

# Space: The Ultimate High Ground

**Space and Missile Systems Center Commander Lt. Gen. Brian A. Arnold, USAF, talks to *Defense AT&L***

**A**ir Force Lt. Gen. Brian A. Arnold retired from his position as commander, Space and Missile Systems Center (SMC), Air Force Space Command, Los Angeles Air Force Base, Calif., at the end of May. During his almost four-year tenure, Arnold was responsible for managing the research, design, development, acquisition, and sustainment of space launch, command and control, missile systems, and satellite systems. With more than 6,500 employees nationwide and an annual total budget in excess of \$10 billion, SMC is the nation's center of excellence for military space acquisition.

James P. McNulty, Defense Acquisition University Los Angeles site manager and professor of systems acquisition management, interviewed Arnold

at his office shortly before the general's retirement. Among other things, Arnold explained what space—the ultimate high ground—is doing to help the warfighter and how systems engineering is helping to contribute to an unprecedented launch success rate.

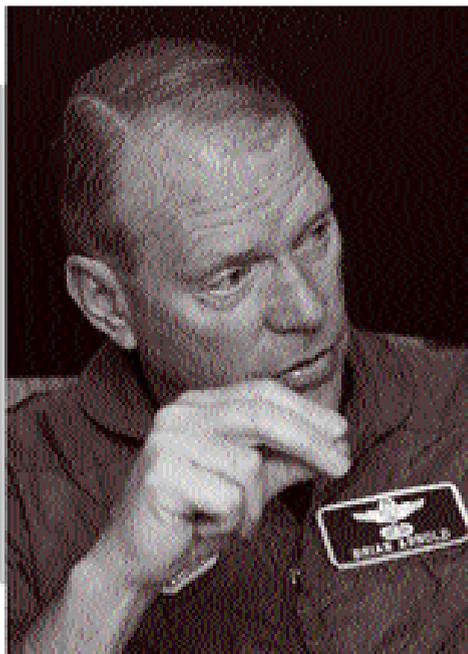
**Q** *The Space and Missile Systems Center is the nation's pre-eminent space acquisition organization, tasked with providing vital space systems in support of national security objectives and the warfighter. What is SMC doing to help deployed military units accomplish their missions successfully and return home safely?*



**The better the warfighter  
learns how to use our  
systems going forward, the  
greater the demand will be  
for space assets.**

**A**

That's an excellent question. One of the things we do here that directly contributes to saving lives and the prosecution of the war in an efficient manner is GPS—Global Positioning System. It has opened up the entire rear. When you tie GPS to a weapon like JDAM [*joint direct attack munition*] and make it an active weapon, that means less re-attacks on the target, and it means saving the



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pilot's life because he or she doesn't have to return to that target over and over again. It reduces the amount of collateral damage around the target area, so you essentially get down to one weapon, one target.

To give you a good analogy, during the Vietnam War, we attacked a bridge—the Dragon Bridge. We lost a lot of good crew members because they went in with unaided or inaccurate weapons, and we had to drop many, many different weapon loads on the target. We might do partial damage to the bridge, but the next day the Vietcong would come back and repair. We had to keep going back and attacking that bridge. If we'd had accurate weapons, then a single weapon could potentially have taken out that bridge. Fast forward to today: in OIF—Operation Iraqi Freedom—bombers are being used in close air-support roles. What a marvelous thing! Who would ever have thought it possible that a GPS and a guy on the ground passing coordinates would enable the crew to accurately retarget a weapon and put it precisely where they want it to go.

Handheld terminals, the “plugger,” [*PLGR, or Precision Lightweight GPS Receiver*], are another important item the Army uses. With them, they can maneuver at will on the battlefield, in the desert, in the middle of the night, or in the middle of a dust storm, without anything except the

handheld device itself; 15 years ago, we would have had a difficult time just maneuvering around the desert at night. Other things: we've been able to counter the jamming that occurred during OIF [*Operation Iraqi Freedom*] by using different processes or capabilities of the GPS.

If you look at the areas of communication, there are things like the Milstar [*a satellite communications system*]. After we got the Milstar VI, a medium data-read communications system, up in orbit, the transmission

of the air tasking order to the field went from about an hour down to about 5.9 seconds. The “so what?” about that is it means the rest of that bandwidth is freed up to do whatever the warfighter needs in passing information back and forth, which is a great capability. The Defense Satellite Communication System, is another program. We launched the last of the DSCS satellites during OIF, and we basically improved our capability between OEF [*Operation Enduring Freedom*] and OIF by about 40 percent, particularly in the Indian Ocean, an area of responsibility; and the system's availability went up to about 99.998 percent, which is about as good as you can get.

Another initiative is the Global Broadcast System, where we provide worldwide one-way transmission of video imagery. We're delivering mega types of data per second to warfighters, and that kind of capability allows them to prosecute the war in a much more efficient manner than we've ever been able to do before.

In terms of weather, we're using the Defense Meteorological Support Program, which provides such real-time weather performance and information in support of the warfighter as temperatures on the ground, pressure, cloud condition, sand and dust storms, and so on. The information allows the warfighter to plan around the things that are affected by the weather, giving a great combat capability.

**Q**

*You mentioned the GPS, which brings me to my next question. You've noted that GPS is not only a military asset, but a "worldwide utility" and a "national treasure." Would you elaborate on this statement a little bit? Also, at the start of the GPS program—and I know it was years ago—was this marriage between commercial and military envisioned?*

**A**

GPS really started out as a military program. The idea was to give a radio frequency to an aircraft, a ship, or a person on the ground that would help them geolocate where they were. We started off with a small vision and it grew; today we've grown to about 28 satellites in orbit. We have the healthiest GPS satellite constellation in our history.

Over time, the civil users began to see the advantages of accurate navigation. Take air travel: the Federal Aviation Agency uses GPS to separate aircraft. The international flying rules allow us to use GPS to put aircraft closer together because you can precision-guide and accurately tell the distance between aircraft. We use GPS for farming, for fishing, for recreational uses, for surveying. It has become another utility out there. It's a free-to-use utility that we provide globally, 24/7. And it just gets more and more accurate. When we build GPS II F, we'll have an L5 frequency, which is a freedom of navigation that enhances civil use capability further. We're very proud of that accomplishment—and clearly, the commercial and civil leaders are delighted with that capability.

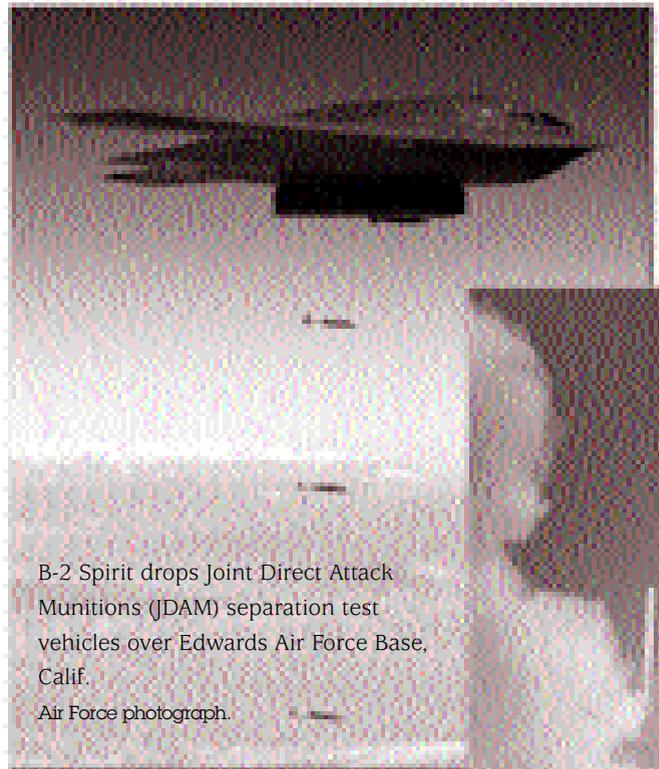
**Q**

*It's a great asset. You mentioned some of the satellites that have recently gone up in orbit—the Defense's Support Program launched their last satellite, DSP 22, in February of 2004. Can you comment on how this has created, as you've said, the "healthiest warning constellation" ever?*

**A**

DSP 22 was our most recent satellite, and we have one more to go—DSP 23. The Defense Support Program has a legacy of great contributions in the missile warning and missile alert arenas, using the infrared sensor on board to detect the launch. We found during Desert Storm that we were able to process the data and intelligence when a scud missile was launched, and we could pass that information quickly back to the theater commander downstream where the weapons might possibly land. So we've adapted the information we get from the DSP program to really give us more versatile feedback for all kinds of users. For example, we can detect forest fires.

We expect that same capability to be expanded when we built our SBIRS—space-based infrared system—which, in addition to missile warning and missile alert, will also perform technical intelligence and battlespace charac-



B-2 Spirit drops Joint Direct Attack Munitions (JDAM) separation test vehicles over Edwards Air Force Base, Calif.  
Air Force photograph.

Titan IVB space launch vehicle thunders into Florida sky carrying a Defense Support Program (DSP) satellite.  
Air Force photograph.



Pararescueman takes GPS readings during a training mission in Sierra Leone.  
DoD photograph by Tech. Sgt. Justin D. Pyle, USAF.



## Lt. Gen. Brian A. Arnold

### *Retired Commander, Space and Missile Systems Center, Air Force Space Command*

**L**t. Gen. Brian A. Arnold retired as commander, Space and Missile Systems Center, Air Force Space Command, Los Angeles Air Force Base, Calif., effective July 1, 2005, after 34 years' service.



As SMC commander, Arnold was responsible for managing the research, design, development, acquisition, and sustainment of space launch, command and control, missile systems, and satellite systems. With more than 6,500 employees nationwide and an annual total budget in excess of \$10 billion, SMC is the nation's center of excellence for military space

acquisition. Arnold was the program executive officer for Air Force space, responsible for the following: Air Force Satellite Control Network; space lift ranges; launch programs; the Evolved Expendable Launch Vehicle Program; the Space-Based Infrared System Program; military satellite communication programs; Navstar Global Positioning System programs; intercontinental ballistic missile programs; Defense Meteorological Satellite Program; as well as other emerging transformational space programs, such as space-based radar. The general was also responsible for managing a portfolio of space superiority system programs.

Arnold was commissioned through Officer Training School at Lackland AFB, Texas, in 1971. Prior to his immediate past assignment, he served as the director of space and nuclear deterrence for the assistant secretary of the Air Force for acquisition. In this role, he was responsible for space and missile systems. Arnold spent the majority of his career as a pilot in FB-111 and B-52 aircraft. He has served as a squadron commander, wing commander, and subunified commander. He has logged more than 3,100 flight hours.

terization. It will be a more enhanced system than the DSP. The way we built the DSP system was more cookie-cutter: we built a lot of them, which saved us money, and we were able to put them up in orbit. They are lasting well past their design life, in some cases one-and-a-half to two-and-a-half times their design life, so when we put DSP 22 in orbit, it contributes to that overall system. And that's how we can say we have the healthiest warning constellation we've ever had in our history.

**Q** *In fact, hasn't one of the satellites lasted 18 years?*

**A** Yes, it's an unbelievable capability. It really is. It goes back to the original strategy: if you can build many of these same kinds of satellites, they're going to last you a long time. Typically, we buy satellites in batches of twos or threes, which makes the up-front development costs extremely high because in the satellite business, as opposed to the airplane business, about 70 percent of your investment is up front in the development, and only about 30 percent or less is in the actual life cycle.

**Q** *Most of our major acquisition programs have had problems with cost, schedule, and performance. Space acquisition, unfortunately, has been no exception. How will the space-specific processes described in the recently signed National Security Space Acquisition Policy 03-01 enhance space to better achieve cost, schedule, and performance goals?*

**A** Good question. First of all, we have had some challenges in cost overruns. We've experienced technical issues, scheduling issues. I've been in the acquisition business for many years, and I can tell you we run into the same kinds of problems with airplanes, weapons systems, missiles, and so on, so space is really no different. The idea that all space programs are broken is fallacy. It's a generalized statement. If anyone says that, you need to challenge it.

In the NSS 03-01, following the direction or recommendation of the Space Commission back in 2001, we are generating a new way to do the beginning or the flight-following of a space program. It is tailored after the way the National Reconnaissance Office does it using their predictor system. We call ours a defense space acquisition board, or DSAB.

In addition, as you prepare to bring the program forward to the DSAB, you go through an independent program assessment. Somebody—who is independent of the program, is perhaps knowledgeable about how the industry built the system, and perhaps has some knowledge of

the Air Force procurement system—is tasked to do an in-depth review of the technical capability and the production capability of the industry out there and to look at the financials and the cost estimates. The independent program assessment is put together and presented at the same time the program manager comes forward to brief the approval process. If the independent program assessment states that the program is mature enough to move forward to whatever milestone decision point is appropriate, that enhances the process because now we have an independent and parallel look at what the program office is estimating about the program's readiness.

We rely on the OSD CAIG [*cost analysis improvement group*] process. The cost estimators there, as well as at the air staff, put together a good cost estimate, and we're also enhancing our own organic cost estimating capability here at the product center, so going forward now as we initiate newer programs we hope to start off with the right pricing for that program and put in the right amount of management reserve. Typically in the DoD 5000 series, you put in about 50 percent cost management reserve; we're looking at about 80 percent, if we can get it. That would give the program manager much more of an opportunity for success in the future to be able to cover the cost overruns that you typically have in very complex hardware- and software-designed satellite programs.

**Q** *Especially where you're pushing the leading edge of technology.*

**A** Exactly. And in virtually every one of our programs, we're recapitalizing across the board—in the communications arena, in navigation, in the weather—so we're pushing the envelope, and when you do that, you run into design problems. That's where you need your management reserve, to allow you to stand back, make the fixes, and then move forward.

**Q** *The importance of space as the ultimate high ground is increasingly being credited and recognized as key to success on the tactical battlefield. How is SMC working to build a foundation that will meet future warfighter space capability needs?*

**A** The idea is that in order to meet the future combat capabilities we need to understand what the requirements are for the warfighter. We start off with what we call an "urgent and compelling requirement" process, where we go out and seek the combatant commanders, going through Air Force Space Command to U.S. Strategic Command, to get their inputs, and then we lock down a baseline of what those requirements are. Air Force Space Com-

mand gives us the requirements that go up through an approved JROC [*joint requirements oversight council*] process, and then we go forward. That allows us to go out and build a technical requirement baseline with industry—the contractors—and then they build their integrated master schedule/ integrated master plan going forward. That's a very big change from the way we've done requirements in the past, and it gives us great stability in our programs. So the first thing we're doing is working with the warfighter to identify the specific requirements, and if we can't get those requirements right away, then maybe we'll spiral them in later on.

The other thing is to provide the warfighter with improved combat capability. An example is when we put up the Advanced Extremely High Frequency Communication set of satellites, the Advanced EHF I, II, and III. You're going to get an increase in capability of about 100 times over what you are getting right now from Milstar. The very first Wideband Gapfiller that we get into orbit will provide greater capability and bandwidth than all the DSCS satellites combined. In each and every case, when we put up a new space system, you have a gain of 5, 10, in places even 100 percent increase in capability over what the previous system has given. That's the combat capability that we're providing to the warfighter. The better the warfighter learns how to use our systems going forward, the greater demand there will be for space assets. No longer can you go it alone. The Army, the Navy, the Air Force, and the Marines have a great appreciation for the combat capability space provides, so the idea is to stay as closely linked with the warfighter as you can to find out the needs, then develop those systems as efficiently and quickly as you possibly can, and field them in the way that the warfighter would really want them.

The chief of staff of the Air Force has asked us to look at a thing called joint warfighting space, which is a unique way of looking at what can we tailor at the tactical level of war for the theater commanders to augment what they don't have from, say, a national system. That entails a responsive satellite that is easily plugged in and integrated into a responsive booster, can launch in a matter of hours or days rather than months, is autonomously checked out on orbit in just a couple of passes, and can use some sort of a common datalink to pass information down to the theater commander. A good example would be something like the blue force tracking system [*technologies that tell military units the location of friendly forces*].

**Q** *You've made mission success a cornerstone of your leadership. As of the end of 2004, MSC had experienced an unprecedented number of successful operational launches in a row. Traditionally, the failure rate for major launches was one out of 10. What factors are contributing to MSC's impressive performance?*

**A**

We are proud to say that today we are 41 in a row (knock on wood). Granted, you are only as good as your last launch, but our focus came from recommendations from the broad-area review that took place back at the end of the 1990s. We'd lost five major launches in '98 and '99, and the president directed the broad area review to stand up and look at what processes we needed to change to get back to a higher success rate.

But you're right: typically in the history of launch, we lose about one out of every 10, so what we went forth with was the idea that mission success would override everything else. It is the number one priority. If you lose just one launch, it's an order of magnitude worse than delaying a launch. I'll take the heat for a delayed launch to make sure that it is ready to go because in this business, launch is final. It's one strike and you're out. Once you light the fire, that rocket is going to go vertical and it better go all the way, or it's going to be a really bad day.

So we focused on things like clear accountability and responsibility. I'm responsible for certifying the flight-worthiness of all our launches to the commander of Air Force Base Command, the chief of staff of the Air Force, and the secretary of the Air Force. I take it as an extremely personal and accountable process, and we do it in a very deliberate fashion. We start off by looking at the issues for each launch, and if we have a problem, by doing root cause investigations and closing the issues. We have better insight than we've ever had before. I have an independent review team—Aerospace Corporation here does a deep-dive review—and I can safely say that at least five or six of those 41 successful launches had issues that were caught beforehand by the Aerospace Corporation.

We do a very serious launch review. We do a mission readiness review. I do an extended flight readiness review. And mission assurance teams are up front and early in identifying problems and in trying to run those to the ground. We've empowered the launch vehicle contractors as full team partners here, and we're all in this together. When they identify a problem, we're glad they've identified it; we successfully run it to the ground and then we go ahead and launch. We're really dedicated to mission success as our number one priority, and I think that is best evidenced in our launch success here.

**Q**

*When you took command, you said, "We need to make sure we recognize and award our quality people, make*



Lt. Gen. Brian Arnold (center) taste-tests chili during the 2004 Annual Chili Cookoff with Chief Master Sgt. James Travis, Space and Missile Systems Center command chief (left), and Brig. Gen. Larry James, SMC vice commander (right).

*sure we recruit the right people, and make sure we're working on career development." What is SMC doing to keep up recruitment and retention of quality people?*

**A**

Another very good question. It's centered around the space professional development that Gen. Lance Lord [commander, Air Force Space Command, Peterson Air Force Base, Colo.] is leading, where we are looking at developing a cadre of space experts in both acquisitions and operations. There are initiatives across the acquisition community and the operations community. One is giving our acquisition folks an opportunity to be commanders. Brig. Gen. Larry James, SMC vice commander, sits on a board where they pick future squadron commanders. We have good examples over the last few years of acquisition leaders being picked to be squadron commanders in operational units. That's very good in showing that there is upward growth.

The other initiative is continuing the education of our young engineers and program officers using the National Security Space Institute, the Defense Acquisition University—they offer a great education for our officers—and partnering with AFIT [*the Air Force Institute of Technology*], and the Naval Postgraduate School, where I do distance learning to allow our young officers to go to school for a few months and then come back here and continue to work on their master's degrees in systems engineering.

We've set up our own acquisition school here at SMC. It's an integrated training and education program that is run

much like a university. We have Air Force training, acquisition training, contractor training, financial management training, and space program training, all captured under our acquisition school. We've only been doing this about a year but we're starting to see some success.

To recruit civilians, we've added about 30 percent locality pay and retention bonuses. To ensure the pay scale matches the high cost of living here, we've used the Defense Civilian Intelligence Personnel System (DCIPS) that allows our civilians to be incentivized with pay incentive awards.

**Q** *You mentioned systems engineering. I know that you champion it as central to a successful acquisition program. How is the effort to revitalize systems engineering progressing?*

**A** I think it is going along very well. If you recall, back in 2002, Tom Young of the Defense Science Board came out to review how we and the National Reconnaissance Office conduct space acquisitions. He found that we needed to re-establish our organic government systems engineering capability. During the acquisition reform era, the decade in the '90s, we actually just scoured that capability out. So we're reinstitutionalizing it with a very deliberate process. It will take some time, probably three to five years, to really refine this, but the focus on mission success is the number one priority, and you begin by revitalizing mission assurance and going back to basics.

The other parts are to continue the investment in our executive pedigree reviews of each of the programs. We find out what are the leading issues out there, what are the connecting issues that have typically caused problems in the satellite program, and we focus on those early on with good foundation systems engineering: looking at the integration at the box level and into the systems level and then building it up through the flight-readiness review, the flight-worthiness certificates, and then at the end of it, a post-flight assessment. Then that all flies into the overall mission assurance activities across the board here. It is a systematic approach to reducing program risk. We're not risk-averse, but we manage risk. The systems engineering revitalization that we've been doing here through my four years is really starting to take effect. People that come here to visit are very interested in how we're accomplishing it.

It entails in-depth program management reviews. I've tasked the Aerospace Corporation to do independent baseline reviews to identify the programs that have problems. If we do have a program that has experienced a lot of problems, we do what we call an ExCom [*executive com-*

*mittee*] where we bring in corporate leadership, sit down on a monthly basis and look at what the issues are with cost, schedule, and performance. Aerospace Corporation also provides me with a weekly watch list of about 20 pages of very detailed issues that I or my program managers need to follow. All of this is a center-wide, process-centric way to start fixing the systems engineering.

**Q** *You've mentioned some of your industry partners. How is your relationship with your industry and government partners progressing?*

**A** It's going very well. One of the things the industry leaders brought to my attention when I first got here was the notion to go back to specs and standards. For a while, during the acquisition reform era, we got rid of all the specs and standards. Now we've gone back and appropriately put in specs and standards where they meet the needs of industry. The feedback from industry is that has been very good for them because now they know the "recipe"—that's my term—for what we're looking for in terms of specs and standards when we go out. We put those specs and standards in a request for proposal.

Another issue is working with the other DoD agencies, for example Air Force Space Command. We've been under Air Force Space Command now for four years, and I've already mentioned the urgent and compelling process we do with their director of requirements. We are also involved with their XP [*plans and programs*] and integrated planning process; we're involved in the overall program execution and developing the program objective memorandum. We're involved with the Air Force Research Lab. The program executive office and the technical executive office exchange on a quarterly basis to build a science and technology roadmap, so it's a push-and-pull working relationship with the Lab to develop those technologies we feel need to be mature or matured before we begin the development of our own big programs here.

At a higher level, we're partnered with the Space Partnership Council including Air Force Space Command, Strategic Command, the under secretary of the Air Force, NASA, and the National Reconnaissance Office. We all get together on a quarterly basis to talk about top-level issues that may affect all types of programs and to work more in unison. There is great synergy created by doing that. In addition, we're working with the educational institutions out there—AFIT and the Naval Postgraduate School I mentioned—for improving our education and developing our corps cadre here to be better program executive officers for the future. The whole idea is to foster the relationship with industry, the relationship with the

DoD agencies, and the relationship with the educational institutions. So it's a three-pronged approach.

**Q** *The Darlene Druyun scandal continues to reverberate throughout the Air Force and the acquisition community. What do you consider the most important lessons learned—or relearned—that the acquisition community needs to keep in mind?*

**A** I think that first of all, we are accountable to the people of the United States and to the U.S. government to hold ourselves to the highest integrity possible. I call it the mirror check: everything we do needs to be open, honest, and straightforward. As program executive officers, we need to hold ourselves to a rigorous, high standard in everything we do, and build the trust and confidence that we are doing the right kinds of things, and that we are executing the money in the right way.

**Q** *SMC was realigned from Air Force Materiel Command to Air Force Space Command at about the same time that you took command. How would you describe the health of the user-acquirer relationship in terms of supporting the customer?*

**A** When I first took over here, we were still under Air Force Materiel Command, and then about a year later, we came under Air Force Space Command, as recommended by the Space Commission. It's a better alignment because I've had a single four-star boss, Gen. Lance Lord, as my spokesman in Washington if I needed one. And my position now reports directly to the under secretary of the Air Force.

The alignment under Air Force Space Command has been good because it gives the operators better insight into the acquisition issues that we have here, and it gives us acquirers out here at SMC a better understanding of what the operators' needs really are. For example, if they build a new requirements document, we help them develop it; they don't do it in the dark and then have it passed over the fence to us. If we are experiencing some troubles in developing a program, we can sit down with the operators and go through the proper trades, if you will, to establish if the 80 percent or 90 percent solution is satisfactory. In the past, we just haven't had that capability. So I think it was the proper alignment, and I think that under the leadership of Gen. Lord, it has probably never been better.

**Q** *SMC and DAU recently signed an agreement establishing a partnership, and SMC is a learning organization.*

*How do you envision this partnership supporting your objectives, and strengthening the capabilities of the workforce?*

**A** I think it is great. First of all, we have a great relationship with DAU, and as we build on the education here—particularly as we continue to build Space 100, 200, and 300, then overlay that with the acquisition processes—DAU is fundamental in creating the building block approach to education the troops need and making sure it is aligned properly. You mentioned earlier the NSSO 03-01 document. Another thing I have worked on with DAU is making sure that we can tailor that into the education of the acquisition processes. It has traditionally been the DoD 5000.2, and as we ingrain the 03-01 into the DAU education process, I think that will be better aligned with the way we are doing our streamlined acquisition process today.

**Q** *And most of that 03-01 is being briefed. We're working hard on that.*

*I have one last question: As you approach retirement and look back over your very long and distinguished career and time spent as SMC commander, do you have any departing thoughts or observations you would like to share with the acquisition workforce?*

**A** Oh, absolutely! It's been a great four years here and a great 34 years, and it's gone by like a flash, let me tell you. I leave with no regrets. First of all, I don't think the Air Force has ever been in greater shape than it is right now. We have the best Air Force on the planet, and it's due in part to all the great people that are out there, the enlisted cadre, the officer cadre, and the civilians. They're better educated. This is an all-volunteer force. I came in during the draft; these people are here through choice. They're very patriotic and they are in for the right reasons. I am just grateful to have had the opportunity to have been here at SMC during the last four years.

We've gone through really dynamic changes here in everything we've done. We've gone away from the 5000 series to the 03-01. We've realigned ourselves from USAF/AQ to report to the under secretary of the Air Force. We've come from under Air Force Materiel Command to under Air Force Space Command. At the same time, we're building an entire new base right across the street. So it's been a challenge. We've had our cost overruns and program slips, but on the whole, I think our space programs are performing. The ones that are in orbit are performing magnificently. I am very proud to have been part of the organization that provided that sort of combat capability to our warfighters.