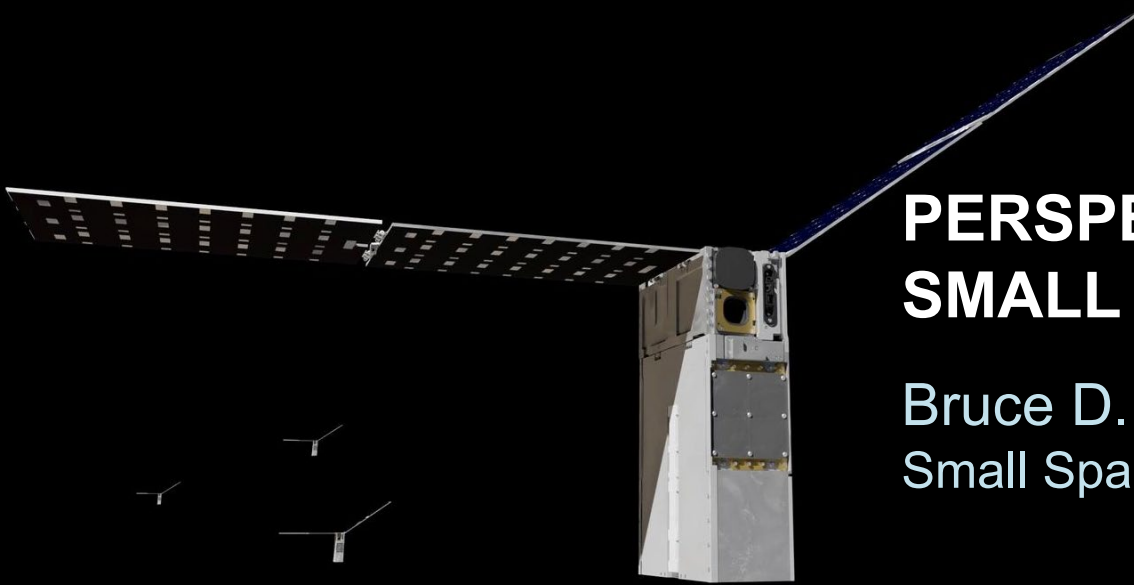




PERSPECTIVES ON SMALL SPACECRAFT

Bruce D. Yost, Director,
Small Spacecraft Systems Virtual Institute

Space Development Agency Workshop ♦
Maui, Hawaii ♦ September 17, 2024

In the News

China launches first satellites for Thousand Sails megaconstellation

<https://spacenews.com/china-launches-first-satellites-for-thousand-sails-megaconstellation/>

August 6, 2024 by Andrew Jones (SpaceNews)

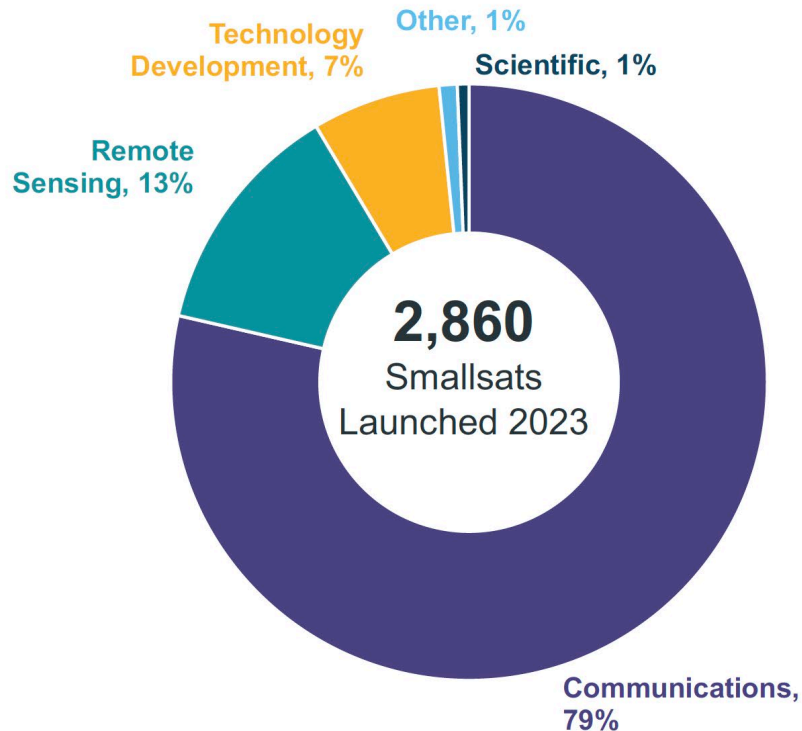
“The Long March 6A upper stage deployed 18 flat panel Qianfan (“Thousand Sails”) satellites into polar orbit for Shanghai Spacecom Satellite Technology (SSST). SSST plans for the constellation’s first stage to consist of 1,296 satellites. 648 of these are to be launched by the end of 2025 to provide regional network coverage.”

Chinese rocket stage breaks up into cloud of more than 700 pieces of space debris

<https://spacenews.com/chinese-rocket-stage-breaks-up-into-cloud-of-more-than-700-pieces-of-space-debris/>

August 9, 2024 by Andrew Jones (SpaceNews)

“LeoLabs, a company which monitors low Earth orbit with a global network of radars, stated later Aug. 8 that its radar data indicates “at least 700 debris fragments and potentially more than 900.” The debris cloud is in-plane with the 18 deployed satellites.”



Smallsats defined by having mass of $\leq 1,200$ kgs

Smallsats launched in 2023

97% of all spacecraft (2022: 97%)

63% of spacecraft upmass (2022: 58%)

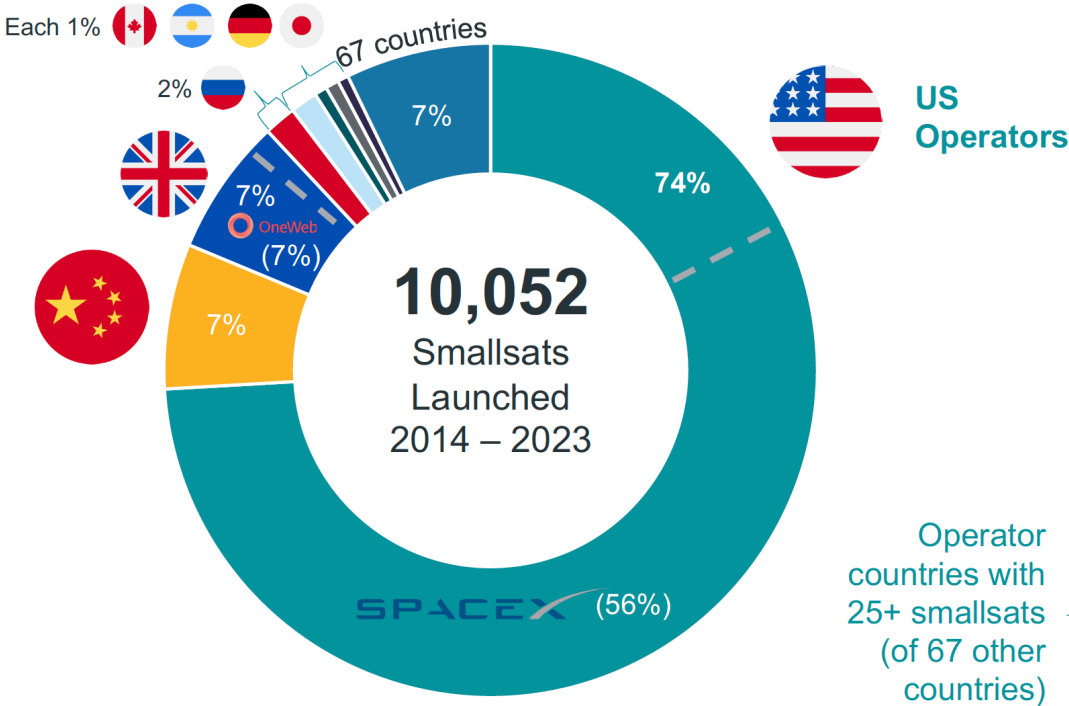
164 of 221 orbital launches (2022: 109)

267 different operators (2022: 212)

5% launched on small or micro launch vehicles (2022: 7%)

Operator and Mission Type Trends

Smallsats 2014 – 2023, by Operator Country

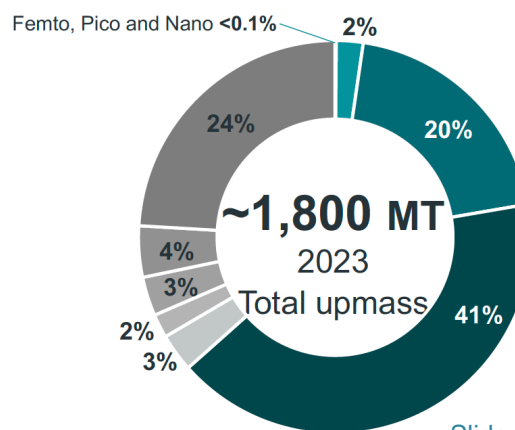
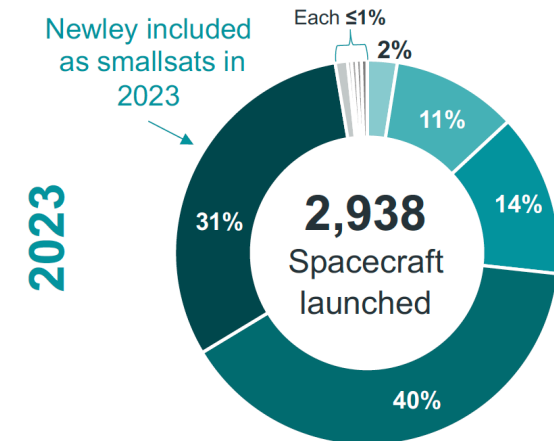
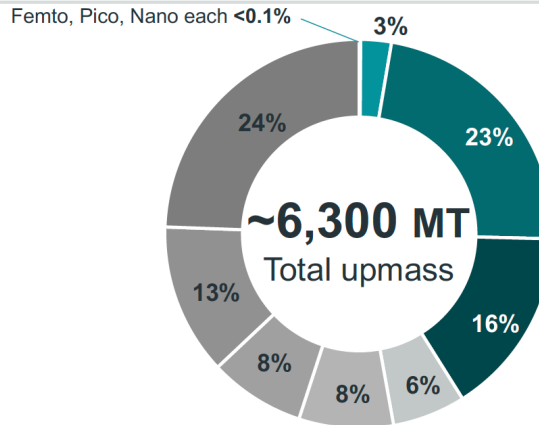
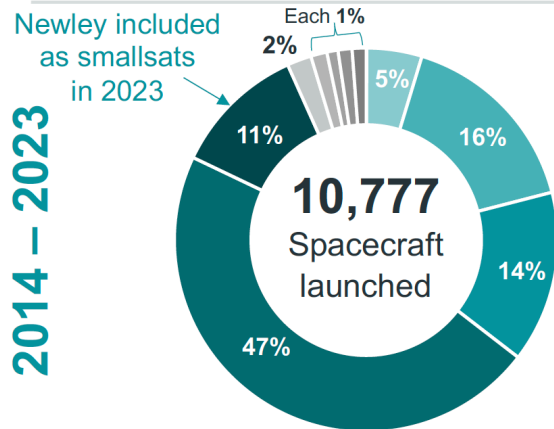


U.S. operators dominate smallsats, accounting for ¾ of those launched since 2014

Operator Country	# of Smallsats
USA	7,420 (5,652 Starlink)
China	719
UK	679 (636 OneWeb)
Russia	159
Japan	135
Canada	66
Germany	62
Argentina	54
Italy	49
France	47
Spain	47
India	45
Finland	38
South Korea	37
Israel	33
Australia	32
Netherlands	31

Smallsats in Context

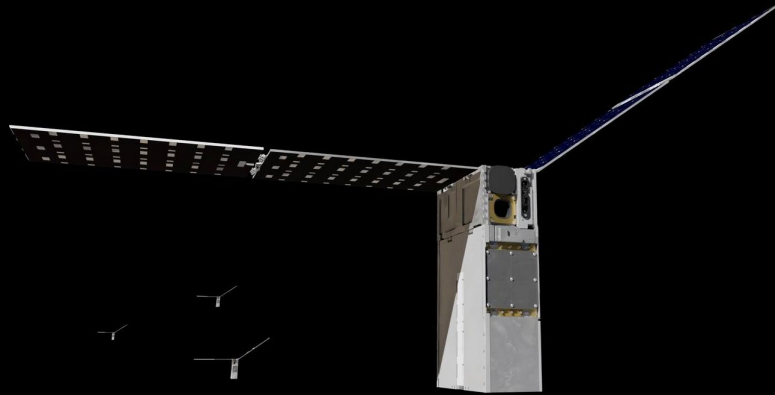
Spacecraft Launched and Total Spacecraft Upmass 2013 – 2022



	Mass Class Name	Kilograms (kg)
Smallsats	Femto	0.01 – 0.09
	Pico	0.1 – 1
	Nano	1.1 – 10
	Micro	11 – 200
	Mini	201 – 600
	Small	601 – 1,200
	Medium	1,201 – 2,500
	Intermediate	2,501 – 4,200
	Large	4,201 – 5,400
	Heavy	5,401 – 7,000
	Extra Heavy	> 7,001

- Smallsats represent 93% of spacecraft launched 2014 – 2023, 41% of total upmass
- Smallsats represent 97% of spacecraft launched in 2023, 63% of total upmass

Starling Technology Demonstration Mission - Overview



Starling Autonomous Swarm Technology Launched: July 17, 2023

Demonstrate swarm maneuver planning and execution, communications networking, relative navigation, and autonomous coordination between four 6U CubeSats

Starling 1.5 Launched as Starling 1.0

Demonstrate a model of space traffic management between two cooperative swarms/constellations with onboard conjunction assessment and collision avoidance capabilities. Develop autonomous maneuvering methods.

Starling in the news:
Navigating by Sight

<https://spacenews.com/navigating-by-sight>

August 20, 2024 by Debra Werner, SpaceNews

Image Credits: NASA



Scan this code for the latest fleet chart.
<https://s3vi.ndbc.nasa.gov/cubesat/fleet/>

