

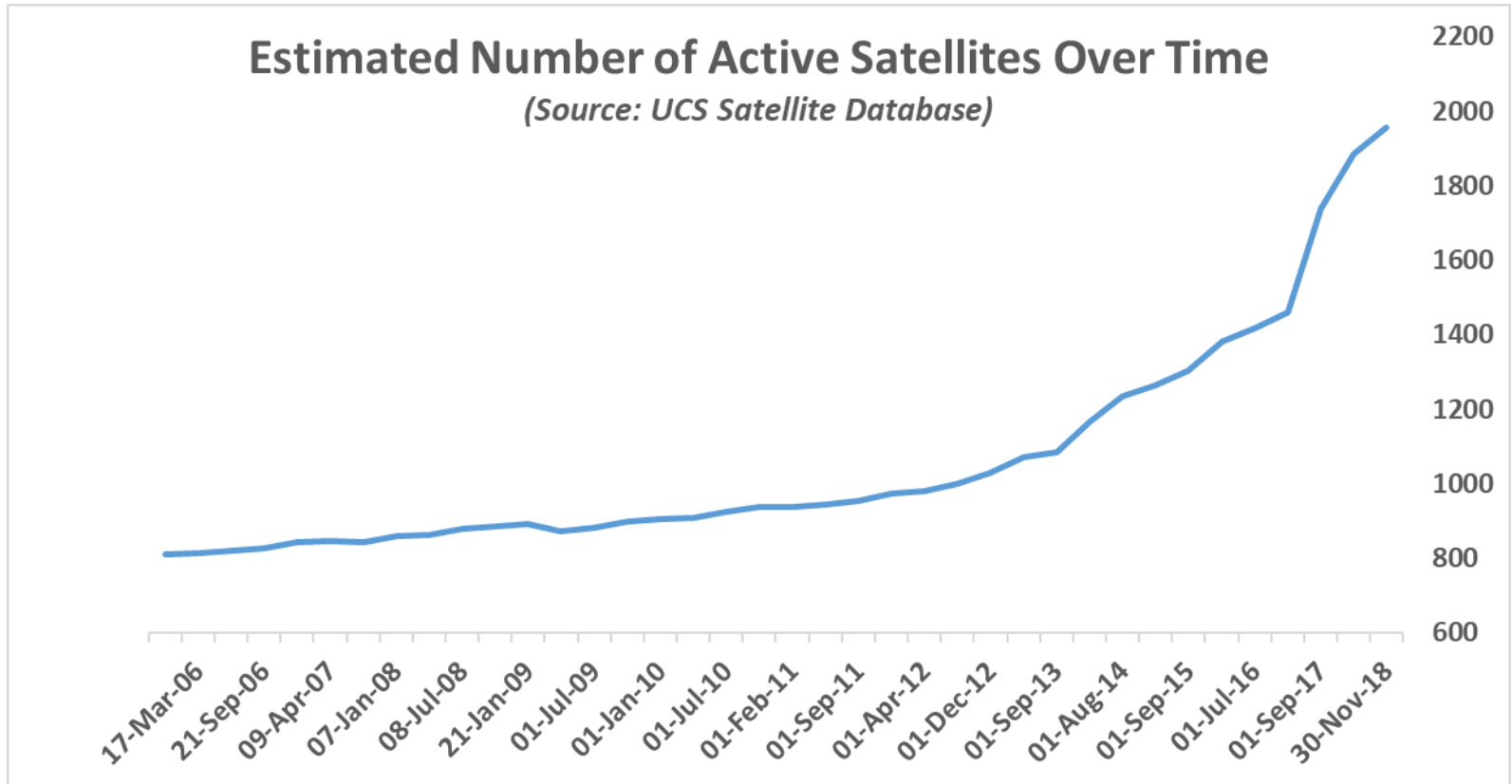
Emerging Trends – Private Sector Space Activities

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A Fundamental Change?

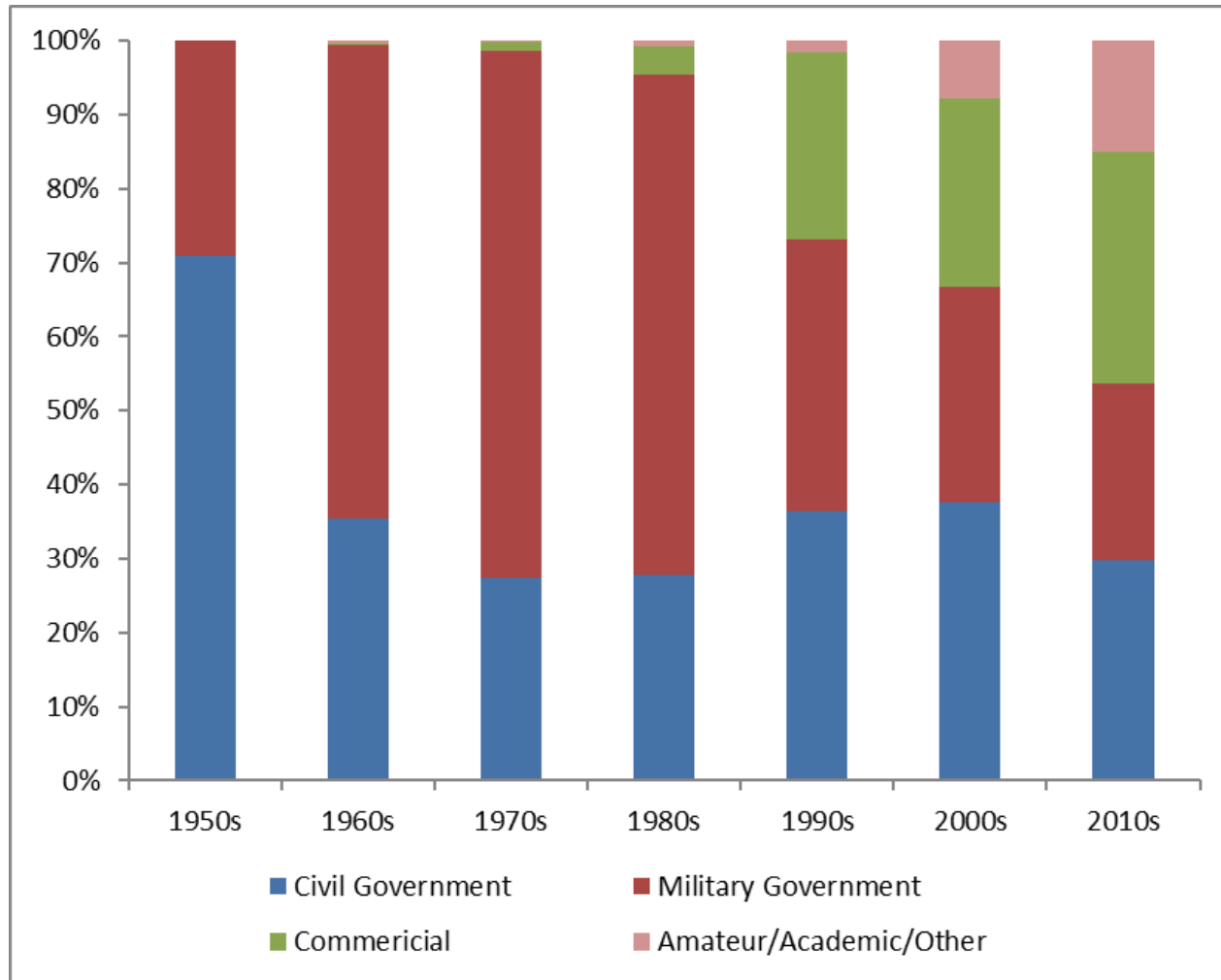


Operating satellites as of Nov. 30, 2018: 1,957

Forecast: Up to 2600 micro/nanosatellites to launch in the next 5 years

Mega-constellations: 16,000+ announced satellites, many not included in above

A Private Sector Driven Domain



Source: McDowell, Jonathan C, 2017—*Satellite Statistics* http://www.planet4589.org/space/log/stats2/own_categ.txt

Share of Satellites Launched per Decade, by Operator Type

Novel Private Sector Applications & Services

Rapid expansion in the number & types of commercial space applications is challenging existing policy context for space activities

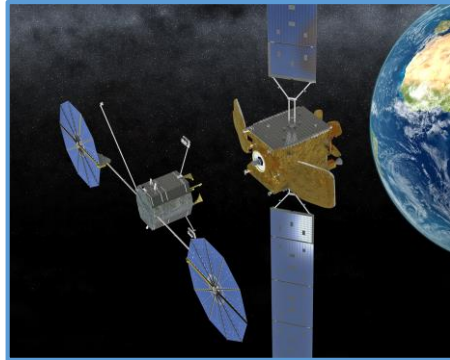


Image Source: Orbital ATK



Image Source: UNOOSA / Sierra Nevada Corp

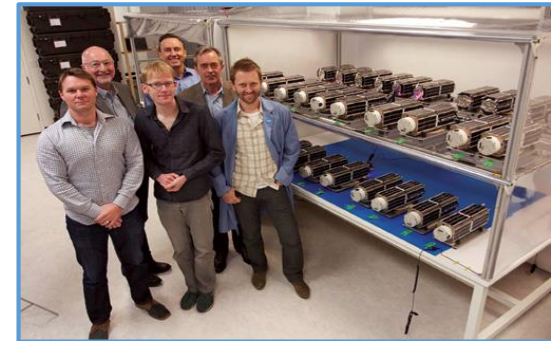
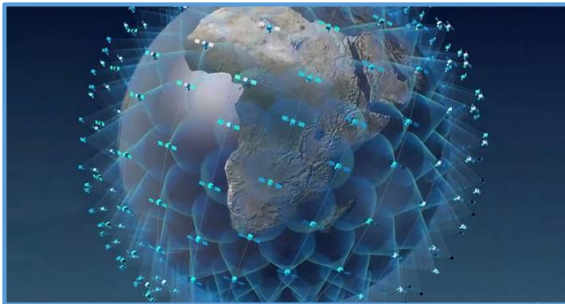


Image Source: [SatMagazine](#)

Governmental policy and regulation must be developed to support these activities, in manner that is consistent with international obligations, and that provides for benefit.

Small Satellites and Small Launch

Small Satellites & Cube Satellites

Opportunities

- Lower costs of access to space technology
- Lower technical and scientific barriers
- Broaden and diversify actors and users
- Enable new applications and services
- Commonly operate at low altitudes with short-lifespans (although this may be changing)

Challenges

- Diverse, heterogeneous set of actors
- Pace of innovation challenges regulatory fit and efficiency
- Often lack propulsion and have limited maneuverability and may pose challenges for tracking
- Reliability may be limited



Source: [SpaceNews](#) and [Spaceflight Industries](#)

Small-class Launch Services

- Emerging market for launch services focused on small satellites
- Including dedicated launch vehicles, broker services, and rideshare launches
- Challenges in developing best practices for payload deployment and identification
- Launch operators as de-facto gatekeeper for payload regulatory compliance

Example – Payload Identification Following Rideshare Launch

[SSO-A SmallSat Express: Launched Dec 3, 2018 aboard a SpaceX Falcon-9 carrying 64 spacecraft from 34 different organizations](#)

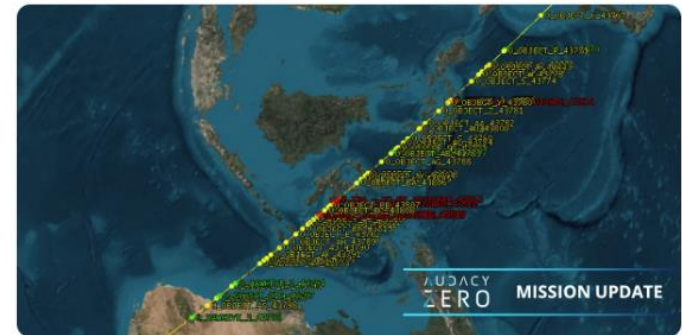
Audacy @Audacy · Dec 7
 More than ever, real-time connectivity is now necessary. Imagine searching for a tiny CubeSat among this flock of 64 satellites from the #SSOA flight. We have 8 min each time it passes, 4 times a day with our ground station. Our search continues



Audacy @Audacy · Dec 11
 @DougonTech @jstutman We're still working on it. For such a massive flight, it's normal to expect it to take up to several weeks as we await more information on the positions of the other satellites. Stay tuned! 🌐

Audacy @Audacy Follow

Mission Update: Identifying Audacy Zero is expected to take up to several weeks. We now have more information on the exact position of other satellites. Yellow objects are those we've tried to make contact with, while the red objects are what we're working on.



7:00 PM - 14 Dec 2018
T.S. Kelso @TSKelso · Jan 4
 Something to think about over the weekend: Since the SSO-A launch on Nov 29, 195 new objects were placed in orbit. Space Track has identified 62 of these & CelesTrak has identified 98, working with the community. We've still got a lot of work to do!

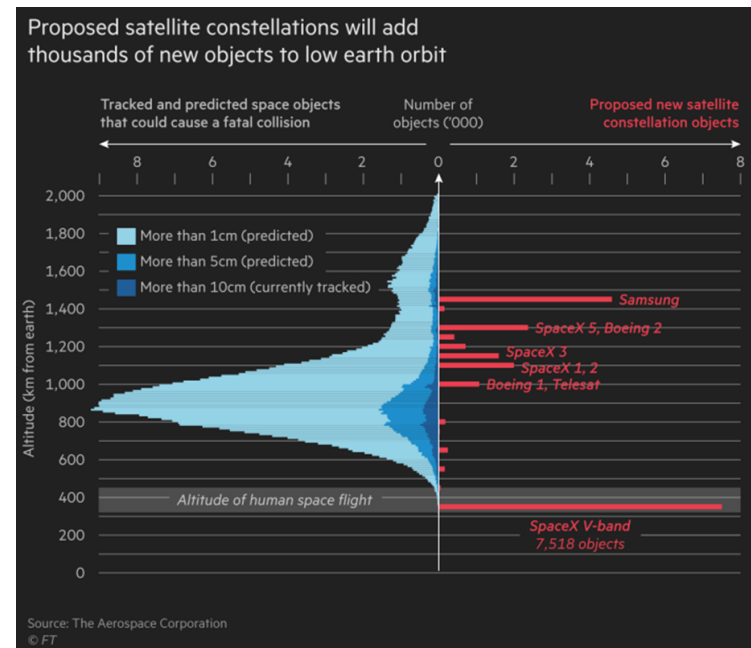
Identification of payloads poses challenges to both operators & commercial and governmental SSA systems. Improvements in info-sharing and tracking capabilities required.

Very Large Constellations

- In an increasingly complex orbital environment, how can operators cooperate on responsible operations?
 - How can operators work with government(s) to ensure safety of operations for all users of the space environment?
-
- Satellite reliability and end-of-life passivation commitments
 - Adequacy of space debris guidelines
 - Spectrum management & coordination
 - Information sharing and transparency
 - Satellite reliability commitments & satellite check-out practices

January 24, 2019
Seoul, Korea

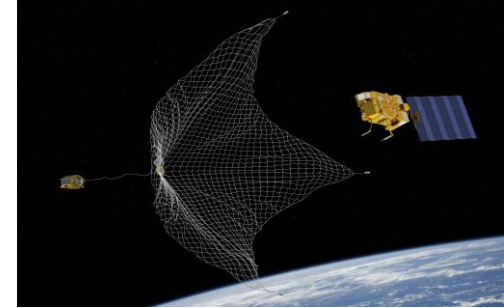
Space Situational Awareness Workshop: Perspectives on the Future Directions for Korea



Source: [The Aerospace Corporation](#) and [The Financial Times](#)

- Inter-operator coordination practices and data-sharing
- Satellite tracking, orbital position sharing, and maneuver notification/coordination
- Best practices for satellite end of life operations, beyond the de-orbit guidelines

On-Orbit Servicing (OOS) and Rendezvous and Proximity Operations (RPO)



- On-orbit servicing (OOS) and Rendezvous and Proximity Operations (RPO) are key to enabling future of on-orbit activities
- Greatly increase the viability of and benefits from space activities
- Raises a number of diplomatic, legal, safety, operational, and policy challenges that need to be tackled
- As OOS/RPO activities develop need to think about role of improved space situational awareness (SSA) info and resources as a key enabling factor
- The role of SSA in OOS includes:
 - Key information to inform and enable operations
 - Monitoring OOS operations to ensure safety and transparency
 - Providing confidence in OOS activities and outcomes

Principles and Guidelines



The United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) in June 2018 agreed to 21 Long-Term Sustainability (LTS) of Outer Space Activities



Leading efforts to develop *Best Practices for Sustainable Space Activities* document: “a consensus-based best practice guidelines focused on preserving sustainability for the various commercial, and other peaceful, uses of space”



Forthcoming *Space Sustainability Rating* announced at IAC 2018

Corporate Social Responsibility Policies of Satellite Operators



- SES's Corporate Social Responsibility brochure states that "Protecting the environment on Earth is important and, as a satellite operator, we understand that protecting the environment beyond our planet is equally important"



- The Corporate, Environmental, Social and Societal Responsibility chapter of Eutelsat's 2016-2017 Annual Management Report refers to a commitment to "Protecting the environment and maintaining the space around the earth uncongested and clean"



- Inmarsat's public Corporate Social Responsibility commitments include "a responsibility to minimize its environmental impact – on the ground and in space"

Norms of Behavior and SSA

- Much of the existing space governance framework is based on norms
 - Norms are likely going to be the main mechanism to address future challenges
 - Far more space actors than ever before, with diverse interests and goals
 - Increasingly challenging to get global consensus on new “hard law”
 - Incentives for satellite operators to set norms/behaviors w/out waiting for governments to act
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- Improved SSA for all space actors is critical to establishing and reinforcing norms of behavior
 - More public and international sources of data will increase awareness of the problem(s) and provide a foundation for norm development
 - More private and national capabilities will increase trust that others are following norms (trust but verify)
 - SSA could eventually provide ability to verify implementation of both voluntary commitments and legally-binding agreements

SSA and Private Sector Space Operations: Policy Questions

- What mechanisms exist for ensuring that the growing number of private sector operators are aware of, and know how to interface, with governmental SSA data sources and services?
- Should safety of spaceflight SSA data services be provided as a civil government function or as a military government function? How should multiple sources and types of data (civil, commercial, military) be integrated and used?
- What responsibilities do operators have to maintain their own SSA data vs. reliance upon government data?
- What role does improved SSA information have in regulatory monitoring, compliance and enforcement?
- Are existing space debris mitigation guidelines sufficient or adequate given the diversification of activities in being conducted in orbit? How does SSA information contribute to understanding this question?
- Should governments consider mandating of propulsion capabilities and/or transponders or tracking aids on satellites?

Thank you

Questions?

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