Designing Reliable and Secure Tactical MANETs

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Objectives:

- To develop and implement practical techniques that integrate Mobile Ad-hoc Network (MANET) *reliability* and *security* for *tactical* operations

- To achieve *superior performance* characteristics in the face of communication uncertainties, failures and adversary attacks.

Approach

- Introduced the notion of the *Trusted Core (TC) of a tactical MANET*

- *Adaptive Communication Monitoring within TC*

- *Dynamic Trust Establishment for Nodes and Data*

- *Network Utility Maximization*

- *Adversary Modeling: Detection and Response*

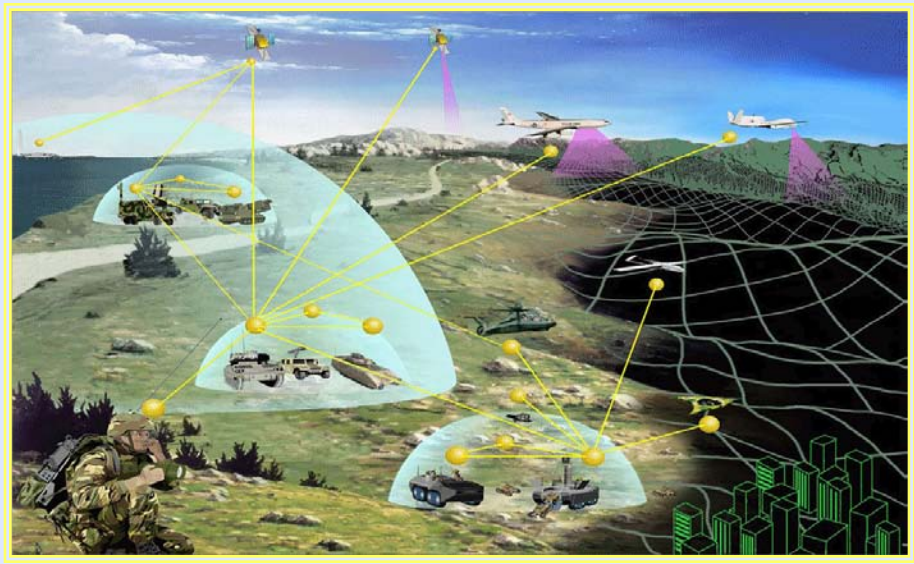
Technical Success:

- Provably reliable and secure services for tactical MANETs

- Security protocols for multi-service tactical MANETs with guaranteed performance

- Effective analysis techniques for vulnerabilities and countermeasures in tactical MANETs and wireless sensor networks

- Transition path to ARL, ARL CTA project, Intel Corp., and Boeing Corp. (FCS Integrator)



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Outcomes (year 2):

- **Refereed Publications:** - 7 journal (e.g., 4 IEEE Transactions, Journal of AI Res., Journal of Sel. Areas in Comm., Comm. in Inf. & Systems)
  - 33 conference (e.g., ACM MobiCom, MobiSys, CCS, WiSEC, CoNext; IEEE ICDCS, KDD, CDC)
- **Collaborations:** US ARL, CTA, Boeing, Intel
- **Results:** introduced notion of Trusted Core, dynamic trust establishment; adaptive protocols; new net. utility max. algorithms; new adversary models and defenses in several MANETs areas

Payoff (year 2) - knowledge gained:

- Practical trade-offs between Machine Learning and Network Utility Maximization in adaptive communication in face of uncertainty and interference
- How to incorporate data-centric trust into stochastic network theory
- Techniques to detect and tolerate node capture by a network adversary in clock synchronization, anti-jamming protocols, and routing
- Techniques for dynamic trust establishment using proximity relations, and for authentication

Follow on successes:

- **new ideas:** distributed prediction and adaptive algorithms with uncertainty handling; predictive, proactive and proximity-based trust; new adversary models for MANETs
- **new projects:** super-linear speedup in prediction with multi-cores; incorporate trust constrains on comm. paths; adaptive resource allocation for routing and network coding
- **new products:** new alg. for adaptive comm.; dyn. trust estab.; jamming det.; synchronization

Remaining technology gaps:

- High-performance Machine Learning for MANETs
- Robust, distributed communication scheduling with reward functions; network coding and routing trade-offs
- Practical algorithms for predictive and proactive trust establishment and integration with proximity based trust protocols; robust response to attacks
- Lightweight protocols for clock synchronization at network and transport layers of a MANET
- Practical tools/techniques in anti-jamming control