



NASA's Communications Services Program

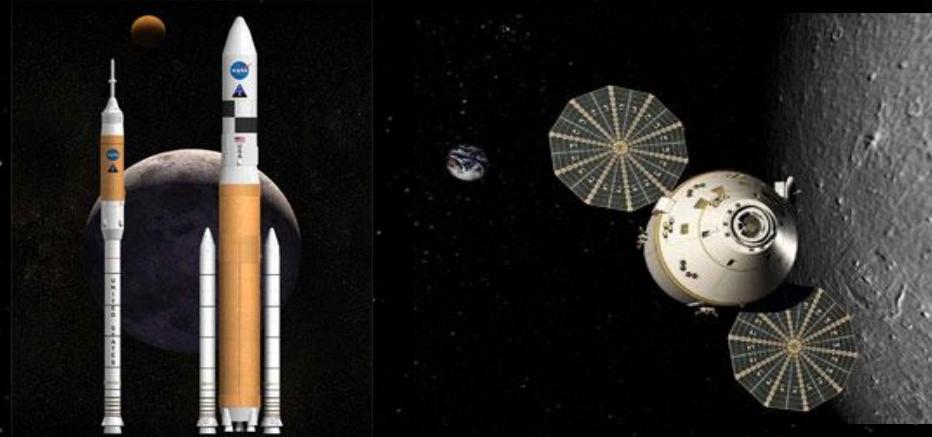
Background, Overview, and Strategy

Philip McAlister

Commercial Spaceflight Development (CSD) Division, NASA HQ
October 2, 2019

How Did We Get Here?

- In 2005, with the phase-out of the Space Shuttle certain, NASA embarked on the Constellation Program, featuring the next generation of traditionally-acquired launch vehicles and spacecraft.
- At about that same time, NASA began a small initiative to have U.S. private industry build, own, and operate spacecraft to resupply cargo to the space station. At that time, only the governments of the U.S., Russia, Japan, and Europe had built such spacecraft.



Constellation Program



Commercial Cargo Program

Fast Forward to 2010

- A Blue Ribbon panel of space experts determined that the Constellation Program was “unsustainable” and the Program was cancelled.
- Even though the Commercial Cargo Program had not launched anything at that time, most of the development was complete and it was going well. Preliminary indications were that the cost of the commercial cargo spacecraft were going to be substantially less than a similar, traditionally-acquired spacecraft would have cost.
- NASA “double-downed” on its strategy to outsource space operations to the private sector by announcing the Commercial Crew Program designed to assist in the development of privately-owned and operated spacecraft to transport astronauts to/from the International Space Station.
- A contentious debate ensued about the future of U.S. human spaceflight.

Common Criticisms

- The “commercial” approach is unproven and risky.
- Private industry is not financially or technically capable of doing a job that only governments have proved to be able to do.
- Private industry will never be able to produce spacecraft as safe and reliable as NASA.
- Private industry will cut corners in order to make a profit.
- The cost savings are illusory.

May 2011



Commercial Crew Program Progress

U.S. National Space Policy

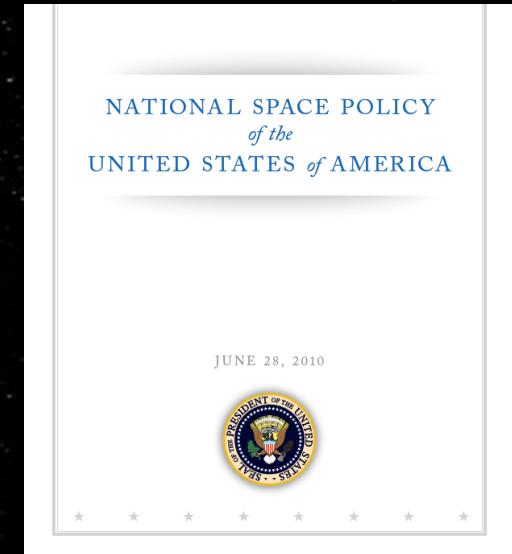
Principle

“A robust and competitive commercial space sector is vital to continued progress in space. The United States is committed to encouraging and facilitating the growth of a U.S. commercial space sector that supports U.S. needs, is globally competitive, and advances U.S. leadership in the generation of new markets and innovation-driven entrepreneurship.”

Commercial Space Sector Guidelines

“To promote a robust domestic commercial space industry, departments and agencies shall:

- Purchase and use commercial space capabilities and services to the maximum practical extent...;
- Modify commercial space capabilities and services to meet government requirements when existing commercial capabilities and services do not fully meet these requirements...;
- Pursue potential opportunities for transferring routine, operational space functions to the commercial space sector where beneficial and cost-effective...”



NASA's Road to Commercialization

2005

Today

Beyond

Commercial Cargo Program

“What I would like to do is to be able to buy [crew and cargo] services from industry...and utilize the market that is offered by the International Space Station’s requirements”

- NASA Administrator
Mike Griffin, June 2005

Commercial Crew Program

“Embrace the commercial space industry...by contracting with American companies to provide astronaut transportation to the Space Station.”

- NASA’s 2011
President’s Budget
Request

LEO Commercialization (International Space Station)



“Transition in a step-wise approach from the current regime that relies heavily on NASA sponsorship to a regime where NASA could be one of many customers of a low-Earth orbit non-governmental human space flight enterprise.”

- NASA Transition
Authorization Act of
2017

Communications Services Program

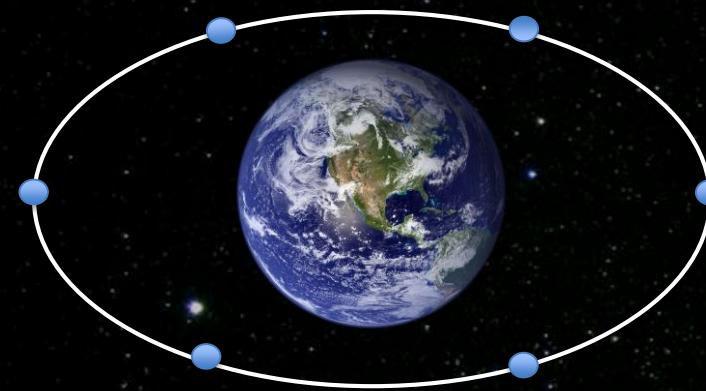


“CSP will...develop an acquisition model for incorporating commercial communications services into operations. NASA will define the acquisition strategy for transitioning near-Earth NASA users to suitable commercially provided services.”

- NASA’s 2020 Budget

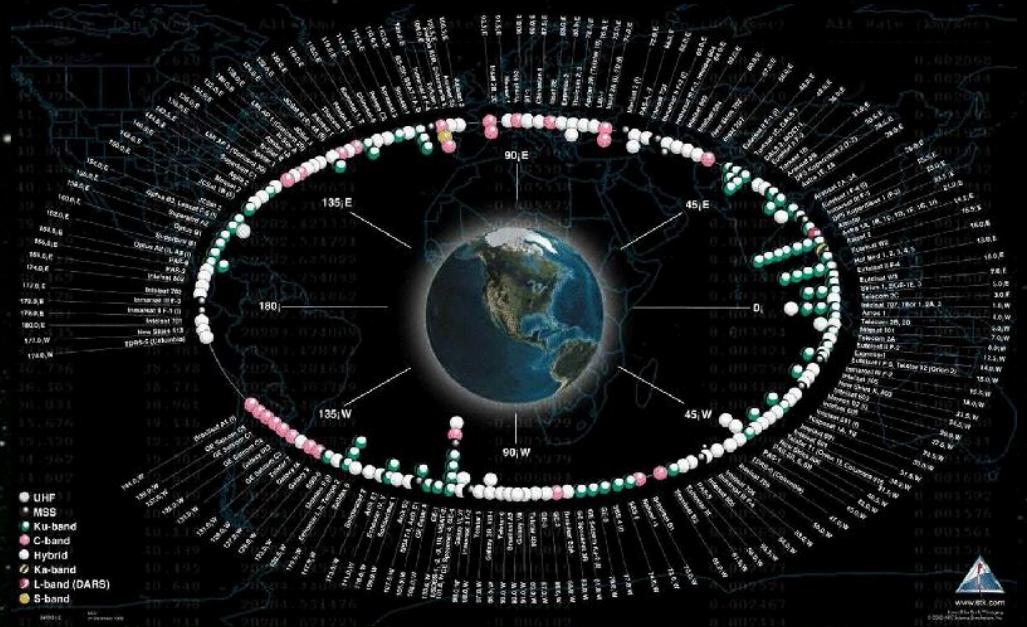
Commercial SATCOM Evolution

1980s



6 Key Commercial Satellites
Around 200 Transponders

Today



Roughly 500 Commercial Satellites
Around 6,000 Transponders

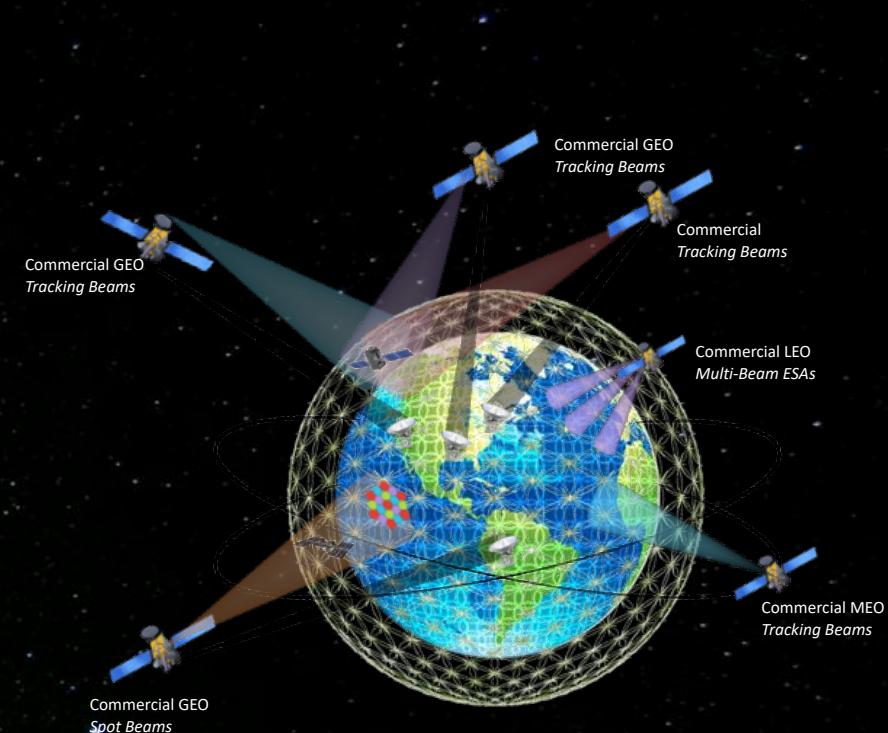
Communications Service Program Overview

FY2020 President's Budget Request (\$M)	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Communications Services Program	3.0	23.4	67.0	101.2	108.9

- The Communication Services Program (CSP) has been established to:
 - Demonstrate the feasibility of commercially-provided satellite communications (satcom) capabilities
 - Acquire future commercial satcom services
 - Phase out reliance on NASA-owned and operated systems
- The CSP will initially pursue opportunities that will allow future NASA missions to deploy flight qualified capabilities for near-Earth users to get satcom services from commercial providers. Longer-term, CSP will be responsible for the acquisition, management, and costs of future operational satcom services, as government assets are retired.
- Benefits include: offering flexible, cost-effective, state-of-the-art satcom services to satisfy NASA mission needs; and promoting a diverse and growing commercial satcom industry.

Communications Services Program Features

- CSP is focused on commercial services and is agnostic on technology (RF, optical), agnostic on orbits (GEO, MEO, LEO), and agnostic on data pathway (relay or direct-to-ground).
- The goal of CSP is to acquire end-to-end commercial satcom services with little to no government furnished equipment or services.
- NASA desires to one of many users and to minimize the need for NASA-unique capabilities.
- Other government agencies will be able to leverage CSP contracts. However, agencies will have to pay for the development of any unique capabilities and subsequent services.



**Conceptual Future
Space Communications
Infrastructure**

Communication Services Program Objectives

- Provide a transition from NASA-owned communication services to commercially provided satcom services that meet NASA's mission requirements
- Provide a standard suite of end-to-end satcom services between the spacecraft and the services, and the service and the mission operation center
- Provide NASA missions with:
 - Delivery of commands and return of telemetry
 - Navigation and timing services
 - The return of the science data created on NASA missions, and support the operation of the science payloads
 - The appropriate level of security
 - Other communication needs (proximity, voice, etc. as required)
- Support missions with real time and near real time data needs
- Provide the scheduling of the needed services
- Commercial spectrum management, certification and compliance

NASA Space Communications Networks

- NASA's Space Network (SN) is a GEO-based relay system also known as the Tracking and Data Relay Satellite System (TDRSS)
 - Unique capabilities include: Global coverage (100% for orbits between 73 and 9,000 km); High data rates (S, Ku, and Ka-band data services); and High-precision tracking and clock-correlation services
- 3 generations of spacecraft comprise the TDRSS Fleet: 10 Active Spacecraft
- 3 Ground Stations and multiple ground terminals form the SN ground segment
- The SN provides multiple services:
 - Forward Data Delivery
 - Return Data delivery
 - Radiometric
 - Science
 - Calibration



- NASA's Near Earth Network (NEN) is a global system of ground based antennas providing tracking and data services for NASA and civil space near earth missions.
 - Provides coverage from early launch to Lunar distances. High, medium and low data rates (S, X, and Ka-band data services)
 - Utilizes NASA owned/contractor operated antennas, commercial ground services, and other space agency antennas
 - A variety of antenna sizes from 7 m to 18 m

NASA Communication Services

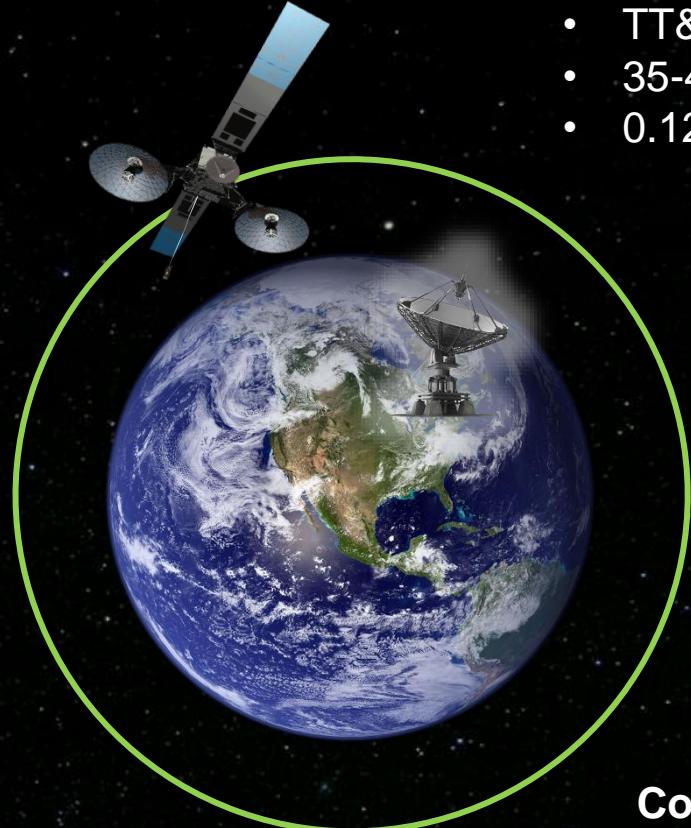
Launch Support

- Launch Vehicle
- SLS, Vega, Antares/Cygnus
- 8 - 10 Missions Per Year
- 400 kbps



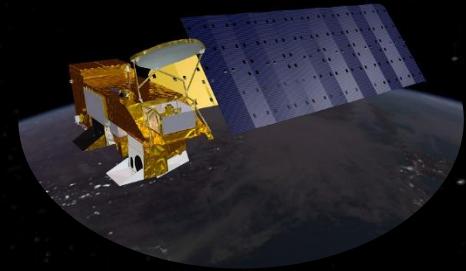
Low Earth Operations (LEOPs)

- Short Duration
- Commercial Crew/Cargo to ISS, Satellites
- 3 Missions Per Year
- 0.125 - 100 kbps



Low Data Rate Routine Missions

- Long Duration
- TT&C of Satellites
- 35-40 Missions Per Year
- 0.125 - 100 kbps



High Data Rate Routine Missions

- Long Duration
- ISS, Gateway, Science Data Return
- 35-40 Missions Per Year
- 1 – 600 Mbps



Contingency

- Services as needed
- Satellites
- 16 Missions Per Year
- 0.125 - 2.048 kbps

Current (2019) Space Network Missions Organized by Missions Type and Data Rate Range

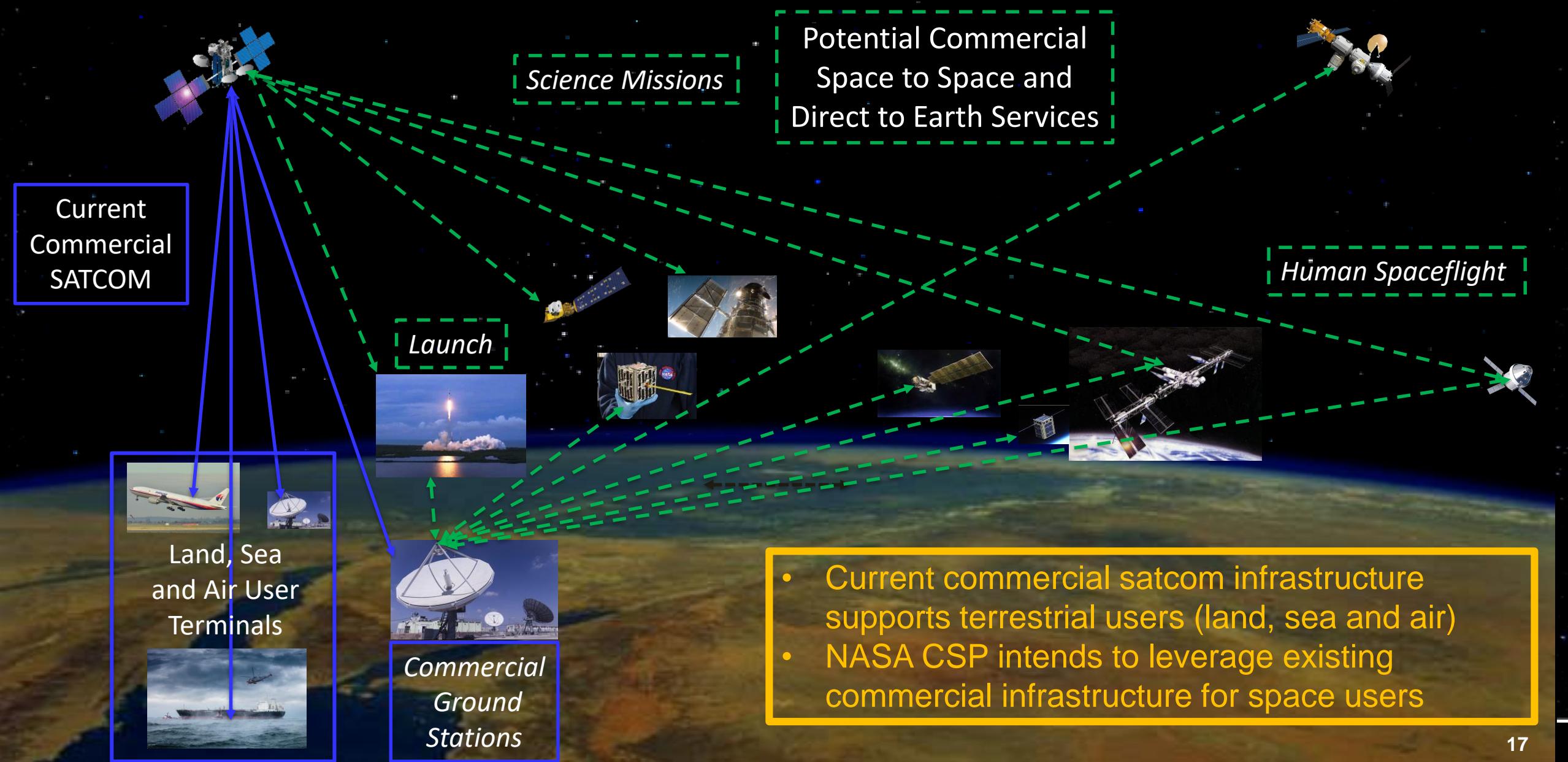
	Type of Mission	Number of Missions	Data Rate Range
Routine Missions	Mission Data (High data rate)	8	1 - 300 Mbps
	TT&C (Low data rate)	17	0.125 – 100 Kbps
Special Case Missions	LEOPs	3	0.125 – 100 Kbps
	ELVs	8-10	Around 400 Kbps
	Contingency	16	0.125 - 2.048 Kbps

Anticipated Missions 2025 - Onward

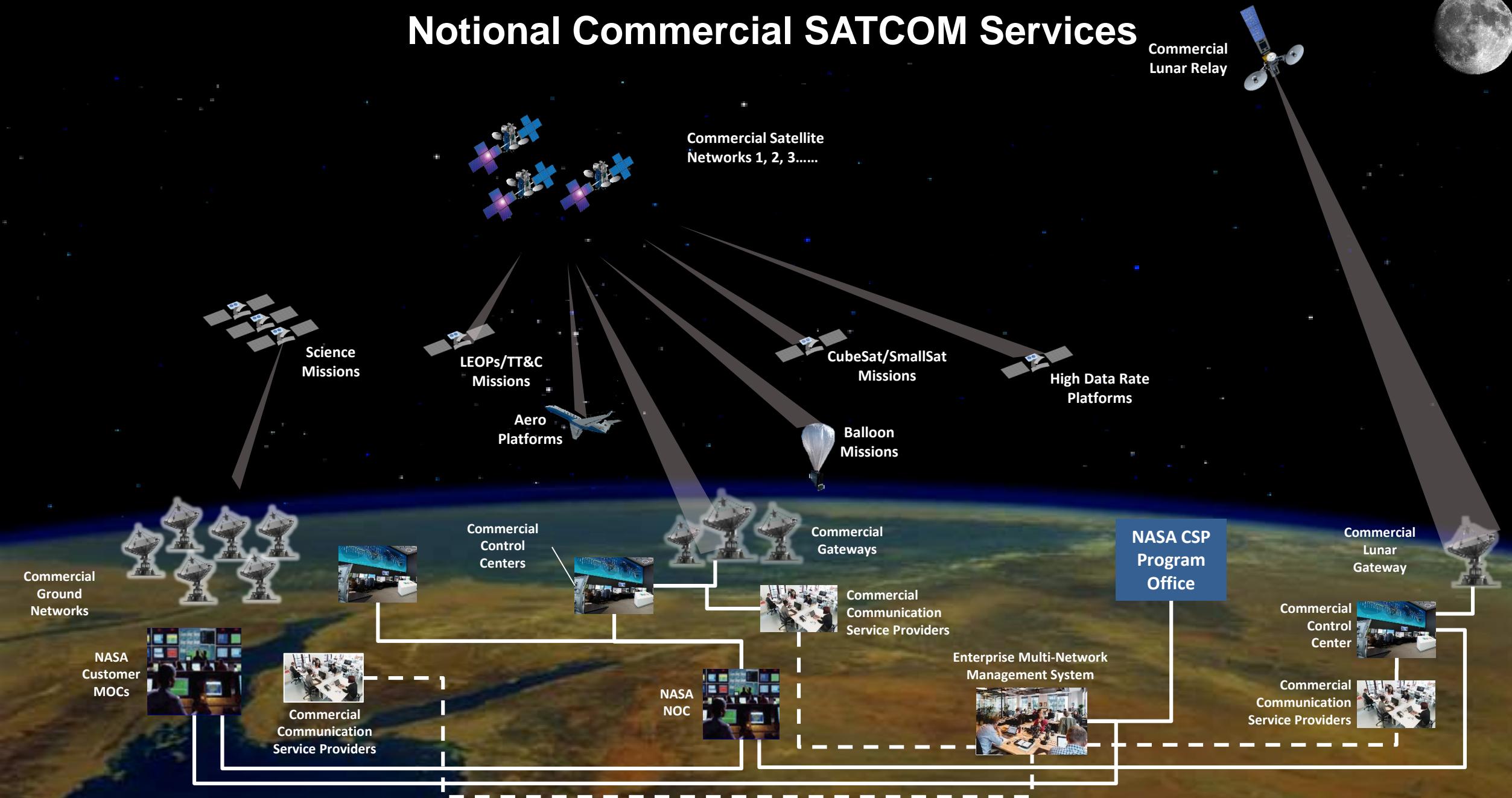
- **Launch Support**
 - > ELVs, Commercial Cargo, Commercial Crew
- **Low Earth Operations**
 - > NASA Near Earth Robotic Missions
 - > International Space Station Missions
- **Routine Operations**
 - > Hubble Space Telescope, Terra, ISS, Aura, Aqua, OCO-2
- **Multiple Earth and Space Science Missions**
 - > Projected to be around the same number of missions
- **CubeSat/SmallSat Missions**
- **Artemis Missions (potential)**



Extending Commercial SATCOM to Space Users



Notional Commercial SATCOM Services



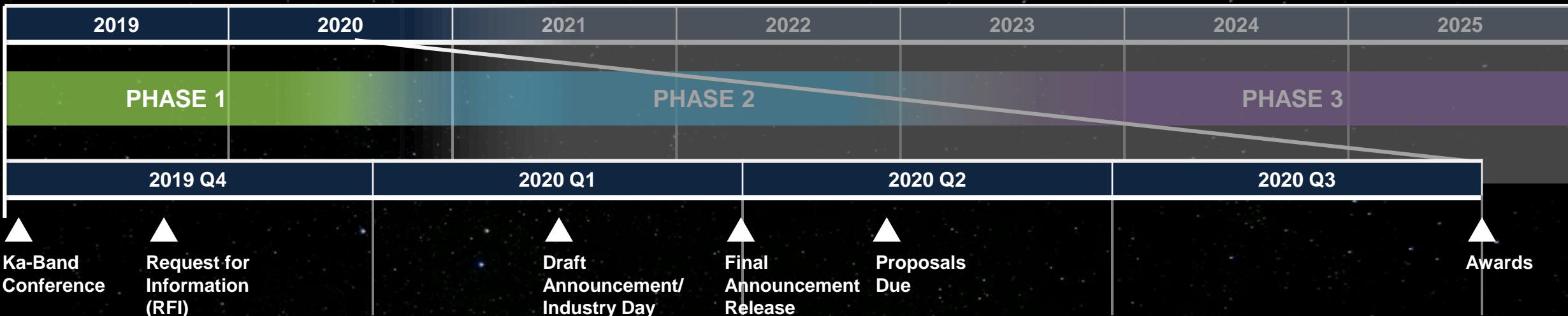
NASA's Communications Services Program (CSP) Strategy and Roadmap



- NASA envisions a 3-phase strategy for transitioning NASA's satcom traffic from government-owned and operated assets to commercial satellite communications capabilities
 - **PHASE 1: NASA's Mission Needs**
 - Identify, characterize, and quantify NASA's future satcom needs, and interact with industry
 - **PHASE 2: Commercial Capability Development and Demonstrations**
 - Establish multiple partnerships between NASA and commercial satcom companies to develop and demonstrate capabilities that can meet NASA's needs
 - **PHASE 3: Commercial Satcom Services Acquisition**
 - Acquire commercial satcom services from multiple providers

CSP Phase 1: NASA's Capability Needs

Key Milestones and Description

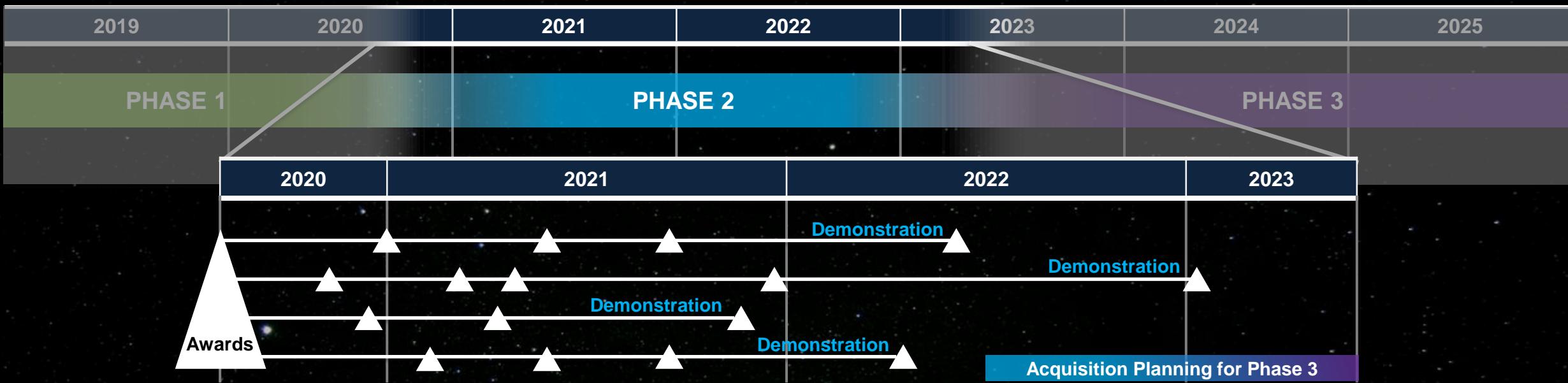


PHASE 1: NASA's Mission Needs will define overall CSP strategy, analyze NASA's satcom usage and future demand, and engage with NASA satcom stakeholders. NASA will then begin interacting with industry and preparing for Phase 2.

- Multiple touch points with industry are planned to ensure future partnerships are well-grounded and mutually beneficial
- Request for information (RFI) will:
 1. Identify top-level future NASA satcom capability needs (**underway**)
 2. Request information from industry regarding how industry can meet those needs (**underway**)
 3. Request feedback from industry on strategy and preferred partnership approaches (**underway**)
- NASA envisions a draft and final announcement for proposals for capability development and demonstrations (Phase 2)
- Multiple awards are planned by the end of FY2020 (goal)

CSP Phase 2: Commercial Capability Development and Demonstrations

Key Milestones and Description

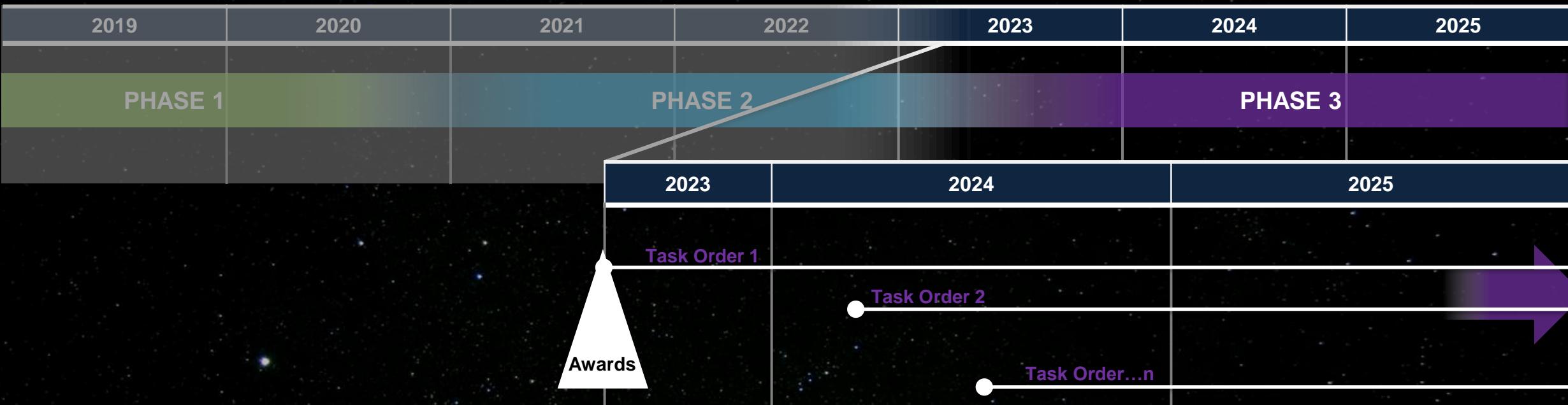


PHASE 2: Commercial Capability Development and Demonstrations will begin with multiple awards for partnerships to develop and demonstrate capabilities and will last approximately 2-3 years. May be extended to enable future on ramps.

- Number of awards is TBD
- NASA would like redundant capabilities whenever possible to encourage competition in Phase 3
- Agreements will feature cost-sharing between NASA and private industry
- Agreements will feature pay-for-performance development milestones culminating in demonstrations
- Industry will retain maximum intellectual property

CSP Phase 3: Commercial SATCOM Services Acquisition

Key Milestones and Description



PHASE 3: Commercial SATCOM Services Acquisition will be a full and open FAR-based competition for services.

- Objective will be the acquisition of *reliable, robust and cost-effective* commercial satcom services
- Long-term contracts are envisioned
- Task orders for specific NASA users will be competed
- Support missions needs for command and telemetry, navigation and data delivery
- Support an integrated approach for mission communication systems and enterprise management (scheduling and data delivery)

Conclusion

- It will be challenging in many ways to make the transition from primarily government-owned and operated satcom infrastructure to a commercial services model.
- NASA is committed to executing CSP in a mutually-beneficial manner between private industry and the government.
- More details about CSP will be forthcoming in the coming months.

Contacts

- CSP is being managed by the Commercial Spaceflight Development division at NASA HQ.
 - Philip McAlister, Director, philip.mcalister@nasa.gov
 - Marc Timm, Program Executive, marc.g.timm@nasa.gov
- NASA Glenn Research Center (GRC) is providing the primary support to NASA HQ.
 - Elias Naffah, NASA GRC, elias.t.naffah@nasa.gov
 - Thomas Kacpura, NASA GRC, thomas.kacpura@nasa.gov