

Achieving situation awareness of emergency response teams

- Inputs to the situation awareness concept
 - Human situation awareness: Endsley model
 - Situation semantics: Barwise and many others
 - Information fusion: JDL model
- Implementing situation awareness
 - Ontologies for situation awareness
 - Logical reasoning about situations and context
 - Uncertainty reasoning

Situation Awareness

- Situation awareness (SAW) is “knowing what is going on around oneself.”
 - More precisely, SAW is the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future (Endsley & Garland).
- SAW occurs at level 2 of the JDL model.

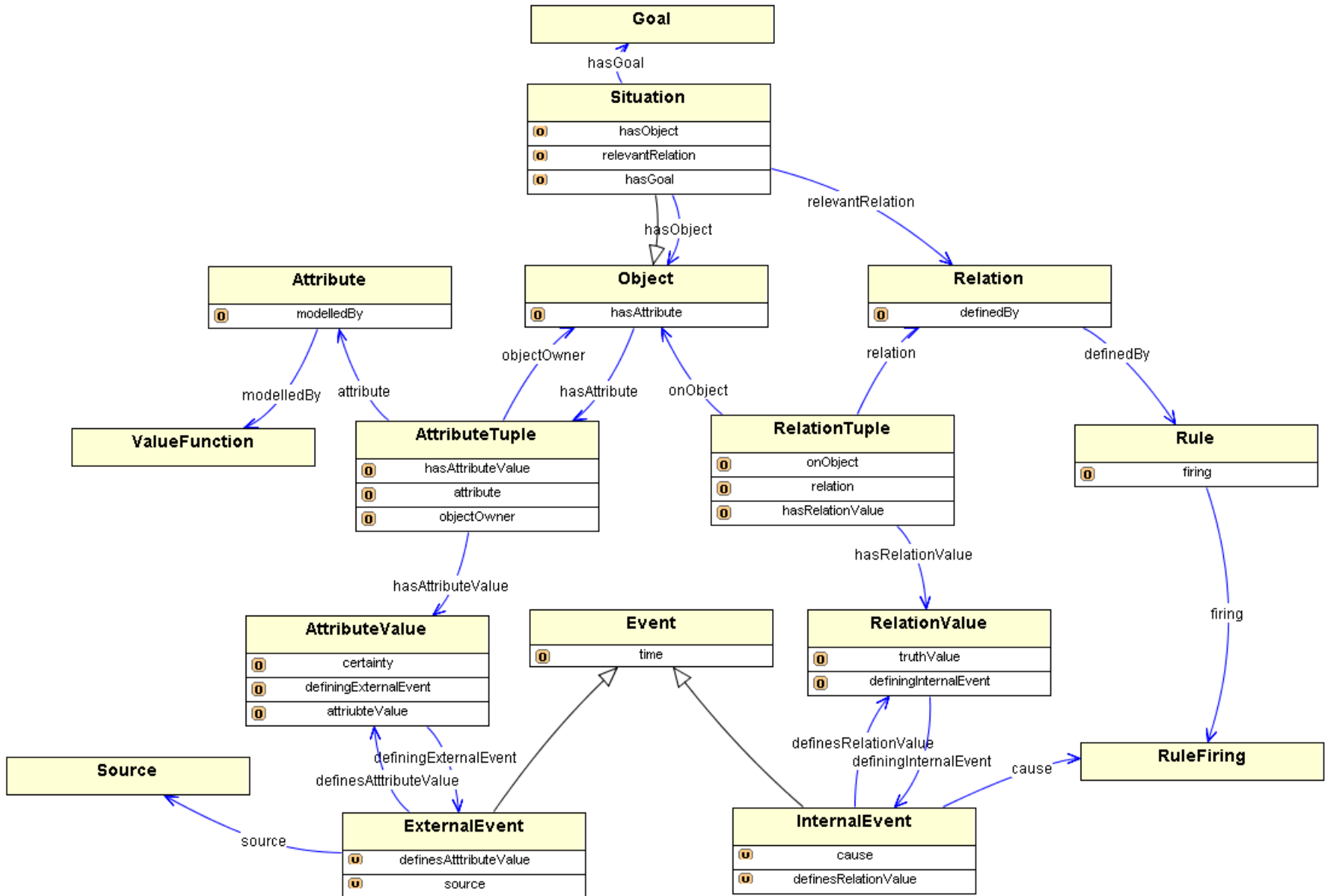
The Joint Defense Laboratories (JDL) model is the standard for information fusion systems.

Level	Name	Process	Endsley Model
3	Impact Assessment	Evaluation	Projection
2	Situation Assessment	Relationships	Comprehension
1	Object Assessment	Identify objects	Perception
0	Signal Assessment	Identify features	

Situation semantics

- Situations are limited contexts for reasoning.
 - Barwise notation: situation \models info
 - Inference uses subsumption on situation classes:
 $S_1 \Rightarrow S_2$
- Situations are themselves perceived objects.
 - The same observations can be interpreted in different ways.
 - One can reason about these differences.

SAW Core Ontology



The Semantic Web and Uncertainty

- There are many sources of uncertainty, such as measurements, unmodeled variables, and subjectivity.
- The Semantic Web is based on formal logic for which one can only assert facts that are unambiguously certain.
- The Bayesian Web is a proposal to add reasoning about certainty to the Semantic Web.
- The basis for the Bayesian Web is the concept of a Bayesian network.

Bibliography

- K. Baclawski, M. Malczewski, M. Kokar, J. Letkowski and C. Matheus. Formalization of Situation Awareness. In *Eleventh OOPSLA Workshop on Behavioral Semantics*, pages 1-15. (November 4, 2002) [pdf]
- K. Baclawski, M. Kokar, C. Matheus, J. Letkowski and M. Malczewski. Formalization of Situation Awareness. In *Practical Foundations of Behavioral Semantics*, H. Kilov, K. Baclawski (Ed), pages 25-40. Kluwer Academic. (2003) [pdf]
- C. Matheus, K. Baclawski and M. Kokar. Derivation of ontological relations using formal methods in a situation awareness scenario. In *Proc. SPIE Conference on Multisensor, Multisource Information Fusion*, pages 298-309. (April, 2003)
- C. Matheus, M. Kokar and K. Baclawski. A Core Ontology for Situation Awareness. In *Proc. Sixth Intern. Conf. on Information Fusion FUSION'03*, pages 545-552. (July, 2003) [pdf]
- M. Kokar, C. Matheus, J. Letkowski, K. Baclawski and P. Kogut. Association in Level 2 Fusion. In *Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications*, pages 228-237. (April, 2004) [pdf]
- M. Kokar, C. Matheus, K. Baclawski, J. Letkowski, M. Hinman and J. Salerno. Use Cases for Ontologies in Information Fusion. In *Proc. Seventh Intern. Conf. Info. Fusion*, pages 415-421. (2004) [pdf]
- C. Matheus, M. Kokar, K. Baclawski, J. Letkowski, C. Call, M. Hinman, J. Salerno and D. Boulware. SAWA: An Assistant for Higher-Level Fusion and Situation Awareness. In *Proc. SPIE Conference on Multisensor, Multisource Information Fusion*, pages 75-85. (2005) [ppt]
- C. Matheus, M. Kokar, K. Baclawski, J. Letkowski, C. Call, M. Hinman, J. Solerno and D. Boulware. Lessons Learned from Developing SAWA: A Situation Awareness Assistant. In *Eighth Int. Conf. Info. Fusion* (July 25-29, 2005) [doc]
- C. Matheus, K. Baclawski, M. Kokar and J. Letkowski. Using SWRL and OWL to Capture Domain Knowledge for a Situation Awareness Application Applied to a Supply Logistics Scenario. In *Rules and Rule Markup Languages for the Semantic Web First International Conference*, A. Adi, S. Stoutenburg (Ed), pages 130-144. Lecture Notes in Computer Science 3791:130-144. Springer-Verlag. (November 10-12, 2005)
- C. Matheus, M. Kokar, K. Baclawski and J. Letkowski. An Application of Semantic Web Technologies to Situation Awareness. In *ISWC'05*, pages 944-958. Lecture Notes in Computer Science 3729:944-958. Springer-Verlag. (2005) [ppt]
- M. Kokar, K. Baclawski and H. Gao. Category Theory Based Synthesis of a Higher-Level Fusion Algorithm: An Example. In *Fusion'06* (2006)
- M. Kokar, K. Baclawski and C. Matheus. Ontology Based Situation Awareness. *Information Fusion*. to appear. (2006)