Lunar Gateway

Canadarm3

SatCan
Industry update

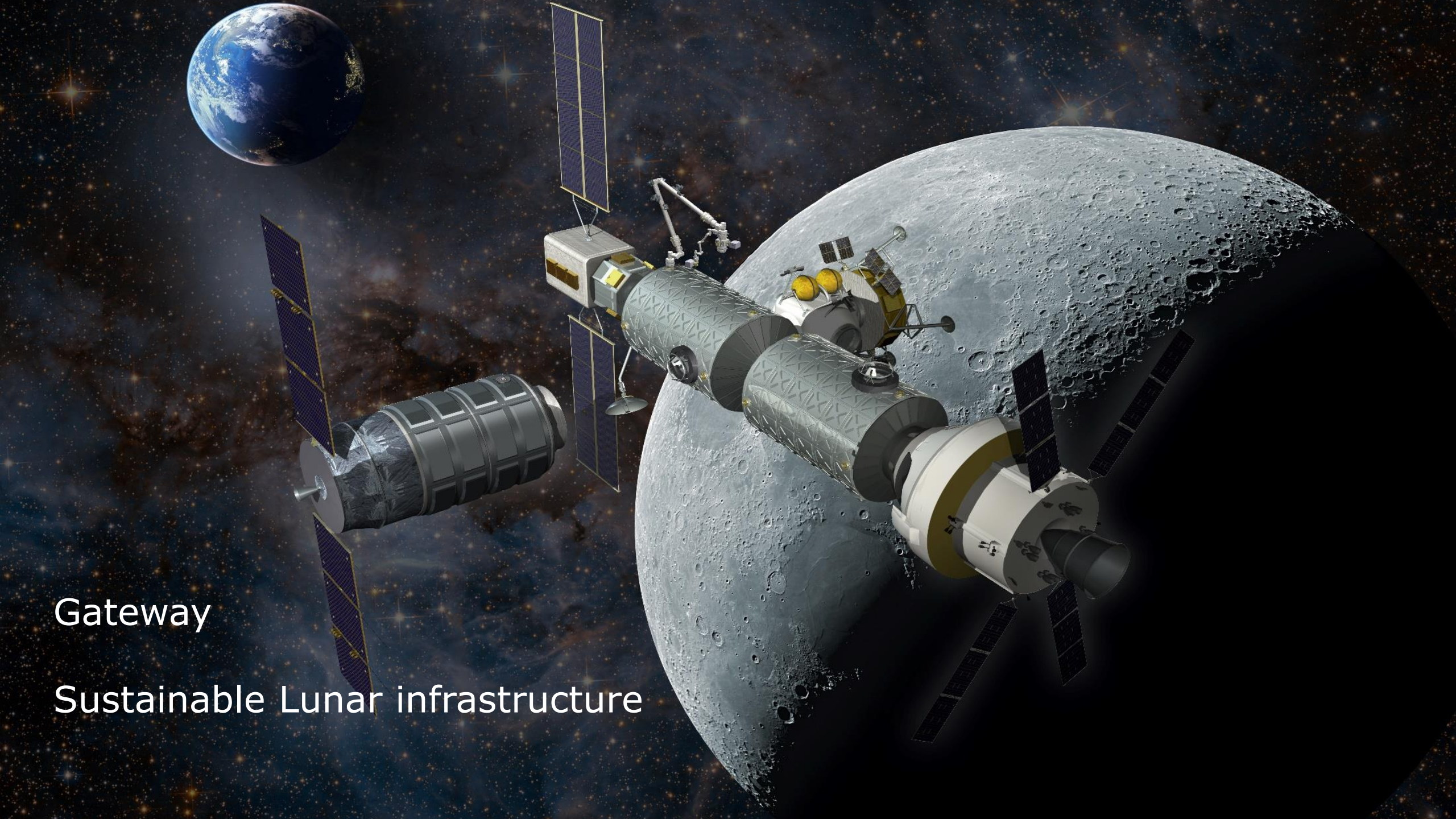
21 September 2020

Reaching for the Moon

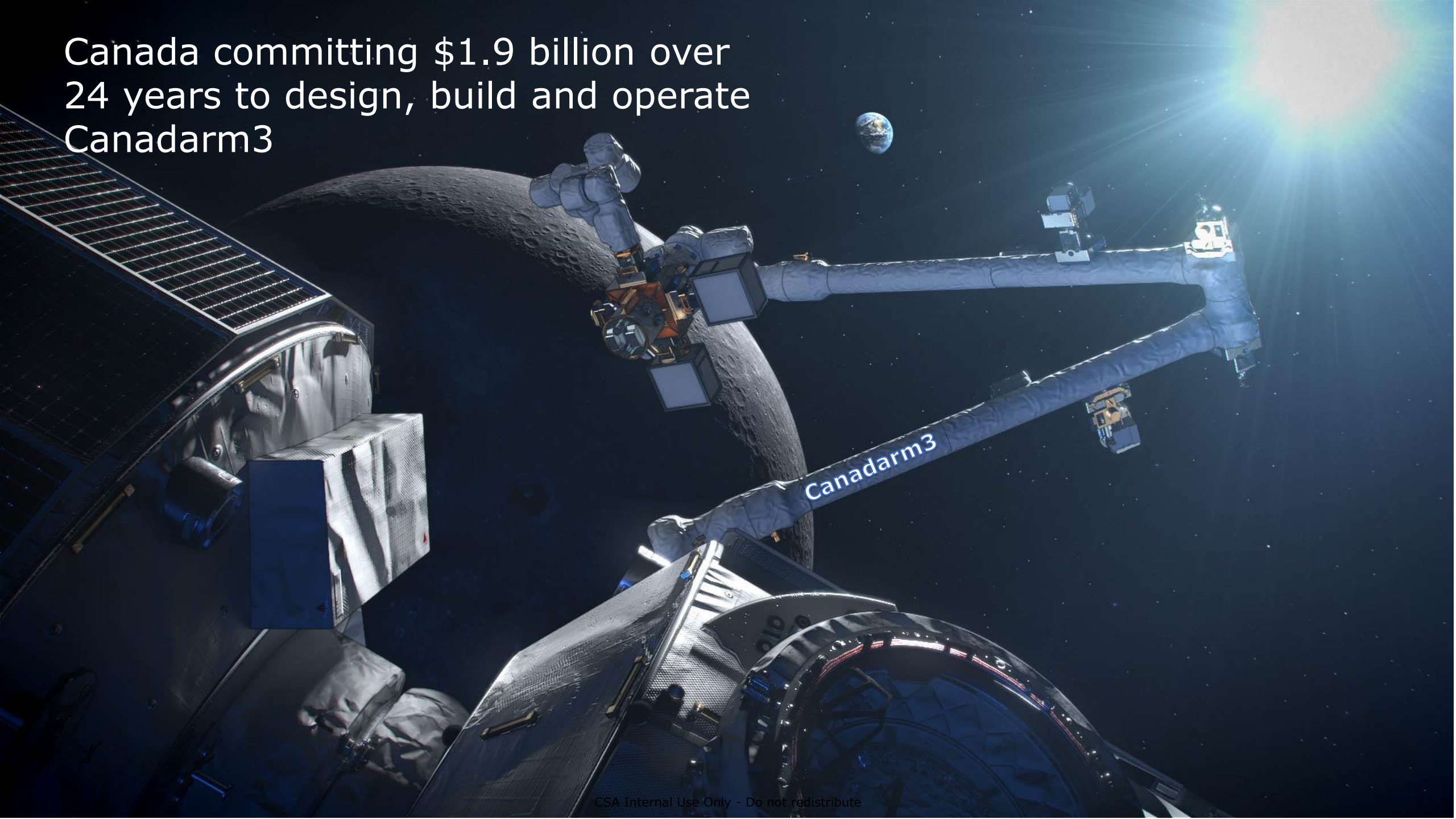
Government of Canada's 2019 Announcements on Space Exploration

- Gateway: Canadarm3
- Lunar Exploration Accelerator Program
- Junior Astronauts Initiative


GATEWAY

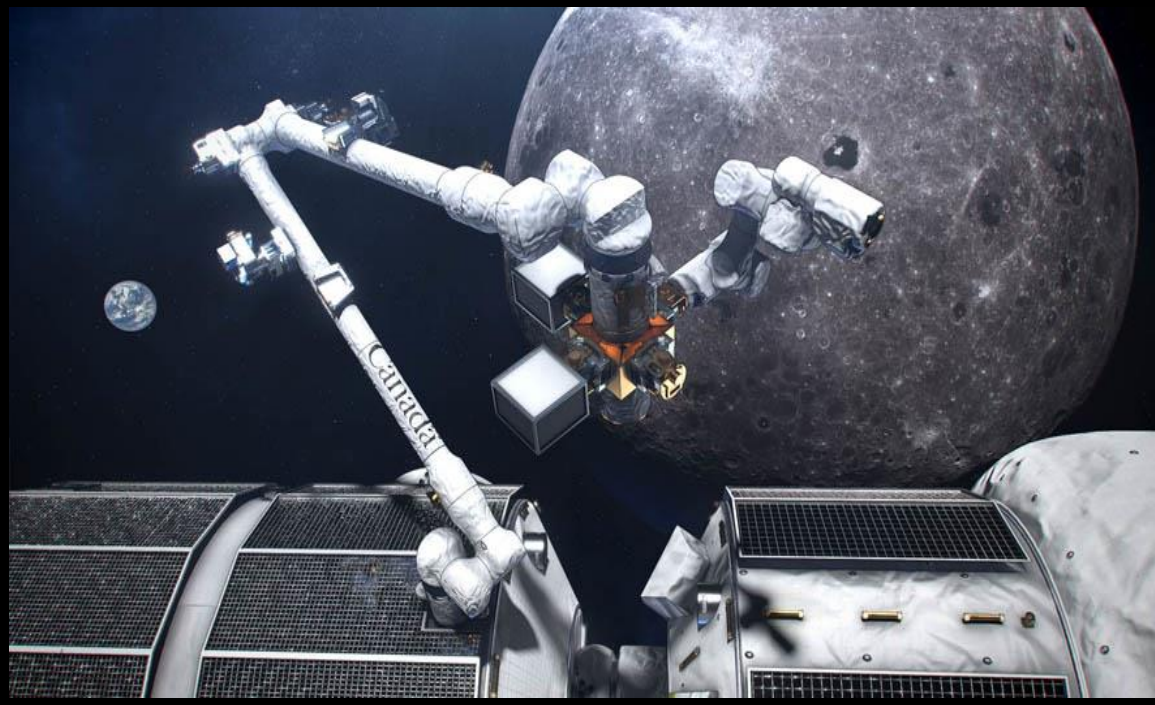

Gateway
Sustainable Lunar infrastructure

Canada committing $1.9 billion over 24 years to design, build and operate Canadarm3



Canada's Robotic System Concept

- The eXploration Large Arm (**Canadarm3**) and its Tools
  - Allows the system to perform inspection and maintenance operations, deploy payloads, capture and berth visiting vehicles, support spacewalking Astronauts, reconfigure the Gateway and assemble Lunar Landers
- The eXploration Dexterous Arm (small arm)
  - Enhances the capabilities of the large arm and perform its maintenance, possibly can be deployed inside Gateway for Intra-Vehicular Robotics
- Gateway External Robotic Interfaces (**GERI**)
  - 2 Types:
    1. Large (Basepoints): Allows large arm to access (walk to) elements of the Gateway
    2. Small (Payloads): Required for any payload handling
  - Robotic interfaces will be on first Gateway module (2023)
  - Phase A contracts concluding



Canadarm3 Concept
Industry solutions pending

- Ground Segment (GS) and Robotic Integration
  - Ground infrastructure that will provide planning, monitoring, commanding, and visualization functions in support of operating the Robotics system from Canada
  - End-to-End planning, integration, and execution of Gateway External Robotics: Assembly, maintenance, logistics and utilization
- Artificial Intelligence (AI) – Autonomy Capabilities
  - Autonomy and AI-driven operations needed to achieve higher level of self-reliance and efficient operations

Technology Transfer & Commercialization (TT&C)

- Canadarm3 procurement strategy aims to spur industrial collaborations, SME development and R&D synergies
- Support TT&C and help grow the Canadian innovation ecosystem

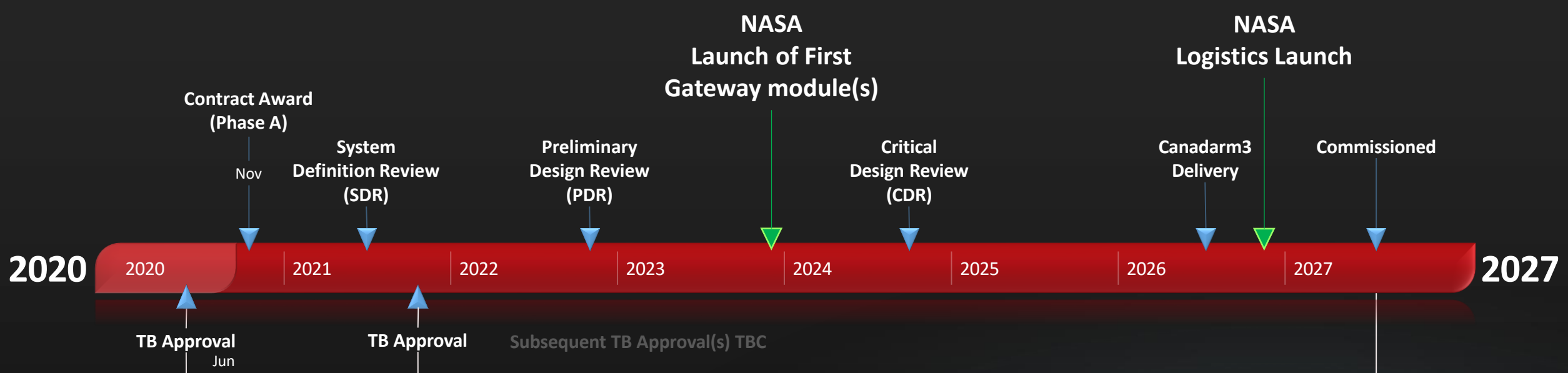
  (Industry ⇔ Research ⇔ Government)

  - Enabled by Government Policy and Programs
    - *Industrial & Technological Benefits policy (ITB) / Canadarm3 Value Proposition*
  - Innovation Superclusters Initiative and Ecosystems development
  - Partnerships & Sponsorship to advance technologies, opportunities, R&D
    - *CSA Space Technology Development Program (STDP)*
    - *CSA Lunar Exploration Accelerator Program (LEAP)*
    - *National Research Council (NRC)*
      - *Industrial Research Assistance Program (IRAP) and NRC Research*
    - *Universities, research consortiums, etc.*
- Industry Day Webinar targeted for end of November

Technology Challenges ahead

- Canadarm3 is a Robotic System
  - Highly capable
    - Next step in Space Robotics evolution
  - Compact
    - Joints, Control Electronics, Materials (Advanced Manufacturing)
  - Novel features
    - Autonomy and AI
    - Self deploying, self-repair
  - Tools and Sensors
    - Vision System, Proximity sensing, Inspection, Safety
  - Ground Segment
    - Design, development, planning, training, operations, data tending tools
  - Communications & STEM
- New challenges
  - Radiation, thermal
  - Contamination (Lunar dust)
  - Landers, sample return, refueling

Notional Schedule



Canadarm3:

First Definition Phase A

Subsequent Phase definition(s) TBC

Subsequent definition Phases (B/C) & Implementation Phase (D)

Operations Phase (E)

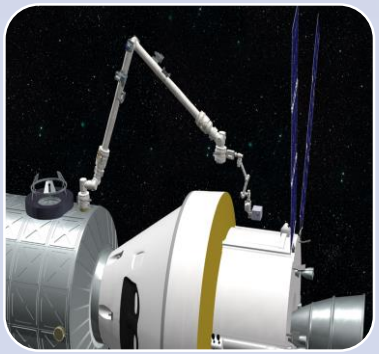
Robotic Interfaces:

First Definition Phase A

Subsequent Procurement strategy TBC

Questions?

Key to a Sustainable Gateway



INSPECTION & SAFETY

Canadarm3 offers the ability for Crew and/or Ground to inspect all exterior surfaces:

Gateway and Visiting Vehicles

"First look"

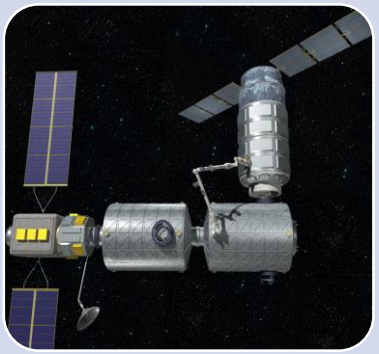
Critical Safety function

VEHICLE CAPTURE

Equipped with a *Free Flyer Capture Tool,* the Canadarm3 can track and capture visiting vehicles

Increases: Mission Success Partnership

Reduces: Mass, Energy, Cost, Risk



ASSEMBLY & RECONFIGURATION

Accommodates infrastructure change, mission re-planning, and enables new objectives

Flexibility, physical connection, interface options, docking and GN&C budgets

LOGISTICS & MAINTENANCE

Service external equipment via replacement and/or transfer to Gateway Airlock for IVA repair

Essential to external resupply & utilization

Untended Ops

Reduced EVAs

Self-maintainable

EVA SUPPORT

Support Astronauts on planned and/or contingency EVAs

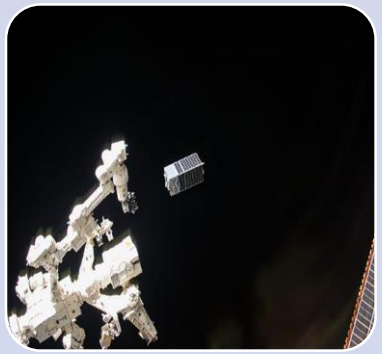
Accessibility

Work platform

Logistics support

Crew transfer

Crew efficiency



SCIENCE

Enables robotic hosting, deployment, and maintenance of science payloads

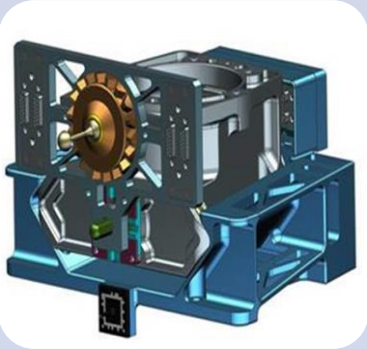
Compatibility with Science Airlock

Increased utilization capacity

Utilization management

Technology demonstration

Key to a Sustainable Gateway



ROBOTIC INTERFACES

Standardized interfaces for simpler integration

Low-Profile Basepoints

Lower-mass Payload Interfaces

Power, Data, Video

Utilization Platform

AUTONOMY

Automated Mission Planning & Ops tools

Enhanced situational awareness

Efficiency

Earth independence

SENSORS & TOOLS

External Cameras

Vision System LIDAR, IR, 3D