A Cross-Layer Architecture for Secure Resilient Tactical Mobile Ad Hoc Networks

Networks & Communications

Objective:

To greatly enhance the survivability of tactical MANETs, to provide resistance to a large variety of attacks, and to adapt to harsh environmental conditions including link/network/protocol failures.

Technical Approach:

- To perform measurements via real deployments and enhancing our understanding of layer dependencies and vulnerabilities in mobile ad hoc networks;
- To build analytical models to characterize the behavioral nuances of these networks
- To design new cross layer protocols that protect against vulnerabilities and provide resilience and robustness against attacks.

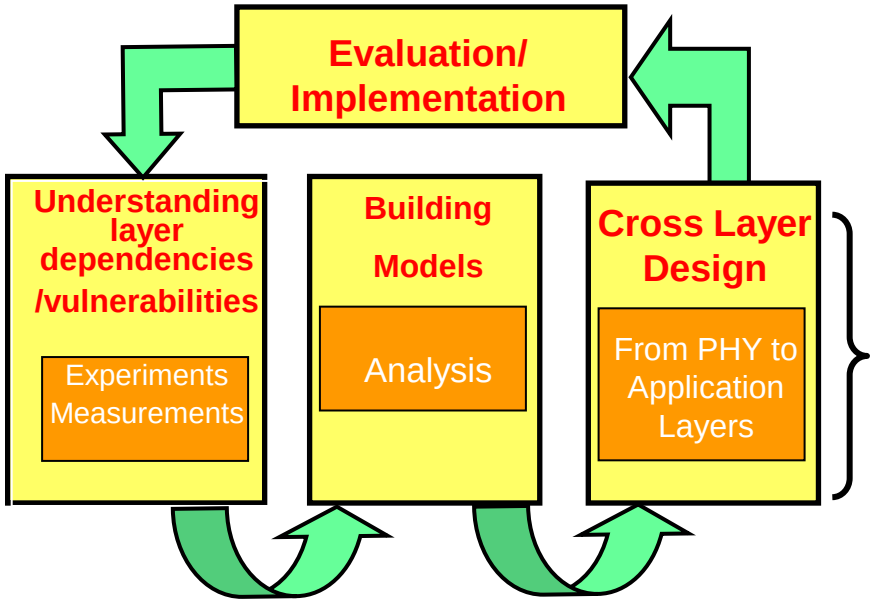
Technical Success:

-Design of a cross layer architecture for resilient and robust MANET

-Analytical models for MIMO based security features, physical layer models for packet loss and adversarial behavior

-Mechanism for adaptive tradeoff between performance, security, and fault-resilience.

-Transition path to ARL CTA and ITA



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Application/Outcome:

- Experimentally validated physical and higher layer characterization and dependencies
- Account for physical layer effects in the cross-layer designs to provide better security and resiliency
- Modeling of a comprehensive set of attacks and fault-management issues
- ARSENAL design will aim for provisioning a basic set of services to be operational without disruption (albeit at degraded performance)

Payoff:

- Papers published in peer-reviewed journals = 19
- Papers published in peer-reviewed conferences = 61
- No. of graduate students supported = 21
- No. of PhDs awarded = 4
- One faculty elected as IEEE Fellow
- One faculty elected as ACM Fellow
- Best paper award in MILCOM-2008
- Best paper award in IEEE MASS 2008

Follow-on Success:

- Secure key extraction using wireless link characteristics, device characteristics, and multiple antenna diversity
- Efficient routing using temporal ordering
- Route magnet detection and countermeasures for packet replay attacks
- Joint network coding and transmission rate control
- MIMO-based security establishment
- Cross-layer designs for jamming resilience

Remaining Technology Gaps:

- Design routing approaches that are immune to colluding attacks
- Mobility modeling and its impact on security and reliability
- Radio authentication and channel characterization
- Design algorithms to optimize network robustness using new metrics