A Multiagent System Supporting Tactical Behaviors and Cybersecurity

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Description of the Effort

- Agents are associated with mobile resources in a tactical unit.
- Agents cooperate not only to achieve overall tactical goals but also for sharing info and situation awareness as well as autonomic cyber behavior (especially cybersecurity behavior)
- We employ dynamic network representations, expressed in our ontology, and do (sub)task assignment and (sub)coalition formation to achieve tactical goals securely.

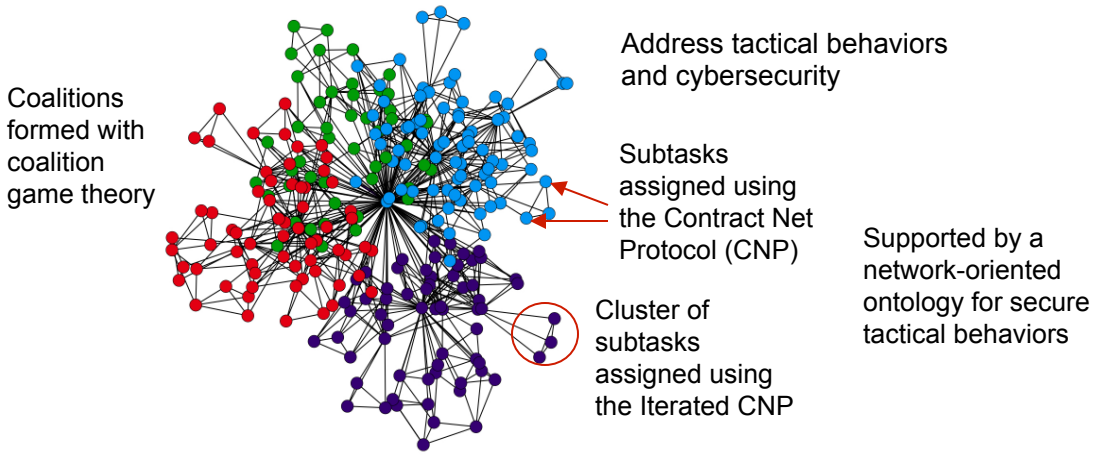
Challenges

- For a situation, find techniques to assign (sub)tasks & establishing (sub)coalitions.
- For a given problem situation, determine the appropriate portion of the network to view and the appropriate level of detail so that threats may be avoided and opportunities may be exploited.
- Determine what ontology elements facilitate reasoning yet capture all relevant information

Risk

- Not enough information on tactical behaviors, cyber environment
- Solution: Interview Army personnel, make reasonable assumptions

A multiagent system assisting a tactical unit



Proposed Technical Approach

- Approaches for assigning (mission and security) (sub)tasks and forming (sub)coalitions
  - The *contract net protocol* (CNP) takes a greedy approach to allocating subtasks
  - Better results obtained with the *iterated CNP* (iCNP), can allocate sets of subtasks to sets of agents
  - *Coalition game theory* is better still—allocate constellations of task to constellations of agents
  - But better results require more computational resources.
- Implementation use JADE (Java Agent DEvelopment Framework) and NetworkX (network analysis).
- Dynamic networks, at different extents and levels of detail, start with ego networks and expand out
- Ontology captures network info, facilitates situation awareness, vulnerability (cybersecurity), trust
  - » Classification helps determine subtask assignments and values of coalitions

Benefits of Proposed Effort

- Cooperation, sharing info (situation awareness), autonomic cyber behavior (esp. cybersecurity)
- Supported by formalisms and theory, will also facilitate our understanding in tactical behaviors.

Rough Order of Magnitude Cost and Schedule

- Three years, $175K per year

Milestones

- 12 months: Concepts, models, and code for an ontology for tactical units based on dynamic networks
- 24 months: Concepts & code for CNP, ICNP, coalition game theory for assigning tasks and forming coalitions
- 36 months: complete multiagent system for tactical behaviors and cybersecurity

Deliverables

Year 1

- Document: Representing the Behavior of Tactical Units with Dynamic Networks (& Python+NetworkX code)
- Document: A Network-oriented Ontology for Tactical Units (and accompanying OWL files)

Year 2

- Document: CNP & iCNP for Tactical Beh. & Cybersecurity Using a Network-oriented Ontology (Java+JADE code)
- Document: Coalition Game Theory for Tact. Beh. & Cybersecurity Using a Network-oriented Ont. (Java+JADE code)

Year 3

- Code + test documents + manuals + transition plans
- Document: A Multiagent System for Tactical Behaviors and Cybersecurity

Point of Contact

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