.15926 software - current state, applications and roadmap

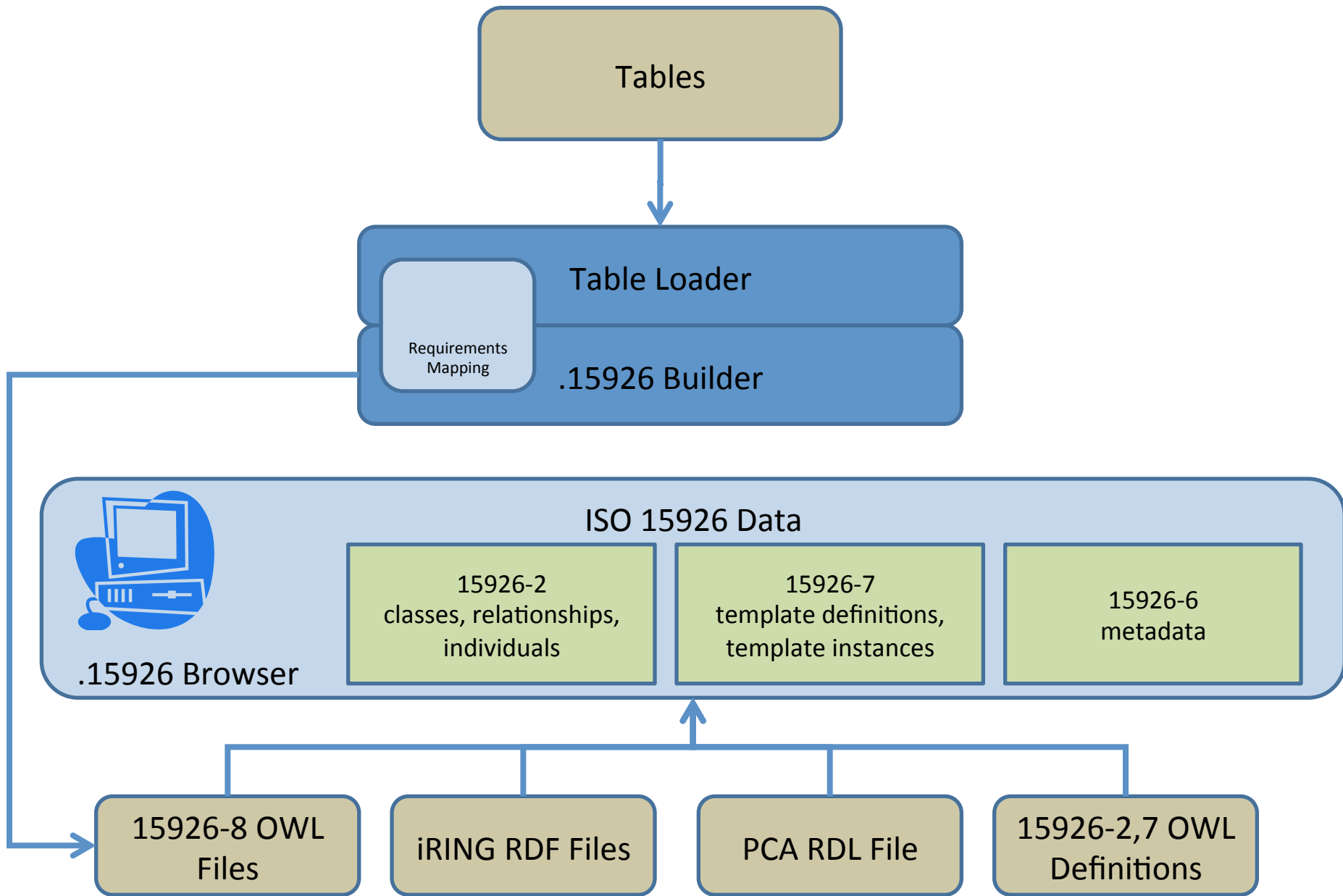

Victor Agroskin
07.06.2011

Few words about the project

- TechInvestLab.ru – Moscow-based strategy and IT consultancy

- Clients interested in ISO 15926
  - GK Rosatom (various companies in nuclear energy)
  - OSK-Sudoexport (shipbuilding holding)
  - INVEL (Electricity Generation Industry Association)

- Client-driven tool development - **.15926**

In search of a 15926-natural way to work with data

First Need – Multiformat Browsing

- ISO 15926-2 definitions from OWL files published at https://www.posccaesar.org/wiki/ISO15926inOWL).

- Class and template definitions as specified in ISO 15926-8 draft

- POSC Caesar Association RDL (3 million triples) from https://www.posccaesar.org/wiki/Rds

- Class and template definitions in iRING Tools export format

- Instance data compliant to ISO 15926-8 draft or from iRING mapping process

- Dependencies
  - Simple tree-dependencies
  - Cross-reference ID bridge from RDS/WIP to PCA RDL bundled with the software

```
                        ┌─────────────────────────┐
                        │                         │
                        │         Tables          │
                        │                         │
                        └────────────┬────────────┘
                                     │
                                     ▼
        ┌────────────────────────────────────────────────────────┐
        │                    Table Loader                         │
        │       ┌──────────────┐                                  │
        │       │ Requirements │     .15926 Builder               │
        │       │   Mapping    │                                  │
        │       └──────────────┘                                  │
        └────────────────────────────────────────────────────────┘
```

ISO 15926 Data

| 15926-2 classes, relationships, individuals | 15926-7 template definitions, template instances | 15926-6 metadata |

.15926 Browser

| 15926-8 OWL Files | iRING RDF Files | PCA RDL File | 15926-2,7 OWL Definitions |

ISO 15926 Part 2 types

- ◇ **RepresentationOfThing**
  - 🗀 Can be classified by (1)
  - 🗀 Can classify (0)
  - 🗀 Disjoint with (21)
  - 🗀 Subtypes (3)
  - 🗀 Supertypes (1)
  - 🗀 Roles (2)

Properties

comment	A [representation_of_thing] is a [relationship] that in
id	part2:RepresentationOfThing
label	RepresentationOfThing

ISO 15926 Part 2 types

- ◇ UpperBoundOfPropertyRange
- ◇ UsageOfRepresentation
- ☐ WholeLifeIndividual
- Search in names (press [insert])
  - Found (16): representation
    - ☐ ClassOfClassOfInformationRepresentation
    - ◇ ClassOfClassOfRepresentation
    - ◇ ClassOfClassOfRepresentationTranslation
    - ◇ ClassOfClassOfResponsibilityForRepresentation
    - ◇ ClassOfClassOfUsageOfRepresentation
    - ☐ ClassOfExpressInformationRepresentation
    - ☐ ClassOfInformationRepresentation
    - ◇ ClassOfRepresentationOfThing
    - ◇ ClassOfRepresentationTranslation
    - ◇ ClassOfResponsibilityForRepresentation
    - ◇ ClassOfUsageOfRepresentation
    - ☐ RepresentationForm
    - ☐ RepresentationOfGregorianDateAndUtcTime
    - ◇ RepresentationOfThing
    - ◇ ResponsibilityForRepresentation
    - ◇ UsageOfRepresentation
- Search in names and annotations (press [insert])
- Search in id's (press [insert])

Properties

comment	A [class_of_class_of_information_representation] is a [c
id	part2:ClassOfClassOfInformationRepresentation
label	ClassOfClassOfInformationRepresentation

PCA (POSC Caesar) RDL

- Search in names (press [insert])
  - Found (32): celsius
    - 🟨 25 DEGREE CELSIUS YEARLY AVERAGE TEMP. ENVIRONMENT
    - ◇ CALORIE PER HOUR CENTIMETRE DEGREE CELSIUS
    - ◇ CALORIE PER HOUR CENTIMETRE SQUARED DEGREE CELSIUS
      - 🟨 hasCodomain = R1 Number space
      - 🟨 hasDomain = HEAT TRANSFER COEFFICIENT
      - ◇ is Scale
      - 🟩 as hasClassified in (Classification instance) #rdl:RDS4317027925
    - ◇ CALORIE PER MOLE PER DEGREE CELSIUS
    - ◇ CALORIE PER SECOND CENTIMETRE DEGREE CELSIUS
    - ◇ CELSIUS HEAT UNIT
    - 🟨 CELSIUS TEMPERATURE
      - 🟨 is SinglePropertyDimension
      - 🟩 as hasClassified in (Classification instance) #rdl:RDS16755613
      - 🟩 as hasSuperclass in (Specialization instance) #rdl:RDS17581528
      - 🟩 as hasSuperclass in (Specialization instance) #rdl:RDS17581545
      - 🟩 as hasSuperclass in (Specialization instance) #rdl:RDS17581562
      - 🟩 as hasSuperclass in (Specialization instance) #rdl:RDS17581579
      - 🟩 as hasSubclass in (Specialization instance) #rdl:RDS17800908
      - 🟩 as hasClassified in (Classification instance) #rdl:RDS7487388
      - ◇ as hasRepresented in (ClassOfIdentification instance) #rdl:RDS999221964
    - ◇ CENTIMETRE DEGREE CELSIUS
    - ◇ CUBIC METRE PER NORMAL CUBIC METRE, 0 DEGREE CELSIUS
    - ◇ DEGREE CELSIUS
    - ◇ DEGREE CELSIUS PER KILOMETRE
    - ◇ DEGREE CELSIUS PER METRE

Properties

Property	Value
rdl:hasDesignation	CELSIUS TEMPERATURE
is	SinglePropertyDimension
Label	CELSIUS TEMPERATURE
rdl:hasCreationDate	2001.10.11
rdl:hasIdPCA	RDS381599
rdl:hasNote	ISO 31-4:1992(E) The thermodynamic temperatur To is
rdl:hasDefinition	t = T - To where To is defined as being equal to 273,1
rdl:hasCreator	u82237
rdl:hasStatus	Recorded
id	rdl:RDS381599

Workspace

- ISO 15926 Part 2 types
  - ISO 15926 Part 7 templates (Part 8 version)
    - Custom definitions in Part 8 form (K:\examples\part 8\Part8_sample_RDL.owl, K:\examples\part 8\Part8_sample_tpl.owl)
      - Instance data (K:\examples\part 8\Part8_sample_instances.owl)
  - PCA (POSC Caesar) RDL
    - RDS/WIP to PCA RDL bridge

Custom definitions in Part 8 form (K:\examples\part 8\Part8_sample_RDL.owl, K:\examples\part 8\Part8_sample...

- New classes (9)
  - Driving
  - Driving
  - Equipment
  - EquipmentHasNozzle
  - HardWork
  - Nozzle
  - PipingNetworkSegment
  - PipingNetworkSystem
  - PipingNetworkSystemHasSegment
- New templates (4)
  - AssemblyRelation
  - BeginningEndOfIndividual
  - BeginningOfPerson_dateAsEventObject
  - ClassifiedAssemblyOfIndividual
    - Roles (3)
      - 1. hasPart: PossibleIndividual
      - 2. hasWhole: ClassOfIndividual
      - 3. hasAssemblyType: ClassOfAssemblyOfIndividual
- Specialized templates (1)
  - PipingNetworkSystemHasSegment
    - Specialization of ClassifiedAssemblyOfIndividual
    - Roles (3)

Workspace

- ISO 15926 Part 2 types
  - ISO 15926 Part 7 templates (Part 8 version)
    - Custom definitions in Part 8 form (K:\examples\part 8\Part8_sample_RDL.owl, K:\examples\part 8\Part8_sample_tpl.owl)
      - Instance data (K:\examples\part 8\Part8_sample_instances.owl)
  - PCA (POSC Caesar) RDL
    - RDS/WIP to PCA RDL bridge
      - Custom definitions in iRINGTools form (K:\examples\rosatom\ProtoAndInitialSetRDF.xml)
        - Custom definitions in iRINGTools form (K:\examples\rosatom\Rosatom.RDF.Export.xml)
          - Instance data (K:\examples\rosatom\instances\installation_work.xml, K:\examples\rosatom\instances\person.x...

Instance data (K:\examples\rosatom\instances\installation_work.xml, K:\examples\rosatom\instances\person.x...

- All entities (30)
  - (InstallationWorkHasIdentifier instance) #0235b151177e63e4b3570595a52f0987
  - (EmploymentRelationship instance) #0b742850d729addf90bcb98827dea9c2
  - (InstallationWorkHasDescription instance) #17d4459e5150eec0645569c4b9fc16d5
  - (InstallationWorkHasBeginningAndEndDates instance) #19a098eca6eff6d000607fb678f8d8f9
  - (PersonHasName instance) #1e1c3634396ed7bbd7a2fd0e438bd1a0
  - (PersonHasName instance) #2a8f184218233a777ba9592aaae7a1fa
  - (InstallationWorkHasType instance) #2afad857df471a2a88b7ff9b00c0bb92
    - is InstallationWorkHasType
    - hasClass = INSTALLATION OF HEAT-MECHANIC EQUIPMENT
    - hasIndividual = (INSTALLATION WORK instance) #http://nedfg/Services/data/rosatom/excel/InstallationWork/Work-456
  - (InstallationWorkHasType instance) #330e637b5c2ea545ae0d480563c914d3

Properties

id	tpl:R67021875926

Custom definitions in iRINGTools form (K:\examples\rosatom\Rosatom.RDF.Export.xml)

- InstallationWorkHasType
  - Specialization of ClassificationOfIndividual
  - Roles (2)
    - hasClass: ClassOfIndividual
    - hasIndividual: INSTALLATION WORK

Requirements Modeling

- From text document to formal model
- Combination of Text Structure Model and Semantic Model for requirements
  - Text Structure Model - "appearance" of requirements for human recognition
  - Semantic Model – "meaning" of requirements for formal representation and verification by computer systems
- ISO 15926 data model as basis for combined representation
- Preparation of modeling tools
  - Table domain-specific language for engineers – Gellish inspired
  - Mapping domain-specific language – Turing-complete, Python code

Properties – Table DSL

Class Name	Property Name	Indirect Property Name	Property Min	Property Max	Source
Tank with maximum allowable pressure 250 kPa	pressure	maximum allowable pressure	250 kPa	250 kPa	TR-123.2.2

Properties – Mapping DSL

```
class_id = r.known('Class Name', ids)
prop = r.known('Property Name', ids)
ind_prop = r.known_or_empty('Indirect Property Name', ids)
vmin = r.nonempty('Property Min')
vmax = r.nonempty('Property Max')
source = r.nonempty('Source')

pr_min = ids.get(vmin, None)
if pr_min is None:
    pr_min = part2.Property(label=vmin)
    ids[vmin] = pr_min

pr_max = ids.get(vmax, None)
if pr_max is None:
    pr_max = part2.Property(label=vmax)
    ids[vmax] = pr_max

rng = part2.PropertyRange(annSource=source)
p7tpl.Specialization(rng, prop, annSource=source)
p7tpl.LowerUpperOfPropertyRange(rng, pr_min, pr_max, annSource=source)
p7tpl.PropertyRangeRestrictionOfClass(class_id, ind_prop, rng)
```

Properties – .15926 view

- 🟨 Tank with maximum allowable pressure 250 kPa
  - 🟨 is ClassOfInanimatePhysicalObject
  - 🔻 as hasSubclass in (Specialization instance) #example:id10127
  - 🔻 as hasClass in (PropertyRangeRestrictionOfClass instance) #example:id10135
    - 🟨 hasClass = Tank with maximum allowable pressure 250 kPa
    - ◇ hasProperty = maximum allowable pressure
      - ◇ is ClassOfIndirectProperty
      - 🔻 as hasProperty in (PropertyRangeRestrictionOfClass instance) #example:id10135
        - 🟨 hasClass = Tank with maximum allowable pressure 250 kPa
        - ◇ hasProperty = maximum allowable pressure
        - 🟨 hasRange = (PropertyRange instance) #example:id10132
          - 🟨 is PropertyRange
          - 🔻 as hasSubclass in (Specialization instance) #example:id10133
          - 🔻 as hasPropertyRange in (LowerUpperOfPropertyRange instance) #example:id10134
            - 🟨 hasLowerBound = 250 kPa
            - 🟨 hasPropertyRange = (PropertyRange instance) #example:id10132
            - 🟨 hasUpperBound = 250 kPa
            - 🔻 is LowerUpperOfPropertyRange
          - 🔻 as hasRange in (PropertyRangeRestrictionOfClass instance) #example:id10135
        - 🔻 is PropertyRangeRestrictionOfClass

Breakdown – Table DSL

Class Name	Whole Class Name	Breakdown Relationship Class
Design	Life Cycle	Life Cycle Stage Composition
Construction	Life Cycle	Life Cycle Stage Composition
Commissioning	Construction	Life Cycle Stage Composition
Utilisation	Life Cycle	Life Cycle Stage Composition

Breakdown – Mapping DSL

```
class_id = r.known('Class Name', ids)
whole_class = r.known('Whole Class Name', ids)
rel_class = r.known_or_empty('Breakdown Relationship Class', ids)
class_class = r.known_or_empty('Class of Breakdown Classes', ids)
source = r.nonempty('Source')


rel_id = part2.ClassOfCompositionOfIndividual
(hasClassOfPart=class_id, hasClassOfWhole=whole_class,
annSource=source)
if rel_class:
    p7tpl.ClassificationOfRelationship(rel_id, rel_class,
annSource=source)
if class_class:
p7tpl.ClassificationOfClass(class_id, class_class, annSource=source)
```

Breakdown – .15926 view

- Life Cycle
  - is ClassOfActivity
  - ▽ as hasClass in (ClassificationOfClass instance) #example:id10102
  - ◇ as hasClassOfWhole in (ClassOfCompositionOfIndividual instance) #example:id10138
    - hasClassOfPart = Design
    - hasClassOfWhole = Life Cycle
    - ◇ is ClassOfCompositionOfIndividual
    - ▽ as hasPair in (ClassificationOfRelationship instance) #example:id10139
  - ◇ as hasClassOfWhole in (ClassOfCompositionOfIndividual instance) #example:id10140
    - hasClassOfPart = Construction
      - is ClassOfActivity
      - ▽ as hasClass in (ClassificationOfClass instance) #example:id10104
      - ◇ as hasClassOfPart in (ClassOfCompositionOfIndividual instance) #example:id10140
      - ◇ as hasClassOfWhole in (ClassOfCompositionOfIndividual instance) #example:id10142
        - hasClassOfPart = Commissioning
        - hasClassOfWhole = Construction
        - ◇ is ClassOfCompositionOfIndividual
        - ▽ as hasPair in (ClassificationOfRelationship instance) #example:id10143
    - hasClassOfWhole = Life Cycle
    - ◇ is ClassOfCompositionOfIndividual
    - ▽ as hasPair in (ClassificationOfRelationship instance) #example:id10141
  - ◇ as hasClassOfWhole in (ClassOfCompositionOfIndividual instance) #example:id10144
    - hasClassOfPart = Utilisation
    - hasClassOfWhole = Life Cycle
    - ◇ is ClassOfCompositionOfIndividual
    - ▽ as hasPair in (ClassificationOfRelationship instance) #example:id10145

Requirements– Table DSL

Statement Classification	Role 1	Role 1 Cardinality	Relates to	Role 2	Role 2 Cardinality	Source
Mandatory	System 1 Typical Design		has as part	Hydraulic System Safety Analysis	(1:1)	TR-123.1.1
Mandatory	System 1 Typical Design		complies to description in	SNIP-1234		TR-123.1.2
Mandatory	R5		is subclass of	Tank with maximum allowable pressure 250 kPa		TR-123.2.2
Mandatory	System 1		has as part	Reserve well	(1:2)	TR-123.2.1

Requirements– Mapping DSL

```python
def R_has_as_part(self, role1, role2, role1c, role2c, source):
    rel_id = part2.ClassOfCompositionOfIndividual(hasClassOfPart=role1,
hasClassOfWhole=role2, annSource= source)
    if role1c is not None:
        p7tpl.CardinalityEnd1MinMax(rel_id, role1c[0], role1c[1],
annSource=source)
    if role2c is not None:
        p7tpl.CardinalityEnd2MinMax(rel_id, role2c[0], role2c[1],
annSource=source)
    return rel_id
def R_complies_to_description_in(self, role1, role2, role1c, role2c, source):
    pi = part2.PossibleIndividual(annSource=source)
# can't use p7tpl.ClassificationOfIndividual, relationship must be returned ro
further classification
    rel_id = part2.Classification(hasClassified=pi, hasClassifier=role2,
annSource=source)
    p7tpl.Description(pi, role1, annSource=source)
    return rel_id
```
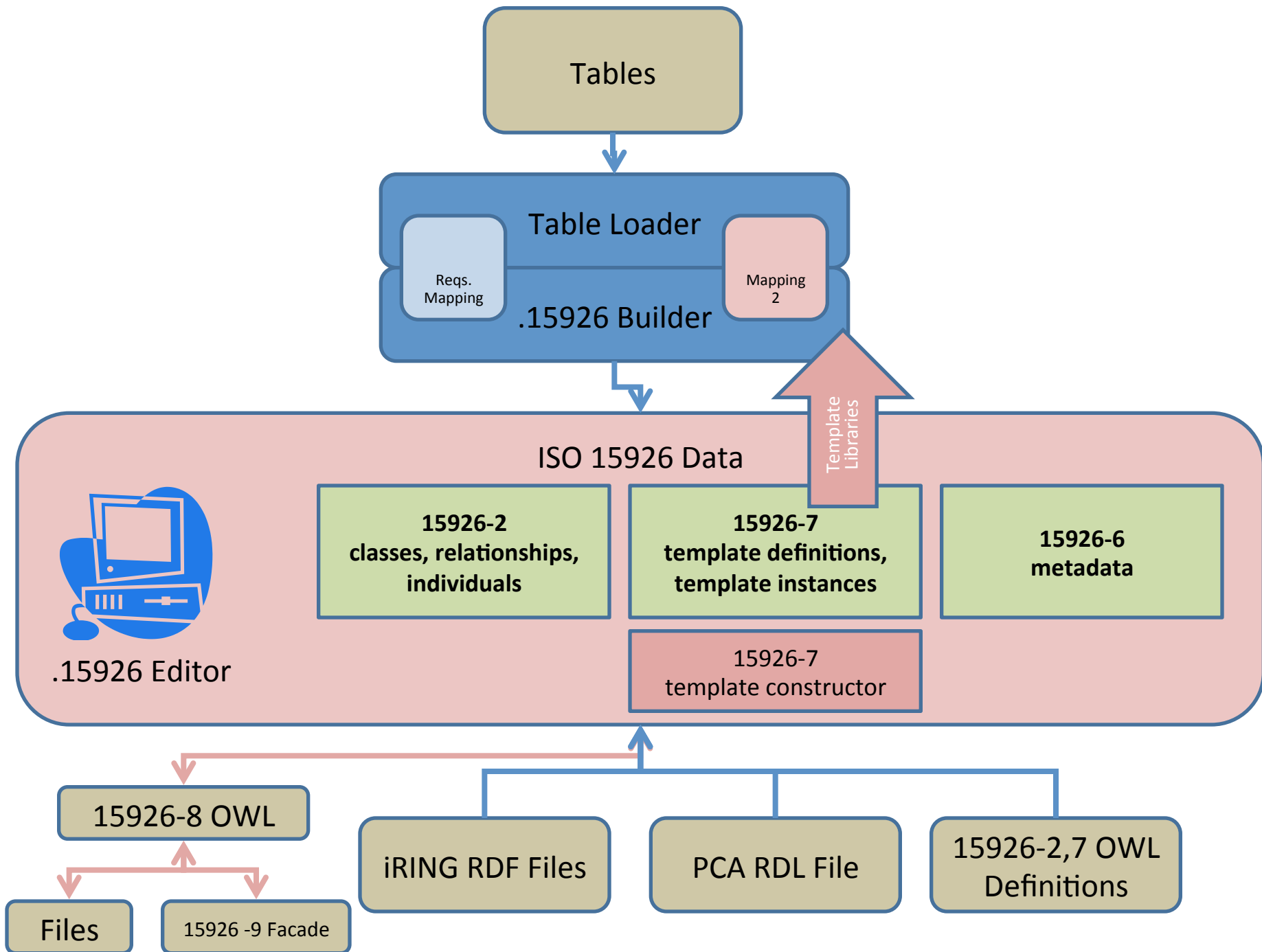
Requirements– .15926 view

- ◇ Mandatory
  - ◇ is ClassOfAssertion
  - ▽ as hasClass in (ClassificationOfClass instance) #example:id10105
  - ▽ as hasRelation in (ClassificationOfRelationship instance) #example:id10176
    - ◇ hasPair = (ClassOfCompositionOfIndividual instance) #example:id10174
      - ☐ hasClassOfPart = System 1 Typical Design
      - ☐ hasClassOfWhole = Hydraulic System Safety Analysis
      - ◇ is ClassOfCompositionOfIndividual
      - ▽ as hasRelationship in (CardinalityEnd2MinMax instance) #example:id10175
      - ▽ as hasPair in (ClassificationOfRelationship instance) #example:id10176
    - ◇ hasRelation = Mandatory
    - ▽ is ClassificationOfRelationship
  - ▽ as hasRelation in (ClassificationOfRelationship instance) #example:id10180
  - ▽ as hasRelation in (ClassificationOfRelationship instance) #example:id10182
    - ◇ hasPair = (Specialization instance) #example:id10181
      - ☐ hasSubclass = R 5
      - ☐ hasSuperclass = Tank with maximum allowable pressure 250 kPa
      - ◇ is Specialization
      - ▽ as hasPair in (ClassificationOfRelationship instance) #example:id10182
    - ◇ hasRelation = Mandatory
    - ▽ is ClassificationOfRelationship
  - ▽ as hasRelation in (ClassificationOfRelationship instance) #example:id10185
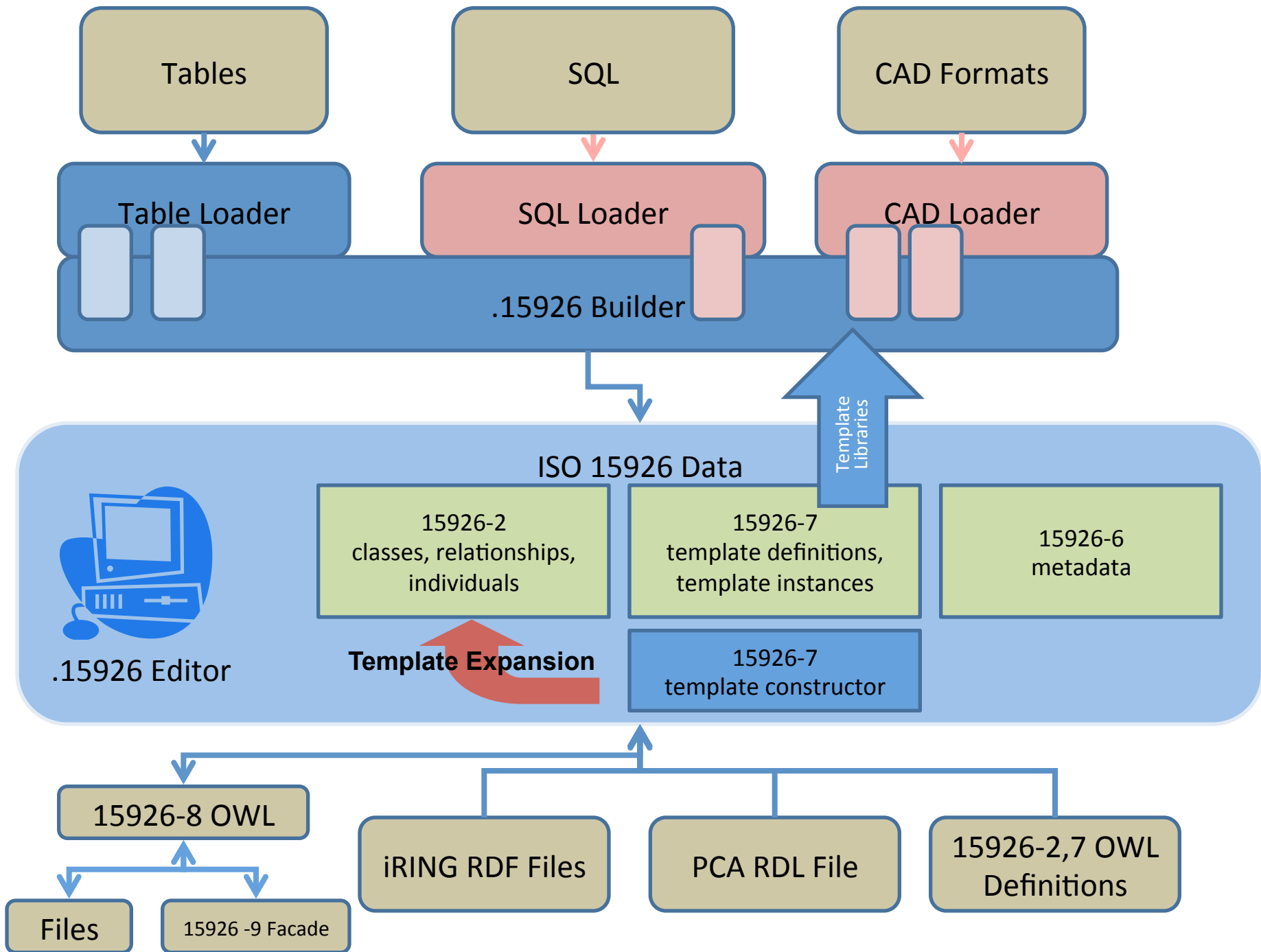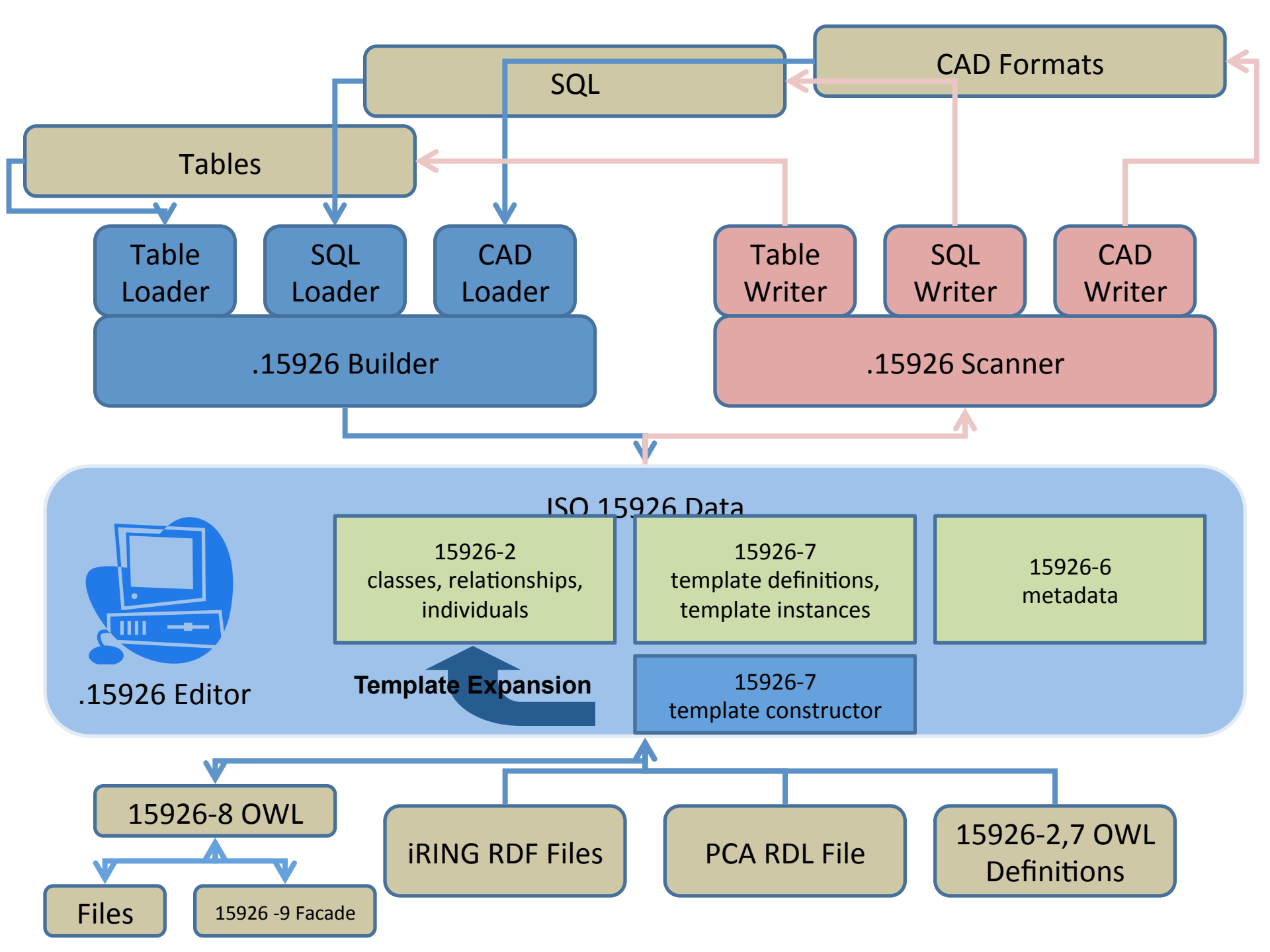
Roadmap

- Client-driven feature sets
- Open plug-in architecture
- Open source release – soon
- Python oriented – for foreseeable future
- Documentation – best efforts
- English language - mandatory

Tables

Table Loader

Reqs. Mapping

Mapping 2

.15926 Builder

ISO 15926 Data

.15926 Editor

15926-2
classes, relationships, individuals

15926-7
template definitions, template instances

15926-6
metadata

15926-7
template constructor

Template Libraries

15926-8 OWL

Files

15926 -9 Facade

iRING RDF Files

PCA RDL File

15926-2,7 OWL Definitions

Thank you!

Download .15926 Browser from http://techinvestlab.ru/dot15926v04alpha4 and watch for new releases.

Comments are welcome at:

dot15926@gmail.com

http://community.livejournal.com/dot15926/

Victor Agroskin

vic5784@gmail.com

Anatoly Levenchuk

ailev@asmp.msk.su

TechInvestLab.ru

+7 (495) 748-5388