Overview on DARPA's "Fostering Sustainable Satellite Servicing Conference"

Mr. David Barnhart
Program Manager, DARPA TTO

Briefing prepared for the European Conference on On-Orbit Satellite Servicing and Active Debris Removal
Brussels, Belgium

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Background

- DARPA hosted a one-day conference on 26 June 2012 to bring together the international community on "Fostering Sustainable Satellite Servicing."

Attendance: Total: 132

- Multiple nations invited/represented including:
  - Canada
  - Israel
  - Australia
  - Sweden
  - Germany
  - France
  - South Korea
  - Russia
  - China
  - Japan
- Multiple USG Agencies, commercial firms and Universities invited/represented:
  - Office of the Under Secretary of Defense for Acquisition, Technology and Logistics
  - Office of the Under Secretary of Defense for Policy
  - US House of Representatives
  - US Department of State
  - NASA
  - US Air Force
  - US Navy
  - Department of Commerce
  - George Washington University, University of VA
  - Satellite Manufacturers, owner/operators and insurers
  - Etc.

Background-Agenda

0830 **Welcome and Overview**
David Barnhart, DARPA Program Manager, Tactical Technology Office
Bill Mackey, Space Affairs Counselor, Canadian Space Agency, Canadian Embassy

0900 **KEYNOTE ADDRESS**
Importance for the future of space activities
Kaigham (Ken) J. Gabriel, DARPA Acting Director

0930 **Sampling of Activities and Projects**
Moderator: Victoria Samson, Secure World Foundation
David Barnhart, DARPA (Phoenix)
Bryan McGuirk, ViviSat (GEO Vivisat)
Dan King, MDA (SIS)
Juergen Drescher, DLR (DEOS)
Manny Leinz, Boeing (Orbital Express)
Ben Reed, NASA (Satellite Servicing Capabilities Office)
Mitsushige Oda, JAXA, (ETS-VII)

1045 **Coffee Break**

1100 **Session 1 – Policy and Legal Issues**
Goal: Identification of key policy, legal or regulatory impediments to technology transition
Moderator: Scott Pace, Professor of Practice of International Affairs and Director Space Policy Institute, George Washington University
Duncan Blake, Royal Australian Air Force
Joanne Gabrynowicz, Professor, University of Mississippi School of Law and Director National Center for Remote Sensing, Air and Space Law Center
Ram Jakhu, Professor, McGill University, Faculty of Law
Phil Meek, Secure World Foundation

1230 **Lunch**

1330 **Session 2 – Information Sharing, Operational Considerations and Safety**
Goal: How to develop data connectivity to develop sustainable servicing
Moderator: Brian Weeden, Secure World Foundation
Dan King, MDA (Space Missions)
Bryan Benedict, Intelsat General (Space Data Association)
Tim Rush, AON (Space Insurance)
Sarah Factor, Office of the Secretary of Defense for Space Policy
Myron Diftler, NASA-JSC (Robotic Operations)

1500 **Coffee Break**

1515 **Session 3 – International Security and Stability**
Goal: How to maintain stability through multi-national activities in space.
Moderator: Bruce MacDonald, Senior Director, US Institute of Peace
Eva Bernhardsdotter, Researcher, Swedish Defense Research Agency
Joan Johnson-Freese, Professor, Naval War College
Jim Fergusson, Professor, Department of Political Studies, University of Manitoba and Director for Centre for Defence and Security Studies

1700 **Conclusions**
Highlights, significant questions and areas for continued discussion
David Barnhart, DARPA

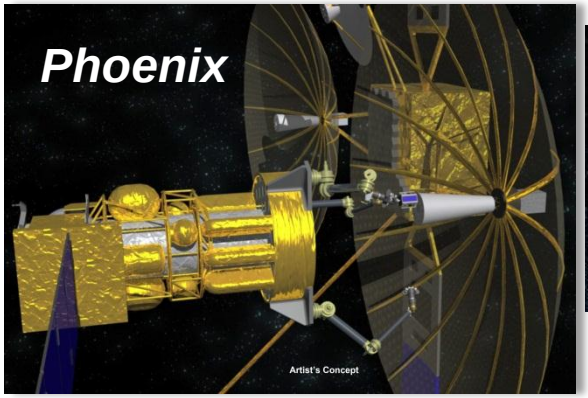
Goals of the DARPA Conference

Foster relevant non-technical dialogue for promoting the sustainment of technologies currently under development in the broad term "servicing."

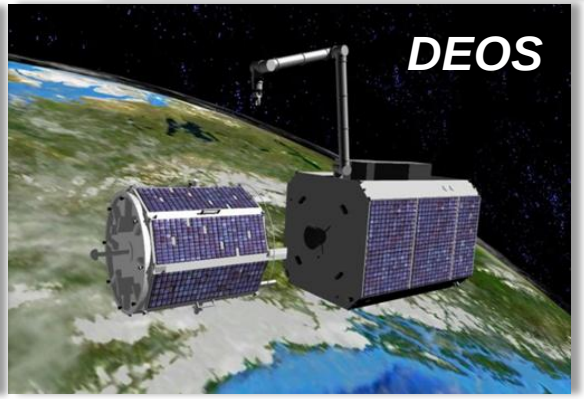
- *Policy attributes and examination of current treaties and agreements for space use relevant to "servicing"*
- *Legal ramifications associated with the various "Servicing" events for commercial and government use*
- *Discussion of regulatory environment that may help provide a sustaining enterprise in all aspects of "servicing"*

DARPA is not "a" or "the" policy organization relevant for Space within the DoD; the conference was a method to uncover and track potentially critical non-technical activities that will affect and ultimately guide future Space Servicing enterprises, which includes Phoenix

To set the backdrop for the day's discussion, we looked at a sampling of activities and projects related to servicing.



Multiple demonstrations and new concepts show robust technology regime for Servicing activities



Session 1 - Policy and Legal Issues identified by panelists

Hosted and Host Payload Implications

- Service of host satellite
  - How does HPL interpose interests if no independent contractual relationship exists with a servicer?
  - Protection of confidential information (export control, classification, IP)
  - Extension of host satellite life (renegotiate HPL agreement or new owner?)
- Transferring a payload from one satellite to another
  - Enforceable standards for 'plug n play' payloads
  - Handling independent 'space objects' in the international legal regime
- During Servicing
  - Exercising jurisdiction and control
  - Disposal of term-expired HPL
  - Independent 'space object' or forever linked to host satellite
  - Minimizing RF interference
- Liability:
  - Shortened/extended life of host satellite
  - Damage to satellite/insufficient power
  - Incompatible additional payload, loss of access to payload
- Contractual relationship between HPL owner, satellite owner and servicer

Servicing in Space Implication to Current Treaties

- Space law is part of public international law.
- Nonexclusive right to use and explore
  - Will satellite servicing be accepted as a use?
  - Path similar to communication, remote sensing, etc.?
- Space law treaty regime
  - Article IX, Outer Space Treaty
    - Most important, relevant provision
  - Registration regime important for servicing activities

Insurability Issue

- Implementation difficult, unproven
  - Actuarial "vacuum"
  - How will "best efforts" and government "held-harmless" be applied, if at all? Precedents for government rescue using "best efforts" and "held-harmless:"
    - 1984 Palapa B-2
    - 1984 Westar 6
    - 1992 Intelsat VI F-3
- Underwriters/Insurers
  - Have the option to take the title to a failed satellite, rarely choose this option
  - Uninterested in satellite servicing R&D
  - Interested in service if and when available
  - Need ability to estimate "pay-off"
- Operators
  - Likely to prefer cash for loss until…
  - Need rational cost-benefit results

Session 1 - Policy and Legal Issues- Open questions identified by Panelists

International Level

- Protecting an object, the environment or both? (UN COPUOS STSC agenda)
- Intellectual property issues
- Liability and risk sharing
- Level of international participation
  - Case-by-case
  - IADC model
  - Intergovernmental consortium
- Level of bilateral and multilateral arrangements
  - Requires focused diplomacy and transparency
  - Treaty? Executive Agreement? Charter? IGA? etc.

US Specific

- Public, private or public-private partnership activity?
- Interagency
  - Regulations (Administrative Procedure Act, etc.)
  - 'Turf' (jurisdiction and budget – Who contracts with the private sector?)
  - Licensing (Which is the appropriate agency? Possible models: launch, remote sensing, etc.)
- Liability and risk-sharing
  - Possible precedent: launch law regime
  - Federal Torts Claim Act

Session 2 – Information Sharing, Operational Considerations and Safety identified by Panelists

Technical Challenges

- Unprepared vs. prepared servicing
- Communications delay, with possible variable latencies of 1-8 seconds
- Proximity operations in remotely operated or automated fashion, unintentional contact sensing/compliance control
- Capture and mating with visiting vehicles; tumbling
- CONOPS
  - Servicers and hardware hosting
  - Command and control network
  - Proximity operations, rendezvous/docking, heritage?
  - Orbital debris considerations

Commercial Operation Perspective

- Commercial objective: uninterrupted client services
- Procured Services versus Procured Servicer
  - Investment, business case challenges
  - Liability
  - Legal/policy considerations
  - Timing
- Space Data Association & Hosted Payload Alliance offer conduits to commercial operators.
- On-orbit servicing can and eventually will provide solutions for a number of on-orbit issues. First agency/company with demonstrated IOC will likely pick up the bulk of the commercial business.
- Only when OOS becomes "heritage" will commercial operators permit dependency on servicing for mission execution.
- Without the commitment of major satellite owner-operators and the advocacy/support of the USG, risks/unknowns associated with commercial OOS may inhibit timely realization of full potential.

Information Sharing Requirements to assess Risks

- Do satellite investors have necessary motivation to invest in satellite servicing?
- Desire to collect insurance money immediately after an anomaly rather than waiting for servicing
- Defining failure is difficult in the insurance industry.
- Can spacecraft bus engineers be incentivized to add servicing fiducials?
- Operational protocol transparency
- Broadcast license for entire GEO belt

Session 3 – International Security and Stability
Open questions identified by panelists

- Technical and political implications of servicing rely upon transparency of the operations. (Intent may be necessary but not sufficient.)
- Levels of laws of the sea applicability to space
  - Naval "rules of the road" – can infer nefarious intent at a certain proximity, discussion of protective zones around sats and possible navigation lights on sats to represent position and orientation to an approaching spacecraft, like ships at sea
  - Space has no analogous "territorial waters"
- Pragmatic considerations
  - Best practice guidelines (maneuver notifications, etc.)?
  - In almost every case, a new space technology could be considered a weapon in some circumstances and not in others. What matters is how it will be used. (Unnecessary/indiscriminate actions and offensive vs. defensive categories are vague.)
- Who does one call if there is a servicing problem?
- How to get commercial investment if there is no current regulatory regime for "servicing"?
- What level of transparency "is enough" in space operations? (i.e. Is knowledge of 12 companies in business for communications in space sufficient or is real time validation of operations required?)

Summary

- DARPA Conference offered an open and honest discussion on non-technical aspects of the new field of "servicing" in space.
- General agreement that technical attributes are driving the realization of the capability. Thus need to discuss in parallel international, legal, policy and regulatory implications.
- General acknowledgement that transparency of operations and intent will help provide the backdrop for various multi-lateral, government and commercial risk reduction measures to sustain "servicing" capabilities.
- DARPA's Phoenix program is endeavoring to be one example of a transparent space servicing mission demonstrating responsible behaviours and activities for consideration in the future.