AMSKepler
ENGENHARIA DE SISTEMAS

MundoGeo 5 set 2023

Antonio Machado e Silva

Pequenos satélites – Sensoriamento Remoto

Antonio Machado e Silva

PEQUENOS SATÉLITES SÃO O FUTURO DO SENSORIAMENTO REMOTO?

NANOSSATÉLITES E CUBESATS: OPORTUNIDADE PARA EMPREENDER NO BRASIL

Antonio Machado e Silva

Futuro do Sensoriamento Remoto passa pelas constelações de pequenos satélites

28 set 2020

MundoGeo Espaço

https://mundogeo.com/2020/09/28/futuro-do-sensoriamento-remoto-passa-pelas-constelacoes-de-pequenos-satelites/

Smallsat

https://www.faa.gov/about/office_org/headquarters_offices/ast/media/2018_ast_compendium.pdf

Mass Class Name	Satellite Mass (M) Kilograms (kg)	
Femto	$M \leq 0.1$	smallsat ≤ 600kg
Pico	$0.1 < M \leq 1$	
Nano	$1 < M \leq 10$	
Micro	$10 < M \leq 200$	
Mini	$200 < M \leq 600$	
Small	$600 < M \leq 1{,}200$	non-smallsat
Medium	$1{,}200 < M \leq 2{,}500$	
Intermediate	$2{,}500 < M \leq 4{,}200$	
Large	$4{,}200 < M \leq 5{,}400$	
Heavy	$5{,}400 < M \leq 7{,}000$	
Extra Heavy	$7{,}000 < M$	

Federal Aviation Administration's Office of Commercial Space Transportation (FAA AST)

AMSKepler

BRYCE space and technology

2011		2022
136 spacecrafts	1745% (30% y) →	2509 spacecrafts
39 smallsats	6054% (45% y) →	2400 smallsats

[1] Smallsats by the Numbers: 2019, https://brycetech.com/reports/report-documents/Bryce_Smallsats_2019.pdf

[2] Smallsats by the Numbers: 2020, https://brycetech.com/reports/report-documents/Bryce_Smallsats_2020.pdf

[3] Smallsats by the Numbers: 2021, https://brycetech.com/reports/report-documents/Bryce_Smallsats_2021.pdf

[4] Smallsats by the Numbers: 2022, https://brycetech.com/reports/report-documents/Bryce_Smallsats_2022.pdf

[5] Smallsats by the Numbers: 2023, https://brycetech.com/reports/report-documents/Bryce_Smallsats_2023.pdf

Without Starlink & OneWeb

2011		2022
136 spacecrafts	1745% (30% y) →	2509 spacecrafts
39 smallsats	6054% (45% y) →	2400 smallsats
136 spacecrafts	**398% (16% y) →**	**677 spacecrafts**
39 smallsats	**1356% (28% y) →**	**568 smallsats**

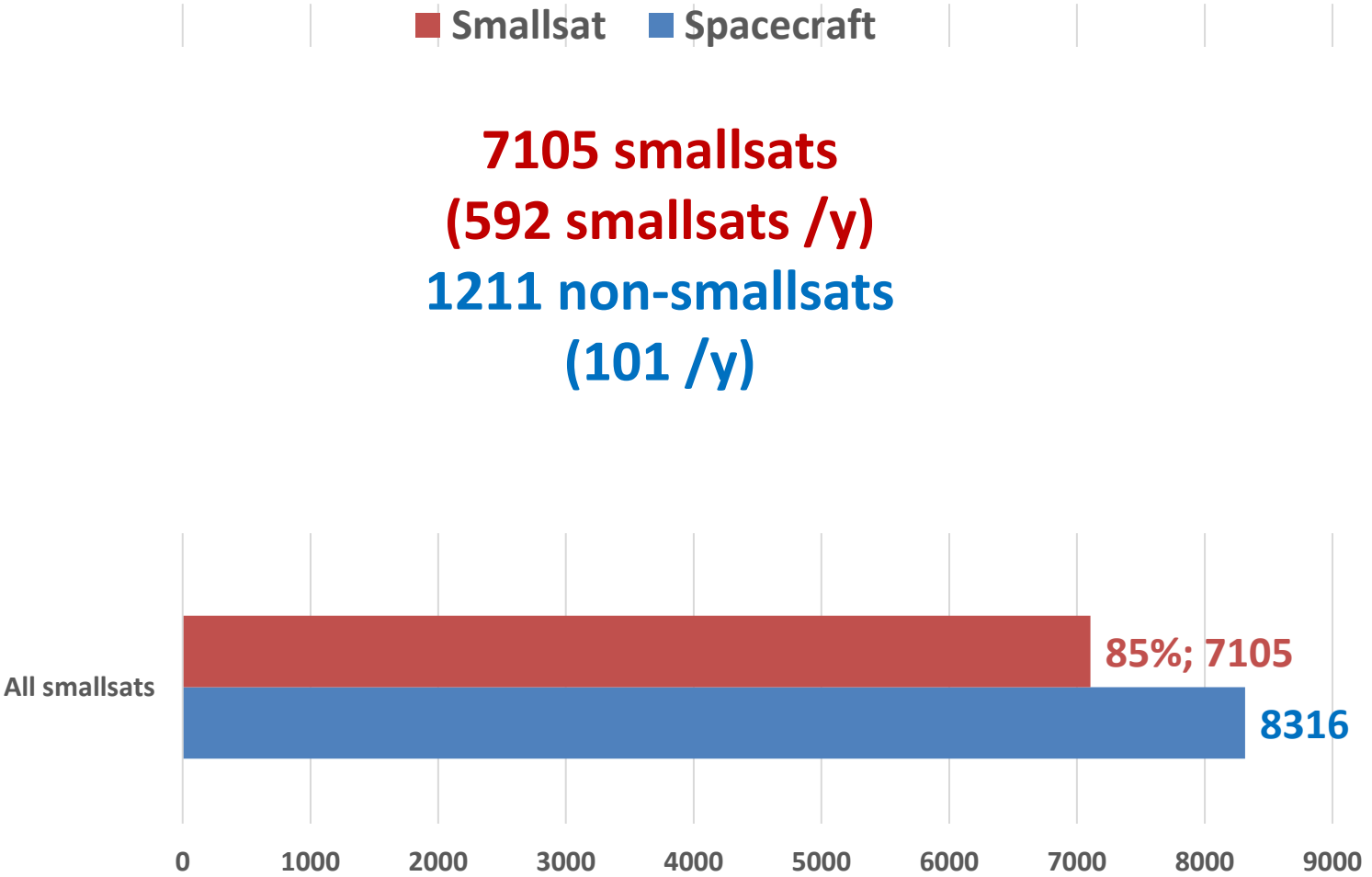
Without Starlink, OneWeb & PlanetScope

2011		2022
136 spacecrafts	1745% (30% a.a.) →	2509 spacecrafts
39 smallsats	6054% (45% a.a.) →	2400 smallsats
136 spacecrafts	398% (16% a.a.) →	677 spacecrafts
39 smallsats	1356% (28% a.a.) →	568 smallsats
136 spacecrafts	**365% (15% a.a.) →**	**633 spacecrafts**
39 smallsats	**1244% (27% a.a.) →**	**524 smallsats**

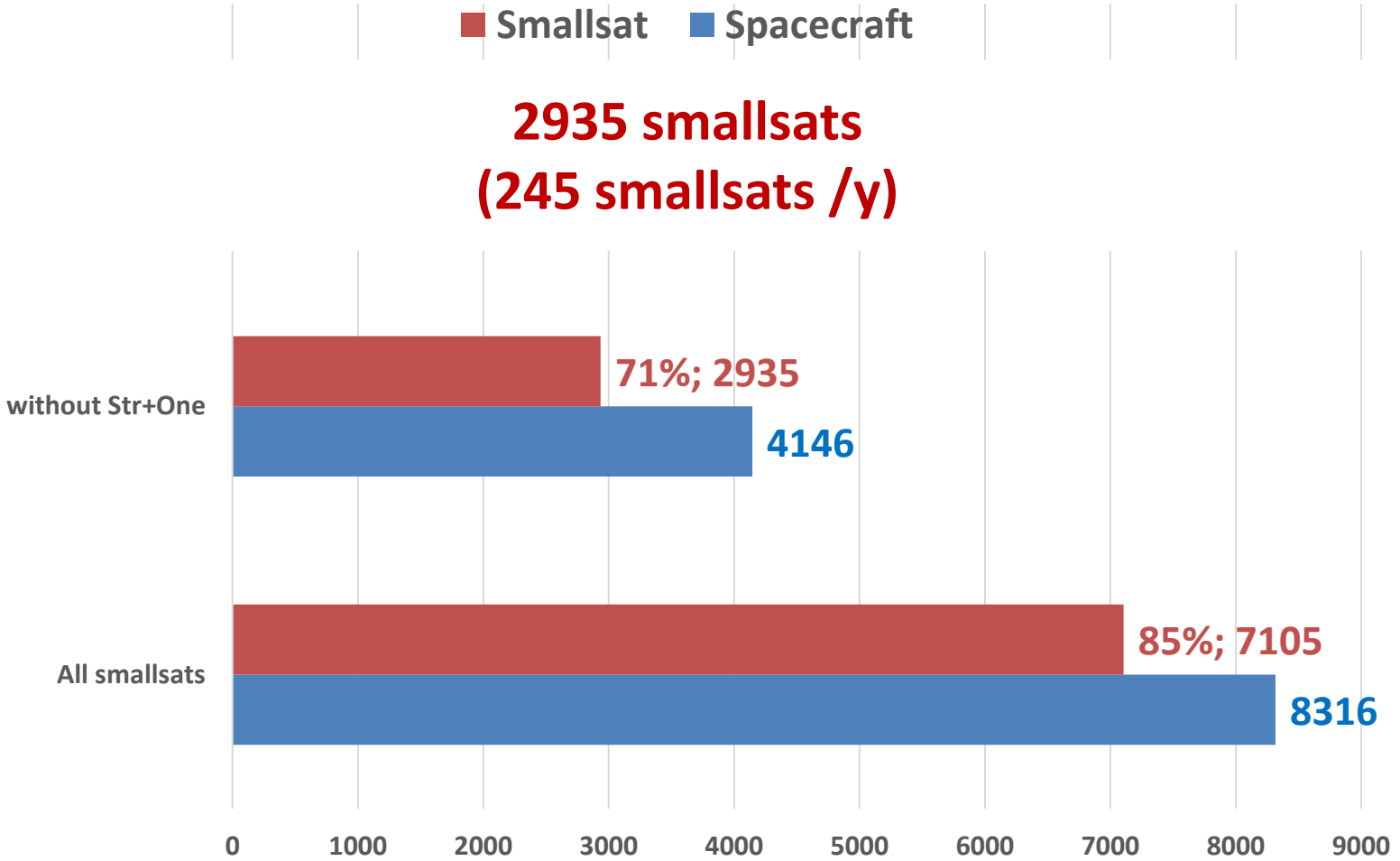
Without all smallsats

2011		2022
136 spacecrafts	1745% (30% a.a.) →	2509 spacecrafts
39 smallsats	6054% (45% a.a.) →	2400 smallsats
136 spacecrafts	398% (16% a.a.) →	677 spacecrafts
39 smallsats	1356% (28% a.a.) →	568 smallsats
136 spacecrafts	365% (15% a.a.) →	633 spacecrafts
39 smallsats	1244% (27% a.a.) →	524 smallsats
97 spacecrafts	**12% (1% a.a.)** →	**109 spacecrafts**

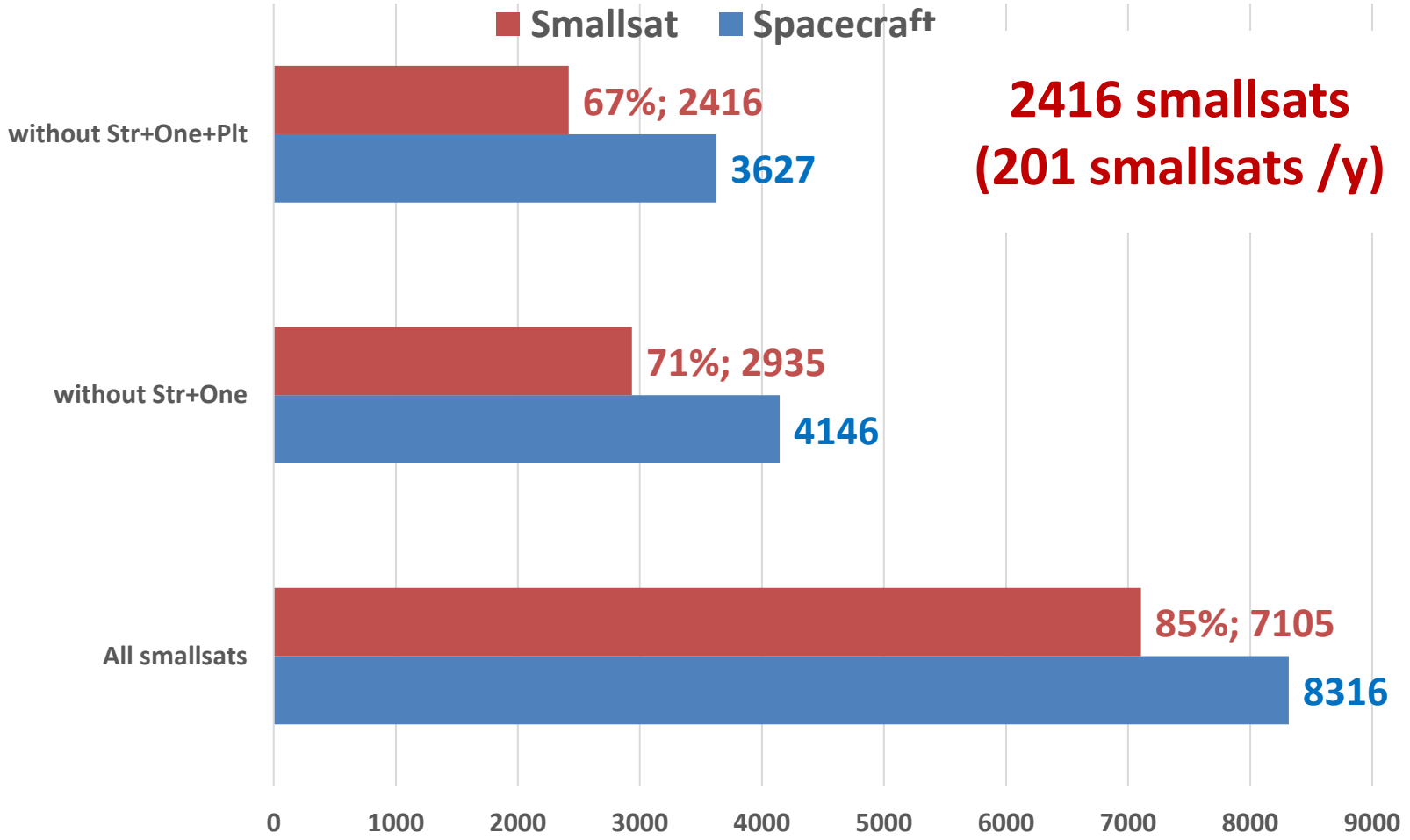
2011 to 2022


Smallsat
Spacecraft
7105 smallsats
(592 smallsats /y)
1211 non-smallsats
(101 /y)
All smallsats
85%; 7105
8316
0
1000
2000
3000
4000
5000
6000
7000
8000
9000

2011 to 2022

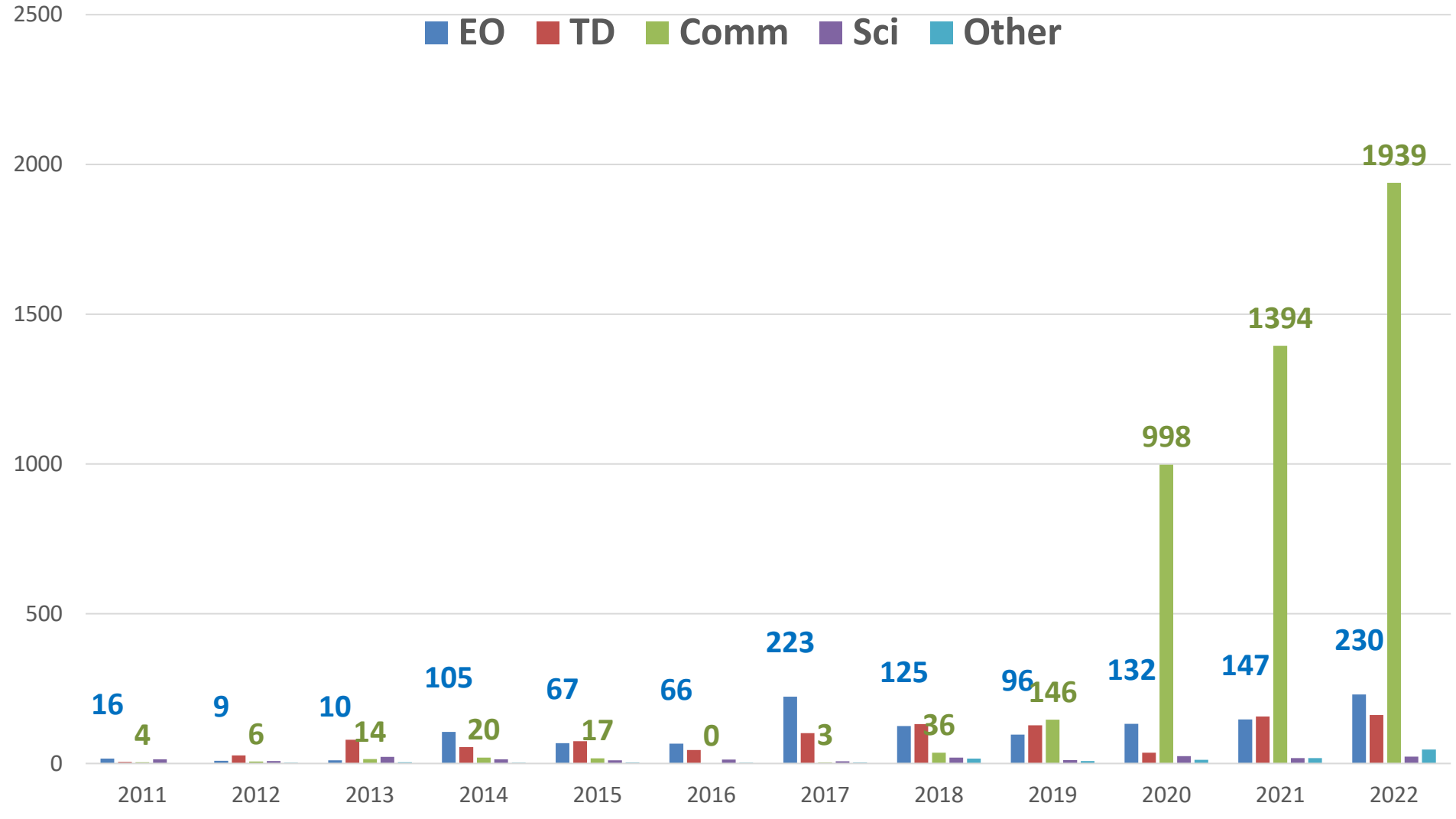

Smallsat
Spacecraft
2935 smallsats
(245 smallsats /y)
without Str+One
71%; 2935
4146
All smallsats
85%; 7105
8316
0
1000
2000
3000
4000
5000
6000
7000
8000
9000

2011 to 2022

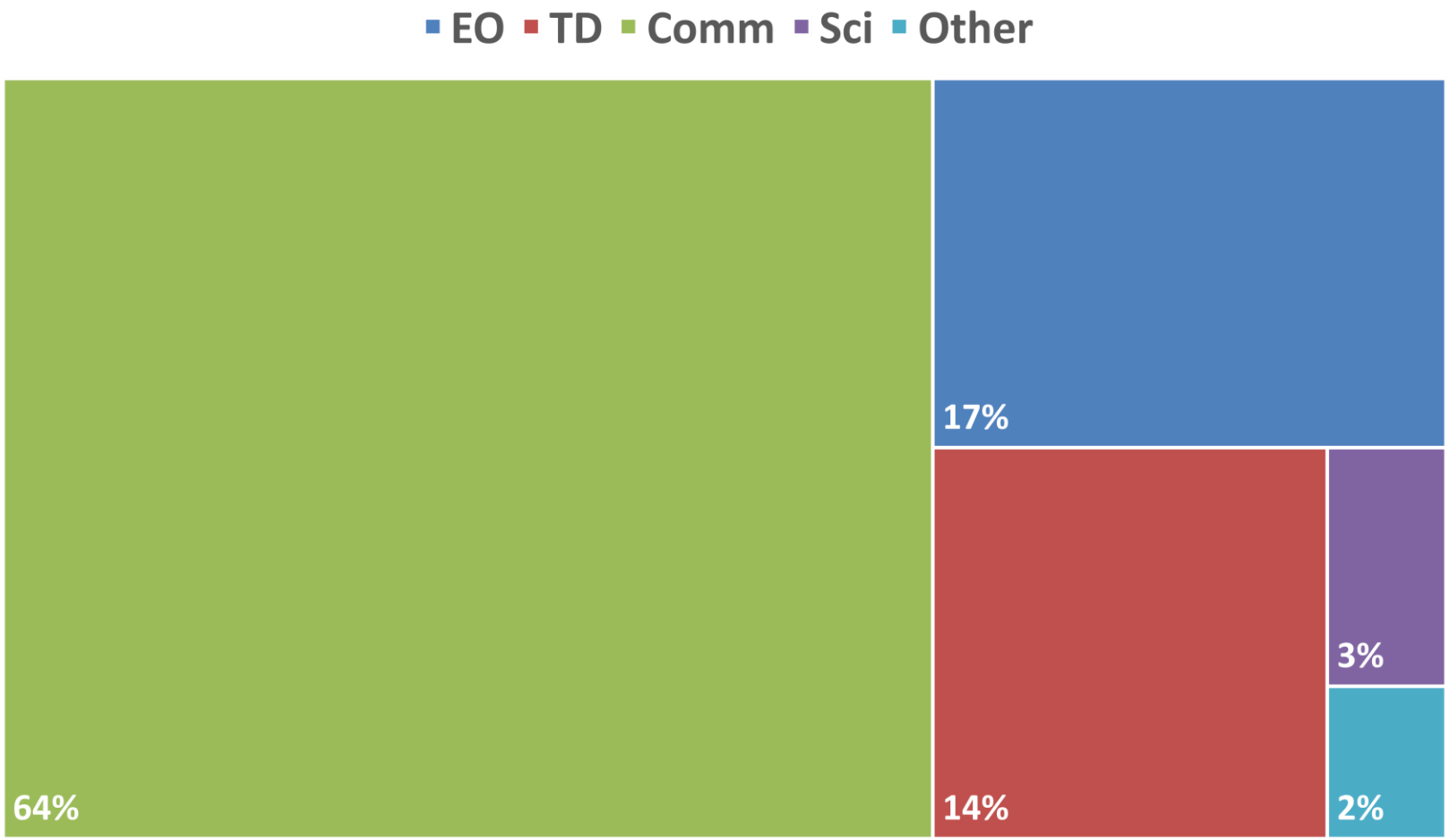


2416 smallsats
(201 smallsats /y)

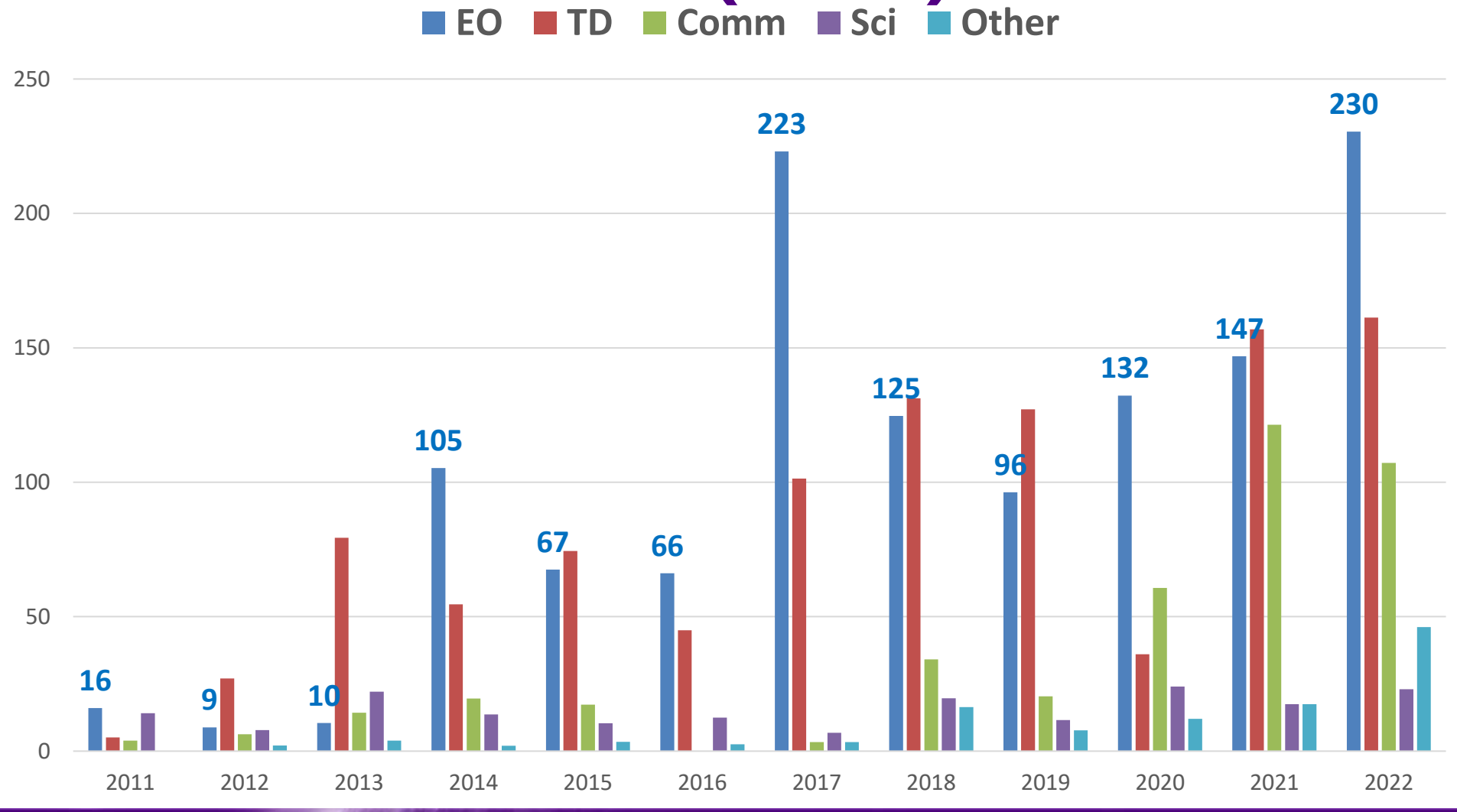
All smallsats (7105)



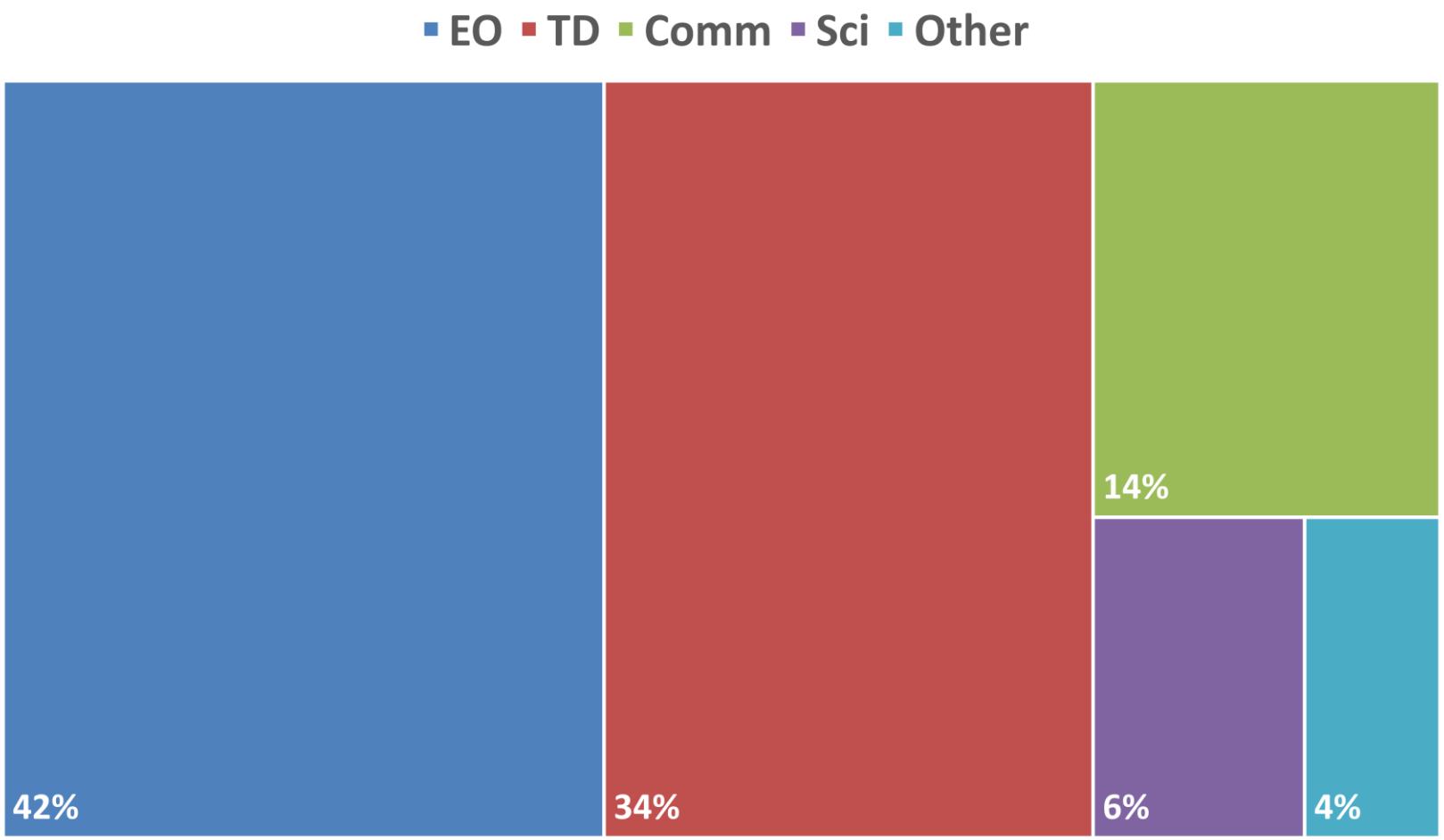
All smallsats (7105)



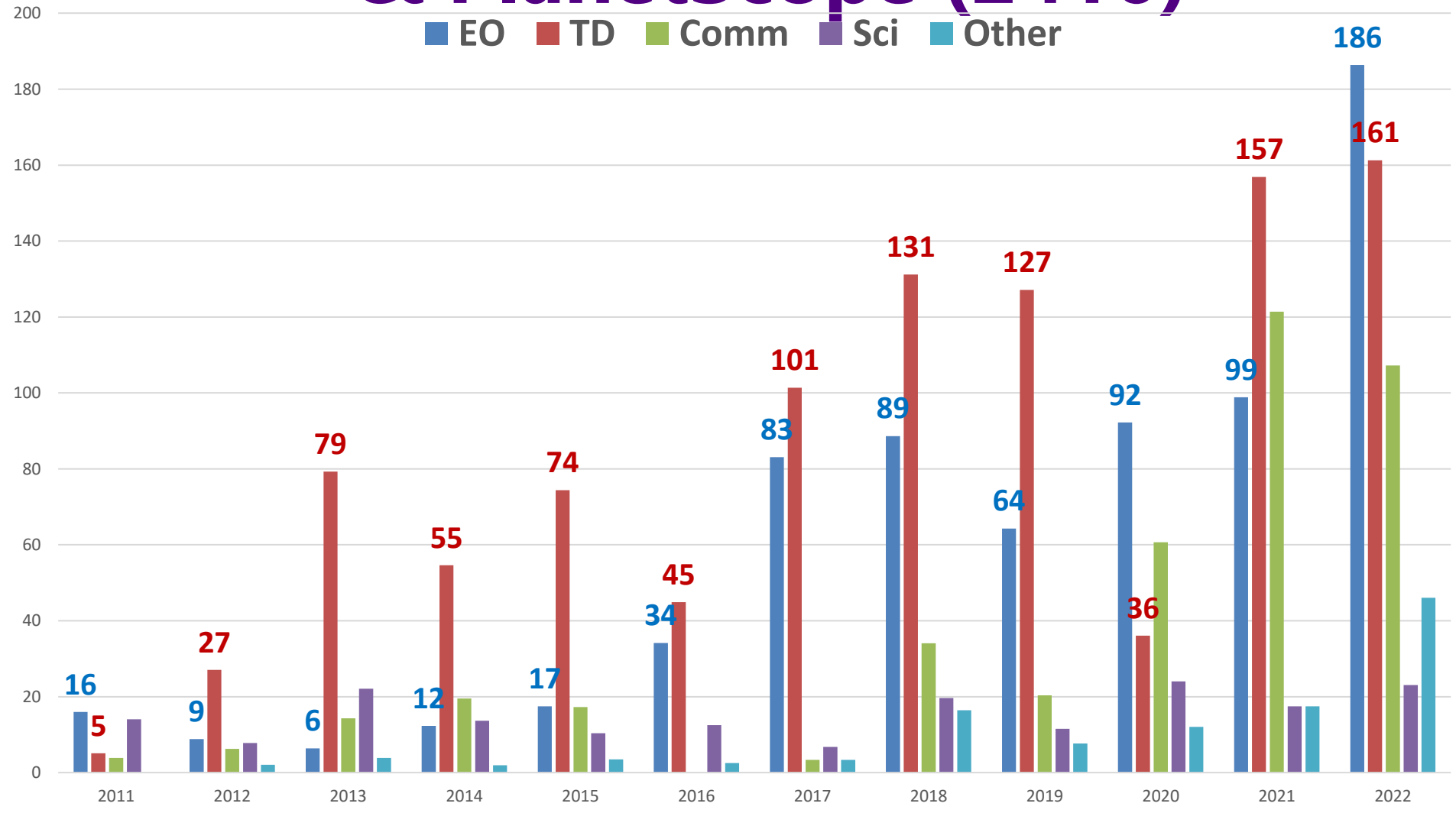
Without Starlink & OneWeb (2935)



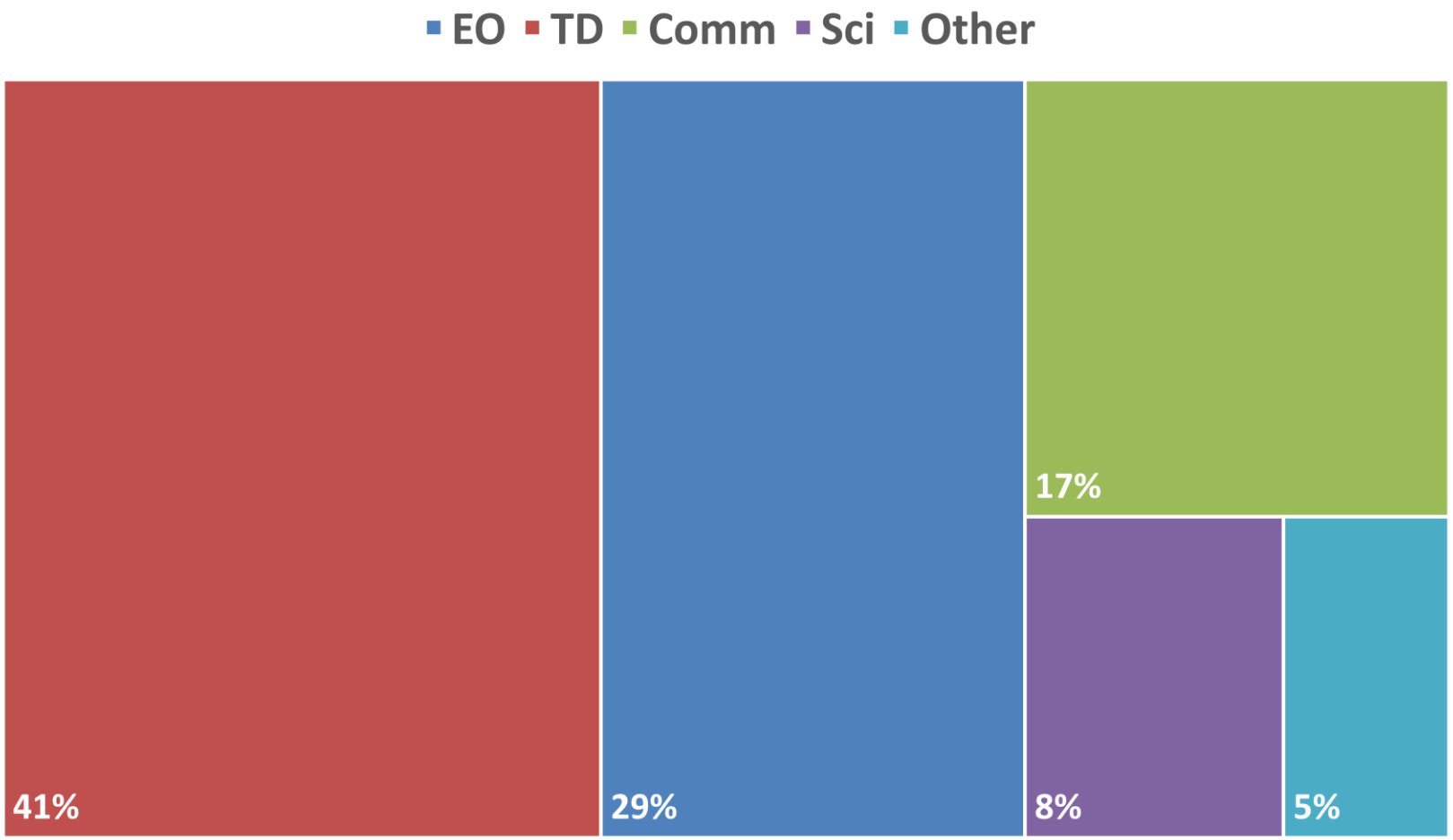
Without Starlink & OneWeb (2935)



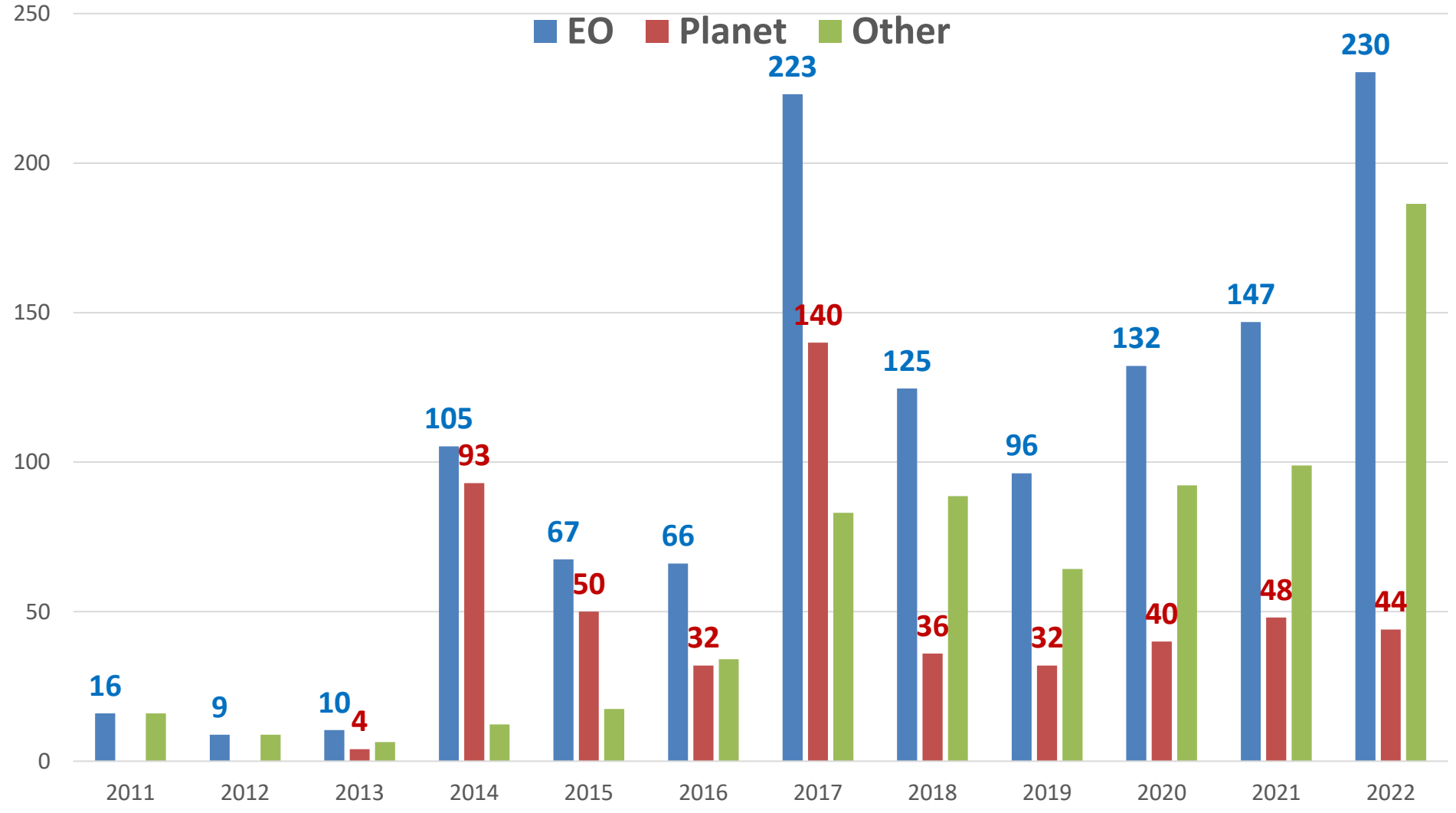
Without Starlink, OneWeb & PlanetScope (2416)



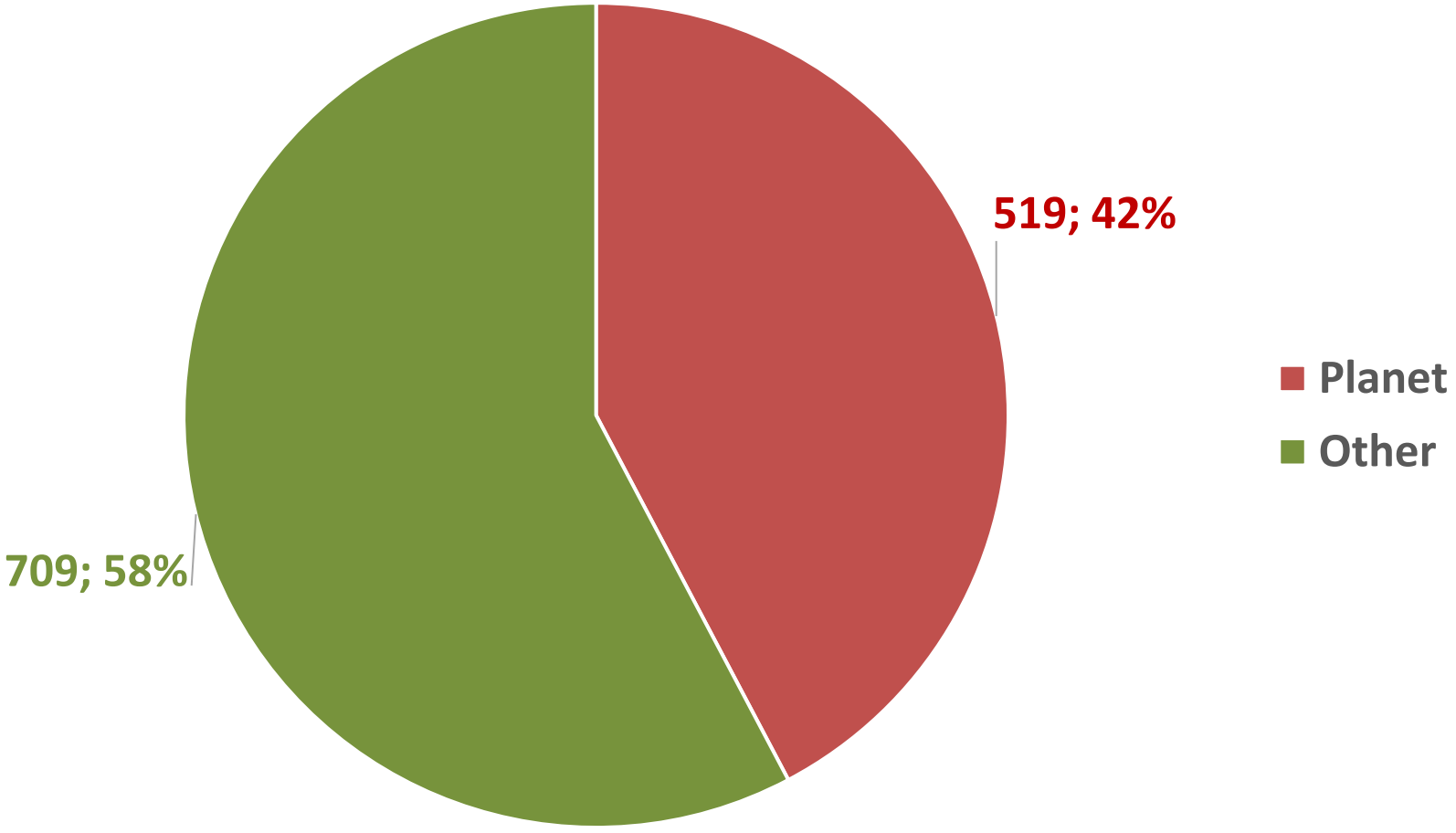
Without Starlink, OneWeb & PlanetScope (2416)



EO Smallsats



EO Smallsats



Top 10 Satellite Technology Trends in 2024

1. Small Satellites

"Equipped with smarter and compact subsystems, small satellites are replacing the need for large satellites and related infrastructure. Small satellites are increasingly positioned in LEO constellations for **earth observation (EO)** and remote sensing to generate superior insights."

https://www.startus-insights.com/innovators-guide/satellite-trends-innovation/

Top 10 Satellite Technology Trends in 2024

5. Artificial Intelligence

“The large volumes of data collected by satellites pose challenges in data handling, analysis, and timely resource management. Machine learning (ML) and AI enable the analysis of satellite data obtained from earth observation (EO).”

SDSat: Software Defined Satellite

Top 10 Satellite Technology Trends in 2024

8. Very High Throughput Satellites (VHTS)

"Demand for satellite-based mobile and broadband communications is surging and GEO satellite network providers respond by increasing their strength and throughput capabilities. This implies that GEO satellites utilize advanced transponders and **software-defined radios** to transmit data at several hundreds of gigabytes or even terabytes per second."

The Rise Of Space-To-Ground Optical Comms — Accelerating Adoption Laser communication

"Another advantage of laser communications is the technology's compatibility with ultra-high-capacity, terrestrial telecom technologies, capable of achieving data rates in the range of several Tbit/s"

http://www.satmagazine.com/story.php?number=731853527

Extra: https://spacenews.com/chinas-changguang-satellite-demonstrates-space-to-ground-laser-links/

Terran Orbital-developed PTD-3 enables 200 gigabits per second space-to-ground optical link

"*The completion of the 200 gigabits per second link is both monumental and record-breaking.*"

https://news.satnews.com/2023/05/14/terran-orbital-developed-ptd-3-enables-200-gigabits-per-second-space-to-ground-optical-link/?mohide=true&mc_cid=d0ea85306a&mc_eid=2e13f6b229

Hyperspectral Imaging Attracts a Host of Space Startups

"Hyperspectral imaging is still in the stages of demonstration and validation."

Aravind Ravichandran, a satellite data strategist for TerraWatch Space

https://interactive.satellitetoday.com/via/june-2023/hyperspectral-imaging-attracts-a-host-of-space-startups/

Planet Tanager constellation

High Precision Hyperspectral Data

400nm (visible) to 2500nm (short wave):

+400 spectral bands – 5nm

Planet Pelican constellation – 30cm

“Planet’s next-generation satellite constellation for delivering high-resolution, rapid revisit information anywhere on the globe.”

New space companies

Obrigado

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