A Linguistic Basis for Multi-Agency Coordination

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2. The Linguistic Basis
   - A formal language for C2 communication
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Intent

At the beginning of a Complex Endeavor each participating organization in a multi-agency operation has its own intent.

As experiments by Farrell (2004, 2006) illustrate an Endeavor will be more successful

- if the organizations communicate their intent (such that each organization knows the intent of the other organizations)

  for Deconflicted or Coordinated Endeavors

- and – *even better* – if they share (parts of) their intent such that they can cooperate

  for Collaborative or Agile Endeavors

Intent

Common Intent

"the sum of shared explicit intent
plus operationally relevant shared implicit intent"
(Pigeau & McCann, 2000)

The implicit part of intent is the main source of misunderstanding and failure in multi-agency operations.

The amount of misunderstandings that arises from not sharing intent increases if the agencies have different kinds of background (military, humanitarian, governmental, …).

Intent

As a conclusion,
at the beginning of a Complex Endeavor
involving Multi-Agency Operations,

intent should be communicated and

an explicit agreement should be aimed at
that expresses common intent.

This Communication and Agreement needs a language.

A Linguistic Basis for Intent and Communication

In the past, we developed a formal language for military communication (including formal communication of intent) because not all recipients can understand free text expressions. Examples are:

- Coalition Forces not speaking English as their native tongue
- Simulated Forces
- Future (smart) Robotic Forces

A Linguistic Basis for Intent and Communication

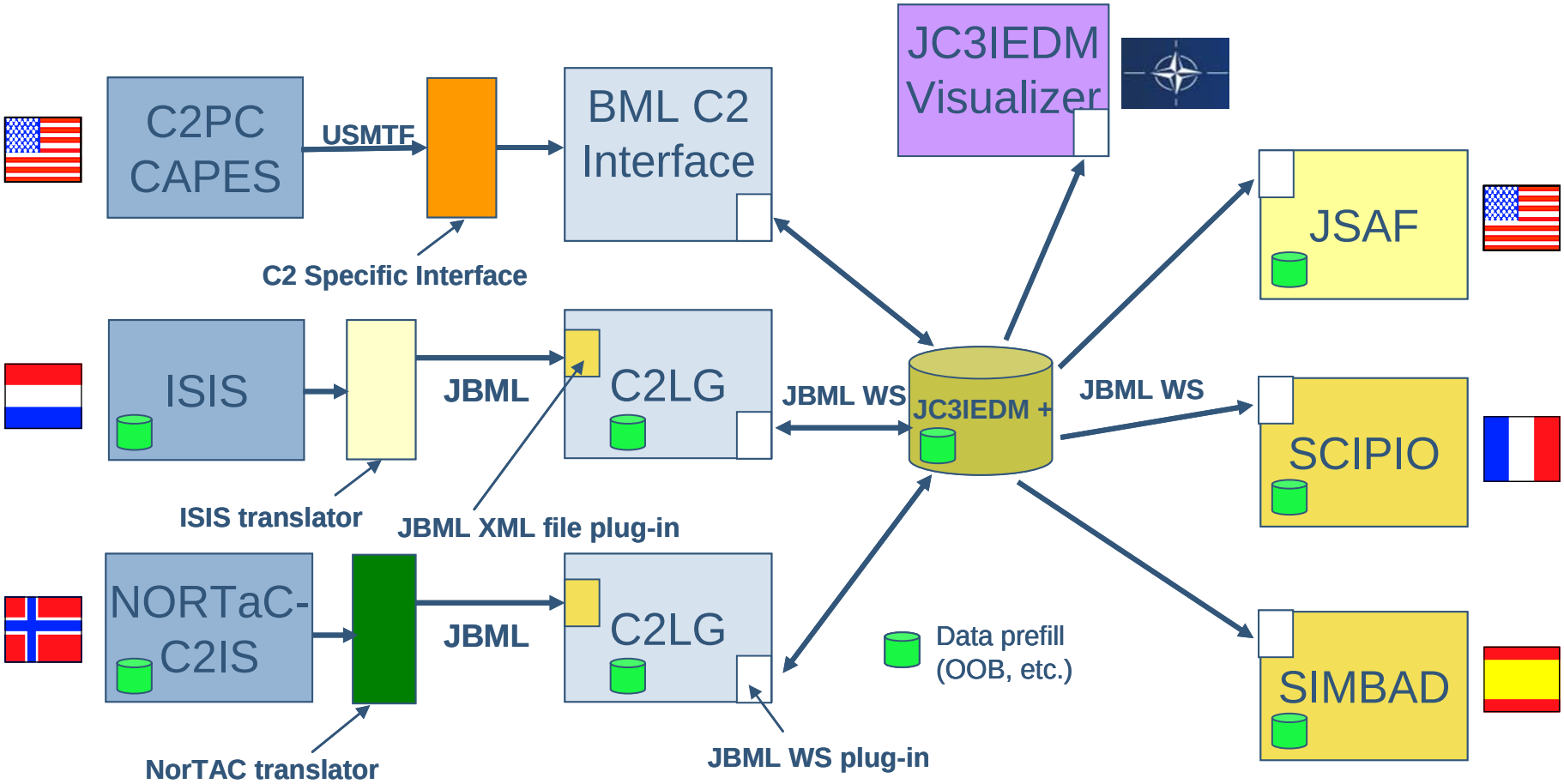
The development of our formal language is part of the BML (Battle Management Language) standardization processes:

- IEEE Simulation Interoperability Standards Organization Product Development Group ("Coalition BML")
- NATO Modeling and Simulation Working Group (NATO RTO MSG-048 "Coalition BML")

Our language is based on a formal grammar:
the Command and Control Lexical Grammar (**C2LG**).

The C2LG has been used in the demonstration given by NATO RTO MSG-048 at I/ITSEC, Orlando in November 2007.

System Architecture of the Demonstration presented by NATO MSG-048 at I/ITSEC, Orlando, Nov. 2007



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New Communications

Purely Military Communications do not work when in a Complex Endeavor:

Orders and Reports are not sufficient.

The speech act "order" assumes that the one who gives the order can expect the one who receives the order will execute it.

In the context of a Complex Endeavor, "requests" are used rather than "orders".

New Communications

Directive:

A Speech act that has the purpose of having the receiver perform a task.

Typical directives are:

Orders typical for classical military operations

Requests typical for complex endeavors

also

[Pleas]

[Challenges]

New Communications

Orders

The right to direct the receiver results from the (classical military) organizational hierarchy. (The receiver is subordinate to the sender.)

Requests

The right to direct the receiver does not result from a organizational hierarchy, but derives from the common intent where the requested action would help to achieve a common goal (as agreed upon in the common intent).

New Communications

Orders

That the recipient of an order executes the ordered task goes without question.

Requests

That the recipient of a request executes the requested task is not certain. However, the requester needs to know whether the requested task will be executed.

Thus, the receiver of a request must **confirm** that the request was received and – if the receiver will execute the requested task – he has to **commit** himself to do so.

New Communications

Our language must also include

Confirmations

and

Commissives.

These types of expressions serve as coordination tools in the multi-agent context of Complex Endeavors.

New Communications

An Expansion of our previous work has resulted in the Multi Agency Operations Language (MAOL)

Military Forces	NGOs and Military Forces
↓ information about intent	↔ exchange of intent agreement on common intent
↓ order	↓ directive: tasking, (order)
↑ report, request	↑ report, directive: request
↔ report, (request)	↔ report, directive: request
	↓ task-confirmation, request-confirmation
	↑ tasking-confirmation, commision
	↔ request-commision, commision

Developing a Command and Control Grammar

We developed our C2 Grammar such that it includes Command Intent, Tasking and Coordination.

Tasking → Command_Intent OB* Coord_Space* Coord_Time*

Command Intent → [Expanded Purpose] [Key Tasks] [End State]

OB is a basic order expression by which tasks are assigned to units. OB consists of a tasking verb and constituents.

A Tasking Grammar

The production rules for the **basic expressions** have the following general form:

OB → Verb Tasker Taskee (Affected | Action)
Where Start-When (End-When) Why Label (Mod)*

"Verb" is an action, normally a task
"Tasker" is a "Who", the unit which commands the task
"Taskee" is a "Who", the unit which executes the task
"Affected" is a "Who", the unit which is affected by the task
"Action" is another action/task affected by the task
"Where" is a "location phrase"
"When" is a "time phrase"
"Label" is a label given to a task to allow it to be referred in other basic expressions
"Mod" refers to conditional modifiers

Command Intent

CI → [Expanded Purpose] [Key Tasks] [End State]

The Expanded Purpose is similar to the End State, but expresses more general aspects of the resulting situation.

The Key Tasks are tasks and conditions that are essential to accomplishing the mission.

The (desired) End State describes the resulting situation that is achieved when the mission is accomplished.

Example: A Disaster Relief Operation

The example is based on ATLAS 2007,
a disaster response exercise

organized by
Civil Protection of Romania
and
German Collaborative Center 461
„Strong Earthquakes“

Scenario: Earthquake in Bucharest;
parameters according to a real earthquake that hit the Vrancea region in 1977; resulting damage in Bucharest calculated on these parameters and the current building structure of Bucharest

Example: A Disaster Relief Operation

Our Scenario (in a less stable and less organized region):

Earthquake in the city of Surgant in province Ibra of ARGA

ARGA has a week government.

The separatist movement CILL wants to “liberate” Ibra.
Neighbor state BARCA supports ARGA against CILL because
It fears that CILL after liberating Ibra will try to liberate
BARCA’s province Novorro.

Example: A Disaster Relief Operation

The Endeavor:

- ARGA's Emergency Operations Center (EOC)
  - controls and coordinates response teams
- Red Cross (NGO)
  - has medical teams
- BARCA's Military Forces
  - protection against CILL
  - has Helicopters
  - has Engineering Equipment: Bulldozers, Cranes, etc.

Example: A Disaster Relief Operation – Intent

[key tasks]:

Rescue civilians in Surgant beginning at time October 2, 2007 at 0800.

rescue EOC OPEN civilian **at** Surgant **start at** TP1 label-kt-01;

Determine building damage and identify those buildings that need to be evacuated in Surgant beginning at time October 2, 2007 at 0800.

classify EOC OPEN facility **at** Surgant **start at** TP1 label-kt-02;

[end state]:

The end state of this operation is that all civilians in danger as a result of the earthquake are safe by October 5, 2007 at 0800.

rescue OPEN civilian **at** Surgant **end at** TP9 RPTFCT label-es-01;

We assume that the EOC and the Red Cross agree on the first key task and the end state as their common intent.

Example: A Disaster Relief Operation – Situation Report ↑

Response Team D to EOC:

Building Melkart Street 1 (Building 2109) is moderately damaged.

status-building-report:
Building 2109 moderately damaged **at** now RPTFCT label-r-01;

Example: A Disaster Relief Operation – Task Report ↑

Response Team D to EOC:

Heard Help Cries at Building Melkart Street 1 (Building 2109);
5 buried persons located.
Begin rescuing.

← The response team starts rescuing without explicit directive because of the common intent.

status-person-report:
5 neutral civilian (label C5) buried **at** Building 2109
at now RPTFCT label-r-02;

task-report:
rescue RT-D C5 **at** Building 2109 **start at** now RPTFCT label-r-03;

Example: A Disaster Relief Operation – Confirmation ↓

EOC to Response Team D:

OK. Response D, you are at Building 2109, rescuing 5 buried people.

task-confirmation: label-r-03;

EOC confirms the rescuing action.

In our language the confirmation is given by referring to the label of the confirmed report or directive.

Example: A Disaster Relief Operation – Request ↑

Response Team D to EOC:

4 people rescued at Building 2109; 1 rescued person badly hurt; medical support needed.

task-report:
rescue RT-D 4 of C5 **at** Building 2109 **end at** now RPTFCT label-r-04;

status-person-report:
1 of C5 (label C28) wounded **at** Building 2109 **at** now RPTFCT label-r-05;

request:
support Medical-Team RT-D **at** Building 2109 **start asap** now label-d-01;

Example: A Disaster Relief Operation – Tasking ↔

EOC to RedCross:

1 rescued person heavily hurt at Building 2109;
request medical support.

status-person-report:
1 neutral civilian (label C28) wounded **at** Building 2109
at now RPTFCT label-r-06;

tasking:
support Medical-Team RT-D **at** Building 2109 **start asap** now label-d-02;

We assume that the Red Cross has agreed to the common intent (to rescue the civilians) and thus can tasked to do so.

Conclusions

- We presented a formal language (the MAOL) for conducting operations through space and time.
- The language presented includes mechanisms to support developing the explicit part of a Common Intent.
- The language also includes the means to coordinate the activities of organizations participating in a Complex Endeavor.
- The grammar this language is based on is being developed and standardized in NATO and IEEE.
- The use of the language not only enables coordination, but also supports collaboration and agility.

Thanks for Your Attention !

Questions and Comments are appreciated.

Backup: Commander's Intent

The United States Department of Defence defines Commander's Intent as:

"A concise expression of the purpose of the operation and the desired end state that serves as the initial impetus for the planning process. It may also include the commander's assessment of the adversary commander's intent and an assessment of where and how much risk is acceptable during the operation."

The US Army in Field Manual 3-0, Operations, similarly defines Commander's Intent as:

"A clear, concise statement of what the force must do and the conditions the force must meet to succeed with respect to the enemy, terrain and the desired end state."

Backup: Formal Language

- Formal Languages provide a rigorous framework for automated processing.
- Formal languages are defined by grammars.
- The military domain provides excellent structure to terms and actions in a formal language.
- Current Message and Data-based communications do not go far enough – a **grammar** is needed to give additional meaning.

Backup: Grammar

A formal language is defined by a ***grammar***.
The grammar provides

- **a lexicon**

  in order to determine the words which may be used

  as well as their semantics (their meaning);

- **a finite set of rules**

  in order to determine how to concatenate the words

  and to give meaning to the catenations.

Backup: Lexical Functional Grammar

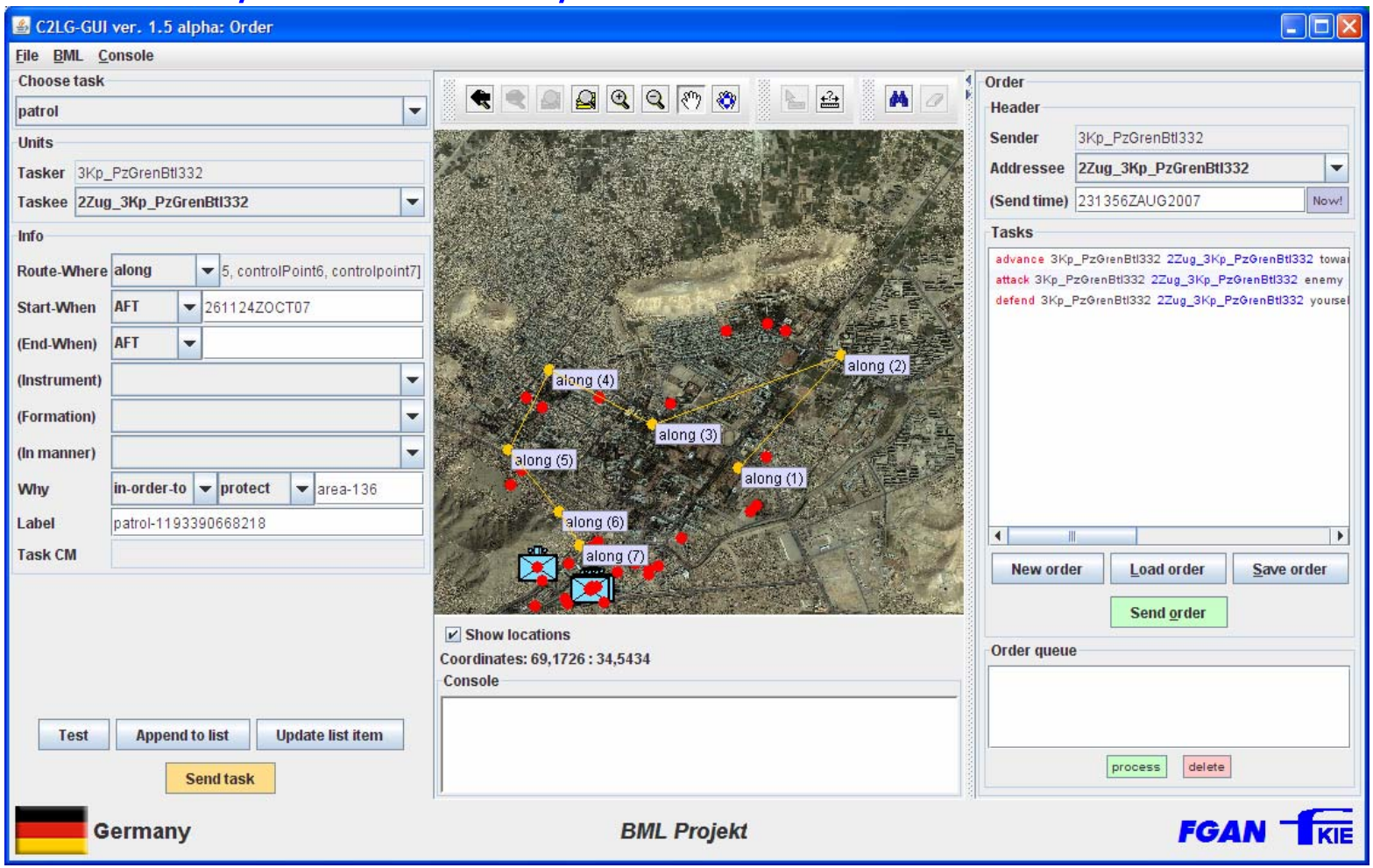
Lexical Functional Grammar (LFG) is a theory of grammar – that is, in general terms, a theory of:

- syntax (how words can be combined together to make larger phrases, such as sentences)
- morphology (how morphemes - parts of words - can be combined to make up words),
- semantics (how and why various words and combinations of words mean what they mean), and
- pragmatics (how expressions are used to transmit information)

We use the Lexical Functional Grammar as the basis for the Formal Grammar.

Backup: The GUI based on the Tasking Grammar

Patrol Order Expression development



Backup: A C2 Reporting Grammar

Task Report

RB → Verb Executer (Affected|Action) Where When (Why) Certainty Label (Mod)*

Event Report

RB → EVerb (Affected|Action) Where When (Why) Certainty Label (Mod)*

Status Report/Position Report

RB → Hostility Regarding (Identification Status-Value) Where When Certainty Label (Mod)*

Example: A Disaster Relief Operation – Order ↓

RedCross to MedicalTeamF

1 rescued person badly hurt at Building 2109;
support rescue team there.

status-person-report:
1 neutral civilian (label C28) wounded **at** Building 2109
at now RPTFCT label-r-07;

order:
support MedicalTeamF RT-D **at** Building 2109 **start asap** now label-d-03;

We assume that the Red Cross can order its Medical Teams to support rescuing civilians (at a specific location).

Example: A Disaster Relief Operation – Tasking Confirmation ↔

RedCross to EOC:

Medical team is moving to Building 2109.

tasking-confirmation: label-d-02;

commission:
support MedicalTeamF RT-D **at** Building 2109 **start at** now label-c-01
regarding label-d-02;

The Red Cross confirms the tasking by EOC.

Example: A Disaster Relief Operation – Tasking Confirmation ↔

RedCross to EOC:

Medical team is moving to Building 2109.

tasking-confirmation: label-d-02;

commission:
support MedicalTeamF RT-D **at** Building 2109 **start at** now label-c-01
regarding label-d-02;

The Red Cross commits itself to support the rescuing with respect to a specific location and a specific time.

Example: A Disaster Relief Operation – Request ↔

EOC to MilHQ:

1 person buried at Building 2109; request crane.

status-person-report: 1 neutral civilian (label C33) …

request:
support OPEN RT-D **at** Building 2109 **start asap** now **by** crane label-d-05;

We assume that the Military Forces have agreed to the common intent (to rescue the civilians) only partially (it is not their prime intent) and thus must be requested to do so.

Example: A Disaster Relief Operation – Request Commission ↔

MilHQ to EOC:

Engineer unit is moving to Building 2109.

request-confirmation: label-d-05;

commission:
rescue EngUnit C33 **at** Building 2109 **start at** now **by** crane label-c-02
regarding label-d-05;

The Military Forces commit themselves to rescue the buried person. This is not exactly what was requested.