



Promoting Cooperative Solutions for Space Sustainability

Space Situational Awareness

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WHAT IS SSA?

Characterizing the space environment and its effects on activities in space

- Locations of objects in space and the ability to predict where objects were in the past and will be in the future
- Space Weather (measurement, warning, and forecasting of the effects of Solar activity on objects in orbit)
- Health, telemetry, planned maneuvers (usually provided by owner/operator)
- Intelligence
 - Information about objects in orbit (images, signals, capabilities, behavior) collected on objects in orbit

Paradigm shift in space regime...

- SSA was born during the Cold War as part of protecting the US and USSR from nuclear attacks
 - Nuclear threat progressed from airplanes to ballistic missiles (and satellites?)
 - Use of space for warning, intelligence, treaty verification
 - Two super powers controlled virtually all aspects of space
- Today's world is vastly different
 - 10 countries have indigenous space launch capability (Iran is the newest)
 - Over 70 entities operate satellites
 - 21,000+ pieces currently tracked, about 1,000 active payloads
 - Space is “congested, contested, & competitive”

- Although the space regime is much different today, SSA has not kept up
 - Still done primarily for military/national security purposes by the military
 - Bureaucracy/security needs have hampered upgrades and modernization, particularly for computer hardware/software and algorithms
- Certain actions in space can have long-term negative consequences for all
- All space actors (launching/operating satellites) need a basic level of data and analytical tools to operate in a safe & efficient manner
- Most space actors do not have this basic data



SSA is inherently international

- “Good” SSA requires a *geographically distributed* network of both radar and optical sensors and *combining sensor observations with owner-operator data*
- Theoretically, building the sensor network can be done unilaterally
 - Large economic cost
 - Need “friends in the right places”, basing agreements
 - Long logistical tails
- Every space actor needs a certain level of SSA for safe and efficient space activities, but few have the resources to build a complete network
 - Many actors can make partial contributions



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CURRENT SSA CAPABILITIES

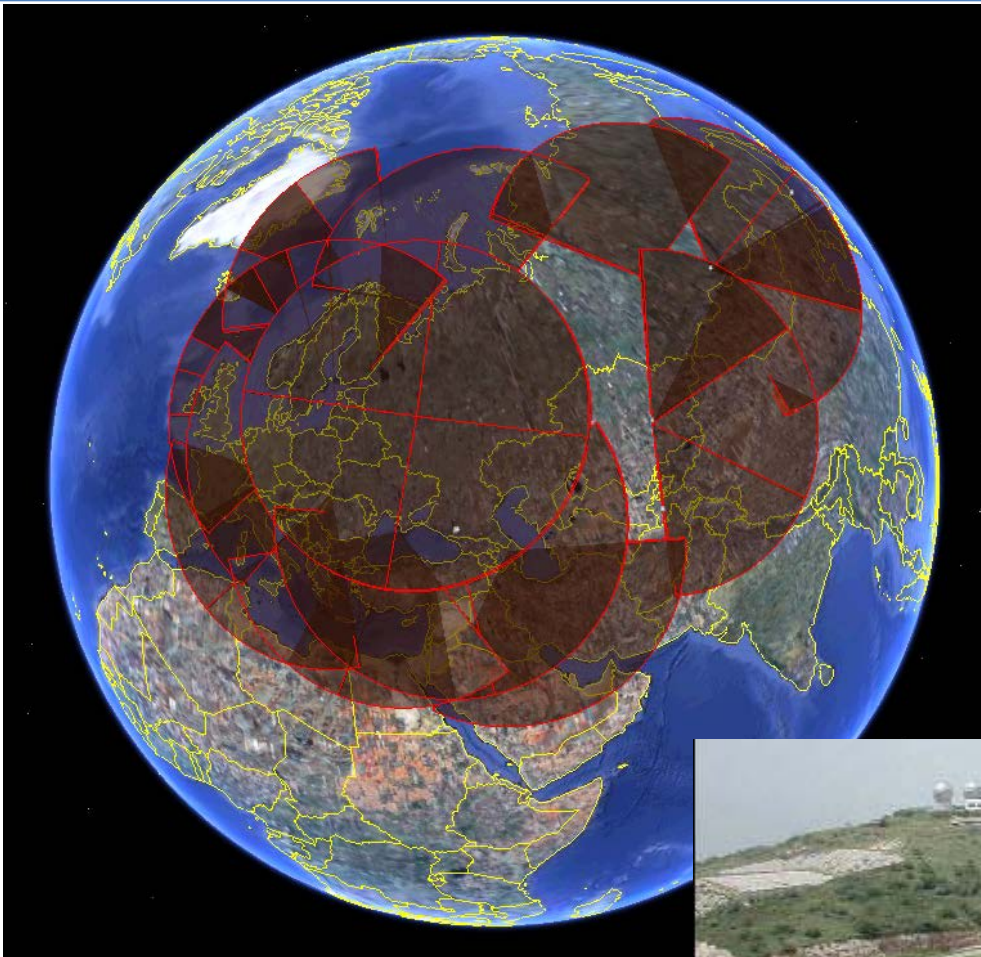


Current Space Surveillance Network



Tracking Radar
Detection Radar
Imaging Radar
Optical Telescope
Network Command and Control

- Run by USSTRATCOM
- Global deep-space coverage
- Northern Hemisphere radar coverage
- Excellent LEO catalog
- Good deep-space catalog



Russian Phased Array
Radar Coverage

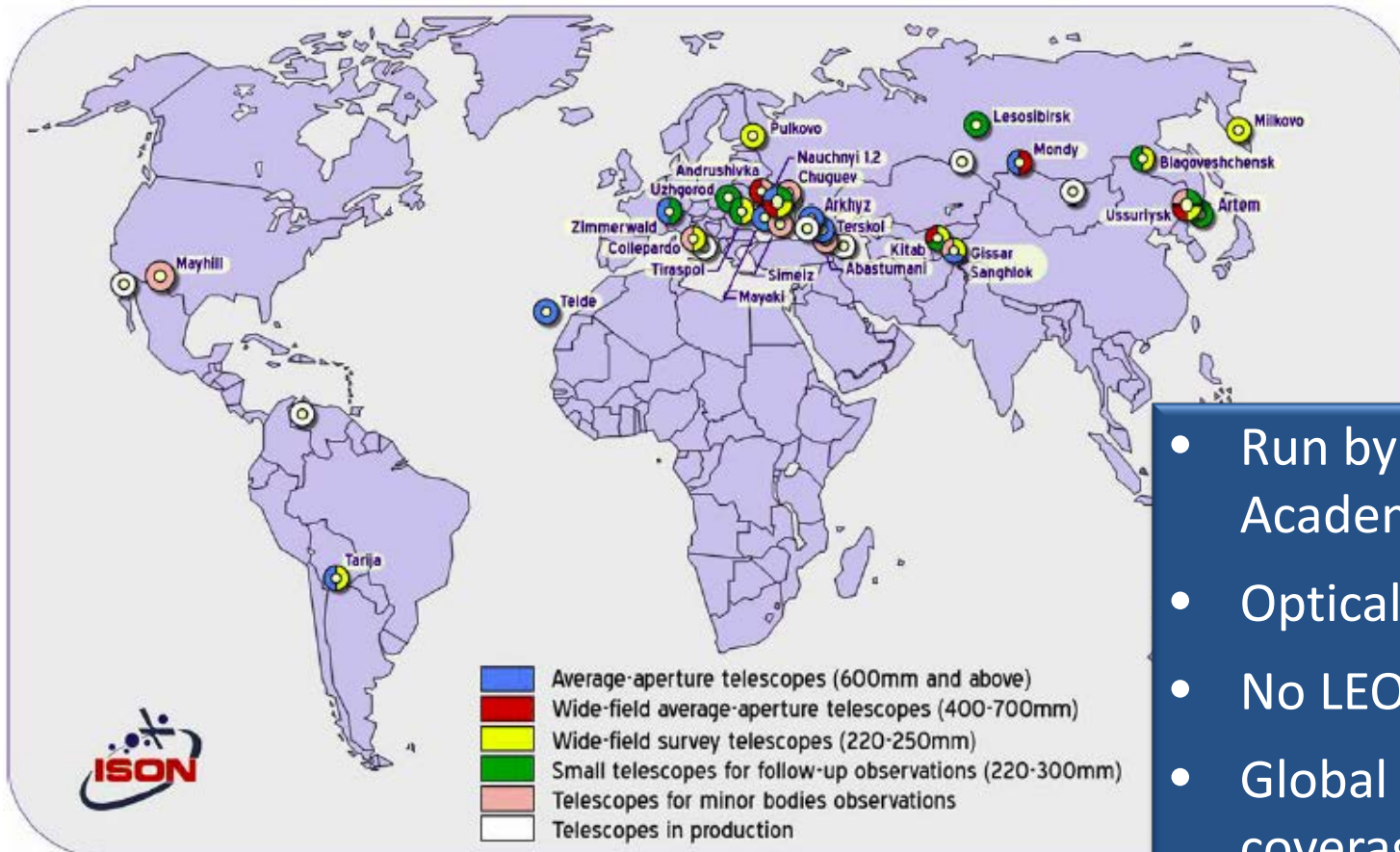
- Run by Russian Military
- Coverage only over Russia
- Good LEO catalog
- Mediocre deep-space catalog

Okno "Window"
Optical Site





- Individual sensors run by ESA or national militaries
- Good individual sensors
- Coverage only over some parts of Europe
- No catalog maintenance (spot checks only)



- Run by Russian Academy of Sciences
- Optical telescopes only
- No LEO coverage
- Global deep-space coverage
- Excellent deep-space catalog

- Several optical telescopes run by the Purple Mountain Observatory
- Likely a number of phased array radars operated by the PLA, but little public information is known
 - LEO only, no known deep-space radar capability
- Two tracking ships that are primarily used to support human spaceflight



- Non-profit organization based in Isle of Man
 - Executive members are SES, Inmarsat, Intelsat, and Eutelsat
 - As of November 2011: 13 full members and 22 total participants representing 342 satellites, 232 of those in the GEO belt, and 110 LEO objects
- Provides a number of services to participating owner/operators through Space Data Center
 - Automated close approach warning
 - Collision avoidance maneuver planning
 - Geolocation of radiofrequency interference
- In talks with USG and other providers on getting access to data on space debris

- There are dozens of private citizens all over the world who track satellites as a hobby
- Techniques range from binoculars and stopwatches to custom-built telescopes, high-power cameras, and radiofrequency detection
- Informally coordinate their activities through email and Internet mailing lists
- Often specialize in tracking national security satellites from many countries



Artist's conception
(credit: EPA)



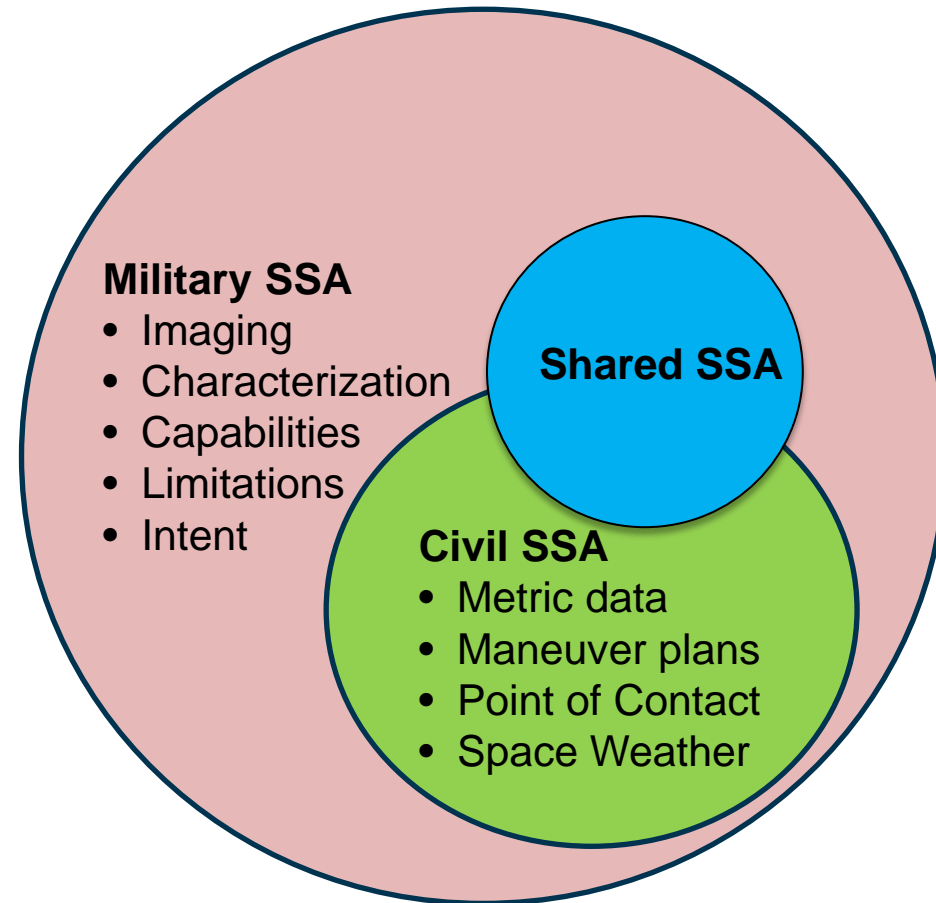
Actual imagery
(credit: Thierry Legault)



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CURRENT INITIATIVES

- Currently, almost all SSA is done for **military** purposes
- Emerging recognition of the need for **civil** SSA to support safety
- Also need to consider some element of **shared** SSA
 - Sharing between allies
 - Sharing between gov'ts and commercial
 - Sharing publicly



- US military planning significant SSA upgrades
 - S-Band Radar Fence
 - Space-Based Space Surveillance (SBSS) System
 - JSpOC Mission System (JMS)
- Expanding USSTRATCOM's SSA Sharing Program
 - In 2010, provided several hundred warnings to satellite operators who performed 126 maneuvers to avoid close approaches with debris
- US is signing MOUs with key partners and allies on data sharing
 - France, Germany, Australia, Canada, UK
 - Progress towards a future Combined Space Operations Center (CSpOC) that integrates allies and commercial partners

- The UN Committee on the Peaceful Uses of Outer Space (UN COPUOS) created a new agenda item on “Long-Term Sustainability of Outer Space Activities”
- Goal is to define “best practices” for ensuring the long-term sustainable use of space
- Four Expert Working Groups, including one on space debris, SSA data sharing, and safe space operations



International Space Code of Conduct

- Starting in 2008, the European Union has produced a series of draft Code of Conducts for Space Activities
 - Signed by all 27 EU member States
 - Operational impact assessment conducted by Pentagon, concluded minor changes would be desirable
- In January 2012, Obama Administration announced that it would be working with the Europeans and other space-faring States to develop an International Space Code of Conduct
 - European draft would serve as a starting point
 - Dialog would include current and emerging spacefaring States
 - End result would be a non-binding, voluntary agreement



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Thank You

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