The Evolution of Computer Generated Forces (CGF) Architectures to Support Information Warfare Effects

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Content

- Introduction – Workshop
- Requirements
- Current Technology
- Conceptual Models
- Architecture
- Design Issues
- R&D Needs
- Conclusions

TTCP JSA TP2

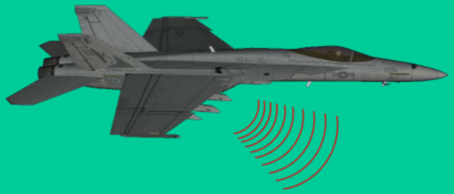
- TTCP Modeling and Simulation as a technology panel
- KTA3 – Synthetic Forces

- Workshop:
  - Implementation of Information Layer Warfare Effects in Computer Generated Forces (CGF) Simulations
  - 25-27 April 2016
  - DRDC Ottawa Research Centre, Ottawa.
  - 17 scientists and industry representatives, 5 nations

M&S Issue

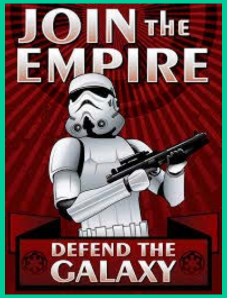
Information Warfare

Munitions



EW

Cyber



Info Ops

- Commanders need to know how to defend and employ Information Warfare and non-kinetic capabilities.
- Training systems are needed for both Specialists and common soldier.
- But how well are non-kinetic / Information Warfare Effects represented in CGF or federations?

AND, we need to reduce the complexity and cost of setting up and using our simulations

Information Warfare

Attacks

- EW
  - Jamming,
  - Interception,
  - False information
- Cyber
  - Denial of service
  - Modification of information
  - Creation of information
  - Theft of information
  - Surveillance
- Influence Operations
  - Social Media campaigns
  - Hearts and Minds
  - Espionage

Effects

- Primary
  - Disrupted flow of information
  - Intercepted information
  - Changed information
  - Created false information
- Secondary
  - Changed decision making and biases
  - Adversary better informed
- Tertiary
  - Slower reactions (org/unit)
  - Loss of trust in people & systems

Information Layer Requirements

- Primary effects are on information content and information flow.
- Secondary and tertiary effects are on decision making and behaviour
- Observation of effects is at tertiary level in unit reaction or lack of reaction to the situation.

- Need to model the information content that will affect decision-making and unit behaviour.

Current Technology

Computer Generated Forces

- Rudimentary communications networks
- Often perfect coms of reports with no uncertainty
- Simple C2 hierarchies
- Limited AI - relies heavily on Human Interactor
- No representation of persistent information Database.
- API may expose a transmission event (Emission PDU) but not the content.
- Simplistic EW models, if at all.
- Usually no Cyber models.

EW Simulators

- Can model EW Attacks, Jamming, Radar, etc
- Scripts to generate content for Coms EW
- Generate EM COP from CGF

Cyber Ranges

- Able to test real threats on isolated real systems & networks
- Too high fidelity for most M&S - only need effect

3rd Party AI

- Automate Pattern-of-life background clutter
- May provide Military Doctrine
- Entities may have "Attitude" – subject to Influence Ops
- Do not include electronic Tx
- Do not react to EW/Cyber

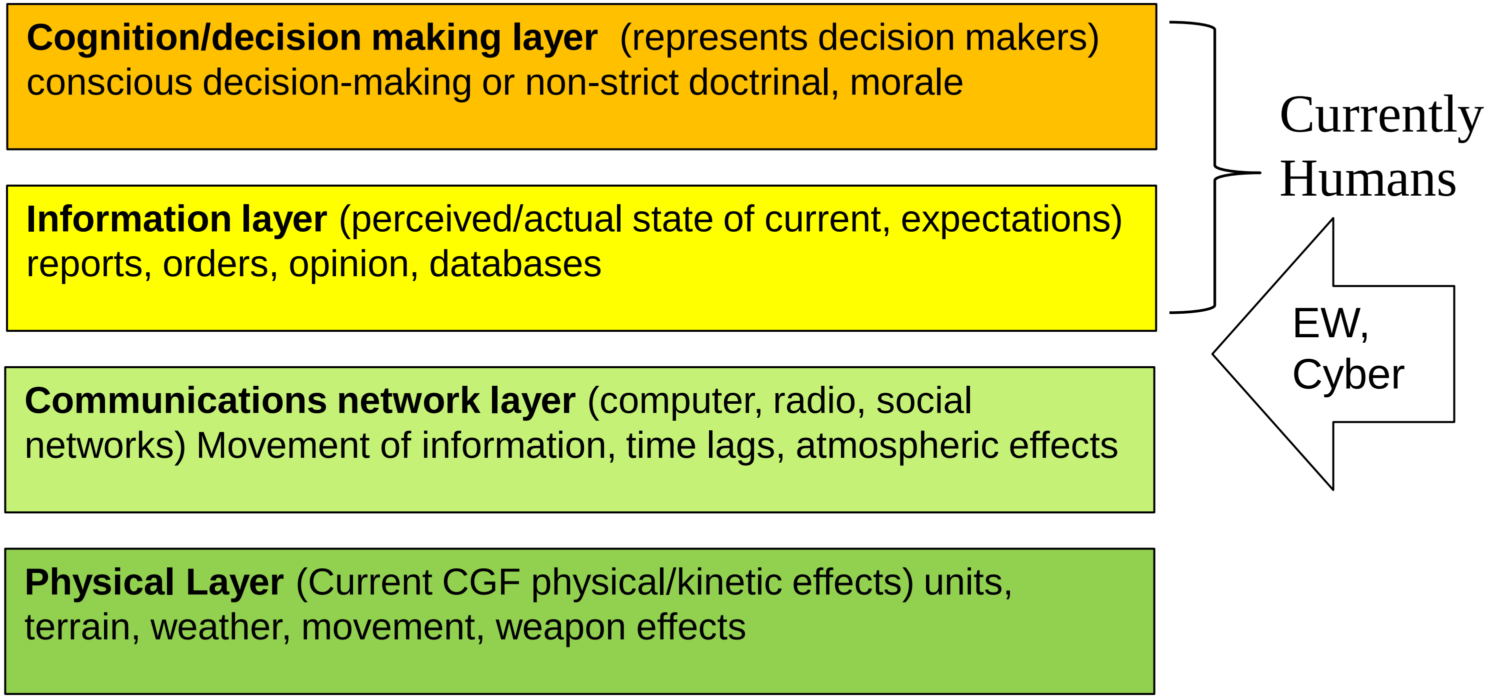
Network Emulators

- Represent radio and wired networks
- Allow Human controlled cyber attacks to disrupt information flow
- Do not understand transmission content

Can these all be integrated together?

We need to reduce the complexity and cost of setting up and using our simulations!

Initial Concept Architecture



Cognition/decision making layer (represents decision makers) conscious decision-making or non-strict doctrinal, morale

Information layer (perceived/actual state of current, expectations) reports, orders, opinion, databases

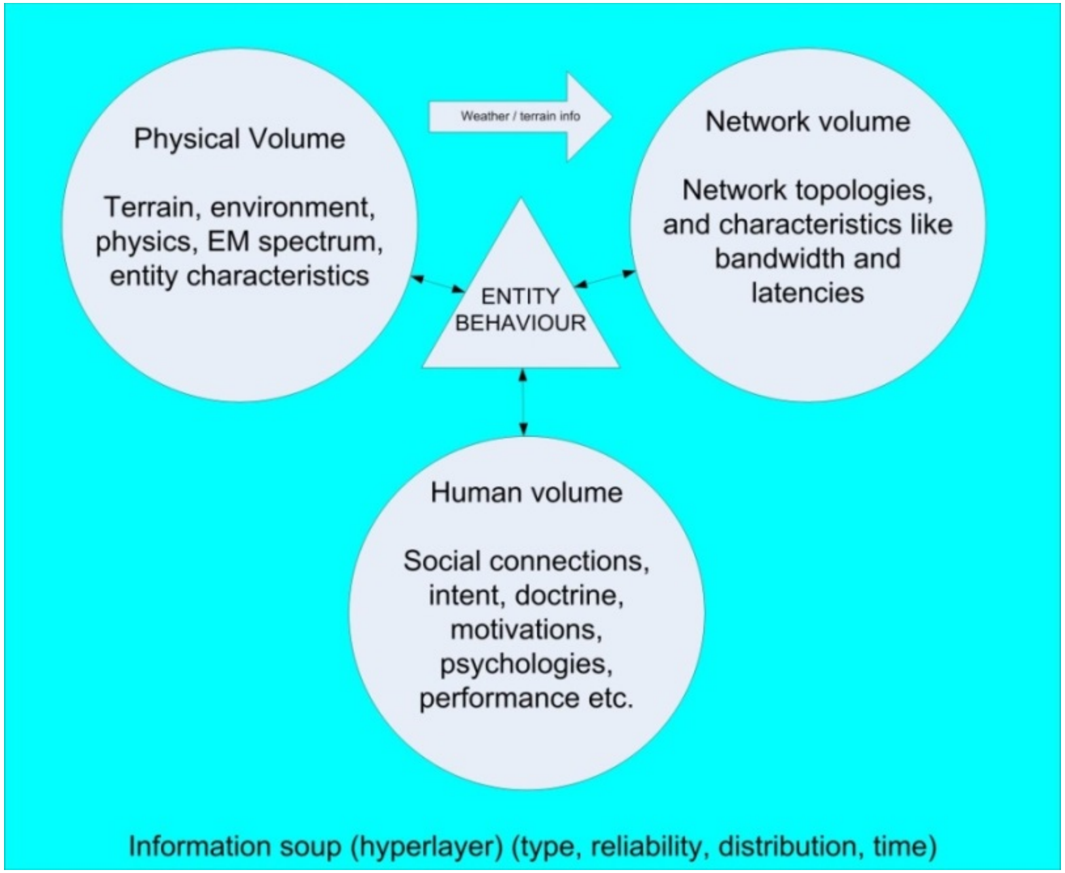
Communications network layer (computer, radio, social networks) Movement of information, time lags, atmospheric effects

Physical Layer (Current CGF physical/kinetic effects) units, terrain, weather, movement, weapon effects

Currently Humans

EW, Cyber

Information Space View



Weather / terrain info

Physical Volume

Terrain, environment, physics, EM spectrum, entity characteristics

Network volume

Network topologies, and characteristics like bandwidth and latencies

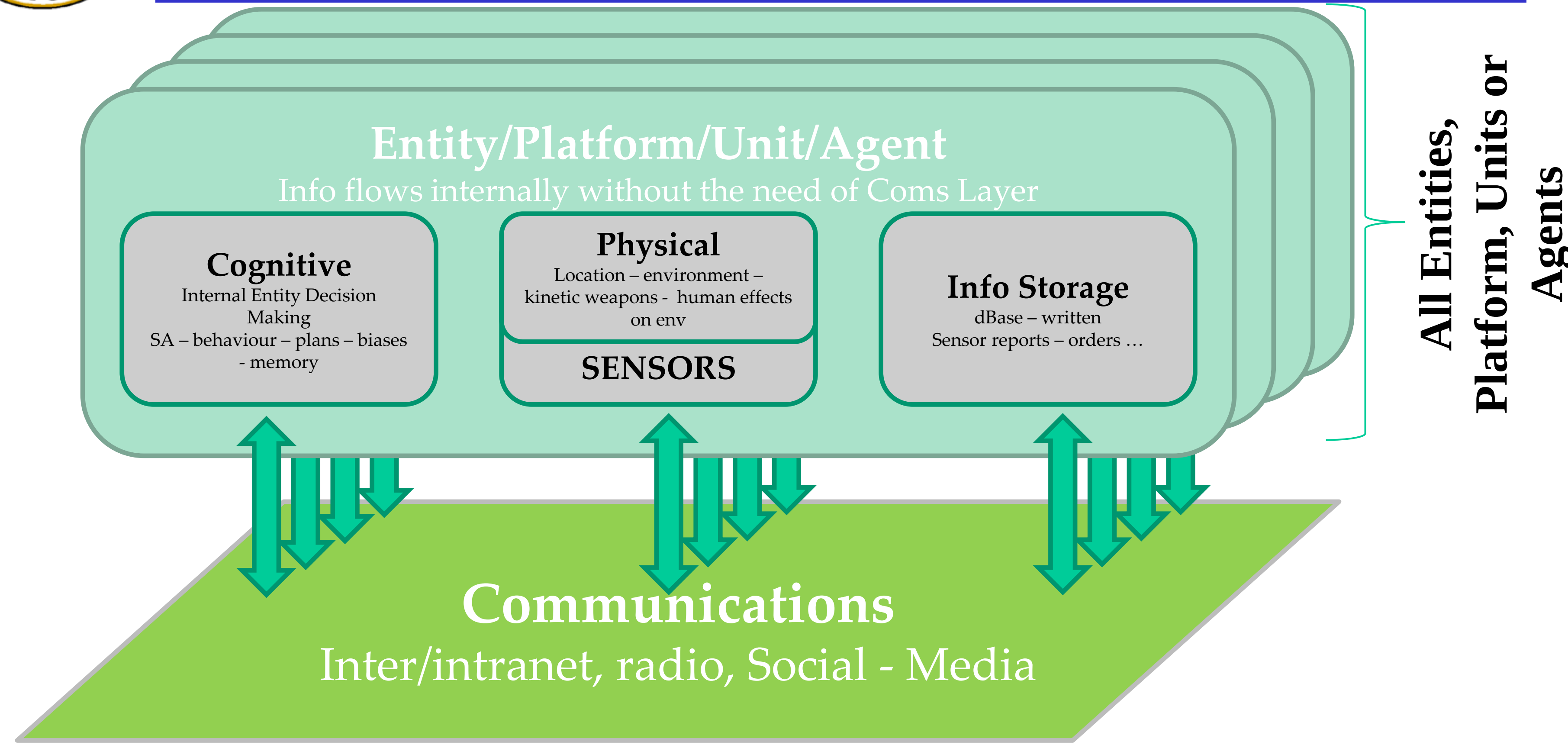
ENTITY BEHAVIOUR

Human volume

Social connections, intent, doctrine, motivations, psychologies, performance etc.

Information soup (hyperlayer) (type, reliability, distribution, time)

Entity Point of View



Entity/Platform/Unit/Agent

Info flows internally without the need of Coms Layer

Cognitive

Internal Entity Decision Making

SA – behaviour – plans – biases - memory

Physical

Location – environment – kinetic weapons - human effects on env

SENSORS

Info Storage

dBase – written

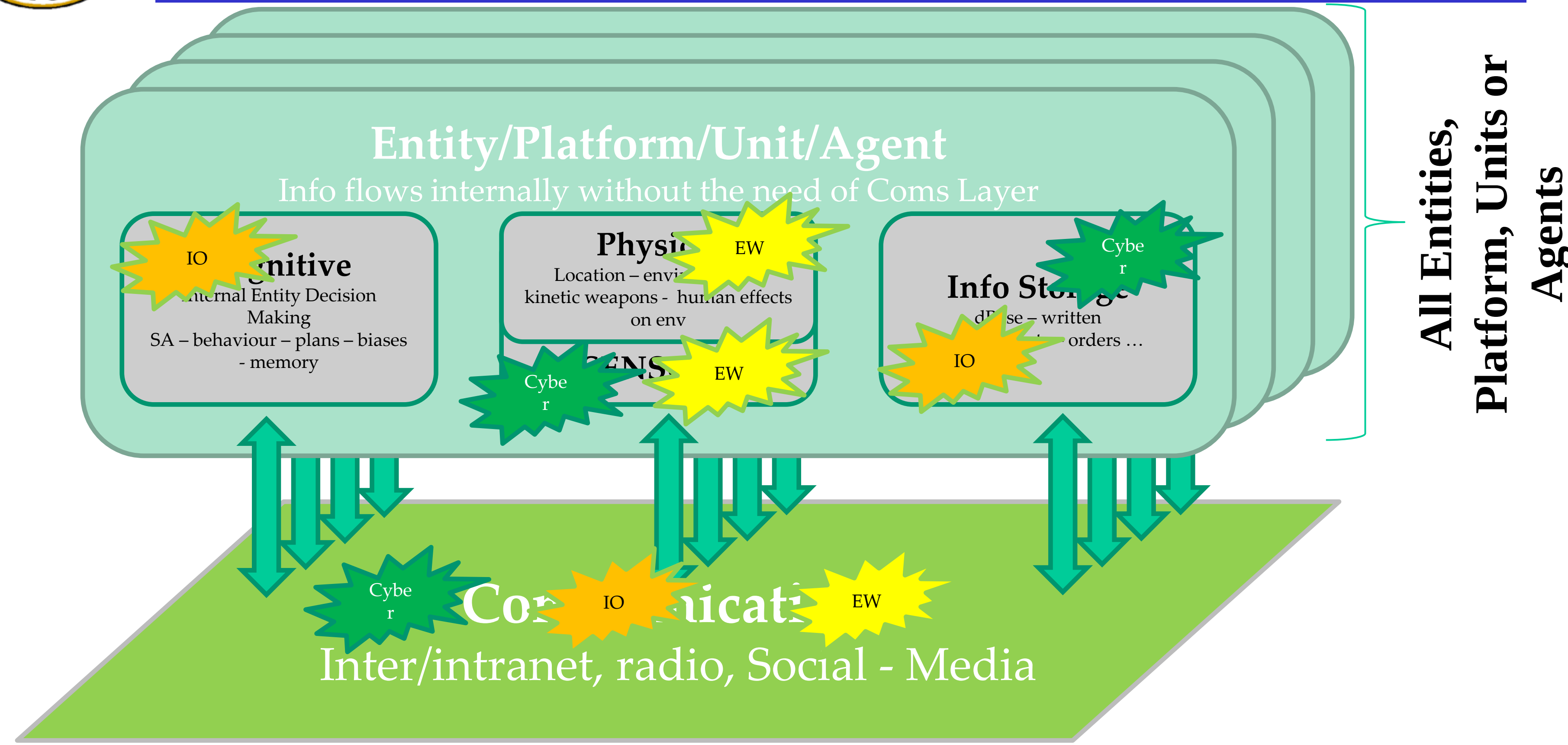
Sensor reports – orders …

Communications

Inter/intranet, radio, Social - Media

All Entities, Platform, Units or Agents

Entity Point of View



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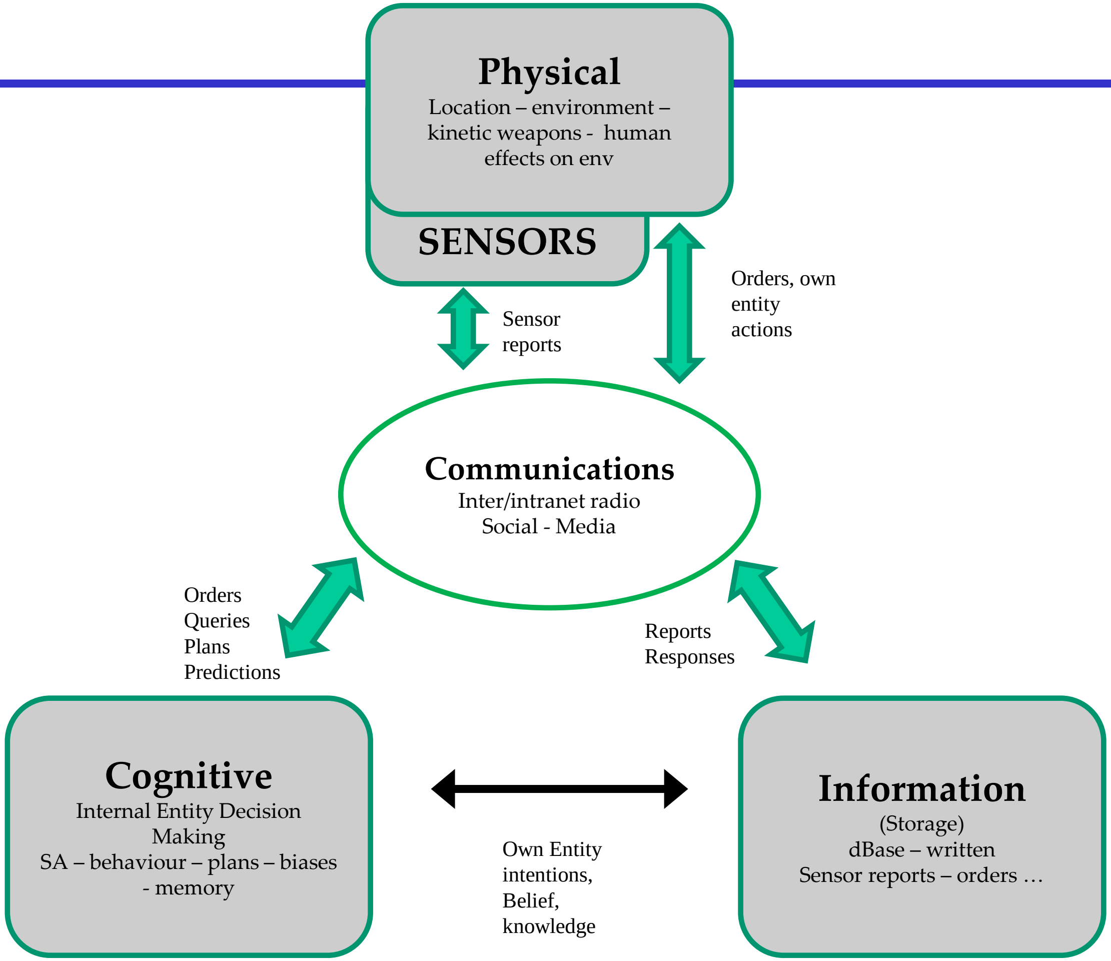

Physical

Location – environment – kinetic weapons - human effects on env

SENSORS

Sensor reports

Orders, own entity actions

Communications

Inter/intranet radio
Social - Media

Orders
Queries
Plans
Predictions

Reports
Responses

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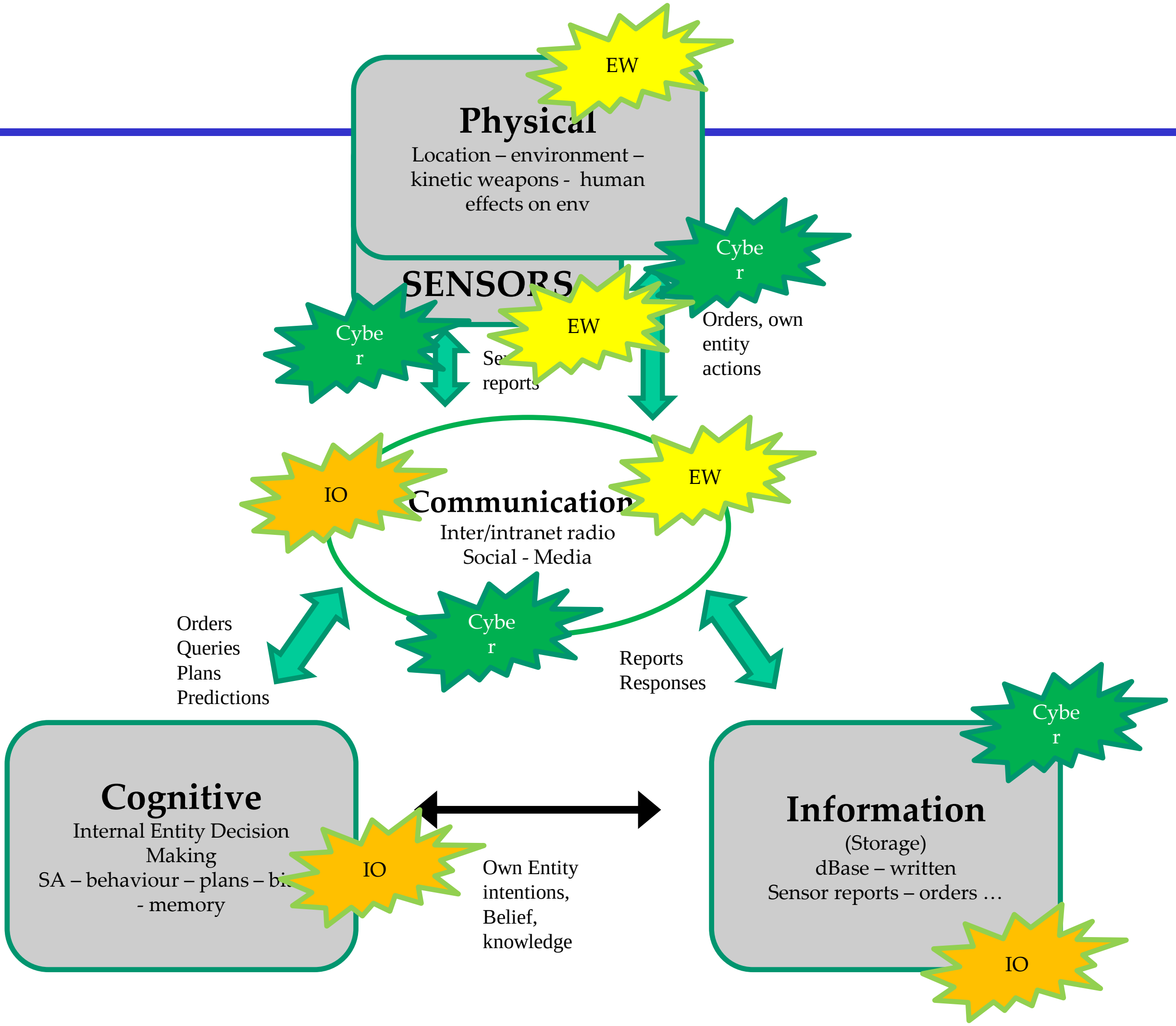
Own Entity intentions, Belief, knowledge

Information

(Storage)
dBase – written
Sensor reports – orders …



EW

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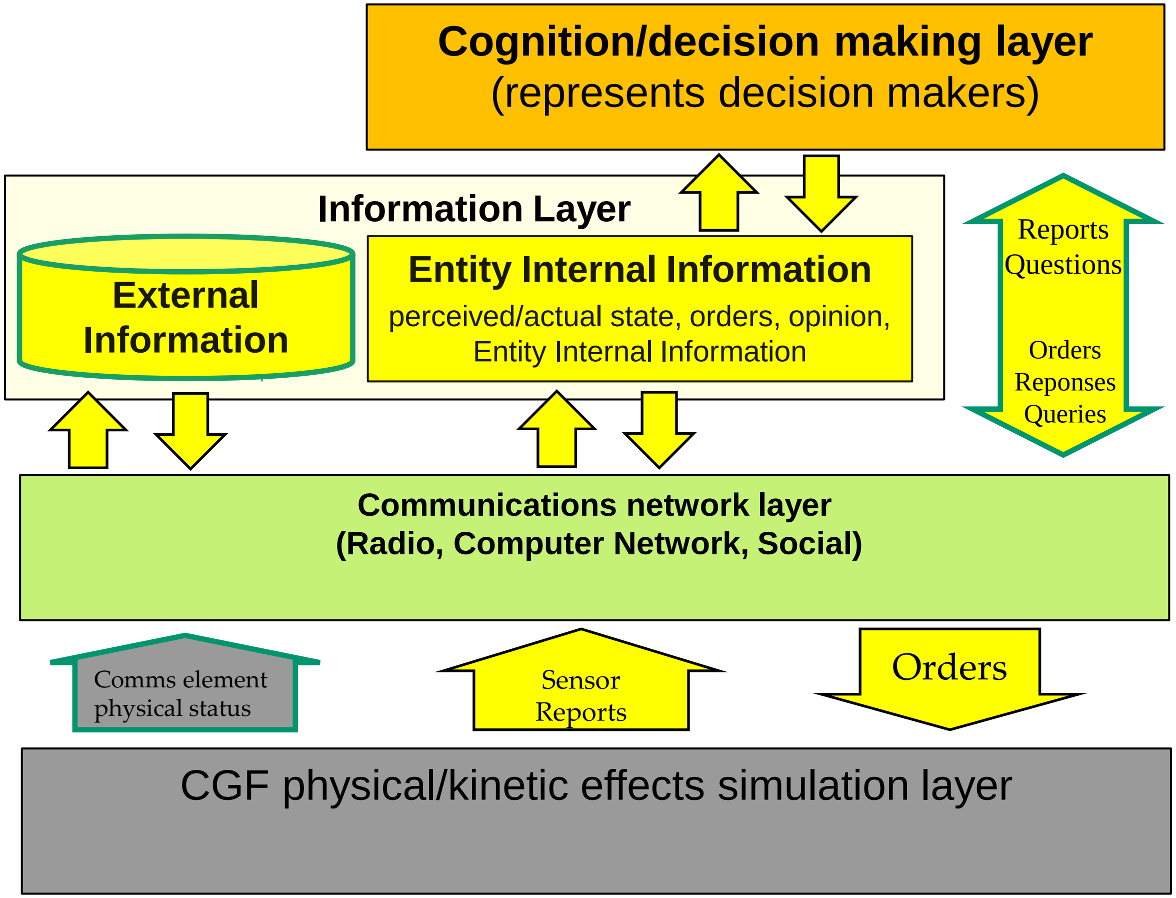
IW Architecture


Cognition/decision making layer
(represents decision makers)
Information Layer
External Information
Entity Internal Information
perceived/actual state, orders, opinion, Entity Internal Information
Reports
Questions
Orders
Reponses
Queries
Communications network layer
(Radio, Computer Network, Social)
Comms element physical status
Sensor Reports
Orders
CGF physical/kinetic effects simulation layer

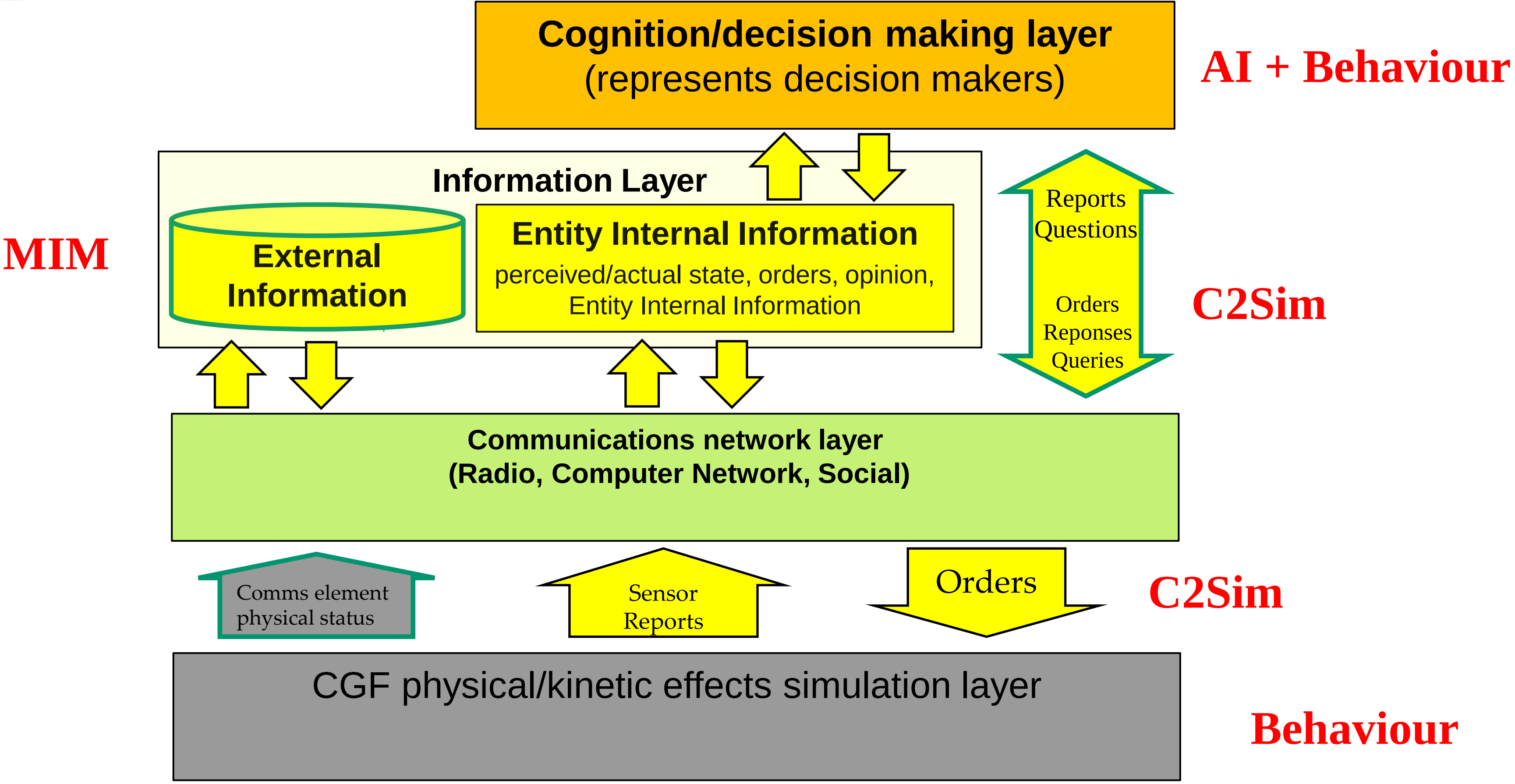
Complexity vs Human Involvement

- Increased complexity of scenarios
  - Socio – Political – Economic
  - Military – Security – Civilian – Non-governmental
- Cost of Human interactors already too high to run even small exercises as often as required
- Cost of scenario development too high both in terms of money, time and VVA
- Need automation of validated unit behaviour and decision-making, coupled with re-use of scenario data.
  - Complex fake worlds
  - Use of classified data from real world
  - Hybrid (?)

Design Issues to be addressed

- Determine layer functionality specifications
- Framework for partitioning functionality into services
- Inter and Intra-layer interface standards
- What is the basic (default) infrastructure required for a meaningful instantiation?
- Behaviour characterization
  - Standards for describing
  - Methodologies for translation between CGF
- Information content models
  - MIP Information Model
  - MetaData for content

What’s Next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AI + Behaviour
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Entity Internal Information
perceived/actual state, orders, opinion, Entity Internal Information
MIM
Reports
Questions
Orders
Reponses
Queries
C2Sim
Communications network layer
(Radio, Computer Network, Social)
Comms element physical status
Sensor Reports
Orders
C2Sim
CGF physical/kinetic effects simulation layer
Behaviour

What’s Next

- Community development of IW architecture
- Advance the parts:
  - How applicable is the MIM for M&S applications
  - MSG-145/SISO - C2Sim – supporting order content, and interoperable specification of behaviour
  - MSG-127 on description of Human Behaviour Modelling
  - IST-121 on Autonomous CGF entities
  - MSG-136 on MSaaS

Conclusions

- In order to model Information Warfare issues an engagement model is needed that explicitly includes information.
- An initial high level architecture has been proposed
- A lot of the pieces are being investigated
  - NATO, SISO, MIP, TTCP
- But needs coordination and a common architecture to avoid too many proprietary non-interoperable solutions
- NATO ET to look at the Information and Decision-Making layers.