



Army Research Office Multidisciplinary University Research Initiative

Unified Research on Network-based Hard/Soft Information Fusion

Option Year Plans

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Proposed Schedule -Progress at Year 1-



Bid Period →	6/09-9/09	10/09-9/10	10/10-9/11	10/11-5/12		6/12-9/12	10/12-9/13	10/13-5/14
Thrust/Task ↓								
1. Source Char	Audio, Text Extr	Human Observ						
2. Common Ref	Multi-msg and OSINT		Networked CR			Networked CR		
3. Data Assoc	Multi-msg, OSINT, ICD		Networked DA			Networked DA		
4 State Estim.	Hard Fusion Prototype Soft Fusion Prototype	Hard+Soft Estimation Fusion Prototype I Ctr Insurgency Centralized	Hard+Soft Fusion Prototype II Ctr Insurgency, Networked			Hard+Soft Fusion Prototype III Civil Emergencies, Networked		
5. Network Effects			Latency, Pedigree			Latency, Pedigree		
6. Test & Eval	ARO Data Set Integration	T&E Methods & Metrics	Parametric-to-Human in Loop Experiments				Parametric-to-Human in Loop Experiments	
7. Extensibility Scalability			Problem-space and Computational Scalability				Inter-Domain Robustness Assessment	
8. Framework	Framework Development		Framework Assess.				Framework Assess.	
9. Concept of Employment			COE for Centralized, Networked Ctr Insurg				COE for Networked Civil Emergency	
Tech Inter Mtgs (Quarterly)	▲	▲▲▲▲	▲▲▲▲	▲▲▲▲		▲	▲▲▲▲	▲▲▲▲
Milestones (◆)			◆		◆			◆



Proposed Schedule -Progress at Year 2-



Bid Period →	6/09-9/09	10/09-9/10	10/10-9/11	10/11-5/12		6/12-9/12	10/12-9/13	10/13-5/14
Thrust/Task ↓								
1. Source Char	Audio, Text Extr	Human Observ	◆					
2. Common Ref	Multi-msg and OSINT		◆	Networked CR		Networked CR		
3. Data Assoc	Multi-msg, OSINT, HARD		◆	Networked DA		Networked DA	◆	
4 State Estim.	Hard Fusion Prototype Soft Fusion Prototype	◆	Hard+Soft Estimation Fusion Prototype I Ctr Insurgency Centralized	◆	Hard+Soft Fusion Prototype II Ctr Insurgency, Networked		Hard+Soft Fusion Prototype III Civil Emergencies, Networked	◆
5. Network Effects			◆	Latency, Pedigree		Latency, Pedigree		
6. Test & Eval	ARO Data Set Integration	◆	T&E Methods & Metrics	◆	Parametric-to-Human in Loop Experiments		Parametric-to-Human in Loop Experiments	
7. Extensibility Scalability			◆	Problem-space and Computational Scalability			Inter-Domain Robustness Assessment	
8. Framework	Framework Development	◆		◆	Framework Assess.		Framework Assess.	
9. Concept of Employment				◆	COE for Centralized, Networked Ctr Insurg		COE for Networked Civil Emergency	
Tech Inter Mtgs (Quarterly)	▲	▲▲▲▲	▲▲▲▲	▲▲▲▲		▲	▲▲▲▲	▲▲▲▲
Milestones (◆)			◆		◆			◆



Proposed Schedule -Progress at Year 3-



Bid Period →	6/09-9/09	10/09-9/10	10/10-9/11	10/11-5/12		6/12-9/12	10/12-9/13	10/13-5/14
Thrust/Task ↓								
1. Source Char	Audio, Text Extr		Human Observ					
2. Common Ref	Multi-msg and OSINT			Networked CR		Networked CR		
3. Data Assoc	Multi-msg, OSINT, HARD			Networked DA		Networked DA		
4 State Estim.	Hard Fusion Prototype	Soft Fusion Prototype	Hard+Soft Estimation Fusion Prototype I Ctr Insurgency Centralized	Hard+Soft Fusion Prototype II Ctr Insurgency, Networked		Hard+Soft Fusion Prototype III Civil Emergencies, Networked		
5. Network Effects				Latency, Pedigree		Latency, Pedigree		
6. Test & Eval	ARO Data Set Integration	T&E Methods & Metrics		Parametric-to-Human in Loop Experiments			Parametric-to-Human in Loop Experiments	
7. Extensibility Scalability				Problem-space and Computational Scalability			Inter-Domain Robustness Assessment	
8. Framework	Framework Development			Framework Assess.			Framework Assess.	
9. Concept of Employment				COE for Centralized, Networked Ctr Insurg			COE for Networked Civil Emergency	
Tech Inter Mtgs (Quarterly)	▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲		▲	▲▲▲▲▲	▲▲▲▲▲
Milestones (◆)			◆		◆			◆



Summary of Year 3 Networked H/S Capability



- Basic Research Advances
 - Hard counterpart of SYNCOIN
 - New Syntactic to Semantic Processing rules in Tractor
 - Human subject studies for several observational categories
 - New formulations and algorithms for data association
 - Complete stochastic graph matching and link analysis capability
 - 2D/3D Data Level Fusion and improved tracking; Acoustic studies.
 - Network science
- Move from centralized to **Networked** Hard-Soft Fusion Capability
 - SOA/ESB, OGC and TML standards, AMQP
 - Stood-up a Distributed T&E Environment (Metric mentioned earlier)
 - Latency issues and impact on H/S fusion results still to be studied
 - Cloud implementation of data association and link analysis
 - More work needed for US Army “global” graph
 - Overall Network Framework



Year 4 and 5 Plan
Completing COIN capability
New Domains
Transitions



Competing COIN Capability



- Achieve a fully integrated and networked COIN H/S Fusion capability
- Perform rigorous Test & Evaluation; possibly make adjustments
- Enhance user focus to facilitate system adoption
- Continue new research in analytics and inference; focus on inductive learning and abduction
- Generate semantically rich information from hard data for H/S fusion



New Directions and Domains



- New Domains
 - Financial Fraud/Forensics (Hard = trade information; Soft = emails, news, etc.)
 - Civil Emergencies



Summary

Option Year Advances



- New Basic Research Results
 - For example: New tasks on Hidden Markov Models to understand temporal elements of the storyline
 - Random Graphs in inductive learning
- Rigorous T&E with distributed, networked and human-in-the-loops aspects
- Specific emphasis to dynamic (and OOSM) elements of hard/soft information flow into the network
- Dealing with conflicting information and (limited) deception
- Translation to Civil Emergencies or Transition domains to demonstrate robustness of the methodologies developed
- Hardened Software with Transition programs
- Sub-set of capabilities to be tested within DCGS-A
- New Relationships with Harvard MURI and enhancements of SNA aspects of the program



Option Year Transition Targets



- I2WD/A2SF and Bio-NODE programs
- ARL APG: uncertainty alignment and graph matching
- AFRL
 - Graph-based analytics to DEBU (Developing and Exploiting Behavior Understanding with Layered Sensing)
 - Extraction Enhancements (such as TRACTOR)
- NAVSEA
 - Hard/Soft Fusion process in vertical process of ASW
 - Computation/Cognition Fusion as integral part of USW-DSS
- Ft. Huachuca (US Army Intel Center for Excellence) and ONR
 - Hard/Soft Fusion in the ISR Sync Process
- DHS data fusion centers
- JIEDDO
- JIATF SO (Joint Interagency Task Force South)
- National Military Command Center (NMCC)