# Counterspace Trends and Their Effect on Security and Stability

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UK-SIPRI Workshop, "Nuclear Escalation Pathways and Outer Space: Views from Europe"

Solna, Sweden

Nov. 21, 2024





#### **Human-Generated Space Objects**

Active satellites as of Nov. 17, 2024:

• Total: 10,739

United States: 7628

Of which, SpaceX' Starlink: 6604

• Russia: 274

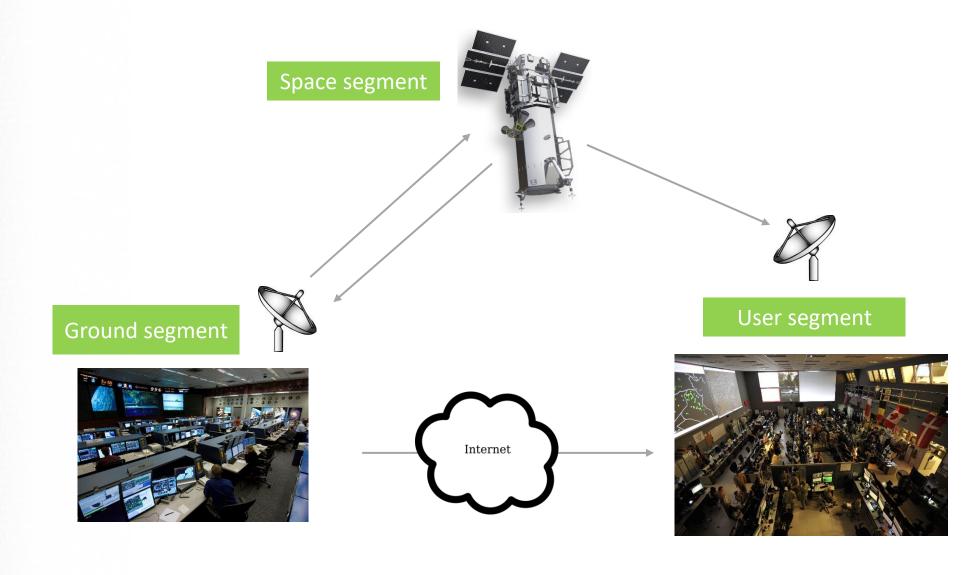
• China: 938

#### **Orbital Debris**

Larger than 10 cm	~40,500	Sources of new debris
Between 1 and 10 cm	~1,100,000	Can cause major damage
Smaller than 1 cm	130 million	Can cause minor damage

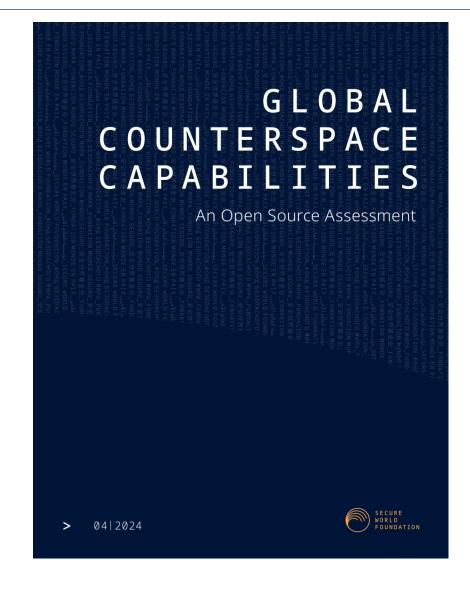


## A space system is more than just a satellite





- Existence of counterspace capabilities is not new, but the circumstances surrounding them are
- Significant R&D/testing of a wide range of destructive and non-destructive counterspace capabilities by multiple countries
- Only non-destructive capabilities are actively being used in current military operations



https://swfound.org/counterspace



## **Counterspace Capabilities**

**Co-orbital:** placed into orbit and then maneuver to approach the target to attack it by various means, including destructive and non-destructive

**Direct Ascent:** use ground, air-, or sea-launched missiles with interceptors that are used to kinetically destroy satellites through force of impact, but are not placed into orbit themselves

**Directed Energy:** use focused energy, such as laser, particle, or microwave beams to interfere or destroy space systems

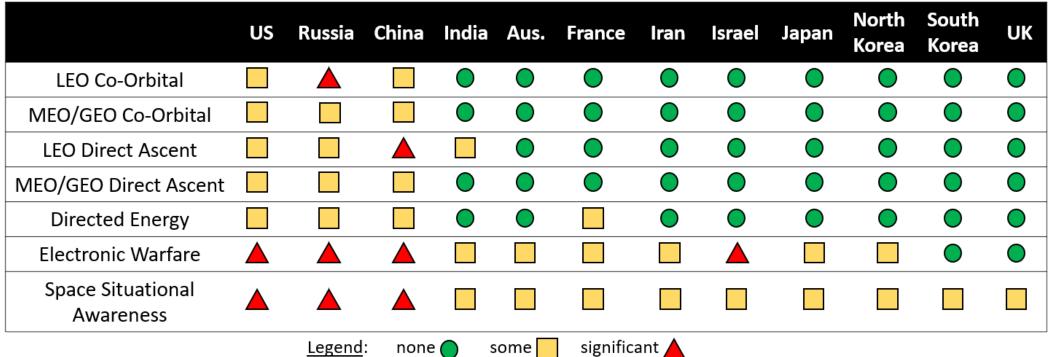
**Electronic Warfare:** use radiofrequency energy to interfere with or jam the communications to or from satellites

**Cyber:** use software and network techniques to compromise, control, interfere, or destroy computer systems

**Space Situational Awareness:** knowledge about the space environment and human space activities that enables both offensive and defense counterspace operations



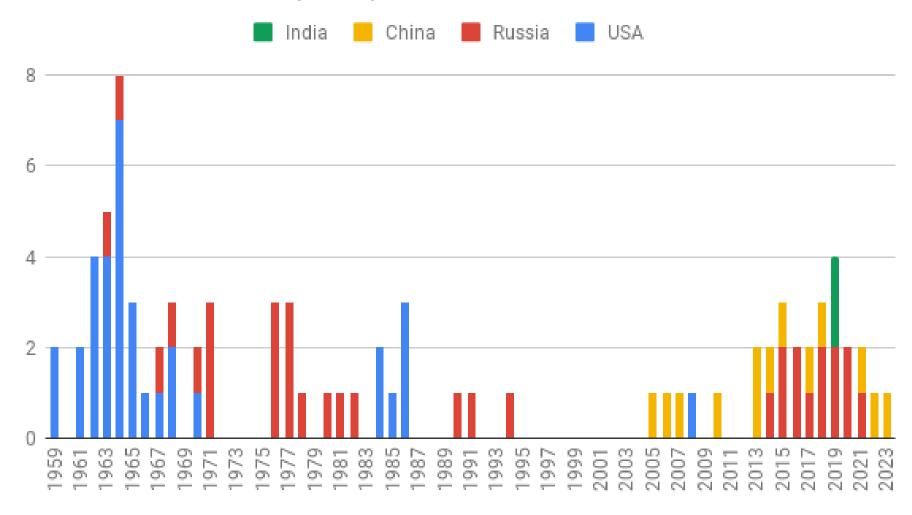
#### 2024 Global Assessment



Legend: none 🔵 some



#### ASAT Tests by Year (2024)





# Case study: Nuclear detonation as an ASAT weapon

- No shockwave (no air to transmit)
  - Blind any optical sensors pointed in its direction
  - Thermal pulse can overload & fry satellites
  - Electromagnetic pulse (EMP) can damage satellites and terrestrial electronics and power grids
- Radiation gets trapped by Van Allen Belts for weeks/months and can degrade/destroy LEO satellites
- Violation of the Outer Space Treaty
- Resolutions at the UN in 2024: UNSC fail, UNGA 1C pass



Image of Starfish Prime nuclear test. Credit: Nuclearweaponarchive



## Fallacy: Every satellite is potentially a weapon

- An ordinary satellite cannot be maneuvered to collide with another one
  - Orbit measurements and propagation are too inaccurate and uncertain
  - The propulsion system on a satellite (if any) cannot deliver the  $\triangle V$  to the required precision for a collision
  - The attitude control systems of satellites are not accurate enough to control the precise orientation that would be required for the  $\triangle V$
  - Satellites do not have terminal guidance sensors that enable last-second corrections to a target
- However, satellites designed for servicing (refueling, inspection, towing, removal)
  or to be able to conduct proximity operations *might* be able to be used as a
  weapon

Questions?

Thanks.

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