Cyber Threats to Space Operations

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• Cyber and Space Operational Dependencies
• Threats - Malware and Hacking
• Electromagnetic Warfare
• Emergent Tech
• Conclusion
• Space does not work without cyber and to a great extent, vice versa
• Protecting space assets through cyber
• Space could become the primary cyber pathway with emergent tech advances
Dependence of air, land, and sea operations on cyber and space situational awareness, navigation, and C4ISR carries with it myriad opportunities for mission failure.

GPS jamming/spoofing just one example of how dependent our forces are on space/cyber capabilities.
US satellite communications provider Viasat experienced a cyberattack that affected its KA-SAT satellite broadband service on February 24, the day Russia invaded Ukraine.

Used extensively by Ukraine military

Breached the management network and issued management commands to overwrite the devices' flash memory, rendering them unable to reconnect to the network but not bricking them altogether

Ground-based network intrusion by an attacker exploiting a misconfiguration in a VPN appliance to gain remote access

US government is now investigating the Viasat hack as a potential Russian state-sponsored cyberattack

CISA and the FBI also published a joint advisory warning US organizations of "possible threats" to satellite communication (SATCOM) networks in the US and worldwide.
• Viruses
• Worms
• Trojans
• DDoS
• XSS
• SQL Inject
• Ransomware
• SDR and EMS
• Etc.
Technology can be lost in microseconds through cyber espionage, giving rogue nations the ability to catch up without the time or investment devoted by first movers.

Cyber has a “low level of entry” compared to space with myriad threat actors.

However, these threat actors, through cyberspace, can pose threats in the space domain through cyber operations.
Both space and cyber also contain imbedded operational vulnerabilities special to their battlespace environs.

While space suffers the tyranny of distance, cyber suffers a tyranny of locality, both of which present different and convoluted vulnerabilities.

Space and cyber have grown rapidly, creating capabilities that make IW and JADO realities.
• Space and cyber cross-domain effects and concepts will continue to pervade every domain
• The most vital components for discussion are cross-domain platforms, hardening across technologies, and IW and JADO superiority
Space and cyber have several technological cause and effect relationships

Cybersecurity:
- Supports and defends space assets
- Provides authentication and encryption
- Use filtering shielding and spread spectrum techniques to protect from jamming, spoofing, etc.
Cyber and space domains share a similar kinetic/non-kinetic threshold.

Both space and cyber may be used consistently to degrade, deny, and deceive adversaries, leading to conflict below the threshold of kinetic operations.

What type of operations define the level of anti-satellite (ASAT) weapons, whether lasing or jamming are considered ASAT, for example?
Cross-domain operations are, more often than not, supported and assured through platform integration and interoperability:

- Kinetic/traditional - close air support, ground support to naval activities, and other integral platform-dependent undertakings
- Network support to space operations and space platform network support to cyber operations

PNT information is a critical enabler for precision-guided munitions (PGMs): aircraft missiles, naval gunnery and land-based artillery shells. Synchronous timing provided by space-based PNT services is also a vital element of many communication and information systems.
• Threats to space and cyber tend to overlap often as the technological vulnerabilities associated with electronic traffic through the electromagnetic spectrum (EMS) pervade every corner of space and cyber operations
  – jamming, spoofing and hacking attacks on communication networks via space infrastructure
  – targeting satellite control systems or mission packages
  – taking control of a satellite to exploit its capabilities
  – shut down, cook/grill solar cells through EMS exposure
  – can lead to potential global cascading effects on critical information infrastructure and networks
Constellation of about 40 geolocation satellites operated by Spire Global is collecting data used by the U.S. Space Force to detect GPS jamming.

Issue now gaining worldwide attention due to Russia’s use of electronic warfare tactics in the run-up to the invasion of Ukraine.

Spire is providing GPS telemetry data to help detect jamming to figure out way to automate manual data analysis techniques and produce more timely intelligence for military operations.

Cluster of four 6U cubesats deployed to detect and geolocate objects based on targeted RF emissions.

Data intended to help military and government organizations manage RF emissions and safeguard against RF and GPS interference.

Emergent Tech

- AI, ML, DL, AA
- Nanotechnology
- Quantum computing
- Hybrid on chip quantum
- Quantum EMS sensing
• Russia’s and China’s pursuit of anti-satellite weapons (ASAT), including laser-armed, satellite-hunting aircraft
  – reduce U.S. and allied military effectiveness
  – offset any perceived US military advantage derived from military, civil, or commercial space systems
Commercial technology that was developed for terrestrial applications and has been repurposed for the space business, specifically for low Earth orbit.

- Uses a “zero-trust network architecture” (ZTNA) where network users by default are not trusted and special keys are required to access encrypted data.
- OrbitSecure also uses blockchain for data transactions so every modification made to the ledger is time stamped and signed, ensuring traceability.