Air Force leaders always have expected much from the stealthy F-22 fighter. As the Raptor stood poised to enter series production early this year, however, they were considering an even more compelling role for the aircraft. The role would use the F-22’s unprecedented capabilities to solve a key problem facing the nation’s forces in decades ahead.

The problem is access.

As world militaries acquire advanced technologies such as cruise missiles, theater ballistic missiles, and mass destruction weapons, it is becoming ever riskier to place large forces close to the battlespace early in a conflict. Taken together, these systems provide what planners call “anti-access” capabilities—that is, the means to deny American and allied forces a safe and orderly entry into a theater of battle.

To guarantee its access to future war zones, the United States plans to acquire defense forces of unparalleled speed, stealth, precision attack powers, and standoff capability. It will rely on these forces to disable those enemy systems with the potential to hold allied forces at bay and to guarantee control of the sky for the advanced sensor and strike aircraft on which the entire US military depends. These capabilities are the hallmarks of the F-22.

The Raptor has all-aspect stealth, meaning that, in engagements beyond visual range, it would be hard to detect from any angle, using any type of sensor. It has powerful new engines that permit it to supercruise—fly at supersonic speed without using gas-guzzling afterburners—and large internal fuel tanks to give it unmatched range and speed for a fighter. Its onboard avionics have tremendous capability to collect information about air and ground threats, fuse those data with intelligence passed to it by Airborne Warning and Control System aircraft and other sensors, and present to the pilot a comprehensive “God’s eye” view of the battlespace.

“Global Reconnaissance Strike”

USAF leaders argue that the F-22, armed with such capabilities, is uniquely suited to the task of overcoming anti-access strategies. One true believer is Brig. Gen. David A. Deptula, a key Gulf War planner who now directs USAF’s office for the Quadrennial Defense Review. In Deptula’s view, “Aerospace power is America’s asymmetric advantage.” Deptula and retired Gen. Richard Hawley, who from 1996 to 1999 commanded USAF’s Air Combat Command, are spearheading a drive for acceptance of a new strategy making fuller use of that aerospace advantage. Called “Global Reconnaissance Strike,” it calls for using new aerospace capabilities such as the F-22’s to guarantee access.

“It’s a concept of operations that we’ve put together … to overcome these threats to the degree that we can, then flow in the follow-on forces that would be required to conduct a Major Theater War successfully,” Deptula said. “It relies on modern aerospace technologies and capabili-
ties inherent in stealth, standoff, precision, and responsiveness.”

Deptula added that the GRS concept acknowledges a need to “paralyze an adversary’s ability to lock us out of where we want to go, whether that be on the ground, on the sea, or in the air.”

Gen. John Jumper, head of Air Combat Command, said the Air Force’s job under the new concept would be to “kick the door down” into a theater of operations, enabled by its unique capabilities in stealth and, in the case of the F-22, speed.

In the new GRS concept, F-22s would be deployed to the rear of the theater of operations, either outside of or on the edge of the range of cruise and theater ballistic missiles. From these peripheral bases, the F-22, taking advantage of its long range and stealth, could quickly sweep the skies of enemy fighters and seize control of the air over the battlespace. Bombers would be based at even more-distant locations. They and the stealthy F-22s, working together, would destroy missile launchers and other anti-access weapons on enemy soil. Bombers could also strike at armored columns on the march.

At the same time, theater ballistic missile defense systems—the Airborne Laser, the Army’s Theater High Altitude Air Defense system, and the Navy’s Upper Tier system—would deploy and protect the peripheral operating bases from the few weapons that could reach them.

Clearing a path for bombers, the F-22 allows the truly critical targets to be hit right at the outset of hostilities, Jumper said.

“The F-22 enables essentially 24-hour-a-day stealth. ... You don’t have to wait until the first moonless night” as is typical when deploying the F-117 and B-2, he said. Working in concert, and using standoff weapons, the F-22 and bombers can produce an intense “shock value” against the enemy, he added.

USAF planners argue that use of peripheral operating bases would provide a measure of protection even from a fast-flying ballistic missile. That is because, between launch and impact, several minutes would pass, providing a degree of warning. By basing no more than a handful of F-22s at any single location, the aircraft could quickly scramble into the air ahead of an incoming missile and relocate to another base.

As the anti-access threats were disabled, the F-22s and bombers could increase sortie rates by recovering briefly at more forward locations for quick-turn refueling and rearming. As the tempo of dismantling the enemy threat quickened, greater numbers of aircraft, followed by naval and ground forces, could enter the theater and begin prosecuting the attack in other dimensions.

Firepower, Not Forces

Hawley, the former ACC commander, suggests that the GRS idea marks a fundamental shift in thinking. “This concept ... attempt[s] to put forth a solution—a joint solution—that would rely on importing firepower, rather than forces, early in a conflict, so that we don’t try to deploy massed theater forces into the teeth of an anti-access threat,” Hawley said. He emphasized that the concept depends not only on Air Force bombers and F-22 fighters, but on Navy Tomahawk cruise missiles and possibly the Army Tactical Missile System.

Hawley added that the future US military, because of its need to have mastery of battlespace information, will still be “dependent upon” Air Force systems such as the E-8 Joint STARS ground surveillance aircraft, E-3 AWACS, RC-135 Rivet Joint electronic reconnaissance aircraft, and the Global Hawk and Predator unmanned aerial vehicles. These, said Hawley, are “airborne systems that must operate in close proximity to the threat and therefore must be defended” by friendly aircraft.

“The key enabler for all of this,” Hawley concluded, “is that advanced air superiority system, the F-22.”

Jumper said ACC has developed a companion Air Force concept called Global Strike Task Force. This concept will “flesh out” GRS with the Air Force’s full role: the ability not only to provide a wedge into the theater but, afterwards, to keep the pressure on day and night.

“After you make available these forward airfields by taking care of the anti-access threat, then you go ahead and deploy ... forces ... that persist over the battlefield and provide those things that require constant cover, like close air support, time-critical targeting—those sorts of things that ... [support] the follow-on phases of the battle, to include putting ground forces in,” Jumper said.

As the anti-access threats are “rolled back,” he added, forward bases would allow the pace of air operations to increase and put greater numbers of enemy targets at risk.

Such forward air bases would not be “100 percent immune” to being hit, but Jumper noted that the US military practiced “for 40 years” to operate even on bases that had been attacked with chemical or biological weapons.

Of all the aircraft now planned or
actually on the books, only the F-22 will have the combination of stealth and speed to operate over the next 30 years against world-class fighters and advanced, “double-digit” surface-to-air missile systems—the SA-10 to SA-20 level of weapons.

“The F-22 is the only system ... that can accomplish all of the things that the theater enabler has to accomplish,” Hawley added. Neither of the other two new fighter programs in the works—the Navy’s F/A-18E/F Super Hornet or the Joint Strike Fighter—will have the ability to play a role in guaranteeing access. The F/A-18E/F is not stealthy and lacks the long range and speed of the F-22. The JSF, though stealthy, won’t have supercruise powers and will not have the F-22’s impressive theater-spanning range.

Deptula said the GRS concept consists of three basic elements—inverting, distilling, and protection.

“Inverting,” he explained, calls for standing the current concept of operations on its head. Instead of waiting for forces to be massed before beginning the attack, the US military, under the GRS concept, “moves into [the] theater very rapidly those key elements, those key forces, that allow you to target the threats” that prevent access by the rest of the US military. These units begin operations within hours rather than waiting for days or weeks to engage.

“Distilling,” Deptula went on, means packing the maximum amount of capability into each combat unit, which typically will be small because it must be rapidly dispatched to battle. The F-22, he noted, distills into one platform “a lot of capabilities that we used to have to bring lots of different platforms into theater to do.” Like the F-15C, the F-22 can control airspace. Like the F-16CJ, it can suppress defenses by knocking out radars and missile batteries. Like the F-117 and F-15E, it can make near-precision attacks.

“Because of their ability to do multiple missions,” he added, “you don’t have to move as many of them into the theater.” This enhances “protection” of the fighting force, because having fewer airplanes at the rear of the theater makes it easier to protect them, Deptula said. In addition, he said, by moving the F-22s around among several bases “you greatly complicate the adversary’s problem in determining where they need to target.”

New Concepts Needed

The new Concept of Operations was developed, Deptula said, as a means to inject reason and new thinking into the QDR 2001 process. “We want to make sure this QDR is not just a resourcing drill for legacy CONOPS,” he said. Deptula added that, when all the services are strapped for cash, and demands on the military are greater than ever, “we want different CONOPS to be part of the equation, as well as modernized forces.”

The F-22’s role in winning Major Theater Wars is not its only mission, as Air Force leaders have pointed out over the last few years. USAF’s role in providing forward presence, enforcing no-fly zones, and responding to various no-notice, Smaller-Scale Contingencies means it must have a fighter that can do the day-to-day work of peacetime, as well.

To meet the demands of routine operations, the Air Force created 10 Aerospace Expeditionary Forces to divide up the work. There are, however, not enough F-22s in the budget to fully equip all of the 10 AEFs.

The current approved Air Force plan
calls for procuring 339 of the new fighters.

“Perhaps it’s too soon to forecast what AEFs will look like by the time we reach the full complement” of 339 F-22s, said Gen. John W. Handy, vice chief of staff of the Air Force. However, he added, “It’s pretty clear [that] we’re going to need more F-22s ... to flesh out [the force].”

Handy added that, without enough F-22s to fill out the AEFs, there is a real risk that it will become a Low-Density, High-Demand system—one of many that regional commanders in chief all clamor for but which are too small in number to match the demand. Such LD/HD systems typically experience excessive operating tempos, leading to retention problems among the crews that operate them and shortages when all available systems must come home for needed maintenance.

The planned procurement of 339 F-22s stems from QDR 1997, when the Air Force accepted the figure in light of intense budget pressures on all the services. The 339-fighter buy amounts to only about three wings’ worth of aircraft. However, the service needs at least four wings, since the Air Force is supposed to have two wings of F-22s for each of the two Major Theater Wars that US forces are supposed to be able to handle at about the same time.

It’s the Math, Stupid

Asked if there are enough F-22s planned to meet the needs of the AEF structure, Brig. Gen. Daniel P. Leaf, Air Staff director of operational requirements, said, “If we were to set a [level of] a squadron-and-a-half per AEF, you’d have to have 572 airplanes.” He added that USAF policy right now still calls for 339 airplanes.

“I’m not raising the bar,” Leaf said, “I’m answering a math question.”

The 1997 QDR did leave the door open on the final buy of F-22s, acknowledging that the Air Force may have to add two wings’ worth of dedicated ground-attack variants to its force structure at some future date.

Leaf said the F-22 is essential if USAF is to make good on the high standard of air dominance it has held since the 1950s. He asserted, “We’ve gone from where we measure our ability to establish dominance over enemy airplanes in terms of kill-to-loss ratios to where we measure it in terms of how long it takes the enemy to quit flying. That is the standard, and I would submit that none of our joint partners are ready to back down from that standard and go anywhere near parity” with competing aircraft.

Leaf added, “I don’t think the nation is ready to back down from that standard, either. It’s going to take the F-22.”

This winter, the F-22 had completed virtually all of the benchmark requirements necessary for it to enter low-rate initial production, and program leaders were prepared for an appraisal by the decision-making Defense Acquisition Board, which was expected to give the go-ahead for production. The timing, however, was such that the Pentagon decided to defer the low-rate initial production decision to the incoming Bush Administration, which indicated a desire to conduct an immediate review of all major aircraft programs.

Pentagon and Air Force officials were cautious about assuming the new Administration would back the F-22, but they did note that, in 1998, several former Secretaries of Defense sent a letter to the incumbent, William S. Cohen, urging him to continue the F-22 program. The list of signatories contained two names of special note: Dick Cheney, now the vice president, and Donald Rumsfeld, who again heads the Pentagon.

By the time the Pentagon DAB review was to take place, the F-22 program had met nearly all of the Pentagon’s 11 specific requirements for entering production. These included firing an Advanced Medium-Range Air-to-Air Missile from the aircraft, beginning aerial tests of the F-22’s stealthiness, and static load tests.

The static load test was marked “incomplete” because the aircraft was stronger than the device finding the limits of its durability. The test rig broke when it had flexed the F-22’s wings to 141 percent of their design strength. The test was supposed to bend the wings to 150 percent. The aircraft still was judged to have passed the trial because it more than cleared the F-22’s flight envelope, according to F-22 system program manager Brig. Gen. William J. Jabour.

“It’s going to take us awhile to repair that fixture,” Jabour said, but he hopes to complete the 150-percent load test eventually.

Flying Software

To get the F-22 past the test gates and into production, the contractor, Lockheed Martin, had to fly Raptor 4005 and Raptor 4006. Both aircraft had to contain complete and fully working Block 3.0 software, which is the full-up avionics suite. The flight of 4005, which took place Jan. 5, was an event “on a par with the first flight of the F-22,” Jabour said. For the first time, a fighter flew “with multisensor fusion ... and it worked.”

F-22 performance will be unprecedented, but there’s nothing exotic about its flight-line care. Maintenance, fueling, and weapons loading will be comparable to that of the F-15 but with 40 percent less equipment and personnel.
The F-22 fighter’s unique combination of stealth, speed, range, and sensor fusion will profoundly alter the way the Air Force conducts aerial combat.

“The history of dogfighting shows us consistently that the loser never saw his opponent until it was too late,” explained a USAF tactician. “The F-22 will allow us to make this unfortunate situation routine for all our adversaries.”

The shorthand description of the F-22’s fighting concept is “first look, first shot, first kill.” The Raptor will be able to penetrate enemy airspace at high speed, without being detected. Information from AWACS airplanes and other intelligence-gathering systems will be piped into the cockpit. There it will be processed and presented in a simple display which shows the F-22 pilot where he is, where both friendly and hostile aircraft are, their type and heading, and the location and effective range of ground threats, such as surface-to-air missile batteries, shown as red circles on a map. Waypoints on a moving map give the pilot the best route to stay stealthy and avoid known threats.

Weaving among the red threat rings, the F-22 pilot will be able to put himself in the most advantageous position to fire at his opponents, while staying out of reach of their weapons. He will reveal himself only briefly—as he illuminates his targets with radar and opens the weapons bay doors—then virtually disappear again.

The F-22 is also at ease operating above 50,000 feet—well beyond the reach of many SAMs. In some cases, the best departure route may be right over the heads of the defenders.

As the enemy aircraft try to escape his missiles, the F-22 pilot either prepares for a second shot, moves on to new targets, or heads out of the danger zone. His Advanced Medium-Range Air-to-Air Missiles need no further guidance and autonomously find and destroy intended targets. The F-22 will be able to carry six compressed-carryage AIM-120C AMRAAMs in its belly.

It is the ability to positively identify and shoot targets well out of visual range—and without being detected—that will enable the F-22 to destroy enemy aircraft at a distance, exposing itself to the least possible risk. Close-in, turning dogfights should be rare.

No Knife Fights

“If I get into a ‘knife fight’ in the F-22, I’ve screwed up,” the tactician observed. Should that happen, though, the F-22’s thrust-vectoring and extreme agility will still give it the edge; the airplane can fly at 60 degrees angle of attack and still point its weapons at an opponent. For the close fight, the F-22 will carry short-range AIM-9X Sidewinder missiles and a 20 mm cannon.

The F-22’s capabilities will open up all sorts of new tactics. One F-22 could hang back, well out of enemy missile range, and illuminate targets with radar while another flies on ahead. His wingman, without ever turning on his own radar and revealing his presence, could shoot at them from closer range, using the other F-22’s radar lock.

With supersonic cruising speed, the F-22 will also have a “running start” to outpace or outlast enemy missiles that might somehow succeed in obtaining a radar or infrared lock. The extra time will give the aircraft’s all-aspect—stealthiness time to work, potentially causing the enemy missiles to lose track and fly harmlessly past. More likely, the F-22 will fly by so quickly that, even if seen, there likely won’t be time to spot, track, and shoot at it before it gets out of range.

In the ground-attack mode, the F-22 will similarly streak into the target area, avoiding defenses, release its satellite guided bombs and hustle out before enemy defenses have a chance to react. Its exposure time again minimized by stealth and speed. Work on new small smart bombs that achieve the same level of destruction with a lighter, smaller weapon, means the F-22 will be able to attack as many as eight targets per mission in the future.
according to Lockheed Martin’s F-22 vice president and general manager, Robert S. Rearden Jr.

Rearden explained that the bridge funding should “preserve funding continuity and keep the program on track in terms of the negotiated price that we have established with the government for the Lot 1 aircraft.” The money will chiefly go to component suppliers that must begin work well in advance of planned delivery.

There were two big hurdles for the F-22 going into the production review. The first was a wide variance between the Air Force’s estimates on F-22 costs and those of Pentagon’s own cost assessment group. Whereas the Air Force believed it could bring the program in under the Congressionally imposed cost cap on the F-22 of $63.4 billion, the Pentagon group estimated the true cost would be around $71 billion.

To guarantee the program would meet the cap, the Air Force and the contractor team are exploring initiatives in which investments would be made on the production line to reduce costs and increase efficiency. This is expected to save enough money over the life of the program that the investment would be paid back and the price target met.

Jabour reported that the Air Force was considering reducing the quantities of airplanes bought in early lots and adding them back later in the program, using the money saved for up-front investments in producibility.

Differing Methodologies

“A small change in assumptions early on can result in wild variations between cost estimates down the road,” said Brig. Gen. John Corley, USAF director of global power programs.

“We and the Pentagon ... have different methodologies for estimating cost. ... They tend to give us less credit for the payoff from these investments than we give ourselves.” On some of the investments, Corley said, the Air Force predicts as much as a 20-to-1 payback, but the Pentagon might only give credit for a 10-to-1 return.

Corley said these are “auditable” predictions, which are based on previous measures that have yielded high levels of savings through production efficiencies.

Rearden acknowledged that previous cost-cutting drills probably picked off most of the ready savings from manufacturing changes but maintained that the new initiatives could easily bring in a “return multiple of 10-to-1.” The initiatives tend to do with how the factory is arranged for assembly, the use of lower-cost fasteners on internal parts, and other component-related work.

Rearden also noted that Pentagon officials are worried the F-22 will require a major configuration change and that this will cause costs to skyrocket, as was the case when the Navy F/A-18 A model proved unsuitable and had to be upgraded to the C model in short order.

Explaining the Air Force position, Rearden said, “If there are changes to the baseline configuration that would cause it to migrate to a new configuration—let’s say, a ground-attack variant were added—that there would be new money” provided by the Pentagon to accomplish that, he reported. He said all of the parties still had to work out the cost-vari ance issue before the Air Force could begin production.

In the push for production, another
The F-22 was the most thoroughly tested airplane in history, even before the first flight. Extensive simulation, modeling, and component testing left little to discover during flight test. The only question now is, will Congress support it?

Warfare platform, loading jamming pods in the Sidewinder weapons bays on the sides of the aircraft. Again, the aircraft would not be radically altered; the service wants to maintain a common baseline configuration. The EW pod surfaces would replace the Sidewinder bay doors, which would have to be altered to be removable, Rearden said. The F-22 will generate enormous amounts of electrical power and has substantial onboard processing capability, making it a good candidate for the EW role.

Jabour noted that the F-22 is a significant advance in stealth over the F-117 and B-2. No special tapes or exterior materials are needed to maintain its stealth, and the radar cross section of the Raptor can be checked in the field by using a new device called the common low-observable verification system. Because much of the interior components can be reached through the weapons bays, fewer access panels are needed on the outside of the airplane, reducing the opportunities for its stealth to be compromised by stray screws or loose-fitting panels.

“The F-22 is designed to be maintained [the way] an F-15 is—out on the ramp,” Jabour asserted. “Clearly, there will be some things that need to be done with a little more skill, ... but [it will require] no special techniques or tools. ... It will not be as difficult to maintain as a B-2.” An automated, portable diagnostics and maintenance aid will also help ground crews quickly assess whether “a two-inch scratch on the top of the wing at this location” will degrade the radar cross section, Jabour added.

During the Presidential campaign, President Bush and his advisors frequently commented that they would reform the military in part by “skipping a generation” of weaponry and moving on to more advanced technology, but USAF leaders believe a generation of fighters has already been skipped, and the fleet must now be recapitalized with a state-of-the-art airplane.

The F-22 replaces the F-15. There is no service life extension program for the F-15, and USAF planners maintain it would cost billions to restart the line and give the F-15 some modest improvements in survivability. In addition, the F-15 simply could not operate past 2010 and survive against projected air-to-air and surface-to-air threats.

“I’ve got 2,000 hours in the F-15,” noted Leaf, the head of operational requirements. “It is a fabulous airplane. It is the undefeated heavy-weight champion of air superiority.” Even so, he said, “it’s still a 1970s-designed airplane, updated to the max. [It is] nonstealthy, nonsupercruise. And you can only make it do so much. ... You have to build a new airplane. So we are.”