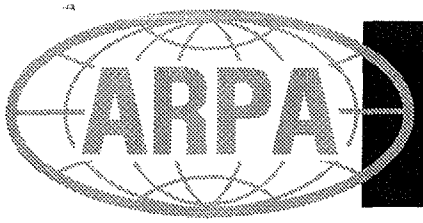

ADVANCED DISPLAYS: WINDOWS INTO INFORMATION WARFARE

by Lance A. Glasser

In order to fight and win on the battlefield of the future, U.S. forces must first win the information war.

Information is the vital commodity that provides competitive military advantage by elevating lethal precision over blind, brute force. Information provides the situational awareness that rolls back the "fog of battle" for U.S. forces and their allies—and reduces the dangers of inflicting "friendly fire." The very concept of military "command" is one of information flow.

Most of the information revolution is still before us. Although dramatic advances in U.S. war-fighting capability have occurred during the past decade, the pace of change will accelerate throughout the next decade. Today's centralized, crew-served information systems will be augmented with smaller, lighter, and more capable individual systems that can be deployed far forward on the battlefield.

Furthermore, the focus of tactical information distribution is shifting from division and brigade staffs down to the individual soldier. Although the amount of information available to senior commanders and their staffs is increasing, the amount of information available to the individual soldier is increasing at an even faster rate.

The net result is that vital information is needed at all levels of a military organization—from the senior commander monitoring large command and control display boards *in real time* down to small units with specialized equipment tailored to their needs. As their functional needs vary, so do the types of their displays.

New capabilities in signal processing and computing, using mobile, low-power, battery-operated devices, are being developed to meet these needs at the small unit level. These devices can collect, analyze and disseminate a wide range of tactical, administrative, and logistical information.

Individual soldiers operating these new products will be tomorrow's combat "force multipliers," as they will be able to rapidly process and communicate (both horizontally and vertically) critical information on the battlefield.

This trend toward greater availability of information should significantly enhance the situational awareness of small units, enabling them to seize the initiative in dynamic battlefield conditions. Soldiers and teams that are cut off from their units can continue to fight using their individual information systems and their commander's "intent."

The U.S. military can capitalize on the new distribution of information by designing new war-fighting organizations. Division and brigade staffs could be reduced as their functions are automated and moved forward to subordinate units. Tables of Organization and Equipment would accordingly reflect higher "tooth to tail" ratios.

Before that can happen, however, the information must be clearly understood by people, and the most efficient means to do that, in terms of data transfer rates, is the human eye.

The military traditionally thinks in terms of maps, imagery, and graphics. The greatest advances in military map displays over the past 20 years was the move from marking on acetate sheets with grease pencils to using alcohol markers to do the same job.

This is not a satisfactory solution. Data inconsistency is a pervasive irritant in frenetic military command centers today because a plethora of dynamic situation maps have to be updated manually. This is a time-consuming, manpower-intensive, error-prone process that prevents commanders from having what they desperately need — a common view of the battlefield.

There is a better way available from display technologies currently in the advanced stages of development: a system of distributed networks of large and small high-resolution flat-panel displays with responsive and consistent digital images.

The supporting research to create these information systems of the future, conducted under a joint industry/government National Flat Panel Display Initiative, is critical to U.S. national security, and is expected to yield important commercial products in an increasingly competitive international marketplace.

"This initiative does not subsidize production or attempt to 'pick winners'," wrote Deputy Secretary

of Defense John M. Deutch in the *Washington Post* on June 21. "It does attempt to tip the balance in favor of production by supporting next-generation research and development by those already contemplating production. It is entirely reasonable for the Defense Department to join in developing technology for the year 2000 with those likely to be in a position to actually build products for the Defense Department in 2000," he concluded.

In land combat, for example, there are five basic tenets of warfare—agility, initiative, depth, synchronization, and versatility—and all require, in varying degrees, distributed decision-making for success on the battlefield.

Consider the problem of a tactical commander viewing the battlefield as a topography of dozens of artificial and self-imposed boundaries. Those boundaries are there for a reason: to prevent one unit from firing on a neighboring one.

The battlefield commander needs to be able to operate in an integrated information and communications environment to rapidly move those artificial boundaries on digital displays to confound the enemy and focus his own forces at speeds not achievable today. Electronic displays are thus critical to competitive military advantage through increased fluidity and flexibility.

The information services available to lower echelons will be even more revolutionary in their impact on warfare. For instance, data storage techniques now being conceived would allow a single soldier to carry all the digital maps ever made. Individuals could peer into a hand-held laser rangefinder with a high-resolution display that can show maps annotated with their location, the location of friendly and enemy units, known mine fields and other critical information. Soldiers could use the same device to see mission plans or consult any of hundreds of manuals—in weight-saving digital electronic format. Other uses not even imagined today undoubtedly will be found.

A parallel trend is toward the need for greater resolution of information. Precision weapons are becoming more lethal and more compact, thus reducing the physical size of a threat that may be potentially lethal to friendly forces. The information problem is further compounded by the greater kill radii of these weapons and their increasing mobility.

Taken together, these factors dictate an increase in the number of picture elements, or pixels, required on a commander's—or even a soldier's—battlefield map. Add to this the growing use of critical data in the form of images from beyond the visible portion of the spectrum, such as infrared and millimeter wave, and the need for higher resolution displays becomes compelling.

Higher resolution also allows the users (soldiers) to select the information they need for the task at hand. Designers of weapon systems cannot always anticipate these needs, and relying on low-resolution systems encourages them to leave out "unnecessary" data that later may be critical for faster data absorption.

Small multiples of data allow the user to be more flexible because all the decisions have not been made for him or her in advance. Such techniques as side-by-side repetition of slightly different images to encourage comparison and a more consistent framework for the data, all made possible by advanced high-resolution displays, allow faster digestion of data. For example, U.S. fighter pilots could distinguish between U.S. and foreign helicopters.

Data overload is a concern, but it is as much a function of *how* information is presented as it is of *what* information is presented. For those worried that more display pixels will cause information overload, Edward Tufte in *Envisioning Information* writes the counter-intuitive prescription, "to clarify, add detail." Tufte goes on to pronounce, "Clutter and confusion are failures of design, not attributes of information."

Displays cannot do the job alone. They must work in concert with other technologies of data storage, processing, transmission, software, and non-visual methods, but displays remain the primary interface to people in the age of information warfare.

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