Towards an Ontology for Army Battle C2 Systems

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Structure of the Talk

- Definition: Ontology
- About Knowledge
- Building Up the Ontology
  - → The Project "*Sokrates*"
  - → The Body Structure of the Ontology
  - → Examples
- Future Prospects

Definition: Ontology

Gruber (1993): "*An ontology is an **explicit** specification of a **shared conceptualization**.*"

explicit:
Everything the system has to know must be represented in the system.

shared conceptualization:
In particular, even the information
human beings do **not** communicate (since it is self-evident for us),
has to be represented.

About Knowledge

- **Declarative Knowledge**
  - →*facts (encyclopedic knowledge)*
  - →*situational knowledge / context*
  - →*rules*
- **Procedural Knowledge**
  - →*how to act*
  - →*how to apply rules*

About Knowledge

Specific facts are stored in the **data base**.

- *The 3./PzBtl84 is attached to the PzGrenBtl332.*

General facts are stored in the **data base**

as well as in the **ontology**.

- *Each unit has a commander.*

The **Relations among Facts** are stored in the **ontology**.

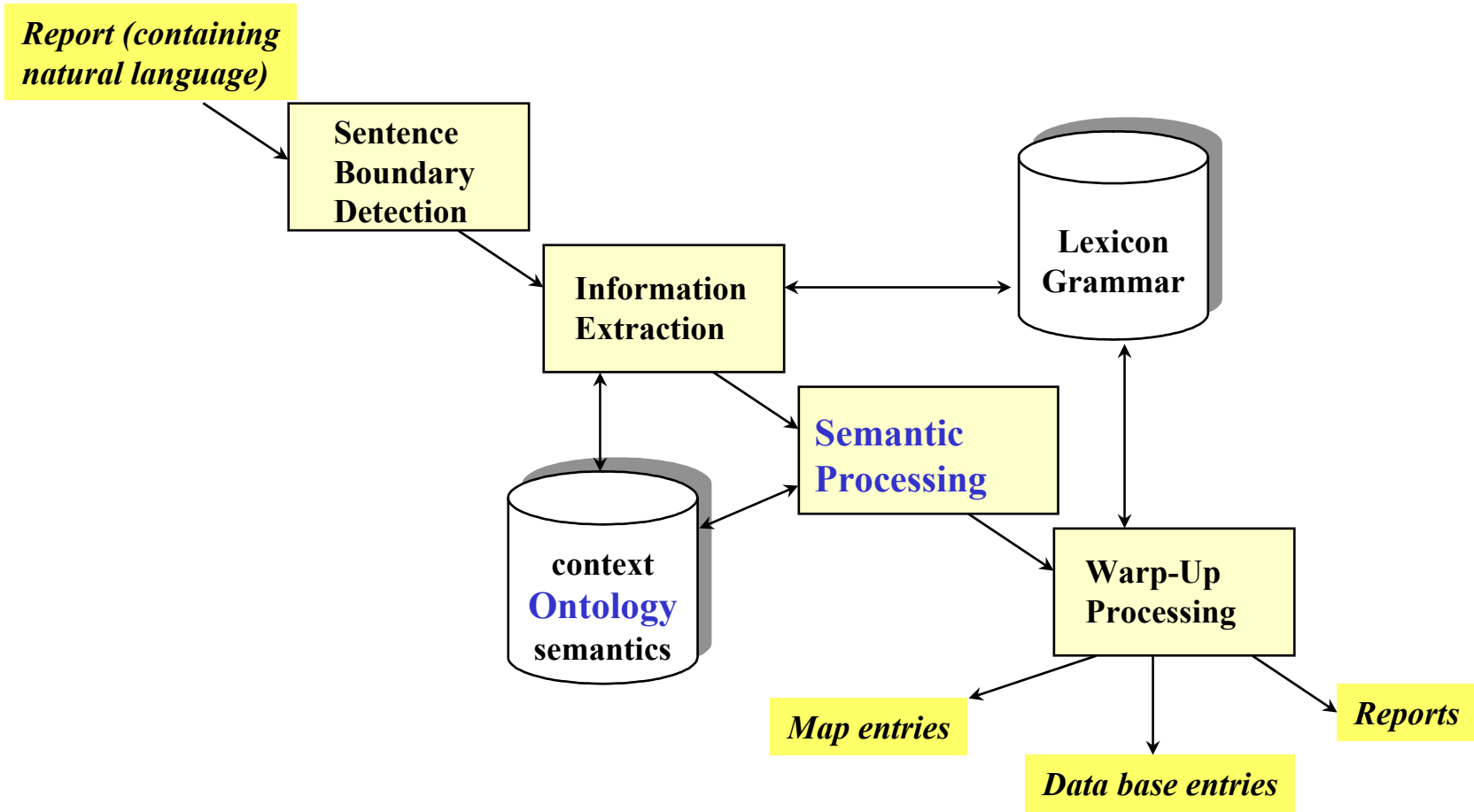
- *If unit A is under operational control of unit B*
  then unit B exercises operational control on unit A.

Building Up the Ontology

The Ontology, this talk is about, is meant to be part of an army battle C2 system. Its **domain** therefore is the battlefield.

To be more precise, we use the ontology as part of the so-called **Sokrates-system**,
a system under development.

The Sokrates-system



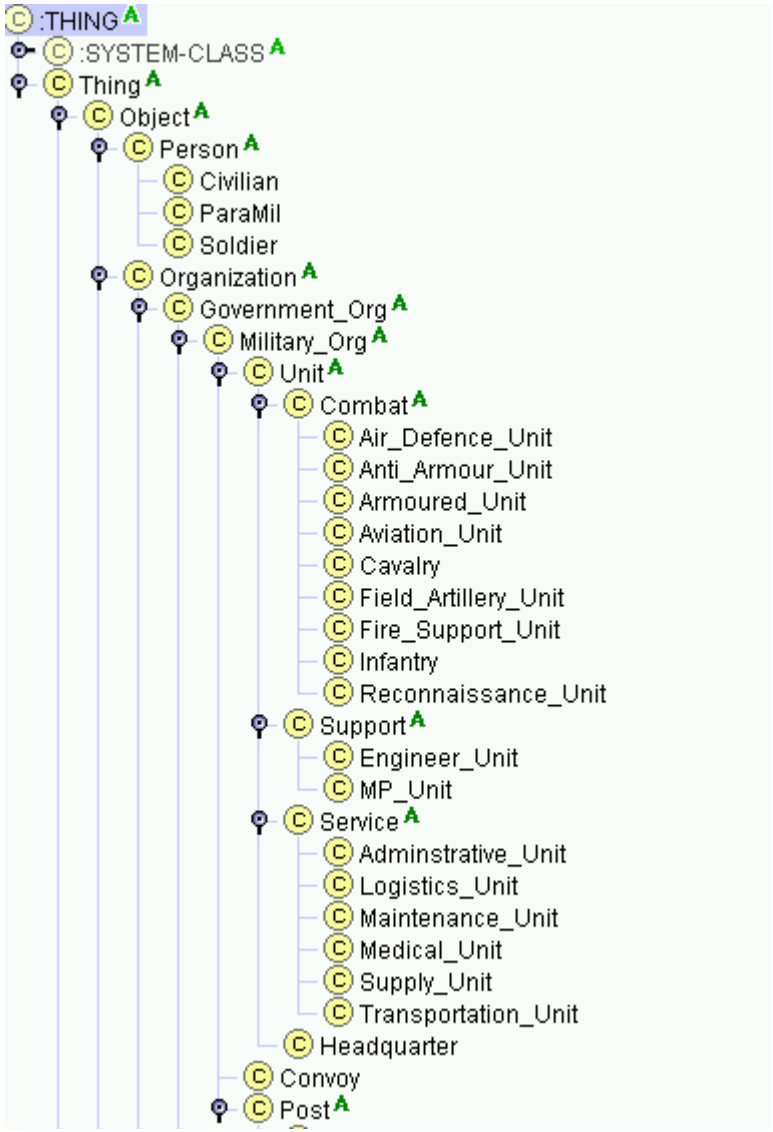
The Sokrates-system: components

Components	Task
Sentence Boundary Detection	The report is resolved into sentences.
Information Extraction	The content is represented by formal means.
Semantic Processing	The formal representation is enriched.
Warp-Up Processing	Map entries as well as data base entries are generated.

The Body Structure of the Ontology

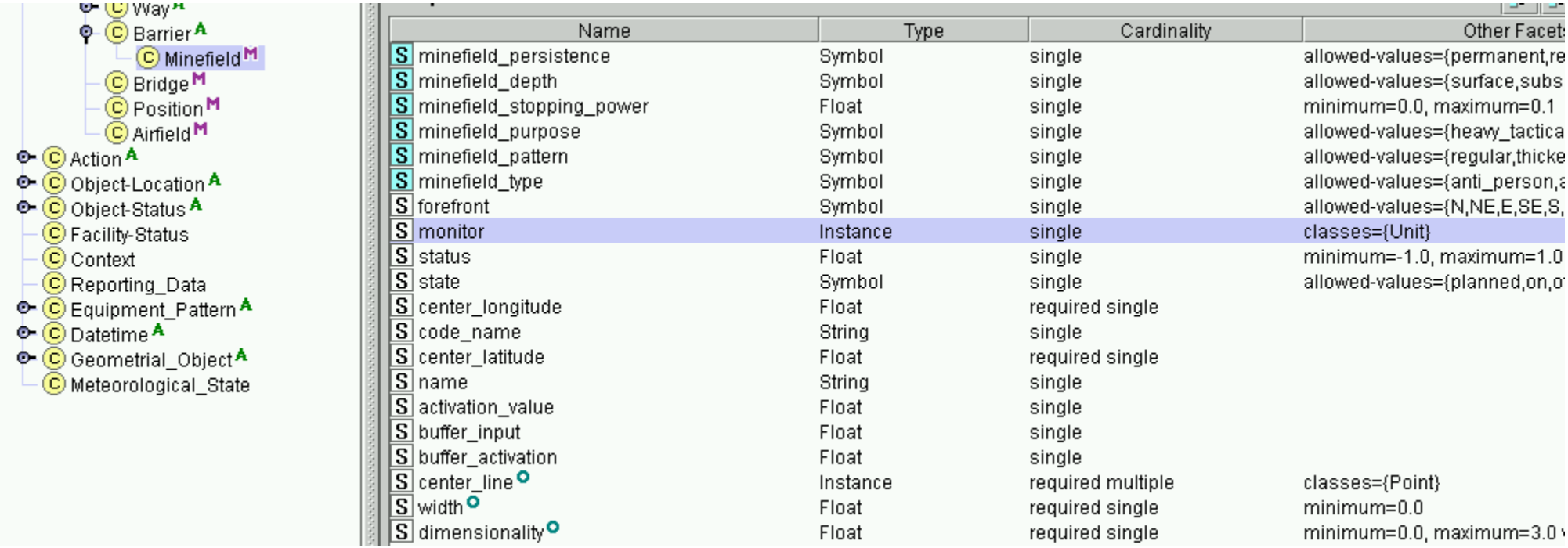
- Hierarchy of **Classes** (Inheritance !)
- **Instances**
- **Attributes: Feature-Value-Pairs**,

- **Constraints**
- **Reasoning-Mechanisms**

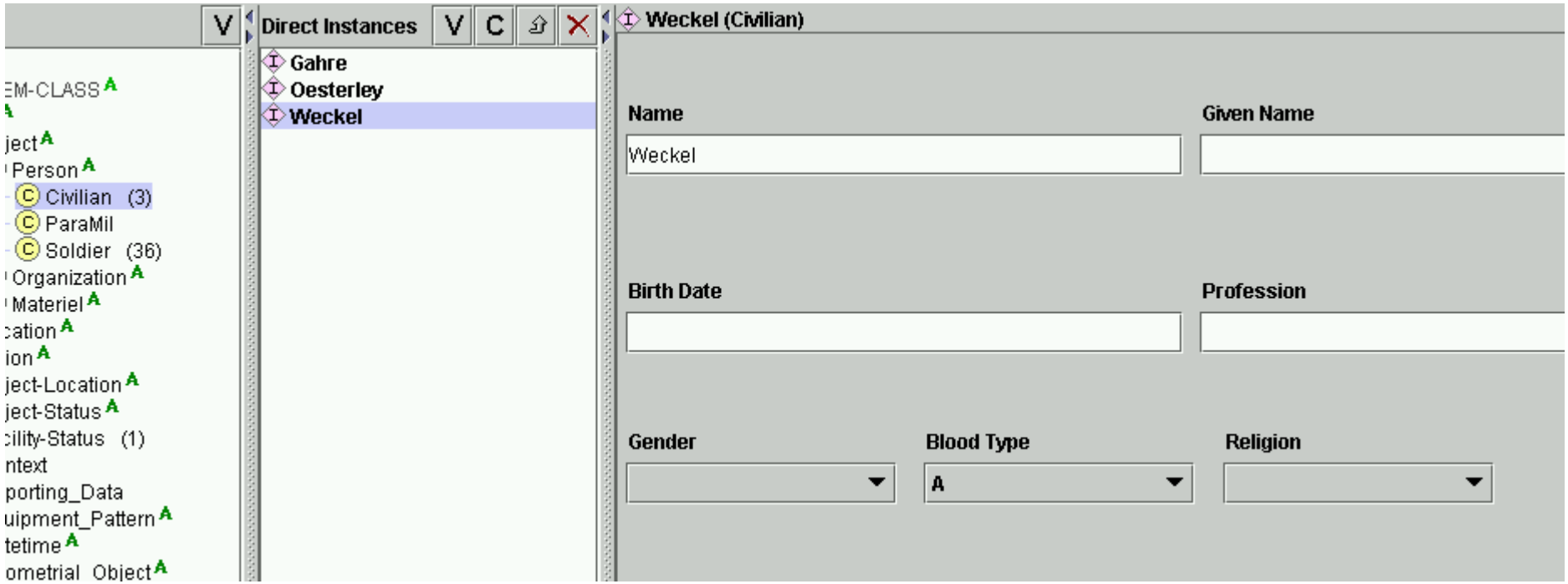


The hierarchy of classes

represents the
"X is a Y"-relation.

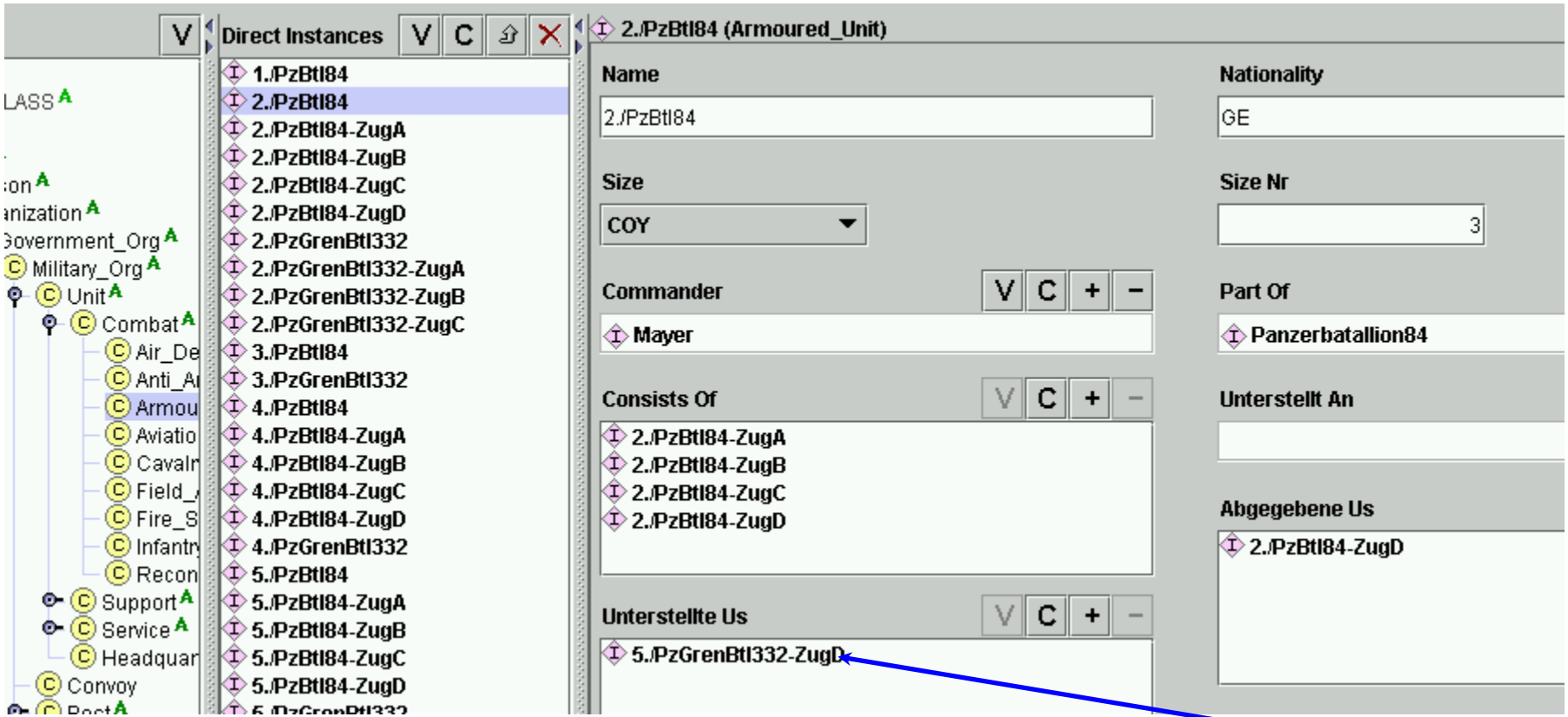


Each class has its specific attributes.
The attribute values are restricted.
Value restrictions are constraints.



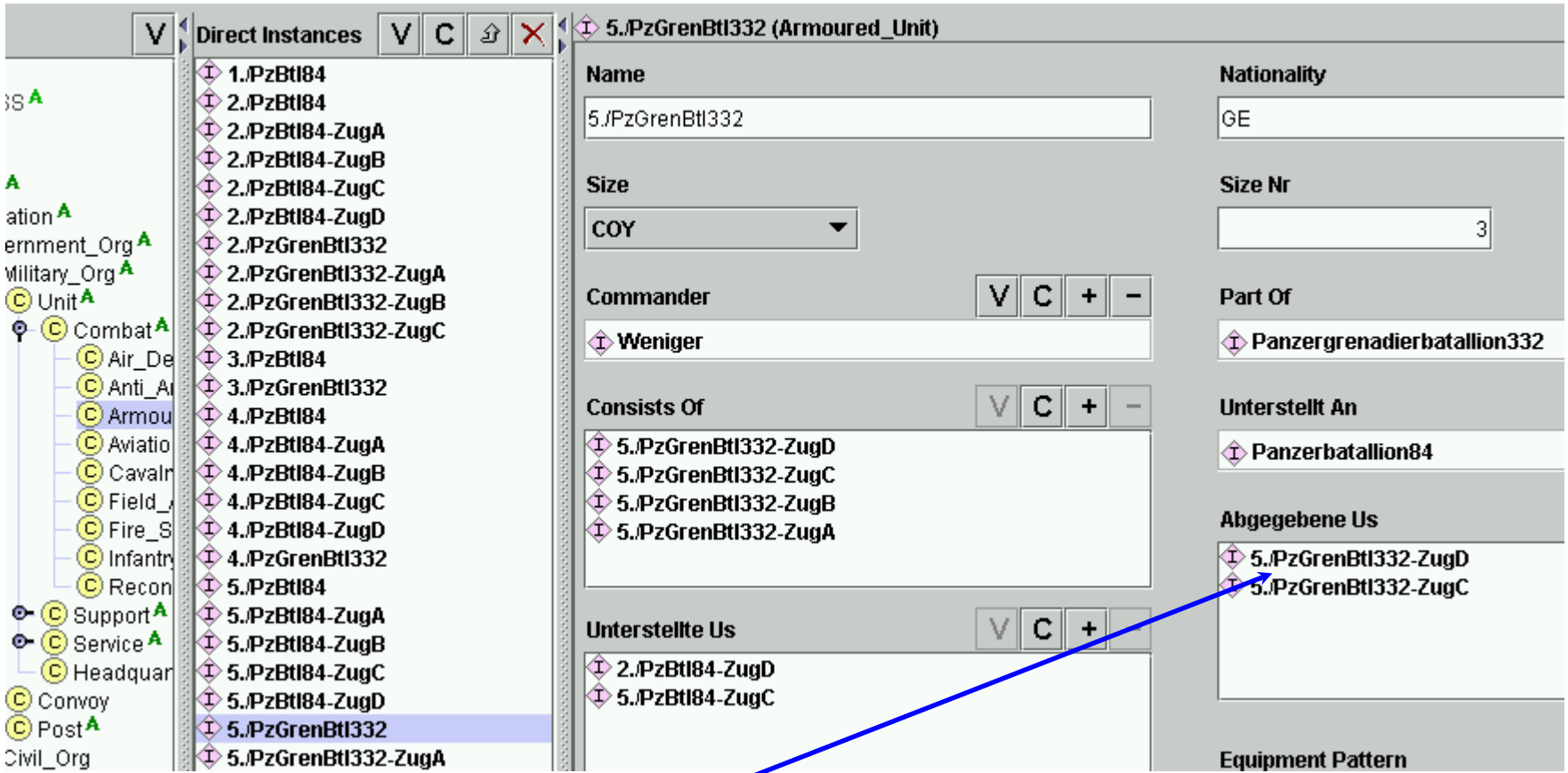
Most of the instances are provided by the underlying data base. The core data base matches the **LC2IEDM** which also provides class names, attribute names, and allowed attribute values.

Example 1: Attachment



The ontology enforces that changes of operational control result in records for **all** the units (instances) affected by the change

Example 1: Attachment



This automatically includes the unit which looses the control.

Example 2: Agent of an Action

(Military) tasks are resolved by units.

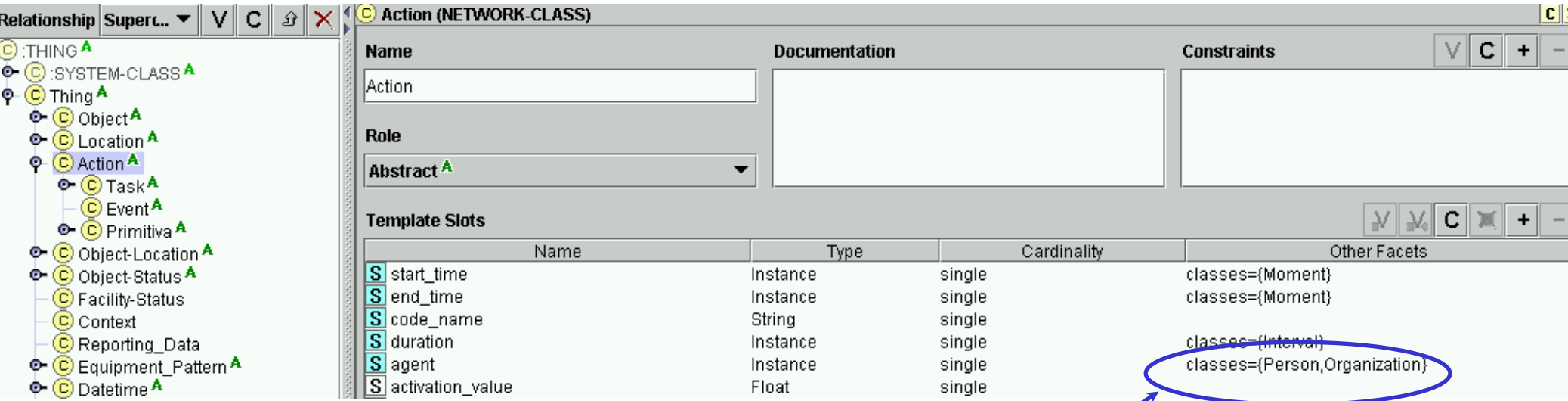
An analysis of the order

"C to all, position 3.1 advance, over!"

by syntactic means, however, suggests

that it is the position 3.1 which has to advance.

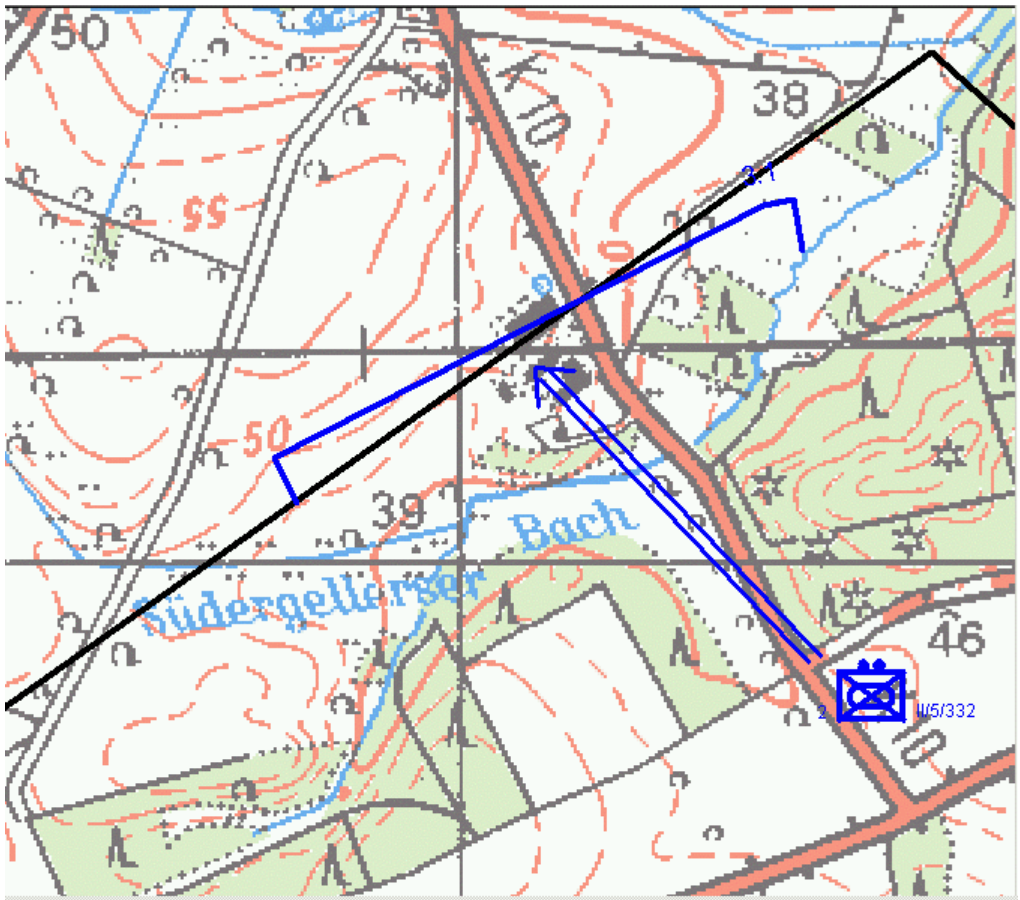
Example 2: Agent of an Action



The ontology determines that actions are carried into execution by persons or organizations, only. This is restricted even further in the case of military tasks.

Example 2: Agent of an Action

Thus,
misinterpretations
are avoided
from the outset.



Example 3: Intrinsic Reference

Local references often take the **speaker** or the **hearer** as origin of the coordinate system (**deictic reference**):

*"The sniper is behind the tree [from **my**/**your** point of view]."*

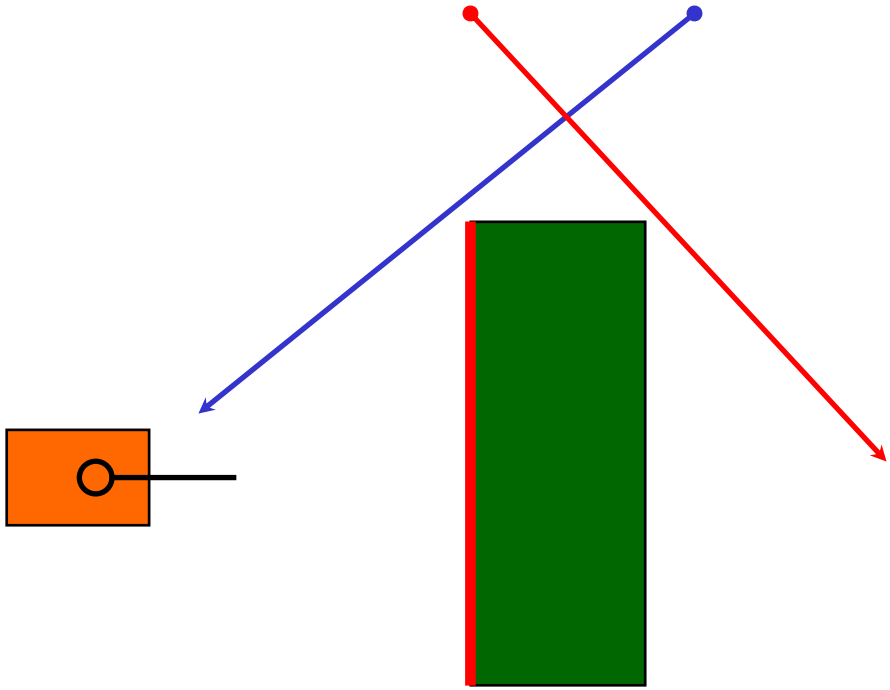
In some cases, however, the origin of the coordinate system is the **relatum** (**intrinsic reference**):

*"The tank stopped in front of **the city hall**."*

Example 3: Intrinsic Reference

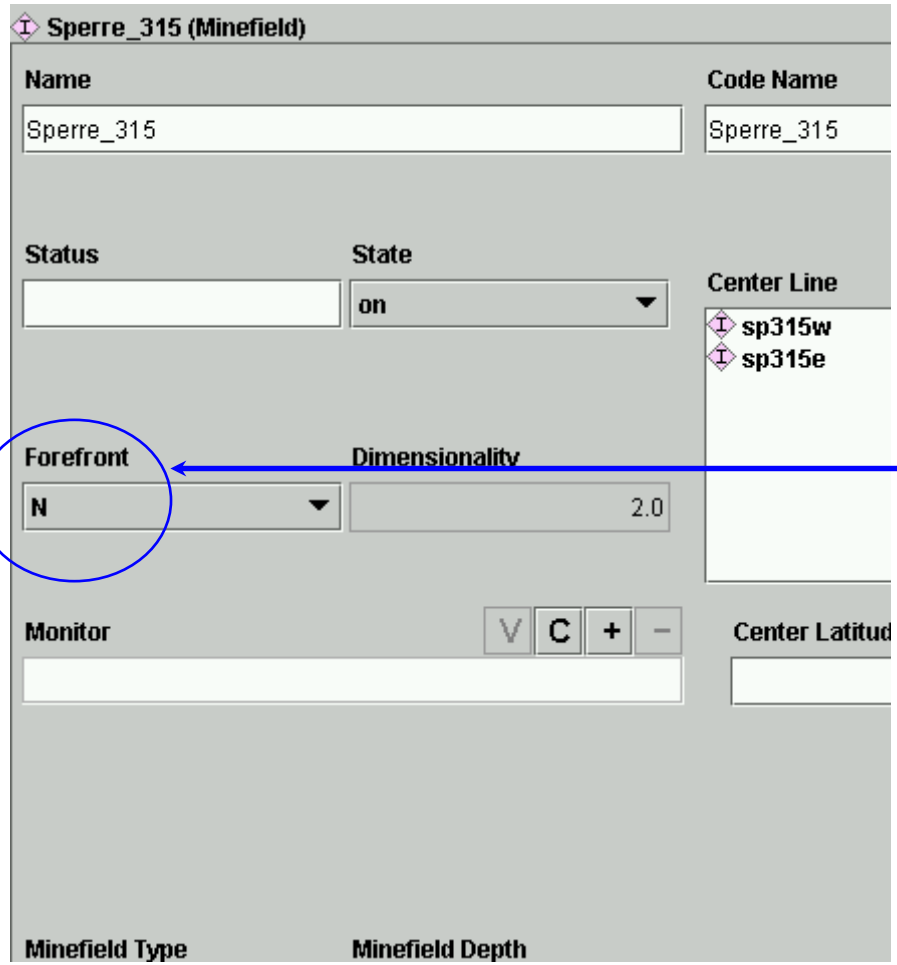
Ambiguities have to be resolved.

(Is the reference **deictic** or **intrinsic** ?)



- reporting unit:
  "Battle tank stopped ***in front of*** *barrier."*

Example 3: Intrinsic Reference



Minimal requirement:

Objects allowing for **intrinsic reference** must be represented together with their orientation.

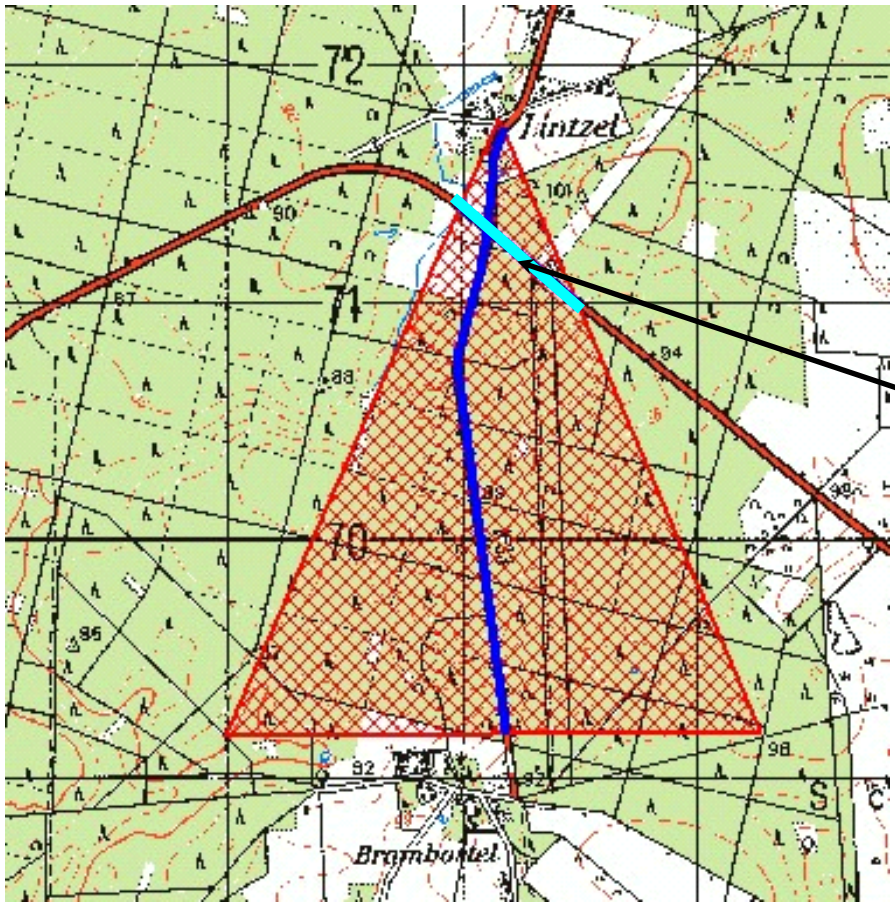
Example 4: Vague Reference

Sometimes, references are vague:

*"**South of Lintzel**, 18 trucks, moving westwards."*

In order to place a symbol on the map,
vague references
have to be transformed into coordinates.

Example 4: Vague Reference



On the basis of the vague reference *"South of Lintzel"* a sector is calculated. Within this sector, road sections are marked, and the most probable one is determined.

The center point of the determined road section is calculated and the respective coordinates are used for mapping.

Future Prospects: Example 5

Part of the functionality provided by the ontology
will be inspired by
psycholinguistic models of language processing:
Kintsch, W. (1998): *Comprehension*. Cambridge University Press.

Step 1
The tank commander reports to the platoon leader:
"*2 in position, no enemy contact, over.*"

Future Prospects: Example 5

Step 2

Information extraction transforms the report into a formal representation.

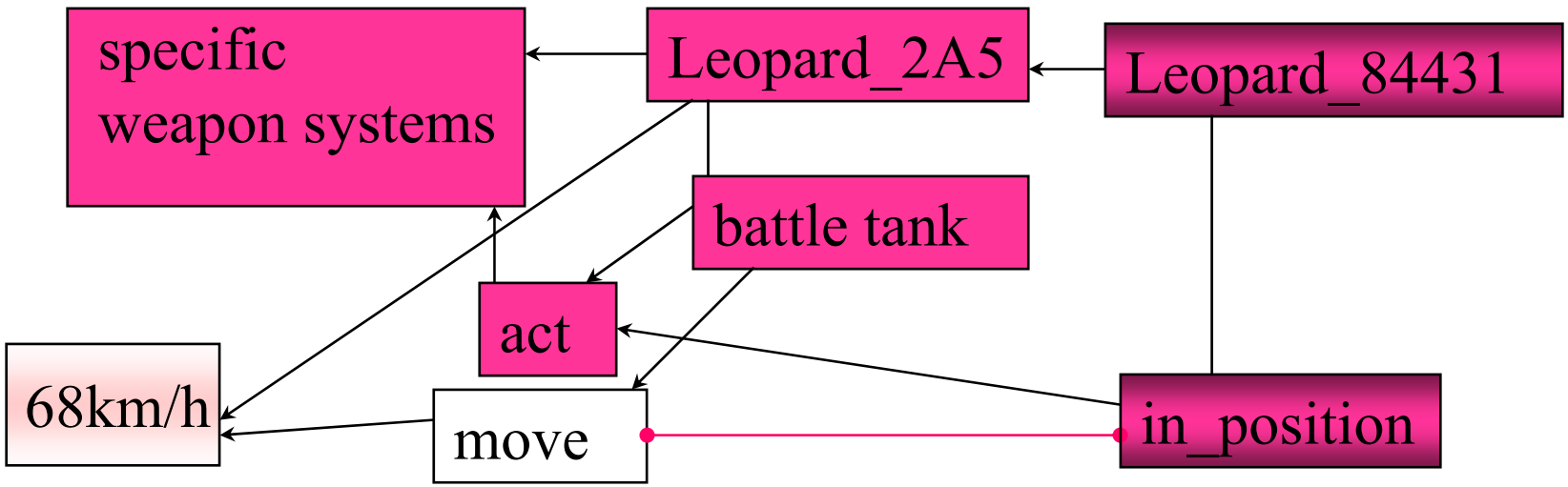
The representation is enriched by the ontology.

This includes the explication of elliptical terms.

Future Prospects: Example 5

Step 3

The ontology operates as (neural) network. Entities mentioned in the report become active. Active items spread their activation. Thus, associated items also become active.



Future Prospects: Example 5

Step 4
Within the ontology network, a tank representation stabilizes. The representation focuses the tank's capability to act and ignores its capability to move.

This representation is used to analyze following reports.

If no contradicting facts are reported, the tank is assumed to stay in the reported position.