A Framework for Semantic Interoperability

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*Abstract —***A fundamental element in any emergency and crisis management situation is the ability to establish communication without misunderstanding between the Command and Control Systems (Information Systems) of all involved co-operating organizations. We will introduce a concept addressing this critical issue.**

I. INTRODUCTION

Crisis management and rescue operations often require several different organizations to work together. In order to cooperate efficiently, it is necessary for them to exchange information between their command and control, management and information systems (IS), i.e., to be interoperable. The same issue also arises in international cooperation, for example in search-and-rescue operations at sea which might involve police, navy, and coast-guard organizations from several countries, i.e., the operations are multinational as well as multifunctional. It is therefore essential to develop future IS that can adapt to different types of situations in which the information exchange needs are not known in advance. A prerequisite for an improved interoperability between different organizations' IS is to create standards, methods and tools which can align terminology, and facilitate translation between various concepts and data sources of heterogeneous systems. In this presentation we will discuss how interoperability solutions developed for the military domain could be adapted to security and crisis management.

Successful security and crisis management involving organizations who are not rigorously trained together requires at least one very important function, reliable communications of critical information like threats and risks. This, in turn, requires that any two co-operating parties are interoperable on a *semantic* level. Two actors (IS) that are semantically interoperable can not only exchange information, but can also interpret and understand the intended meaning of the information in a common way. This is a key issue in the interaction between groups that do not share common frames of reference acquired through a common culture or through education. Support for semantic interoperability is therefore a prerequisite for the ability to participate in operations with other organizations, both nationally and internationally.

A simple example with a catastrophic result:
(CNN) -- **NASA's metric confusion caused Mars orbiter loss** "NASA lost a $125 million Mars orbiter because one engineering team used metric units while another used English units for a key spacecraft operation" … so the operation failed in ability of preserving the semantics of the position of the spacecraft through the communication. (**CNN.com** September 23, 1999)

II. RESULTS

The traditional means of exchanging information between systems do not guarantee that the intended meaning of information (the semantics) is preserved. To ensure semantic interoperability, an architecture encompassing a common terminology (ontology) is needed. Such an ontology is implicit among a group of people exchanging messages (otherwise the communication would be impossible), but made explicit in this architecture. This allows every message between communicating actors to include references to one or several ontologies according to which the message is interpreted.

FOI has since 2007 worked to clarify the concept of semantic interoperability, to build skills in this area, and to propose solutions. In cooperation with NATO's primary research group in this field, a general logical framework in the shape of an architecture for semantic interoperability has been developed: Semantic Interoperability Logical Framework (SILF).
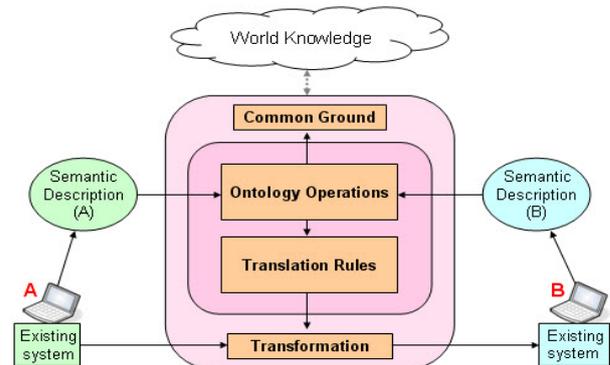

Figure 1. An overall view of SILF - Semantic Interoperability Logical Framework.

This presentation gives an introduction to the problem of semantic interoperability, and also addresses the problem from an international perspective. The various levels of interoperability will be discussed and arguments given that a solution for semantic interoperability must involve the use of ontologies (i.e. knowledge-based semantic interoperability). SILF will be introduced, and in connection with that the conditions necessary for SILF to function efficiently will be discussed, with examples taken from the civil security domain.

REFERENCES

[1] Vahid Mojtahed, Martin Eklöf, Jelena Zdravkovic, Semantisk interoperabilitet - Slutrapport för projektet Semantisk interoperabilitet, 2007-2009, FOI-R--2846—SE, 2009