RESQML V2
A data exchange Standard for Earth-Model Description

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On behalf of ENERGISTICS : www.energistics.org

5th European Meeting on 3D Geological Modelling

Who is Energistics and who participates

Who is Energistics

- Energistics is a global, non-profit, membership consortium that facilitates the development and adoption of technical open data exchange standards in the upstream oil and gas industry.
- **Membership** consists of IOCs, NOCs, oilfield service companies, software vendors, system integrators, regulatory agencies, universities and the global standards community.
- **Standards** are developed by workgroups (known as Special Interest Groups, or SIGs) made up of industry experts from member companies.

In summary, the standards are created *by* the industry *for* the industry, facilitated by Energistics.

GEOSIRIS

Energistics Members

What is RESQML ?

- **What Is RESQML ?**

- RESQML is an **XML** (for Meta data and semantic knowledge expression)- **and HDF5** (for binary Data)-based **information - exchange standard** that facilitates reliable, automated exchange of data among software packages used in subsurface workflows.

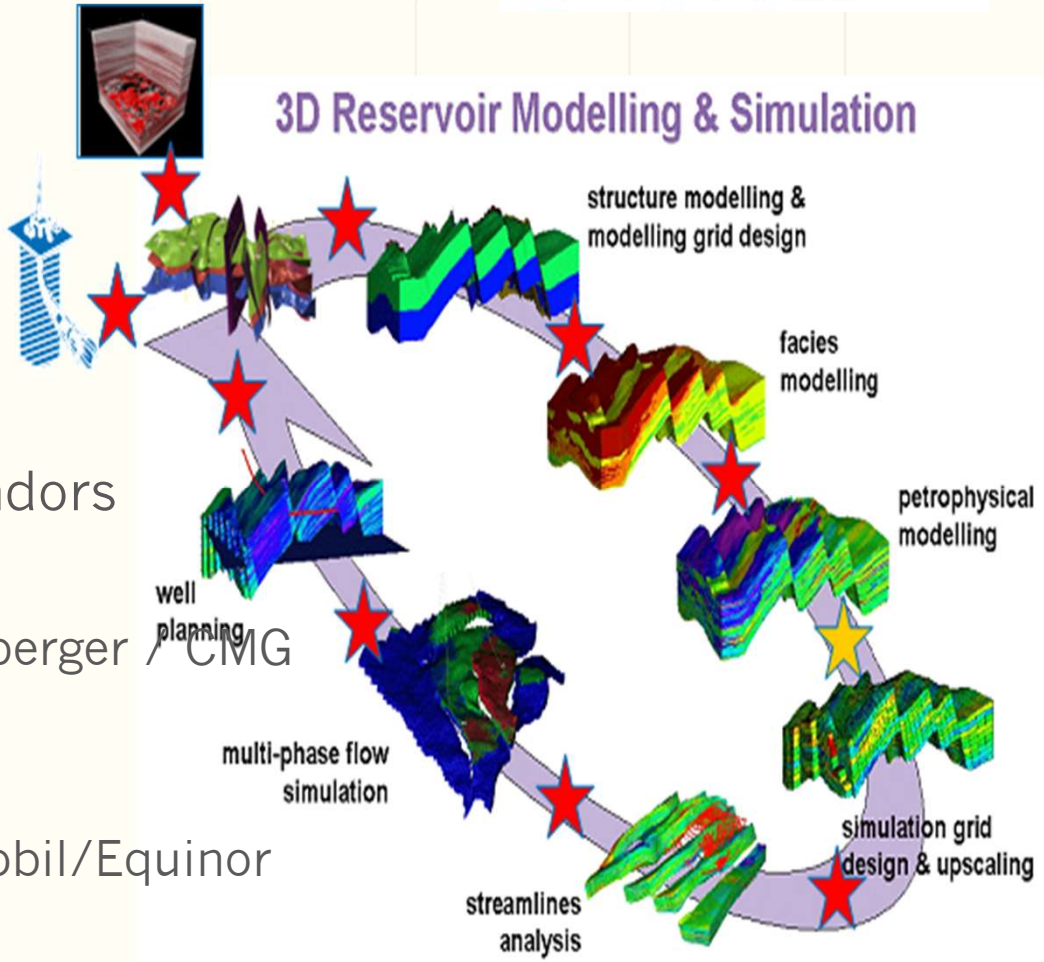
- The standard RESQML itself is a Meta Data Model and consists of a set of XML schemas (XSD files) and other standards-based technology, which developers implement into software packages. Software that has implemented RESQML can read and write the standard format.

- RESQML has been developed by a global consortium of operators, service companies, software vendors, and government agencies under the umbrella of Energistics

RESQML 2.0 Solution Scope

A solution to exchange 3D Geomodels

- On The entire workflow
  - Seismic to simulation
  - All kinds of grids
  - Traceability via metadata
  - Coordinate systems, etc.
- Supported by Geosciences Vendors
  - Already commercial
    - Paradigm / Roxar / Schlumberger / CMG / DGI / IFP En Group
  - Internally used
    - Total / Shell / BP / ExxonMobil/Equinor
  - **Open and free of charge !**

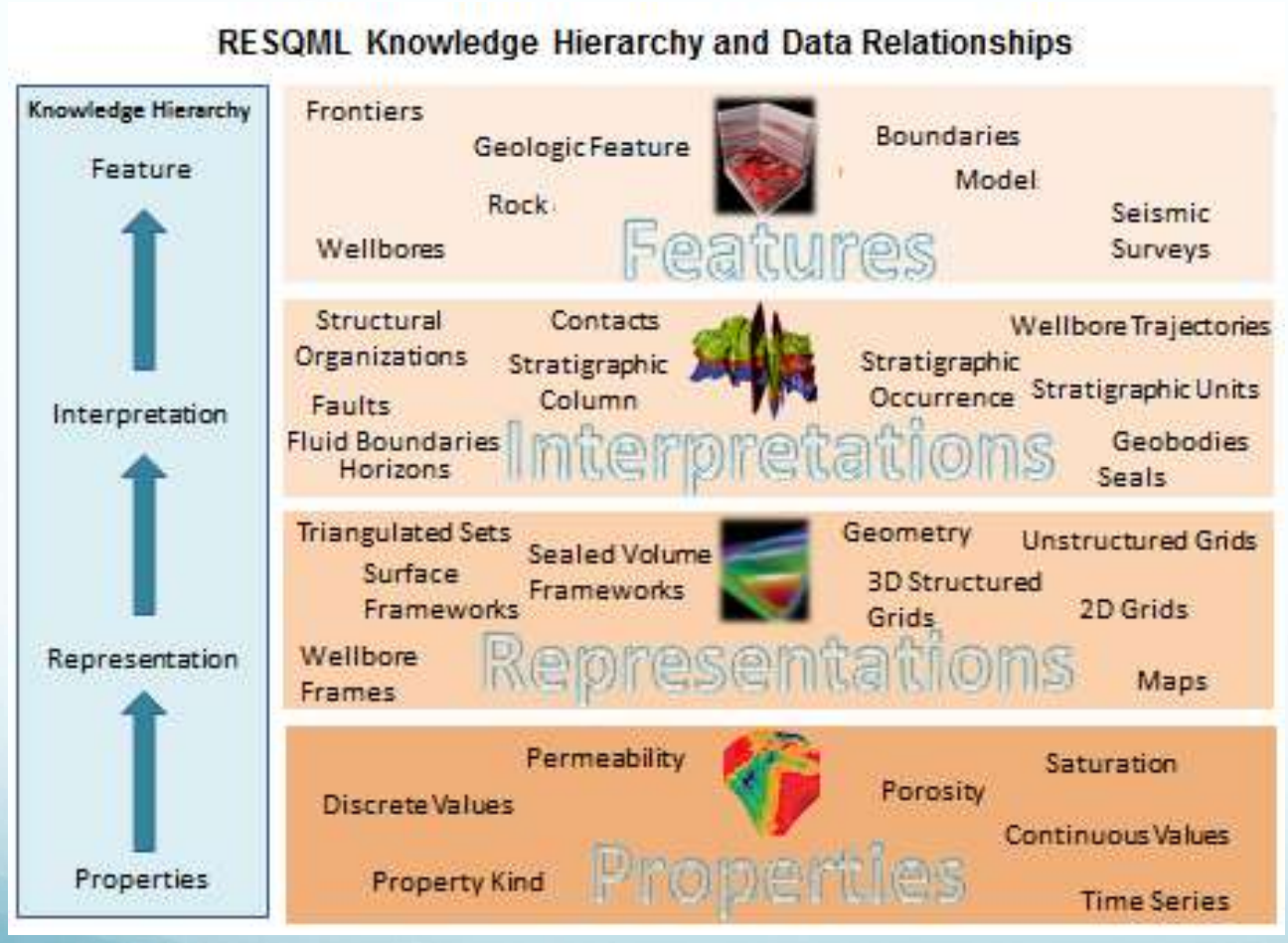


PARTICULARITIES OF RESQML INITIATIVE

- Based on an UML 2 MODEL designed by Vendors and Petroleum Cies
- Inherits of more than 25 years of shared industrial Experiences
- Can be used on the entire geomodelling Workflow (in Petroleum Industry)
- Traceability is embedded (it contains at citation object which is an ISO 19115 profile and a Activity Model to manage workflows).
- The Meta data Model is more complete than all models manipulated by any Vendor products
- It is delivered, documented and maintained by an Open Consortium.
- Training, Open source APIs, demonstrators and software utility tools are available from www.Energistics.org

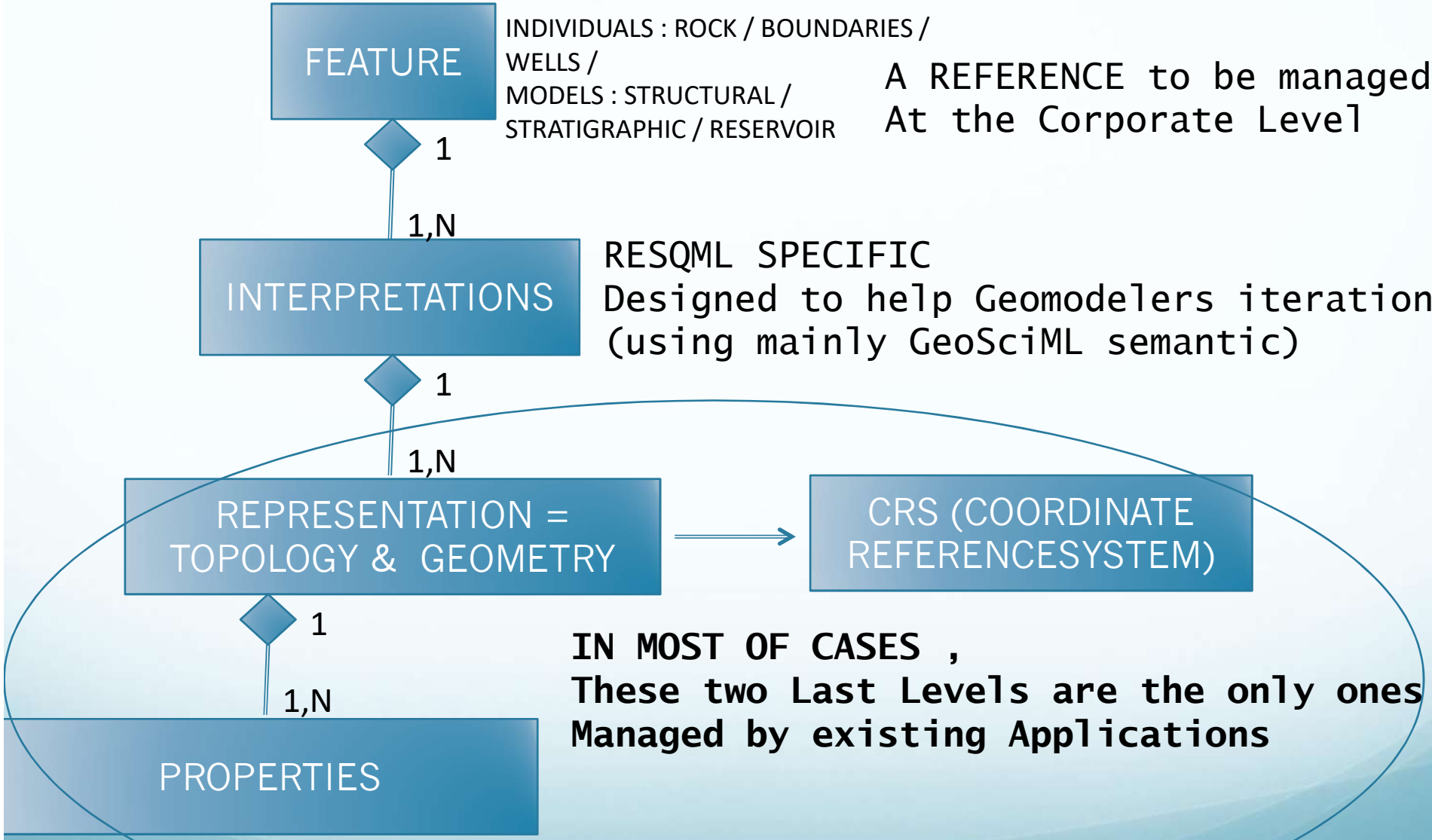
PARTICULARITIES OF RESQML

THE FIRP : Feature / Interpretation/ Representation/ Properties



- Reference (Individuals and Models)
- Interpretation Meta Information
- Topology & Geometry
- Properties (attached to topology)

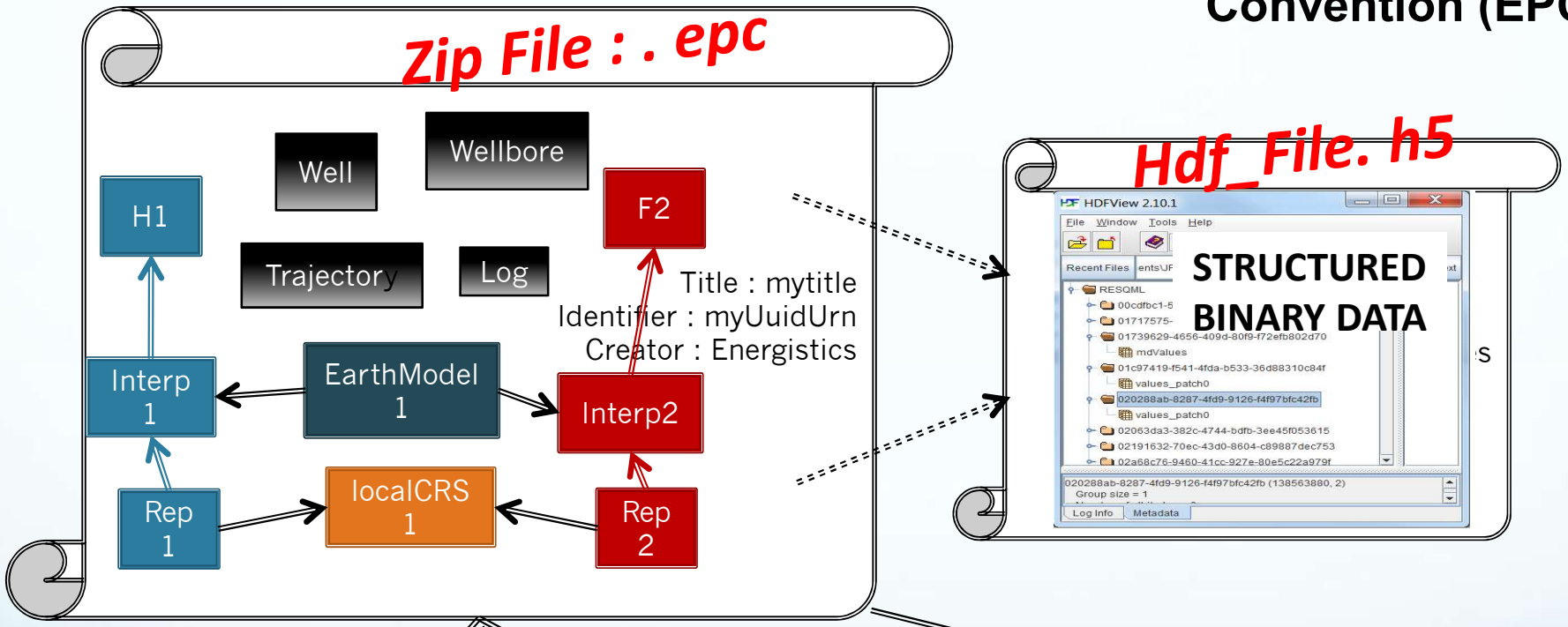
PARTICULARITIES OF RESQML DATA MODEL



PARTICULARITIES OF RESQML

UUID : Universal Unique ID on each top Level element

Plenty of xml files associated in the Energistics Packaging Convention (EPC)

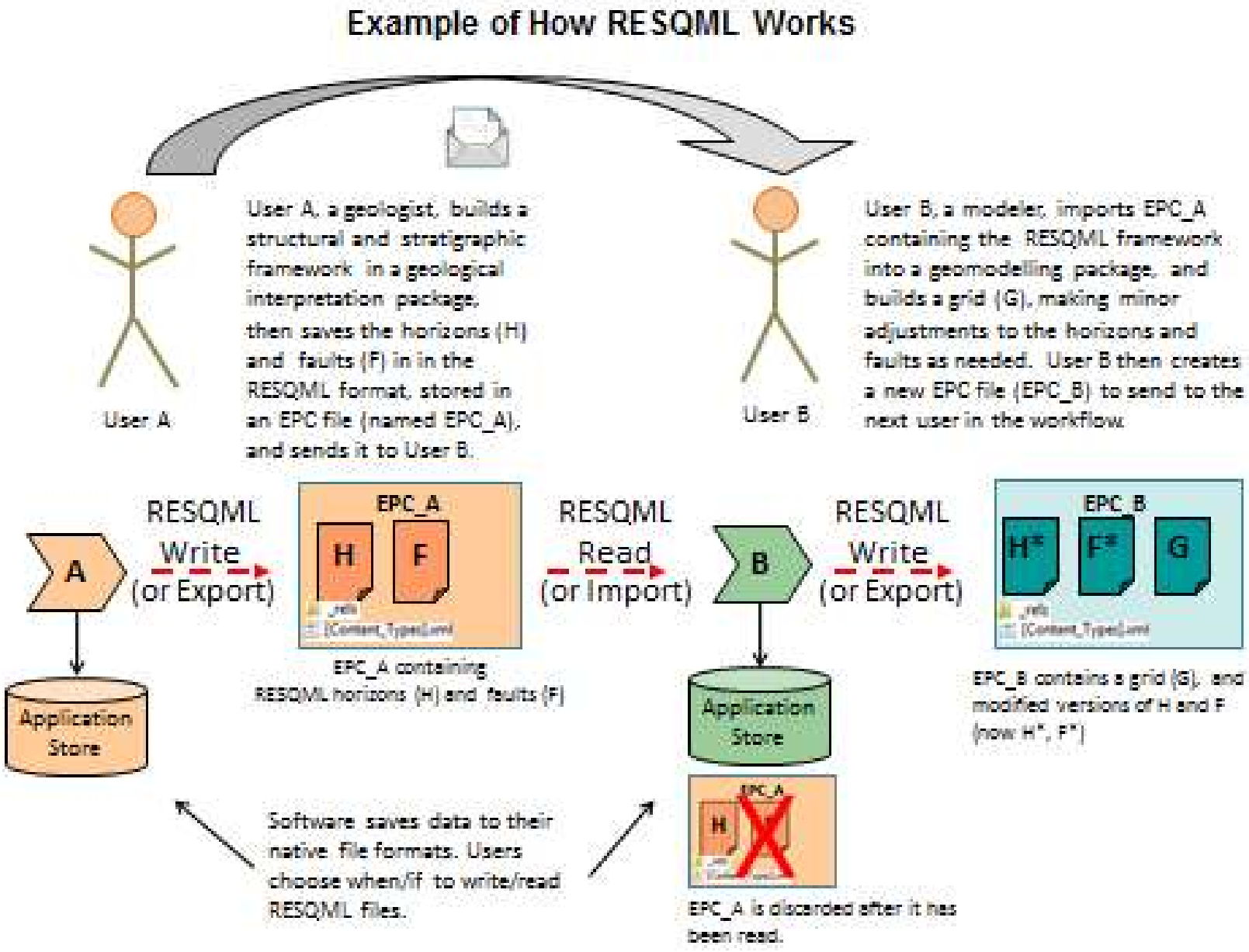


Can be formatted using

Can be packaged into

<WITSML/>™ | <PRODML/>™ | <RESQML/>™

The original Use – Case



Example of a Collaborative Realisation

The Resqml Pilot : a Live demo in Anaheim (Annual SEG conference) With real Data - Kepler Field, Na Kika, Gulf of Mexico

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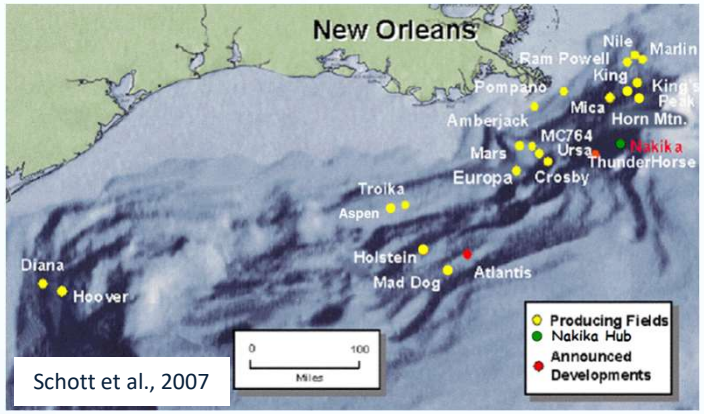
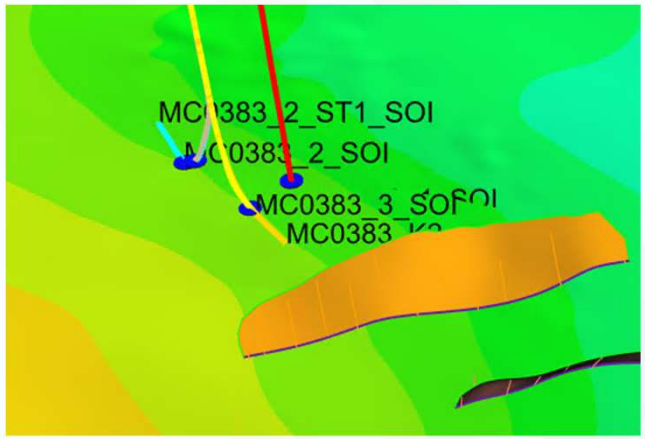
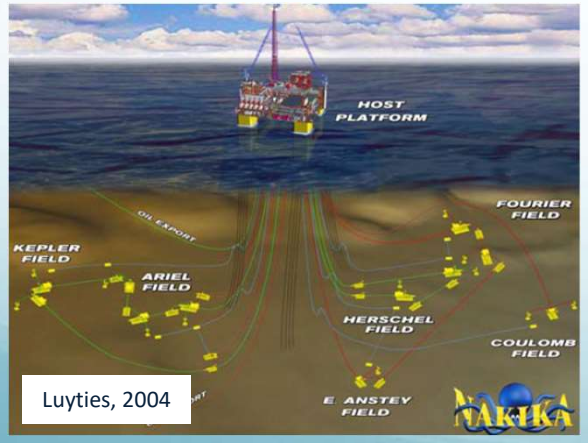


Schott et al., 2007

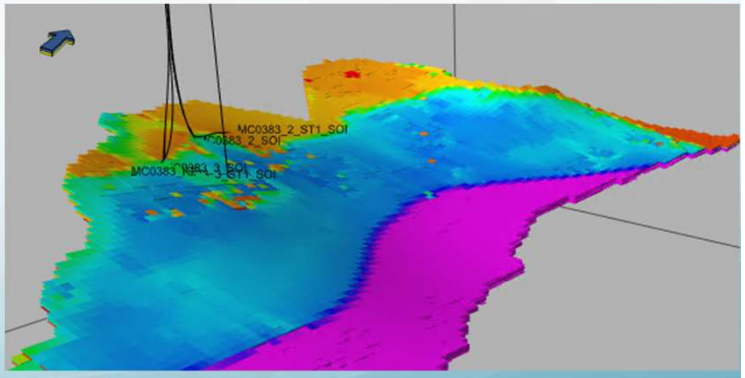
Data in project:

- Wells (trajectories, logs, picks)
- Faults
- Horizons
- Polygons
- 3D grid arrays (static)
- 3D grid arrays (dynamic time-stepped)





Luyties, 2004



Demo Scenario – Partner Data Exchange

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- The demo simulates a hypothetical workflow:
  1. The operator sends a geological model to a partner
  2. Who generates an alternative facies scenario
  3. With an alternative porosity scenario
  4. Which leads to an alternative pore volume estimate
  5. Integrated back into the original model
  6. Destined for reservoir simulation
  7. And subsequent visualization of the time-stepped result

- While many of the products involved in this demonstration could support many, if not all, aspects of the workflow, we wanted to demonstrate the power of the standard for transferring data across multiple products.

RESQML v2.0.1 live Demonstration

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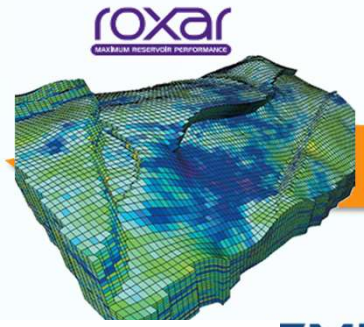
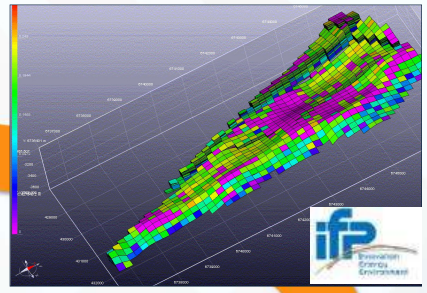


Grid creation
(RMS)

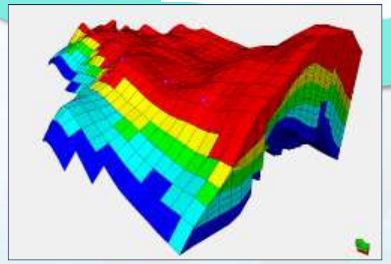
EMERSON

Facies modeling
(Skua)



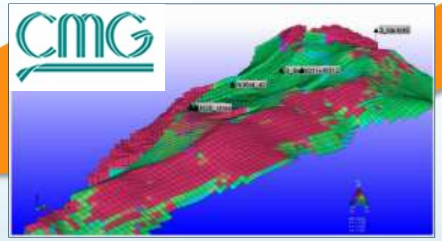
Fracture porosity
(OpenFlow)

Schlumberger



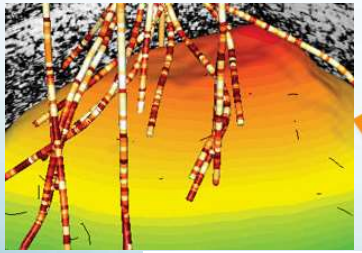
Property calculation
(Petrel)

amazon web services



Reservoir simulation
(Builder, IMEX and Results)

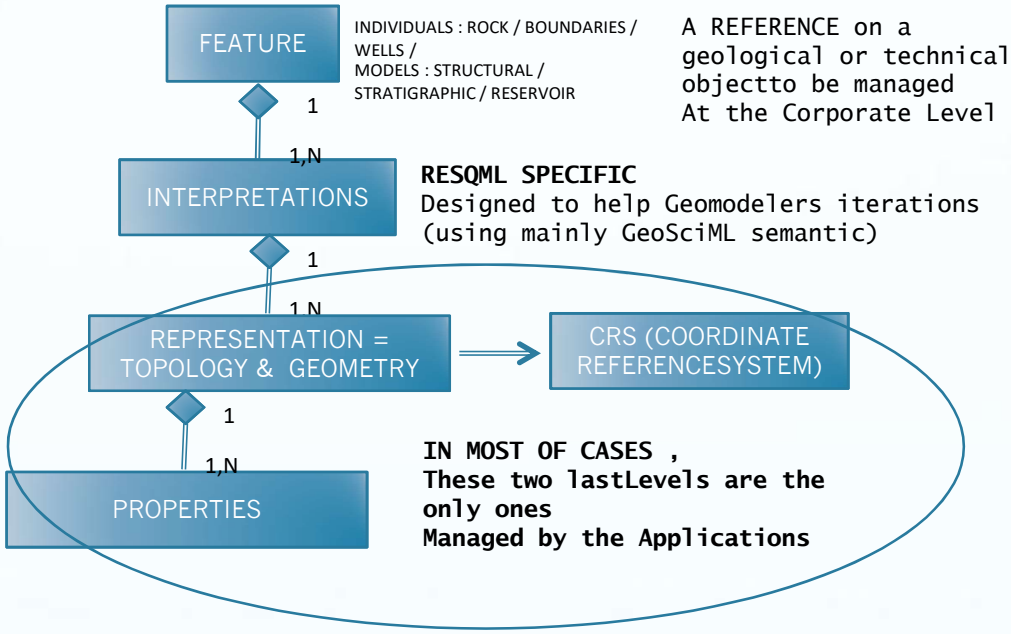
DYNAMIC GRAPHICS, INC.



Results visualization
(CoViz 4D)

Focus on Important Specific Resqml Concepts :

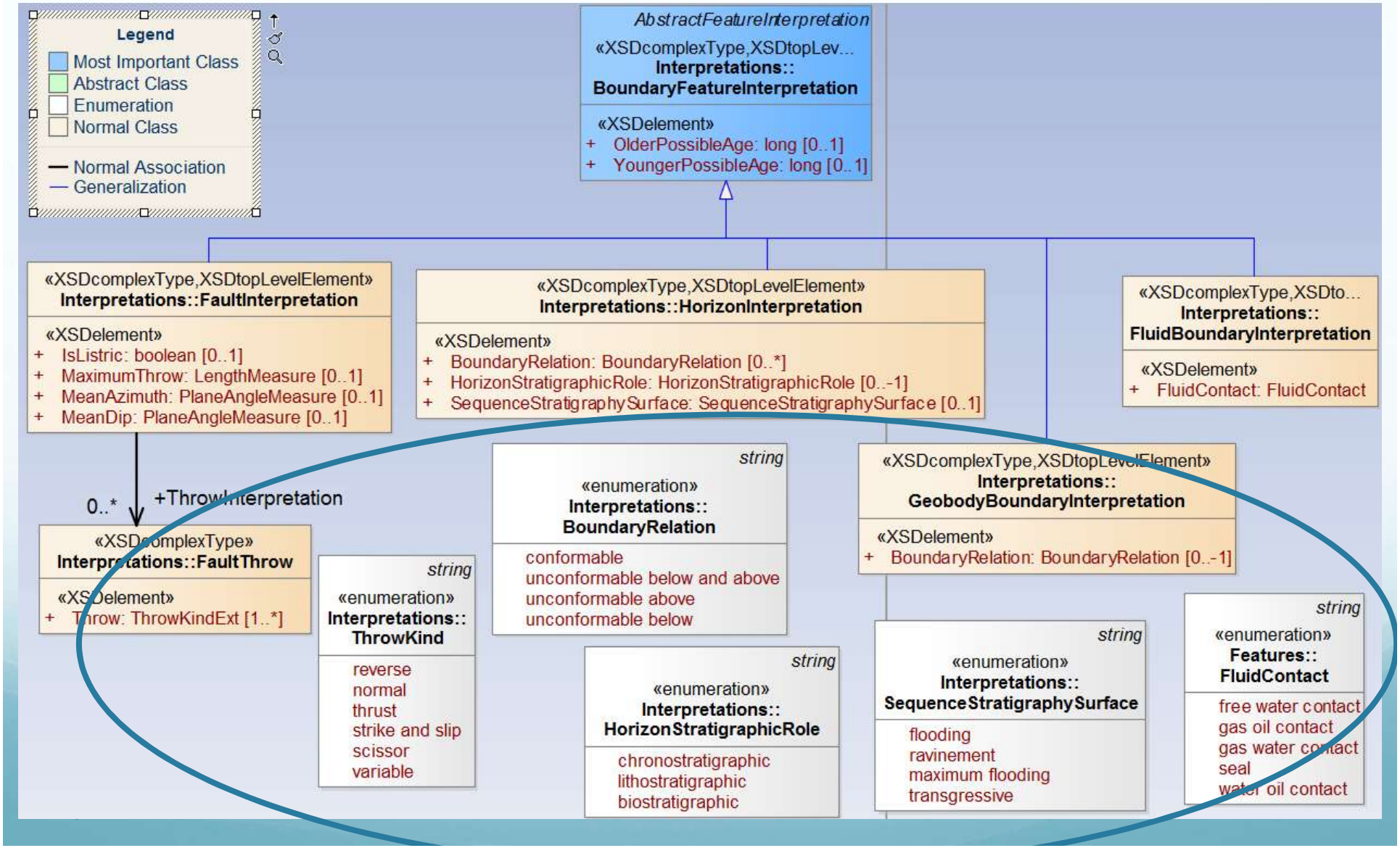
1/ Interpretation of an Individual Feature



- The Feature IS a geological or a technical Object.
- The **Interpretation** Level is used to associate semantic information provided by an interpreter to enrich an individual geological Object by geological knowledge and keep it all along the life cycle of the object.
- Examples of individual geological object Interpretation are Horizons, GeobodyBoundaries, Faults, Stratigraphic Units Interpretations

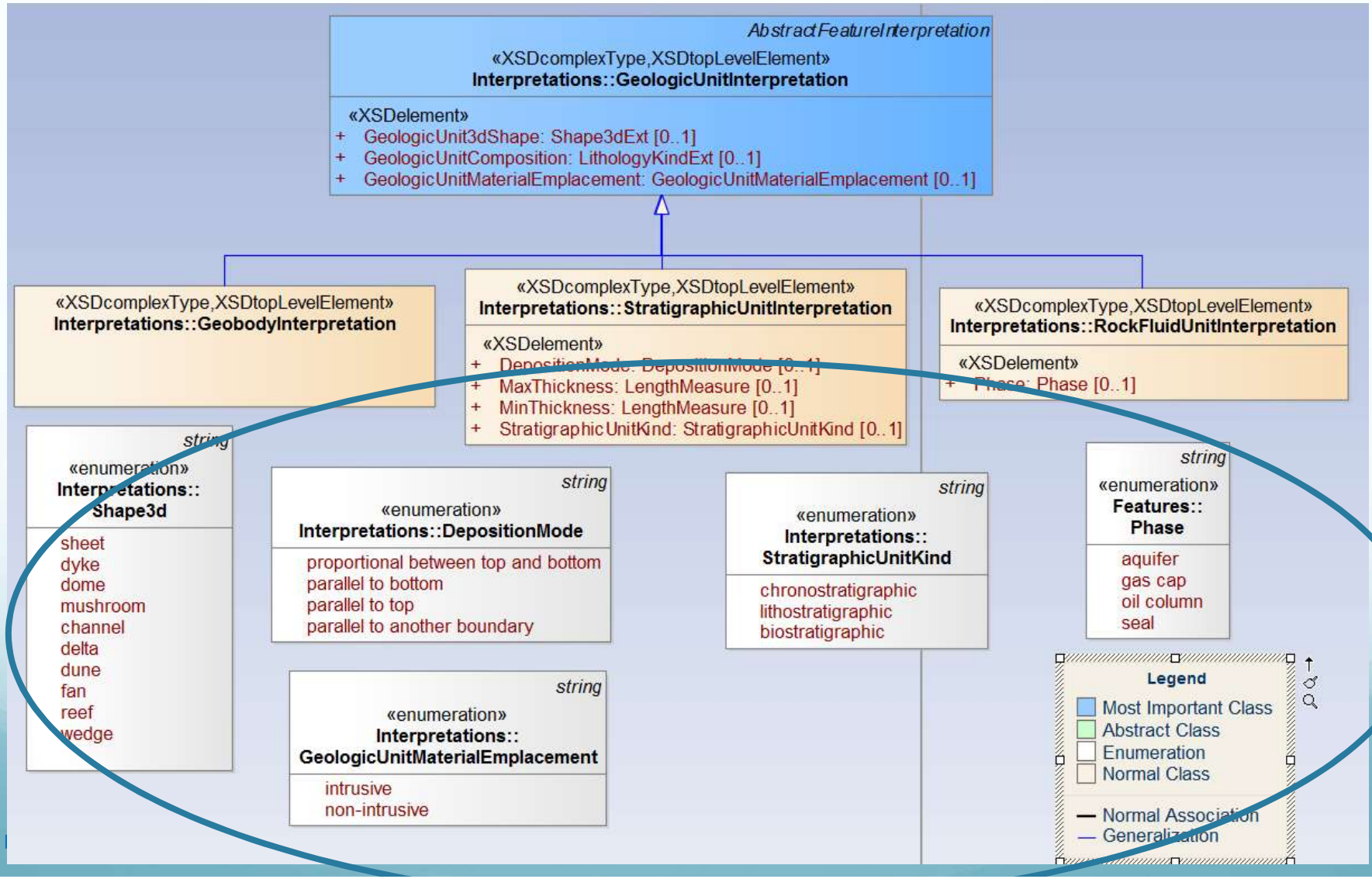
RESQML MAIN CONCEPTS : THE **SEMANTIC** ASSOCIATED TO **BOUNDARY FEATURE INTERPRETATION**

« HAVE A LOOK AT THE ENUMERATIONS »



RESQML MAIN CONCEPTS : THE **SEMANTIC** ATTACHED TO **GEOLOGIC UNIT INTERPRETATION**

« HAVE A LOOK AT THE ENUMERATIONS »



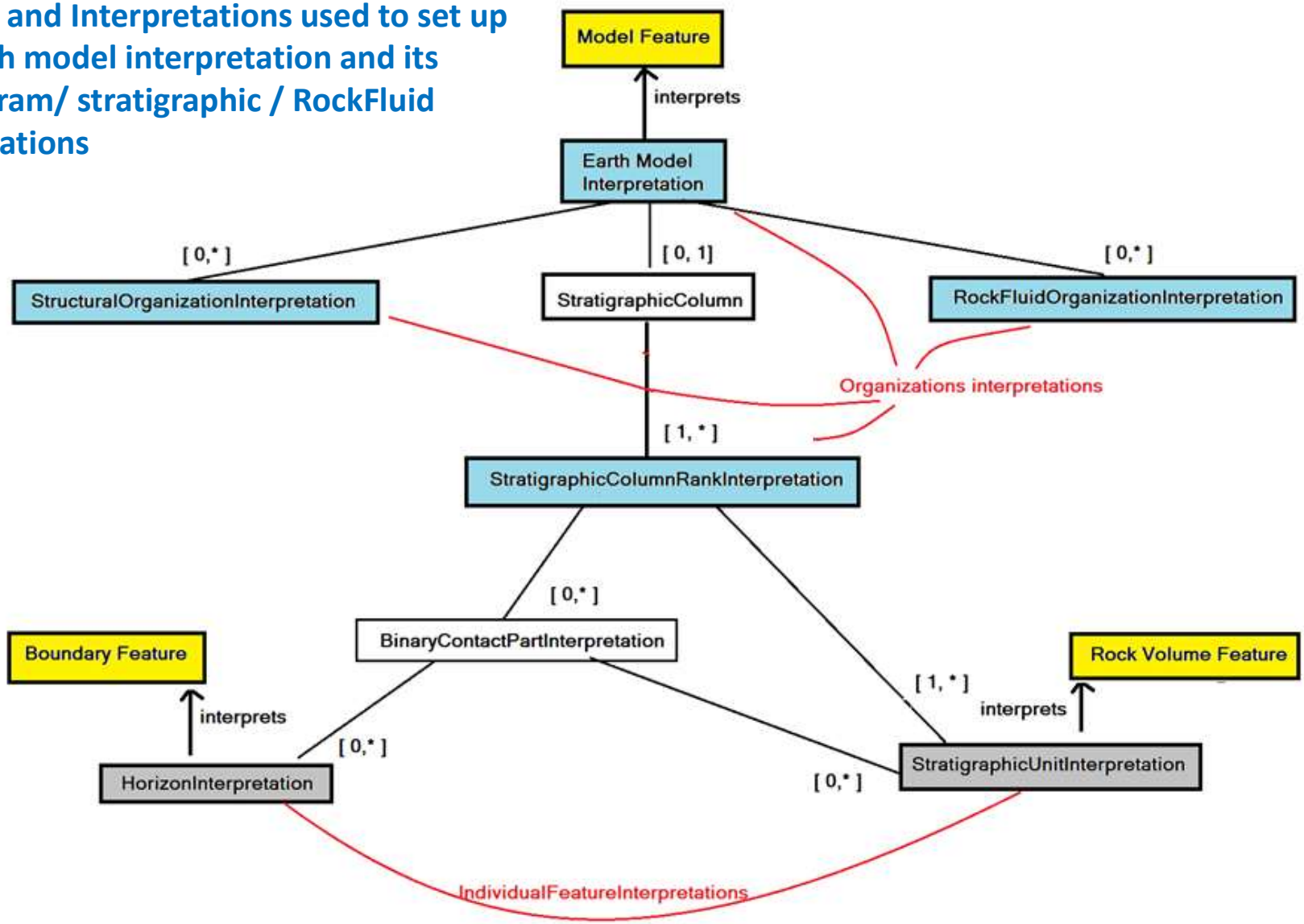
Focus on Important Specific Resqml Concepts : 2/ Collection of Organisation Interpretations : the Earth Model Interpretation

- **RESQML can represent 3 OrganisationInterpretation :**
  - The StructuralOrganisation gather (by age or by apparent depth):
    - A sequence of Horizons and Fault Network
    - A description of each Fault Network (which fault stops on which)
  - The StratigraphicOrganisation gather (by age or by apparent depth) :
    - A sequence of Stratigraphic units
    - A description of their geological relationships (which unit « conformable or not » stops on which unit « conformable or not) and their contacts (which HorizonInterpretation correspond to one of these relationships)
  - The RockFluidOrganisation gather (By apparent Depth mainly)
    - A sequence of fluid units

- **And These Three Organisations can be linked to one Earth Model Interpretation to ensure the consistency of the information all along the life cycle of the model**

RESQML MAIN CONCEPTS : **EARTH MODEL** INTERPRETATION

- **Simple diagram showing example Model feature and Interpretations used to set up an earth model interpretation and its structuram/ stratigraphic / RockFluid organisations**



The reason why RESQML integrat…

This capability is unique to transfer complete and consistent 3D Geomodeling Information and free of any vendor or product strategy

Most of the time only individual features and their representation are exchangeable between applications.

- In particular, the geological Hypotheses used to build 3D Model are lost
- By keeping in the organisation the memory of the geological rules and the semantic applyed to the individual interpretations used to build the model, the RESQML format allows to understand how and why this model was built.
- By gathering the Structural, Stratigraphic and RockFluid Organisation on a specific EarthModel Interpretation, the RESQML format allows to tranfer a consistent « assemblage ».
- All the Individual FeatureInterpretation linked in this assemblage and their Representations should be part of the transfer (physically or by reference)
- And Usually, the 2D/3D Model Representation (Geological or Simulation 3D grid) are then linked to the EarthModelInterpretation Object and this is the way to retrieve all we need as information.

The Situation Today

- From early 2017 , nearly all vendors in Petroleum Geosciences were adopting RESQML and realize operations and demonstration Pilots
- Recently, with the EGIS Geotechnique Cie we implemented a link between Resqml and the BIM and we will demonstrate it during this meeting.
- All Vendors are now focused for adoption on Well Bores / Structural / Stratigraphic information and 3D Simulation Grid representations exchange.
- This standard looks mature, Documentation and utilities to use it are Open source and free of charge on the Energistics site : www.energistics.Org/portfolio/resqml-data-standards/.
- By example , You can find C++, C#, java read/write APIs, 3D user oriented « Paraview » visualisation, EPC exploration debugging and Validation Tools.
- And.. If you invite me for one day or two, I can explain everything about RESQML and help you to implement it.. Then, you will be able to discuss with many other software.

How the Geomodeling Community can take benefit of this standard ?

How the Geomodeling Community can take benefit of this standard ? First : by testing and adopting it ..

- By having access to the RESQML tools and community : see www.energistics.Org/portfolio/resqml-data-standards/.
- By developing (using these tools), Resqml read and write capabilities and use it even internally to archive 3D Geomodels.
- By accessing IndividualRepresentation and Models embedded in major Vendor databases.
- By exchanging Consistent Models between vendors or research products
- By having the opportunity to participate to « well known » but today closed Geomodeling workflows.

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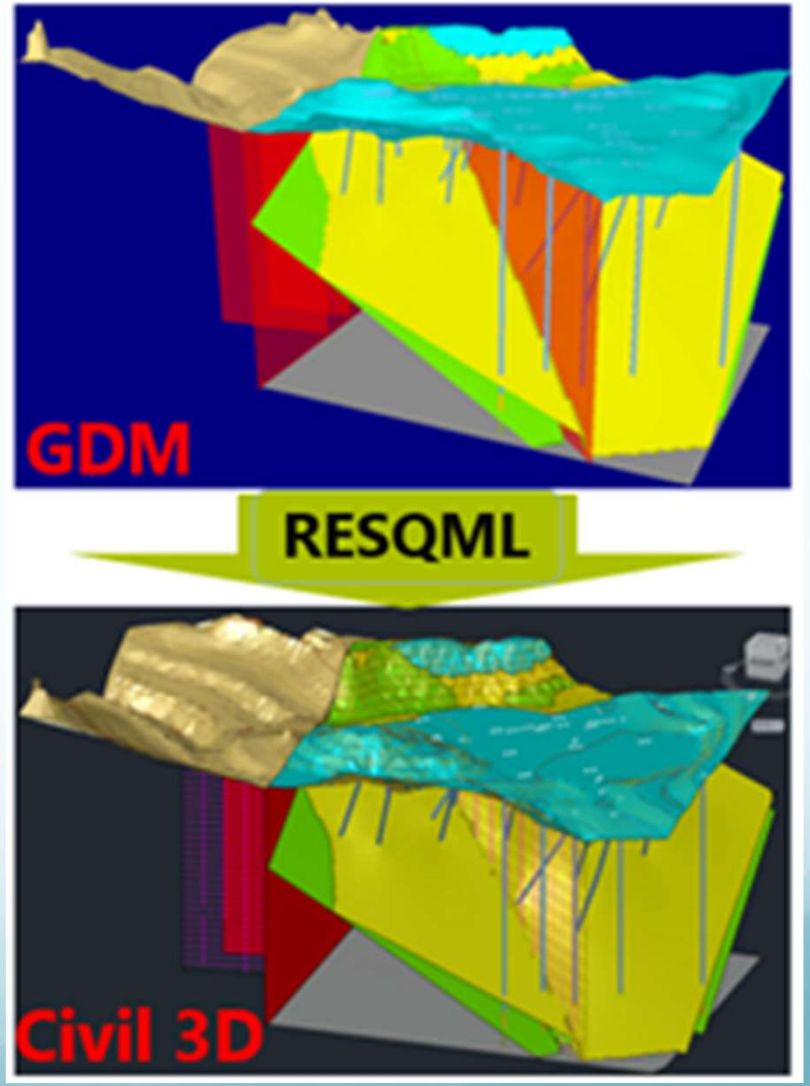
How the Geomodeling Community can take benefit of this standard ?
Second : by participating to advanced initiatives

- By participating to Energistics Initiative to manage the 3D Geomodeling information on local or external clouds.
- By participating to open initiative to publish RESQML information through web services with the ETP (Energistics Transfer Protocol) .
- For all these objectives Geosiris is open for any collaboration (visit, assistance, training, implementation) as we did with EGIS geotechnique for a very concrete BIM objective.



And more !

- By using RESQML as a way to support a « Digital Twin » to realize More and more Use cases / Workflows of Geomodeling
- And « liberate » the users from closed workflows or closed database management and open the way to structured and consistent 3D Geological Models dissemination.
- And imagine any type of Intelligent procedure (data mining, knowledge capture, knowledge extraction, knowledge diffusion) which could be applied on the semantic information contained in the xml files and the binary data contained in the hdf5.
- And again .. Don't be affraid to adopt it,.. it works and we have free tools to help you playing with.

Thank you

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