The Evolution of Space Rendezvous and Proximity Operations and Implications for National Security

Dr. Brian Weeden
Director of Program Planning
Secure World Foundation
Trends in the space domain

Old Space Paradigm

➢ National
➢ Secret
➢ Military-led
➢ Independent
➢ Strategic

New Space Paradigm

➢ International
➢ Transparent
➢ Commercial-led
➢ Interdependent
➢ All levels of war

Space is becoming “normalized”
COMMERCIAL RENDEZVOUS AND PROXIMITY OPERATIONS AND SATELLITE SERVICING
How we do satellites today

Credit: SSL and SpaceNews
What if cars were like satellites?
The problem of anomaly resolution

Credit: ExoAnalytic Solutions
SATELLITE INSPECTION
Chandah

LIFE EXTENSION
Effective Space solutions
Northrop Grumman

SATELLITE REFUELING
Airbus Defence & Space
SSL

MODULAR SATELLITE ASSEMBLY
NovaWurks
iBOSS

DEORBIT / END OF LIFE SERVICES
Astroscale
D-Orbit
Altius Space Machines

And future activities and applications, which would leverage technology, norms, and standards
Chandah Satellite Inspectors

Credit: Chandah Space Technologies
Northrup Grumman Life Extension Service

Credit: Northrup Grumman
SSL Satellite Refueling

Credit: NASA Goddard
iBoss Modular Satellite Assembly

Credit: iBOSS GmbH
Promoting Cooperative Solutions for Space Sustainability

Astroscale Debris Removal

Credit: Mainichi

USSTRATCOM Operational Law Conference
Omaha, NE, Sept 6-7, 2018
NATIONAL SECURITY IMPLICATIONS
The future of space...

Credit: MaritimeTraffic.com
THE USS VINCENNES AND A DEADLY MISTAKE

By Molly Moore
July 4, 1988

A $1 billion Aegis guided-missile cruiser, considered the most sophisticated combat ship in the world, yesterday shot down a large Iranian passenger airplane that was apparently mistaken for a small F14 fighter jet.

The apparent mistake cost an estimated 290 civilian lives, according to the Iranian government, and has raised questions about the capabilities of the high-technology combat ship that was intended to revolutionize the Navy's ability to protect its fleet.

In the heat of a skirmish with Iranian gunboats, the sophisticated radar system that is supposed to be able to identify hundreds of potential targets simultaneously indicated to the ship's operators that the approaching Iran Air A300 Airbus was an attacking F14 fighter, U.S. officials said.

Minutes later, with the airliner nine miles from the ship and closing, the USS Vincennes fired two Standard surface-to-air missiles. The Vincennes crew, hampered by the gulf's hazy summer skies, did not see the commercial plane until it exploded, officials said.

Credit: The Washington Post
From Russia, Unofficial Assurance about Intent of Lurking Luch Satellite
by Mike Gruss — October 20, 2015

The Russian satellite, alternatively known as Luch or Olymp, launched in September 2014 and seven months later moved to a position directly between the Intelsat 7 and Intelsat 901 satellites, which are located within half a degree of one another in geostationary orbit 36,000 kilometers above the equator. In late September, the satellite moved again, according to an analysis published Oct. 5 by Brian Weeden, technical adviser at the Secure World Foundation.

The satellite has now settled at 24.4 degrees west longitude, right next to the Intelsat 905 satellite at 24.5 degrees west, according to information available on the space tracking website n2yo.com, which republishes U.S. Defense Department data.

Moiseyev said the Luch “is simply a relay satellite, sending signals from spacecraft to Earth, for example from the International Space Station — we have communications problems there — and from one satellite to another.”

“In no way can it be an ‘aggressor,’” he told the state news agency. “Any satellite can make some clumsy maneuvers, but collisions are extremely rare.”

Credit: SpaceNews
<table>
<thead>
<tr>
<th>Date(s)</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 11 Nov 2016</td>
<td>Launch, initial GEO drift</td>
</tr>
<tr>
<td>12 Nov 2016</td>
<td>Rendezvous with Chinasat 5A (163 deg E)</td>
</tr>
<tr>
<td>13 Nov – 28 Dec 2016</td>
<td>Proximity Operations with Chinasat 5A</td>
</tr>
<tr>
<td>25 Apr – 19 June 2017</td>
<td>Relocated to 125 deg E</td>
</tr>
<tr>
<td>20 June – 29 Sep 2017</td>
<td>Parked next to Chinasat 6A</td>
</tr>
<tr>
<td>29 Sep – 8 Oct 2017</td>
<td>Relocated to 118 deg E</td>
</tr>
<tr>
<td>11 Jan 2018</td>
<td>Initiated Eastward drift</td>
</tr>
<tr>
<td>10 Feb</td>
<td>Rendezvous with Chinasat-20</td>
</tr>
<tr>
<td>11 Feb – 16 Mar</td>
<td>Proximity operations with Chinasat-20. Distance between objects generally under 10 km, several times within 1 km</td>
</tr>
<tr>
<td>17 Mar – 14 April</td>
<td>Relocated to 115 deg E</td>
</tr>
</tbody>
</table>

Credit: AGI, Breaking Defense
**Space ROE?**

**RULES OF ENGAGEMENT**

All enemy military personnel and vehicles transporting the enemy or their supplies may be engaged subject to the following restrictions:

A. When possible, the enemy will be warned first and asked to surrender.

B. Armed force is the last resort.

C. Armed civilians will be engaged only in self-defense.

D. Civilian aircraft will not be engaged without approval from division level except in self-defense.

E. Civilians should not be harmed unless doing so is necessary to save U.S. lives. If possible, civilians should be evacuated before any U.S. attack.

F. If civilians are in the area, artillery, mortars, armed helicopters, AC-130s, tube-launched or rocket-launched weapons, and tank main guns should not be used against known or suspected targets without the permission of a ground maneuver commander, LTC or higher.

G. If civilians are in the area, all air attacks must be controlled by a FAC or FO.

H. If civilians are in the area, close air support, white phosphorus weapons, and incendiary weapons are prohibited without approval from division level.

I. If civilians are in the area, infantry shoots only at known enemy locations.

J. Public works such as power stations, water treatment plants, dams, and other utilities may not be engaged without approval from division level.

K. Hospitals, churches, shrines, schools, museums, and other historical or cultural sites will be engaged only in self-defense against fire from these locations.

L. All indirect fire and air attacks must be observed.

M. Pilots must be briefed for each mission as to the location of civilians and friendly forces.

Credit: The Associated Press

Credit: GlobalSecurity.org

Figure C-1. Example of rules of engagement.
But remember space is different

WAY FORWARD
The Woomera Manual


McGill

Manual on International Law Applicable to Military Uses of Outer Space
• **Goal:** Create a publication that provides an overview fundamental principles, laws, norms, and best practices for safe, predictable, and responsible activities in space

• **Two specific audiences:**
  – Countries developing space programs and/or having to oversee and regulate their first satellites
  – Universities and start-up companies that are developing/operating satellites

www.swfound.org/handbook
Satelliteconfers.org
Incidents in Space Agreement?

Agreement Between the Government of The United States of America and the Government of The Union of Soviet Socialist Republics on the Prevention of Incidents On and Over the High Seas

BUREAU OF INTERNATIONAL SECURITY AND NONPROLIFERATION

Signed at Moscow May 25, 1972
Entered into force May 25, 1972

Narrative
Treaty Text
Protocol

Credit: Wikimedia Foundation
Space arms control?

Credit: United States Mission to Geneva
“As with past frontiers, it is those who show up, not those who stay home, who create the rules and establish the norms in new areas of human activity.”

Dr. Scott Pace, Executive Secretary, National Space Council
THANK YOU

QUESTIONS?

bweeden@swfound.org
Human-generated space objects

Active Satellites

<table>
<thead>
<tr>
<th>Total number of operating satellites: 1,886</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States: 859</td>
</tr>
<tr>
<td>LEO: 1,186</td>
</tr>
</tbody>
</table>

Current through 4/30/2018
Data from the Union of Concerned Scientists

Space Debris

<table>
<thead>
<tr>
<th>Larger than 10 cm</th>
<th>~20,000</th>
<th>Sources of new debris</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between 1 and 10 cm</td>
<td>~500,000</td>
<td>Can cause major damage</td>
</tr>
<tr>
<td>Smaller than 1 cm</td>
<td>Many millions</td>
<td>Can cause minor damage</td>
</tr>
</tbody>
</table>

Data compiled from U.S. Strategic Command, NASA, and ESA.
Current and future of space debris?

Proposed satellite constellations will add thousands of new objects to low earth orbit.

Credit: The Aerospace Corporation and The Financial Times