Towards Ontology Matching Suitable for Information Integration in Time-Critical Situations
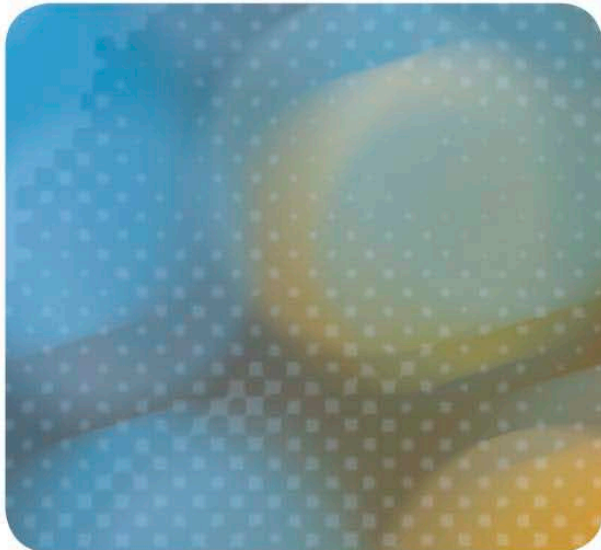
16th ICCRTS

June 21-23 2011

Québec City
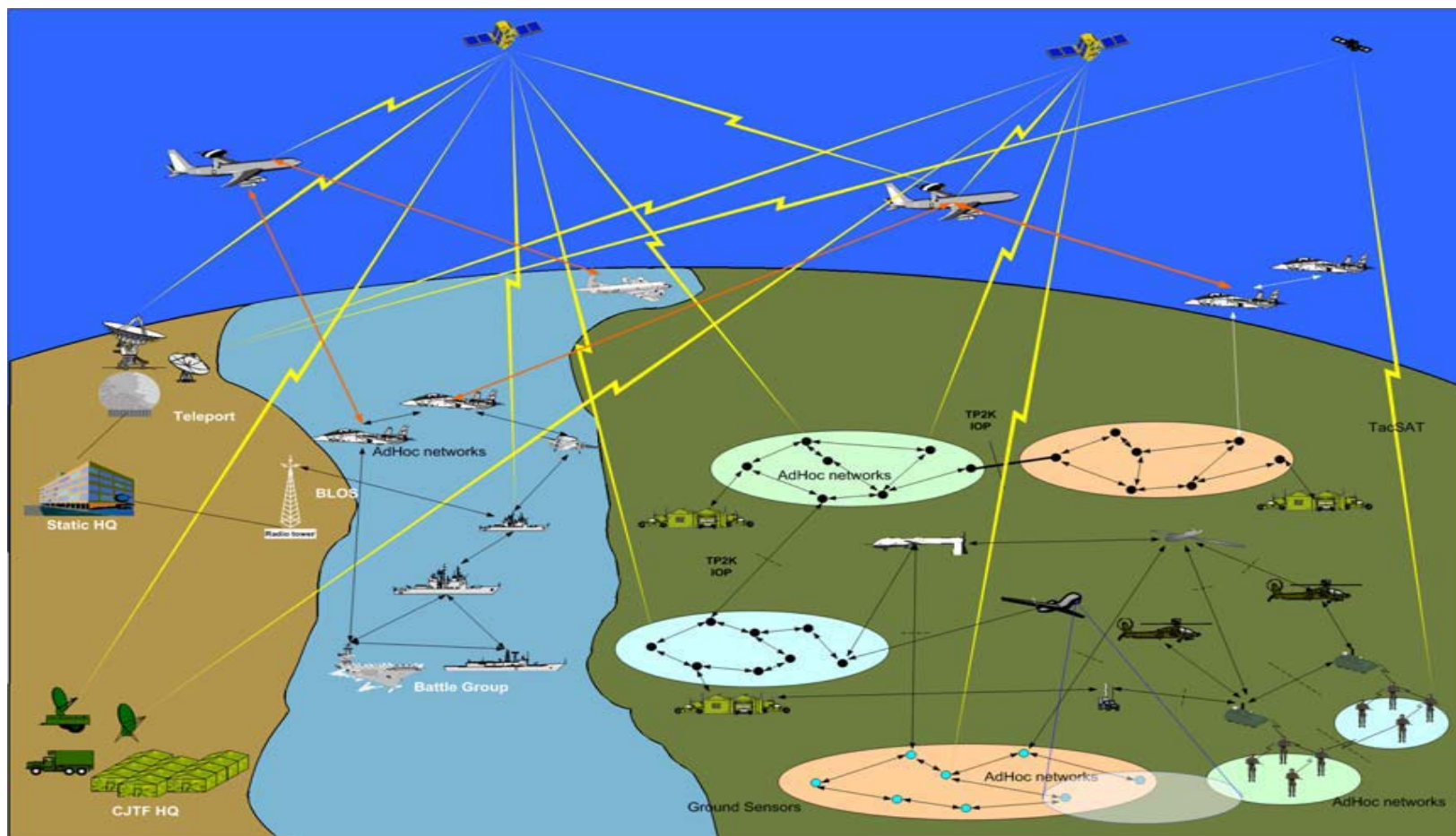
Bjørn Jervell Hansen

Senior Scientist

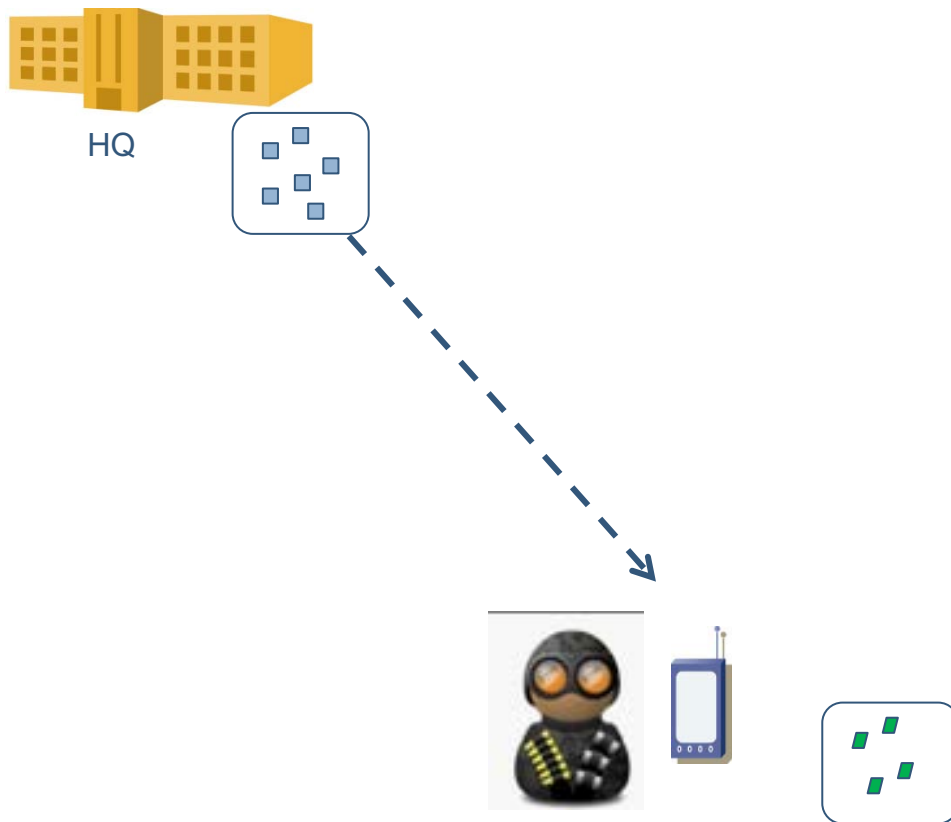Norwegian Defence Research Establishment (FFI)

Outline

- Need for Flexible Information Integration in NNEC

- Ontology-Based Information Integration

- Ontology Matching

- Deductive Ontology Matching

- Further work

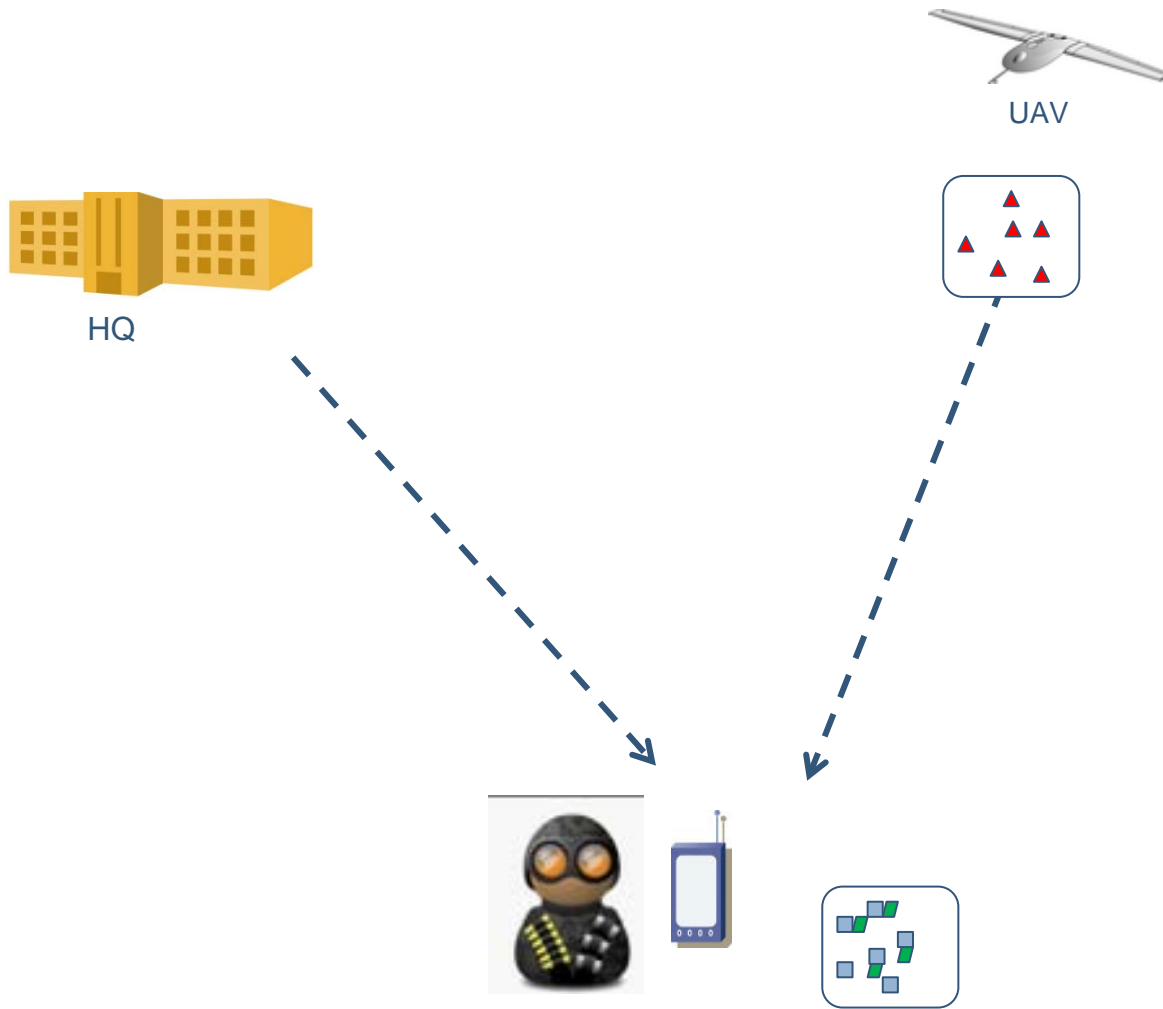# NNEC –
Need for Flexible Information Integration

Source: NATO NEC Feasibility Study
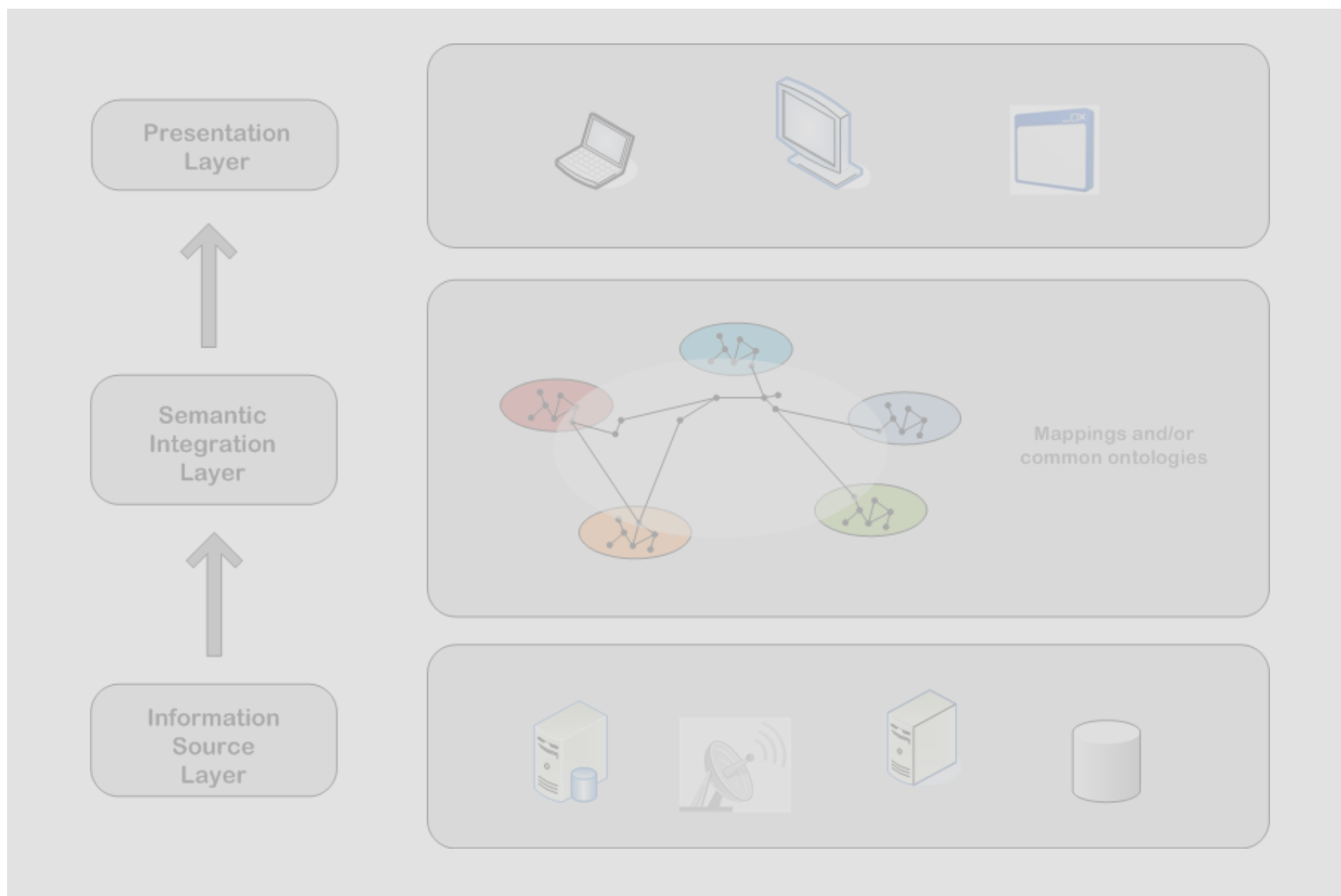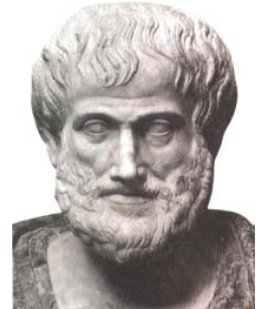
Example

Example

UAV

HQ

Time-Critical Situation

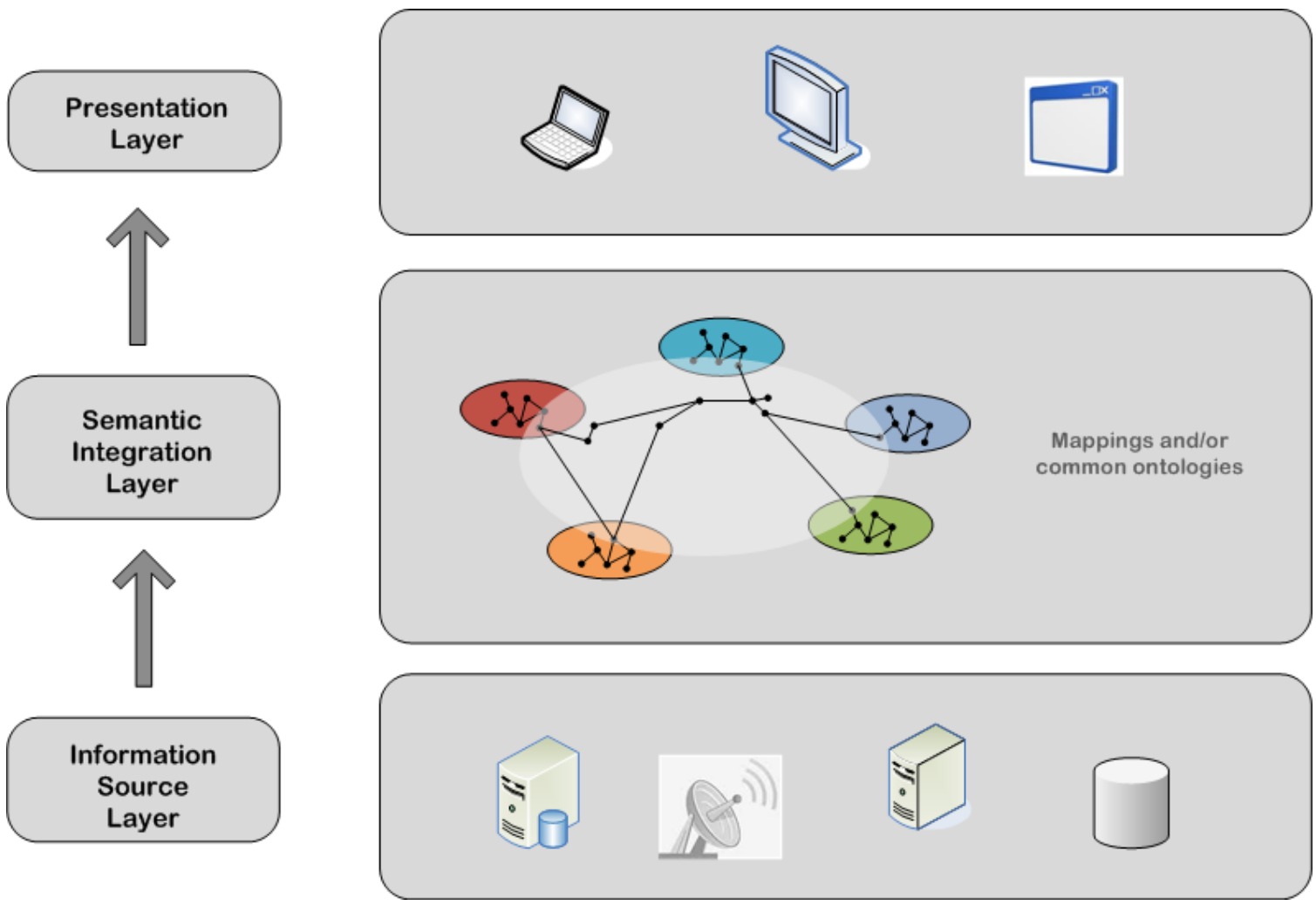# Ontology-Based Information Integration

Ontologies

- Philosophy:
  - "Ontology is the study or concern about what kinds of things exist - what entities or `things' there are in the universe."
    - *The Oxford Dictionary of Philosophy.* Oxford University Press, 1996

- Computer Science:
  - "An ontology is a formal representation of a set of concepts within a domain and the relationships between those concepts"
    - http://en.wikipedia.org/wiki/Ontology_(computer_science)
  - Computer processable

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Linking of Ontologies

Ontology-Based Information Integration

Presentation Layer

Semantic Integration Layer

Information Source Layer
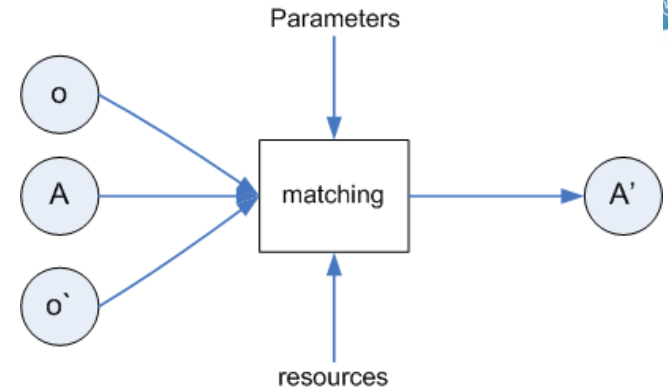
Mappings and/or common ontologies

Ontology Matching

- *The process of finding relationships or correspondences between entities of different ontologies*

Euzenat & Shvaiko (2007)

- Manual or semi-automatic process
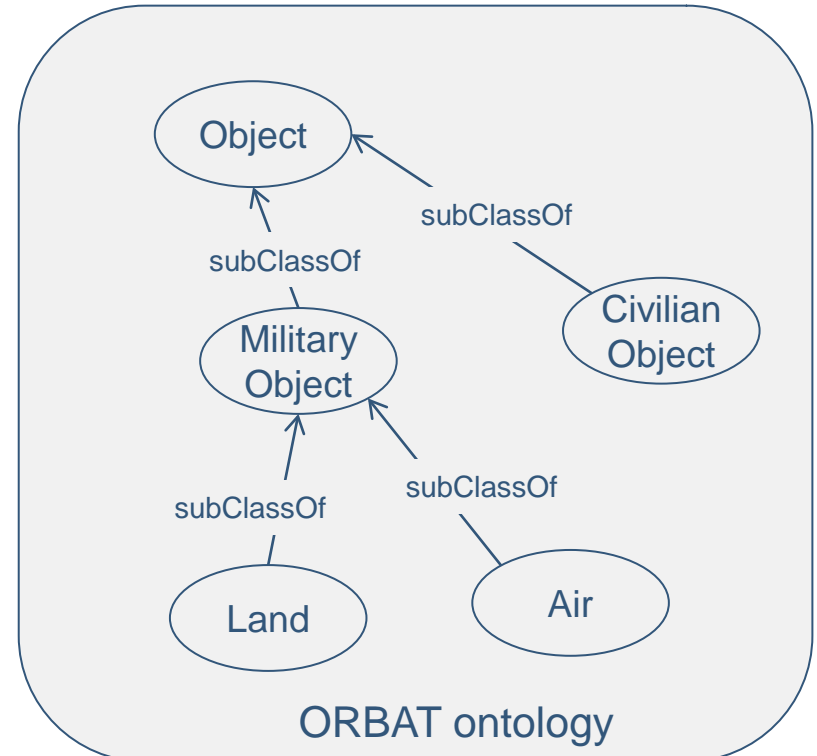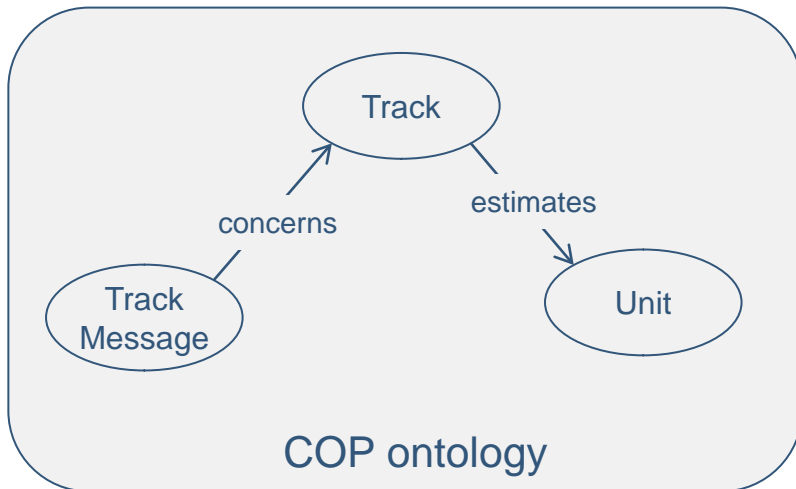
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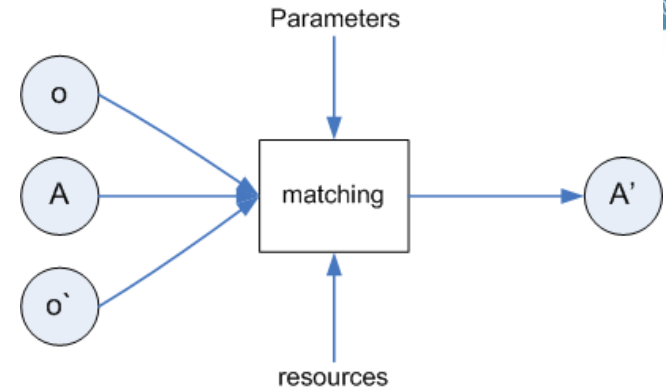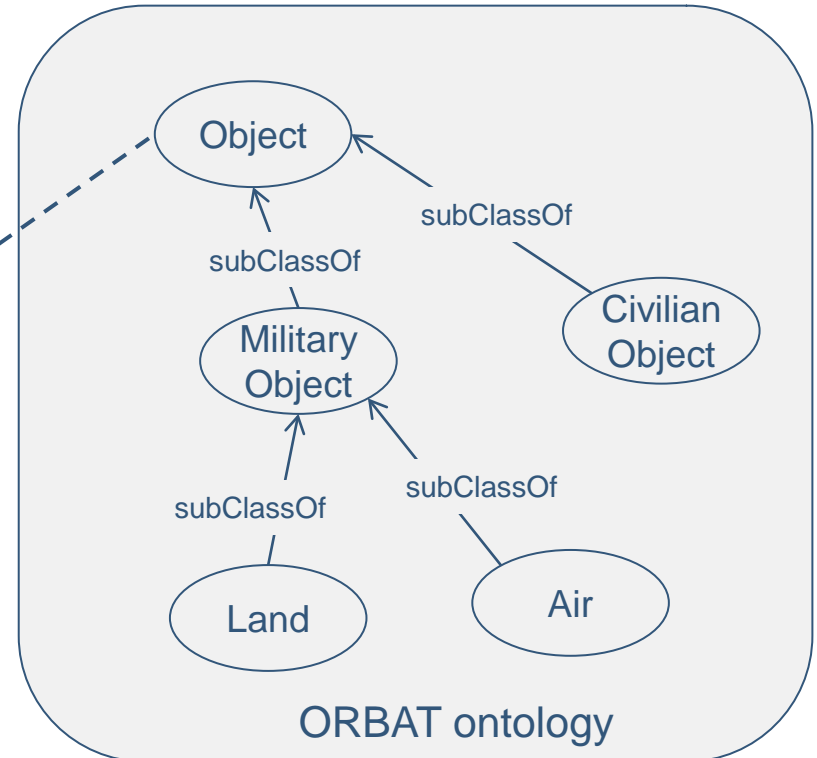
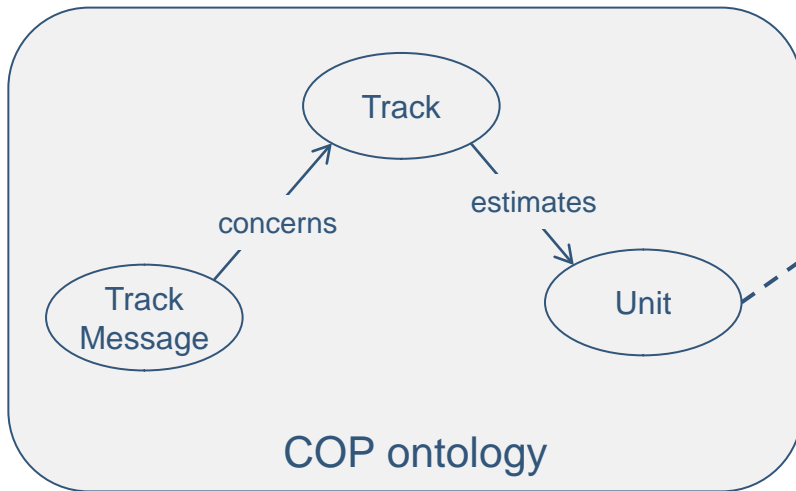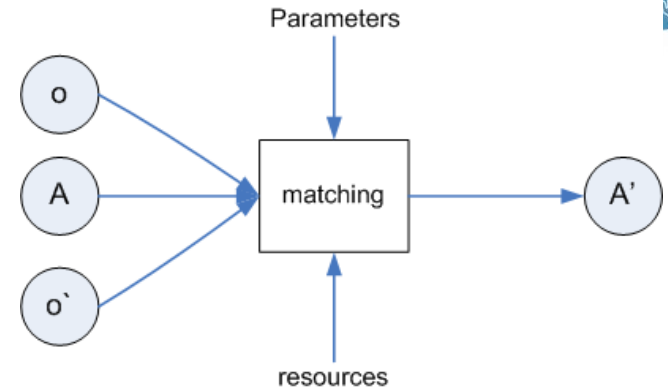# Ontology Matching

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Concept Ontology 1	Score	Relation	Concept Ontology 2
Unit	0.86	=	Object
Unit	0.71	=	Land
Track	0.34	=	Land
TrackMessage	0.23	=	MilitaryObject
Track	0.11	=	Air

COP ontology

ORBAT ontology

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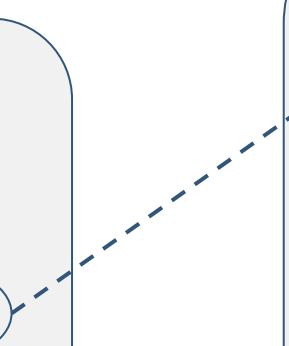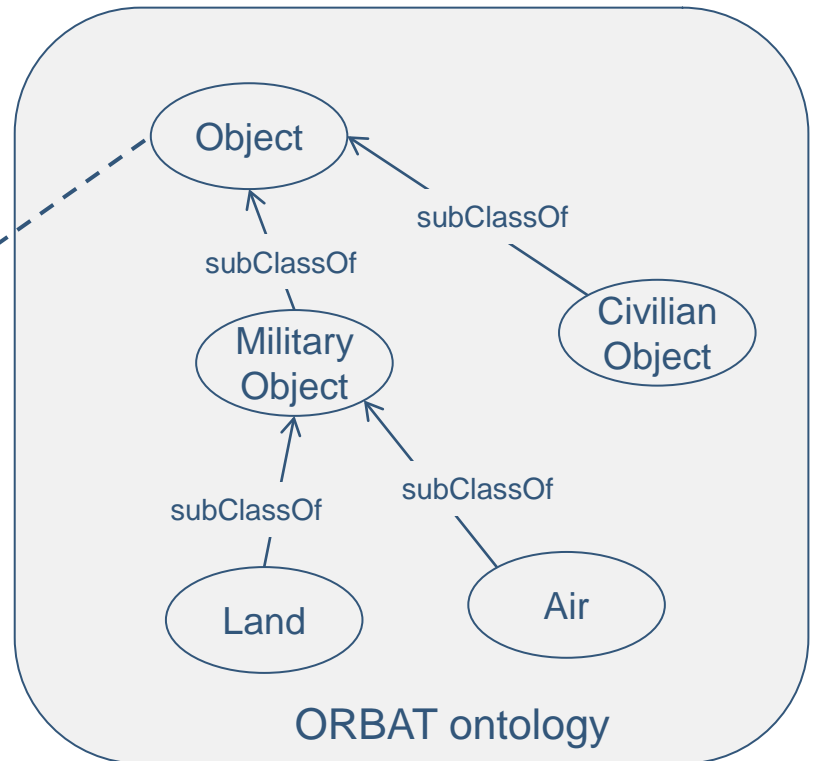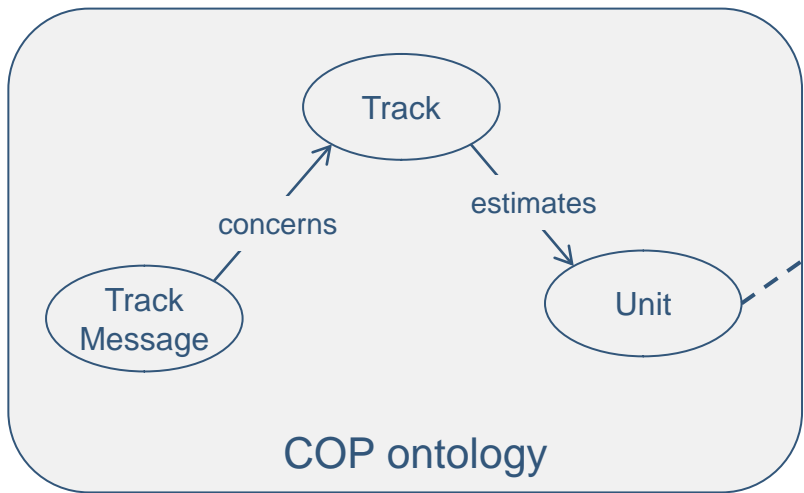
COP ontology

ORBAT ontology

Requirements for Ontology Matching in Time-Critical Situations

- **Speed**
    - The matching have to be performed in a matter of minutes
    - No user in the loop

- **Quality**
    - Errors in matching is not acceptable
    - Thresholds not sufficient
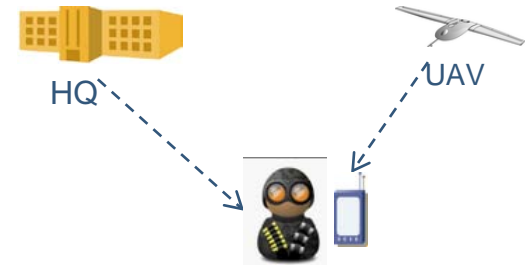
HQ

UAV

Deductive Ontology Matching

- Ontology matching techniques based on deductive reasoning
  - Guarantees the correctness of the conclusions provided that the input is correct
  - Demands a preprocessing phase generating the input

- Proposed preprocessing: Fetching of prior ontology matching results

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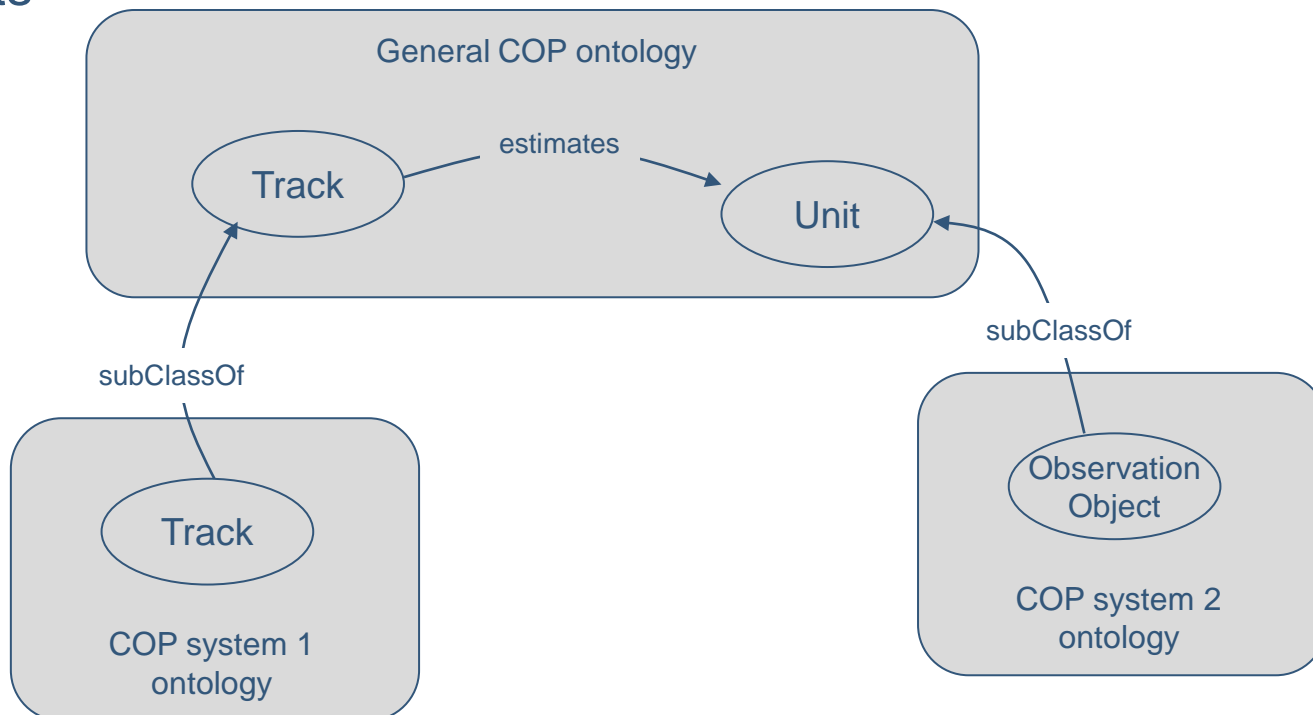
Deductive Ontology Matching

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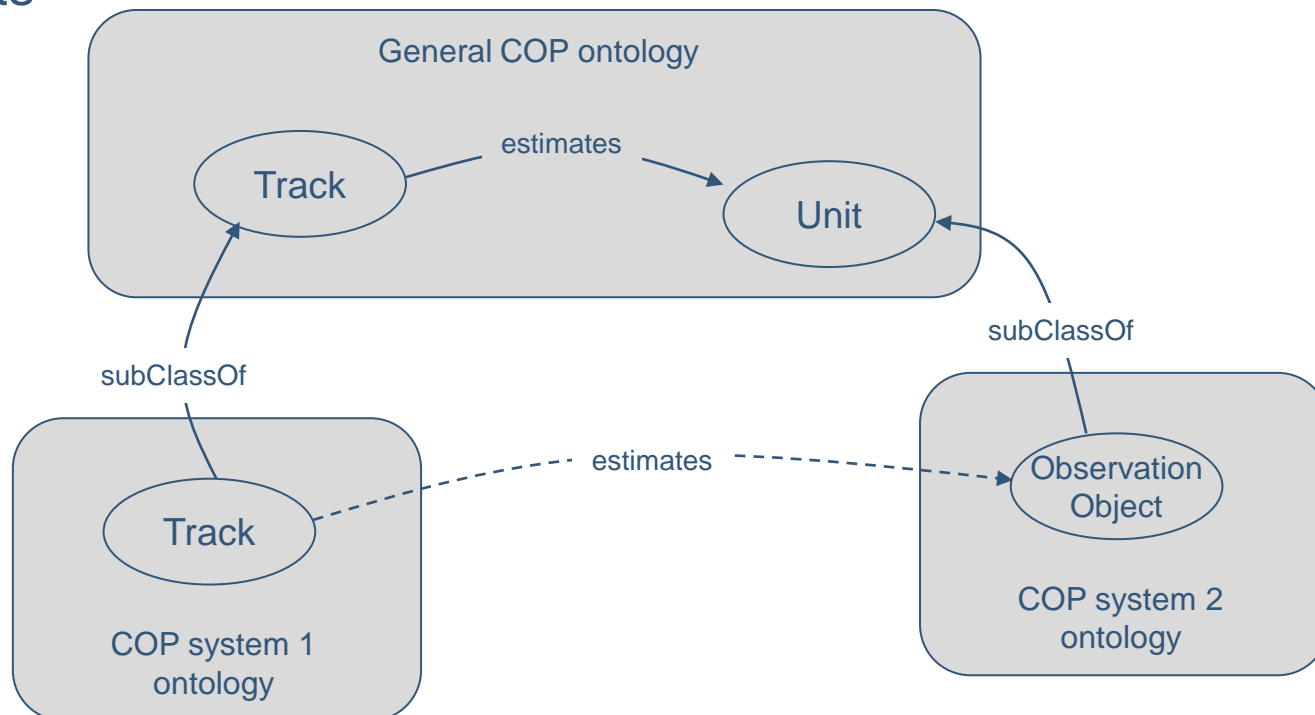 - Guarantees the correctness of the conclusions provided that the input is correct
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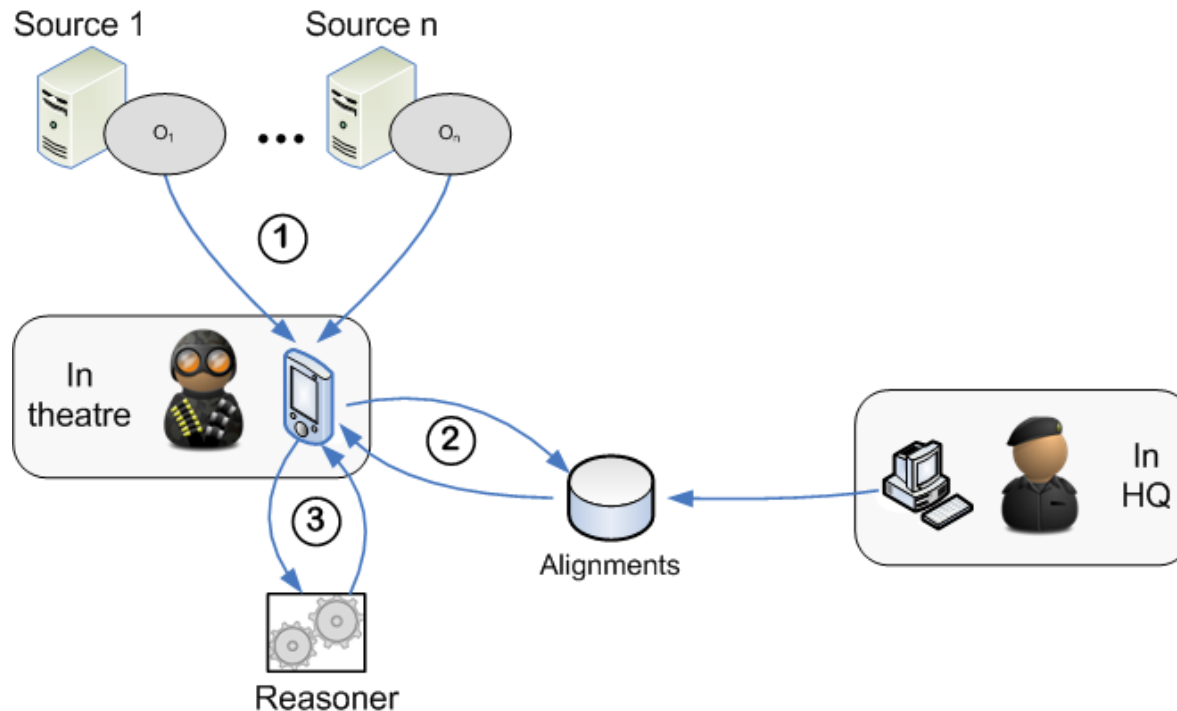
Deductive Ontology Matching Architecture

- An HQ staff responsible for ontologies and ontology matching
  - Also contributions from in-theatre users
- Reasoning provides secondary links between the ontologies

Further Work

- Testing in a lab environment
  - Alignment API & Server (Euzenat et al.)
  - W3C stack of semantic web technologies

- The speed of the proposed process

- Robustness with regards to the quality in the input alignments

- Combination of existing matching algorithms to provide support to the users generating the input alignments

Conclusion

- NNEC will increase the need to integrate information from different sources

- Ontology-based information integration is a possible contributor to solve this challenge

- Ontoloy matching is a key technology, as ontology usage is based on the linking of several ontologies

- In time-critical situations, deductive ontology matching has the potential to ensure needed speed and quality