

ROYAL CANADIAN
AIR FORCE



AVIATION ROYALE
CANADIENNE

'Strong, Secure and Engaged'

The Next Generation of Canadian
Space Domain Awareness



Mr. Cam Stoltz (Col Ret'd)
Director Space Requirements
28 April 2021



OVERVIEW

- 'Strong at Home, Secure in North America and Engaged in the World'
- Research & Development (R&D) in New Space Technologies
- SDA Engagements, Current and Future Partnerships
- DND's Roadmap & SDA Capabilities

'STRONG, SECURE, ENGAGED'



UNCLASSIFIED



A New Canadian Vision for Defence: STRONG, SECURE, ENGAGED.

STRONG at home



SECURE in North America



ENGAGED in the world



Space effects are a joint enabler across all missions & integral to Pan-Domain Ops



- Steadfast defence of Canada
- Rapid disaster response
- Effective search and rescue
- Enhanced presence in the Arctic
- Innovative defence sector



- Continuous watch over Canadian air and sea approaches
- Modern and effective NORAD
- Strong defence relationship with the U.S.
- Cutting edge defence research



- Robust commitment to NATO, UN and Coalitions
- Support to Canadian interests and humanitarian assistance
- Improved early warning
- Integrated capacity building with partners

**AGILE, COMBAT READY CANADIAN ARMED FORCES
AND RESILIENT PEOPLE AND FAMILIES**



SSE - SPACE OBJECTIVES

- In collaboration with allies, Deter ...increasingly relevant to the space and cyber domains
- Invest in and employ (Deliver) a range of space capabilities
- Defend and Protect space capabilities
- Work with partners to promote Canada's national interests on space issues
- Provide leadership in shaping international norms for responsible behaviour in space
- Conduct cutting-edge R&D on new space technologies

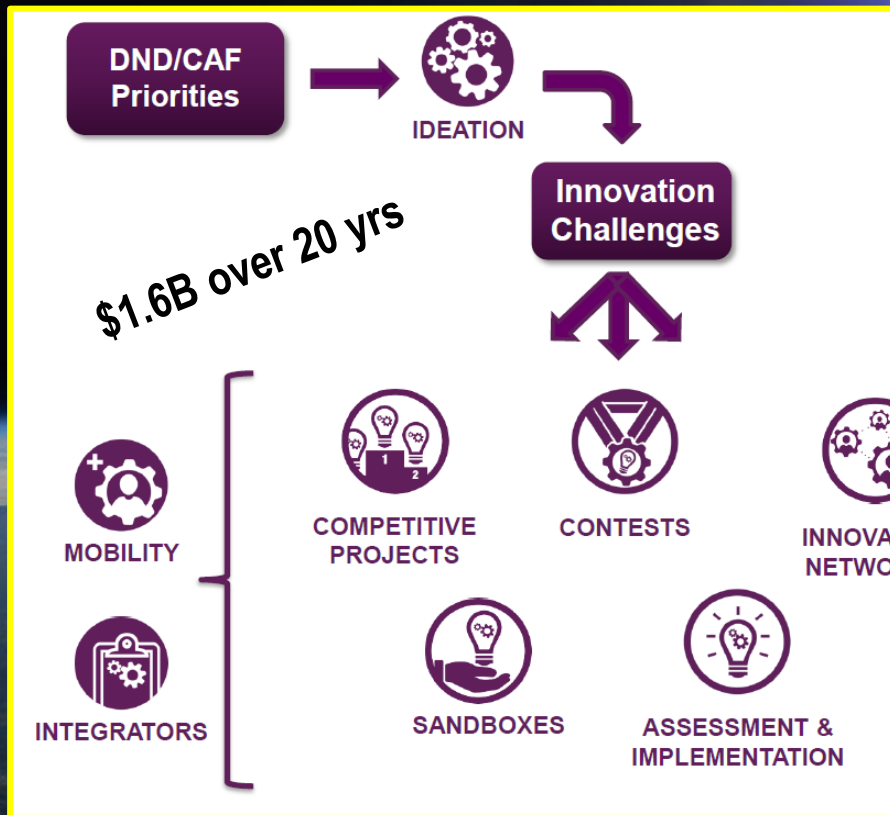
UNCLASSIFIED

RESEARCH & DEVELOPMENT

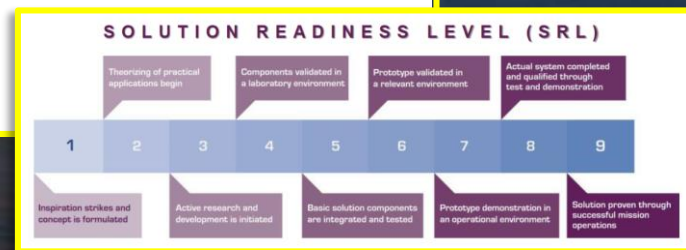


UNCLASSIFIED

S&T INNOVATION FOR DEFENCE EXCELLENCE AND SECURITY (IDEAS) PROGRAM



Challenges	Date launched	Status
CFP 1 Challenge 13: Identification and Characterization of Space Objects	April 2018	4 solutions funded completion by May 2021
CFP 3 Challenge 2: Collision Course - tracking and de-orbiting space debris	August 2019	6 solutions funded completion Dec 2020
CFP 3 Challenge - Shields up! Defend & Protect satellites from natural and artificial threats	Sep 2019	7 solutions funded completion Feb 2021



<https://www.canada.ca/en/department-national-defence/programs/defence-ideas.html>

UNCLASSIFIED

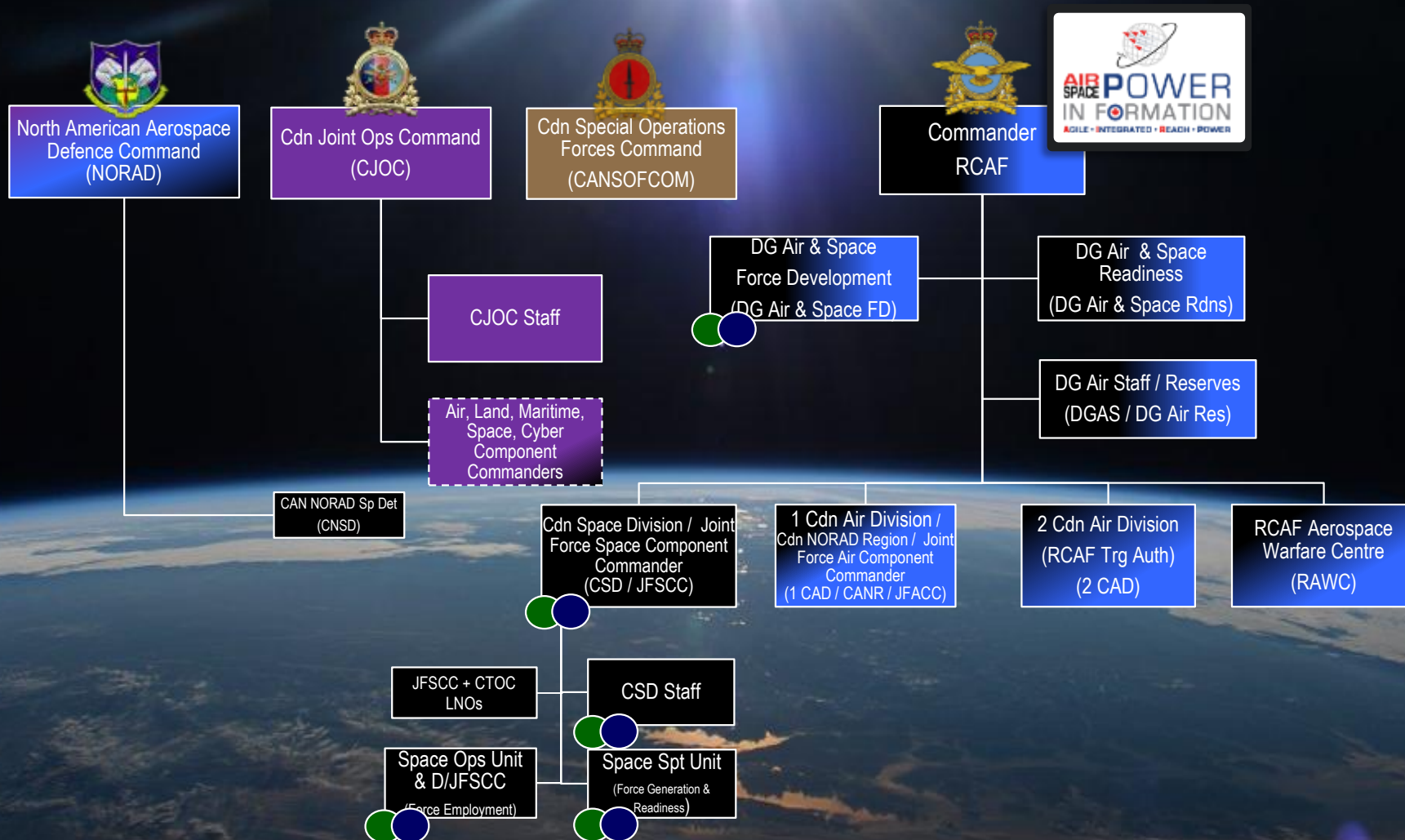
SPACE DOMAIN AWARENESS (SDA)

ENGAGEMENTS, CURRENT AND FUTURE PARTNERSHIPS



UNCLASSIFIED

CAF JOINT SPACE – 2024



Space Pers: CSD/FD/Rdns/CNSD/Defence Space Enterprise

275

Air power:

Space power:

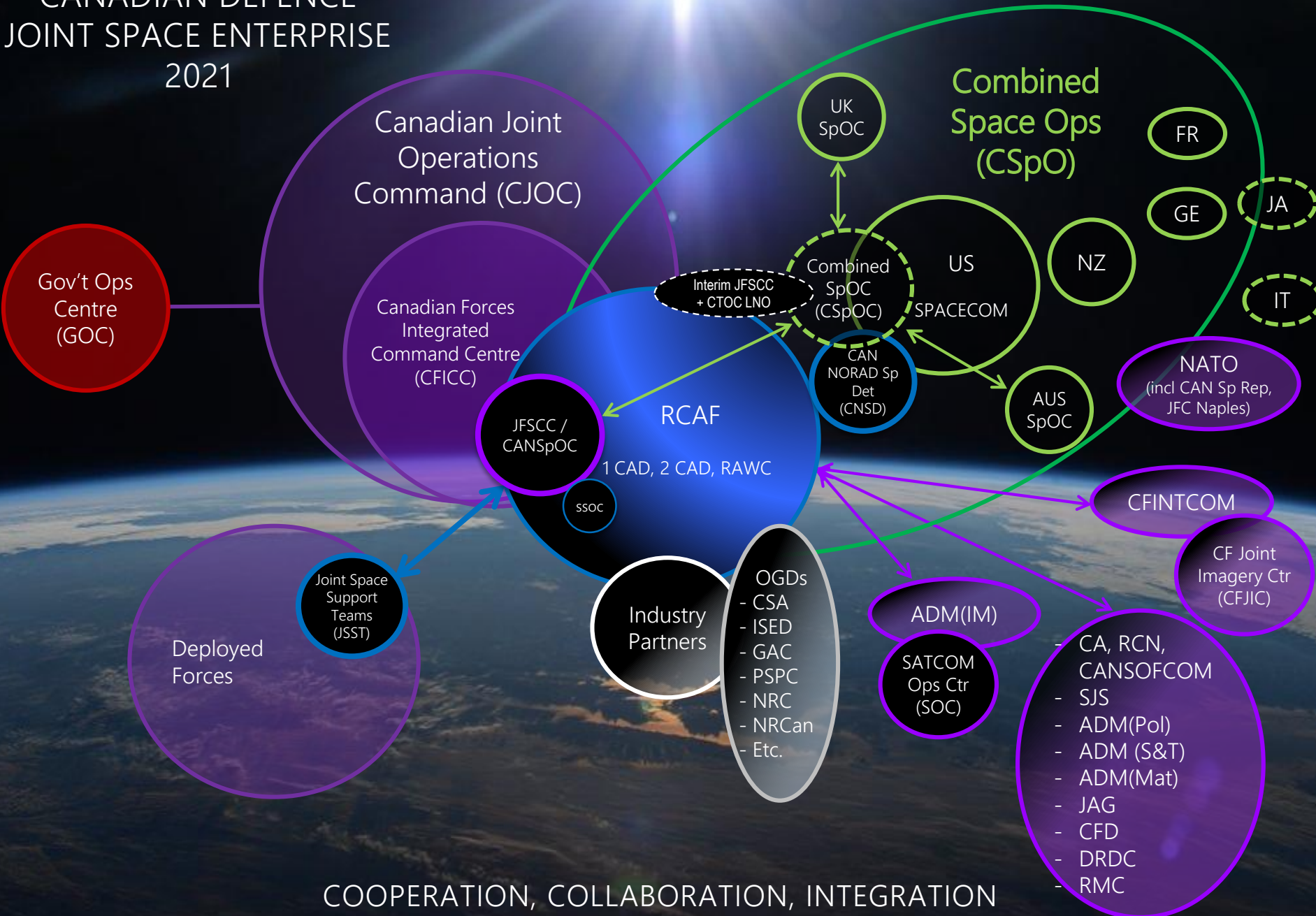
Joint:

SOF:

Cdn Army + Royal Cdn Navy embedded:

UNCLASSIFIED

CANADIAN DEFENCE JOINT SPACE ENTERPRISE 2021



COOPERATION, COLLABORATION, INTEGRATION
UNCLASSIFIED

COMBINED SPACE OPERATIONS (CSpO) ON SOCIAL MEDIA



Royal Canadian Air Force @RCAF_ARC - Apr 18, 2020

"Destabilizing test activities can affect space safety/stability, which is essential for 🇨🇦, our partners and allies. It is more important than ever to advance norms of responsible behavior in space!" BGen Kevin Whale, CAF Space Component Commander



U.S. Space Command @US_SpaceCom - Apr 15, 2020

It's a shared interest, responsibility of all spacefaring nations to create safe/stable/operationally sustainable conditions in #space. In this time of crisis, space systems support global logistics/transpo/comms to defeat #COVID19. go.usa.gov/xv8rH



Royal Canadian Air Force @RCAF_ARC

Combined Space Operations initiative Principals from 🇨🇦🇨🇦🇩🇪🇬🇧🇫🇷🇮🇹🇯🇵 met on 13-14 Jan to continue work on a shared vision and mission to ensure the space domain remains safe, secure, and accessible to all.

rcaf.forces.gc.ca/en/space/partn...

COMBINED SPACE OPERATIONS COUNTRIES WILL:

- Lead as responsible space actors
- Enhance the resilience and protection of space systems
- Be ready to operate together

Canada.ca/Defence

Canada

1:01 PM - Jan 15, 2021 - Twitter Web App



Royal Canadian Air Force @RCAF_ARC - Jul 23, 2020

"Testing of space-based weapons on orbit destabilizes the space environment. Ensuring responsible behaviour in space is critical for Canada, our partners, allies and the broader global community." BGen Mike Adamson, CAF Space Component Commander



Russia conducts space-based anti-satellite weapons test
U.S. Space Command has evidence that Russia conducted a non-destructive test of a space-based anti-satellite weapon. On July 15, ...
spacecom.mil



National Defence @NationalDefence - Aug 6, 2020

On 23 July 2020, representatives from 🇨🇦🇨🇦🇩🇪🇬🇧🇫🇷🇮🇹🇯🇵 attended the virtual combined Space Operations (CSpO) Principals Board.



Canada.ca/Defence

Canada

UNCLASSIFIED

DND SPACE MOUs AND PARTNERSHIPS

All Space MOUs	#	Partners	Summary
PERSONNEL - Exchange of defence personnel	6	OGDs (CSA, ISED) & US	Agreement to provide on-site working assignments to selected military members, scientists, engineers and logisticians. Including CAF members' assignments as Astronauts.
RDT&E - Satellite bus and payloads, Command & Control Information Systems (C2I)	5	Allies (FEYEs)	Collaboration in research, development, testing, evaluation, and prototyping potentially leading to new and improved defense capabilities.
OPERATIONS - SATCOM, ISR, SSA, PNT, Search & Rescue	11	OGDs (CSA, NRCan, SSC) & Allies (FEYEs + DEN, LUX, NED, DEU, FR)	From sensor data sharing, development and operations of space effects, development & coordination infrastructure and mission command and control systems; and policy.

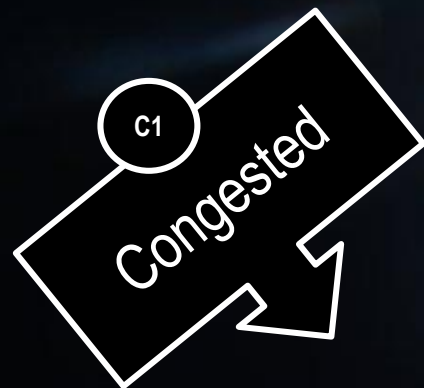
SDA specific partnerships: 10 MOUs & 5 SAs/PAs

SPACE DOMAIN AWARENESS (SDA) ROADMAP



UNCLASSIFIED

Now, Space is...



Canada has ~60 satellites on orbit (commercial, civil, military);
~55 active, 5 debris



>2200 active satellites

>23,000 tracked objects...

...plus >500,000 smaller objects we can't track,
travelling at up to 36,000 km/hr

Example: GEOINT Planned Expansion

2012 2014 2016 2018 2020 2022 2024 2026

TODAY

Not to mention satellites for...

- Communication
- Position, Nav, Timing
- Missile Warning
- Weather
- Etc.

UNCLASSIFIED

SDA & DENYING SPACE

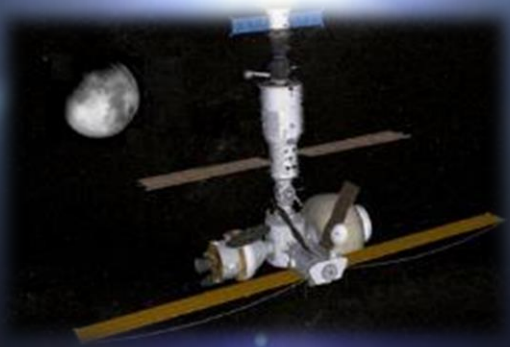


Source: "Competing in Space", National Air & Space Intelligence Center, December 2018

- Potential adversaries have developed a wide array of **ground and space-based weapons** to disrupt/deny commercial and military space systems:
- **Jamming** of GPS and comms satellites
- **Blinding** of ISR satellites using directed energy weapons
- **Anti-satellite missiles**
- Space-based **on-orbit counter-space capabilities**
- **Physical attacks** against ground sites and infrastructure
- **Cyber attacks** against space systems and infrastructure

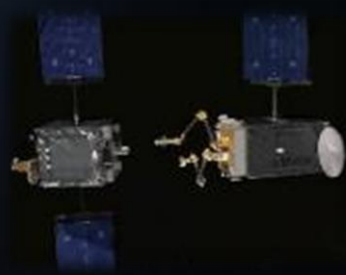
UNCLASSIFIED

Space is...



Lunar Gateway

On orbit servicing,
refuel, repair...



Space mining...



Exploration...

High Altitude
Platforms -
Pseudo-Sats



SDA OVERALL PROGRAM 2040

SSA



Sapphire

Intel



Surveillance of Space 2

Surveillance of Space 3

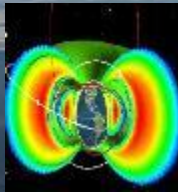
R&D



NEOSSat

MSSSat (Redwing)

Space Weather



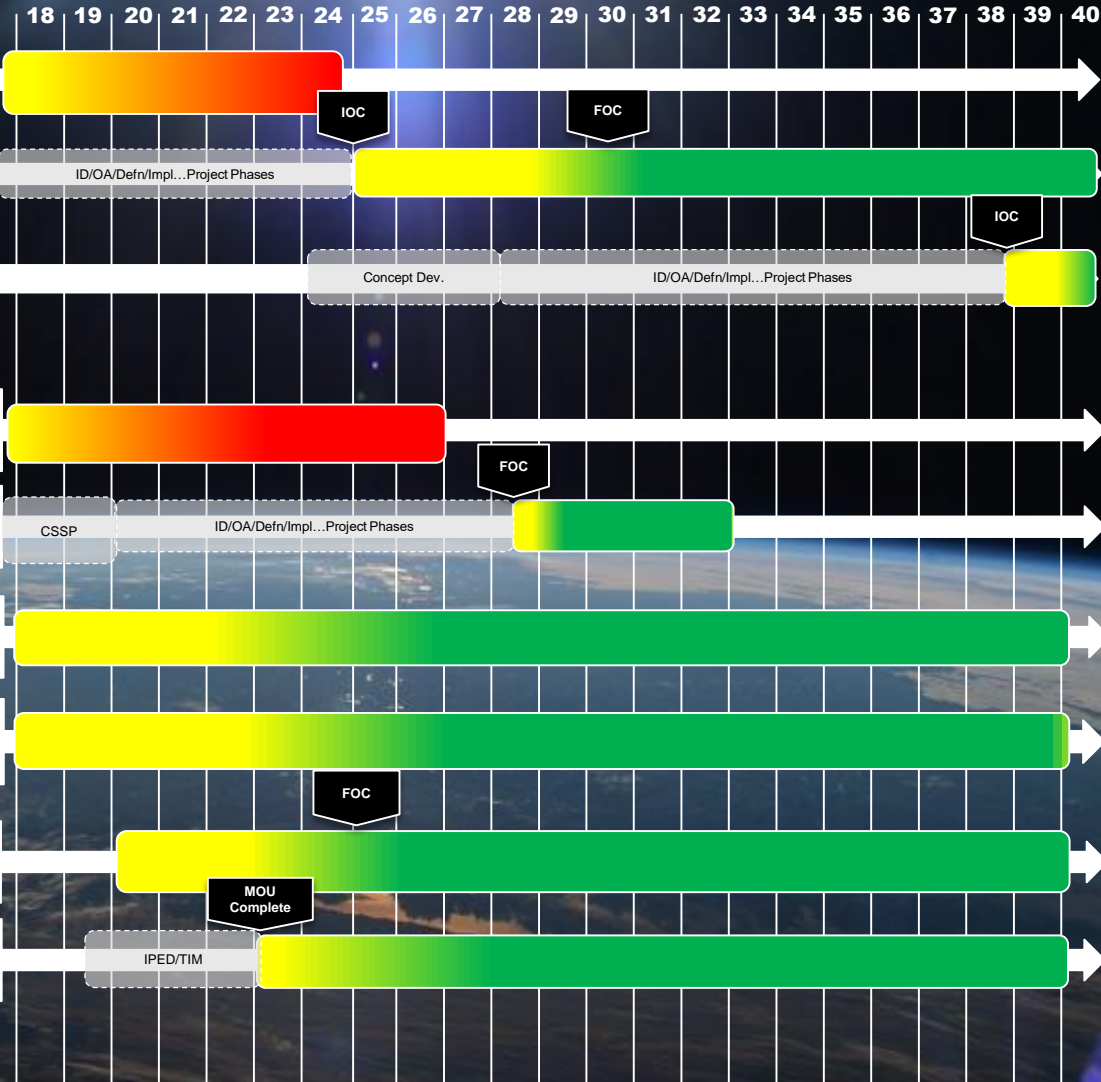
Canadian Space Weather Forecast Centre (CSWFC) collaboration

NATO - subWG

DevSecOps Unit

US Space C2 Program

Command & Control (C2)



Dual-mission platforms
Pattern-of-life

Characterize
Sense

Protection
Anomaly analysis

Agile C2
Big Data Analytics
Mission Assurance

UNCLASSIFIED

	Capability in service
	Interim or limited capability in service
	Ad-hoc capability available when possible
	No capability available / risk of gap

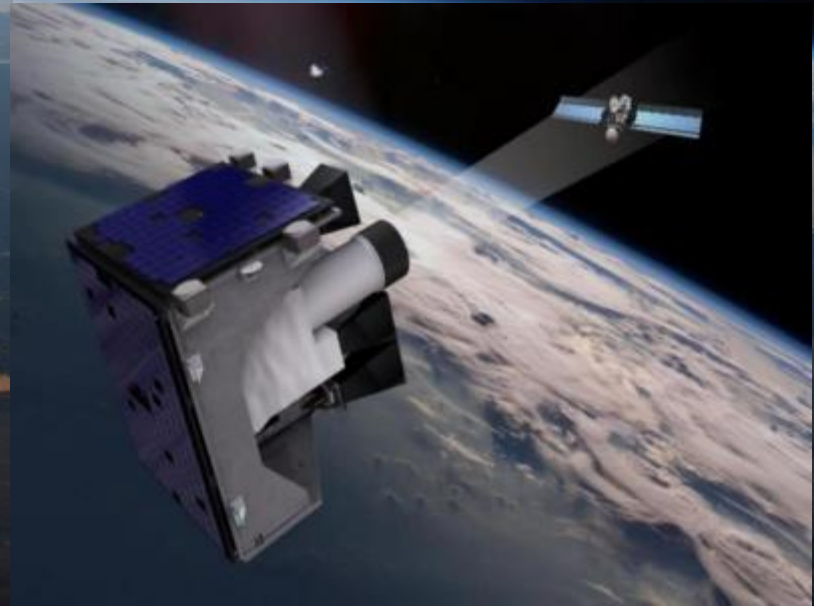
CANADA'S CURRENT SSA CAPABILITY



UNCLASSIFIED

CANADIAN SPACE SURVEILLANCE SYSTEM

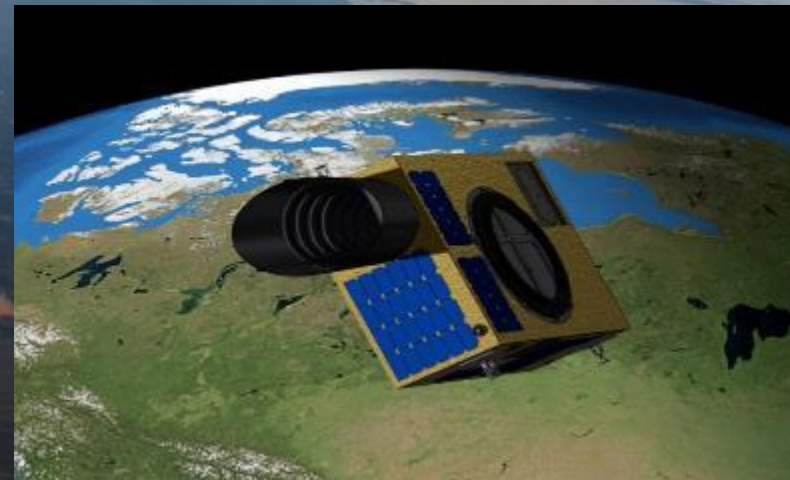
- Launched 25 February 2013
- Mass: ~ 148 kg
- Dimensions: ~ 1 m³
- Orbit: 784 km sun-synchronous
- Tracking Capability:
 - 360 objects per day (requirement)
 - >450 objects per day (proven)
- Field of View: 1.4 degrees
- Brightness Sensitivity:
 - Visual Magnitude 6 to 15 (requirement)
 - Visual Magnitude 16 (proven)
- Design life: 5 years (goal of 7)



UNCLASSIFIED

NEAR-EARTH ORBIT SURVEILLANCE SATELLITE (R&D)

- Joint project between CSA and DRDC
- Dual mission microsatellite:
 - Asteroid astronomy, and
 - Space Situational Awareness (SSA) research
- Prime Contractor: Microsatellite Systems Canada Inc. (Mississauga, ON)
- Launched 25 February 2013
- Mass: 74 kg
- Dimensions: 137 × 78 × 38 cm
- Orbit: 792 km sun-synchronous



UNCLASSIFIED

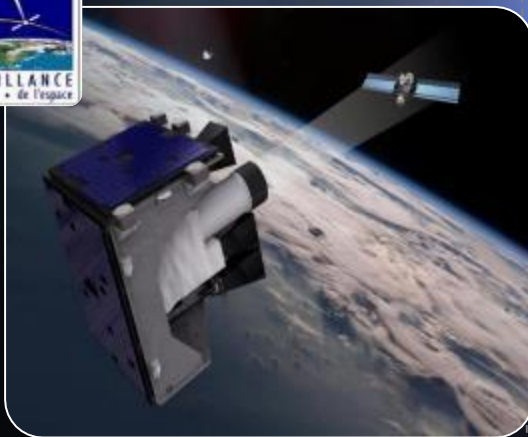
CANADA'S FUTURE SDA CAPABILITY



UNCLASSIFIED



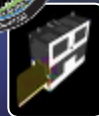
**S&T/SSA
MicroSat**
(Near Earth Object
Surveillance Satellite)
(NEOSSat)



Sapphire



Today



**S&T/SDA
Multipurpose
Space
Surveillance
(MSS-Sat)**



**Surveillance of Space 2
(SofS 2)**



Project

**SDA IS CRITICAL FOR PROVIDING THE OPERATING PICTURE OF ALL ACTIVITIES
IN SPACE FOR THE PROTECTION AND DEFENCE OF KEY SPACE ASSETS.**

UNCLASSIFIED

SURVEILLANCE OF SPACE 2 PROJECT

Aim

Sustain SSA strategic relevance and Allied burden sharing

Key Stakeholders



RCAF



CJOC



SSN (US)



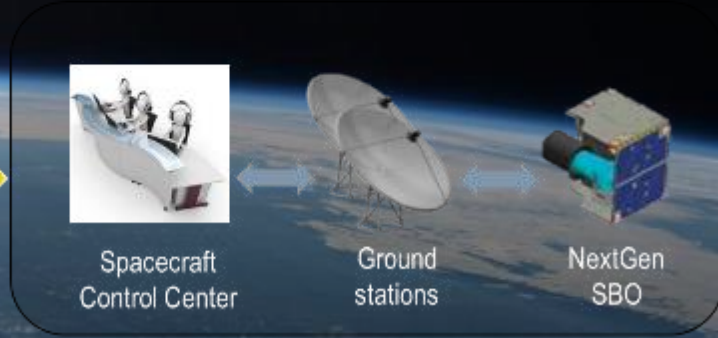
CSpO (Allied)



GBO Sensor Segment



Sensor Systems Ops Centre



SBO Sensor Segment

- SofS 2 intends to deliver both a Ground-based Optical (GBO) sensor system as well as an Space-Based Optical (SBO) sensor system.
- SofS 2 will support both national and allied space surveillance missions

UNCLASSIFIED

SURVEILLANCE OF SPACE 2 (SOFS 2)



PROJECT SCOPE:

SofS 2 will enable the RCAF to continue performing deep space surveillance for the protection of Canadian deep space assets, mission assurance for space-based capabilities that support the CAF, and to ensure Canada is an active contributor to the operations of the US Space Surveillance Network (SSN). Preferred option consists of both Space-Based Optical (SBO) and Ground-Based Optical (GBO) systems.

NEXT STEPS:

Project Approval to enter the Definition (Def) phase in Fall 2021 in order to begin engineering studies and issue Requests for Proposals (RFP).

PROJECT STATUS:

- In Options Analysis

- Def: Fall 2021

GBO

- Imp: 2024
- IOC: 2025
- FOC: 2026

SBO

- Imp: 2025
- IOC: 2029
- FOC: 2030

- Preliminary Estimate

- Total Project Value: \$100M-\$250M

CONTACT INFORMATION:

Project Director: Maj Charles Wood

Email: Charles.wood2@forces.gc.ca

QUESTIONS?

For industry questions regarding SofS 2:

- Refer to the information available on buyandsell.gc.ca
- RFI W8474-207923/A (GBO) & RFI W8474-187639/B (SBO)
- Point of Contact: Alan Chan, PSPC

UNCLASSIFIED

ROYAL CANADIAN
AIR FORCE



AVIATION ROYALE
CANADIENNE

'Strong, Secure and Engaged'

The Next Generation of Canadian
Space Domain Awareness



Mr. Cam Stoltz (Col Ret'd)
Director Space Requirements
28 April 2021

