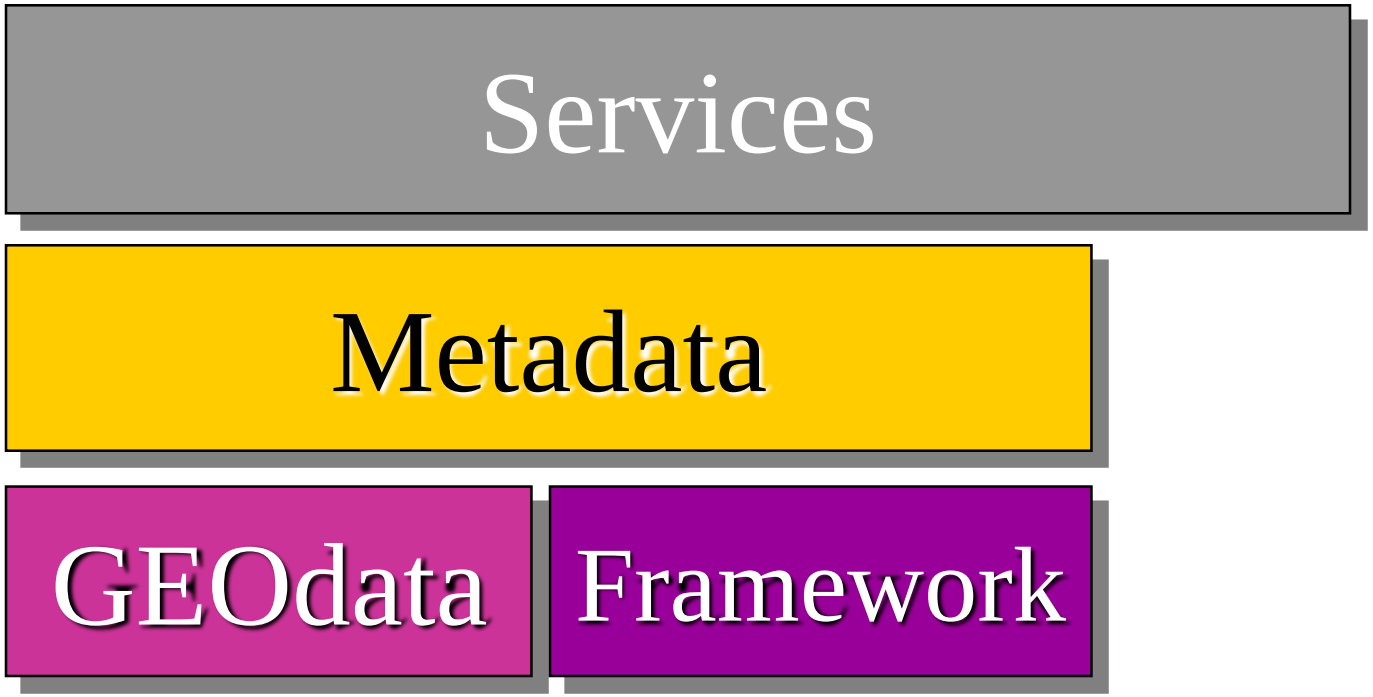


Framework Supports

- Community development of sets of spatial primitives, feature representation and attribution to a lowest common denominator
- Participant collecting, converting, or associating information to common *Framework* feature specifications
- Multiple representations of real-world features at different scales and times by feature identifier and generalization

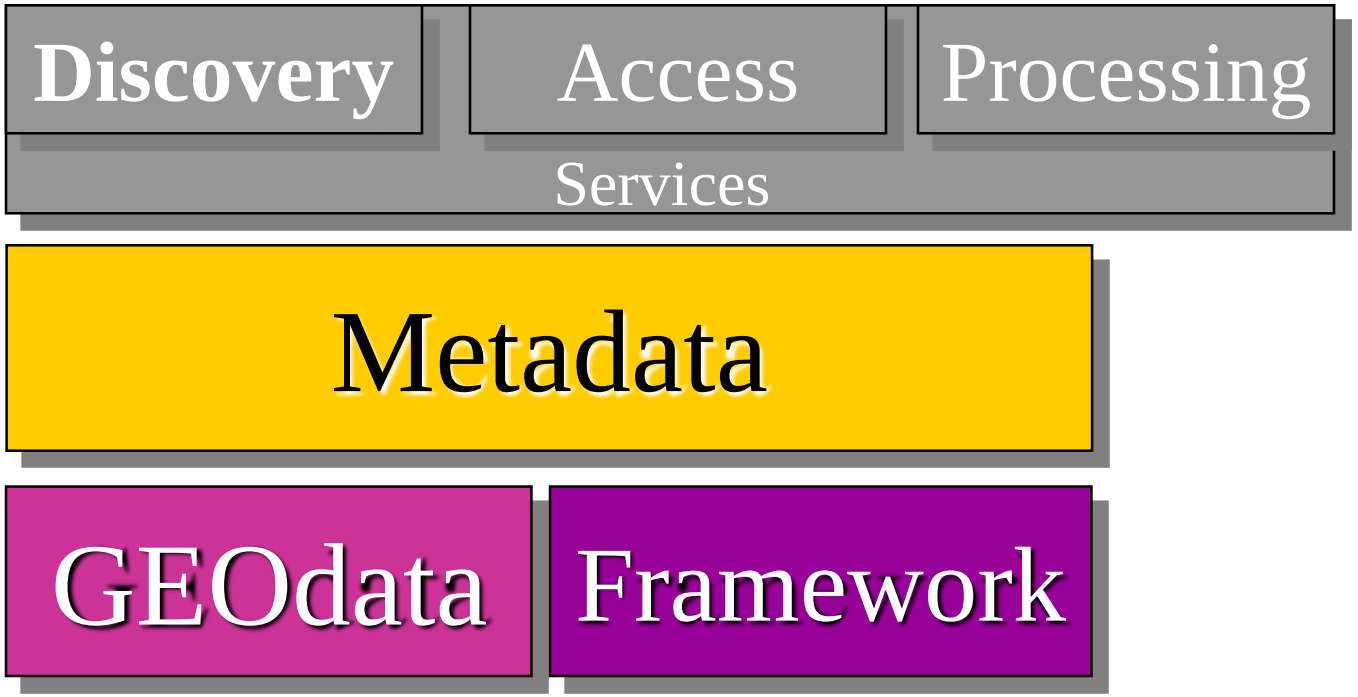
Services

- Spatial Data Infrastructures include services to help discover and interact with data



Discovery Service

- "Discovery Service" is the core function of the clearinghouse for geospatial information

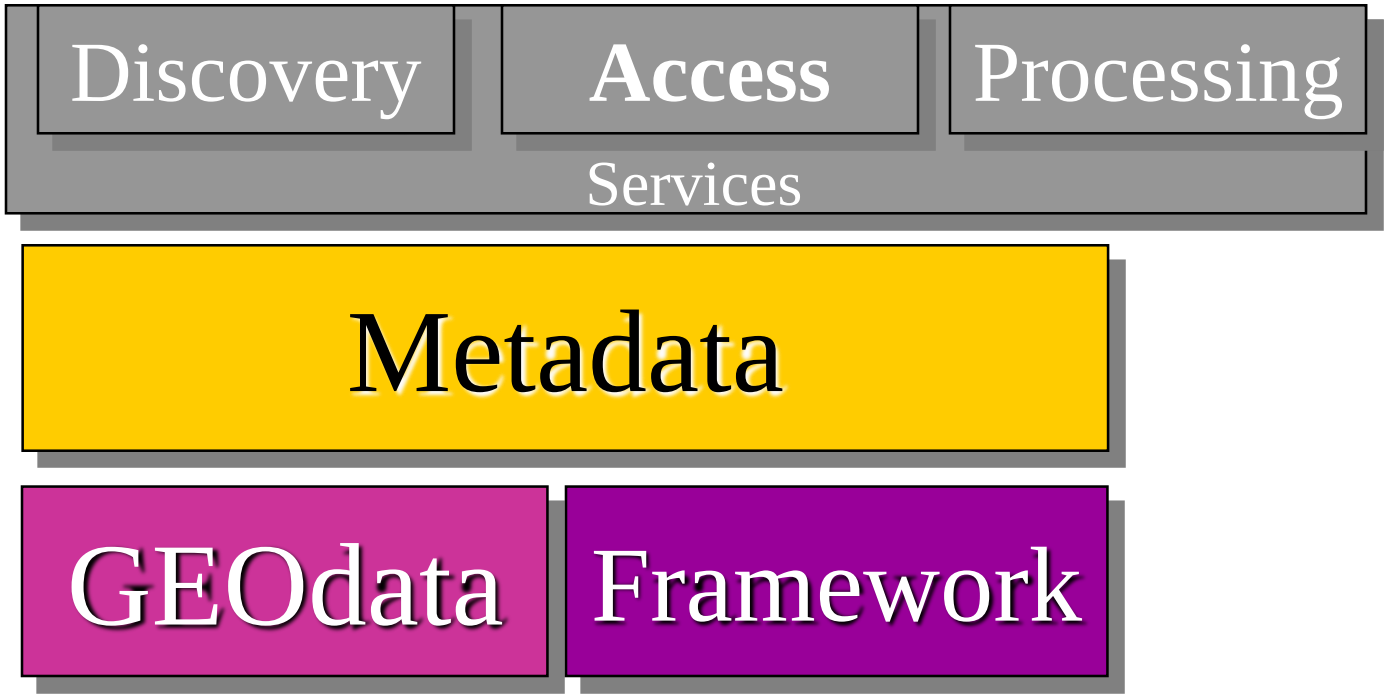


Clearinghouse Provides

- Search for spatial data through fields and full-text in the metadata
- Links to full data (if available)
- Uniform, distributed search through a single user interface to all servers worldwide
- A free advertising mechanism to provide world access to holdings under the principle of “truth-in-labeling”

Access Service

- "Access Service" provides standardized access to geospatial information via static files on ftp or online data streaming services
- Service delivers raw data, not maps

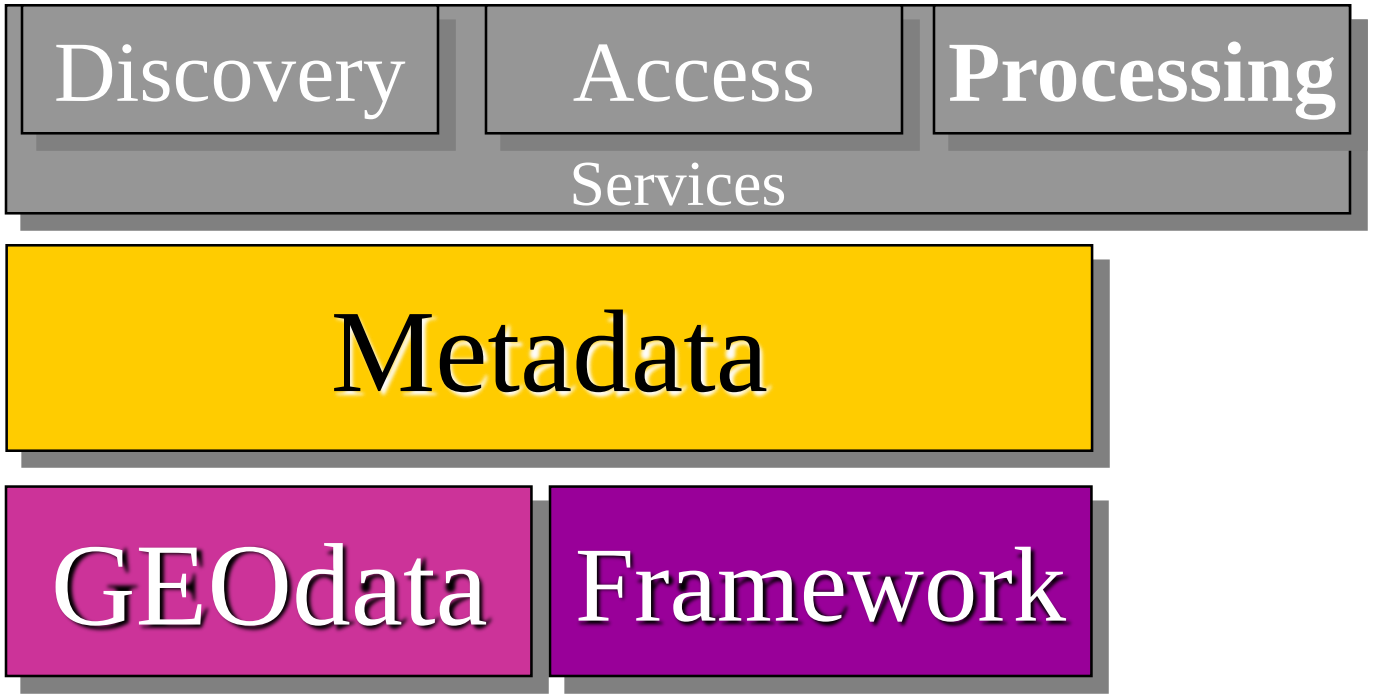


Data Access Concepts

- Standardization of data access implies
  - Definition of model used for the data to be exchanged
  - Adoption of an exchange or encoding format
  - Agreement on data access protocol(s)
- Organizations should strive to identify the mode(s) of operation to simplify data exchange

Processing Services

- "Processing Services" provide additional processing of geospatial information

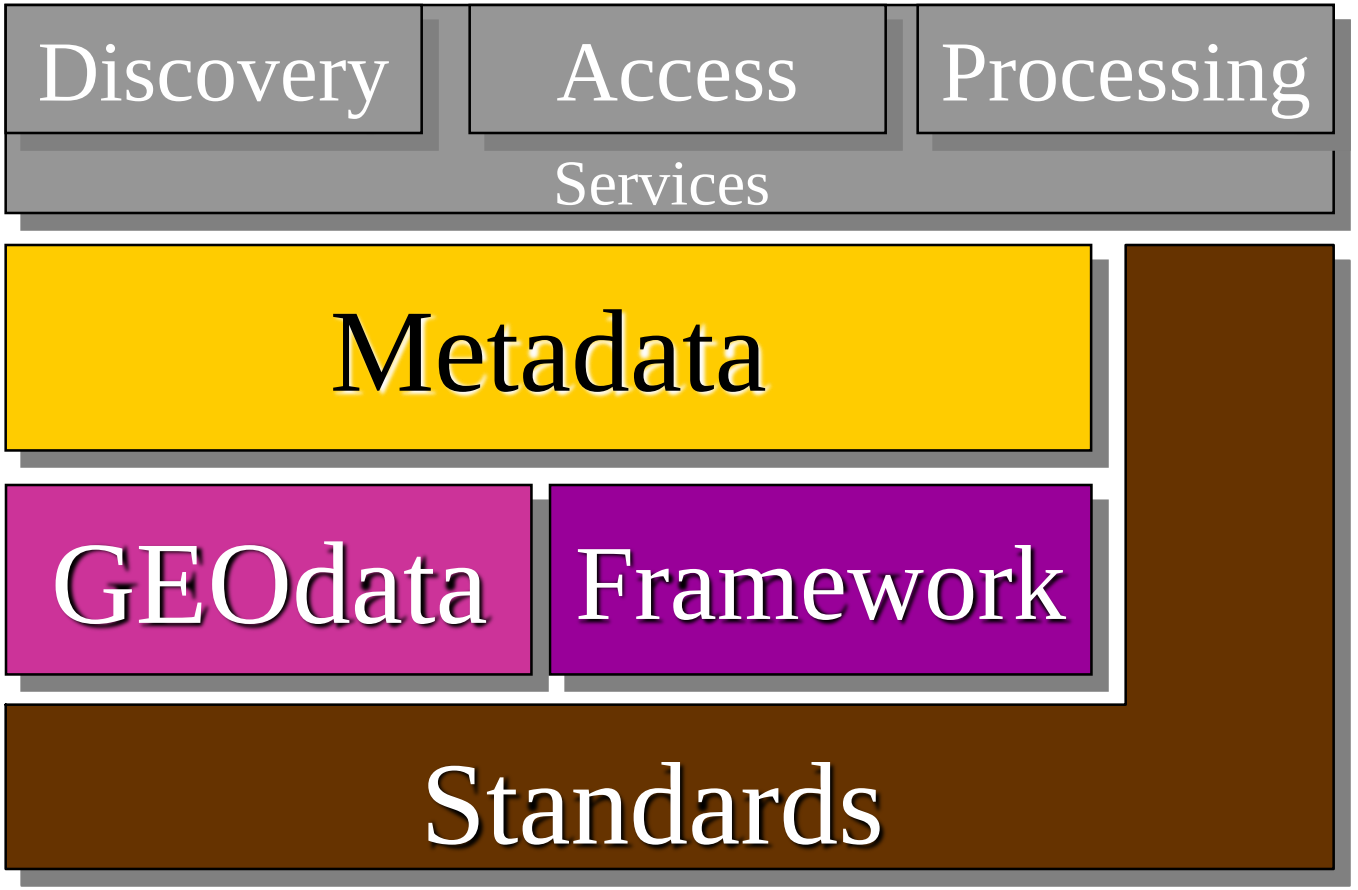


Processing Services

- Capabilities that extend and enhance the delivery of data through processes applied to raw data:
  - Web mapping services (WMS)
  - Symbology
  - Coordinate transformation
  - Analysis or topologic overlay services

Standards Make NSDI Work

- Standards include specifications, formal standards and documented practices



World Without Standards



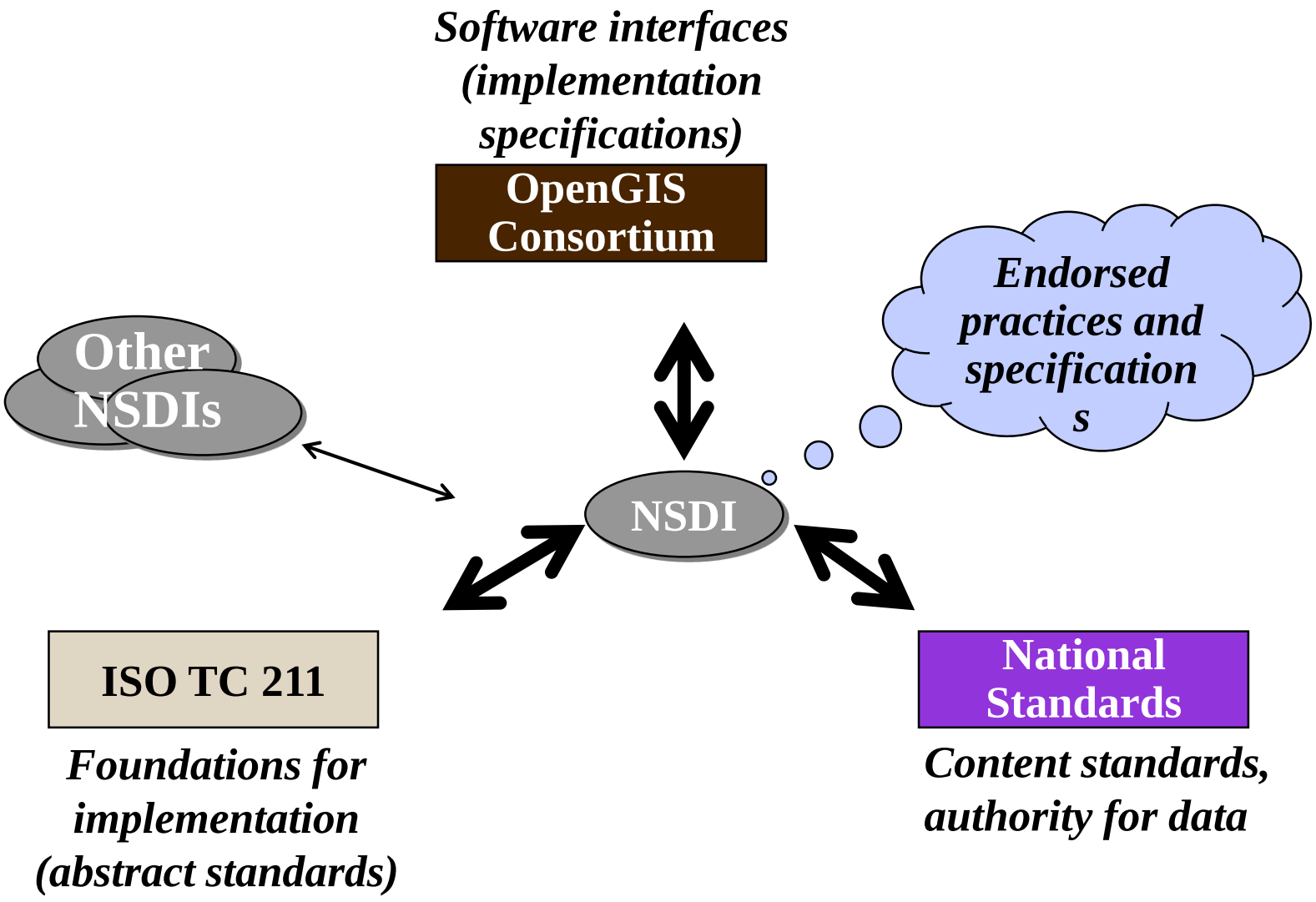




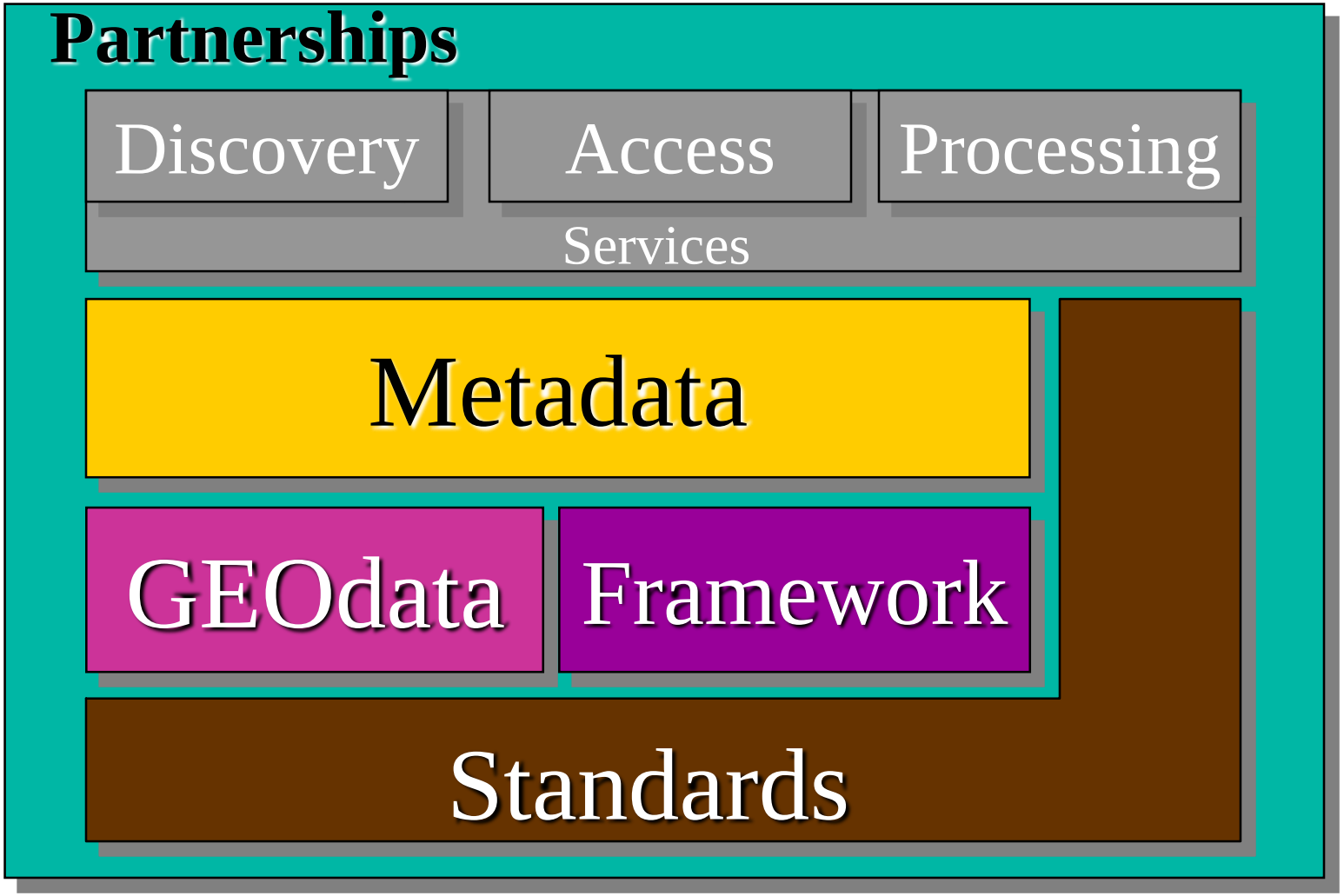
FGDC Standards

- Created by thematic subcommittees as national standards, representing community consensus view of data theme or common approach
- Submitted for 90-day public review
- Reviewed across disciplines for uniformity
- Published as US federal standards
- Standards by ISO, OpenGIS Consortium and other national bodies are used first (if they exist)

Roles of Standards Bodies



Partnerships Extend Capabilities



NSDI Components - Governance

Components of a Spatial Data Infrastructure (SDI)

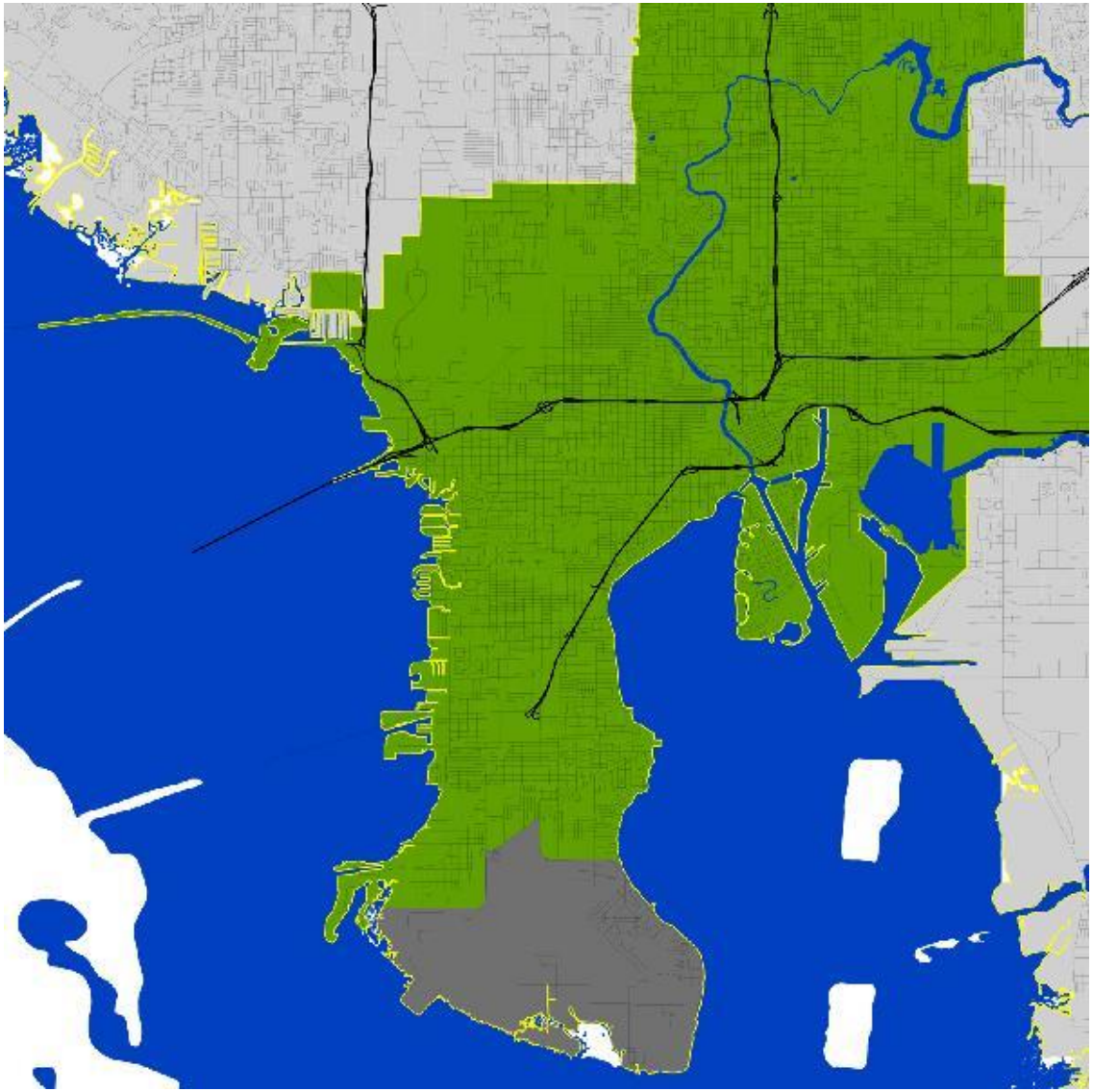
- **Policies & institutional arrangements (governance, data privacy & security, data sharing, cost recovery)**
- People (training, professional development, cooperation, outreach)
- Data (digital base map, thematic, statistical, place names)
- Technology (hardware, software, networks, databases, technical implementation plans)

Example of Rising Sea-levels

- Gradual
  - Global warming and melting polar ice
- Catastrophic
  - Tsunamis
  - Tropical storms

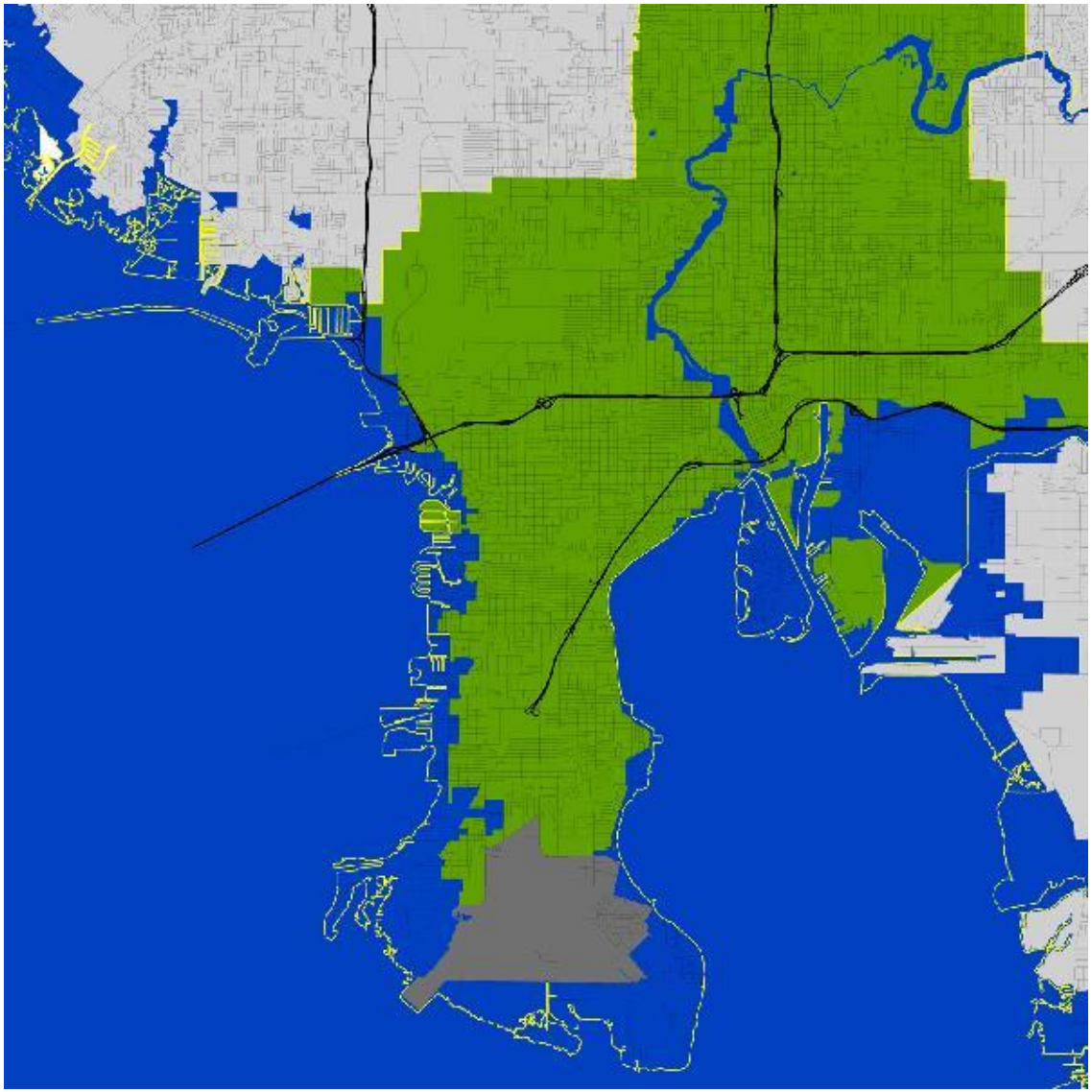
Tampa Bay, Florida - “Quiet” Time

Sea Level



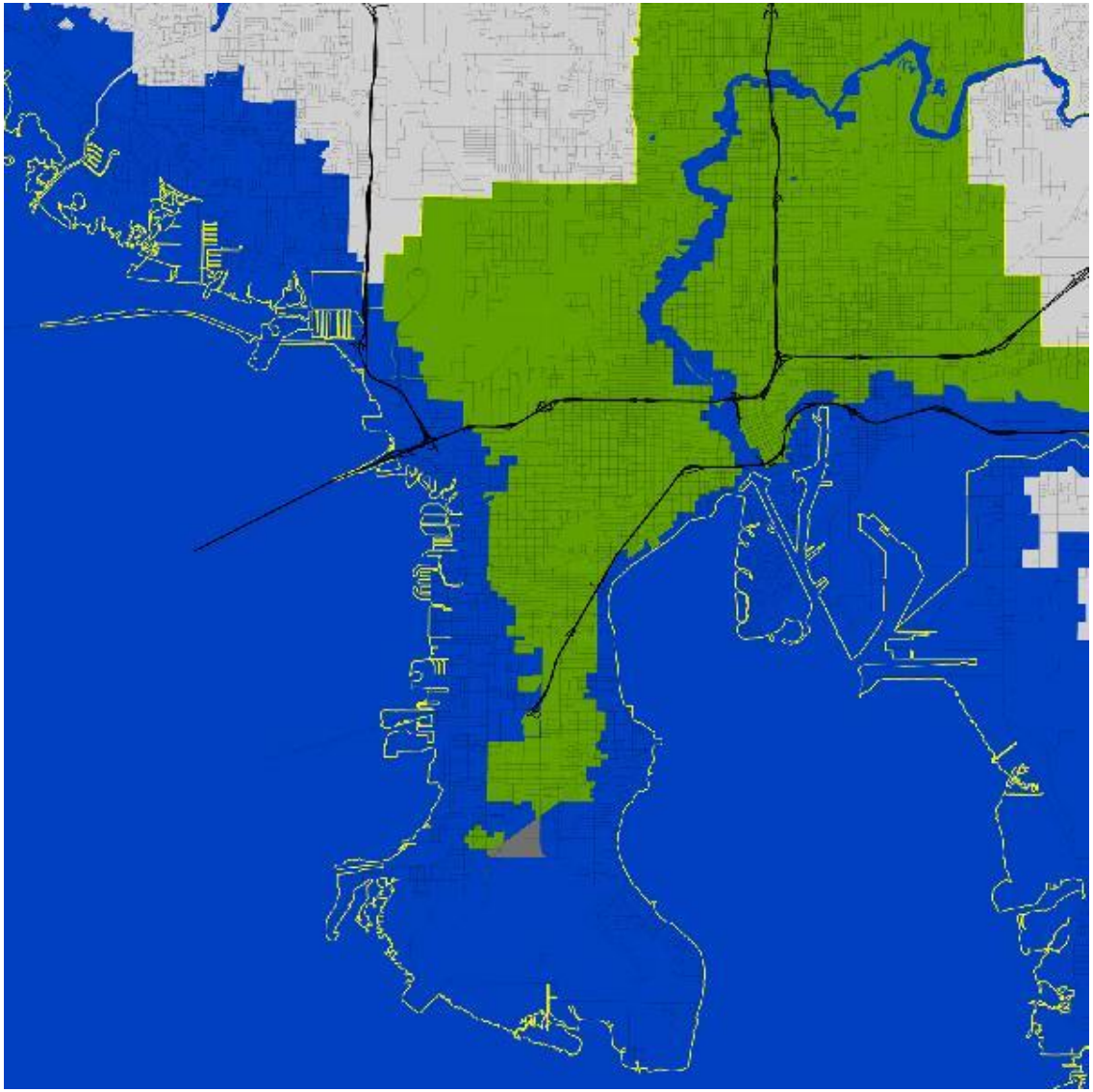
Category 1 Hurricane Storm Surge

Sea Level + 2.13 m



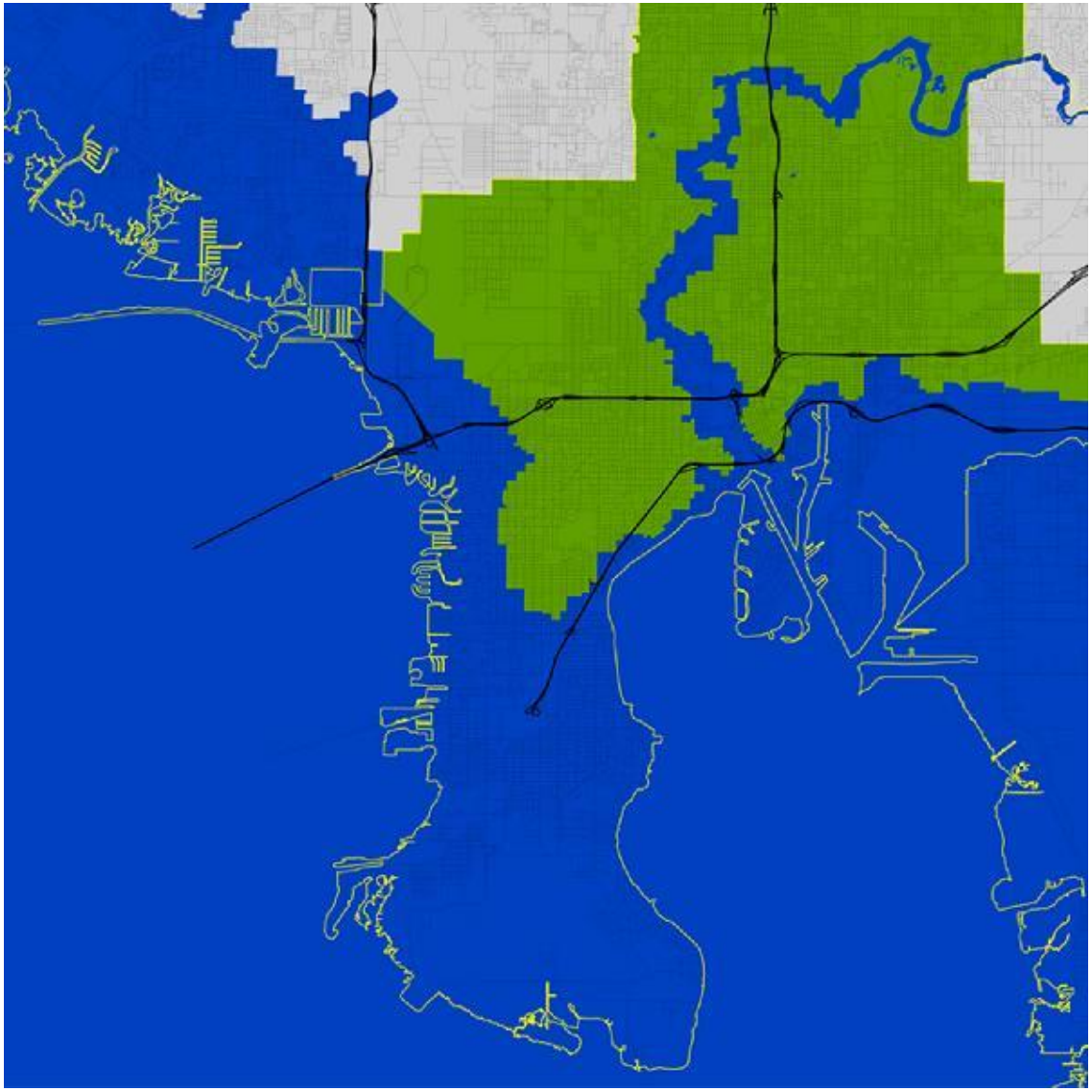
Category 2 Hurricane Storm Surge

Sea Level + 3.96 m



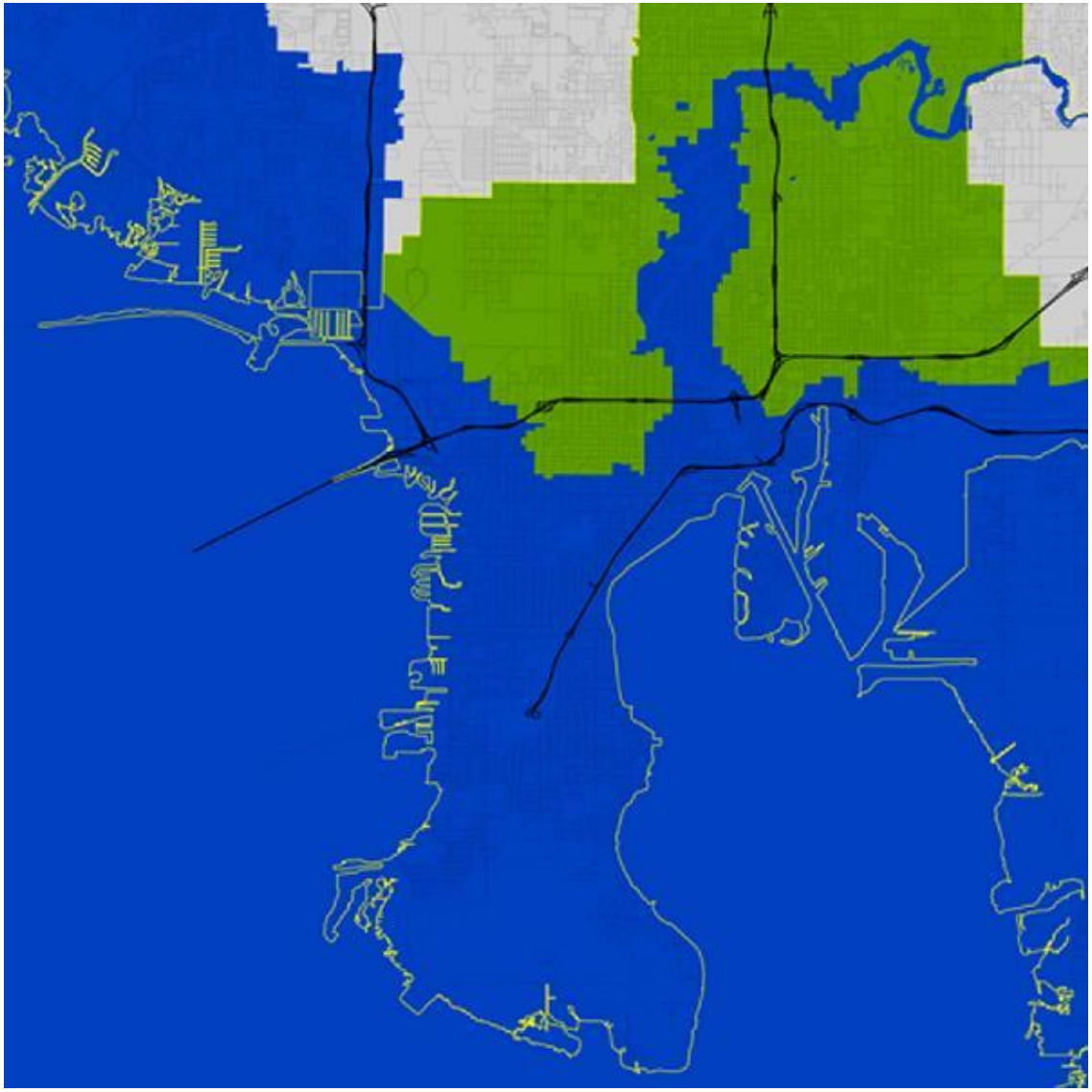
Category 3 Hurricane Storm Surge

Sea Level + 5.49 m



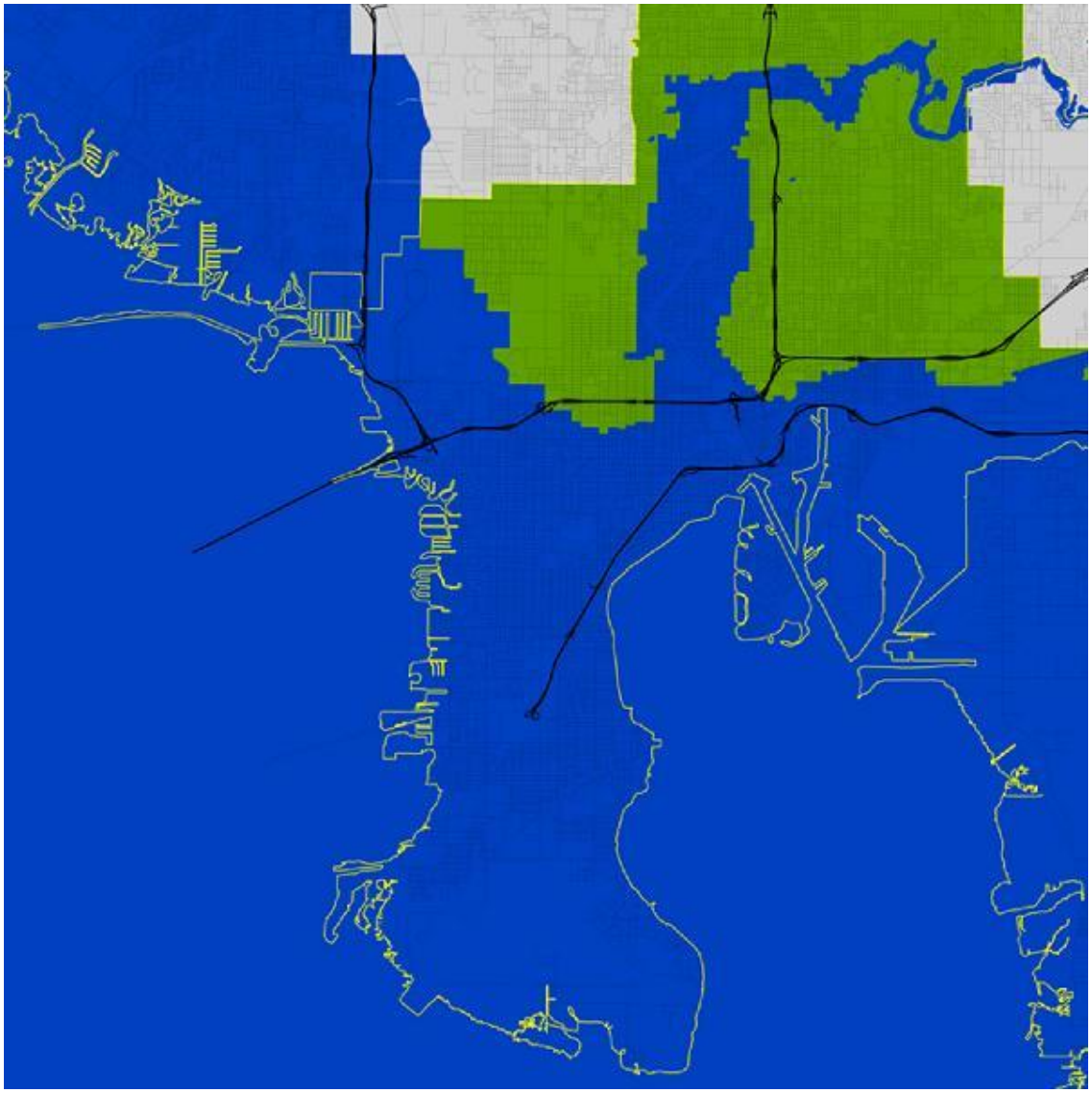
Category 4 Hurricane Storm Surge

Sea Level + 6.71 m



Category 5 Hurricane Storm Surge

Sea Level + 8.53 m



Data

- Are created by many different organizations
- Are the most expensive investment for many organizations
- Are used to solve many different problems
- Use many different methods and technologies

Data sharing can be difficult

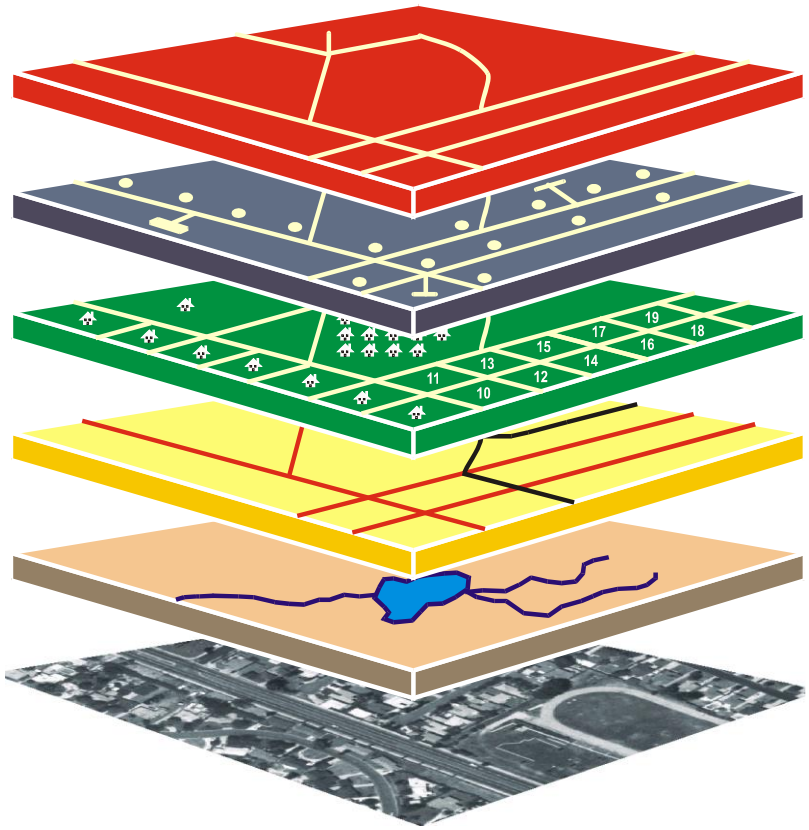
- Data may be hard to find or collect
- Data may be difficult to access
- Data may be hard to integrate and require reprocessing
- Data may not be current and/or complete
- Data may be undocumented
- Redundant data may be in conflict



The Vision of NSDI

- Current and accurate geospatial data
  1. will be readily available
  2. to contribute locally, nationally, and globally
  3. to economic growth, environmental quality and stability, and social progress

Readily Available



Pipes and manholes

Cables and poles

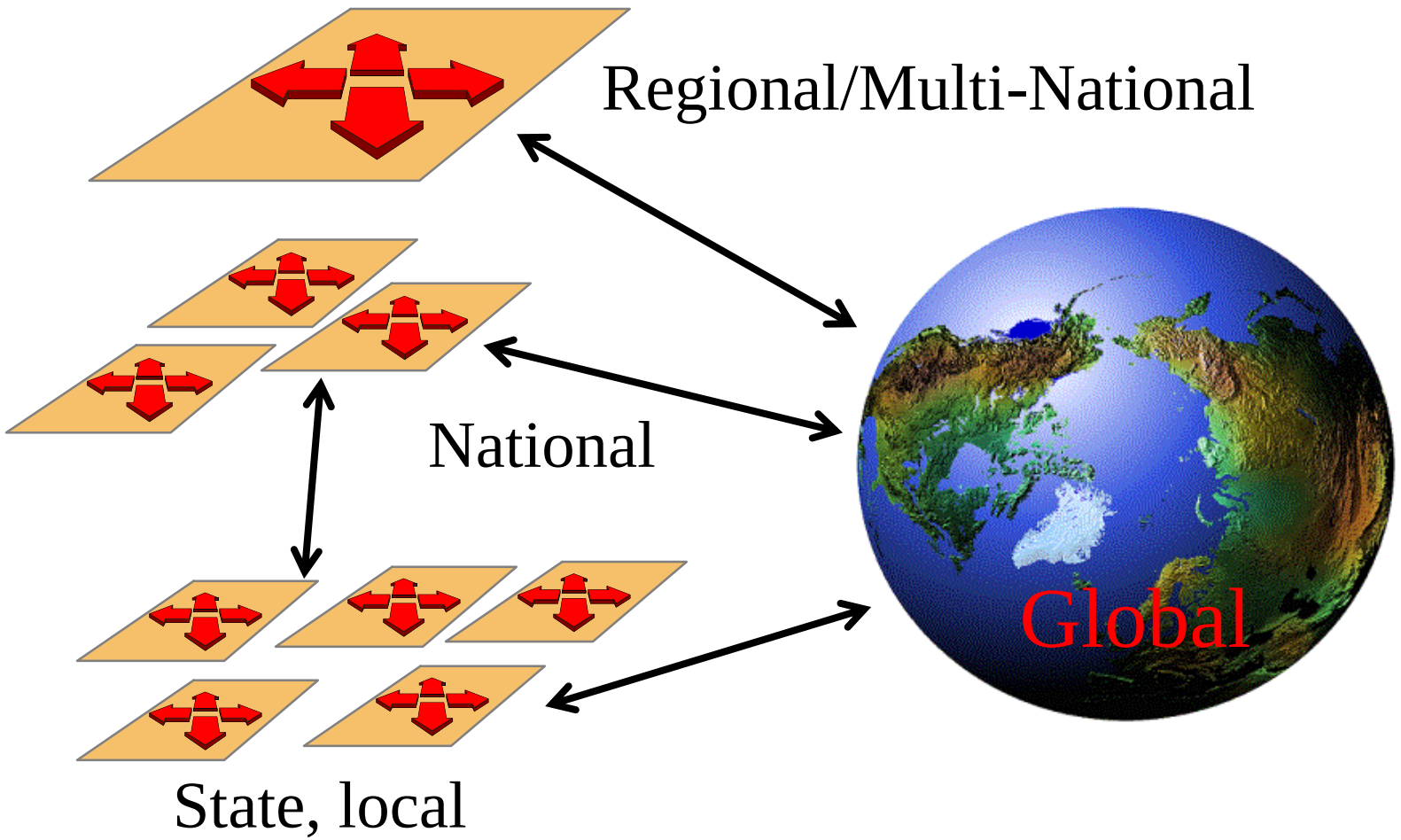
Property lines

Streets

Geography

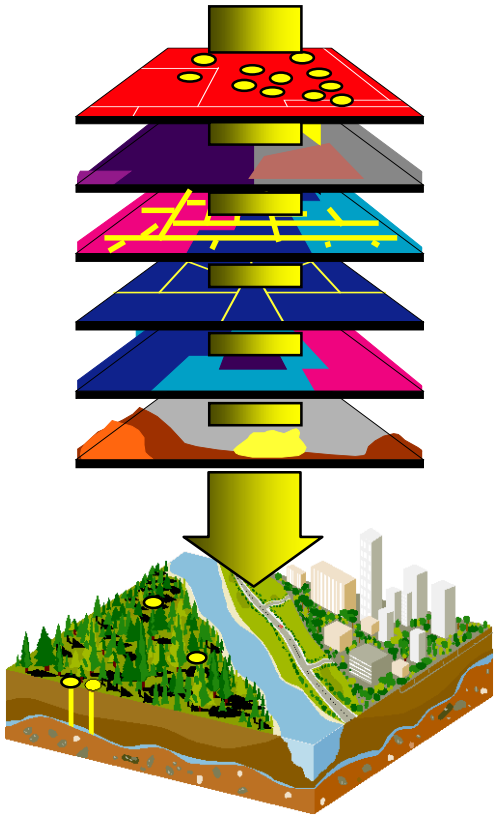
Aerial photographs

Delivered from Best Sources



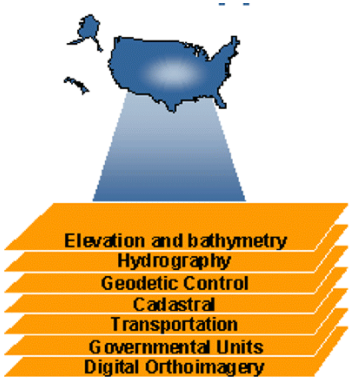
Why build an NSDI?

- Build data once and use it many times for many applications
- Integrate distributed providers of data: Cooperative governance
- “Place-based management”
- Share costs of data creation and maintenance
- Support sustainable economic, social, and environmental development

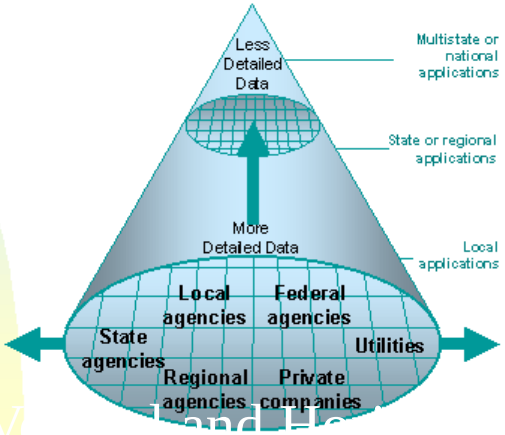


Three Key NSDI Concepts

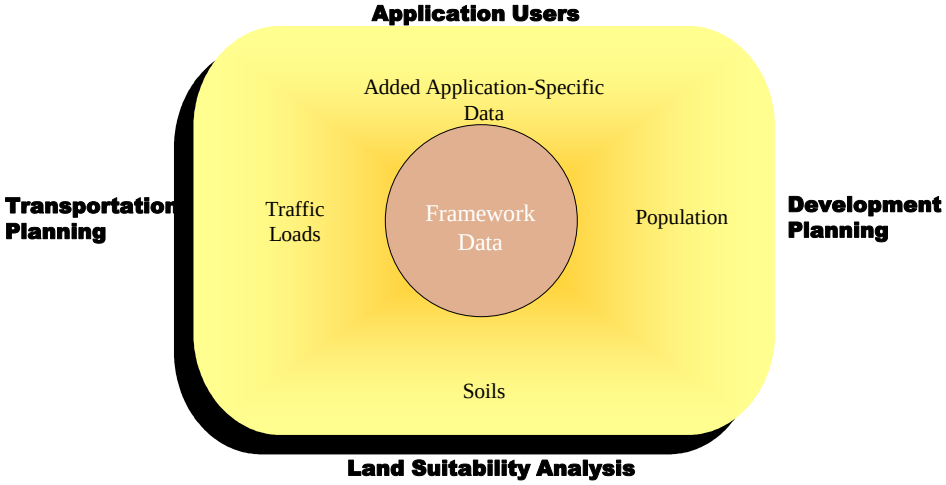
Framework Approach



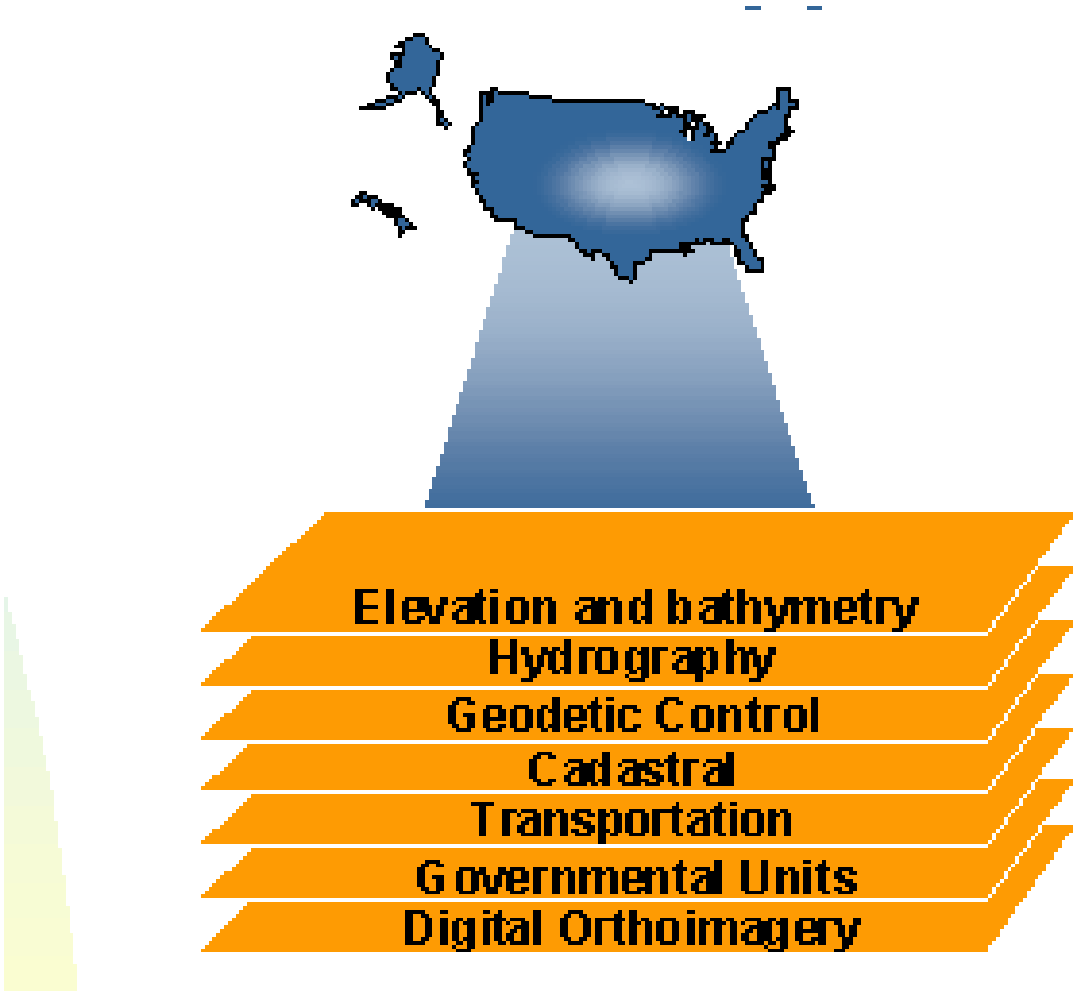
Framework Dimensions



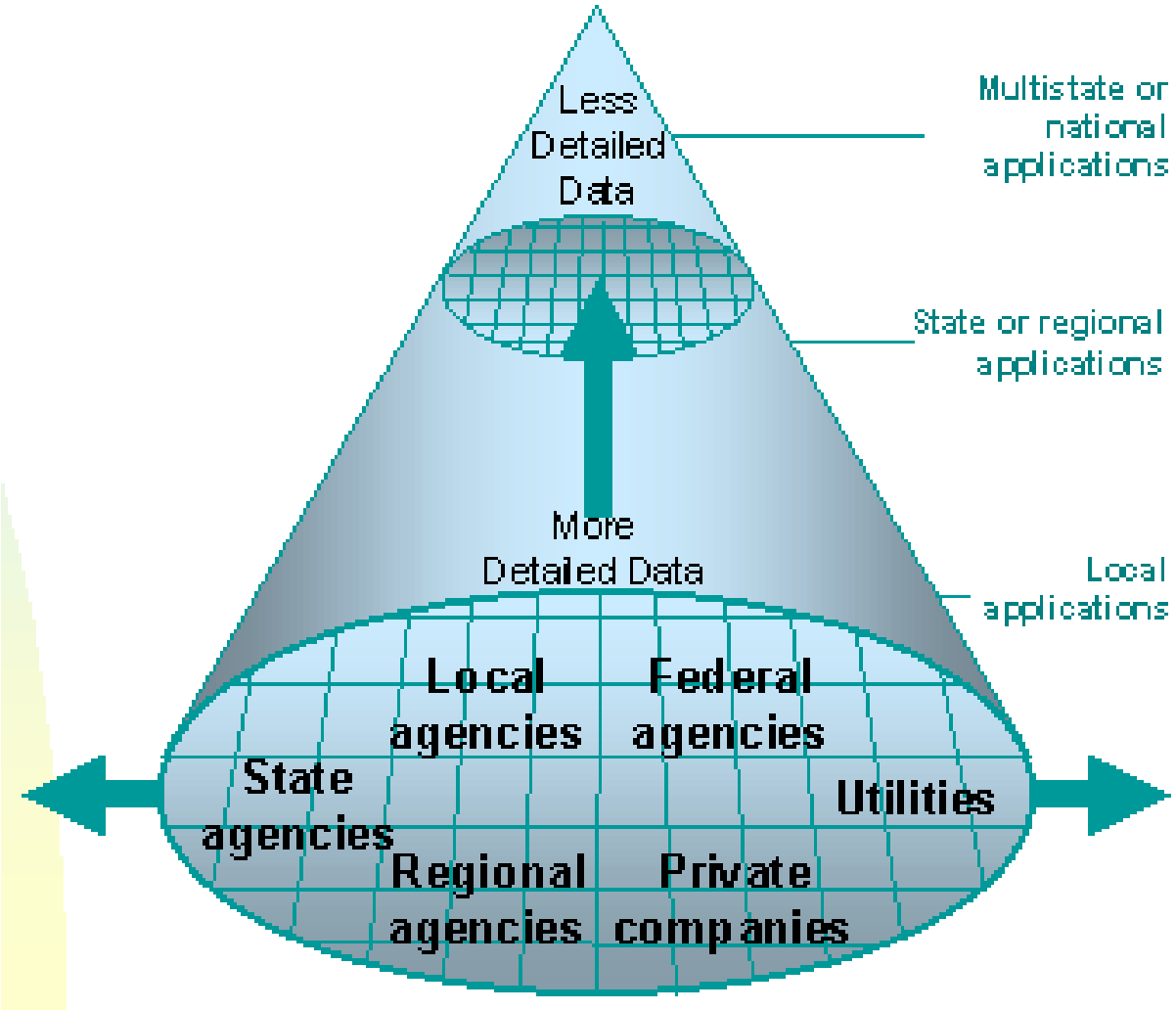
Data Sharing



Framework Approach

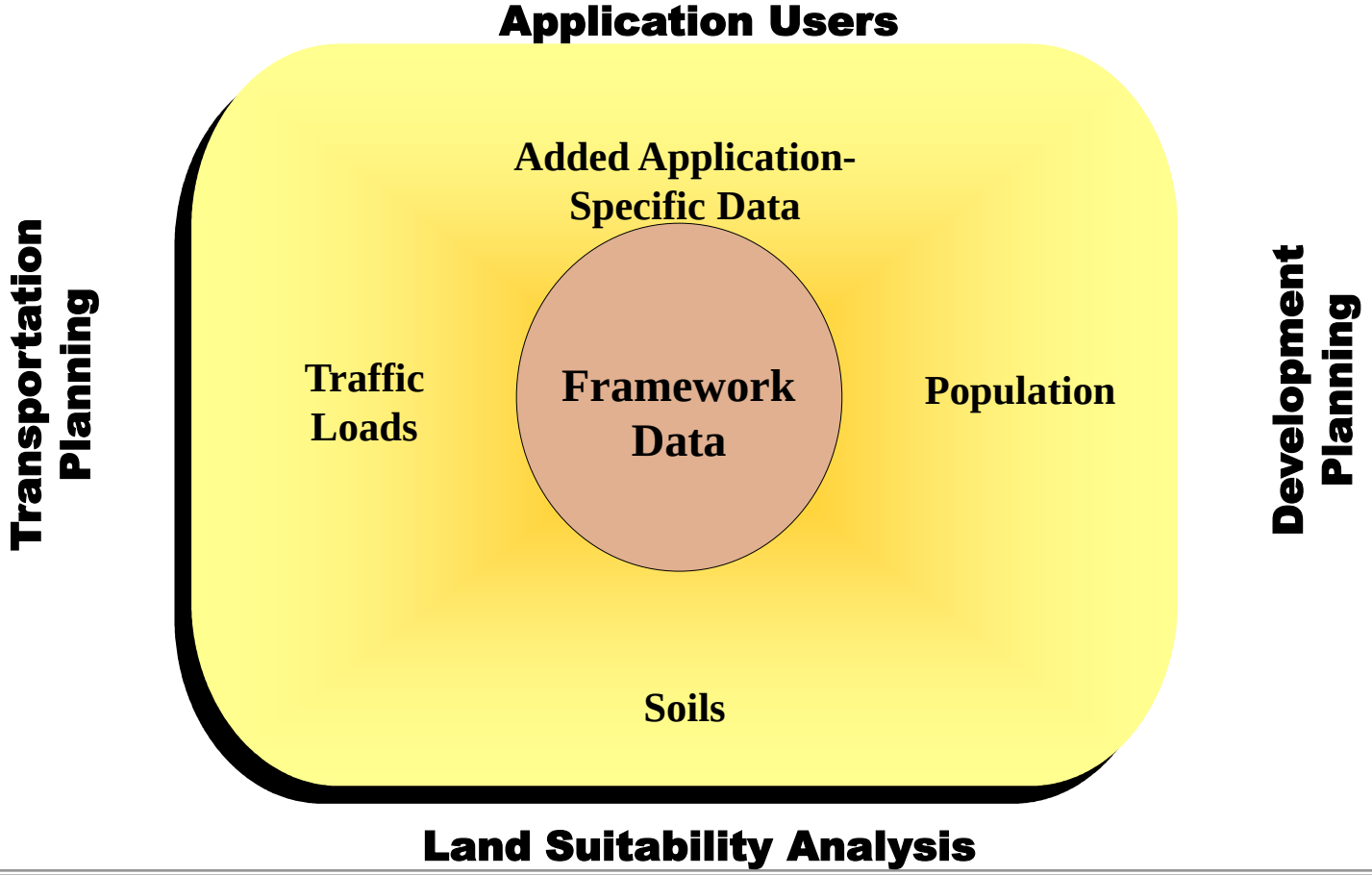


Framework Dimensions



Data Sharing

- Data from federal, regional, state, tribal, local, private companies and utilities

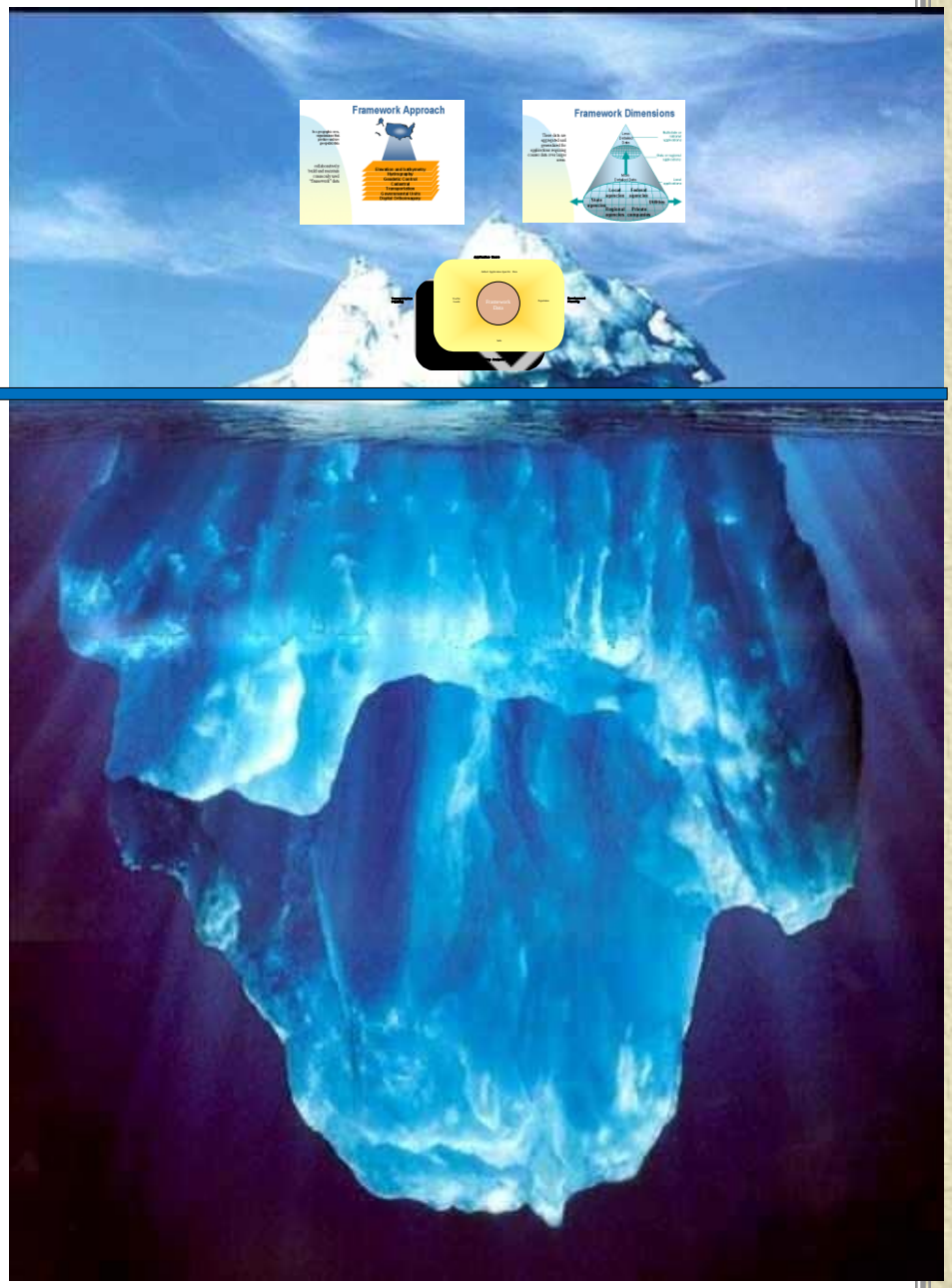


NSDI Iceberg

Concepts

Practices

90%



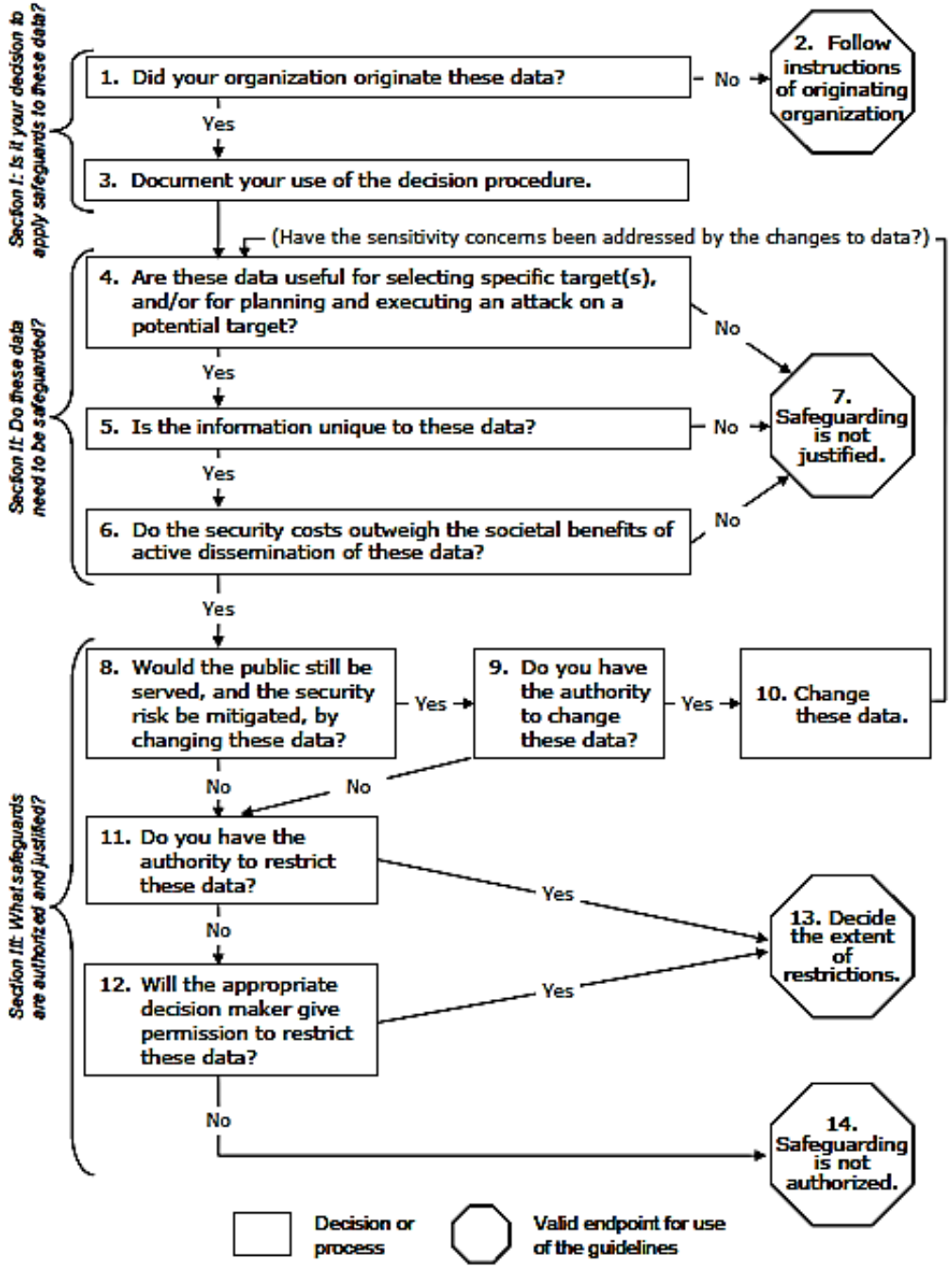
Common Issues

- Data sharing (level 1 interoperability)
  - How are data exchanged?
- Defining geographic objects (semantics)
  - What is a road?
- Sharing costs (financial)
  - Who pays?
- Involving local governments (participation)
  - More bureaucracy?
- Vertical integration (control, use and distribution)
  - Data and Organizations

Issues for data sharing and integration

- Technical issues
  - Multiple scales
  - Data exchange
- Institutional issues
  - Cost-sharing
  - Maintenance
  - Metadata
- Security issues

Decision Tree for Security Issues



Keys to Successful Development

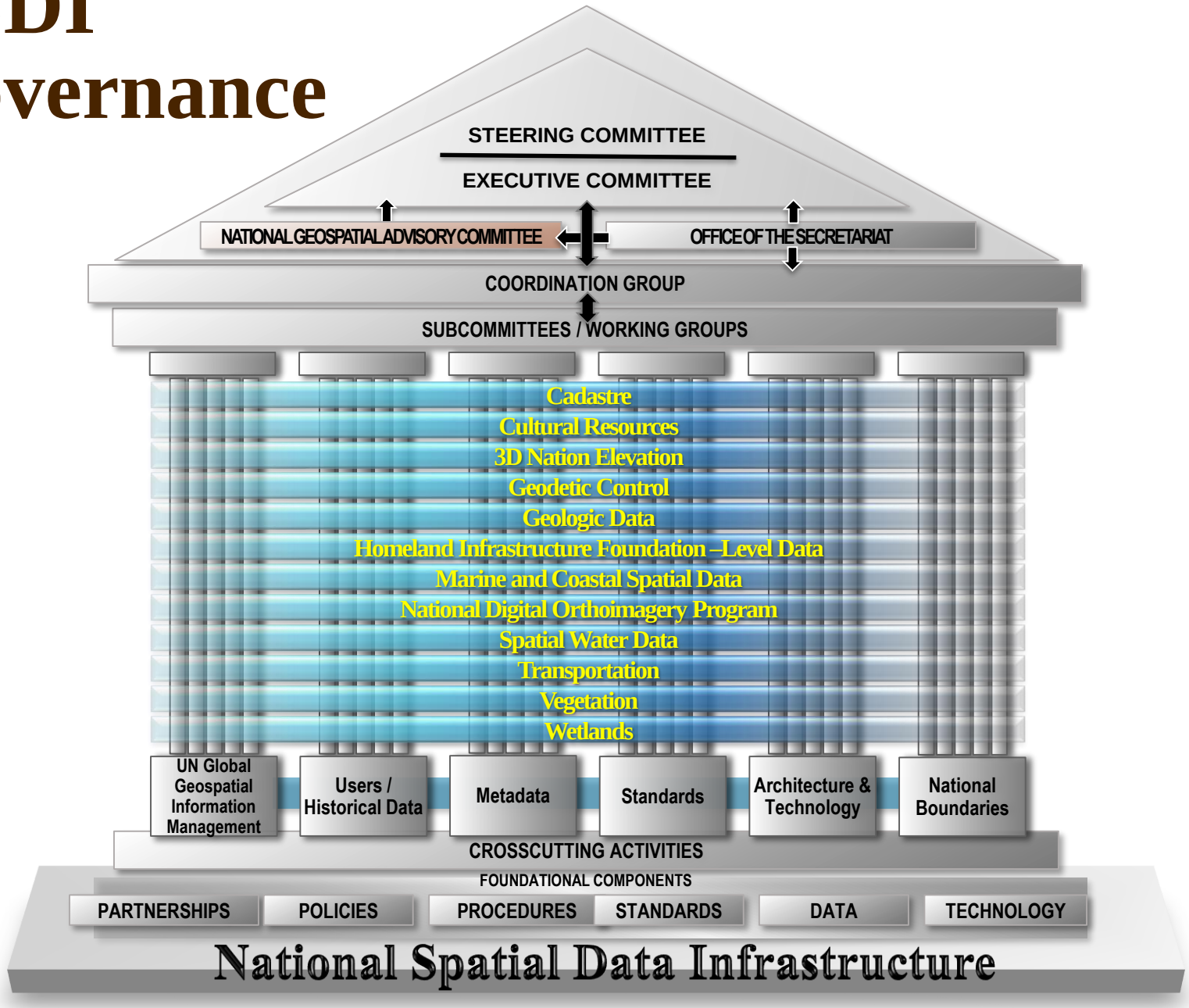
Cooperating partners with compatible visions, aligned priorities and focused objectives.	Political Context *Executive Leadership*
Aligned legislation to ensure that exchanged data is accorded proper legal weight.	Legal Interoperability ⟷ *Legislative Alignment*
Coordinated processes in which different organizations achieve a previously agreed and mutually beneficial goal.	Organizational Interoperability ⟷ *Organization & Process Alignment*
Precise meaning of exchanged information which is preserved and understood by all parties.	Semantic Interoperability ⟷ *Semantic Alignment*
Planning of technical issues involved in linking computer systems and services.	Technical Interoperability ⟷ *Interaction and Transport*

ACES

The FGDC builds alliances to address these and other issues

- Address institutional barriers
- Develop incentives for participants
- Designate data stewards
- Identify and develop policy changes
- Encourage metadata creation
- Develop clearinghouse
- Enhance the framework
- Encourage the use common standards and participate in national and international standards committees

NSDI Governance

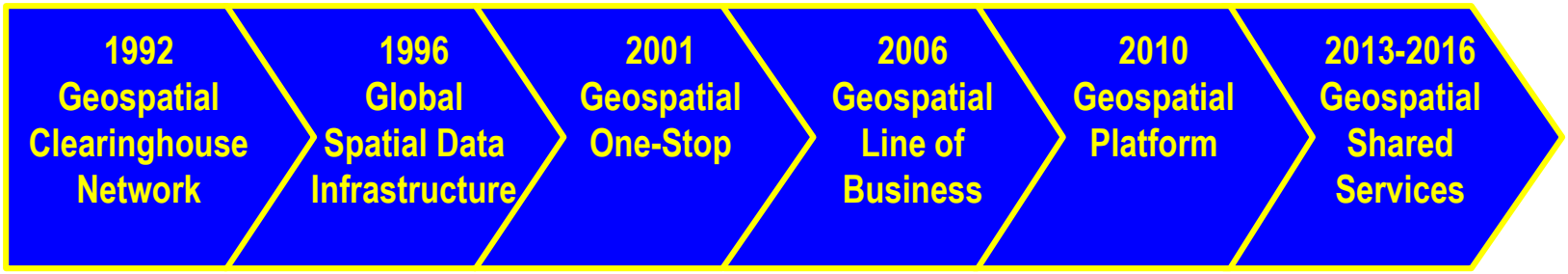


Solutions

- *"For every complex problem, there is a simple solution, and it is wrong."*
  Niccolò Machiavelli



Evolution



- Core FGDC functions
- NSDI
- Framework data
- Develop Policy
- Geospatial standards

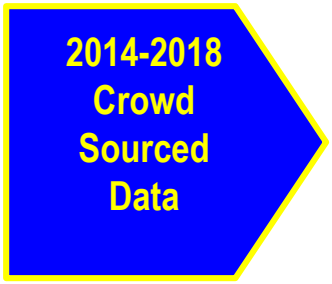
- International recognition of SDI concepts
- Local to global involvement
- FGDC support of GSDI initiatives

- Discovery and search of geospatial assets from all levels of government

- Enterprise program
- Business requirements
- Data lifecycle
- Common services
- Segment
- architecture

- Portfolio management
- Shared architecture
- Common data, services and applications
- Cloud computing

- Data, service, applications / shared infrastructure
- Mobile technology
- Place-based solution
- Geo-enabling government



NSDI Past and Future

Past	Future
Enable the access, sharing and use of geodata across agencies	Focus on applied information for improved place-based decision making
Enable geodata and metadata standards	Leverage shared and standards-based services
Reduce duplication of effort among agencies collecting geodata	Promote placed-based business intelligence & smart, shared applications
Improve the quality and quantity and reduce to cost of geodata	Core set of geodata layers that interface with non-spatial data
Collect and make geodata more accessible to agencies	Real-time data feeds and sensor webs for improved awareness & decision making
Establish key partnerships with state, local and regional governments, tribal nations, academia and industry	Establish policies and SLAs to access and share real-time geodata operations management and decision support
Increase the benefits of using existing agency data	Use of multi-temporal information linked to place

NSDI Past and Future

Past	Future
Reduce the monolithic systems storing and managing duplicate geodata & apps	Integrate and use advanced technologies & associated standards & best practices
Collaborative efforts focused on geodata	NSDI as infrastructure extending beyond data to include people & processes
Establish framework for managing federal geodata & sharing with external groups	Make data discoverable for innovation by all sectors of economy
Create institutional knowledge about federal geodata needs and collaborative acquisition and use	Nurture a “virtual organization” with institutional knowledge to create consensus and community for geodata
Create a framework of personnel dedicated to understanding & supporting Federal geodata needs	Provides mechanism for everyone to visualize and explore geodata to derive information and knowledge
Provide the fabric for a nationwide map	Position NSDI as an enabling resource for discovery, access, integration and application of location information