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THE FOFA CONCEPT AND THE FOFA DEBATE

On several occasions, NATO's Supreme Allied Commander Europe (SACEUR), General Bernard W. Rogers, has warned that were the Warsaw Pact to attack NATO, it would only be a few days before he would have to ask NATO political leaders for permission to use nuclear weapons. Neither of the two implied choices—surrender or nuclear war-is a pleasant one. Some analysts believe that the Soviets might overrun NATO so quickly that NATO would not have time to decide to use its theater nuclear weapons. Only strategic nuclear weapons would be left.

With the strong backing of the United States, General Rogers has been pushing for a third alternative, to improve NATO's conventional defenses so that the credibility of NATO's deterrent is maintained. FOFA is a major element of this conventional force improvement.

Many observers have suggested that major changes are needed in NATO's conventional force structure, posture, and organization, as well as in its strategy for employing those forces and in its procurement procedures. But several major political and bureaucratic factors combine with geography to limit NATO's likely options. First, economic and political realities make it doubtful that the number of NATO army divisions and air force wings will be increased substantially. Early in its history, NATO decided to rely on both conventional and nuclear weapons because it could not afford a completely conventional defense. Second, NATO is a defensive alliance, and will not

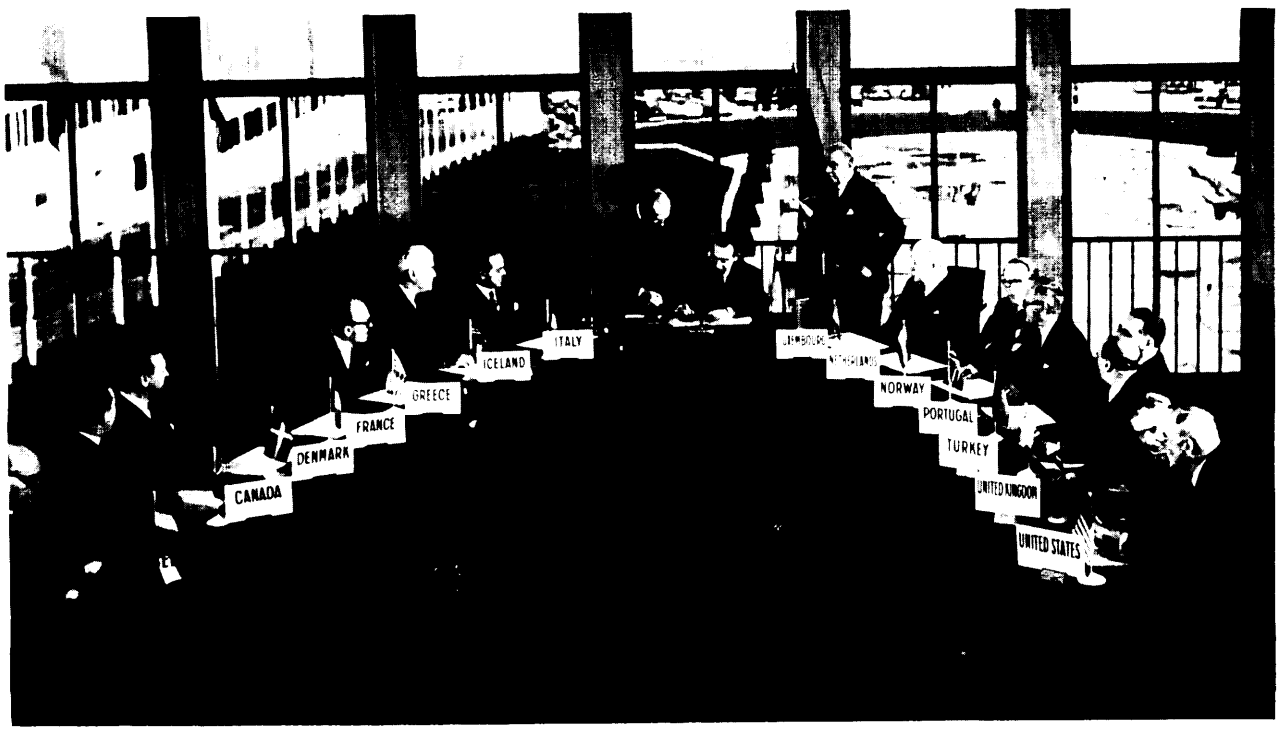


Photo credit NATO

NATO members signing the Paris Agreement in 1954.

adopt publicly a strategy that calls for sending its ground forces deep into Warsaw Pact territory, even though that might give it a better chance of victory and of keeping conflict off NATO soil. Tactical counterattacks, however, would not be precluded, and opinions differ on how deep those might be. Third, NATO cannot plan to fall back deep into Germany in the face of an attack, trading space for time. Losing large parts of Germany would be catastrophic for the Alliance, and planning to do so would be unacceptable to German public opinion. These factors force NATO into a defensive posture close to West Germany's border with East Germany and Czechoslovakia, which, combined with a "share the burden" political policy that gives each member nation in the Central Region a section of the border to defend, sharply restricts freedom for major force movements along the front to counter Warsaw Pact force movements.

Within these constraints, NATO has decided both to improve the conventional forces it has in place, and to adopt the FOFA concept. These initiatives cannot overcome NATO's fundamental problems, but are designed to make better use of what Alliance members have procured and are procuring.

In simple terms, FOFA means using longer range weapons—airplanes, enhanced artillery, rocket launchers, and guided missiles-to attack enemy ground forces that have not yet come close enough to NATO's defending ground forces to engage them in direct combat. The purpose of attacking follow-on forces is to impede the ability of the Warsaw Pact commanders to bring their ground forces into the battle when they want to and at full strength. While it has application to operations in all parts of Europe, the primary focus of attention is on the Central Region.

Three major factors came together to produce the FOFA concept and make it a major part of NATO's defensive strategy. First is a recognition that successfully attacking the follow-on forces could have a profound effect on the ability of the Warsaw Pact to execute its offensive strategy. Second is a new emphasis on directly attacking the ground forces themselves, in addition to facilities such as air bases that would support them: NATO has always had plans for interdiction missions into enemy territory. Third-and perhaps most relevant to the issues before Congress-is the recognition that achieving a significant capability to attack follow-on forces depends strongly on exploiting new technologies. In theory, FOFA provides an opportunity to exploit technology to offset a fundamental East-West asymmetry.

The Warsaw Pact not only enjoys significant numerical superiority over NATO in the Central Region, it also has the advantage of conducting a strategically mobile offense while NATO's ground forces have much less freedom to maneuver in response. The Warsaw Pact, following Soviet doctrine and leadership, organizes its divisions into armies, which are organized into army groups (called fronts by the Soviets), all under the command of a theater commander.[1] NATO expects that these forces would be used not uniformly across the entire border, but to conduct rapid, deep, powerful thrusts into selected sectors of NATO's defensive line. These would be aimed at getting into NATO's rear area, disrupting NATO's ability to command and control its forces, capturing or destroying NATO's theater nuclear forces, and cutting off NATO's individual army corps from each other and from their support. These thrusts are likely to be directed at NATO's weakest corps sectors. The strongest—especially the U.S. corps—are likely to see only holding actions, designed to prevent them from redeploying to aid in defending against the main attacks. Of course, NATO cannot know in advance how the offensive would be conducted; surprise is a basic tenet of Soviet doctrine. This offensive would be preceded and accompanied by massive air and mis-

[1]Organizationally, Warsaw Pact armies are roughly equivalent to NATO corps, Pact fronts are roughly equivalent to NATO Army Groups, and the commander of the theater of military operations (TVD) is roughly equivalent to NATO's Central Region commander. However, at each level there are major differences between NATO and the Warsaw Pact, for example in manpower and firepower.

sile attacks against NATO's air bases and other fixed facilities, and by small attacks by special forces deep within NATO territory.

NATO expects that a Warsaw Pact offensive would be conducted with succeeding waves, or echelons, of ground forces. Once thought to be rigidly structured, this offensive is now believed likely to display a good deal of flexibility at several levels of organization. The fronts conducting the initial attacks would be divided into first echelon armies that would begin the attack, as well as operational maneuver groups (OMGs)[2] that would exploit it and second echelon armies that would continue it. The division among these elements is not rigidly set. It could vary among fronts and be altered as the front goes into battle. Each army would be divided into first echelon divisions to spearhead the attack, second echelon divisions, and mobile groups. And within each division there could be first and second echelon regiments. After the first fronts have done their jobs, the theater commander would have second fronts available to follow them. By NATO's definition, all those forces moving up behind the forces that are directly engaging NATO's defenders are follow-on forces.

NATO lacks a similar layered structure, although there is some ability for reinforcement. Defending NATO divisions would defend against one attack, only to be faced with another attack by fresh forces, and then another, and so on. So, for example, a single U.S. (or German, or Belgian) division might defend against two (or one, or three, or more) first echelon divisions of the first echelon army, and—depleted from that battle—be attacked by a fresh second echelon division of that same army, and then by a force from the first echelon of the second echelon army, etc. If the Soviet plan went forward unimpeded, there would be no time for the U.S. force to recover between assaults on it: each attack would find it weaker than the preceding one did. Alternatively, while occupied by an attack by the first wave, it might be bypassed by follow-on forces seeking to reach deeper objectives.

[2]Also called Mobile Groups.

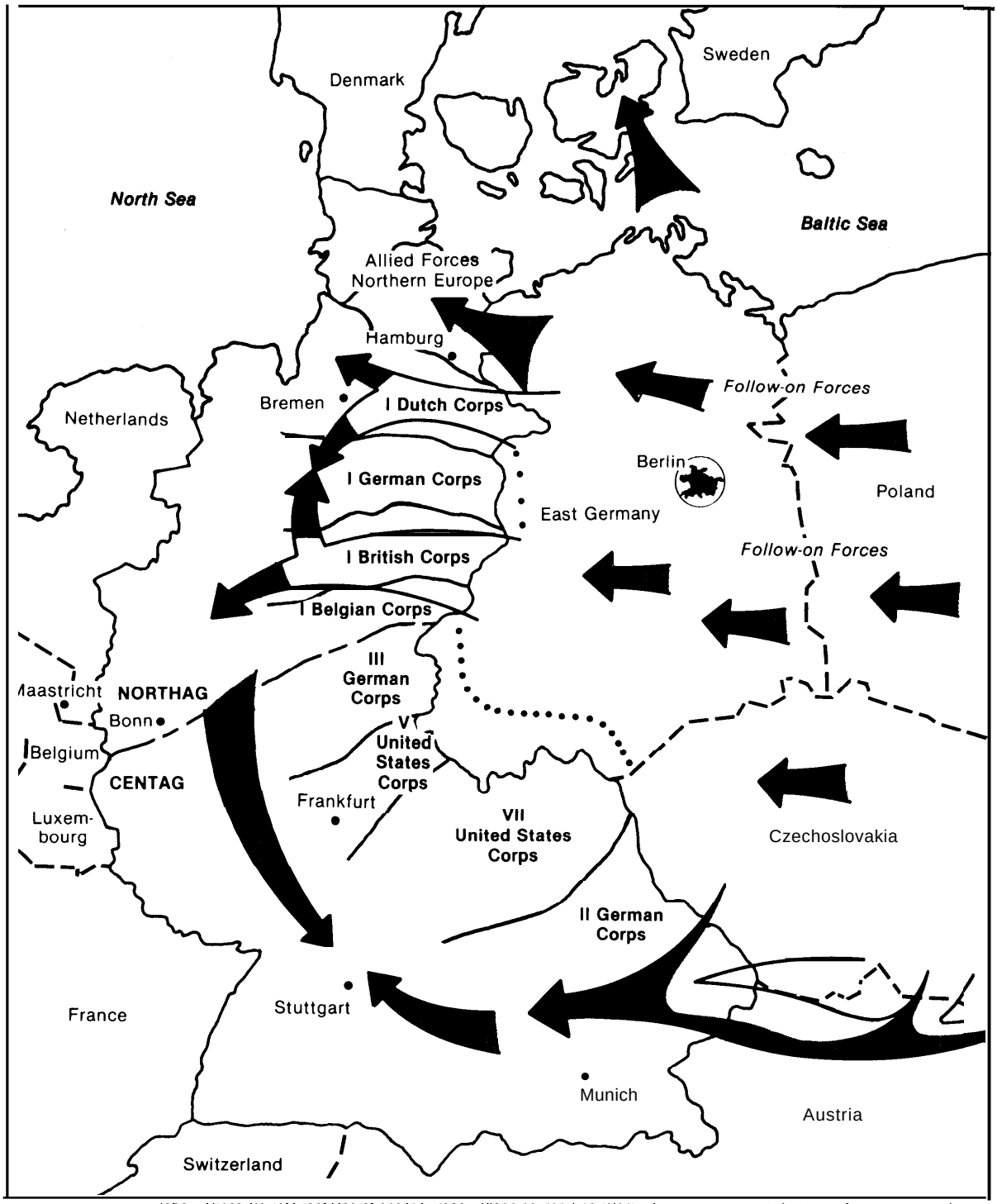
Because of evolving flexibility in the way the Soviets would use their forces, NATO cannot expect a "set piece" of equal waves attacking each division, or a uniform attack across the Region. It can rely on two fundamental aspects of a Pact offensive: that all the forces will not attack at once; and that the Pact has much greater freedom to maneuver their forces to attack heavily on selected parts of the front than NATO has to maneuver in response. FOFA seeks to oppose both of these: impeding the movement forward of follow-on forces, reducing the forces that NATO's defenders have to face and helping improve NATO's ability to recover from one battle before facing another; and moving firepower rapidly across the front to compensate for difficulties in moving ground forces across the front.

Some believe that simply directing firepower against forces moving up, or against main Soviet efforts, will not be effective: there are so many targets that not enough would be killed to make a difference. In this view, it will be necessary to find that small part of the force that is the focus of the attack and destroy it, thus causing the entire effort to fail. Doing this requires an ability to monitor and accurately assess Warsaw Pact force movements.

FOFA was a matter of some controversy when first proposed, and some still argue that it is not sound policy. Some Europeans, perhaps confusing FOFA with the U.S. Army's AirLand Battle concept, have seen it as offensive and inconsistent with NATO's defensive posture. Others argue that it is more efficient to wait until targets are close before attacking them, that attacking deep diverts resources from the close battle while providing little payoff. Still others believe that the follow-on forces will not be very important to the Soviet offensive, that most of the combat capability will be in the initial attack. Finally, there are several groups who argue that while the idea may be sound in principle, it will be very costly and extremely difficult—if not impossible—to implement.

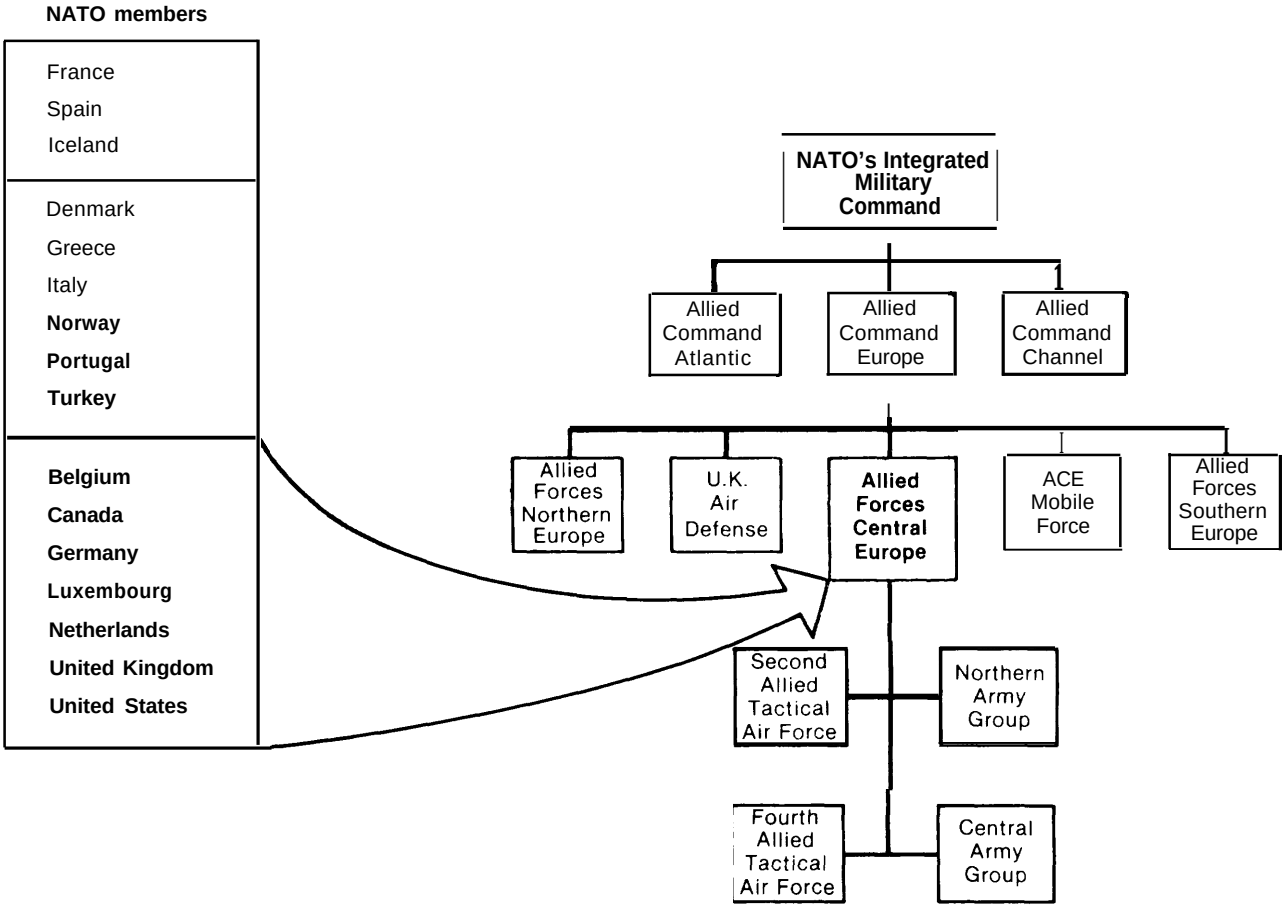
The FOFA concept is still under development, and is seen somewhat differently by the

Figure 2-1 .—Warsaw Pact Offensive



SOURCE Adapted from John G Hines, Soviet Front Operations in Europe—Planning for Encirclement, a paper presented at a conference sponsored by the Alumni Association of the Norwegian National Defense College Study Committee, Apr 25-26, 1985

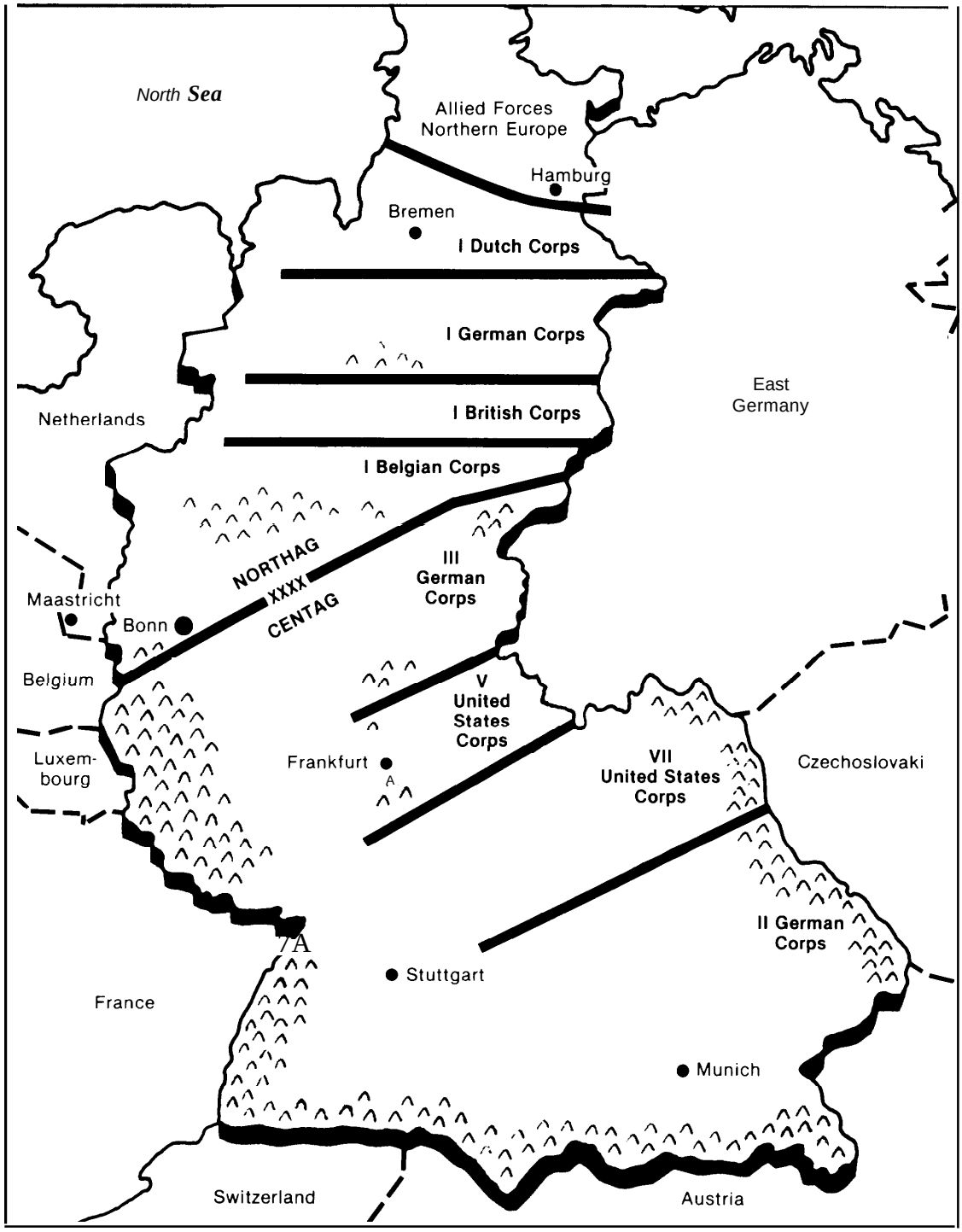
NATO's Integrated Military Command



principal players: SHAPE (Supreme Headquarters Allied Powers Europe, the headquarters for NATO's Allied Command Europe); the U.S. Army; the U.S. Air Force; and the defense forces of our Allies. SHAPE's perspective is all of Europe including the entire Central Region, and it defines FOFA as delaying, disrupting, and destroying follow-on forces from just beyond the troops in contact to as far in the enemy rear as NATO systems can reach. SHAPE considers FOFA from the point of view of: 1) the corps commander, who wants to control the forces about to move in against his troops; 2) the Army Group commander, who wants to delay the second operational echelon (second echelon armies) until his corps have dealt with the first and his reserves are in place; and 3) the Central Region commander, who would like to make the second strategic echelon (second fronts) irrelevant to the war.

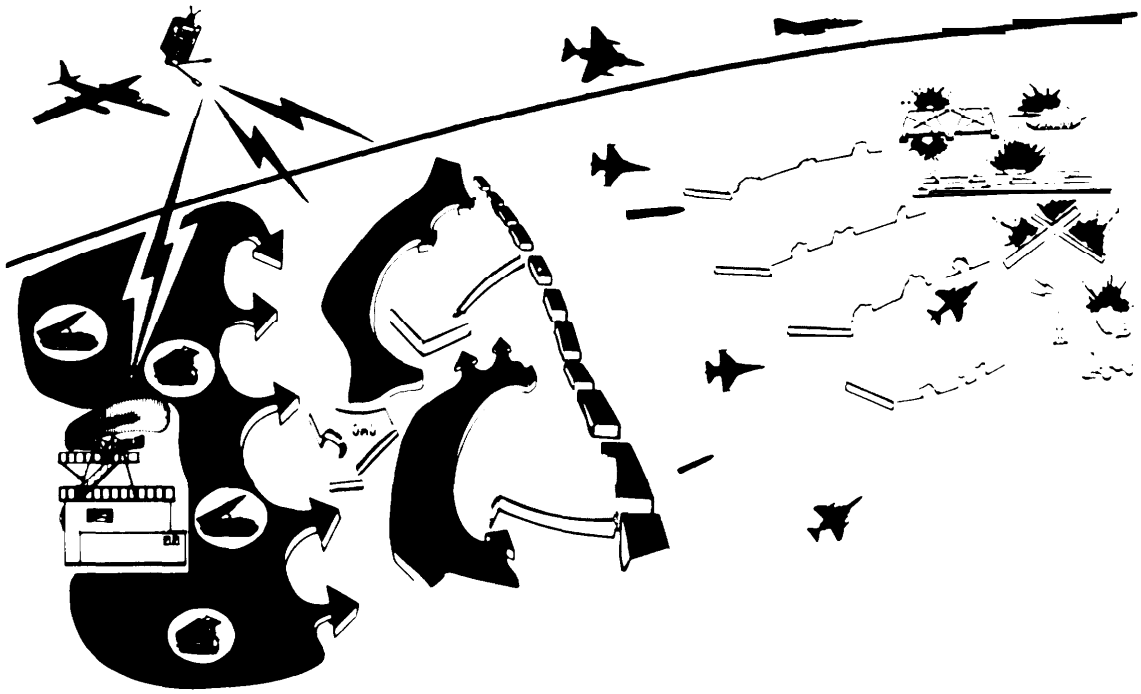
The U.S. Army sees FOFA as the "deep battle" part of its operations, as a means for "metering" the flow of enemy forces; its concentration is almost entirely on those sectors in which U.S. Army forces would be defending. As the Army sees it, striking deep not only reduces the threat to the defending ground forces, but also improves the effectiveness of the ground forces in handling the threat. Because their primary concern is the progress of the close battle, focused at the individual corps and subordinate division commanders' levels, the Army's approach puts great emphasis on

Figure 2-2.— NATO'S "Layer Cake" Defense



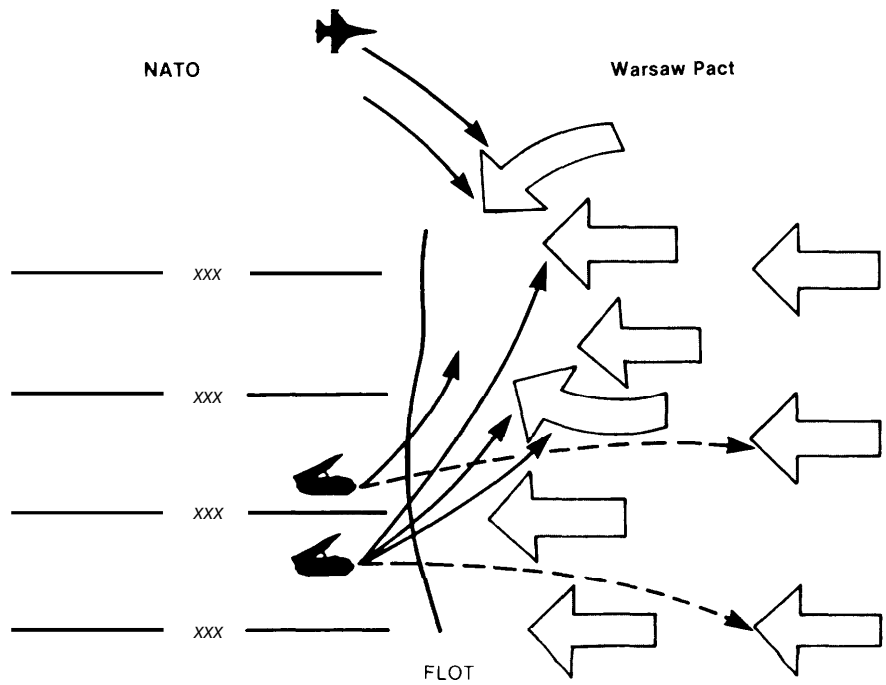
SOURCE. Off Ice of Technology Assessment, 1987

Figure 2-3.— FOFA Reduces Advancing Forces



SOURCE SHAPE

FOFA Provides Cross Corps Support



SOURCE Off Ice of Technology Assessment 1987

identifying and attacking those units-individual battalions, regiments, and possibly entire divisions-that pose the most pressing threat to its ground forces in the immediate future.

The U.S. Air Force, which sees FOFA as falling under its existing interdiction mission, views it primarily from the Army Group/ATAF (Allied Tactical Air Force) level, the command level above corps. While individual regiments and even battalions might be targeted at the request of corps commanders, the Air Force is more likely to think in terms of attacks on whole divisions or their component regiments, possibly before they become an immediate threat to a corps sector. Attacking these larger targets while they are farther out makes it easier to preplan takeoff times and attack routes—necessary to keep attrition down-and permits giving greater latitude to pilots to choose among specific target vehicles within the larger array. The Air Force is also interested in the concept of striking very deep to cause long delays in the arrival of the second fronts.

Is FOFA Appropriate to the Threat?

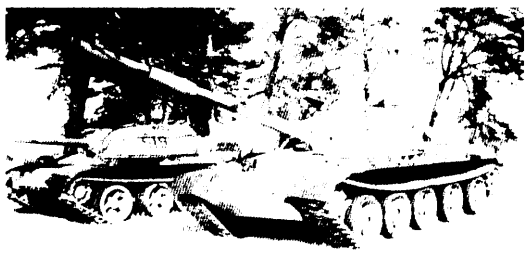
We can never know exactly what the Soviets would do if they went to war against NATO. Analysts working from similar sources have disagreed over whether the Soviets would launch a conventional offensive, and whether follow-on forces would play a significant role in that offensive. There is currently general (but not unanimous) agreement that the Soviets are at least preserving the option for a conventional offensive, and most observers argue that they would want to begin with a conventional offensive and keep it conventional as long as possible. Most observers also agree that while the Soviets are developing considerable operational flexibility in their use of ground forces and have considerable latitude to beef up the first echelons at the expense of the second echelons, there will be significant follow-on forces at all levels.

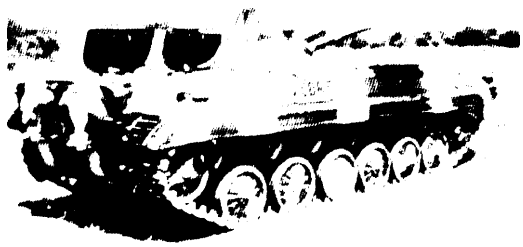
There is currently a great deal of uncertainty —and a great deal of controversy—concerning a number of factors of importance to FOFA. In particular:

1. how much flexibility Soviet ground forces commanders have at various levels of organization to change the direction of attack, to compensate for unanticipated situations, and to allocate their forces among first echelon, second echelon, and mobile groups;
2. how sensitive the Soviet offensive plan would be to delays and to destruction of some of its forces;
3. how robust and resistant to disruption the Warsaw Pact command and control system is;
4. how important the follow-on forces are to Soviet strategy; and
5. how much they could move their forces forward prior to hostilities.

Mobilization is an important factor in a war in the Central Region. It is thought unlikely that the Soviets would attack without any mobilization: not enough of their forces would be ready and in place. However, some analysts believe that by increasing the numbers, quality, and readiness of their forces in Eastern Europe, and by reforming their command structure, the Soviets may be developing a capability to do just that. NATO military planners are acutely aware that NATO would need several days of mobilization before it could effectively resist a massive attack, in addition to whatever time would be needed to recognize a Pact mobilization and decide to respond. Hence, NATO planners are very concerned about a Pact attack preceded by a short or concealed mobilization.

A NATO ability to attack follow-on forces would pose a dilemma for the Soviets: short mobilizations mean more Soviet forces would have to move forward during hostilities when NATO could shoot at them, and less opportunity to 'front load' the offensive; long mobilizations would risk giving NATO sufficient warning to also mobilize. This is part of the appeal of the concept (discussed below) of using B-52 bombers carrying cruise missiles to put the rail lines in Eastern Europe at risk. Second echelon fronts—and possibly elements of





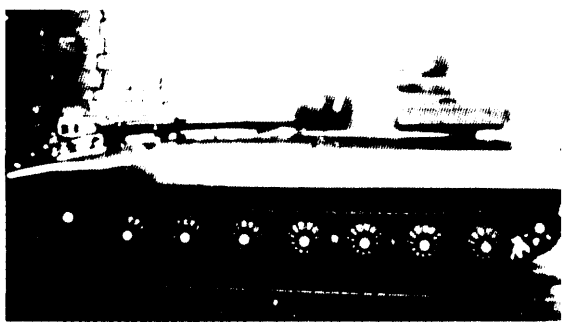


Photo credit U S Department of Defense

Elements of Soviet army forces.

the first fronts—would have to come forward across Eastern Europe by rail to reach the battle. After leaving the rails, they would be transported on roads in Poland, Czechoslovakia, and East Germany, and finally move under their own power to join the battle.

It is widely believed that Warsaw Pact and NATO forces would be intermingled to considerable depth. There would be Pact penetrations into NATO territory and NATO penetrations into Pact territory—much like interlocking fingers. Some analysts believe that it therefore would be extremely difficult to pick out and attack the follow-on forces.

How Do Our NATO Allies View FOFA?

Our European Allies generally have been slower to accept FOFA than the United States has. Up through early 1986 there appeared to be little enthusiasm: conservative defense-minded governments were cautiously in favor; opposition Socialist parties were generally opposed. Underlying some European reactions have been long-standing transatlantic tensions on the degree to which NATO should rely on conventional forces, sharing of defense costs, and trade in defense equipment. This was heightened by a perception, especially among the Germans, that FOFA would draw resources from the close battle—their primary concern—and yield little in return. The situation was aggravated because FOFA came in the midst of several other (primarily United States, or at least viewed as such) initiatives that seemed to arrive at a faster pace than the Europeans could respond, and because of calls for still greater spending increases to implement FOFA.

There is mounting evidence that the Allies are moving toward greater understanding and acceptance of the FOFA concept, and are becoming more enthusiastic for developing and procuring systems that could support FOFA.

To the Germans, whose thinking strongly influences other Central Region nations, FOFA is of lower priority than fighting the close battle or air defense, a sentiment echoed by some other nations. However, they have apparently dropped their efforts to get NATO to assign priorities among the key mission concepts. It is difficult for the Germans to accept anything that might appear to reemphasize forward defense, which is a cornerstone of German public acceptance of NATO. And German membership is itself a basis of the Alliance.

The British, Germans, Dutch, and Belgians —as well as the French, who are not part of Allied Command Europe–have accepted the value of attacks out to the range of the Multiple Launch Rocket System (MLRS), and are planning to procure MLRS as well as enhanced artillery and targeting systems. However, for some this procurement is at least ten years in the future.

The Germans and British accept, in principle, the value of striking deeper with army systems, but have not yet decided whether it can be made practical and cost-effective. The Dutch and Belgians think that their defense establishments are too small to support the necessary complex packages of systems. All the air forces are interested in upgrading their interdiction capabilities, but here again the smaller forces are limited in the variety of systems they can support. Within the Conference of NATO Armament Directors, a FOFA baseline listing the basic capabilities needed for FOFA and specifying a near term interest in ranges out to 150 kilometers has been approved. Work is now underway to produce an agreed list of candidate systems to meet these basic needs.

Availability of funding will limit what all the nations can do (the United States included). This is particularly a problem for the British, whose defense budget is expected to decline in real terms (with significant declines in spending for conventional defense in order to fund Trident), and for the Belgians, who are more likely to apply whatever money is available primarily to improving their ability to fight the close battle.

The focus of attention appears to have shifted from the conceptual to the more concrete arena of arms production and cooperation. It seems clear that the Europeans are unlikely to be enthusiastic about FOFA if FOFA means buying

Photo credit NATO

Ministerial meeting of North Atlantic Council.

predominantly American technology. There is also evidence that they are becoming interested in producing and selling systems that could support FOFA. On the other hand, while it may be difficult to separate real concerns from rhetoric, it may be unwise to dismiss all previous European concerns as a rhetorical smokescreen for economic considerations. U.S. efforts to develop greater Alliance cohesion and cooperation on the development of FOFA systems have centered on the Department of Defense (DoD) Defense Science Board FOFA II Task Force, and the 1985 Nunn Amendment initiative. Both have apparently achieved some initial success in arousing European governmental and industrial interest, but it is too early to tell whether there will be significant concrete results.

Nonetheless, some major elements are discernible. The Europeans are most interested in those approaches to implementing FOFA that are most in consonance with what they have already been planning. In this they are not alone-the U.S. approach to FOFA also includes only systems that were underway before the term "FOFA" was invented. However, the U.S. approach is focused at longer ranges than the European, and one source of friction appears to be the reluctance of our Allies to jump to an approach centered on our products.

In particular, the Europeans are interested in shorter ranges—out to roughly 30 kilometers —where enhanced artillery and MLRS (which several are now buying) could be applied, and in air interdiction. The Europeans appear most interested in FOFA enhancements to systems in which they have already made large national investments, such as the Tornado aircraft, and continuing parallel development of sensor systems–e.g., Remotely Piloted Vehicles (RPV), the United Kingdom's Airborne Stand-Off Ra-

dar (ASTOR), and the French Observatoire Radar Coherent Heliporte d'Investigation Des Elements Ennemis (ORCHIDEE)–that may duplicate U.S. efforts. U.S./European cooperative efforts may thus focus largely on ensuring some degree of interoperability among competing systems. The Germans are developing attack drones for use against armor and air defenses, and advanced anti-armor weapons to be carried on combat aircraft. There appears to be little European enthusiasm for longer range attack missiles, like ATACMS. Indeed, political problems—centering on public perceptions of such missiles as being "offensive," on arms control considerations, and on notions that they are destabilizing because the Soviets might think they carry nuclear warheads and respond with nuclear weapons—surround the deployment of such missiles in Europe, and might cause problems as the United States seeks to deploy them.

There is a growing recognition within Europe —including France-that cooperative programs are the key to obtaining costly modern capabilities. But the Europeans have several concerns about cooperative programs. There is little sentiment for buying goods produced in the United States, and a growing reluctance simply to co-produce U.S. developments, because that stunts the growth of European technology. They prefer co-development programs that draw on and nurture the technological strengths of all parties. Many see in U.S. policy several impediments to cooperative programs: "buy American" sentiments; an inability to commit to a several year project; "black" programs that they cannot have access to; restrictions on transferring technology to our allies; and restrictions on sales of resulting products to third parties.

Based on past experience with cooperative arms production, the process of developing and procuring the many systems required for FOFA is likely to be quite time-consuming. There are several fora—formal and informal groupings of European states, bilateral and multilateral arrangements including the United States, industry-to-industry cooperative programs, and attempts to sell existing systems or their co-production—through which such deals can be arranged. All will have to be harmonized, and the final products gotten through their respective national governments.

Both the British Labour Party and the German Social Democratic Party appear to be deeply opposed to FOFA (and to a number of other basic NATO ideas). Labour stands a reasonable chance of coming to power. If this happens, NATO will face a very different situation, because both Britain and Germany are not only major players, but have a strong influence on how the smaller countries react. Even out of power, both these parties are important political forces in Europe.

How Might the Soviets Respond to FOFA?

The Soviets are likely to regard FOFA both as worrisome and as presenting an opportunity to stimulate and exploit a controversy within NATO. Their reactions to it have taken, and most likely will continue to take, two forms: political exploitation of a new controversy within NATO; and adjustment of their operations to take account of it.

Their propaganda has played on many of the concerns voiced in Europe, in particular: that FOFA is an offensive doctrine that threatens the East; that FOFA would be destabilizing because missiles carrying conventional warheads could not be distinguished upon launch from nuclear missiles; and that it would lower the nuclear threshold through the use of conventional weapons of high destructive potential. The Soviets have taken the position that FOFA is yet another manifestation of aggressive U.S. behavior and intentions, and has contrasted that to the peace-loving image they paint of themselves. They have drawn a picture of the United States developing an aggressive stance with new weapons having the destructive potential of "weapons of mass destruction" (i.e., nuclear weapons). They will try to use it to drive a wedge between the United States and Europe, and to stir up the European left.

Although these concerns may not be taken very seriously among defense professionals in Europe, they do have some support within the major opposition parties in Germany and Britain. Furthermore, these and similar arguments can be exploited by the Soviets to influence public opinion, and perhaps elections, in the democratic European states. The threat to NATO is both political and military. The Soviets would probably prefer to split NATO and separate the United States from Europe by political means if they could do so, rather than risk war.

On the military level, they are concerned both about the concept itself, and about the individual systems being designed to support it. In the first instance, they have added FOFA into their ongoing reevaluations of their strategy and operational art. Their reaction may ultimately take the form of deemphasizing the second echelon at all levels (and otherwise "front-loading' their offensive), or increasing the combat capability of their leading units, or both. However, geography and a desire to limit the vulnerability of massed forces to a nuclear strike will reduce their opportunities for front-loading. They can also be expected to take active and passive countermeasures against the weapons and other systems used by NATO to find and attack their follow-on forces. Each of these steps can be taken only at some cost.

The Soviets appear to have deep concerns about the rapid reaction capability of NATO's new strike systems. In the abstract, such systems could counter their plans faster than they could modify their plans in response, and steal the initiative from them. They will probably take measures to speed their planning cycles or protect them from FOFA weapons. They are also developing similar systems and the theory of their use on the modern battlefield.

IMPLEMENTING FOFA

Initially, a great number of different FOFA concepts were under discussion. But over the past few years, several important study efforts have helped to narrow the range of possibilities by taking into account both operational considerations and technological realities. Attacks could be conducted either by ground-launched missiles or interdiction aircraft against a variety of targets at many different ranges from the FLOT. The targets could be combat units, selected high-value elements of the combat units (e.g., command posts or surface-to-surface missile launchers), or the supplies for those units. Moreover, attacks could be launched to create chokepoints—for example, by dropping a bridge or sowing a mine field along a route of advance-just as a unit would be about to move through. Attacking the combat units might delay, disrupt, or destroy them; attacking their command posts could disrupt their ability to contribute to the offensive, and creating chokepoints would delay their advance,

What and Where to Attack

Of the three general types of targets-groups of vehicles, individual high-value units that, while mobile, tend to spend most of their time moving, and fixed chokepoint targets-the fixed targets are the easiest to target, requiring at most some indication that the time is right to hit them, in addition to information that can be gathered in peacetime. The high-value targets are inherently difficult because their presence can be obscured. When NATO deploys rapidly responding reconnaissance and targeting systems that can find moving vehicles (as well as the weapons to engage them) these targets will probably become easier to locate and destroy than the high-value targets. Until then, there is likely to be more interest, as a practical matter, in the high-value targets.

Quantitative analyses have tended to favor attack of moving combat units either in transit from division assembly areas (roughly 50

to 150 kilometers from the FLOT) to final assembly areas (out to perhaps 50 kilometers from the FLOT), or in their move out of final assembly areas to join the battle. Although opportunities to attack stopped units should not be ignored if they present themselves, attacking moving units provides a better basis for planning; stopped units are more likely to have taken measures to hide from both detection and attack.[3] The concept is to attack battalions or entire regiments, destroying so much of their combat capability that they can no longer be usefully committed to the assault as scheduled.

In attacking these units, emphasis could be put on killing tanks, the other armored vehicles, or the soft-skinned vehicles such as trucks. Destroying tanks is particularly difficult; their heavy armor is designed to protect against most munitions. Fewer than half the armored combat vehicles, however, are tanks. The others —armored fighting vehicles, armored personnel carriers, surface-to-air missile launchers, and surface-to-surface missile launchers, as well as armored engineering equipment needed by the combat vehicles-are easier to put out of action and are also important to the combined arms offensive. Fewer than one-third of the vehicles in a Soviet division are armored, but the closer the division gets to the battle, the more of its soft-skinned vehicles it leaves behind.

The supplies for these forces would be almost as hard to find as the forces themselves, but easier to kill. However, analyses differ on the value of attacking supplies. Although supplies are vital, the Soviets may have much more than they absolutely need. Some conclude that forces going into battle carry enough on board to do without resupply for a while. On the other hand, some analysts conclude that these are potentially valuable targets, especially supply units that are part of combat units (i.e., "organic supply"). In order to continue an attack or move forward and exploit it, a combat unit would need at least minimal critical supplies.

[3]The U.S. ASARS-II system now in Europe can detect stopped vehicles.

Close to the battle, combat vehicles would outnumber supply trucks, making each supply truck a more valuable target.

High-value targets such as command posts, missile launchers, and resupply points are worth attacking when they can be located. No means of routinely locating and engaging them has as yet been identified, but the fact that they tend to stay put for many hours increases the likelihood that clues from a number of sources can be pieced together successfully. If found, they could be killed with today's weapons; they are much fewer in number than the combat vehicles. The Army believes that attacking these targets could seriously disrupt the offensive. In the near term—until systems for locating moving units and weapons for attacking masses of armored vehicles become available-attacks would probably be limited

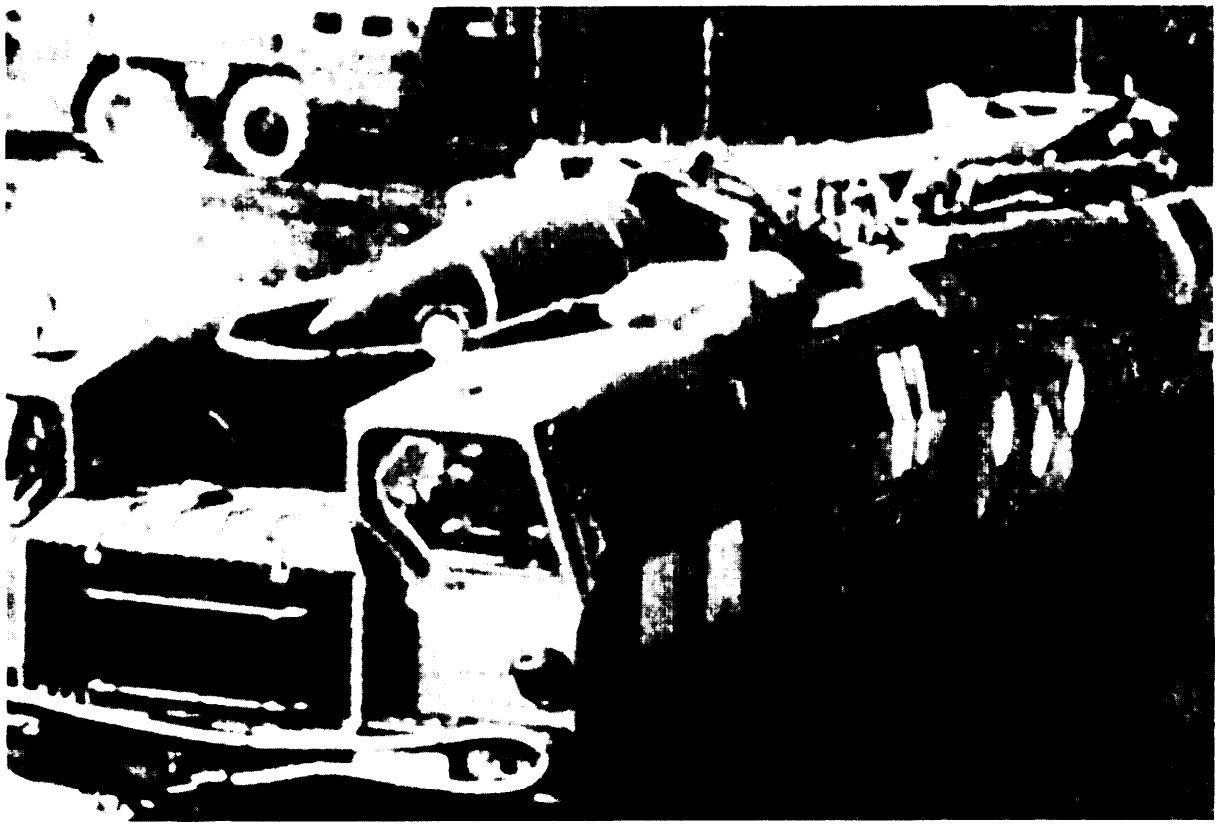


Photo credit U S Department of Defense

Less well-protected Soviet vehicles outnumber the tanks.

to such high-value targets and to creating chokepoints to cause delay.

Causing delays can be very useful if the delays are sufficiently long; however, studies indicate that most attacks would be incapable of causing significantly long delays. In many cases, there may be enough "slop" in the Soviets' schedule to compensate. Two promising exceptions are: deep strikes against the rail lines in Eastern Europe, where delays measured in weeks may be possible; and strikes very close to the FLOT, where delays of just a few hours may be very significant. Some analysts believe that it is very important to delay the second operational echelon to allow NATO's reserves to get into place, and to delay the second strategic echelon until NATO has successfully dealt with the first.

In general, the closer to the FLOT the attacks take place, the more systems can reach the targets, the more effective the attacks are likely to be, and the more direct their effect on the close battle. However, waiting for the enemy to get very close risks not being able to fire enough rounds in the time he is exposed to attack. Furthermore, this is not necessarily an argument in favor of short-range systems, because longer range systems have greater flexibility to redirect fire across the front.

Obtaining the Capability

The Systems: What's in the Inventory, What's Being Bought, What's Under Development

Supporters of the FOFA concept believe that some or all of these approaches can be made to work, *if* all the necessary pieces can be procured. They differ as to which would be the most useful and the most feasible.

Implementing any of these approaches will require a package of systems, the major components of which are:

1. reconnaissance, surveillance, and target acquisition (RSTA);
2. data analysis and handling (data fusion);
3. attack platform;
4. munitions; and
5. systems to protect the airborne RSTA assets and to help the attack aircraft penetrate to their targets.

All of these will have to work and be available in sufficient quantity if the concept is to be viable.

This is illustrated in table 2-1, which suggests packages of systems to support specific operational concepts. None of these concepts could be fully implemented today, because systems are not yet deployed. Furthermore, a great many more systems than are shown here—both existing and developmental-might be brought to bear. Table 2-2 shows what the U.S. Army and Air Force are currently buying and developing. NATO favors an evolutionary approach to FOFA, i.e., implementing a limited capability while more effective systems mature.

Reconnaissance, Surveillance, and Target Acquisition (RSTA) Systems

Currently the Services have in Europe a number of different systems that can detect and locate fixed targets and targets that move infrequently. Most of these systems are based on aircraft, and locate their targets by imagery or by detecting electronic emissions. They lack an ability to look over broad areas for long periods of time to find moving units and rapidly (i.e., within seconds) report that information to users. The Joint Surveillance Target Attack Radar System (Joint STARS), currently in full-scale development, is designed to do that. Although strongly supported by DoD, it has been a controversial program in Congress.

Remotely piloted vehicles (RPVs) could also serve this function, but over a generally much smaller area. Whereas one Joint STARS might support several corps at once, one of the Army's Aquila RPVs might typically support a brigade's MLRS batteries. Aquila could see targets masked from Joint STARS by terrain and vegetation and could identify individual vehicles. It has also been a controversial program. Several other RPVs are under development both here and in Europe. The Europeans generally favor RPV systems, have many in the field, and are developing upgrades and new systems, particularly the CL289. The British are developing abroad area surveillance system—called ASTOR–and the French are developing a heliborne MTI system called ORCHIDEE.

The Precision Location Strike System (PLSS) has also been controversial and the program was recently scaled back by DoD and Congress. PLSS would have been used to locate radars of air defenses threatening NATO interdiction aircraft and RSTA platforms such as Joint STARS.

Data Analysis and Handling

NATO's ability to attack moving targets is also limited by data-handling systems that consume long periods of time getting information from RSTA systems to analysts and to attack systems. This problem has been compounded because modern collection systems can collect large amounts of data. The Joint Tactical Fusion program, as well as other efforts, are working on using modern computers to streamline this process. Systems like Joint STARS will be able to send data both to assessment centers to plan attacks, and directly to attack systems such as MLRS batteries.

Attack Platforms

Currently NATO has a variety of tactical aircraft-including U.S. F-16s, F-4s, and F-111s, British and German Tornados, and several other types—conventional artillery, and the Lance missile to strike into Warsaw Pact territory. All of these are limited in their ability to attack follow-on forces. Of the aircraft, only the Tornados and F-1 11s can operate at night and in bad weather,[4] and they will have other interdiction tasks as well.

[4]The others can fly at night, but because they lack systems to support effective navigation and weapons employment in the dark, they would not be particularly effective.

Table 2-1 .—illustrative Packages of Systems To Support Specific Operational Concepts
(as yet, not all the pieces exist)

	Reconnaissance, surveillance, and target acquisition		Attack	
Operational concept	Reconnaissance, surveillance, situation assessment	Target acquisition, attack control	Platform	Weapon
1, MLRS and artillery attack of regimental columns: 5 to 30 km deep	GUARDRAIL, TRS, ASARS, Joint STARS, and ASAS	AQUILA and AFATDS	8-inch Artillery and MLRS	SAD ARM MLRS/TGW
2. Aircraft attack of division columns: 30 to 80 km deep	GUARDRAIL, TRS, ASARS, Joint STARS, and ENSCE	Joint STARS	F-16	MSOW carrying Skeet or TGSM or CEB
3. Ballistic Missile attack of division columns: 30 to 80 km deep	GUARDRAIL, TRS, ASARS, Joint STARS, and ASAS	Joint STARS and AFATDS	MLRS launcher	ATACMS carrying DPICM or TGSM or Skeet
4. Attack with aircraft:create chokepoints and then attack the halted vehicles: 80 to 150 km deep	GUARDRAIL, TRS, ASARS, Joint STARS, and ENSCE	ASARS and GACC	F-15E F-16	AGM-130, MSOW carrying various munitions Including mines
5. Air-launched cruise missile attack of rail network; 350 to 800 km deep	Various national systems	(on the weapon)	B-52	Cruise missile with various munitions

NOTES
1 Definitions
AFATDS—Advanced Field Artillery Tactical Data System provides target data to artillery and M LRS batteries
AGM-1 30—an air-launched missile
ASARS—Advanced Synthetic Aperture Radar System provides images of fixed objects
ASAS—a developmental Army center for collecting, analyzing, and disseminating surveillance data
ATACMS—Army Tactical Missile System a ballistic missile to be launched from MLRS launchers
AQUILA—a remotely piloted vehicle
CEB— Combined Effects Bomblet Similar to DPICM; designed to be dispensed by the Combined Effects Munition (CEM)
DPICM—Dual Purpose Improved Conventional Munition unguided submunition for use against light armor and soft targets
EN SC E—the Air Force version of ASAS
GACC—Ground Attack Control Center a developmental center for controlling air attacks against ground targets
GUARDRAIL–a tactical surveillance system
Joint STARS—Joint Surveillance Target Attack Radar System moving target Indicator and attack control
MLRS—Multiple Launch Rocket System
MLRS/TGW–Terminally Guided Weapon a smart anti armor submunition for MLRS
MSOW—Modular Standoff Weapon a weapons dispenser
SADARM –Search and Destroy Armor a smart anti.armor submunition for artillery
Skeet —a smart anti-armor submunition
TGSM —Terminally Guided Submunition a smart anti.armor submunition
TRS—Tactical Reconnaissance System carries various sensor suites
2 Reconnaissance surveillance, and situation assessment would be performed by a number of systems–particularly those shown here —feeding into the as sessment center Although all need not find the target for the attack to take place, the more there are the greater the chances are that the target will be found, recognized and identified with sufficient accuracy to attack it
3 Not all the submunitions displayed in the table are necessarily being developed for deployment on the weapons shown, however, there is no fundamental reason why they could not be engineered onto those weapons

The Air Force is currently buying the LANTIRN system for the F-16, which will enable it to operate effectively at night. They have also begun to procure the F-15E which is designed for interdiction and carries the LANTIRN and a terrain-following radar. The F-15E has much greater range than the F-16.

The Army is procuring the Multiple Launch Rocket System (MLRS), which has about twice the range of 155mm artillery. The ATACMS ballistic missile,[5] which is designed to reach well over 100 kilometers into enemy territory with high accuracy, has entered full-scale development. It will be launched from the MLRS launcher. The Germans are developing attack drones for killing armor and air defenses.

Munitions

Munitions are another major limitation on NATO's ability to attack follow-on forces. Current generation weapons are effective primarily against single, soft targets; the Air Force has weapons (e.g., the GBU-15) that can be used to destroy bridges. The Air Force's Maverick missile can be used to kill tanks (and other

[5] Also called "Army TACMS" or just "TACMS." The Army split this development off from the Joint TACM S, or JTACM S program.

Table 2-2.—Status and Costs of Selected FOFA-Related Programs

System	Status[a] (3/1/87)	Air Force Programs Through FY 1987 Funds[b] appropriated	Air Force Programs Through FY 1987 Units procured[c]	Expected total Acquisition[d] Cost[b]	Expected total Units procured[c]
Platforms					
F-15A/B/C/D/E	proc/FSD	$ 35B	925	$ 46B	1,270
F-15E	proc/FSD		50		390
F-16A/B/C/D	proc	$ 23B	440	$ 48B	2,740
A-7 upgrade	FSD	$ 35M	N/A	$190M	N/A
ATF	DEM/VAL proto	$550M	0	TBD	750
Pods:					
LANTIRN	proc	$ 1.86	150 nav 10 tgt	$ 4B	700 nav 700 tgt
Munitions and direct-attack weapons'					
CEM	proc	$ 1.2B	48,000	$ 2.2B	96,000
SFW	FSD	$ 85M	0	$ 2.3B	14,000
GATOR	proc	$560M	10,200	$560M	10,200
HVM	adv dev	$ 34M		$ 1.8B	
missiles			0		100,000
fire control sys			0		200
HTM	FSD	0	0	$88M RDT&E	TBD
DAACM	pre-FSD	$ 19M	0	$340M	2,850
Standoff weapons					
GBU-15	proc ends	—	—	—	—
AGB	prop	TBD	TBD	TBD	TBD
HARM	proc	$ 1B	4,500	$ 2.1B	7,300
LCS	adv dev	$ 33M RDT&E	TBD	$ 67M RDT&E	TBD
AGM-65D/G	proc	$ 1.96	10,000	$ 6B	60,000
AGM-130	FSD	$110M	40	$ 2.1B	5,600
MSOW	RFP/PD rel 3/87	0	0	TBD	TBD
AMRAAM	FSD/proc	$ 1.8B	180	$ 8B	17,000
RSTA Systems:					
JSTARS E-8A	FSD	$625M	2	$ 3B	10
PLSS[e]	OUE	$675M		$675M	
AMS[e]			3 +		*3+*
SNS[e]			6		*6*
case			1		1
TRS[f]	proc	$ 1.5B	—	$ 1.9B	
TR-1s			27		27
SS[f]			14		14
PGS[f]			1		1
BGS[f]			1		2
F-O TRS[g]	adv dev	$ 27M	0	$ 1.6B	TBD
ESM	pre-FSD	$ 34M	0	$230M	34
GACC	pre-FSD	$ 3.5M	0	$ 40M	N/A
Communications and data fusion systems'					
JTFP	FSD	$ 80M	0	TBD	TBD
HAVE QUICK (I/II/IIA)	FSD/proc	$160M	22,000	$500M	43,000
Electronic warfare systems:					
EF-111A U/G[h]	FSD	$ 90M	0	$265M	38
F-4G WW[i]	FSD	$240M		$565M	
computers			150		150
receiver groups			0		124
Compass Call	FSD	$325M	16	*$520*	16

NOTES

[a] adv advanced, DEM demonstration, dep deployment, dev development, FSD full-scale development, OUE operational utility evaluation PD Program Directive proc procurement, prod production, prop proposed, proto prototype, RFP request for proposals, VAL validation

[b] Approximate in current ('then-year') dollars

[c] Approximate number planned

[d] Including cost Of research, development, testing, evaluation, and procurement but not operation and maintenance

[e] PLSS Precision Location Strike System, AMS Airborne Mission Subsystem, SNS Suite Navigation Subsystem, CPS Central Processing Subsystem 3 + indicates three all-up AMSS plus a partial AMS requiring refurbishment

[f] TRS Tactical Reconnaissance System, SS sensor suite, PGS prototype ground station BGS bunkered ground station

[g] F-O TRS Follow-On Tactical Reconnaissance System (ATARS)

[h] LUG upgrade

[i] WW Wild Weasel

SOURCE US Air Force (SAF/LL), January 1987

Table 2.2.—Status and Costs of Selected FOFA-Related Programs—Continued

System	Status[a] (3/1/87)	Army Programs Through FY 1987 Funds[b] appropriated	Units procured[c]	Expected total Acquisition[d] Cost[b]	Units procured[c]
P/at forms					
MLRS	proc	$ 3.1B		$ 4.9B	
launchers			392		681
rockets			1951000		440,000
ATACMS	FSD	$350M	—	$ 1.2B	TBD
Reconnaissance, Surveillance *and* Target *Acquisition (RSTA) Systems*					
RPV/TADARS	FSD	$820M		$ 2.2B	
GCS			5[k]		53
AV[l]			12		376
IEW UAV[m]	dev	$ 28M		$110M	
GCS			2		6
AV[l]			12		46
JSTARS GSM	FSD	$240M	3	$730M	95
T R A C	adv dev	$ 25M		TED	1
Improved GUARDRAIL/ Common Sensor	proc	$300M	28	$1.0B	65
&fun/f lons					
DPICM					
155 mm	proc	$ 2.0B	4.4M	$ 4.3B	9.4M
8-inch	proc	$620M	640.000	$640M	650,000
155 mm BB[n]	FSD	$ 56M	35,000	$ 2.2B	1.0M
MLRS/TGW	adv dev	$ 72M	—	TBD (Incl $310M RDT&E)	TBD
SADARM	adv dev	$190M			
MLRS rounds				$ 3.4B	50,000
155mm rounds				$910M	70,000
8-inch rounds				TBD	6,000
Communication Systems					
SINCGARS	proc	$480M		$ 4.9B	
air			150		14,000
ground			12,000		280,000
A D D S	proc	$280M		$ 2.4B	
NCS[o]			4		140
EPLRS[p]			670		22,000
J T I D S			10		580

NOTES
[a]adv advanced DEM demonstration dep deployment dev development FSD full scale development OUE operational utility evaluation PD Program Directive proc procurement prod production prop proposed proto prototype RFP request for proposals VAL validation
[b]Approximate current then year dollars
[c]Approximate including cost of research development test and evaluation and procurement but not operation and maintenance
[d]GCS Ground Control Station
[k]Incomplete MICNS Remote Ground Terminals only
[l]AV Air Vehicle
[m]Details for Initial EW UAV '01 follow on Objective I E W U AV programs under development
[n]BB Base Bleed shell
[o]NCS Net Control Station
[p]EPLRS Enhanced Position Location Reporting System
See Glossary for other terms

SOURCE U S Army (OSA/LL) January 1987

armored vehicles) one at a time,[G] but a capability to attack groups of vehicles with a single shot and to defeat masses of armor is generally lacking. Currently, the Air Force is buying the Combined Effects Munition (CEM), which dispenses about 200 bomblets (CEBs) from a tactical munitions dispenser dropped from an airplane. The CEB is effective against trucks and most armored combat vehicles except tanks. The Army is buying a similar munition, called Dual Purpose Combined Effects Munition (DPICM) for the MLRS. Although the DPICM could conceivably go in the ATACMS, current plans call for initial ATACMS to carry the anti-personnel-anti-material (APAM) munition which has essentially no capability against armor. The German Tornado carries the MW-

[G]1, A NT I RN will support shooting two Mavericks per pass, but the pilot must find a target for each Maverick he launches and line it up with the crosshairs on his cockpit display while flying his airplane. Many observers believe that multiple passes per launch are more likely than multiple launches per pass.

1 dispenser that drops the KB-44 anti-armor submunition as well as several other submunitions.

These munitions, although capable of hitting several targets per weapon launch (or an area target, or one whose location is imprecisely known), are all unguided, and hence most will fall on empty ground. Moreover, they have little effectiveness against tanks. The next generation of munitions, currently in development, will have both greater effectiveness against tanks and seekers to guide them to their targets. These include sensor-fuzed weapons, such as the Army's SADARM and the Air Force's Skeet, that fire a self-forging slug at a target, and the Army's Terminally Guided Submunition (TGSM, also called terminally guided weapon, or TGW) that guides directly to a target and detonates a shaped charge warhead. Technical issues still surround these programs, but these munitions are needed if attacking tank columns is to become a reality. The Germans are developing a new, improved, anti-armor submunition and a smart launcher for it to be carried by an airplane.

Whether or not scatterable mines can provide an effective means of creating chokepoints (or exploiting natural chokepoints, or augmenting the effects of dropping bridges) is a matter of some controversy. Advocates believe a scatterable mine system could provide great payoff for a small investment. Both Services have inventories of anti-vehicular and anti-personnel mines, and programs to develop smart mines that can sense targets at a distance and fire munitions (e.g., Skeets) at them. But mine programs tend to have low priority in both services.

In defense procurements, munitions have tended to get low priority. The munitions are just as important to FOFA as any of the other system components. If the concept is to work, the proper munitions will have to be bought and bought in sufficient quantities to do the job.

Assembling the Pieces: "Packages" of Systems

The five general packages of systems listed below are now under serious consideration. All are evolutionary in the sense that it is envisioned that capabilities will expand as new developments come online. With the possible exception of the last, all can be implemented with limited capability before all the pieces of the package are available:

1. package based on MLRS and artillery,
2. package based on the ATACMS ballistic missile,
3. package based on F-16,
4. package based on F-15E, and
5. package based on B-52s carrying cruise missiles for deep strike.

MLRS and Artillery

The Army is currently procuring the Multiple-Launch Rocket System.[7] This, combined with existing artillery, will provide some capability to engage follow-on forces during their movement from final assembly areas to the battle (see table 2-3). The DPICM[8] submunitions being procured for these rockets will have some capability against light armored vehicles as well as against high-value targets like command posts, but very little against tanks. Anti-armor capability will improve with the deployment of the MLRS/TGW submunition[9] and the SADARM for the artillery, both of which could be in production in the early 1990s. The Army plans to procure 350 MLRS launchers.

Important improvements in the ability to attack moving targets would be obtained from either Joint STARS or an RPV system that could target directly for an MLRS battery.

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[7]Several of our Allies also have plans to acquire MLRS.
[8]Dual Purpose Improved Conventional Munition.
[9]MLRS/ Terminally Guided Warhead, a smart anti-armor submunition.

Table 2-3.—Packages Based on MLRS and Artillery

	Targets				
	Stopped high value	Fixed chokepoints	Moving units		
			Trucks	ACV	Tanks
Platform	MLRS (P)	MLRS (P)	MLRS (P)	MLRS (P)	MLRS (P)
RSTA	current	current		Joint STARS (F) or RPV (F, D, N)	
Munition	DPICM (P)	mines (various stages)	DPICM (P)	DPICM (P)	TGW (D)

KEY I In Inventory
P - In production
F = In full scale engineering development
N - Not yet in formal development
AC RON YMS
MLRS—multiple launch rocket system
DPICM—dual purpose Improved conventional munition
Joint STARS —Joint Surveillance Target Attack Radar System
RPV–remotely piloted vehicle
TGW—terminally guided weapon
ACV—armored combat vehicle

This concept has the advantage of being consistent with the preferences of our Allies, several of whom have plans to buy MLRS. And—if deployed across the Central Region-would provide a consistent capability across the region. The range of the MLRS limits its use in supporting other corps, and therefore the abilit y to concentrate firepower across the region.

ATACMS Ballistic Missile

Adding the ATACMS missile would give a U.S. corps the ability to attack divisions moving from division assembly areas to final assembly areas, helping to alleviate some of the short reaction problems in the previous approach. It would also provide some capability to support neighboring corps and to concentrate fire on massing forces. DoD's efforts to interest the Allies in ATACMS have thus far been unsuccessful,[10] but solely United States deployments could be of some value across nearly the entire Central Region.[11]

The initial ATACMS will be procured with APAM submunitions which are not effective against armored vehicles. Without a system like Joint STARS, it would be limited to attacking soft high-value targets that don't move very often, such as command posts, missile launchers, communications links, and logistics links-when they could be adequately located. Joint STARS would support the attack of moving supply trucks, and-with the addition of anti-armor submunitions like TGW[12]—moving armored columns. These targets also might be located with RPVs or some combination of other systems. Attacking moving columns would also require systems to analyze and disseminate data quickly. Attacking small groups of moving vehicles or a specific group of vehicles within a larger column at 100 kilometers beyond the FLOT would require a cue that the target had arrived at the intended aimpoint just prior to missile launch. However, if the object is to attack any vehicles within a large column, less timely information would suffice.

Some observers consider the ATACMS to be too closely linked to the RSTA system and lacking in flexibility. They claim that breaking the link of rapid target observation, location transmission, and launch would render the system nearly useless against mobile targets.

[10] This may be changing. Presentations to the NATO Army Armaments Group Panel on Surface-to-Surface Artillery in November 1986 generated interest on the part of Germany, Italy, and the Netherlands, but had not yet resulted in changes in official positions.

[11] ATACMS deployed in U.S. V corps could reach as far north as the British I corps sector. ATACMS deployed with U.S. III corps, if I I I corps is deployed into NORTHAG, can extend that coverage to the border of the Central Region. However, 11 I corps would be in reserve and would not likely be deployed at the beginning of the war.

[12] or I RTGSM, or SADARM, or DPICM, etc.

Photo credit LTV Aerospace & Defense Co

ATACMS missile, launched from MLRS launcher.

Others believe that these concerns are overblown, and that even without Joint STARS and advanced anti-armor submunitions, ATACMS would be very important.

Although the ATACMS missile makes good military sense, there may be political problems associated with deploying it. Some Europeans have voiced concerns that ballistic missiles launched into Warsaw Pact territory will be misinterpreted, leading to a nuclear response; others fear that it will strengthen the U.S. corps so much that the offensive will be channeled against weaker sectors. We do not know how serious or enduring these concerns are. The Soviets can be expected to play on at least the first of these. On the other hand, if the ATACMS works and is deployed, the Europeans may want it in their forces.

As arms control proposals get shuffled in the wake of Reykjavik, some may cause problems for the ATACMS; at one time the German Government was reported to have asked the United States to seek to include limits on ballistic missiles with ranges exceeding 100 kilometers in the intermediate range arms control negotiations with the Soviets. If the United States is to preserve the option to deploy ATACMS, negotiators will have to see to it that ATACMS is excluded from negotiated limits, either by limiting only missiles with longer ranges, or by some means of differentiating nuclear from conventional ballistic missiles. This would become difficult if ATACMS were to be made capable of carrying a nuclear warhead.

Compared to the next two concepts, which rely on tactical airpower, the MLRS and

Table 2-4.— Packages Based on ATACMS

	Targets				
				Moving units	
	Stopped high value	Fixed chokepoints	Trucks	ACV	Tanks
Platform	ATACMS (F)	ATACMS (F)	ATACMS (F)	ATACMS (F)	ATACMS (F)
RSTA	current	current		Joint STARS (F) or RPV (N, D, F)	
Munition	APAM (1) DPICM (P)	mines	APAM (1)	[TGW (D)] [DPICM (P)] [IRTGSM (D)]	[TGW (D)] [IRTGSM (D)]

KEY I In Inventory
P In production
F In full scale engineering development
N Not yet in formal development
( ) The next generation submunition for the ATACMS has not yet been selected TGW or IRTGSM could fit, as could [he DPICM currently inproduction

ACRONYMS
ATACMS– Army Tactical Missile System
DPICM—dual purpose Improved conventional munition
IRTGSM—infrared (guided) terminally guided submunition
Joint STARS—Joint Surveillance Target Attack Radar System
RPV—remotely piloted vehicle
TGW—terminally guided weapon
ACV– armored combat vehicle

ATACMS concepts share some advantages and disadvantages. They are more dependent on the RSTA systems—airplanes have pilots who can compensate to some extent for late, inaccurate, false, or missing information; and although the ATACMS can be fired laterally into other corps sectors, the launchers cannot easily be moved large distances in response to movements in Warsaw Pact forces. Tactical airpower, by contrast, can be shifted rapidly across most of the Central Region.

Conducting air interdiction is much more complicated than launching a missile. Attacking aircraft would have to deal with enemy air defenses, requiring defense suppression, escort aircraft, and preparation of attack corridors. Although the Air Force practices attacks on fixed targets and moving targets that appear approximately where and when anticipated, planning large interdiction efforts against moving targets that may appear on short notice is difficult. Although it generally takes many hours to plan an attack, once planned it can be redirected on shorter notice, although not as quickly as a missile launcher can be reprogrammed. NATO can expect the Pact to make a strong effort to close NATO's air bases: effective airbase attacks would be likely to lead to a reduction in sorties available for FOFA. In addition, there are likely to be many competing demands for interdiction aircraft. In conversations in Europe, OTA found general agreement among Army and Air Force officers that few aircraft would be available for FOFA during the first few days, because the more immediate concerns of protecting NATO's airspace and ensuring NATO's ability to fly over the battle area should take precedence in the first few days. However, this is not set in stone, and if SACEUR and CINCENT decide that emphasis should be on interdiction the first day, it will be.

Because of the specific disadvantages of each approach—air interdiction and missile attack—a combination of the two would appear to be more effective than either alone.

F-16 Aircraft

This concept would provide coverage similar to that of the ATACMS, but with greater latitude to be moved to different sectors of the front. It would make use of an existing asset, the F-16, which is already in the force and in production. Furthermore, attacking into Pact territory with interdiction aircraft is accepted by U.S. Allies, who themselves have capable interdiction aircraft including F-16s and the

Tornado. The German Tornado, which carries unguided anti-armor submunitions in its MW-1 dispenser, may beat present NATO's best asset against masses of armor.

If used against combat units, this concept would almost certainly require a broad area RSTA system like Joint STARS, especially if it is to be responsive to Pact force movements across the Central Region. Until such a system becomes available, it might be possible to focus a complicated combination of other systems to obtain the necessary information. However, unlike the preceding concepts, this one would have greater capability to compensate for shortcomings in the RSTA system.

Other developments will be needed to complete this concept. The CEM is similar to the Army DPICM–it is effective against lightly armored vehicles, soft vehicles, and personnel, but has little effectiveness against modern tanks. If tanks are also to be attacked, it would have to be replaced, or supplemented, by a Skeet or some other terminally guided anti-armor submunition. The LANTIRN, as well as short stand-off missiles like AGM-130 or GBU-15 configured to carry a submunition dispenser or an inertially guided dispenser, would be valuable for increasing aircraft survivability.

F-15E Aircraft

Under current plans, the F-15Es will start to appear in Europe in the late 1980s. These two-seat airplanes, configured primarily for ground attack but retaining their fighter capabilities, will have much greater range and payload than the F-16s, as well as night and all-weather capability supported by LANTIRN and terrain-following radar. They will, however, cost considerably more than F-16s. The F-15Es will supplement United States Air Force in Europe's (USAFE's) deeper attack capabilities that currently reside exclusively with the F-111s.[13] F-15Es and F-111s could attack targets well into Western Poland. The F-15Es

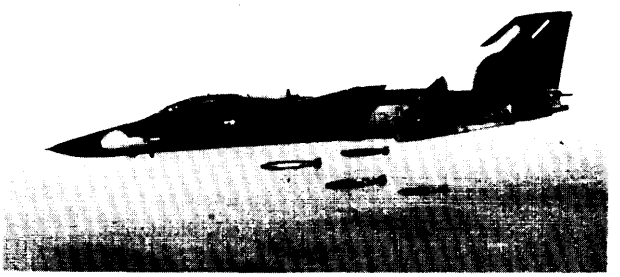

Photo credit U S Department of Defense

F-1 11s, current mainstay of NATO's deep attack capability.

and some tasked F-111s[14] could be operated with or in place of the F-16s as described above, and could be used to extend FOFA capability to create chokepoints on the Oder and Neisse Rivers (the GDR-Polish border) and attack units in transit on road and rail in Western Poland.

If they operate beyond the range of the F-16s, the F-15Es will also be generally beyond the range of Joint STARS and similar tactical surveillance systems. This will not limit their ability to operate against fixed targets like airfields and bridges, but it will affect their ability to attack moving targets, and to create chokepoints at the optimum time. Furthermore, the deeper these aircraft operate, the more difficult it becomes to protect them. The greater range of the F-15E could also be exploited to operate out of bases that are farther from the battle (perhaps in Britain), and therefore less likely to be attacked than bases used by the F-16s. The greater range would also provide improved flexibility to operate throughout the Central Region in response to an evolving Pact offensive.

Deep Strike Using B-52s Carrying Cruise Missiles

The Air Force is considering the use of B-52 bombers carrying long-range cruise missiles to interdict the rail network across Eastern Europe. One variant of the cruise missile could

[13] This might also be augmented by B-52s, and possibly FB-111s.

[14] The F-1 11s, limited in number, already have several important missions including interdiction and air base attack, and standing nuclear alert.

Table 2-5.– Packages Based on F-16 Aircraft

	Targets				
			Moving units		
	Stopped high value	Fixed chokepoints	Trucks	ACV	Tanks
Platform	F-16/LANTIRN	F-16/LANTIRN	F-16/LANTIRN	F-16/ LANTIRN	F-16/LANTIRN
RSTA	current	current		Joint STARS (F) Advanced RPVS (?)	
Weapon/Munition	Bombs, cluster bombs, TMD/CEM (P)	mines, bombs	TMD/CEM (P) cluster bombs	TMD/CEM (P) Rockeye (1) Maverick (I, P)	TM D/Skeet (D) Maverick (I, P)
Other	systems for defense avoidance and suppression and for protection of RSTA assets				

KEY I In Inventory
P - In production
F In full scale engineerIng development
N Not yet in formal development
ACRONYMS
LANTIRN –Low altitude navigation and targeting Infrared system for night
TMD—tactical munitions dispenser
CEM–combined effects munition (a TMD carrying Combined Effects Bomblets)
Skeet—an IR guided submunition that fires a self-forging slug Also called SFW, or sensor fuzed weapon
Rockeye —a cluster bomb containing anti armor submunitions
Maverick—an anti.tank guided missile
ACV—armored combat vehicle

Table 2-6.—Packages Based on F-15E Aircraft

	Targets				
			Moving units		
	Stopped high value	Fixed chokepoints	Trucks	ACV	Tanks
Platform	F-15E (P) F-ill (1)	F-15E (P) F-1 11 (I)	F-15E (P) F-1 11 (I)(?)	F-15E (P) F-1 11 (I)(?)	F-15E (P) F-1 11 (I)(?)[a]
RSTA	current	current		Joint STARS (F)	
Weapon/Munition	Bombs, cluster bombs, TMD/CEM (P)	GBU-15 (1) AGM-130 (F) mines	TMD/CEM (P) cluster bombs	TMD/CEM (P) Rockeye (1) Maverick (I, P)	TM D/Skeet (D) Maverick (I, P)
Other	systems for defense avoidance and suppression and for protection of RSTA assets				

KEY I In inventory
P In production
F - In full scale engineering development
N Not yet in formal development
ACRONYMS
GBU 15–a highly accurate guided glide bomb
AGM-130—a powered version of the GBU-15
TMD—a tactical munitions dispenser
CEM —combined effects munition (a TMD carrying Combined Effects Bomblets)
Skeet—an IR guided submunition that fires a self-forging slug Also called SFW or sensor fuzed weapon
Rockeye—a cluster bomb containing anti-armor submunitions
Maverick—an anti.tank guided missile
ACV—armored combat vehicle
[a]F 11 1s are typically tasked for deep missions against targets like airfields and bridges

be configured to drop bridges, while another would sow smart mines along the rail lines. These aircraft would be flown from the United States to their launch points, launch their missiles against fixed targets, and return to bases in the United States. It has been estimated that by the mid-1990s suitable cruise missiles could be developed and built in sufficient numbers, and the airplanes could be released from their strategic nuclear roles through introduction of B-Is into the force.

The primary goal most likely would be to delay the arrival of forces rather than to cause attrition. In theory, this would prevent the second fronts from arriving in time to exploit the

successes of the first fronts, and allow NATO time to reverse the situation.

Proponents of this concept contend that having the capability to hold the rail lines at risk in time of war could force the Soviets to a long mobilization, bringing their forces through the rail lines in peacetime and therefore providing NATO with long, unambiguous warning. A "long warning" scenario is generally more favorable to NATO than a "short warning" scenario, because NATO is expected to mobilize more slowly than the Warsaw Pact. However, the added warning would be of value to NATO only if NATO accepts it and reacts accordingly.

This concept would make use of existing assets, the B-52s. There would be no aircraft procurement costs, but operations and maintenance would be incurred to keep the force active for this (and other conventional) roles. Eventually, those B-52s would have to be replaced by more modern aircraft or extensively overhauled. Suitable tanker aircraft support would have to be made available. Because of the long range of the bombers and of the weapons they would carry, exposure to enemy air defenses could be kept to a minimum. Compared to the other four concepts, the requirements for timely surveillance are much less.

The proposed cruise missile could be developed from an existing type—e.g., the Boeing ALCM or the Tomahawk. Engineering studies have shown that this ought to be a straightforward task; it has yet to be demonstrated, however. Alternatively, a new missile could be developed.

Problems related to arms control may also have to be solved. Under the SALT II agreement, the B-52 was defined and counted as a strategic nuclear delivery vehicle. Whatever arms control agreements ultimately are produced in the wake of Reykjavik will have to come up with a definition of a strategic bomber. If this option is to be pursued, either some way will have to be found to keep conventionally armed B-52s from being counted as strategic nuclear weapons, or the United States will have to give up some nuclear capability to get conventional capability.

REMAINING ISSUES

There are a number of FOFA-related programs that Congress will decide on. Some—such as the F-15E and the ATACMS missile—do not appear very controversial, although that might change. The controversial issues are: Joint STARS, Aquila RPV, a successor to PLSS, and advanced munitions programs. In addition, Congress will have to deal with cooperative development and production with our Allies.

Joint Surveillance Target Attack Radar System (Joint STARS)

Although Army, Air Force, and SHAPE favor the Joint STARS, it has been the subject of much controversy, particularly in Congress. In each of the past 3 years, the House opposed the system while the Senate supported it. Conference action has supported funding for the system. The Joint STARS, now in full-scale engineering development, is built around a moving target indicator (MTI) radar carried on an E-8A (modified Boeing 707) aircraft. It would provide both surveillance information to assessment centers, and targeting information to command centers and directly to missile launchers or attack aircraft. From a patrol orbit behind the FLOT, it would provide broad area coverage over extended periods of time.

Opponents argue that the Joint STARS will be vulnerable to Warsaw Pact surface-to-air missiles (SAMs) and interceptor aircraft, and will either be shot down or have to retreat so far from the FLOT as to be not worth its cost. They favor stopping the program until a much more survivable version can be produced. Pro-

ponents acknowledge its vulnerability, but argue that a variety of protective measures could greatly enhance its survivability, and that even when taking protective measures it would be capable of providing a great deal of capability.

The capability that Joint STARS (or a system like it) would provide is very important to most FOFA concepts. FOFA could be done without it, but with much greater difficulty and probably much less effectiveness. The system would be very useful for identifying the focus and major movements of a Pact attack, and, before the shooting starts, for monitoring Pact troop movements and providing effective warning of an attack. The Air Force believes that an 13-8A-based system is necessary for deployments to areas other than Europe. Proponents argue that it would be useful to get a system into the field as soon as possible, so that crews can learn how to operate it and find out what it can really provide.

Prior to hostilities, the Joint STARS could operate very close to the FLOT and observe Pact movements deep inside East Germany and Czechoslovakia. In wartime, the Air Force would defend the Joint STARS (and the airspace it and other surveillance aircraft operate in), suppress enemy air defenses, and adjust the patrol pattern of the E-8A to reduce its vulnerability. At selected times it could surge forward, that is, patrol closer to the FLOT with dedicated defenses in order to look into selected deeper areas. As the war progresses and Pact defenses are suppressed, it should become possible to increase the amount of time spent patrolling closer to the FLOT.

If operated as the Air Force now intends, the E-8A Joint STARS should be capable of providing frequent broad area coverage to a depth of 50 to 100 kilometers beyond the FLOT. There will be a great many targets within this band, and more weapons can attack here than deeper. Attacking combat units in this band can be more efficient because many of the noncombat vehicles will be left behind as the units prepare to go into battle. Furthermore, frequent coverage is likely to be of greater importance within this band than deeper: the targets are expected to traverse this band rapidly and be less constrained to major roads. Surge operations would allow some coverage of deeper areas. This pattern of operations would generally require the Joint STARS to operate farther from the FLOT than the nominal setback usually discussed for it. The coverage would similarly be reduced from what a nominal orbit would provide,

Some opponents of the E-8A Joint STARS have suggested that consistently deeper coverage could be obtained by basing Joint STARS on an inherently more survivable platform that could operate closer to the FLOT without being detected. OTA has not been given access to information on such programs, and the reader should be aware that there is potentially relevant information that OTA does not have. In general, such a system would have its own limitations. For it to be stealthy, it will have to carry an equally stealthy radar, known as 'LPI" (or low probability of intercept) radar, and a radar antenna that—when illuminated by a threat radar-is as difficult to detect as the airplane. LPI may be achieved in part by managing power, that is by reducing the amount of energy a radar transmits in a given time, which reduces the amount of information the radar can obtain. Therefore a stealthy Joint STARS would also not be able to gather as much data as the E-8A Joint STARS in its nominal orbit.

Because the reduction in coverage would take the form of "looking" less rather than moving back from the FLOT, coverage of both deep and shallow targets would be reduced.

We at OTA do not have enough information to compare the coverage of a E-8A Joint STARS taking evasive, protective action and a stealthy alternative, but we believe that such a comparison would be important. We believe that if Congress does not have enough information to make a decision on Joint STARS, it ought to mandate a study comparing the cost, survivability, coverage, and operational utility of Joint STARS and proposed alternatives operated in a realistic manner, but ought not to stop the development program in order to do so.

One alternative that might be considered is an E-8A Joint STARS complemented—rather than replaced—by a more survivable system. The E-8A Joint STARS could provide complete coverage to a limited depth, and each could provide limited coverage deeper in Pact territory. The coverage of both would be limited by terrain and foliage, but limitations might be less for the more survivable platform.

An important consideration for either a substitute or a complementary platform is whether the necessary LPI radar could be built from the Joint STARS radar, or would require an entirely new development effort. Without more information, OTA cannot answer this question in detail. However, the Joint STARS radar has substantial capacity for conversion to LPI operation. It appears to OTA that *if* the LPI radar were to operate in the same frequency band as the Joint STARS radar, much of the existing design could be used.

Replacement for the Precision Location and Strike System **(PISS)**

For fiscal year 1987, Congress decided, at the request of DoD, to deny funding for procurement of the Precision Location Strike System (PLSS, pronounced "pens"), and to appropriate $20 million for further development and testing. Congress and DoD now face the issue of whether a new system is needed to perform the function originally conceived for PLSS.

Until this year, PLSS–a developmental surveillance and control system designed to detect, identify, and accurately locate modern mobile, electronically agile radars and jammers in near real time—was an important part of the program for improving surveillance in Europe. However, the Air Force has not requested funding for procurement, and apparently has taken the position that other systems could adequately do the job for which PLSS was designed. Moreover, PLSS has encountered many problems and delays during its long development history.

Others still see value in PLSS, particularly for targeting modern mobile SAMs, and as a major contributor to the survivability of Joint STARS and other surveillance systems. It has demonstrated emitter location speed and accuracy which are superior to those of existing theater systems, as well as a high emitter reporting rate. These may be necessary if, as expected, at the outbreak of a war enemy radars shut down, move, change frequencies, and begin wartime operations in short on-time, electronically agile modes.

Modern mobile, electronically agile radars and jammers would accompany and protect follow-on forces; an ability to attack them soon after they are detected in a new location would be very valuable to protecting allied aircraft used to detect and attack follow-on forces. PLSS has demonstrated a capability to locate and report more such emitters per hour with greater accuracy and timeliness than all other U.S. systems now reporting to Europe combined. It would use electronic equipment carried aloft by three TR-1 aircraft operating together, each communicating with a central processing ground station. The ground station would report emitter locations, and could also control attacks against emitters.

During development, PLSS has failed to demonstrate emitter location errors as small as those required by its specifications, and its reliability has been a problem. However, recently its performance has steadily improved. Emitter location accuracy has approached the specified value, and the reporting rate requirement has been reduced to what PLSS has already demonstrated. In addition, the system has often reported each actual emitter as several. Some causes of this problem were identified and corrected.

Munitions Programs

There are three major concerns regarding munitions programs: 1) the effectiveness of anti-armor submunitions in a realistic combat environment; 2) buying enough munitions for FOFA to have an effect; and 3) what to do about mines.

Munitions programs-and the weapons to carry them—tend to be a neglected area. They are usually not glamorous, and are often can-

didates for scaling back and stretching out in order to save money. None of the FOFA concepts will work if there are not enough munitions to kill a large enough number of targets to have an effect. A multi-billion dollar investment in RSTA, data analysis centers, missiles, and airplanes of various types can be undercut by not buying enough munitions. OTA cannot say how many of each type are needed (indeed, that is a job for the Services). However, the Warsaw Pact forces in Eastern Europe have hundreds of thousands of vehicles, including many tens of thousands of armored combat vehicles.

Although current-generation unguided submunitions can be effective against most vehicles, including most armored combat vehicles, advanced guided anti-armor submunitions now under development may be the key to being able to destroy groups of tanks. Because they are guided, they may also be much more effective against less heavily armored vehicles. Two types are under development: sensor fuzed weapons—e.g., the Air Force Skeet and the Army SADARM—that sense the presence of a target within their search areas and fire a self-forging slug at it; and terminally guided submunitions--like the Army's TGW for MLRS —that search a large area, guide to the target, and detonate a shaped charge warhead on impact.

These concepts have been demonstrated in controlled environments, but important questions remain regarding their ability to operate in the presence of countermeasures to both warheads and seekers. Both operational and technical countermeasures are of concern. There has been concern that enemy forces could use the cover of both forests and villages to obscure the signature of the target vehicles and to deflect incoming warheads so that they lose momentum or do not hit the armor at an angle that permits them to penetrate. Dashing between covered locations could reduce the exposure of the targets. Both spreading formations out and bunching them tightly up could affect the number of vehicles a group of submunitions hits. There is also concern that the damaged vehicles littering the battlefield might attract submunitions away from functioning vehicles.

Smoke and various types of material covering a vehicle could reduce the ability of a sensor to find it. Various schemes have been suggested that would cause the munition to guide to a spot off the target rather than one on it, as have devices that would cause a shaped charge warhead to detonate before reaching its target.

Various advanced types of armor are under development in the East and in the West. Some are very effective against shaped charge warheads; others are more effective against kinetic energy weapons like self-forging slugs. How well advanced munitions do against advanced tanks will depend in part on how well the warhead characteristics match the armor characteristics of the target.

Not all suggested countermeasures are practical and effective. However, it is very important to test munitions against various types of targets employing various types of countermeasures. Programs like the joint Chicken Little series of tests can be very valuable in this regard.

Remotely Piloted Vehicles

The Army is developing a family of unmanned aerial vehicles (UAVs, a term which includes both remotely piloted vehicles and drones) to perform a variety of functions including surveillance, reconnaissance, target designation, jamming, and attack. The most mature member of the family, the Aquila RPV of the TADARS (Target Acquisition/Designation Aerial Reconnaissance System) now in full-scale development, has been a matter of concern in Congress.

UAVs could usefully complement airborne stand-off radar systems like Mohawk, ASARS-II, and Joint STARS: these could quickly search large areas and tell UAVs whereto look; and UAVs could find the targets and discriminate among them. UAVs could also find or follow targets hidden from airborne radars by hills or trees. Aquila could locate shallow tar-

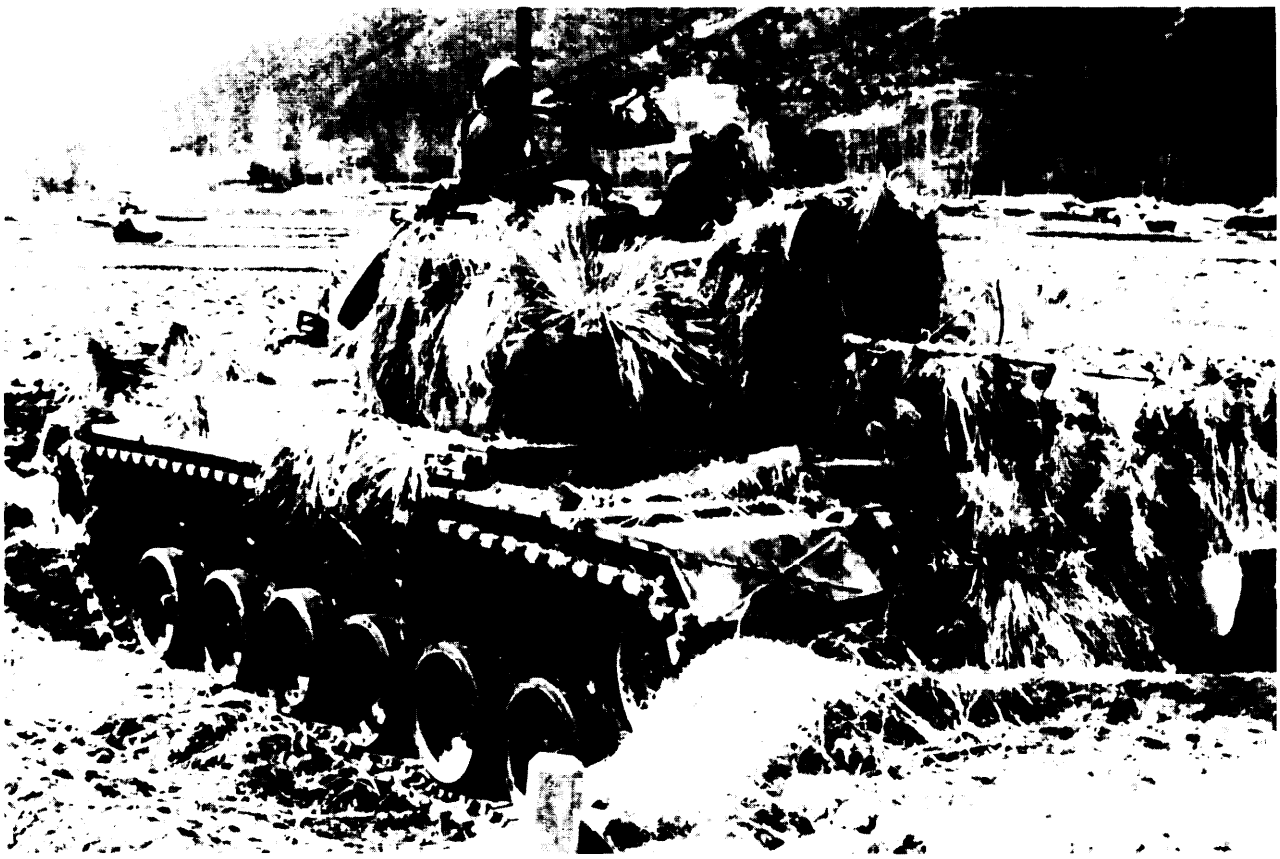

Photo credit U S *Department of Defense*

Simple countermeasures, such as a **camouflaged tank, may be able to outwit smart submunitions.**

gets with greater precision and designate them with a laser for either Copperhead artillery rounds or laser-guided bombs. Several types of UAVs are now operational or under development in Belgium, Canada, France, Germany, Italy, the United Kingdom, and Israel.

Since 1978, the estimated time to develop TADARS has more than doubled and the estimated program cost has quadrupled; the number of RPVs to be produced has been halved. However, the major problems which have beset the system now appear to have been solved. TADARS will have unique capabilities for accurate location and laser designation of shallow targets. These could be useful for FOFA: TADARS could find and locate targets for artillery, MLRS, and ATACMS, and designate for laser-guided bombs.

Other RPVs have been proposed as alternatives to Aquila, but lack its target location accuracy, laser designation capability, and jam-resistance. According to the General Accounting Office, procuring another RPV and equipping it with the laser designator, navigation, and communications systems developed for Aquila would cost about $100 million more and take a year longer than completing TADARS.

Arms Cooperation

When FOFA was first advanced, some Europeans tended to see it as a vehicle to sell them American defense systems. The Defense Department has been working to dispel this problem by encouraging European-American arms cooperation programs as well as the identifi-

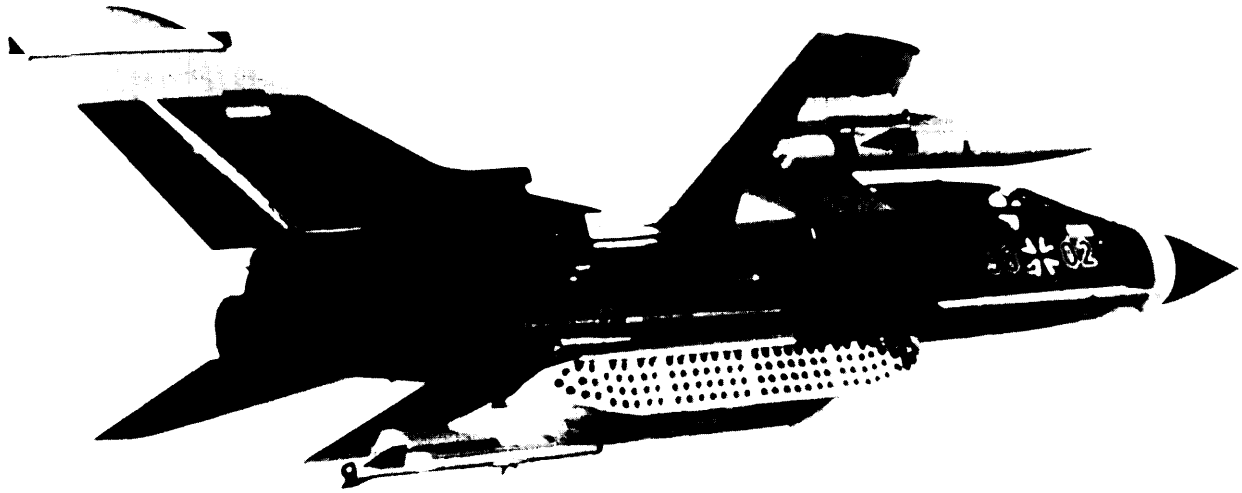

Photo credit NATO

Tornado aircraft, result of European collaboration, carry in the German MW-1 munitions dispenser.

cation of European systems that could support the concept.

The principal foci of activity have been the NATO Conference of National Armaments Directors (CNAD) and the Defense Science Board FOFA II Task Force. A major stimulus to cooperation has been the money made available under the 1985 Nunn Amendment.

The FOFA II Task Force has been working with similar advisory groups associated with European governments to identify potential areas of cooperation that could then be recommended to their respective governments for further action. The group will report during the first half of 1987 on strategies to achieve cooperation on several programs.

There are two major activities related to the CNAD. The first is a FOFA ad hoc working group that is preparing a paper outlining the types of systems that are necessary to achieve a FOFA capability. This activity is important because it helps define what the allied governments (as distinct from NATO itself) agree constitutes FOFA. Concurrently, the United States is negotiating a number of memoranda of understanding concerning co-development of systems, only some of which are FOFA related.

There has been a meeting of the minds on a number of questions, but thus far the Europeans have shown no official interest in either ATACMS or Joint STARS[15] (although there is interest in interoperability among Joint STARS and the British ASTOR and French ORCHIDEE MTI systems). Although some of the arguments against these systems have been on fairly fundamental grounds, interest may develop in the future, particularly after the systems are fielded and their real capabilities become known.

This process will pose three important issues for Congress. First, if Congress supports this form of cooperation, they will have to provide the requisite funding for cooperative programs. Second, Congress may have to make choices between slowing programs to bring the Europeans on board and proceeding only in the United States. Finally, the Europeans may

[15] There reportedly has been interest on the working level.

seek to sell us their equipment, to smooth the two-way street. Congress will then have the usual choice between buying American or buying European.

The Europeans are enthusiastic about the possibilities for joint programs; however, they are somewhat skeptical about the possibilities for successful cooperative ventures, especially with the United States as a partner. National interests generally complicate such efforts, and U.S. policies are seen as complicating them still further. Nevertheless, the trends are away from buying U.S. products, and toward greater intra-European cooperation. The Europeans believe that their technology equals that of the United States in many areas and may surpass it in some.