Data Solutions and a Platform for use to Meet UN Sustainable Development Goals by 2030

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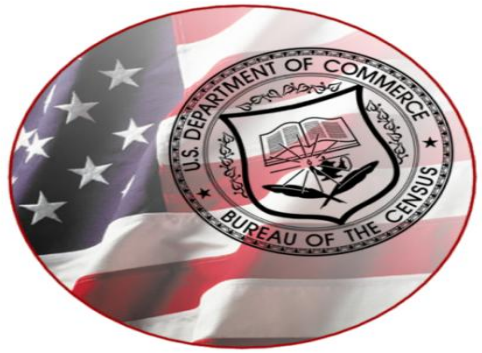
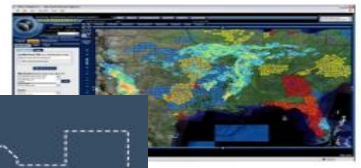
August, 2017

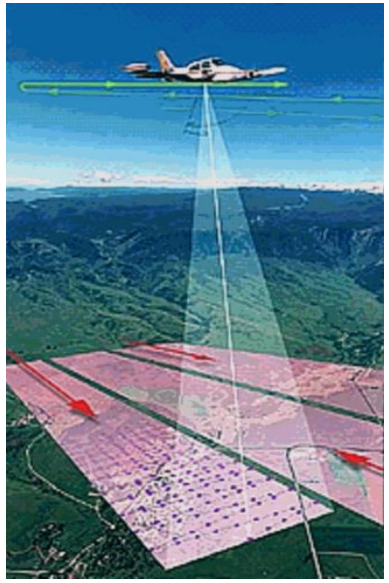
PLATFORM: COMPUTING / STORAGE TRENDS:

- Computer System Performance –
  - Hardware - **EVOLUTIONARY** – Moore's law still holding
  - New possibilities at Research Level – not yet proven
    - DNA for Storage; 3D Glass, Holography; Carbon Nanotubes, Graphene, Quantum
  - Software – **DISRUPTIVE** – **Parallelism** => clusters of **10,000+** computers, **CLOUD, ML, AI**
- Software – **FLEXIBILITY -** NOW Supporting many Data types in Databases
  - Databases/persistent stores: ***POLYGLOT PERSISTENCE*** now can handle ***ALL*** types of data
  - Software – ***GRAPH STORAGE, SEMANTICS, ONTOLOGIES***
    - – Add all types of data, build *NEW* relationships
  - Enables ***MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE*** (ML, AI)
  - Stream data arriving; Filter the data; ML: Keep what matches your requirements; aggregate it, make it accessible for **ALL SEVENTEEN (17)** goals.

Acquiring/Keeping Data for ***17*** Sustainable Development Goals: Need One Platform for **ALL** Variety, Velocity, Volume of Data





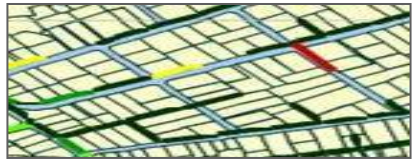


- VIDEO: UAVs, DRONES, SURVEILLANCE
- IMAGERY/Raster: (Satellites, Medical)
- Sensors (IOT), LIDAR, 3D, RFID, Wearables
- Social Media, Web Scraping, Mobile Phones
- New data products for: Land and Water mgmt, Agriculture, Environment Transportation, Terrain and City Models, SDIs for planning, maintenance, Emergency response, Defense, Intelligence, Consumers , Healthcare
- Genomics (DNA Sequencing)
- Semantics , Ontologies →
- Machine Learning, AI
- **Location is a Powerful Organizing Principle**
- **MULTIPLE VERSIONS OF THE ABOVE**

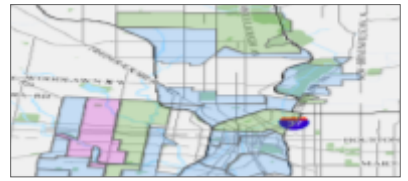
Managing All Spatial, Graph, Statistic Data – in One Store

Location and Statistics analysis with Secure, scalable storage for enterprise data

"Points"



"Lines"



"Polygons"

SQL access

Web Services (OGC)

SPARQL End Point

40+ Graph Analysis Functions (PGX)

Oracle Spatial and Graph

ORACLE DATABASE 12c

Spatial Vector Acceleration

Geocoding

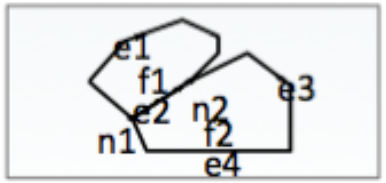
Routing

Inferencing

Property Graphs

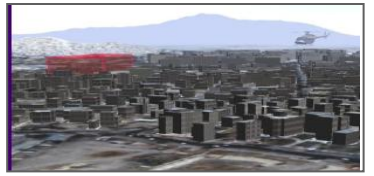
Network Graphs

RDF Semantic Graphs



Topologies

Rasters



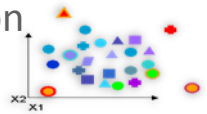
3D, point clouds (LiDAR)

Oracle Statistics / Analytics Machine Learning Algorithms

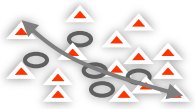
- **Classification**
  - Logistic Regression
  - Decision Tree
  - Random Forest
  - Neural Network
  - Support Vector Machine
  - Naïve Bayes
  - Explicit Semantic Analysis
  - Gaussian Mixture Models

- **Clustering**
  - Hierarchical K-Means
  - Hierarchical O-Cluster
  - Expectation Maximization

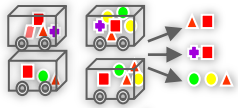
- **Anomaly Detection**
  - One-Class Support Vector Machine



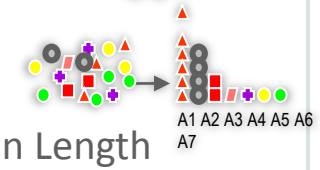
- **Regression**
  - Generalized Linear Model
  - Support Vector Machine
  - Random Forest
  - Linear Model
  - Stepwise Linear regression
  - LASSO



- **Association Rules**
  - A priori



- **Attribute Importance**
  - Minimum Description Length
  - Principal Component Analysis
  - Unsupervised Pairwise KL Divergence



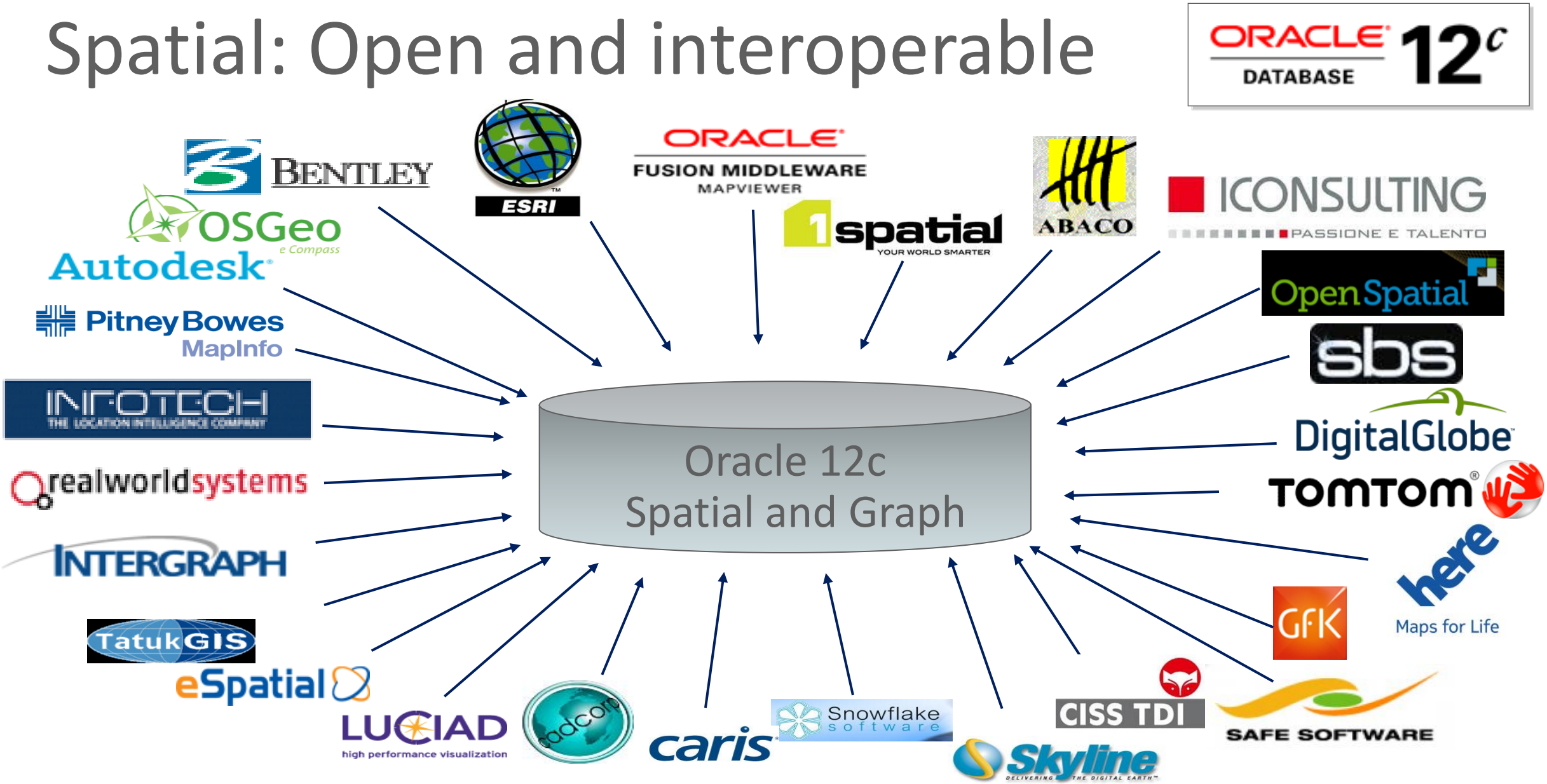
- **SQL Predictive Queries**

- **Statistical Functions**

- **Algorithm Text Support**
  - Algorithms support text type
  - Tokenization and theme extraction
  - Document similarity

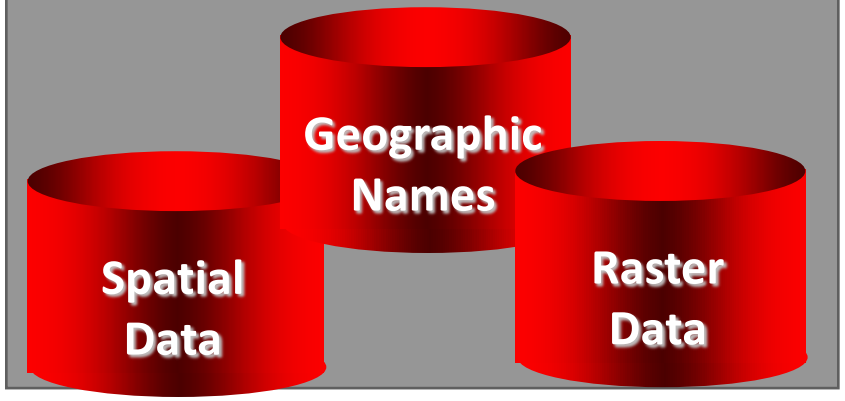
- **Feature Extraction**
  - Principal Component Analysis
  - Non-negative Matrix Factorization
  - Singular Value Decomposition
- **Time Series**
  - Single Exponential Smoothing
  - Double Exponential Smoothing
- **Open Source ML Algorithms**
  - CRAN R Algorithm Packages through Embedded R Execution
  - Spark MLlib algorithm integration

Spatial: Open and interoperable



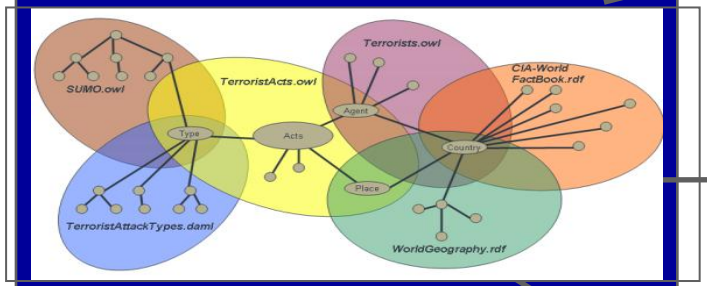
Sustainable Goals: Repurposing Data: Ontology-driven Enable Shared, Actionable Knowledge

National Mapping Private Cloud



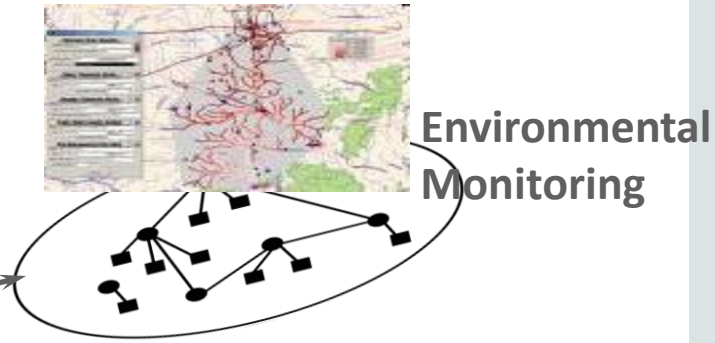
- Simple Features
- GeoRaster
- Topology
- Networks
- Gazetteers
- …

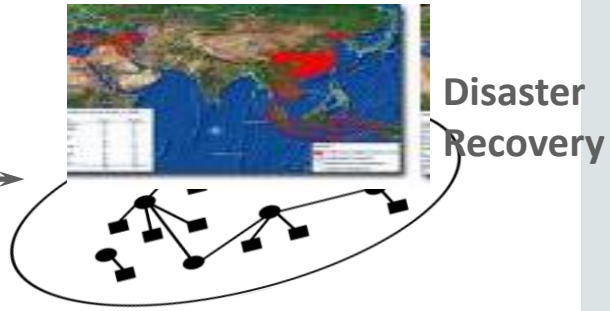
RDF & OWL Metadata



- Data Integration
- National Map schemas
- Geographic names
- Temporal
- Naïve Geography
- …

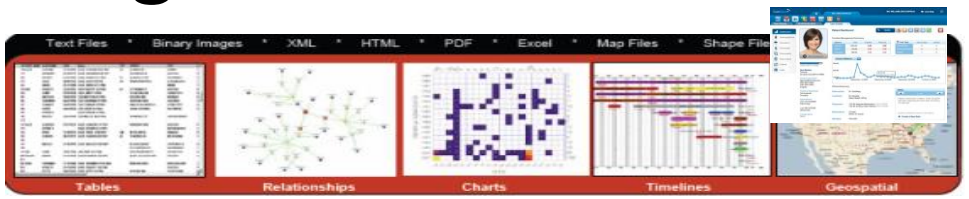
Application Ontologies





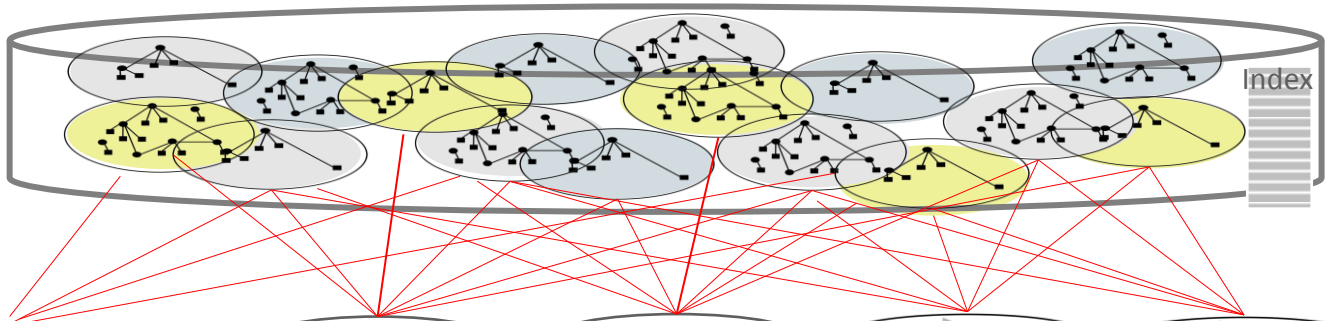
Harmonizing the Electronic Health Care Ecosystem – Goal 3 Using Semantics, Ontologies

Enterprise-wide, Patient-centric, longitudinal Record System



Domain Ontologies

(business metadata + Ontologies)

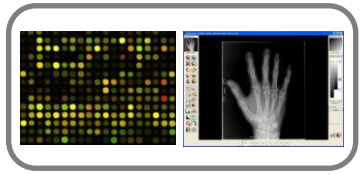


Data Servers

Lab/clinical Care | Research | Content Mgmt | Billings/Claims | Reporting/BI

Data Sources / Data Types

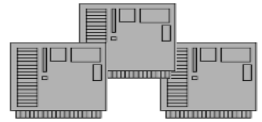
Social Media



Medical Devices

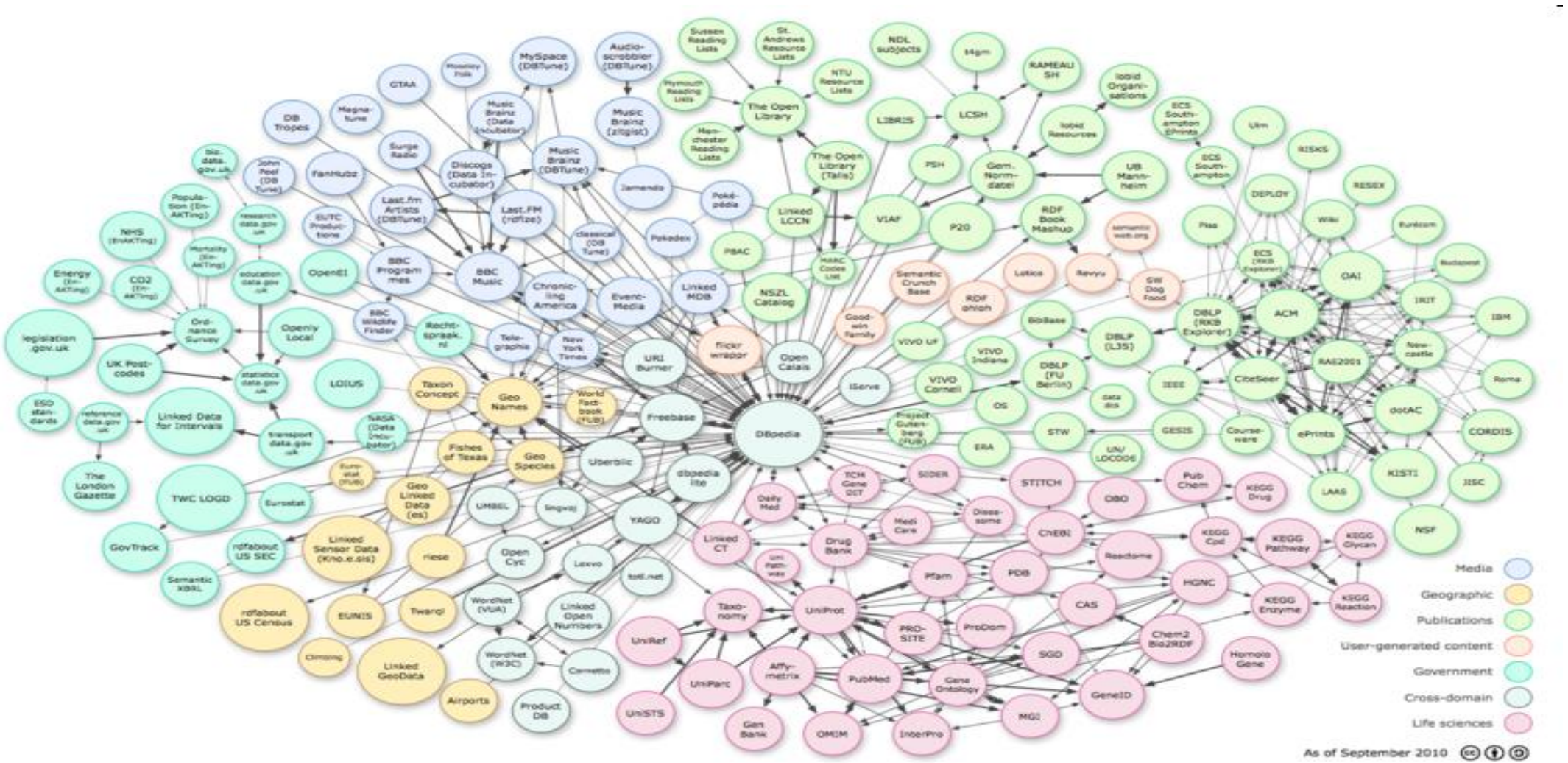
Lab Information Systems

Subscription Services



Legacy Patient Records

Linked Open Data:
Connecting With other Services and Clouds

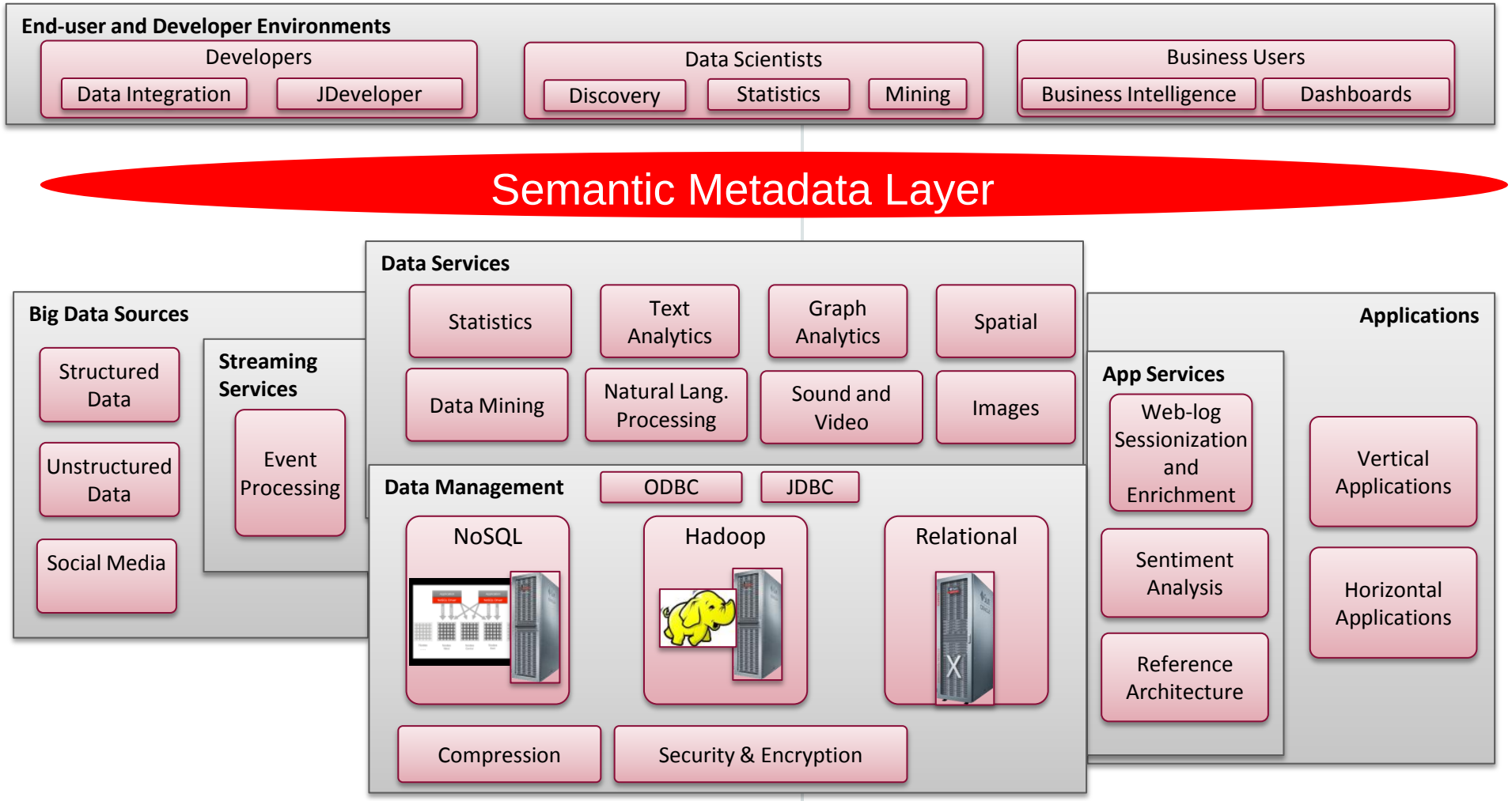


Oracle: Linked Data support: on-premise or in the Cloud

- Highly scalable, secure triple store based on RDF (Resource Description Framework)
  - ***1 TRILLION TRIPLE BENCHMARK**, leading Triple Store:W3.org*
  - 1.13 million triples per second query performance
- SPARQL and SPARQL in SQL support
  - Apache Jena and OpenRDF Sesame pre-integrated
  - SPARQL endpoint enhanced with query control
  - GeoSPARQL support (classes, properties, datatypes, query functions)
- Forward-chaining based inferencing engine in the database
  - Various native rulebases (RDFS, OWL2 RL, SKOS, ...), integration with OWL2 reasonsers (TrOWL, Pellet)
- RDB to RDF mapping on relational data aligned with RDB2RDF standard

Support Breadth of National & UN Data ABOVE STOVEPIPES

Data arrives, is filtered, stored data is available to ALL Organizations

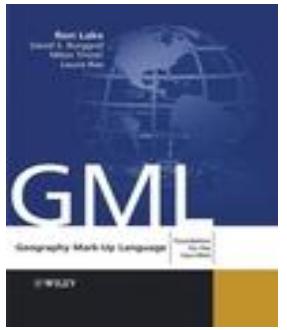


GUIDANCE: THIS IS AN ARCHITECTURE TO SUPPORT ONE SHARED MULTIPURPOSE NATIONAL / UN STORE

You Enhance Innovation & Sharing By Using **STANDARDS**

e.g. – The Spatial / Semantics Data Domains

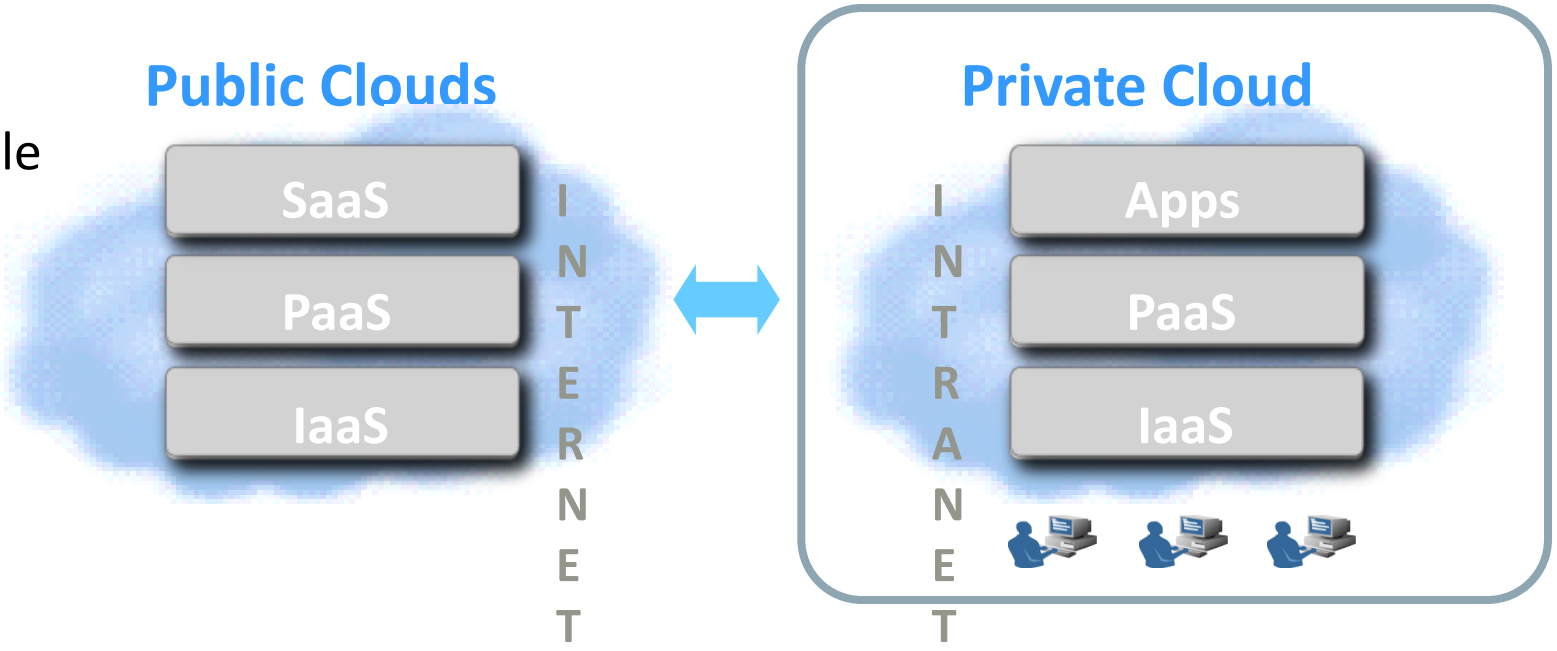
- **ISO**
  - **TC 211; TC 204**
- **Open Geospatial Consortium**
  - **Simple Features; GML; Web Services**
- **De-facto Standards**
  - **SHP, MGE, DXF, KML**
- **Professional Standards**
  - **ISPRS, FIG, WMO**
- **Java, .NET, Flash**
- **W3C: RDF,OWL, SPARQL, GeoSPARQL**
- **TAGGED METADATA – agree on tags**



SQL3/MM Spatial

Public Clouds, Private Clouds: Data/Statistics Platforms

- Used by multiple tenants on a shared basis
- Hosted and managed by cloud service provider



- Exclusively used by a single organization
- Controlled and managed by in-house IT

Trade-offs

Lower *upfront* costs ⟷ Lower *total* costs

Outsourced management ⟷ Greater control over security, compliance, QoS

OpEx ⟷ CapEx & OpEx

ELASTICITY is key value of Clouds

Oracle Technology Supplies both Public and Private clouds

YOU MAY NEED A CLOUD IN EACH COUNTRY ---DEPENDS ON THEIR LAWS

To Meet 2030 Goals: Do Not Build Your Solutions From Scratch

Long Term Cost of Ownership rises with custom construction & Open Source

Time to Build

Optimizations

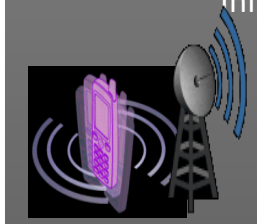
Maintenance

UN-GGIM: “train the individuals is at least five years”

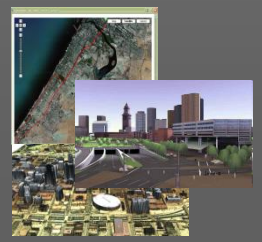
Sustainable Goals: All Data Types /Ontologies/ ML / AI Bases: Success Enhanced with ***MULTI-MODEL DATABASE PLATFORM***

Big & Fast Data

Volunteered Geographic Statistical Information



Sensors Streaming Data



Geo-referenced Video, 3D, LiDAR Satellites

Simplify Statistics IT

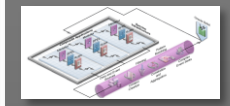
Support for Open Standards

Spatial Database, Application Server, BI, tools

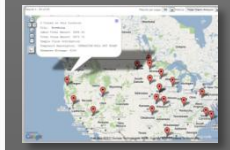
Support by Leading Partner solutions

Multi-Model Engineered Systems

Deep Analytics



Real-time Complex Event Processing



Dense Visualization

Spatial Analysis Graph Analytics

On Premise, On Cloud, Shared Services

Shared GeoSpatial Services
Location Aware Everything

Fully Parallel and Secure