USING A COMMAND AND CONTROL LANGUAGE TO SIMULATE OPERATIONS IN A MULTI-AGENT ENVIRONMENT

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The Challenge: Increased Complexity

Things are getting harder for defense – Increased

- Diversity of defense roles & security challenges ➔ more to deal with
- Uncertainty and pace of change ➔ less time to adapt
- Number of inter-related actors and effects ➔ less predictable
- Number of constraints and public scrutiny ➔ less options

Therefore defense can't be sure, in advance, of:

- What it will have to do, and with who — so can't optimize
- When it will have to do it — so can't prepare
- How to ensure success and avoid failure — so can't control

How to deal with this Complexity?

The premium will be more on the ability to…

- rapidly decide, *as situations develop*, what is to be done, how, who with, & how to measure success and failure
- rapidly assemble tailored diverse (incl. non-defense elements) teams and get them operational and effective,
- maintain effectiveness under unpredictable and rapidly evolving conditions, retaining ability to mount additional operations as needed

…rather than on the ability to do particular kinds of operations very well – which is the 'usual' kind of mission effectiveness

dynamic properties of the force that 'emerge' as a result of many decisions about structure, process, doctrine, personnel, equipment, training, ...

Requires Adaptivity

How to support these new challenges

- How can we give provide better tools (simulation) to prepare for and deal with complexity. We focuses in particular on simulators to:
  - Long Term: Understand complex environments on (e.g. Danger Island)
  - Medium Term: Simulators for Decision Support (e.g. Pollux)
  - Short Term: Simulators to support Training (e.g. Castor)

Simulator requirements to cope with complexity

Flexible with respect to scenarios

- Traditional war fighting
- Urban warfare
- Peace keeping

Flexible in the models used

- Decision making should be ‘plug-and-play’, so different models can be tried (e.g. different command styles)

Reduced manpower

- A Staff must be able to run models many times (not just once), to discover optima and understand the ‘state space’

Must be coupled with operational systems

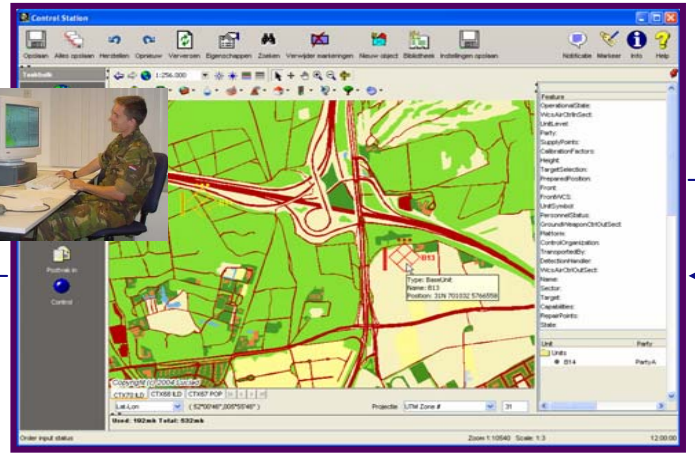
- Simulation must understand plans, not require human interpreters
- This includes using ‘commanders intent’

Kibowi simulation plaform (www.kibowi.com)

- Used both for analysis and as a constructive training tool
- Able to simulate at Platoon, Company, Battalion, Brigade or Division granularity
- Plans/COAs can be exchanged with C2, Ground Truth returned
- Scripts can be used to write ‘doctrinal’ behaviour for entities

plans →

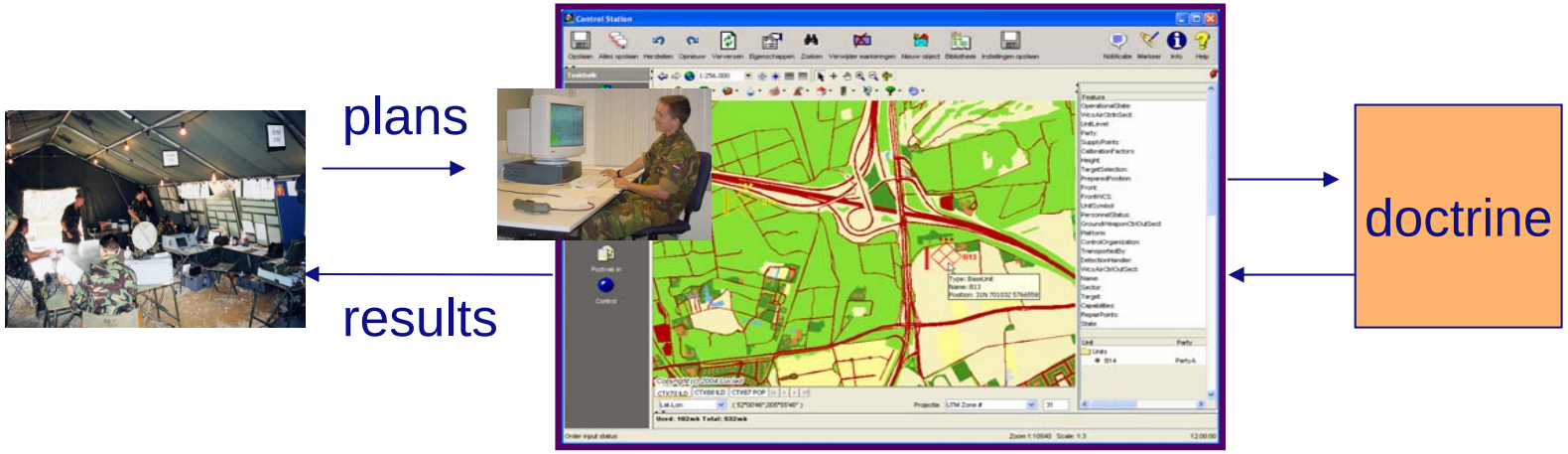
← results



→ doctrine

Kibowi Limitations being Addressed

- Humans are needed to translate received Plans/COAs to lower level tasks needed for fidelity/validity
- Doctrinal scripts can only be changed by programmer and will only work for Kibowi
- Scenario's are Force-on-Force (kinetic). No modelling of population, infrastructure, …
- Runs about real-time



Architecture Wishes

Decision-making should be independent of simulators

- Reuse, plug-and-play

Separate

- C2
- AI (plugable) for Lower Control Decision Making (tactics)
- Simulator

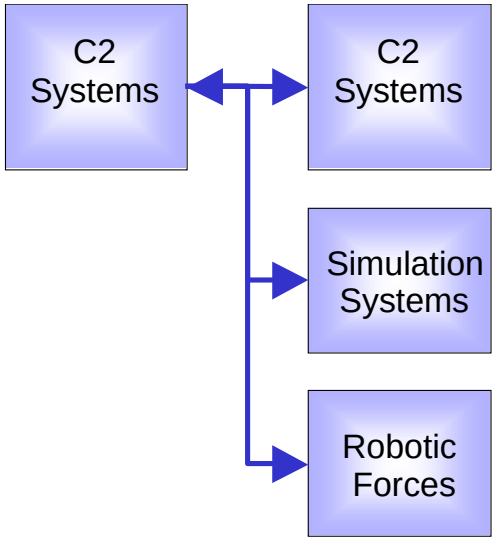
Use Intelligent Agent software for implementing Lower Control (LOCON) reasoning

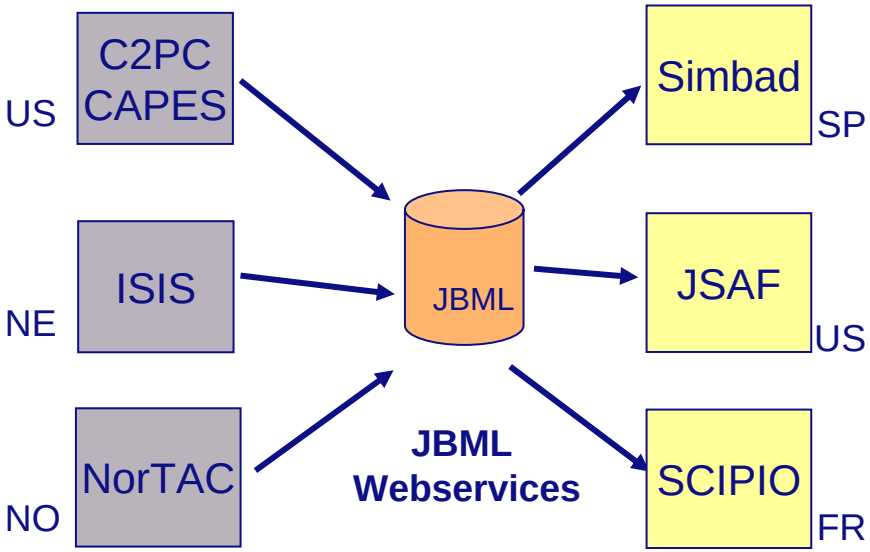
- Used the 2APL kernel of Utrecht University (http://www.cs.uu.nl/2apl/)

Military communication & standards between these components are needed (on top of common Intelligent Agent standard ACL (Agent Communication Language)

Battle Management Language (BML)

- Translate orders/reports in a computer readable language
- Command and Control Lexical Grammar (C2LG) language (Schade & Hieb 2005-2008)
- Used the Joint BML (JBML) web-service implementation of C2LG in the NATO Coalition BML Working Group MSG-048
- Standardization process by the Simulation International Standard Organization (SISO) in progress

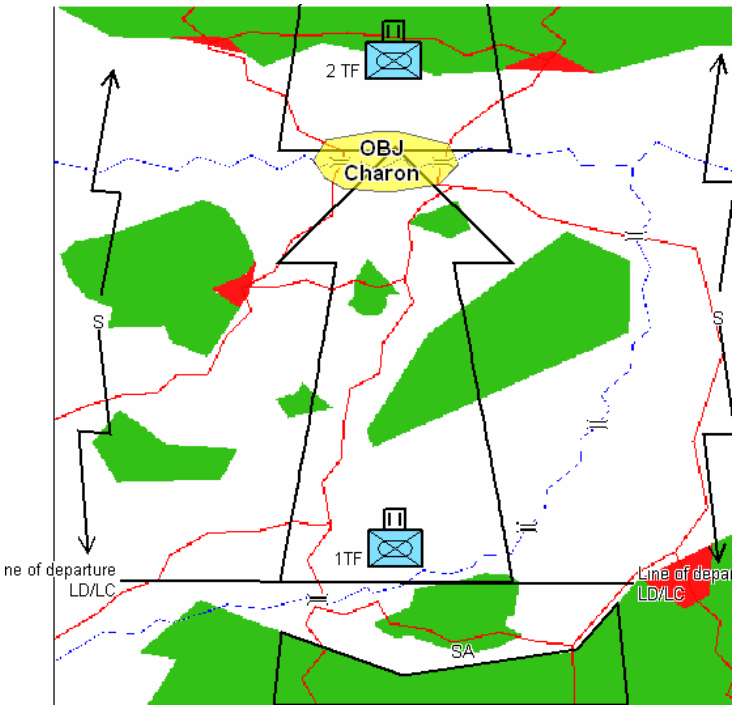




MSG-048 Demonstration in Dec 08

A 5W example of C2LG BML

Who, What, Where, When, Why



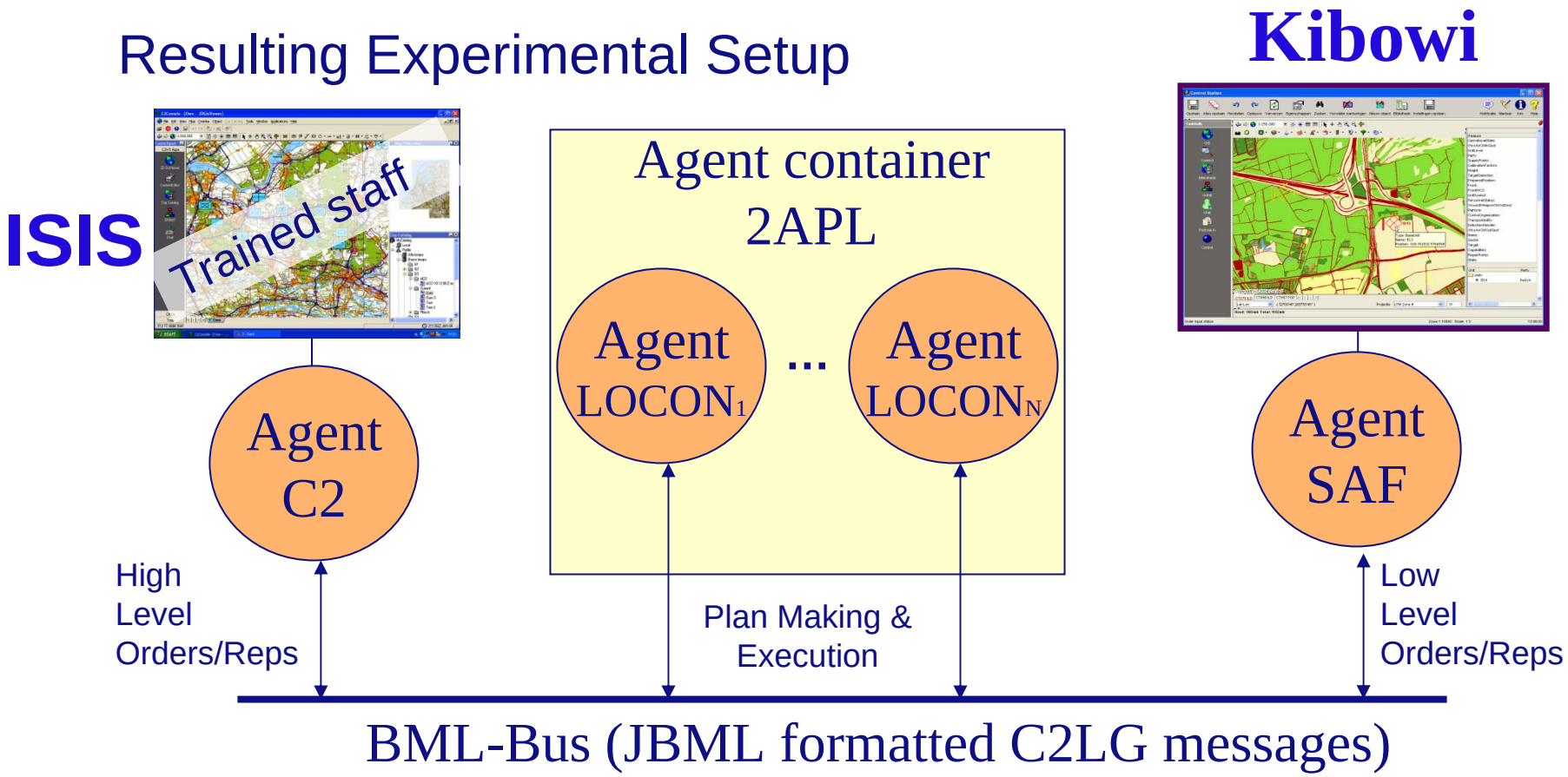
Current (partial) OpOrder in text

- **Assignment**
  1st TF seizes Bridges 1 and 2 over the Aa River intact enabling the fast forward movement of
  43 Bde to pass through their lines
- **Synchronization**
  Start after 110600Aug08
  End before 111000Aug08

The same Order in C2LG (computer readable)

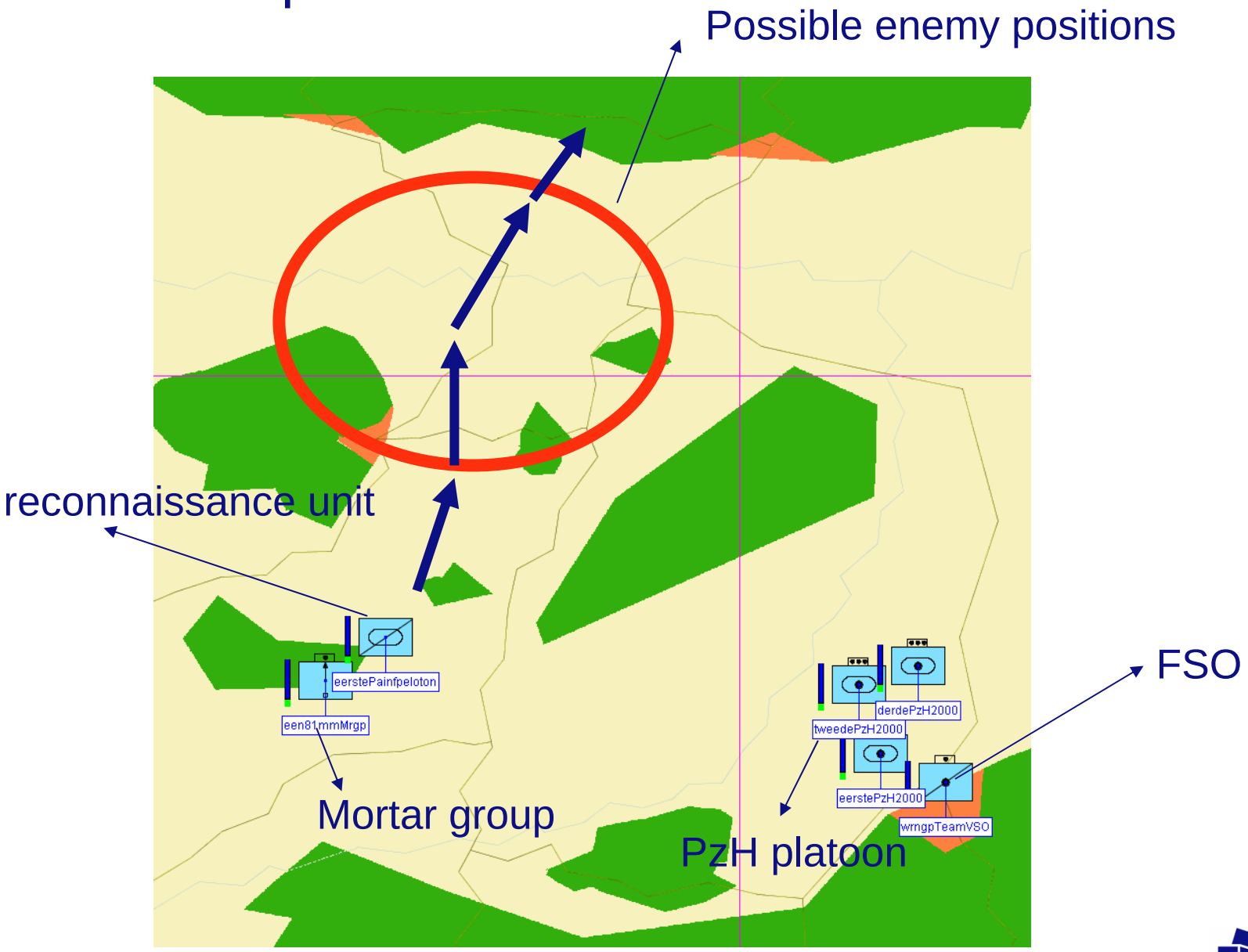
- Order1: 43 Bde **(Who-Tasker)** orders 1 TF **(Who-Taskee)** to seize **(What)** Bridges 1 & 2 **(Affected)** at Aa river **(AtWhere)** ASAP 110600aug08 **(StartWhen)** NLT 111000Aug08 **(End when)** in-order-to enable order2 **(Why)**
- Order2: HQ **(Who-Tasker)** orders 43 Bde **(Who-Taskee)** move **(What)** …

Resulting Experimental Setup



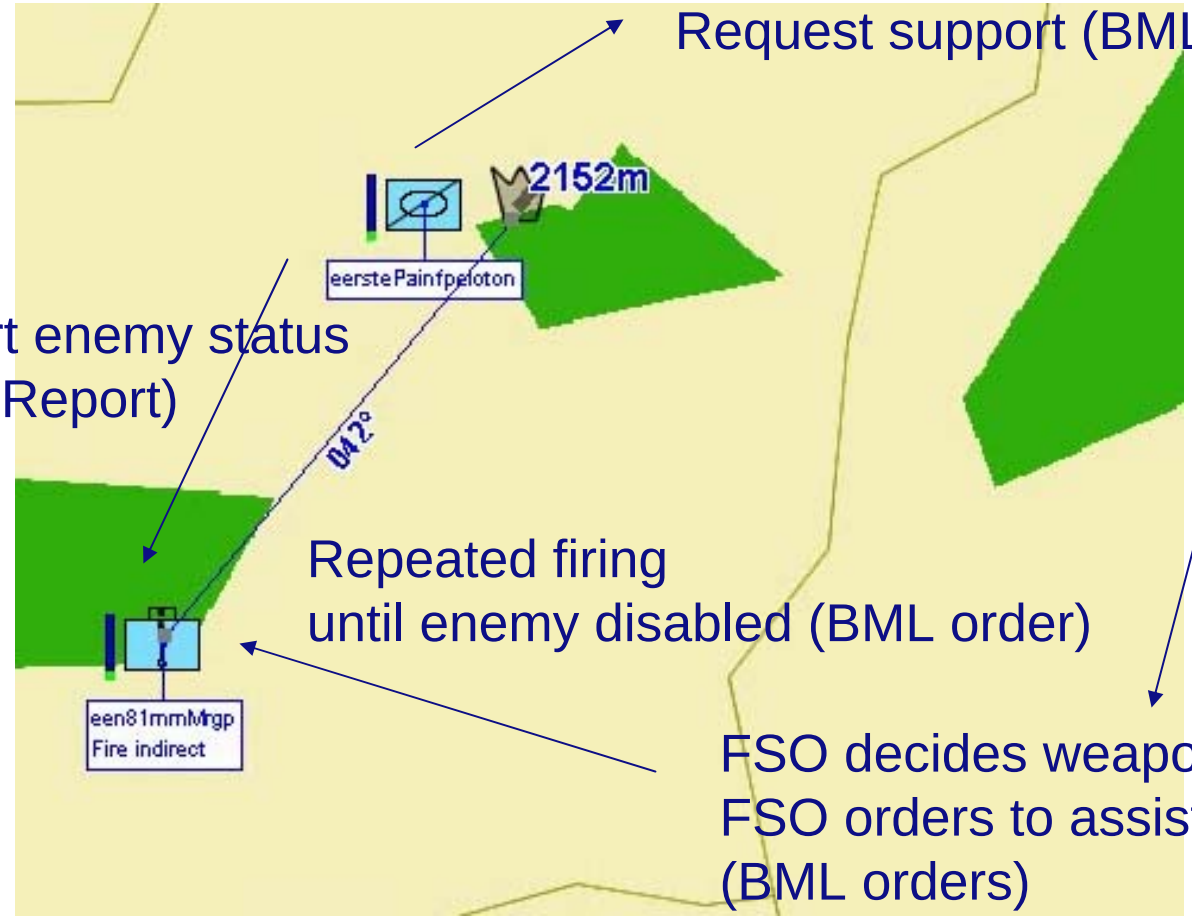
- Software Agents communicate with JBML format
- “Pluggable” commanders logic in 2APL container(s)
- Commanders logic not dependent on specific SAF (Semi Automated Force) or C2

Proof of Concept Scenario



COA in progress

Spot enemy (BML reports)
Request support (BML request)



Report enemy status
(BML Report)

Repeated firing
until enemy disabled (BML order)

FSO decides weapon system
FSO orders to assist
(BML orders)

Proof of Concept conclusions

- Agents and BML deliver wished ‘plug-and-play’ architecture
  - C2LG based BML successful in PoC
  - 2APL Agents can reason in this domain
  - No LOCON was needed for scenario
- Emerging standard make agents reusable, however …
  - Additional standards needed for terrain, weather, …
- Putting behavior in agents and the validation of this behavior is a lot of work!
  - No documents describe how to ‘command’ in a formal logical way
  - 2APL programming is for AI programmers only
  - This again stresses the importance of reuse (do it once)
- C2LG cannot yet express interdependency of orders (sequence)

Our way ahead

- For C2LG based BML
  - Add order interdependent Commanders Intent
  - Contribute to JBML language and experiments
  - In time, covert to C-BML standard

- For Simulation
  - Make agents logic easier to maintain (tools for adding doctrine)
  - Add standards for terrain, C2 fused data, …
  - Include more non-kinetic aspects in Kibowi simulation (e.g. collateral damage, population attitudes, emotions, …)

- For Complex Endeavors
  - Include ‘orders’ to Non Governmental Organizations (NGOs) (C2LG Schade-Hieb 2008), Population, …
  - Investigate usefulness of BML on the Campaign level
    - Can we include/combine culture, politics, hearts-and-minds, …?

Thank you
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