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# GPS: CAN WE AVOID A GAP IN SERVICE?

## HEARING

BEFORE THE

SUBCOMMITTEE ON NATIONAL SECURITY
AND FOREIGN AFFAIRS

OF THE

COMMITTEE ON OVERSIGHT
AND GOVERNMENT REFORM

HOUSE OF REPRESENTATIVES

ONE HUNDRED ELEVENTH CONGRESS

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# GPS: CAN WE AVOID A GAP IN SERVICE?

**THURSDAY, MAY 7, 2009**

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON NATIONAL SECURITY AND FOREIGN AFFAIRS,
COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM,
*Washington, DC.*

The subcommittee met, pursuant to notice, at 10 a.m., in room 2154, Rayburn House Office Building, Hon. John F. Tierney (chairman of the subcommittee) presiding.

Present: Representatives Tierney, Foster, Cuellar, Kucinich, Flake, and Duncan.

Staff present: Andy Wright, staff director; Elliot Gillerman, clerk; Brendan Culley and Steven Gale, fellows; Margaret Costa, intern; Jeremiah Rigsby and Aaron Wasserman, legislative assistants; Dan Blankenburg, minority director of outreach and senior advisor; Adam Fromm, minority chief clerk and Member liaison; Tom Alexander, minority senior counsel; Mitchell Kominsky, minority counsel; Dr. Christopher Bright, minority senior professional staff member; and Glenn Sanders, minority Defense fellow.

Mr. TIERNEY. Good morning. A quorum being present, the Subcommittee on National Security and Foreign Affairs' hearing entitled, "GPS: Can We Avoid a Gap in Service?" will come to order.

I ask unanimous consent that only the chairman and the ranking member of the subcommittee be allowed to make opening statements, and without objection so ordered. I ask unanimous consent that formal written testimony from Dr. Scott Pace of the Space Policy Institute of George Washington University's Elliott School of International Affairs, as well as formal written testimony from Dr. Bradford Parkinson, the chief architect of GPS and the original GPS Program Manager, be accepted for the record. Without objection, so ordered.

[The prepared statement of Mr. Pace follows:]

**House Committee on Oversight and Government Reform**

**Subcommittee on National Security and Foreign Affairs Hearing**

**"GPS: Can We Avoid a Gap in Service?"**

Thursday, May 7, 2009 - 10:00 AM – RHOB 2154

**Written Testimony of Dr. Scott Pace, Director, Space Policy Institute**

Elliott School of International Affairs, George Washington University

I would like to thank Chairman Tierney, Ranking Member Flake, and distinguished members of this Subcommittee, for providing an opportunity today to provide input on this important topic.

The Global Positioning System is a vital U.S. military space capability and a source of strategic national advantage to U.S. forces. It is also an increasingly vital part of several critical infrastructures for air transportation, maritime shipping, electrical power, communications, natural resource management, and emergency responders at the federal, state, and local levels. The continued stability, health, and protection of GPS capabilities are thus vital to a wide range of national interests.

GPS is a successful dual-use technology that has benefited from Air Force operational stewardship and bipartisan policy support across multiple Administrations and sessions of Congress. It is a notable and all too rare example of domestic as well as international cooperation with benefits to the national security, civil, commercial, scientific, and international communities that use GPS. This success has been due to an enlightened sense of national self-interest that includes civil as well as military concerns and a willingness to encourage market-driven innovation through open, stable technical standards. GPS has been correctly characterized by U.S. policy as a public good that uses information technology to enhance the productivity of many infrastructures and systems rather than a narrow aerospace, consumer, or sector-specific service.

Emerging foreign systems such as Galileo in Europe and Compass in China have the potential to complement GPS and benefit all GPS users if care is taken to ensure there is no harm to the military utility of GPS and commercial innovation continues to be market-driven. Per U.S. policy guidance, the State Department has taken a leading role in crafting cooperative relations with Japan, India, Russia, and Europe. China is also an increasingly important part of multilateral discussions among satellite navigation providers.

The topic of this hearing is "Can we avoid a gap in service?" and given the well-known challenges faced by civil and military space systems, it is a timely question to ask. The GPS program is undergoing a transition to a new generation of satellites, GPS Block III. The highest priority needs to be placed on the timely and successful deployment of the GPS IIIA satellites and the prompt movement to the GPS IIIB series. These satellites will carry a variety of modernized signals and capabilities that are vital for all users, civilian and military. Foreign systems cannot compensate for gaps in the deployment of GPS III even without considering the serious national security and economic concerns from such reliance.

Rather than a technical description of GPS services, I would like to characterize the positioning, navigation, and timing services in terms of three qualities: accuracy, availability, and reliability.

**Accuracy** – means more than just the meters-level positioning provided by consumer devices, but also encompasses the real-time centimeter-level accuracy used in precision surveying and construction. It means the millimeter-level accuracy achievable by scientific users in conjunction with other technologies to understand the motion of the Earth's surface and behavior of the oceans. This level of accuracy requires precise knowledge of the GPS constellation in space, stable GPS signals, and *stable relationships between the signals* so as to extract the most accurate position information possible from the system.

**Availability** – normally means that there are enough satellites visible to a user anywhere in the world to provide good geometry for positioning and navigation. In addition, each satellite must itself have a full complement of working subsystems and on Earth the radio frequency spectrum must remain clean and relatively free of interference, whether intentional or unintentional. One

can have many satellites in orbit but if their subsystems are failing or the spectral "noise floor" is too high, then the GPS service will not be available.

**Reliability** – has an obvious technical meaning in terms of the GPS signals, but it also includes policy and program management considerations. Users around the globe place their trust in the operators of the GPS space and ground segments as well as the government authors of the "Interface Specifications" or ISs that describe current GPS signals as well as the modernized signals. If the ISs are wrong, ambiguous, or unstable, that undermines the effective reliability of GPS by undermining the trust that global users have placed in GPS.

A decision to make an investment in using and relying on GPS, sometimes for very critical public safety or economic applications requires a high degree of trust. The open, transparent specification of GPS signal characteristics (not the sensitive technology that creates the signals) has helped create that necessary trust. Public and private investment decisions have in turn enabled market-driven competition to drive down prices and drive up performance to the benefit of all users, civilian and military.

As GPS moves to modernized civilian signals such as L2C, L5, and future L1C the United States needs to continue to provide stable, open specifications for civil signals that encourage adoption, innovation, and investment in GPS. *These specifications need to support the needs of the installed base at least as well as provided by current signals.* To do otherwise will merely encourage international investments to flow toward foreign systems that are willing to provide stable, open specifications that meet the expectations of today's global users.

The *U.S. Space-based Positioning, Navigation, and Timing Policy* of December 2004 includes a goal that says the United States should field capabilities that ensure we have the "pre-eminent military space-based positioning, navigation, and timing service." There is much to admire in this policy, which continued the foundation laid by the 1996 GPS Policy of the Clinton Administration, but I would suggest deleting the qualifier "military" after "pre-eminent." Given our nation's reliance on GPS, there is no place for being second in civil or national security applications.

The major challenges facing GPS can be placed into four general categories:

**GPS Modernization:** Keeping the GPS Block III satellite acquisition on cost and schedule is crucial to preventing or minimizing gaps in GPS coverage. In particular, fielding satellites with additional signals "L2C" and "L5" to benefit civil and aviation users worldwide is critical to maintaining U.S. leadership in positioning and navigation services. Other improvements include: (1) a modernized search and rescue capability to replace the aging COSPAS-SARSAT network; and (2) laser retroreflectors to enable precise GPS satellite position measurements needed to continue improving the underlying geodetic reference frame and analysis of orbit determination errors. Next-generation air traffic management systems such as "ADS-B" appear to require more GPS satellites than formally required for Defense users. Thus the current Department of Transportation funding line for civil GPS improvements may need to be increased.

**Spectrum Protection:** GPS signals are faint and adding power in space can be prohibitively costly. Thus it is vital to protect the radio spectrum used by GPS from intentional (e.g., hostile) or unintentional (e.g., commercial) interferences. GPS is a global utility that supports a variety of safety applications around the world so international cooperation is important to maintain regulatory protections for the spectrum used by GPS. At home, the FCC and NTIA have important roles in preventing interference to GPS from commercial products and services. Continuing enforcement attention is needed to prevent or remove sources of interference in bands used by GPS as wireless technologies evolve.

**International Relations:** Discussions with the European Union are seeking to resolve questions on whether timely access to Galileo signal information will be implemented in a non-discriminatory manner. In contrast, Japan is seeking to build an augmentation system "QZSS" which is fully compatible with GPS and there is a long history of quickly resolving GPS trade-related questions with Japan.

**Government Management:** The stability of GPS policy across multiple Administrations and Congresses has greatly contributed to the trust shown by the large number of GPS users around

the world. No changes in national policy or management structure are needed, however the effective management of GPS requires a continuation of the strong interagency partnerships and White House oversight that has helped ensure U.S. leadership in this crucial area. Particular attention needs to be paid to assuring that appropriations for GPS and its augmentations are well coordinated to assure the most efficient modernization effort possible.

The fundamental issue is trust. The United States has earned global trust in GPS from over two decades of operational excellence and policy stability. It is ours to lose.

Thank you. I would be happy to answer any questions you might have.

[The prepared statement of Mr. Parkinson follows:]

# Mitigation of Possible GPS Brownouts

Professor Bradford Parkinson
Chief Architect of GPS
Original GPS Program Manager
Stanford University
Department of Aeronautics and Astronautics

# Background

- GPS now has over 50 Million Civil Users and up to 100,000 DOD users
  - Vital to infrastructure – especially FAA's NextGen
  - Essential to virtually every DOD Weapon System
- Current "Requirement" is for 24 sats, but level of service is 29 to 30
  - Independent review teams repeatedly advocated requirement be raised to 30
    - Defense Science Board, GPS Independent Review Team, PNT Advisory Board say 30
    - European and Chinese competitors both set at 30 Sats

# GPS Brownouts -

## Satellite numbers fall to less than current service

- Risk of Brownouts repeatedly pointed out by independent review teams
  - IIF Replacements greatly delayed
    - Congenital Defects due to bad procurement practices imposed on the Developers in late 90s
    - Design now quite old – many parts no longer available
  - IIIA now underway (finally)
    - Delayed by DOD for at least 3 years
    - Independent reviewers believe it is potentially a model procurement/development
    - Main impediment is multilayered approval process above the Program Office

# GAO Report Omission

***44 months Award-to-Launch*** Demonstrated by GPS I

- List of historic development times omitted the most significant one – GPS I (June 74 to Launch Feb 78)
  - Brand new design – no prototype
- Keys included:
  - Streamlined Approvals
  - Only one small change to contract
  - Integrated Product team – heavy USAF involvement at contractor

**It can be done – goal was 36 months!**

# GPS Constellation Size

(Currently 31 sats – could be down to 24 or less in 2018)

- *Constraints* on Brown-out Mitigations
  - Only *current GPS* signals will help (Civ and Mil)
    - User equipment for new signals will not be fielded
  - Brand New Foreign Satellite Developments of no help
- *Options*– in order of value
  1. Use **previously retired GPS satellites** still available
  2. **Speed up GPS IIIA** (expedite milestone approvals)
  3. Develop a **simplified GPS IIIA satellite (IIIS)** in parallel with IIIA (no extra payloads)

  X. Restart /Extend IIF line (would be risky, expensive, and late)

•Desired: about 6 more Satellites by 2016
to help insure a constellation of 24 to 30

# 1. Reactivate Previously Retired GPS satellites still available (in operational orbits)

- Pros
  - USAF has already prepared for this (~5 sats available)
  - Procedures well established – low operational risk
  - More older satellites will probably qualify to do this
  - Option is virtually free
- Cons
  - Old satellites – will only give a few years each & ***will not completely resolve problem***
  - Will not activate non-GPS functions

# 2. Speed up GPS IIIA
## (expedite milestone approvals)

- Pros
  - Already on contract
  - Design underway and going well
  - Includes new International signal
  - Almost ten times more military power
- Cons
  - Speedup constrained by funding and budgeting process
  - Earlier DoD level management impediments
    - Confusing chain of command
    - Many can say no – no one can say yes
    - Considerable unnecessary delay

# 3. Develop simplified GPS IIIA satellite (IIIS) in parallel with IIIA (no extra payloads)

- Pros
  - All essential boxes already at PDR for IIIA
  - Has modernized signals and additional power
  - Also would need streamlined decision making
  - Could be dual launch – savings about $75M/ sat
  - Could be accommodated with current contract
- Cons
  - Additional Payloads not included
  - Not budgeted
  - Strain on contractor and Program Office

# X. Restart /Extend IIF line

- Pros
  - Already designed
- Cons
  - Design and Parts obsolete – must be redesigned
  - Still untried – may have further congenital defects
  - Lacks Powerful Military signal (Hostile Jammers have seven times more effective area with IIF signal than GPS IIIA)
  - Does not have new International Signal (L1C)
  - Probably would have to be recompeted (a "new" design)
  - Major near term budget hit – IIF is still overrunning

# Conclusions

options can be done in parallel, where reasonable

- Option #1 (Reactivating retired satellites) should be continued and expanded where feasible
- Option #2 (speeding up IIIA schedule) should be encouraged and supported
- Option #3 (IIIA derived spartan satllite – IIIS) should be seriously explored and used if possible
- Option X is a non-start, IIF design is dead end – an old design against old requirements

Above all, the senior decision chain has to become a part of the solution with appropriate urgency
A risk mitigation plan is needed, using options 1, 2, and 3

Mr. TIERNEY. I also ask unanimous consent that the hearing record be kept open for 5 business days so that all members of the subcommittee will be allowed to submit a written statement for the record. And without objection, that's so ordered as well.

Well, again, good morning. And today the Subcommittee on National Security and Foreign Affairs will continue its oversight of the defense procurement with a hearing that focuses on the technology that most Americans find very familiar, a GPS, or Global Positioning System. The GPS was invented by the United States for the purpose of assisting the military in combat operations, but has now expanded to all manner of industries from personal transportation assistance to commercial aircraft navigation to emergency medical response. GPS is made technologically possible by a group of satellites known as constellation, positioned in such a manner that when communicating with receivers on the ground we can pinpoint the location anywhere in the globe.

As an acquisition program, GPS service falls within the clear responsibility of the Department of Defense, most notably the Air Force. However, it affects multitudes of users far beyond the military. Civilian government agencies rely on it, as do commercial industries, personal users, and the international community. Indeed, it is as much a part of the world's infrastructure as it is a critical system for national defense. Unfortunately, that reliance is at risk of being misplaced.

This morning's hearing was called in light of the subcommittee's requested Government Accountability Office report entitled, "Global Positioning System: Significant Challenges in Sustaining and Upgrading Widely Used Capabilities." In this report GAO documents weaknesses in the procurement of upgrades for GPS satellites, as well as the negative effect that these failings have had on current and future efforts. The current block upgrade of GPS, GPS IIF, has overrun its original estimated costs of $729 million by an additional $870 million. In addition, the block will be completed 3 years late.

This is not a new problem for Department of Defense procurement. We have another situation where the contractor given total system responsibility for the development could not execute the job either on time or on budget. According to the GAO, no major satellite program undertaken in the past decade has met its scheduled goals. It would seem that GPS is no exception. What was built as an effort to streamline the acquisition process instead resulted in a lack of oversight and control by the Air Force and Department of Defense.

This doesn't bode well for the next GPS block upgrade, GPS IIIA, which just began in May of last year under an extremely aggressive acquisition schedule. The Air Force has engaged a different company and plans greater oversight for this block.

The GPS IIIA contract was intended to be reminiscent of the days before acquisition reform when the government tracked contracts closely rather than letting the companies run free. There's a novel idea. That sounds good. However, like the predecessor GPS block and so many other Department of Defense procurements, the contract is a cost-plus type contract, meaning the government will pick up the tab no matter how expensive it ends up becoming. This

system not only hinders the accountability on behalf of the contract to the government, but also hinders the accountability of the government to the taxpayer.

I look forward to hearing from our Air Force and Department of Defense witnesses today about how the failings of the past will be avoided.

Of greater concern even with cost overruns and delay is the real possibility of a gap in GPS service. The Department of Defense has a formal commitment to users to provide 95 percent availability of service, which has been achieved through a minimum of 24 satellites in the GPS constellation. With the aging of satellites in the GPS constellation there are serious questions about whether that availability can be maintained.

I direct your attention to the monitors on either side of the room. The graphics on the screen depict the probability of maintaining this 24-satellite commitment. The first graphic shows the probability of a 24-satellite constellation falling to roughly 80 percent in the 2011–2012 timeframe. The second graphic depicts a scenario where if the GPS III block encounters even just a conservative 2-year delay the probability of maintaining a full service constellation drops precipitously starting October 2013, possibly going as low as 10 percent by 2018.

In light of recent history I am troubled if we are wholly relying on the hope that the GPS acquisition schedule holds as it stands today.

This brings us to a second and equally important set of issues. How is the Department of Defense preparing for this potential occurrence and what impact may there be to users if a gap does occur? The reality is from an acquisition perspective we are nearing the eleventh hour. The President's fiscal 2010 budget terminates funding for the primary GPS back-up system, LORAN. That puts a lot of pressure on DOD to ensure that GPS meets all user needs; a precarious position to be in if a gap is looming.

What are the Department of Defense and the Air Force doing to prepare users for what could be a shock to the system? Department of Defense and users need a robust dialog in order to ensure that user requirements are met and funded, users are prepared for any possible reduction of service, and the GPS industry can be involved in discussions about potential mitigation strategies.

GPS is a critical asset in our economy and to our security. It's unfortunate that we may find ourselves in a position of weakness because we've not yet learned to get our procurement house in order. My hope is that today's hearing will provide the opportunity for all parties to come to the table to air and address concerns and to bring public attention to this important matter.

Mr. Flake.

Mr. FLAKE. Thank you, Mr. Chairman. As we all know, GPS is an important asset to the military and for civilian purposes. The chairman explained very well the problems that we've had; cost overruns, significant delays with an ex-version of GPS in terms of the satellite systems. Now, we know that the next generation will come, and that is slated to be on time at this point. We want to make sure that the problems we've had recently don't plague the new system coming up.

There are obviously problems with the procurement system that we have at DOD, and I look forward to the testimony and seeing what we can do better in the future. Thanks.

Mr. TIERNEY. Thank you, Mr. Flake. The subcommittee will now receive testimony from the first panel before us today.

Ms. Cristina Chaplain currently serves as a Director for Acquisition and Sourcing Management at the U.S. Government Accountability Office, where she has responsibility for GAO assessments of military and civilian space acquisitions. Ms. Chaplain has also led a variety of Department of Defense-wide contracting related and best practice evaluations for the GAO. Ms. Chaplain holds a B.A. from Boston University and a M.A. from Columbia University.

Major General William N. McCasland is a Director of Space Acquisition in the Office of the Under Secretary of the Air Force, where he directs development and purchasing on space and missile programs to Air Force major commands, product centers and laboratories dealing with acquisition programs. He has served in a wide variety of space research acquisition and operation roles within the Air Force and the National Reconnaissance Office. General McCasland holds a B.S. from the U.S. Air Force Academy and a Ph.D. from the Massachusetts Institute of Technology.

And Dr. Steve Huybrechts currently serves as the Principal Director for C3, Space and Spectrum, in the Office of the Secretary of Defense, where he has oversight responsibility for most of the Nation's military space, command and control communications, navigation warfare, meteorology, oceanography and spectrum allocation activities.

Would you like to take on some more responsibilities?

Previously he was assigned to the Air Force Research Laboratory, where he was responsible for selecting and managing many of the Nation's highest priority space experiments, as well as directing the Air Force's research portfolio of spacecraft power structures and control technologies. Dr. Huybrechts holds a Ph.D. from Stanford University.

I want to thank all of you for making yourselves available today and sharing your substantial expertise. It's the policy of the subcommittee to swear in witnesses before they testify, so I ask you to please stand and raise your right hands. If there are any persons who will be submitting testimony along with you, please ask them to rise and raise their right hands as well.

[Witnesses sworn.]

Mr. TIERNEY. The record will please reflect that all of the witnesses answered in the affirmative. All of your written testimonies will be submitted on the record, so everything that you have written down and submitted to us will be there.

We allocate about 5 minutes for people to make an opening comment. You will see the amber light come on when there's about a minute left. When the red light comes on, the floor opens and you drop through if you go to the 5 minutes. But generally we try to hold off on that drastic thing and we'll let you go a little bit over because we value your testimony. We want to hear what you have to say, but we do want to have a chance to have some questions and answers and get to the second panel as well.

So, Ms. Chaplain, if you would be kind enough to start.

**STATEMENTS OF CRISTINA CHAPLAIN, DIRECTOR, ACQUISITION AND SOURCING MANAGEMENT, GAO; MAJOR GENERAL WILLIAM N. McCASLAND, DIRECTOR, SPACE ACQUISITION, OFFICER OF THE UNDER SECRETARY OF THE AIR FORCE; AND DR. STEVE HUYBRECHTS, PRINCIPAL DIRECTOR, COMMAND, CONTROL, COMMUNICATIONS, SPACE AND SPECTRUM, OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE NETWORKS AND INFORMATION INTEGRATION/CHIEF INFORMATION OFFICER**

**STATEMENT OF CRISTINA CHAPLAIN**

Ms. CHAPLAIN. Mr. Chairman and members of the subcommittee, thank you for inviting me today to discuss our work on the Global Positioning System. We perform this review for your committee in light of the criticality of GPS to the military, the economy, and many, many individual users, as well as challenges that have been facing the acquisition programs.

We've issued a comprehensive report which is available on the GAO Web site. The report covers our findings on the acquisition of the satellites, the ground control equipment, the military user equipment, as well as the larger coordination of GPS. Today I just want to highlight what we believe are the most important takeaways of our work.

In short, all three acquisition programs have had major issues in development which have had major consequences for GPS users. The GPS IIF satellite acquisition program, for example, as you mentioned, was delayed 3 years due to an array of issues, including requirements changes, a loss of expertise in building the GPS satellites on the contractor side, lax program oversight, and technical problems that the program is still dealing with. This, coupled with the aging of satellites in orbit, the decrease in the number of satellites that were planned for the IIF program, and scheduled risks going forward with the IIIA program, presents the risk of a capability gap.

Military user equipment acquisitions have also been delayed considerably due to funding shifts and diffuse attention. This has also had severe consequences for users. DOD purposefully reopened already manufactured satellites 10 years ago to install capability that would lessen the effect of jamming of GPS for military users. But today because of delays in the production of military user equipment we may not see that capability be taken advantage of for another 10 years.

Last, because of developmental delays, ground control equipment for GPS cannot presently support some capabilities of the newer satellites in orbit. With regard to the potential gap in satellite capability our analysis, as you said, shows that if both the IIF and IIIA programs are executed on schedule, there's still just an 80 to 90 percent probability that the GPS constellation will stay above 24 satellites. With a 2-year delay the probability drops to as low as 10 percent.

A couple notes about our analysis. One, we largely replicated the methodology employed by the Aerospace Corp. and relied on their reliability parameters. We matched the results of our analysis of

what could happen without the delay with the results for Aerospace Corp.

Two, there are measures available for the Air Force to deal with the gap, such as turning off a secondary payload for periods of time. But this produces other tradeoffs that need to be considered. Moreover, such measures may not be able to compensate if there are long delays in schedule.

Three, our analysis is based on the commitment of the Air Force to maintain a 24-satellite constellation, and many users, civilian and military, have expressed a desire for 30 or more satellites, particularly to assure coverage in mountainous and urban areas.

Four, the Air Force insists that it's on a good track to meet the schedule for the IIIA program, and we agree that it is and commend the Air Force for taking a number of actions to make the program more executable. However, it's important to remember the program is still in its early phases. The Air Force anticipates shaving off 3 years of what was done for the IIF program, and it is still not clear whether the IIF program has overcome its schedule problems. Also, the program is not merely replicating IIF, it is aiming to build GPS on a much larger satellite bus, increase the power of the military signal by a factor of 10, and add a new signal, all of which could create technical and design difficulties for the contractor.

Last, as you said, no major space program in recent years has been delivered on time. Some programs that have also tried to adopt better practices for development have still run into schedule delays. As we pointed out in other work, some space programs are facing delays as long as 7 years. So in our view, there are reasons to be concerned about the schedule for GPS IIIA. Moreover, as mentioned before, even without a delay there's still up to a 20 percent chance the constellation will fall below 24. Clearly that alone warrants attention from senior leaders and everyone involved with GPS, which our recommendations are focused on and which the DOD concurred with.

Before I conclude I would like to point out that we also focus on a larger coordination of GPS among civil agencies, the international community, and others. This is a very broad area which was frankly impossible to audit comprehensively in the time that we had. But it was clear through our discussions and analysis of documents that there is confusion on how civilian agencies should get their needs met by GPS, and frustration on DOD's part, which is focused on keeping the program executable.

I look forward to the discussion of today's second panel because it will also shed light on the degree that users are aware of risks facing the program and whether they are in a position to manage those risks. That concludes my statement, and I look forward to talking more about the report.

[The prepared statement of Ms. Chaplain follows:]

United States Government Accountability Office

GAO

Testimony

Before the Subcommittee on National Security and Foreign Affairs, Committee on Oversight and Government Reform, House of Representatives

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# GLOBAL POSITIONING SYSTEM

## Significant Challenges in Sustaining and Upgrading Widely Used Capabilities

Statement of Cristina T. Chaplain, Director
Acquisition and Sourcing Management

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GAO-09-670T

May 7, 2009

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**Highlights**

Highlights of GAO-09-670T, a testimony before the Subcommittee on National Security and Foreign Affairs, Committee on Oversight and Government Reform, House of Representatives

# GLOBAL POSITIONING SYSTEM

## Significant Challenges in Sustaining and Upgrading Widely Used Capabilities

### Why GAO Did This Study

The Global Positioning System (GPS), which provides position, navigation, and timing data to users worldwide, has become essential to U.S. national security and a key tool in an expanding array of public service and commercial applications at home and abroad. The United States provides GPS data free of charge. The Air Force, which is responsible for GPS acquisition, is in the process of modernizing GPS.

In light of the importance of GPS, the modernization effort, and international efforts to develop new systems, GAO was asked to undertake a broad review of GPS. Specifically, GAO assessed progress in (1) acquiring GPS satellites, (2) acquiring the ground control and user equipment necessary to leverage GPS satellite capabilities, and evaluated (3) coordination among federal agencies and other organizations to ensure GPS missions can be accomplished. To carry out this assessment, GAO's efforts included reviewing and analyzing program documentation, conducting its own analysis of Air Force satellite data, and interviewing key officials.

### What GAO Recommends

GAO recommended that the Secretary of Defense appoint a single authority to oversee the development of GPS, including space, ground control, and user equipment assets, to ensure these assets are synchronized and well executed, and potential disruptions are minimized. DOD concurred with our recommendations.

View GAO-09-670T or key components. For more information, contact Cristina T. Chaplain at (202) 512-4841 or chaplainc@gao.gov.

### What GAO Found

It is uncertain whether the Air Force will be able to acquire new satellites in time to maintain current GPS service without interruption. If not, some military operations and some civilian users could be adversely affected.

- In recent years, the Air Force has struggled to successfully build GPS satellites within cost and schedule goals; it encountered significant technical problems that still threaten its delivery schedule; and it struggled with a different contractor. As a result, the current IIF satellite program has overrun its original cost estimate by about $870 million and the launch of its first satellite has been delayed to November 2009—almost 3 years late.
- Further, while the Air Force is structuring the new GPS IIIA program to prevent mistakes made on the IIF program, the Air Force is aiming to deploy the next generation of GPS satellites 3 years faster than the IIF satellites. GAO's analysis found that this schedule is optimistic, given the program's late start, past trends in space acquisitions, and challenges facing the new contractor. Of particular concern is leadership for GPS acquisition, as GAO and other studies have found the lack of a single point of authority for space programs and frequent turnover in program managers have hampered requirements setting, funding stability, and resource allocation.
- If the Air Force does not meet its schedule goals for development of GPS IIIA satellites, there will be an increased likelihood that in 2010, as old satellites begin to fail, the overall GPS constellation will fall below the number of satellites required to provide the level of GPS service that the U.S. government commits to. Such a gap in capability could have wide-ranging impacts on all GPS users, though there are measures the Air Force and others can take to plan for and minimize these impacts.

In addition to risks facing the acquisition of new GPS satellites, the Air Force has not been fully successful in synchronizing the acquisition and development of the next generation of GPS satellites with the ground control and user equipment, thereby delaying the ability of military users to fully utilize new GPS satellite capabilities. Diffuse leadership has been a contributing factor, given that there is no single authority responsible for synchronizing all procurements and fielding related to GPS, and funding has been diverted from ground programs to pay for problems in the space segment.

DOD and others involved in ensuring GPS can serve communities beyond the military have taken prudent steps to manage requirements and coordinate among the many organizations involved with GPS. However, GAO identified challenges in the areas of ensuring civilian requirements can be met and ensuring GPS compatibility with other new, potentially competing global space-based positioning, navigation, and timing systems.

Mr. Chairman and Members of the Subcommittee:

I am pleased to be here today to discuss the Global Positioning System (GPS)—a space-based satellite system that provides positioning, navigation, and timing data to users worldwide—that has become essential to U.S. national security and a key component in economic growth, transportation safety, homeland security, and critical national infrastructure in the United States and abroad. In view of the importance of GPS to the military, the economy and other critical sectors, and problems being experienced in the acquisition of GPS, you requested that we perform a comprehensive review of the program. Our report, which was issued on April 30, presents our findings in considerable detail. My statement today will focus on the essence of what we found.

In summary, it is uncertain whether the Air Force will be able to acquire new satellites in time to maintain current GPS service without interruption. If not, some military operations and some civilian users could be adversely affected. In addition, military users will experience a delay in utilizing new GPS capabilities, including improved resistance to jamming of GPS signals, because of poor synchronization of the acquisition and development of the satellites with the ground control and user equipment. Finally, there are challenges in ensuring civilian requirements for GPS can be met and that GPS is compatible with other new, potentially competing global space-based positioning, navigation, and timing systems.

## Background

The U.S. government provides GPS service free of charge and plans to invest more than $5.8 billion over the next 5 years in the GPS satellites and ground control segments. The Department of Defense (DOD) develops and operates GPS, and an interdepartmental committee—co-chaired by DOD and the Department of Transportation—manages the U.S. space-based positioning, navigation, and timing infrastructure, which includes GPS. DOD also provides most of the funding for GPS. The Air Force is responsible for GPS acquisition and is in the process of modernizing GPS to enhance its performance, accuracy, and integrity. The modernization effort includes GPS IIF and IIIA, two satellite acquisition programs that are to provide new space-based capabilities and replenish the satellite constellation; the ground control segment hardware and software; and user equipment for processing modernized GPS capabilities. Other countries are also developing their own independent global navigation satellite systems that could offer capabilities that are comparable, if not superior, to GPS.

## Air Force Faces Significant Challenges in Acquiring GPS Satellites

In recent years under the IIF program, the Air Force has struggled to successfully build GPS satellites within cost and schedule goals. It encountered significant technical problems that still threaten its delivery schedule and it struggled with a different contractor for the IIF program. These problems were compounded by an acquisition strategy that relaxed oversight and quality inspections as well as multiple contractor mergers and moves, and the addition of new requirements late in the development cycle.

GPS was not the only space program started in the 1990s to face such challenges. In fact, DOD continues to face cost overruns in the billions of dollars, schedule delays adding up to years, and performance shortfalls stemming from programs that began in the 1990s and after that were poorly structured, managed and overseen. What sets GPS apart from those programs is that GPS had already been "done" before. The GPS IIF program was far less ambitious than efforts to advance missile warning and weather monitoring capabilities, for example.

Our report documents the history of the IIF program and the decisions made early on that weakened the foundation for program execution. What is important to highlight today is that the program is still experiencing technical problems that still threaten its delivery schedule. For example, last year, during the first phase of thermal vacuum testing (a critical test to determine space-worthiness that subjects the satellite to space-like operating conditions), one transmitter used to send the navigation message to the users failed. The program suspended testing in August 2008 to allow time for the contractor to identify the causes of the problems and take corrective actions. The program also had difficulty maintaining the proper propellant fuel-line temperature; this, in addition to power failures on the satellite, delayed final integration testing. In addition, the satellite's reaction wheels, used for pointing accuracy, were redesigned because on-orbit failures on similar reaction wheels were occurring on other satellite programs—this added about $10 million to the program's cost. As a result of these problems, the cost to complete GPS IIF will be about $1.6 billion—about $870 million over the original cost estimate of $729 million. The launch of the first IIF satellite has been delayed until November 2009—almost 3 years late.

The Air Force is taking measures to prevent the problems experienced on the GPS IIF program from recurring on the GPS IIIA program. Some of the measures the Air Force is taking include:

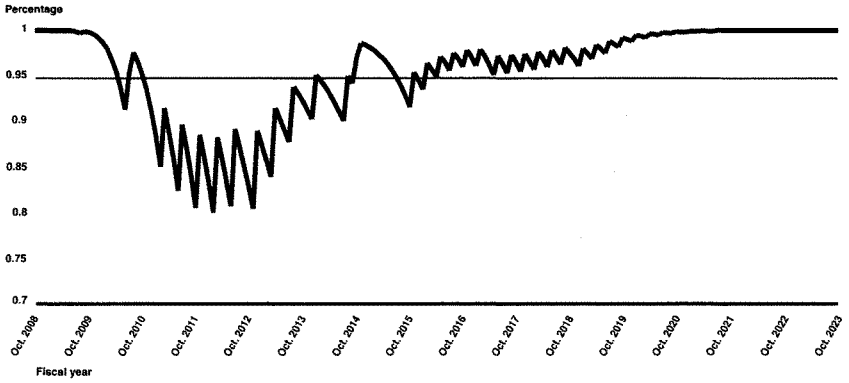
- using incremental or block development, where the program would follow an evolutionary path toward meeting needs rather than attempting to satisfy all needs in a single step;
- using military standards for satellite quality;
- conducting multiple design reviews, with the contractor being held to military standards and deliverables during each review;
- exercising more government oversight and interaction with the contractor and spending more time at the contractor's site;
- using an improved risk management process, where the government is an integral part of the process;
- not allowing the program manager to adjust the GPS IIIA program scope to meet increased or accelerated technical specifications, system requirements, or system performance; and
- conducting an independent technology readiness assessment of the contractor design once the preliminary design review is complete.

These efforts are not trivial. The primary causes of space acquisition problems in our view include (1) the tendency to start space programs too early, that is, before there has been assurance that the capabilities being pursuing can be achieved within resources and time constraints and (2) the tendency to attempt to achieve all requirements in one step rather than gradually. The GPS IIIA program was structured to avoid these problems and ensure the program has the right knowledge for moving forward into the acquisition process. Moreover, our work has cited prior acquisition strategies in which the lack of contractor oversight was a problem. Again, the actions being taken on GPS IIIA put controls in place to strengthen oversight and government involvement. We also recognize that the GPS IIIA program took steps to produce realistic cost estimates, which has generally not been done in the past.

Nevertheless, there is still a high risk that the Air Force will not meet its schedule for GPS. First, it is aiming to deploy the GPS IIIA satellites 3 years faster than the IIF satellites. Second, the time period between the contract award and first launch for GPS IIIA is shorter than most other major space programs we have reviewed. Third, GPS IIIA is not simply a matter of replicating the IIF program. Though the contractor has had previous experience with GPS, it is likely that the knowledge base will need to be revitalized. The contractor is also being asked to develop a larger satellite bus to accommodate the future GPS increments and to increase the power of a new military signal by a factor of ten. In view of these and other schedule issues, we believe that there is little room in the schedule to accommodate difficulties that the contractor or program may face.

Where does this leave the wide span of military, civil, and other user of GPS? If the Air Force does not meet its schedule goals for development of GPS IIIA satellites, there will be an increased likelihood that in 2010, as old satellites begin to fail, the overall GPS constellation will fall below the number of satellites required to provide the level of GPS service that the U.S. government is committing to providing. The performance standards for both (1) the standard positioning service provided to civil and commercial GPS users and (2) the precise positioning service provided to military GPS users commit the U.S. government to at least a 95 percent probability of maintaining a constellation of 24 operational GPS satellites. Because there are currently 31 operational GPS satellites of various blocks, the near-term probability of maintaining a constellation of at least 24 operational satellites remains well above 95 percent. However, DOD predicts that over the next several years many of the older satellites in the constellation will reach the end of their operational life faster than they will be replenished, and that the constellation will, in all likelihood, decrease in size. Based on the most recent satellite reliability and launch schedule data approved in March 2009, the estimated long-term probability of maintaining a constellation of at least 24 operational satellites falls below 95 percent during fiscal year 2010 and remains below 95 percent until the end of fiscal year 2014, at times falling to about 80 percent. See figure 1 for details.

**Figure 1: Probability of Maintaining a Constellation of at Least 24 GPS Satellites Based on Reliability Data and Launch Schedule as of March 2009**




Source: GAO analysis of DOD data.

Such a gap in capability could have wide-ranging impacts on GPS users, though the exact impact is hard to precisely define, as it would depend on which satellites stop operating. To illustrate, however, the military could see a decrease in the accuracy of precision-guided munitions that rely on GPS to strike their targets. Disruptions in service could require military forces to either use larger munitions or to use more munitions on the same target to achieve the same level of success. Intercontinental commercial flights use predicted satellite geometry over their planned navigation route, and may have to delay, cancel, or reroute flights. Enhanced 911 services, which rely on GPS to precisely locate callers, could lose accuracy particularly when operating in urban canyons or mountainous terrain.

The Air Force is aware that, over the next several years, there is some risk that the number of satellites in the GPS constellation could fall below its required 24 satellites, and that this risk would grow significantly if the development and launch of GPS IIIA satellites were delayed by several

years. Consequently, Air Force Space Command has established an independent review team to examine the risks and consequences of a smaller constellation on military and civil users. There are measures the Air Force and others can take to plan for and minimize these impacts, which are detailed in our report. However, at this time Air Force representatives believe the best approach to mitigating the risk is to take all reasonable steps to ensure that the current schedule for GPS IIIA is maintained. Moreover, it is unclear whether the user community knows enough about the potential problem to do something about it.

## New Satellite Capabilities Will Not Be Leveraged Because of Delayed Delivery of Ground and User Equipment Capabilities

To maximize the benefit of GPS, the delivery of its ground control and user equipment capabilities must be synchronized with the delivery of the satellites so that the full spectrum of military assets and individual users can take advantage of new capabilities. This is a challenging endeavor for GPS as it involves installing GPS equipment on board a wide range of ships, aircraft, missiles, and other weapon systems. Our review found that because of funding shifts and diffuse leadership, the Air Force has not been successful in synchronizing satellite, ground control, and user equipment segments. As a result of the poor synchronization, new GPS capabilities may be delivered in space for years before military users can take advantage of them.

The Air Force used funding set aside for the ground control and user equipment segment to resolve GPS satellite development problems, causing a delay in the delivery of new GPS capabilities. For example, in 2005 the Air Force began launching its GPS IIR-M satellites, which broadcast a second civil signal. Unfortunately, the ground control segment will not be able to make the second civil signal operational until late 2012 or 2013—7 years later. Likewise, a modernized military signal designed to improve resistance to jamming of GPS will be available for operations on GPS satellites over a decade before user equipment will be fielded that is able to take strategic advantage of it.

Because leadership for acquisitions across the space community is fragmented, there is no single authority responsible for synchronizing all segments related to GPS. The responsibility for developing and acquiring GPS satellites and associated ground control segments and for acquiring and producing user equipment for selected platforms for space, air, ground, and maritime environments falls under the Air Force's Space and Missile Systems Center. On the other hand, responsibility for acquiring and producing user equipment for all other platforms falls on the military services.

## Challenges in Coordinating Requirements and Ensuring Compatibility

GPS has produced dramatic improvements both for the United States and globally. Ensuring that it can continue to do so is extremely challenging given competing interests, the span of government and commercial organizations involved with GPS, and the criticality of GPS to national and homeland security and the economy. On the one hand, DOD must ensure that military requirements receive top priority and the program stays executable. In doing so, it must ensure that the program is not encumbered by requirements that could disrupt development, design, and production of satellites. On the other hand, there are clearly other enhancements that could be made to GPS satellites that could serve a variety of vital missions—particularly because of the coverage GPS satellites provide—and there is an expressed desire for GPS to serve as the world's preeminent positioning, navigation, and timing system. In addition, while the United States is challenged to deliver GPS on a tight schedule, other countries are designing and developing systems that provide the same or enhanced capabilities. Ensuring that these capabilities can be leveraged without compromising national security or the preeminence of GPS is also a delicate balancing act that requires close cooperation between DOD, the Department of State, and other institutions.

Because of the scale and number of organizations involved in maximizing GPS, we did not undertake a full-scale review of the requirements and coordination processes. However, we reviewed documents supporting these processes and interviewed a variety of officials to obtain views on their effectiveness. While there is a consensus that DOD and other federal organizations involved with GPS have taken prudent steps to manage requirements and optimize GPS use, we also identified challenges in the areas of ensuring civilian requirements can be met and ensuring that GPS is compatible with other new, potentially competing global space-based positioning, navigation, and timing systems. According to the civil agencies that have proposed GPS requirements, the formal requirements approval process is confusing, time consuming, and difficult to manage. Regarding the international community, while the U.S. government has engaged a number of other countries and international organizations in cooperative discussions, only one legally binding agreement has been established.

## Stronger Leadership Paramount to Addressing GPS Problems

GPS has enabled transformations in military and other government operations and has become part of the critical infrastructure serving national and international communities. Clearly, the United States cannot afford to see its GPS capabilities decrease below its requirement, and optimally, it is one that should stay preeminent. Over the past decade, however, the program has experienced cost increases and schedule delays, and though the Air Force is making a concerted effort to address acquisition problems, there is still considerable risk that satellites will not be delivered on time and that there will be gaps in capability.

As such, we concluded in our review that focused attention and oversight is needed to ensure the program stays on track and is adequately resourced, that unanticipated problems are quickly discovered and resolved, and that all communities involved with GPS are aware of and positioned to address potential gaps in service. But this is difficult to achieve given diffuse responsibility for the GPS acquisition program. Importantly, several recent congressional studies have found that authority and responsibilities for military space and intelligence programs are scattered across the staffs of various DOD organizations and the Intelligence Community, and that this is contributing to difficulties on all major space programs in meeting their schedules.

The problem is more acute with GPS because of the range of organizations involved in the program. As mentioned earlier, because different military services are involved in developing and installing equipment onto the weapon systems they operate, there are separate budget, management, oversight, and leadership structures over the user segments. And while there have been various recommendations to accelerate the fielding of military user equipment, this has been difficult to do partially because the program office is experiencing technical issues.

We recommended that the Secretary of Defense appoint a single authority to oversee the development of the GPS system, including space, ground control, and user equipment assets, to ensure that the program is well executed and resourced and that potential disruptions are minimized. The appointee should have authority to ensure space, ground control, and user equipment are synchronized to the maximum extent practicable; and coordinate with the existing positioning, navigation, and timing infrastructure to assess and minimize potential service disruptions in the event that the satellite constellation were to decrease in size for an extended period of time. Given the importance of GPS to the civil community, we also recommended that the secretaries of Defense and Transportation, as the co-chairs of the National Executive Committee for

Space-Based Positioning, Navigation and Timing, address, if weaknesses are found, civil agency concerns for developing requirements and determine mechanisms for improving collaboration and decision making and strengthening civil agency participation.

In responding to our report, DOD concurred with our recommendations, and stated that it recognized the importance of centralizing authority to oversee the continuing synchronized evolution of the GPS and that it will continue to seek ways to improve civil agency understanding of the DOD requirements process and work to strengthen civil agency participation. We continue to believe that DOD will consider an approach that enables a single individual to make resource decisions and maintain visibility over progress and establish a means by which progress in developing the satellites and ground equipment receive attention from the highest level of leadership, that is the Defense Secretary and perhaps the National Security Council, given the criticality of GPS to the warfighter and the nation, and the risks associated with not meeting schedule goals. In addition, as DOD undertakes efforts to inform and educate civil agencies on the requirements process, we encourage it to take a more active role in directly communicating with civil agencies to more precisely identify concerns or weaknesses in the requirements process.

Mr. Chairman, this concludes my statement. I will be happy to answer any questions that you or other Members of the Subcommittee have at this time.

# Appendix I: Scope and Methodology

To assess the acquisition of satellite, ground control, and user equipment, we interviewed Office of the Secretary of Defense (OSD) and Department of Defense (DOD) officials from offices that manage and oversee the Global Positioning System (GPS) program. We also reviewed and analyzed program plans and documentation related to cost, schedule, requirements, program direction, and satellite constellation sustainment, and compared programmatic data to GAO's criteria compiled over the last 12 years for best practices in system development. We also conducted our own analysis, based on data provided by the Air Force, to assess the implications of potential schedule delays we identified in our assessment of the satellite acquisition. To assess coordination among federal agencies and the broader GPS community, we interviewed OSD and DOD officials from offices that manage and oversee the GPS program, officials from the military services, officials from civil departments and agencies, and officials at the U.S. Department of State and at various European space organizations. We also analyzed how civil departments and agencies coordinate with DOD on GPS civil requirements, and how the U.S. government coordinates with foreign countries. We conducted this performance audit from October 2007 to April 2009 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

# Appendix II: Contact and Acknowledgments

For further information, please contact Cristina Chaplain at (202) 512-4841 or chaplainc@gao.gov. Individuals making contributions to this testimony include Art Gallegos, Greg Campbell, Maria Durant, Laura Hook, Sigrid McGinty, Jay Tallon, and Alyssa Weir.

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Mr. TIERNEY. Thank you very much.

General.

**STATEMENT OF MAJOR GENERAL WILLIAM N. McCASLAND**

General MCCASLAND. Good morning, Chairman Tierney, Ranking Member Flake, distinguished members of National Security and Foreign Affairs Subcommittee——

Mr. TIERNEY. May I ask you to pull the mic closer to you and make sure it's on.

General MCCASLAND. Yes, sir. There we go. Yes, sir. I'm Major Neal McCasland, the Air Force's Director for Space Acquisition in the Pentagon, and it's a distinct privilege to address you on the Air Force's management and execution of the GPS program. I've provided a written statement for the record, so will limit my opening remarks.

GPS provides accurate location and time information in all weather, day and night, worldwide. It's vital to military and civil activities, including mapping, aerial refueling, weapons, search and rescue operations, banking, Geodetic Survey, and agriculture. The Air Force, as the developer, operator, and steward for GPS, is committed to maintaining GPS as the gold standard for positioning, navigation, and timing information.

As your committee has noticed, and this hearing is evidence, a sure GPS capability is critical to the success for many missions, from humanitarian relief to military operations. The Air Force is committed to continuity of this critical service. To that end, sustainment of the constellation is our No. 1 priority.

In addition, we continue to make improvements to the constellation, including new civil signals, more jam resistant military codes, new receivers, increasing accuracy, and integrity of the service.

The foundation for success, both technically and schedule wise, lies in our mission assurance process. Mission assurance is a disciplined application of management system engineering and quality principles over the entire life cycle to ensure mission needs are satisfied. It's a culture we've worked hard to rebuild at the Space and Missile Systems Product Center that permeates the GPS team as ingrained throughout all its functional disciplines.

Simultaneously, senior leadership across the Air Force, Departments of Defense, and Transportation have committed to GPS program success. This shared goal enhances capability synchronization, budget advocacy, and stability and provides the support we need to deliver and execute our plan.

The Air Force, sir, is committed to maintaining GPS as the premier provider of positioning navigation and timing services. We have a high confidence plan to sustain and modernize this critical national capability.

Thank you for inviting me here today. I'm ready to answer your questions.

[The prepared statement of General McCasland follows:]

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SUBCOMMITTEE ON NATIONAL SECURITY AND FOREIGN AFFAIRS
U.S. HOUSE OF REPRESENTATIVES

STATEMENT OF

MAJOR GENERAL NEIL MCCASLAND

DIRECTOR, SPACE ACQUISITION, OFFICE OF THE SECRETARY OF THE AIR FORCE

BEFORE THE SUBCOMMITTEE ON NATIONAL SECURITY AND FOREIGN AFFAIRS

HOUSE COMMITTEE ON GOVERNMENT OVERSIGHT AND REFORM

ON "*GPS: CAN WE AVOID A GAP IN SERVICE?*"

7 MAY 2009

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U.S. HOUSE OF REPRESENTATIVES

Mr. Chairman, Ranking Member Flake, distinguished Members of the Subcommittee on National Security and Foreign Affairs, it is a privilege to address you on the Air Force's management and execution of the Global Positioning System (GPS) acquisition program. GPS provides accurate location and time information for unlimited users in all weather, day and night, anywhere in the world. It is vital to numerous military and civil activities, including mapping, aerial refueling, weapons delivery, rendezvous operations, search and rescue operations, banking, transportation and agriculture. The Air Force, as the developer, operator, and steward for GPS, is committed to maintaining GPS as the gold standard for positioning, navigation, and timing information. I will focus my discussion on recent program successes, plans to sustain and modernize civil and military capability, and the interagency partnerships required to guarantee GPS program success.

**RECENT SUCCESSES**

First, let me talk about a few recent successes. In September 2007, the 22-year-old, unsustainable legacy GPS Master Control Station was replaced by the Architecture Evolution Plan System, or AEP, which improved GPS accuracy, provided the capability to operate the GPS IIF satellites, and will increase the ability to protect the military's use of GPS signals. The transition from the legacy to this new control segment was seamless to GPS users worldwide.

We are also significantly modernizing the GPS space segment. In March we launched the seventh vehicle in the current generation of GPS satellites, known as Block IIR-M. This family of satellites supports a second civil signal, L2C, and a new fully-encrypted military-exclusive signal, M-code, that will provide improved anti-jam performance. The IIR-M launched in March just performed a successful test broadcast of a third civil signal, known as L5. This enabled the US to secure its filing for the frequency with the International Telecommunication Union.

The next generation of GPS satellites is the IIF family. This program has taken longer than planned to reach first launch due to the program's initial acquisition strategy, new requirements added for modernized GPS navigation signals and flexible power, defense industrial base consolidation, and technical issues. These issues propelled the Air Force to launch a campaign to rebuild our confidence in the schedule of this critical space system through a renewed focus on mission assurance.

We have now achieved multiple milestones for the first GPS IIF space vehicle including successful thermal vacuum and final integrated systems testing for satellite #1. At the same time, we are preparing to send the second space vehicle to Cape Canaveral as a pathfinder and also establishing a production line for the remaining vehicles. I'm confident we'll launch the first IIF in the first half of FY10, and the remaining space vehicles will be produced and available as needed over the next three to five years.

Finally, we have put great emphasis on the all-important user equipment. To date, the Air Force has procured nearly 345,000 Defense Advanced GPS Receivers, upgraded Miniaturized Airborne GPS Receivers, and procured 80,000 Ground Based GPS Receiver Applications Modules. Collectively, these deliveries represent significant enhancement to security and GPS anti-jam capability, increasing combat effectiveness.

**PLANS TO SUSTAIN AND MODERNIZE**

As important as these successes have been, we must continue to modernize. As we evolve all three GPS segments, we will deliver significant new capabilities. For the military user, both the GPS M-Code and increased power are key enablers of navigation warfare capabilities. The civil user will gain two new signals to provide greater accuracy, integrity, and utility.

A key element of our strategy is to deliver the first GPS III satellite to a known schedule. We worked hard with our requirements arm, our industrial partners, and our fiscal planners to ensure we integrated every lesson from the past to create a high-confidence GPS III schedule. In addition, our approach utilizes a significant amount of Lockheed Martin GPS IIR-M space vehicle heritage. The GPS IIIA program completed extensive pre-award risk reduction activities and demonstrated early designs and prototypes of higher-risk items. These efforts allowed us both to adopt a phased acquisition approach to pursue a low-risk set of capabilities for the initial satellites to support constellation replenishment and to allow longer technology maturation timelines for more challenging capabilities. Two weeks from now, the GPS IIIA program completes its Preliminary Design Review on schedule. This milestone demonstrates that the design addresses requirements with adequate margin to meet program objectives. The program is on track for a first launch in 2014.

The modernized control segment required to support the Block III Satellites, as well as critical information assurance and effect-based operations requirements, is currently in the technology demonstration phase and has completed system design review and prototype demonstration. We will soon down-select to one vendor to complete system development, with delivery in 2013.

New military user equipment is under development to exploit advances in the space and control segments. Currently, the three Military GPS User Equipment (MGUE) Technology Demonstration vendors continue to mature critical technologies, burn down risk, and provide a baseline for the new approach to information assurance requirements. All three vendors are developing prototype hardware capable of receiving new and existing GPS signals, and each has conducted a Critical Design Review. Prototype hardware deliveries begin in early Fiscal Year 2010. Based on the technology demonstration work, our approach to MGUE development and

integration will emphasize modularity in the design to enable integration into the large number of end user applications and platforms. Available in 2015, these lighter, faster new receivers will be reprogrammable and include security and jam-resistant improvements.

The foundation for success both technically and programmatically in our modernization efforts lies in our mission assurance process. Mission assurance is a disciplined application of management, systems engineering, and quality principles over the entire lifecycle to ensure mission needs are satisfied. It is a culture that we've rebuilt at SMC that permeates the GPS team and is ingrained through all functional disciplines.

Three elements are key to the mission assurance culture: risk management, disciplined engineering, and strong government oversight. Proper risk management has been in place from the beginning of the programs. Prior to awarding development contracts, the government conducted extensive risk reduction activity to establish an allocated requirements baseline and develop and demonstrate early designs and prototypes of higher risk items.

Disciplined engineering for GPS means we have taken a government-led enterprise approach to engineering processes. This approach emphasizes rigorous baseline management, institution of specifications and standards, and government responsibility for cost, schedule and technical trades. The enterprise approach also provides for integrated system-level testing to validate the service provided to warfighters and civil users alike.

Consistent with recommendations of several studies on acquisition, we've staffed the team with experienced and trained personnel who can exercise clear government oversight. Learning from the difficulties encountered with GPS IIF, we have placed responsibility to deliver our system back where it belongs – with the government. We have also put a team of retired military officers and senior contractor leadership in place to provide management, systems engineering, and business operations training and mentoring for these personnel.

Simultaneously, senior leadership across the Air Force, DoD, and DoT have committed to GPS program success. This shared goal enhances capability synchronization, budget advocacy and stability, and provides us the support we need to deliver to our plan.

## UNITY OF EFFORT

GPS supports both military and civil users and requires involvement, advocacy, and resources from the DoD and DOT. Within the DoD, Air Force Space Command is responsible for leading GPS requirements development and advocacy through the Joint Requirements Oversight Council. Acquisition responsibility for GPS falls under the Program Executive Officer for Space working through the Deputy Undersecretary of the Air Force for Space Acquisition and the Undersecretary of Defense for Acquisition, Technology and Logistics.

DOT is the lead civil agency for GPS and coordinates the requirements, resources, and advocacy across the civil community. To ensure unity of effort between DoD and DoT, the President signed the US Space-Based Positioning, Navigation, and Timing Policy on 8 December 2004. This policy established guidance and implementation actions for space-based PNT programs, augmentations, and activities for US national and homeland security, civil, scientific, and commercial purposes. The policy also created a National Space-Based PNT Executive Committee to advise and coordinate among federal agencies. This process is working well, and has yielded great benefit for the GPS enterprise.

## CONCLUSION

The Air Force is committed to maintaining GPS as the premier provider of positioning, navigation, and timing for users around the world. We have high-confidence plans to sustain and modernize this critical national capability on planned schedules.

Mr. TIERNEY. Doctor.

**STATEMENT OF DR. STEVE HUYBRECHTS**

Dr. HUYBRECHTS. Good morning, Chairman Tierney, Mr. Flake, distinguished Members. Thank you for the opportunity to testify before the Subcommittee on National Security and Foreign Affairs.

Mr. TIERNEY. Can I ask you as well to pull that closer to you. That would be helpful.

Dr. HUYBRECHTS. I'm sorry. Is that better?

I have also provided a written statement for the record, and General McCasland has gone through much of DOD's position so I'll limit my opening remarks.

My name is Steve Huybrechts. I'm here today representing Mr. Grimes, the former Assistant Secretary of Defense for Networks and Information Integration. As stated before, I'm the Principal Director for Communications, Command and Control, Space and Spectrum.

GPS does play a major combat support role today in both Operation Iraqi Freedom and Enduring Freedom. The system plays an ever increasing role in a wide range of DOD missions, including counterinsurgency operations, force and infrastructure protection, collection of intelligence, and strike of time critical targets.

I appreciate the chance to again highlight the importance of GPS to a wider audience and the importance of keeping funding for GPS across both defense and civil lines stable.

Mr. Chairman and members of the subcommittee, I thank you again for the opportunity to speak to you today. We greatly appreciate your support, and I look forward to continued collaboration.

[The prepared statement of Dr. Huybrechts follows:]

RECORD VERSION

STATEMENT BY

DR. STEVE HUYBRECHTS

PRINCIPAL DIRECTOR,

FOR COMMAND, CONTROL, COMMUNICATIONS,

SPACE AND SPECTRUM

BEFORE THE

U.S. HOUSE OF REPRESENTATIVES

OVERSIGHT AND GOVERNMENT REFORM COMMITTEE

SUBCOMMITTEE ON

NATIONAL SECURITY AND FOREIGN AFFAIRS

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INTRODUCTION

Good afternoon, Chairman Tierney, Congressman Flake, and Members of the National Security and Foreign Affairs Subcommittee. I am Dr. Steve Huybrechts, the Principal Director, Command, Control, Communications, Space and Spectrum representing the Office of the Assistant Secretary of Defense for Networks and Information Integration/Department of Defense Chief Information Officer. I am pleased to appear before the Subcommittee to discuss the Global Positioning System.

The Deputy Assistant Secretary of Defense (DASD) for Command, Control, Communications, (C3), Space and Spectrum reports to the Assistant Secretary of Defense for Networks and Information Integration (ASD/NII).

The ASD(NII)/DoD CIO is the principal staff assistant and advisor to the Secretary of Defense and Deputy Secretary of Defense on non-intelligence space matters including space-based positioning, navigation and timing, satellite communications, space based information integration, space control, operationally responsive space, space access, satellite control, , environmental sensing, and space launch ranges. ASD(NII) also oversees space Milestone Decision Acquisition Program (MDAP) activities of the DOD Executive Agent for Space and develops and implements PNT policy.

The recent GAO report, Global Positioning System: "Significant Challenges in Sustaining and Upgrading Widely Used Capabilities," recommends

that the Secretary of Defense appoint a single authority to oversee the development of the Global Positioning System (GPS), including space, ground, and user assets, to ensure that the program is well executed and resourced and that potential disruptions are minimized. The Department concurs with that recommendation.

The Department has recognized the importance of centralizing authority to oversee the continuing synchronized evolution of the GPS. To that end, Deputy Secretary of Defense Lynn has reaffirmed that the Assistant Secretary of Defense for Networks and Information Integration (ASD(NII)) is the Department's Principal Staff Assistant to oversee Positioning, Navigation, and Timing, and, specifically, is designated with authority and responsibility for all aspects of the Global Position System (GPS).

Further, under oversight of the ASD(NII), the U.S. Air Force is the single acquisition agent with responsibility for synchronized modernization of GPS space, ground control, and military user equipment. The Air Force acquires the GPS space and control segments, and provides the fundamental system design and security requirements necessary for acquisition of GPS user equipment and applications in support of diverse missions across the Department. The Joint Functional Component Command Space, under the authority of US Strategic Command, exercises operational control of the on-orbit GPS constellation.

Given the diversity of platforms, and equipment form factors involved, it is impossible for the Air Force to unilaterally produce a "one-size-fits-all" solution applicable to all DoD missions.

The GAO also recommends that the Secretary of Defense, as one of the Space-Based Positioning, Navigation and Timing Executive Committee co-chairs, address, if weaknesses are found, civil agency concerns for developing requirements and determine mechanisms for improving collaboration and decision making and strengthening civil agency participation. The Department agrees with that recommendation as well.

The Department is aware that we employ a rigorous requirements process in support of our extensive operational and acquisition responsibilities and that the process is a source of frustration for civil agencies without similar processes in place. In an effort to address the issue, we have worked with the civil agencies to put in place a GPS Interagency Requirements Plan, jointly approved by the Vice Chairman of the Joint Chiefs of Staff, who is in charge of our process, and the Department of Transportation (DOT), acting on behalf of all civil agencies. Further, we are now in the process of jointly coordinating an updated Charter for an Interagency Forum for Operational Requirements (IFOR) to provide meeting venues to identify, discuss, and validate civil or dual use GPS requirements for inclusion in the DoD GPS acquisition process. Finally, we sponsor educational outreach opportunities for civil agencies to become more fully acquainted with the DoD requirements process, including a day-long "Requirements Process Summit"

jointly conducted by the Joint Staff and Department of Transportation on April 29, 2008. We will continue to seek ways to improve civil agency understanding of the DoD requirements process and work to strengthen civil agency participation.

Summary

The Global Positioning System is critical to the conduct of military operations and the US military's superiority is dependent on it. DoD provides location, navigation and timing through the GPS System to precise/autonomous weapons and forces. I look forward to answering your questions.

Mr. TIERNEY. Well, thank you for what I can only term as minimalist testimony. It was both you and General McCasland. I don't want to be overly critical on that, General McCasland, but I read your testimony and heard what you have to say and some would term it as happy talk in the context of what we're doing here. And I understand the Air Force is excited about its mission or whatever, but we have some serious difficulties here in issues that I think have to be confronted on that.

Let me start. Dr. Huybrechts, at least your written testimony did address the two questions that the Government Accountability Office posed. And so, Ms. Chaplain, let me ask you, has the Department of Defense as far as GAO is concerned responded as you would anticipate and as you would have hoped with respect to the two issues and recommendations that you presented?

Ms. CHAPLAIN. The Department of Defense concurred with both recommendations.

Mr. TIERNEY. Have they done anything about it?

Ms. CHAPLAIN. The report just went out, so I don't see what they've done yet. In describing their concurrence they've pretty much said the leadership structure that's in place for GPS serves them well. And what we're concerned about is that there's a lot of people that have a hand in the GPS program, and it's not always clear who's really in charge of the program.

That gets to be particularly troublesome when it comes to the user equipment. Each military service develops its own user equipment that goes on every kind of weapon system you can think of. And that's where we see a huge delay, getting that user equipment onto weapon systems. So the military services have their control over that issue. Acquisition, technology and logistics have control on oversight over the acquisition side of GPS. The NII office is designated as the lead office for GPS. And there's also many, many other players involved with GPS.

So again in our view what we were hoping to see was just strength and kind of leadership focused on GPS because of the potential capability gaps, because of the risks in acquisition, and because of the criticality of GPS to everybody in the Nation.

Mr. TIERNEY. Dr. Huybrechts, are you that person? Are you the one that draws it all together to make sure that they're coordinating and getting things done in a timely fashion?

Dr. HUYBRECHTS. That is my role, yes, up at the OSD level. We have put a single service, the Air Force, in charge of all segments of the GPS program. This is unlike the way that we handled many of our other space programs where multiple services are involved. So from that perspective you do have a single entity that's in charge of acquisition and operation of the system. My office at the OSD level has been given by the Deputy Secretary of Defense singular responsibility for this program.

That said, we have to manage the program within the Department's processes. It's one of many programs and has to get traded off against all the other various departments' needs.

I would like to address the issue of the user equipment delay, if I could. I think that about 4 or 5 years ago the Department and particularly the Air Force did recognize that there was a risk of a gap if we did not act.

Mr. TIERNEY. They did or did not recognize?

Dr. HUYBRECHTS. Did, did recognize that. And it's for that reason that within the resources available to the program that we prioritized the space segment followed by the ground segment upgrades higher than the user equipment. That's one reason the user equipment is lagging, is because we wanted to prioritize any mitigation or mitigation of a gap in service.

Mr. TIERNEY. So you took from Peter to pay Paul. Basically you took money out of the end user aspect to deal with the satellite situation?

Dr. HUYBRECHTS. Yes. I would argue that it's probably less an issue of money than it is just an issue of people that understand this technology that can do this kind of work. There's only so many resources that we can apply to the various things within space that we're trying to execute. And within this program and the elements of our Nation that understand this technology we prioritize continuity of service.

And now if you look where we are focused today it's largely on the user equipment because we feel we have a pretty solid plan going forward for the continuity of the service issue.

Mr. TIERNEY. We're going to get to that in a second. Ms. Chaplain, does that give you any comfort?

Ms. CHAPLAIN. I know you're familiar with GAO's concerns about the larger acquisition process. And one of the things we harp on is investment strategies and prioritizing across the Department. In my view, if you're going to put a priority on GPS you need to have a priority on the user equipment and look beyond the space portfolio for those resources if it's so important to the military.

Mr. TIERNEY. And I'm curious, how does the Air Force really manage all of the other departments and tell them what needs to be done when? General, do you have any difficulty with that? What I hear from the GAO report is everybody is sort of getting their aspect of it ready when it's ready and putting it on whenever they might, and there seems to be no control over getting them all coordinated and synchronized. What are you doing with that?

General MCCASLAND. Let me elaborate a little bit on that. First off, the Air Force's role in user equipment is to develop product lines that are available for the other services and any user to integrate them. And just as something to show, I have here engineering models of the Next Generation M-code compatible user equipment that we're going to be fielding to operate with GPS III satellites. Now, these are very early engineering models, and it's from two different vendors, and it's just an illustration that we're making technical progress today.

To your broader question about management, it's the Air Force's role to develop product ties and make available for production gear like this. And these are chip sets and subassemblies that have all the functions of GPS on them and to make them available for the defense industry and the other services as a whole. And this is because the Air Force really shouldn't be in a position of building the end item that is fielded into Army mechanized equipment or into ships or into other people's airplanes.

Mr. TIERNEY. But I suspect that somebody, if not the Air Force then Dr. Huybrechts' office, should be in the business of making sure they get it done on time and to certain standards.

General MCCASLAND. Yes, sir, you bet. And the standard setting inside the Department, the Office of Secretary of Defense sets policy oversight, the Office of the Chairman of the Joint Chiefs sets technical standards for functional integration across this enterprise. And we've been through this in many ways. If you may recall, the original fielding of GPS into the military took these tools of synchronization. And so there's been two generations of modernization of GPS user equipment since the original fielding. All of them have followed a pattern that we've learned from. And it's a balance for a program manager, say the manager of an Army mechanized equipment line. You know, that program manager has their own set of schedule and cost constraints and services to integrate into his weapon system. So our job in the Air Force is to create an opportunity for that program manager to have good choices, economical equipment, technical standards, so that we can support them. The timing and the synchronization of this is an issue that we look to and support OSD in their oversight role. We in the Air Force are accountable for the integration into Air Force weapon systems, but we also decentralize that so that the program manager of those particular weapon systems are the first line of accountability of the integration of a new service like GPS or satellite communication or any other service into their particular program. This is an effort of some complexity in its synchronization, but it's a balance between the specialized nature of a service like GPS and the mission function of a particular weapon system that has to integrate service like this.

Mr. TIERNEY. Mr. Flake.

Mr. FLAKE. Thank you. I appreciate the testimony. Major General McCasland, I never really heard what you thought of the GAO report. Do you agree with the finding? Do you concede that there's a problem and an issue here or is everything just hunky-dory?

General MCCASLAND. Well, as the Department's response, Ranking Member Flake, indicated, we generally agree with that. We offered some clarification and comments. If I may, and take the lead from your question, let me step through a couple of reactions to the report.

To start with, with this risk of a gap. As the GAO indicated, they followed the methodology and the technical assumptions that we use in the Air Force to monitor this. Those assumptions were provided to them some time ago, about a year ago. And in that time some things have changed. These lifetime assumptions are a bit like actuarial tables with people, except we don't have human history to base them on, we've got a much shorter history and population. The specific population we base it on is the flying population of GPS IIR satellites. And in this year the IIR satellites have continued to live, so the models that we base their future forecast have grown a little bit. So just in the year we can look to this same gap, and if we were to recalculate it, it would be only about half the depth that it is today.

The second comment that I would make, and the GAO did acknowledge this in the report, is that this model is based on a pre-

dicted launch rate and it's based on the full use of all the power on the satellite for all the payloads. So those are two choices that the operators, and General James, who will be on panel II, could speak to, the operator will have choices to make. They'll have choices to make about how fast they actually launch the satellites and they'll have choices to make about the way they spend the power on the satellites.

So when we take all of this in the whole, we on the supply end have choices to make every budget year with the degree to which we program the rate, the build rate, and the replenishment of the pipeline, the operator has choices to make for how fast they consume the pipeline and how fast they consume the on orbit resources, the degree to which they consume the available electrical power.

With all of that, we are confident that we've got several degrees of margin in preventing a gap like has been depicted in the GAO's report. So the GAO's report is accurate insofar as those technical assumptions are what happens. We think that there are many choices that will allow us the way to not face those circumstances over the next few years, sir.

Mr. FLAKE. Ms. Chaplain, one of the ways to extend the life of these satellites is obviously to cut secondary payloads or cut power to those, I guess, to extend the life. One of those secondary assignments or purposes of these satellites is nuclear detonation detection system. Is that one of the secondary payloads that can be jettisoned, if you will, or put aside? And if it is, yes, the life of the satellite is extended, but do we have a gap then in some of the secondary purposes, the nuclear detonation detection system?

Ms. CHAPLAIN. Well, our point is you can turn off those secondary sources and conserve a lot of power, but that needs to be a discussion that needs to take place precisely for what you're saying, that to look at what other gaps you might be facing in other capabilities.

Also, with regard to predicted launch rates, it's important to note that last year we had a lot of issues in launch manifest, a lot of back-up. So even what you assume can be a good launch rate may not turn out to be the case.

With regard to the assumptions of data being based over a year ago, I would like to note that we held up our report a little bit longer so that we could receive data from DOD that came to us in March 2009, updated all our analyses, and that's what you see reflected in our report.

Mr. FLAKE. So you stick to the percentages?

Ms. CHAPLAIN. I'm very confident what we have is about as recent as we could possibly get.

I would also comment that these same gap scenarios have appeared in other documents, including described, but not in the chart form, in the report that DOD delivered to Congress on the GPS system in December 2008. So the concern about gaps is a long-term one, because basically a lot of satellites that are in orbit are aging. And there's only—you know, you do have measures you can take to conserve power and stretch out the constellation. There have been times before when people have been worried about gaps and the Air Force has managed them quite successfully.

But here we are again, and our point is this is a high risk and we just need a lot of attention and resources on it.

Mr. FLAKE. Doctor, do you have anything to add to that, particularly with regard to the nuclear detonation detection system? Is that one of the choices to not have that function as a way to extend the satellite?

Dr. HUYBRECHTS. Sure. That is one of the choices. I would point out that the NDS system, the new detection system, does not require 24 packages on orbit. It's a much lower number. The reason we launch one on every GPS is just to have a standard satellite configuration so we're not worried about which orbit we're going into. So there is a fair amount of leeway there to turn off payload capability without impacting performance of the system.

I also want to add that we're using the term "gap," and that sounds very black or white. Compared to pretty much all of our space capabilities, the GPS constellation degrades whether it's from 30 to 29 or 24 to 23 or 5 to 4 more gracefully just because of the numbers of satellites. This is kind of like the number of sweaters in my teenage daughter's closet, right? To go from 24 to 23 sweaters is not like she doesn't have any more sweaters. It may seem terrible to her.

So what we're really talking about is a slight chance, and our analysis, which is independent of the Air Force's, is more in line with General McCasland's analysis. We're more in the 10 to 20 percent chance, so a small chance of going for a short period of time from 24 to 23 satellites. It's not as if GPS will turn off.

I point out the original GPS spec was only 21 satellites. The decision to move to 24 in the late 1990's was somewhat arbitrary. I don't want to call it an arbitrary number, but it was sort of an estimate of what we could afford versus the cost-benefit of building more satellites. We decided we were going to shoot for about 24 satellites.

So we shouldn't be sitting here thinking that all the GPS receivers are going to stop working. What you're going to get is a slight degradation in performance over small portions of the world for small periods of time, and relative to today, and in primarily impacting users in canyons and places like that.

Mr. TIERNEY. Thank you. We didn't realize you were under such stress having a teenage daughter, but we'll try to be easy on you now.

Mr. Foster.

Mr. FOSTER. If you could continue on that point. The degradation that you see then has to do with the resolution you've got or the acquisition time or what? How does it show up when you get fewer and fewer satellites?

Dr. HUYBRECHTS. You will see it—you would see it—I mean, you would see it today if we—today we're flying 30 or 31. If you lose one today, which is well within our tolerance, you will see the same impact; a slight degradation in accuracy, and possibly for certain users that are in deep canyons, etc., you will have less opportunity to get four satellites in view, you know, a slightly smaller opportunity to get four satellites in view and therefore be able to compute a resolution. So for certain very specialized users a slight increase in the acquisition time potentially to get the four satellites

in view, and maybe a slight change in the accuracy, also over certain spots of the globe for shorter periods of time.

Mr. FOSTER. And I understand there's also a European competitor system, Galileo, I think. And do you know what the time scale for that is and what its capabilities are nominally from both a commercial and a military point of view.

Dr. HUYBRECHTS. There is a European satellite system. It is currently a paper system. But there is money allocated to go off and build it. I believe that they are still targeting 2013 or 2014 timeframe to be launching satellites. Depending on which analysis you believe, that may be very optimistic or it may be accurate.

Mr. FOSTER. And the intention is to make a system where you just have reprogrammable digital receivers that you can listen to either the European or the U.S. system. Will a typical commercial system at least be able to work off of either system?

Dr. HUYBRECHTS. We have a negotiated agreement with the European Union so that our signals will be compatible, so that when their satellites launch it will be possible to build receivers that can accept signals from both systems simultaneously. Potentially if we're flying 24 satellites and they're flying 24 satellites, a user would have access to 48 satellites at that point for the civil signal. We don't have any agreements at the moment for—relative to their—they don't have a military, so you don't have a national security signal, but there's potential for that there, too.

Mr. FOSTER. The next question is for General McCasland. Are the two modules that you have here the only modules that will be the standard solution for all Earth-born equipment.

General MCCASLAND. Those are prototypes of what the Air Force intends to make available as standard engines for the GPS military user equipment. There is a commercial industry that has shown us that they will also develop GPS user equipment for commercial applications, and some have capitalized military applications as well. So we will build this product line and make it available with the documentation.

My own sense is that our American industry will also develop their own product lines and make those available to suppliers as well.

Mr. FOSTER. So from a military point of view you intend to have one product line and everyone is just going to use it, or are you just going to say here is a reference design and then all the different services are going to go and come up with modified versions that?

General MCCASLAND. That's the core of the GPS receiver that you've got in your hands; the radio, the cryptography——

Mr. FOSTER. Well, I take it this ball grid array that's sort of double sticky taped on here is a mechanical prototype here.

General MCCASLAND. Yes, sir. Those are engineering prototypes, those are pretty early models. I just wanted to illustrate that it's moved beyond paper.

Mr. FOSTER. Now it's in the plastic. Do you have working silicon for all the pieces of the—you know, the actual chips that will be here?

General MCCASLAND. I'm sorry, sir?

Mr. FOSTER. Do you have working silicon? Do you have integrated circuits that do the job?

General MCCASLAND. For the subassemblies we do there. For the correlators, the security modules, we do. We haven't gotten a working prototype. The working prototypes are due at the end of our—in the end of the fiscal year 2010 program.

Mr. FOSTER. And is there anything in the space-borne equipment that is being held up because of uncertainties in the Earth bound equipment?

General MCCASLAND. No, sir, not at all.

Mr. FOSTER. Or do you have a well-defined technical interface there, any independent design problems?

General MCCASLAND. Well, they are dependent, of course. But we've published the signal structure specifications. And along the lines of Dr. Huybrechts' last comment, we work to define that because the signal structure, it's definition——

Mr. FOSTER. So those have been frozen already?

General MCCASLAND. Yes, sir.

Mr. FOSTER. So there's no uncertainty that crosses over. OK. My light is red.

Mr. TIERNEY. Mr. Duncan, you're recognized for 5 minutes.

Mr. DUNCAN. Well, thank you very much, Mr. Chairman, and thank you for calling this hearing. Our briefing paper and our memorandum says the current modernization program was projected to cost $729 million with a completion date of 2006. The Air Force has failed to meet cost and scheduling goals for this project. GAO estimates that this project is $870 million over budget and 3 years past due. And I remember reading last year in the GAO report that said the Pentagon had a total of $295 billion in cost overruns on just its 72 largest weapon systems, and nobody got upset about that. Apparently you're not supposed to criticize the military in any way today. And I think in part it's because the figures are so high that nobody can really comprehend it. People did get upset about the $328,000 photo mission to New York City. Maybe they can understand that a little bit better. But now, according to our memorandum, $1 billion 6 hundred million has been spent on this program and yet it's still not completed, and it's $870 million over budget.

General McCasland, is anybody upset about that or are we just going to gleefully go on so that if Chairman Tierney holds a hearing on this a year or two from now people are just going to come in and tell us it's even more over budget and further behind schedule? I mean somebody ought to be upset about this.

General MCCASLAND. Well, sir, I won't dispute being upset. I am, too. Because as a supplier that's resources that I don't have available to meet my operational customers' needs. So I'm inclined to resonate with you.

As the GAO report pointed out, the particular portion of the GPS program that those figures were associated with is the GPS IIF satellite program, the current production program. And the GAO noted that a number of circumstances conspired to aggravate the business performance of that program, one of which was the consolidation of the defense industry. The GPS program was awarded to Rockwell Collins. As the industry consolidated Rockwell was purchased, its factory operations moved up to—it integrated with

the former Hughes Space and Comm factory in El Segundo under Boeing ownership.

The second dimension that the GAO also noticed, noted in her report, was that the government also chose to evolve and modify this program at the same time in response to user demands. We had military and civil requirements that we were trying to meet, additional services for civilian second civil signal and the beginnings of the evolution of the M-code modernization and the power growth for the military.

The third thing that the GAO also noticed in the IIF program was that we awarded the IIF program under an experiment of acquisition streamlining that we now look back and say was not successful.

And so the combination of those have added up to cost and schedule growth that the GAO has rightly reflected on. The GAO also noted that for every one of those we've taken steps to ensure that those circumstances aren't being repeated on the GPS block III program. We believe that the industry consolidation is stable, that the supplier base is healthy, they have a business volume that tells us that we can count on doing business with the same people that we've signed the contract with. Now, admittedly, that is subject to circumstances beyond defense's control, but it appears to be a broadly accepted assumption that the industry is stable.

We've put into practice kind of a "back to basics" approach for government oversight, the use of military standards, and we think that's already showing signs of success.

Third, we delivered——

Mr. DUNCAN. Let me say this. I see my time is about to run out. You know, it seems to me that Federal bureaucrats, and particularly the Pentagon, can rationalize or justify or excuse almost anything. It seems to me that it ought to be awfully difficult to make excuses for an $870 million cost overrun. But I suppose that since it is money that's not coming out of anybody's pocket over there at the Pentagon people don't really care that much. And I just think it's terrible. I mean, I can't describe words adequate to express my feelings about this because I have a feeling that if we come in and have this same hearing a year or 2 years from now we're going to hear that there's even more cost overruns. And if this was happening in the private sector, either people would be fired or a company would go out of business. I think it's shameful.

Thank you, Mr. Chairman.

Mr. TIERNEY. Thank you, Mr. Duncan. Mr. Duncan and I are going to start our own party on this issue, because I couldn't agree more. And we are going to have a series of hearings about procurement in the Department of Defense right on throughout this session, because it's outrageous and he's absolutely right. I don't think, General, that circumstances conspire. That's not what happens. People mess up, all right, and I think the Department of Defense in a big way has messed up, starting with the idea of whatever they call reform being an absolute joke. Their reform was essentially to take out oversight and management, to take out scheduling and procurement people, to fork over all their responsibilities to things that were inherently government and turning it over to

the private industry as if they were going to be trusted to do everything with no self-interest at all.

I don't know who is responsible for that decision. I would like to know whether anybody's head rolled for it? Do you know of anybody that lost their job for changing the system? Apparently we have written testimony on the record from the original program manager for the first GPS system that went on time and within budget, and then some genius decided to change that process and to put it with what they call reform and take out all of the protections and safeguards for the taxpayers' moneyand for the end users' ability. So who made that decision, General or Doctor, and whose head rolled for it?

Dr. HUYBRECHTS. Are you asking who made the decision to reopen the IIF satellite?

Mr. TIERNEY. Who decided between the first GPS and the next iteration that they were going to fix something that wasn't broken and drive us to the point where we're now behind schedule and over 100 percent overrun of cost? Who went from the system where you had people in oversight, you had government people at the industry's places watching over this, where you had schedulers who knew what they were doing and how to account for variations, where you had program managers watching it every day to a system where you just gave it to the contractor and have a nice day? I mean, who is responsible for that?

General MCCASLAND. Well, Mr. Chairman, the timeframe of these decisions were in the late 1990's, and I didn't prepare for a historical accounting.

Mr. TIERNEY. Well, I'm sorry that you didn't, but clearly this hearing was about what went wrong and what's going right, so maybe you should have. But the idea is who would it be? Would it be your level, the person that was in your seat that would make that decision? Or, Doctor, would it be the person that was in your seat at that time that would be responsible?

Dr. HUYBRECHTS. The decision to open up the IIF satellite and add the new civil and military capabilities was made in the late 1990's at the White House level.

Mr. TIERNEY. OK. It was made at the White House level to actually change the whole system of how it was done instead of following the program aspects of the previous one to go to another thing, they made that at the White House as opposed to the Department of Defense?

Dr. HUYBRECHTS. The decision to modernize the GPS system——

Mr. TIERNEY. I'm not talking about that, Doctor. You know what I'm talking about. I know the idea to modernize it. Who made the decision of how they were going to manage it? That's what I want to know. And I doubt very much that was made at the White House. That was made somewhere in the Department of Defense. And my question to you is, who in the Department of Defense, at what level and what particular seat, decided to go for a program that was operating perfectly well to a system that gave it all over to the contractor without any government oversight or any essential government oversight, who made that decision?

Dr. HUYBRECHTS. If you're asking who made the decision to change how we did space acquisition writ large, because we did

change space acquisition and how we did it, not just in this program but across all the space programs at that time, I would have to take that question for the record.

[The information referred to follows:]

CHARRTS No.: HOGR-02-001
House Government Reform Committee
Hearing Date: May 07, 2009
Subject: GPS: Can We Avoid a Gap in Service?
Congressman:
Witness: Dr. Huybrechts
Question: #1

Question: Why is it that the acquisition approach for GPS block IIF was altered from the approach taken in earlier blocks where the acquisition was more successful (i.e., achieved with minimal cost and schedule overruns)? What are the differences between the two approaches that led to the problems with the GPS block IIF acquisition?

Answer: The acquisition strategy was changed primarily in response to the 1990s Department of Defense acquisition reform movement. Starting in 1993, the Department began initiatives seeking to reduce acquisition costs and streamline execution through increased emphasis on commercial practices and standards, strict control of cost "as an independent variable," reduction of paperwork and required reviews, and a shift toward using the private sector to accomplish work previously done by the government. The environment motivating these initiatives included reduced overall defense budgets, and major defense industry consolidations that spurred contractors to demand more flexibility and less burdensome oversight in order to remain competitive. Cost became the driving factor in competitive procurements, sometimes at the expense of fully understanding developmental risks in the changing business environment.

In an effort to follow the Department's lead and increase acquisition efficiency, Air Force acquisition reform initiatives put more responsibilities on the contractor, eliminated the proven baseline of Military Specifications, Military Standards, and detailed design reviews, and significantly reduced Government's active involvement in program development and its ability to provide detailed insight/oversight. At the time of award of the GPS IIF contract to Rockwell, this was considered low risk due to the expected use of heritage Rockwell II/IIA designs. However, shortly after award, the contract requirements were opened up with the GPS Modernization initiative which added major new capabilities to the IIF and which required significant redesign of the IIF navigation payload and associated modifications to the overall spacecraft. In addition, Rockwell was bought out by Boeing which led to a series of contractor, program office, and factory changes which further exacerbated execution of the program. In summary, the lack of government insight and lack of comprehensive systems engineering underpinnings on the GPS IIF program created challenges for the development and for incorporation of the modernized capabilities into the heritage design.

Mr. TIERNEY. Would you do that, please, and let us know, because essentially we have run into this problem. The Government Accountability Office tells us over and over again these are the issues; the relaxed oversight, relaxed quality inspections. We are finding it—we found it with the Coast Guard program, you know, Deepwater. They gave all the contracts to the same contractor; the one to design, the one to build, the one to oversee. And when all that went wrong, they gave the same contract to the same company to fix it.

We're running into this every time we turn around. I think part of what's incumbent upon us is to make sure it doesn't continue on. Now, General, you tell us that you have essentially gone back to basics here, and I hope that's so. The Government Accountability Office reports that's what you tell them. There's going to be more oversight of this; you're going to have more quality inspectors onsite.

General MCCASLAND. Yes, sir. The engagement of support offices like the Defense Contract Management Agency, field offices, the way we engage with the contractors, all of that is, frankly—it isn't so much that we forgot the recipe, it's that we consciously chose to try to in an unsuccessful manner, and we're going back to the methods that Dr. Parkinson used when he was a colonel. They've served us well.

Mr. TIERNEY. I hope you haven't forgotten the recipe. Again, I think if somebody had something that wasn't broken and they decided to fix it, I would like to find out who it was and what was motivating it. I doubt that it was sheer stupidity, but that might be the case. But if something else was motivating, we better find out what happened, investigate it and see where it leads us on that.

The other problem I think we're going to have that is replete throughout all these different procurement programs is people qualified to do the scheduling, is people qualified to do the program managing. Are you having difficulty finding enough people to qualify to take care of your systems, including this particular system?

General MCCASLAND. Mr. Chairman, that is an issue that does concern the Air Force. In fact, the Secretary of the Air Force released a plan called the acquisition improvement plan tied to his strategic goal of capturing acquisition excellence. He released that plan just this week. One of those elements is precisely aimed at growing and qualifying and training the acquisition work force.

So I share your concern. The human capital is the heart and soul of good oversight, and we're committed to the health of that work force. That's the career force that I grew up in. I have a personal sense of commitment to growing the next generation of leaders in that role, and I'm really pleased to see my service Secretary support that agenda.

Mr. TIERNEY. Are you able to share a copy of that department document?

General MCCASLAND. We would love to.

[The information referred to follows:]

*Headquarters United States Air Force*

# Acquisition Improvement Plan

*Prepared by the Office of the Assistant Secretary of the Air Force (Acquisition)*

*4 May 2009*

U.S. AIR FORCE

*Integrity – Service - Excellence*

**THE SECRETARY OF THE AIR FORCE**
**CHIEF OF STAFF, UNITED STATES AIR FORCE**
**WASHINGTON DC**

MAY 4 2009

MEMORANDUM FOR ALMAJCOM-FOA-DRU/CC
DISTRIBUTION C

SUBJECT: Air Force Acquisition Improvement Plan

The United States Air Force is committed to recapturing acquisition excellence by rebuilding an Air Force acquisition culture that delivers products and services as promised–on time, within budget and in compliance with all laws, policies and regulations. To do so, we have developed the attached Acquisition Improvement Plan.

This plan focuses our efforts and will serve as our strategic framework for the critical work of modernizing and recapitalizing our air, space and cyber systems. It builds on lessons learned from past shortfalls in our procurement processes; but more importantly, it establishes five goals and 33 actions that ensure rigor, reliability and transparency across the Air Force acquisition enterprise.

The Assistant Secretary of the Air Force for Acquisition (SAF/AQ) is designated as the lead for developing a detailed implementation plan, and will incorporate inputs from Air Force Materiel Command, Air Force Space Command, and the appropriate HQ USAF/MAJCOM staffs by June 15, 2009. We are confident that this plan and your focused leadership will enable the Air Force to regain its reputation for acquisition excellence.

Michael B. Donley
Secretary of the Air Force

Norton A. Schwartz
General, USAF
Chief of Staff

Attachment:
Acquisition Improvement Plan

## Introduction

The Air Force acquisition system performs a vital role in rapidly adapting current and new capabilities in support of the wars in Afghanistan and Iraq; it is a cornerstone in our ability to develop and deliver future warfighting capabilities for air, space, and cyberspace systems. For that reason, the Air Force acquisition system must deliver products and services that perform as promised – on time, within budget, and in compliance with all laws, policies and regulations. We owe our fellow Airmen and fellow taxpayers no less. Air Force capability, credibility, and pride are on the line, and all are damaged each time the process falters.

## Background

In 2008, the Government Accountability Office (GAO) upheld protests and overturned United States Air Force contract award decisions related to the CSAR-X helicopter and KC-X tanker programs. In addition, the GAO concluded that the DoD acquisition process does not deliver the promised capabilities to the nation's warfighters in a timely and efficient manner. Budgets are overrun routinely and requirements continue to creep well beyond their initial scope. We find that the Air Force acquisition process reflects many of the same problems reported by GAO.

In response to these events and related GAO reports, the Secretary of the Air Force and the Assistant Secretary of the Air Force (Acquisition) met with GAO leadership to

discuss the strengths and weaknesses of the Air Force acquisition process. In addition, they directed a comprehensive internal look at our source selection process and an assessment of Air Force acquisition as a whole, as well as an independent assessment of Air Force acquisition conducted by the Center for Naval Analyses (CNA).

The assessments concluded that there have been numerous factors contributing to Air Force acquisition concerns which we summarized into the following five critical areas:

1. Degraded training, experience and quantity of the acquisition workforce;
2. Overstated and unstable requirements that are difficult to evaluate during source selection;
3. Under-budgeted programs, changing of budgets without acknowledging impacts on program execution, and inadequate contractor cost discipline;
4. Incomplete source selection training that has lacked "lessons learned" from the current acquisition environment, and delegation of decisions on leadership and team assignments for MDAP source selections too low; and
5. Unclear and cumbersome internal Air Force organization for acquisition and Program Executive Officer (PEO) oversight.

As directed by the Secretary of the Air Force, we are responding to these findings with numerous improvements to ensure the Air Force continues to be a responsible steward of the taxpayers' money and a responsible provider of capabilities for our nation's warfighters.

## Our Challenge

Recapturing acquisition excellence requires an experienced, skilled, empowered, and accountable workforce, and begins with proper requirements and adequate and stable funding. The following five initiatives and their associated actions set forth a comprehensive improvement plan for addressing the foregoing acquisition issues.

**#1: Revitalize the Air Force Acquisition Workforce**

A return to acquisition excellence must start with a concentrated effort to improve the acquisition workforce as a key to providing the best warfighting capability. Regardless of other improvements the Air Force may make in the acquisition process, they will not endure without sufficiently educated, trained and experienced professionals capable of executing the acquisition mission in the modern industrial environment. The complexity of the governing legislation, regulations, policies, procedures, and practices requires specialized education and training, and many years of experience to master. To operate effectively, today's acquisition workforce must be supported by a human resource environment that recognizes the complexity of the acquisition mission and grooms professional journeymen as well as future leaders in all of the acquisition functional specialties.

The Air Force acquisition workforce is staffed with outstanding men and women dedicated to their mission and their country. They perform heroic feats daily to ensure our Air Force has the best weapon systems in the world. However, while they perform top quality work, we have failed to adequately manage their professional development and maintain sufficient numbers of these experienced professionals. The result is an acquisition workforce eager and willing to take on any challenge, but in many cases one that is inadequately prepared for the task at hand. In some cases, the workforce lacks the necessary training or education to accomplish the mission. In others, the workforce simply does not have the depth of experience or specific skill sets necessary to accomplish the critical tasks.

As we better develop our workforce, we must also ensure it is appropriately sized to perform essential, inherently governmental functions and is flexible enough to meet continuously evolving demands. The size of the Air Force acquisition workforce, as currently defined, was decreased from a total of 43,100 in 1989 to approximately 25,000 in 2001 where it has remained since. A proposal to increase the workforce by over 2,000 employees (247 officers, 11 enlisted, and 1,804 civilian) is currently under consideration for the critical areas of systems engineering, cost estimating, program management, contracting, logistics, financial management, and legal. If approved, all new military authorizations would be added in FY10 and civilian authorizations added between FY10 and FY13.

The Air Force will undertake the following actions in support of revitalizing the Air Force acquisition workforce:

1. Exploit newly delegated expedited hiring authority to fill current civilian vacancies;
2. Increase and fund military and civilian personnel authorizations, as required;

3. Fully utilize the recruitment, training, and retention funding derived from Section 852 of the FY08 National Defense Authorization Act (NDAA);
4. Develop and implement recruitment and retention initiatives, including management training programs and bonuses where appropriate;
5. Increase manning priority for civilian and military acquisition positions;
6. Examine the mix of military and civilian acquisition personnel and the mix of Senior Executive Service and General Officers to ensure we have the right balance of military and civilian personnel to ensure leadership, experience and stability;
7. Develop a succession planning procedure for acquisition leadership in functional specialties;
8. Establish training and experience objectives as part of the career paths for each acquisition specialty and increase the availability of specialized training;
9. Assess the acquisition workforce to determine the appropriate level of personnel needed to accomplish inherently governmental work and the level of support contractors needed to assist with work that is not inherently governmental; and
10. Examine the possibility of re-assigning responsibility for acquisition workforce management to AFMC as the lead command.

**#2: Improve Requirements Generation Process**

A world class acquisition effort is not only the responsibility of the acquisition community – it requires the cooperation and support of other organizations across the Air Force. Most importantly, it requires a coordinated effort to develop requirements that can meet the users' needs and, at the same time, be reasonably incorporated into effective

acquisition strategies that maximize competition and allow for a fair and open source selection process.

Requirements must be acquisition-friendly and produced in a format that is readily adaptable for use during source selection and throughout the acquisition process. The acquisition team must be involved early in the requirements trade-off decision process, with experienced systems engineers to help guide the requirements community in this complex process. The warfighters must resist the temptation to pursue high risk requirements that are too costly and take too long to deliver in favor of an incremental acquisition strategy that delivers most, if not all, requirements in the initial model with improvements added as technology matures – the "block" acquisition approach. We must recognize the majority of requirements might be satisfied at a lower cost using alternative approaches, so trade-space options are critical.

In the future, there will be acquisition involvement earlier in the Air Force requirements development process and systems engineering techniques will be applied to assist in the tradeoffs that occur as part of the process. Further, incremental acquisition strategies that deliver early, if only partial, operational capability will be pursued rather than strategies that deliver the 100% solution, as often the 100% solution is too costly, takes too long to deliver, or performance risk is too high.

The Air Force will undertake the following action items in support of an improved requirements development process:

1. Ensure acquisition involvement and leadership in support of the lead command early in the development of program requirements;

2. Require that the Service Acquisition Executive (SAE) and, when applicable, the Commander, Air Force Materiel Command (AFMC/CC) or Commander, Air Force Space Command (AFSPC/CC), when appropriate, certify that the acquisition community can successfully fulfill the requirements in the Capabilities Development Documents (CDD) in conjunction with the Air Force Requirements for Operational Capabilities Council (AFROCC);
3. Require the PEO to coordinate the Request for Proposal (RFP) and the associated attachments with the lead requiring MAJCOM/CC or his/her designee based on ACAT level;
4. Carefully minimize the number of Key Performance Parameters (KPP) and other requirements to the appropriate level for acquisition programs; ensure all requirements are finite, measurable, prioritized, and can be evaluated during a source selection;
5. Require incremental acquisition strategies that reduce cost, schedule and technical risk and produce operational capability earlier; and
6. Freeze program requirements at contract award, and require subsequent changes to Major Defense Acquisition Program (MDAP) KPPs be accompanied with adequate funding and schedule considerations that are reviewed and agreed upon by Chief of Staff of the Air Force prior to JROC validation; and similarly require changes to other requirements be reviewed or proposed by the lead Command (MAJCOM) Commander or his/her designee before presentation to AFROCC.

**#3: Instill Budget and Financial Discipline**

Regardless of the quality of our acquisition workforce and processes, and regardless of having clearly defined and validated requirements, we will be unable to deliver on time and within budget if we do not exercise budget and financial discipline. Budget instability is disruptive to program execution and a contributor to cost growth and schedule slips. Establishing adequate and stable budgets is critical for program success. Program baselines must be based on realistic schedule and technical assumptions and accurate cost estimates – not just the cost of the lowest bid. In addition, as budgeting, performance or schedule deviations occur, our acquisition process must have the flexibility to adjust requirements or cancel programs that become unexecutable. Without this flexibility, programs will be forced to move ahead under unrealistic expectations on the part of Congress and the public.

We must also strive to control the costs of our programs during contract performance. In this regard, we are joining with the Defense Contract Management Agency and the Defense Contract Audit Agency to scrutinize contractor costs with the objective of driving improvements in contractor and subcontractor cost discipline. In particular, it is time to begin a systematic review of contractor overhead costs to assure ourselves that these costs are reasonable. Contract profits will also be examined to ensure they are commensurate with risk and performance. Controlling the cost of programs is vital to ensuring our acquisition system delivers as promised and within budget.

As part of this acquisition improvement plan, the Air Force will emphasize realistic budgeting based on realistic program cost estimates. Once budget baselines are established,

achieving program stability and cost control will be given the same priority as technical performance and schedule.

The Air Force will undertake the following action items to instill budget and financial discipline in the acquisition of major programs:

1. Establish program baselines for cost, schedule and technical performance after Preliminary Design Review (PDR);
2. Identify and implement means to increase cost estimating confidence levels and establish more realistic program budgets;
3. Stabilize program funding – once funds are committed to a major acquisition program, funding will not be changed without the informed advice of the SAE;
4. Establish a formal review of contractor overhead costs for reasonableness;
5. Review individual development contract profitability to ensure profits and award fees are comprehensively tied to cost, performance, and schedule; and
6. Place renewed emphasis on ensuring contractor earned value management systems meet minimum requirements to provide confidence that such systems are effective for evaluating program progress and properly used by both contractor and government managers.

**#4: Improve Air Force Major Systems Source Selections**

An effective source selection process is also an essential element of acquisition excellence. When our process is challenged by a contractor and found lacking by the GAO or the courts, essential capability is delayed and public trust is damaged. In general, we know how to conduct source selections; the vast majority of Air Force source selections are

performed correctly and without protest. In fact, the Air Force source selection process has produced remarkably good results for many years.

However, a small number of recent high profile contractor protests of source selection outcomes motivated us to re-examine our processes. This review revealed weaknesses in our procedures for large system acquisition source selections. It also became apparent that the training of acquisition professionals in this highly specialized, technical acquisition process was inadequate. In the interest of perfecting the procedures, we allowed the process to become overly complicated, which led to unnecessary opportunities for error. We also found that some of the skill sets required to conduct a major source selection had become very scarce, particularly for organic military and civilian personnel. While source selection is a very narrow piece of the acquisition mission, it is a highly visible and important piece. The Air Force considers improvement of the source selection process to be one of its most critical acquisition improvement goals.

So we must go back to the basics. We must ensure our personnel have the required experience and training to conduct source selections. Where necessary, we must revise our processes and policies to ensure they do not hinder our efforts.

The Air Force will undertake the following action items in support of an improved source selection process:

1. Modify Air Force source selection procedures to strengthen governance of the process, including Service Acquisition Executive (SAE) approval of source selection leadership for major acquisitions, and use of realistic source selection schedules;

2. Improve source selection training to include the most current lessons learned and ensure this training is available and mandatory for all MDAP source selection teams prior to initiation of new source selections;
3. Require the use of Multifunctional Independent Review Teams (MIRTs) in the Air Force business clearance process by employing additional internal Air Force reviews during all phases of the source selection process from RFP preparation through contract award and debriefing of competitors;
4. Appoint a team of the most qualified Air Force source selection experts to provide on-call augmentation/consultation to source selection teams across the Air Force;
5. Create a designation for both civilian and military personnel records to identify individuals with competency and experience in source selection procedures and ensure this competency and experience are considered in assigning personnel to key acquisition positions;
6. Review the current acquisition planning process as it relates to RFP and source selection planning; and
7. Simplify the source selection process wherever possible.

**#5: Establish Clear Lines of Authority and Accountability within Acquisition Organizations**

The current wing/group/squadron structure was established to provide additional command opportunities and promotion success for our most experienced uniformed acquisition experts. The structure appears to have created a number of negative unintended consequences. For example, establishing a hierarchical military structure diminished the functional mentoring and support that once provided our contracting officers with the sense

of authority that allows necessary independent decision-making. The current structure also resulted in a top-heavy management structure whose manning requirements have drawn many of our limited number of acquisition experts out of "hands-on" acquisition work and into less connected management/command roles. We found that the current organization structure inhibits efficient reallocation and rotation of personnel resources, disconnects employees from what should be their functional mentors, and in many ways inhibits proper career management, including workforce training. Most importantly, we have not been successful in meeting our goals for Below the Promotion Zone (BPZ) promotion percentages nor for Senior Development Education (SDE) selection for those that are In the Promotion Zone (IPZ).

The Air Force PEO construct has been criticized for being cumbersome and failing to eliminate what many believe to be excessive program briefings at multiple management levels before every major decision. Further, the PEOs report to the SAE in their role as acquisition officials, and they report through an entirely different chain of command in their role as commanders. This dual reporting creates the propensity for conflicting mission priorities and divided attention that can lead to ineffective acquisition leadership.

The Air Force will undertake the following action items to establish clear lines of authority and accountability within the acquisition organizations:

1. Reassess the wing/group/squadron structure and determine if the shortcomings can be corrected without a reorganization – provide specific actions that could be taken within the existing structure or recommend change in the structure;

2. Explore a realignment of the rating and reporting chain for the contracting function to ensure the independence of the contracting officers, who are matrixed back to the Wings/Groups/Squadrons, to ensure compliance with OSD policy;
3. Reassess the PEO construct and offer recommendations for improvement; and
4. Assess the value of re-establishing functional matrix management at the centers.

## Conclusion

Many of the planned actions contained in this document are already underway. For example, we are working hard to improve the source selection process, starting with improved requirements definition and improved training of our source selection teams. We have plans for increasing the size of the workforce in the near future. We are also moving forward with plans to examine contractor overhead rates and contract profit as part of a joint project with the Defense Contract Management Agency.

We are also developing more detailed implementation plans for the individual actions within each issue category, including the specifics of each action, the planned date of completion, and the offices responsible for completing each action. While our plan is beginning to firm up, we will remain flexible with the ability to adjust to suggestions and initiatives proposed by Congress and the Office of the Secretary of Defense. Progress will be reported internally during monthly updates with the Secretary and the Chief of Staff through the end of FY09. Thereafter, progress will be reported quarterly until completed.

The Air Force is committed to strengthening its acquisition processes. It will take the involvement of the entire senior leadership of the Air Force – in particular, the Secretary and the Chief of Staff and the Assistant Secretary for Acquisition – to maximize improvement. It will also require the full support of the uniformed Air Force, including the Commanders of

Air Force Materiel Command and Air Force Space Command, the military deputy to the Assistant Secretary for Acquisition and the Director for Space Acquisition.

We are dedicated to providing our Airmen, joint force, the United States and our international partners the best equipment – on time, and on cost – to fly, fight and win in air, space and cyberspace. We will develop, shape and size our workforce and ensure adequate and continuous training of our acquisition, financial management and requirements generation professionals. In so doing, we will re-establish the acquisition excellence in the Department of the Air Force that effectively delivered the Intercontinental Ballistic Missile; the early reconnaissance, weather, and communications satellites; the long-range bombers like the venerable B-52; and fighters like the ground-breaking F-117 stealth aircraft – all world class accomplishments.

In all aspects of this work, the Air Force remains committed to our core values: Integrity first, Service before self, and Excellence in all we do.

*Integrity – Service – Excellence*

U.S. AIR FORCE

# *A Roadmap to Recapture Acquisition Excellence*

Mr. TIERNEY. If you would, we would appreciate it.

Doctor, do you want to add anything to that just before I close out. What is the Department doing with respect to what we're told is a shortage of qualified people in the pipeline to do program management and to do scheduling on projects of this nature?

Dr. HUYBRECHTS. Finding good people is always difficult. Colonel Dave Madden, who I have the highest respect for, who runs the GPS program office out in Los Angeles, is one of the better program managers I believe that I've met. But he has one of the most difficult jobs in the U.S. Government. You manage a very large enterprise, it's a very complex system, and it's difficult to find good people. We have been trying—I'm not an expert on the personnel systems in the Department of Defense. I would be happy to find you an expert to bring here.

Mr. TIERNEY. I think we may do that. I think we may have a hearing with people in here. If this is a problem, as it appears to be, and we've had people come to us of late, I should tell you, and explain to us that no matter what we're talking about in a contract, and the Government Accountability Office I think in almost all the programs on the general report of overruns and schedule problems indicated that was a real serious issue on that. So I think we will want to have a separate hearing on that.

Thank you. Mr. Flake.

Mr. FLAKE. I don't have any particular questions at this point. I just want to echo what's been said here. It seems that we're hearing some, as the chairman put it, happy talk. And there are ways to explain why these overruns have occurred, both in cost and time. But we want to make sure that the lessons are learned and in the future we're not here, as Mr. Duncan said, a year from now hearing the same thing, just more expensive and more timely at that time.

So thank you.

Mr. TIERNEY. Will the gentleman yield?

Mr. FLAKE. Yes.

Mr. TIERNEY. One of the questions on that, too, is continuity of program managers. I remember that was mentioned in the GAO report as well. So what are we doing about the fact that people just continually—there was a particular number of people that went through that program, seven different program managers, each of whom—five of whom served for only 1 year each. That can't be healthy for a program this sophisticated and complex. So what are we doing about that?

General MCCASLAND. Well, sir, I believe that particular reference was looking at the program management inside industry. So it's an expectation that we hold to our suppliers that they also field a stable leadership team.

Mr. TIERNEY. This is the IIF program, had seven different program managers, the first five of whom served 1 year each. That's not your colleagues, that's you.

General MCCASLAND. Well, again, the early days of the IIF program were in the 1990's. Today it's our policy to keep the wing commanders in place, the program managers, Colonel Madden, in place a minimum of 3 years. And we recognize through the whole

acquisition leadership chain that the continuity of acquisition leadership is one of the keys.

Mr. TIERNEY. Are you having success holding it for 3 years?

General MCCASLAND. Yes.

Mr. TIERNEY. Thank you.

Mr. Foster.

Mr. FOSTER. You have—do you have an integrated project schedule in place.

General MCCASLAND. Yes, sir. Yes, sir.

Mr. FOSTER. And could you provide us with a list of the high-level milestones that we can anticipate in the next 1 or 2 years?

General MCCASLAND. Yes, sir.

Mr. FOSTER. When you come back a year from now, we can track you against those.

General MCCASLAND. Yes, sir.

Mr. FOSTER. OK. And in terms of the system degradation, do you actually have a good—either a modeling or a lot of field experience to really understand this, what's going to happen as the satellites stop?

General MCCASLAND. Right. I feel that the Air Force has really the gold standard in—that's been developed by our federally funded research and development center of the Aerospace Corp. This has been their—their corporate focus since they were founded in the early 1960's. So they have pioneered and keep the technical research on satellite failure modes and effects, actuarial forecasts, device physics phenomena in the space environment, the science basis for making these kinds of runs. So, yes, sir, I think it is the best in the world.

Mr. FOSTER. You think it is a well understood degradation process.

General MCCASLAND. Oh, yes, sir, very much so.

Mr. FOSTER. I yield back.

Mr. TIERNEY. Mr. Flake.

Mr. FLAKE. Dr. Huybrechts, as far as streamlining the procurement process, are—we know that's been a problem in the past, but is that being taken care of?

And one other question. I just want to make sure that Congress isn't part of the problem here. Are there congressionally directed projects or contracts that you have to deal with that slow the process or complicate the process, given the mandate to make sure these contracts are open to competitive processes?

Dr. HUYBRECHTS. I'm not from the procurement process side of the Department. That would be our acquisition technology and logistics. We have a new Under Secretary there. He has some strong ideas, I believe, on how we are going to change the procurement process to make it more effective. I wouldn't presume to speak for him and the kinds of changes he wants to make, but, again, I could take that for the record or bring in somebody from his office to discuss it.

[The information referred to follows:]

CHARRTS No.: HOGR-02-002
House Government Reform Committee
Hearing Date: May 07, 2009
Subject: GPS: Can We Avoid a Gap in Service?
Congressman:
Witness: Dr. Huybrechts
Question: #2

Question: Are the cost and schedule problems faced by the GPS block IIF acquisition the result of congressional efforts at acquisition reform? If so, how? Is the GPS III acquisition at risk of experiencing the same problems?

Answer: Acquisition reform initiatives set the stage for many of the IIF challenges. While these reform initiatives were, in general, shaped by acquisition streamlining law and DoD policy in the mid-1990s, the specific IIF issues trace to multiple causes including Air Force and industry actions. The GPS III acquisition is structured to prevent the types of problems experienced by the GPS IIF program. The GPS III acquisition is specifically designed to be low risk/high confidence to ensure satellites are available to replenish and sustain the satellite constellation. Incremental upgrades are targeted to meet future capability needs of the users. To achieve this low risk/high confidence approach the program has placed heavy emphasis on low-risk/high confidence design, proven technologies, a return to Military Standards/Specifications/Handbooks, and substantial risk reduction including component prototyping for early problem identification and concept maturation. The GPS III strategy also calls for three distinct increments (GPS IIIA, GPS IIIB, and GPS IIIC) which build a low risk/high confidence foundation on GPS IIIA then add remaining capabilities in later increments.

Mr. FLAKE. Let me ask General McCasland that second question. Is Congress playing the proper role here; are we giving you the flexibility and—with which you need to carry this out, or are we complicating the process by directing you, perhaps, with congressionally directed earmarks or projects that make it more difficult to do your job?

General MCCASLAND. Well, sir, focusing on the GPS program, my sense in interaction with the Congress over the past decade has been one of a very healthy interaction with the defense oversight committees and a supportive role, both in terms of critically examining our plans and in providing the funding that we need to execute the program.

But with that entree, I point out that the GPS III program is going to enter into a little more complicated nuance. There is a Presidential directive that assigns the responsibility for budgeting new civil capabilities to the Department of Transportation, and so the synchronization of their budget requests in the Congress with the defense budget request, the preponderance of the money will be defense. But we have chosen as a matter of national strategy to program budget and request appropriations from the civil funding line to add to the military funding line for this national capability. That's going to be new territory for us, and I respectfully suggest that would be worthy of careful attention.

Mr. FLAKE. Thank you.

Mr. TIERNEY. Ms. Chaplain, this is apparently a cost-plus contract. Is there a better way to do it?

Ms. CHAPLAIN. I believe the better way to do it is to focus on not making the mistakes in the past. Fixed price for this type of program would be difficult because you're trying to advance technologies, and there is a lot of unknowns. When we've tried fixed-price arrangements before for space programs, it was done at the time that we were also trying to implement these other kinds of acquisition reforms, and it was very poorly implemented, and it resulted in almost disastrous consequences.

So under the contract scenario we are in, I would just say they need to exert good oversight over the contractors. They need to make sure the program stays stable. They need to make sure requirements don't change. They need to really look at contractor performance and base the award fees on how the contractors performed.

I think a lot of things have been done on the IIIA program to position the program for success, and I'm hopeful that will be more successful than other space programs in the past.

Mr. TIERNEY. Thank you.

Gentlemen, do you write into your contracts some protection against industry mergers interrupting the course of things?

General MCCASLAND. Sir, we don't explicitly require them to make commitments like that about what they'll do within their companies. We make a business agreement with them to deliver goods, services and supplies for a period of time.

Mr. TIERNEY. But then when they don't do it because they are merging or whatever, you just pay them more money. It is a contract; it would seem you put things in to protect yourselves.

General MCCASLAND. Yes, we do.

Mr. TIERNEY. You don't necessarily say that you are going to restrict them from merging and consolidating, but you can say that you have some say over whether or not it is going to happen if it is going to impact adversely the progress on your program.

General MCCASLAND. Yes, yes, sir. And the tools to protect the taxpayers' interest there range from our incentive fee program, which has an opportunity to earn money if they deliver, and penalties if they don't. We ultimately, even on a cost-reimbursement contract, reserve the prerogative to decide whether charges are allowable.

And last, with respect to the contract type, I'd point out that the GPS IIIA program at this stage is in its development cycle, which is appropriate to use a cost-reimbursement contract. But we reserve the prerogative to negotiate a different contract class for production articles. For example, the GPS IIF program today is—has a mix of a cost-reimbursement effort for the first satellites to get that production unstable, and then fixed price buys for the last eight, I believe.

Mr. TIERNEY. OK. Will you have your office prepare for us an accounting, then, of the delays that were caused by—and one of the reasons you cite for this overrun of costs and the delay was the mergers and the consolidations. So provide for us an accounting of how many bonuses or fees were not paid when that caused a slowdown in an overrun, and what other exercises were taken under the contract to protect the taxpayers' rights, because I think we have a right to know that they weren't getting bonuses and fees and other things for taking self-interested consolidations and mergers and slowing down the project and running us over costs, and at the same time getting rewarded for it. And so if you would do that, I would appreciate it.

General MCCASLAND. Yes, sir. I certainly recall even recently very low to zero award fees being paid to the IIF contractor as we were struggling to turn that program around.

Mr. TIERNEY. I would just appreciate you putting that in so we can formally see that, if you would.

General MCCASLAND. You bet, sir.

Mr. TIERNEY. Now we have a whole host of problems here generally with procurement, not just with the GPS program on that, so I want your assurance that you're either dealing with them or going to deal with them. One is starting programs too early before the design is where it ought to be, or whatever. Are you dealing with that?

General MCCASLAND. Yes, sir. And I think that, you know, the GAO noted in this report that we had put in extensive precompetition risk-reduction activities into the program. I think it's evidence of success that we had a functioning engineering brassboard of the entire GPS IIIA payload available before we made contract award. It was part of the precompetitive risk-reduction activities.

We passed a serious and thorough scrub by the OSD Director of Research and Engineering, who attested to the technological readiness, part of OSD's due diligence. So I am confident that we started this program on a good foot.

Mr. TIERNEY. Now, do you cite any contracting program managing weakness? Do you think you have any that exist right now, or have you filled all those gaps?

General MCCASLAND. Sir, I think at this stage of the program, the program management strategy is as well tuned as we know how to do it.

Mr. TIERNEY. All right. So you have no problems with technical expertise; you have all you need at your fingertips?

General MCCASLAND. We—we are adequately resourced for executing the program today, sir.

Mr. TIERNEY. All right. You see no capability gaps in the industrial base?

General MCCASLAND. Well, the space industrial base is, of course, the people who actually build us. I believe the prime industry base is healthy and strong. We all have some concern about the secondary suppliers, the vendors, the people who field independent subassemblies like gyroscopes, and star sensors, and space-qualified components. That's an industry that is under some stress, and we monitor it very carefully.

In fact, we have an interagency working group spanning all of national security space focused on the health of the space industrial base. We exchange information. We provide a forum for those vendors to bring correlated problems they are seeing across the industry to our attention. And the DDR&E in OSD has a certain amount of funding available for support of the industry base. In my mind, when I look at industry, that's the level that has the risk that concerns me the most, sir.

Mr. TIERNEY. OK. But you are doing all you can do about it right now.

General MCCASLAND. Yes, sir, I believe—I believe so.

Mr. TIERNEY. What are we doing about protecting against new requirements being added as a project is going on and not having an impact on that? Are we shutting it off, just deciding we're going to have a particular product, that's going to be up in this program, new things go in the next end, or what are you doing?

General MCCASLAND. Yes, sir, that's a very important point, because as the GAO noted, a part of what made—what contributed to the cost growth on the IIF program was the folding in of new requirements.

We have chosen to structure the GPS III program in a way to pre-plan those insertions. And what I mean by that is that we have a capability list for the final product version of GPS III that includes a number of low-risk features and includes some high-risk features. We chose to take on the most important and lower-risk features first in IIIA and to size the spacecraft, its power, its chassis size, the launch size to provide the room to grow for the higher-risk features.

We will make separate decisions as the requirements for those higher-risk functions, further power growth, additional signals, additional security features, and we'll conduct a detailed assessment of alternatives and risk assessment and decide what package of those are ready for including in a distinct second bloc or potentially a third bloc.

Now, this isn't a win all around. Our military users had to reconcile that they would be patient enough to wait longer than they might have. The assurance we gave them is that we had a higher confidence of delivering what we had committed to in exchange for that. And that appears to be a bargain that is holding water. And we welcome your support of that, too, sir.

Mr. TIERNEY. Well, it would seem to me at some point somebody, either the doctor or you or someone else, would have the authority to say, you know what, enough. We planned this particular program to do those things, we thought it was what we wanted. If something is going to be added on that is going to bring this way over cost, and we are behind schedule, you'll have to wait for the next bus.

Who has that authority? Is it you, Doctor?

Dr. HUYBRECHTS. That authority rests with the joint staff requirements process. I would say what I mentioned earlier, that 4 or 5 years ago when we recognized that we potentially had a constellation sustainment issue, the Air Force came forward with a plan. Originally there was no IIIA, B, C; there was just a III, and we were going to build the whole thing right up front. They came up with a plan where the IIIA is really just a low-risk satellite to make sure that we have something to keep the constellation going. And then we have plans to insert the various capabilities into the later locks.

Mr. TIERNEY. And then last I look at the General—the Government Accountability Office, and I see they have identified nine practices associated with effective scheduling estimating. Of those nine, one was met in this IIIF—IIIA schedule, one was not met, and seven were partially met.

Are you focused on that, and are you going to bring that up to all best practices?

General MCCASLAND. Sir, I'd like to take that for the record, because as little time as I have had to review this report, I wasn't able to actually itemize what those practices were. But I would be pleased to go answer that for the record, if you would allow me, sir.

Mr. TIERNEY. We appreciate it. Thank you.

[The information referred to follows:]

CHARRTS No.: HOGR-02-003
House Government Reform Committee
Hearing Date: May 07, 2009
Subject: GPS: Can We Avoid a Gap in Service?
Congressman:
Witness: Major General McCasland
Question: #3

Question: Please provide an assessment of how the GPS III acquisition is addressing the following challenges that lead to program cost growth identified on pages 14-15 of the GAO report:" DOD starts its space programs too early, that is before it has assurance that the capabilities it is pursuing can be achieved within resources and time constraints;" inadequate contracting strategies;" contract and program management weaknesses;" the loss of technical expertise;" capability gaps in the industrial base;" tensions between labs that develop technologies for the future and current acquisition programs;" divergent needs in users of space systems; and" short tenures for top leadership and program managers within the Air Force and the Office of the Secretary of Defense have lessened that sense of accountability for acquisition problems and further encouraged a view of short-term success.

Answer: The GPS IIIA program implemented a low risk/high confidence approach with an emphasis on heritage design and high technology readiness. Technologies planned to be implemented in GPS IIIA were required to have a Technology Readiness Level (TRL) of 6 by the System Design Review (SDR) in Fall 2007. (DoD policy requires the technology in a program be demonstrated in a relevant environment prior to MS B.) GPS III capabilities requiring technologies not at TRL 6 were deferred to later increments. To ensure technology readiness to support later increments, the GPS IIIA contract includes a Capability Insertion Program to mature technologies to TRL 6 by the SDR of GPS IIIB or IIIC.

*"Inadequate contracting strategies"*
The GPS III program has been structured to emphasize and reward on-time, on-cost delivery. The contract is a Cost Plus Incentive Fee / Award Fee (CPIF/AF) contract. Seventy percent of the award fee amount is based on meeting critical program milestones demonstrating maturity and progress towards first launch. These are defined annually by the Program Manager. The CPIF portion of the contract focuses on cost management. It has a 5% target fee and the contractor is required to share 30% of both overruns and underruns until the overrun results in no fee at all. Additionally, there is a significant negative penalty for late delivery of the first satellite vehicle. Finally, the Acquisition Decision Memorandum makes clear that the ability of the GPS IIIA prime contractor to be awarded the GPS IIIB contract is primarily dependent on successful performance on the GPS IIIA contract.

*"Contract and program management weaknesses"*
Strong program management is critical to the success of complex space programs. The GPS III contractor has placed an experienced, successful program manager over this contract with extensive GPS space vehicle management experience. The government has selected a GPS III Program Manager through a command screening process which identifies the best candidates to

lead critical Air Force programs. Both of these leaders are supported by strong, experienced teams. Unlike recent programs where cost estimates have significantly underestimated the scope and complexity of programs, the GPS IIIA cost estimates considered a full range of historical development and integration issues, the current technology readiness levels, the significant early risk reduction, prototyping of key payload components, and funding of early risk identification and mitigation efforts in determining a realistic and executable program cost estimate. The Air Force has fully funded the GPS program at the 80% confidence level to eliminate potential delays due to funding constraints.

*"Loss of technical expertise"*
The GPS III contractor team is staffed by experienced GPS IIR-M and A2100 personnel. The government team has been staffed with experienced and capable senior personnel who bring a wealth of space acquisition, engineering and operations experience, drawing from a variety of challenging space programs. Additionally, "Back-to-Basics" acquisition training has been implemented for all program personnel to teach the basic fundamentals of acquisition oversight (not insight). Finding experienced space systems engineering talent is always a challenge, but the Air Force is committed to training and maintaining GPS III staffing.

*"Capability gaps in the industrial base"*
The GPS IIIA program has placed significant early emphasis on space-qualified parts, materials, and processes used on the program and committed appropriate resources and expertise in this critical area. The early identification of parts outside the standard Space Quality Baseline will allow the program to define manufacturing, test, and screening requirements for parts and place early orders with vendors. In addition, the GPS Wing identified the need to sustain their most experienced space atomic clock supplier to build the GPS III space clocks. An engineering development contract was implemented between the build of the GPS IIR/IIF clocks and the beginning of the GPS IIIA contract to ensure critical clock expertise and personnel remained available to the GPS IIIA program. In addition, the GPS Wing required the GPS III prime contractor to fund an alternate vendor clock development program as part of their Capability Insertion Program to further ensure the sustainment of the industrial base in this critical area.

*"Tensions between labs that develop technologies for the future and current acquisition programs"*
Due to the strong emphasis on heritage design and maintaining a low-risk, high-confidence acquisition strategy, no technologies currently under development in the labs are required for the GPS III program.

*"Divergent needs in users of space systems"*
Air Force senior leaders took a well-conceived and articulated GPS III strategy to the Joint Requirements Oversight Council (JROC). The low-risk, high-confidence approach and incremental development in GPS IIIA, IIIB, and IIIC delayed technical risks to later increments, and a Capability Insertion Program (CIP) investment program was established to systematically reduce those risks. The JROC senior leaders fully endorsed the incremental development approach as the best way to achieve constellation sustainment, deliver vital warfighter capabilities, and execute the program on cost and on schedule.

*"Short tenures for top leadership and program managers within the Air Force and the Office of the Secretary of Defense have lessened sense of accountability for acquisition problems and further encouraged a view of short term success"*
The Air Force has instituted a 3-yr minimum for Program Managers of ACAT 1D programs.
The Air Force has put their strongest team on GPS III.

Mr. TIERNEY. Mr. Flake, anything else?

Mr. FLAKE. No.

Mr. TIERNEY. I want to thank all of you for your testimony. This is helpful to us and, I think, helpful to our next panel. It will give them an idea of what is going on, and we will be anxious to hear their remarks as well. I would appreciate it if you have an opportunity to submit those things that you promise for the record at your earliest convenience. So thank you all very much.

And now we'll take a little pause as we set the second panel up and maybe come back in 5 minutes.

[Recess.]

Mr. TIERNEY. In the interest of time, we were told that we're going to have a vote in a few minutes, and I would like to give you the opportunity to hopefully get your testimony in before that. But it is only one vote, so if it does ring, it will be just a very brief interruption, and we will be back. So I apologize for that.

This panel will probably not take as long as the last panel for the fact that we want to hear from you. We may not have that much of a question grilling back and forth on that, but we want to hear from you about what you know about potential issues arising with that and how it will impact your particular area on that.

So now we're going to receive testimony from the second panel. Let me introduce each of you.

Lieutenant General Larry D. James is the Commander of the 14th Air Force, Air Force Space Command, and Commander of the Joint Functional Component Command for Space, U.S. Strategic Command, in Vandenberg Air Force Base, California. He leads more than 20,500 personnel responsible for providing missile warning, space superiority, space situational awareness, satellite operations, space launch and range operations. General James holds a B.S. from the U.S. Air Force Academy and an M.S. from the Massachusetts Institute of Technology.

Ms. Karen Van Dyke is the Director, Position Navigation and Timing, Research and Innovative Technology Administration, at the Department of Transportation. Ms. Van Dyke was a member of a team that conducted a study for the Office of the Secretary of Transportation to identify and analyze GPS vulnerabilities and interference mitigation techniques for all modes of transportation. Ms. Van Dyke holds both a B.S. and an M.S. from the University of Massachusetts at Lowell. Nice to see Massachusetts so well represented here today.

Mr. F. Michael Swiek currently serves as executive director of the U.S. GPS Industry Council, which he helped to found with the leading U.S. GPS manufacturers in 1991. Mr. Swiek IS also currently president of Mike International LLC, a consulting practice concentrating on policy and regulatory issues affecting various issues in high-technology trade. He served for 10 years with the Central Intelligence Agency, working on export control and technology security issues. He holds a B.A. from Bowdoin College and an M.A. from Georgetown University.

Mr. Chet Huber is president of OnStar Corp., a wholly owned subsidiary of General Motors Corp. He joined General Motors Electric Motor Division as a co-op engineering student in 1972, and

held a variety of engineering, operations and marketing roles before joining OnStar. I guess you'd call that job security, huh?

His positions included director of the aftermarket business; general director of aftermarket parts and service; and general director, sales, marketing and product support. Mr. Huber holds a B.S. from General Motors Institute, now Kettering University, and an M.B.A. from Harvard University.

I want to thank all of you for making yourselves available here today and helping us out with your testimony. Again, it is the policy of the committee to swear in witnesses before they testify, so if you would please stand and raise your right hands.

[Witnesses sworn.]

Mr. TIERNEY. The record will please reflect that all of the witnesses have answered in the affirmative.

As with the first panel, your full written statements will be entered on the record. There's 5-minute opening statements—the lights are the same for the second panel as they were for the first—and then we'll go to questions if the panel members up here have any.

General, would you please start?

**STATEMENTS OF LIEUTENANT GENERAL LARRY D. JAMES, COMMANDER, 14TH AIR FORCE (AIR FORCE STRATEGIC), AIR FORCE SPACE COMMAND, AND COMMANDER, JOINT FUNCTIONAL COMPONENT COMMAND FOR SPACE, U.S. STRATEGIC COMMAND; KAREN L. VAN DYKE, DIRECTOR, POSITION NAVIGATION AND TIMING, RESEARCH AND INNOVATIVE TECHNOLOGY ADMINISTRATION, DEPARTMENT OF TRANSPORTATION; F. MICHAEL SWIEK, EXECUTIVE DIRECTOR, U.S. GPS INDUSTRY COUNCIL; AND CHET HUBER, PRESIDENT, ONSTAR CORP.**

**STATEMENT OF LIEUTENANT GENERAL LARRY D. JAMES**

General JAMES. Chairman Tierney and Ranking Member Flake, thank you for the opportunity to be here today. I'm honored to be here as the Commander of the Joint Functional Component Command for Space.

It's a privilege to address you on our role in operating the Global Positioning System, as well as represent the combatant commander users around the globe. My testimony today focuses on the importance of GPS to the warfighter, the health of our current constellation, and U.S. Strategic Command's strategies to ensure the most robust space-based positioning, navigation and timing capabilities provided by the GPS constellation.

Certainly, as we have heard earlier, as we look to the importance of GPS, we understand that GPS provides that key PNT, position navigation and timing, data to users worldwide and has truly become essential to U.S. national security and economic well-being. GPS is the centerpiece of global PNT services, and the GPS constellation enables an ever-increasing arsenal of military and civil applications.

GPS provides critical services to our forces around the globe. From infantrymen walking the streets of Fallujah, to ships combating piracy off the straits of Somalia, and to aircraft patrolling our

country's borders, it is evident that GPS is critical to successful military operations. Strong communications links, operational relationships and reachback ensure that U.S. Strategic Command provides the combatant fix that the U.S. combatant commanders need around the globe.

As we look at our constellation health and status, we have today exceeded requirements by maintaining a constellation of 30 operational satellites, and we've achieved sub–3-meter accuracy with that constellation. As you heard earlier, by employing residual operations and power management, we have options to maintain full GPS capabilities and ensure continued support to global users.

We must continue to focus on future requirements for GPS capabilities. Matching future user requirements with technological advances will allow U.S. Strategic Command to provide the most advanced and reliable space effects in response to the growing demands of the Nation's GPS users.

In conclusion, the U.S.' dependence on GPS across our military, civil and commercial users requires PNT capabilities to ensure our ability to safely and effectively operate in diverse environments. The DOD must continue to build the relationships, processes and capabilities within the global space community that allow us to operate effectively together to meet our national security objectives.

Thank you very much.

Mr. TIERNEY. Thank you, General.

[The prepared statement of General James follows:]

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SECURITY AND FOREIGN AFFAIRS
HOUSE COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM

STATEMENT OF

LIEUTENANT GENERAL LARRY JAMES

COMMANDER

JOINT FUNCTIONAL COMPONENT COMMAND FOR SPACE

BEFORE THE SUBCOMMITTEE ON NATIONAL SECURITY AND FOREIGN AFFAIRS

HOUSE COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM

ON "*GPS: CAN WE AVOID A GAP IN SERVICE?*"

7 MAY 2009

NOT FOR RELEASE UNTIL RELEASED BY THE SUBCOMMITTEE ON NATIONAL
SECURITY AND FOREIGN AFFAIRS
HOUSE COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM

Mister Chairman, Ranking Member Flake, and distinguished Members of the Security and Foreign Affairs Subcommittee, I am honored to be here today for my first opportunity to appear before you as United States Strategic Command's (USSTRATCOM) Commander of the Joint Functional Component Command for Space (CDR JFCC SPACE).

It's a distinct privilege to address you on the role we have in operating the Global Positioning System (GPS) constellation, and to represent the men and women of JFCC SPACE who employ space capabilities around the globe every day. These dedicated and innovative Soldiers, Sailors, Airmen, and Marines work hard to maximize the effectiveness of our space assets as they execute the command and control of our worldwide space forces.

Today I will focus my discussion on the importance of GPS to the warfighter, the health of our current GPS constellation, and USSTRATCOM's strategies to ensure the most robust space-based positioning, navigation, and timing (PNT) capabilities are provided by the GPS constellation.

**IMPORTANCE OF GPS**

GPS provides PNT data of such accurate and reliable nature to users worldwide that it has become essential to U.S. national security and economic well being. USSTRATCOM provides PNT effects to Department of Defense (DoD) global users that are critical to military operations. GPS is the centerpiece of global PNT services and the GPS constellation enables an ever-increasing arsenal of military and civil applications.

GPS provides critical services every second to our deployed forces around the globe from the infantrymen walking the streets of Fallujah, to the ships combating piracy off the coast of Somalia, to the aircraft patrolling our country's borders. The criticality of GPS to the warfighter

is readily apparent in on-going operations in Afghanistan where GPS services provide foundational data, enabling us to track the location of U.S. and coalition forces.

For the military users, there are multiple examples of GPS successes. For example, precision accuracy of the GPS-guided Excalibur artillery rounds have enabled the U.S. Army to remove top al-Qaida operatives while firing within close proximity of infantrymen, reducing collateral damage and risk to Soldiers on the ground. In July 2007, with only two rounds fired, Excalibur took down a top al-Qaida target responsible for improvised explosive devices (IEDs), vehicle-borne IEDs, and indirect fire attacks. Excalibur's accuracy has also enabled the U.S. Army to engage targets in missions in the Diyala province of Iraq when aircraft were unable to provide support due to weather. On 27 March 2009, following an enemy ambush against a coalition unit, a B-1B Lancer used a GPS-guided 500 lb bomb to destroy a series of enemy fighting positions and a fortified heavy machine gun position near Tarin Kowt, Afghanistan. On 28 March 2009 near Asmar, Afghanistan, a formation of F-15E Strike Eagles attacked enemy forces with GPS guided Joint Direct Attack Munitions (JDAMs), hitting a sniper hideout and a group of enemy gunmen firing at coalition troops. Right now, the USS Eisenhower (Ike) Carrier Strike Group is on station supporting coalition forces executing OPERATION Enduring Freedom. On 26 April 2009, four F/A-18 Super Hornets flown from the deck of the Ike delivered four 500 lb GPS-guided JDAMs onto enemy fortified compounds and machine gun fighting positions, ending a fire fight with coalition forces. Clearly, the GPS constellation enables our forces worldwide to maneuver into a militarily advantageous position and then, through various GPS-aided munitions, exploit that tactical advantage to create effects ranging from tactical to strategic. GPS is critical to successful military operations across a multitude of engagements, and strong communication links, operational relationships, and reach back with the

GPS Operations Center (GPSOC) and the Joint Space Operations Center (JSpOC) ensure USSTRATCOM is able to provide users the effects they need.

The User Operations Section within the GPSOC is the main interface for coordination of GPS effects with military users; however, the JSpOC also serves a vital role in military support. Whether it is a need for enhanced data accuracy, or the need to tailor additional operational support to a specific mission, the GPSOC and the JSpOC work directly with users to ensure warfighter needs are met. This means both the GPSOC and JSpOC are in constant communication with theater users to ensure optimum GPS availability and accuracy.

## CONSTELLATION HEALTH AND GAP MANAGEMENT

As with all our military satellite constellations, the GPS constellation includes satellites which have exceeded their design life, operate with partial capability, or are a single key component away from failure. However, we have taken operational steps to mitigate the impacts of potential satellite losses to ensure continued support to warfighters and the global community of users.

Although required to maintain 24 GPS satellites on orbit at 95 percent probability, we have exceeded requirements by currently maintaining 30 operational satellites and have achieved sub-three meter accuracy. We conduct "residual operations" as an on-going solution to mitigate any potential gap in GPS by retaining older, partially mission capable satellites in a back-up mode that can potentially be returned to operations if a satellite in the constellation fails. Currently three vehicles are held in residual status, and through in depth analysis, residual satellites are returned to the constellation every six months to ensure PNT operational capability.

Additionally, we use "power management" as a way to extend the PNT mission on GPS satellites. While the planned degradation or suspension of secondary payloads are not regularly used as an operational tactic, technique, or procedure, we do regularly assess the health of individual satellites. As part of the assessment we balance the needs of the primary GPS mission, Space-based PNT, against the needs of the secondary missions on board. After coordination with the secondary payload mission team, those systems may be power managed or "shut down" to extend the PNT mission on the satellite.

While we continue to exceed current expectations and system requirements, we must continue to focus on future requirements for GPS capabilities for our military and civilian/commercial users. Ever-changing and increasing user requirements demand that our next generation of GPS incorporate a more robust anti-jam signal, more power directed capabilities, and faster signal acquisition to ensure users have the capabilities necessary to produce desired effects. Matching future user requirements with technological advances will allow USSTRATCOM to provide the most advanced and reliable space effects in response to the growing demands of the nation's warfighters and commercial users.

## CONCLUSION

Space has a vital role, which is epitomized by the GPS constellation, across all instruments of national power – Diplomacy, Information, Military, and Economic interactions. Specifically, the United States' dependence on GPS across our military, civil, and commercial sectors requires PNT capabilities to ensure our ability to safely and effectively operate in diverse environments on the ground, at sea, in the air, and in space. Working in collaboration with other departments and agencies in the U.S. Government, the DoD must continue to build the

relationships, processes, and capabilities within the global space community that allow us to operate effectively together to meet our national security objectives. You can be proud of your Soldiers, Sailors, Airmen, and Marines that expertly tackle the challenges we face every day.

Mr. TIERNEY. Ms. Van Dyke.

**STATEMENT OF KAREN VAN DYKE**

Ms. VAN DYKE. Chairman Tierney, Ranking Member Flake and members of the subcommittee, I am Karen Van Dyke, Acting Director for Positioning Navigation and Timing in the U.S. Department of Transportation's Research and Innovative Technology Administration [RITA]. I appreciate the opportunity to appear before you today to discuss the criticality of the Global Positioning System to civil user community.

GPS technology is increasingly woven into the fabric of American society, from cars and planes to cell phones and wristwatches. It improves productivity and efficiency in many areas of commerce. For example, today's construction, farming, mining, shipping, surveying and traffic management systems have become dependent on GPS. It allows agriculture operations to continue through low-visibility conditions, such as rain, dust, fog and darkness, and to apply chemicals precisely, reducing environmental impact while also reducing production costs.

GPS also furthers the scientific aims, such as weather forecasting, earthquake prediction and environmental protection. Furthermore, the precise GPS time signal derived from atomic clocks is embedded in critical economic activities, such as synchronizing communication networks, managing power grids and authenticating electronic transactions.

Of particular interest to the Department of Transportation is the Federal Aviation Administration's next generation air transportation, NextGen, program. NextGen is a wide-ranging transformation of the national air transportation system to meet future demand and support economic viability of the system.

NextGen will reduce fuel burn and greenhouse gas emissions, allow more direct time-based routing, enable safer operations, and reduce runway incursions. United Airlines already has pioneered the use of tailored arrivals based on GPS from Honolulu to San Francisco, with a fuel savings at 1,600 pounds per flight.

GPS is the foundation for NextGen navigation and surveillance. The continuity of funding and integrity of the planned launch schedule of the GPS constellation is vital to the Nation moving ahead with NextGen.

I would like to thank the Air Force for dedicated service in providing extremely reliable operation of GPS since it achieved initial operating capability in 1993. The United States clearly is the leader in space-based positioning, navigation and timing, and we must continue to maintain and improve GPS to maintain this U.S. technology leadership position.

Sustainability of the GPS constellation is critical to users worldwide. The Department of Transportation is committed to modernization of GPS, and fully funding the DOT portion of GPS modernization for new civil capabilities is critical to ensuring that the GPS III program remains on schedule to ensure future constellation sustainment.

The Department of Transportation is confident that the Department of Defense will continue to operate at or above the minimum GPS performance standard commitment of 21 healthy satellites 98

percent of the time, equivalent to 24 healthy satellites 95 percent of the time, and will find innovative methods to extend the life of the GPS satellites to prevent any gaps in availability. We recognize that the GPS system has exceeded performance commitments with 30 satellites currently operational, and that some users may have come to expect this level of service.

The Department of Transportation is a provider as well as a user of GPS services, augmenting the GPS signal to improve accuracy and integrity. FAA provides the Wide Area Augmentation System [WAAS], and RITA coordinates resources and plans for the inland component of the Nationwide Differential GPS System [NDGPS], operated and maintained by the U.S. Coast Guard. The U.S. Air Force and U.S. Coast Guard and Federal Aviation Administration have agreements to coordinate notification of GPS performance and any disruption of GPS service to the user community.

When the constellation is at its minimum GPS performance commitment, outages for aviation and other users will be experienced on a routine basis, which could result in complaints and economic impact. For users who equip with GPS augmented by WAAS, these impacts are reduced, supporting minimum availability requirements of 99 percent or more. However, like any radio and navigation system, GPS is vulnerable to interference that can be reduced, but not eliminated.

In 2001, RITA's Volpe National Transportation System Center issued a vulnerability assessment of the transportation infrastructure relying on the Global Positioning System. The findings of this assessment indicated that there was awareness within the transportation community of risks associated with use of GPS as a primary means for position determination and precision timing.

Due to the reliance of transportation on GPS signals, it is essential that threats be mitigated, and alternative backups be available, and the system be hardened for critical applications. DOT has determined that sufficient alternative navigation aids currently exist in the event of a loss of GPS based service.

Potential backup capabilities to GPS are being explored as part of a National Positioning Navigation and Timing Architecture study initiated in 2006 by the Department of Defense and the Department of Transportation. The overarching goal of this architecture, with GPS as its cornerstone, is intended to overcome identified capability gaps and achieve an evolutionary path to providing integrated, space-based, terrestrial and autonomous solutions in the 2025 time period that will ensure the continuity of government-provided PNT services.

In conclusion, I would like to thank the committee for allowing me to discuss the civil user perspective of GPS. The Department of Transportation is committed to our—continuing our strong working relationship with the Department of Defense to maintain our global leadership in space-based PNT.

I'd be glad to answer any questions you have.

Mr. KUCINICH [presiding]. Thank you for your testimony.

[The prepared statement of Ms. Van Dyke follows:]

**STATEMENT OF**
**KAREN VAN DYKE**
**ACTING DIRECTOR, POSITIONING, NAVIGATION, AND TIMING**
**RESEARCH AND INNOVATIVE TECHNOLOGY ADMINISTRATION**
**U.S. DEPARTMENT OF TRANSPORTATION**

**BEFORE THE**
**NATIONAL SECURITY AND FOREIGN AFFAIRS SUBCOMMITTEE**
**HOUSE COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM**

**HEARING ON:**
**GPS: CAN WE AVOID A GAP IN SERVICE?**

**MAY 7, 2009**

Chairman Tierney, Ranking Member Flake, and Members of the Subcommittee:

I am Karen Van Dyke, Acting Director for Positioning, Navigation and Timing in the U.S. Department of Transportation's Research and Innovative Technology Administration (RITA). I appreciate the opportunity to appear before you today to discuss the criticality of the Global Positioning System to the civil user community.

GPS technology is increasingly woven into the fabric of American society, from cars and planes to cell phones and wristwatches. It improves productivity and efficiency in many areas of commerce. For example, today's construction, farming, mining, shipping, surveying, and traffic management systems have become dependent on GPS. The technology enhances public safety by preventing transportation accidents and by reducing the response times of ambulances, firefighters, and other emergency services. It allows agriculture operations to continue through low visibility field conditions such as rain, dust, fog and darkness, and to apply chemicals precisely, reducing environmental impact while reducing production costs. GPS also furthers scientific aims such as weather forecasting, earthquake prediction, and environmental protection.

Furthermore, the precise GPS time signal, derived from atomic clocks, is embedded in critical economic activities such as synchronizing communication networks, managing power grids, and authenticating electronic transactions.

**Importance of GPS to NextGen**

Of particular interest to the Department of Transportation is the Federal Aviation Administration's (FAA) Next Generation Air Transportation System (NextGen) program. NextGen is a wide-ranging transformation of the national air transportation system to meet future demand and support the economic viability of the system while reducing delays, improving safety, and protecting the environment. NextGen will change the way the system operates – reducing congestion, noise, and emissions, expanding capacity and improving the passenger experience. NextGen is a highly complex, multilayered, evolutionary process of developing and implementing new technologies and procedures.

NextGen will reduce fuel burn and greenhouse gas emissions, allow more direct, time-based routings, enable safer operations, and reduce runway incursions. United Airlines already has pioneered the use of tailored arrivals based on GPS from Honolulu to San Francisco, with a fuel savings of 1,600 pounds per flight.

GPS is the foundation for NextGen navigation and surveillance. The continuity of funding and integrity of the planned launch schedule of the GPS constellation is vital to the nation moving ahead with NextGen.

**Commitment to GPS**

I would like to thank the Air Force for their dedicated service in providing extremely reliable operation of GPS since it achieved Initial Operating Capability in 1993. The United States clearly is the leader in space-based positioning, navigation, and timing and we must continue to maintain and improve GPS, its augmentations, and backup capabilities to meet growing national security, homeland security, economic security, civil, and scientific demands, and to maintain this U.S. technology leadership position.

Sustainability of the GPS constellation is critical to users worldwide. The Department of Transportation is committed to modernization of GPS and providing funding to ensure the development and modernization of the next generation of GPS to provide new civil capabilities. Fully funding the DOT portion of GPS modernization is critical to ensuring that the GPS III program remains on schedule to ensure future constellation sustainment.

The Department of Transportation is confident that the Department of Defense will continue to operate GPS at or above the minimum GPS Performance Standard commitment of 21 healthy satellites 98 percent of the time, equivalent to 24 healthy satellites 95 percent of the time and will find innovative methods to extend the life of the GPS satellites to prevent any gaps in availability. We recognize that GPS has exceeded performance commitments with 30 satellites currently operational, and that some users may have come to expect this level of service.

**Mitigation of Disruption**

The Department of Transportation is a provider, as well as a user, of GPS services, augmenting the GPS signal to improve accuracy and integrity. FAA provides the Wide Area Augmentation System (WAAS), and RITA coordinates resources and plans for the inland component of the Nationwide Differential GPS System (NDGPS), operated and maintained by the U.S. Coast Guard. WAAS and NDGPS stations are a part of the National Oceanic and Atmospheric Administration (NOAA)-managed national Continuously Operating Reference Stations or CORS network of over 1300 permanently operating GPS receivers maintained by over 200 federal, academic and private organizations. The U.S. Air Force, U.S. Coast Guard, and the Federal Aviation Administration have agreements to coordinate and provide notification of GPS performance and any disruptions of GPS service to the user community.

For aviation users relying on unaugmented GPS, when the constellation is at its minimum GPS Performance Standard commitment, outages will be experienced on a routine basis, which could

result in complaints and economic impact. For users who equip with GPS augmented by WAAS, the impacts are reduced, supporting minimum availability requirements of 99% or more.

However, like any radionavigation system, GPS is vulnerable to interference that can be reduced, but not eliminated. In 2001, RITA's Volpe National Transportation Systems Center issued the "Vulnerability Assessment of the Transportation Infrastructure Relying on the Global Positioning System". The findings of this assessment indicated that there was awareness within the transportation community of risks associated with use of GPS as a primary means for position determination and precision timing. Due to the reliance of transportation on GPS signals, it is essential that threats be mitigated and alternative back-ups be available, and the system be hardened for critical applications. DOT has determined that sufficient alternative navigation aids currently exist in the event of a loss of GPS based services.

Potential back-up capabilities to GPS are being explored as part of a National Positioning, Navigation and Timing (PNT) Architecture study, initiated in 2006 at the request of the Assistant Secretary of Defense for Networks and Information Integration and DOT's Under Secretary of Transportation for Policy. The overarching goal of the architecture, with GPS as its cornerstone, is intended to overcome identified capability gaps, and achieve an evolutionary path to providing integrated space-based, terrestrial, and autonomous solutions in the 2025 time period that will ensure the continuity of government-provided PNT services.

In conclusion, I would like to thank the Committee for allowing me to discuss the civil user perspective of GPS. The Department of Transportation is committed to continue our strong working relationship with the Department of Defense to maintain our global leadership in space-based PNT.

I would be glad to answer any questions you may have.

Mr. KUCINICH. Mr. Swiek, you may proceed.

**STATEMENT OF F. MICHAEL SWIEK**

Mr. SWIEK. I would like to thank Chairman Tierney, Ranking Member Flake, and Mr. Kucinich, and distinguished members of the subcommittee for providing an opportunity today to discuss this important topic.

Global Positioning System [GPS], is one of the great U.S. success stories involving shared national assets. GPS is a national model of successfully balancing military advantage and civilian equities to serve a broad and diverse range of national interests from national security and public safety to enabling critical infrastructure, advancing scientific research, facilitating local government productivity and enhancing the productivity and competitiveness of diverse industries that are important to our economy and serving millions of individual Americans every day.

GPS is a model of government-industry cooperation contributing to the national economy through the entrepreneurial creation of companies, industries and jobs deriving value for users from integrating GPS positioning navigation and timing information into applications and solutions.

The initial military investment in GPS has not only met military requirements and demonstrated invaluable military utility for the warfighter, it also provided a signal for civilian use at little to no additional cost. The dedicated men and women of the U.S. Air Force Space Command have achieved superb operational management of the GPS constellation for all users under G—under Air Force stewardship of GPS. This operational excellence, together with predictable U.S. policy over two decades, has given the global community a stable signal that has provided a solid foundation for tremendous private-sector investments in receiver and applications innovation. The result of this enlightened U.S. approach has been the worldwide adoption of GPS as a global information utility, providing major productivity benefits to the Nation.

It is difficult to say with precision just how big the GPS industry is because it touches and contributes to so many different applications and areas in so many ways. Some recent estimates have impressive numbers, such as 15 to 50 billion per year or more, depending on how one counts the direct and indirect effects of GPS.

GPS is a core information technology from many industries that are key to the U.S. economy. Examples include agriculture, aviation, construction, vehicle navigation, fleet management, public safety, geographical information systems, land use, environmental monitoring, earthquake monitoring, wildlife monitoring, disaster management, telecommunications, E911 cell phones, mapping, mining, marine transportation, surveying, infotainment. I could go on probably for hours, but there is—trust me, there is at least a couple of hundred more.

More impressive than the aggregate value of United States—or worldwide GPS industries—is the effect that GPS can have on the productivity and competitiveness of key industries. GPS enhances productivity at times as much as 30 percent through exploitation of precise positioning, navigation and timing information.

It is not an exaggeration to say that GPS is everywhere, not only where we commonly and almost ubiquitously see it, such as in consumer car-navigation devices such as OnStar and the Garmin on the dashboard; it is there, essential and critical even where you don't realize it. Whenever you make a call on your cell phone, withdraw money from your ATM, send an e-mail, you are using GPS. GPS precise time signals are essential tools for synchronizing the networks through which the services operate. Turn on a light, and you are probably using GPS as well, as electric power grids similarly use GPS precise time signals for synchronization. The road you drive on may have been built by construction equipment guided by GPS. Not only has the term "GPS" become a common term in the public lexicon, it has become an essential and critical utility on which public and private infrastructures depend.

U.S. industry has been a major factor and leader in the development of today's GPS industry through entrepreneurial vision, technological innovation and private-sector investment, but we have not done this alone. The U.S. Government has promoted and encouraged this development by establishing, maintaining and reinforcing a stable policy framework that has consistently received farsighted and bipartisan support. It has been a true partnership of shared visions, discussions and debates, cooperation and coordination. This has been possible through the open dialog that has taken place since the early days of GPS, some 25-plus years ago, between civilian and military, industry and government on technical and policy issues as the technology system and applications have evolved.

As we move forward to new generations of GPS satellites and signals, the challenge is to maintain this impressive level of reliability and stability. Successful adoption of modernized civilian GPS signals will occur if the installed user base can continue to trust the consistent and stable policy framework that the U.S. Government has provided GPS for two decades. The new signals will need to sustain a legacy of accuracy, availability and reliability established over the past 20 years.

The adoption of GPS is a testament to the trust of users in Air Force stewardship. Users rely on the ability of the Air Force to operate and maintain the satellite constellation and stable signal structures that serve the warfighter and diverse civilian users in a way that both enhances our national and economic security. We strongly encourage the continuation of the open and balanced dialog between all stakeholders, users and providers, civilian and military, industry and government. Our industry association strives to be an objective information resource to support this dialog.

Thank you for the opportunity, and I'd be happy to answer any questions you may have.

Mr. KUCINICH. I thank the gentleman.

[The prepared statement of Mr. Swiek follows:]

**House Committee on Oversight and Government Reform**
**Subcommittee on National Security and Foreign Affairs Hearing**

*"GPS: Can We Avoid a Gap in Service?"*
*Thursday, May 7, 2009 - 10:00 AM – RHOB 2154*

**The Testimony of Mr. F. Michael Swiek, Executive Director, U.S. GPS Industry Council**

Thank you Chairman Tierney, Ranking Member Flake, and distinguished members of this Subcommittee, for providing an opportunity today to discuss this important topic.

The Global Positioning System (GPS) is one of the great U.S. success stories involving a shared national asset. GPS is a national model of successfully balancing military advantage and civilian equities to serve a broad and diverse range of national interests, from national security and public safety, to enabling critical infrastructures, advancing scientific research, facilitating local government productivity, and enhancing the productivity and competitiveness of diverse industries that are important to our economy and serving millions of individual Americans every day.

GPS is a model of government-industry cooperation contributing to the national economy through the entrepreneurial creation of companies, industries and jobs deriving value for users from integrating GPS positioning, navigation, and timing information in application solutions. The initial military investment in GPS has not only met military requirements and demonstrated invaluable military utility for the warfighter; it also provided a signal for civilian use at little to no additional cost. The dedicated men and women at USAF Space Command have achieved superb operational management of the GPS constellation for all users under Air Force stewardship of GPS. This operational excellence, together with predictable U.S. policy over two decades, has given the global community a stable, reliable signal that has provided a solid foundation for tremendous private sector investments in receiver and applications innovation. The result of this enlightened U.S. approach has been the worldwide adoption of GPS as a global information utility, providing major productivity benefits to the Nation.

It is difficult to say with precision just how big the GPS industry is because it touches and contributes to so many different applications and areas in so many ways. Some recent estimates have impressive numbers such as $15-50 billion annually worldwide depending on how one counts direct and indirect effects. GPS is a core information technology for many industries that are key to the U.S. economy. Examples include agriculture, aviation, construction, vehicle navigation, fleet management, public safety, geographical information systems, land use, environmental monitoring, earthquake monitoring, wildlife monitoring, disaster management, telecommunications, E911 cell phones, mapping, mining, marine transportation, surveying, infotainment, and probably a couple of hundred additional areas or more.

More impressive than the aggregate value of U.S. or worldwide GPS industries is the effect that GPS can have on the productivity and competitiveness of key industries. GPS enhances

productivity at times as much as 30 percent through exploitation of precise positioning, navigation, and timing in value chains. It is not an exaggeration to say that GPS is everywhere, not only where we commonly and almost ubiquitously see it, such as in consumer car navigation devices. It is there, essential and critical, even where you don't realize it. Whenever you make a call on your cell phone, withdraw money from your ATM, or send an e-mail, you are using GPS. GPS precise time signals are essential tools for synchronizing the networks through which these services operate. Turn on a light, and you are probably using GPS as well, as electric power grids similarly use GPS precise time signals for synchronization and fault detection. The roads you drive on may have been built by construction equipment guided by GPS. Not only has the term "GPS" become a common term in the public lexicon, it has become an essential and critical utility on which public and private infrastructures depend.

U.S. industry has been a major factor and leader in the development of today's GPS industry through entrepreneurial vision, technological innovation, and private sector investment. But, we have not done this alone. The U.S. Government has promoted and encouraged this development by establishing, maintaining and reinforcing a stable policy framework that has consistently received farsighted and bipartisan support. It has been a true partnership of shared visions, discussions and debates, cooperation and coordination. This has been possible through the open dialogue that has taken place since the early days of GPS, some 25 plus years ago, between civilian and military, industry and government on technical and policy issues as the technology, system and applications have evolved.

As we move forward to new generations of GPS satellites and signals, the challenge is to maintain this impressive level of reliability and stability. Successful adoption of modernized civilian GPS signals will occur if the installed user base can continue to trust the consistent and stable policy framework that the U.S. Government has provided for GPS for two decades. The new signals will need to sustain the legacy of accuracy, availability, and reliability established over the past twenty years. The adoption of GPS is a testament to the trust of users in Air Force stewardship. Users rely on the ability of the Air Force to operate and maintain the satellite constellation and stable signal structures that serves the warfighter and diverse civilian users in a way that enhances both our national and economic security. We strongly encourage the continuation of the open and balanced dialogue between all stakeholders; users and providers, civilian and military, industry and government. Our industry association strives to be an objective information resource to support that dialog.

Thank you. I would be happy to answer any questions you might have.

## COMMERCIAL GPS APPLICATION EXAMPLES

*The following examples of GPS applications provide user testimony that describes their decision metrics (e.g., productivity gains, return on investment and timeframe) to invest in and use commercial and consumer GPS products:*

***Precision Survey:***

- **California:** The Bay Bridge replacement project benefited from precision GPS and optical technologies. The new 6,500-ton, 350-foot section of the San Francisco-Oakland Bay Bridge, used precision GPS to "retrofit-by-replacement" an opening in the existing bridge. One of the busiest bridges in the U.S. was shut down on August 31, 2007 at 8:00 pm and seventy hours later—11 hours ahead of schedule—the bridge was reopened.

- **Chicago, Illinois**: Rebuilding the Dan Ryan:

o One of the busiest expressways in the U.S., Chicago's 14.5-km Dan Ryan Expressway underwent complete reconstruction from 2005 to 2007. The largest expressway rebuild in Chicago history, the massive $975-million project stayed on its swift three-year timeline by utilizing the latest GPS-based surveying, 3D data modeling, and machine control technology.

o Divided into five sections, the project was a model of efficiency, quality control and productivity. By the end of 2007, the rebuilt road included several new lanes, reconfigured ramps, a new interchange, and enhanced lighting and sewers. The reconstructed Dan Ryan is safer, wider, more durable and easier to access.

o The project's sections were connected through a precise control network. Set by the engineering companies using GPS-based systems, the control network covered 12,950 km2 and facilitated project coordination. In addition, the local precision GPS network was used by project surveyors who wanted to connect to the network without any base station.

o For earthwork and construction, the general contractor and subcontractor used GPS grade control equipment, real-time precision GPS surveying systems and optical total stations. With grading, slope and actual position information inside the cab, they could run machine crews around the clock, greatly increasing productivity, minimizing errors and streamlining costs. They estimated that by project end about a million cubic yards of dirt was moved.

o The earthwork crews were connected to the larger project through a 3D road model calibrated to the precision GPS network. The road model was downloaded in real time into the GPS-based control equipment and calibrated to within 9 mm tolerance.

o Using that same 3D road model, the survey subcontractor's four crews utilized GPS rovers and total stations to set over 91,440 linear m of construction survey layout, as well as perform other tasks. The road model allowed the crews to work quickly and accurately, keeping up with around-the-clock schedule.

o The Dan Ryan's fast pace and high accuracy requirements highlight how GPS-based technology helps connect the jobsite for greater efficiency, accuracy, and productivity.

***Precision Agriculture:***

Small growers to agri-business throughout the U.S. and worldwide use high precision GPS products in every step throughout the growing process.

- **Nebraska:** precision GPS network expands to meet increasing demand for +/- one inch repeatable accuracy:
  - o In 2004, a company operating this precision network added capacity to meet fast growing customer demand for +/- one inch repeatable accuracy of precision GPS autopilot systems for farm equipment use in precision applications
  - o In 2006, this company expanded capacity to serve 35 customers throughout their trade area
  - o Some of the precision network signals are reliable as far as 12 miles from the transmitter (serving about 129,000 to 163,000 acres).
    - § "The customer may move the precision GPS receiver to different machines throughout the year" according to the company president.

- **Illinois** corn growers see big payback on precision GPS steering systems:
  - o This corn grower raises about 3,000 tillable acres of corn and soy beans. "These precision GPS systems save us $17,000 per year in fuel, labor, and repairs. At the same time, they increase our income by $54,000 each year due to less compaction, precise placement of seed over strip-tilled fertilizer, plus increased productivity and timeliness of planting and harvest operations. And those savings are based on $2.50 per bushel of corn and $2.50 per gallon of diesel fuel."
  - o "These reduced costs and extra income from precision GPS products are repeatable—they happen every year and provide a return on investment of 110 to 120 per cent per year." The longest payback for a customer is approximately 2.5 years and the fastest payback is 3 months.

- **Kansas** grower:
  - o "KSU research shows a possible 10-15 percent yield increase with strip tillage. Last Fall, we decided to upgrade to automated steering with precision GPS. When we knifed in Fall anhydrous, our pass-to-pass accuracy was one inch or better—often ¼ to ½ inch. When I went back with the N applicator, our system dropped the knives right back into the same grooves. This spring we will plant with our GPS on a Cat 55, then put the system on our sprayer. In a year or two, I can see adding a second GPS system, so we can run it on different jobs at the same time."

***Precision Construction:***

- Big Island, **Hawaii:** development project is being built on a 450-acre site, mindful of the delicate ecosystem, shoreline offset requirements, and indigenous culture:
  - o The construction company added GPS-based automatic grade control in 2005.
  - o The fact that operators have instantaneous cut-and-fill feedback is something they like. When they are ripping, they can drop their blades and the display will say you need to drop the blade another two feet to be on plan.

o A significant advantage of the GPS-based automatic grade control system is that the work can be accomplished in one pass with little need for rework.
o "When this huge, complicated project is complete, I will be able to say that the finished grades match exactly what is on the plan with no deviations or exceptions—including the golf course, which understandably has to be dead on."
o "The feedback from the developer is that we're hitting grade consistently within three-tenths of an inch of the finished contour. They are amazed that we're grading that close to the plan specs."
o "Without automatic grade control, it would have been a nightmare to maintain accuracy on the slope. Because the dozers have the site plan right in the cab, we save a tremendous amount of time and increase our productivity."

• **Georgia:** Construction project: 2 million square foot footprint of a logistics warehouse:
o "We're glad our motor grader is equipped with the latest GPS-based grade control, according to the construction company building this project. We wouldn't have been nearly as precise, nor completed the pad as quickly.
o "We had our own survey crew check the building pad when it was completed. The finished pad was consistently within a half inch of the plan, throughout the whole plan throughout the whole expanse, fully one-third of the mandated tolerances... which was very, very, impressive."
o According to the construction company, the right tolerances of the graded pad made for much smoother placement of concrete. If you are even a quarter-inch on two million square feet, that is a lot of additional concrete. It is estimated that each additional quarter-inch of concrete would cost $1 million dollars."
o "When you're talking about the major advantages of equipping our motor graders and dozers with the GPS-based systems, the big on is time....it takes less time to do the work and to do it right. We're completing projects sooner, and we've literally cut our rework by 70 percent using the GPS system."
o As an example of the time saved, the construction company pointed to a four acre section of the parking lot that they had recently graded in 2 and ½ days. "If I had completed that section the conventional way with driving hubs every 25 feet, it would have taken six days."

• **Wisconsin:** a smaller excavating and utilities contractor:
o "You know we're still relatively new to the GPS-based grade control technology and the site positioning system rover. What sold my management were the productivity gains, combined with the desire to remain competitive in this market where bids can be separated by pennies per yard."

***Fleet Management in Service to the Elderly and Handicapped:***

Santa Clara County, **California**. As a non-profit, public benefit organization, OUTREACH is committed to the mission of supporting older adults, individuals with disabilities and low-income families with their efforts to lead independent and self-sufficient lives. From our origins as a War on Poverty program over 30 years ago, OUTREACH has grown to be one of the nation's premier Adult with Disability Acts (ADA) Paratransit and community transportation providers.

OUTREACH's service model is unique because it combines human service values with a transportation system that incorporates cutting-edge technologies, such as the Global Positioning System (GPS) and custom software solutions to increase program efficiency and cost effectiveness. The first year of operating the GPS-based paratransit vehicle tracking system, Outreach saved approximately $435,000.

Mr. KUCINICH. Mr. Huber, before we go to you, there is a vote on right now. The chairman, Mr. Tierney, went to vote. He's coming back momentarily. So what we're going to do, I'm going to declare a 5-minute recess. I believe that Mr. Tierney will probably be back in a minute, but I'm going to go to make sure that I don't miss my vote. And so we will be in recess, let's call it until the call of the Chair, and my guess is it will be within 5 minutes. Thank you.

[Recess.]

Mr. TIERNEY [presiding]. My apologies. The vote was closer than it was to ending.

I've read all your testimony, so I don't want you to think we're ignoring you on that. We read them last evening.

So, Mr. Huber, I understand that you were about ready to put yours on the record, and I ask you to do so.

**STATEMENT OF CHET HUBER**

Mr. HUBER. Thank you, Mr. Chairman. I am Chet Huber, the president of OnStar, a wholly-owned subsidiary of General Motors Corp. I also serve as a member of the NASA PNT Advisory Board, and I've also served on the CDC's Advisory Committee on Injury Prevention and Control.

With nearly 6 million active subscribers, OnStar is the leading telematics service provider, employing over 2,200 individuals in the United States and Canada. OnStar is now standard on virtually all General Motors's vehicles and has developed a prominent national brand position.

Our core safety, security and peace-of-mind services include automatic crash response and emergency services, which we deliver from three call centers in Pontiac, MI; Charlotte, NC; and Oshawa, Ontario, Canada. Other services include turn-by-turn navigation, stolen vehicle location assistance, and monthly OnStar vehicle diagnostic e-mails. We also offer one-button, hands-free, prepaid wireless calling.

In a typical month, after call screening, we provide unique and critical support for public safety agencies in responding to over 2,000 automatic crash notifications and over 10,000 occupant-initiated button presses. These include heart attacks, strokes and crashes not triggering an automatic call. Last November, OnStar marked its 100,000th automatic crash response.

Monthly, we also pass on to public safety over 6,000 Good Samaritan calls for everything from crashes involving other vehicles, to roadway hazards, to possible AMBER Alert sightings; and we assist with over 500 stolen vehicle location requests, including on many new vehicles the ability to actually slow down a vehicle to avoid a high-speed pursuit.

Other monthly service statistics include the delivery of 3.4 million monthly diagnostic e-mails, nearly 1 million turn-by-turn routes, and over 53,000 remote door unlocks.

Delivering these services and growing to our current scale has required deep and fundamental technological innovation as we've uniquely integrated cellular, GPS and voice recognition with extensive on-board and off-board software. This has required hundreds of millions of dollars of investment and resulted in the filing of over

500 patent applications, with new filings still occurring at the rate of once every 6 days.

A critical element in our delivery of services is location. OnStar use the civilian L1C/A signal to deliver our location-based services like automatic crash response, stolen vehicle location assistance, and turn-by-turn navigation. We also used, directly or indirectly, the GPS timing signal to enable other valuable services like remote door unlock and diagnostic e-mails. An accurate, available and reliable GPS constellation is at the heart of our capability to deliver these services.

We offer three recommendations for your consideration. First, we must address the health of the current constellation. We are concerned that a recent report shows that eight of the current satellites are one component away from total failure. Loss of signal will immediately affect GPS accuracy and availability.

Second is the GPS system is modernized. It's imperative that the U.S. Government formally commit to preserving the L1C/A signal to ensuring backward compatibility for legacy applications with no loss of performance from current levels. Automotive applications of GPS, like OnStar, are embedded into the vehicle's electrical system and subjected to extensive validation testing. Because of this, it is impractical to retrofit GPS-related hardware and ensure the reliable delivery of services to subscribers. Therefore, the benefit—to the benefit of our millions of customers as well as others facing similar legacy issues, we are asking Congress and the executive branch to work together to develop a policy that supports backward compatibility at current performance levels.

Regarding performance, it is important to understand that the current GPS system is performing at a level well above the specified minimum, and operators have come to use that performance to improve and enhance services. Any modernization initiative that degrades backward-compatible performance, such as reducing the number of satellites making up the constellation, would likely adversely impact the provision of services by OnStar, including the quality of location information we provide to public safety, thereby potentially increasing the response time of public safety personnel to crash victims and others in need of emergency assistance.

Our third recommendation, and this is also important in legacy applications, is that we commit to maintaining the current PRN code for the primary orbital slots as satellites in those slots are replaced. Legacy hardware is not capable of being expanded to accommodate more than 32 slots, so renumbering above 32 will likely affect performance of legacy applications.

Thank you, Mr. Chairman. I look forward to your questions.

Mr. TIERNEY. Thank you.

[The prepared statement of Mr. Huber follows:]

**Before the**
**Committee on Oversight and Government Reform**
**of the**
**United States House of Representatives**
**Subcommittee on National Security and Foreign Affairs**

**Testimony of Mr. Chet Huber, President, OnStar**

Thank you Mr. Chairman and good morning. I am Chet Huber, President of OnStar, a wholly owned subsidiary of General Motors Corporation. I am currently a member of the NASA PNT Advisory Board and have served on the CDC's Advisory Committee on Injury Prevention and Control.

With nearly 6 million active subscribers, OnStar is the leading telematics service provider employing over 2,200 individuals in the U.S. and Canada.[1] OnStar is now standard on virtually all General Motors' retail vehicles and has developed a prominent national brand position. [2]

Our core safety, security and peace of mind services include Automatic Crash Response and emergency services which we deliver from three call centers in Pontiac, Michigan; Charlotte, North Carolina and Oshawa, Canada. Other services include Turn-by-Turn navigation, stolen vehicle location; and monthly OnStar Vehicle Diagnostic emails. We also offer one button, hands-free, prepaid wireless calling.

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[1] Telematics is a growing market. There is currently one additional significant telematics service provider with between 500,000 and one million active subscribers and several automotive manufacturers have announced plans to begin to offer telematics services in the future.

[2] OnStar also provides service to a small number of vehicles from other manufacturers.

In a typical month, after call screening, we provide unique and critical support for public safety agencies in responding to:

- Over 2,000 Automatic Crash Notifications and
- Over 10,000 occupant initiated Emergency Button presses. These include heart attacks, strokes, and crashes not triggering an automatic call. Last November, OnStar marked its 100,000th Automatic Crash Response.

Monthly, we also pass on to public safety:

- Over 6,000 Good Samaritan calls for everything from crashes involving other vehicles, to roadway hazards - to possible Amber Alert sightings. And we assist with
- Over 500 stolen vehicle location requests including - on many new models- the ability to slow a stolen vehicle down to avoid a high speed pursuit.

Other monthly service statistics include delivery of:

- over 3.4 million diagnostic emails,
- nearly one million Turn-by-Turn routes and
- Over 53,000 remote door unlocks.

Delivering these services, and growing to our current scale, has required deep and fundamental technological innovation as we've uniquely integrated cellular, GPS and

voice recognition with extensive on-board and off-board software. This has required hundreds of millions of dollars of investments and resulted in the filing of over 500 patent applications with new filings at the rate of one every six days.

A critical element in our delivery of services is location. OnStar uses the civilian L1C/A signal to deliver our location-based services like Automatic Crash Response, stolen vehicle location assistance and Turn-by-Turn navigation. We also use directly or indirectly the GPS timing signal to enable other valuable services like remote door unlock and monthly diagnostic emails. An accurate, available and reliable GPS constellation is at the heart of our capability to provide these services.

We offer three recommendations for your consideration:

First, we must address the health of the current constellation. We are concerned that a recent report shows 8 of the current satellites are one component from total failure. [3] Loss of signal will likely immediately affect GPS accuracy and availability (geographic coverage).

Second, as the GPS system is modernized, it is imperative that the U.S. government formally commit to preserving the L1C/A signal and to ensuring backward compatibility for legacy applications with no loss of performance from current levels.

[3] GPS Operations CGSIC Brief (Sep 15 2008), Civil GPS Service Interface Committee Meeting. The Constellation Status Summary additionally indicated that of the currently 29-32 healthy satellites, 19 are past design life and 18 are one component away from partial failure.

Automotive applications of GPS, like OnStar, are embedded into the vehicle's electrical system and subjected to extensive validation testing. Because of this, it is impractical to retrofit GPS related hardware and assure the reliable delivery of services to subscribers. Therefore, for the benefit of our millions of customers - and others facing similar legacy issues - we are asking Congress and the Executive branch to work together to develop a policy that supports backward compatibility at current performance levels. [4]

Regarding performance, it is important to understand that the current GPS system is performing at a level well above the specified minimum standard and operators have used that performance to improve and enhance services.

Any modernization initiative that degrades backward compatible performance - such as reducing the number of satellites making up the constellation - would likely adversely impact the provision of services by OnStar, including the quality of location information we provide to public safety - thereby potentially increasing the response time of public safety personnel to crash victims and others in need of emergency services.

Our third recommendation – and this is also important to legacy applications - is that we commit to maintaining the current PRN code (or satellite signature structure) for the primary orbital slots - as satellites in those slots are replaced. Legacy hardware is not

[4] In-vehicle screen based navigation systems are one example of applications that share similar legacy issues.

capable of being expanded to accommodate more than 32 slots so renumbering above 32 will likely affect performance of legacy applications.

In conclusion, Mr. Chairman, OnStar and GM support the continued modernization of the GPS system. A modern and robust GPS system is essential to OnStar's ability to deliver future services.

Modernization will create opportunities to address current issues like urban canyons and to add new capabilities. For example, modernization offers the potential to support lane level accuracy in automotive applications, opening the possibility of important new vehicle-to-vehicle safety-related applications that are in experimental development. Additionally, strategies to support interchangeability with Galileo and other systems offer important opportunities to enhance performance.

But as we modernize, we must ensure backward compatibility at current performance levels for legacy applications like OnStar and thereby avoid significant disruptions in valuable services that carry important public safety benefits.

Thank you, Mr. Chairman. I look forward to your questions.

Mr. TIERNEY. Thank all of you for your testimony.

Mr. Huber, those concerns that you raised, the final three on that, are you having any dialog at all with the Department of Defense now or with the combined committee about making sure that those are addressed?

Mr. HUBER. We actually have had an opportunity to participate as a member of the PNT Advisory Committee, and that, I think, is one of the reasons that committee was formed by NASA to draw in comments by private industry and other constituencies. And we've also had extensive dialog with the U.S. Department of Transportation and others. So we are making those points——

Mr. TIERNEY. And your sense is that you are being heard?

Mr. HUBER. Yeah. Our sense is that they understand the issues, and we are hopeful that they will be comprehended in the future strategy.

Mr. TIERNEY. I have sort of a painless approach to this, I hope, for all of you. There's really three things I think we want to know and put on the record from you. I'm going to lay all of them out and then just go left to right and give you a chance to respond.

We are interested in the awareness throughout either your particular entity or industry that you—or area that you represent, the awareness of concerns raised by the Government Accountability Office's report. We would like to know if you've identified potential mitigation strategies to lessen the effect on your company or entity or association in the event there is a diminished availability to the worst-case scenarios laid out in that report. And last, what's your status of preparation to implement any such strategies? General.

General JAMES. Yes, sir. In terms of the awareness, certainly at the JFCC Space, my position in Strategic Command, Air Force Space Command, all of those entities, because we are so closely intertwined with the acquisition community, we certainly are very aware of the GAO report, of the constellation management issues and those sorts of things.

In speaking for the broader combatant commanders out there, the CENTCOMs and the PACOMs of the world, I can't say that they are necessarily aware that there is a potential of degradation in the future. Their concern obviously is more near-term focused, am I getting my GPS signal today and so on.

Certainly as a representative of those combatant commanders, we go out and educate the theaters on what they can and can't do with all of our space systems, and we will continue to do that over time as this unfolds. So that's kind of from an awareness perspective.

Mr. TIERNEY. Except one of the things I thought I heard in the first panel is one of the strategies from the military to maybe deal with this issue is to use some and power down some of the backup in certain cases or whatever. I would assume you're exempting out the battlefield people from that type of distinction, or do they also have to make that kind of consideration when they use the system?

General JAMES. No, sir. The intent is obviously not to infect—not to affect any users. In terms of the potential mitigation strategies, which is where I would address that question, we, as the operators of GPS, out of Schriever Air Force Base in Colorado, have a variety of things that we look at. Certainly, first of all, we have residual

satellites. We generally operate a certain number of what we call PRN codes for the constellation. So right now we have three satellites that are not a part of that constellation, but that can still provide an effective navigation signal. That's due to the limitations of the ground system in terms of how many satellites we can actually operate in the constellation.

So we have three residual spacecraft right now. We bring those out of residual mode every 6 months to test them and make sure that they have a valid navigation system. So that's one of the mitigation strategies we currently have.

As satellites, older satellites, no longer fit in the constellation, we still retain them as a viable system that we can bring in should we have an unexpected failure.

The second piece of that, as you heard earlier, is power management, that is one way to, again, extend the life of a particular spacecraft. And again, there is a lot of analysis that will go into that in terms of how does that affect the other user, the new data detection system user. Again, as you heard, as we continue to launch new satellites, we continue to populate that new data detection system capability, and they do not require a full 24 satellite capability. So we have options there with the older satellites to power manage and extend the life of those particular spacecraft.

And third, as you also heard earlier, the GPS constellation isn't kind of an on or off thing, it's a dynamic, integrated assessment of if you get down to a certain level of satellites, where do you have less accuracy, where do you have less coverage time and so on. And we manage that by where we actually place the particular spacecraft in the constellation. So in terms of how we mitigate this, we do have options to make sure that if we do create an issue with a less accurate area, we can put that perhaps over in an area where there are very few people or very few operations.

And then finally, in term of your status in preparing for this, we do think about this, we have thought about this, and we do have plans to address this as we move to the future and we see how the constellation evolves and how those satellites are delivered to us for launch.

Mr. TIERNEY. Thank you very much.

Ms. Van Dyke.

Ms. VAN DYKE. Yes, thank you, Mr. Chairman.

In terms of the awareness concerns, I think the GAO has done a really good job within the government reaching out to the government agencies to circulate their draft report. But, of course, it hasn't been released to the public yet, so as it is released, certainly our job in representing the civil community is to ensure that there is awareness.

But having said that, the Department of Transportation, and particularly our organization, RITA, leads the Civil GPS Service Interface Committee, which is the public outreach of the GPS, and at all of our meetings we have the GPS and Air Force Space Command give us updates on the constellation. And so certainly the awareness of some of the status problems, the availability of satellites, some of the potential problems have been briefed at the meetings.

And also, as I mentioned in my opening remarks, the Volpe National Transportation System Center had done a vulnerability assessment. And so while it's a separate problem, being concerned about interference to the signal, a lot of the mitigation would be the same.

So we have certainly tried to make the user community aware of potential interference, the need to integrate GPS with other navigation aids or have operational procedures to mitigate the problem, which would also apply to any degradation due to availability of GPS satellites.

In terms of the status of the preparation, again, it is very similar to the need for backup systems to mitigate against interference. So we have been aware and certainly working with the user communities, particularly for federally provided systems, to ensure for transportation safety of life that we do not have any degradation of service, and that continues to be an ongoing challenge as GPS just becomes integrated into every single application. And often, particularly for timing applications, it is a silent enabler that many do not even have awareness of how well and how widely it is used in our communication systems.

Mr. TIERNEY. Thank you.

Mr. Swiek.

Mr. SWIEK. Thank you, Mr. Chairman.

As far as awareness goes of potential gaps in GPS or degradation of services, answer that from our community, which is primarily the receiver manufacturers and to some degree the user and customer community, the answer is yes and no. Among the technical people in the companies manufacturing the receivers, yes, they are aware of constellation status. Yes, they receive briefings from the Air Force at different conferences, they see the status of the constellation over a period of years, they monitor that. So are they aware there is a potential degradation? Yes.

When you start getting to more the public at large, the users of GPS particularly in the consumer area, I would say there the awareness is probably nowhere near as great, mainly because GPS works and has worked reliably for many, many years. When you go to the faucet and turn on the water in your house, it works; you don't think about it. You only think about it if you have a warning that something imminent is going to happen or has happened and you need to take adjustments to compensate for that.

So the awareness issue, yes and no. Engineers, technical people, people in the manufacturing community, yes.

What would be the impact of gaps in coverage, degradation of services? Again, difficult to say because of the broad scope and reach of GPS into different types of applications. Mitigation plans and strategies, yes. Again difficult to say. Depends on if it happens, when it happens, where it happens, to whom it happens.

Degree of disruption, again difficult to pinpoint exactly. There is a wide variety of areas, public safety areas, like air transportation, like marine transportation, E911, some of the critical timing applications. If there was a serious degradation that would cause a disruption or outage of GPS, yes, it would be felt and noticed.

However, the people who put these systems together are very prudent and very cautious, so there are usually back-up systems

already in place, because not only from a degradation of constellation status, but there are other factors that could cause vulnerabilities to the system. And these have largely been accommodated to a certain degree.

As far as the consumer end. If there is a degradation of service, well, you tend to get that anyway when you are using GPS in a casual recreational environment now. The GPS unit in your car frequently is blocked by tall buildings, heavy tree coverage, etc., as you're driving along. This, in effect, reduces the number of effective satellites you can see or the optimal navigation solution that you are using.

Does this mean the whole system goes down, and it becomes useless? No. Again, it may compromise some degree of accuracy or availability, but in general it doesn't cause a major problem. If this becomes systemic and endemic over a long period of time, then I think the biggest problem you see is a loss of confidence of—in GPS as a market force, and that can have some consequences. But in general the Air Force has done a marvelous job of giving a signal that nobody has to think about, they only use and take benefit from. So I hope this clarifies some things for you.

Mr. TIERNEY. No, it is helpful. And I think your part of this is that the GAO report is, in fact, a warning shot. It is not imminent, it is not something that is going to slap people in the face, but it is at least a notice to people that we better start paying attention, we better start working through this.

You want to add?

Mr. SWIEK. Add one more thing. In this regard we haven't seen the full GAO report yet. Is it released to the public?

Mr. TIERNEY. Today. That's why the hearing.

Mr. SWIEK. I will make sure our member companies receive that. But this type of awareness building along with the outreach at the Air Force and Department of Transportation, Department of Defense due to the civilian community I think shows a responsible stewardship of GPS. They don't hide things and sweep them under the rug. It is there so everybody knows. And this, I think, is another hallmark and good sign of prudent U.S. stewardship of GPS.

Mr. TIERNEY. Mr. Huber, we know you're aware, because of the content of your testimony, of course, or whatever. But in your particularized use for it, what strategies would put in place?

Mr. HUBER. Yeah. We are very aware, not of the GAO report, but we are absolutely looking forward to seeing that. We thought about this, as you might expect, because we're selling a commercial product today with millions of customers in it.

The heart of what we do is an emergency response to things like the crash of a vehicle. And so we have been developing methods, even in those situations where we are strained today, like in urban canyons, to actually we've created unique software in the vehicle. We use the wheel speed sensors from antilock brake systems to provide dead reckoning that gives us an ability to keep an accurate location on the vehicle within bounds as we're shaded from GPS.

We are starting now actually with the launch of the new Camaro, we are actually building gyros in the vehicles to give us the next level of precision. And that will help us in any degradation sense, so it helps us be better at our normal services. It will also

help us in any scenario where we're otherwise shaded, in places like the Big Dig in Boston. I mean, it gives us a great opportunity to get people through that the way they want to come through it.

The thing that is of most concern to us longer term is in cases where there are literally gaps, geographic gaps, in coverage across the United States that move depending on what the constellation configuration looks like and how many satellites are up. I mean, if you saw a map from our last November announcement of our 100,000th crash response, you can see we populate the United States. There are crashes everywhere in this country, not just in very populated areas. And so we are actually working with Verizon Wireless as a key technology partner for us in our most extreme case of crash response to see what we might be able to use in the case of a missing GPS component to be able to use their network drive solutions to at least be able to help us respond in an emergency case. It won't help us in a navigation scenario, but our main commitment it the emergency community.

Mr. TIERNEY. Thank you.

Mr. Kucinich is recognized for 5 minutes.

Mr. KUCINICH. Thank you, Mr. Chairman.

To General James—and, Mr. Chairman, you may have asked some of these questions. I just returned, so I'm not—if I duplicate it, I apologize ahead of time. Who updates the GPS data, and how often is it updated?

General JAMES. Sir, if you're referring to the data that goes into the satellites, that is done by the Operation Squadron at Schriever Air Force Base. They are solely dedicated to managing that constellation and providing uploads when required. They can determine when a signal is starting to degrade below a certain level, and they actually put an upload into the spacecraft to update its position so that we then maintain that high level of accuracy. So that's the responsibility of the Air Force out of Schriever Air Force Base.

Mr. KUCINICH. Where do you get the data from though?

General JAMES. Sir, the data is from our ground network of systems around the world that monitors GPS at different locations, at Ascension Island, Hawaii, Guam. So we are constantly looking at the constellation and the satellites and measuring their accuracy, because over time that accuracy does degrade, and so we monitor that 24 hours a day, 7 days a week, and provide those uploads into the spacecraft as required.

Mr. KUCINICH. So the accuracy of the information at any given time, would you ascribe a percentage to it?

General JAMES. Well, sir, again, our intent is to maintain a worldwide accuracy below 3 meters. And so——

Mr. KUCINICH. Of what, please?

General JAMES. Below 3 meters. Now, again, that's better than the specification that we have, because we have a good number of satellites with very accurate atomic clocks on board. But again, worldwide we have the ability to monitor those accuracies around the globe. We have the software that tells us exactly what the accuracies are at any time and given location.

Mr. KUCINICH. Does the Department of Defense lease the information that it has to private contractors, or sell it, or in any way distribute it to other contractors?

General JAMES. No, sir, we do not. If you're talking about that knowledge of what accuracy a GPS satellite has, that's actually inherent in the signal of the GPS, so it's not leased or sold, it's available.

Mr. KUCINICH. It's—we know, for example, there are companies who—who sell GPS services.

General JAMES. Yes, sir.

Mr. KUCINICH. They don't have their own network the way the Department of Defense has. What—how are they able to do that?

General JAMES. Sir, I believe a couple of things. When you say selling GPS services, one is a GPS receiver.

Mr. KUCINICH. Selling receivers that they then get the same information through that receiver that anybody else would get? Is that what you are saying?

General JAMES. Yes, sir. Absolutely. Or they may create a service where they use GPS—for example, mechanized farming—that they sell that overall service, which involves a GPS receiver and other processes, to execute that.

Mr. KUCINICH. But anybody's free to do that; is that right?

General JAMES. Yes, sir.

Mr. KUCINICH. But the underlying technology is—and the mapping and the updating of it is accomplished through the resources of the U.S. Government; is that right?

General JAMES. That's correct.

Mr. KUCINICH. Are there any other nations that are involved in a cooperative effort with us on that?

General JAMES. Sir, to my knowledge there are no other nations providing funding for the GPS. We operate the system, and we provide that to our allies without charge.

Mr. KUCINICH. And do other nations help provide the data; where we don't necessarily have people present to provide the information, do we have gaps that are being filled in?

General JAMES. No, sir, it is the worldwide sites. For example, the Ascension Island site, certainly that is a British island, so we have agreements with the British to operate this. But we provide for all the operational costs around the world.

Mr. KUCINICH. Thank you, Mr. Chairman.

Thank you, General.

Mr. TIERNEY. Thank you.

I would like to give each of you an opportunity to share with us anything that you think we ought to know and didn't have the foresight to ask before I wrap up. That doesn't mean there necessarily is something, but I give you the opportunity anyway.

General.

General JAMES. Sir, just briefly I think, again, I would state as we look at GPS accuracies and GPS capabilities, it is a very layered problem. As we said earlier, it is not a black-and-white thing. We can manage this, we can look through in terms of power, in terms of clocks, in terms of updates and who will replace the satellites in the constellation to make sure we provide the capability

that we need to provide where we need to provide it. I would leave that thought for the committee.

Mr. TIERNEY. Thank you.

Ms. Van Dyke.

Ms. VAN DYKE. Yes, Mr. Chairman. I would just like to reiterate the Department of Transportation's commitment to the modernization of GPS for new civil capabilities. As Major General McCasland said, the Department of Transportation is now providing funding for those capabilities, and it is important for the sustainment for the GPS III constellation that we have the adequate funding to provide to the Air Force. And I would just like to reiterate our strong working relationship with the Department of Defense. I think that we have had really good information sharing and a very cooperative process, and I certainly anticipate that will continue.

Mr. TIERNEY. Thank you.

Mr. Swiek.

Mr. SWIEK. I'd just like to emphasize that GPS is really an example of government done right. You don't hear that too often these days.

Mr. TIERNEY. Unless you account for the 100 and something percent overrun in cost and 3 years in delays. It is interesting, it goes to Mr. Duncan's point. There's not a bit of upset or anger of anybody in here on that, and it is sort of startling when you think about it. It was a $700-something million project that cost $870 million more on that, and 3 years late, and we don't get a blink. It is just interesting, you know. If that were an education program or something like that, people would be going ballistic.

Mr. SWIEK. Both my parents were accountants, and they would see an awful lot of fault with that as well. But as far as the delivered performance of GPS, before——

Mr. TIERNEY. Once it gets going, it does well is what you're saying.

Mr. SWIEK. Yeah. It is really a great success story. The main thing is maintain the integrity of the signal, maintain the delivery performance, maintain the dialog between industry/government, between military/civilian users, and the forums we've had, because it really has been a wonderful, cooperative approach.

Delays, outages, overruns, etc., yes, these are all of concern. As the system matured and expanded, these maybe were inevitable, but they need to be addressed, and for that regard we are glad that the subcommittee and others in government are able to look at this. So continue on.

Mr. TIERNEY. Mr. Huber.

Mr. HUBER. I can only say the GPS system has evolved into an amazing public utility. And I would say that things like OnStar were probably not conceived of when those satellites were launched.

I would suggest that if you project any vision of a future, this system will spawn incredible further innovation that will bring a range of benefits to society and spawn technology and job creation.

And so thinking of this today, it is almost unfair to not understand what hasn't been invented yet, but this is ripe territory for commercial applications in particular and those that overlap with

public-sector agencies to create a better future for a lot of people. And so I would say that's the vector that this thing is headed on.

Mr. TIERNEY. I thank you for all your comments. Look, this has become an incredible system, and I agree with you the technology is astounding. It has done a lot of good things.

One of the reasons why the subcommittee is so intent on having the oversight is we need this to continue working. Our reliance on national security issues, obviously, are very serious and very critical, but, as I said, in lightening effects on the industries and the civil market as well. So we want to make sure that it functions and it comes up in a timely manner and doesn't get degraded, but we do also have that responsibility in seeing that it happens on time and within budget, within reason, because we don't have an unlimited budget.

We have a lot pressures on this country, and so we want to try to make sure that we have a continuation of these hearings. This will not be the last one. We might not have to hear from you folks again for a while, but the first panel will be revisited again along with others to address some of those questions on why we would take a system that was working in terms of oversight and kick it out the door and try something that was obviously not very successful.

So thank you for giving up your time and making the effort to be here with us today, sharing your expertise. We really do appreciate it. Thanks.

Meeting adjourned.

[Whereupon, at 12:07 p.m., the subcommittee was adjourned.]

[Additional information submitted for the hearing record follows:]

GPS Satellite Acquisition Milestones

2 Jun 09

| GPSW | Dates |
|---|---|
| Block IIR | |
| IIR-17(M) Launch | 17 Oct 2007 (A) |
| IIR-18(M) Launch | 20 Dec 2007 (A) |
| IIR-19(M) Launch | 15 Mar 2008 (A) |
| IIR-20(M) Launch | 24 Mar 2009 (A) |
| IIR-21(M) Launch | 12 Aug 2009 (T) |
| Block IIF | |
| SV-1 Final Design Verification (FDV) #3 (M-Code) | 31 May 2007 (A) |
| SV-1 DOP-15 (Integrated System Test) Complete | 17 Aug 2007 (A) |
| SV-1 Thermal Vacuum (TVAC) Complete | 15 Nov 2008 (A) |
| SV-1 Final Integrated System Test (FIST) Complete | 12 Feb 2009 (A) |
| SV-1 Flight Final | Sep 2009 |
| SV-1 FCA/PCA | Sep 2009 |
| SV-1 Delivery | Sep 2009 |
| SV-1 Available for Launch | Nov 2009 |
| SV-1 Launch * | Jan 2010 (T) |
| SV-2 DOP-15 Complete | Apr 2009 (A) |
| SV-2 TVAC Complete | Nov 2009 |
| SV-2 Delivery | Mar 2010 |
| SV-2 Launch * | Jul 2010 (T) |
| GPS IIIA | |
| System Design Review (SDR) | 30 Nov 2007 (A) |
| Key Decision Point (KDP) B | 8 May 2008 (A) |
| Bus PDR | Mar 2009 (A) |
| Nav PDR | Apr 2009 (A) |
| GPS IIIA PDR | 21 May 2009 (A) |
| Milestone C (APB) | Nov 2009 |
| Nav CDR | May 2010 |
| Comm CDR | Jun 2010 |
| Bus CDR | Jul 2010 |
| GPS IIIA CDR | Oct 2010 |
| Build Approval | Jan 2011 |
| GPS IIIA SV-1 Available for Launch | May 2014 |

* Current planning dates - Mission not officially on Launch Manifest

(T) Tentative

(A) Actual

Program: GPS IIF Satellite Production & Operational Control Segment
Contractor: Boeing
Contract #: F04701-96-C-0025

| Period | Dates | Award Fee Pool | Percentage Earned | Award Fee Earned | Unearned Award Fee/ Fees not paid |
|---|---|---|---|---|---|
| 1 | 22 Apr 96 - 31 Dec 96 | $923,877 | 91.00% | $893,694 | $84,183 |
| 2 | 1 Jan 97 - 31 Dec 97 | $1,396,818 | 92% | $1,274,974 | $121,844 |
| 3 | 1 Jan 98 - 31 Dec 98 | $3,068,042 | 91% | $2,174,974 | $228,111 |
| 4 | 1 Jan 99 - 31 Dec 99 | $4,042,715 | 92.80% | $3,932,969 | $296,030 |
| 5 | 1 Jan 00 - 31 Dec 00 | $7,809,787 | 93% | $7,263,102 | $546,625 |
| 6 | 1 Jan 01 - 31 Dec 01 | $18,286,929 | 99% | $18,104,060 | $182,869 |
| 7 | 1 Jan 02 - 31 Dec 02 | $9,938,079 | 91% | $9,043,652 | $895,427 |
| 8 | 1 Jan 02 - 30 Sep 02 | $19,436,367 | 72.56% | $14,102,648 | $5,333,719 |
| 9 | 1 Oct 03 - 30 Sep 04 | $16,092,680 | 71.56% | $11,515,948 | $4,576,732 |
| 10 | 1 Oct 04 - 30 Sep 05 | $14,732,779 | 64% | $9,429,431 | $5,303,347 |
| 11 | 1 Oct 05 - 30 Sep 06 | $12,736,948 | 0% | $0 | $12,736,948 |
| 12 | 1 Oct 06 - 30 Sep 07 | $6,468,459 | 82.60% | $5,342,237 | $1,126,222 |
| 13 | 1 Oct 07 - 30 Sep 08 | $7,872,532 | 85% | $6,705,387 | $1,167,145 |

Program: GPS IIR Satellite Production
Contractor: Lockheed Martin
Contract #: F04701-89-C-0073

| Period | Dates | Award Fee Pool | Percentage Earned | Award Fee Earned | Unearned Award Fee/ Fees not paid |
|---|---|---|---|---|---|
| 1 | 1 Jan 93 - 30 Sep 94 | 194,766.18 | 93% | 181,500.00 | 13,266.18 |
| 2 | 1 Oct 94 - 30 Sep 95 | $630,731.90 | 92% | $580,273.00 | $50,458.90 |
| 3 | 1 Oct 95 - 30 Sep 96 | $912,085.27 | 91% | $829,997.00 | $82,088.27 |
| 4 | 1 Oct 96 - 31 Dec 96 | $245,589.00 | 93% | $228,397.77 | $17,191.23 |
| 4 | 1 Jan 97 - 30 Jun 97 | $608,578.00 | 93% | $565,977.54 | $42,600.46 |
| 5 | 1 Jul 97 - 31 Dec 97 | $859,459.00 | 91% | $782,107.69 | $77,351.31 |
| 6 | 1 Jan 98 - 31 Dec 98 | $1,392,880.98 | 97% | $1,351,094.55 | $41,786.43 |
| 7 | 1 Jan 99 - 31 Dec 99 | $1,436,433.00 | 89% | $1,278,425.37 | $158,007.63 |
| 8 | 1 Jan 00 - 31 Dec 00 | $1,475,295.29 | 98% | $1,445,789.38 | $29,505.91 |
| 9 | 1 Jan 01 - 31 Dec 01 | $1,276,698.50 | 98% | $1,251,165.99 | $25,532.51 |
| 10 | 1 Jan 02 - 31 Dec 02 | $1,999,512.44 | 98% | $1,953,523.65 | $45,988.79 |
| 11 | 1 Jan 03 - 31 Dec 03 | $2,017,503.03 | 100% | $2,017,503.03 | 0 |
| 12 | 1 Jan 04 - 31 Dec 04 | $2,744,825.89 | 99% | $2,717,378.00 | $27,447.89 |
| 13 | 1 Jan 05 - 31 Dec 05 | $2,694,715 | 100% | $2,694,715 | 0 |
| 14 | 1 Jan 06 - 31 Dec 06 | $2,817,446 | 100% | $2,817,446 | 0 |
| 15 | 1 Jan 07 - 31 Jan 08 | $3,071,529.44 | 100% | $3,071,529.44 | 0 |
| 16 | 1 Feb 08 - 31 Dec 08 | $1,998,173.00 | 100% | 1,998,173.00 | 0 |