

DARPA Space Overview

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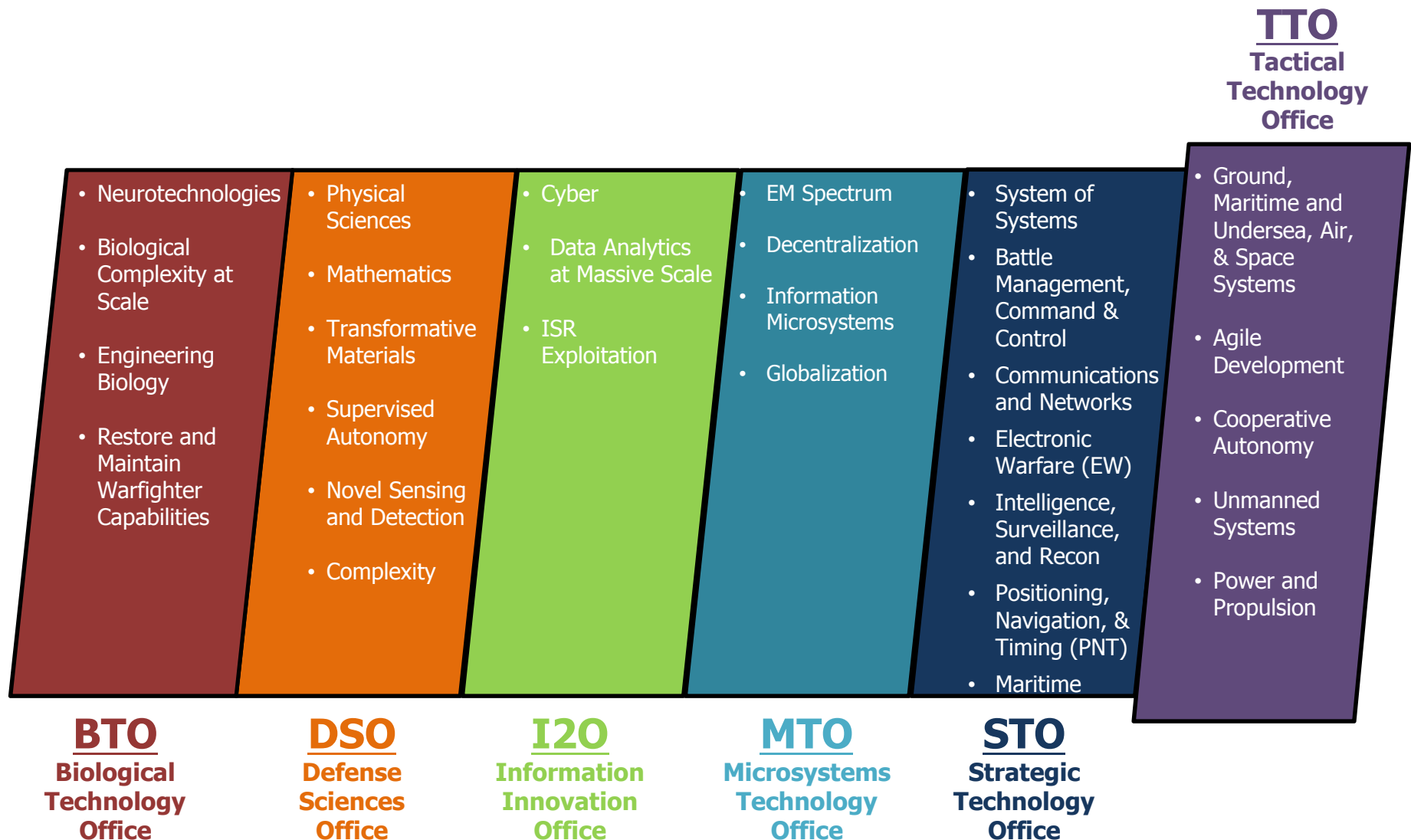
Briefing prepared for the Commercial Space Transportation Advisory
Committee (COMSTAC)

September 17, 2014





DARPA technical offices



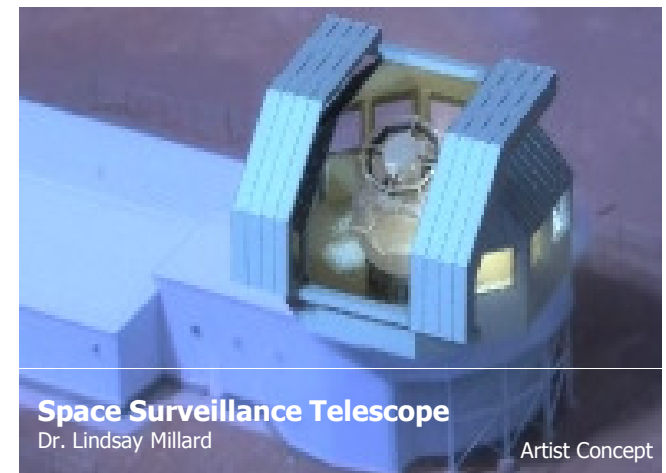
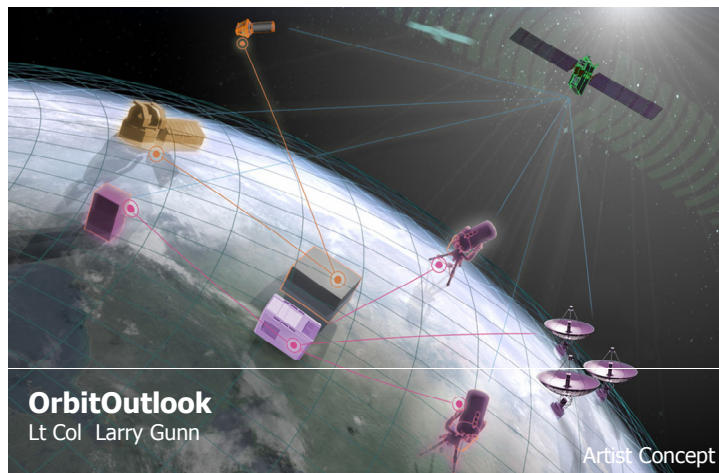
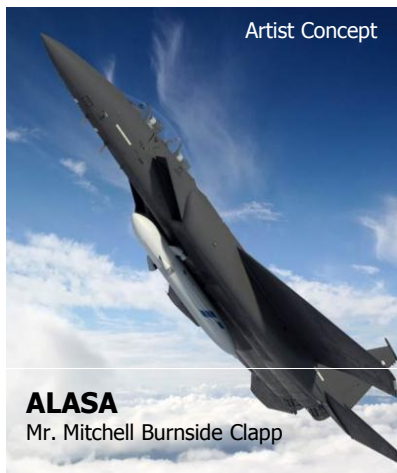
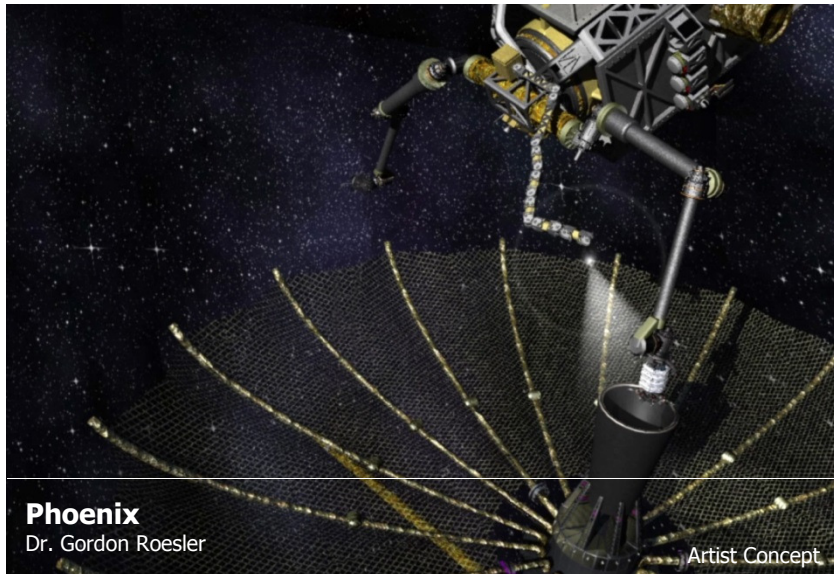


DARPA Vision

- Flexible, affordable access to include augmentation and reconstitution
 - Resilience for a congested, contested environment
 - Affordable, routine, and reliable access to space
 - Aircraft-like space access to lower cost and increase capabilities
 - Unwarned capabilities (novel payloads)
 - Rapid small satellite constellation capability
 - GEO space robotics to repair and assemble very large satellites that could not be launched
- Real-time space domain awareness
 - Real time detection, tracking, and attribution versus catalog maintenance and days to weeks of forensics
 - Real time indication and warning with displays and decision tools



Space systems



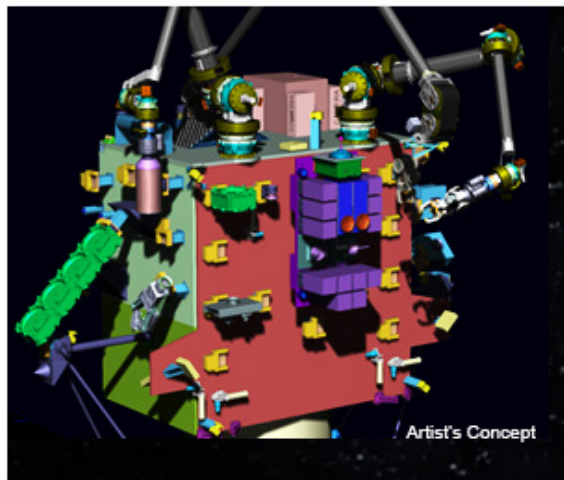


Phoenix



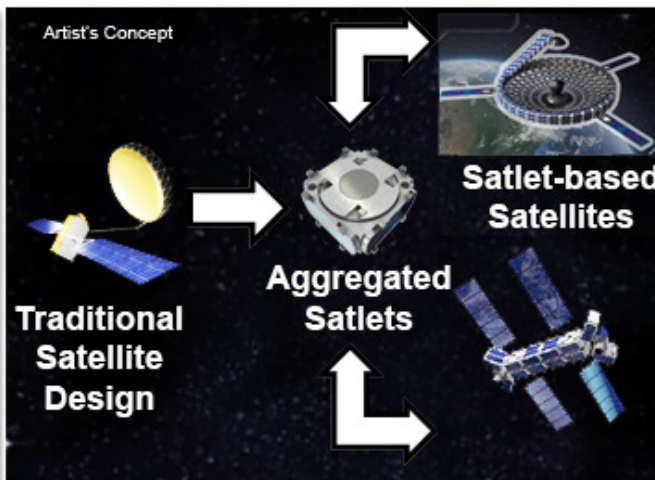
Phoenix

Developing technologies for more flexible, cost-effective satellite operations in GEO



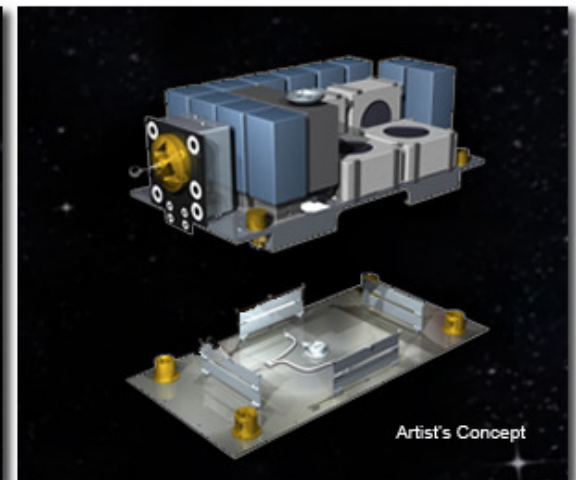
Advanced GEO Space Robotics

A variety of robotics technologies to address key on-orbit mission needs (including assembly, repair and asset life extension) in the harsh environment of geosynchronous Earth orbit (GEO). Development activities include the maturation of robotic arms and multiple generic and mission-specific tools for a future robotic assembly platform, the Servicer/Tender



Spacecraft Morphology (Satlets)

A new low-cost, modular satellite architecture that can scale almost indefinitely. Satlets are small modules that incorporate multiple essential satellite functions and share data, power and thermal management capabilities. They also physically aggregate in different combinations that would provide capabilities to accomplish diverse space missions

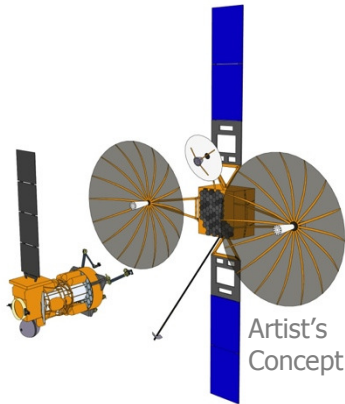


Transfer to Orbit (Payload Orbital Delivery (POD) System)

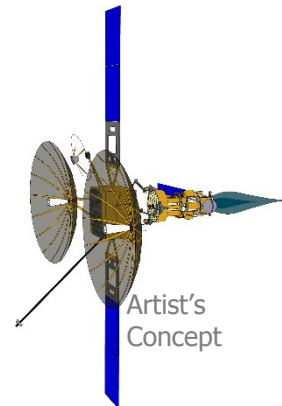
A standard mechanism designed to safely carry a wide variety of payloads, including satlets, to GEO aboard commercial communications satellites



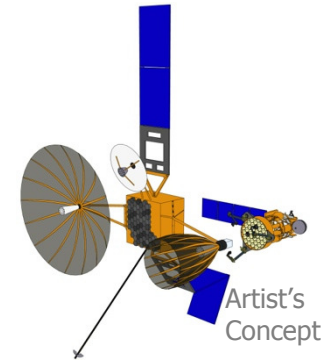
Future Goal: GEO Robotic Servicing



- Provide unparalleled **high-resolution images on request** of spacecraft experiencing anomalies
- Inspections would be enabled by a RMMV with a sensor suite and dexterous arms with cameras
 - Stand-off inspections (50m-1km)
 - Close inspections (5m-50m)
 - Docked inspections



- **Cooperatively move spacecraft in orbit**, recover spacecraft in off-nominal orbits and extend lifetimes through propellant conservation
 - N/S station keeping recovery
 - End-of-Life to GEO graveyard
 - Repositioning within the GEO belt



- **Assist spacecraft experiencing anomalies**, helping to ensure that missions can be completed at maximum performance
 - Free stuck appendages
 - Supplement attitude control
 - Perform docked inspections



Jointly engaging commercial and government stakeholders

DARPA seeks to jointly engage commercial and government stakeholders to co-invest in a future technology demonstration

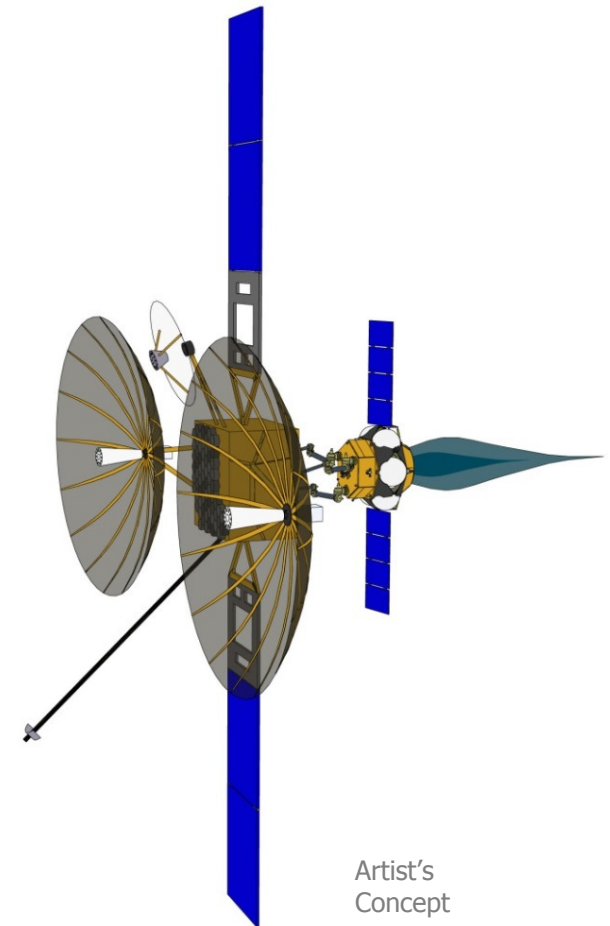
- Commercial partner would notionally provide GEO bus
- Robotic payload would notionally include government-furnished equipment (GFE) based on Phoenix research

Partnership structure

- Government will notionally lead a joint integration team
- 6-12 month government demonstration would include on-orbit checkout
- Commercial operator would assume all subsequent operations

Unique partnership approach would enable a *self-sustaining* capability with many benefits

- Reduced program cost for the government
- Long-term availability
- Resilience and cost stabilization to both government and commercial stakeholders



Goal: Share costs, enhance value, and improve space architecture resilience

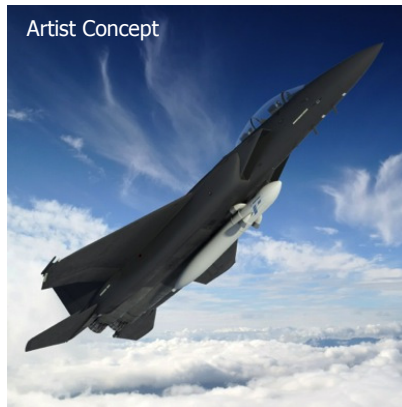


Airborne Launch Assist Space Access (ALASA)



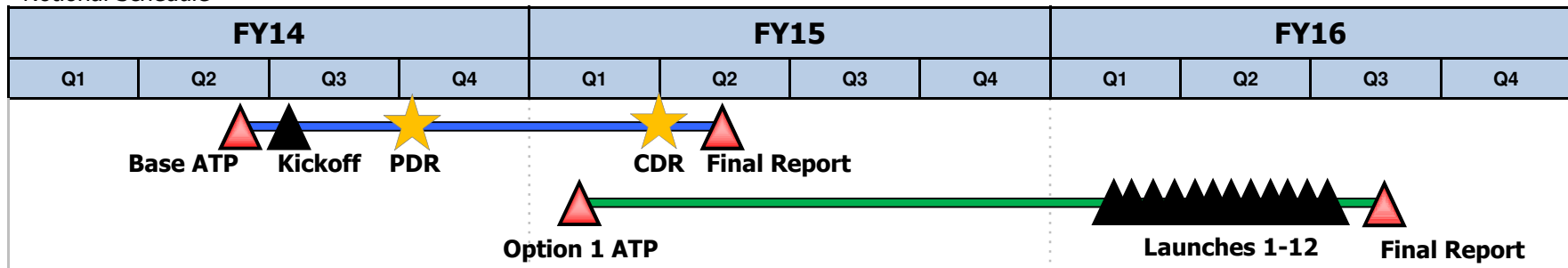
Airborne Launch Assist Space Access (ALASA)

Goal: Provide more affordable, routine, and reliable access to space



- Leverage performance, flexibility and re-usability of air launch
- Take advantage of streamlined design and manufacturing
- Reduce infrastructure costs by using runways vs. fixed sites, automating operations; avoiding unnecessary services
- Exercise the concept frequently enough to show learning curve effects
- 100 lbs to LEO for \$1M, including integration and range costs

Notional Schedule



Approved for public release; distribution unlimited

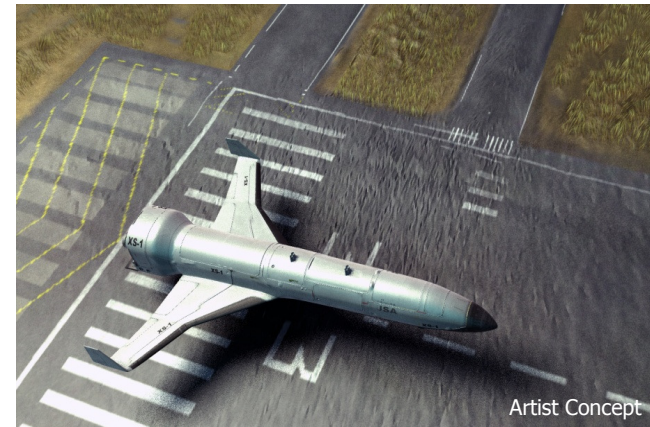


Experimental Spaceplane (XS-1)



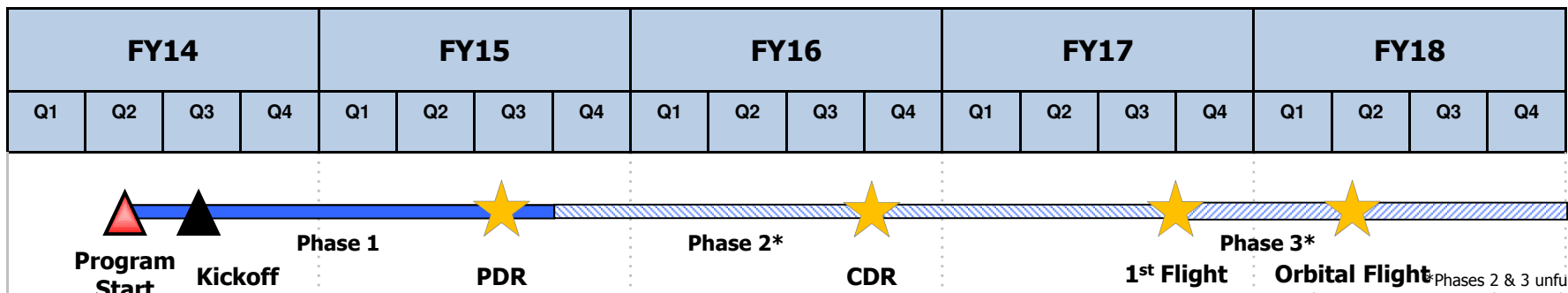
Experimental Spaceplane (XS-1)

Goal: Lower launch costs and increase space capabilities with aircraft-like space access



- Enable routine space access by designing a reusable, long life platform with system integration enabling “aircraft-like” operations using light weight/high energy airframe and high propellant mass fraction, protected from -300°F to +3,000°F
- The platform will be a reusable first-stage system, be able to fly 10 times in 10 day, to Mach 10+ at least once, delivering a demo payload to orbit

Notional Schedule



*Phases 2 & 3 unfunded;
Pending program success and POM16 budget

Approved for public release; distribution unlimited



Experimental Spaceplane (XS-1) Goals

- Expand the reusable air-launched concept with a hypersonic vehicle capable of launching 3,000- to 5,000-lb payloads for \$5M per launch
- Mature and integrate technologies supporting launch and hypersonic vehicles
- Take advantage of investments in commercial launch and space tourism
- Demonstrate mission assurance by flying 10 times in 10 days

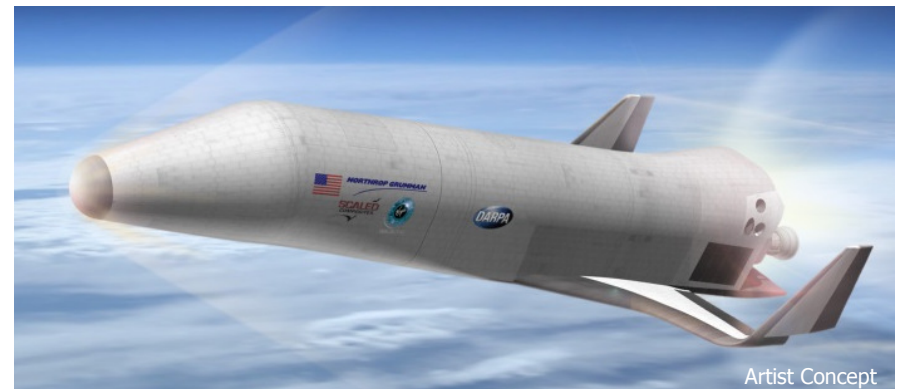
Phase I Awards



Masten Space Systems
working with XCOR



The Boeing Company working
with Blue Origin



Northrop Grumman working
with Virgin Galactic



Other Transactions Authority (OTA)



Other Transactions (OT)

- DARPA awards different types of funding to ensure that we can attract a wide variety of performers
- Typical awards are traditionally spelled out by the Federal Acquisition Regulations (FAR), but grants and cooperative agreements are also awarded, mostly to universities
- In addition to those agreements, OTs are awarded to attract commercial companies that had previously not worked with the federal government, expanding the options for advanced technology development



Other Transactions (OT)

Defense Business Board briefing on encouraging innovation in the marketplace, July 24, 2014:

- To attract commercial innovation, DoD must change its acquisition model
 - Business process innovation on the customer side is a necessary first step
 - DoD must adapt its behavior, policies, and procedures to the current market realities

Source: http://www.defenseinnovationmarketplace.mil/resources/DBB_Innovation-24July2014.pdf



Benefits of an OT

- Attract a wider variety of companies to do business with the government
- Allow contractors to use their own cost accountability principles, subject to generally acceptable accounting principles (GAAP) and commercial practices
- Structured like a commercial agreement, so businesses can process the agreement just like any other
- Cuts down on traditional contracting impediments including Intellectual Property, cost accounting, auditing, etc.
- Payments are made based on measurable milestone achievements

For more information contact:

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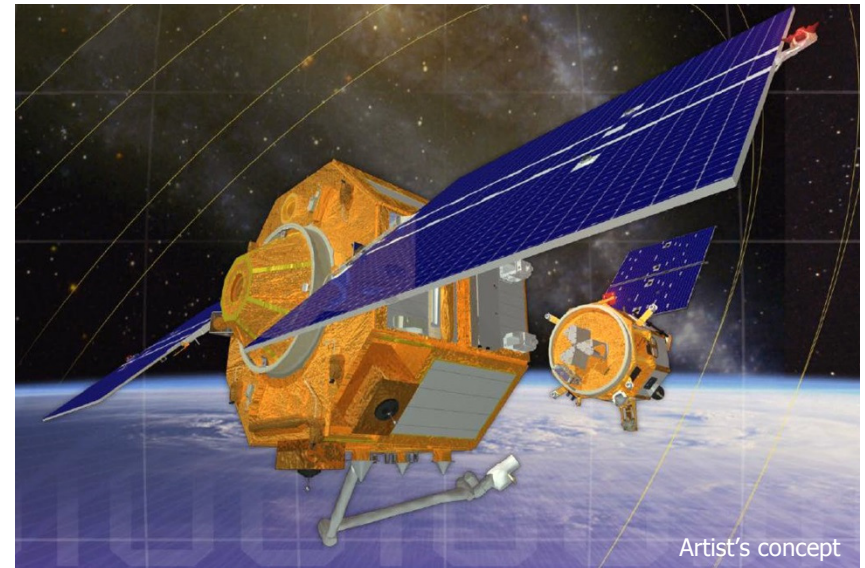
Notable programs developed under an OT

Global Hawk



High altitude, long endurance (HALE) unmanned air system (UAS) with intelligence, surveillance, and reconnaissance (ISR) capabilities

Orbital Express



Robotic, autonomous on-orbit refueling and reconfiguration of satellites to support a broad range of future U.S. national security and commercial space programs



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