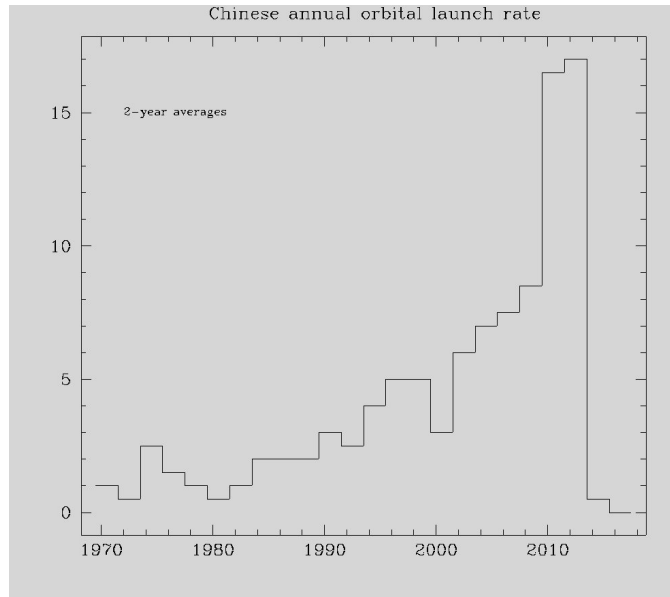


# China Satellite Update - 2014

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Following China's first satellite launch, China's orbital launch rate remained relatively low at about one to two launches per year for 20 years. In around 1990, that rate began to increase gently and fairly steadily until 2011 when the 2-year-average launch rate leapt by a factor of two.



Let us consider the year 2013 in detail. There were 15 Chinese orbital launches, including the first launch of the new Kuaizhou solid fuel launch vehicle from the Jiuquan Space Center. The remaining launches were all by rockets of the Long March (Chang Zheng) family, which comes in several variants, some built by the Beijing-based CALT and some by the Shanghai Academy of Space Technology.

2013 Chinese orbital launches by rocket type and launch site				
	Jiuquan	Xichang	Taiyuan	Total
Kuaizhou	1	0	0	1
CZ-2C	1	0	1	2
CZ-2D	2	0	0	2
CZ-2F	1	0	0	1
CZ-3BE	0	3	0	3
CZ-4B	1	0	1*	2
CZ-4C	1	0	3	4
Total	7	3	5	15

\* The CZ-4B launch from Taiyuan failed to reach orbit.

In 2013 the 14 successful launches put 17 Chinese-owned and -manufactured satellites

in orbit. Two launches carried three payloads each. One launch carried a Bolivian-owned (Chinese-manufactured) satellite. In 2012, with a record 19 successful launches, China orbited a European-built satellite for a Hong Kong-based company as well as Turkish and Vietnamese satellites and an additional 24 Chinese (non-Hong-Kong) satellites. The ability for a launch vehicle to carry multiple satellites means that you must be careful to state whether you are counting orbital launches (how many rockets) or satellites launched (how many payloads).

2011-2013 Chinese and US orbital launches and satellite payloads launched			
	2011	2012	2013
Chinese launches	19	19	14
US launches	19	16	20
Chinese sats, number	18	25	17
US sats, number	38	31	82
Chinese sats, tonnage (est.)	47	53	29 (metric tons)
US sats, tonnage	407	84	87 (metric tons)

Note 1: One Chinese failure in 2011 and one in 2013.

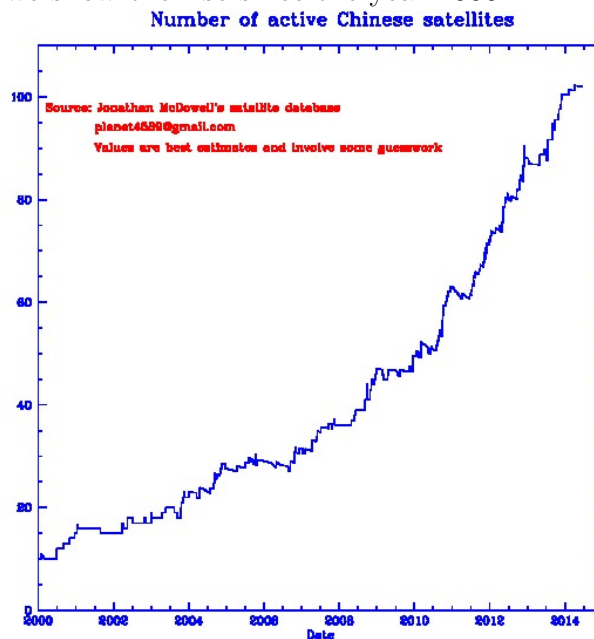
Note 2: One US in 2011 and one in 2013.

Note 3: US figures include Sea Launch (1 in 2011, 3 in 2012, 1 in 2013).

Note 4: Figures for satellites do not include launch failures

Note 5: 2011 US tonnage figures include Space Shuttle Orbiters

Although China does launch occasional satellites for other customers, the bulk of its launches are of domestic Chinese-owned satellites, also mostly but not exclusively Chinese-manufactured. This has led to a corresponding increase in the number of active Chinese satellites in orbit. Here we show the rise since the year 2000:



The data for this figure are created by estimating the end-of-life dates for each Chinese

satellite (launch dates are well known). For geostationary satellites this is easy enough - when the satellite stops stationkeeping maneuvers and/or sent to a graveyard orbit it is considered to be dead. This kind of analysis works for maneuvering low orbit satellites too; but Chinese LEO satellites at 500 km or above often do not maneuver. End of life dates for some (civilian) satellites in such orbits are made public, but for others we must guess their operational lifetimes based on typical Chinese satellite lifetimes measured for the other categories, or noting their replacement by new satellites in the same orbital plane. Nevertheless I believe that the estimates given here are good to plus or minus 10 percent of the total.

Another uncertainty is in the definition of 'active'. The end of a satellite's life is sometimes abrupt - a power supply failure, a reentry while still active - but can also be gradual, with a move to reserve status, then formal retirement, perhaps still with a tracking beacon active, or even repurposed for flight controller training, before finally falling completely silent. My definition of 'active' includes any form of transmission between the satellite and its ground controllers. This contrasts for example with statistics from the Union of Concerned Scientists ( <http://www.ucsusa.org/nucleareaponsndlobalecurity/solutions/space-weapons/ucs-satellite-database.html> ) which I believe tends to use retirement from an active constellation as an end-of-life value and so counts fewer satellites as active. Therefore, readers should not expect estimates of the statistics of active satellites from different sources to agree exactly.

With these caveats, here are my estimates for the current state of Chinese space:

Chinese Satellites, June 2014		
	Best Estimate	Estimate Range
China: Total still in orbit	146	Exact
China: Total still active	101	95 to 105 ?
World: Total still active		1100 to 1300 ?
US: Total still active		500 to 550 ?
Russia: Total still active		120 to 140 ?

What are these satellites doing? China's 101 satellites which I estimate to be active are itemized below. I divide the satellites into civilian government, military/intelligence, commercial, and non-profit (university and amateur, a category which is significant for other countries but not yet for China). The case of Beidou is tricky, as for GPS in the US. The GPS system was developed for the US military, but is now also a key part of our civilian infrastructure - if you, gentle reader, are like most of my friends, you probably couldn't find your way to a local restaurant for dinner if GPS went down. I therefore consider GPS to be a true case of what is often called 'dual-use' - military and civilian. Beidou I assess to be similar, although its civilian uses in China are essentially all governmental for the time being. It is true that many other satellites whose intent is mostly civil return data that is of military use, and it is possible that some mainly military-intelligence imaging satellites return data that is sometimes used by civil government agencies. It is also true that the management of many space activities that I consider 'civil', such as human spaceflight, are

in China the responsibility of parts of the defense establishment. Despite these complicating factors I think it is usually fairly clear, and usefully meaningful, to distinguish civil and military satellites. We may contrast the environmental research satellites such as HJ-1A, whose work is described in open papers, with the Yaogan series for which neither detailed satellite descriptions nor resulting data are available. My conclusion is that the Chinese space sector has a strong military component, but not one dominated by military activities; the balance is similar to that in the rest of the world.

- **1 non-profit:** HOPE-1 amateur radio sat
- **15 commercial and semi-commercial:**
  - 7 Hong Kong based commercial - Asiasat, Apstar, ABS
  - 8 semi-commercial comms - Chinasat/Chinastar
- **35 civilian:**
  - 3 civil GEO comms - Tian Lian (TDRS equivalent)
  - 2 civil LEO comm - Chuanxin
  - 4 civil GEO weather - FY-2
  - 3 civil LEO weather - FY-3
  - 11 mostly civil LEO imaging and remote sensing (HY, China-DMC, HJ-1A/B, CBERS, GF-1)
  - 1 mostly civil LEO radar imaging (HJ-1C)
  - 2 civil deep space (Chang'e 2,3)
  - 1 civil human spaceflight related (Tiangong)
  - 8 mostly civil technology (SJ-7, 9, 15, 16; Shiyang 4, 5, TT-1)
- **36 military:**
  - 5 mostly military GEO comms (ZX-1,2,20,22)
  - 4 probably military early warning (SJ-11)
  - 9 mostly military LEO imaging (Yaogan, ZY-3, KZ-1)
  - 5 mostly military LEO radar (Yaogan)
  - 13 military LEO signals intelligence (SJ-6, Yaogan)
- **14 military/civilian** navigation constellation (Beidou)

What of the future? A 2014 report by the US DoD ('Annual Report To Congress, Military and Security Developments Involving the PRC 2014') suggested that China would launch '100 satellites through 2015'. If the report, apparently compiled in early 2014, is talking about new satellites launched in the period Jan 2014 to Dec 2015, this seems

completely unrealistic. I would expect probably 40 to 50 satellites in that period - possibly even 60 if they open a new pad or two, but 100 seems implausible. It is technically possible if most of them are tiny cubesats. One could imagine a plan to launch a cubesat cluster of some kind (of order 50 satellites deployed on a single rocket, as has been done with Minotaur and Dnepr). China has not done much with cubesats yet, so I don't believe such a plan is likely with domestically produced satellites, and I am not aware of any US, European or Japanese intentions to carry out such a cluster launch using a Chinese launch vehicle. In the longer term, with the opening of the Hainan launch site, the development and flight test of several new launch vehicles, China's satellite launch rate may increase significantly.

The introduction in 2013 of the new Kuaizhou rocket, for quick launch of low orbit satellites, reflects an interest in what in the US is called 'operationally responsive space'. The Kunpeng-7 high altitude suborbital launch vehicle test, although it carried a science payload, may indicate development of a related high altitude ASAT capability. At the other extreme, the recently unveiled Chang'e-5 Flight Test Device, which appears to be a 1/2 scale Shenzhou and is intended for a lunar orbit and Earth return mission, heralds a more sophisticated and ambitious deep space program which will lead to a robotic sample return mission in 2017 and may be the first real indication in hardware, albeit subscale, of a future Chinese effort to send humans into deep space. But the bulk of Chinese space activity in the next several years seems likely to involve continued launches in now-established satellite series - Yaogan, Beidou, Shi Jian, Feng Yun, etc. - and continued collaboration with European satellite manufacturers for China's domestic satellite telecommunications needs.

## **Acknowledgements**

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