Dr. Mari Maeda
Program Manager
Information Processing Technology Office

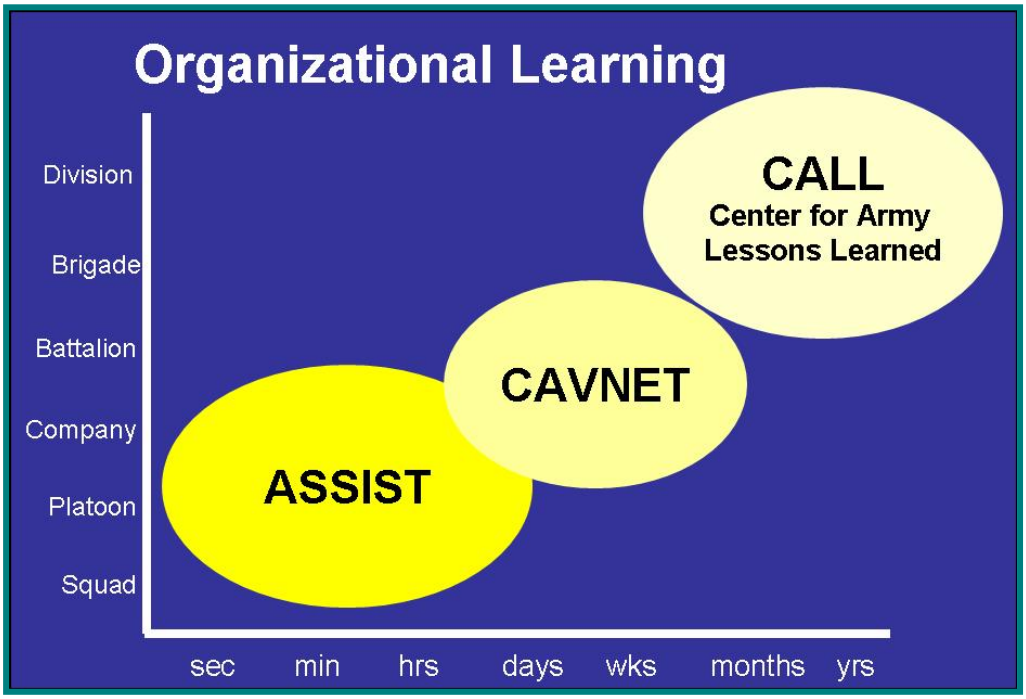
Making the Most of Sensing and Experiencing for the Next Patrol

Hundreds of patrols go out each day in Iraq. During these patrols, our Soldiers and Marines interact with the local population. They survey and try to understand the environment. They build up a collective experience that is invaluable to fighting the war. In IPTO, a number of efforts, such as the ASSIST program, are underway to help make the most of sensing and experiencing for these warfighters.

In addition to being a rifleman, each individual on a patrol has an extremely important role of an information gatherer. The importance of human intelligence in counter-insurgency warfare has been emphasized over and over again. "Who lives and works in the neighborhood? Who are the local power brokers? Was this man observed in the vicinity of the last incident? Was this vehicle parked here yesterday?" They try to develop an understanding of the pattern of life. They are on a lookout for deviations from the normal, deviations that may indicate the presence of threats. "The children are running away from our convoy. The last time they did that it was right before an IED went off." The environment is confusing. Buildings look homogeneous. With no street names or numbers to reference, our troops must remember and look for landmarks and distinguishing features. It is an ongoing learning process.

What technologies can help Soldiers make the most of what they observe and learn? How can we help the Soldier who is going out on the next patrol to be better informed and better prepared? We are developing tools to help the warfighters share their experiences, in the form of pictures and videos that are searchable by locations and keywords. The goal is to provide near-term support to the troops in Iraq, addressing one of the serious shortcomings in the existing reporting process: hierarchical information flow.

Today, reports flow up the chain of command. The information is boiled down and filtered before being distributed back to the lower units. As a result, full information is often inaccessible to the junior officers who need it the most. We need a reporting format that is visually rich, but appropriately structured, and we need more direct horizontal communications between information collectors and consumers. Fortunately, there have been recent efforts to promote peer-to-peer information-sharing in the field. Last year in Iraq, the 1st Cavalry Division stood up CAVNET to allow junior officers to directly post their discoveries such as newly discovered enemy tactics through what is essentially a message board system on a secure network. In one instance, the

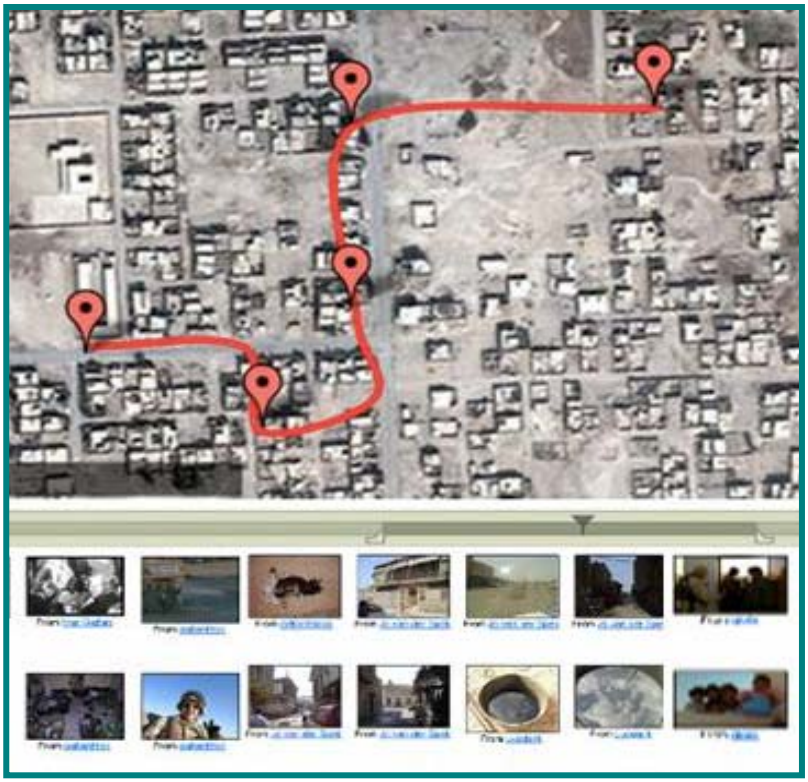


commander of a unit learned that insurgents were wiring IEDs behind posters of radical Shiite cleric Moqtada al-Sadr. They were rigged to explode when US forces tore them down. This finding was posted. A few days later, when a Soldier in a different part of the city encountered one of these suspicious posters, he immediately knew to call in an explosive ordinance disposal team. Lives were saved.

Traditionally, the Center for Army Lessons Learned (CALL) has played an important role in the organizational learning process. But with its formal mechanism for collecting and vetting lessons learned, it operates on a time scale of many months, if not years. CAVNET-like technologies allow knowledge sharing directly between company commanders, shrinking the time scale to days or weeks. With ASSIST tools, the captains, lieutenants, and sergeants who are the frontline leaders of this war can share new information within hours—even minutes and seconds—and, most importantly, share contextual data that provides a fuller picture of people, neighborhoods, and events.

Before going on a patrol, a lieutenant can use a map to search the database for knowledge about a neighborhood of interest. In the field, visual BOLOs (Be On the LookOut alerts) can be transmitted and received. After a vehicle makes a sudden U-turn at a traffic checkpoint, a BOLO message is sent: “a white station wagon with two passengers heading east.”

Surrounded by potential threats, a warfighter must be able to function with minimal burden. The required hardware should be lightweight, power-efficient, and intuitively easy to use. Using a keyboard or a stylus is too distracting. Can we



come up with new technologies that automatically capture his experience? Can a computing system observe and adjust to the state of a warfighter to aid him and to maximize his performance? We believe that, in the future, artificial cognitive systems will continually monitor, record, and assess a warfighter and his activities. On-soldier multimodal sensors will track the environment as well as his physiological state. An effort in the Improving Warfighter Information Intake Under Stress program has been able to demonstrate a basic technique for tracking a Soldier's cognitive load and adapting a presentation of situational awareness data to maximize his performance.

The future requires a symbiosis of human and machine in a way that synergistically exploits the strengths of each. One uniquely human strength is the ability to make sense of torrents of raw, multisensory information by extracting what is important in the context of previous experience. "The streets look emptier than usual today. That guy just doesn't look right. That truck coming toward us is moving too fast." But implicit in this strength is a critical weakness. Photographic memory is extremely rare in humans. Eyewitness testimony is highly unreliable. This is because human observation is so strongly shaped by expectation, that expectation can actually override sensory input. Machine strengths complement those of humans. A machine can easily capture and retain accurate data on huge numbers of events. But sensors see only what they are pointed at, and the volumes of signal level data must be abstracted and indexed to be turned into usable information. This process of data abstraction is called perception, and there are enormous challenges.

One strategy for advancing this capability is to focus on the cross-correlation of different sensor inputs. Just as communications can be made more reliable through spatial, frequency and temporal diversity, perception could be made more reliable by maximizing the diversity of evidence sources. Hence, raw data from an on-soldier multimodal sensor suite might go through linguistic interpretations, vision processing, and motion extraction. Low-level objects and events are automatically recognized and labeled. Higher order representations of scenes, activities, and patterns are then generated through correlation and inference. In addition to cross-correlating inputs from an individual Soldier's sensors, we must explore cross-correlation of sensors from multiple Soldiers for a full understanding of their collective experience. Ultimately we want the system to bring sensor inputs into an inference structure that fully exploits the context and prior knowledge, and bring a sense of expectation to the perception process, even better than we humans can. We want the system to recognize threat situations based on immediate observations and experiences of the past—to alert a Soldier if he is on a patrol near a building from which another unit had taken fire, or if the number of people in the street seems abnormally low for a Friday morning, or if a squad is too closely following the pattern of previous patrols.

We are looking for new ideas to help realize this vision. We want to develop software that, to take the words of one lieutenant, does things, not TO him, but FOR him.