CWL：A Common Web Language for Humans and Computers

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Problems to be Solved
- Language Barrier -

- Almost all web pages are written in English

- People can not get information in their mother tongue.

- Machine translation is not a solution
    - quality
    - coverage

Problems to be Solved
-Machine Understandablility -

- HTML tag information
  - Insufficient to intellectually utilize contents of web pages

- RDF and OWL
 - No standard vocabulary to describe web contents

Objectives of CWL

- For exchanging information through the web and also for enabling computers to process information semantically.

- To describe contents and meta-data of web pages written in natural languages.

- To realize a language barrier free world in the web and will also enable computers to extract semantic information and knowledge from web pages accurately.

Requirements for CWL

- To be independent from any natural languages and shall enables users to develop conversion systems between CWL and each natural language.

- Different from natural languages, to be a formal language playing the same role of natural languages for humans.

  - This allows easy bi-directional conversion between CWL and other formal languages used in the web.

  - Based on CWL, various kinds of controlled language can easily be developed because of unambiguous structure of CWL.

- To be able to be easily be implemented in RDF/OWL.

CWL representation

CWL Yerevan 25 Sep 2007
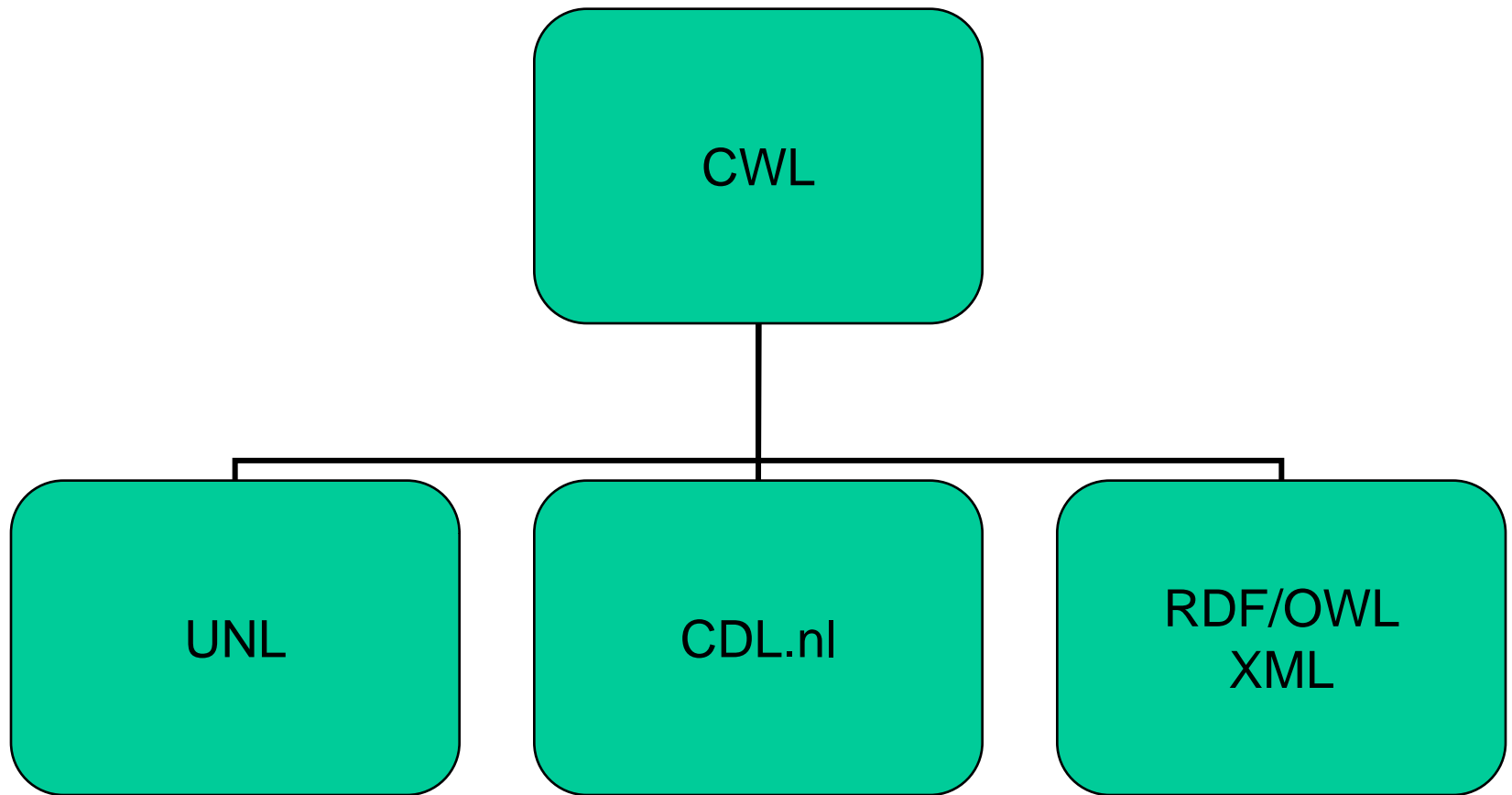
CDL

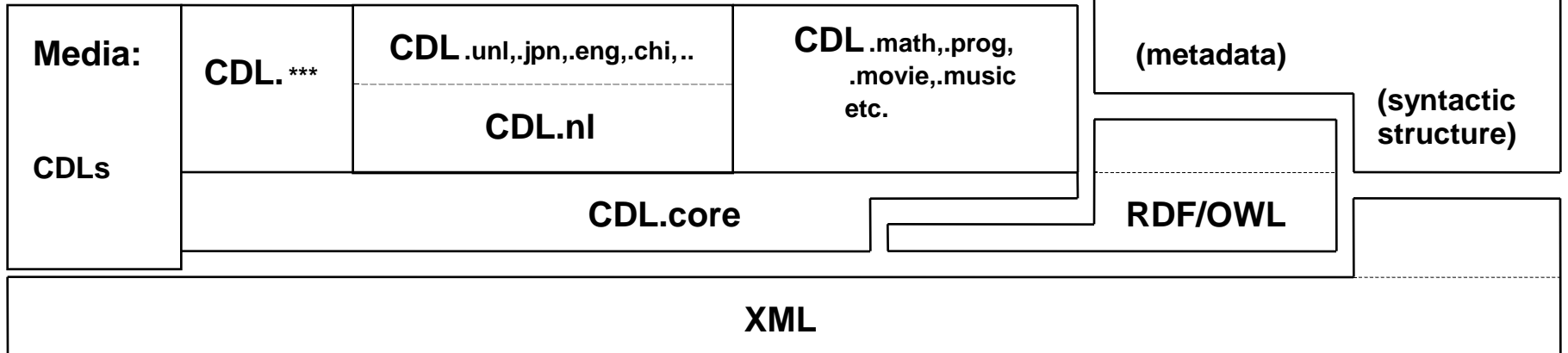- The CDL (Concept Description Language) is a language proposed by ISeC for Semantic Computing (SeC) R&D. CDL is fundamental language within SeC (Semantic Computing) framework.

- CDL describes semantic/conceptual structure of contents (resources).

CDLs

Applications: **Intelligent services provided by intelligent systems and intelligent environments**

Content: **Multimedia contents and multimodal interaction**

(semantic structure)

Media:

CDLs

CDL. *******

CDL **.unl,.jpn,.eng,.chi,..**

CDL.nl

CDL **.math,.prog, .movie,.music etc.**

(metadata)

(syntactic structure)

CDL.core

RDF/OWL

XML

CDL.nl

- The CDL.nl (CDL for Natural Language) consists of grammar, ontology and lexicons.

- Top ontology of CDL.nl is mainly based on the UNLKB. It is developed under funds from SCOPE of Japanese Ministry of Internal Affairs and Communications.

- Ontology and lexicons are based on Universal Words (UWs) of UNL developed under the United Nations (United Nations University).

Natural Language Representation in CDL.nl

Ex.1 "I received a report that a computer was purchased yesterday."

```
{#A event:
        {#B event:
                <#11:yesterday>
                <#12:computer>
                <#13:purchased>
                [#13 tim #11]  [#13 obj #12]
        }
        <#2:report>
        <#3:received>
        <#4:I>
        [#2  cnt  #B]  [#3  obj  #2]  [#3  rec  #4]
}
```

Top Ontology of CDL.nl

CDD.nl
   concept
      nominal concept
         thing
            abstract thing
               attribute
                  quality
                  feature
              event
                  action
                      mental action
                      physical action
                      process
                  phenomenon
                      mental phenomenon
                      physical phenomenon
                      process

Top Ontology of CDL.nl

```
CDD.nl
   concept
        nominal concept
                thing
                        state
                                mental state
                                physical state
                        group
                                group(icl>volitional thing)
                                set
                        information
                        quantity
                        rule
                        way
                                behavior
                                manner
                                method
```

Top Ontology of CDL.nl

CDD.nl
  concept
      nominal concept
          thing
                      attributive thing
                      concrete thing
                              living thing
                                          human
                                          animal
                                          plant
                              natural world
                              substance
                      functional thing
                              facilities
                              tool
                      volitional thing
                              human
                              animal

Top Ontology of CDL.nl

CDD.nl
   concept
      nominal concept
         thing
             place
                area
                relative place
             time
                period
      predicative concept
         do
             act
             express
             make
             take
             change
             move
             put

Top Ontology of CDL.nl

CDD.nl
   concept
      predicative concept
         do
               mentally do
               physically do
               do(agt>thing)
                    do(agt>thing,obj>thing)
         occur
               become
               happen
                    change
                    move
               mentally happen
               physically happen
               occur(obj>thing)
                    occur(gol>thing,obj>thing)

Top Ontology of CDL.nl

CDD.nl

  concept

      predicative concept

         be

            be(aoj>thing)

               be(aoj>thing,obj>thing)

      attributive concept

         (qua<thing)

         (mod<thing)

      adverbial concept

         (qua<predicative concept)

         (mod<predicative concept)

            how

Relations of CDL.nl

CDD.nl
   relation
        predicative relation
                agt (agent)
                aoj (thing with attribute)
                cag (co-agent)
                cao (co-thing with attribute)
                ptn (partner)

                ben (beneficiary)
                cob (affected co-thing)
                obj (affected thing)
                opl (affected place)

                ins (instrument)
                met (method)
                man (manner)

Relations of CDL.nl

CDD.nl
   relation
        predicative relation
               plc (place)
               plf (initial place)
               plt (final place)
               scn (scene)

               gol (goal, final state)
               src (source, initial state)
               via (intermediate place or state)

               dur (duration)
               tim (time)
               tmf (initial time)
               tmt (final time)

Relations of CDL.nl

CDD.nl
   relation

       inter concept relation
             and (conjunction)
             or (disjunction, alternative)
             fmt (range)
             frm (origin)
             to (destination)

             equ (equivalent)
             icl (included, a kind of)
             iof (an instance of)

       inter event relation
             con (condition)
             coo (co-occurrence)
             pur (purpose)
             rsn (reason)

Relations of CDL.nl

CDD.nl

   relation

      inter event relation

         seq (sequence)

      qualification relation

         bas (basis)

         cnt (content)

         mod (restriction)

         nam (name)

         per (proportion, rate, distribution)

         pof (part of)

         pos (possessor)

         qua (quantity)

Attributes of CDL.nl

CDD.nl
   attribute
        attribute of nominal concept
              logicality
              view of reference
        attribute of predicative concept
              aspect
                    @begin
                    @complete
                    @contine
              time
              view of emphasis, focus and topic
              attitude(modality)
              feeling and judgement
        attribute for attribute
              modifying attribute on aspect

UNL

a language for computers

- Artificial language (Semantic Network with Hyper Node)

    A node represents a concept

    An arc represents a relation

    A node can be annotated by attributes

- Consists of;

    Universal Words: vocabulary

    Relations, Attributes: syntax

    Knowledge Base: semantics

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Long ago, in the city of Babylon, the people begun to build a huge tower, which seemed about to reach the heavens.
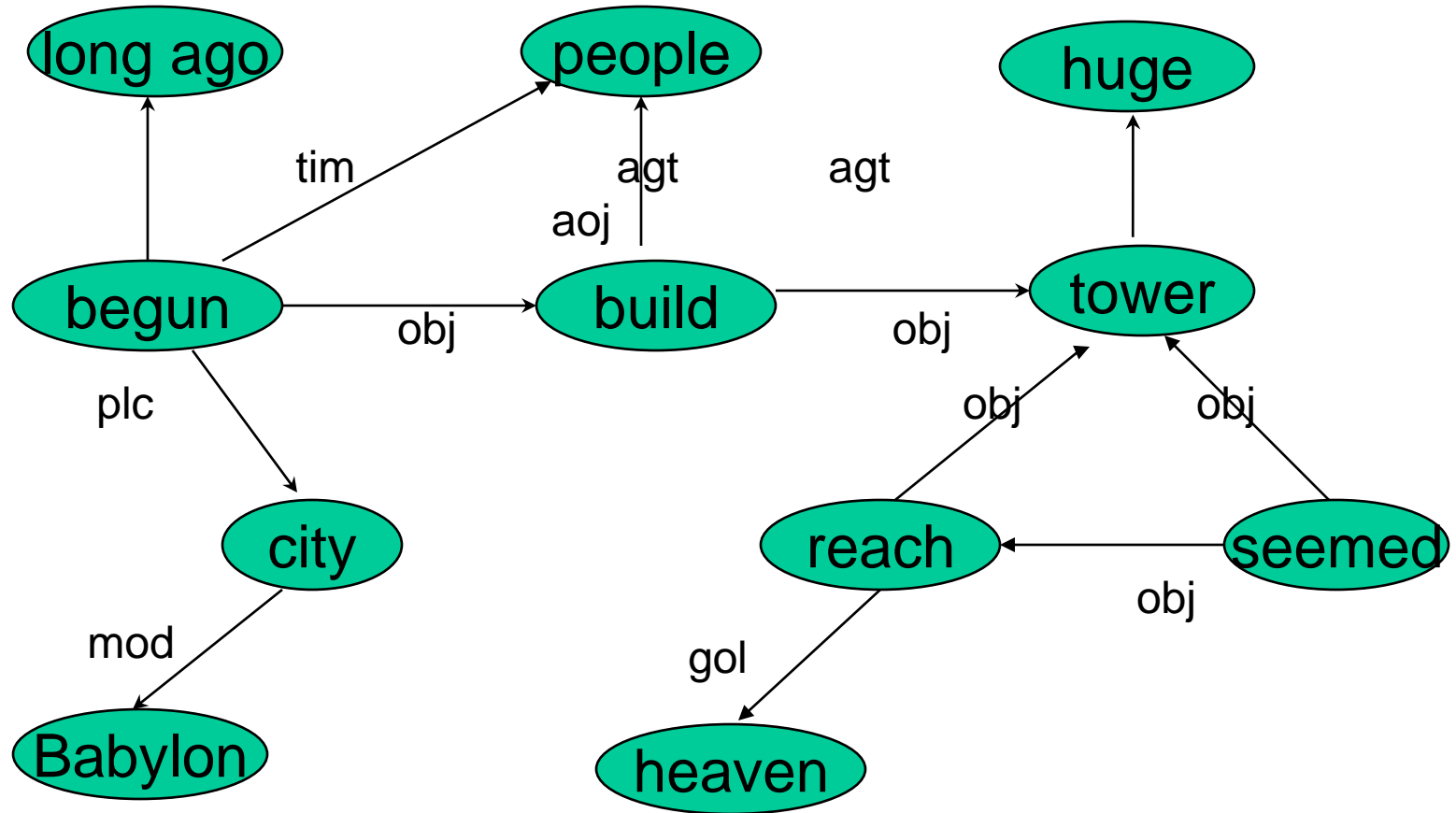
{unl}

tim(begin(agt>thing,obj>thing).@entry.@past,long ago(icl>ago))

mod(city(icl>region).@def,Babylon(icl>city))

plc(begin(agt>thing,obj>thing).@entry.@past,city(icl>region).@def)

agt(begin(agt>thing,obj>thing).@entry.@past,people(icl>person).@def)

obj(begin(agt>thing,obj>thing).@entry.@past,build(agt>thing,obj>thing)
@past)

agt(build(agt>thing,obj>thing),people(icl>person).@def)

obj(build(agt>thing,obj>thing)),tower(icl>building))

aoj(huge(icl>big),tower(icl>building))

aoj(seem(aoj>thing).@past,tower(icl>building))

obj(seem(aoj>thing).@past,reach(icl>come).@begin.@soon)

obj(reach(icl>come).@begin.@soon,tower(icl>building))

gol(reach(icl>come).@begin.@soon,heaven(icl>region).@def.@pl)

{/unl}

Relation

- Constitutes syntax of the UNL

- Expresses objectivity together with UWs

- Expresses how concepts(UW) constitutes a sentence related each other

- 46 relations

  agt, and, aoj, bas, ben, cag, cao, cnt, cob, con, coo, dur, equ, fmt, frm, gol, icl, ins, iof, man, met, mod, nam, obj, opl, or, per, plc, plf, plt, pof, pos, ptn, pur, qua, rsn, scn, seq, src, tim, tmf, tmt, to, via

Attributes

- Mainly describe subjectivity
- Attributes group:

  - Describing logical characters and properties of concepts

  - Times with respect to the writer
- Writer's view on aspects of event
- Writer's view of reference to concepts
- Writer's view of emphasis, focus and topic
- Writer's attitudes
- Writer's feelings and judgments

Attribute for Describing Logicality

@transitive   has transitivity

@symmetric   has symmetricity

@identifiable   can identify the subject

@disjointed   all element concept do not hold common
instance.

      all connected concept do not share
instances.

Attribute for Times Respect to Writer

@past   happened in the past

@present   happening at present

@future   will happen in future

Attribute for Writer's View on Aspect of Event

@begin   beginning of an event or a state

@complete   finishing/completion of a (whole) event

@continue   continuation of an event

@custom   customary or repetitious action

@end   end/termination of an event or a state

@experience   experience

@progress   an event is in progress

@repeat   repetition of an event

@state   final state or the existence of the object on which an action has been taken

Attribute for Writer's View of Reference on Concept

@generic   generic concept

@def   already referred

@indef   non-specific class

@not   complement set

@ordinal   ordinal number

Attribute for View of Emphasis, Focus, and Topic

@contrast   contrasted UW

@emphasis   emphasized UW

@entry   entry or main UW of a sentence or a scope

@qfocus   focused UW of a question

@theme   instantiates an object from a different class

@title   title

@topic   topic

Attribute for Writer's Attitude

@affirmative	affirmation
@confirmation	confirmation
@exclamation	exclamation
@humility	in a humility manner
@imperative	imperative
@interrogative	interrogation
@invitation	inducement
@polite	polite way
@request	request
@respect	respectful way
@vocative	vocative

Attribute for Writer's Felling and Judgment

@ability   ability, capability of doing something

@get-benefit   speaker's feeling of receiving benefits
                          through the fact or result of something (to
                          be) done by somebody else

@give-benefit   speaker's feeling of giving benefits by
                          doing something for somebody else

@conclusion   logical conclusion due to a certain condition

@consequence   logical consequence

@sufficient   sufficient condition

@consent   consent feeling of the speaker about   something

@dissent   dissent feeling of the speaker about something

@grant   to give/get consent/permission to do something

@grant-not   not to give consent to do something

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Attribute for Writer's Felling and Judgment

@although	something follows against [contrary to] or beyond expectation
@discontented	discontented feeling of the speaker about something
@expectation	expectation of something
@wish	wishful feeling, to wish something is true or has happened
@insistence	strong determination to do something
@intention	intention about something or to do something
@want	desire to do something
@will	determination to do something
@need	necessity to do something
@obligation	obligation to do something according to (quasi-) law, contract, or …
@obligation-not	obligation not to do something, forbid to do something according to (quasi-) law, contract or …

Attribute for Writer's Felling and Judgment

@should   to do something as a matter of course

@unavoidable   unavoidable feeling of the speaker about doing something

@certain   certainty that something is true or happens

@inevitable   logical inevitability that something is true or happens

@may   practical possibility that something is true or happens

@possible   logical possibility that something is true or happens

@probable   (practical) probability that something is true or happens

@rare   rare logical possibility that something is true or happens

@unreal   unreality that something is true or happens

Attribute for modifying Attribute on Aspect

@just   expresses an event or a state that has just begun or ended/completed

@soon   expresses an event or a state that is about to begin or end/completed

@yet   expresses an event or a state that has not yet started or ended/completed, together with

@not

Attribute for Writer's Felling and Judgment

@admire	admiring feeling of the speaker about something
@blame	blameful feeling of the speaker about something
@contempt	contemptuous feeling of the speaker about something
@regret	Regretful feeling of the speaker about something
@surprised	surprised feeling of the speaker about something
@troublesome	troublesome feeling of the speaker about the occurrence of something

Attribute for Convention

@passive   passive form

@pl   more than one

@angle_bracket   < > are used

@brace   { } are used

@double_parenthesis   (( )) are used

@double_quote   " " are used

@parenthesis   ( ) are used

@single_quote   ' ' are used

@square_bracket   [ ] are used

Types of UW

- Basic UW
- Restricted UW
- Extra UW (Imported UW)
- Temporary UW

Universal Word

- <UW>::= <headword> [<constraint list>]

- <headword>::= <character>…

- <constraint list>::= "(" <constraint> ["," <constraint>]… ")"

- <constraint>::= <relation label> { ">" | "<" } <UW> [<constraint list>] |<relation label> { ">" | "<" } <UW> [<constraint list>] [{ ">" | "<" } <UW> [<constraint list>]] …

- <relation label>::= "agt" | and" | "aoj" | "obj" | "icl" | ...

A kind of UW

- Basic UW

  Express set of every concept an English word(/phase/clause) can express

  ex)   spring

- Restricted UW

  Restrict a concept by constraint

  ex)   spring(icl>tool)

          spring(icl>season)

          spring(agt>person,obj>person)

Basic Category of UW

- UWs should belong to the following categories

    - Nominal Concept
    - Verbal Concept
    - Adjective Concept
    - Adverbial Concept

UW

- Nominal Concept
  - swallow(icl>thing)
- Verbal Concept

change(agt>thing)	I changed my mind.
change(obj>thing)	The weather will change.
remember(agt>thing)	I cannot remember his name.
remember(aoj>thing)	Do you remember me?

UW

- Adjective Concept

  positive(aoj>thing)   Are you positive about that?

  a positive fact

  only(mod<thing)   the only person

- Adverbial Concept

  weekly(icl>how)   This class is held weekly.

  only(icl>how)   The child only cried.

UW

- If the ambiguity of an UW still remains, upper category labels of UW system(hierarchy) or case relations will be used.

- Restrict using upper category

swallow(icl>bird)   the bird

"One swallow does not make a summer"

swallow(icl>action)   the action of swallowing

"at one swallow"

swallow(icl>quantity)   the quantity

"take a swallow of water"

UW

- Restrict using case relations

spring(agt>thing,obj>wood)	bending something
spring(agt>thing,obj>mine))	blasting something
spring(agt>thing,obj>person, src>prison))	escaping (from) prison
spring(agt>thing,gol>place)	jumping up "to spring up"
spring(agt>thing,gol>thing)	jumping on "to spring on"
spring(obj>liquid)	gushing out "to spring out"

CWL representation

CWL Yerevan 25 Sep 2007
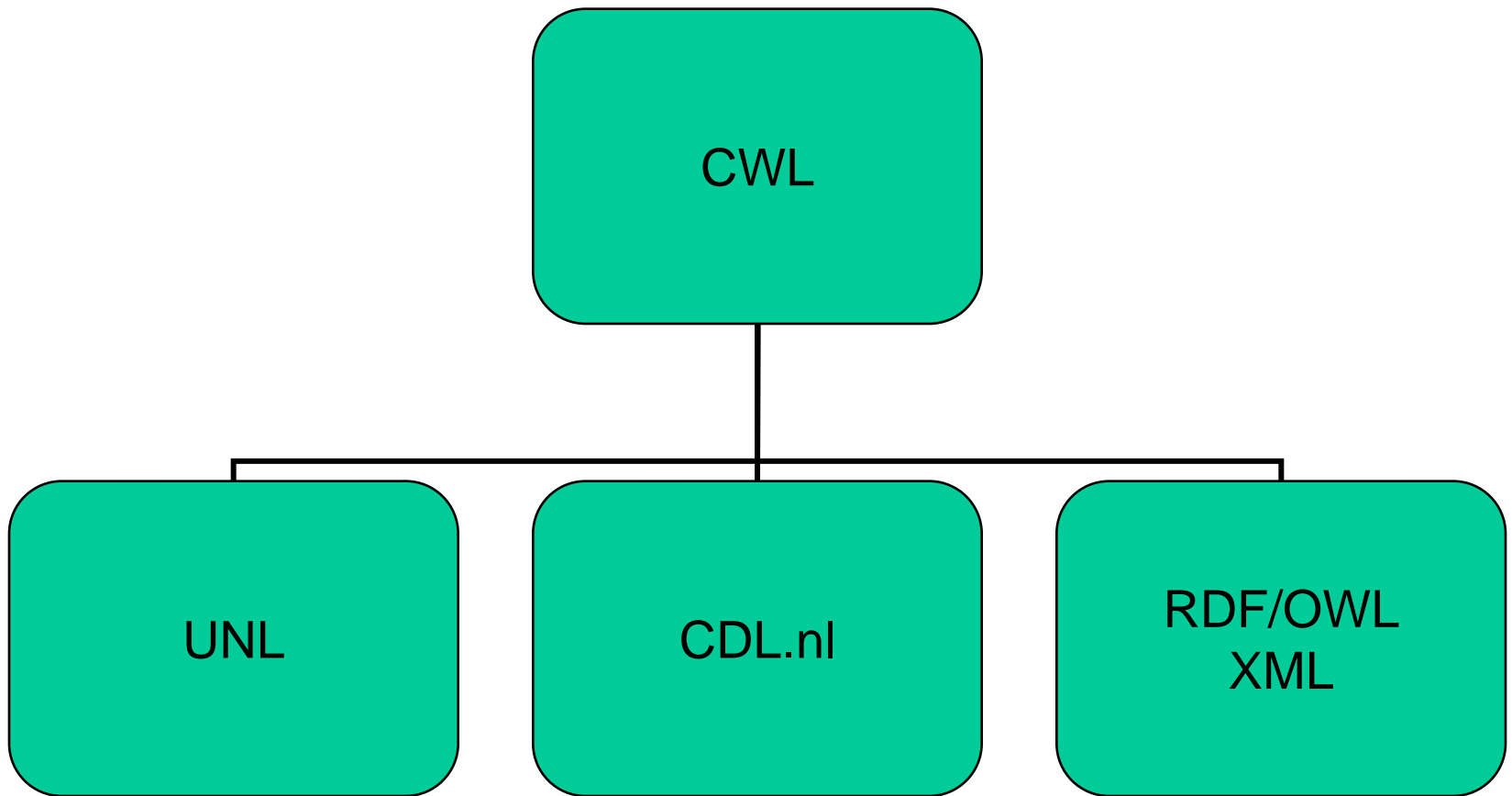
UNL expression
Table Form , List Form

• <sentence> I purchased a computer yesterday. </sentence>

{unl} //Table Form of UNL expression

agt(purchase(icl>buy(agt>person,obj>thing)).@entry.@past),   I)

obj(purchase(icl>buy(agt>person,obj>thing)).@entry.@past), computer (icl>machine))

tim(purchase(icl>buy(agt>person,obj>thing)).@entry.@pst), yesterday(icl>day))

{/unl}

{unl}   // List Form of UNL expression
[W]
I :01
purchase (icl>buy(agt>person,
    obj>thing)).@entry.@past:02
computer (icl>machine):03
yesterday (icl>day):04
[/W]
[R]
02**agt**01
02**obj**03
02**tim**04
[R]
{/unl}

CDL

• <sentence> I purchased a computer yesterday. </sentence>

CDL // Model&Syntax

{#S Situation;

  {#A Event tmp='past';

   {#A1 purchase

    (icl>buy(agt>person,obj>thing) ;}

   {#A2 I   ral='def';}

   {#A3 computer(icl>machine)

    ral='def';}

 {#A4 yesterday(icl>day) ral='def';}

  [#A1 cdd.nl#**agt** #A2]

  [#A1 cdd.nl#**obj** #A3]

  [#A1 cdd.nl#**tim** #A4]

}
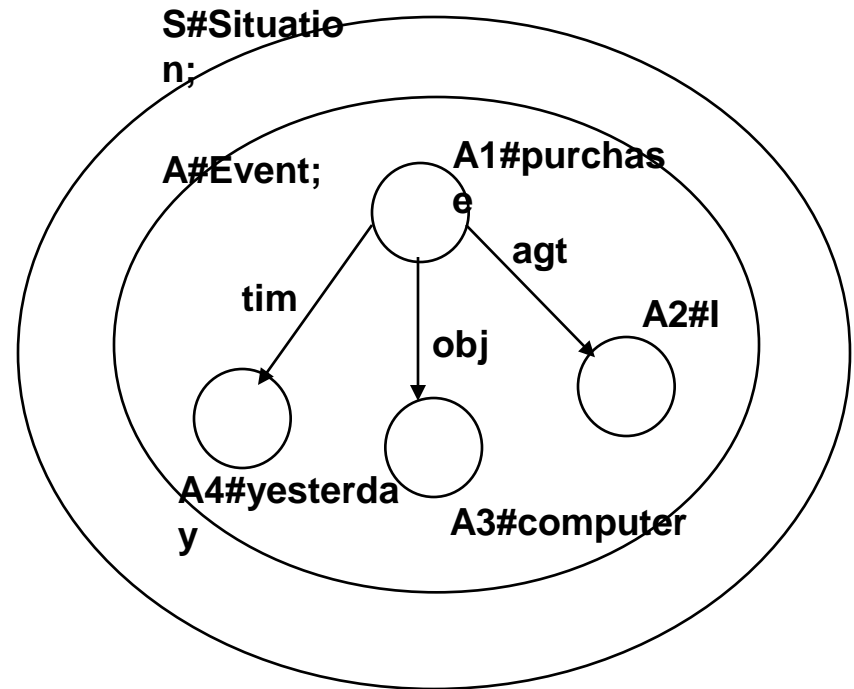
RDF

•<sentence> I   purchased   a   computer   yesterday. </sentence>

RDF // N-Triples representation: Subject Property Object".**"**
#S rdf:type Situation.
#A rdf:type Event.
#S hasComplexEntity #A.
#A hasElementalEntity #A1.
#A hasElementalEntity #A2.
#A hasElementalEntity #A3.
#A hasElementalEntity #A4.
#A1 rdf:type purchase(icl>buy(agt>person,obj>thing).
#A2 I rdf:type I.
#A2 I ral 'def'.
#A3 rdf:type computer(icl>machine).
#A3 ral 'def'.
#A4 rdf:type yesterday(icl>day).
#A4 ral 'def'.
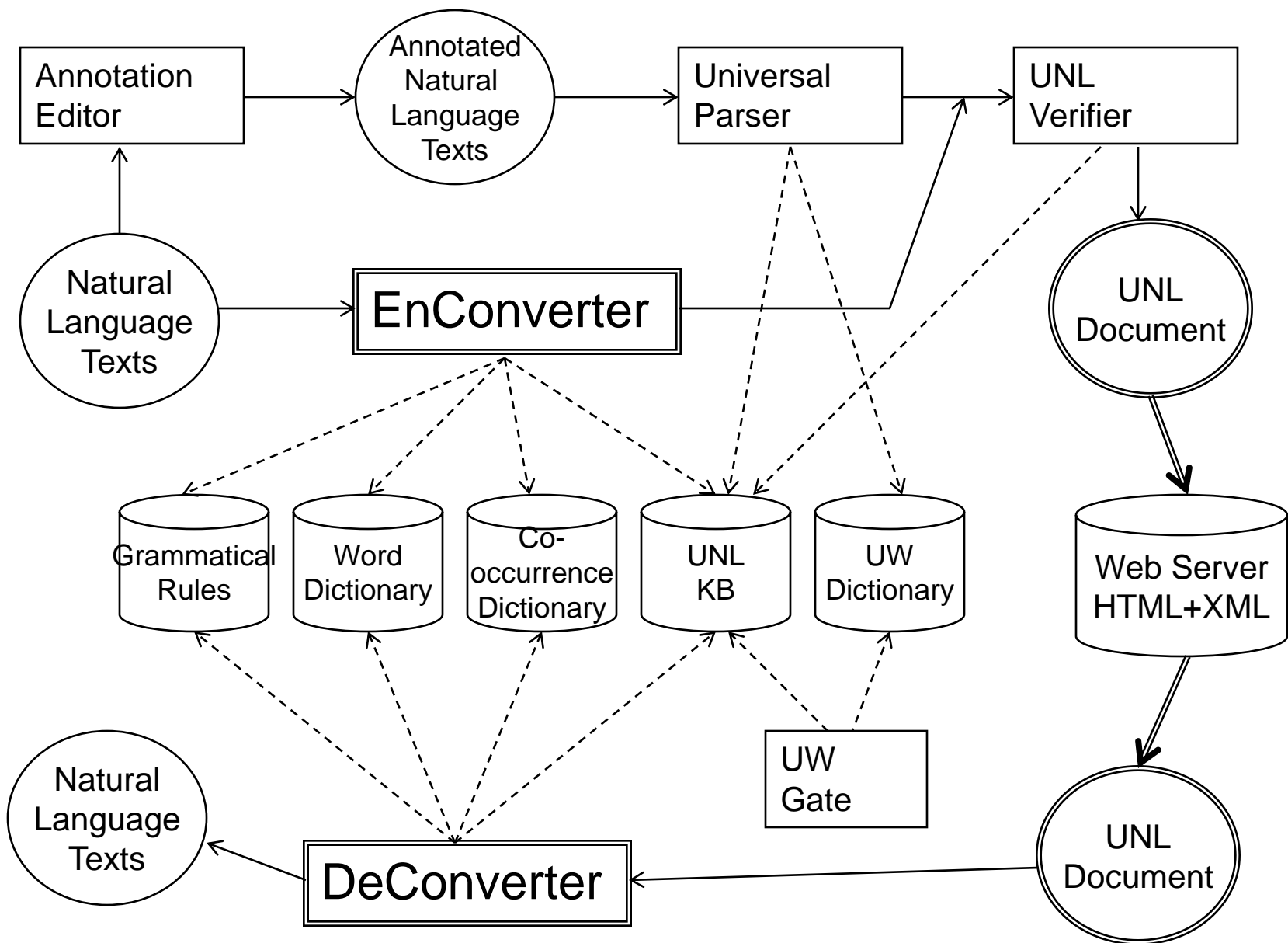#A1 agt #A2.
#A1 obj #A3.
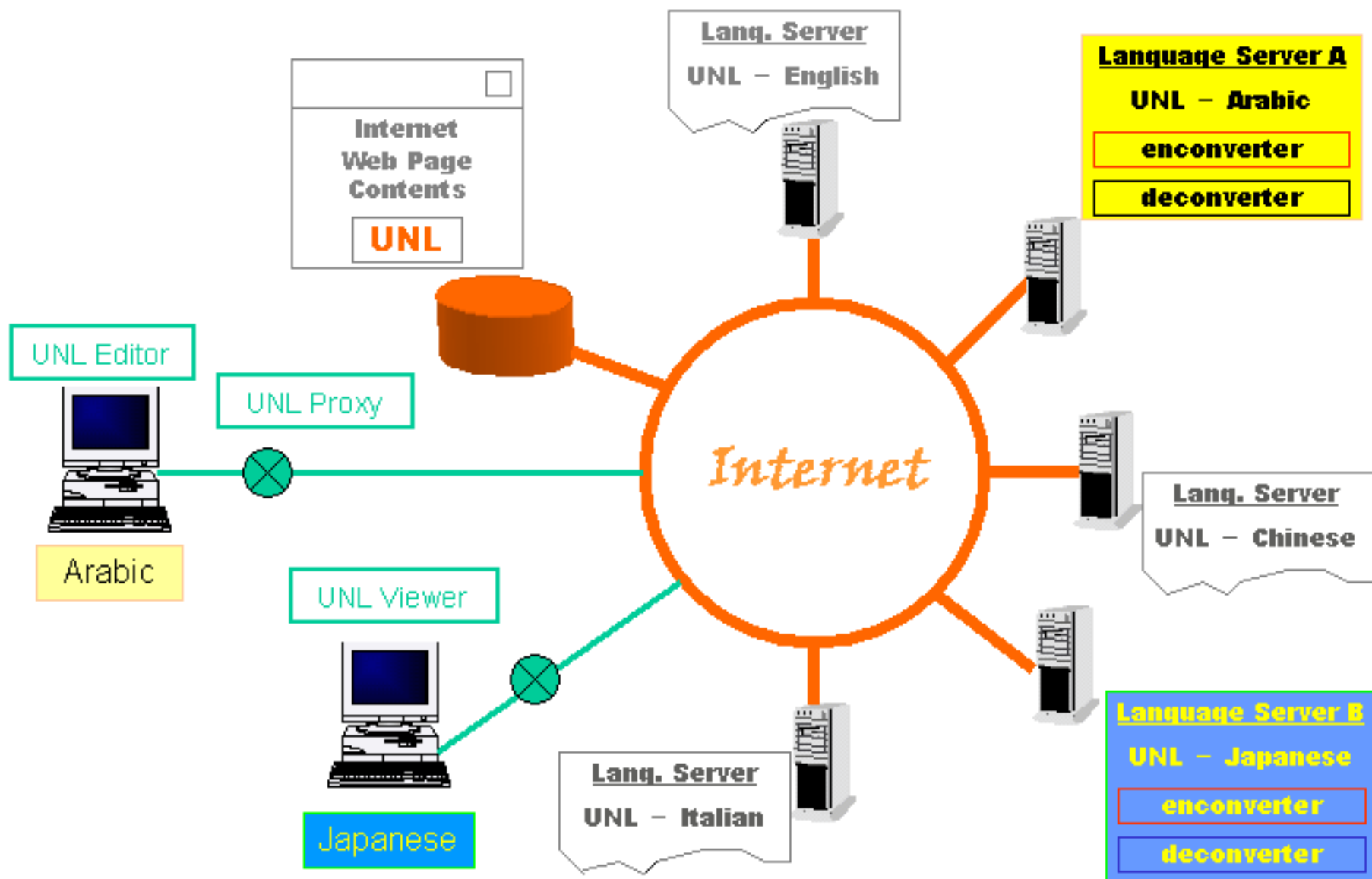#A1 tim #A4.
#A tmp 'past'.

Platform

- We use the UNL System as a platform of CWL.
- CWL Platform

  - UNL System

  - Conversion system between UNL and CDL.nl

  - Conversion system between CDL.nl and RDF

  - Ontology (UNLKB) in CDD.nl

  - Ontology in OWL

UNL System

CWL Yerevan 25 Sep 2007
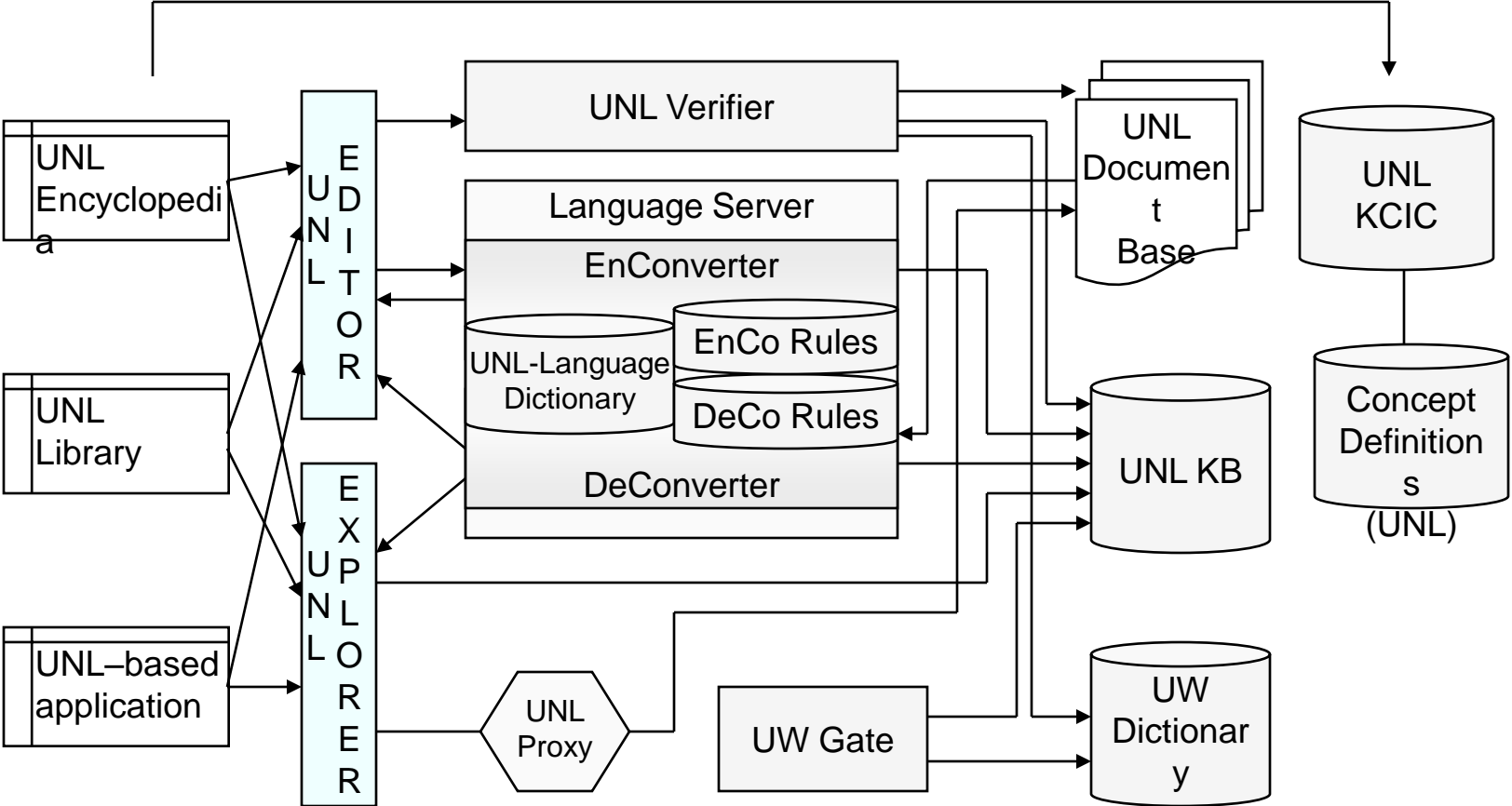
Common Web Language Incubator Group CWL XG

- Participants
  - W3C member can participate
  - Invited Experts
- Duration: Nov 2006 to Oct 2007
- Objectives
  - Specifications of CWL
  - Pilot model of CWL Platform