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Command and Information Systems

Arthur K. Cebrowski

Vice Admiral Arthur K. Cebrowski, USN, was appointed Director for Command, Control, Communications, and Computer Systems (J-6), the Joint Staff, in October 1994. Previously he served as Director, Space and Electronic Warfare (N-6), on the staff of the Chief of Naval Operations (CNO). Vice Admiral Cebrowski has commanded fighter Squadron 41 and Carrier Air Wing 8, both embarked in USS Nimitz. *He later commanded the assault ship* USS Guam. *During Operation Desert Storm, he commanded the aircraft carrier* USS Midway. *Following promotion to flag rank, he became Commander, Carrier Group VI and Commander, America Battle Group. In addition to combat deployments to Vietnam and the Persian Gulf, he has deployed in support of United Nations operations in Iraq, Somalia, and Bosnia. He has flown multiple aircraft, principally fighters, from several aircraft carriers and deployed to all ocean areas. His tours of duty have included service with the U.S. Air Force, the staff of the Commander in Chief, Atlantic Fleet, and the staff of the CNO on four occasions. He has been a member of the CNO's Strategic Studies Group and a Federal Executive Fellow at the Council on Foreign Relations. His personal decorations include five awards of the Legion of Merit, Bronze Star, two Meritorious Service Medals, 10 Air Medals, two Navy Commendation Medals with Combat "V." He is also the 1991 winner of the John Paul Jones Award for Inspirational Leadership. He holds a B.S. degree in mathematics from Villanova University and an M.S. degree in computer systems management from the Naval Postgraduate School.*

Cebrowski: Maybe what we can do is start in a slightly different way to help orient the discussion a little bit. It's useful for me to know where you are and what's on your mind, and what questions or issues interest you—if you have some. You may say, "Well, this fellow from the Joint Staff is coming. He's the J-6, whatever that is. He's a Navy officer, but so what?"

Student: I'm interested in the development of joint communications technologies that allow the services to communicate with each other in joint operations.

Cebrowski: Any other comments or questions? I was told you were all bright, inquisitive people.

Student: This is an Army guy, though, Admiral.

Student: Now that I've been challenged, I feel compelled to speak. If you're accused of being ignorant, you should at least demonstrate it. I would be interested in a similar topic, but as it applies to the tactical level, especially with the Army's press with Force 21, and why there are benefits for doing this.

Student: Sir, I'm interested more in what's going on, in terms of both the CINCs and the whole jointness issue, with regard to the smaller operations that are happening today, and the ongoing applicability of the sorts of lessons we learned from Desert Storm to these operations.

Student: Sir, I'm also interested in the Army's digitization plan and Force 21. I am specifically interested in having digitized command and control systems down to the vehicle commander level in the Army and whether that overloads them and degrades warfighting skills.

Student: Sir, I'm primarily looking at kind of a broad rubric of issues under "information warfare," in particular, the non-battlefield vulnerabilities of our information infrastructures and an adversary's capabilities to attack those systems.

Student: Sir, one of the issues I'm interested in hearing your comments about is the changing roles of the theater CINCs and the Pentagon, because they both now have almost identical sets of information on which to act. At least my experience in the Pentagon is that the Pentagon has now started to take on a lot more of what used to be the CINCs' responsibilities.

Student: I'm interested in the role of doctrine at the individual level. I'm a ROTC cadet, so I'm interested in the way indoctrination happens and the effect of changing technologies on Air Force structure.

Cebrowski: Doctrine or indoctrination?

Student: I guess the role the doctrine plays in indoctrination.

Student: I'm with the civilian side, National Institutes of Health. I'm interested in the generic question of introduction of technology and the balancing act between complexity and simplicity—simplicity for clarity of the message, and complexity in terms of confronting proliferating variables.

Student: Admiral, I'm interested in what your viewpoint is on lumping in intelligence with C^3, C^4, or whatever. We've had a number of readings that indicate that that's a bad marriage.

Cebrowski: Maybe someone else should answer that. That's a good question.

Student: Sir, we've heard a lot of different views on information warfare and that whole topic. I wonder if you'd make some comments. We've heard yeas and nays and all those different points of view. I'd like to hear what the J-6 has to say on that.

Student: Admiral, with the abundance of information that has now become available, whose responsibility is it to decide what information goes to the commander, and what criteria should be applied?

Cebrowski: Okay, good. I'll start with that one.

Oettinger: If I might chime in on that in a slightly different vein, we have heard Admiral Tuttle talk about Symphony, Sonata, Copernicus, et cetera, and then we heard Admiral Owens talk about system of systems,* and in line with this question of who gets what from where, and who gets to pick what comes to what from where, could you give us some sense of what the reality is nowadays on this sequence from Tuttle's ideas to Owens' statements to where things are in March 1996?

Student: Let me throw a little more out for you. We're writing a paper on a grand strategy for national security. When we talk about a grand strategy for U.S. national security, I'm not so much worried about offensive information warfare as far as the Department of Defense is concerned. I'm more concerned about defenses within the United States and perhaps what role should the military be playing in helping the United States defend itself, because some of the things that we would need to be doing are far beyond what we're able to do. What role could we play to help defend the United States as part of our grand strategy for national defense?

Cebrowski: Anybody else? No burning issues? Good. Thank you very much. This is very helpful. I'll come back next week.

Let's start with the question of who decides who gets what information and pull that thread from there, and we'll see where that takes us as far as picking up the other issues. The reason I start there is because I think this is where we've had the fundamental change. Heretofore, we've largely used the nineteenth century industrial model when dealing with information: that is, the

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* Jerry O. Tuttle, "The Copernican Pull," in *Seminar on Command, Control, Communications and Intelligence, Guest Presentations, Spring 1993.* Cambridge, MA: Program on Information Resources Policy, Harvard University, August 1994; William A. Owens, "The Three Revolutions in Military Affairs," in *Seminar on Command, Control, Communications and Intelligence, Guest Presentations, Spring 1995.* Cambridge, MA: Program on Information Resources Policy, Harvard University, January 1995.

bosses controlled the workers on the shop floor by metering out to them just the things they needed to do the job, and otherwise kept them in the dark. This was a means of control. It was a means of keeping the work force somewhat off balance, certainly keeping management ahead of labor with regard to whatever disputes there might have been.

Now, this stems from the notion that information, or, in a more confined way, intelligence, has value so long as I have it and no one else does, or a very small number of people; in other words, the notion of secrets. Now society has turned that on its head, and information has increased value in proportion to its proliferation. If that's the case, then who cares what the answer to your question is? That is the most, I suppose, obtuse way of saying it.

To put a little sharper point on it, it's the user who cares. If the user cares about this, if the user is responsible for getting, using, and securing his information, then let's step back and look at the obverse: who should be metering the degree of ignorance of that work force?

I put forward a vision that was based on this notion at the CINCs' conference last summer, and one four-star said, "Well, if you make all this information available, how are you going to control your troops?" Then he caught himself as he realized what he'd said, and suddenly it struck him that his comment was fresh from the Neolithic past. This is a big, big change, and from this change almost everything else flows. So I think this is the first order of understanding in this whole business.

Student: If you look at it from that perspective—if you say that more information is better, and let the users decide what information they need—then you run into the problem that there is so much information, and how do all the users have time to decide what they need and what they don't need? If you look at it from the perspective of intelligence, there's got to be some kind of balance between dissemination of information to make it effective and control over that information so that you can maintain the security.

Cebrowski: First of all, implicit in the way you asked the question about security is that my only vehicle for security is to withhold it. Is that really true? Does that then tidily wrap up all the elements of security? What does it do, say, for assured access, which is an element of security? How about nonrepudiation? How about integrity of the information? More than anything else, is the information of any value if you clamp down on it in the name of security?

We see this again and again and again. Information that is held very closely normally suffers from arrested intellectual development. We take a very, very clever program that's in the black world, and we put it in the vault and we keep people from seeing it. It's really developed very well; it's finely honed, and it's fully funded. Everyone who has visibility on it is very pleased with it. Then we find out that there's no training; there's no doctrinal development. We cannot easily upgrade the program. It's not clear what the logical next steps are, and how this interacts with other things, which may not be at such a degree of classification. So the program atrophies, but the budget line doesn't because you're compelled to maintain this thing. Maybe the target even moves out from under the cross-hairs as society moves on and develops along different lines, and so the target for that system is simply not there any longer. But you don't have the ready means to come to grips with it. That is one extreme example of what happens when you put the clamps on these things and don't do it in a rather comprehensive and clever way to account for the things that really add value.

In a way, that was a good way to start because it got me to one of the truly core features here, one of the causes.

Oettinger: Before you move on, may I ask a question, because there's another element of your answer to his question on which I'd like your views in terms of comparative advantage for the United States. You described the situation as one in which information becomes available sort of to everybody and this negates the nineteenth century view of management control. Now,

in a democratic society that has certain recognized merits, in terms of the more authoritarian among the U.S. adversaries or potential adversaries, what kind of comparative advantage, if any, do you think this approach gives us?

Cebrowski: Excellent. There's one thing that Martin Van Creveld said that a lot people say, but I have problems with it, and it's a sentence that goes something like this: "The history of warfare is characterized by the need for information and the inability of the command system to provide it."* I don't like that. I frequently put up that quotation with a big X through it, and the reason I do that is because implicit in that is the notion that it is the command system's responsibility to provide information. Notice it says "command *system*." It doesn't say it's the responsibility of "command," which is a wholly different thing. In other words, the information system or information processes are subordinated to the command system.

With the despotic enemies that we are likely to have to do business with, we see they need their hands on all the levers of power. Information they recognize as one of those, and consequently, the information system is directly aligned with command subordination. When you do that, you incur vulnerabilities. If I know the information system, I know the command subordination. I have the command system. So that generates a very, very great weakness, which is a matter of doctrine, as we say in the military, that we will exploit.

Secondly, because the information is narrowly channeled, its shelf-life expires before it's used by as many people as could use it. In other words, it's not leveraged, so they derive less power from the information. Those two things, to my way of thinking, line up as the fundamental difference between the "us" and "them" in the use of information, and I think that distinction is very powerful. Of course, we can debate that, and I'm certainly willing to do so. But that's largely how I see it.

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* Martin Van Creveld, *Technology and War: From 2000 B.C. to the Present*. New York: The Free Press, 1989.

The Russians—I guess it was the Soviets—in their writings coined the expression "the military-technical revolution." We have essentially adopted the notion because we found ourselves, in the 1990s, in fact technically living in the 1970s. Then we looked around that great toy store of information technology, and we grabbed it up. We bought a very great deal of it, and we put it in our platforms and schooled people up on it. It was a useful strategy. It did bring us into the 1990s, I think, fairly well. Is that the strategy that is going to take us into the 21st century? I think not, from a couple of points of view.

First of all, it does not take into consideration the fact that the society has changed; that is, our customer has changed, and the customer's needs have changed. So, rather than talk about a military-*technical* revolution, which focuses mostly on the insertion of technology, I go all the way up the other end of the spectrum and talk about a revolution in *security* affairs, which has to do with the change of values in society, the way society works, and society's expectations of the military. We have seen a change in that. Society expects the military to be far more discreet. There's no doubt about it. Society still understands that there is indeed a very violent and uncertain element involved in warfare. I think they accept that far more than most of us now believe.

As we've discussed over lunch, this is now a society where less than 50 percent of the population is engaged in either agriculture or industry. We are, indeed, an information-based society. This is the source of creation and distribution of power and wealth in America, and this is new.

Because of that, the people have certain expectations. They expect discriminance, far more than they ever have before. It used to be that in the military we would think of ourselves as being in the business of generating smoking holes. Larger ones were better than smaller ones, and if we could have a very, very large ones at low cost, that was called "more bang for the buck." The customer's no longer interested in that, and, frankly, neither are we. We must be far more discreet, far more discriminating. It is not so much that the American people

aren't willing to send their sons and daughters into combat, but they aren't willing to have them go into combat in a way that, first of all, puts the outcome at risk. "What, you're going to let my son be shot at and you don't know whether you're going to win? You're not going to do that." Secondly, it has to be done intelligently. "What do you mean, you let him be shot at when you had this or that information? You could have prevented it! You could have reduced his exposure, and you didn't." That's the stuff that admirals and generals should be hanged for. That's what the customer expects, and we ought to be able to provide it.

So we have this whole large revolution in security affairs that's operating out there, and your military has to operate within that context. That's a context of values, and it's a context of technologies. Clearly, we can look off to society and we could learn some lessons, see how they organize, get some doctrinal tips from them, and that would all be fine. But that is the environment in which it takes place.

Then we come to another question, which is, "Well, what about the doctrine in this?" That becomes the key point because we're finding, yet again, that it is not so much the technology, it's how it's used and how you organize to use it. We've seen it in the past; we've seen it for centuries. It is still true. It is as true today as it ever was, and we are as much in denial of that today as we ever have been.

Student: Amen.

Cebrowski: It is not just for people wearing this uniform or some other one. This is abroad in the land. That's why you see corporations go under.

Oettinger: I think that's a very accurate observation, and I agree with its almost-universality. Let me hazard my views on why it's so. It has to do with this quotation I mentioned in Ryan's session from Holmes: "It cannot be helped, it is as it should be, that the law is behind the times."* It's not only true for the law, it's true for damn near everything else. When some new technology and new things come on, it takes a long time for us to figure out what to do with them. Almost typically, the first use is to do everything we've always been doing, only slightly differently, with the new technology. In the horseless carriage era, it took a long time before people figured out that with the automobile you do things entirely differently from the way you did them with horse and buggy. I guess the bad news is that no one has yet figured out any way of cutting that short. If that's the case, then we're in for a fairly protracted period of wallowing around in this current set of revolutions before some great light dawns. Is that an unfair gloss on what you've just said?

Cebrowski: No. It's not unfair, but I reach a different conclusion, and that is: I don't see the protracted period of muddling around. Because things move quickly today, it will *seem* as protracted as it's always been, but if you were to measure it in absolute terms, by years, I suspect you will find that it's going to be less. I think it'll be so for a couple of reasons. One of them is because of the budget, which will act as a forcing function. Another one is this expectation of society that, "Well, gee whiz, my kid in Kansas can get 150 channels of sports and sleazy movies, so why can't you transmit a map to my other son who's in the field someplace?" That is a legitimate demand by our people, and we need to respond to that. Even though the military, in general, is held in very high regard in society at large, it won't take too many errors along this line and we'll find that we don't feel very comfortable with that whole business.

For example, I went over to the Hill a few months ago with a great list of fairly expensive (a couple of hundred million dollars worth) C⁴ISR (that's command, control, communications, computers, intelligence—although I prefer information—surveillance, and reconnaissance) upgrades for all the services; different platforms to do

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* Oliver Wendell Holmes, *Collected Legal Papers.* New York: Harcourt, Brace and Company, 1921.

different things. I marketed it on the basis that this will help keep us from screwing things up like this, this, this, and this—citing historic examples in the recent past. They said, "Great! Do it!" All four of the key committees supported it, and we got most of it funded.

So I think that the customer will force us, and the budget will force us. Our own sense that we really can wring a lot more out of this stuff is going to push it. So I think that will tend to accelerate. However, the impatience is going to go up at the same time, because we'll watch the rest of society, and I think because of that it'll seem interminable to us. So I'm not quite as pessimistic as I might have been, particularly before I went up to the Hill and had some successes. Maybe that's not a good basis for making the judgment.

Another thing that makes me feel a little bit better is that last week I went out into the field with III Corps in Central Texas. This is a very, very large corps. It's a heavy corps. This is a corps that has among its missions to do the counteroffensive in Korea, if that's what gets called for. It's a significant task. We saw some things in the field which were very heartening. Here are some of them (figure 1). One of the fellows who was with me made this list, and I think he picks up on some good points.

Generalship is changing out in the field. It's not universal; it's not sharply focused,

but it is, indeed, changing. This slide talks to the video teleconferencing, but that is only a part of it. To run through a couple of things, it used to be that the general would spend much of his time out and about with his various brigades and battalions and whatnot, talking to the various commanders. Then he'd come back to his command post and proceed with what he had to do. Why did he do that? He did that because he didn't know where they were. He didn't know what their combat power was. So, he essentially had a handful of trusted agents, himself among them, who would go out and put eyes on the troops and make an assessment of their ability to fight.

With such things as video teleconferencing, and such things as GPS (Global Positioning System) and quality information links, he doesn't have to do that anymore. Because he's not doing that, he's spending more time doing what only he can do, which is the planning and directing appropriate for his level of command.

That would be interesting if that were the only thing, but it's not. It just ripples on from there. For example, because he now has knowledge of his own forces, and the same things that give him knowledge of them also give him knowledge of the enemy's disposition and, indeed, the rest of the environment, he can now play a significant role in what has been called "the deep battle," whereas before, he always had to focus on the wolf closest to the sleigh, and you couldn't really blame him. He was interested in the close-in fight or the near battle. Now he can spend some amount of his time planning and directing the deep battle. So that's another change. But that's just the beginning of that change, because as he starts doing this, he actually finds that the distinction between the near and the deep battle blurs, and the battlefield then becomes a continuum for him. This, of course, is very useful because that's the way it really is. So now, the functioning of his mind is conforming more to reality, and, hence, it's more powerful.

Another thing that the generals are beginning to discover (and I enjoy talking about this because I'm a Navy guy—you might say a disinterested third party) is that the combat power of the force relates di-

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Power of C⁴ISR:

- **Generalship with video tele-conferencing**

- **Whiteboard battle management**

- **Real-time battle status exchanges**

- **Assured Blue Force position locations**

  − **EPLRS/JTIDS + GPS**

- **Real-time UAV employment**

- **J-STARS battle cueing**

- **ATM bandwidth optimization**

Figure 1

Observations

rectly to how tired the troops are. If you look at the battlefield, you see what is apparently a lot of Brownian motion out there. What's really happening is that movement is painful. It's hard to move. To give you a sense of how hard it is to move the force that we've put over there in Bosnia, if you look at the number of railroad cars there versus the number of soldiers, there's one railroad car for every two soldiers. That gives you a sense of what it takes to move and maintain that stuff.

The burden on the soldier of moving is significant. However, he has to move, because if he doesn't, his battlefield becomes static. He cannot take advantage of openings. He cannot position himself. He is no longer a maneuver force. You might just as well put up a wall and guard it. Not very exciting. So, he has to move. But he's moving on not particularly good information. As his information develops, he makes adjustments in his movements to different points on the field, and every time he make an adjustment, he's in effect expending his combat power in the form of fatigue and wear and tear on equipment. (You're an Army guy; you can agree or disagree with me.) But you can get to the point, in certain environments, where you can sap the combat power a very great deal. But now, with a little bit of knowledge, oh my! He can put his people in the right place. Furthermore, with the right amount of knowledge, he doesn't have to make the decision as quickly as he did before, so again, there's less wasted motion.

But now comes the need to synchronize, or rather, coordinate with other forces because it's not just a matter of knowing where the enemy is going to be, it's also a matter of knowing where the rest of the friendly forces are going to be, not all of which are under your command. As other friendly forces move—air power for example—I would make adjustments based on that. If, for example, I know that certain targets are going to be struck in a certain area, and I know that I'm going to have close air support, my risk is now low and I can now move in this particular way, whereas if there were considerable doubt in my mind as to whether those targets were to be struck and close air support were to

be available, I'd go somewhere else entirely. Then, if in the process of going there I find that this has changed—that these things are now available, those targets are going to be struck—have I lost the opportunity? Have I committed my force too much in another direction, too much along another line, so that now I'm suboptimized and this air power that's being a provider over here is now squandered? Or do I redirect the effort and suffer the pains of an energy loss by moving this force?

This might sound incredible to you, but my Army colleague here tells me that if you take a division and string it out on the highway in its normal march it runs about 100 miles, so it's not an insignificant thing to do. Moving that and making an adjustment of just a few degrees requires considerable expenditure of energy.

Student: Is there any fear that by overreliance on video teleconferencing, especially at the generals' level, you're going to lose intangibles like the generals knowing who's out there?

Cebrowski: Yes. It's not just video teleconferencing. It's all of the information technologies. We asked Dave Alberts* to try to catalogue for us the list of the unintended consequences of information technology. They run to such things as that in my planning my visual horizon is now focused down on the 17-inch display, and that's as far as it is now. Or, I'm paralyzed into inaction because I'm waiting for the next piece of information that I know will remove some uncertainty, so I don't act when I should act. Subordinates second-guessing seniors; seniors micromanaging subordinates; confusion over what's of value and what isn't of value; loss of texture among the information, so not only its value but also its timeliness are getting confused and you can't really tell the difference. So there's a whole set of these things that are being actively pursued as adverse unintended consequences.

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* David S. Alberts, Director, Center for Advanced Command Concepts, Institute for National Strategic Studies, National Defense University.

Oettinger: I imagine that this would also revive the older controversy of whether you want the fellow somewhere up the chain meddling with the decisions of the commander on the scene—what used to be called in Vietnam days the 7,000-mile screwdriver. Could you comment on that?

Cebrowski: This is a reality. You might say it's the ultimate flattening of the organization, and it's a real possibility. My experience is that information-age people derive more power from this rather than less.

Oettinger: I'm sorry, at which end of the hierarchy?

Cebrowski: Both. This is the way it works. First, a little anecdote. When we did the Haiti operation a year ago October, we ran a portion of GCCS (Global Command and Control System), the Joint Maritime Command Information System portion, which had the common operational picture. It was on the JTF (Joint Task Force) commander's flagship on scene, it was in the USACOM headquarters, and it was also in the Pentagon. On seeing it, General Shali said, "Oh, my gosh, we finally did what we swore we would never let happen. The tactical picture is now in the Pentagon." What are some things that happen when this goes on?

Student: There was one piece beyond that, sir, and that was that they were going to put it in the White House Situation Room. The agreement between the J-3 at ACOM and the Joint Staff was that they pulled back, and nobody would have it. So I guess that's the reason why they didn't install it.

Cebrowski: Yes, and this is a very good point. Every time a senior asks a question of a subordinate, you've changed the priorities of that subordinate. Now, to the extent that you provide this information uphill, you reduce the number of questions that get asked. Providing the information uphill, intelligently, is as important as providing it downhill intelligently. In other words, what is indeed a consistent and true operational picture for you at the on-scene

level has to be the same to your senior. To the extent that it's different, you generate doubts: "Is this really what I'm looking at?"

Oettinger: Just to follow up on a recurrent theme in the seminar, you have here re-opened yet another one of those critical balances where the technology does nothing to avoid this issue. It just re-opens it. How much do you send upstairs? How much does upstairs send downward? What this does is facilitate the exchange, but in no way answers the question of how much is enough one way or the other.

Cebrowski: That's right. To my way of thinking, truth is truth, and that's what should be sent. Any commander at lower echelons who cannot tolerate his countrymen seeing the truth probably ought to be fired. You're down there dealing with the truth, and the next echelon is dealing with it, and the senior guys ought to be dealing with it. When the senior people muck around with it, and make the military into failures, we don't necessarily fire them. That's called democracy. It's the way it works. We did a marvelous job of winning the Persian Gulf War. Two years later, we still had arms control people trying to get into various facilities in Iraq. What were they doing for the intervening two years? Where were they the day after the war ended? That's just the nature of it.

We might do a grand job in the military, but it's not the military that wins or loses. It's the country that wins or loses. And so, we have to find ways to form teams with everyone else in the country, and if sharing information will help do that, well then, by golly, we ought to do that. Otherwise, we need to develop the mechanisms to do that, because a whole lot of stuff hangs on what goes on in the "interagency." If you're on a team with these folks, and if you expect them to respond in a timely way and carry their share of the load—which, believe me, is problematic—then we ought to be telling them the truth. Else how can you expect to team with someone to whom you can't tell the truth?

So, I don't feel too bad about it. We seem to have gotten through the Haiti thing. I wish I knew who it was and exactly what

the story was, but it went something like this. After a question was asked of this operator over and over again, he finally said, "For crying out loud, why don't you just look at your screen? It's been on there all along. Go over here and click there, and you'll have that information." Lo and behold, the number of questions went down. That allows seniors to ask more intelligent questions.

For the junior guy, you now have the opportunity for more collegial work. The slide (figure 1) talks about whiteboard battle management. It's very collegial. You find it's no longer the sort of "You go there, I'm going to say this." Maybe someone was missing an important piece of intelligence or interpreted something incorrectly. You now have the ability to get rather high-speed resolution of issues in planning that you couldn't before, so much so that you no longer have to observe what's going on, figure it out, make a decision, perform an action, find out what you did, and start all over again, which is a very stuttering way of going to war, but it's the way we've always done things. It's called the OODA (observe-orient-decide-act) loop. Now the OODA loop looks a lot less interesting because we no longer deal with this jerky way of doing business. We find that operations will tend toward a continuum, so that's a somewhat different construct. That changes generaling a little bit.

GPS I've already mentioned to you. One of the things that changes it is the ability to disseminate, the principle of which in digitization is what we call variable message format, Link-16, messages, which means that we have a waveform and several media to promulgate the consistent operational picture. It's enormously powerful.

Oettinger: EPLRS on that slide is what?

Cebrowski: EPLRS (Enhanced Position Location Reporting System) is a fairly big box. It's fairly expensive. JTIDS (Joint Tactical Information Distribution System) in aircraft right now is fairly big and expensive. On the other hand, you will find that we can mechanize these things down at much lower cost. We'll have it on many

more platforms. By the time we reach the turn of the century we'll probably have digital data links out on about 20,000 ships, aircraft, tanks, Bradleys, trucks, a whole host of vehicles.

Student: Returning to an earlier point, would you clarify this whiteboard battle management? Who are the people now involved in this what I would term ad hoc decisionmaking style? I'm just not really clear on who is engaged in this collegial process.

Cebrowski: The ones that we witnessed last week in the field were the corps commander, an Army three-star, and his two division commanders, who were two-stars. So this was a three-way party. It would ...

Student: Did you also watch General Coffee (M6 Bob Coffee, Commander, 4th ID, Fort Hood, Texas) do it with the security brigade commanders?

Cebrowski: That was division down to ...

Oettinger: They are now at different locations, but connected via video teleconferencing, so that although each of them had the immediacy of whatever their perceptions were of their location, the collegiality came from the fact that they could exchange views and take counsel of one another over an instantaneous video link. Am I understanding the situation correctly?

Cebrowski: That's right. But there are several other tools that increase the power of it. For example, working from the same map, which has the same grid coordinates, and having that up on the screen for everybody simultaneously, with the same markings on it—the same weather overlay, or enemy warfare overlay, or whatever it is—and then the ability to draw on that, erase it, make judgments about certain combat powers or certain elements that were on the map is very important, and the ability to come off the map and be there face-to-face with these people. There's a sense of looking into the other person's eye and seeing how frazzled are they really? How committed to

that judgment are they? So you read the body language. You read the level of fatigue or anxiety, these little interpersonal things which tend to be very important.

It's also interesting how you have the three or four or whatever generals on the screen and one of them says something and then some captain or major in the back says, "No. No. That's not right. He's not there. It's really over here," and you get this sort of spontaneous interaction. In other words, everyone in that command post feels involved. I don't really understand the phenomenon, but it's not just those three guys. That is, again, part of the power. It's an unintended consequence, but in this case, very, very favorable. So, that's good.

Since we're talking about changing the battlefield, and changing generaling, let's jump from here to the next slide (figure 2). I do know it's the height of arrogance to say "emerging realities," as opposed to "emerging perceptions of reality," or hoped-for reality ...

- C⁴ISR capabilities are *required to support*
  - Increasingly expeditionary forces
  - Speedy and stealthy forces
  - Smaller units with greater lethality
  - Coalition forces
- Sensors *must more closely couple* with shooters
  - To provide quality and timeliness
  - To avoid loss of fleeting engagement opportunities
- Demand for knowledge *outstrips the demand for data*
- *Simultaneous execution* of highly responsive autonomous action *and* synchronized operations
- Quality in C⁴ISR *starts with interoperability*

    Munitions and C⁴ISR form the centerpiece of combat capability

Figure 2
Emerging Realities

Oettinger: At Harvard, arrogance is not a vice.

Cebrowski: Let me back up for a second here before going further. When we started, Tony asked me to perhaps make a comment on what the J-6 is thinking about today—what's on the front burner for me versus not so front. I hope what's coming across to you is that, for the senior guy in this organization, understanding what business I'm in, what my customers' needs are, and what my operating environment and my customers' operating environments are, are core to me, and that it is the job of the leader to provide vision. That's where I spend the vast majority of my time, doing those things, trying to understand what's going to happen. We are, in general, a very, very ponderous organization. We're a very ponderous government. It's very hard for us to make 90-degree turns and reposition ourselves. So, it's very useful for us to understand where things might be going so that we can start repositioning ourselves to take advantage of some of these things. That is where I spend a lot of my time.

Let's take a look at the force: the customer to whom I have to provide command and control services (figure 2). It's far more expeditionary. Let's face it, the U.S. Army is not in Europe. It's in Kansas. It's in Louisiana. It's wherever it has to be. This is an abrupt change in strategy. The nation has only three ways to secure its far-flung interests. Either you're positioned forward—permanently or on deployment, or you make strategic movement forward on warning, or you have a client state that shares your security interests, or you do some mix of those things. The nation over the last five years has made a major, major strategic decision to rebalance those three legs.

What are we doing in the world of command and control in consideration of that change? Forces are getting faster and they're stealthier. There's a very interesting phenomenon that goes around here. As units get smaller, we find that per unit—whether it's per person, or per truck, or per ship, or per platform, or however you want to count it—the lethality has gone way up. It is our conviction that the C⁴ISR capabil-

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ity must be commensurate with the lethality—the combat power, if you will—rather than where it sits in somebody's pecking order of echelons or hierarchies, because we look at the effectiveness, and that is the output end, which has to do with combat power, not the input end, which has to do with force structure.

We talk a lot about coalition forces, not necessarily because our allies bring a lot of combat power, but because sometimes our allies bring legitimacy. In either case we have to find ways to do that.

Sensors are being more closely coupled with shooters. It has to do with the fact that we have moved away from the emphasis on quantity of information towards quality. It used to be that in the J-6's office the big sign behind the desk said, "It's bandwidth, stupid!" Now that sign's not there anymore; it's quality, and a big element of quality has to do with timeliness as well as accuracy and a few other attributes and features which are very, very important. One of the reasons why this is so important is shown here.

Before I get to that one, we've invested very, very heavily in sensors—a few hundred billion dollars, and we have billions and billions of dollars worth of weapons to bring to bear. Wouldn't it make sense to spend a little bit of money to see that somehow the sensor was connected to the weapon? In fact, we're doing that. But it's not just a matter of connecting it; it's a matter of *how* to connect it: to connect it in such a way as to preserve these qualitative features as well as to derive more power out of the sensors. So, if you look at the traditional ratio of enemy seen to enemy fired upon, you see it's several thousand to one. We think that there are some things that we can do in the world of C^4 to have that ratio tend more toward one. That's what we'd like to do.

Now, as that ratio tends more towards one, it means that there'll be great pressure on battlefield entities to hide. Hence, they become more stealthy. Alternatively, if they spend a lot of time hiding, they tend to lose their combat power because there's a time element to combat power, and the war will pass you by. So you hid. Well, that's great, but what did you do? You didn't do anything, you hid. It's not particularly exciting.

So, the other thing is, "Then I'll be very, very fast. I'll try to beat the timeline of his sensor-to-shooter coupling." Then what you'll have is a tension between the hiders and the shooters, and how fast you can go and how well you can hide. I project that we will see that tension grow. That has ramifications for the information product and how it's disseminated to the field.

Oettinger: Before you go on, if memory serves me right, the issues you've just described are issues that I remember your predecessor, Jerry Tuttle, talking about, in terms of this connectivity between the sensors and the shooters. First of all, is that an accurate memory, and if it is, are we seeing these things coming to fruition, or is this a new tack for addressing the same problems by different means or what?

Cebrowski: First of all, it's the same subject revisited, but from a different perspective. Also, Jerry Tuttle is a visionary, and what Jerry Tuttle would have liked to have had, but couldn't, we can now do. We're in the midst of implementation of this.

The next thing is that C^4I for the Warrior, the underpinnings of which really came from Jerry Tuttle, was in reality C^4I for the admirals and generals.

Oettinger: And now you're talking about getting down to a shooter rather than the command level.

Cebrowski: That's right, and we're also talking about the difference between battlefield awareness and battlefield knowledge: knowledge not being just the result of more awareness, but knowledge being something that is qualitatively different, which supports a different decision maker for different purposes. It supports a different customer, and that's a relatively new thing that has implications for what we're going to do with our information technology.

This simultaneous execution (figure 2, 4th bullet) is an interesting doctrinal piece, more for the Army, perhaps, than anyone else, although folks would do well to re-

spond to it because it ends up being a pacing item for all the other services. The Army likes to have synchronized operations because traditionally you want to direct massive firepower at the point of contact to assure success in taking the objective. Folks who were not synchronized were largely viewed as squandered firepower or combat power, and forces at risk, because they were not swept up in the whole as a cohesive mass with the inherent defensive properties that went with that.

I started talking about, "No, there's a tension between synchronized operations and autonomous operations." This comes from just talking to some folks who have either been in exercises or in real combat. You always hear such stories as, "We were just ready to take the objective when they told us to move off to the north so that artillery could come in and do its work on this particular objective, and then, lo and behold, the artillery fell short, perhaps to the position to which they relocated, or perhaps not, and the objective was lost." You hear a succession of these. "Well, I was doing this air defense problem, and I was just getting ready to engage with my fighters when I was told to vector off to the north because surface-to-air missiles and anti-aircraft artillery were going to take that and I was going to be directed off onto this other region or sector where there was yet another threat for me to cope with. I went over there, but the threat never materialized, and lo and behold the artillery and the SAM systems did not defeat the enemy, but they got through." You hear this over and over again. What this means is that guy and that platoon were going to take this objective if they had been allowed to operate autonomously, and it could have been a done deal.

Some people say, "Well, but now you're at risk, because perhaps the force there was larger than you saw and higher authority could actually see more than you did." Now what we're saying is there's the presumption that higher authority is smarter. Well, I'm a three-star. I've *been* higher authority, and I'll tell you higher authority is frequently dumber, and that's just the way it is. Sometimes he's smarter, but frequently he's smarter in different

things. Hence, the power of the collegial work. "Autonomous operations" does not mean that there's anarchy on the battlefield. It does mean that a person can execute his orders without further instruction. It does not necessarily mean that he can execute his orders without further information. The information system needs to accommodate this autonomous operation, just as it will accommodate synchronized operations.

My colonel here (Colonel Roy Edwards) says, "The reason everyone in the Army hates you is because they hate this word 'autonomous.' Why don't you just say 'super-synchronized'?" As it turns out, there is some wisdom to that. The wisdom is that if you have the high degree of knowledge that the Force 21, properly executed, will provide, you can have autonomous operations, and the level of knowledge of all the adjacent forces and higher echelons will be such that the force will automatically resynchronize by itself. So, synchronization, then, becomes a fallout of the thing rather than a wicket which one must hurdle, which must be gotten over in order to conduct the operation.

Oettinger: That's a marvelous concept, but the embodiment of it in historical and contemporary reality is kind of like biological evolving systems, which tend to be sloppy and take time and make many errors, with much sort of dead detritus along the way. One can see the perversions of that idea already looming. There is no such thing as a sort of free lunch or an ideal system.

Cebrowski: In the absence of all else, what you say is absolutely true. But the big thing that is absent is organizing principles. You apply an organizing principle to this— a framework, bounds, rules, commander's intent—plus what we're talking about here, again, is not anarchy. This means that not only is there an organizing principle, but there is also an organizing authority. For example, the same person who authorizes and organizes one thing does the same thing at another location, and this may be exercised in the form of command by negation, because he does have visibility of this thing. We have a lot of experience with

command by negation. It works very, very well. As a matter of fact, if I do have a combat expertise, it is in air defense, and this is where we see this, indeed, work extremely well. We have about 15 years of good experience with it, so we know it can work. You're still deeply troubled.

Oettinger: Yes, for example, where do the two fighters that shot down the helicopters [in Iraq in 1994] come in on that? I don't quite know whether it was because it was autonomous or because it was synchronized. The avoidance of accidents, I guess, remains a problem under either model.

Cebrowski: It's difficult. That's right. It's difficult to see. Suppose we take the tightest control, which means we have direct control. So the F-15 pilot calls the AWACS (Airborne Warning and Control System) and says, "I have here these two Hind helicopters that originated from south of 36 degrees north latitude. They are now flying in this area here. I have positive hostile identification on them. Request permission to fire." The AWACS goes back to headquarters in Incerlik, Turkey, or wherever it was, and then on up, and finally the President of the United States says, "Yup, okay, it satisfies the ROE (rules of engagement); shoot them." It would not change the outcome one iota.

Student: The problem is found in the data, or at least translating the data into information. These guys gave them this concept, and they acted upon it.

Cebrowski: That's right, information quality.

Oettinger: Well, yes and no. There's an Army major here who's doing a thorough analysis of it.* It turns out to be an enormously complicated set of issues. Maybe toward the end of the semester we'll have a chance to talk about it some more. The question of avoidance of accidents is over-

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* Scott A. Snook, *"Practical Drift: The Friendly Fire Shootdown Over Northern Iraq."* Ph.D. Dissertation, Harvard University.

laid on all of this, and I'm not sure that any of these guarantee against accidents. I just want to make a note of that on the side to come back to later this semester. It remains a troublesome area.

Cebrowski: The drive—and it's a legitimate drive—to reduce accidents to zero is the formula for paralysis. We need to find another way to suppress accidents.

Oettinger: Suppress is probably an unreasonable goal. Reduce, perhaps.

Cebrowski: Whatever.

Student: Sir, with regard to increasing the sighting-to-shooting ratio, doesn't that run counter to efforts to reduce accidents? It seems like if you want quicker reactions and shooting, that runs counter to safety. If these decisions are being made quickly, doesn't that mean that strategy and doctrine need to be decided beforehand, before the possibility of engagement? The natural pause of sighting something and then sort of sorting out the thrust of what's going to happen and reevaluating the position seems to go away. It's like you have to have your mind made up ahead of time exactly what you're going to do.

Cebrowski: Yes. With regard to the first question, if the amount and quality of information—the level of knowledge—do not change, and you merely accelerate the decision process, then you've made a change to one variable, and it should not be surprising to you that performance falls. It won't necessarily fall, because sometimes people just dither for too long. [Admiral] Arleigh Burke used to say, "When in doubt, attack. If you need more time, attack." The reason is because the additional time that you take to prepare is also time that you're giving the enemy. You're never going to be absolutely ready, so go with it. But that's a different kind of thing.

What your question implies is that I'm not any smarter than I'm going to be, and since information arrives according to some time flow to it, I'm shooting before I get information that I would have if I shot later. Consequently, the likelihood of shooting

the wrong things is higher. That's true, but that's not what I'm talking about. What I'm talking about is that you elevate the level of knowledge and awareness *a priori*. Then because you've done that, you've enabled certain other kinds of operations or activities that wouldn't have been available within prudent risk otherwise.

Student: Sir, this is more, I guess, of the same sort of question, but strategically, if there's no pause, or there is less pause, it seems that it gives us less of a chance to reevaluate the entire thrust. It's like you could see a whole sequence of events, of actions, of attacks, taking place, and then you have to recoup and decide what happened when the dust clears. Instead of the natural pause that a slower process might entail, it seems like you have to have your mind made up ahead of time.

Cebrowski: Yes. That's right.

Student: It's very, very hard wired into what you're doing. It all needs to be decided sort of on the run.

Cebrowski: No. First of all, I do not propose that we either regulate information, or worse, allow a still lesser amount of information, to go into an operation without the adequate planning and intelligence preparation of the battlefield. It absolutely must be done with prudence. Prudence demands it. So, you simply do that. We're always going to use prudence.

As far as waiting and pausing, this brings up the notion of speed of command, another very important element in operations. You'll pardon the digression here. People talked a lot about developing the requisite massive firepower at the point of contact. That devolves to attrition; attrition devolves to dollar signs, dead people, and does not always yield victory. Generally, we find that battles are not won or decided on the basis of attrition. That raises up now the maneuver warfare priesthood who says, " Ah, it's maneuver." It is position. It is position in movement. So this is now mass over time. That was an interesting piece of complexity, but it still devolves to mass, which devolves to attrition, and you're

back to where you began. The thing that really tends to decide battles is speed of command: that is, how quickly the other fellow gets the sense, for example, that his strategy is unraveling. With what speed do the blows fall, as opposed to precisely where they fall, and the relationship amongst them?

At the grand, grand, grand scale, I suppose one could say it's the difference between Hiroshima and Nagasaki on the one hand and Dresden and Hamburg on the other. About the same number of people were killed in both places, but one of them took just a few seconds and the two events were very closely coupled in the nuclear case. In the conventional case, it took a day, a day and a half, for each of those, and the time between them was much longer because it took a lot longer for the force to regenerate. One ended the war; the other one did nothing except kill lots of people. So it is the relationships of things or the speed of things that count.

Another way to look at it might be the short-armed boxer who finally gets inside the reach of the other guy. He just starts pummeling away for all he's worth. One blow is not necessarily well connected with the other one in terms of where it falls, but it comes quickly after it, and it seems absolutely relentless, and the big guy either takes his beating, or else he says, "I'm out of here," and takes the fall, the count to eight, so he can reset and start over again. That's really the way combat tends to be. One side finally says, "Whoa, I'm out of here," or else he becomes a spoiler and says, "Well, I'm going to lose anyway. I'm just going to make it as expensive as possible." It depends on what the larger national scheme is.

Enough of that. The last bullet (figure 2) is a truism, and it's a cause of one of our real problems with the way we think about things, in that we think of command and control as elements of warfare and so on. We think of it in warfare terms. When we model that in our mind, that comes out to be red-blue, and blue-red interactions. But C^4 isn't like that. C^4 is blue-blue and red-red kind of actions, a slightly different concept.

So, the essence of C^4 is being able to connect to somebody and to interoperate. If you can't do this, you just don't have it. It is the core fundamental piece. It is not something where we can decide, "Well, you know, if we have it today, that's good. If we don't tomorrow, we'll just get by otherwise." No, it's not like that at all. This is inherent to being able to do any good things in warfare.

When you come down to the bottom line of this whole business, it's that the relationships count. It's the relationship between munitions and the sensor that now forms the centerpiece of warfare. Somebody may say, "Wait a minute!" as one person did to me not too long ago. "*People* are the centerpiece of warfare." That's absolutely true, because people deliver the munitions. People operate the communications systems. People command. People do intelligence. People do all that business. People move this stuff to bear. People are the whole thing. Yes, I'll admit that. So what? Of course it's people.

The exciting thing, though, is the relationship between and among munitions and sensors as opposed to numbers of tanks, numbers of airplanes, Bradleys, ships, or whatever. If you back up, you say, "If that is now the centerpiece of warfare, what else has got to change? What are my budget implications to this?" Well, we have some, believe it or not, that you can see. For example, ships and aircraft are lasting much longer than they ever have before. Why? Because they're expensive, and you can't pay for them. Why aren't we falling on our swords over the whole thing? Because we now realize that the tank, the airplane, the ship, are reusable containers, and the power is in the sensor and the munitions it carries and the linkage between those two. It is that linkage from which power derives, because this is the value-added function in warfare. It's the old saw, "A society makes war the same way it makes money." We add value to society by inserting information, and that's what we do in the battlefield. So this should come as no surprise.

Student: I have a quick question with regard to if the sensor is the shooter, which is a very popular idea, it really depends on

whom you define as the shooter. What it sounds like is that sensor systems must be coupled with weapon systems. But there is a command and control function over the firing of the weapon systems. Is that what you mean when you say sensors must be coupled with shooters? Who are the shooters in your premise?

Cebrowski: Yes. C^4I for the Warrior is not C^4I for the admirals and the generals. Is it the JTF commander? Is it the brigade commander? Is it a fighter pilot?

We took all the sensors and we made a great big list of them and gave the list—it's very long and it's worth billions of dollars—and we took all these shooters, the platforms and their weapons on them, and then what we did is we drew lines to them. This line went through a few things. One of these was major command nodes. Another place was other, more mobile command and control, such as AWACS, although I think the Air Force hasn't decided yet whether it's command and control, but you have that. You might have a cruiser, say, in the Navy sense. What would be the Army analog to a field command post, say, that would control the forward fire support?

Student: Advanced Field Artillery Tactical Data System (AFATDS).

Cebrowski: Yes, something like that. So you have some kind of fire support. So, in any case, you know, this would go through somehow and come out and go over there. It tended to be very, very linear, and because it was linear, we found a couple of things. One is that *this* was the sensor that was meant to serve *this* weapon and it went through *this* command post at this point and then it went through *that one* there. We added up the timeline of the whole thing, and we found out that when the kid called for fire out on the point, 35 minutes later he got a round. So, we said, "Well, is this good enough?" The answer was no, because he really needs more. So we asked the Army, let's say, in the case of AT-ACMS (Army Tactical Missile System), "How soon do you really need it?" And the guy says, "Twenty minutes." I said, "Twenty minutes? How'd you get that

number?" When we pulled the thread, we found out that was faster than anyone ever thought that they could really logically expect to get it, but not by a lot. In other words, it was reasonably attainable. So we'll stretch things out a little bit.

So we said, "Wait a minute. Suppose we took this product and we put it on a broadcast system, on a pipe, and so it went into *this* command post and then simultaneously went to *this one* and went over here to *this one* and then it went right through to *this* weapon system, to *that* weapon system, and to *that* weapon system over there. Let's take a look at what happens to the timelines." Then, lo and behold, we got it down to three minutes, two minutes, and we asked the kid at the point what he really thought he needed, and he said, "Gee, two minutes is nice, but faster would be better."

So that's the reality of it. If your son or daughter were out there on the point calling for fires, two minutes would seem pretty slow to you. I don't think you'd be too upset about the fact that we break some doctrinal china, and we've already got that round for your son and daughter, and the American people won't be too upset about it either. But if you don't, they ought to hang you.

But one of the things we did is that we've gone to essentially broadcast mode. What that means is that now I no longer have people who are remote to the need with their hands on the spigots.

Oettinger: But it seems to me that highlights your side comment about breaking a bit of doctrinal china. There are really two things going on here. One is the need, if you have a weapon, to have information about the target be there almost instantaneously. I might even imagine continuous tracking, even if it's not with an organic sensor that's in your own airplane or in your tank, but if it's somebody else's asset, you'd like to be coupled to it instantaneously. But that is kind of an informational loop which, conceptually at least, ought to be quite distinct from the command loop that says, "Even though you see it, you shoot or you do not shoot." Now, again, the doctrine might be, "If you see it, you shoot it," or doctrine might be, "If you

don't, if you see it, you first ask permission of high headquarters." The point that I'm making, though, is that it seems to me that with this technology, as always, those two things are fundamentally distinct conceptually, and they ought not to get confused, whether the technology permits it or not. I see you nodding, so I think you agree. Could you elaborate on that a bit?

Cebrowski: That's right. That was the core to the earlier question that I started with in the whole business. When we couple up the command system with the information system, and we put these folks who are remote to the battle in charge of it, we find, for example, that in delivery for an ATACMS or a JSOW (joint standoff weapon) or something like that on a target, when we do the analysis, we're talking about many, many minutes—16 minutes, 22 minutes, something like that. When we separate them and we have a different command doctrine, such as command by intent or command by negation, when the commander has the visibility, he has the ability to negate the attack. He knows that the other person is attacking, and he knows he's going to attack the target, and consequently he can insert himself, but not in such a way that it interferes with the timeline, so you get down near around two or three minutes. The impact on the battlefield is profound.

Information is meant to be provided by the information system. The elements of command are meant to be provided by the command system. The command system should ride the information system, but just ride it. In other words, it's part of it. The command system is hierarchical by nature. It's a thin line and it's vertical. The information system should flow over the enterprise like a wave.

Oettinger: This is music to my ears. I think it's critical for the class to appreciate.* This is not exactly a commonly accepted

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* Anthony G. Oettinger. "Compunications in the National Decision-Making Process," in Martin Greenberger, editor, *Computers, Communications, and the Public Interest.* Baltimore, MD: Johns Hopkins University Press, 1971, pp. 73-114.

viewpoint. This relationship between the command and information systems, and their distinctiveness, is, to my memory, almost always ignored rather than emphasized the way you have done. So, I think you're hearing here something that is of profound importance. More people are oblivious of it and recognize it the way our speaker has today. So, thank you, it's admirable.

Student: I'm sorry, Admiral. Could you back up just half a second for those of us who are still living in the Neolithic eras? Using the principle that you just talked about, can you discuss a practical application of how that would work versus how an alternative would work? Obviously everyone says information is good, but it's a question of different philosophies of how it should be managed. You've talked about one where the command should ride, not drive, the information. Now could you give an alternative philosophy of that as well?

Cebrowski: Oh, yes. Let me give one and then give a personal vignette that illustrates some of it.

I've got a JSTARS (Joint Surveillance Target Attack Radar System) that senses a target. It does not have command and control capabilities; that is, authority to command, to direct fire, is not resident within that platform. Somebody made that decision. Instead, what we do is we transmit the data—and it is data—on a very high volume data link called SCDL (secure data link). It happens to be a proprietary data link so that no one else can read it, like no other friendly force. Another stupid decision, if you'll pardon the expression. You can tell there's a little emotion in this because I've been fighting this mentality for too long. I'm not talking about what you might be alluding to, where you are in your thinking; I'm talking about the fact that sometimes people do things their own way so that they can have power for themselves and exclude others, so that their role can be more dominant. This is called "hard-wiring doctrine." That's the part that's stupid, because next week the doctrine changes and then where are you? You can't afford to deal with it, because you can't keep up with

it. Instead, you want an information system that can be tolerant of whatever mode of doctrine is needed at the time.

Oettinger: Thanks. I would have said it differently: that you don't want to confuse information with the exercise of authority; that having information universally available is not the same thing as diffusing authority everywhere.

Cebrowski: That's right.

Oettinger: The two are absolutely independent variables.

Cebrowski: Beautiful, that's great. I wish I'd thought of that.

So this comes down, goes through what's called a GSM, Ground Station Mobile, and the GSM does a little bit of processing or interpretation, passes it to another headquarters or intelligence center node that does something, and then it gets passed to the senior command post. The senior command post makes the decision about whether or not this should be taken under fire. If the decision is yes, then that is passed to a place where the decision is made about who takes it under attack. Then somebody says, "That target should be verified because we're now passing the 15-to-20-minute mark in this whole thing. The target may have been mobile. Is it still there?" So we now send somebody out to see it. And if it is, a round is finally released, and then we find out that in the meantime the guy you've been supporting has been overrun. So that is one case.

Case two is the JSTARS has been modified this time, such that it does have a commander housed in it, and in addition to the SCDL, there is a Link-16 on there. The Link-16, in its broadcast mode, goes down to several batteries simultaneously. It also goes to a few aircraft, F-15Es, which happen to be in the area and have an air-to-ground capability. It goes to a Spruance destroyer, which is within range for its armament. As well as those weapons and weapon systems, it also goes to the command system that supports those batteries, and it goes to higher authority, all at the same time.

And so, what happens is that the guy in that JSTARS aircraft moves the symbol over onto the target, slides his designator symbol over to this F-15E, and releases the button. You now have a pairing. That pairing shows up in that F-15's cockpit. It shows up on all of those batteries, and shows up back in the command post at the intelligence center, all at the same time. And somebody says, "Okay, Bilge Pump one-five just paired F-15E, call sign umpty-squat, with target 12-17." Someone says, "Well, great, good," and the target is killed, and it's now a matter of minutes. That's the way it works. And, surprise, that's what we're trying to do! We're installing Link-16 in JSTARS. We're fighting the fight to break the doctrine so that we can put command authority in the aircraft, and you're going to get that.

Seventy-five percent of the force is going to have Link-16—that's air, ground, sea capability. We're looking at 2005 now. The ground forces will have about 80 percent by the turn of the century. So that's what happens.

Now the little vignette that goes with it. I'm the deputy JTF commander in Riyadh, and we're enforcing the no-fly zone south at 32 degrees north latitude. I walk into the command center. I'm the senior person there. As I walk in, I look up on the big board, and I see a pairing line go up between a friendly symbol and an unknown symbol, which, before my eyes, has changed to a hostile. I turn to the watch and I say, "What is that?" The watch barks out this question to the fellow sitting next to him, who barks into the phone up to the AWACS. The AWACS then talks to the Rivet Joint (F-15) aircraft, back to the AWACS. I'm starting to wonder what this conversation is that I'm listening to, and then all of a sudden I hear the AWACS tell the F-15 driver, "Positive hostile ID required." That means visual ID. I say, "Whoa. I already have enough information here to know that that's a hostile and the guy is cleared to shoot. Where'd that come from?" It came from the fact that higher authority walked in and said, "What is this? What's going on here?"

The F-15 guy already knew that he could shoot, but higher authority inserted

himself, unintentionally, and it had this consequence. The reason it had this consequence is because doctrinally we generally tend to run more toward direct command—more in some services than others. So, the presumption is that everything here stops until the admiral gets his question answered. So that is the doctrinal and educational issue, and we changed that. My question had nothing to do with whether or not this guy was cleared to shoot. I just wanted to know what it was—was this a MiG-25 or MiG-23? I didn't really care which one it was. I was just kind of curious. In either case he's going to be history. What we need to do is work the doctrine and the culture that goes with it, so that as this information technology comes along, in our heads we're swept along with it.

Oettinger: But again, to underscore this, what it illustrates is the separation of this doctrinal point of how to interpret the query—in this case, the innocent and unintended query by the JTF commander—as opposed to having the information around. One reason for underscoring is that this debate has been going on at the other end of the hierarchy as well in terms of the question of, for example, whether the President sitting in the Situation Room ought to muck around. This goes back to the 7,000-mile screwdriver question and titanic battles over the years over the question of whether the President of the United States, as Commander-in-Chief, should have direct access to the sorts of raw stuff that a shooter sees versus the interpreted finished intelligence provided by 16 hierarchies in the intelligence community and delivered on a silver platter by none other than the Director of Central Intelligence in his statutory role, as opposed to 16 other guys or a direct wire. It's at a different level, but it's the same kind of doctrinal question, which I hear you answering by saying, "Hey, whether it's the commander in chief or the guy in the cockpit or in the tank, let the information wash over all of them."

Then the doctrinal question of who, at what time, should do which—interfere, be misinterpreted, or whatever—is an important doctrinal question. But I guess you and I agree on this notion that you let the infor-

mation wash over everybody, and you settle these doctrinal questions, as they should be, as doctrinal questions over who does what when, and what do you prefer: positive control, negative control, et cetera. But that's an independent question.

Cebrowski: Let me quickly ripple through a couple of questions here because I'm almost out of time. And Boston traffic being what it is ...

Oettinger: You don't want to miss your plane.

Cebrowski: I have a pretty abrupt endpoint here. Current operations, small-scale operations, operations other than war, and whatnot, versus Desert Storm types of things. The information service—not system, mind you, but service—that we should be providing our forces should be appropriate to whatever size force, whatever force composition, and whatever mission, no matter where it is. That is the J-6 vision and what we need to provide.

Does information have more power in one circumstance than another? Certainly it does. However, one of the things we pretty much know is that, in general, less knowledge is worse than more knowledge, so we just provide.

On joint communications technologies, the vision piece is that we resolve some fundamental issues concerning databases and data-file structure and access protocols, and then we just come up on the Net. Independent of hardware, independent of whatever country you're from, or what your force is, or where you are in this whole business, that's ultimately where we go and that's how, I think, we ultimately solve the joint and the interoperability problem. We say, "I don't care. If you want to buy Honeywell, be my guest. If you want to buy Siemens, be my guest." It's just like if you go to the local computer store because you want to come up on the Net: you buy what suits your fancy and you're confident that it's going to work on the Net. That's essentially where we're going.

IW (information warfare) versus non-battlefield vulnerabilities: just a couple of quick thoughts on this. Let's cut it in two

different directions. First of all, there's offense and there's defense. As the J-6, I focus a whole lot more on defense than I do on offense. I think offense is pretty easy. Defense is pretty exciting. There are a whole lot of complications in defense because much of what we're defending has nothing to do with the military. It's commercial structure. It's privately owned or it's a public utility. That's just way that it is. This is a complication you largely don't have with offense, and consequently, the policy, legal, regulatory, and organizational ramifications are much more exciting. It's also more important to us.

First of all, it's a matter of national security generally, writ large under the Constitutional provisions for providing for the common defense. So there is certainly a role there. Secondly, it's involved in the deployment of forces, in that all force movement forward is highly dependent on our infrastructures, which are either dominated or controlled by our information infrastructure via systems called SCADAs (supervisory control and data acquisition) or something similar to that. As a consequence, the securing of those systems is very important to force deployment and the sustainment of a deployed force, because we have moved from being a just-in-case force to a just-in-time force, and so visibility and information and intelligence products to support the military, in a timely way, around the world, are indeed critical. Much of that rides the public switch network. So we have an interest there. Third is employment of force, and this has to do with defense on the battlefield.

My focus is on the first two because those are the most difficult. Those are the parts that will touch the most people, and have to do with the underpinnings of our ability to bring combat power to bear in accordance with national policy.

The third one I can deal with, perhaps, in a couple of different ways, one of them being the more traditional means of defense. It is a second-order issue to me, but it's not following by a lot. The J-6 does not spend a lot of time there. I expect the services to spend their time on the defense for the employment side. So that's the rough break on things there, on the IW issue.

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On the intel versus C^4 relationship, is this a bad marriage? It might be, except that it's not a marriage. Contrary to its being bad, many people are saying that this, indeed, would be a good thing. If you look at the intel process line, the last line is dissemination, and the closer you move along that process line, with each step, you become more involved in the same kinds of things that the J-6 is involved in. So, no, this is not a marriage. We need some kind of marriage. I don't know what the organization would look like, and I don't much care, as long as we find a way to work together so this ends up being a nice smooth continuum. I think we can do that.

There was a wonderful question concerning the relationship between simplicity and complexity, and this is something that we have grappled with. This morning, with the Strategic Studies Group at the Naval War College, we were talking about this very thing. Clausewitz, the widely quoted but seldom read author, said something to the effect that in war everything is simple but everything is difficult. There is certainly a great element of truth to that. The wisdom of it is that the undercurrents, the underpinnings, of combat are really quite simple, and very, very fundamental. It's useful to know this broad sweep of things, because in the execution we have a great overlay of enormous complexity that masks very basic undercurrents that run through conflict. If we could have a good understanding of those, and not be distracted by some of the complexity, then we may, in fact, perform better.

I look for two kinds of simplifying functions. The first one is not particularly exciting. This is the one where the complexity is masked, like in your computer. You sit down at the terminal and you don't know what's going on in that chip with the billions of bits and the FLOPs (floating point operations) and the terabytes and whatnot. Who cares? You just do your thing. It has enormous complexities underneath there, and it's absolutely masked to you. That's one way to do it:

we'll make things simple by aggregating it at a high enough level and sooner or later, if you do so, you'll be able to reduce everything to a curve that's generally of the form: $y = 1 - e^x$ or something like that. You'll find that everything in the world devolves to a curve that has an "e" in it and looks like that. But that's not particularly useful all the time.

Instead, it may be more useful to say, "Wait a minute, let's get underneath all of that complexity and put that in its place. We'll find this simple piece, focus on it, develop an understanding of what the real core relationships are, and let's work those, and try to find a way to shed some of the apparent complexity." If I can make a prediction, I think we'll start to see some of that happening in our information processes, as they come along, where people are going to start saying, "This just doesn't matter." For example, load up all those Army guys, move them all over the battlefield, like this; it's hard, it's complicated, I've got to mechanize and coordinate all this, but I find out that when my knowledge level goes up, I'm doing less of that. And so, all of a sudden, movement to engagement is a lot simpler. I suspect we're going find, over time, that we can do that.
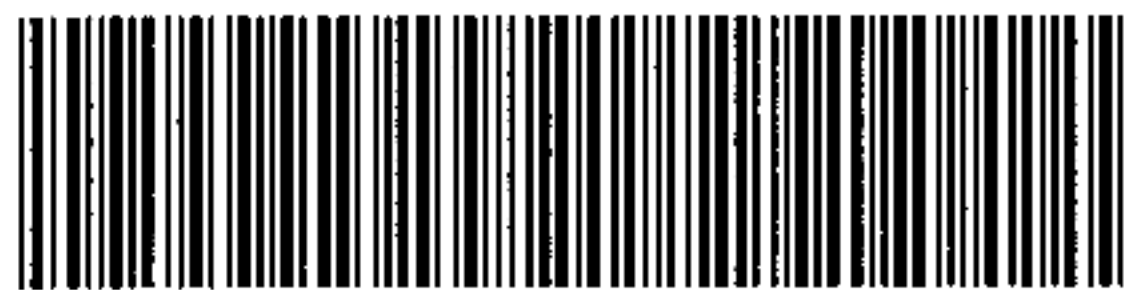
There's a whole bunch of things. For example, I think air defense command and control is one of the simplest things in the whole world. That just rockets along. It's intuitive: strike is going in that direction. I think one of the great holdouts is maneuver warfare, which is hard and complex. It's the most complex. It has more moving parts than anything else, so it's not surprising that it's the last one.

I'm out of time. I hope I dealt with your questions, probably not adequately, but well enough at least to give you something different to think about.

Oettinger: Before I thank you formally and close the meeting, I do want to give you a small token of our great appreciation.