National Aeronautics and Space Administration

Marshall Space Flight Center

Space and Missile Defense Symposium

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marshall

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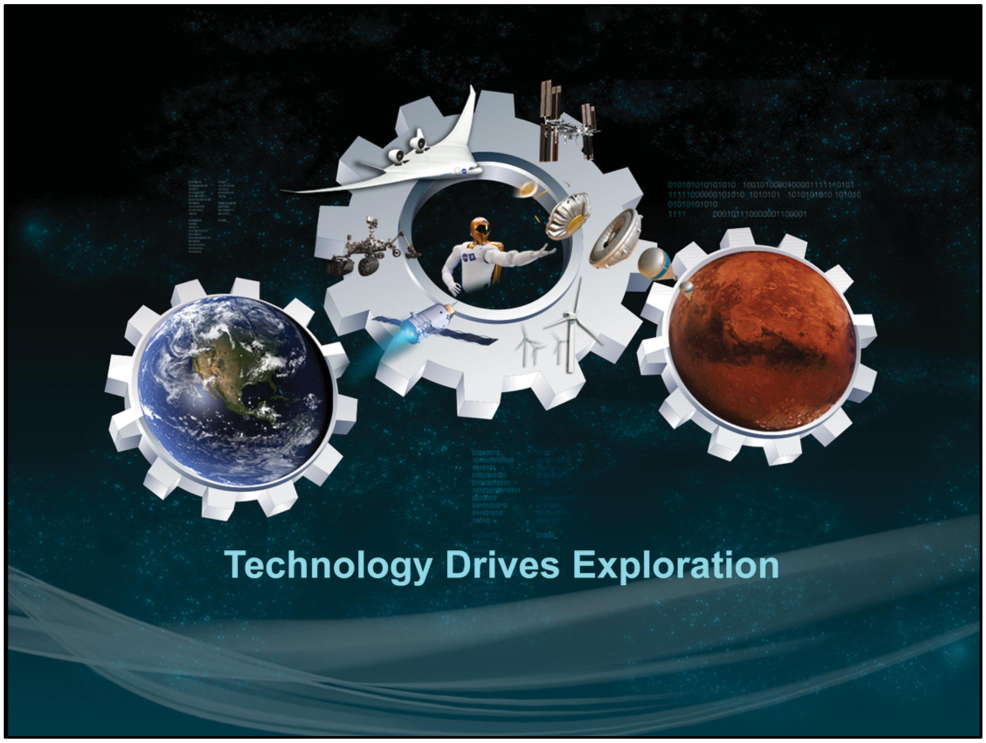
Thank you for having me here today.

I am really glad to be included in this discussion because we don't always pair NASA with many of the groups here today, we all share a similar mission. The intersection of our needed technologies is significant. Different purposes but with similar technologies.

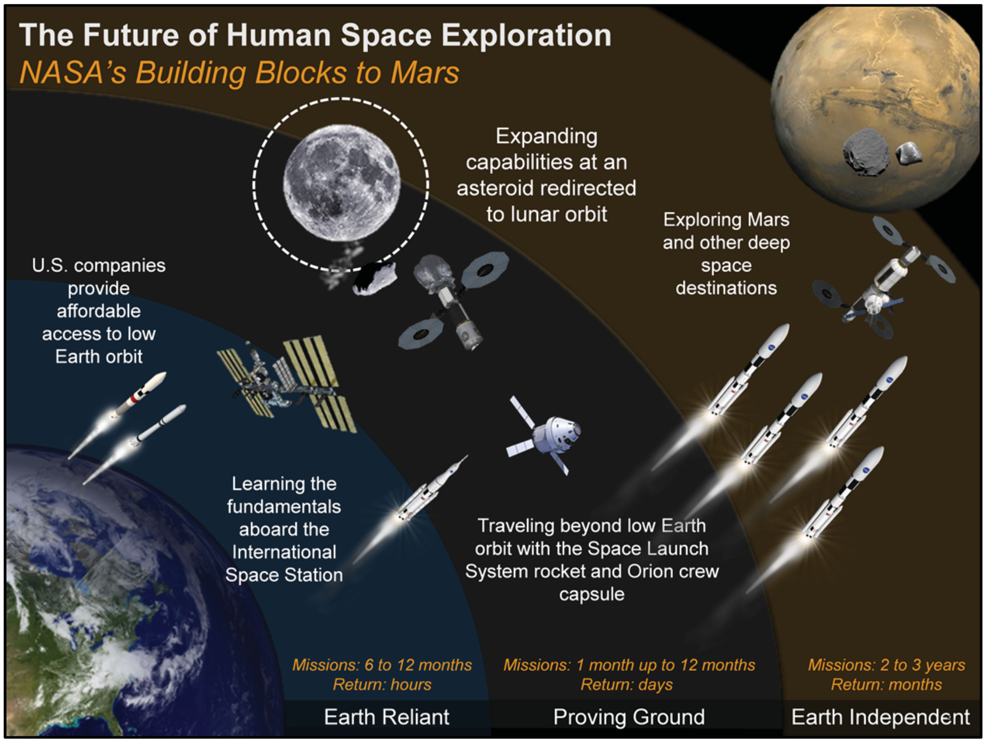
Whether you are in defense of the homeland or civil space, all our work is a part of our national space program.

Different players, same team.



At NASA, our technology concentration is technology that drives exploration-exploration with humans and robotics. Exploration driven by our need to explore and exploration to execute science.

As I have said, Some of our technologies are unique to NASA but many are either synergistic or even critical to both civil and defense space.   Often times there are examples where one of us or the other has created a paradigm shift in capability that has benefitted the other.



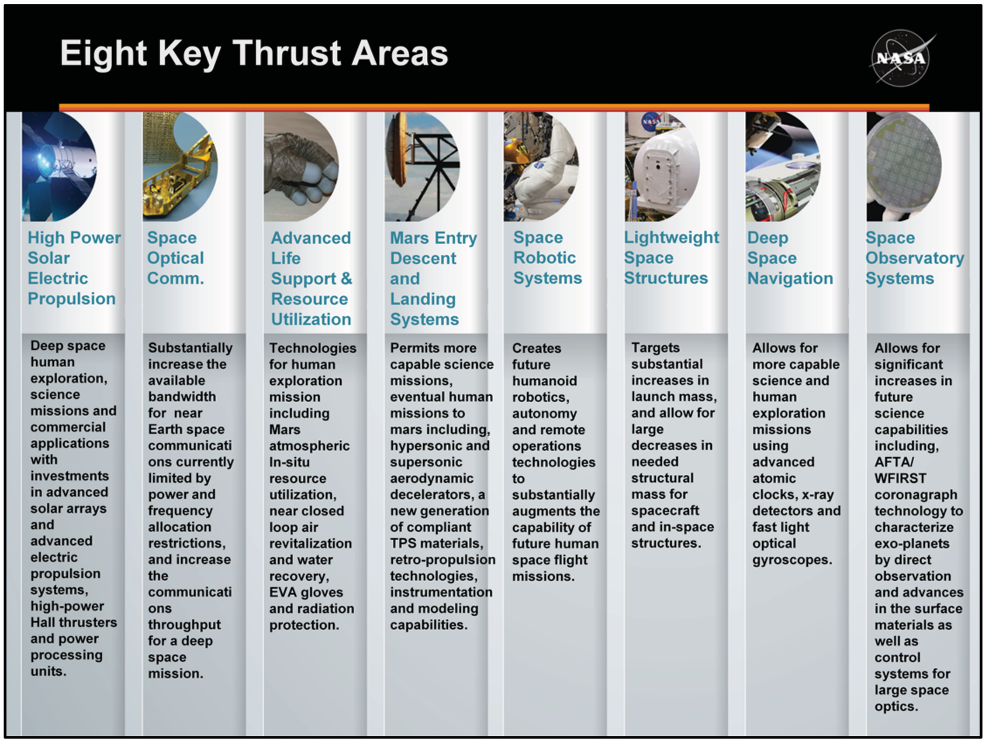
Here is a snapshot of the Agency's human exploration goals.

We've made a lot of advancements in technology applications in low Earth orbit. And we will continue to make those types of advancements- expanding from low Earth orbit and establishing deep space exploration.

The future is deep space. Bolden has issued a challenge for us to send humans to an asteroid by 2025 and to Mars in the 2030.

We are going to have to rely on advanced technology to get us there.

STEP THROUGH THE SLIDE, LEFT TO RIGHT, LEO to Mars



Our technology needs and challenges for reaching greater destinations are pretty clear. This is from NASA's Associate Adminstrator for Space Technology. This comes from a more detailed roadmap, but with current resources these are the current focus areas of Space Technology.

To get there and back we are going to need a heavy lift rocket. A rocket like SLS. We will also need rendezvous and docking, and a life support system that is the cornerstone. We need to be able to withstand the deep space environment- hot, cold and radiation, especially radiation. Reduced trip times and shielding are critical. Because of the distance and duration, you have to consider maintenance, spares, resupply, etc. [Analogy: a trip in your boat from DC to Mt. Vernon is very different than a round-the-world trip with only one stop… there is paradigm shift in requirements.]

To live in deep space you have to consider a host of things: radiation, waste management, and life support systems.

To be productive in deep space we have to be equipped to do something when we get there.

And of course landing on Mars is much more complex landing once we get there. Landing a Rover on Mars is complex, landing humans an order of magnitude more complex.

Quick left to right.... Prop for Cargo capability, rapid and high throughput communications, High recapture and recycle for life support systems, Landing in the inhospitable and unpredictable Martian atmosphere, robotics as work multipliers and assembly in space, lightweight (the “gear” ratios to Mars) structures, deep space navigation, and science observatory systems (doing groundbreaking science, like large space optics)

This is a snapshot of the Agency's technology events and milestones. Marshall has leading roles in the items you see in orange. Anything beyond 2015 is of course somewhat contingent on funding and further approval, but this is the framework for the future.

At Marshall, we have a diverse technology portfolio, and I couldn't mention or highlight all of our work in 15 minutes so I have tried to hit the high notes.

Major technology priorities includes nuclear propulsion, cryogenics storage, advanced manufacturing (composites and metallic) and smallsats, especially smallsat propulsion systems - all of which have the capability to enable greater advancements for exploration and science missions. Marshall also places great value on technologies that allow for low cost access to space and enable better x-ray optics, etc.

Marshall is engaged in a three year technology demonstration project to perform realistic, non-nuclear testing of various materials.

We have been able to develop and fabricate nuclear fuel elements, and perform testing within the same temperatures and pressures as a high performance engine designed for the future of rocket propulsion.

Building in space capability that more than doubles the best that chemical propulsion ISP can do is important to deep space exploration.   Reducing trip time and increasing mass capability (more shielding, more supplies, etc,) makes it more likely.

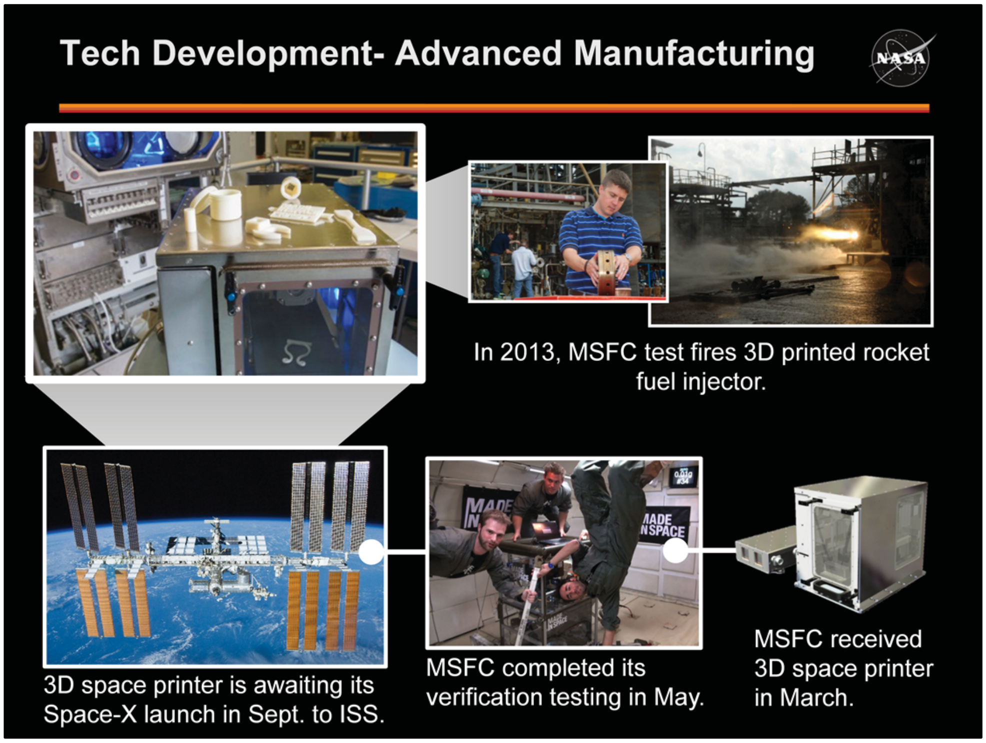
The Agency and Marshall have been steadily working on new and advanced space-based cryogenic applications.

With cyrogenics, we have to be able to do a couple things. At Marshall we have one initiative to reduce cost and weight in regard to launch vehicles and other spacecraft system designs.

In 2013, we successfully tested a 2.4m composite cryotank. We have since moved on to testing the 5.5m composite cryotank.

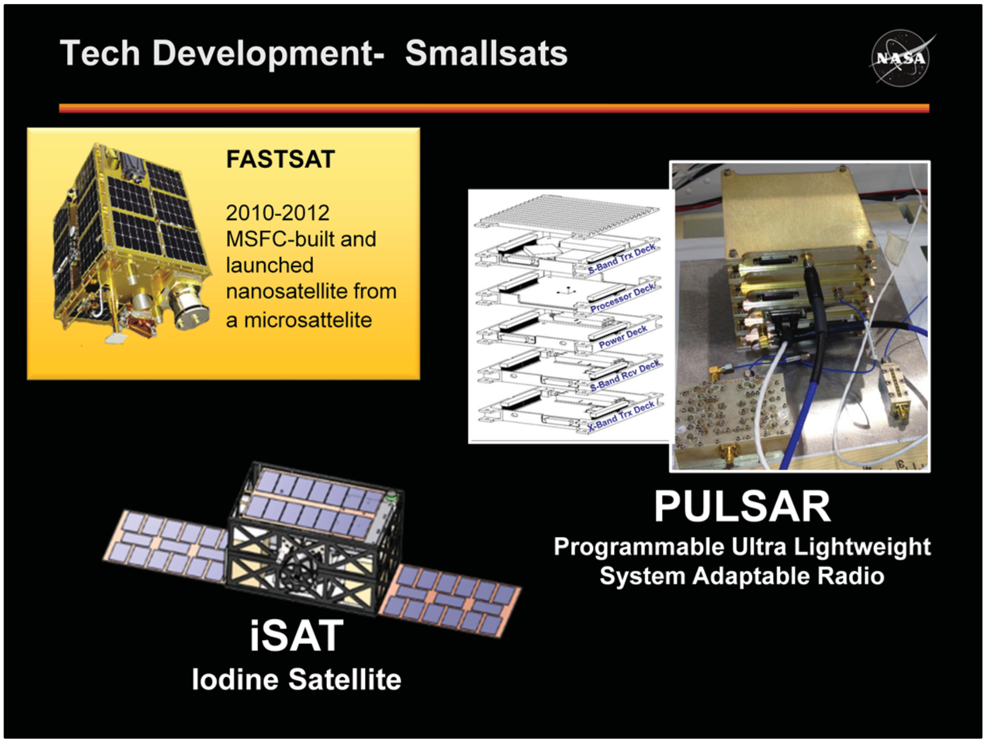
With respect to storage and transfer

Marshall tested an engineering development unit, as a technology demonstration, to show that it is possible to store, transfer, and measure cryogenic propellants in orbit for longer durations valuable for deeper human space exploration. We came up with a number of new techniques to measure and help control the cryogenics in a space like environment. This is important since Liquid cyrogenics boil off in space. You can imagine if your car today was losing fuel while in this presentation. Another tough but solvable hurdle to deep space exploration.



Marshall had a previous successful test of the largest single 3D printed item ever used in rocket fire test. We will continue progress towards significantly reducing manufacturing costs of flight hardware.

Marshall has worked with Made in Space, Inc. to launch the first 3D printer to space this year. This effort began as a SBIR with MIS and was one of the projects highlighted by the President at the White House Maker Faire event in June. This 3-d printer will be responsible for building space station's spare parts, as well as tools and upgrade materials if they are damaged or improved- giving astronauts greater flexibility and saves the Agency time and mass, all of which ultimately mean cost savings. A proving ground on building a "machine shop" if you will that can go beyond stunts and actually replace parts on the ISS.

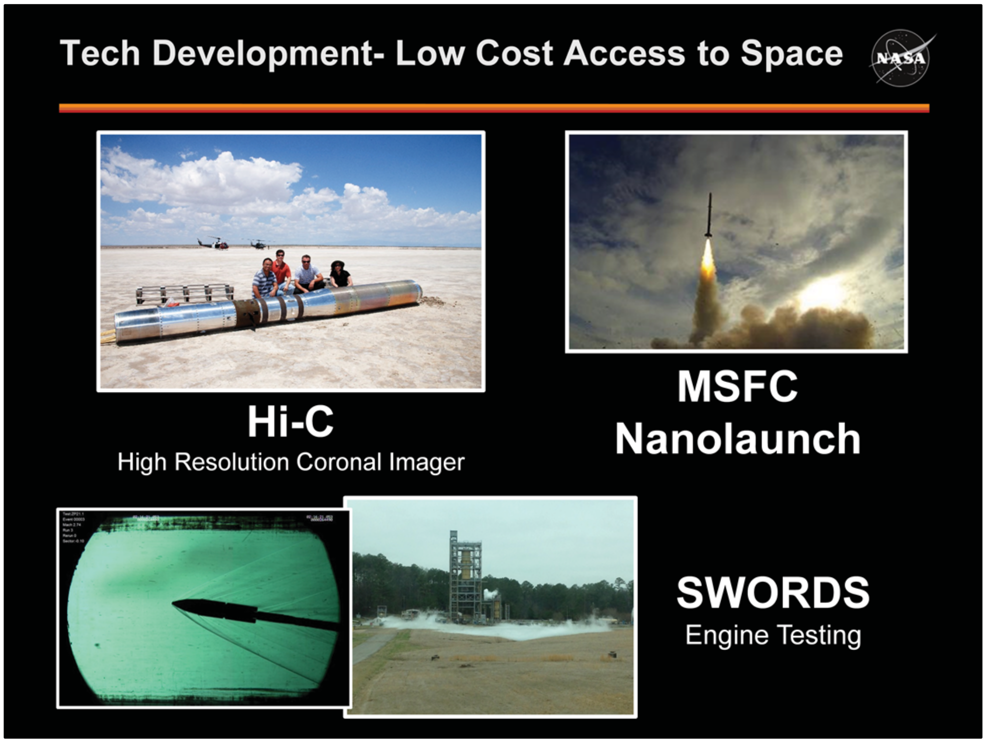


We want to be able to do the real missions. To do that, we need better advancements in propulsion, power and communications.

We are expanding on our previous success with FASTSAT (which Dynetics was a key player in), and working on a suite of concepts and technology demonstrations to advance small sat technologies.

In particular I will mention iSAT. iSAT is a technology demonstration mission to demonstrate the use of a iodine for greater thrust-to-mass ratios in a cube sat architecture. Right now it is the concept review stage, but we are building parts as we speak.   Small sats are great, but without real propulsion they are not very capable.

Marshall is also working on a technology known as PULSAR which will offer a radiation tolerant SDR transponder. We have tested PULSAR already on a small balloon (with the next plan, SLS) and the outcomes are really impressive- this transponder will be more capable and more importantly have lower cost.



I would be amiss if I didn't mention a few of the ways we are gaining low cost access to space.

Marshall is engaged in developing nanolaunch vehicles, which you will hear about in more detail in the NASA panel later today.

Our sounding rocket program has launched Marshall-developed, highly sophisticated optics into LEO that have celebrated unique successes such as capturing the highest-ever resolution images of the Sun. We really want to be able to go orbital at the same price as sub-orbital.

Marshall also just finished testing the largest liquid methane fuel and liquid oxygen engine for SMDC's nano-launch vehicle known as SWORDS.

Team Redstone

Together, We Make Bold Things Happen

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