

Mobile Ad Hoc Networking for the Transformed Army (MANTA)

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Project Data

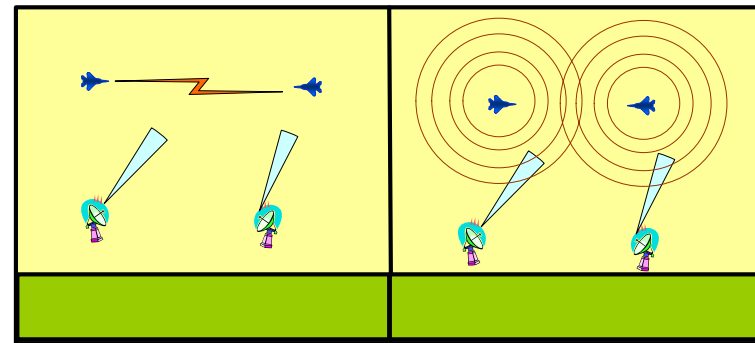
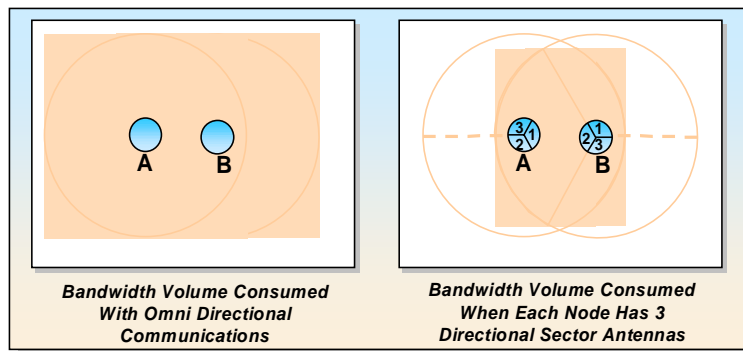
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- **Funding Source: MITRE Sponsored Research**
- **Principal Investigator: Robert C. Durst/Kevin H. Grace**
- **Business Leader: Marnie Salisbury**
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- **Technical Area: Comms and Networks**
- **External Web URL:
http://www.mitre.org/tech_transfer/mobilemesh/**

Problem

- **Highly directional communications are needed for Army transformation in order to provide:**
 - **Dramatically higher data rates**
 - **Low probability of detection and intercept**
 - **Resistance to jamming.**
- **Quality of service (QoS) mechanisms are needed to support the C4ISR collaborative applications.**
- **Current mobile ad hoc networking techniques neither embrace directionality nor differentiate QoS.**

Background

- **Directional communications**
 - Consume smaller bandwidth volumes, thus enabling increased spatial reuse of spectrum resulting in increased network capacity
 - Provide stealth for airborne platforms



- **QoS requires predictable channel access**
- **But existing contention-based access schemes rely upon omni-directional communications and random access...**

Objective

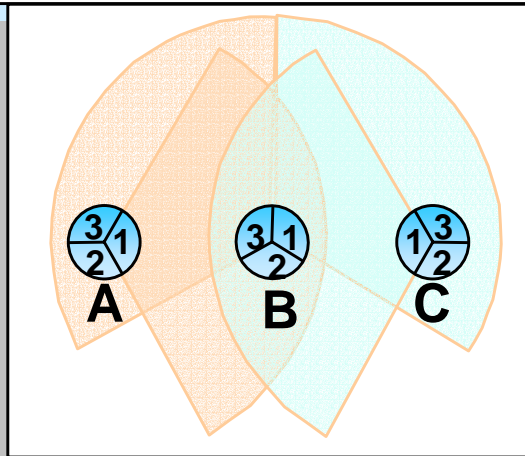
- **What channel access mechanisms can best combine directional and omni-directional elements in ad hoc networks?**
- **What channel access mechanisms support quality of service?**
- **How should one initiate and maintain a network topology in directional ad hoc network environments?**
- **What routing and antenna scheduling algorithms are necessary to achieve standard (unicast), high-assurance, and multipoint data delivery services in directional ad hoc networks?**

Activities

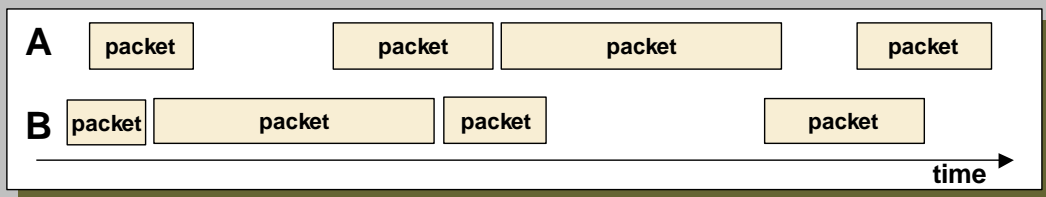
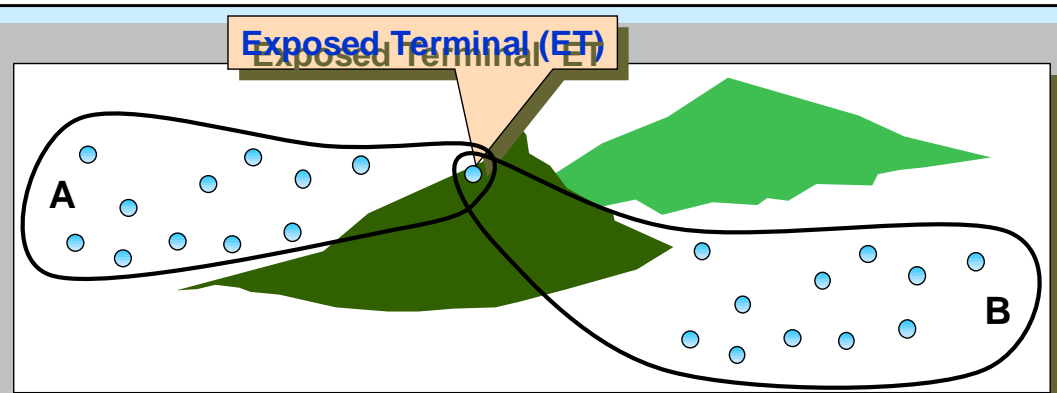
- We have developed channel access protocols for ad hoc networks that
 - Support both “omni” and “modestly” directional communications
 - Differentiate QoS
 - Support highly directional communications in airborne nodes
 - Exploit ultra-wideband (UWB) signaling
- We implemented these protocols in our proof-of-concept prototype directional radio system or in high-resolution OPNET models.
- We are actively developing routing protocols to provide multicasting and multihop QoS.

Highlight

- Our channel access techniques ensure fairness and support QoS while avoiding the classic “hidden terminal” and “exposed terminal” problems.



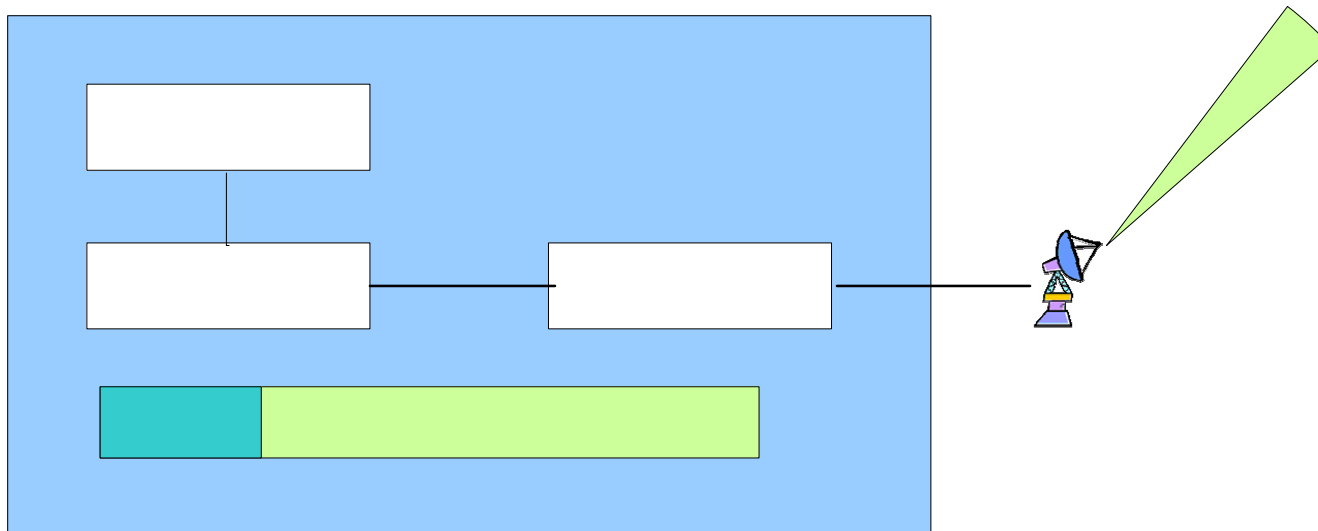
A and C are hidden from each other – they cannot directly “sense” each other. Our signaling protocol eliminates collisions by providing “indirect sensing” via echoes.



Time synchronized transmissions (à la SCR and SUMA) avoid the exposed terminal problem seen in asynchronous protocols such as 802.11b.

Highlight

- Our highly directional research has produced MAC and LLC protocols.
 - The LLC protocol maintains the network topology, generates the channel access schedule, and synchronizes the schedule across a network.
 - The MAC protocol controls the antennas to provide reliable data link access.



Impacts

- Two journal and six conference papers: contributed to the *Journal of Interconnection Networks*, *IEEE Journal of Selected Areas of Communications*, *IEEE Military Communications Conference*, *IEEE International Conference on Computer Communications and Networking*, *OPNETWORK*, and the *Army Science Conference*
- MAC schemes being considered for inclusion in the MIL-STD-188-220 for use with the SINCGARS radio
- Contributed to multiple other programs within MITRE concerning ad hoc networks

Future Plans

- **Will use our access schemes to improve the data transmission performance of the SINCGARS Combat Net Radio**
- **Building OPNET models for use in the M&S environment developed for the DARPA FCS-Communications, JTRS, and FCS programs**
 - **Will evaluate our protocols in the scenarios used by these programs**
 - **Will determine if our schemes achieve program requirements**