The **Distributed Ontology Language** (DOL):
Ontology Integration and Interoperability Applied to Mathematical Formalization

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`http://ontoiop.org`

Ontology Integration and Interoperability

(OntoIOp) Working Group of **ISO**/TC 37:

• 50 experts (≈ 15 active contributors)
• representing relevant communities:
  • ontology languages and logics
    e.g. Common Logic, OWL
  • conceptual and theoretical foundations
    e.g. model theory
  • technical foundations
    e.g. ontology engineering; linked open data
  • application areas
    e.g. manufacturing
• **ISO 17347 standard** (to be available freely)
  • committee draft in September 2012; final in 2015
• Standard specifies Distributed Ontology Language:
  • **Syntax:** text (for humans); XML and RDF (for tools and [web] services)
  • **Semantics:** direct set-theoretical (+ institutional, category-theoretical); translational; "collapsed"
  • **Conformance** of basic ontology languages, serializations, documents, applications

Logic Translation Graph for the DOL-conforming Ontology Languages

— subinstitution
⋯⋯ theoroidal subinstitution
– · – simultaneously exact and model-expansive comorphisms
– – model-expansive comorphisms

grey: no fixed expressivity
green: decidable ontology languages
yellow: semi-decidable
orange: some second-order constructs
red: full second-order logic
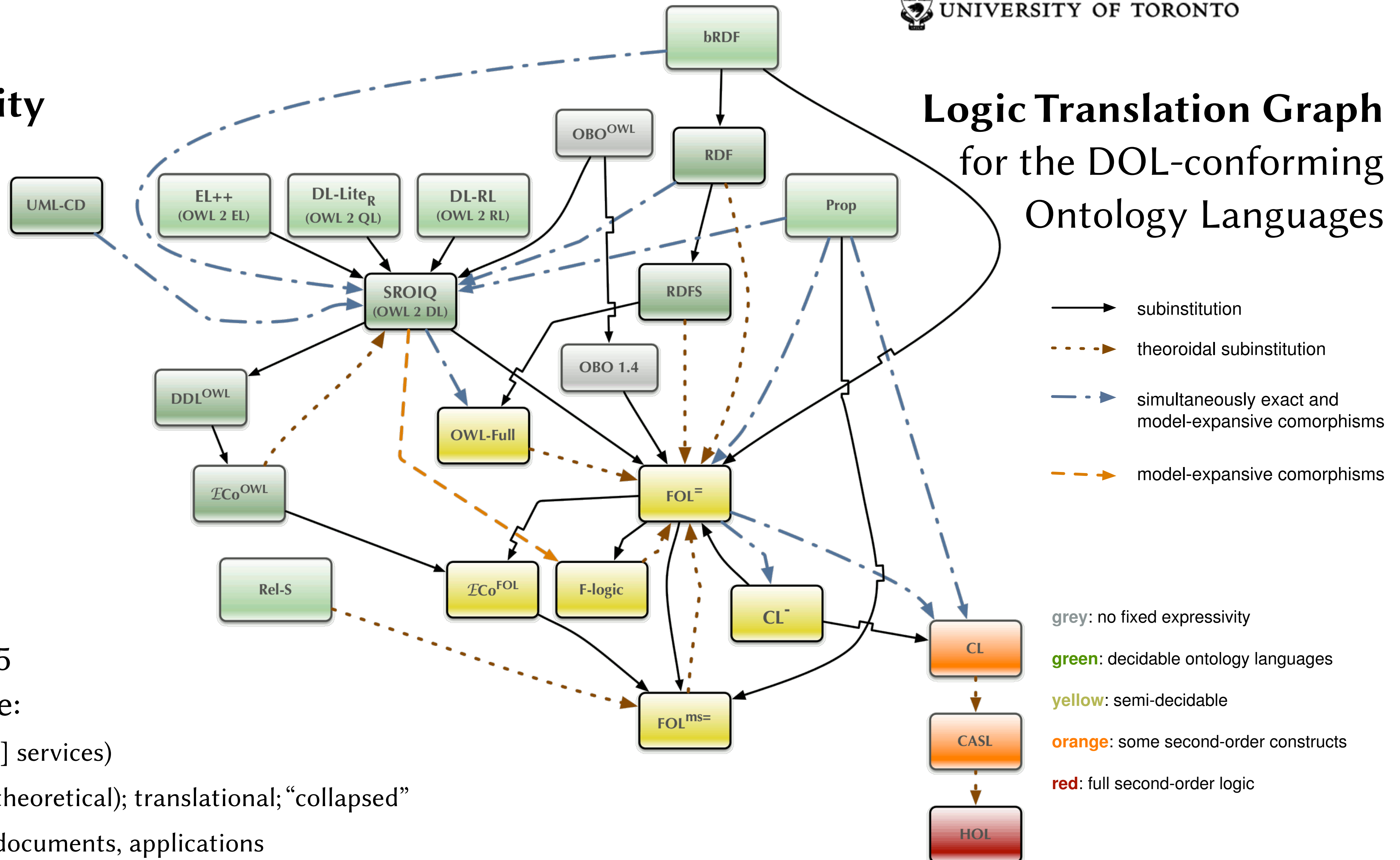
Use Case: **Verifying Meta-theoretical Relationships** in COLORE

```
%prefix(                      %% prefixes for abbreviating long IRIs: this distributed ontology
  :   <http://code.google.com/p/colore/.../owltime/owltime_interval/mappings/owltime_le.dol#>
  log: <http://purl.net/dol/logics/>                %% DOL-conforming logics (see graph)
  ser: <http://purl.net/dol/serializations/>        %% serializations, i.e. concrete syntaxes
  int: <http://code.google.com/p/colore/.../owltime/owltime_interval/>  %% namespaces of the ontologies
  ord: <http://code.google.com/p/colore/.../orderings/> )%          %% in this distributed ontology

%% The following ontologies are in the logic Common Logic, and written in the Lisp-style CLIF syntax
logic log:CommonLogic syntax ser:CommonLogic/CLIF

ontology ord:linear_ordering =           %% Here we use Common Logic's ontology import facility, but ...
  (cl-imports ord:partial_ordering) (forall (x y) (or (leq x y) (leq y x) (= x y)))

%% DOL also has a general import facility: We create the ontology of linearly ordered time intervals
ontology int:owltime_le = int:owltime_linear then int:owltime_e  %% that begin and end with an instant
  %% ... by extending linearly ordered time intervals with intervals that begin and end with an instant

ontology int:mappings/owltime2orderings = (forall (x y) (iff (leq x y) (or (before x y) (= x y))))
(forall (x y) (iff (lt x y) (before x y)))          %% map time intervals to general linear orderings

interpretation i %mcons :            %% interpreting linear orderings as time interval orders
  ord:linear_ordering to {int:owltime_le and %def int:mappings/owltime2orderings}
```

• **COLORE**: repository of 500+ **Common Logic ontologies** (`http://colore.googlecode.com`)
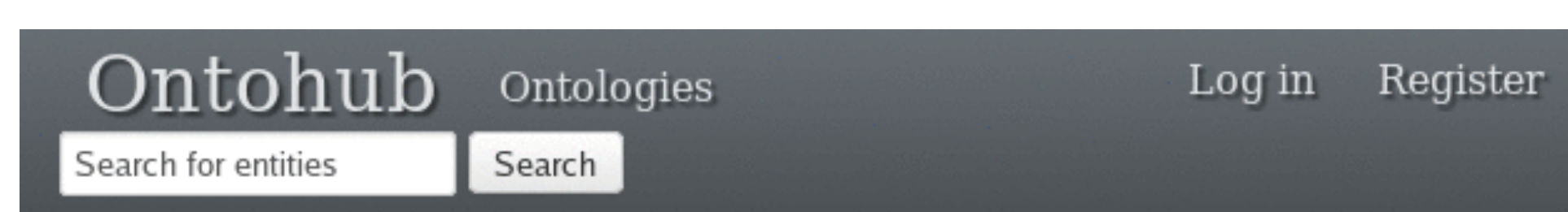• **commonsense domains**: time, space, shape, processes
• **mathematical domains**: algebraic structures, orderings, graphs, incidence structures
• **Meta-theoretical relationships** of interest: maps, definitional extension, conservative extension, inconsistency, imports, relative interpretation, faithful interpretation, definable equivalence

Tool Support for Verification and Management:
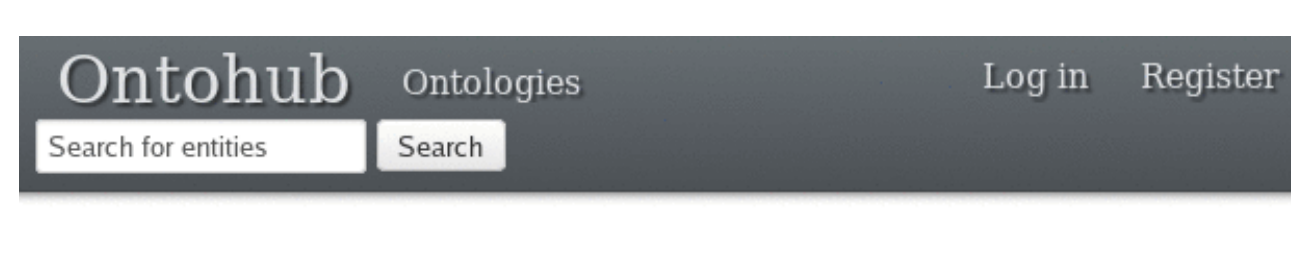## Hets (standalone), Ontohub (web; `http://ontohub.org`)

• Hets: multi-logic static ontology analysis and verification
• Ontohub: logic-independent ontology storage and browsing

DOL gives ontology interoperability a formal grounding and makes heterogeneous ontologies and services based on them amenable to automated verification.