INCREASING THE EFFECTIVENESS OF REACHBACK AND REMOTE COMMAND AND CONTROL

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1. BACKGROUND

Commanders and their staff, when geographically dispersed, continue to choose what they find to be the most effective remote collaboration tools: email and radio messages. Even command and control systems that provide a unified view of the battlefield among remote collaborators are often supplanted by more traditional tools, such as a large paper map (McGee et al. 2000). Figure 1 is one example in a division command post where we observed 19 command and control systems supplanted by an 8-foot-high paper map. Indeed, today's computer interfaces often impose too high a barrier for the capture and delivery of situational assessment (McGee et al. 2002).

To compensate, commanders traditionally meet face-to-face at least once daily to debrief each other on the outcome of the day's fight and to coordinate a strategy for the next day's engagement. Each of these meetings presents a risk to commanders, in addition to lost time during travel and various other concerns. Ongoing activity at higher echelons may consist of this activity continuously, such as that seen in Figure 2. At lower echelons, coordination is typically medited by a radio or other messaging platform. Common to each of these scenarios, the coordination and collaboration is mediated by physical tools, e.g., an up-to-date common operational picture (COP) as depicted in both Figures 1 and 2. Much of the promise of collaboration technology, from video-conferencing to real-time collaboration tools, is meant to alleviate the need for face-to-face meetings and improve moment-to-moment coordination. However, these tools fall woefully short of meeting the needs of commanders in the battlefield.

2. WHAT'S MISSING FROM CURRENT COLLABORATION TOOLS

As depicted in Figure 2, the COP allows for rapid coordination of simultaneous streams of activity with activities such as pointing or gesturing, accompanied by short spoken phrases, or the addition of markers and annotations to the map. By sharing a COP during the activity, collaborators can establish a common frame of reference, and can thereby identify terrain features or units, establish boundaries, etc. very quickly. This can be done with a simple sketch of the terrain when a map is inadequate or unavailable.

Figure 1. Officers in a military command post.

The COP, however, does not readily support the same type of activity or amount of bandwidth when it occurs between two remote participants. Even if two of them are kept in sync with one another, tools to support the collaborative activity are simply unavailable. Though prototypes have recently been developed that support real-time sharing of ink on a COP, most of these systems assume that barriers to their adoption, such as resolution, usability, portability, do not exist. Furthermore, none of them adequately support the natural inclinations of commanders to stand beside or in front of a common map, reviewing the battle or preparing for the next by speaking, gesticulating, and pointing at the map, while their audience may be listening remotely.

Figure 2. A commander and his staff discussing the tactics of a defensive position along a DMZ.

Commercial tools do not adequately support the task either. They assume that the information needed to make a decision is available only in a person's expression (i.e., video teleconferencing) or on a computer program's screen (e.g., screen sharing or shared data repositories). We argue that though these may be key ingredients,

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shared access to and interaction with the COP itself plays a more strategic role.

3. BACKGROUND AND FUTURE CONCEPT

Two recent systems, Rasa (McGee & Cohen 2001) and HI-SPACE (May et al. 1998), enable peole to interact with computers using something that comes naturally to us—language and gesturing. Rasa is a tool that allows users to draw control measures on the plasic overlays of paper maps or other images and to draw unit symbols on Post-it Notes® that can then be placed on the overlays. This system is able to capture and understand the symbols and spoken language that are used in tandem, through the use of sensors (e.g., pen, touch, audio, and video) and recognition systems (i.e., natural language understanding, handwriting recognition, etc.). The Human Information Workspace (HI-SPACE) captures and tracks the motion of hands above a tabletop display using machine vision (i.e., a video camera). Up to three pairs of hands can be tracked over a digital display surface. Hand poses are recognized by the HI-SPACE and can be used to interact with any computer program.

Figure 3 is a conceptual picture of a COP tool that combines the capabilities of Rasa and the HI-Space to support the kind of rapid coordination outlined above. With such a tool, commanders could point at tomorrow's objective, quickly sketch the ingress route, position units on the terrain, and present the remaining parts of the draft course of action. The commander's actions appear on the remote maps and her sketches are projected upon them. In response, using their large COP paper maps, her officers could provide alternative courses of action. As they gesture over their maps, shadows of their gestures appear in 2D, as shown in Figure 3. We have begun to merge these two systems in order to implement the concept described here. Currently, a single user can use one of their hands to interact with the digital COP-tool in Rasa, while it is running on the HI-Space, adding units and control measures via drawing tactical symbology on the map. These interactions and the consequent objects are shared with remote users. However, support for multiple, concurrent, side-by-side users, reflections of their gestures near the map (possibly implemented as shadows), and more complete annotations of the dynamics of the situation is ongoing.

4. IMPACT AND SUMMARY

With HI-Space and Rasa and with the proposed merger of their capabilities, commanders potentially gain increased situational awareness and common ground with remote teammates. Work at these tools is more like looking over the shoulder of colleagues during discussions or arguments than is currently possible. Including real world activities and real world tools within the computer-mediated command and control will allow critical information to be more easily exchanged and understood, increasing the level of coordination within command hierarchies. This in turn should substantially enhance force responsiveness versatility and lethality. Agility, survivability, and sustainability are increased by designing systems, like Rasa, that equally support low-fidelity, low-bandwidth, paper-based computational tools as well as high-fidelity, high-bandwidth digital tools.

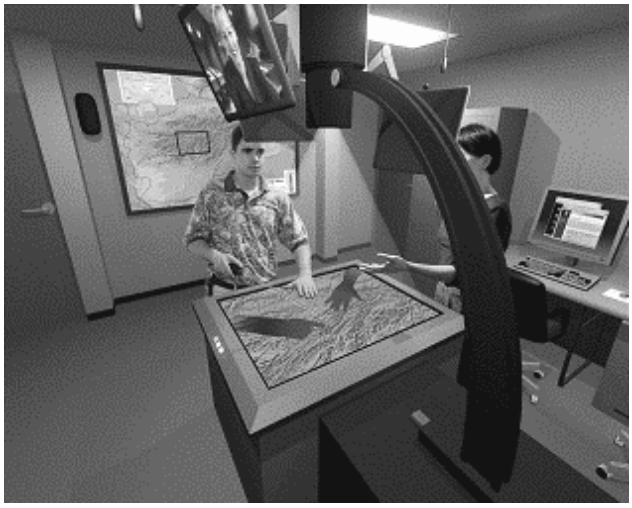

Figure 3. A concept photograph of a remote command and control collaboration system that supports gesturing.

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