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GSFC NEWS

tech transfer

The GMSEC software platform expands system design options and simplifies mission operations for satellite missions.

GMSEC Issue

in this issue:

from the chief


Nona Cheeks

This issue of *Tech Transfer News* is devoted primarily to the Goddard Mission Services Evolution Center. GMSEC (pronounced "GEM-sec") is a software architecture that enables different applications and components to seamlessly work together through a common messaging system interface. GMSEC provides advances in satellite command and control system architectures to simplify integration, allow for increased automation, and enable new operations concepts. It also makes it far easier to upgrade and maintain a system for years and even decades, without locking into any one vendor, since components can now be swapped out and added as needed. This is a critical consideration for long-term missions.

NASA Goddard Space Flight Center (GSFC) originally conceived and defined GMSEC to support its satellite missions. However, the use of GMSEC has spread well beyond GSFC. For example, the U.S. Air Force's commitment to GMSEC currently rivals GSFC's. Other NASA centers and government agencies have also expressed interest in adopting the GMSEC platform.

In this issue, we begin with an interview of Dan Smith, Project Manager for the Goddard Mission Services Evolution Center. Dan shares a good summary of the history and context behind GMSEC, where it stands now, and future goals. He and his team also provide a high-level overview of GMSEC components and how they work together. Another article looks at the benefits that GMSEC offers, and how these benefits can differ from application to application, and agency to agency. Our tour of GMSEC is concluded with a review of the many technology transfer opportunities it provides. It's interesting to note that GMSEC is responsible for one of the highest numbers of Tech Transfer Agreements at GSFC. And although the GMSEC core application itself is not available for tech transfer to private industry, many commercial developers are already benefitting from the fact that it provides an important avenue for selling to GSFC and other government agencies as well, as GMSEC-compliant applications can be used on any GMSEC-based system.

Also in this issue, our regular legal contributors, attorneys Bryan Geurts (Chief Patent Counsel for GSFC's Office of Patent Counsel) and Erika Arner (Partner for the law firm Finnegan, Henderson, Farabow, Garrett & Dunner), look at the Patent Reform Act of 2011. As we go to press, the Act has passed both the U.S. Senate and House, although work remains to be done to resolve several differences between the two versions. Bryan and Erika offer their perspectives on the Act and what it means for the future of U.S. patenting and the protection of intellectual property rights.

We hope you find this issue interesting and informative. If you would like to learn more about GMSEC, or any other GSFC technology, please feel free to contact the Innovative Partnerships Program Office at 301-286-5810, or visit http://ipp.gsfc.nasa.gov

Nona Cheeks
Chief, Innovative Partnerships Program Office
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"GMSEC provides advances in satellite command and control system architectures to simplify integration, allow for increased automation, and enable new operations concepts."

GMSEC Technology Transfer Opportunities

NASA Goddard Space Flight Center (GSFC) is currently seeking to transfer the GMSEC architecture and components to other government agencies for use in developing satellite control and support systems. GSFC has already successfully transferred GMSEC across NASA to other centers. The Air Force, as well, has enthusiastically adopted GMSEC, and GSFC's Innovative Partnerships Program Office is looking to capitalize on this momentum to continue to spread the benefits of GMSEC across the Federal Government. And though the GMSEC architecture will remain open source, private industry can benefit from GMSEC as well, as the standardized architecture provides commercial software vendors with a market to sell their applications to different programs across multiple agencies without having to undertake major redesigns.

Photo by Bill Hrybyk

Spearheading the GMSEC technology transfer initiative is Ted Mecum. As a Senior Technology Transfer Manager within the NASA Goddard Space Flight Center's Innovative Partnerships Program (IPP) Office, Ted is responsible for the identification, review, and evaluation of advanced aerospace technologies for potential patenting, and/or licensing options in addition to the negotiation of mutually beneficial partnerships between NASA and private industry, academia, and/or other government organizations. Prior to joining the IPP Office, Ted spent 12 years as an Electronics Reliability Engineer in the Parts Branch of GSFC's Office of Flight Assurance, supporting various GSFC Flight projects.

"GMSEC is one of our more highly requested software suites; between other government agencies and within NASA it has been transferred over 50 times to other users through our software usage agreement (SUA) process," said Ted. "Our goal here is to make others outside GSFC aware of the benefits of using GMSEC and the potential savings in both system development and operational costs by adopting our proven architecture."

For more information about GMSEC, please visit:
http://gmsec.gsfc.nasa.gov/

To discuss how your federal agency or private company can access the myriad benefits that GMSEC provides, please contact Ted Mecum at 301-286-2198, or alfred.t.mecum@nasa.gov.

Ted Mecum

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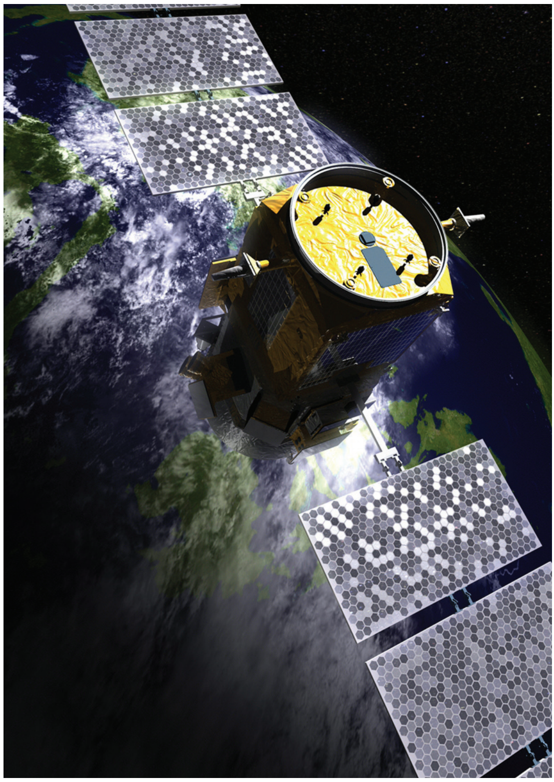

Featured Interview

In this issue of GSFC Tech Transfer News, we speak with Dan Smith, Project Manager for the GSFC Mission Services Evolution Center (GMSEC). Our interview with Dan touched upon a wide variety of topics, including the history of GMSEC, how and why it was initially developed, how its importance and utility has spread well beyond GSFC, and the benefits it brings to both government agencies and the commercial software market.

Q: Can you tell us a bit about the development of GMSEC?

I've been involved in satellite ground systems for 30 years. Traditionally, each mission was done as a one-off project; the system for each satellite was built from the ground up. The products selected for that system were basically chosen on the basis of supporting that one satellite. As a result, each system had its own set of characteristics and custom software – even for very similar functions. Rather than continue to build each system from scratch and using custom interfaces, we said, "Let's look at a new approach." For example, every mission needs to receive and process telemetry, so we decided to define a standard telemetry interface. This let us mix and match products that support this interface, rather than keep getting boxed into using a particular vendor. And this allowed us to integrate new software more rapidly while providing more choices to our end-users.

We did this primarily through middleware, standard message definitions, and our GMSEC Applications Interface. To support NASA's mission-critical applications, we utilized a middleware product originally developed for use on Wall Street and for financial institutions. Applications plug into the middleware using the applications interface and the standard messages.

Q: How did software vendors react?

They were big supporters of our efforts, actually. Suddenly, vendors who had never been able to work with GSFC could do so by making their products compatible with GMSEC. For example, L-3 Communications and GMV each had their first ground software sales for GSFC missions after demonstrating their products in the GMSEC environment.

Many more vendors can now sell to GSFC. And, from our viewpoint, we have a lot more products to choose from; and we can avoid vendor lock-in issues associated with more rigid system development efforts. One of the biggest values of my job is to compile a catalog of compliant products from which GSFC missions can choose when building a satellite support system.

During the development of GMSEC, an important thing happened. Someone asked, "You can plug and play vendor products, but what if your middleware product needs to be changed?" And of course they had a very good point. Middleware companies may go out of business, get acquired, and so on. So GMSEC needed to not only define the plug and play components — the applications — it also needed to define the communication layer interfaces. This approach was unique in the industry. The goal was to be able to swap out the communication layer without the applications even knowing about it. To do this, we looked at lots of middleware vendors, including IBM, to see how they passed messages, and then normalized their features and capabilities. We support high-end, very robust middleware products for operations as well as open source and GSFC-developed middleware for development use. We also made the core of GMSEC Open Source, so product vendors could ensure their products were compatible with it.

The US Air Force has enthusiastically adopted GMSEC and now operates the largest GMSEC lab in existence.

We're now seeing some interesting spinoffs from our open approach. Initially, there was some concern that our vendors would revolt. But instead, as I mentioned earlier, they now see this as a broader entry into the government market, because anyone who's GMSEC compatible has an opportunity to sell us products.

Q: Has interest in GMSEC spread beyond GSFC?

Absolutely. For example, the biggest GMSEC lab isn't even at GSFC anymore; it's at an Aerospace Corporation lab supporting the Air Force in Chantilly, Virginia. Starting about five years ago, the Air Force, the National Reconnaissance Office, and others became interested in what we were doing. General (Michael) Hamel commissioned a study that basically said, "Go look at what we want for our control centers." They came back and reported that the closest things out there that met their requirements were GMSEC and another architecture developed in Europe. Bear in mind, they decided this on their own, with no lobbying from us.

Based on these findings, the Air Force called us and said they wanted to be involved. They set up their lab three years ago, and within eight weeks they had configured five product suites, for eight satellites. Configuring a system in eight weeks was unheard of. Since then they've been adding components at an amazing rate, testing out their ability to go operational. At Kirtland Air Force Base, the Operationally Responsive Space Office now has an operational GMSEC system for an in-house test satellite, with the goal of using it for future launched missions as well.

There's also interest from the JSCC (Joint SatOps Compatibility Committee). The JSCC represents all U.S. government space agencies; it conducts weekly teleconferences to discuss common ground system and operations challenges. They are now looking at GMSEC for potential use across all multiple U.S. government space organizations.

Q: Does this raise governance issues?

How to do governance across government agencies is a big question. Who should the Air Force call at 3:00 AM if something goes wrong? Who certifies that a new product is GMSEC compliant? What government entity spans all the agencies that may adopt GMSEC? These are big issues that need to be tackled.

We're used to working with the Air Force through individual Space Act Agreements, but how can we do this when we're talking about 30 missions across multiple agencies? A common clearinghouse approach would make a lot more sense, but we need to figure out the best way to do that, a way in which the government agencies can work together for the benefit of everyone. Through the JSCC, we are actually in talks now at the level of the Office of the Secretary of Defense.

Q: We talked earlier about how GMSEC benefits private industry by allowing a broad entry point into selling to GSFC. What other benefits does GMSEC offer to commercial companies?

It certainly creates a huge market opportunity for them. The reality is, GSFC alone doesn't fly enough satellites to make us very attractive to this industry segment. But thanks to the efforts of the JSCC, government groups have gotten together and are moving shoulder-to-shoulder in the same direction. Industry is taking their cue from this initiative, because it means that anyone who's compatible with GMSEC can potentially sell to agencies across the government.

This in turn makes more products available for GSFC, because although we may not comprise a large enough market for some software developers, the U.S. government certainly does; and we can now choose from all these GMSEC-compliant products that were developed with the U.S. government in mind. In fact, these vendors are now looking at GSFC as an entry point into the government market — they provide their GMSEC products to us first, and then to the Air Force, and so on.

The core of GMSEC is a communications architecture; that piece doesn't know it's a satellite control system. It's the applications that define it as such. Therefore GMSEC could be used for other things. For example, the Goddard Flight Dynamics Facility is utilizing GMSEC for their system to help add automation and simplify system monitoring and message passing; and the NASA IV&V Facility has used GMSEC to create a software test environment. Neither of these systems is being used for satellite control. We recently received a request from the Food and Drug Administration to discuss possible uses of GMSEC. GMSEC can be used for any number of purposes.

Q: What challenges remain for GMSEC?

Probably the biggest issue for GMSEC is when the word "standard" is applied to it. When people think of standards, they think of a controlled standard, something you can point to in a procurement spec. Currently, you can't really do that with GMSEC, other than to say "Call Dan Smith," which obviously is not a viable option going forward.

The CCSDS (Consultative Committee for Space Data Systems) is where space agencies from around the world keep their standards. The European agencies are currently working on a standard architecture; but the U.S. has a rule that we cannot introduce a new standard to compete with an existing one. Therefore GMSEC can't at the present time become the standard for CCSDS. We are looking at whether we could merge GMSEC with the other CCSDS efforts. The Object Management Group, the people who maintain the well-known CORBA (Common Object Request Broker Architecture) spec, has indicated they're willing to take on GMSEC. The military has also suggested the possibility of making GMSEC a MILSPEC. So finding a home for a formal GMSEC standard is still an open topic. But until that happens, it's difficult to reference in a procurement specification. So despite GMSEC's success, we still have concerns across the industry because it's not a formal standard.

Another issue is the business model for keeping GMSEC going. Since 2001, GMSEC has been funded by Goddard. As other agencies get involved, and GMSEC continues to extend beyond simply supporting Goddard missions, it will make sense for others to share a larger portion of this expense. And of course, there's governance, which I talked about earlier. Finally, there's still some who may say we've done fine building each satellite system from the ground up for years, so why change now?

But in the end, what's good for the government agencies as a whole should be good for GSFC. I really believe in the new NASA Mission Statement and Goals. A clear goal of NASA is to infuse game-changing technologies throughout the nation's space enterprise – not just within NASA. The goal states that we should benefit NASA, other government agencies, and our space product vendors and contractors. GMSEC is directly aligned with this goal

Q. What is planned for GMSEC over the next several months?

The entire GMSEC team is very busy right now. Barbie Medina was recently named the GMSEC Project Deputy and will be helping increase our interaction with the GSFC mission teams, and she'll be identifying new products for development. In September, we are updating the GMSEC Lab with operations consoles and large display screens to allow demonstrations in a more realistic mission operations setting.
And we continue to increase our involvement with outside organizations including other NASA Centers and government agencies. In the past week alone, we received requests from another Air Force organization, the Food and Drug Administration, and several commercial product venders; all wanting to discuss potential use of GMSEC and long-term collaborations.

The entire GMSEC team is excited about the value we are bringing to GSFC and the GMSEC benefits being recognized far beyond the GSFC boundaries.

Dan Smith

Code: **580**

Years with NASA: **10**

Education: **B.S. Computer Science, University of Maryland; M.S. Information Systems Technology, George Washington University**

GMSEC Technical Overview

In this article we take a quick overview of the GMSEC in-house components and how they integrate with the GMSEC framework to provide a versatile platform for GSFC missions. Our guide for this tour is LaMont Ruley, Associate Branch Head of the Ground Software Systems Branch (Code 583). LaMont serves as the GMSEC Project Development Lead, where his responsibilities include ensuring that all GMSEC software development follows the NPR 7150.2 and the CMMI Level 2 processes. He also oversees the planning and content of each major GMSEC software release, sent every six months to GMSEC users.

According to LaMont, a GMSEC system architecture consists of the:

- GMSEC Applications Programming Interface (API) and GMSEC standard messages
- An underlying middleware message bus
- GMSEC-developed support tools
- Domain-specific GMSEC-compliant components

With the basic GMSEC framework, missions can add domain-specific, GMSEC-compliant components, such as a telemetry & command system, and any of eight ancillary applications developed by the GMSEC team. They can also add other GMSEC-compliant applications, developed in-house or purchased from outside vendors listed in the GMSEC catalog.

API (Application Programming Interface)

"The API is the true backbone of GMSEC," states LaMont. "It allows the applications to subscribe and publish to the middleware, irrespective of which middleware is selected." Using the GMSEC API (GSC 15143-1) with standard GMSEC messages enables components to exchange information and to provide and access services.

This helps reduce application development to its simplest form, relieving it of the communications burden: a component only needs to know how to send information to, or get information from, the information bus via the API. No other knowledge of the system - such as what other applications created the messages or where they are located - is required. Applications only interact with the GMSEC information bus and not directly with other applications. This capability helps give GMSEC its flexibility.

The API has been instantiated for several different programming languages, including C, C++, Java and Perl. Each instance of the API for a programming language provides a set of common messaging functions with both synchronous and asynchronous delivery mechanisms. Functional messaging categories include establish/terminate a connection, build-a-message, publish/subscribe, and request/reply. The applications interact using telemetry frames, log messages, and directives.

Communications Middleware

As previously stated, the GMSEC framework includes the provision of a core middleware layer. At present, the GMSEC API supports five middleware products: the GMSEC Message Bus, TIBCO SmartSockets, IBM WebSphere MQ, Apache ActiveMQ, and Oracle WebLogic (Fusion). Any of these can be used to provide the messaging services for a GMSEC-based system.

GMSEC-compliant components communicate with other components and utilize their provided services through the API. The API uses the underlying middleware to exchange messages. Thus, the application components are sheltered from (and require no specific knowledge of) the middleware. This means that one middleware can be swapped out at any time, with no system disruption. For example, a system built around one vendor's middleware can be modified to use another vendor's middleware, provided it is compatible with the GMSEC API. The remaining applications in the system do not need to be modified in any way; since they communicate with the API rather than directly to the middleware, the applications would not even be aware that the middleware has been changed. This avoids vendor "lock in," which can be a challenge when designing systems for missions that may be on orbit for years or even decades — long enough for a software vendor to go out of business, get acquired, stop supporting a product, and so on. It also allows programmers to use a free middleware for development and transition to a higher performance system for mission operations.

GREAT (GMSEC Reusable Event Analysis Toolkit)

GREAT (GSC-16224-1) is a suite of applications for logging, displaying, archiving, and reporting on events and messages. Displays can show selected real-time and historical messages. It can also generate reports from archived messages, and perform statistical calculation, data analysis, and data mining.

"GREAT is one of GMSEC's most-used applications," reports LaMont. "It can display all messages transmitted along the information bus. It can perform filtering — for instance, to show only telemetry data, or alerts — and can also archive data for future retrieval."

CAT (Criteria Action Table)

"CAT (GSC-15611-1) is a rules-based automation application" says LaMont. "Basically, it says, 'If A happens, do B.' For example, if a certain event occurs — or doesn't occur, such as a scheduled event not occurring within a pre-defined time period — then CAT will tell ANSR to send a message to the appropriate person." By taking a pre-determined action in response to a specific event or condition, CAT automates a wide set of ground system functions that otherwise might require dedicated staff.

ANSR (Alert Notification System Router)

ANSR (GSC 16027-1)is an alert response application that can autonomously text or email mission operators for satellite events or anomalies. ANSR receives directive messages off the information bus (via the API, as explained earlier) and then goes through its pre-defined calling tree to send a notification. This reduces the need to have

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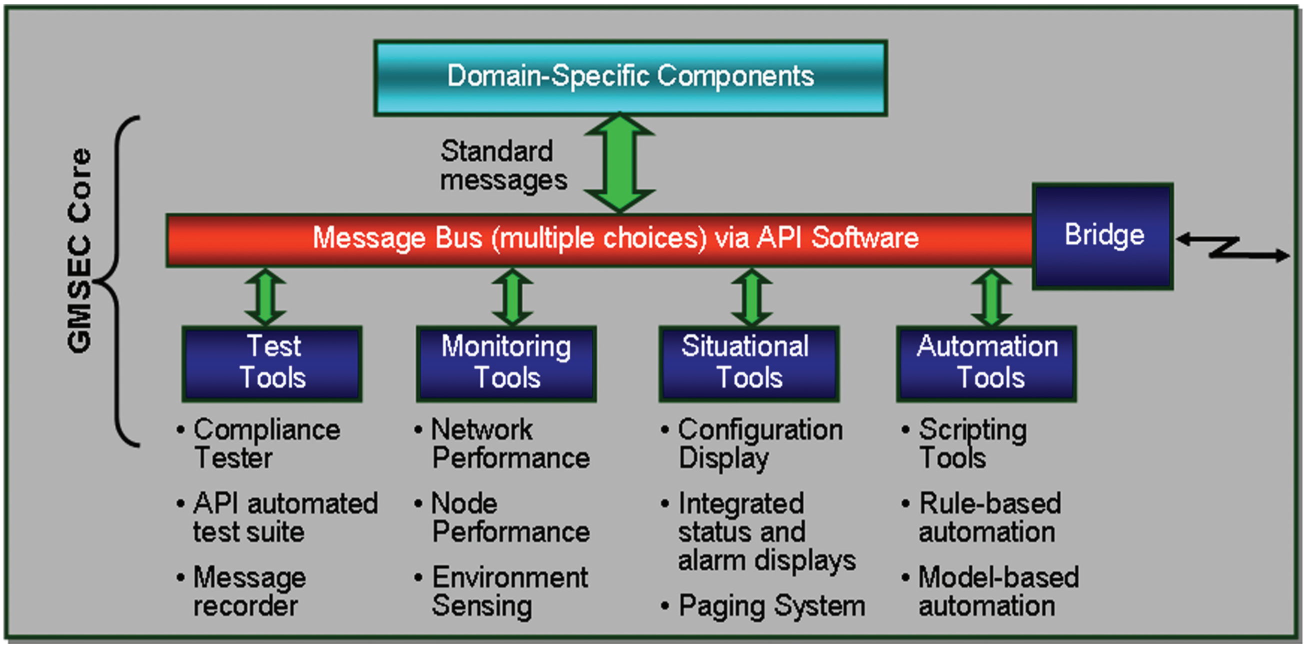


The GMSEC architecture allows for domain-specific components to be easily integrated with general purpose system support tools developed by the GMSEC team.

someone constantly monitoring messages to determine whether or not an anomaly has taken place. Instead, ANSR can be invoked only when necessary, and will take on the responsibility of confirming a notification has been acknowledged.

GEDAT (GMSEC Environment Diagnostic Analysis Tool)

GEDAT (GSC 16276-1) provides a graphical display of the GMSEC environment, identifying all GMSEC-compliant components connected to the GMSEC information bus. The display shows numerous components performing message exchanges via the API with a primary and secondary underlying middleware.

GEDAT provides views of the system from different perspectives so operators can monitor an activity of interest. Some viewing perspectives include by mission, by facility, and by computer node.

System Agent

Each computer in a GMSEC system runs its own System Agent (GSC-15747-1). These agents provide some of the raw data used by GEDAT. This includes host identifying information, CPU utilization, memory utilization, and disk utilization. This allows GEDAT or other components to monitor essential resources, and flag them whenever they reach or approach critical levels. System Agent also interacts with the local operating system to invoke system specific commands.

GRASP (GMSEC Remote Access Service Provider)

GRASP (GSC-16172-1) allows for the remote viewing, via the Internet, of GMSEC information. GRASP addresses the transfer of selected information from a GMSEC environment to a web server (in a secure manner if needed). It also defines the interface to that information for web applications.

GPD (GMSEC Parameters Display)

GPD (GSC 16073-1) provides a simplified visual display of the telemetric and ground system parameter values. Any defined parameter value can be quickly grouped into a display for real-time viewing and monitoring. GPD can also group mnemonics, perform limit checking, and initiate user-defined actions when thresholds are violated.

RAA (Room Alert Adapter)

RAA (GSC-16167-1) collects server room environmental data and places this information on the information bus. The hardware sensor box supports various wired and wireless sensors, including temperature, humidity, power, flood, and so on. This allows for remote monitoring of environmental variables, to provide immediate knowledge of any out of bounds conditions. These conditions can be detected by CAT, which will then issue a directive to ANSR requesting that a text or email be sent to the on-call operations team member.

…And More

Of course, the GMSEC applications mentioned in this article are only the ones developed in-house; any GMSEC-compliant application from any vendor can theoretically be part of a system. "That's one of the primary advantages of GMSEC" explains LaMont. "When our customers come to us, we say 'here's a catalog of applications you can choose to build your system.' They can then just select whatever applications they want, and we'll put it together for them and demonstrate it in our lab. This makes a satellite support system relatively easy to build — and also easy to upgrade and modify if you ever need to swap out components somewhere down the road."

Takeaways

The GMSEC framework/information bus consists of an API, standard messages, and an underlying middleware. A GMSEC System consists of the framework/information bus along with GSFC-created components: GREAT, CAT, ANSR, GEDAT, System Agent, GRASP, GPD, and RAA. In addition, there is a catalog of GMSEC-compliant vendor applications from which to choose when building a GMSEC-based system.

For more information about the technical aspects of GMSEC, please contact LaMont Ruley at 301-286-5805, or email GMSEC@nasa.gov.

The Benefits of GMSEC

GMSEC provides a standard software architecture for developing systems where applications communicate and exchange data over a messaging bus. The systems that can be developed using the GMSEC architecture extend beyond satellite support. The high-level advantages of this approach are probably readily apparent: By writing to a standard interface, developers can add and replace applications without disrupting other components of the system. Further, designers can build their systems by selecting from a catalog of existing applications, rather than having to create (or heavily modify) each application for each system. This means that systems can be put together much more quickly and with less expense, using components that in many cases have already been coded, debugged, and proven in the field.

In this article, we look at the specific benefits GMSEC brings to a satellite support system, the application for which GMSEC was originally designed. We address the following questions: What specific benefits does GMSEC bring to my mission or application? Or phrased another way: If I adopt GMSEC, what will I be getting that I wouldn't if I built my system from the ground up? It speaks to the versatility of GMSEC that the answers to these questions depend on the mission or application to which GMSEC is being applied. Different NASA centers, and different government agencies, may see significantly different sets of benefits from implementing a GMSEC-compliant system.

Satellite Support Systems

"I was speaking with a senior Pentagon official a while ago," reports Dan Smith, GMSEC Project Manager. "And he said that GMSEC is like an iPhone for satellite control systems. What he meant was that GMSEC provides a documented framework so that many others can write compliant applications for users to select from."

This level of standardization and simplified integration is seen as an enabling technology for reaching an ambitious goal of the Operationally Responsive Space Office (ORS). Their goal is to build, launch, and begin operations of a new satellite within seven days to meet a newly defined critical need; a process that historically has taken several years. The satellite control center will need to be built in even less time. To make this possible, both the satellite and its support system need to be developed concurrently with pre-approved components and many key assumptions. Satellite components will be available at the fabrication facility and will connect using a "USB for space." For the ground system, telemetry and command databases for the selected instruments will be merged, and GMSEC-compliant components will be added to a multi-mission architecture already based on GMSEC.

Product vendors have reported that the ORS goal can be reached with the use of GMSEC and appropriate assumptions.

Photo courtesy of ORS

A GMSEC-based system at the Operationally Responsive Space (ORS) facility at Kirtland Air Force Base uses a mix of GSFC products, commercial products, and ORS custom software to monitor test satellites under construction.

Over time, the rapid deployment efforts may influence how missions at GSFC are designed and developed.

The image on page 8 shows the ORS environment in which satellites could be built quickly. In the background at upper left, technicians in a clean room are assembling a satellite. In the foreground, software engineers are configuring and testing the GMSEC-compliant system to support integration testing and later operations. By using pre-tested GMSEC components and a standard format for their telemetry and command database, they can be ready for a new satellite within days -- a virtual impossibility if the systems were coded from scratch for each satellite.

A major advantage of using off-the-shelf components rather than new code is risk reduction. Pre-existing applications have already been tested and potentially used in the field. Therefore the risk that they contain serious software bugs or other issues should be much lower than it would be in new, untested code.

Adopting GSMEC has already paid dividends. For instance, Jim Busch, who was a lead engineer for the Tropical Rainfall Measuring Mission (TRMM) ground system re-engineering effort, stated after the redesign efforts that "TRMM has realized a reduction in flight operations costs of over 50% as compared with the pre-GMSEC architecture." A major reason for the cost reduction is the ability to use GMSEC components to enable new levels of automation and to support "lights out" operations for nights and weekends – the system can call the appropriate person if there is a problem.

GMSEC Benefits to GSFC

As the preceding section illustrates, GMSEC provides a number of important benefits to GSFC missions. According to Dan, foremost among these is that it makes it easier to create systems with high levels of automation, thereby reducing cost and risk. In addition, since more commercial command and control products are now GMSEC compatible, this increases the choice of applications for missions. At the same time, software engineers can still use "old favorite" legacy applications if they are GMSEC-compliant, which often makes developers more willing to adopt this approach.

As we've noted, GMSEC can produce a significant reduction in integration time, since components can be added or upgraded without impacting the existing system. For longer missions, new components could be replaced or added slowly over time without affecting the underlying system design. Testing can also be done in parallel. The GMSEC approach is also ideal for using multiple small distributed development teams, since developers only need to know how their application works with the message bus (via the API) and don't need extensive knowledge of the other components in the system. The GMESC framework approach also allows for a certain degree of "safe" experimentation, as new components with novel functionality can be tried out without endangering the operation of the system as a whole. And of course, a standard messaging platform allows for much easier collaboration with other NASA centers and government agencies.

Especially important at GSFC is the missions' ability to take advantage of other investments. Many different organizations provide funding to maintain GMSEC components and add new capabilities of value to multiple missions. By using a GMSEC architecture, missions can take advantage of the investment of others.

GMSEC Benefits to the Air Force

As noted in the "Featured Interview" with Dan Smith, the U.S. Air Force is also a major adopter and supporter of GMSEC. They see the potential for an expanded enterprise-level architecture based on the GMSEC approach and message specifications. By connecting multiple facilities and mission systems using a security-enhanced GMSEC approach and increasing interoperability, they can allow for new levels of operations flexibility and capability backup, can create new situational awareness focus areas, and can bring more commonality to their broad set of mission ground systems. Adaptability is also key. For legacy systems in which the Air Force has made significant investment, it would be better to adapt and evolve these systems to keep up with technological advances rather than having to completely replace them every few years.

Conclusion

Collectively, GMSEC systems can be developed faster, have increased capabilities, and can cost less than systems of the past. Dan likes to borrow a NASA phrase from the past, with a slight modification. "We really are enabling systems to be built that are 'faster, better, cheaper — through innovation,'" notes Dan. "You can be faster, better, and cheaper at the same time, but you need to be creative about it. Shorter schedules, smaller development teams, more product choices, risk reduction — GMSEC gives us all that. And the more widely adopted it is, the more benefits it brings to everyone."

Takeaways

GMSEC provides general advantages of system development speed, mission support cost, and operational efficiency to all missions and applications in which it is applied. It also provides specific benefits to different centers and agencies. For GSFC, primary GMSEC features include the ability to automate systems, a choice of proven off-the-shelf components, and extremely fast deployment. For the Air Force, benefits include interoperability, adaptability, and situational awareness.

For more information about the benefits of adopting GMSEC, please contact Barbie Medina at 301-286-4438, or email her at GMSEC@nasa.gov.

Transferring GMSEC Technology

tech transfer

The Goddard Mission Services Evolution Center (GMSEC) is an architecture designed to provide a layer of commonality and integration for software systems. Originally conceived to support GSFC satellite systems, GMSEC has evolved into a platform to support a variety of systems, both within and outside GSFC.

For an overview of GMSEC; including its history, development, purpose, and future plans; see the article "Featured Interview" with Dan Smith in this issue of *GSFC Tech Transfer News*. For a high-level summary of the GMSEC components and how they work together; see the article "GMSEC Technical Overview" in this issue

In this article, we'll review the tech transfer opportunities GMSEC provides to its three primary customers; Goddard missions, other NASA centers, and other U.S. government agencies. We'll conclude with a brief look at some of the commercialization opportunities GMSEC may also offer for private industry.

Tech Transfer Within GSFC...

Within Goddard, GMSEC has been operational since 2005, with different missions using it in different ways. The first three missions that used the GMSEC framework showed that systems could be integrated rapidly. Each of the three used a different set of components "from the GMSEC catalog," with some in common and some different. The mission goals ranged from "I need more automation," to "I need an inexpensive solution," to "I need to support new operational concepts." The GMSEC approach was the enabler that allowed all three goals to be met.

Automation is an important capability for GMSEC systems. Each software application publishes its status on the GMSEC message bus. Other components read and assess these messages and can send directives in response to discovered conditions. For instance, if the schedule reports that a satellite contact should be starting and then the start of data is not reported within 30 seconds, the system can automatically page the supervisor, check the status of the system hardware, and send a request for the antenna site to try again to acquire the data. GMSEC's Criteria Action Table (CAT) helps facilitate this ability. CAT allows the flight operations team to define automation rules in terms of criteria to recognize and the actions to be taken. There is a lot of power in a rules-based system such as this, since it's user-configurable and allows for automatic, and even autonomous, handling of many mission operations activities.

CAT is only one example of the components that make up the GMSEC system. Each component is separately reported as a NASA technology and requires a software release for technology transfer to each of the end-user missions. Every six months, new updates of GMSEC in-house components are released to GSFC missions, resulting in dozens of tech transfer events per year just within GSFC.

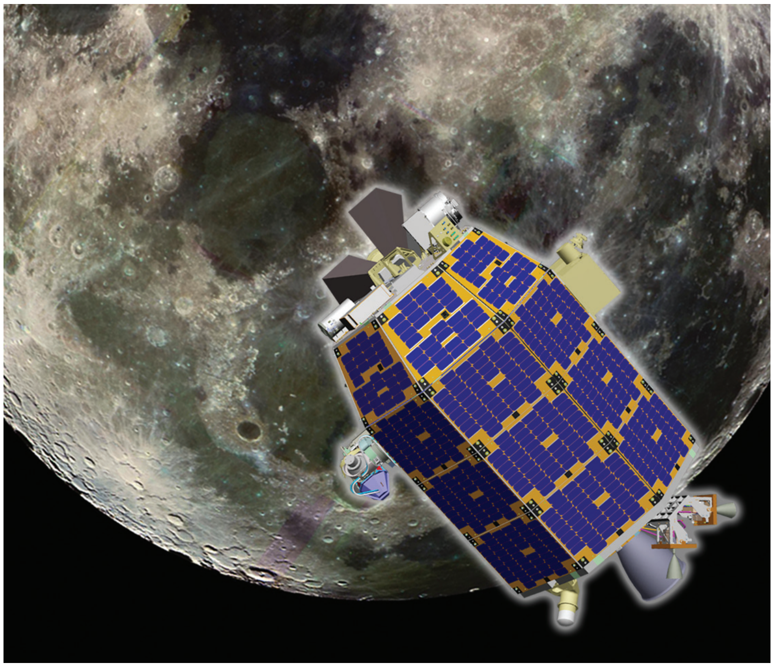
The GMSEC team is now working with most of GSFC's missions under development (including MMS and GPM) and the team continues to work with the on-orbit Earth Science and Space Science missions. In addition, the GSFC Flight Dynamics Facility, even though it is not a satellite control center, is being reengineered to a GMSEC architecture to take advantage of message passing, simplified integration, and automation capabilities of GMSEC.

...With Other NASA Centers...

A second customer population for GMSEC consists of other NASA centers. In 2006, in support of the then-upcoming Constellation mission, five different NASA centers ran a successful test in which they used GMSEC to set up a communications system in which they could exchange messages with each other.

Most of the NASA operations Centers have had GMSEC labs and continue to evaluate or use GMSEC.

- Marshall Space Flight Center has used GMSEC operationally for event message processing.
- Ames Research Center employs GMSEC for the (LADEE) and the Interface Region Imaging Spectrograph (IRIS) missions.
- Johnson Space Center and GSFC are currently in discussions concerning GMSEC, with lab evaluations being conducted at Johnson.
- Jet Propulsion Laboratory is collaborating with GSFC to use GMSEC to exchange messages between the Centers, potentially providing backup capabilities and software sharing
- Independent Verification and Validation Facility has created a software test suite based on GMSEC.
- Wallops Flight Facility is examining GMSEC for range operations at their launch site.



Artist's rendering of the Lunar Atmosphere and Dust Environment Explorer (LADEE). LADEE, operated by Ames Research Center, is just one of many examples of GMSEC being transferred within NASA.

It's important to note that not all these centers are using GMSEC for operational missions yet. However, the preceding list does provide some idea of how widely the use of GMSEC continues to spread throughout NASA.

…And With Other Government Agencies

GMSEC has also gained a great deal of traction within non-NASA U.S. government space agencies. The Air Force has sponsored a large GMSEC test facility in Chantilly, Virginia for the past three years. They have identified areas where GMSEC could be enhanced to better meet Air Force operational requirements, and now fund GSFC to make the changes. The team in Chantilly supports other Air Force organizations across the country.

The Los Angeles Air Force Base put out a Request for Information (RFI) to industry for no-cost support within their GMSEC lab. The RFI stipulated that all components must be GMSEC-compatible. Some 25 different vendors responded; and the Air Force is now preparing for a multi-day demonstration of the capabilities from ten vendors integrated with GMSEC — strong indication for how important GMSEC has become for both the Air Force and their software suppliers.

"Recently, the Air Force Space Development and Test Directorate (SDTD) in Albuquerque contacted us," reports Dan. "Representatives from SDTD and Lockheed Martin visited GSFC to discuss the potential development of a satellite control system based on GMSEC to operate their DSX mission. The following week, their Lieutenant Colonel visited GSFC and said he would like to have his entire center move towards GMSEC to support six satellites already in operations plus the DSX mission, plus one more new mission. We also have work going on with the Air Force Research Laboratory, and the Los Angeles Air Force Base. The Air Force is really off and running with GMSEC."

Another important organization involved with GMSEC is the DoD's Operationally Responsive Space (ORS) Office. The ORS has a goal of being able to go from the "declaration of urgent need phone call" to an on-orbit operational satellite in seven days. To put that into perspective, it typically takes NASA three to five years to complete this task. If the ORS achieves this goal and is able to build a satellite within seven days, that means the ground support system has to be created in only two or three days. The only really plausible way to do this is to have a system such as GMSEC in place, where compatible components can be quickly selected and assembled, with the knowledge they will all work together. Vendors are very much behind this concept; one has even stated that with GMSEC and the ORS assumptions they are able to make, they can build a ground system in four hours!

Other government agencies interested in GMSEC include the Naval Research Laboratory, which supported a test in 2010 where GMSEC messages were exchanged between GSFC and the NRL to receive telemetry and to command a DARPA satellite through the Air Force Satellite Control Network and their ground station in Guam. And both the National Oceanic and Atmospheric Administration (NOAA) and National Reconnaissance Office (NRO) have discussed GMSEC with GSFC. GMSEC personnel are often asked to present the GMSEC concepts to other government management teams or to larger audiences at selected conferences.

The ORS and Air Force's involvement with GMSEC has led directly to further tech transfer opportunities. "The Air Force brings lots of other people through GSFC or we meet them at their facilities," explains Dan. "Over the last six months, GMSEC presentations have been given to Air Force Generals, Directors of NRO, U.S. space policy writers, and representatives of the Office of the Secretary of Defense."

Commercialization Opportunities

GMSEC enjoys tremendous support from commercial product vendors, but not by having them commercialize GSFC technologies. Instead, vendors realize that offering GMSEC-compliant products allows them to more easily market their capabilities to NASA and to the Air Force and others.
As Dan notes, "We have had vendors coming forward and say 'We can do GMSEC for you,' but that's not what we want. We've made the core of GMSEC available as Open Source software, but we want to retain control over it, and not have GMSEC become a proprietary company product." In addition, the potential creation of many variants of the basic framework would destroy the very capability that makes GMSEC so powerful.

However, there may be some pockets of tech transfer opportunity within specific, non-core GMSEC components. One example could be the previously mentioned CAT rules application. According to Dan, "CAT works great, but it doesn't really represent an area of core expertise for GSFC. There may be companies out there that could take it over and make it better. We'd be willing to consider that possibility for CAT and perhaps some of our other components."

Ultimately, however, the major benefit GMSEC provides to commercial software developers is the market it creates for them. "We're at the point of achieving critical mass," states Dan. "Our vendors are saying, 'If I support GMSEC, look at all the potential government customers I'll have.' It's really started to take hold."

Conclusion

GMSEC has clearly become important within GSFC, other NASA centers, and other agencies within the U.S. government. In the process, it has generated a great deal of tech transfer activity. "Tech transfer is what makes GMSEC valuable," concludes Dan. "Sure, we could just continue to implement homegrown systems rather than implementing GMSEC. But look at what we'd be missing."

Takeaways

GMSEC generates a high level of tech transfer within GSFC, other NASA centers, and other government agencies (particularly the Air Force). Its widespread adoption presents a significant benefit for the commercial software industry, because it creates a large government market for any product that is compatible with GMSEC.

For more information transferring GMSEC and other Goddard technologies, please contact the GSFC Innovative Partnerships Program Office (Code 504), http://ipp.gsfc.nasa.gov (phone: 301-286-5810, email: techtransfer@gsfc.nasa.gov).

Patenting Perspectives

In this edition of Patent Perspectives, we look at the Patent Reform Act of 2011 (also known as the America Invents Act). The Act was passed earlier this year in the U.S. Senate by a vote of 95 to 5; a version was also passed by the U.S. House of Representatives on June 24 by a vote of 304-117. Differences between the House and Senate bills are now being resolved.

Offering their perspectives on the Patent Reform Act of 2011 are attorneys Bryan Geurts (Chief Patent Counsel for GSFC's Office of Patent Counsel) and Erika Arner (Partner for the law firm Finnegan, Henderson, Farabow, Garrett & Dunner).

Bryan Geurts

Erika Arner

Q: Very briefly, what's different about the Patent Reform Act of 2011?

Erika: This represents the fifth or sixth attempt at patent reform in the past five or six years. This bill, however, has gotten further than any of the previous ones, passing the Senate on March 8. It's been approved by the House Judiciary Committee (on April 14 by a 32 to 3 vote); the full House was scheduled to take it up June 22. I believe it has a real shot at getting passed.

This is a real effort by Congress to improve the quality of patents. It also provides more opportunities for third parties to challenge weak patents, with several provisions aimed at this goal.

Bryan: In general, the U.S. is marching towards harmonization with the rest of the world in terms of how IP is protected. This Act advances that goal.

Q: And harmonization is a good thing, correct?

Bryan: In concept, yes. However, global harmonization is certainly not the most important feature of a viable US patent system. When discussing harmonization, it's important to understand why the U.S. has been traditionally different from other countries in some areas. For example, we allow a one-year grace period after an invention is disclosed for the inventor to file a patent application. The rest of the world basically requires the inventor to file the application first before using the invention publically — in other words, first-to-file takes priority over first-to-invent. This is one of the primary differences between how the U.S. handles patent protection and how the rest of the world does it. In my opinion, there is a fundamental fairness to our current first-to-invent approach that is important to retain.

Erika: I think first-to-file is a positive development, because it would streamline the patent review process and create efficiencies. Currently, there are a lot of inefficiencies due to interferences. This places a burden on the Patent Office, creating several years' worth of backlog.

That being said; I don't favor full harmonization either. For example, other countries exclude certain areas from patenting which the U.S. allows, because this country has a broader view of what's patentable. I think putting in these specific exclusions is unfortunate. We'll see if they stay in the final version of the Act.

Q: How does the Act affect Prior User rights?

Erika: We currently have a very limited form of Prior User in place now, which basically covers business practices that were traditionally protected using Trade Secrets. Its purpose is to protect companies that have been using business processes for years, without knowing these processes could be patented. They're protected if someone comes along and patents those processes. This protection only applies, however, if the company can show that they've reduced the process to practice, and have already put it into commercial use.

What is being proposed in the Patent Reform Act of 2011 is much broader, but it still requires the process be commercialized before Prior User rights apply.

Q: Does the Act change how the U.S. Patent Office is funded?

Bryan: This has been an issue for years. Through fees, the USPTO historically brings in more than it spends; but Congress still insists on funding it. Understandably, the Patent Office would like to keep the revenues it generates and become self-sufficient, which is eminently sensible. This debate is ongoing.

Erika: A good example of what's wrong with the current system is that the Patent Office had several initiatives planned that would significantly expedite the examination process, something my clients were looking forward to. But when the budget was approved using a continuing resolution to keep the federal government from shutting down, the funding for these initiatives was cut, which means that the Office will continue to make little progress on its backlog.

Bryan: What it ultimately boils down to is this: Can Congress resist getting its hooks on the money that the Patent Office brings in? This could be difficult, since the Office has a track record of generating far more money than it's given, and Congress spends that surplus on other things. A self-reliant USPTO will have more money to do its job.

Q. How good are the chances that the Patent Reform Act of 2011 will pass?

Bryan: I think it's less than 50/50. Its chances of success are closer than previous patent reform bills, but it's not quite there yet.

Erika: Agreed, although I think the chances are much better than in the past.

Bryan: I think one of the major problems here is simple inertia. In the past, the single biggest point of contention with patent reform has been how to calculate damages. This is not as big an issue with this year's version.

Erika: Again, I agree with Bryan. The patent community has traditionally been sharply divided on the issue of first-to-file versus first-to-invent, with heavy lobbying from both sides. But now, first-to-file is less controversial than before. There are still some pockets of resistance, but there's not as many barriers standing in the way of the Act receiving House approval.

Readers, what patent issues would you like to have Brian and Erika discuss in future issues? Please send suggestions to lucy.a.stefanelli@nasa.gov.

Business Networking and Outreach

2011 National SBIR/STTR Spring Conference

(April 10-13, 2011, Madison, WI)

Goddard IPP Office staff members Tom Bagg and Jenny Geiger hosted the NASA booth at the 2011 National SBIR/STTR Spring conference which took place at the Monona Terrace Community and Convention Center in Madison, Wisconsin, on April 10th through 13th, 2011. This year's conference attracted over 600 attendees, small businesses and government agencies. Office staff also held one-on-one discussions and partnering meetings with attendees and distributed literature on the NASA SBIR /STTR Program.

NASA OPTIMUS PRIME Spinoff Awards

(April 11th-14th, 2011, Colorado Springs, CO)

The Innovative Partnerships Program (IPP) Office hosted the NASA OPTIMUS PRIME Spinoff Awards Ceremony in Colorado Springs, Colorado, on April 11th-14th. The ceremony was held to award students in grades 3 through 8 whose video entries best represented a spinoff technology chosen by the contestants. Individual student winners were awarded glass trophies featuring an etched image of Transformers character OPTIMUS PRIME inside. On hand to present the winners with their trophies was the voice of OPTIMUS PRIME, actor Peter Cullen. The OPTIMUS PRIME Spinoff Award promotes NASA spinoffs, recognizes innovation through technology transfer and promotes innovative communication of spinoff stories to the public through video.

The voice of OPTIMUS PRIME, actor Peter Cullen, presents 6th - 8th grade NASA OPTIMUS PRIME Spinoff Award Contest winner Dahlia Huh, with a trophy for her winning video on how Star-mapping tools enable the tracking of endangered animals.

Innovative Partnerships Program (IPP) Office Senior Technology Manager Darryl Mitchell (center) accepts the 2011Outstanding Technology Transfer Award along with (from Left) FLC Chair, Dr. Scott Deiter, Innovative Partnerships Program Chief, Nona Cheeks, Office of Patent Counsel Chief, Bryan Geurts, Director of the Innovative Partnerships Program, Douglas Comstock, and FLC Vice-Chair, Dr. Theresa Baus.

2011 Federal Laboratory Consortium National Meeting

(May 2–5, 2011, Nashville, TN)

The Innovative Partnerships Program (IPP) Office hosted the NASA exhibit at the 2011 Federal Laboratory Consortium (FLC) National Meeting held May 2nd through 5th, 2011, at the Nashville Marriott in Nashville, Tennessee. This premier meeting is held to develop strategies and opportunities for linking laboratory mission technologies and expertise with the marketplace. IPP staff hosted an exhibit to present the Programs features and benefits which typically draws over 300 attendees, including federal laboratory and agency technology transfer professionals, patent attorneys, licensing professionals, technology marketing organizations, and other related professionals, as well as state and local government staff and businesses interested in technology transfer, partnering, and the commercialization of federal laboratory innovations and technologies. Participants represent a cross-section of technology areas, including aerospace, medical, biotech, fuels, electronics, energy, defense, agriculture and more.

Business Networking and Outreach

Conference on Lasers and Electro-Optics (CLEO)

(May 2-6, 2011, Baltimore, MD)

The Innovative Partnerships Program (IPP) Office hosted the NASA exhibit at CLEO 2011, the Conference on Lasers and Electro-Optics. The IPP Office has developed a new campaign focused on transferring wavefront sensing, and related optical processing technologies to the private sector. The campaign began in May, with the CLEO 2011 conference in Baltimore, continuing through August with SPIE West in San Diego, and leads up to Industry Day at Goddard in the fall of 2011. The focus of this campaign is to enable firms to look through NASA's treasure chest of innovative technologies and find ways to create exciting new products for consumers and industry.

Brent Newhall, IPP Software Release Assistant, discusses wavefront sensing technology used on the James Webb Space Telescope with attendees at the CLEO: 2011 Conference on lasers and electro-optics.

Innovative Partnerships Program Office Technology Manager Enidia Santiago-Arce talks with Explore @ Goddard attendees about the NASA Optimus Prime Spinoff Award Contest.

Explore @ NASA Goddard

(May 14, 2011, Greenbelt, MD)

The innovative Partnerships Program (IPP) Office hosted tables at the 2011 Explore @ Goddard event on May 14, 2011. This event offered the public an opportunity to explore the Goddard campus and allowed an unprecedented look at seldom seen areas of the Goddard campus. The IPP Office showcased the NASA @ Home & City application that demonstrates how spinoff technologies are used every day in our daily lives, and also demonstrated NASA's Massively Multiplayer Online (MMO) Game, Moonbase Alpha, which was recently awarded Best Government Game by the Serious Games Showcase and Challenge.

Society for the Advancement of Material and Process Engineering (SAMPE)

(May 23-26, 2011, Long Beach, CA)

The Innovative Partnerships Program (IPP) Office attended the Society for the Advancement of Material and Process Engineering (SAMPE) 2011, in Long Beach, California, on May 23rd through the 26th, 2011. This premier conference is held by the only technical society that encompasses all fields of endeavor in materials and processes. SAMPE is an international professional member society that provides information on new materials and processing technologies through commercial exposition, technical forums, and journal publications or books, in which professionals can exchange ideas and views. SAMPE provides a unique and valuable forum for scientists, engineers, designers and academicians.

Innovative Partnerships Program Office Sr. Technology Manager Ted Mecum interacts with SAMPE attendees about leveraging GSFC's cutting-edge processing technologies.

IPP Office staff members Darryl Mitchell and Melissa Jackson, along with IPP Office Chief, Nona Cheeks, present Union Park Elementary fifth graders Isaliz Gonzalez, Grace Romano, Julianna Sanchez, and Samantha Herrod, with NASA OPTIMUS PRIME trophies for their winning video, "UPE NASA Spinoff UV Protective Fabric" .

NASA OPTIMUS PRIME Spinoff School Awards
(May 23-25, 2011, Orlando, FL)

Innovative Partnerships Program (IPP) Office staff members were on hand at Union Park Elementary School in Orlando, Florida, to personally deliver first place awards to four students. Isaliz Gonzalez, Grace Romano, Julianna Sanchez, and Samantha Herrod won the NASA OPTIMUS PRIME Spinoff Award Contest for the 3rd – 5th grade category. The OPTIMUS PRIME Spinoff Award Contest is a national video contest sponsored by NASA and toymaker Hasbro. The goal of the contest is to help students understand how NASA technology 'transforms' into things used daily here on earth. The fifth-graders wrote and produced a video about fabrics created through NASA that protect skin from ultraviolet rays. Their video was titled, "UPE NASA Spinoff UV Protective Fabric". The first round of judging was done through a public online voting process. From there the top five videos were sent to a NASA judging panel that chose the top videos. Each student won a NASA OPTIMUS PRIME trophy, a winner's certificate signed by NASA Administrator Charles Bolden, and passes to tour the Kennedy Space Center Visitors Complex. Fifth grade teacher Kimberley Klein was also given a special award for inspiring her students to be a part of the contest.

2011 Goddard SBIR/STTR Conference
(June 9, 2011, Greenbelt, MD)

NASA's Goddard Space Flight Center hosted the 2011 Small Business Conference on Thursday, June 9th from 7:30 am - 4:30 pm at the GSFC campus in Greenbelt, Maryland. The conference is designed to provide small businesses with a series of education and networking sessions to help increase the knowledge base of how to successfully do business with the National Aeronautics and Space Administration (NASA). Over 400 individuals from small businesses, federal organizations and prime contractors attended the event.

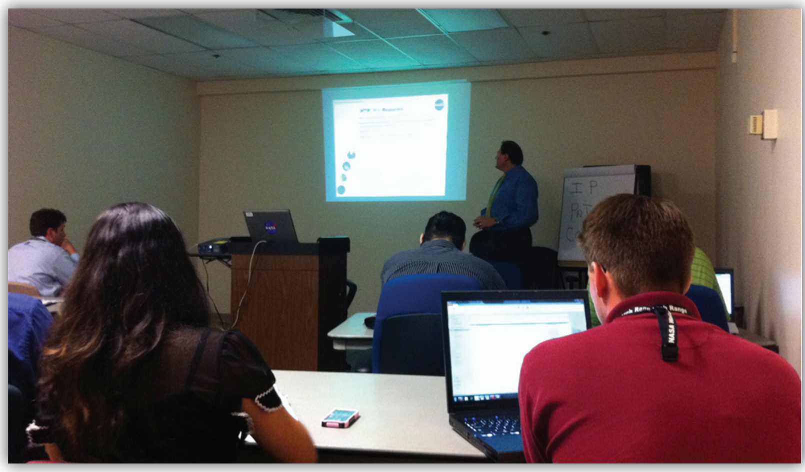
SBIR Program staff Tom Bagg and Jenny Geiger discuss the SBIR/STTR program with Small Business Conference attendees.

IPP Office Awards Liaison Dale Clarke and Technology Manager Dennis Small speak to Small Business Conference attendees about GSFC's Applied Engineering and Technology Directorate.

Business Networking and Outreach

Technology Innovation and Technology Transfer Training
(June 21, 2011, Greenbelt, MD)

Goddard's Innovative Partnerships Program (IPP) Office offered a Technology Innovation and Technology Transfer Training class on June 21st to help civil servant personnel and contractors better understand the ins and outs of managing innovation and intellectual property to foster technology transfer licensing and partnering opportunities.



Senior Technology Manager Ted Mecum informs GSFC innovators about the importance of reporting new technologies and innovations to the IPP Office.

IPPO staff members Courtney McEachon and Rachel Rachfal distribute NASA Spinoff publications to Celebrate Goddard Day attendees.

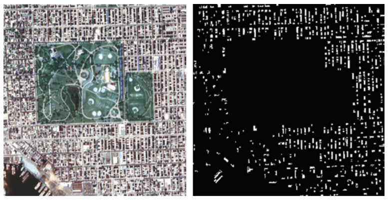
A line forms as IPPO staff Rachel Rachfal and Heather Choi play the ever-popular Spinoff Prize Wheel Game with Celebrate Goddard Day attendees at the Applied Engineering and Technology Directorate tent.

Celebrate Goddard Day
(June 22, 2011, Goddard Mall, Greenbelt, MD)

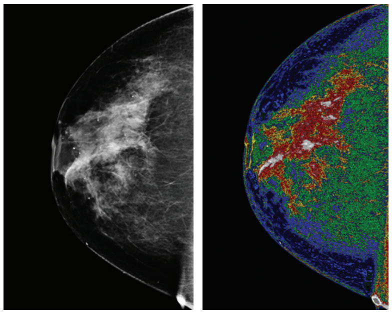
NASA Goddard Space Flight Center's Innovative Partnerships Program (IPP) Office participated in the Applied Engineering and Technology Directorate's (AETD) exhibit during Celebrate Goddard Day on June 22, 2011 on the Goddard Mall. This event gave Goddard personnel, summer interns and their families the opportunity to become acquainted with the various aspects of NASA Goddard as well as to participate in fun activities and to take tours of the center, all according to the theme "Diversity: The Goddard Advantage." The IPPO display gave attendees a great opportunity to learn about the annual NASA OPTIMUS PRIME Spinoff Award Video Contest, a Massively Multiplayer Online demo game, and various IPPO publications about avenues for partnerships and technology development. The IPPO also featured an interactive prize wheel question and answer game featuring questions that tied into the diversity theme and focused on innovation, partnerships, the SBIR/STTR program and technology transfer activities like software release and spinoff technologies. Nearly 500 game winners spun the wheel to win a prized memento. Other highlights of the AETD exhibit included a QWIP camera that took infrared pictures of attendees and a large "NASA Payload Operation Control Center in microcosm" antenna that listened to selected LEO satellites as they passed overhead.

Special Award Announcement

We are pleased to announce that NASA Goddard Space Flight Center was once again the recipient of R&D Magazine's R&D 100 award. The 49th Annual R&D 100 Awards honors the 100 most technologically significant products introduced into the marketplace over the past year. Goddard was awarded the prize for its Recursive Hierarchical Segmentation (RHSEG) software which has been successfully commercialized as part of Bartron Medical Imaging's MED-SEG™ product. The commercial form of the technology has led to a superior way to identify abnormal regions in digital medical images, such as mammograms.



Above: RHSEG used for its original purpose, automatically segments satellite imagery of a residential neighborhood.
Below: MED-SEG™ automatically segments a mammogram, highlighting areas of interest in white.



Bartron partnered with NASA Goddard's RHSEG inventor Dr. James Tilton to expand their imaging capabilities. By incorporating the RHSEG software's ability to analyze 3D data sets, an enhanced MED-SEG™ will be able to produce a pixel-level view of all sides of a tumor, lesion, or other area of interest. While current technology can produce 3D imagery, the RHSEG software will be able to segment an image in ways that more clearly define problem areas.

Considered a benchmark of excellence, the R&D 100 awards were reviewed by an independent judging panel and the editors of R&D Magazine and the winners were selected from a strong field of candidates. All of the 2011 award winners will be recognized at the R&D 100 Awards Banquet on Oct. 13, 2011 and you can view a listing these winners at the R&D Magazine's web site below:

http://www.rdmag.com/Awards/RD-100-Awards/2011/06/R-D-100-2011-Winners-Overview/

Partnership Agreements April- June 2011

The IPPO is pleased to announce the recent signing of these partnership agreements.

Partner	Technology/ Focus	Type	NASA Goals/Benefits
Maryland Technology Development Corporation (TEDCO) Columbia, MD	Technology partnerships and marketing of NASA Goddard Technologies	Non-Reimbursable Space Act Agreement	NASA GSFC and TEDCO will benefit from the formal relationship that will allow TEDCO to promote NASA GSFC technologies, capabilities, and needs. This will be executed by way of organized efforts including meetings with and between GSFC innovators and prospective businesses with an expected outcome of potential collaborations and/or licenses of NASA GSFC technologies. This partnership will lead to an increase in economic growth and success of Maryland businesses.
Learning.com Portland, OR	NASA's BEST Students	Non-Reimbursable Space Act Agreement	NASA GSFC and Learning.com's primary goals for this project are to increase the awareness and usage of NASAs BEST Students (NBS) curriculum, and to connect teachers to NASAs BEST Students professional development offerings. The parties propose that the NBS curriculum be hosted directly in Learning.com's Sky digital learning environment. Sky enables school districts to use any Web resources to make every classroom a 21st century classroom. The proposed content hosting in Sky will include all metadata as well as the NBS content itself.
Xilinx Inc. San Jose, CA	HQ NEPP, Parts and Packaging	Non-Reimbursable Space Act Agreement	This Agreement is for NASA GSFC to conduct an independent heavy ion evaluation of the radiation performance of the Xilinx XQR5VFX130-CF1752 integrated circuit. This device has the potential to be a game changer for space system design by both simplifying design requirements (i.e., reduced additional radiation mitigation) while providing high level system performance and reconfigurability.
AURA Tucson, AZ	IRMOS instrument install and use at Kitt Peak	Non-Reimbursable Space Act Agreement	The purpose of this program is to enable astronomical observations, by James Web Space Telescope (JWST) designated scientists and the National Optical Astronomy Observatory (NOAO) general observer community, using the NASA Infrared Multi-Object Spectrograph (IRMOS) instrument installed at the Association of Universities for Research in Astronomy (AURA) telescope facilities at Kitt Peak. The IRMOS is a first of its kind spectrograph that utilizes a Micro-Electro-Mechanical Systems (MEMS) micro-mirror array for aperture control to enable both sparse target multi-object spectroscopy and integral field Hadamard transform imaging spectroscopy.

metrics

Tech Transfer Metrics April- June 2011

New Technology Reports: 22

Discontinuous Mode Power Supply by John Lagadinos and Ethel Poulos (Code 555)

Goddard Mission Services Evolution Center (GMSEC) Environmental Diagnostic Analysis Tool (GEDAT) Version 2.0 by Sharon Orsborne (Code 583)

Dual Double Wedge Pseudo-Depolarizer with Anamorphic PSF by Peter Hill and Patrick Thompson (Code 551)

Depolarizion using Time Delay Integration by Eugene Waluschka and Mark Wilson (Code 551)

Development of a One-Gram Microvalve by Glendon Benson (Code 699)

Fiber Coupled Pulsed Shaper for Sub-Nanosecond Pulse Lidar by Tony Roberts, Gregg Switzer, and William Suckow (Code 554)

GeoTorrent by Vuong Ly (Code 583), Pat Cappelaere, and Dan Mandl (Code 581)

Educational NASA Computational and Scientific Studies (enCOMPASS) by Nargess Memarsadeghi (Code 587)

Miniaturized High Speed Modulated X-ray Source by Keith Gendreau, Zaven Arzoumanian, Nick Spartana (Code 662), and Steve Kenyon (Code 543)

Nonlinear Optimization Phase-retrieval Algorithm for Undersampled Data Utilizing Frequency-Domain Aliasing Technique by Matthew Bolcar (Code 551)

XTCE GOVSAT Tool Suite 1.0 by James Rice (Code 606.3)

Continuation Methods and Non-linear, Non-Gaussian Estimation for Flight Dynamics by Randy Paffenroth and Philip Du Toit (Code 595)

Land Information System (LIS) Software, Version 6.1 by Christa Peters-Lidard, Sujay Kumar, Yudong Tian (Code 614.3), David Mocko (Code 613.2), James Geiger (Code 587), and Jonathan Case (Code 614.2)

Blocking Filters With Enhanced Throughput for X-ray Microcalorimitry by Mark Hagen, Jacob Betcher, and David Grove (Code 662)

Advanced Navigation Strategies for Asteroid Sample Return Missions by Kenneth Getzandanner, Bobby Williams, Jeremy Baumann, Russell Carpenter, and Anne Long (Code 595)

Multi-Purpose Radio Signal Generation for Space Applications by Ken Gold, and Stephen Metcalfe (Code 596)

Photon Counting Electronics and Architecture that Supports Real-time Statistical Signal Processing and Time-to-Digital Conversion, Storage, and Communications with Aerospace Borne LIDAR Computing Applications by Roman Machan, Edward Leventhal, Anne Gaumond, Robert Jones (Code 568), Joseph-Paul Swinski (Code 582), Brian Clemons (Code 564), Jan McGarry (Code 694), and Philip Luers (Code 565)

Modeling and Design of Metal Mesh Resonant Filter Design for Far-Infrared Application by Wei-Chung Huang (Code 567)

Comparison of Sigma-Point and Extended Kalman Filters on a Realistic Orbit Determination Scenario by John Gaebler, Sun Hur-Diaz, Russell Carpenter, and Anne Long (Code 595)

Integrated Laser Characterization, Data Acquisition, Command and Control Test System by Paul Stysley, Barry Coyle (Code 554), and Eric Lyness (Code 699)

Application Of A Physics-Based Stabilization Criterion To Flight System Thermal Testing by Matthew Garrison (Code 545)

Deepak Condenser Model (DECOM) by Deepak Patel (Code 545)

Tunable Frequency-Stabilized Laser via Offset Sideband by James Thorpe, Jeffrey Livas, and Kenji Numata (Code 663)

Apparatus and Method for a Light Direction Sensor Douglas Leviton (Code 551)

Patents Issued: 8

Systems, Methods, and Apparatus of a Low Conductance Silicon Micro-Leak for Mass Spectrometer Inlet by Dan Harpold, Hasso Niemann (Code 699), Bernard Lynch, and Brian Jamieson (Code 553)

Template for Deposition of Micron and Sub-Micron Pointed Structures By Diane Pugel (Code 553)

Swarm Autonomic Agents with Self-Destruct Capability by Michael Hinchey and Roy Sterritt (Code 585)

A Two-Axis Direct Fluid Shear Stress Sensor by Sateesh Bajikar (Code 553), Edward Adcock, and Michael Scott (Code D304)

High Field Superconducting Magnets by Peter Shirron and Thomas Hait (Code 552)

Spring Joint with Overstrain Sensor by Bryan Gaither (Code 602) and Peter Phelps (Code 695)

Patent Applications: 4

Photonic Choke-Joints for Dual-Polarization Waveguides by Edward Wollack, David Chuss (Code 665), and Kongpop U-yen (Code 555)

Detector for Dual Band Ultraviolet Detection by Diane Pugel, Feng Yan, Bing Guan, Carl Stahle, Laddawan Miko, David Franz, Shahid Aslam (Code 553)

A Device and Method for Gathering Ensemble Data Sets Paul Racette (Code 555)

System and Method for Improved Computational Processing Efficiency in the HSEG Algorithm by James Tilton (Code 606.3)

Provisional Patents Issued: 1

Depolarizion using Time Delay Integration by Eugene Waluschka, Mark Wilson (Code 551)

ICB Awards April- June 2011

Patent Application Awards: 16

Widely Tunable Optical Parametric Generator Having Narrow Bandwidth by Steven Li (Code 554)

Electrospray Ionization for Chemical Analysis of Organic Molecules for Mass Spectrometry by Yun Zheng, David Franz (Code 553) and Stephanie Getty (Code 541)

Low Power, Automated Weight Logger by John Cavanaugh (Code 554) and Wayne Esaias (Code 614.5)

Wind and Temperature Spectrometer With Crossed Small-Deflection Energy Analyzer by Federico Herrero and Theodore Finne (Code 673)

Space Link Extension Return Channel Frames (SLE-RCF) Service (User side) Software Library by Timothy Ray (Code 583)

Ion Source with Corner Cathode by Patrick Roman (Code 553) and Federico Herrero (Code 673)

Imaging Device and Circuit for Same by Michael Krainak (Code 554)

Aerodynamically Stabilized Instrument Platform by Ted Miles (Code 569) and Geoffrey Bland (Code 580)

Low-Noise Large-Area Quad Photoreceivers Based on Low-Capacitance Quad Photodiodes by Abhay Joshi (Code 600)

System and Method for Progressive Band Selection for Hyperspectral Images by Kevin Fisher (Code 581)

Novel Superconducting Transition Edge Sensor Design by John Sadleir (Code 553)

Phase Retrieval System for Assessing Diamond-Turning and Other Optical Surface Artifacts by Matthew Bolcar and Alex Maldonado (Code 551)

Expandable and Reconfigurable Instrument Node Arrays by Lawrence Hilliard and Manohar Deshpande (Code 555)

Flash Drive Memory Apparatus And Method by Michael Hinchey (Code 585)

LIDAR Luminance Quantizer by Gerard Quilligan, Jeremy Dumonthier, and George Suarez (Code 564)

System and Method for Phase Retrieval for Radio Telescope and Antenna Control by Bruce Dean (Code 551)

Tech Brief Awards: 26

Monolithic Large Format Infrared Bolometer Arrays With Integrated Optically Reflective Backshorts by John Abrahams (Code 553)

Secure Peer-to-Peer Networks for Scientific Information Sharing by Homa Karimabadi (Code 600)

ICB Awards April- June 2011

Innovative Thermal Control Method for High Current Wire Bundles by Injecting Thermally Conductive Filler Inside Bundle by Gregory Greer (Code 545)

Reflective Occultation Mask for Evaluation of Advanced Occulter Designs for Planet Finding by Patrick Roman (Code 553), John Hagopian, 551 Shahram Shiri, Rick Lyon (Code 667)

Miniature, Variable Speed Control Moment Gyroscope by Paul Sorensen, Robert Kline-Schoder, and Steven Bilski (Code 551)

A Two-Axis Direct Fluid Shear Stress Sensor Suited for Aerodynamic Applications by Michael Scott, Edward Adcock, and Sateesh Bajikar (Code 553)

Link Analysis in the Mission Planning Lab (MPL) by Divyang Mago (Code 589) and Felipe Arroyo (Code 569)

A Near-Infrared Photon-Counting Camera For High Sensitivity Astronomical Observations by Michael Jurkovic (Code 600)

A GIS Software Toolkit for Monitoring Areal Snow Cover and Producing Daily Hydrologic Forecasts using NASA Satellite Imagery by Brandon Moore, Brian Harshburger, and Troy Blandford (Code 600)

Carbon Nanotubes on Titanium Substrates for Stray Light Suppression by Stephanie Getty (Code 541), John Hagopian, and Manuel Quijada (Code 551)

A Small, High Reliability Microprocessor for ASIC and FPGA Implementation by Richard Katz and Igor Kleyner (Code 564)

Development of a Silicon Wafer Scale Substrate for Mircroshutters and Detector Arrays by Murzy Jhabvala (Code 550), Christine Jhabvala, and Audrey Ewin (Code 553)

Variable Sampling Mapping: A Novel Supplement to Iterative-Transform Phase Retrieval Algorithms for Undersampled Images, Broadband Illumination, and Noisy Detection Environments by Bruce Dean (Code 551)

Method for Selective Clean of Mold Release from Composite Honeycomb Surfaces by Diane Pugel (Code 553)

Wavefront Sensing Analysis of Grazing Incidence Optical Systems by Scott Rohrbach and Timo Saha (Code 551)

Multicolor Detectors for Ultrasensitive Long-Wave Imaging Cameras by Ari Brown, James Chervenak (Code 553), Edward Wollack and Dominic Benford (Code 665)

Low-Cost, Rugged, High-Vacuum System by Robert Kline-Schoder and Paul Sorensen (Code 551)

Method for Utilizing Properties of the SINC(X) Function for Phase Retrieval on Nyquist-Under-Sampled Data by Michael Aronstein and Jeffrey Smith (Code 551)

Phase Retrieval System for Assessing Diamond-Turning and Other Optical Surface Artifacts by Matthew Bolcar and Alex Maldonado (Code 551)

Phase Retrieval for Radio Telescope and Antenna Control by Bruce Dean (Code 551)

Experiment in On-board Synthetic Aperture Radar Data Processing, with Radiation Hardening by Software, on Tilera Multicore Processor by Matthew Holland (Code 587)

Use of CCSDS Packets Over SpaceWire to Control Hardware Using Hardware Compatible with the Software Bus Utilized within the Core Flight Executive (CFE) by William Yuknis (Code 561)

The Invasive Species Forecasting System - Applications/QuickMap by Neal Most (Code 614.5)

MATTLAB Automated Test Tool (MATT) by Joel Henry (Code 551)

Fabrication of a Kilopixel Array of Superconducting Microcalorimeters with Microstripline Wiring by James Chervenak (Code 553)

Use of Spare Logic Resources: Dynamic Test Points by Richard Katz and Igor Kleyner (Code 564)

Software Release Awards: 25

Telemetry and Science Data Software System 1.0 by Liang Hong (Code 614.2) and Lakesha Bates (Code 567)

Distributed System Integration Lab Communication Adapter (DSILCA) by Thomas Jackson (Code 581), Jacob Hageman (Code 596), Sara Haugh, Carlos Ugarte, James Dailey, Gregory Menke, and Christine Kelly (Code 582)

Automated Mission Planning and Scheduling System (AMPS) (Version 2) by Terri Wood (Code 586), David Hempel and Dave Ripley (Code 583)

CFS CFDP by Robert McGraw and Barbara Medina (Code 582)

MATTLAB Automated Test Tool (MATT) by Joel Henry (Code 551)

XFDS: Automation Framework Designed for Flight Dynamics Products Generation by Wayne McCullough, Linda Jun, Robert Wiegand (Code 583), Timothy Esposito (Code 444), John Watson (Code 583) and Carla Matusow (Code 553)

Integrated Test and Operations System (ITOS) Release 8 by Brian Feldman, Gregory Greer, Barbara Milner, Matthew Lew (Code 583)

Orbit Determination Toolbox by Kate Gregory, Keith Speckman, Sun Hur-Diaz, Derek Surka, Dave Gaylor, Russell Carpenter, and Kevin Berry (Code 595)

The Invasive Species Forecasting System - Predictors/GSENM by John Schnase (Code 606), Neal Most, Peter Ma, and Roger Gill (Code 614.5)

Pandora Spectrometer Control and Analysis Software by Alexander Cede and Jay Herman (Code 613.3)

Estimated Spectrum Adaptive Postfilter (ESAP) And The Iterative Prepost Filtering (IPF) Algorithms by Irving Linares (Code 564)

Gold Standard Test Set (GTST) by Jacob Hageman (Code 596), Thomas Jackson (Code 581), and James Dailey (Code 582)

Integrated Lunar Information Architecture for Decision Support Version 3.0 (ILIADS 3.0) by Karin Blank, Stephen Talabec, Carl Hostetter, Matthew Brandt and Troy Ames (Code 587)

The Invasive Species Forecasting System - Command Interpreter (iShell) by Neal Most (Code 614.5)

Space Weather iPhone App by Richard Mullinix, Marlo Maddox, David Berrios (Code 587), and Michael Hesse (Code 674)

Experiment in On-board Synthetic Aperture Radar Data Processing, with Radiation Hardening by Software, on Tilera Multicore Processor by Matthew Holland (Code 587)

Visual System for Browsing, Analysis and Retrieval of Data (ViSBARD) by Carl Cornwell (Code 612.2) Dana Roberts (Code 672), and Ryan Boller (Code 587)

SAIC Algorithm Testbed For Asteroid Detection (SALTAD) verison 1.5 by Peter Gural (Code 600)

The Invasive Species Forecasting System - Applications/QuickMap by John Schnase (Code 606), Peter Ma, Neal Most, and Roger Gill (Code 614.5)

Telemetry and Science Data Software System 2.02 by Liang Hong (Code 614.2) and Lakesha Bates (Code 567)

Space Operations Learning Center (SOLC) by Daniel Binebrink (Code 540), Ben Lui, Heng Kuok (Code 585), and Barbara Milner (Code 583)

Generic Reusable Aerospace Software Platform (GRASP) by Rodney Davis (Code 589)

The Invasive Species Forecasting System - Programs/SWLR by Neal Most, Roger Gill (Code 614.5)

The Invasive Species Forecasting System - Core Services (iCore) by Neal Most, Roger Gill, and Peter Ma (Code 614.5)

The Invasive Species Forecasting System - Architecture and Operation by Neal Most (Code 614.5) and John Schnase (Code 606)

From left to right: LaMont Ruley, Barbie Medina, Dan Smith, and Bob Wiegand

Ryan Detter

Photos by Bill Hrybyk

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