Joint ICG-IOAG Multilateral Cislunar PNT Workshop
11-13 February 2025
Vienna, Austria

Outline of Lunar Exploration Scenario in ISECG

Kota TANABE

Co-Chair
International Architecture Working Group (IAWG)
International Space Exploration Coordination Group (ISECG)

Director, Space Exploration System Technology Unit
JAXA Space Exploration Center (JSEC)

Self-introduction (Biography)

1995.4 :	Joined JAXA (Former NASDA)
~ 2001.12 :	Tracking and Control Center
	✓ *ETS-VII (Rendezvous & Docking Experiment)*
2002.1 ~ 2004.12 :	Permanent Mission of Japan in Vienna
	✓ *Special Advisor to COPUOS*
2005.1 ~ 2013.12 :	HTV Project Team
	✓ *Communication subsystem development*
	✓ *Lead Flight Director for HTV2*
2014.1 ~ 2016.7 :	HQ / Human Resources Department
2016.8 ~ 2021.6 :	HTV Technology Center
	✓ *Project Manager for HTV Small Re-entry Capsule*
2021.7 ~ Now :	Space Exploration System Technology Unit
	JAXA Space Exploration Center (JSEC)
	✓ *Director of the Unit*
	✓ *Co-chair of the ISECG/IAWG*

HTV7 Departure from ISS (with HTV Small Reentry Capsule)

Recovery of HTV Small Re-entry Capsule

International Space Exploration Coordination Group

ISECG is a voluntary, non-binding coordination forum of space agencies which:

- Exchange information regarding interests, plans and activities in space exploration
- Work together to strengthen both individual exploration programmes and the collective effort

Principles

- Open and inclusive
- Flexible and evolutionary
- Effective
- Supportive of mutual interests

Origin and foundation

- In 2006, 14 space agencies began a series of discussions on global interests in space exploration.
- The Global Exploration Strategy, the framework for coordination, was released in May 2007.
  - ✓ A key finding of this framework document was the need to establish a voluntary, non-binding international coordination mechanism through which individual agencies may exchange information regarding interests, objectives, and plans in space exploration with the goal of strengthening both individual exploration programmes as well as the collective effort.

International Space Exploration Coordination Group

ISECG
International Space Exploration Coordination Group

27 Agencies
11 working groups
220+ individuals

International Space Exploration Coordination Group

ISECG Senior Agency Managers from participating space agencies at the European Astronaut Centre in Cologne, Germany (December 2024)

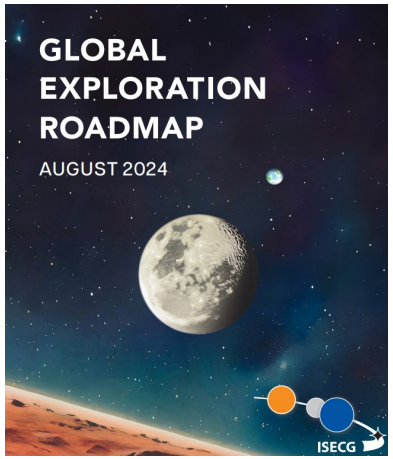
Working groups

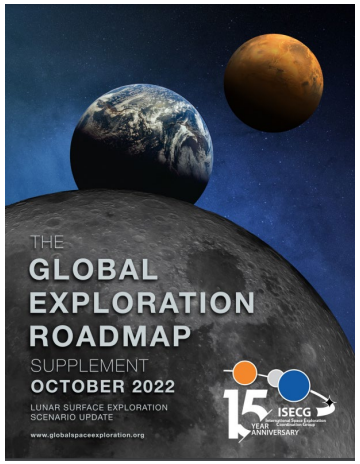
- Senior Agency Managers (SAM)
- ISECG
- Analogues Action Team (AAT)
- Emerging Agencies (ESWG)
- Roadmap (ERWG)
- Strategic Communication (SCWG)
- Architecture (IAWG)
- Nuclear Action Team (NAT)
- Science (SWG)
- Technology (TWG)
- Benefits Tiger Team (BTT)
- Commer-Cialisation (CWG)
- LSS Gap Assessment Team

International Space Exploration Coordination Group

Knowledge sharing and critical thinking

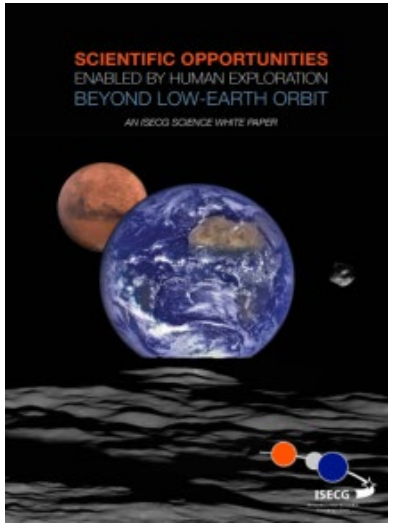
Global exploration roadmap

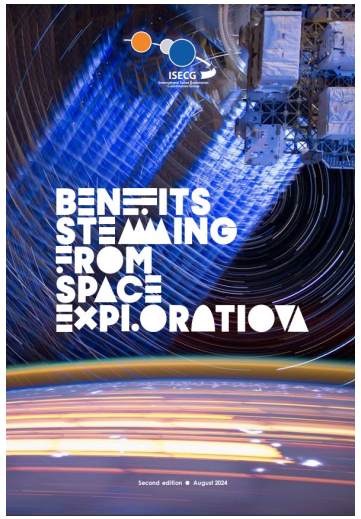




Moon surface scenario

Science white paper





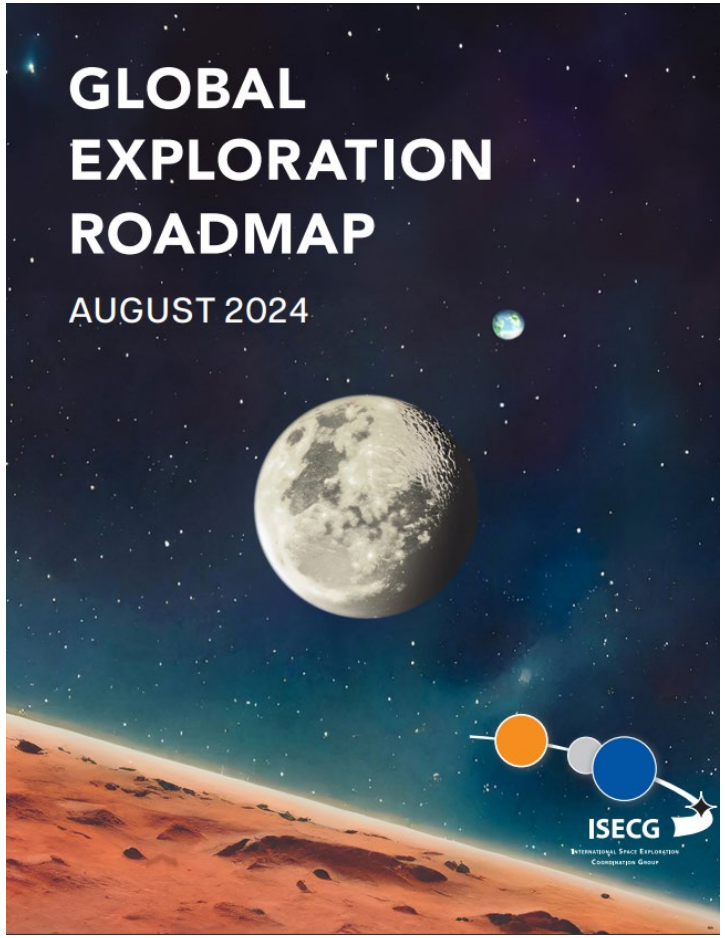
Benefits white paper

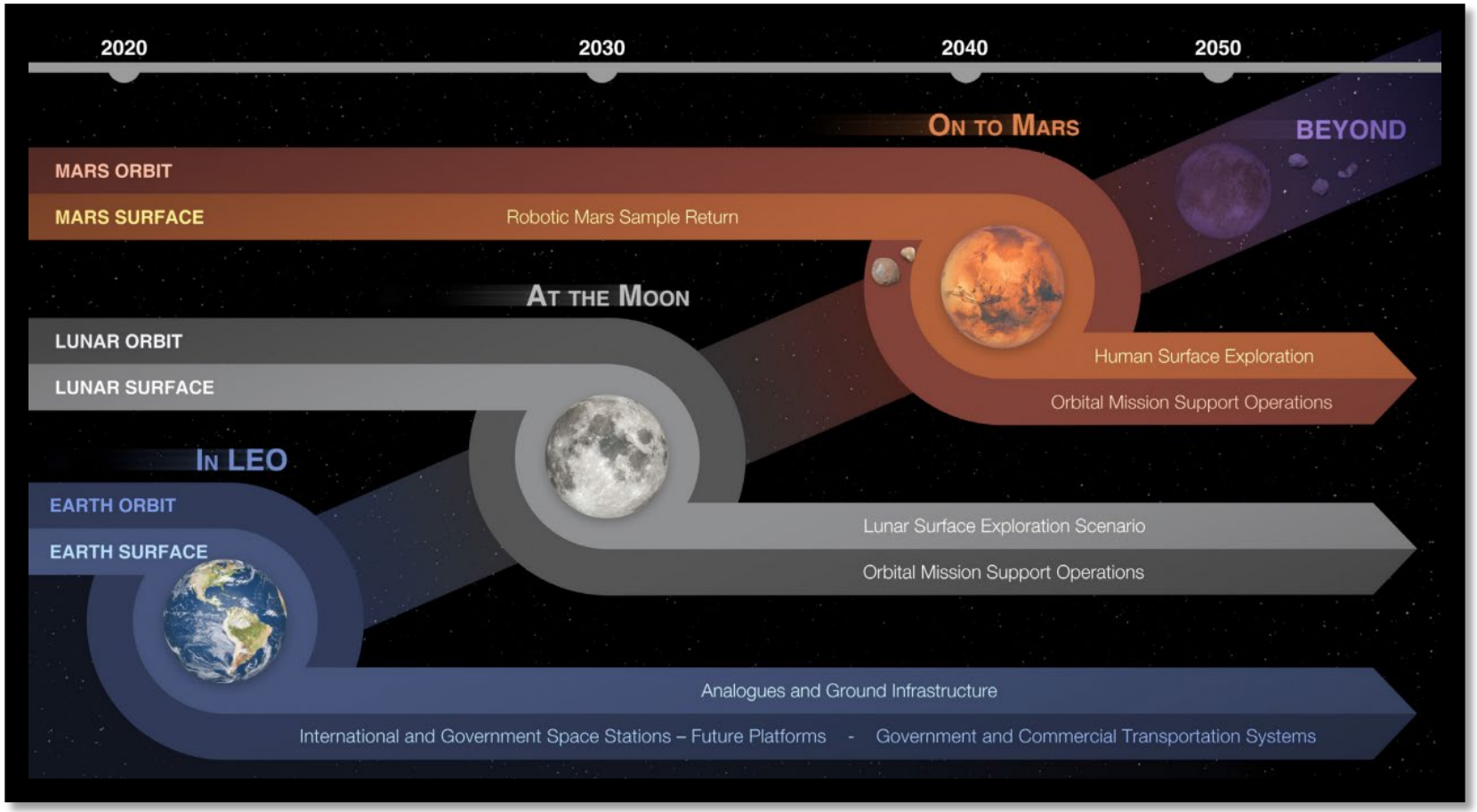
Global exploration critical technologies needs

- Lox/Methane propulsion
- Dust mitigation
- Autonomy
- ISRU
- Nuclear power and propulsion

In work: : Life Support Systems

Global Exploration Roadmap 2024
Following a shared path





https://www.globalspaceexploration.org/?page_id=1371

ORGANIZED BY:

ASTRONAUTICA AD PACEM HOMINUMQUE PROGRESSUM

HOSTED BY:

AIDAA
ASSOCIAZIONE ITALIANA
DI AERONAUTICA E ASTRONAUTICA

CO- HOSTED BY:

ASI Agenzia Spaziale Italiana

LEONARDO

SUPPORTED BY:

IAA INTERNATIONAL ACADEMY OF ASTRONAUTICS

IISL

SGAC

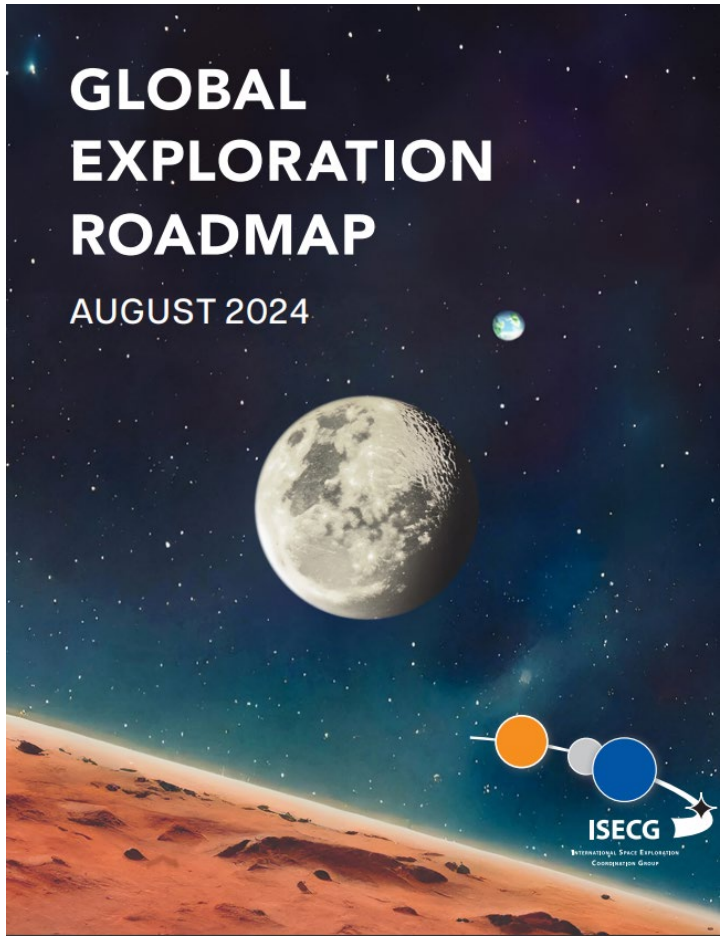
MILAN 2024

iac 75th INTERNATIONAL ASTRONAUTICAL CONGRESS

14 – 18 OCTOBER 2024 MILAN – ITALY

RESPONSIBLE SPACE FOR SUSTAINABILITY

Global Exploration Roadmap 2024
Following a shared path



2024 edition – high level refinements

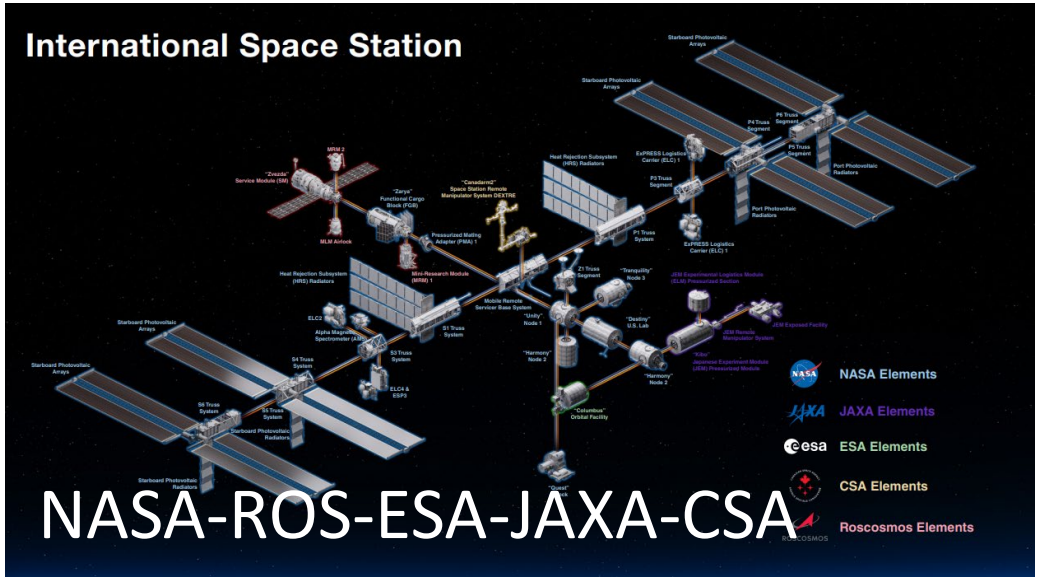
- An expanded vision from 27 space agencies including contributions from emerging space agencies
- Horizon to 2050, with an emphasis on sustained exploration
- Benefits of space exploration
- Scientific knowledge made possible
- Activities beyond the Moon and Mars, with an emphasis on synergies between robotic and human exploration
- Critical technologies that will enable humans to live on and explore the Moon for long periods of time

Global Exploration Roadmap 2024
Following a shared path

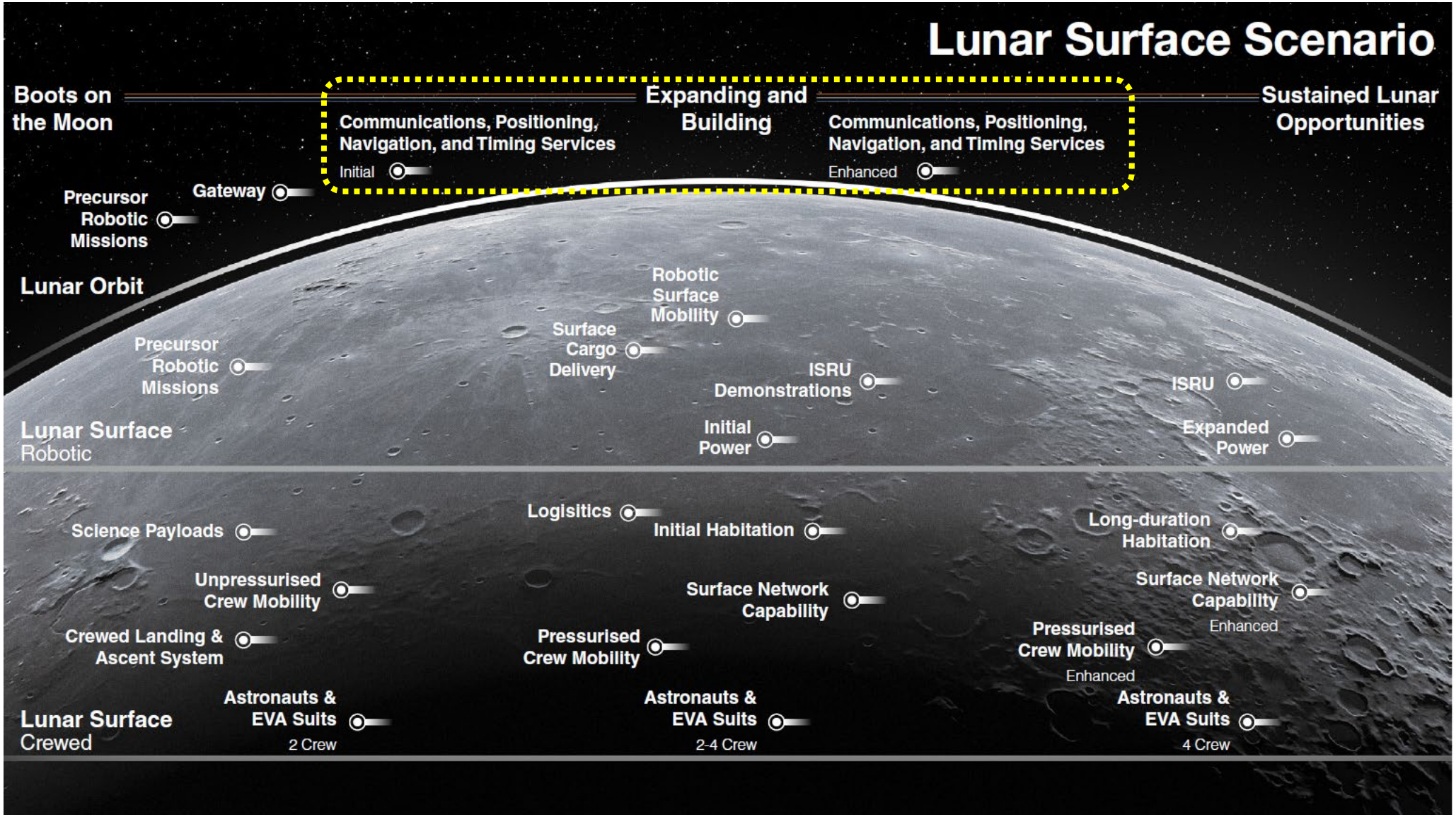
2024 edition – increasing industry capabilities

- Spaceflight, especially human systems, transitioning from government funded capabilities to commercial services available to many agencies and individuals
- New commercialization efforts from NASA, CSA, ESA, UK, JAXA and many others
- Possibly allowing lower costs to more agencies, enhancing space exploration and strengthening the space economy and benefits on Earth

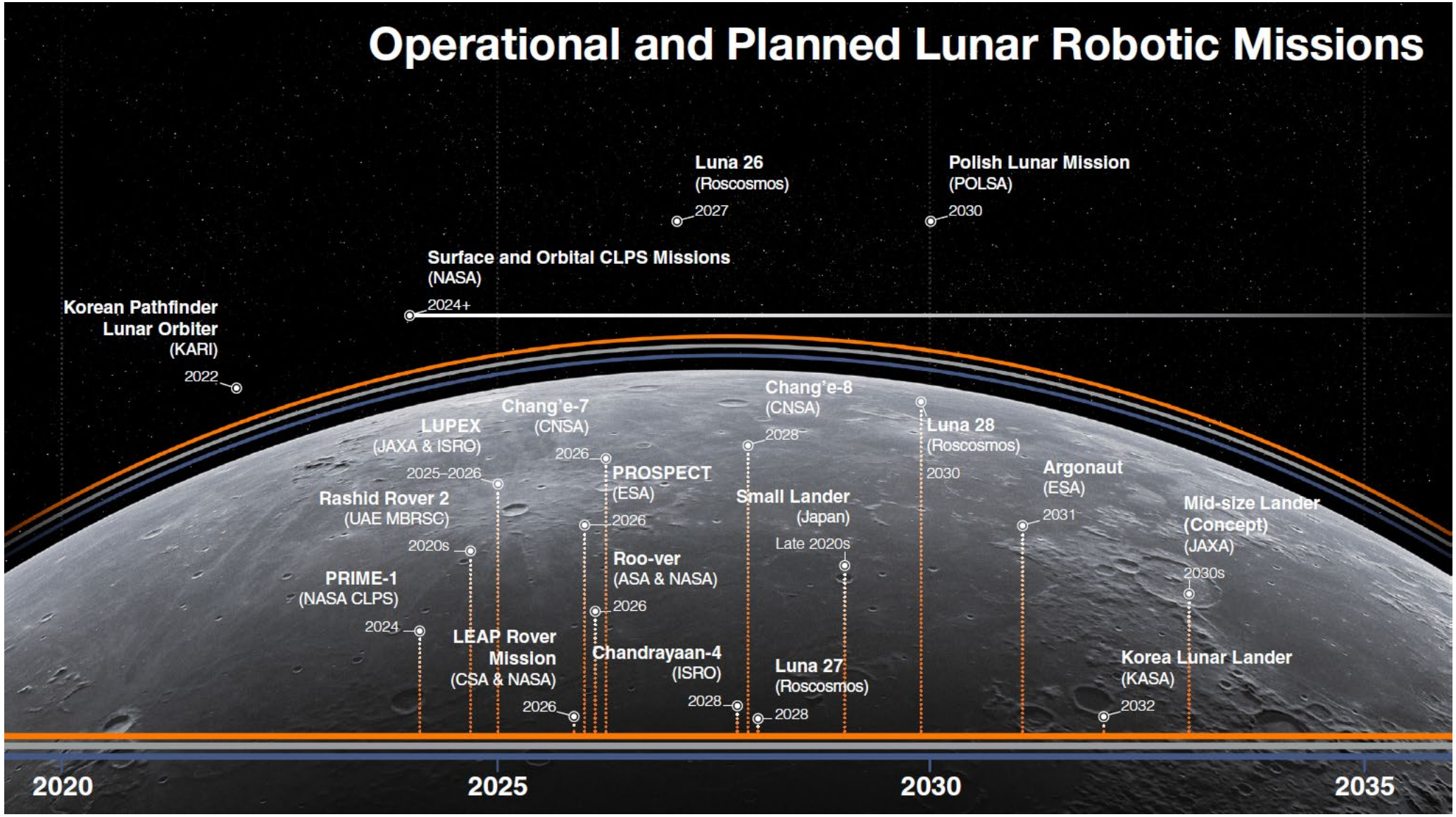
Trends & development – **Low Earth Orbit**



Trends & development – **Moon**



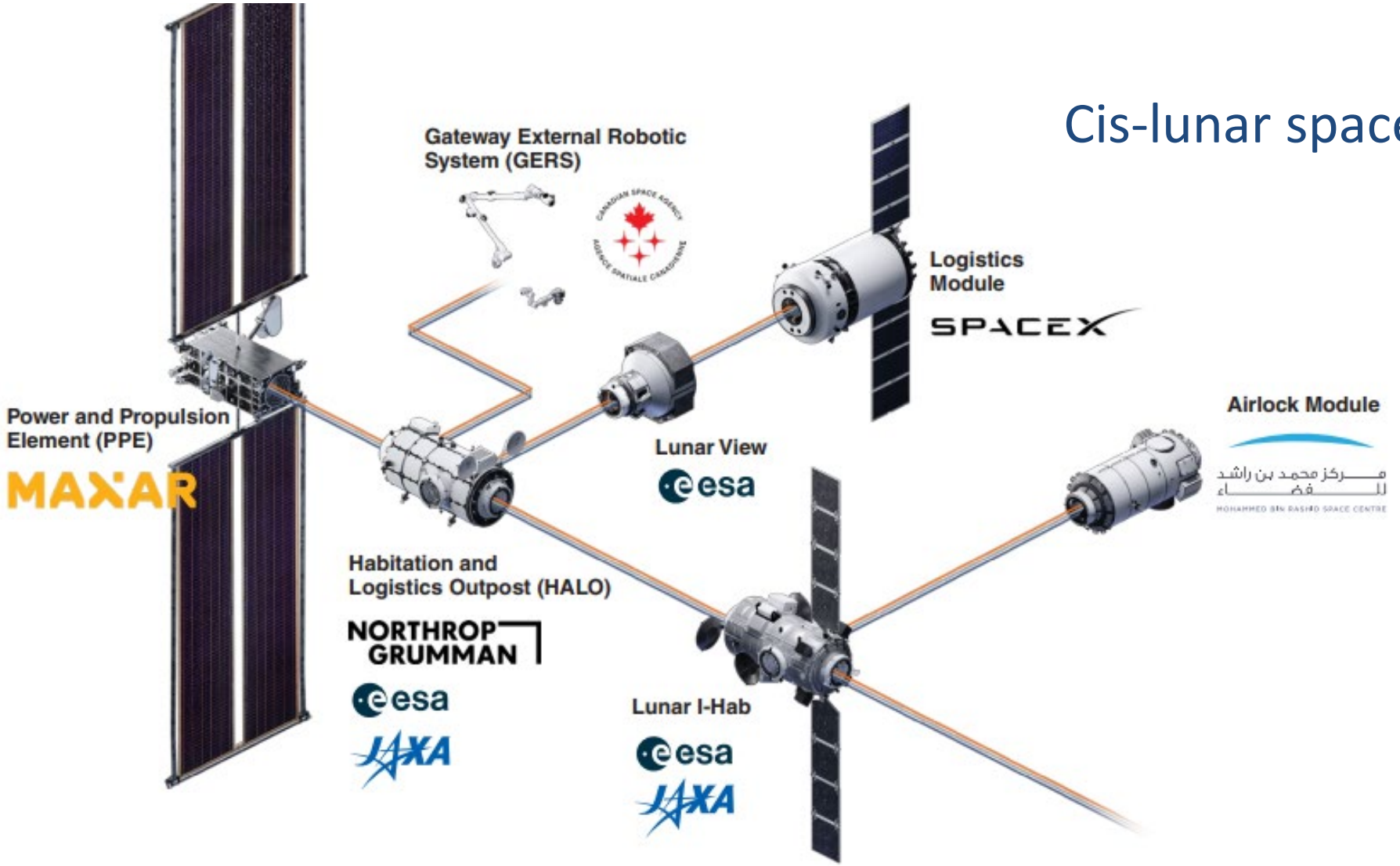
Trends & development – **Moon**



Trends & development – **Humans exploring the moon (1/2)**

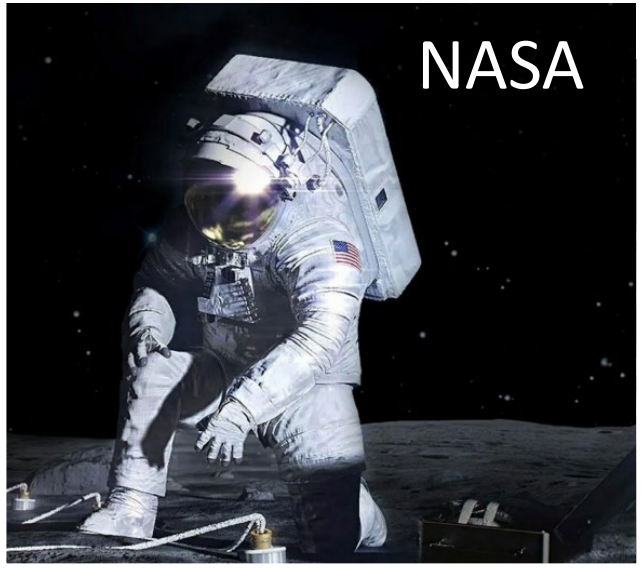
ISECG
International Space Exploration Coordination Group

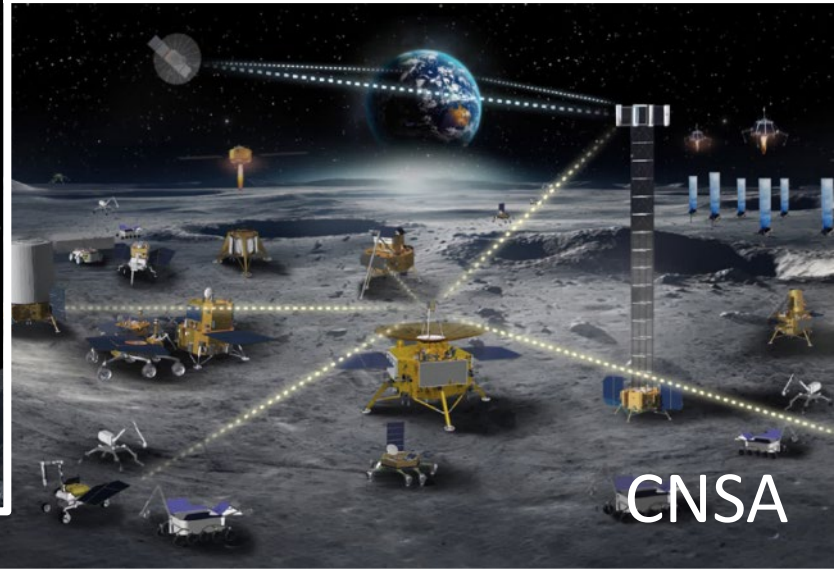
Cis-lunar space

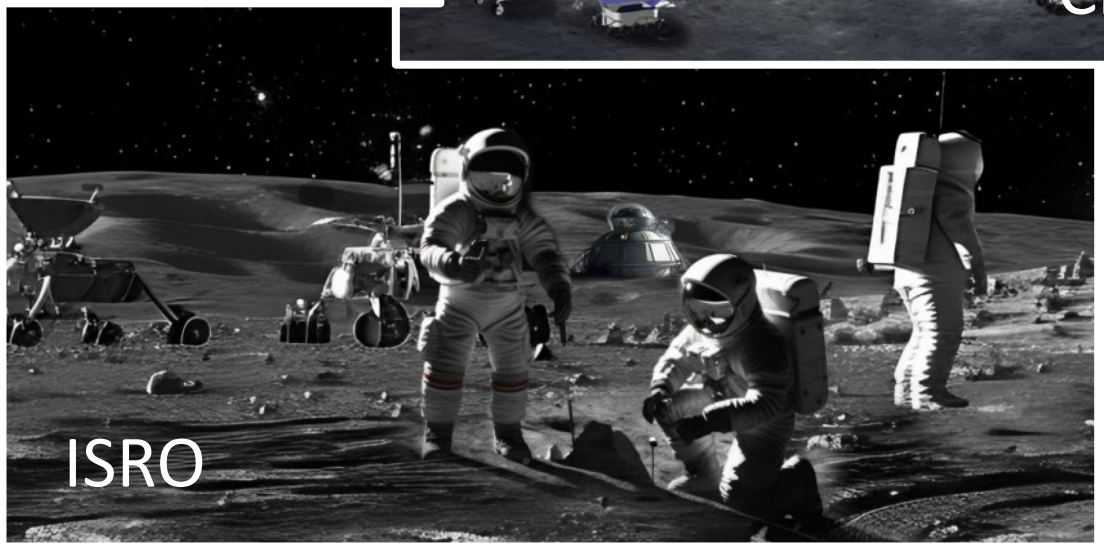


Trends & development – **Humans exploring the moon (2/2)**

ISECG
International Space Exploration Coordination Group







Trends & development – **Communication & Navigation**

GER2024 indicates the importance of the Communication and Navigation technology to support future lunar exploration

Communications and Navigation for Lunar Exploration

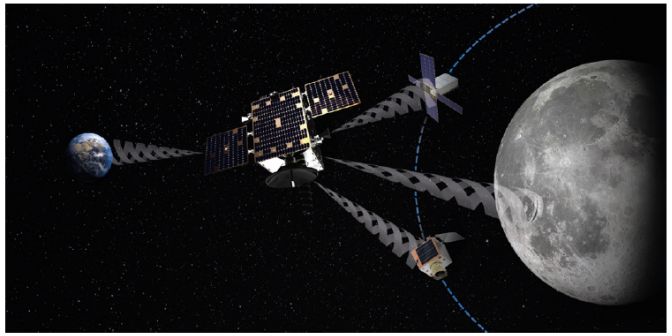
Successful, long-term exploration on and around the Moon will require communication, positioning, navigation, and timing (CPNT) technology for orbiting and surface assets. This CPNT architecture links elements such as spacecraft in lunar and Earth orbit, nodes on the lunar surface, and ground stations on Earth.

Develop infrastructure (e.g., power, communication, and navigation systems) with high availability necessary to achieve the objectives for sustained exploration and continuous human presence		**Power:** 300 kW of power generation **Communications:** 1 Gbps for global lunar coverage Moon-Earth data rate; 100+ Mbps for Earth-Moon data rate **Navigation:** A few meters' accuracy with the reference station on the lunar surface **Additional systems:** TBD

Extract from Lunar Surface Exploration Scenario Objectives (Chapter 5)

Communications and Positioning, Navigation, and Timing

Communications and PNT are essential for all space exploration missions. Long-distance communication between space elements and ground stations requires secure, high-speed transmission of housekeeping data, audio, high-definition video, and mission-related information. Robotic and human activities on the Moon or Mars require positioning and interactive communication coverage across multiple elements. Interoperability and standardisation present many opportunities for international collaboration.



Visualisation of a future lunar telecommunications and navigation infrastructure. (SSTL)

Extract from Critical Technology Areas (Chapter 8)

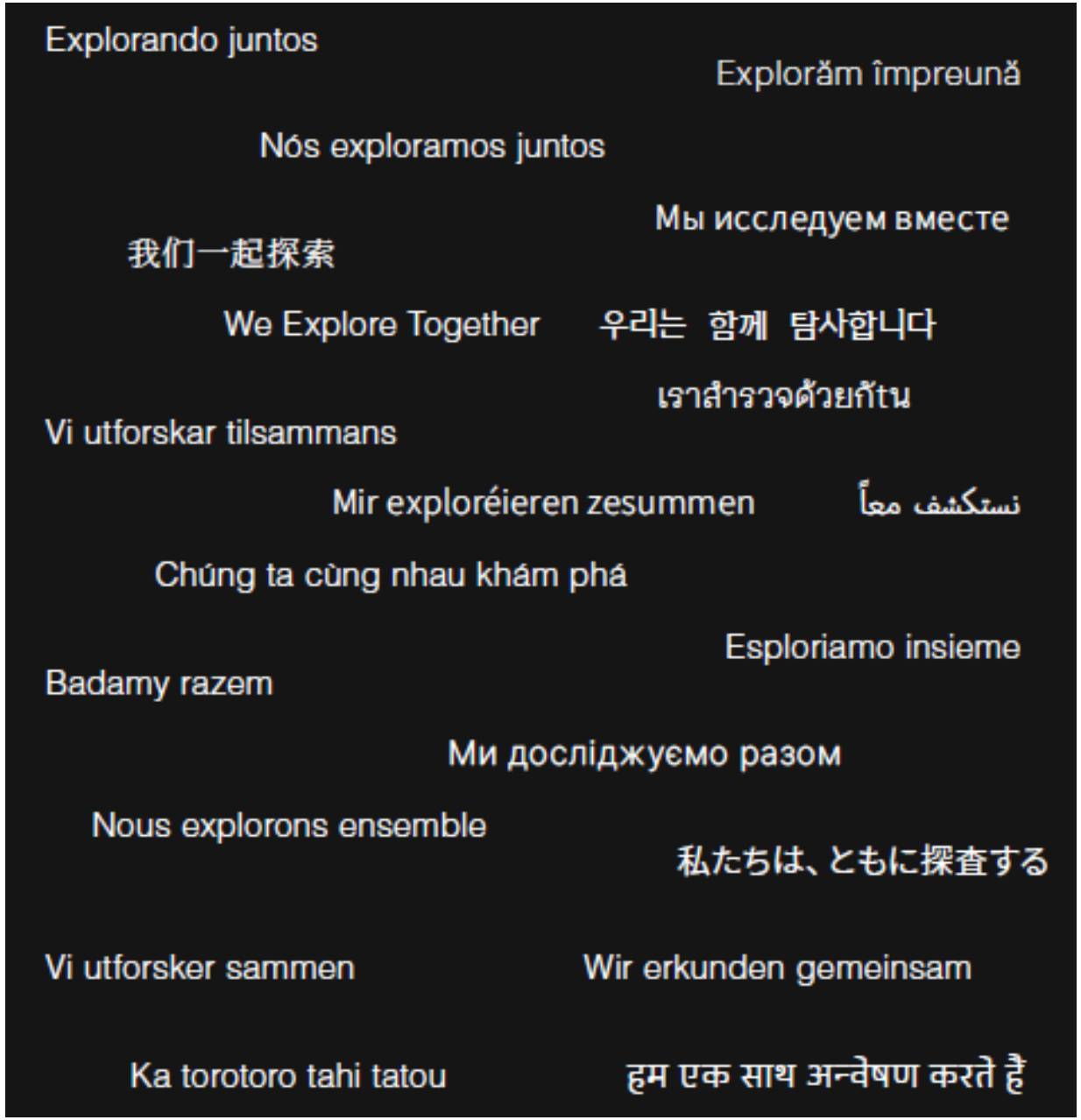
Summary

- **Introduced an overview of ISECG and its working group activities**
  - Voluntary, non-binding coordination forum of 27 space agencies (as of now)

- **Published the updated Global Exploration Roadmap (GER2024) which highlights several key topics including future lunar surface scenarios and planned lunar missions**

- **Cislunar communication and navigation (CPNT) capability is considered as one of the essential infrastructures to support these lunar missions**
  - Necessity of international cooperation for sustainable lunar exploration

Thank you !



ISECG
International Space Exploration Coordination Group