The Changing Cast of Space Actors:

Internationalization, Commercialization and Democratization

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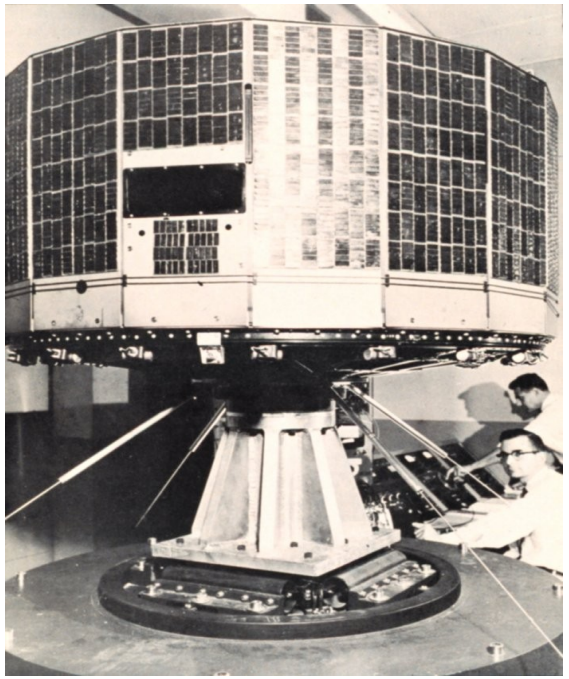
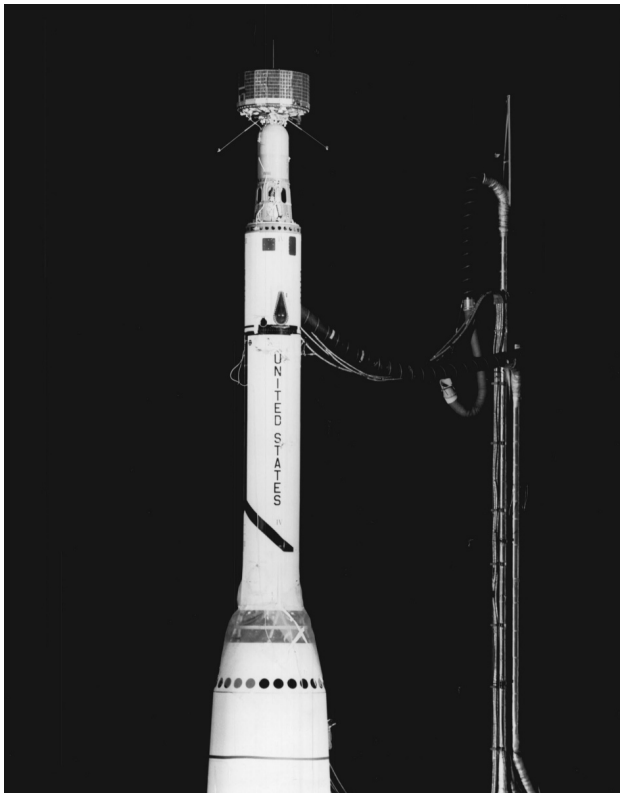
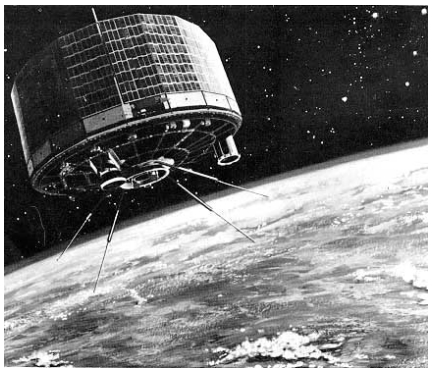
Internationalization

The 1960s – the superpower era in space





New Jersey-built satellite on California-built rocket orbited from Florida launch pad, mission control in Maryland



Tiros 1 - 1960

How things have changed..

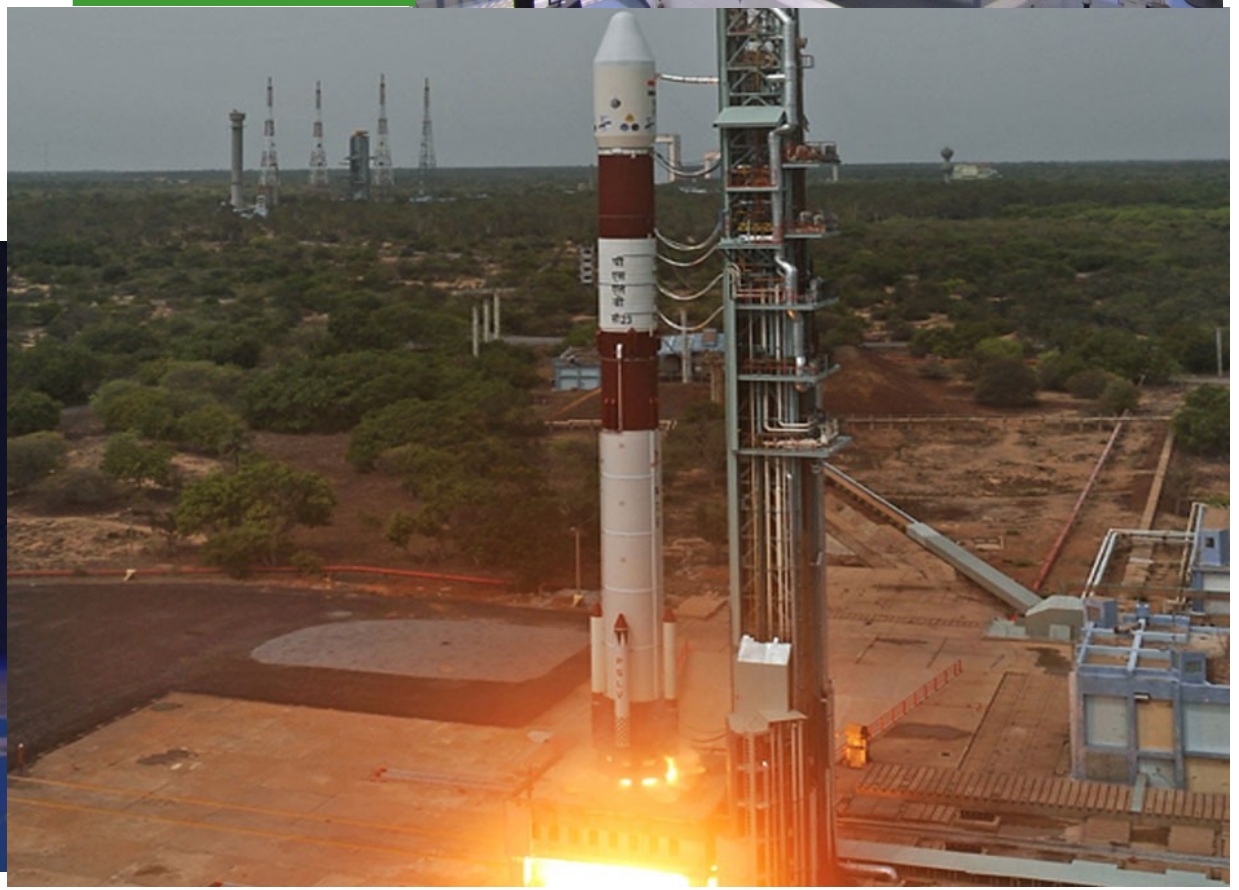
Azersky satellite (2014)

Built in Stevenage (UK) and Toulouse (France)

Launch procured by French company on Indian rocket

Launch from Indian spaceport in Andhra Pradesh

Resold in orbit to Azerbaijan

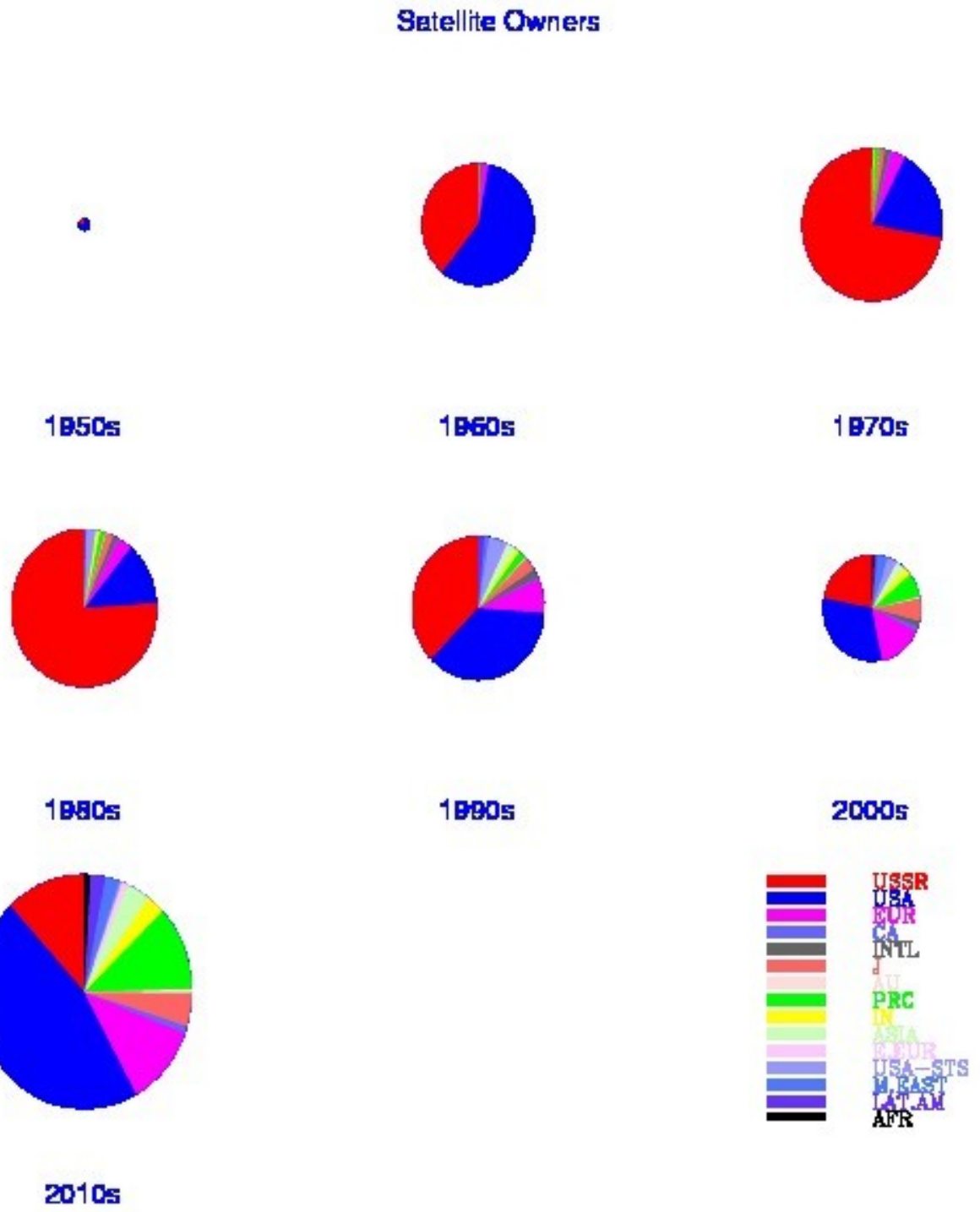


Steady increase in internationalization over the decades

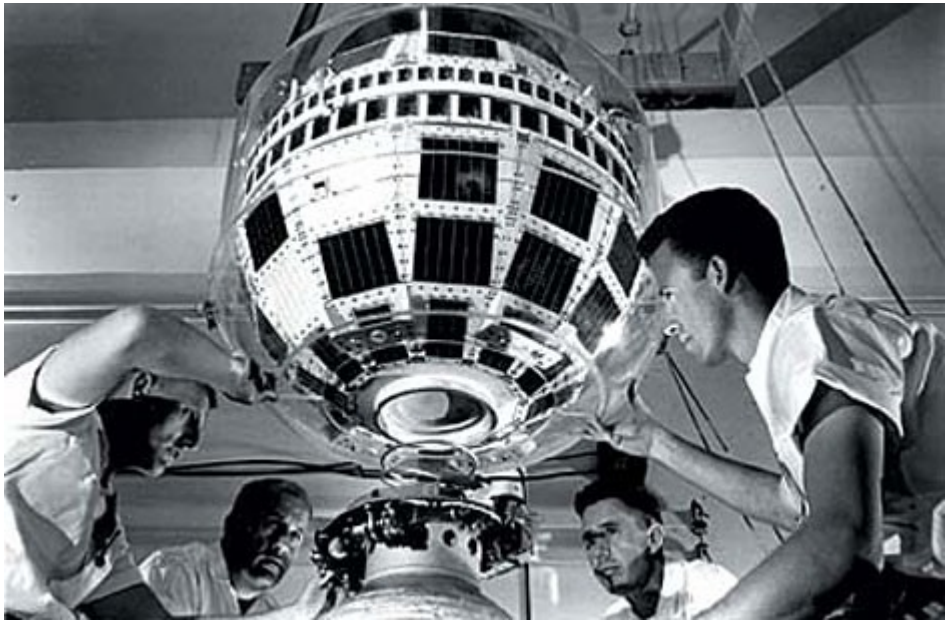
Size of circles proportional to total number of sats launched

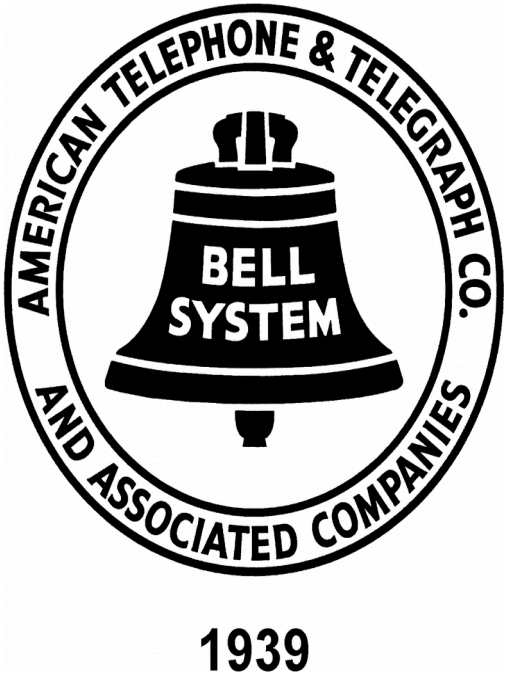
USSR dominated number in 1970s-1980s with lots of short lived sats, US had fewer longe lived ones

US dominates now, partly due to lots of cubesats



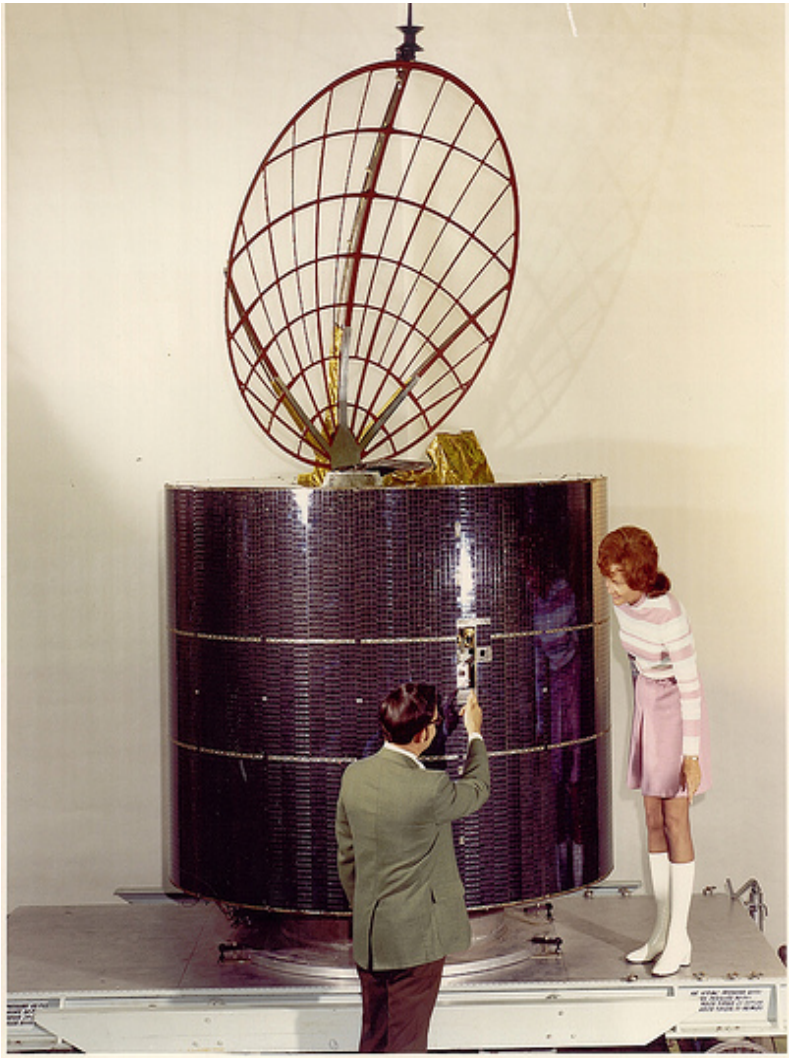
Commercialization and globalization





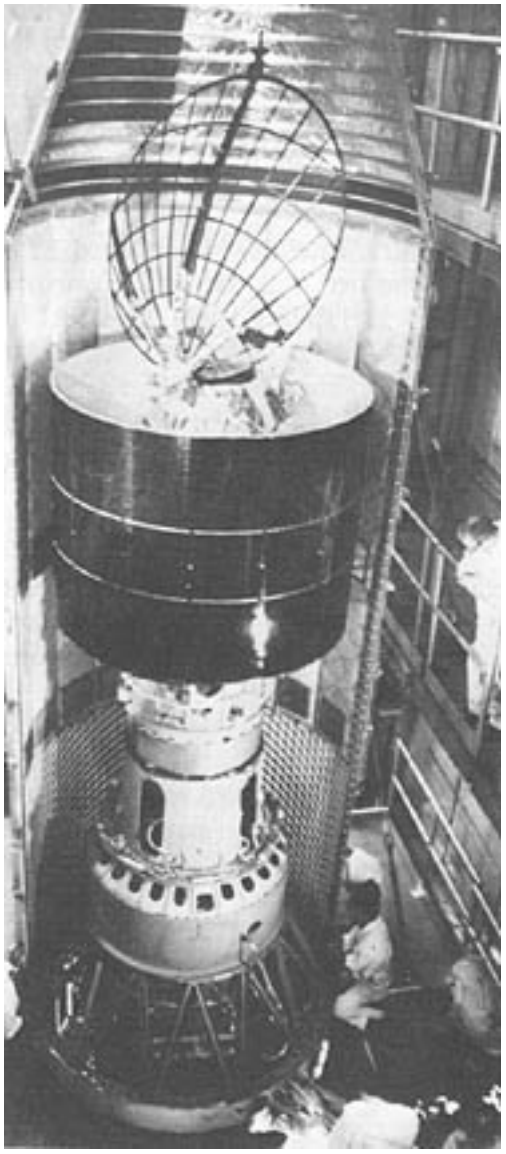
1962-1963

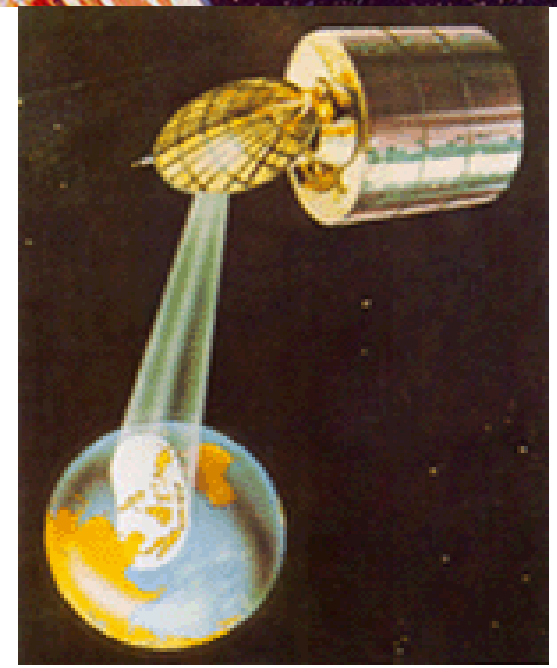
Telstar 1 and 2 – AT&T funded the first commercial communications satellites and paid NASA to launch them

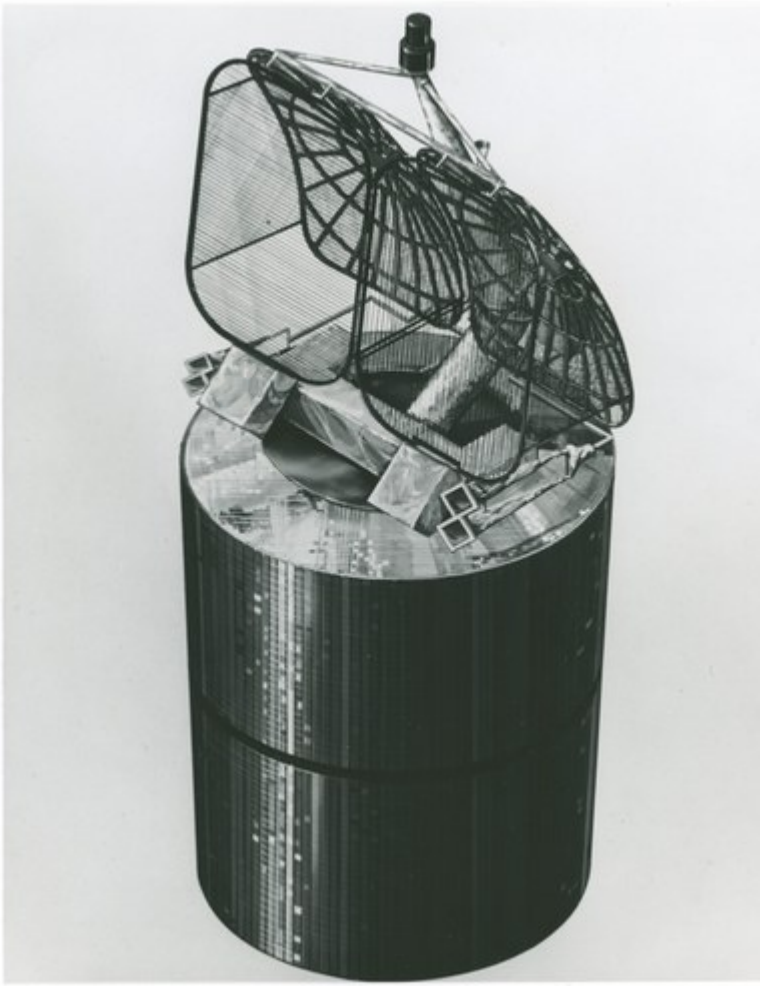


Telstar was not followed up – the next commercial satellite system had to wait for geostationary satellites to be mature.

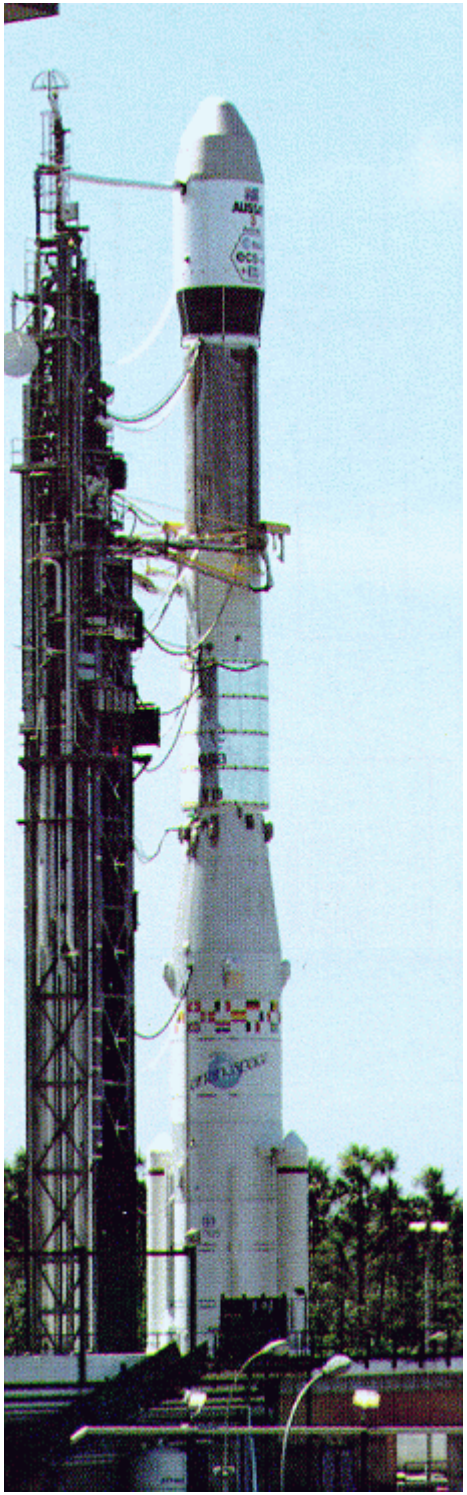
In 1972 the Canadian company Telesat was established as a commercial enterprise by the Canadian government
The `Anik' system was the first of a rush of first-generation commercial communications satlelites built by Hughes and RCA







1974: Western Union's Westar
1975: RCA Globcom's Satcom
1976: Comsat General's Marisat and Comstar
1976: Perumtel of Indonesia's Palapa



Government precusors transition to fully commercial operations:

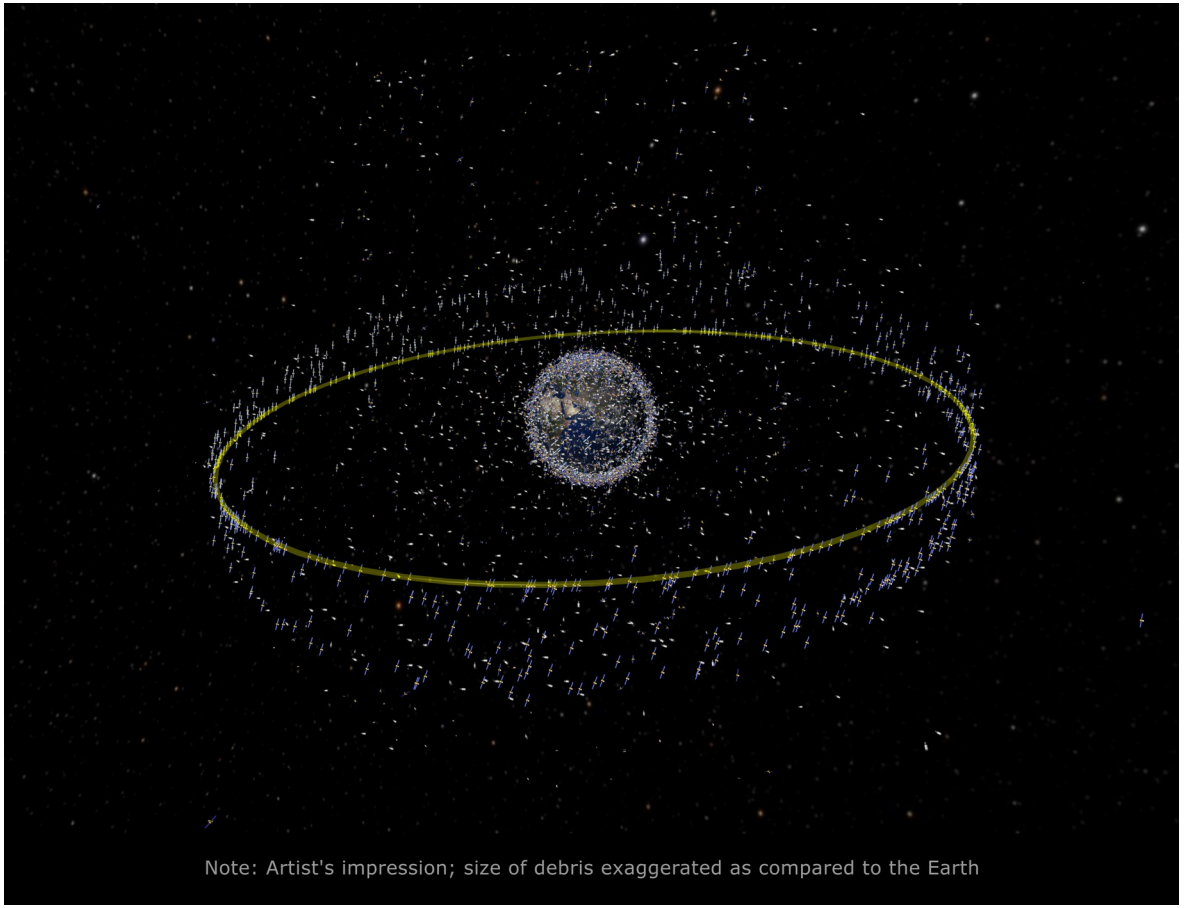
Communications satellites:	1970s to 1980s
Launch vehicles:	1980s to 1990s
Imaging satellites:	2000s
Microgravity satellites:	1990s, largely failed
Space station cargo delivery:	2010s, govt. only customer

As of Sep 2018:

538 active geostationary satellites

307 (57%) of these are owned by commercial companies

A few big operators (44 Intelsat, 39 SES)



With the globalization of corporations, space commercialization becomes space globalization

SES (Societe Europeene des Satellites)
- Based Luxembourg, 1985 (first satellite 1988)
- Absorbed RCA Americom (New Jersey) 2001
  (Absorbed GTE Spacenet 1994)
- Abosrbed GE Capital (Gibraltar) 2001
- Absorbed Nordic Satellite (Stockholm) 2005
- Absorbed New Skies (The Hague) 2006
  (spun off from INTELSAT in 1998)
- Stake in Nahuelsat (Argentina), Quetzsat (Mexico)
- Former stake in Asiasat (Hong Kong) and Star One (Brazil), etc.

As of 2018, 39 SES SATELLITES OPERATING IN GEO – 7% of total
Activities in many countries; satellite control centers in US and Lux.
Which country do the SES satellites belong to?

SES ASTRA
An SES GLOBAL Company

Another effect of globalization and mergers:
buying and selling satellites in space

1985: Satellite Business Systems sells 4 sats to MCI Corp
1992: BSkyB sells its two satellites to Telenor (Norway) and Sirius (Sweden)

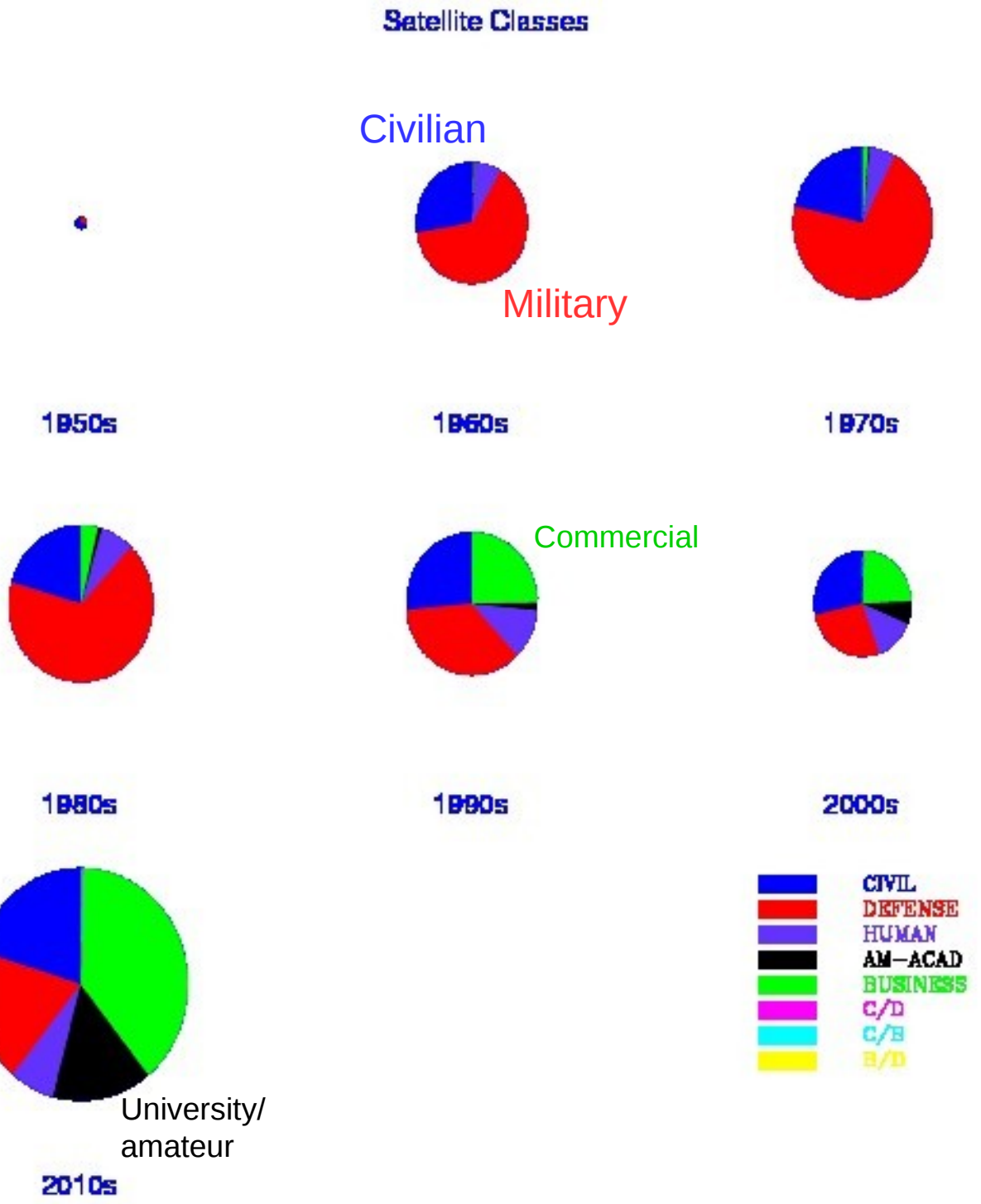
– more sales here and there in 1990s, but in 2000s see whole in-orbit fleets change hands

2004 - 4 Loral Telstars become Intelsats
2006-2007 – 21 Panamsat satellites (PAS and Galaxy) sold to Intelsat
2006 - New Skies fleet sold to SES

The defense sector (red) shrunk after the cold war

Commercial sector became important in 1990s

Non-profit sector is a factor starting in 2010s

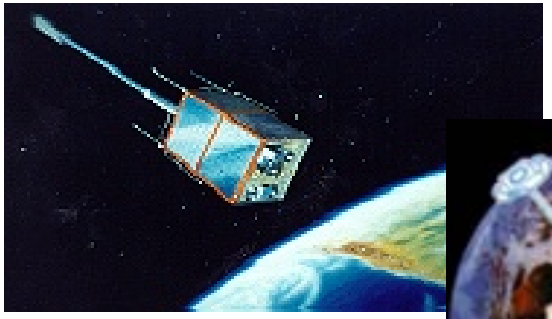


Democratization

Surrey Satellite (1990s): Space for developing nations

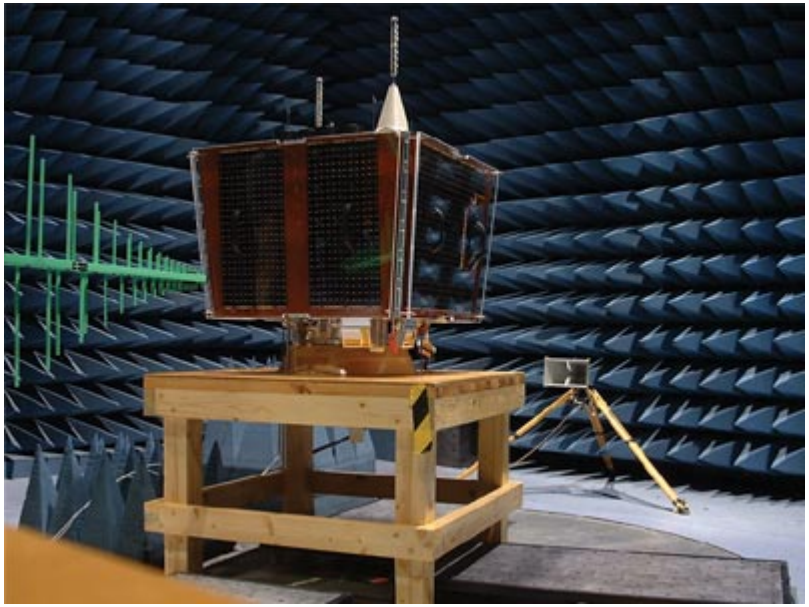
Alsat (Algeria) 2002

Tiungsat (Malaysia) 2000

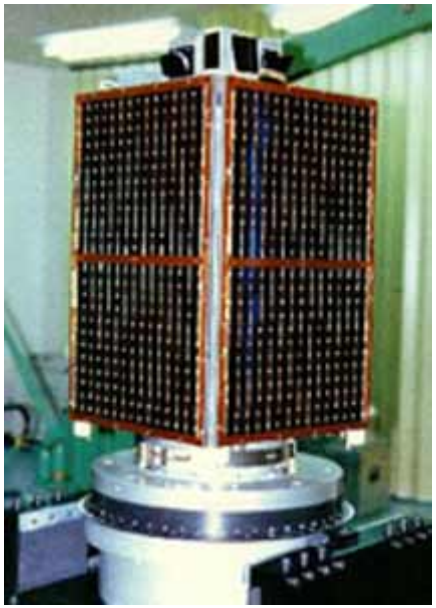


Fasat (Chile) 1998

Posat (Portugal) 1993



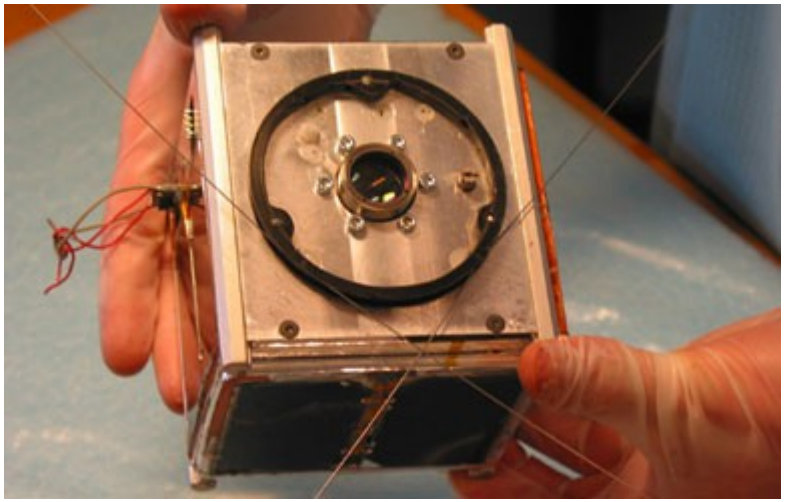
Bilsat (Turkey) 2003



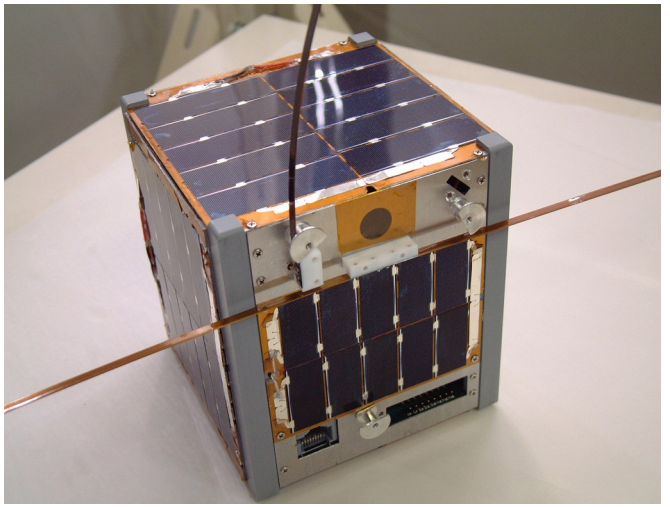
Uribyol
S Korea 1992

Nigeriasat-2 2011

Cubesats: 1 kg, 10 cm (2 lb, 4 in for the metric impaired)
Standard kit for universities to make students build sats in engineering courses
Can also make '3U' cuboids 30 x 10 cm
97 Cubesats launched 2003-Feb 2013 by 66 organizations in 20 countries



Aalborg U. 2003



Univ. of Tokyo, 2003

Cubesat deploy from ISS, 2012

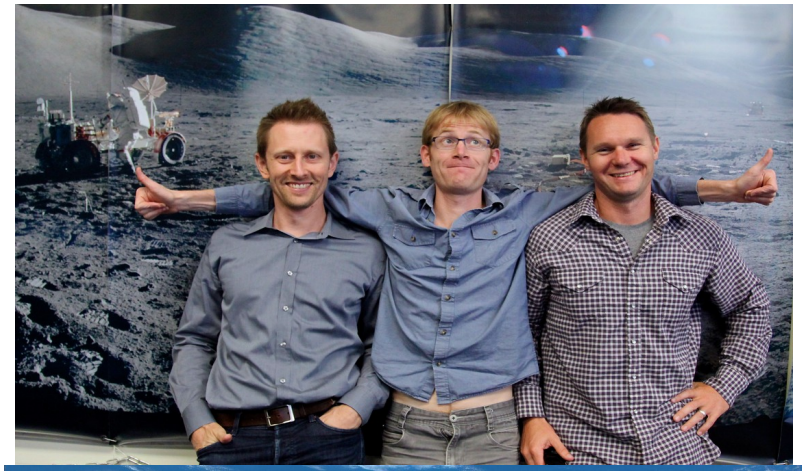
Triple-cube Quakesat, Stanford 2003

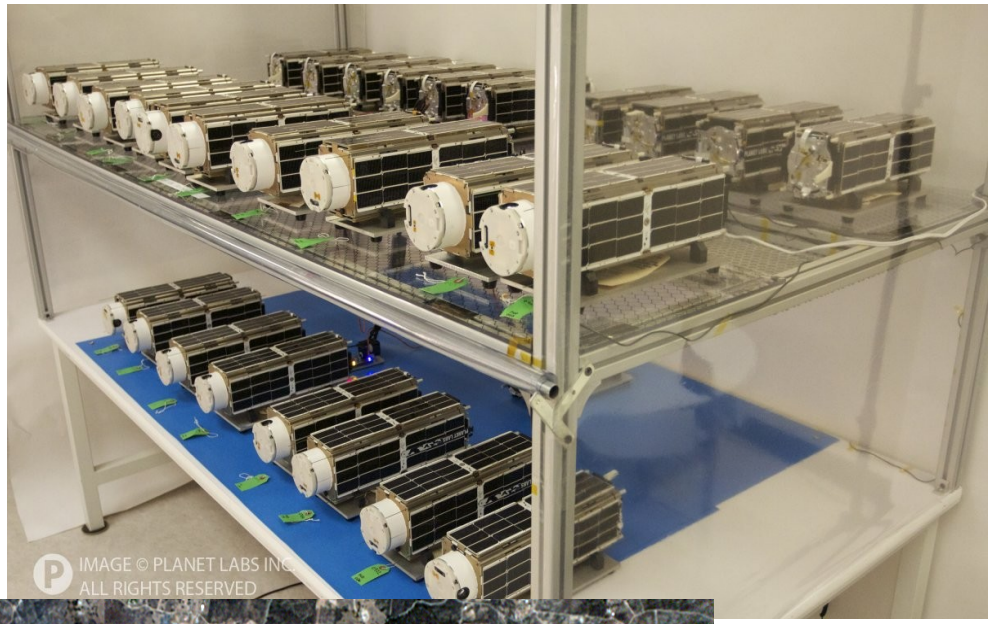
2013: CUBESAT EXPLOSION!

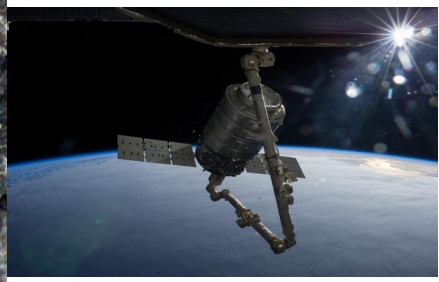
99 Cubesats launched Jun 2003-Feb 2013 by 63 organizations in 20 countries

120 Cubesats launched Mar 2013 – Feb 2014 by 57 organizations in 18 countries

(Cumulative: 219 Cubesats by 108 orgs in 28 countries)

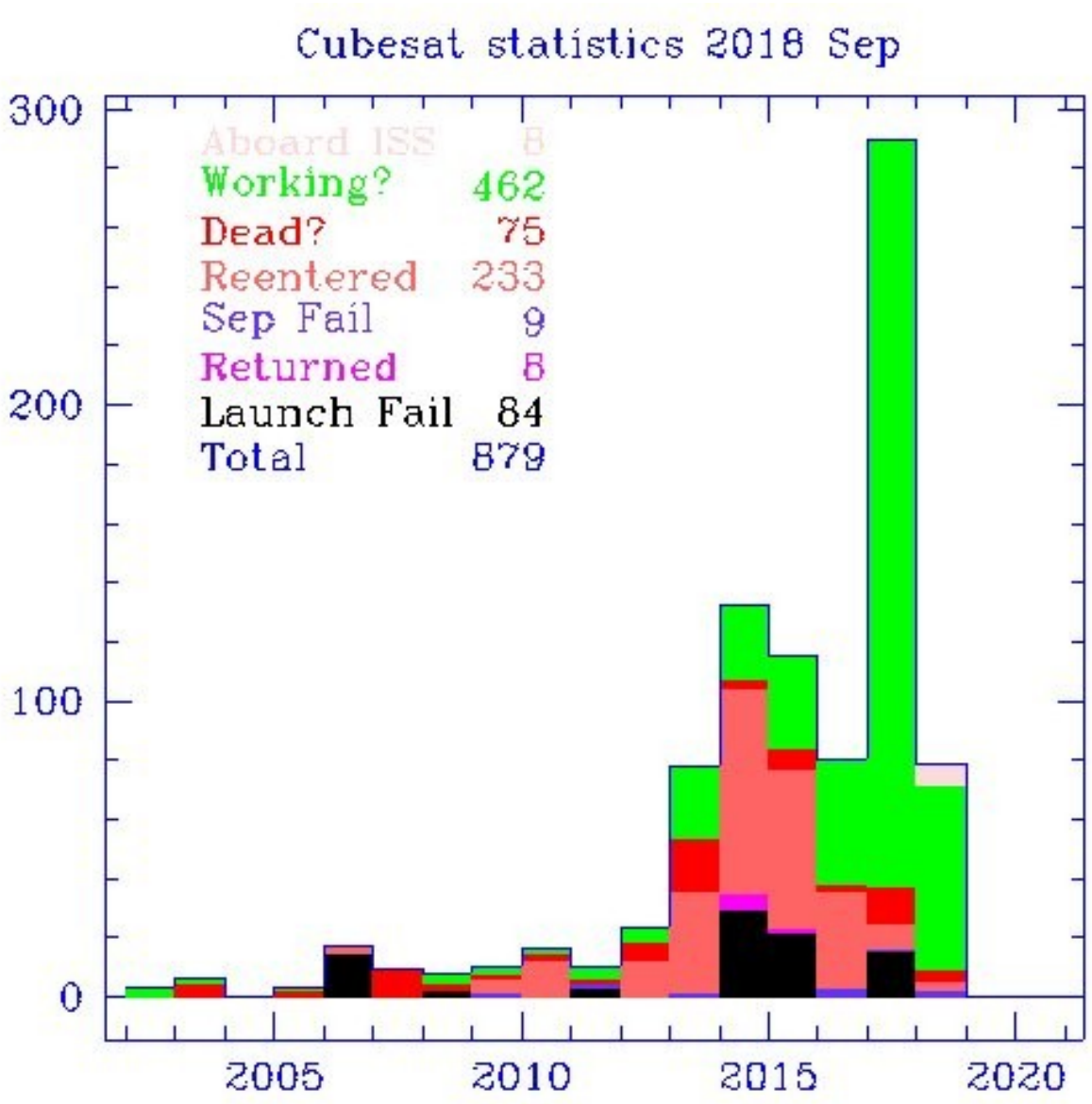






Chris, Will and Robbie left NASA to found PlanetLabs in a San Fran office building – 71 satellites launched since 2013, first big Cubesat constellation

The Cubesat Explosion



http://planet4589.org

TOTAL 57 COUNTRIES:

USA 652
Japan 32
China 21
Germany 14
S Korea, Russia 13
Denmark 11
UK 10
Italy, Singapore 7
Canada 6
Netherlands, Spain, France,Turkey 5
Belgium,India,Australia,Israel 4
Brazil, Norway,Peru,Lithuania, S Africa 3
Switzerland,Vietnam,Ukraine,
Ecuador ,Argentina,Austria,Switzerland, Finland,
Greece, Sweden 2
Kazakhstan, Emirates, Uruguay, UAE,
Algeria, Poland, Pakistan, Colombia,
Romania, Hungary,Estonia, Bangladesh,
Bulgaria, Bhutan, Chile, Costa Rica, Czechia,
Ghana, Kenya, Mongolia, Malaysia, Nigeria,
Phillipines, Pakistan, Poland, Slovakia, Taiwan 1

Includes 33 startup commercial companies