Summary

BASIC OBSERVATIONS

The adoption of the Supreme Allied Commander Europe's (SACEUR's) follow-on forces attack (FOFA) concept is an effort to enhance deterrence by dealing with a potential vulnerability–the risk that even if the North Atlantic Treaty Organization's (NATO's) forces could largely withstand the initial attack by the Warsaw Pact's first echelon, pact follow-on forces could overwhelm by sheer numbers, or could exploit tactical advantages to penetrate into NATO's rear. It does not reflect a downgrading of other missions such as fighting the close battle. Although NATO has always sought a capability to delay, disrupt, or destroy such follow-on forces, the means to do so have been limited. NATO's adoption of the FOFA concept reflects a recognition of new opportunities to carry out this mission—both through new technology and through the development of new procedures to take advantage of existing capabilities.

Although NATO could attack follow-on forces using the systems currently in the inventory, realizing the full potential of the concept is usually linked to exploiting emerging technologies–especially those associated with gathering the information required to attack the targets (reconnaissance, surveillance, and data handling), and advanced weapons concepts. **The technologies of primary interest are now relatively mature, and could result in fielded systems over approximately the next decade.**

In considering how best to support the FOFA concept, there are several basic points which bear on many congressional decisions:

- **procurement of systems ought to be tied to clearly defined operational concepts.** It is important to understand how the job is to be done before buying the tools to do the job. However, concept development should be rooted in an understanding of what is technically feasible.
- **Systems ought to be considered not individually, but as complete packages to support specific operational concepts.** The process of attacking follow-on forces is a complicated one, with many steps between initial detection of the target and successful attack. It requires a number of different systems to perform different functions compatibly. Since failure to buy one or two could greatly reduce the value of investments in the others, it is important to treat them in groups.
- **Component systems will have to be procured in sufficient quantities.** It is likely that large numbers of targets will have to be engaged. If attacking follow-on forces is to aid NATO's defense, the capacity will have to exist to attack enough to make a difference. If having this capability is to aid deterrence, it should be apparent to the Soviets that NATO has this capacity.
- **Some systems will be "key systems."** Failure to procure them will greatly reduce the ability to implement the concept.
- **Some redundancy may be desirable.** Complicated systems that have to perform many consecutive functions are subject to disruption in many ways. Redundancy in some of those functions reduces the vulnerability.
- **Practice and training will be important.** The process of attacking follow-on forces is likely to be complex, as are many of the systems used to support it. Facilities to train commanders and operators will be of value.

It is largely up to the Department of Defense (DOD) to-provide Congress with lists of what systems the services require and how many of each are needed. This report provides a framework for understanding the plans that DOD submits to Congress. It reviews the place of FOFA in NATO strategy, outlines operational concepts, and reviews the developments of particular interest for attacking follow-on forces.

BACKGROUND: NATO STRATEGY AND THE THREAT TO THE CENTRAL REGION

NATO's Flexible Response strategy, adopted in 1967, rests on conventional, theater nuclear, and strategic nuclear forces. It is a strategy for deterrence based on the idea that:

> The price of an attack on Western Europe must remain the possibility of triggering an incalculable chain of nuclear escalation.[1]

NATO–which does not want a nuclear war any more than the Warsaw Pact does—would resist a conventional offensive with conventional forces, but would reserve the option for deliberate escalation should its conventional defense be unsuccessful. NATO's conventional defense must "provide a reasonable prospect of frustrating a conventional attack."[2]

Soon after the founding of the Alliance in 1949, it became clear that for economic and political reasons NATO would not deploy the number of army divisions and combat aircraft that studies showed were required to meet the threat posed by Soviet forces in Central Europe. NATO's solution to this shortfall in conventional forces was to introduce nuclear weapons. Nuclear weapons compensated for NATO's disadvantage in conventional firepower, and reduced the burden of maintaining large conventional forces. Moreover, the threat of a nuclear strike against Warsaw Pact armies gave NATO two distinct strategic advantages. It forced the Warsaw Pact armies to disperse in order to reduce their vulnerability to a nuclear strike, which limited their ability to conduct an offensive strategy based on concentrating massive forces against a prepared defense. And by confronting the Soviets with the incalculable risk that a conventional attack could set off a chain of escalation leading to nuclear destruction of Soviet territory, it provided NATO a deterrent that relied less on the possibility of actually having to fight an intensely destructive modern war on NATO territory.

Soviet gains in nuclear weaponry led NATO in 1967 to adopt a new strategy, Flexible Response, which remains in effect today. Flexible Response relies on a "triad" of conventional, theater nuclear, and strategic nuclear forces designed to maintain the credible possibility that a war could become nuclear and escalate to a strategic nuclear exchange; that credibility is supported by a conventional capability which is strong enough that NATO would not be forced into an early decision to use nuclear weapons.

Two important factors govern NATO strategic thinking. First, both nuclear and conventional capabilities are essential; neither one can substitute for the other. Second, as a defensive alliance, NATO is precluded from adopting an aggressive, offensive military strategy.

These major strategic considerations, along with the threat and the realities imposed by geography, shape the current situation in Europe. The major threat to NATO comes from the continental forces of the Warsaw Pact, concentrated in Central Europe along the eastern border of the Federal Republic of Germany (West Germany). in the Central Region, NATO lacks "strategic depth," while facing an adversary with extreme strategic depth and the ability to use that depth to bring large land forces to bear in an offensive.[3] While the territory of the Warsaw Pact extends thousands of kilometers (km) back into the Soviet Union, it is less than 500 km from the inter-German border to the English channel. Moreover, the loss of substantial portions of West Germany, a major NATO land power in this Central Region, would be extemely serious for NATO.

The Warsaw Pact has adopted a "blitzkrieg" strategy that appears to be aimed at defeating NATO conventionally before NATO could decide to escalate to the use of nuclear weapons.[4] This

[1] General Bernard Rogers, "Follow-On Forces Attack (FOFA): Myths and Realities," *NATO Review,* December 1984, pp. 1-9.
[2] Ibid.
[3] One important aspect of strategic depth, especially from the defender's perspective, is the ability to trade space for time, to fall back when attacked in order to organize a responsive defense and to counterattack. Great depth was exploited in this way by the Russians against the offensives of Napoleon and, much later, Hitler.
[4] Some analysts believe that a Soviet offensive could be nuclear from the outset.

strategy depends on a ground offensive in which the initial attack is likely to be followed by succeeding waves, or echelons, of follow-on forces, all supported by air power.

Echeloning forces in-depth attempts to overwhelm a defense by bringing fresh forces against defenders exhausted by the preceding wave. Soviet doctrine calls for a carefully timed and coordinated attack, with each succeeding echelon committed at the time and place where it could be most effective in exploiting the success of its predecessor and extending the Warsaw Pact advance deeper into NATO territory. This permits the Soviets to assign individual units specific preplanned objectives and a schedule for achieving those objectives. It avoids moving massive amounts of men and equipment forward just prior to an offensive, thus avoiding giving NATO unambiguous warning of attack and overloading available roads. In the Central Region, where West Germany borders East Germany and Czechoslovakia, NATO would face a massive Warsaw Pact ground offensive that could involve over 100 divisions.

Depending on how they fit into the offensive plan, some follow-on forces would start from just behind the initial attack forces, others would begin farther back in East Germany, Poland, and Czechoslovakia, and still others would begin in the U.S.S.R. Those farthest back would be transported by rail or by road. Closer in they would group into combat units and proceed under their own power toward the battle.

NATO has a much smaller number of divisions in place in the Central Region or able to deploy there rapidly; the only immediate prospects for reinforcement would be from three French divisions in West Germany that might be assigned to NATO in wartime[6] and from several U.S. divisions which could arrive by air. NATO's only other reinforcements—some 20 U.S. Army and National Guard divisions plus one Canadian brigade–would arrive only much later, primarily by sea, and in some cases only after mobilization and training.[7]

Within the Central Region, eight army corps of five nations—West Germany, Belgium, The Netherlands, Great Britain, and the United States—are each assigned the responsibility of defending a specific sector along the border that divides West Germany from East Germany and Czechoslovakia. A Canadian brigade is also garrisoned in the Central Region. Each national corps (or other unit) has its own structure, equipment, and national doctrine; only in time of war are they assigned to a unified NATO command structure. The northern corps form the northern army group (NORTHAG) under the command of a British general; those in southern Germany form the central army group (CENTAG) under a U.S. general. Each army group is supported by a multinational Allied Tactical Air Force (2ATAF in NORTHAG, 4ATAF in CENTAG); the commanders of 2ATAF (COM2ATAF) and 4ATAF (COM4ATAF) report to the Commander of Allied Air Forces Central Europe (COMAAFCE). COMAAFCE, in turn, reports to the Commander-in-Chief, Central Region (CINCENT), a German general to whom the commanders of CENTAG and NORTHAG also report. Finally, the entire European theater–which includes the northern and southern regions as well—is under the command of SACEUR, a U.S. general.

A major consequence of NATO's structure is that the Soviets are free to allocate their forces to best advantage, and are likely to concentrate in the sectors they believe to be the weakest—particularly the Dutch and Belgian sectors in NORTHAG–while NATO's ability to shift its ground forces across corps sectors is limited.

Attacking follow-on forces is a specific defensive response to the Warsaw Pact strategy, within the context of NATO's posture. If NATO's defending forces successfully resist the initial attack, they might be in danger of being overwhelmed as successive waves of fresh forces joined the at-

[5] Although these numbers provide the basis for a rough force comparison, there are many detailed differences between a NATO division and a Warsaw Pact division; they are not strictly equivalent units.

[6] France withdrew from the NATO military structure in 1966 and has not formally committed itself to providing troops for the common defense of NATO territory.

[7] Though not counted in the NATO force totals, there are in addition some 10 French army divisions and 13 French reserve divisions as well as West German, Belgian, and Dutch home-defense militias that could assist NATO.

tack. However, if the schedule of the offensive could be upset and the rate of introduction of fresh Warsaw Pact forces limited by delaying, disrupting, and destroying the follow-on forces, then the defenders would have a better chance of defeating each successive echelon as it arrived. Some believe that destroying the coherence of the offensive would be sufficient to cause it to fail.[8]

NATO's planners and commanders will have to decide how to allocate assets among the close battle, the follow-on forces attack, and the air battle. What forces the member nations provide will determine the NATO commanders' flexibility in making those allocations. Allocating resources to attacking follow-on forces would affect the success of the close battle, but would reduce the assets available for the close battle. Similarly, airplanes not used to attack follow-on forces might be used to suppress air defenses (which would facilitate attacking follow-on forces), provide close air support for the close battle, or defend NATO aircraft against Pact air strikes.[9]

[8]It is important to note that some observers believe Soviet doctrine is becoming more operationally flexible; while echelonment would still perhaps remain the favored strategy, commanders might be given the flexibility to allocate forces between first and second echelons according to the circumstances.

[9]Not all aircraft could fill all these roles. Procurement decisions will affect the commanders' future flexibility to allocate.

CONCEPTS FOR FOLLOW-ON FORCES ATTACK

Several general concepts for attacking follow-on forces have been suggested. NATO has some capability to implement each of these now, but that capability is limited and might be improved dramatically by suggested measures. These concepts, described below, are:

- ***Long-Range Attack.*** Attack follow-on forces deep in the enemy rear where they are lined up in transit on trains or roads. The advantage of this is that the enemy forces are concentrated and vulnerable, and their locations are relatively predictable. However, it may be difficult to know what is being transported on any particular train.
- ***Intermediate-Range Attack.*** Closer in, identify and attack critical enemy forces that are particularly threatening to a NATO corps sector within a day or two. This would allow NATO to concentrate its fire in a way that would most directly affect the success of the Warsaw Pact's next move.
- ***Cross-Corps Support.*** In the event of an attack concentrated against one or a few NATO corps sectors, attack heavily the follow-on forces in the threatened sectors using the long-range attack capabilities of other corps.

The specific targets would include groups of tanks and other less heavily armored combat vehicles, as well as surface-to-surface missiles, air defenses, command posts, and support vehicles. Some of these are fixed, some are movable, and others are highly mobile. Most are soft, others are hard. In order to be able to attack these targets effectively, it would also be necessary to take actions against targets—such as air defenses—that might restrict NATO's capability to conduct surveillance and to strike into enemy territory.

Within these overall approaches, there is some disagreement about which targets ought to be hit in order to most effectively delay, disrupt, or destroy a given Soviet force element. Some argue that the tanks are the most important targets. Others maintain that all the combat elements are important, and that concentrating on killing tanks—which is relatively difficult—is not necessary. Some argue that disrupting command and control is the most effective way to stop the offensive, while others would attack logistics and supply. Still others argue that disrupting the Soviet schedule is the heart of FOFA, and that the most effective way to attack is to concentrate on creating chokepoints, which might also facilitate effective attacks on the force elements themselves.

Finally, some believe that because timing is critical, what gets hit is not as important as hitting, for example, a command post, or a bridge, or a tank battalion just when the Soviets need it most.

Many specific operational concepts can be formulated within these general concepts, Several are discussed below. There are several general themes that run through this discussion of operational concepts. First, the closer an enemy force is to the area of the immediate battle, the more immediate is its threat. inflicting a given amount of damage or imposing a given amount of delay will be more significant for forces about to be committed to battle. At shorter ranges, NATO's ability to find targets with its tactical surveillance systems and to attack them with ground or air force weapons is also much greater. As the range to target increases, the number of surveillance and attack systems that can reach the targets decreases, the time between detection and attack may increase, and the attrition suffered in reaching the targets may also increase.

The second major point, however, is that at long ranges the targets–primarily forces being transported by rail–become more predictable and easier to localize, and this fact may well compensate for the lack of surveillance coverage.

Finally, operational concepts for follow-on forces attack do not exist in a vacuum. Other missions are likely to be crucial for their success—in particular the suppression of enemy air defenses.

Intermediate-Range FOFA

Within 150 km, prime targets for follow-on forces attack are the armored combat units which pose the most immediate threat to NATO's defensive position. Throughout the war, new forces would arrive in this band after being transported from farther East by truck or rail; thus the forces in this band—wherever their starting point—would continue to be key targets for follow-on forces attack as they always will represent the Warsaw Pact's immediate capability to add to the offensive. An attack that imposes a delay of 12 hours or more in the movement of a unit through this band could cause a significant disruption in the Warsaw Pact schedule for prosecuting the immediate battle.

There are three general mission concepts for attacking forces in this range band: attacking units on the move on roads, attacking them while stopped, or attacking them while stalled in "traffic jams" created at chokepoints. Furthermore, creating chokepoints or attacking specific facilities such as command posts could have value in their own right by delaying or disrupting the advancing forces.

When on the move under its own power, an armored combat division would, if possible, move on three or four parallel routes. A division moving over roads could stretch over 40 km. A surveillance system that can distinguish between armored vehicles and trucks (there are roughly twice as many trucks and other light vehicles as armored vehicles; among the armored vehicles, there are three times as many light-armored vehicles as tanks) could increase the value of the resulting attack.

Divisions on the move could be expected to stop from time to time. These stops could be short, necessitated by considerations such as traffic control or emergency repairs; moderately long stops for food and rest; or very long stops while waiting to be committed to the battle.

Chokepoints might be created by dropping key road bridges or sowing minefield. The Warsaw pact units attempting to move forward could pile up at these points, disrupting their schedule and presenting a concentrated target for further attack. C^3 facilities, particularly those associated with traffic control and river crossings, are also valuable targets under this concept. Although chokepoints are fixed targets whose locations are known ahead of time, the optimal timing of an attack may well depend on being able to monitor the movement of the follow-on forces so that the chokepoint will have the greatest effect.

Some more specific targets in this range band are also of interest—in particular surface-to-surface missile units and command posts. They are, however, more difficult to locate and identify.

Air Attack

Under current procedures, NATO army group commanders (on advice of the corps commanders) would provide the NATO regional Allied Air Force Commander, COMAAFCE,[10] with requests for air support and lists of target priorities. COMAAFCE must weigh these requests against competing demands for aircraft (e.g., air-to-air combat missions or attacks on enemy airfields) and apportion weights of effort to each category of missions. Specific target lists are identified by the corps commanders, and missions are allocated to them by the ATAFs in coordination with the army group commanders. In general, the closer to engaged ground forces the attacks are to take place, the more weight is given to specific targets nominated by the corps commanders. " This planning, which would determine in general terms the numbers of aircraft required, their ordinance loads, and where they would go, would routinely occur well in advance of the actual attack. There would then follow more detailed preparations, in which particular aircraft are assigned to each mission (which may require putting together a "package" of aircraft from several different tactical units in a coordinated attack), the aircraft are loaded and fueled, and the crews are briefed. There is considerable flexibility within this system, however, to reallocate aircraft on the basis of new information received up until take off, and to a lesser degree, even after take off. In addition, the U.S. Army and Air Force are pursuing a number of initiatives under the recent Memorandum of Agreement to improve coordination in locating and carrying out attacks against deep targets.

In the case of the mobile follow-on force targets, up-to-date information on the target location would have to reach the pilots as close to the actual attack as possible. The longer the time lag between target location and attack, the lower is the probability that the aircraft will find its target.

Aircraft are able to compensate, to some degree, for a lack of precise target-location information by placing a human observer on the scene; on-board targeting equipment can further compensate. However, the heavy Warsaw Pact air defenses, especially those that move with the combat units, limit the flexibility aircraft may exercise in searching for an imprecisely located target.

Attacking aircraft thus need to be able to minimize their exposure to air defenses. Air-to-ground missiles that allow aircraft to remain some distance from the target; munitions that are more effective and which can engage several targets per pass; and targeting systems that allow the aircraft to launch its weapons without making an initial pass to search for the precise target location can all assist in attaining this goal. This latter can be accomplished either by systems that can communicate real-time target location data to aircraft in flight to the target, or by sensors carried on board that give the aircraft a greater autonomous capability to find an imprecisely located target.

Surface-to-Surface Missile Attack

Planning an attack with Army weapons such as surface-to-surface missiles can be less complicated; the procedures for allocating and packaging aircraft for an attack are avoided. Some coordination with the air forces would however be necessary to make sure that missile firings do not interfere with air operations and to avoid duplication of effort. Moreover, targeting information may come from Air Force systems.

Precise and timely target location information is, however, more essential in the case of ground-launched weapons: current missiles cannot search for targets as airplanes can. If missiles are to be used against armored combat units moving on roads, an attack location would have to be preselected based on advance observation 01 the moving units; the missile would be launched

[10] The commander, Allied Air Forces, Central Europe (COMAAFCE) is the air component commander for the Commander-in-Chief, Central Region (CINCENT). COMAAFCE is "dual-hatted" (he "wears two hats"): he is also the Commander-in-Chief, U.S. Air Forces in Europe (CINCUSAFE).

[11] United States procedures are specified in Joint Operational Concept, Joint Attack of the Second Echelon (J-SAK) (TAC Pamphlet 50-26, TRADOC Pamphlet 525-16, U.S. REDCOM Pamphlet 525-4, Dec. 13, 1982). Close air support sorties are distributed to corps. Battlefield air interdiction sorties are flown against targets identified and prioritized by the Army. Air interdiction targets are selected from those nominated by the Air Force and those nominated by the Army to meet the joint commander's interdiction strategy.

when the units are observed to reach a point that would place them at the attack location when the missile arrives several minutes later. This timing may not be critical if the target is a long column of vehicles. Sensors that can distinguish between tracked and wheeled vehicles could increase the value of these attacks, given an effective antiarmor munition.

Cross= Corps Support

One important new possibility raised by follow-on forces attack is that one corps could use its long-range attack capabilities to support another corps, adding a flexibility that is currently possessed only by the air forces. Warsaw Pact forces may well concentrate their attack on the weaker NATO corps–particularly the Dutch and Belgian corps assigned to defend areas in the northern half of Germany, where the level terrain adds to their vulnerability. The Warsaw Pact attack in other sectors would then aim just to tie up the other corps and prevent them from moving to reinforce the weak points.

The United States and German corps are the best equipped to hold their forward defensive positions even without attacking the follow-on forces facing their corps sectors; they are also the most likely to be equipped in the future with a capability to attack follow-on forces. However, if some corps are to fire across corps boundaries in support of others, procedures would have to be developed by which the Army Group commander tasks the individual corps (which actually own the weapons) and coordinates fire across corps sectors. Today, NATO corps routinely plan cross-corps support with artillery.

Long-Range FOFA

At depths of greater than 150 km or so, the follow-on forces–second-echelon armies and second-echelon fronts—do not represent as immediate a threat. And an equivalent attack against the forces in this band is less quickly felt in the immediate battle: because the forces are farther away from commitment, they have greater leeway to repair damaged vehicles or otherwise compensate for damage caused by an attack. The ultimate objective is nevertheless the same: to control the rate of arrival of fresh forces at the immediate battle area.

The general mission concepts involve attacking divisions on trains; attacking railroad facilities such as generating stations and bridges; and, as in intermediate-range FOFA, attacking units on roads.

Trains moving across Poland are difficult to detect; doing so would require satellites or airplanes that penetrate deep into Warsaw Pact territory.[12] But the very large number of trains required for moving many divisions forward might present regular and predictable targets with a high density of high-value armored vehicles.[13]

Railroad facilities offer a number of suitable targets. The seven railroad lines that cross Poland from the Soviet Union have few north-south interconnections. Dropping the railroad bridges that cross the Oder-Neisse Rivers could thus create an effective obstacle. Other fixed targets include railroad generating stations, the railroad signal-control system, off-loading areas where the units shift from rail to road, and the transshipment points along the Polish-Soviet border.

Attacking units on the roads or in assembly areas poses problems similar to those discussed above for attacks at intermediate range, but compounded by the greater range and by the probability (which increases with range) that armored vehicles will be interspersed with trucks. The armored fighting vehicles are likely to be carried on transporters rather than moving under their own power. Greater range makes finding the units more difficult, and severely limits the numbers of existing aircraft that can reach these targets; and given current air-to-ground weapons that require a close approach to the target area, attacks at long range would also increase aircraft exposure to enemy air defenses.

As with intermediate-range FOFA, there are in addition a number of specialized targets of interest: command posts, nuclear weapons facilities, surface-to-surface missile units, and C^3 facilities.

Virtually all of the surveillance data in this band will have to come from national sensors, espe-

[12] Over-the-horizon radar might also provide some capability.
[13] There is, however, some controversy about this Point.

cially satellite-based systems. Making that information available to NATO poses a number of problems, some technological and some procedural (such as U.S. security regulations that govern the release of national sensor data to foreign countries), However, as noted above, units being carried by train may present continuous and predictable targets; other targets are fixed, such as bridges and power stations. While sensitive surveillance data may help to make a decision about when best to launch an attack against such targets for maximum effect, such data are not required in order to know that these targets are there.

An essential requirement is that the delivery system have sufficient range; most of the long-range band is reachable only by strategic bombers, although much is also within range of certain fighter/bombers (F-1 11s and Tornados). This situation will not change in the near future. Bomber crews would have to be trained for such a tactical mission. At the direction of higher U.S. authorities, the Strategic Air Command would make the bombers and crews available to NATO.[14] The problem of enemy air defenses is serious; at long range most escort aircraft (which could protect the bombers from enemy interceptors and could attack or electronically jam air defenses) lack the range to accompany the attack. A long-range air-to-ground missile that would allow the bombers to remain out of range of enemy antiaircraft missiles would provide the greatest assurance of survivability. Short-range air-to-ground missiles could keep the bombers away from at least the terminal defenses around heavily defended points, such as power stations and bridges.

For attacking divisions being transported by trains, such a missile would need sensors capable of following the rail lines and detecting trains. Effective submunitions, capable of both derailing the train and destroying the armored and unarmored vehicles on the trains, would also be required.

[14] SAC now maintains a liaison with USAFE and with SHAPE to facilitate tasking these aircraft. Their role is not necessarily limited to attacking at long ranges.

REQUIREMENTS, CAPABILITIES, OPPORTUNITIES

Each of these concepts requires the following general elements: 1) **surveillance and target acquisition** systems to identify and locate the targets; 2) timely **analysis and dissemination** of the information to permit planning attacks; 3) timely **command** decision allocating attack assets to targets; 4) **platforms** to deliver the weapons to the targets; 5) **control** of the platform to the location of the target at the time it arrives; 6) **weapons** that can engage the targets; 7) **munitions** that can destroy the targets; and 8) **survivability** of airplanes and their bases, ground-based launchers, and surveillance systems, so that operations can continue. Since there are great numbers of individual vehicles, it would be important for each weapon to be able to engage several targets. Developments that limit the exposure of NATO aircraft to enemy defenses would also be important. Because attack of follow-on forces is likely to require many sorties throughout the war, it cannot tolerate high attrition rates.

In the Central Region, NATO currently has a substantial number of airplanes that might be used for attacking follow-on forces. Although these aircraft have the potential to deliver thousands of tons of ordinance per day, their ability to effectively attack follow-on forces is limited by: the ability to provide and exploit target information in a timely manner, the number of individual targets each aircraft could engage per sortie, the ability of the munitions to kill the targets, the ability to control weapons to targets, and the ability to operate at night and in bad weather. There is some capability in all these areas, but much room for improvement. Furthermore, it is unlikely that all these aircraft would be devoted to attacking follow-on forces. Although some aircraft might be dedicated to that mission, others would have the flexibility to carry out other missions, such as providing a favorable enough air situation to make attacking follow-on forces attractive In addition, many of NATO's interdiction aircraft

are dual capable; some number of them will be withheld to stand nuclear alert.

Within about 30 kilometers, follow-on forces could also be attacked with artillery or the Army's multiple launch rocket system (MLRS). Several Allied nations also plan to acquire MLRS. Targeting could be supported by the Aquila RPV (remotely piloted vehicle; a small unmanned aircraft controlled from the ground), or by other Army systems such as the OV-1D Mohawk airplane. Several of the Allies also operate RPVs.

A number of measures that have been suggested for improving NATO's ability to attack follow-on forces are described qualitatively below. In the next few years improvements might be obtained by altering operational procedures and procuring sufficient quantities of existing systems. Systems that have undergone significant development–some currently in development and others unfunded—could be available in the late 1980s or early 1990s. In the far term, developments now in relatively early stages might be exploited.

Although the application of developmental systems is described here on the assumption that they will work as advertised, there is always risk associated with development. Many of the systems have been tested to varying degrees, but neither complete concepts nor the complete process of attacking follow-on forces, from target identification to destruction, have been tested under anything approaching wartime conditions.

Many of the developments discussed here have applications beyond follow-on forces attack. Their overall value should be judged within a wider context.

Near-Term Opportunities

In the near term, the following steps might improve follow-on forces attack capability. To some extent these are all being done now. Many are procedural and might be done at low cost. However, they require effort, and are not without risk of unsatisfactory outcome:

- continue to develop and exercise procedures to strike targets deep in Warsaw Pact territory using FB-111s or B-52s carrying conventional weapons;[15]
- develop procedures to provide the output of some intelligence systems to tactical users sufficiently quickly to support engagement of follow-on forces;
- develop procedures for command and control of attack aircraft and army weapons that are sufficiently responsive to support attack of follow-on forces;
- extend procedures for cross-corps support with ground-launched weapons to include MLRS,[16] and in the future ATACMS;[17]
- procure sufficient numbers of existing weapon systems that would be useful for attacking follow-on forces, in particular the MLRS, GBU-15,[18] and the tactical munitions dispenser;[19] and
- improve training for planning and execution.[20]

Currently NATO has little capability to strike very deep against divisions being transported forward by rail and road. These are attractive targets because the units would be all lined up, and would exist in such high density along a few well-defined routes that detailed surveillance might not be required to guide the attack airplanes to the targets. Few airplanes–primarily the F-111s which have many other tasks—can strike sufficiently deep. Using FB-111s or B-52s (trained and equipped by the Strategic Air Command and operating under SACEUR's operational control) could provide a major increase in the amount of ordinance that could be delivered against these

[15] SAC has offices at USAFE and SHAPE to facilitate the tasking of these aircraft. As these aircraft are replaced in the strategic bomber force, they could be used to augment the firepower available to SACEUR.

[16] MLRS is the Army's multiple launch rocket system.

[17] Army Tactical Missile System. See appendix for description.

[18] GBU-15 is an Air Force weapon: a guided glide bomb. Once released from the airplane, it can be "flown" by a weapon systems operator in the airplane by means of a data link that transmits a TV picture from the weapon's seeker to the airplane and transmits guidance controls from the weapon systems operator in the airplane to the weapon.

[19] The tactical munitions dispenser is dropped from an airplane. It breaks open in flight and drops submunitions. Several types of munitions are available for use in dispensers, and others are under development.

[20] For example, by using the training facilities of the Warrior preparation Center near Ramstein Air Base in West Germany.

targets.[21] Existing guided bombs like the GBU-15 (or future powered and otherwise improved versions such as the AGM-130) might be used to attack important fixed targets and perhaps trains, and munitions dispensers with currently available submunitions could destroy many types of vehicles, but not the most modern tanks. Buying enough munitions would be a key to success. Timely information from national intelligence systems that can see deep into enemy territory might improve capability to find trains or columns in road march, and cut down on search time and exposure to enemy air defenses. However, since current air-to-ground weapons require aircraft to come close to the target in order to attack it, these aircraft would still have to penetrate air defenses both enroute and in the vicinity of the target.

Within about 1 so km of the close battle, information on enemy maneuver units (e.g., tank battalions) provided by tactical reconnaissance aircraft may be incomplete, and late when attack aircraft reach expected target locations.[22] (The same limitations would apply to ground-launched weapons; NATO, however, currently has ***no*** ground-launched weapons with a range comparable to that of aircraft.) Furthermore, many of the weapons carried by NATO's attack aircraft have relatively low kill rates against large numbers of vehicles, especially against armored vehicles. Several are limited by darkness and weather conditions, as are most of NATO's airplanes. The tactical munitions dispenser could provide a capability to destroy a few soft and lightly armored vehicles per sortie, while the guided bombs could improve capabilities against fixed structures and other important single targets. The multiple launch rocket system could provide the army some capability to engage follow-on forces located by corps reconnaissance systems, but its range is limited; it, too, is limited by its current munition, which has a low kill rate against heavy armor.

NATO nations–especially the United States–have intelligence gathering systems that can gather important information on potential targets. That information does not generally go directly to NATO tactical users. If it must go through a lengthy sanitization process, it will be too old to be of much value. Developing procedures for making intelligence information available on a timely basis could be important for attacking follow-on forces.

Attacking mobile follow-on forces will place demands on NATO's command structure. Procedures will have to be in place to assess surveillance information, decide what to do, task attack aircraft or ground-launched weapons while the targets still have value, and get timely target location information to the attackers so that they can find and attack them. For the past several years, the U.S. Army and Air Force have been working on joint measures to streamline this process.[23]

Midterm Opportunities

Current Programs

Several systems that are expected to reach maturity during the next several years could have important implications for attacking follow-on forces. These will require substantial funding, and many of the programs still have problems awaiting resolution:

- ASARS II synthetic aperture radar surveillance system;[24]
- PLSS emitter location system;
- Joint STARS moving target radar and weapon control system;
- products of the Joint Tactical Fusion program (e.g., ASAS and ENSCE) as well as other C^3 improvements;
- F-1 SE;
- LANTIRN navigation and targeting system for tactical aircraft;
- Army TACMS ballistic missile;

[21] See "NATO Deploys Boeing 6-52s in Deep-Strike Attack Exercise," *Aviation Week and Space Technology,* Sept. *9, 1985.*

[22] That does *not mean* that the targets would never be found, or that all reports would be very old. Judicious coordination of reconnaissance and attack aircraft, when conditions permit, can greatly reduce the delay. Stopped vehicles may remain stopped many hours. Finally, aircraft vectored toward the predicted location of a division on the move are likely, after some searching, to find all the targets they can handle.

[23] See, for example, joint Operational Concept, Joint Attack of the Second Echelon (TAC Pamphlet 50-26, TRADOC Pamphlet 525-16, U.S. REDCOM Pamphlet 525-4, Dec. 13, 1982), 1982, and the Memorandum of Agreement on U.S. Army-U.S. Air Force Joint Force Development Process (May 22, 1984). This MOA covers developmental programs as well as procedures.

[24] One ASARS II prototype is currently flying.

- smart antiarmor submunitions, such as Skeet and SADARM and the MLRS/TGW;
- AGM-130 missile;
- RPV/TADARS, an Army reconnaissance and target designation system; and
- various electronic warfare capabilities and IFF (identification friend or foe) to enhance the capability of NATO forces to penetrate into enemy airspace and return safely.

The ASARS II, PLSS, and Joint STARS systems are designed to provide surveillance data on fixed, emitting, and mobile targets, respectively, to properly equipped users. Based on aircraft flying nominal patterns over NATO territory, they would see targets in enemy territory .25 The systems developed under the Joint Tactical Fusion program (probably available after ASARS II, PLSS, and Joint STARS) would correlate these data—as well as data from other sources such as reconnaissance aircraft and RPVs—into a coherent picture of enemy activities. This could be used as part of the general situation assessment leading to identifying the most threatening enemy units and planning attacks. With more direct links to aircraft and missile launchers, the sensor systems could be used to update target location information up until the attack aircraft take off, or the army launches a missile. Target update information might also be sent directly to attacking aircraft in flight. If all this works, it would provide NATO the capability to identify the most important targets, plan its strikes accordingly, and be fairly confident that most of the attacking aircraft would find their targets, provided that NATO forces were properly equipped to receive and exploit the information. The weapon control implicit in sending updates directly to the attacking aircraft would be similarly important. It would minimize the amount of searching an aircraft would have to do in order to locate its target, and hence minimize its exposure to enemy air defenses. It would facilitate successful attack by aircraft lacking sophisticated target acquisition systems, such as the LANTIRN.

LANTIRN is a two pod system designed to fit several aircraft including both the F-1 6 and the F-15E (a version of the F-15 designed for ground attack and having greater range/payload capability than the current F-1 6). The LANTIRN navigation pod will provide the capability to navigate at low altitude at night, while the targeting pod will find targets, and lock weapon seekers onto them. it would expand the area that the pilot can see, enhance his capability to detect a target, and give him a capability to search for targets in the dark.

Loading dispensers with smart antiarmor submunitions would improve NATO's ability to exploit this improved data by allowing each sortie to engage groups of vehicles. A proper weapon mix would also include dispensers loaded with submunitions for attacking vehicles other than tanks, and dispensers loaded with mines. The AGM-130, a powered version of the GBU-15, would provide greater standoff for the launch aircraft. It could be useful in attacking trains, vehicles on roads, major air defense sites, or other fixed facilities that might be defended with local defenses.

The availability of these airborne capabilities will depend on the survivability of NATO's airfields, among other factors.

The Army TACMS (ATACMS) missile will have the capability to engage targets well beyond the range of MLRS, either in front of a NATO corps, or laterally to support another corps. If target location updates are received just prior to launch, and if effective submunitions are provided, it will be capable of engaging moving targets as well as fixed or stopped targets. It will provide the theater commander a capability in addition to that provided by the Air Force. This maybe especially important early in the conflict when requirements for aircraft sorties are high and heavy Warsaw Pact air defenses–not yet suppressed–may restrict operations.

Other Midterm Opportunities

Other measures that have been explored over the past few years might produce greater benefits from these systems. One is a target update link from the Joint STARS directly to an ATACMS or air-launched missile in flight, to further reduce target location uncertainty.[26] Another is the pro-

[25] Actual range would depend on location and altitude of patrol.

[26] Direct updates to air-launched missiles have also been considered.

vision of antiarmor submunitions for the ATACMS, currently planned for later production models. These two taken together could give the ATACMS the ability to attack targets such as tank battalions. A version of the ACM-130 that carried a submunition dispenser was under development but plans for procurement have now been dropped. If loaded with antiarmor submunitions and combined with a seeker to follow rails or roads, this could provide the capability to destroy vehicles on rails or road march. It might provide all attack aircraft with greater ability to stand off beyond defenses while attacking.[27] The LOCPOD, a powered dispenser being developed by a multinational consortium, might play a similar role.

Far-Term Opportunities

Most of the developments discussed above would be expected to enter procurement during the next few years. Given typical procurement patterns, their impact would begin to be felt during the 1990s, although in some cases inventories might not be filled until after the turn of the century.

Some problems would still remain. There has been concern over the survivability of PLSS, ASARS, and Joint STARS. The aircraft that carry these systems could be vulnerable to rapid progress in Soviet air defenses. Associated ground sites and the airfields from which NATO aircraft operate could also be vulnerable to attack. If follow-on forces attack were to depend on these systems, losing one or more might seriously degrade capability, as would moving patrol stations west to reduce vulnerability. Similarly, attack aircraft attempting to penetrate into Warsaw Pact territory can be expected to face increasingly capable air defenses; and all attack systems, with the exception of strategic bombers based in the continental United States, would be subject to prelaunch attrition.

Ideas have been proposed for addressing these problems. Some are highly classified. More survivable platforms are being studied. Using long-range cruise missiles would enhance the survivability of attack aircraft, but probably at a price—cruise missiles have proved expensive. Variants of existing missiles, the JTACMS, and the multinational NATO Long-Range Stand-off Missile are possibilities. For attacking deep into Pact territory, B-1s might be more survivable than B-52s, but would probably be less available.[28]

There has been concern that developments in Soviet armor might greatly reduce the effectiveness of new antiarmor submunitions. Programs are currently underway to explore improvements in armor and methods for defeating advanced armor.

[27] The B-52 Conventional Stand-off Capability program is investigating putting target acquisition systems on 6-52s.

[28] B-52s could become available as B- 1s replace them for strategic nuclear missions. B-1s could become available without reducing strategic forces if and when they are replaced by the Advanced Technology Bomber. Of course, a decision to send some of SAC's bombers to support SACEUR rather than hold them for nuclear missions is always possible.

"PACKAGING" CONCEPTS

A complete concept, or system, for follow-on forces attack should be considered as a "package" of individual systems, each of which has a different job. For example, a package must at least include system elements for performing target acquisition and weapons delivery, as well as effective munitions. They all have to be there and operate for the concept to work. In deciding what to fund, Congress may want to suggest that DOD present complete packages, so that the effectiveness of the entire concept can be analyzed and the utility of each component can be readily understood. This approach would help Congress understand: the full extent of what has to be procured, when the full capability might be in place, how limited the capability would be until various elements were procured in sufficient quantity, and what the consequences might be of not procuring particular pieces (or failure of developments to meet expected goals). For some elements of a package there may be several candidate systems to choose among. For others, there

will be only one viable choice, and failure to obtain it could have serious consequences for the viability of the package.

As a simple example, a package might include a LANTIRN-equipped F-16 that carries a tactical munitions dispenser and receives information from Joint STARS, ASARS II, and PLSS.[29] A joint tactical fusion facility would assimilate target information and pass data to automated command and control facilities supporting planning, tasking, and execution. The munitions dispenser can be loaded with either Skeets–an antiarmor submunition—or the Combined Effects Munition, which is effective against personnel and vehicles other than modern tanks. This entire package might be available in quantity by the mid to late 1990s, and–if everything works as advertised–would be capable of successfully attacking tank battalions as well as other maneuver units. Other elements would also be needed to make the system complete. **This example is illustrative only; it is not an OTA recommendation.** Other packages might be as capable.

[29]Both Joint STARS and LANTIRN improve the capability of the F-1 6 to find the target. The joint STARS decreases the area it has to search–by updating the target location—and the LANTIRN increases its capability to search the area. The closer to the target Joint STARS updates the airplane, the less it has to search. LANTIRN also provides the ability to navigate at night and in bad weather, which would be important with or without Joint STARS targeting information.

REPRESENTATIVE REMAINING QUESTIONS

Besides the obvious question of how well all these developments will work, especially in the presence of Soviet efforts to counter them, several important questions remain to be answered. First, for a given level of effort, how successful can NATO expect to be in attacking follow-on forces, and indeed how is success to be measured? How does success in attacking follow-on forces translate into success overall, and how successful does follow-on forces attack have to be? How do we balance striking very deep (i.e., against rail lines in Poland) versus attacking those forces that pose an immediate threat? Since the assets used to attack follow-on forces will generally come at the expense of forces to fight the close battle-either sorties diverted or money not spent on other systems—how do we gauge and balance follow-on forces attack against the close battle?[30] How will NATO's capabilities degrade as parts of its ability to attack follow-on forces are lost–either through attrition or through lack of funding?

[30]This is not to say that an ability to attack follow-on forces can only be obtained by reducing force structure in other areas (although some have stated that doing so would be a cost-effective trade). FOFA capability will be obtained by extending the interdiction capability of the Air Force to include a significant capability against the forces themselves, and extending the range of the Army's firepower and the ability to use it successfully against moving forces. However, the funds used to extend these capabilities will then not be available for other applications, and the systems tasked to attack follow-on forces in wartime will not be simultaneously available for other missions. For example, funds spent procuring TACMS missiles are not available to be spent on tank modernization, or air defense, or additional antitank guided missiles. An F-16 sortie flown to attack follow-on forces 100 km deep means one less F-16 sortie available to fly air defense, or to attack enemy air bases. In weighing alternative applications of the same resources, it will be necessary to consider how each would affect the outcome of the war. The effect of the reduction in one area will have to be weighed against the effect of the improvement in another within some framework that takes both into account.