



Software Solutions Division Advanced Mobile Systems Initiative

Mobile computing describes the use of computing technology on the go, through devices such as smartphones, tablets, portable computers, wearable computers, and sensors. The Software Engineering Institute (SEI) is focusing on **pervasive mobile computing at the tactical edge**—environments in which front-line soldiers and first responders operate.

The SEI is working to realize this vision for soldiers and first responders:

- **Front-line soldiers:** Dismounted soldiers receive information that is more relevant and useful to their current mission; on devices that consume fewer battery and bandwidth resources; and using applications that they can easily and quickly customize to support their specific needs.
- **Humanitarian assistance/disaster response:** On-scene responders with access to local information about the resource needs of victims—such as food, water, shelter, and medicine—can make better decisions that maximize use of local resources and external assistance.

The SEI explores the architecture and implementation of mobile systems that increase the flexibility of edge users to respond to diverse missions. In these systems, *pervasive computing*—use of devices embedded with chips that can connect to a network—plays a major role.

Our Work

New generations of handheld and wearable devices are constantly emerging. The SEI strives to provide users at the tactical edge with flexibility and rapid, simple deployment of capability. Another goal is to meet the quality expectations of the dynamic and often hostile “last-mile” environments. The SEI identifies architectures and software engineering methods and practices that will help achieve these ends.

Our research projects, described below, explore solutions to critical problems such as how smartphones and similar devices can best interact with infrastructures to provide optimal capability and resource conservation; how to deliver information and avoid information overload; and how to rapidly adapt smartphone apps and verify their security characteristics.

User-Configured Situational- Awareness Mashups

The SEI is developing a capability that allows soldiers and first responders to build customized mashups from multiple Department of Defense and public data sources and to view the results on a single display on Android smartphones and tablets. Users will also easily be able to filter information and add additional relevant information about mashup elements—or other elements of interest—using their own devices.

Information Superiority to the Edge — Group-Context-Aware Mobile Applications

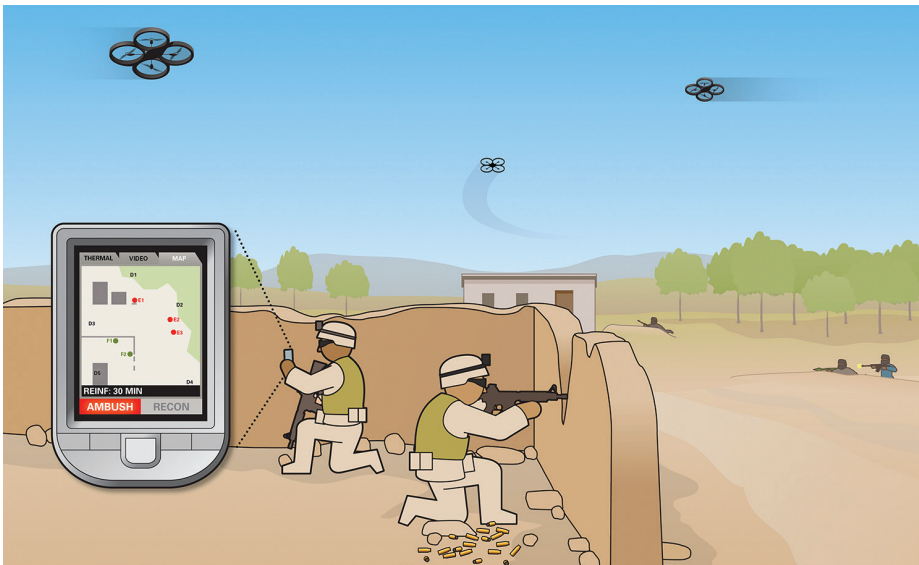
The SEI seeks to improve information capture and display for warfighters and first responders using new generations of handheld devices (such as smartphones or small tablets) in hostile or crisis situations.



An earthquake has hit a large city, and search-and-rescue crews are looking for survivors. Resources are scarce, including human crews, and help is needed to locate potential survivors quickly.

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Soldiers have found cover and deployed drones from their backpacks during an ambush. The enemy has found cover and is sniping from obstructions or higher ground. The soldiers need aid in locating enemies and finding paths of retreat.

This work will

- extend the use of contextual data from one individual's context to the context of group members working to achieve a common goal
- adapt the information displayed on the handheld to the user's and the group's context
- use individual and group context to optimize resources such as battery and bandwidth
- reduce the cognitive load on end users

Cloudlet-Based Cyber-Foraging to Optimize Resource Consumption

The goal of this project is to optimize resources and increase computation capability of mobile devices by using cloudlets as computation-offload and data-staging elements. Cloudlets are discoverable, localized, stateless servers running one or more virtual machines. Soldiers can offload resource-intensive computations or captured data onto cloudlets from their mobile devices.

Cloudlets can be easily deployed in vehicles or other platforms, and they can enhance processing capacity and conserve battery power for mobile devices.

Edge Analytics — Context-Aware Network Analysis in Resource-Constrained Environments

This exploratory project aims to improve the analysis of information gathered by soldiers in the field, by guiding the type and fidelity of the analysis. To achieve this goal, the project is investigating lightweight, ready-to-field network-analysis algorithms and use of sensed contextual information. This work will support decision making in the field by enabling users to trade timeliness and fidelity of responses to get sufficient information at the right time. Dismounted soldiers will be able to access these capabilities even when they are disconnected from the enterprise network.

Secure and Assured Mobile Computing Components (SAMCC)

The SAMCC exploratory project seeks to provide a secure and assured digital-container format for mobile-computing components. SAMCC will provide software portability and trusted execution across a spectrum of mobile computing platforms. We will demonstrate this capability in a task involving face detection and recognition from images and video taken from multiple vantage points of a large crowd of up to hundreds or thousands of people.

Self-Governing Mobile Ad Hocs with Sensors and Handhelds (SMASH)

The SMASH exploratory project is working to create portable middleware and rapid prototyping of group autonomy for real-time systems. SMASH is built on open architectures, such as the MADARA reasoning engine for distributed artificial intelligence, and context inference from sensors about the operating environment. SMASH also explores intelligent data control, such as filtering at the source, suppression of low-priority data, and shaping of payloads to maximize bandwidth utilization.

Related Web Site

www.sei.cmu.edu/mobilecomputing

For More Information

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