Efficient Reuse and Integration at NASA - Its Not Just the Technology

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Let's just all go to Service Oriented Architectures, have everyone follow our group's data formats, and make sure all new systems share my system's requirements. I'll build the best system with the latest technologies and use it for everything we do. Imagine how high our scores will be for reuse percentage and for integration time when the metrics team completes their assessment.

It doesn't work that way!

NASA's Goddard Space Flight Center flies over 30 advanced scientific satellites. At NASA we are extremely advanced, very risk averse, and always cost constrained. We are asked each year to do more with less, use proven products and tools, and to advance our technologies while not taking any risks. For mission control centers, a key mistake could jeopardize a billion dollar satellite. An important key to balancing these seemingly contradictory demands is our innovative approach to software reuse and information standardization. Beyond the technology, however, are new business practices and relationships with industry which are enabled by our new architecture approach and our view of the role of government in promoting changes in an industry known for one-off solutions.

Generally, a mission control center is developed for each satellite mission and several new missions are launched each year. Missions last from a couple months to several decades. With each mission having its own budget, schedule, development team, and facility space, there has been little motivation for collaboration across missions. As a result, NASA has many different systems with widely varying levels of reuse, or even similarity.. Past efforts to increase software reuse have focused on a few common tools modified as needed for each mission. Metrics like "percentage of lines changed" and "new/modified/reused" were developed to measure efficiency. Over time, we learned to isolate our mission-specific changes in the code and then to make configurable software components. These approaches helped, but we still had too many different approaches to similar requirements, new tools could not be applied easily to multiple projects, and we had difficulty applying older software to new operations concepts.

Our new satellite control system architecture effort was started in 2001 and has been operational since 2005. It is now being adopted for other applications at NASA and elsewhere. It is based on the concepts of publish/subscribe message-oriented middleware with plug-and-play components. We worked with companies across the United States that sell satellite control software and were able to develop common message standards for key interfaces. We asked that the product vendors do not modify their product software, we prefer that they develop small adapters to adjust their interfaces to ours. Our “storefront lab” has integrated about 75 products using these standard messages and new missions can select from these offerings to best meet the functional needs of their program.

Although the integration time to get tools that have never talked to each other working on the same system can be cut to almost zero, we have made another problem worse. Once the software is running, it has to be configured. By mixing the internal and the vendor products on the same system, we have cases where one system needs the same list of thousands of satellite parameters in 5 unique formats. There are no widely adopted standards for the data representation, and the players involved include both the satellite control teams and the satellite manufacturers.

The presentation will describe NASA’s efforts in moving to a much more efficient development, integration, and configuration process for mission critical software systems. It has to do with technology and with interactions with the vendor community. It has to do with how we work with our own stovepipe-based technical organizations. It has to do with what we consider the inherently governmental role in establishing the business case for industry players to move in the directions we see for the future. The technology is the easy part.

Many of the lessons learned and new concepts are applicable well beyond our own applications area.

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