WITSML v2.0
Release Candidate Overview

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CTO

energistics®
Energy Standards

25 Years of Energy Standards

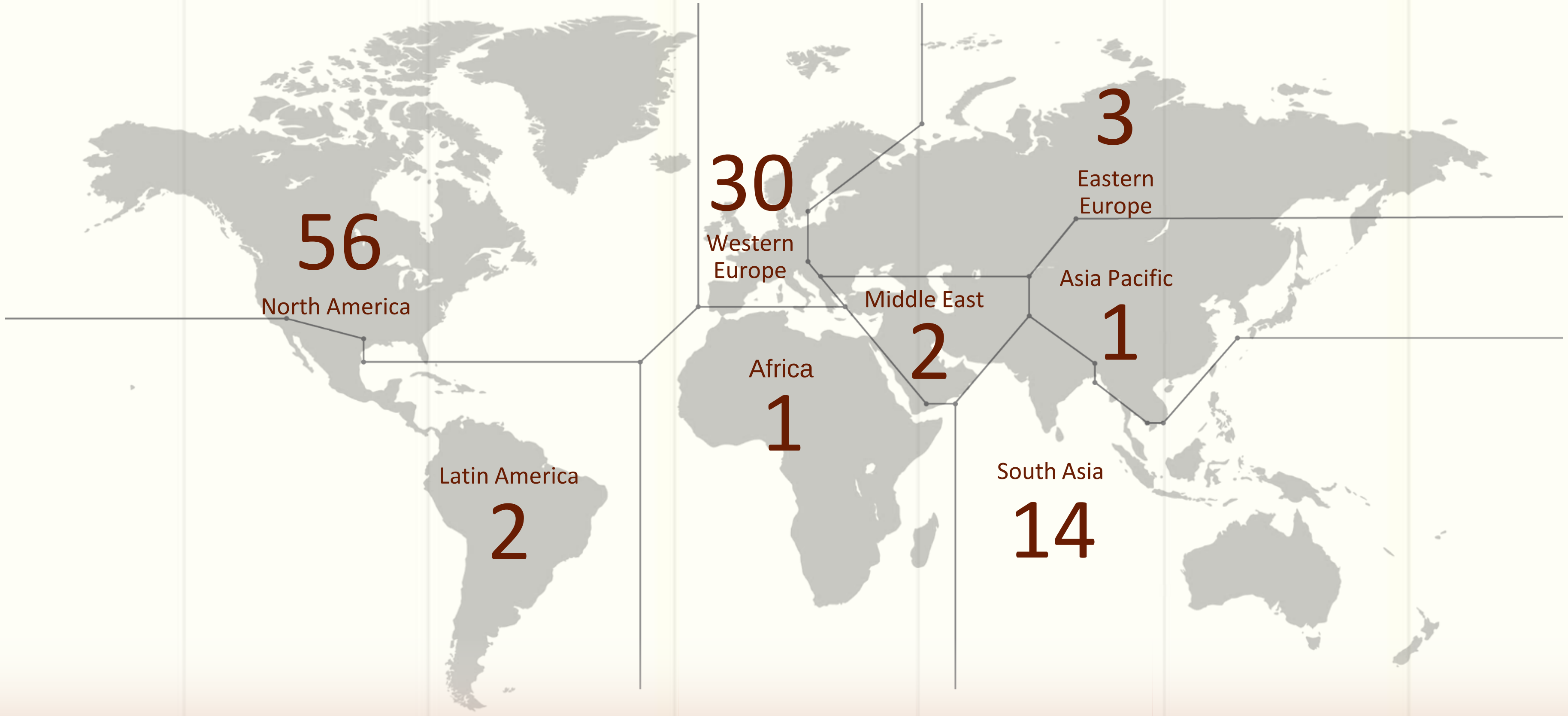
This morning:

- » Energistics
- » WITSML
- » Standards v2.0
- » WITSML 2.0
  - Data objects
  - API (ETP)
- » Release Candidate contents

Who are we? (Hint: we are not a vendor…)

- » Energistics is a global, non-profit, membership consortium focused on developing open data exchange standards in the upstream oil and gas industry. We have served the industry for more than 25 years.
- » Our membership consists of E&P companies, oilfield service companies, software vendors, system integrators, regulatory agencies and the global standards community
- » Our standards are developed by workgroups (known as Special Interest Groups, or SIGs) made up of industry experts from our member companies
- » In short, the standards are created by the industry for the industry

World-wide



10	8	14	47	15	10	5
Operators	Oilfield Services	Regulators	Solution Providers	Associations	Media Partners	Universities

Industry-Wide

accenture High performance. Delivered.
AZGS Arizona Geological Survey
BAKER HUGHES
BARDASZ
bp
CNSOPB Canada-Nova Scotia Offshore Petroleum Board
CGG
Chevron

CDA Oil & Gas UK
CMG Computer Modelling Group Ltd
DataHorizon
Department of Energy & Climate Change
U.S. Department of the Interior March 3, 1849
devon
DYNAMIC GRAPHICS, INC.
E&Tech Developments

əDrilling
energySYS
EPIM
ExxonMobil
F2i F2I-CONSULTING
GEOLOG Surface Logging
Geologix
GEOSIRIS
GroViz

GROUNDWATER PROTECTION COUNCIL
HALLIBURTON
HRH geological services
ifp Energies nouvelles
IDS
Infosys
INT
KONGSBERG
L&T Infotech

MarkLogic
NOV NATIONAL OILWELL VARCO
Navita Origo solutions
NEW ZEALAND PETROLEUM & MINERALS
noah CONSULTING
NORWEGIAN PETROLEUM DIRECTORATE
OFS Portal
OFI INDIA
OILWARE

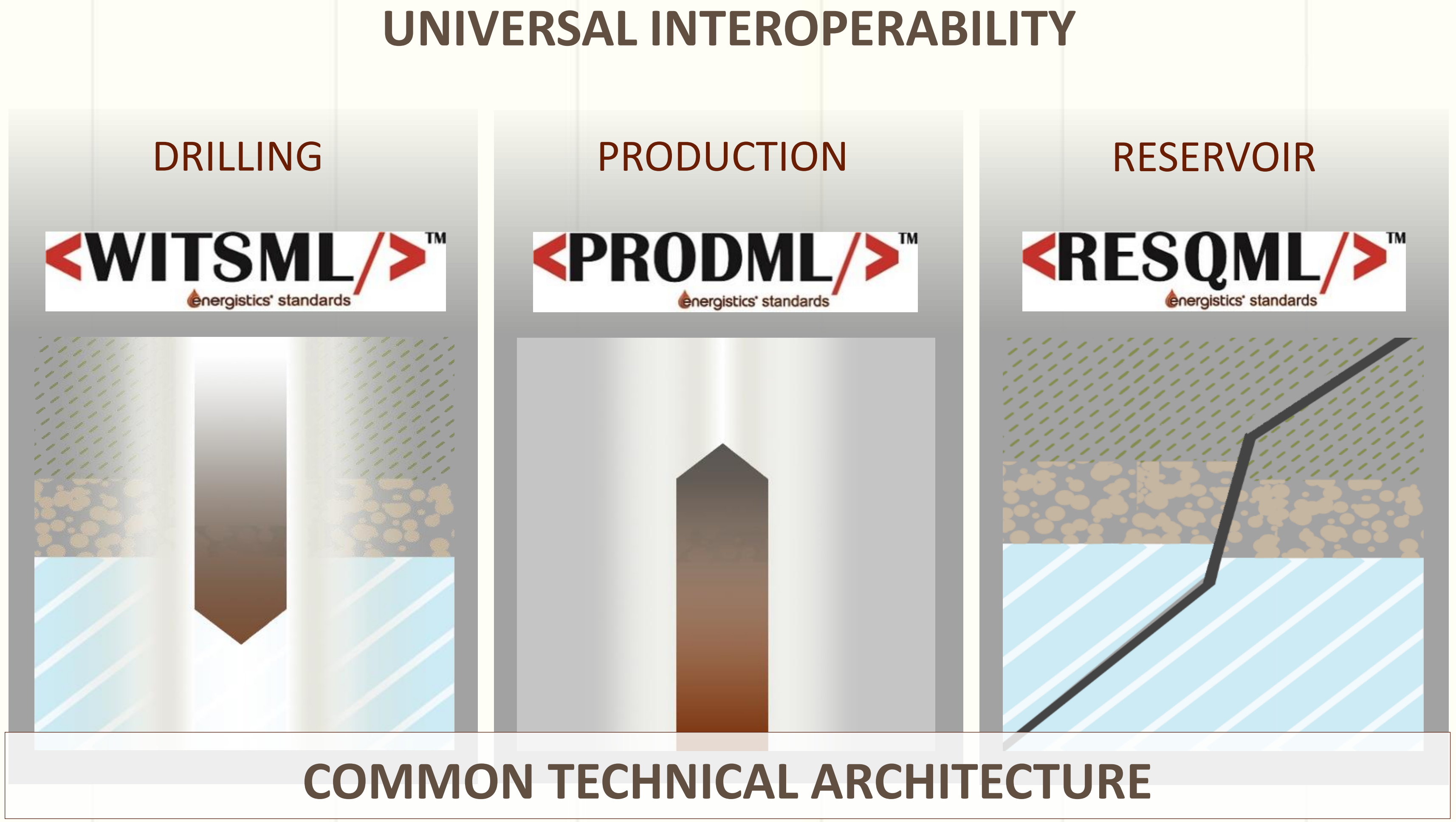
TIBCO
ORACLE
OSIsoft.
P2
Paradigm
pason
peloton well focused
PetraBYTES Oilfield Analytics & Big Data Repository
Petroleum Agency SA

petrolink
PETRONAS
PETROSYS
pds petrotechnical
PIONEER NATURAL RESOURCES
Polaris Guidance Systems LLC
Radmond Open platform for mobile collaboration
roxar Maximum Reservoir Performance

أرامكو السعودية Saudi Aramco
Schlumberger
Scientific Drilling
Sekal
skkmigas
SSG
STAATSOLIE
energistics Energy Standards

Statoil
Tech Mahindra
TNO innovation for life
TOTAL
Weatherford
WellSite SOFTWARE
WIPRO Applying Thought
woodside

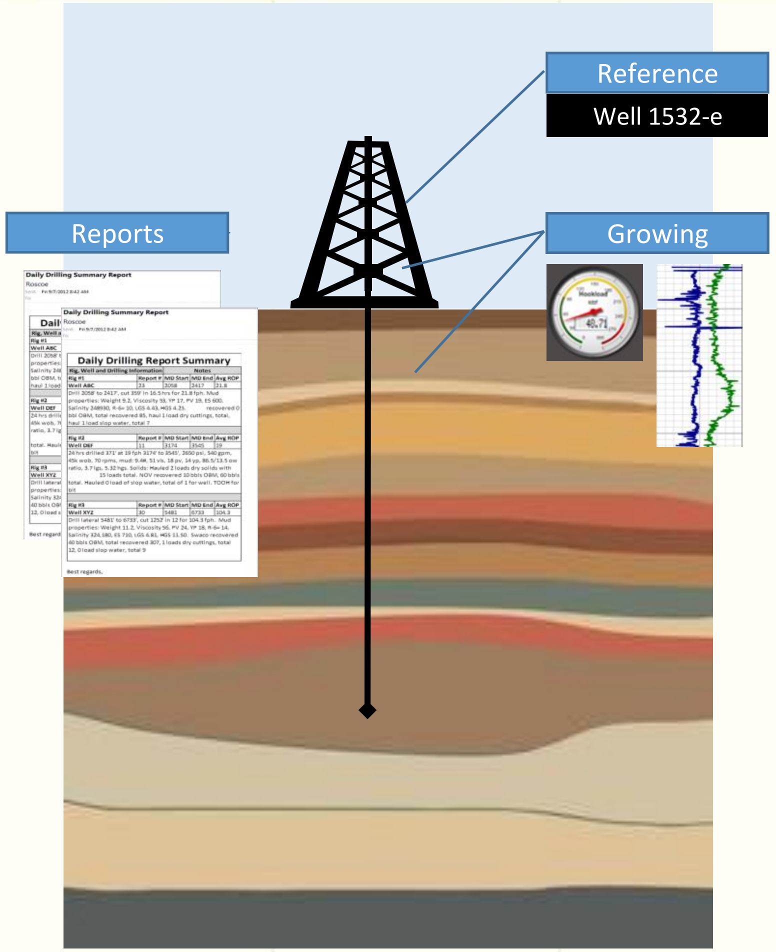
Energistics Family of Standards



Version 1.X Use Cases

» Consistent high-quality transfer of wellbore and drilling-related data

- Data transfer to real-time operations centers
  - Reference objects – Well and Wellbore
  - Growing objects – Log (time, depth), Trajectory, Mudlog
  - Snapshots in time – with "report" information
- Move well-related data between applications
- Real-time availability of drilling operations



WITSML V1.4.1 Overview

» Set of schemas defining 27 primary objects
  - Well, wellbore, logs, etc. used in drilling operations
  - Enumerations file (enumValues.xml)

» API defining server (and client) behavior
  - Simple methods (AddToStore, GetFromStore)

New Requirements on Transfer Standards

- » Big data/analytics
  - Analytics on data in motion
- » High-performance transfer standards
- » Broader workflows – not just wellsite to office
  - Application to application
  - File-based transfers
  - Archival workflows
  - Expanded metadata

How Are Standards v2.0 Better

- Integrated
- Programmer oriented
- New workflow support
- Training available
- New underlying technology

Integrated

» Among the MLs

» Between the standards bodies

- SEGY/SEGD in epc
- HDF use
- OGC in MLs
- IEP/ISO 19115
- MathML coming

Programmer Oriented

» More convenient XML style

» Better documented

» Open source code

» Devkits

New Workflow Support

- » Server and serverless
- » Data management workflows
  - Data quality/assurance
  - Archival workflows
  - Data heritage
  - Metadata

Training

- Training first conducted in 2015
  - Three private classes already delivered/scheduled
- Up to a 3-day class on each ML
  - WITSML public class earlier this year
  - Further public classes to be scheduled
- Webinars

WITSML v2.0

- Continues to provide XML “data objects”
- Is based on the Common Technical Architecture
- Deprecates the legacy SOAP API, replaced by ETP v.1.1+
- Has a simplified XML schema structure & fewer files
- Data object documentation

What Can v2.0 Do I Couldn't Do Before?

- True, secure, low-latency data streaming
- Data quality assurance
- Wellbore Geology, Stimulation and Cementing design and execution

- Unlimited types and organizations of channel data
- Tracing through multiple generations of aggregating servers

- Elimination of polling traffic

WITSML 1.4.1 Data Objects

- attachment
- bhaRun
- cementJob
- changeLog
- convCore
- coordinateRefSystem
- drillReport
- fluidsReport
- formationMarker
- log
- message
- mudLog
- objectGroup
- opsReport
- rig
- risk
- sidewallCore
- stimJob
- surveyProgram
- target
- toolErrorModel
- toolErrorTermSet
- trajectory
- tubular
- wbGeometry
- well
- wellbore

WITSML 1.4.1 Data Objects vs 2.0

- attachment
- bhaRun
- **cementJob**
- changeLog
- convCore
- coordinateRefSystem
- drillReport
- fluidsReport
- **formationMarker**
- **log**
- message
- **mudLog**
- objectGroup
- opsReport
- rig
- risk
- sidewallCore
- **stimJob**
- surveyProgram
- target
- toolErrorModel
- toolErrorTermSet
- **trajectory**
- tubular
- wbGeometry
- well
- wellbore

Removed – Moved to Common – Completely Redesigned – Largely unchanged

WITSML 2.0 Data Objects

- Attachment
- BhaRun
- CementJob
- CementJobEvaluation
- Channel
- ChannelSet
- CuttingsGeology
- DepthRegImage
- DrillReport
- FluidsReport
- InterpretedGeology
- Log
- OpsReport
- Rig
- Risk
- ShowEvaluation
- StimJob
- StimJobStage
- ToolErrorModel
- ToolErrorTermSet
- Trajectory
- TrajectoryStation
- Tubular
- Well
- Wellbore
- WellboreGeology
- WellboreGeometry
- WellboreMarker
- WellboreMarkerSet

Data Objects:

» New naming style – Pascal style

» Focus on better attribute names

» More documentation for each element

» Substitution groups are just for the Aggregate object

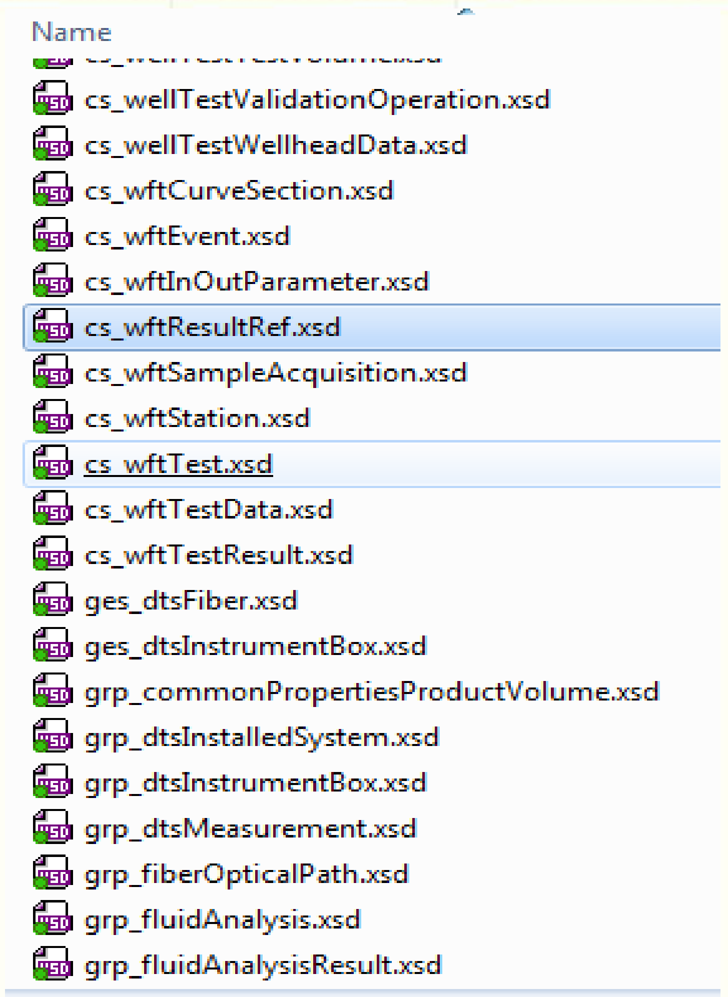
» More use of inheritance

Data Objects: Simpler Structure

- There are two kinds of schema file structures
  - The obj_ schema file has a single global element
    - This is an individually addressable "top-level" element
    - Top-level elements inherit from AbstractObject
  - The other named .xsd files only contain types
- The earlier structure is deprecated
  - No plural root, no docInfo
  - No repetition of inherited elements

Data Objects: Fewer Files example

- » Before: 200 files in schema folder
- » WITSML 2.0 will have
  - ~27 top level objects
  - 1 common base across all MLs
  - fewer component elements
- » Top level “obj_” files stay
- » Component “cs_” naming goes
- » Global equipt “ges_” naming goes
- » Group file “grp_” naming goes
- » Add one xsd file per UML package



Name
cs_wellTestValidationOperation.xsd
cs_wellTestWellheadData.xsd
cs_wftCurveSection.xsd
cs_wftEvent.xsd
cs_wftInOutParameter.xsd
cs_wftResultRef.xsd
cs_wftSampleAcquisition.xsd
cs_wftStation.xsd
cs_wftTest.xsd
cs_wftTestData.xsd
cs_wftTestResult.xsd
ges_dtsFiber.xsd
ges_dtsInstrumentBox.xsd
grp_commonPropertiesProductVolume.xsd
grp_dtsInstalledSystem.xsd
grp_dtsInstrumentBox.xsd
grp_dtsMeasurement.xsd
grp_fiberOpticalPath.xsd
grp_fluidAnalysis.xsd
grp_fluidAnalysisResult.xsd

Data Objects: Common

» One file for each typ_ style

» Base types - “abstractString”

» Enum types - “well fluid”

» Data types - “timestamp”

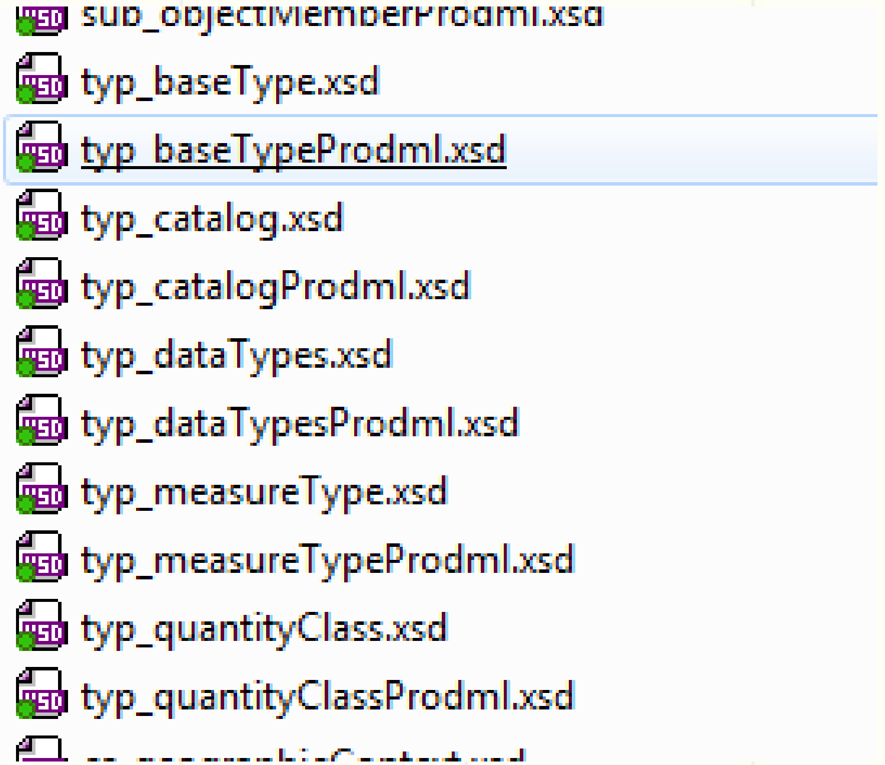
- Old – everything ML-defined
- New – xs types used

» Measure types - “angle Measure”

» Quantity classes - length in “m”

- Old – different types per ML
- New – common across all MLs

» Shared schemas – CRS, root



sub_objectMemberProdml.xsd
typ_baseType.xsd
typ_baseTypeProdml.xsd
typ_catalog.xsd
typ_catalogProdml.xsd
typ_dataTypes.xsd
typ_dataTypesProdml.xsd
typ_measureType.xsd
typ_measureTypeProdml.xsd
typ_quantityClass.xsd
typ_quantityClassProdml.xsd

New Underlying Technology - CTA

- ETP
- UML->XML (->JSON?)
- EPC/OPC & Breaking XML
- UoMs
- PWLS
- HDF
- EIP

UML: Unified Modeling Language

- Energistics uses UML to generate XML schemas
  - and other artifacts including documentation
- UML is an OMG specification, the latest is 2.4.1 at
  - http://www.omg.org/spec/UML/2.4.1/
- Enterprise Architect currently supports UML 2.4.1
- Energistics uses and delivers class diagrams
  - Other UML diagram types may or may not be used

Use of XML

- What Energistics' members have always used
- Energistics standards use XML v 1.0, not 1.1
- XML is W3C recommendation - latest ed. of v 1.0 is
    - http://www.w3.org/TR/2008/REC-xml-20081126/
- Energistics does not require other XML standards
    - Like XPath, XQuery, XLink, etc.
    - Simplicity aids in uptake

ETP: Energistics Transfer Protocol

- ETP is a new data exchange specification
- Enables real-time data transfer between applications
- Is delivered as a specification and as sample code
- Works by sending pre-defined messages
  - The messages are grouped together into “protocols”
  - The description of these protocols make up the standard
- No server required, just sender and receiver

ETP: Use Across Energistics MLs

» ETP was developed initially for WITSML™
  - Since WITSML is not a truly real-time transfer

» The other MLs will use it as well

» ETP can be used
  - For any kind of data transfer
  - From the field to the office
  - Between applications in the office
  - For any sensor-based M2M application (IIoT)

ETP: Protocols

ETP currently consists of eight child protocols:

- 0: Core
- 1: ChannelStreaming
- 2: ChannelDataFrame
- 3: Discovery
- 4: Store
- 5: StoreNotification
- 6: GrowingObject
- 7: DataArray

ETP: Protocols

ETP currently consists of eight child protocols:

- 0: Core – Creates and manages ETP sessions
- 1: ChannelStreaming – Exchanges channel-oriented data
- 2: ChannelDataFrame – Exchanges frame-based data
- 3: Discovery – Understand the contents of a data store
- 4: Store – Perform CRUD operations on data in a store
- 5: StoreNotification – Receive notification of data changes
- 6: GrowingObject – Manage growing parts of data objects
- 7: DataArray – Transfer large, binary arrays

ETP: WebSocket

- ETP is itself a sub-protocol of WebSocket
- ETP uses web ports to reduce connectivity problems
- The messages are payload data in Websocket frames
- Messages can travel in both directions
  - Used for discovery and later for query

ETP: Avro

- » ETP uses a subset of the Avro 1.7.5 functionality
  - ETP defines all messages using the Avro schema file format
    - The Avro schemas are managed in and produced from UML by EA
  - All messages on the wire are serialized per the Avro rules
  - ETP uses Avro additional schema attributes
  - ETP does not use Avro RPC and container file facilities
- » ETP supports Avro use of both binary and JSON data

ETP: JSON

» The Avro schemas are created in JSON for Avro use

» ETP also supports JSON encoding of data via Avro

ETP: git

» ETP is issued as a formal specification
» For developers, IT artifacts are also available via git
» git is a widely-used version control system
  - The commercial version used for ETP is Bitucket
» The Bitbucket repository also holds the documents
» The IT artifacts are UML and Avro schemas in JSON
» Source code in several languages is also available

ETP: Distribution Methods

» The availability of source depends on the language
  - C# code is delivered as a nuget package
  - Javascript (node.js) is distributed via mpm
  - Java and C++ are in the Energistics Bitbucket repository

» Source could include a full sample implementation
  - Or might only contain proxy classes

» All code is contributed and maintained by members

WITSML v2.0 RC contents

- » XML schemas – the standard
- » XSLT transforms
    - From both WITSML 1.3.1 and WITSML 1.4.1.1
- » Sample XML files
    - Additional files available soon from Statoil/Kongsberg
- » Documentation
    - Improving as the review period continues
- » Feedback Form in zip file
    - Comments due June 30

Wrap Up

ANY QUESTIONS?