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and Control**

**C⁴I for the Warrior
Richard C. Macke**

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C⁴I for the Warrior

Richard C. Macke

Vice Admiral Macke is Director for Command, Control, Communications, and Computer Systems for the Joint Staff. He became a naval aviator in 1961, attended Navy Test Pilot School in 1965 and then served in the Weapons System Test Directorate. He then went to VA-27 and flew more than 150 combat missions in Southeast Asia from the USS Constellation. He next went to the U.S. Naval Postgraduate School and earned a Master of Science degree in Operations Research and Systems Analysis. In 1971, he reported to VA-66, Cecil Field, Florida, as Executive Officer. In 1975, he was assigned to the Navy Office of Legislative Affairs in the Pentagon. After completing nuclear propulsion training, Vice Admiral Macke served as Executive Officer of the USS Nimitz (CVN-68). He served as executive assistant to the Director of Command and Control, prior to reporting to the USS Dwight D. Eisenhower as Commanding Officer in 1984. He was selected for flag rank upon leaving the "Ike" and reported as the Commander of the Naval Space Command, where he led initiatives to enhance space support to tactical warriors. He reported as Commander Carrier Group 2 in 1988, completed a deployment to the Mediterranean, and in 1990 he became Commander, Carrier Group 4. Vice Admiral Macke assumed his current position in 1991. He has earned numerous decorations and awards during his career.

Oettinger: We are fortunate today that our speaker agreed to come, and thereby has left an unbroken line back to the very first person who held his office, in the days when it only had C² in it. Admiral Macke will be talking to us today about C⁴I and warfighters. One last question, Sir: I hope that you are interruptible with questions as you go along?

Macke: That was one of the first things I was going to say — most definitely.

This presentation was put together to brief to the Chiefs and SECDEF (the Secretary of Defense). I've pulled a couple of the slides, but there are 10 more of them. As we go through this (figure 1), I think you'll see it is kind of pointed at that level of audience. I don't use a script, therefore I am thoroughly interruptible. Sometimes it helps me get back on the right train if I get too far afield.

What brings this about and what drove me to this is where we are today. Information technology is here; it's a warfare science. We're using it on a daily basis. I told a story earlier today of soldiers carrying laptops to war. It's a fact. I think there were more laptops in Desert Storm than there were 500-pound bombs.

The warfighters have taken the information technology that's available, created command and control systems and, in so doing, created noninteroperable command and control systems. If you look at the way we are set up today service-wide (figure 2), the Army has the Army Tactical Command and Control System (ATCCS); the Air Force is coming up with Theater Battle Management (TBM), sometimes known as CTAPS. Copernicus, also known as

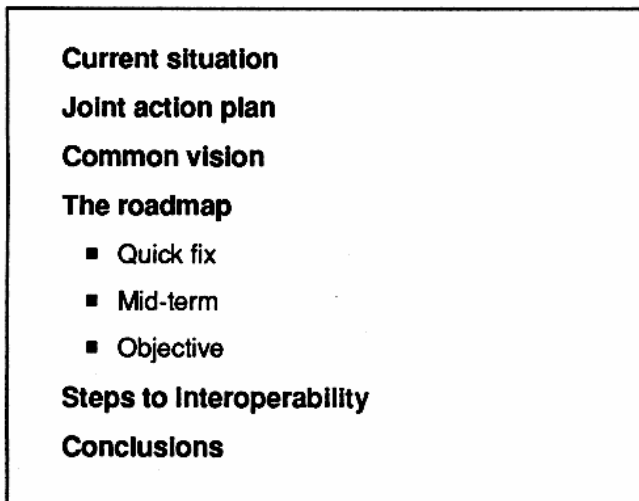


Figure 1
Overview

JOTS,* is the architecture for the Navy. The Navy Tactical Command System Afloat (NTCS-A) is the system. And another system known as Marine Tactical Command and Control System (MT CCS) for the Marines. The SOF (Special Operations Forces) guys have their own, and you can add the Coast Guard, and then if you really want to see how confused the picture is, I can bring in the European theater's command and control system, I can bring in the Atlantic Command's command and control system, I can bring in Southern Command's command and control system, and for almost every commander in chief (CINC) I can bring in another command and control system. The only thing common about all these is that they don't work with each other. Each of them is a stovepipe. So when the Commander of the Joint Task Force (CJTF), this joint warfighter, sits down with his forces and says, "I want to know what my forces are doing," he has to have five or six or seven or eight displays to tell him what each of his different components is doing in a joint fight. And that's what it looks like (figure 2).

They're mechanized differently, they work differently, and they display obviously individual service-unique types of information, or in some

cases it's theater-unique. But it's a mismatch, and again, when the joint warfighter sits down to review the situation, he has to go to a bunch of different displays, then he has to integrate what he's seeing and bring it together so that he gets a joint, cohesive war-fighting force. We are smarter than that. We don't need to make him be the fusion device. We have the capability of doing the fusion for him. With the exception of one ship, I can walk into a carrier command center, with the tactical flag command center afloat on a carrier, and I will find at least four different displays that I have to look at in order to come up with the full picture. One thing tells me some intelligence information, another one tells me location of forces, another one gives me management logistics, and on and on. And as the war-fighter, I have to be the integrator. Again, we don't need to do that; we can make this better and more clear.

Oettinger: A couple of points. One is, I suppose it's even worse than what you say, because to try to decipher this within the services' different systems, but even within different intelligence, disciplines, and on and on ...

Macke: Some of this stuff is behind a green door.

Oettinger: You bet. Now, on the other hand, if, as you said a moment ago, you integrate at all, somebody does the fusion of all this, and then relieves the warfighter of some burden. It also hides a great deal from him.

Macke: With intelligent fusion, you can't hide it.

Oettinger: Pardon me?

Macke: Initially, the intelligence types did not like this concept. They said, "You're putting the analysts out of business." I'm not putting the analysts out of business. There are still going to be things that the analyst has to do and sort out, but there are an awful lot of things that are nothing more than matching time, position, and course or speed on contacts and saying, "Yes, that's the same contact," or "No, it isn't the same contact." Maybe it's some electronic information that you picked up on it, and you bring those all in. Instead of now having six or seven duplicate contacts in my database that I've got to do the fusion on, let the machine do the fusion. If it doesn't fuse, then you need to spit it out and an analyst, a brain, has to take a look at it.

Why did we get to this? Whose fault is it? I'm big on that, so I want to know whose fault it was, and as I looked around, the best thing I could come up with

*Joint Operational Tactical System (or Jerry O. Tuttle System); see Jerry O. Tuttle, "Tailoring C² Systems to Military Users," *Seminar on Intelligence, Command, and Control: Guest Presentations, Spring 1989*. Program on Information Resources Policy, Harvard University, Cambridge, MA, 1989.

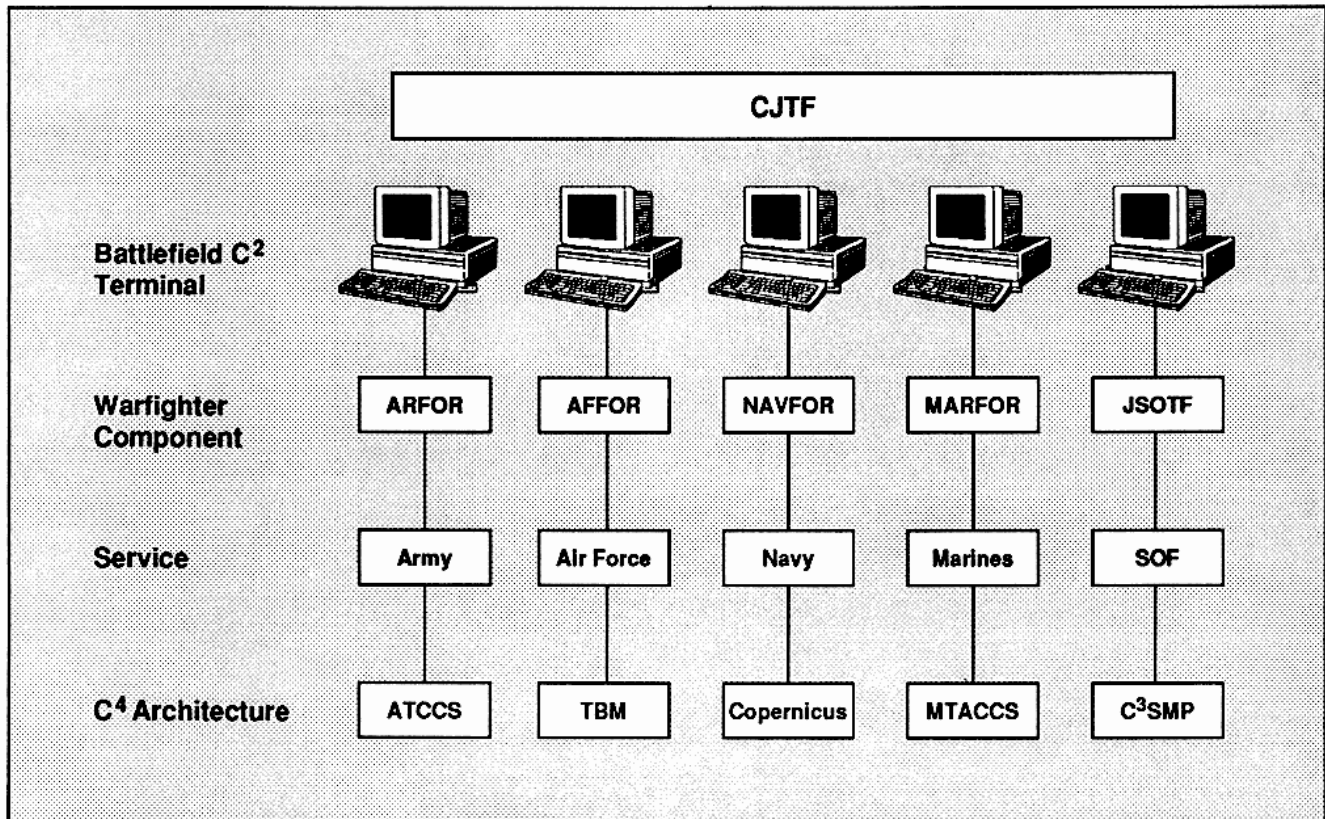


Figure 2
Current Situation

was a mirror. It really is the joint side of the house's fault. We have not provided the framework, the architecture, to make these things interoperable. What Jerry Tuttle did in the Navy with Copernicus has created an architecture for the Navy so that the Navy systems would now work through one architecture. What I'm trying to do is to create that same thing for the joint world — a little more complicated, put together a little differently, but basically the same thing.

We need the bus to plug into, so that these machines can share information with each other and it can be displayed on one common machine and given to the joint warfighters. We provide this bus, and C⁴I for the Warrior is this bus (figure 3). It is intelligence in addition to C⁴, and it has to be. Intelligence, if you're using that information for the sake of the power of information, is useless. If you can't put the information in the hands of somebody who can shoot, then it's useless information. You know, warfighters ask that. Intelligence information that doesn't get into the hands of a warfighter is

useless. So we have to make sure that the intelligence part fits in.

The machine that's being developed — in fact, it's about ready to go today — is a Sun SPARC workstation, but it can be any of the high-powered workstations that have a capability of bringing in a lot of different information, and displaying it in a lot of different fashions. This is going to be the heart of Southern Command's command and control system, and it will be the heart of the total antidrug network that's coming down the pike.

The purpose, then, is to establish this joint architecture that everybody can work through (figure 4). It provides the common target to bring in the lessons we learned from Desert Storm. Why is interoperability driven so hard into my head that we have to do it? When I walked into the Joint Staff, a gent by the name of Powell said, "The Marines couldn't talk to the Army in Desert Storm; find out why, and fix it," and I read those lips and I understand that it's a lot bigger problem than just that.

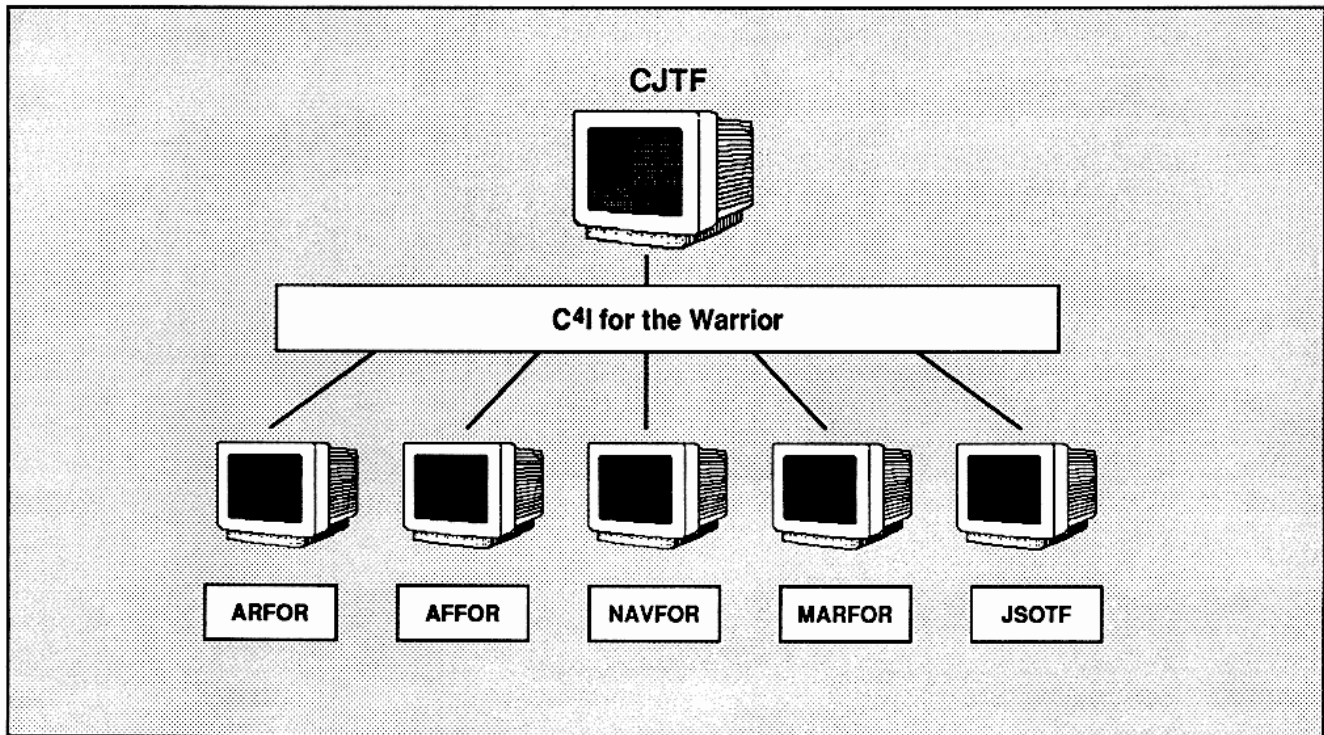


Figure 3
Joint Warfighter C² Terminal

To get 100 percent interoperability, we're asking, "Starting with the basics, what are you trying to build? And what are you trying to do with command and control? What does command and control do for the warfighter? What does C⁴I do for the warfighter?" It gives him the capability of having a true picture (and I really have to be careful of the word "picture" because I'm talking representation, and a lot of people want imagery when I say picture). So there's a difference, a big difference in bandwidth — to get a true representation of what's out there. A conglomeration of Clausewitz and Grant and what some others have said lead me to — if you want to win, then you need to pick the place you're going to fight, you need to pick the time you're going to fight, and you need to pick the forces that you're going to engage. If I can elect those things, then I ought to win that fight. If I win all the fights, I ought to win the war. So if you have this, then you can select where the engagements are going to be. And again, if you can do that job, you're going to win the war (figure 5).

If you look at the current trends in command and control (figure 6), I think one of the important things

is that all the arrows aren't being applied toward a central focus, and that's what we were trying to show with this. The interesting thing is to look at where the commonalities are. We are working with open systems. We are developing fusion centers. We are removing those fusion centers slowly but surely from the center of power out toward the warfighters. Artificial intelligence (AI) is being worked on. I don't think we have artificial intelligence today; I think we're a long way away from it. But some of the things we do have in the AI world will help in this fusion process. Some of this stuff doesn't exist yet. We do have wide area (WANs) and local area networks (LANs), and we have to have multilevel security (MLS) — an absolute key. If you can't have MLS on a system that will handle information from Unclassified through Sensitive Controlled Information (SCI), then we've got a problem. We aren't going to get it all in one place and then be able to control through access what amount of information any individual can pull out of it, or any display he can pull out of it. That doesn't exist today, but we're getting closer. A prototype system will exist on the global transportation

Establish an objective C⁴I concept to support the joint warfighter

- Provide a common target
- Incorporate lessons learned from Desert Storm
- Adapt to changing strategy and world environment
- Achieve 100% interoperability

Figure 4
Purpose

network out at TRANSCOM (Transportation Command) by the end of this year. Unfortunately, it's another stovepipe. We can't pick it up and transport it and move it to something else, but it's a good start.

We have individually compartmented mode workstations. The Defense Intelligence Agency (DIA) has those installed and operating now so they can control the level of access in the SCI umbrella and selectively handle codeword access within that. So, there are pieces of MLS that are working.

We're getting better on standards. I'm not talking standardized systems now, I'm talking system standards. I'll get into that a little bit more.

To focus on where we're going, as Copernicus took the center of the universe off Washington, D.C., and moved it out to the battle group commander, then this is kind of the same thing (figure 7). Let's take the focus of what we're doing and move it out to the warfighter (figure 8). Let's put the focus of what command and control, communications, computers, and intelligence do on the warfighter.

Establishing a roadmap — how we can get there — is the key (figure 9). The dollars aren't there to do anything different. I talked a little bit earlier about how it would be nice to start with a clean sheet of paper and design a system that would do all this. It isn't affordable. We couldn't cover it with the national debt, let alone the defense budget. So you can't do that, number one. Number two, I don't want to do that because we have good systems. All those systems that I showed you work. They do the

job they were designed to do. They were built by warfighters, they were built for the warfighters, and they do precisely what the people want them to do. So, don't throw away what works, but let's see if we can do something to make them interoperable, to make them work with each other (figure 10).

We are now looking at evolutionary technology improvements; in essence, about an 18-month to two-year half-life of renewing software and hardware, simply because things are moving that fast. We're improving our systems in an evolutionary fashion. As you do that, a lot of things can be incorporated.

Student: I'm curious. Are Copernicus and all those others coded in Ada?

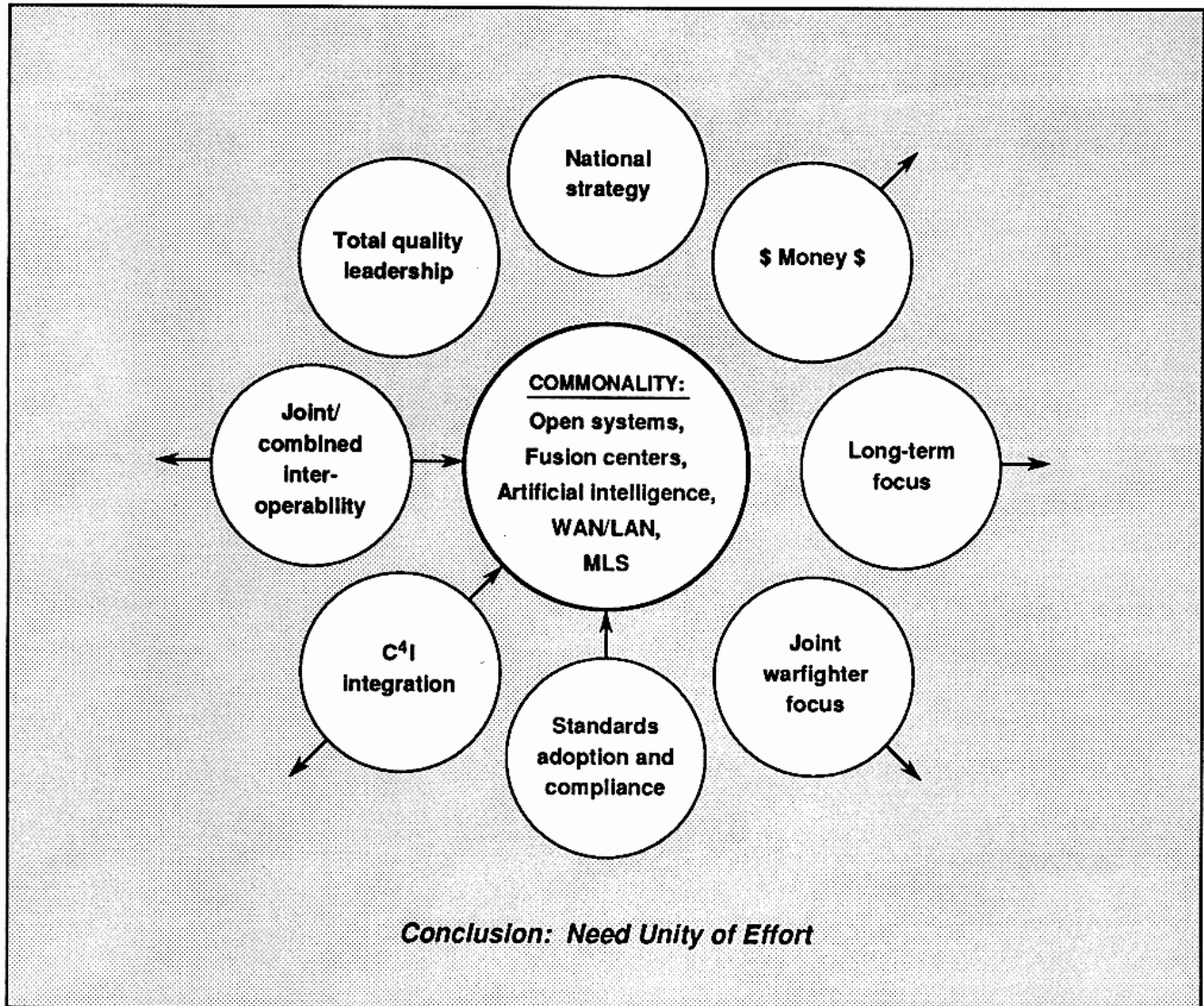
Macke: I'm sorry you named it. JOTS started in a language called Rocky Mountain BASIC written by the Engel brothers in Denver, CO.

Student: And can you say anything about how the multilevel security operates? Is there a bus of all knowledge that each of these things taps into?

Macke: There's a common database that holds all of the information on a hyperLAN. You're denied access to certain levels of that unless you have the right clearance. You can't do that on a password; we've learned that passwords can be defeated. So we're probably going to be talking fingerprints, retinal scans, I don't know; but especially for the extra sensitive information, you've got to have a positive way of controlling it. DIA works on a codeword basis right now, but they're in a Top Secret SCI system. It's that level. It's just the codewords that you're pulling out of that.

The warrior needs a fused, real time, true picture of his battle space and the ability to order, respond, and coordinate horizontally and vertically to the degree necessary to prosecute his mission in that battle space.

Figure 5
What the Warrior Needs



**Figure 6
Present Trends**

Student: I'm worried about the integrity of the information as it travels down the hyperLAN and what have you.

Macke: The LAN itself obviously has to be cleared with the highest level, but now you as an Unclassified user can go on there and pull up unclassified information — eventually, even down to the paragraphs. As we classify paragraphs, you can pull out pieces of a document without pulling the whole document if you don't have that level of clearance. I don't know how it works. One of the major stumbling blocks has been the database — a multilevel secure database. That is now in testing

and both NSA (National Security Agency) and TRANSCOM think that they have a working database.

Student: I don't understand why at such high levels? Why at the CINC level? Why does the high commander need all this?

Macke: No, no. The level I'm talking about is the guy out fighting below the CINC. I'm talking about a level sub to the CINC. Some of this information needs to get to the guy in the trench, but it needs to ride on a system that he's taking with him. Now, the CJTF is the commander of a joint task force; that

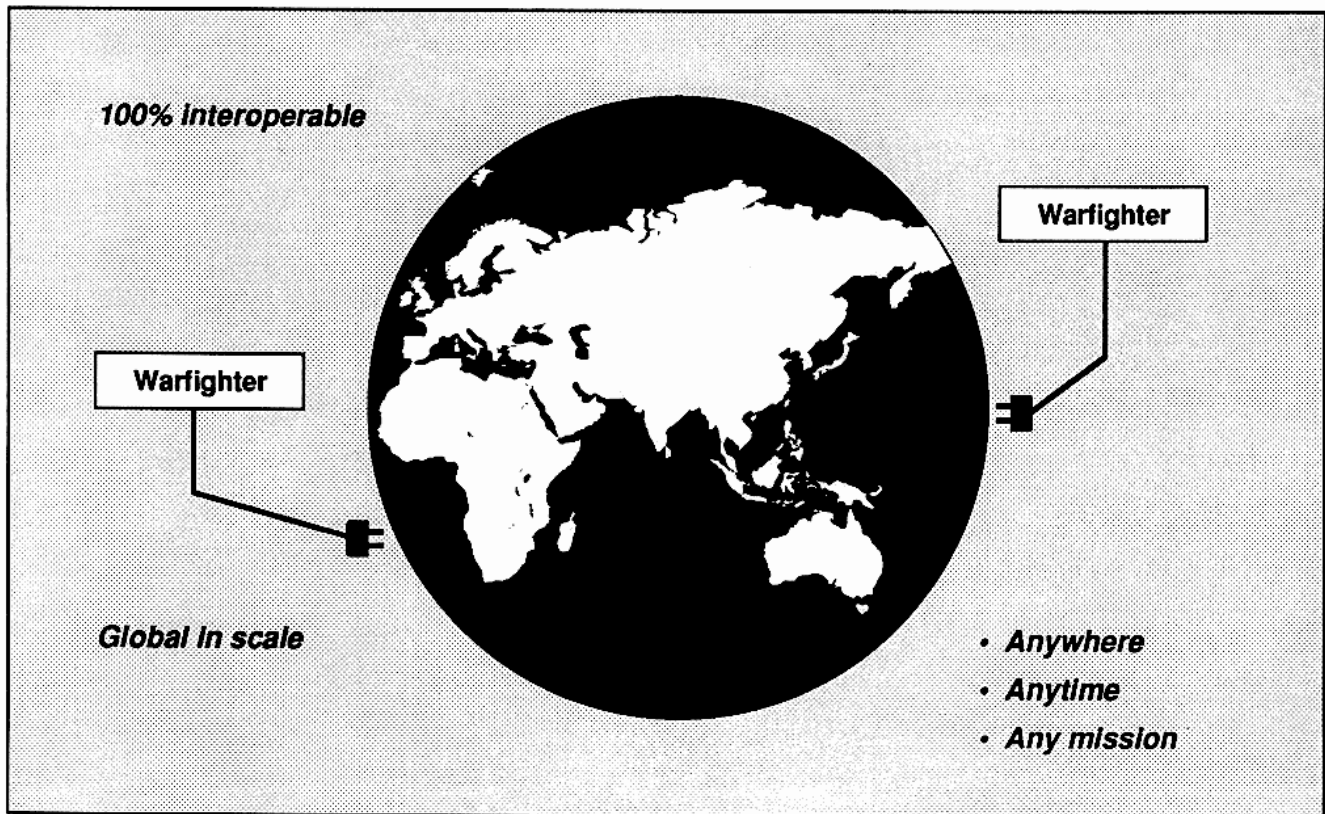


Figure 7
Where We Are Going

normally is a two- or three-star officer and is below the CINC. The CJTF in Desert Storm was General Schwarzkopf. He was the CINC, but again, that was a big operation. The CJTF in Bangladesh who went in to do the relief during the hurricane was a one-star. So it can be any level of flag. I want to move the focus out of the high level and put it out on the warfighter, on the guy who's doing the dirty work.

Oettinger: Before you go on, I want to take you back one moment, because I was thinking of your mention of pulling them all together, leaving each system that's working and doing its job; it has a wonderful ecumenical sound, and I'm deliberately putting this in a somewhat baiting fashion. How would you defend that statement against the notion that it's just another usual Navy parochialism that says, we'll do our own thing. Because it seemed to me that if an Army officer were speaking here, he might take a more ecumenical view. I'm caricaturing prejudices in this matter.

Macke: If Jerry Hilmes were here talking to you (he's in the Army, a C⁴ czar), he'd be selling ATCCS to you and showing you how they're going about integrating that system and integrating the entire Army under a single architecture, and I fully support that; I think it's a superb effort. What I want to do is not just have that system work across the Army, but I want to be able to get that information out and shared with the Navy system, the Air Force system, and with the joint task force commander. I want to bring it out to his level.

When I first saw the Army's tactical command and control system demonstration, I said, "That's beautiful! Great presentations! How does the CINC see this?" And he said, "Well, we draw it on a map and we carry it over to him on the sneaker net." Now that was a term that I'd never heard in my life — the sneaker net. There's a guy in tennis shoes who carries the disk from one place to another. So, each of those systems is a very good system. They do the job they're designed to do, but you need to get them to work with each other. That's what I'd

Establish unity of effort

- Focus on the joint warfighter

Draw the roadmap

- Establish near, mid, long range goals

Guide the implementation

- Evolutionary to be affordable

Figure 8
Joint Action Plan

like to see, and as I said — and you all are more aware than I am — as the world has defocused, we do have a global requirement that exists today.

What we want to be able to do is let that warfighter go out there, wherever he goes, and plug into an existing infrastructure. I used to call it the database in the ether and my guys have come up with a term called “infosphere” that I like better: it’s an existing infrastructure. My simple-minded analogy is — as long as I stay in the U.S. and I want to use an electric razor, I plug it into an outlet — 60 cycle, 115 volt, AC — and if I’ve got a global infrastructure that has that kind of commonality that I can plug into, then I can go out and have a warfighter do what he is able to do anywhere, anytime, any place. This is where we’re trying to get, but it is not achievable today, obviously, so we’ve laid out a plan to get there. And any plan that you lay out within the Department of Defense, if you don’t get some good firm ground rules down, will burrow and wiggle and take off on you.

So, that’s what we need to do — get this thing laid out, get a coordinated effort going in the right direction, and then at the dollar end of it, capitalize on the things that exist out there now. Capitalize on using the existing systems, don’t throw them away. Let technology help us to do this, and that’s just through evolutionary acquisition and bringing in ideas as patchwork the first time around. The second time around, they’re picked up in the rework, and if we can migrate toward national and international standards, we can truly use commercial off-the-shelf (COTS) equipment.

Now, there are still some applications where we’ll never be able to do that, where we have unique military requirements. We are going to use more

commercial satellite communications simply because we don’t have enough that’s pure military. But, when we do that, there is still going to be a hard core of requirements that have to ride military satellites. They’ve got to have some jam resistance capabilities to them. They’ve got to have some other protection that only the military designed satellites are going to provide. Commercial systems don’t get into that sort of capability. You still need a Milstar. You still need a DSCS (Defense Satellite Communications System) III with jam-resistance capability. But you could still do some other things in other areas. We can do this across a wide spectrum.

The other side of this, as we adopt the developing national and international standards (they’re not all out there yet) — I’m talking data formats, communication protocols, waveforms, those sorts of things — it will really help us in what I call a “come-as-you-are” set of allies. This means you don’t know ahead of time who “they” might be, as we were faced with in Desert Shield and Desert Storm. So if we can go to international standards, that certainly is going to help in the ability to fight with a coalition set of allies. This is very difficult in a DOD environment; but if we don’t do that, we’re never going to get there.

Student: Can you elaborate a little bit more on some ideas you might have on how you’re going to work with this business of coalition?

Macke: Well, again, if you’re using COTS equipment, then they’ll probably use the same thing or they’ll use equipment that has been built to the same international standards, so some degree of interoperability exists. We’re never, not in my lifetime, going to get away from the requirement for liaison teams. That’s what was used in Southwest Asia and that’s what we’re going to have to do. We have put together a pool of material, of equipment, and we’re expanding that so that we will have communications equipment, we’ll have crypto equipment, and things that we can pick up, take to a theater, and then send out with liaison teams with our allies. Instead of having to rip equipment from operating units, we’ve built this pool under NSA auspices. It’s called a “contingency utility package” or something like that. It’s communications equipment and crypto equipment; those will be part of the liaison teams that go out.

There’s a lot going on in the Pacific Rim that CINCPAC is working on. We now have Link 11 with the Japanese. I think there is full compatibility now on NTDS; and we’re also working with the Koreans. I just heard this week that we now have

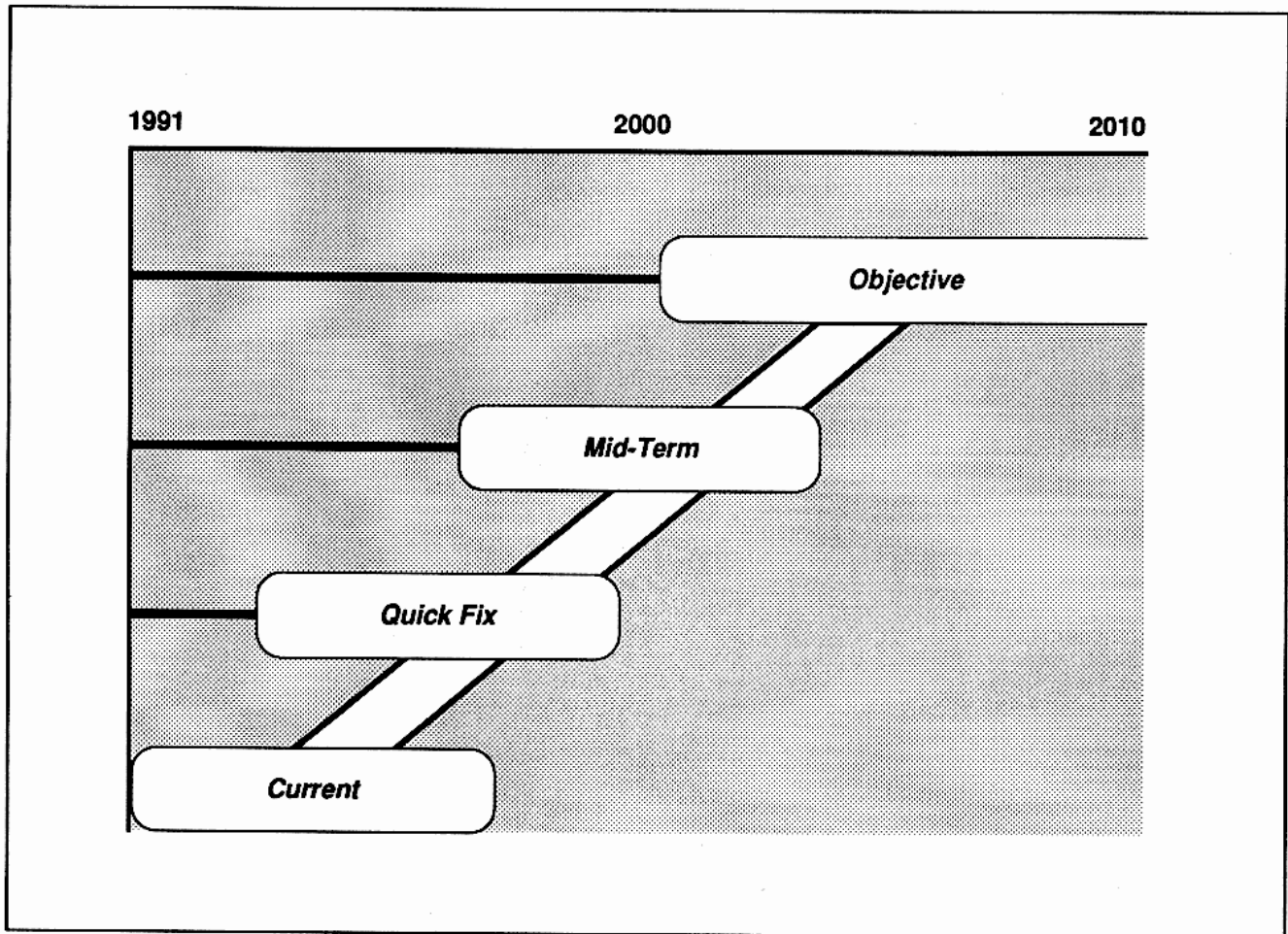


Figure 9
Roadmap

gotten SINCGARS (Single Channel Ground and Air Radio System) to work between General Riscassi's people and the Koreans. So, there are things that are ongoing a piece at a time. I'm going out in two months to Combined Communications and Electronics Board, which is Australians, New Zealanders, Canadians, U.K., and U.S. That's a forum that works on interoperability. NATO is one forum that's existed for a long time that works on interoperability; but, with the exception of NATO, those things kind of fall into the CINC's purview. The theater CINCs are the ones who are going out and setting up the interoperability with the allies that are in their arenas. And it's a step-by-step-by-step process. It's not done overnight.

We are continually working on joint exercises with our allies. A lot more is going on with Sing-

apore right now. In fact, we're moving a command in there, as I'm sure you're aware, because we got out of the Philippines. I think across the Pacific Rim has obviously got to be the biggest challenge, because there is no NATO infrastructure to work through and everything is done on a bilateral basis.

Okay, we've defined a problem; how do we go about fixing it? The first thing again, in my simple-minded viewpoint, is that if you have machines that don't talk to each other, what do they need to be able to do? They need to be able to talk to each other (figure 11). How do they do that? They do that through a common language. Now I can't go back in and rewrite the programs in every one of those systems. So I need, number one, to establish a common language, and number two, build translators that will translate from whatever that system

Implement revolutionary ideas in an evolutionary scheme

Lead a coordinated, fluid, dynamic, team effort

Keep it affordable

Capitalize on:

- Current investments
- Advancing technology
- Commercial capabilities

Maintain a common vision

Figure 10

Roadmap Considerations

uses into this common data format. We have some of those things; there are message text formats — TADILs, and JINTACCS (Joint Intelligence Tactical Command and Control System), the one that everybody loves so much. The problem is that we have too many of them. I want 12 common data formats that will transfer information between existing command and control systems, and Strassmann's* answer to that was that it will take at least 400 different data formats.

I've had a tiger team out working for five weeks now; they've visited every CINC, they've found out what systems are in use, what data they use, how they use it, what format it's in. We are down to about eight common data formats right now, one of which is OTH GOLD. Everybody says that's the best data format that exists. So, I think we can achieve what we're trying to do — find common data formats, define what those are, and establish interoperability across existing systems through translators (figure 12). These things exist on the market; they're not complicated. They're really pretty easy to go with so that in the near term we can get systems that will achieve interoperability through talking to each other. Is that total interoperability? No; but that's a big step in that direction. It can be done. It is being done.

*Paul A. Strassmann, responsible for computer matters in the Office of the Assistant Secretary of Defense for C³I in the Bush administration.

The Alaskan command has CTIS (Command Tactical Information System). Lieutenant General McInerney* up in Elmendorf, Alaska, has Delta. This is Macintosh-based; it's a stovepipe system, but it's a good system. The 6th Infantry Division uses it and it works very well for them as a part of the Alaskan Command, and it's got some neat X-Windows capabilities. The majority of the work that was done on this was done by an Air Force E6 by the name of Sergeant Carroll and now he's got an Army major from the Army Artificial Intelligence Center named Roberts up there, and that lady is about 17 levels above what I can understand. They're helping do this. Sergeant Carroll said, "I'll write you a translator so you can bring JOTS information in on CTIS." So JOTS is being displayed on CTIS. Not only is it the JOTS information, it's JOTS symbology.

Sergeant Carroll wrote this translator in his BOQ room, at night, in one month. Now this guy's smart. He's going to go on the outside and make a lot of money. They're not all as simple as that, but translators exist.

In the mid-term, we get the translators installed and we can get the interoperability; in the next five years, all systems will talk to each other (figures 13 and 14). And as you go through your 18-month to two-year cycle of buying new software, updating your software, buying new hardware, you can incorporate this back into your program so you're not hanging on a translator. The translator isn't necessarily a box. It's probably a hunk of software — 200 lines of code — that you have really hung onto your program, but that's overhead. And a few hundred lines of code sometimes mess up a full program; they still need to get integrated. Strassmann told me that a program exists that will go through and rewrite the data formats within programs. If that works, that's fine, but he isn't going to try it on one of mine first. He's got to show me that on something else. That's one of the big things. So you start incorporating everything you've been doing in the first phase in the mid-term.

Interoperability is the primary design consideration. That means that now when people are building systems, they're thinking interoperability whether they want to or not, because we're going to hit them with another hammer called dollars if they don't.

Another important element is to start moving the fusion away from the fixed base, the whole center of

*LTG Thomas G. McInerney, Assistant Vice Chief of Staff, USAF.

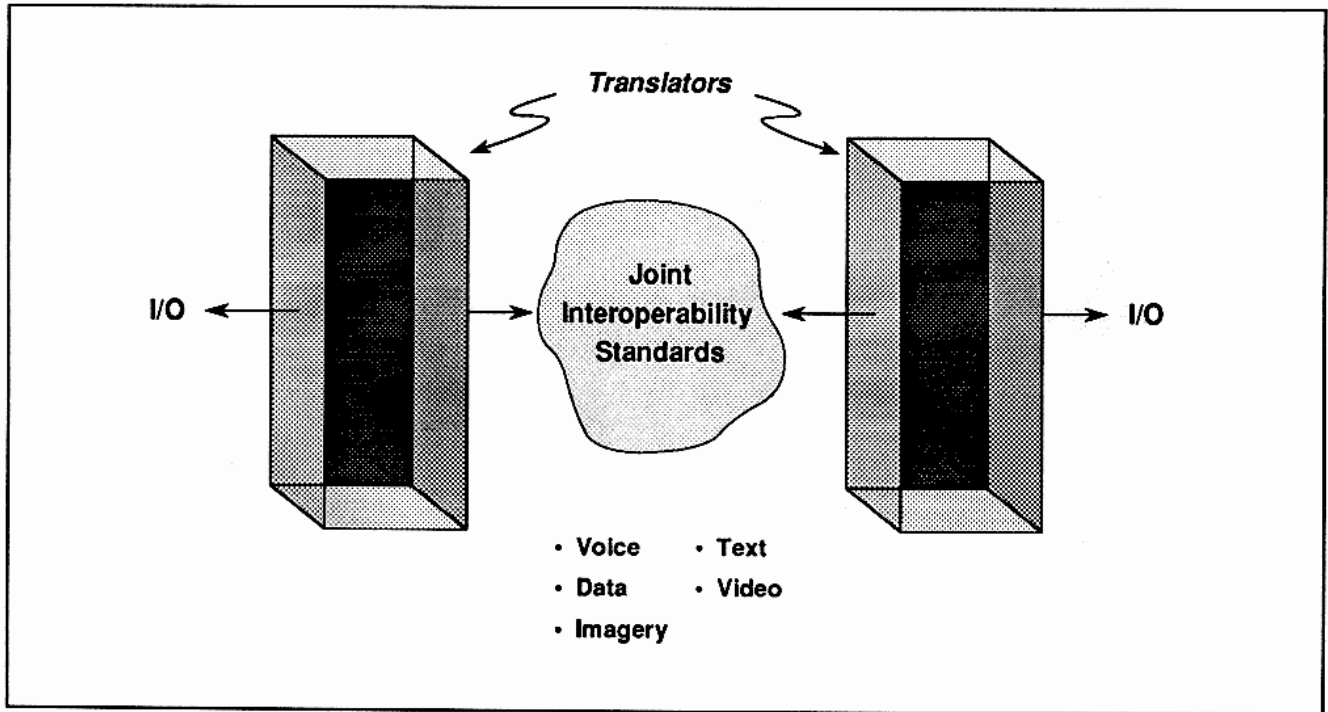


Figure 11
Quick Fix

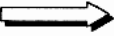
the universe. Start moving your fusion centers geographically toward where the warfighters are so that you can limit what's being electronically transmitted. You can make a smaller database because it's theater- or area-specific, and it gives quicker access, so the guy can pull the information out of it faster than he could before. That helps a lot.

The "where" we're trying to get to is this database of information that the warfighter can plug into and pull out what he wants (figures 15 and 16). Copernicus — pull versus push. We almost put ourselves out of business in Desert Shield and Desert Storm with pushing information out. The horror stories that you heard were true, simply because we had so overloaded the communications capability. I pick on the spooks, on the intel types. Eighty-page messages were going into the theater from different people each day. Four of them originated from four different sources. One was SI (special intelligence), one was GENSER. We looked at about two weeks' worth of those messages. I said, "Highlight everything that's value added in that two weeks." It was less than 20 percent of what was transmitted. So 80 percent of what we were trans-

mitting was the same information over and over again. That's how you clobber communications channels. That's push; that's not pull. So, if we moved those data centers out toward the fighter, we would only put value added into him, whether it's intelligence or whatever it is. That makes things a lot easier.

Pull versus push. You go out and ask a warfighter, "What don't you want me to send you?" The answer is, "Nothing; send me everything. Don't deny me any information." I've been on the other end of that chain as a warfighter, and when I was asked that question I said the same thing. So how do you implement pull versus push? That's a tough problem to try and work around.

The way I define it is going back to this battle space. The warfighter has an area that he's concerned with, be that 100 kms on either side of the forward edge of the battle line, 50 kms on either side of him, be it a 500-mile radius around my battle group, be it Kuwait, be it a theater, whatever it is, but a warfighter has a battle space. Usually a company commander has a small one; a CINC has a big one. That follows pretty logically. So tell him to

Now  **Program Objective Memorandum (POM) years**

Achieve interoperability through the use of C⁴I translators

Establish and enforce joint information exchange standards

Promote commonality

- Databases
- Procedures

Buld on funded programs

Example

Figure 12
Quick Fix

define his battle space, and then only pull the information that applies in that battle space; you are geographically limited.

If the guy's over land, he probably doesn't care about submarine information, so we can eliminate that level. If he's only fighting an air war, he's not worried about where the tanks are. But say what your battle space is, let that be the definition of what you're going to pull out of this infosphere. I think this is doable. If the warfighter is sitting off the Guajira Peninsula, he does not need to see what's going on in the Red Sea.

How do you create this "infosphere"? This isn't the answer, Motorola is proposing a system called "Iridium." (Iridium, because there are 77 satellites and that's the atomic number of iridium.) This is a cellular system. You take your cellular phone anywhere in the world and you can talk to any other point in the world; 77 satellites in mid-Earth orbit do their thing. That's a global architecture. Will this solve our problem? No; it's a 9600-bit throughput and that won't handle anywhere near what we've got to be able to put through systems. It does say, however, that the civilian world is doing some things out there that might help us achieve our needed capabilities.

How are you going to enforce this thing (figure 17)? Enforcement of interoperability is the job of the Military Communications Electronics Board, which I chair, through the JROC (the Joint Requirements Oversight Council), which in turn is chaired

by the Vice Chairman of the JCS. It consists of all the vice chiefs from the services.

The acquisition process is controlled by the Secretary of Defense through the Defense Acquisition Board. There's a sublevel to that called MSARC (Military System Acquisition Review Councils — a lot of acronyms in there), but there are a lot of different review authorities that hold the ability to spend money and that's how you enforce it (figure 18). You enforce it with dollars. I'm looking for the first one now that's supposed to have interoperability and doesn't; then I can go to the Office of the Secretary of Defense (OSD) and say, "Cut the funding! Tell them to make it interoperable or don't give them dollars." We're going to have to hang somebody out to dry in order to do this; but I think that will get people's attention and they'll understand. We've had some standards, although I don't think they're as good as we can do, but there have been standards out there before. People got waivers to them because they were too hard or too expensive or too whatever, and we've got to stop that. We've got to set standards and say, "You will meet them." We have to use the Joint Interoperability Test Center at Fort Huachuca, which for us in DOD, has a capability of doing interoperability testing across a wide spectrum of equipment.

My bottom line is, you tell the equipment what environment it has to work in, you put it in that environment, and make it do that. If you can do it at the breadboard stage, you can probably fix problems a lot more cheaply than if you wait until you've got a production set of equipment and then you decide to do interoperability testing.

Oettinger: What level are we talking about? Let me give you my image as I hear you say this. You know, if I'm near a phone line anywhere in the world, I can today reach any other place with plain voice. In Desert Storm, the folks, as you were saying, came with their laptops; so, at one level, there was global interoperability. In fact, it didn't require knocking any heads, it just required some subversion that's been going on for the last decade, where the young ones essentially said, "The hell with all this ponderous stuff," and at a certain level, they managed to do it. At other levels, as you described between some of the service systems, it doesn't go. At some levels you can imagine what you're saying about making things interconnect. You have standards for certain protocols, electrically and logically, so one thing can talk to another, but then some guy has put out an application this year with a new intelligence thing, or whatever, and

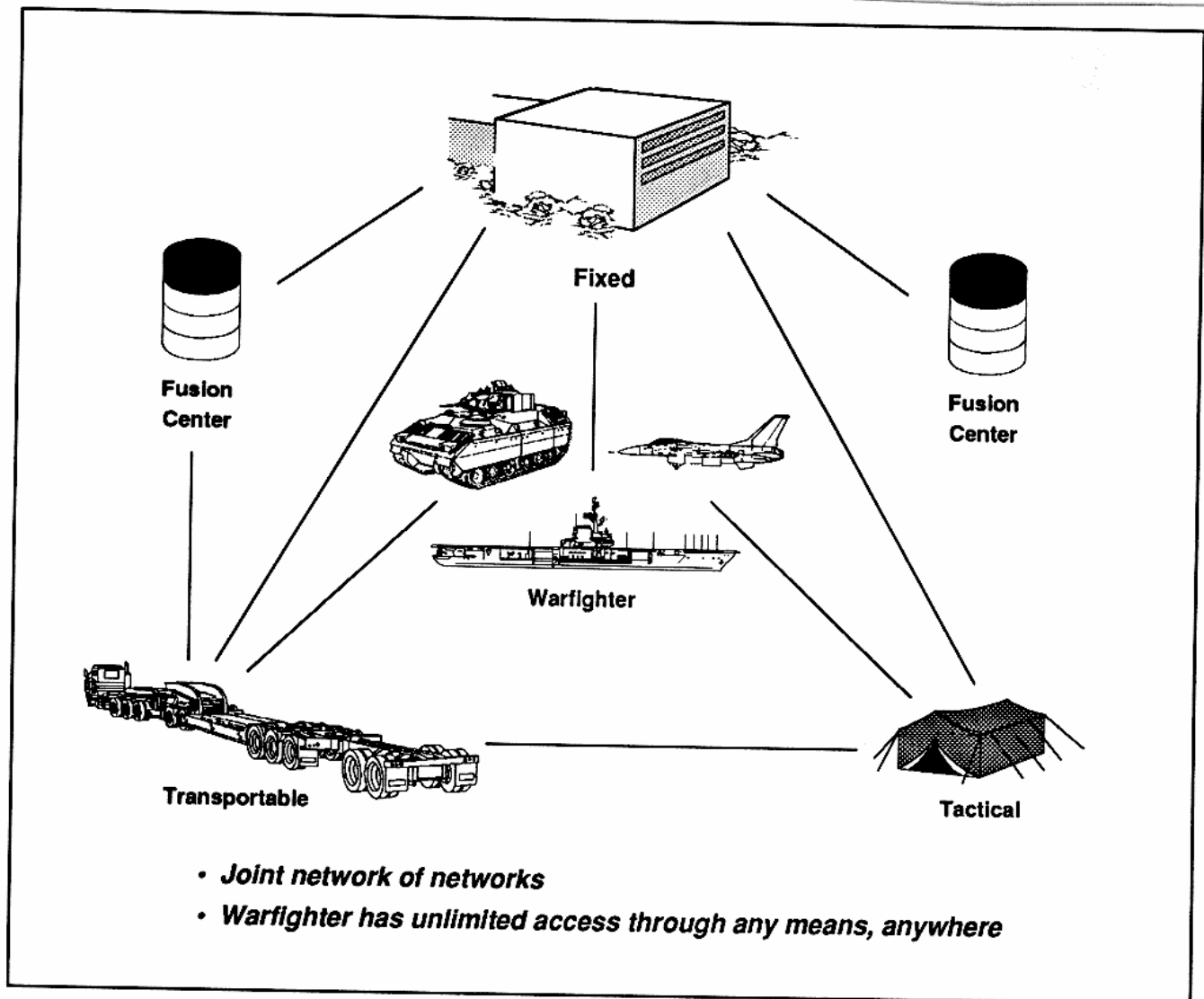


Figure 13
Mid-Term

he hasn't told anybody else about it, and so it won't connect. So I'm trying to get a sense of what's already done (this is not a dream, it's reality) and at the other end, some things you aren't ever going to do. What's your image of where that's going to be true and not trivial but not impossible?

Macke: There are several different facets to that. One is, you've got to decide where you need interoperability and what you need interoperability with. So, any particular equipment or system that comes along needs to be looked at to see what the interoperability requirements are. Then those need to be specified, and you need to test that piece of equipment in that environment; so it's a long-

winded process. Not every one of those is going to be subject to a Defense Acquisition Board. So you're going to do the MSARC at a sublevel and you've got the service acquisition boards who will also work on this. Through the Military Communications Electronics Board — you work that side of it. Will some slip through? Yes, probably. But we are writing an interoperability instruction to put teeth in the program which is in draft and out for comments now.

We did have some interoperability in all those computers that were running around in Saudi Arabia; however, if the Army guy had his laptop and he was working through a TYC-39 switch, and

POM + 10 years

Interoperability is the *primary* design consideration.

All C⁴I systems are interconnected in joint networks, making systems transparent to the warrior.

Joint/combined standards are integrated with national and international norms.

Information fusion is resident at all war-fighter levels.

Figure 14
Mid-Term

the Marine had his laptop and he was working through a TYC-42 switch, both of which were built to TRI-TAC (Tri-Service Tactical Communications) standards but the 39 got modified to digital so it would work with the multiple subscriber equipment), they can't talk to each other. So those two computers weren't talking to each other simply because the switches were incompatible, the telephone line couldn't operate right. You can go on ad infinitum. How do you solve that problem? My answer to that was, "You, CECOM (the Communications Electronics Command out of Fort Monmouth), are the smartest guys I know of on switches. You do most of the work with them. You are the software configuration control for switches and nobody's going to change the software unless you bless it." You need one place to point to and say, "You own it and you make it right."

Student: You said that you want to get the fusion point out of the Beltway area. First, it can't be in the field.

Macke: Yes, it can be in the field. Again, taking a small example, where you have a hyperLAN (a local area network but put on a hyper channel, so you've got nearly infinite pipe size to flow information around it) you take the database out of the mainframe now and you hang it off the hyperLAN. You take your applications programs out of the mainframe and hang them on a Sun SPARC off the hyperLAN. So in essence you start distributing the mainframe around a high-speed local area

network, and what you're doing is getting that stuff out of the Beltway; you're moving it out. Take that to a wide area network example and expand it out globally, and you've got your database out where you work on it.

Student: To the theater or the area that you need?

Macke: But in this infosphere, again, what I visualize is the database in the ether. I'm talking about a distributed database. I'm talking about an ether that's filled with information and you're going to reach up there and suck out what you need to fill your battle space.

Student: In the theater, you're going to be able to select that.

Macke: I'll get to that in a minute, but you should be able to plug into it, define your battle space, and suck out the information that's going to fill the database (figure 19). There's network management. It isn't that simple by a long shot; but it can be done. The engineering and production and having the stuff in operation doesn't exist yet, but the technology exists today.

Student: You're looking at making the CINCs the focus for all of this, each in their own area?

Macke: Actually, the joint task force (JTF).

Student: The JTF, right. Then will there be potential interoperability problems between JTFs? Did they each develop their own or is someone keeping an eye on that?

Macke: Because you tell me who's going to be in that JTF.

Student: Well, that was my question, because ...

Macke: You don't know. They've all got to have some of the same things. They've all got to have interoperable systems, so whoever is assigned as that JTF — whether that's Third Fleet, whether it's the 12th Air Force, whether it's 5th Corps or 2nd ID — whatever he's got with him has to work wherever he's sent. Again, we thought that we were pretty well set; we knew the 12th Air Force and 9th Air Force were going to support LANTCOM (Atlantic Command). However, the 9th Air Force ended up supporting CENTCOM (Central Command). The 7th Corps was designed to support EUCOM (European Command). The 7th Corps ended up in Saudi; actually, they ended up in Iraq.

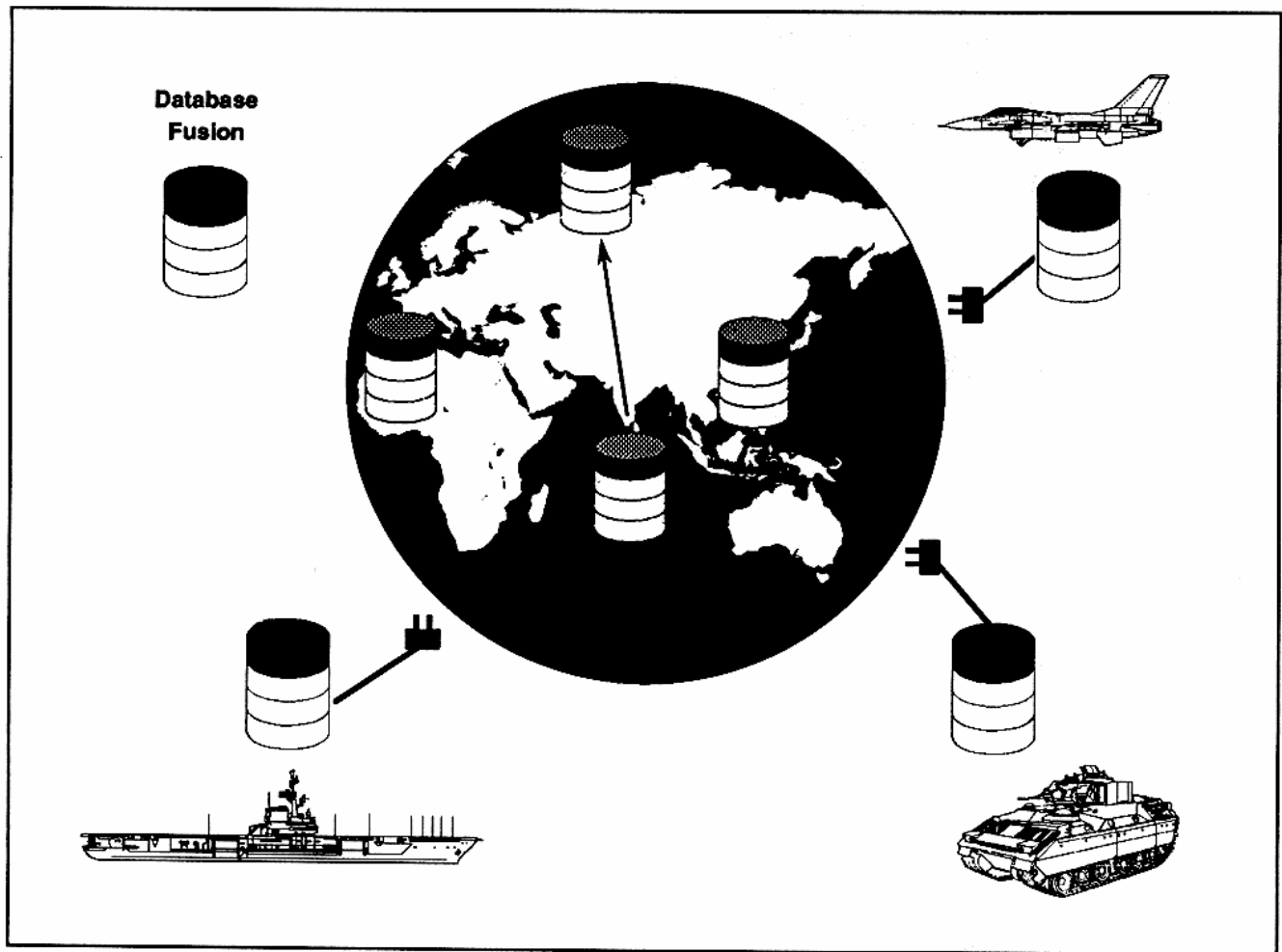


Figure 15
Objective

Student: Everything I've heard about issues of interoperability among the coalition forces says: put it down to CINC level and that will solve the problem. If we're dealing with these kinds of issues, it seems like there's going to be some more argument.

Macke: You let the CINCs solve the problem and you get a CINC stovepipe. You've got to set the standards for interoperability across the full joint arena from the CJCS level to the JTF level, and then ensure that they have interoperability there. If they do, then when you establish this JTF, you've got this bus that you can plug into so that you have interoperability. And you now have established a bus that exists around the world, filled with information that they can plug into and pull out what they need. Yes, sir?

Student: Maybe I'm missing something; especially in a fleet setting for this world, which essentially is having a worldwide bus that all task forces or CINCs will have access to — kind of a little window into whatever element is relevant to them, is that correct? A question of fleet setting or a TBG (theater battle group) setting, how are you going to get the bandwidth requirements on it and things like that?

Macke: SHF (super high frequency) is going on the carriers now, which will solve a lot of the bandwidth problem; EHF (extremely high frequency) will help us solve that. But then the second thing is, you've got to control the amount of information moved. We can keep this down to megabits instead of terabits.

Student: The only problem is if you want the imagery.

2000 and beyond

Fully developed fusion at all warfighter levels

Supports warfighter

- Available
- Transparent
- Pull/auto updating

Figure 16
Objective

Macke: If the bandwidth really can be handled with SHF and EHF.

Oettinger: Let me express a concern and see how you both react. In a sense, what you just described is the least of the problems, though it's nontrivial. You have the bus, and people pull off information, and I think I heard you say the technology is there, it's a question of implementing, an expression of dollars, it's a question of political will, all of those things. It's no problem, in principle. I go back to one of these earlier pictures where there were three or four things on the screen, and he said this picture represents a battlefield, or a piece of ocean, whatever it might be, and each of those is designed because I designed it for myself, because that's what I'm comfortable with. I think that the problem of interoperability at that level, where people have designed pictures to suit their own purposes, and suddenly you walk in and you say "What the hell is going on?" and the symbols mean something different, is a much, much harder area. The question you were asking was about some technical stuff a technician can solve, and it becomes invisible in a sense, whereas the stuff that's on those screens gets very personal; ultimately it's extremely personal. And what I learn and what I'm comfortable with may in fact really be Greek to you, because it's a Greek at the other end and you're in the Eastern Med. So, can you address that set of questions? Because I think he gave you too easy a question.

Macke: The fact is that how you present that information is a local program; it's a local application on a machine. It has nothing to do with an infosphere of information; it's just how you take the information that's given to that machine, and how

you present it, and that's an application. We can't quite do it today, though we're pretty close. How that application is presented ought to be selectable by the guy sitting at the terminal. He ought to be able to put in a few keystrokes that will give him a presentation that he likes. Because if he doesn't like it, he isn't going to use it, and he's going to be mad at that instead of thinking about what he should be doing. He's going to be mad because he doesn't like the way information is presented and now he's got to think harder about what it really means. Those are the things that are going to be occupying his subconscious, rather than "How am I going to go beat this enemy?" That's what you want a warfighter to be thinking about. So each new guy that uses it, looks at it, or has it in his command center, should be able to put that in the format he wants.

Student: It is my experience that when you have a multi-user or multi-audience thing, you tend to have the lowest common denominator, and some huge data structure driving around a race track, and whoever queries it will get it.

Macke: In my experience, the boss puts it in the way he understands it. JOTS is in the format it's in because that's the way Jerry Tuttle understood it.

Student: I guess my earlier worry is, has anyone devised some way to encrypt everything running around the race track?

Macke: That's the multilevel security. If this company commander says "Give me 50 clicks," and he's got a TS-only clearance, which is what he's logged onto the system with, and there's some information that's at a higher level, he isn't going to get it. Now that still gives me a little heartburn. If he dies because he couldn't get this information, I'm mad. But I'm not sure how to handle it. But it still has to be at the multilevel secure system. This is not trivial.

Student: I worry about this because I was a software engineer and know how many ways you can get at a river of information; it's very scary to me.

Macke: Then if you lay the concept out and you let the people start evolving toward that concept, keep the goal, get them focused, we will eventually get there. I think even with the coalition side of the house we will. It will help us bring about an easier interoperability with our allies.

I, the eternal optimist, think we can do what we've laid out to do; I think it is achievable (figure 20). It does have revolutionary concepts, but it does

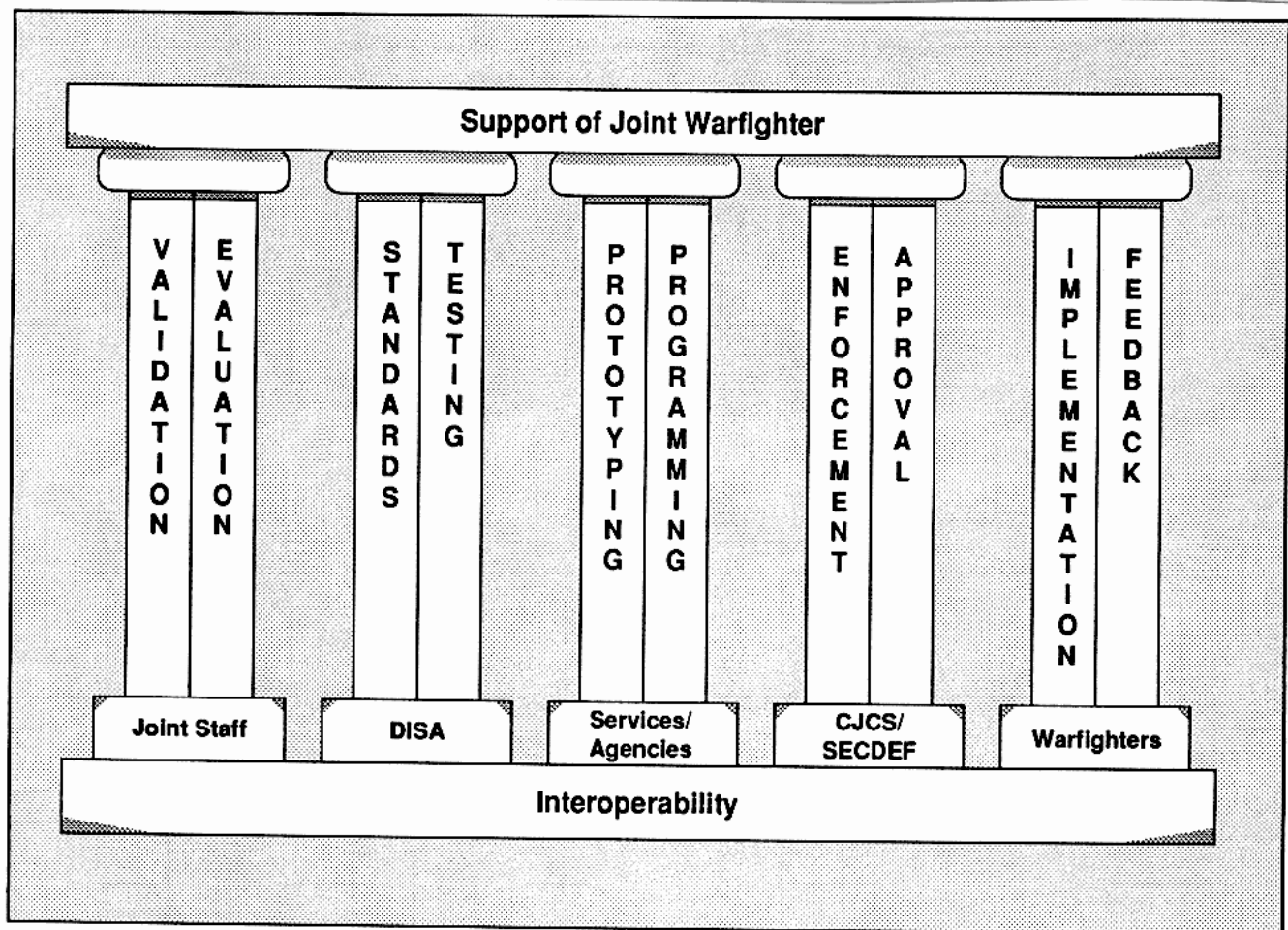


Figure 17
Pillars of Interoperability

also have an evolutionary process, it is a phased concept. And believe me, if you can't prove that it's going to stay affordable, it isn't going to happen, because the dollars aren't there to do that. The dollars in C⁴I are staying up and in particular the dollars in C³ are staying up better than other dollars within DOD right now. There is a good realization that C³ is a force multiplier, it is needed, and that part of the budget is staying in better shape.

In the near term, the top half of this was to get the guys from the Tank (Office of the Joint Chiefs of Staff) to help us, and we've gotten good support there. I personally briefed four CINCs and have gotten tremendous support. The tiger team has now visited all 10 CINCs as of tomorrow. I don't have any feedback on the last one, but the other nine were very supportive. Everybody is into this. The services

are supporting it, the Secretary of Defense and the Assistant Secretary of Defense for C³I are. The first thing to do is go out and find out what these information exchange standards are, what I call data format standards, so that we can obtain interoperability among the existing machines.

I formed this tiger team. I asked each of the services to give me a person for it: we have people from DISA (Defense Information Services Agency), people from the National Security Agency. CIA did not send a representative, though they are aware of it. We've got DIA, it has about 18 people on it; we tasked them for 12 weeks. I said, "In 12 weeks I want you to go out and come back and give me the data format standards that are going to work." Part of that is my way of doing business — give people an impossible task and normally they'll go out and

JCS/OSD support:

- Support the concept
- Enforce interoperability policies

OSD/Joint Staff/Services/CINCs/DISA:

- Determine information exchange standards
- Develop joint implementation plan and SECDEF directives

Figure 18

Near Term Actions

do it. Then I told the leader of this organization, "Oh, by the way, if you can't do that, let me know, and it's OK." After five weeks of operation they're saying they think they can do it, that they'll have the data format standards done in six weeks. Then my intent is to take those, take some Paul Strassmann money, build or buy the translators, and then take some existing systems and make them interoperable.

I'm a warfighter, not a communicator. I want things in my hand. I want things I can hold and see and do things with. That enthusiasm that we have right now with people is going to fade away if we don't give them something; so, in the fairly near term, I want to be able to show them something out there, some interoperability, so that they know this thing isn't a pipe dream and it really can work. Then at the same time we need something that enforces this; that directive is written in draft form and is out for chop.

We talked about all these different systems out there, and that we wanted to make them interoperable under a commander of the joint task force.

When the problem is posed, "I need another piece of information," fifteen guys show up with a black box and show me how I can get that information. But I can't do that — I can't keep adding weight to this kid who has to go out into the trenches somewhere. We've got to be able to make the information ride on his system. We can do all kinds of things upstream on the Pentagon side of the joint task force and that's a concept that I fully support; I think it really works. I think there are a lot of things up there. We can combine all these things, feed it into here, but from there on down it needs to ride on

what the warfighter's going to take to war with him — not another box, not another machine, but the ones that he has already been trained, equipped, and organized by his service to take with him. You always have to get a plug in for Goldwater-Nichols when you wear the joint thing. So don't add weight — this is the key (figure 19).

We're doing this in a separate environment today. Again, is it possible? Yes, it is. The Joint Visual Information Display System (JVIDS) rides on the antidrug network (ADNET), which really is a network (figure 21). JOTS, which is the Jerry O. Tuttle system, has been separated from that because the administrative antidrug network has on it the Drug Enforcement Agency, the U.S. Coast Guard, the U.S. Customs Service, the El Paso Intelligence Center (EPIC), the FBI, Canadians, Mexicans, Peruvians, Bolivians. There are about 200 nodes, and probably another 200 are going to come on line. You can't put full system on it because we don't want to share all that information with everybody on the net. So JVIDS is the main thing that rides on that (figure 21). This is about half of the current systems used in the drug war, and I don't know what each of those acronyms stands for. I know some of them. Every one of them has its own set of hardware, its own set of telephone lines that connect them: we're not talking small change, we're talking probably a hundred million dollars a year on telephone bills to support this entire thing. It has its own terminals, so when you go out there you play it on that. I get it all onto one phone line. I want one network, one network manager: DISA, which is the right place obviously for that. We're going to do that, that's coming, and I want it to ride on that single network, I want it to work on existing equipment so that you don't have to have a new set of hardware to do it.

That terminal I mentioned way back at the beginning will do that; there are also several others that will do that today. This works with this, with this, and this (figure 21). Those three work together today. This one as it comes on-line in an open system form, which will start happening later this year, will also work with it. We've got about half of them that right now can ride a single set of phone lines and work on the hardware that exists on the system. Instead of being systems, they're functionalities; so you ride this stuff as a functionality on a system, versus building a new system.

Student: My first question would be how long before the Medellin cartel ...

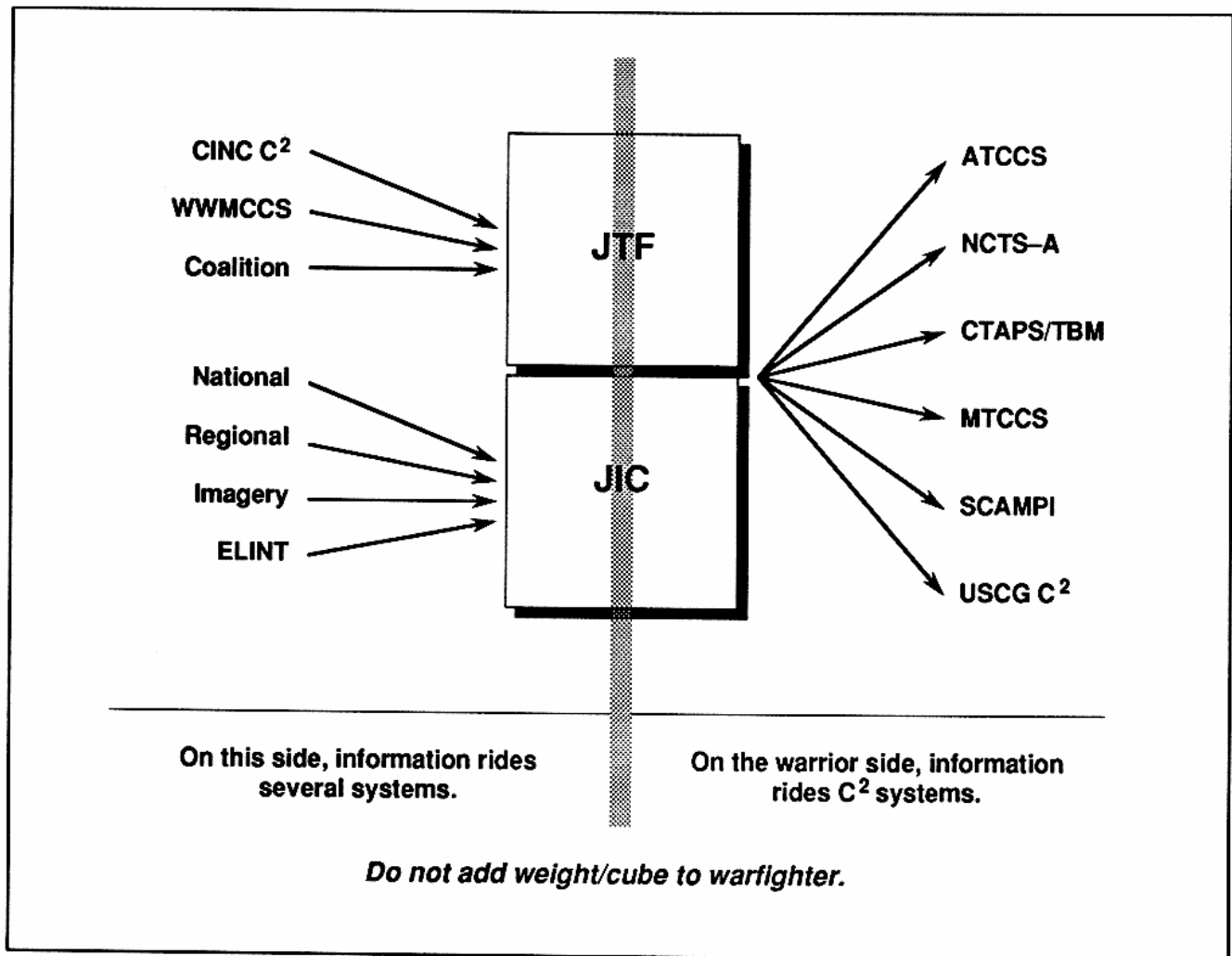


Figure 19
The Warrior Line

Macke: The Medellins are dead, but there's a new cartel that comes out of Peru now instead of Colombia. I can't remember the name of it, but they're the big drivers down there now. They've got enough money to buy anything they want to buy. You do everything you can to keep the information network from being compromised, but you can't stop it from being compromised, which is part of why we aren't going to put a JOTS on it. We aren't going to put submarine locations on the antidrug network. Our intelligence work against the druggies is pretty good, so if there is a compromise going on you're probably going to find out about it, and then you can go back and try and close the hole. The druggies are good, and they're sophisticated, but they aren't as good as some people build them up to be.

Student: A more difficult question. Sensors, from the Navy to Air Force — here's some overlap. The Navy can see airplanes, the Air Force can see ships. Who decides the priorities? Some place gets the same signal as another source and there can be a mismatch.

Macke: That's the fusion. That's taking what I call duplicate reports: several different reports on a single entity. AWACS gives me a report on it and an E2 gives me a report on it; a submarine sees it and gives me a report on it. If I know that that is a single entity, the fusion thing will then put that all together as a single report. Now, as a warfighter, what I'd like to see is a little "3" next to it, or I'd like to see it presented to me in some way that I know it is three different reports fused into one

Objective concept supports the warfighter

- Is global in scope/always available
- Provides information he needs when he needs it
- Assures 100% interoperability

Objective concept is achievable

- Implements revolutionary ideas; evolutionary process
- Captures advanced technologies

Objective concept is affordable

- Capitalizes on current investment
- R&D shared/pay as you go
- Promotes "oneness"/unity of effort in fiscally constrained environment

Figure 20
Conclusions

because that's going to affect my confidence level on how much I believe that. Or maybe I'd like to know what the sources are. Maybe I'd like to be able to window it, and pull up some information so that I know what the sources are. Maybe there's a source I'm not cleared to know, so it's just going to tell me "restricted" or something like that. But I'd still like to know that, because if it's a source I'm not cleared to know I may know something about whether that source is very good or isn't very good. If it's an HFDF (High Frequency Direction Finder) hit, I won't trust it much because high-frequency direction finding is not the world's most accurate means of locating things. There are other systems that when they say it's there, it's probably there. So you need to have it fused, but then I'd like to have some confidence level assigned to it when it's presented to me. Now that's me, maybe not everybody wants that same thing; part of the presentation should be controlled by the warfighter.

Student: There was the Goldwater-Nichols Act in 1986. It's taken now six years to get to this point and it's going to be another 10 years before it will be implemented.

Macke: The Goldwater-Nichols was an act that Cheney and Powell implemented and that's the difference. I mean that in all honesty, and you can hear that on Capitol Hill. I've heard Senators say it; I've heard Congressmen say it; I've heard industry say it. Those two guys, Secretary Cheney and Chairman Powell, are the two guys who are turning Goldwater-Nichols into reality, and that's part of where this falls out. That's the best one-two punch the Department of Defense has ever seen. That's not a Dick Macke quotation. It comes from a lot of people.

Oettinger: Of course, it may disappear, you know, by January 20th, but still ...

Macke: I've heard some of your esteemed colleagues make that very comment: How are you going to institutionalize this, C⁴I for the Warrior, so when the next SECDEF and Chairman come along it doesn't all fall apart?

Oettinger: I think the answer to that is in part that you're looking at forces both for integration and for disintegration. The problems that Admiral Macke mentions are not new problems today. It's now 30 years since I got involved with a thing called Committee on Data of the U.S. Intelligence Board (CODIB), which was haggling over whether certain information should occupy this many columns of an 80-column card, or that many columns of an 80-column card. You know, of course, it was partly a technical problem for very contemporary reasons and was also partly a turf problem, because by insisting on standards, different agencies could refuse to share information without *appearing* to refuse to share information (on the grounds that it was a technical problem). Now the incentives to share information have been increased by legislation and enforced by activist Secretaries and Chairmen of Joint Chiefs. If the activist Secretaries and Chairmen disappear, then enforcement will be somewhat less. Let me make this comment. The technical components of these problems are one aspect, but the institutional and organizational and political aspects are entirely different, and sometimes the two coincide and sometimes they don't, and in order to understand the time scale of implementation, you've got to look at both, otherwise it makes no sense.

Macke: Yes, sir. I think that's right on. How do you institutionalize the things Cheney and Powell are doing so that they will be carried on ad infinitum? On a micro scale of that, one of the

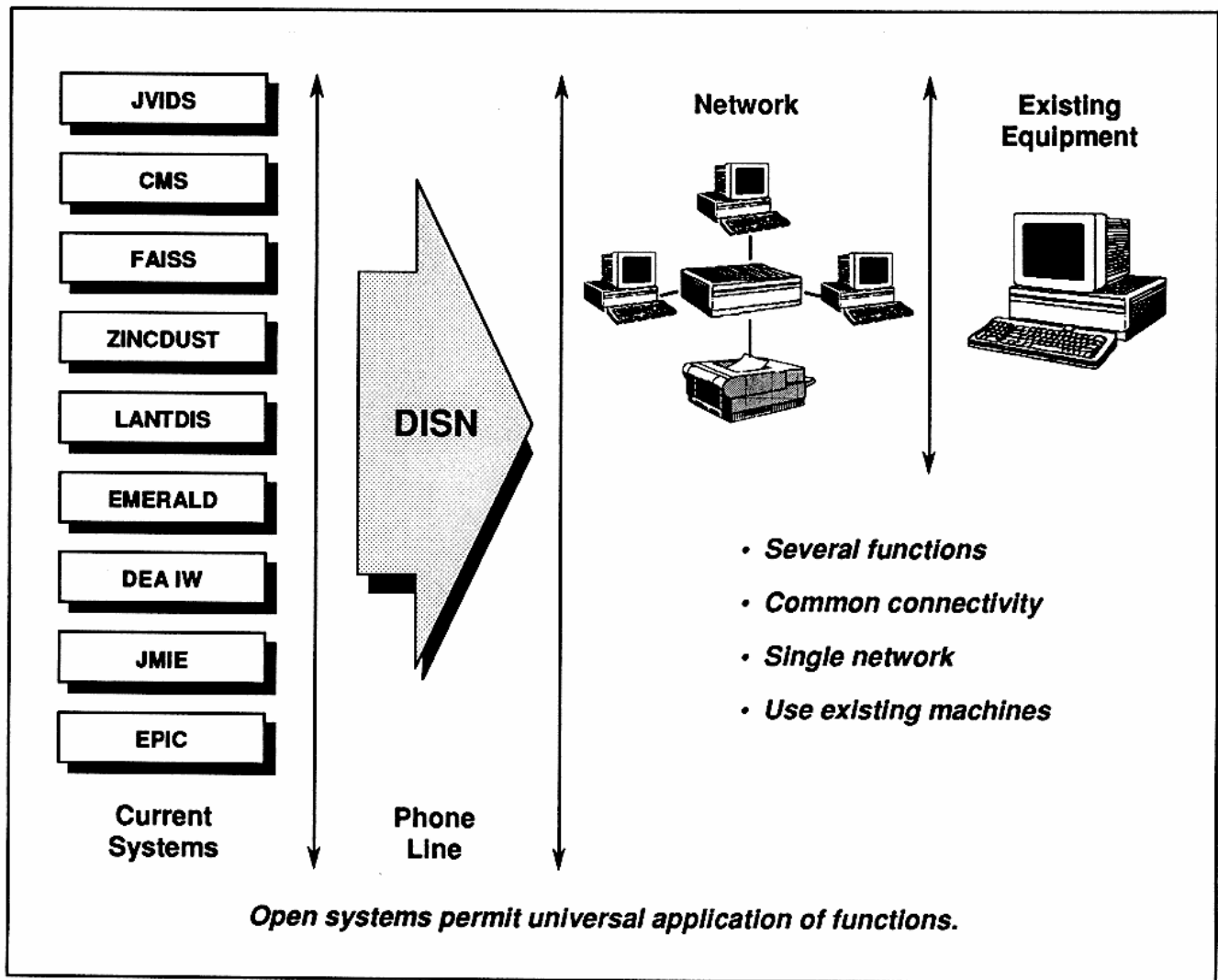


Figure 21
ADNET: Netted Functionalities, Not Unique Systems

things we thought needed to be done right away with C⁴I for the Warrior was to get a DOD implementation directive out. So that was with the first tasks assigned to my people. "I want you to go out and define the data standards and, at the same time, write the DOD implementor so we can get that sucker on the street and try to get some sort of institutionalization." Will it stay there? It's got to have people make it happen because paper doesn't make things happen.

McLaughlin: Earlier on, you mentioned a road map incorporating lessons in Desert Storm. In the open forum here, can you talk about some of those lessons from a J-6 viewpoint?

Macke: There are a couple of big ones. The problem of the Marine and Army switches that didn't work together was solved fairly rapidly with software; but the next thing we found out was that even though those switches were interoperable, can we put them back through an AT&T or a Northern Telecom switch into the big world? That didn't work. It goes on and on forever. So, again, the answer is that I want one person I can go beat on the head with a two-by-four and say, "That's your problem, you fix it!" and that was the people at Fort Monmouth because they were the experts on it. And, they readily took that on and said, "We'd love to. We've never had that enforcement authority before. We'd love to have that."

Imagery transmission devices — the famous SIDS — Secondary Imagery Dissemination System. Thirteen different systems (the numbers I've heard, I'm not positive they're right) none of which operate with each other. We have designed the standard now, National Imagery Transmission Format (NITF) number 2, that will be approved here within a month, and that's the standard that all systems will work to for imagery transmission. The imagery transmission on the systems I was showing you here today are also NITF. They meet those standards.

The distribution of the air tasking order got a lot of publicity because we had to fly it out to the ships, out to the carriers. That problem was bandwidth, a big message that needed to be sent out in a short time. You can go back 50 years and recognize now that the Navy made a serious mistake when we decided to hang our hat on UHF (ultrahigh frequency) satellites. We should have gone SHF back when everybody else went SHF, but that's what we're doing today. We're putting in SHF now. Every carrier that deploys has SHF on it. We have five carriers that are permanently outfitted with DSCS capability. Had we been able to put that over onto INMARSAT (International Maritime Satellite), we could have done it on a commercial system; all the rest do that so they can maintain the security on it. And INMARSAT existed on the ships, but the machine that generated the air tasking order wasn't formatted to take that and put it on INMARSAT. That problem will be solved.

Oettinger: Excuse me, that's interesting because that was a Navy problem; the Air Force had less difficulty. We heard stories of people using their PCs who went into a common database and called down their portion of the air tasking.

Macke: They were using their PCs with the right application software plugged into a CAFMS terminal. They had to have another CAFMS terminal to plug into. But that's true. The new system under theater battle management will have an even more extensive capability to do that. It ties into the WCCS, the Wing Command and Control System, and it's a good architecture.

One of the facts about interoperability is that it consists of doctrine, procedures, training, and technology, and it's all four of those things. What I've really talked about here is the technology side of that house. But if all four of them don't march down the road together, then you've got a problem. You may have interoperability, but it may not be the best thing that you've ever seen. I think the ATO

(air tasking order) is a classic example of that. CAFMS drove the way JFACC (Joint Forces Air Component Commander) worked because of the magnitude of the job; CAFMS was the only thing that would do that scheduling algorithm for him. That technology dictated how the JFACC did his job. That's wrong; technology should not drive doctrine. Right now they are marching down the road together as we go to CTAPS, and the people from the Tactical Air Command and the Army's TRADOC (Training and Doctrine Command) and Army, Navy, Air Force, and the Marines are together now working on what that doctrine should be and CTAPS will reflect that. But that to me was a very important lesson that was learned from Desert Storm. Today I can send a 1200-sortie ATO over UHF in under two minutes on a 24:1 compression algorithm that's been built. We didn't have that during Desert Storm. Again, how do you handle this volume of data? There are some very interesting compression algorithms working today — 24:1 is a big compression ratio — without losing information.

Oettinger: And there are 10 times that coming along.

Macke: Yes. Maybe we can work out that terabit problem somewhere down the line. That's being worked today on a different system — but it's \$5 million a month for the telephone bill!

McLaughlin: When Hill Dickinson* spoke here about 12 years ago, he spoke about the fact that the services had to make the staff colleges want to get people to write in orders that were understandable to the other people within their own service. His problem was now that he had four languages that he was supposed to coordinate and, in the meantime, they turned the staff colleges into sort of a master's degree in international affairs, and nobody could even write their own goshdarn staff orders anymore. That side of the problem does not seem to have advanced quite as fast as the technology in the past 12 years.

Oettinger: Let me go back to an earlier point that was raised: how do you get things together? (Admiral Macke answered in one word: "fusion.") The example that you took was a fairly sharp one. Your running example was to get a plane out there, or a

*Hillman Dickinson, "Planning for Defense-Wide Command and Control," *Seminar on Command, Control, Communications, and Intelligence: Guest Presentations, Spring 1982*. Program on Information Resources Policy, Harvard University, Cambridge, MA, 1982.

ship, or something, and you have different sensors looking at it and you want to get a composite picture that you trust and so forth. That's a hard enough problem, but I think there's a reasonably high degree of confidence that the problem has a solution that people would agree on. Like, "here is a paper clip on this table and it's not a tank and it's not an airplane," or "here is a plane of this or that type," and that kind of problem is hard enough, because a lot of the discussion was about that kind of a problem and how hard it is. But it's nothing compared to the problems that go up the hierarchy where, even if you had the common intelligence, you would still have difficulty. And it seems to me one layer up, say, problems associated with bomb damage assessment (BDA) where, you don't have the fair amount of agreement on the criteria: is this a ship or is this a plane or is it something else? But after a softening up attack what do you regard as a reasonable risk to go and send people into? You're going to have a long argument over that BDA even if the intelligence is perfect, and then you go one layer up and you talk about intentions as opposed to capabilities and, again, even if you've got the best human intelligence, you're dealing with an order of magnitude of greater uncertainty. I just want to make sure that there's no illusion that solving some of the technical problems, which will lead one to identifying ships or planes and tanks, does not imply in the slightest that it removes these other layers from the state of art rather than of science.

Macke: You can pretty well define history and that's what position is: it's history. What the guy's going to do in the next 24 seconds to 24 hours is very important and there are some things that you can do with fusion and some with artificial intelligence that will help in that arena. That really is where you're going — back to the analysts. You're going back to the human brain and saying, "Okay, what is this guy going to do? What can I tell by the way he is formed up? What can I tell by his traffic? What can I tell by whatever analysis techniques I've got?" Some of that can be done through fusion devices. I can take traffic analysis, I can take formation, the disposition of his forces, and some of that can go into the fusion device to spit out and say, "I think this is what's going to happen." The vast majority of that is going to take a smart intelligence analyst taking a look at it and trying to give you a guess; it's still going to be a guess as to what he's going to do. Obviously, if you want to pick the place, the time, and the forces to engage, you not

only need to know where he is now, you need to know what his intentions are.

Oettinger: The odds of getting contrary indications from different intelligence disciplines, or different sensors, are much greater as you go up this hierarchy from the object out there to the intention.

Macke: I heard Sir Julian Oswald, who is First Sea Lord of the British Navy, say that we had the ability to count the grains of sand in Kuwait, but we could not tell when Saddam was going to step on them. I think there's a lot of truth to that.

Oettinger: Well, there's a whole range in between and it seems to me very critical to keep that in mind.

Macke: And not everything is going to fuse. Not even if you take all of these more concrete examples is everything going to fuse every time. Somebody punches in a bad number in the latitude or the longitude, from something as simple as that, all the way to "It was an HFDF hit and it's way off." Is that another entity out there or is that the same entity, the same ship, or the same whatever? And then the analysts look at it and make their decision, and their decision may be "We don't know. Maybe that's a second one or maybe it isn't." And now the warfighter's got to say, "Am I going to assume that I've got only one or am I going to assume there's two?" Those are the decisions that we pay warfighters to make. So it isn't always going to be a perfect world.

Oettinger: Because you brought in the other elements — people, doctrine, and so forth, even though your discussion was principally focused on the technology, we have a little more time. If you have any other comments on the doctrine or on people, I think that folks will find that helpful.

Macke: The training side of this house — I guess I have two major comments on that. Training is critical, obviously. You don't maintain warrior skills if you don't train like you're going to fight. The dollars for training are going down. We're not going to be able to train as much as we would like in both the joint arena (and you've got to train jointly) and in the combined arena, training with allies. So there's a lot of effort in how to optimize the dollars to do training, but I'm sure that we're going to get the maximum value out of them. Joint training is a healthy hunk of that answer — joint and combined. There are a couple of exercises in the Pacific going on this year that I think will be very good. We had to cancel Team Spirit, which was a big exercise in

Korea, for political reasons. But with a ULCHI Focus Lens I think it's still going to go. We've got to do them in a joint fashion and, therefore, you need to get everybody coordinated. That becomes something that we haven't worked on this hard before. Most of our exercises and training before have been done as individual services and now we're not doing them that way. So there's a lot of effort going in that direction.

We're going to do more simulation training because it's cheaper, but if you're going to go to the warrior prep center and play fancy games (Fort Leavenworth has a great simulation capability there), that's not training like you fight, and that training, I think, has little value. So what we're trying to do is build the training so that we can play it on the war-fighting command and control system. Build the simulation and play it on the war-fighting command and control system so the guy sits in the space he is going to sit in, looking at the machine he's going to look at, making the same sorts of decisions that he's going to make if it were real war, and let him do it in the same environment that he or she would do in a real war scenario. We just did an Arctic Warrior exercise up in Alaska where the Navy's wargaming system, NWGS, coming out of Point Loma in San Diego, was being fed into Alaskan Command's Command and Tactical Information System. That simulation was part of the Arctic Warrior exercise. So it can be done.

We are working diligently to come up with a simulation that works the drug war, which is a different kind of war, because you can't shoot. That gets to be a real pain in the neck sometimes: when you're sitting down there off the Columbia coast, and you've got a known bad druggie on your track radar, and a 120-mile missile that's right there under your index finger and you can't push that button. It is a frustration, but we're not in the law enforcement business, and rightfully so. So it's a different sort of simulation that you've got to do. And that one hasn't been solved yet. We do not have a good simulation of how you work the drug war.

Student: Did I understand you correctly? The guy in the trench can have the same information that the admiral generates through this system?

Macke: If that's what he wanted to pull, yes, if he has the clearance level to get that.

Student: The smaller unit can have the same information as the general?

Macke: The guy in the trench ought to have access to the same information that the general has access

to. That doesn't flatten it. The orders are still going to go down the hill, and the response is still going to come back up the hill.

Oettinger: I think that's a very, very critical point.

Macke: Yes, but there's another side to it.

Oettinger: Yes, that's a very critical point, which deserves nailing down at this point. What modern information technology has done is disassociate the organizational issues from the technical.

Macke: Information is not knowledge.

Oettinger: It is not power.

Student: It is not power?

Oettinger: No, no, no. I wrote on this point in an article 20 years ago* at a meeting with then-Deputy Secretary of Defense David Packard, and I argued it out. The flow of power, as in command downward, and the flow of information sideways or upward have historically been linked. They can be completely detached. You can have the kind of flow he's describing with a highly stratified organization or a flattened one — you name it. It's completely a matter of choice now, and the notion that they're tied inexorably gets in the way of creative and flexible invention of other ways to handle this.

Macke: My heartburn with the intelligence guys is that they have information that they don't give to the warfighter, and information is useless if I don't put it in the hands of somebody that can shoot. So information is not power. Everybody should have the information to which they have a clearance or access. We have too long used it in that fashion: that information is power; that I know something that you don't know; that's wrong.

Oettinger: But one of the things that reinforces the notion of the importance of doctrine because if the President, the CINC, and the soldier in the foxhole all have the same information, then doctrine and rules of engagement about what kind of order, what kind of trigger, when and what is to be considered an order for action become absolutely critical, otherwise you'd have chaos. Before, you could rely on that downward filtering to provide a control mechanism. When you have this flattening of information access, then the question of exactly how you want to exercise command and control becomes

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

very critical, and the problem with not seeing the separation of the information from the authority is that you then fail to ask these questions. I still see very little by way of discussion, doctrine, and so on that address that problem squarely. Now you may have seen more of it, but it's an absolutely central problem for future force planning and teaching.

McLaughlin: You can talk about separating information from power and moving up and down the echelon ...

Macke: But they need to be on the same system. That is command and control. It's information flow and orders.

McLaughlin: But, again, we've always had this discussion. If you skip back an echelon looking for the information, there's somebody in the chain you can give the information to. But I think what we see in our organizations is that, once you start separating these and looking at them differently, you go back and reexamine what the power structure is. When you read about some flattening of corporate organizations, I think it's recognition of the change in the speed of the flow of information. An awful lot of organizational echelons used to exist to simply collect and collate information, which is now being done by the computers. You don't need that node anymore and all of those people had good jobs.

Oettinger: The nodal hierarchical tree structure that we associate with traditional organizations is traceable to the railroads. And it becomes obvious because you have the district and the region and slow communications by narrowband communications, by telegraph, was copied from the railroads into the Prussian general staff, then copied from that into U.S. Army organizations, and then copied into the corporate world. It began with the railroads and essentially has not been thought through in depth since then, until very recently, when this kind of observation was made.

Student: I think you can also translate that to Ma Bell's network management theory, which is what the railroads were doing. Now the biggest network management thing I think we've got going is the telephone.

Oettinger: Well, and they copied it.

McLaughlin: Ma Bell founder (Theodore Vail) had been the leader of the railway mail service post office.

Oettinger: The lineage is easily traceable. That's right.

Macke: And that's the biggest network.

Oettinger: The old proverb — knowledge is power — remains sort of true. If I know something about tomorrow's stock market and I can buy or sell before you can, I have something up on you. So that remains. I don't think either Admiral Macke or I or anybody else is challenging that. The sense in which I think we're differentiating is that in older organizational and technical structures, the flow of knowledge and the flow of power were essentially the same or very closely linked. I think the statement we're making is that you can imagine the flow of information in this flat universal way where everybody knows what's going on without necessarily being an authority or an exerciser of power.

Macke: Let me rephrase it. You should not derive your authority from information. Information is needed by everybody and you shouldn't play the "I know something you don't know" game. You can't fight that way. You're handicapping the guy who is going out there and can get shot, and we should not do that.

Oettinger: It's not exactly an accident, by the way, that this eloquent statement is being made by an admiral. If we had a general sitting there, I think you would find somewhat less of that attitude. I think partly that the tradition in naval forces has been more along these lines by necessity because the guy in the ship has been detached and has to know what is going on and make decisions detached from higher authority, whereas in armies there's always been more of a possibility and a need for things to travel up and down at every moment, so you find navies more sympathetic to this technological trend than you would find armies or the air force or such.

Student: That was my question. Have you found any resistance to that idea? I've been a warrior and it sounds good on the surface, but is it.

Macke: I haven't found any resistance to C⁴ for the Warrior. The resistance that I initially got out of the intelligence community wasn't that they didn't want to share information, it was that they didn't want to put their analysts out of a job and they thought that was what fusion was going to do.

Oettinger: The leopard doesn't change its spots.

Macke: Well, there are some that do now and again. The DIA people and Mike McConnell,* (who

*VADM John M. McConnell, USN, Director of NSA.

is going out to NSA), the J-2 on the Joint Staff. After they get over their first little problem of "Are you invading my territory?" they enthusiastically came aboard and they participated in the tiger team and everything else. Yes, sir?

Student: I'm just following your statements. Are you having any difficulty getting information out to the man with the gun being shot at? Are there worse offenders within the intelligence community as you see it; and then where in the pipeline between Langley or Andrews do you think the problem lies? You know, one side will say that the intelligence community isn't passing on the intelligence communiqué or just getting called within the services.

Macke: A classic example concerns Major General Funk who was 3rd Armored commander, part of 7th Corps, and he's now on the Joint Staff. He's a sharp, sharp tanker. His comment was that he wanted to see what was over the next dune, and nobody could provide him that. That got misinterpreted in some areas to being that this is a national intelligence shortfall. We couldn't tell General Funk what was over the next dune. First off, that isn't a national intelligence problem. What's over the next dune is an organic 3rd Division problem and they should have solved it themselves. Until you get about 50 dunes out, I don't think you're talking national; but everybody assumed that what he wanted was primary imagery down at the company level. Well, you can't do that, and that's not what he wanted. He didn't want primary imagery. He wanted some representation of what was over there. So you've got to bring this back into context, and we blow it out of context and say, "Well, the national systems couldn't provide what we needed because they couldn't give Butch Funk what was over the next dune." When you hear that, it's tripe, because people haven't brought that back into the right context of what it is. We had the SIDS problems, imagery transmission device problems, and nonstandardization — that certainly was a problem. The JIC, the Joint Intelligence Center, was being exercised for the first time. It was a little slow to get set up, which isn't all the Intelligence Center's problem; everybody had some problems out there. We won the war, though; let's not forget that, contrary to John Conyers* trying to rewrite the history of the war.

*Rep. John Conyers, Jr. (D-MI).

Student: So when you were there you never thought about which artillery units were over that dune and whether the Pentagon was not passing information to the Army?

Macke: The Pentagon knew it was breaking down somewhere between there and, in fact, that information was known. And it was known in theater, but it didn't get out to ...

Student: So it made it to the CINC level and then got lost.

Macke: You put it on the Army's tactical command and control system and therefore he has ATCCS and his maneuver control system now tells him where the bad guys are.

Oettinger: Again, there are choices here. This is information is power, knowledge is power itself. You'll recall, and I can't remember now whether it was in class or over lunch, Dick Kerr* talking about his personal image of the role of CIA as the eyes and ears of the President, and as part of checks and balances. Now if you have that kind of image, it leads you to thinking about sharing in a somewhat different way because you're responding to a different responsibility and one can agree or disagree with that or take a different stand on it, but the issue again of who knows what for what purpose and serves which master is an issue that will not go away. But with some technological waving of the wand that becomes more of an issue because there's more of a choice. You can tweak it one way or another so something that might not have been a choice becomes a choice to be exercised, and reasonable people will disagree over it. So again, I want to keep emphasizing that the technology is widening the range of choice and therefore the range of painful decisions that have to be made and enforced with the people and the doctrine.

McLaughlin: No, I think there are a couple of other pieces to that. I think that for a long time we had a high degree of confidence in doing some things — sources and methods that provide a substantial leg up — and maybe were paranoid about compromising, knowing the value of the information security side of that. And I think we feel that anything is knowable if you want to throw enough dollars at it. I think a lot of the sources and methods are almost blown, perceptually at least, so that the willingness to open the green door has improved substantially in the last 10 years.

*Richard J. Kerr, Deputy Director of Central Intelligence.

Macke: They strip out the source when they do it, which is fine because the information still gets out.

McLaughlin: I think part of it is having had enough warfighters that you will get far enough along in the system knowing what's there and the value in the trenches. I mean, going back to Dave Richardson* being head of Task Force 77 out there in Yankee station, and discovering for the first time all kinds of things that were available that he would have dearly loved to have had as a wing commander.

Oettinger: Yes, you could go back to the proceedings of the seminar. Reading Richardson was an eye opener because if you compare that with Admiral Macke's presentation today, you'd be amazed at how far the world has come. Richardson, as John has pointed out, was perhaps among the first warfighters, if you will, to discover that there were tools out there that, before then, had been kind of the province of bearded technical people. It is interesting to see how widely the diffusion has since taken place; but one of the concomitant effects of that is that a lot of the organizational certainties have come unglued. And one of them — again let me make explicit something which was implicit — is that the analysts worry that they're out of a job and that sort of thing. There are different assets which for very good reasons are controlled by different people. If that control moves around, somebody's job is on the line. Who knows if somebody is quite humanly going to say, "hey," and the way they'll put it is not, "you're going to take my job away," but "I am most competent to do that, and won't this job get degraded if someone less competent handles it?" which among users is a reasonable concern. We don't want amateurs mucking around. So overlaid on everything else are these rice-bowl turf questions, or, to get back to the warrior, can I control it and say, "work for me" when I need it, or does somebody else control it and say, "No, it's going to work for me." Who sets the priority? So again, there's that whole set of issues.

Macke: As a warfighter, if that enemy that you didn't tell me about because you derived his location from a source that I wasn't cleared for kills me, I'm going to be mad.

Oettinger: There'll be retribution in Heaven, that's for sure.

Student: Do you believe that such joint exercises with other countries will contribute to enhancing interoperabilities?

Macke: There's a lot of interoperability both on joint and the combined front at least on a bilateral basis, that comes out of that because we bring in the Navy in addition to the Army and the Air Force. The Korean Navy works with the U.S. Navy and the U.S. Navy works with the Army. It's a full-blown joint and combined exercise. So those sorts of exercises, I think, are very good. One of the systems that I didn't mention was TACCIMS, which is probably the one you're familiar with — Korea's command and control system. We need to do joint exercises because we've got to get that interoperability training doctrine and procedure side done among our own forces. But, similarly, we need to go out and do not only bilateral but multilateral combined exercises. A major lesson learned, and I've got it written right in the middle of my desk, is number one, interoperability, and number two, how do you fight with a come-as-you-are set of allies? But right now, other than trying to work through the international fora, the Combined Communications and Electronics Board and in NATO, that is mostly done at the theater CINC level, so that the J-6 type of interoperability with the Koreans is actually done by U.S. forces in Korea J-6 but under General Childs at CINCPAC.

Oettinger: If we're going to get you to your next appointment, we're going to have to stop now. Thank you.

*Vice Admiral David C. Richardson, USN (Ret.); see "The Uses of Intelligence," *Seminar on Command, Control, Communications, and Intelligence: Guest Presentations, Spring 1981*. Program on Information Resources Policy, Harvard University, Cambridge, MA, December 1981.



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