

The Ukraine War's Impact on the Business of Spaceflight



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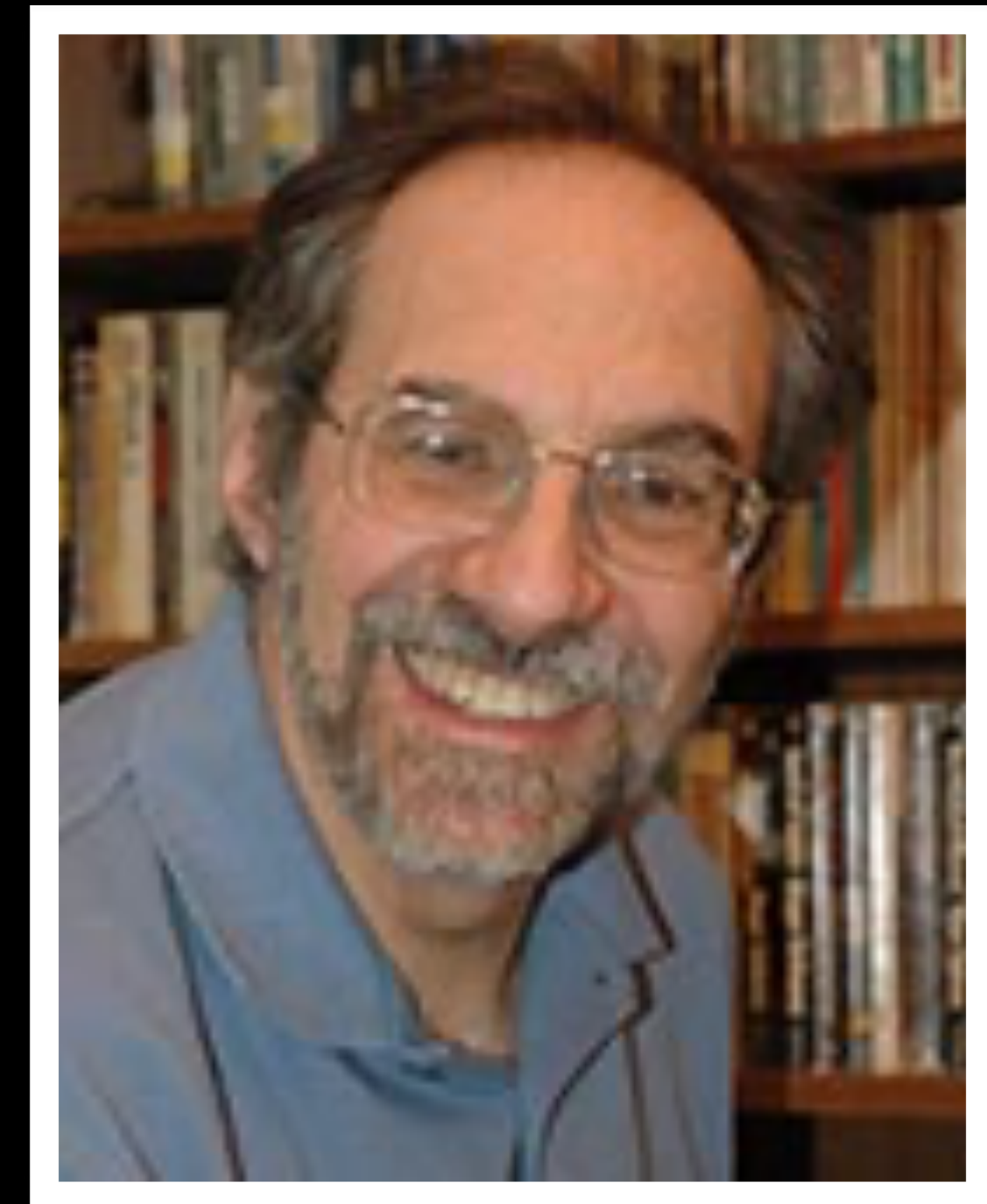
Who Are We?



Stephen Fleming
(Moderator)
Arizona Space
Business Roundtable



Alex Rodriguez
CEO
FreeFall 5G, Inc.



Bob Zimmerman
*Space Historian &
Science Journalist*
BehindTheBlack.com

International Ramifications

Russia

Loss of Soyuz International Launch Market



Sanctions Block Future Satellite Business

Impossible to purchase insurance for a Russian launch now



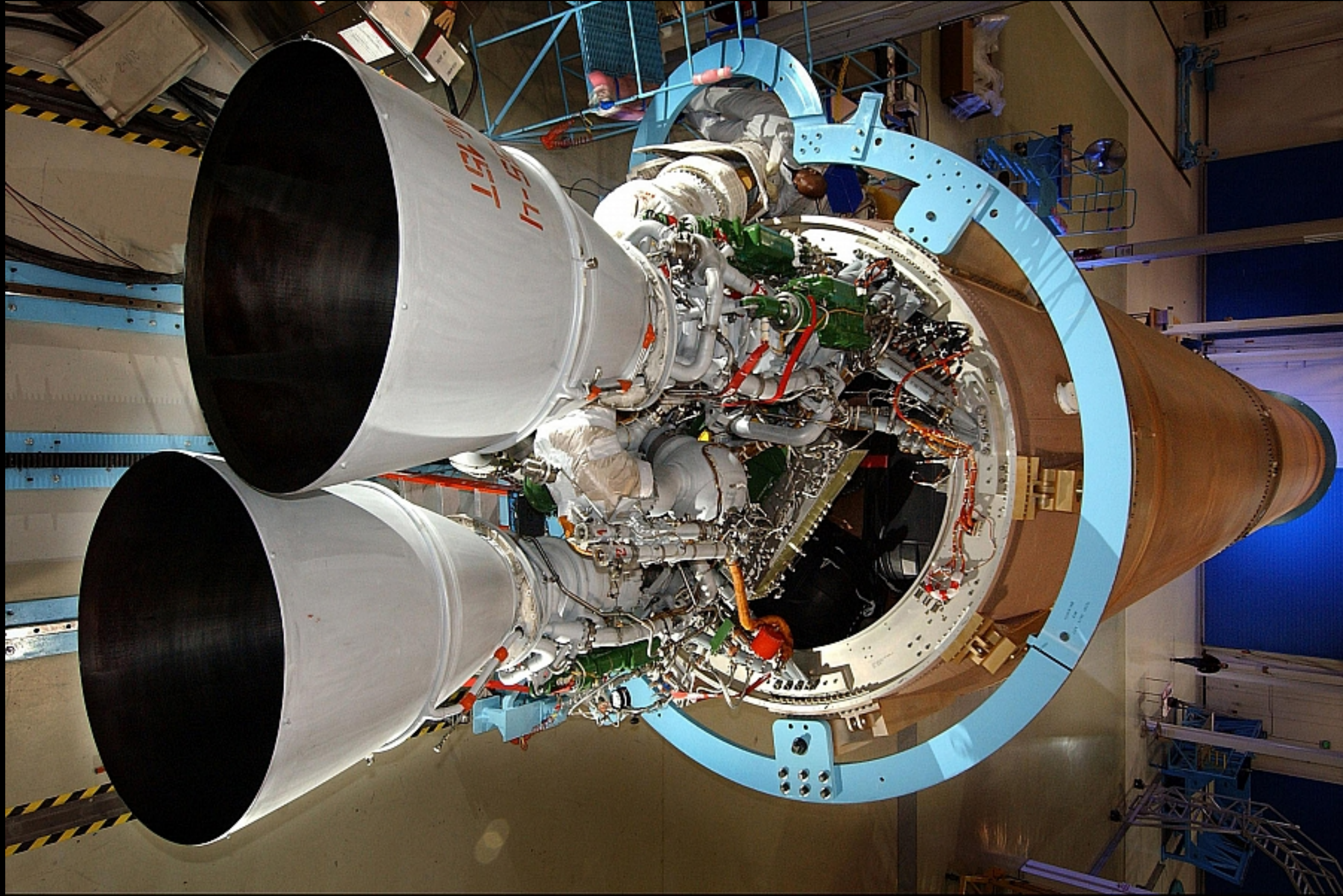
Satellites Include Western Components

Will affect Russia's ability to continue manufacturing



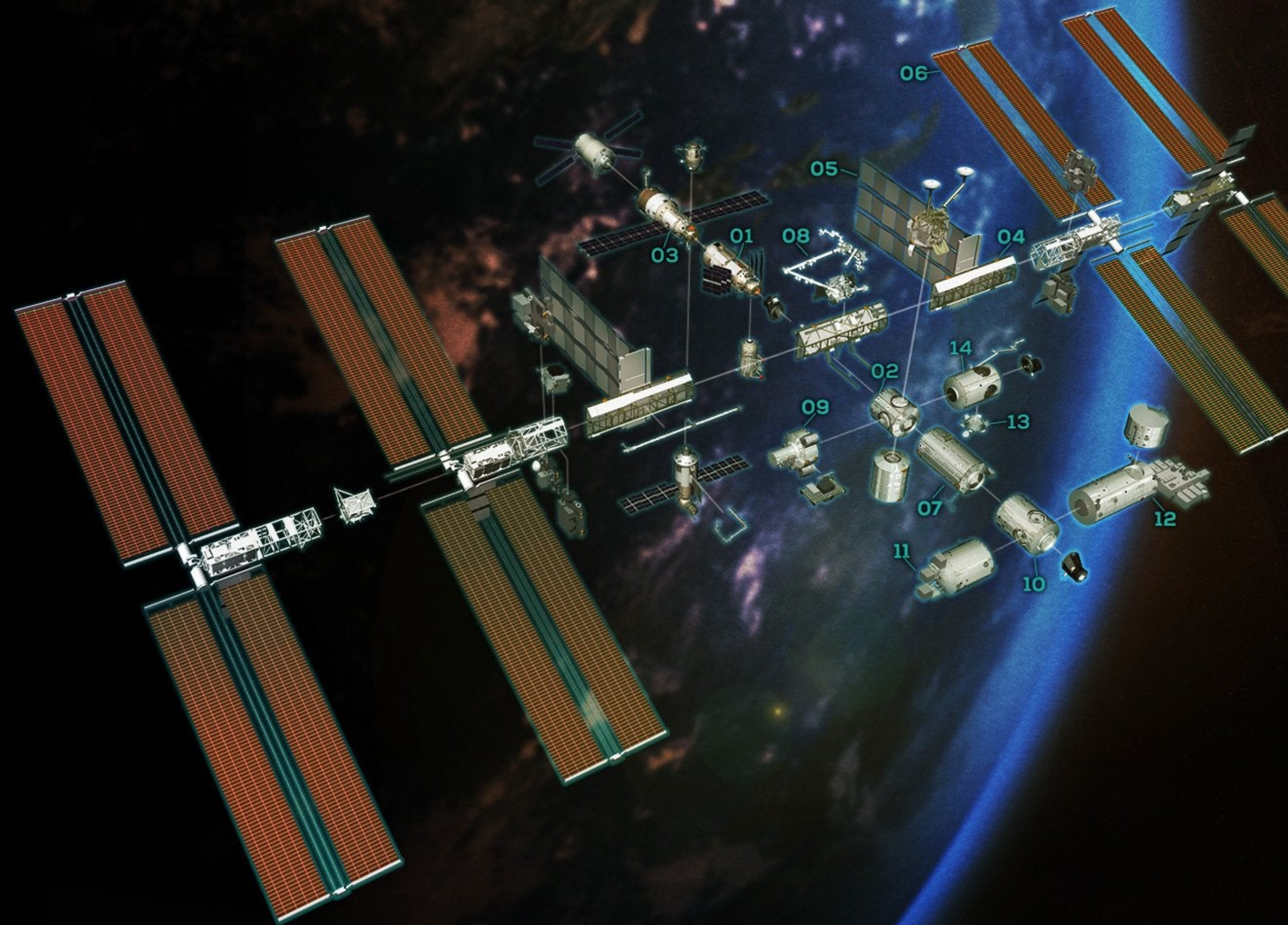
No More Rocket Engine Sales to the West

The End of a Hard-Currency Market




Russia Will Likely Reduce ISS Cooperation

INTERNATIONAL SPACE STATION



 **01. ZARYA**
Added by Roscosmos Nov 1998

Commissioned and funded by the U.S. and built in Russia, Zarya was the first piece of the International Space Station ever put into orbit. It was designed to provide the station's initial propulsion and power.

 **02. UNITY (NODE 1)**
Added by NASA Dec 1998

The Unity node was the first U.S. piece of the International Space Station. It connects the Quest airlock, the Destiny laboratory, the Zarya module, the Tranquility node and the Permanent Multipurpose Module.

 **03. ZVEZDA**
Added by Roscosmos July 2000

Zvezda served as the early cornerstone for the first human habitation of the station. It serves as a docking port for Russian cargo and crew vehicles as well as the ATV cargo craft.

 **04. TRUSS STRUCTURE**
Added by NASA 2000-2009

Composed of multiple elements delivered by the space shuttle, the Integrated Truss Structure forms the backbone of the station.

 **05. RADIATORS**
First Added by NASA Dec 2000


Most of the space station's systems produce heat, which needs to be transferred from the station to space to maintain acceptable temperatures and keep the systems running.

 **06. SOLAR ARRAYS**
Added by NASA 2000-2009

The International Space Station's enormous solar arrays provide renewable energy to the laboratory by converting solar energy into electricity.

 **07. DESTINY LAB**
Added by NASA Feb 2001

Destiny is the primary research laboratory for U.S. payloads, supporting a wide range of experiments that contribute to health, safety and quality of life for people all over the world.

 **08. CANADARM2**
Added by CSA Apr 2001

The space station's robot arm, Canadarm2, was a key part of the construction of the station and continues to play a vital role in day-to-day operations.

 **09. QUEST AIRLOCK**
Added by NASA July 2001

The U.S. Quest airlock is directly across from the Tranquility node and is attached to Unity. It enables crew members to perform spacewalks in U.S. or Russian spacesuits.

 **10. HARMONY (NODE 2)**
Added by NASA Oct 2007

Harmony is a node on the station that is used to connect Kibo, Columbus and Destiny. It is also the docking port for the Cygnus, Dragon and HTV cargo vehicles.

 **11. COLUMBUS LAB**
Added by ESA Feb 2008

As the European Space Agency's largest single contribution to the station, the Columbus laboratory supports scientific and technological research.

 **12. KIBO LAB (JEM)**
Added by JAXA 2008-2009

The Kibo Laboratory is Japan's first human space facility and enhances the unique research capabilities of the International Space Station. It has an airlock and robotic arm attached to it.

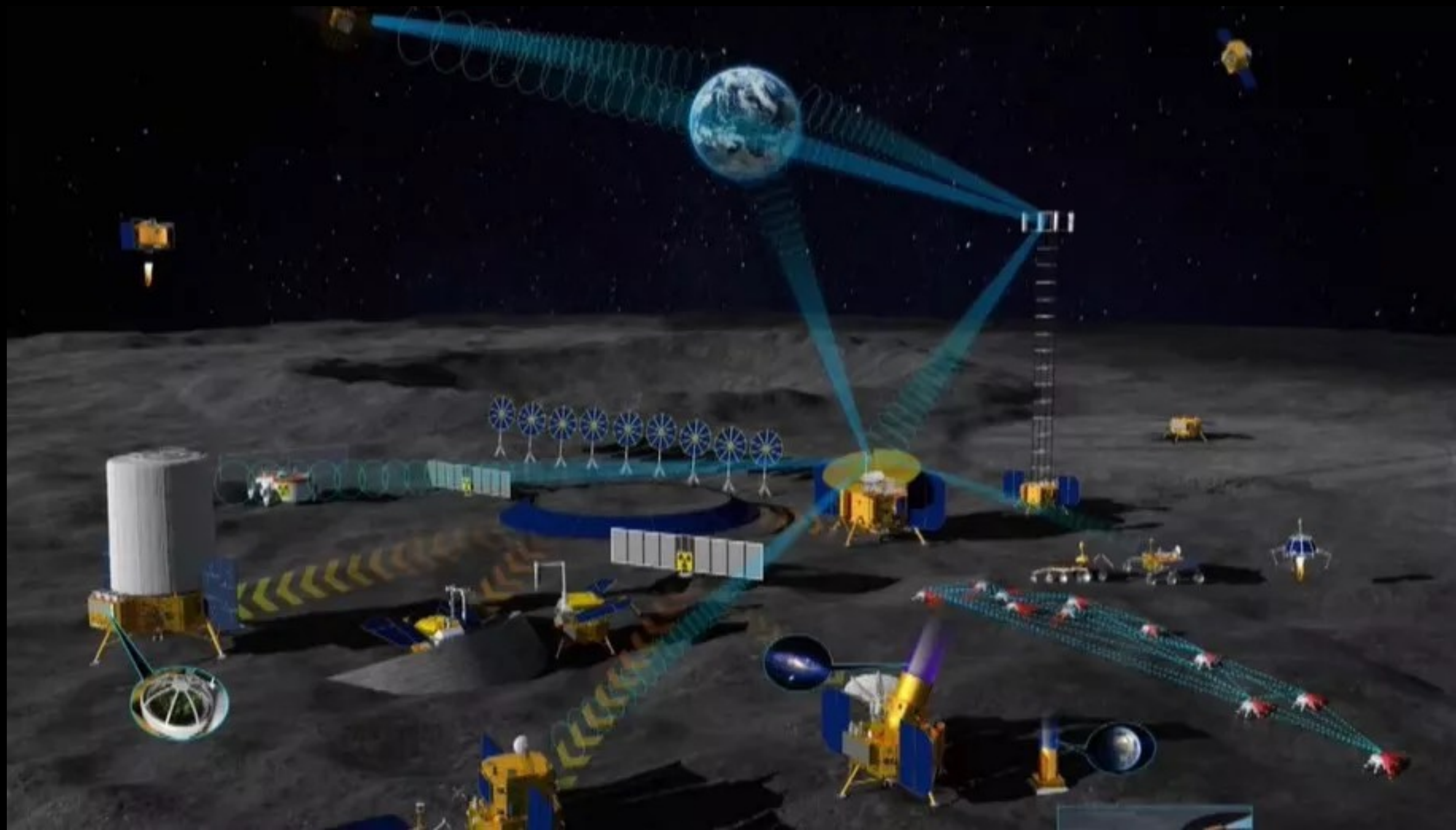
 **13. CUPOLA MODULE**
Added by NASA Feb 2010

The Cupola is a panoramic control tower for the International Space Station, with windows through which operations on the outside of the station can be observed and controlled.

 **14. TRANQUILITY (NODE 3)**
Added by NASA Feb 2010

The Tranquility node was one of the last U.S. components added to the International Space Station. Some of the crew's exercise equipment is located in it as well as some of the environmental systems.

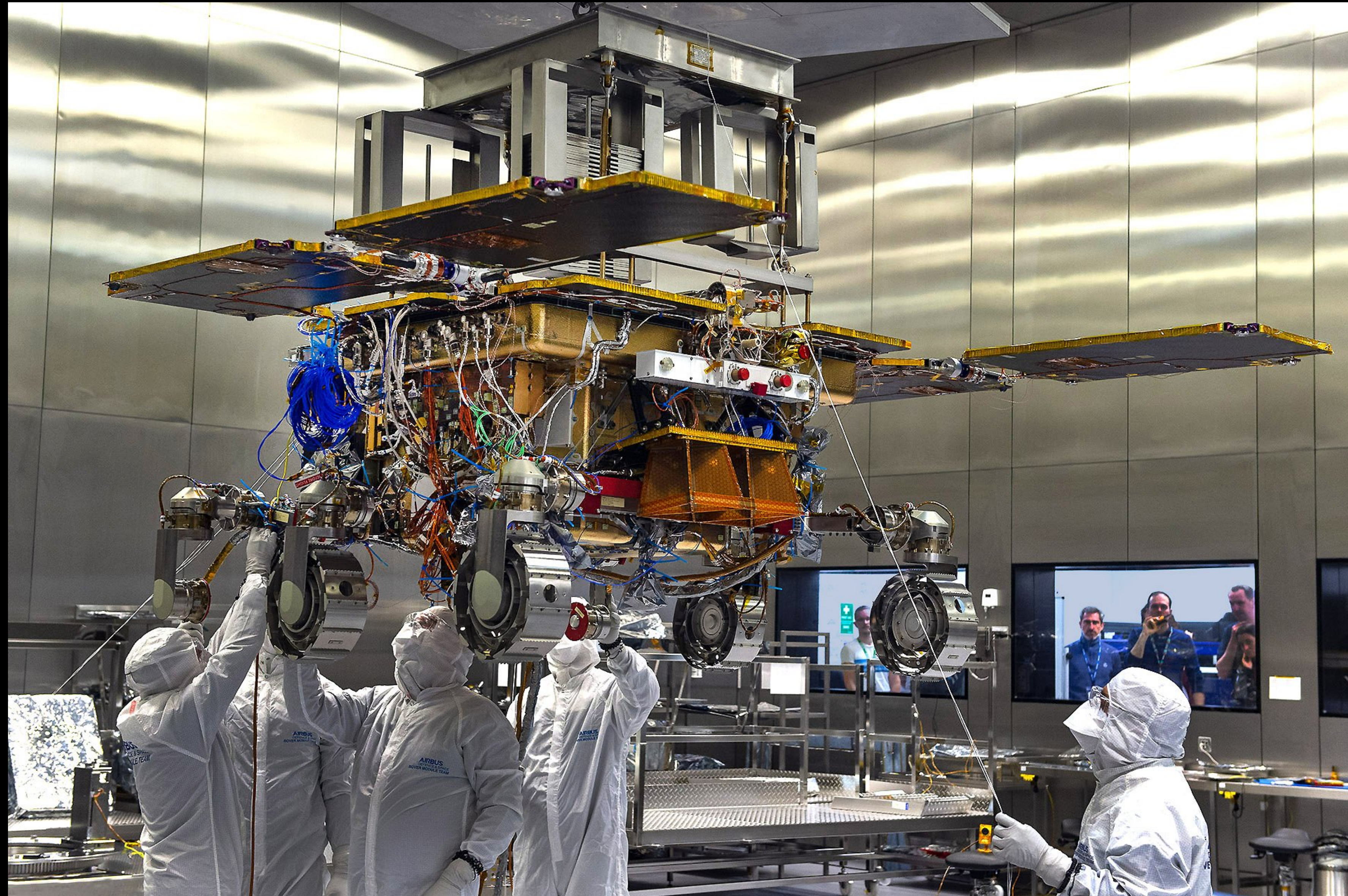
Increased China-Russia Cooperation?



Europe

Breakup of All Russian-ESA Partnerships

ExoMARS Rover on hold until.... 2026? Maybe?



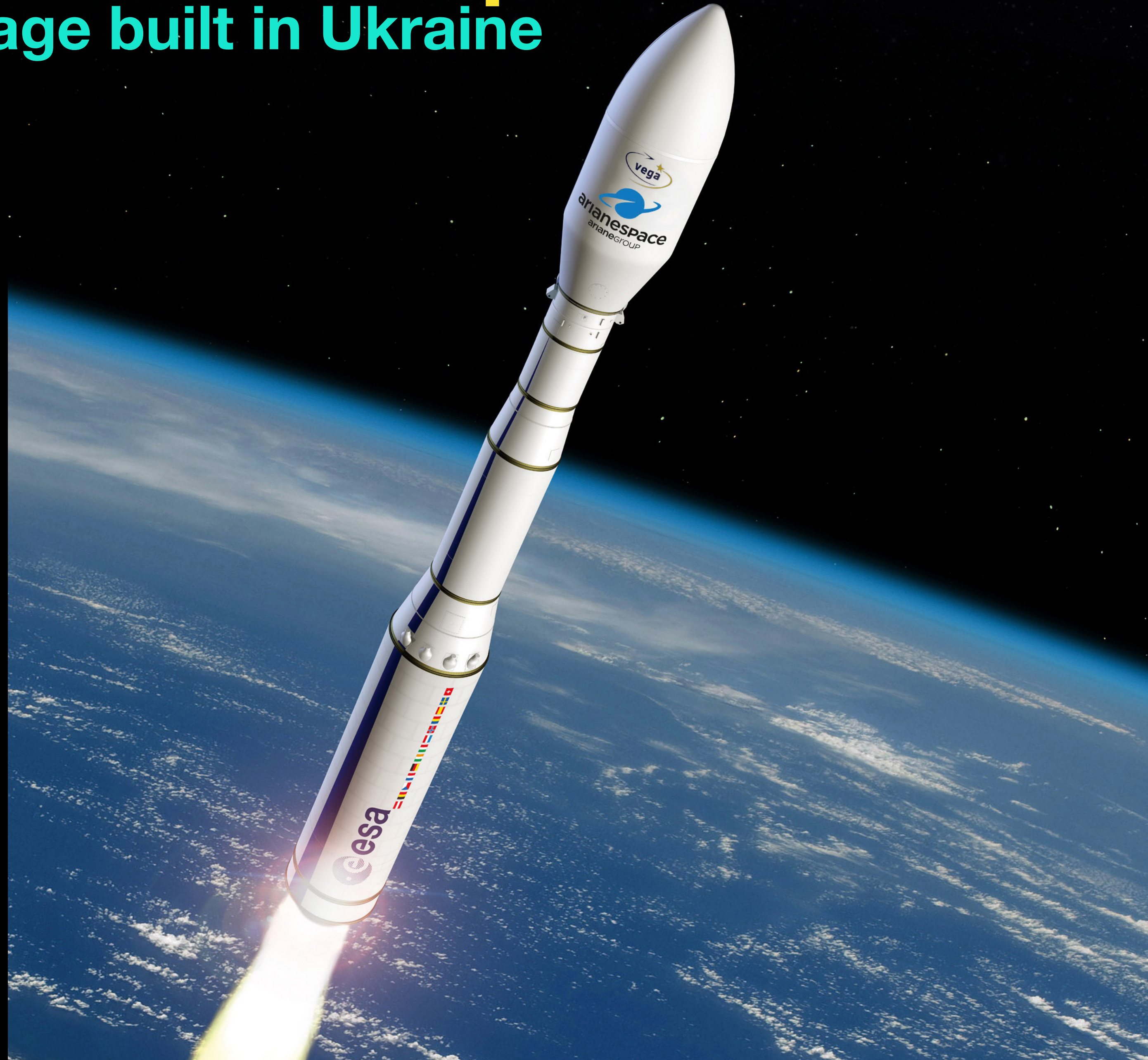
Breakup of All Russian-ESA Partnerships

Spektr-RG telescope in orbit shut off (German-Russian mission)



End of Russian-Arianespace Partnership

Vega-C second stage built in Ukraine



End of Russian-Arianespace Partnership

36 OneWeb satellites were on the launchpad for March 4th launch!



End of Russian-Arianespace Partnership

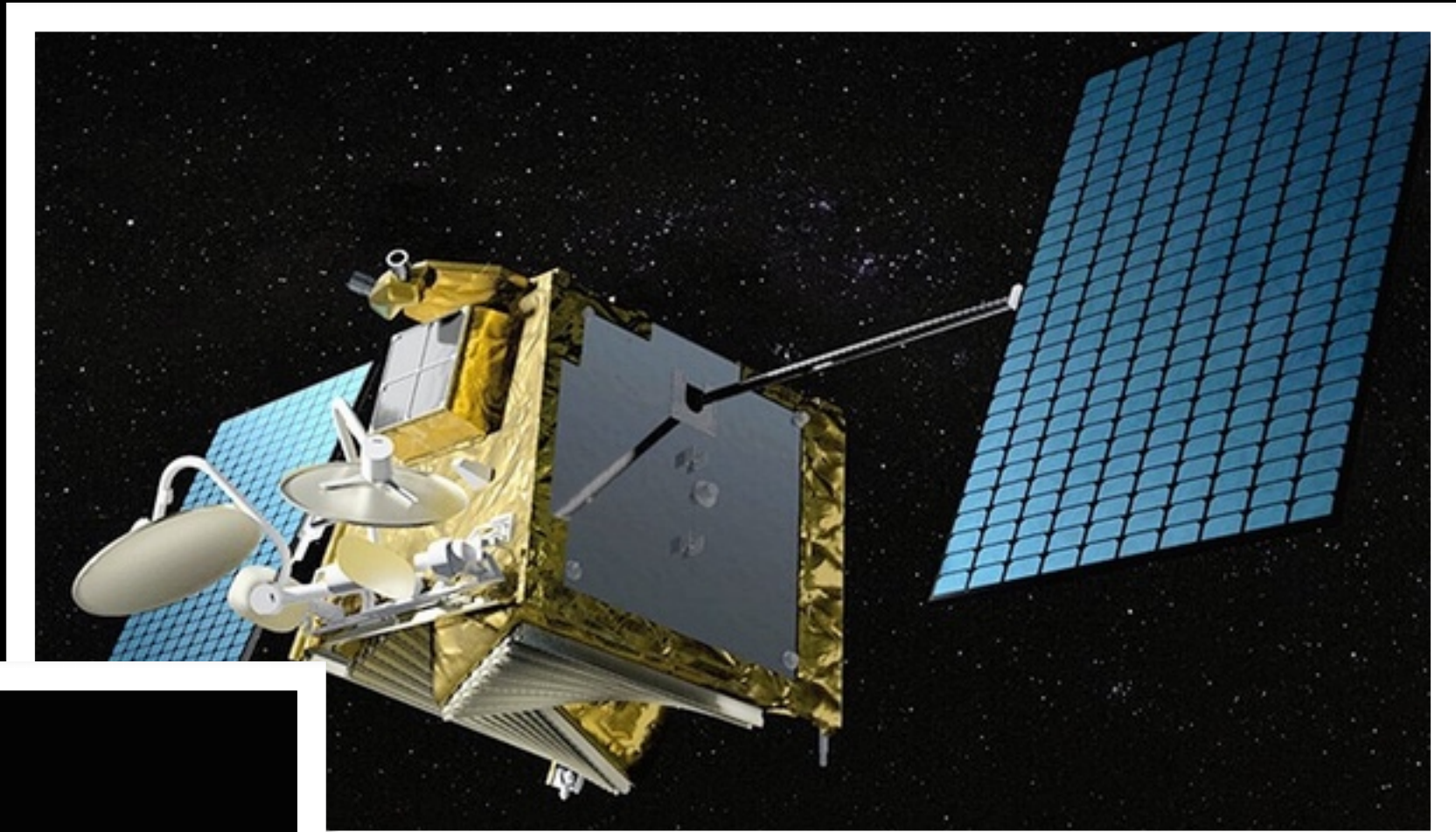
Russia abandons launches from French Guyana



Multiple European Satellites Lose Rides



MATS (Sweden)



OneWeb (UK)



Galileo (ESA)

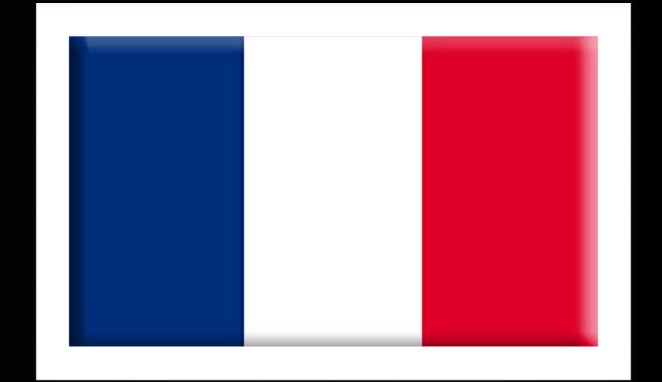


Euclid (ESA)



Earthcare (ESA)

Germany & France to Join Artemis Accords?



ARTEMIS ACCORDS

United for Peaceful Exploration of Deep Space



Ukraine

Overall Damage to Aerospace Industry

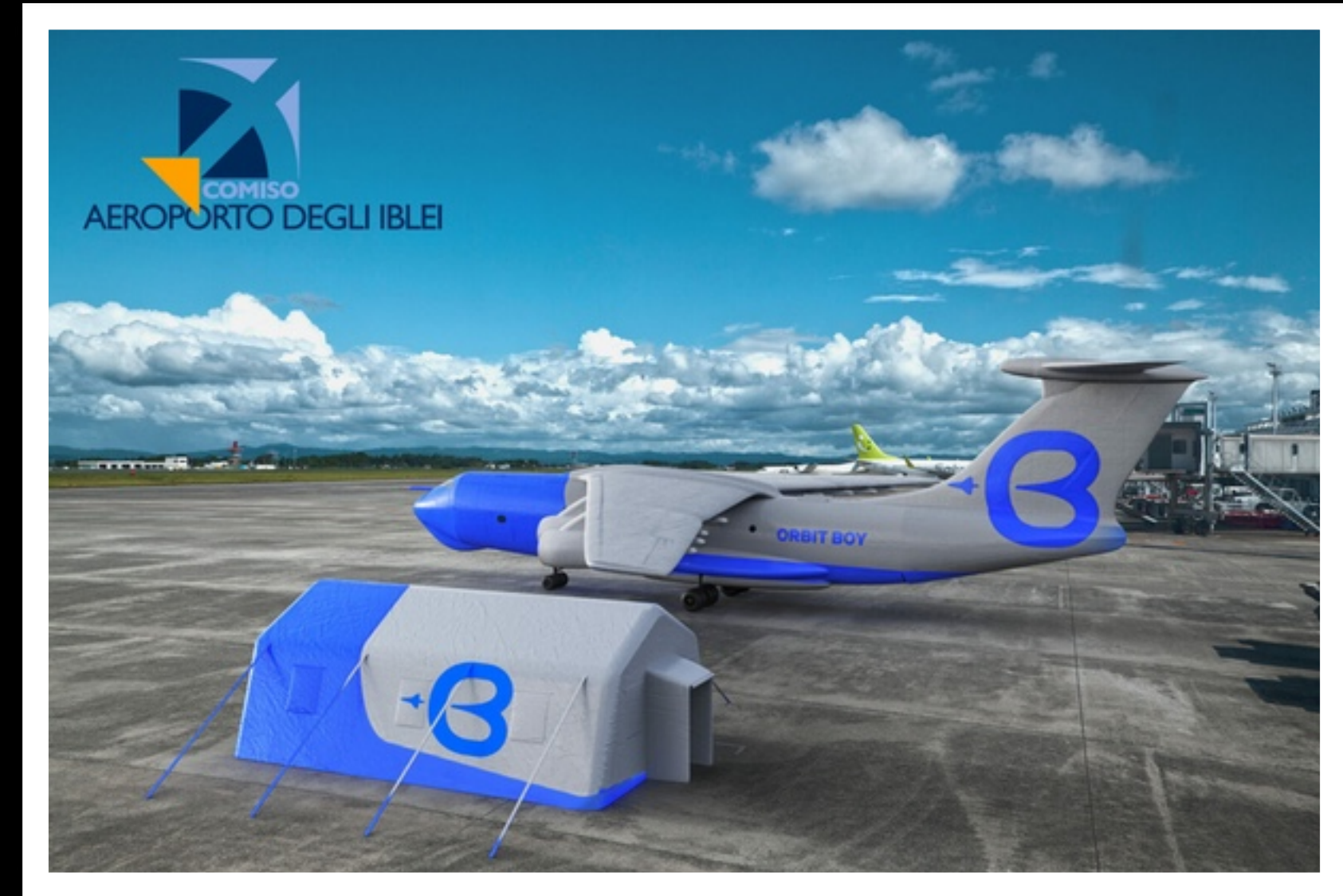
An-225 Destroyed – Symbol of Ukraine Aerospace



Ukraine Loses Western Partnerships



Skyrora (Scotland)



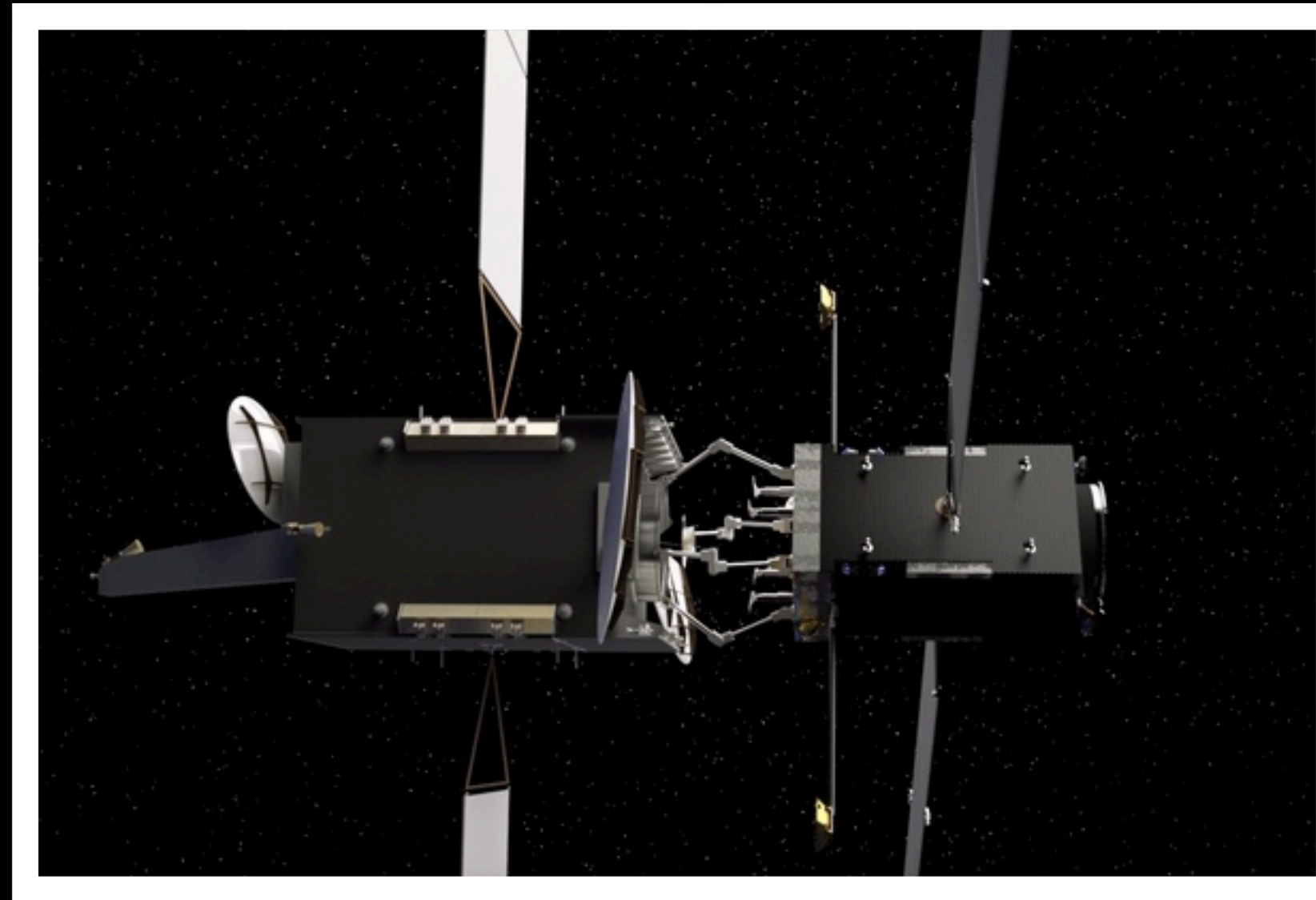
Orbit Boy (UK)



Cyclone 4M (Canada)

Ukraine Loses Western Partnerships

Kurs Orbital (US)



**Northrop Grumman
Antares first stage (US)**

Launcher Space (US)



Ukraine to Join European Space Agency?



Rest of World

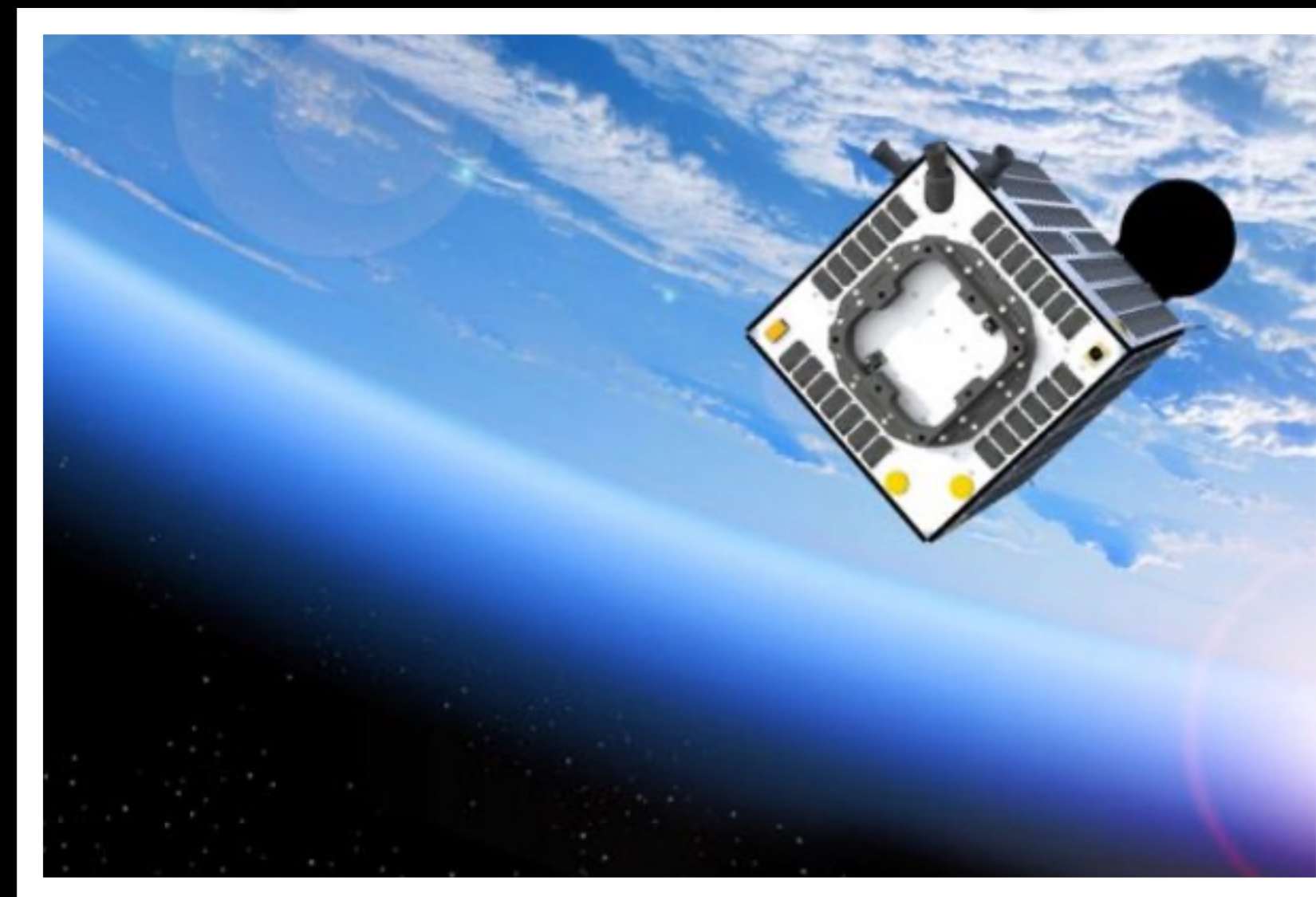
Japanese and South Koreans Lose Rides



Synspective (Japan)



CAS500-2 and
KOMPSAT-6 (Korea)



Axelspace (Japan)

India May Pick Up New Launch Contracts



USA: Defense/Military



...with Russian Troops in Bosnia, 1999-2000



...with SecDef William S. Cohen in the Pentagon



Viasat Modems Hacked

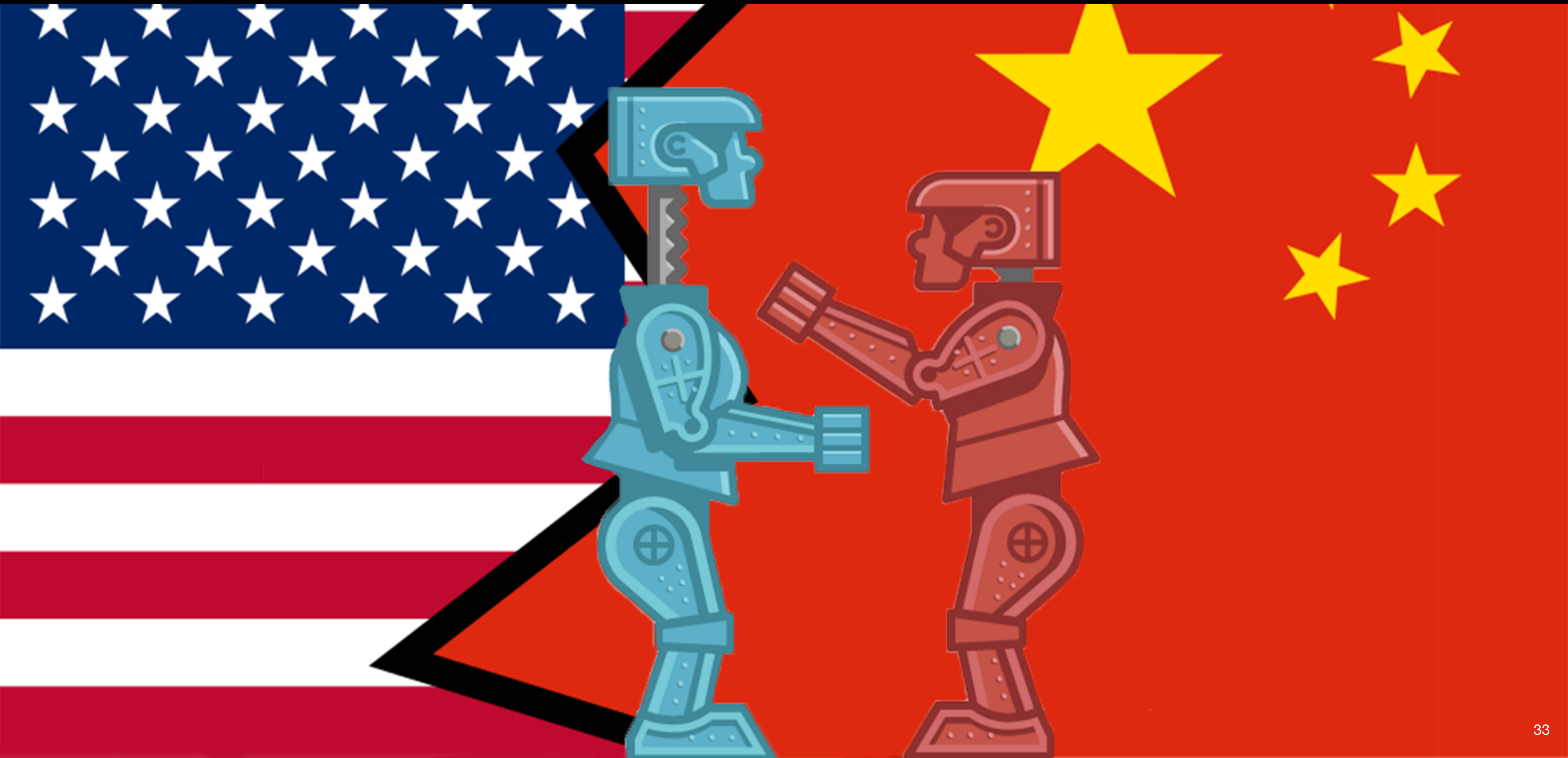
US believes Russia disabled modems prior to Ukraine invasion



Mark Vande Hei Returns via Soyuz



Increased Caution with Global Supply Chains



Real-Time Commercial Satellite Images of Attack

Mariupol Devastation from Maxar



Orbital Debris

Heightened concern that Russia may use space weapons



USA: Commercial Space

End of Soyuz/Dragon Seat Barter



No Impact on ULA's Rockets

Has warehoused sufficient (24?) RD-180 engines for Atlas launches



No New Northrop Grumman “Antares”

First stage built in Ukraine; only two left on hand



Project Kuiper buys “everyone but SpaceX”

83 launches for 3,236 satellites



OneWeb (UK) Cannot Meet Planned Schedule



**A REVOLUTION
IN SATELLITE
MANUFACTURING**

No one has ever built a satellite in one day... we will build several every day!

TOTAL COVERAGE
Internet to everyone,
everywhere on Earth

SpaceX Will be Launching OneWeb Satellites



OneWeb

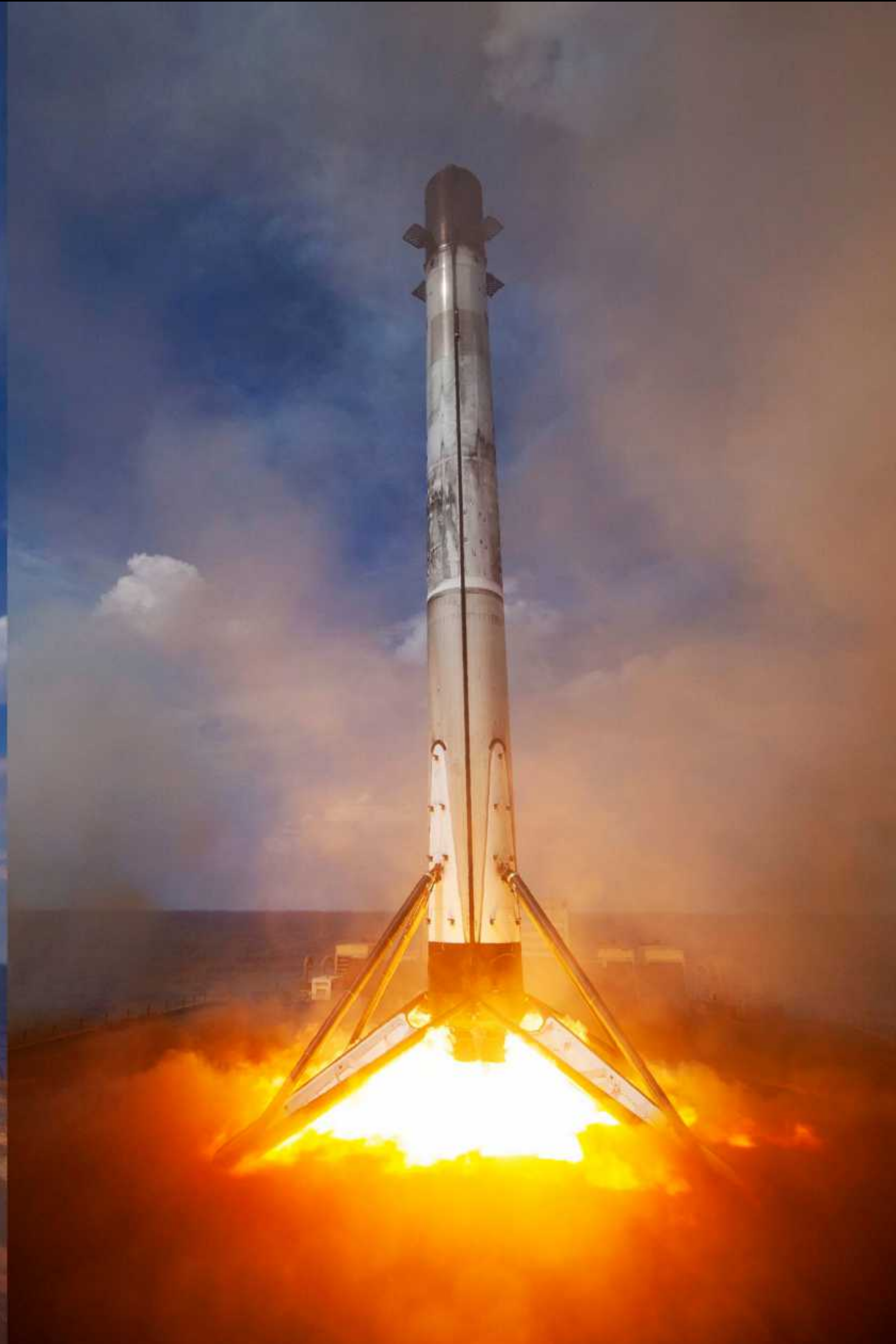


SPACEX

Starlink Terminals Delivered to Ukraine



SpaceX is the Big Winner



Q&A?