DARPA TTO Air and Space Portfolio Update

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Briefing prepared for the National Research Council Aeronautics and Space Engineering Board (ASEB) Meeting

April 25, 2016

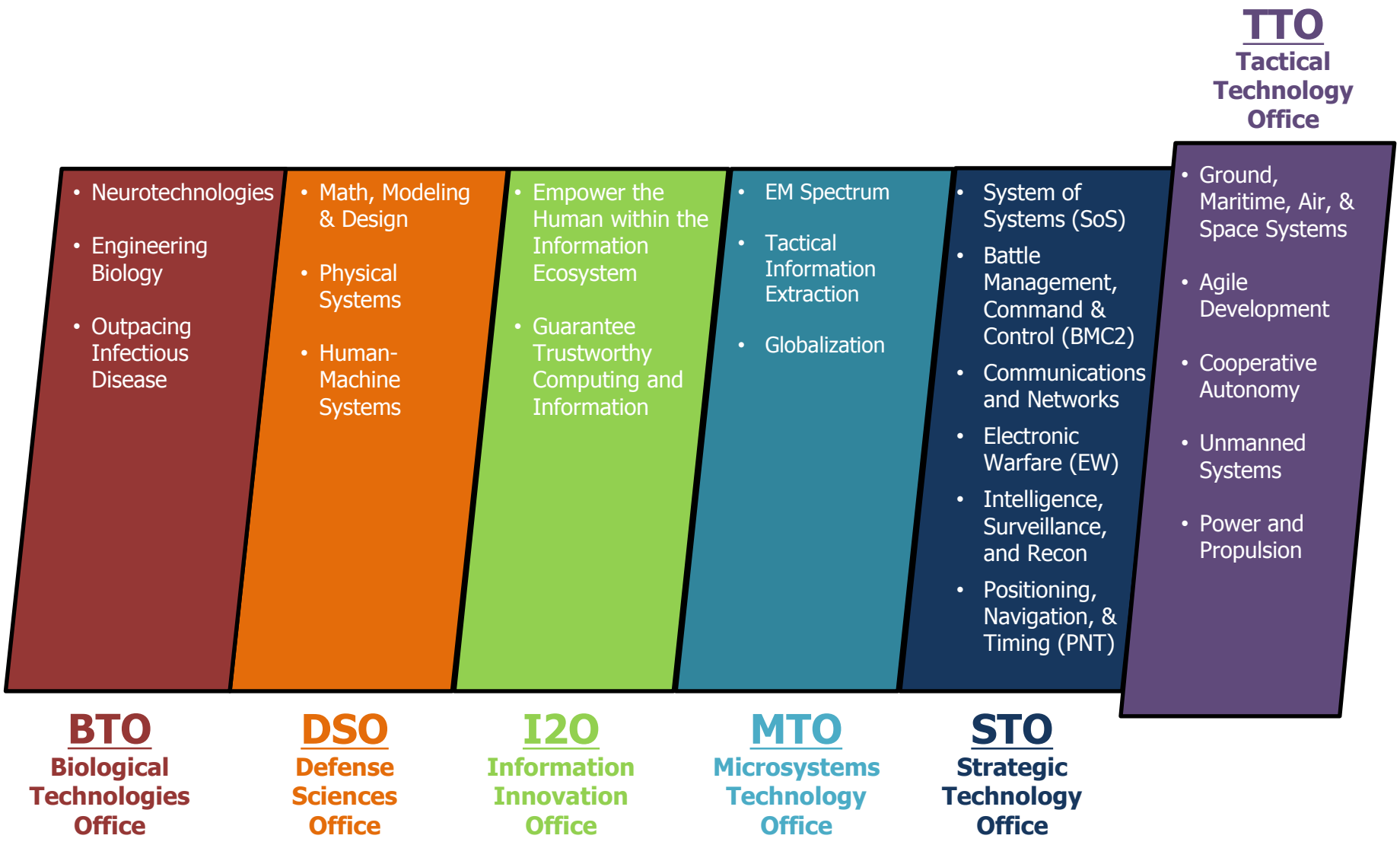
DARPA Mission

The Defense Advanced Research Projects Agency (DARPA) was established in 1958 to **prevent strategic surprise** from negatively affecting U.S. national security and **create strategic surprise** for U.S. adversaries by maintaining the technological superiority of the U.S. military.

To fulfill its mission, the Agency relies on **diverse performers** to apply multi-disciplinary approaches to both advance knowledge through basic research and **create innovative technologies** that address current practical problems through applied research.

As the DoD's **primary innovation engine**, DARPA undertakes projects that are finite in duration but that create **lasting revolutionary change**.

DARPA Technical Offices



TTO Hypersonic Portfolio

Hypersonic Air-breathing Weapon Concept (HAWC)

Goal: Transformational changes in responsive, long-range strike capabilities against time-critical or heavily defended targets

The HAWC program is program is a joint DARPA/Air Force effort that seeks to develop and demonstrate technologies that would enable transformational changes in responsive, long-range strike capabilities against time-critical or heavily defended targets

Tactical Boost Glide (TBG)

Goal: Enabling air-launched, tactical-range hypersonic boost glide systems

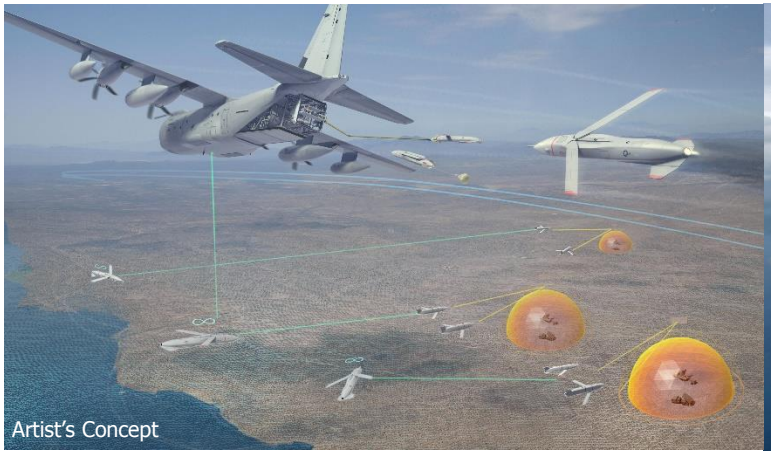
The TBG program is a joint DARPA/Air Force effort that seeks to develop and demonstrate technologies to enable air-launched, tactical-range hypersonic boost glide systems

Three primary objectives for both programs include Vehicle Feasibility, Effectiveness, and Affordability

Gremlins

Gremlins seeks to develop an air-launched, air-recoverable platform to enable a new class of distributed airborne capabilities (DAC)

Aims to move away from approach reliant on effectiveness/ survivability of individual, monolithic platforms



In distributed model, a volley of small vehicles are air-launched, execute distributed warfare missions and can be recovered

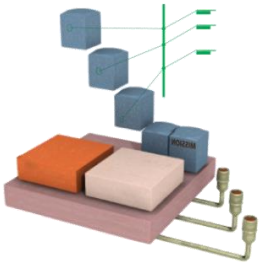
- Seeks to provide cost-effective contested/denied environment capability
  - Host-symbiont concept would overcome range and responsiveness limitations inherent in small platforms
  - Recovery capability would facilitate reuse of costly payloads and reduce cost per use
- Would be enabled by air-launched, air-recoverable platforms: gremlins
  - ~300 nm ingress/egress, ~1+ hr loiter
  - Would deploy in volleys and be recovered with existing host aircraft

Beginning Phase 1

Aircrew Labor In-cockpit Automation System (ALIAS)

ALIAS seeks to develop a drop-in automation kit to advance state-of-the-art automation in the Cockpit

Artist's Concepts



ALIAS conversion kit

Short non-recurring engineering effort; rapid per-tail "ALIAS" modification with low per-tail target cost

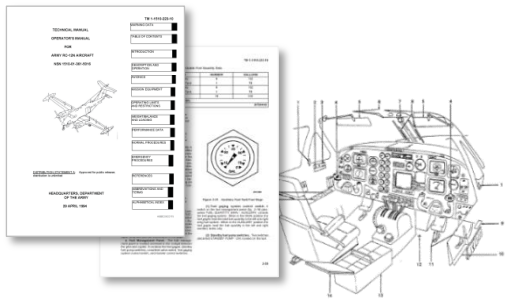
Apps

- ▶Basic mission navigation (ALIAS-provided)

Open developer interface:

- ▶Mission-specific (e.g. tactical logistics)
- ▶Payload-specific (e.g. ISR)
- ▶Enhanced capability (e.g. sense and avoid)

Variable (2/1) crew operation via simple tablet/voice interface common to on-board and off-board operation



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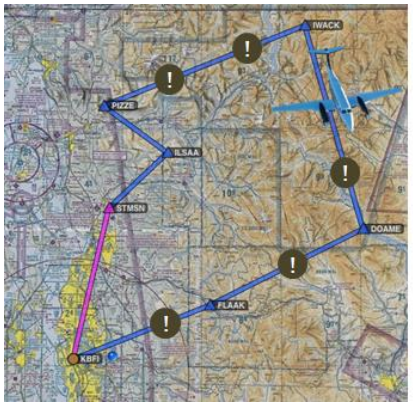
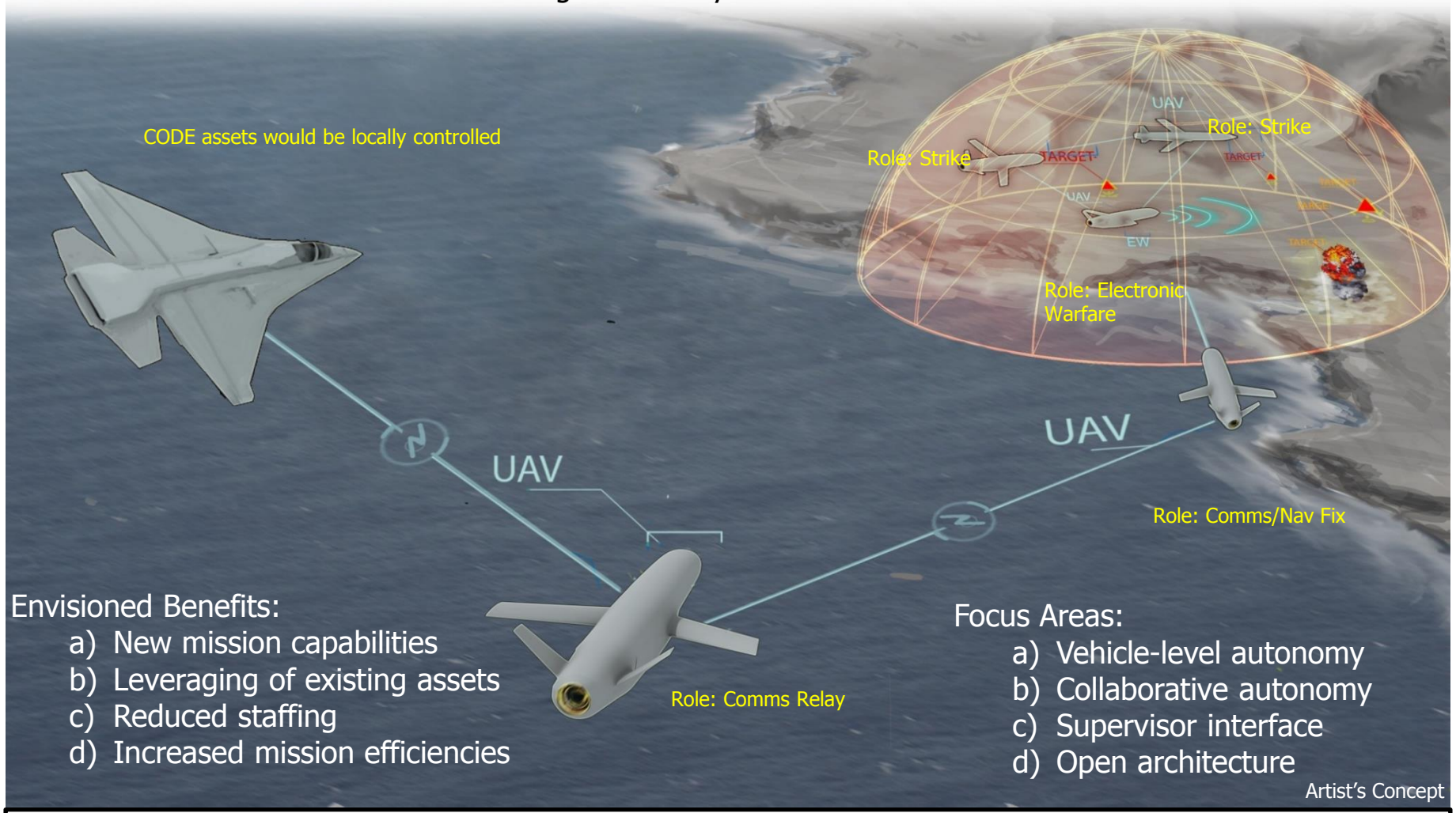


ALIAS plans to demonstrate a complete flight from takeoff to landing, including dealing with contingencies

Finishing Phase 1, starting Phase 2 later this year

Collaborative Operations in Denied Environment (CODE)

CODE seeks to develop and demonstrate the algorithms to expand the mission capabilities of legacy assets through autonomy and collaborative behaviors



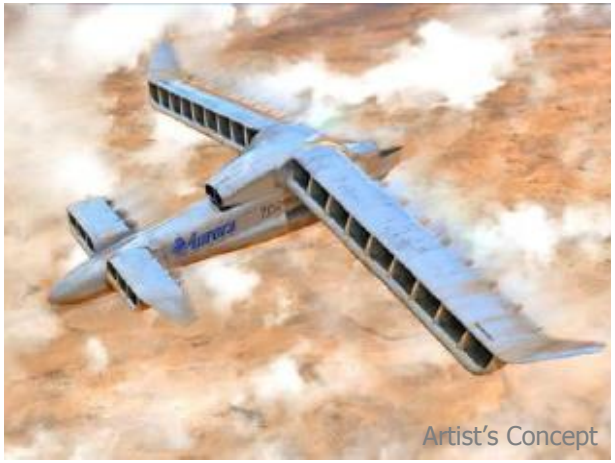
Kicking Off Phase 2

Vertical Takeoff and Landing (VTOL) X-Plane

- Design, develop, build and fly an experimental aircraft that can:
  - Fly at high speeds
  - Hover efficiently
  - Cruise efficiently
  - Perform useful work

  } Demonstrate these objectives concurrently on a single aircraft

- Demonstrate at relevant scale
  - $GW_{X\text{-}Plane}$ = 10,000 lbs – 12,000 lbs
  - Allowed for 20% margin above 10,000 lbs to capture variability in designs and COTS
  - Technology scalability in either direction – lighter/heavier
- Validate X-Plane capabilities in flight
  - Demonstrate, measure, verify


Artist's Concept

Performance Objectives	State of the Art (Helicopter)	VTOL X-Plane
Sustained max. speed	150-170 kt	≥ 300 kt
Hover efficiency (Aircraft FM)	60%	≥ 75%
Cruise efficiency (Aircraft L/De)	4-5	≥ 10
Useful Load	35-40% GW	≥ 40% GW

Kicking Off Phase 2

ALASA Plan Forward

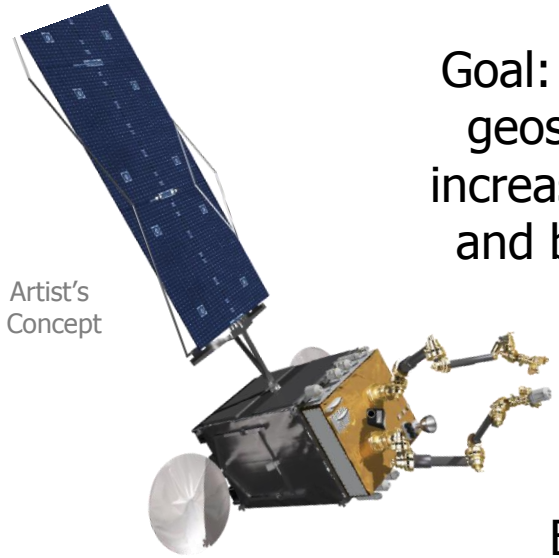
- The original Airborne Launch Assist Space Access (ALASA) program goal was to develop and fly a small satellite launch system
  - Deliver 100 lbs to low Earth orbit for $1M/flight
  - 24-hour call-up to orbit; 12-hour relocation to an alternate launch site
  - Program plan included 12-demonstration launches
- Technical challenges with propellant development showed it is premature to proceed to flight
  - Unable to achieve controlled ignition, stable combustion
- Continuing to pursue enabling and enhancing technologies, which will be shared with the community
  - Additional propellant safety testing
  - Complete and transition software and hardware which are designed to reduce range and flight operations costs


Artist Concept


Artist Concept

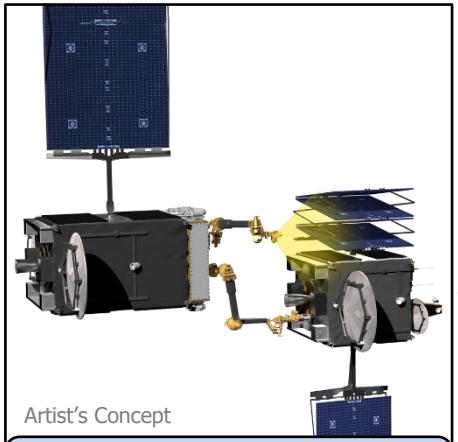
Current actions further ALASA program objectives, even without a fielded system

Robotic Servicing of Geosynchronous Satellites (RSGS)

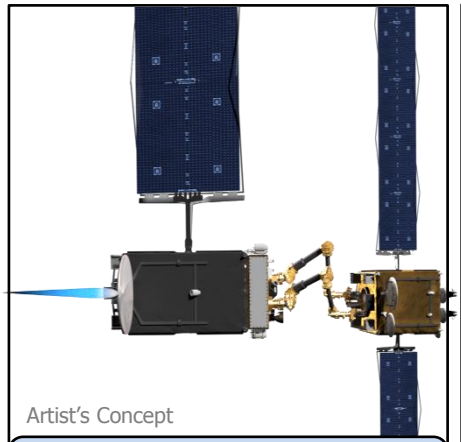

Artist's Concept

Goal: To create a dexterous robotic operational capability in geosynchronous Earth orbit (GEO), that can both provide increased resilience for the current U.S. space infrastructure, and be the first concrete step toward a transformed space architecture with revolutionary capabilities

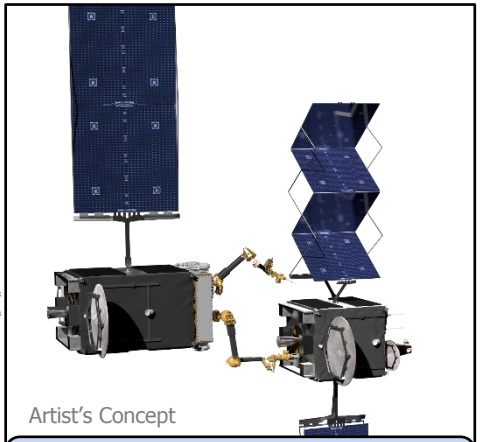
Envisioned Mission ensemble


Artist's Concept

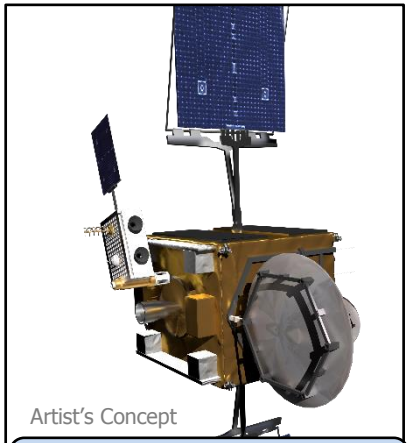
Cooperatively **inspect** spacecraft experiencing anomalies


Artist's Concept

Cooperatively **assist** with orbit adjustments


Artist's Concept

Cooperatively **correct** mechanical problems


Artist's Concept

Cooperatively **install** self-contained payloads on-orbit

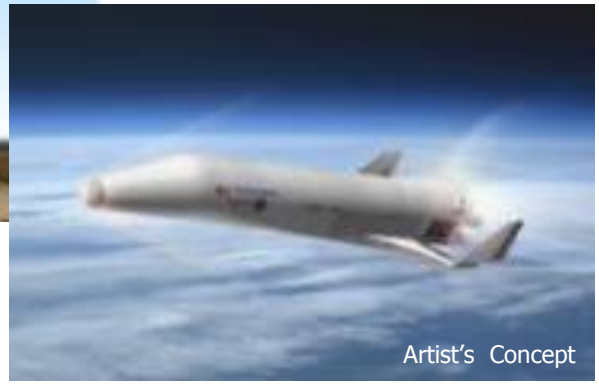
Program solicitation posting soon

Experimental Spaceplane (XS-1)

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

XS-1 aims to:

- Break cycle of escalating space system costs by:
  - Enabling future space system architectures
  - Leveraging interests & capabilities of commercial sector and space tourism
- Expand the reusable air-launched concept with a hypersonic vehicle capable of launching 3,000- to 5,000-lb payloads for less than $5M
- Mature and integrate technologies supporting launch and hypersonic vehicles
- Demonstrate mission assurance by flying 10 times in 10 days



Finishing Phase 1, Phase 2 kickoff at the end of 2016

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