

RFID and ISO 15926

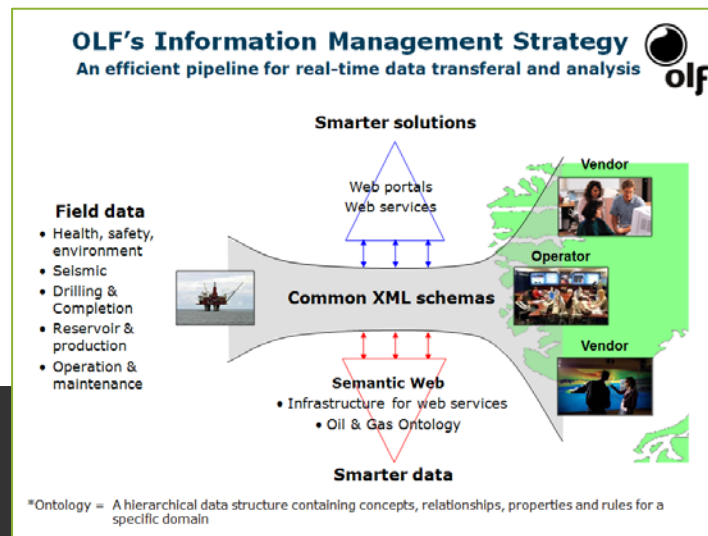
Jennifer Sampson

Introduction - RFID project

- OLF together with BG, BP, ConocoPhillips, GDF SUEZ, Shell and Statoil financed a project outlining the use of RFID technology in the offshore oil and gas industry. (2007-2009, Project leader: Ovidiu Vermesan, SINTEF)
- Produced [OLF RFID guidelines Parts 1-9](#)
- The goal was to define the requirements and needs of the oil and gas industry for the deployment of RFID technology to successfully undertake the adoption and evaluation of the technology for:
 - petroleum personnel monitoring in critical situations,
 - cargo carrying unit tracking,
 - drill string components and tools tracking,
 - monitor and manage mobile and fixed equipment.

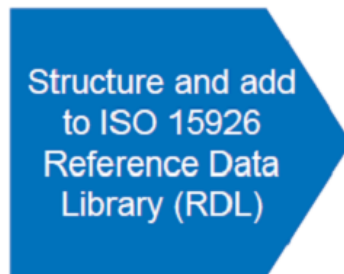
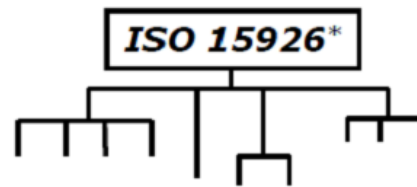
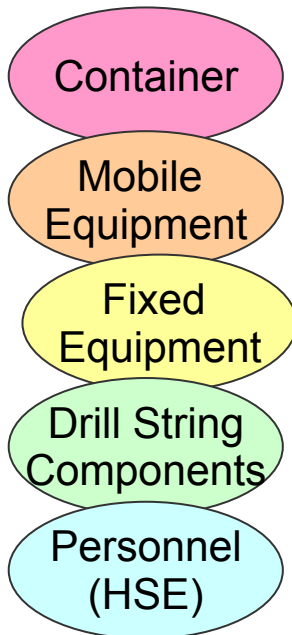
Background

- Implementation of OLF's Integrated Operations (IO) Generation 2,
 - i.e. integration between operators and suppliers in real time requires a common communication platform based on international standards.
- Key elements of this platform are a common terminology and a reference IT architecture.
 - RFID data should be well defined to enable efficient data sharing across disciplines and organizations.
 - Within each RFID system all data concepts should be aligned with the terminology in use in the offshore industry.

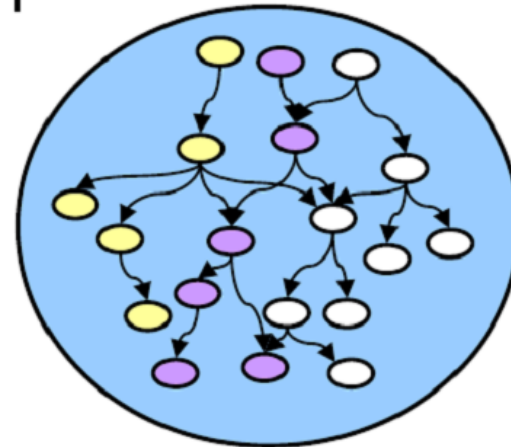


Deployment Areas of RFID Reference Data

Domain Specific
Nomenclatures



Oil and gas
ontology
(Reference Data)



* ISO 15926 – *Integration of life-cycle data for process plants including oil and gas production facilities.*

Architecture - Logical View

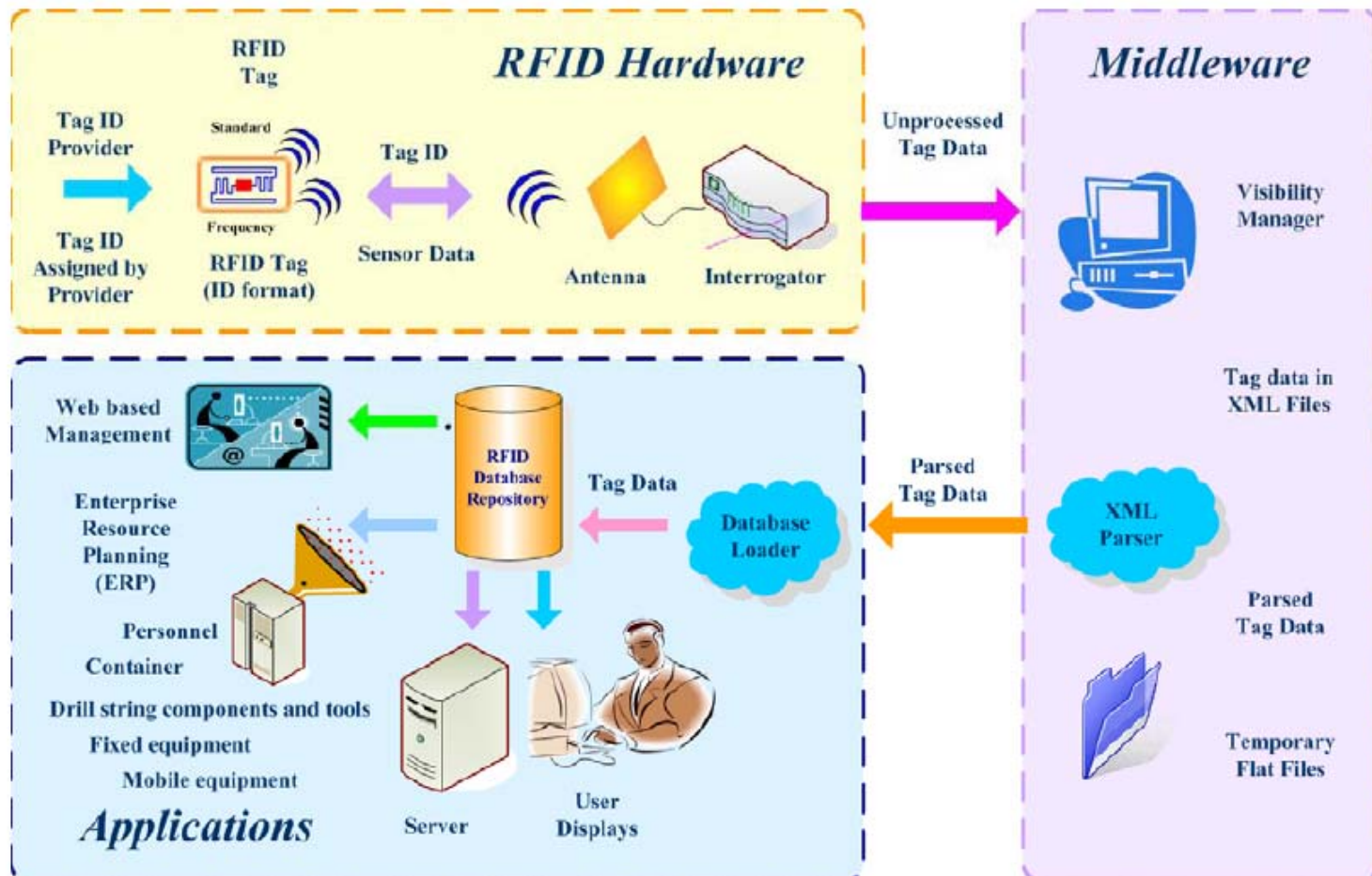


Fig. 5: RFID Architecture logical view.

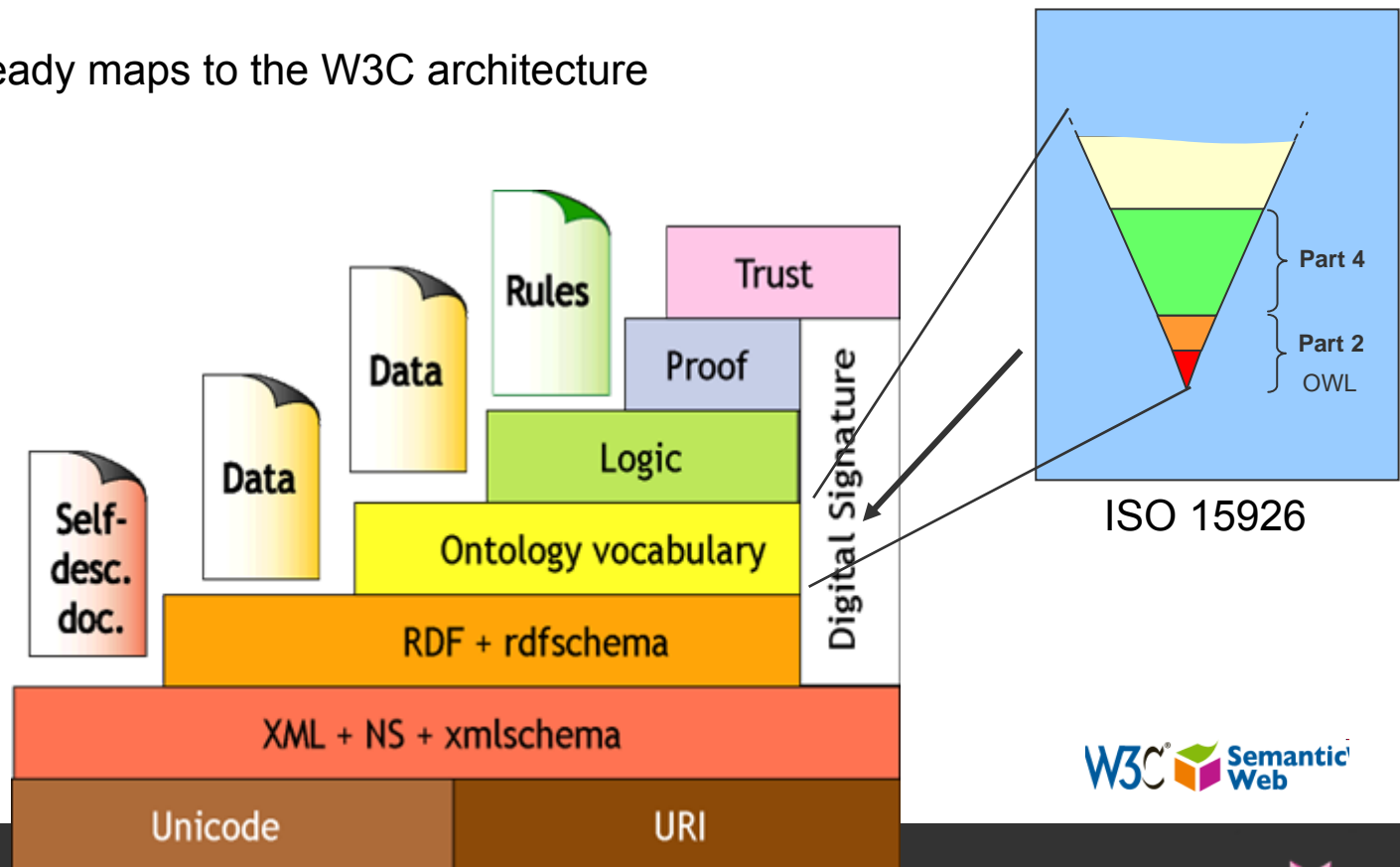
Semantic Web Stack

Architecture for the Semantic Web

The basic principles can be used to help solve enterprise interoperability

Open Standards of the World Wide Web Consortium – W3C

ISO 15926* already maps to the W3C architecture



Ontology

- An ontology is an artefact consisting of:
 - a **vocabulary** used to describe a particular view of some domain
 - a set of **explicit assumptions** regarding the intended meaning of the vocabulary.
 - Usually includes **classification** based information
 - Constraints capturing **background knowledge** about the domain
- Thus, an ontology describes a formal specification of a certain domain:
 - Shared understanding of a domain of interest
 - Formal and machine manipulable model of a domain of interest

Reference Data Complexity

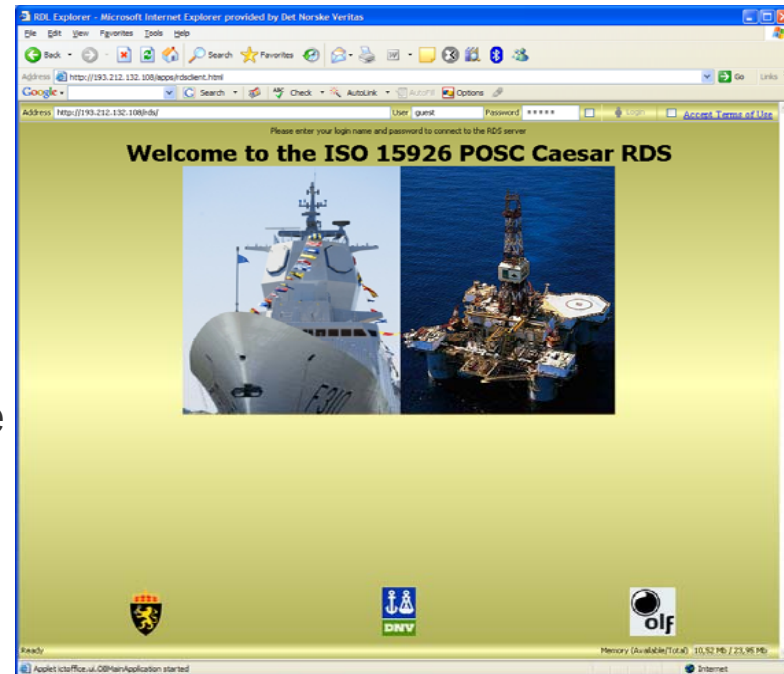
Decrease of ambiguity

- Dictionary
 - Terms and definitions
- Taxonomy
 - Classes in sub-/superclass hierarchy
- Ontology
 - Constraints
 - Connections

PCA's RDS

-where the RFID reference data will end up

- The reference data (ontology) is available free of charge at PCA's Reference Data System (RDS)
- RDS consists of 3 parts – ISO, WIP and submission area
- The RDS is linked up to Internet and all technologies and services of the Web are available.
- Special Interest Groups maintain and enhance the different domains of the ontology
- www.posccaesar.org



RFID Ontology phase 1 status

- So far 65 concepts with definitions
- classification and specialization relations
- other relations and roles
- Containers, mobile equipment & drill string components
 - fixed equipment and personnel for phase 2.
- OWL ontology in progress

Container XML working example

- XML for Containers (Statoil)

- NORSOK standard Z-015 Temporary Equipment

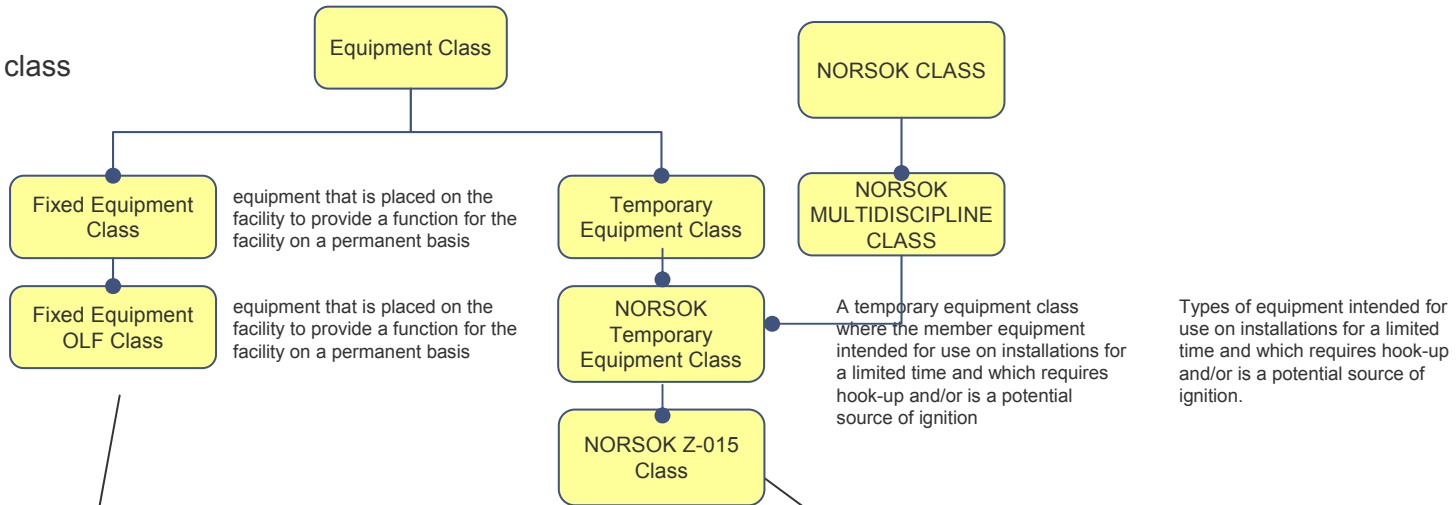
e.g Type U07: Well service equipment

Description of equipment:

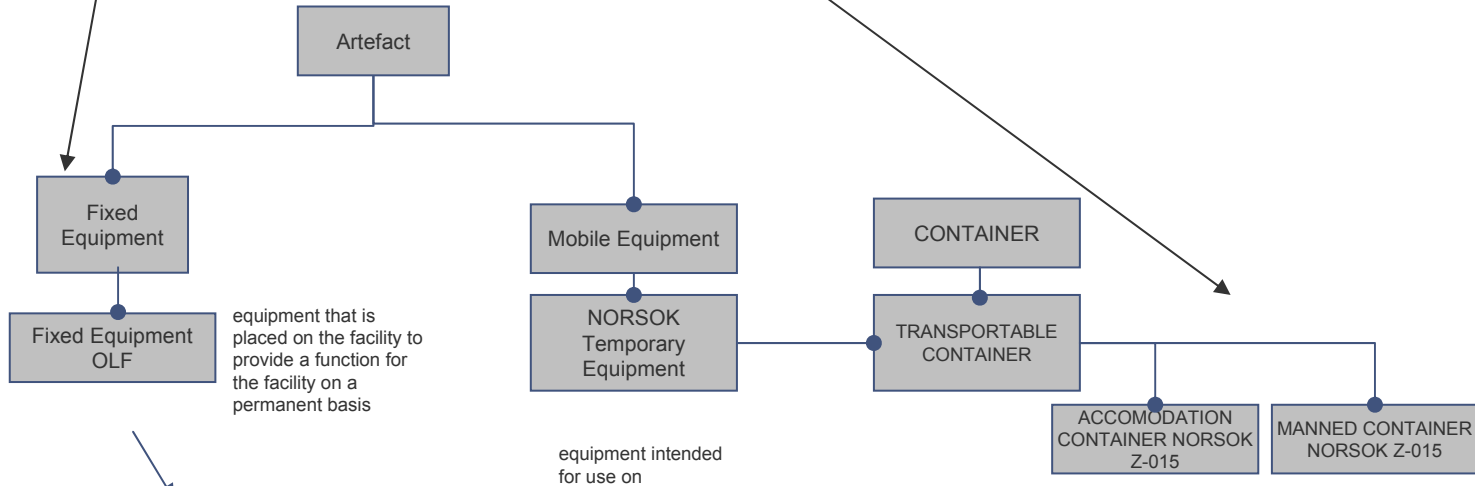
All equipment used in connection with preparations for and performance of well interventions (wireline, coiled tubing, snubbing, well testing etc.).

```
<?xml version="1.0" encoding="ISO-8859-1" ?>
- <OffshoreInd>
- <ContainerInfo>
  <ClassID>3</ClassID>
  <Container_ownerID>100254</Container_ownerID>
  <Container_owner_name>SWIRE</Container_owner_name>
  <Product_numberID>1455567</Product_numberID>
  <Container_desc>MUD Container</Container_desc>
  <Container_serial_number>FSM1724</Container_serial_number>
  <Certificate_number>74907</Certificate_number>
  <Certificate_exp_date>2008-11-04</Certificate_exp_date>
  <Container_manufacture_date>2004</Container_manufacture_date>
  <Payload>5250 kg</Payload>
  <Max_gross_weight>7100 kg</Max_gross_weight>
  <RentingCompany>Kongsberg Offshore</RentingCompany>
  <ContainerTypeZ015>U07</ContainerTypeZ015>
  <ProcessEventDateTime>2008-02-11T13:23:55</ProcessEventDateTime>
  <ProcessEvent>Loading ship</ProcessEvent>
- <Location>
  <locationLat>60.412327</locationLat>
  <locationLong>5.011482</locationLong>
  <locationName>CCB Ågotnes Plan 1</locationName>
</Location>
</ContainerInfo>
</OffshoreInd>
```

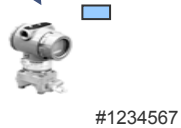
Class of class



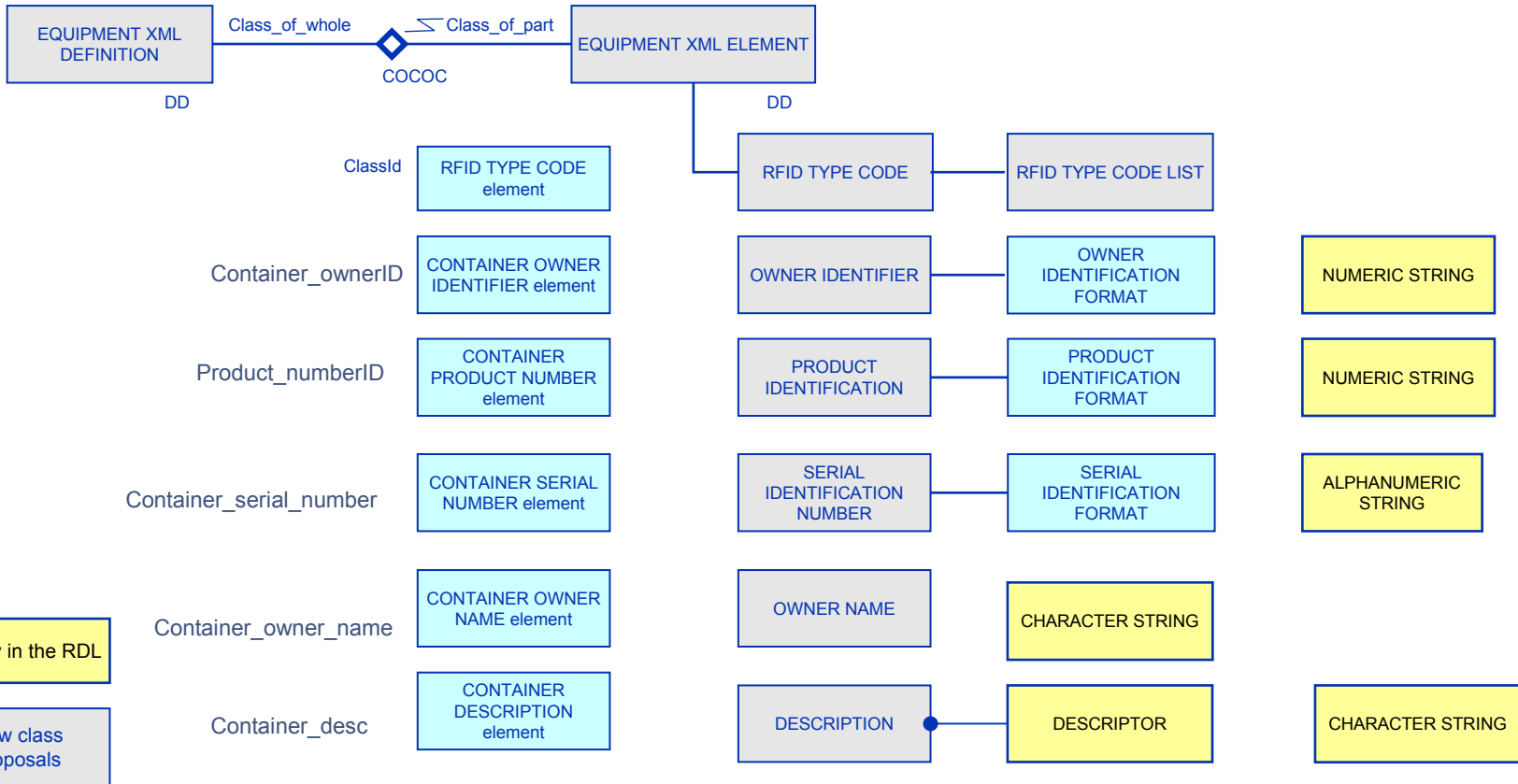
Class



Individual



XML data elements



Already in the RDL

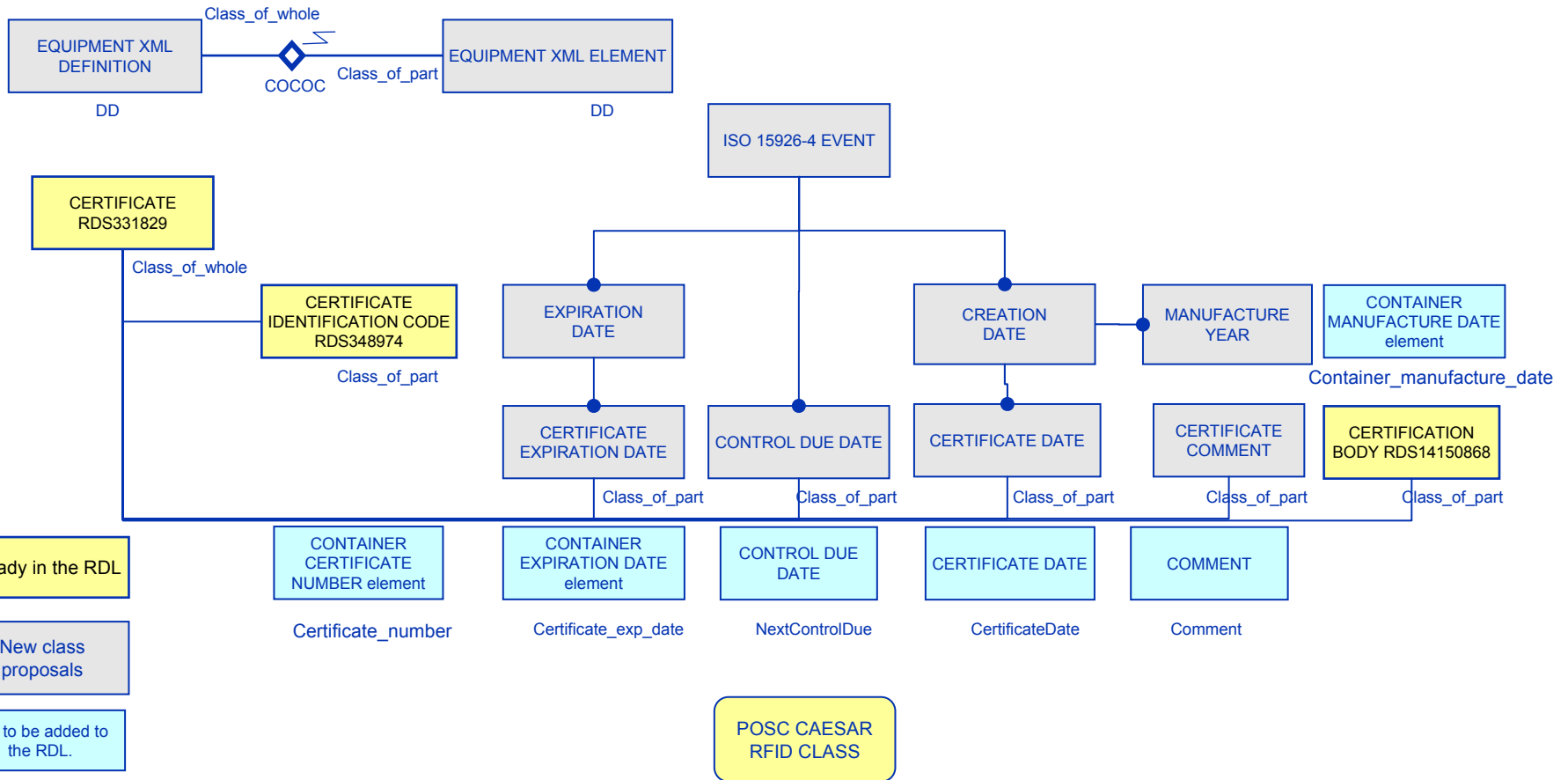
New class proposals

Not to be added to the RDL.

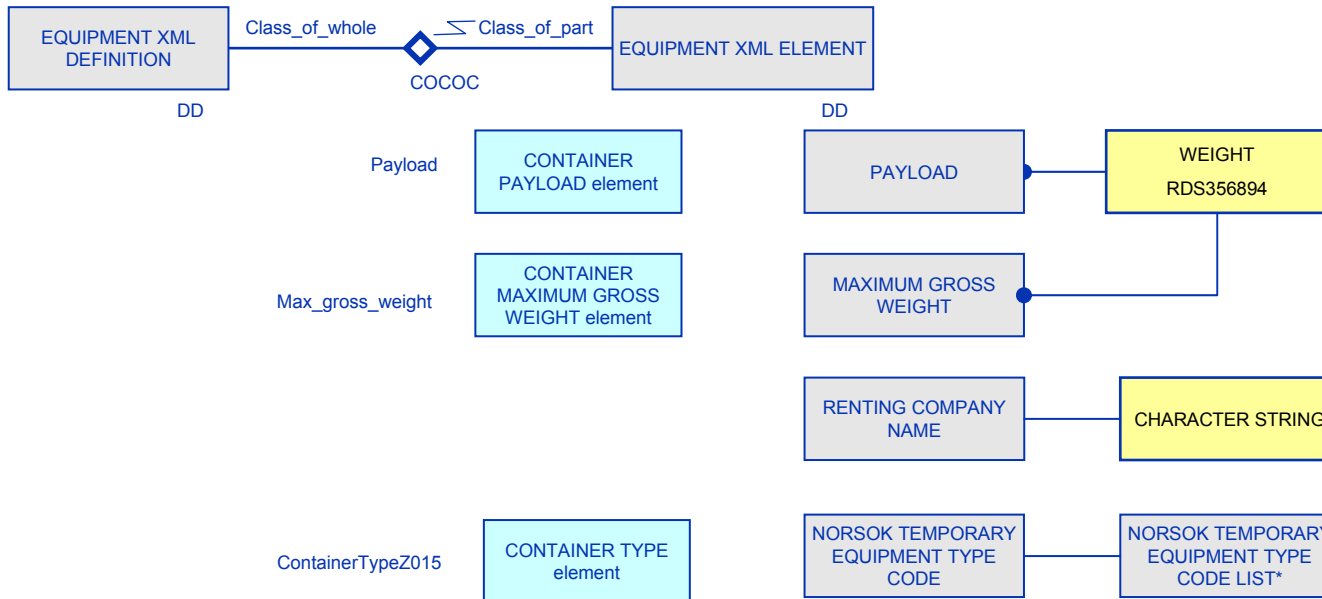
A container serial number is an alpha numeric number (36 bit, 11 digit) for Containers on the NCS. The serial number is one part of the RFID-tag information.

DD – document definition

XML data elements



XML data elements



See next slide

* Codes are specified in the NORSOK Z-015 documents

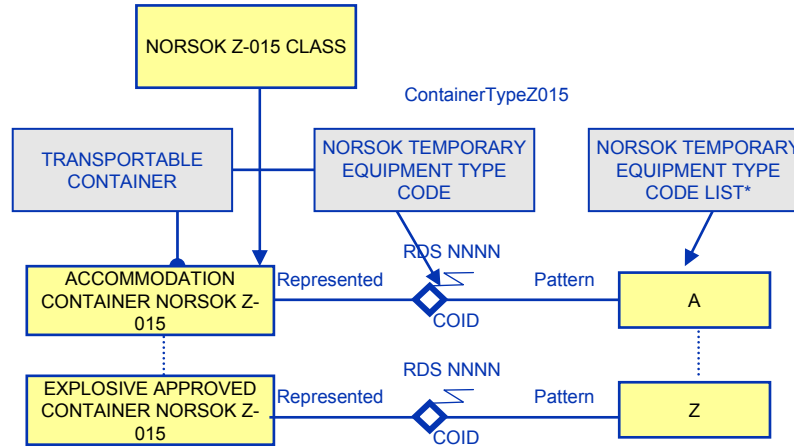
Already in the RDL

New class proposals

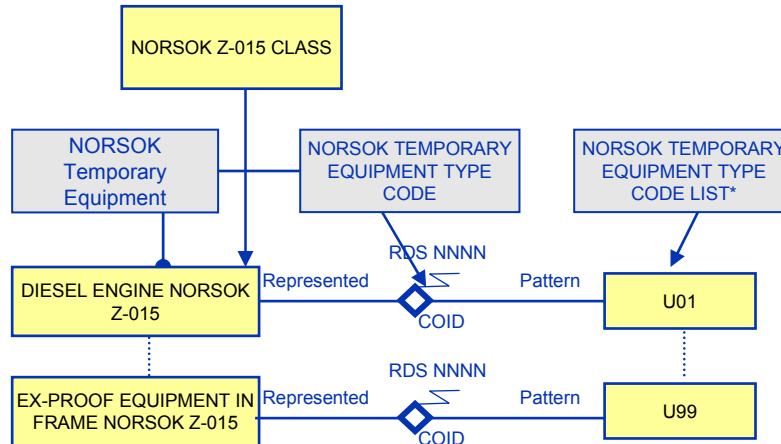
Not to be added to the RDL

Norsok temporary equipment type code

Types of Containers with Code (see table 4.1.2 page 6) Norsok Z-05



Types of Equipment with Code (see table 4.1.2 page 7) Norsok Z-05



Already in the RDL

New class proposals

Protégé Ontology Work Bench

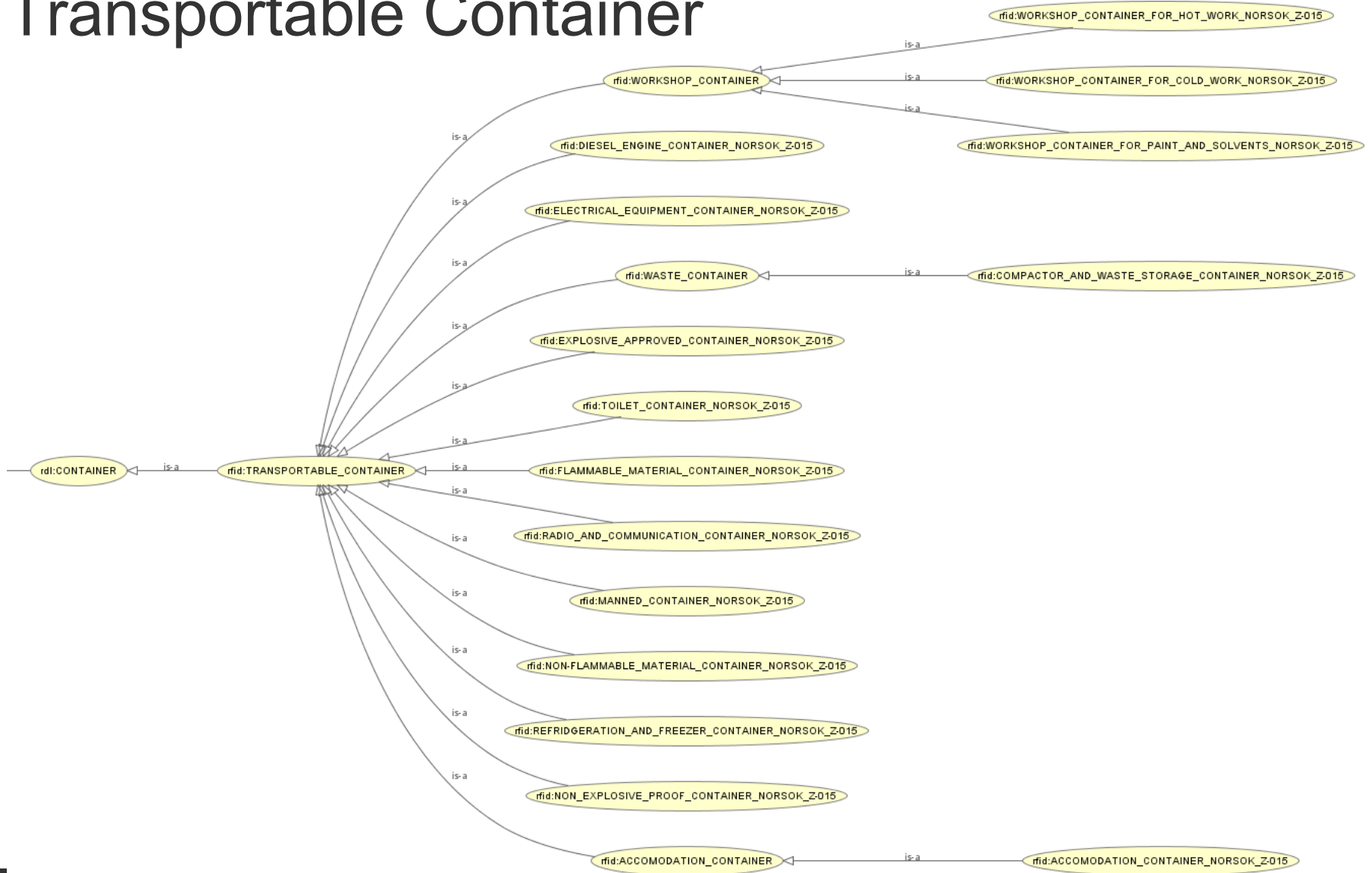
The screenshot displays the Protégé Ontology Work Bench interface. At the top, the title bar shows the file path: `rfid.owl (http://RFID_in_ISO15925/rfid.owl) - [C:\rfid_ontolog\rfid.owl]`. Below the title bar is a menu bar with options: File, Edit, Ontologies, Reasoner, Tools, Refactor, Tabs, View, Window, Help. A dropdown menu is open under 'Reasoner', showing 'Classify... Ctrl-R' and a radio button selection for 'FaCT++' (selected) and 'None'. Below the menu bar is a toolbar with icons for navigation and editing. The main workspace is divided into several panels:

- Left Panel (Class Hierarchy):** Displays the asserted class hierarchy for `rdl:DRILL_STRING`. The hierarchy starts with `owl:Thing` and branches into `part::Thing`, `rdl:ISO_15926-4_THING`, `part::AbstractObject`, `part::PossibleIndividual`, `part::Activity`, `part::ActualIndividual`, `part::ArrangedIndividual`, `rdl:ISO_15926-4_ARRANGED_INDIVIDUAL`, `rdl:ISO_15926-4_ORGANIZATION`, `rdl:DEPARTMENT`, `rdl:ISO_15926-4_INANIMATE_PHYSICAL_OBJECT`, `rdl:ARTEFACT`, `rdl:MOBILE_EQUIPMENT`, `rdl:NORSOK_TEMPORARY_EQUIPMENT`, `rdl:TRANSPORTABLE_CONTAINER`, `rdl:ACCOMMODATION_CONTAINER`, `rdl:DIESEL_ENGINE_CONTAINER_NORSOK_I-015`, `rdl:ELECTRICAL_EQUIPMENT_CONTAINER_NORSOK_I-015`, `rdl:EXPLOSIVE_APPROVED_CONTAINER_NORSOK_I-015`, `rdl:FLAMMABLE_MATERIAL_CONTAINER_NORSOK_I-015`, `rdl:MANNED_CONTAINER_NORSOK_I-015`, `rdl:NON-FLAMMABLE_MATERIAL_CONTAINER_NORSOK_I-015`, `rdl:NON_EXPLOSIVE_PROOF_CONTAINER_NORSOK_I-015`, `rdl:RADIO_AND_COMMUNICATION_CONTAINER_NORSOK_I-015`, `rdl:REFRIDGERATION_AND_FREEZER_CONTAINER_NORSOK_I-015`, `rdl:TOILET_CONTAINER_NORSOK_I-015`, `rdl:WASTE_CONTAINER`, `rdl:WORKSHOP_CONTAINER`, `rdl:EX-PROOF_EQUIPMENT_IN_FRAME_NORSOK_I-015`, `rdl:HIGH_PRESSURE_CLEANING_EQUIPMENT_NORSOK_I-015`, `rdl:NON_EX-PROOF_EQUIPMENT_IN_FRAME_NORSOK_I-015`, `rdl:WELL_SERVICE_EQUIPMENT_CLASS`, `rdl:DRILL_STRING`, `rdl:LIFTING_APPLIANCE`, and `rdl:PIPE`. Other branches include `part::Event`, `part::PeriodInTime`, and `part::PhysicalObject`.
- Right Panel (Class Annotations):** Shows the annotations for the selected class `rdl:DRILL_STRING`. It includes:
 - Annotations:** A plus sign icon to add annotations.
 - hasExplanatoryComment:** "Used to transmit fluid and rotational power from the Kelly drive or top drive to the drill collars and bit. Often, especially in the oil patch, the term is loosely applied to both drill pipe and drill collars. Some type of drilling fluid is almost always pumped down the inside of the drill string and circulated back up the annulus, or ring shape void between the drill string and the formation."
 - hasDefinition:** "An artefact that is an assembly of drill pipe with attached tool joints."
 - hasIdPCA:** "RDS648718821"
 - label:** "DRILL STRING"
- Bottom Panel (Class Description):** Shows the description for `rdl:DRILL_STRING`. It includes:
 - Equivalent classes:** A plus sign icon to add equivalent classes.
 - Superclasses:** A plus sign icon to add superclasses. The list shows `rdl:ARTEFACT`.
 - Inferred anonymous superclasses:** A plus sign icon to add inferred anonymous superclasses.
 - Members:** A plus sign icon to add members.
 - Disjoint classes:** A plus sign icon to add disjoint classes.

Acknowledgements This work was conducted using the Protégé resource, which is supported by grant LM007885 from the United States National Library of Medicine.
<http://protege.stanford.edu/>



Transportable Container



Mobile Equipment

User Vocabulary Item	Definition
Equipment (Mobile Equipment)	Heading, not for use in semantics
UniquelDentificationNumber (UIN)	Text/number
SerialNumber	Text/number
Description	Text
EquipmentType	Text
Model	Text
Producer	Text
ProducedYear	Year
Payload	Kg
Max_gross_weight	Kg
Certificate	Heading, not for use in semantics
CertificateNo (PK)	Number
CertificateDate	Date
CertificateExpiry	Date
CertifiedBy	Signature (electronic)
NextControlDue	Date
Comment	Text
Document	Heading, not for use in semantics
Document (PK)	Document number
Description	Text
Revision	Revision number
Mobile Equipment Events	Heading, not for use in semantics
Project	Project number
Purchase Order No	Text/number

Events

- Preliminary structure defined
 - Set of events to be proposed by the industry
- In ISO 15926 RFID ontology there will be an abstraction/model which can be mapped to different implementations e.g. EPC.
- GS1 / RFID Innovasjonsenter AS
 - EPCIS events
- TRAC ID - Drilling
- Statoil - Containers
- Aker Solutions – mobile equipment

Events – basic structure



Proposed Events (Trac ID):

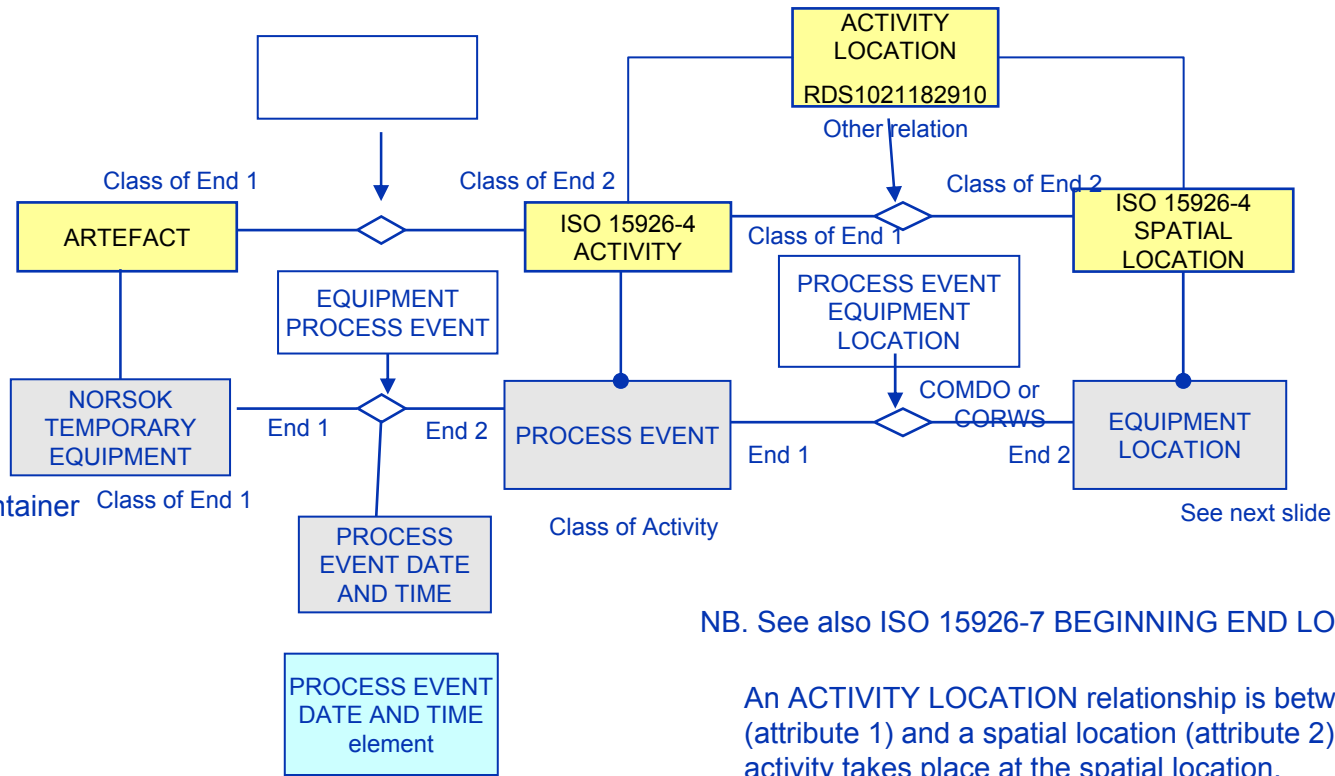
- Stock Yard
 - New Tubular received
 - Received from Inspection
 - Received from offshore
 - Sent to Inspection
 - Sent to offshore
- Inspection
 - Received from storage
 - Received from repair
 - Sent to storage
 - Sent to repair
 - Sent to scrap
- Repair
 - Received from inspection
 - Sent to stock yard
- Rig
 - Received from carrier
 - Loaded onto carrier
 - Sent to location
 - Received from location
- Drilling
 - Tally changed

Already in the RDL

New class proposals

Not to be added to the RDL.

Equipment Event Location WIP



- Personnel
- Transportable Container
- Mobile Equipment
- Fixed Equipment
- Drill string, Pipe

See next slide

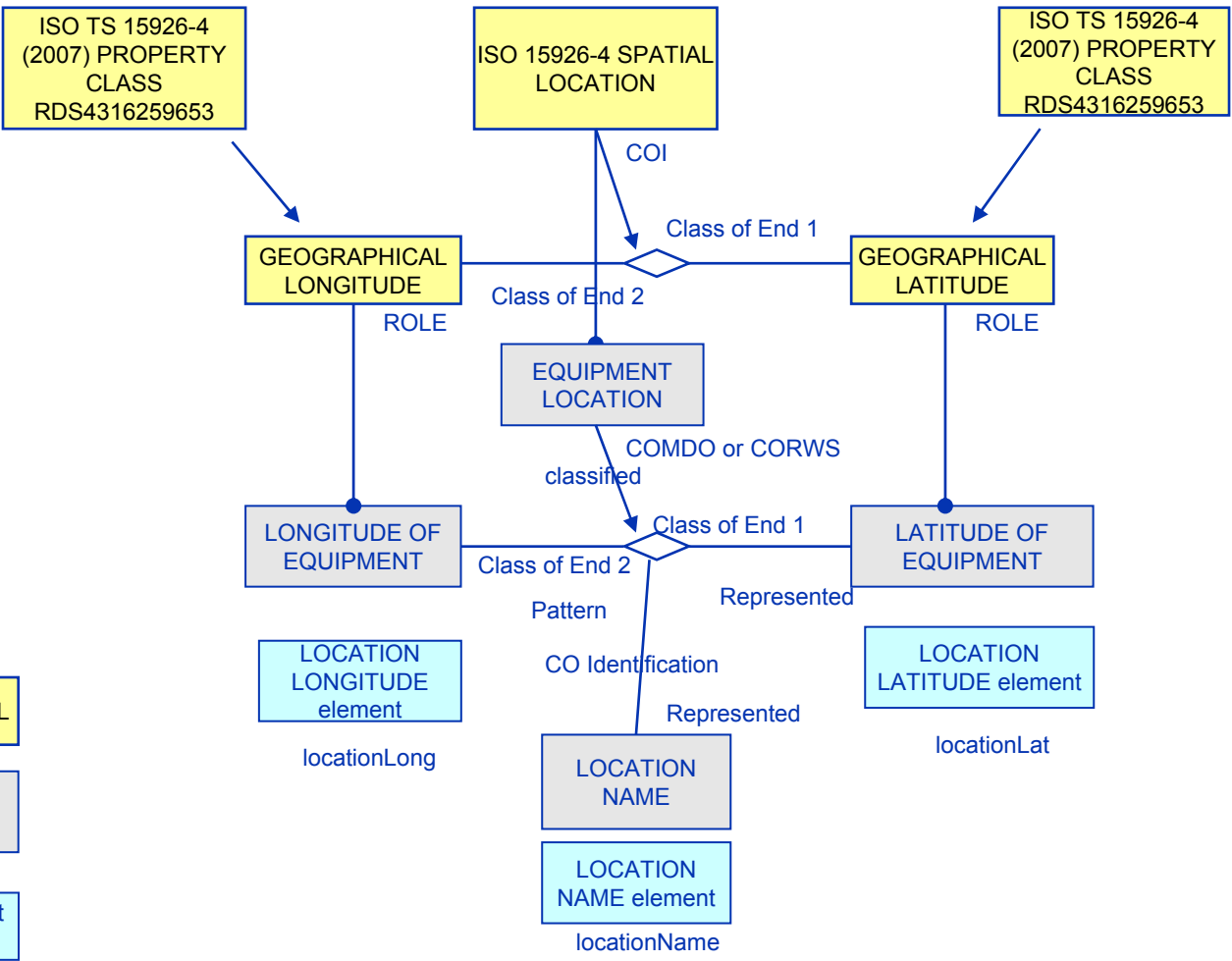
NB. See also ISO 15926-7 BEGINNING END LOCATION OF ACTIVITY

An ACTIVITY LOCATION relationship is between an activity (attribute 1) and a spatial location (attribute 2), stating that the activity takes place at the spatial location. This relation was introduced in the defining axiom for template ISO 15926-7 LOCATION OF ACTIVITY. Its entity type should really be CLASS OF RELATIONSHIP WITH SIGNATURE. It is recorded here as OTHER RELATIONSHIP due to technical restrictions in the reference data database.

- Already in the RDL
- New class proposals
- WIP
- xml elements (not to be added)

ProcessEventDateTime

Location WIP



Already in the RDL

New class proposals

xml elements (not to be added)

Open issues

Issue	Description	Possible resolution
1	RFID identifier and the components to be agreed on and then modelled in the ontology.	Solution forth coming.
2	XML documents agreed and defined on for the other four business areas namely: drill string components, mobile equipment, fixed equipment and personnel.	Input required from industry groups to define XML schemas for each business area.
3	Agree on the level of abstraction for equipment and attributes that are relevant for each business area.	Review meetings for each business area to establish commonalities between XML elements.
4	Reviewing of the concepts, definitions and RDL taxonomy (hook classes) to be carried out.	To be able to identify the correct location in the taxonomy, good definitions need to be in place. Improvements to some definitions will be necessary to more precisely capture the meaning.
5	Drill string components - more specific definitions are required regarding the actual information to be used in RFID applications for drill string component tracking.	Drill string components working group could be established. Maersk Drilling together with Trac ID and other industry parties interested in collaborating here to specify the concepts and definitions.
6	Use of templates, development of signatures and multidimensional objects to be defined. e.g. equipment event, process event location, 'thing'-ownership, equipment rental etc.	To precisely model more complex concepts and relations than already exists it is recommended that ISO 15926-7 templates be utilised.

Summary

- OLF RFID project produced 9 guidelines for the deployment of Radio Frequency Identification (RFID) in the oil and gas industry through a common understanding, practice, and technology platform adoption to achieve data interoperability between RFID and corporate systems.

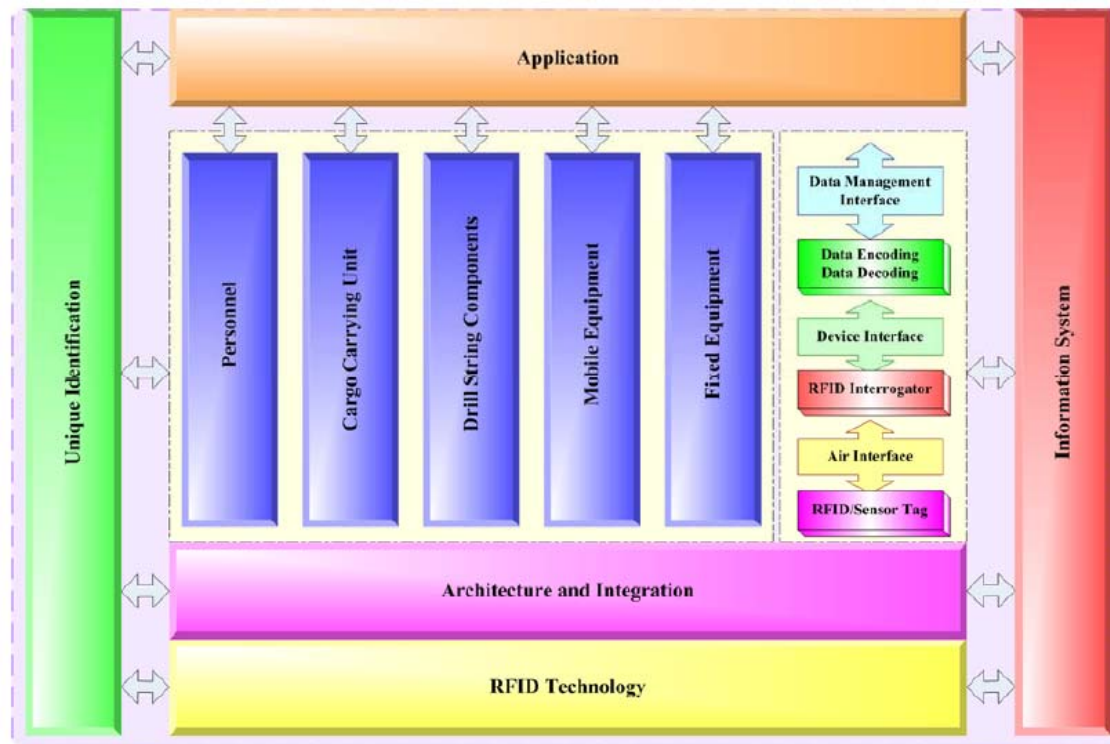


Fig. 1: RFID guideline documents organization.

Thank you

RFID and ISO 15926

Jennifer Sampson

Principal Analyst Information Technology Infrastructure

jensam@statoil.com

www.statoil.com