Title: Tactical Mobile Clouds

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Introduction
Currently, light infantry soldiers do not have access to their cyber resources the moment they depart the forward operating base (FOB). Recently returned commanders have reported on the dearth of computing ability once a mission is underway. This is computing ability that could have been applied to communications, sensor collection, complex data processing as well as command & control. We propose to address the issues by developing a tactical mobile cloud implemented on a swarm of heterogeneous, semi-autonomous robots.

Background
This proposal has its origins in the Flowing Valued Information (FVI) project. FVI’s objective was to enhance the flow of information on the battlefield by providing a framework for moving information to whom the commander declares has a need to receive as well as valuing information.

A significant result from this effort was an implementation of FVI Need-to-Share (FVI-NTS), an adaptive communications architecture termed that allows groups to share discrete information with each other in a secure manner via a repository service. Our group later developed an extension called FVI-NTS-Real-time ((FVI-NTS-R) that was able to process streaming data.

There are several enabling technologies related to this project. Software Defined Radios implement communication functions normally found in hardware, in software. Cognitive Radios seek to leverage the advantages of SDRs by enabling them to adapt their operating parameters such as power consumption, computation or communications tasks based on factors in the environment. Another enabling technology is wireless sensor networks (WSNs). These networks have extensive applications in the military as they facilitate the remote monitoring of physical environments. Finally, recent work has led to improved vulnerability assessment in static networks. We seek to extend their effort to mobile ad-hoc networks (MANETs).

Approach
To implement the tactical mobile swarm, we will focus our efforts in the following areas:

*Adaptive network topologies:* We will extend recent results in static network vulnerability awareness by applying them to dynamic networks formed by mobile swarms. We will also develop and extend robot motion strategies to support various tactical missions. Next, we plan to implement swarm algorithms using the motion strategies to support mission and extend the life of the network. Finally, we will study biological examples of heterogeneous networks for inspiration in applying the above strategies within heterogeneous cloud architectures.

*Node-level mission repurposing:* We will investigate techniques to repurpose individual nodes based on mission requirements. Three mission areas that we will study are complex algorithm execution (e.g. swarm-level sensor data processing), communications transceiver, and sensor data collection.

*Adaptive computing architecture:* Two areas are important for this mission. First, we will explore sensor positioning to address the problem of sensor coverage optimization in wide area surveillance. Secondly, we will also study data transmission and processing balances within the swarm.
Relevance
Dr. Marilyn Freeman, the US Army Chief Scientist, recently identified seven “Big Army Problems that S&T Must Help Solve.” Insufficient force protection through full spectrum operations, overburdened soldiers (physically and cognitively), and the lack of timely mission command and tactical intelligence were three of the challenges she identified. The proposed tactical mobile swarm research project addresses these three challenges.
References


J. James, F. Mabry, K. Huggins, "Seeing the Real World: Sharing Protected Data In Real Time," Hawaii International Conference on System Science (HICCS - 45), Grand Wailea, Maui, HI, USA, 4-7 January 2012.

