USCC Hearing on "The Rocket's Red Glare: China's Ambitions to Dominate Space"

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Panel 2: Space as a Contested Domain: Expansion of China's Military and Commercial Space Activities

Witness topic: China's Commercial Space Industry and Supply Chains

1) How would you characterize the current status of China's commercial space industry, and what role does the central government play in fostering its growth and development?

I would characterize the Chinese commercial space industry as extremely vibrant, but in some ways also tenuous. It is vibrant because there have been multiple high-level government proclamations in support of commercial space over the past decade, giving provinces, cities, private VCs, and entrepreneurs support to establish commercial space firms. It is tenuous because these firms are, in many cases, struggling to put together a business model. This dynamic is largely due to the fact that support for Chinese commercial space, like many industries in China, comes from the supply side rather than the demand side: the Chinese government provides funding for space companies, they provide free land, subsidies for employees, etc., but they seldom provide contracts for actual goods and services.

The Central Government also plays a guiding role, publishing nebulous announcements about their support for space. This includes Satellite Internet being included in the National Development and Reform Commission's (NDRC) list of New Infrastructures, multilateral agreements specifying space cooperation (i.e. "A New Era of China-Africa Cooperation" from November 2021 mentioning space projects[1]), and vague pronouncements about opening up of relatively closed industries (i.e. the 2023 publication by MIIT of the "Opinions on Innovating the Management of Information and Communication Industry to Optimize the Business Environment", which called for orderly opening up of the satellite internet industry [2]).

2) Describe China's domestic policies at the provincial level that are shaping the future trajectory of China's commercial space industry.

Most provinces have some element of space in their medium-long-term development plans. This could be reflected in a 14th Five-Year Plan, development plan for developing "New Productive Forces", development plan for "New Infrastructures" (which could include satellite internet), or development plans that align with other national-level strategic policies.

Certain cities also have this type of policy. Taking Shanghai as an example, the city has:

[1] https://www.gov.cn/zhengce/2021-11/26/content_5653540.htm
[2] https://www.gov.cn/zhengce/zhengceku/202408/content_6966820.htm

a. 14th Five-Year Plan for Shanghai to Build a Science & Technology Innovation Center with Global Influence[3] (includes satellite internet and rockets)
b. 2022 Shanghai Action Plan to Create a Future Industry Innovation Highland and Develop and Expand Future Industry Clusters[4]
c. 2023 Shanghai Action Plan to Promote Commercial Space Development and Create a Space Information Industry Highland (2023-2025)[5]
d. Certain districts also have targeted subsidies. The Songjiang District of Shanghai (home to the G60 Industrial Base/SpaceSail constellation) published a list of targeted subsidies this week[6]:
    i. "Major Project" subsidies: Up to ¥5M for rented office space ¥10M for purchased office space, and up to 15% of a project's total fixed asset investment, to a maximum subsidy of ¥30M per project.
    ii. "Supporting Satellite Constellation" subsidies, providing one-time subsidies of 10% and 20% of launch and insurance costs, respectively of a single satellite, to a maximum subsidy of ¥2M per satellite and ¥5M per enterprise
    iii. "Supporting Production and Launch of Spacecraft", providing subsidies of ¥10,000 per kg of satellite launched to an annual maximum of ¥500,000 per satellite and ¥5M per enterprise.
    iv. "Supporting Joint Innovation Among Industries", offering subsidies of up to ¥10M per project at a rate of not more than 30% of the project total for "commercial space enterprises to form alliances with universities, research institutes, and upstream and downstream enterprises"
    v. "Support Creation of Technological Innovation Platforms", offering subsidies of up to ¥10M per project at a rate of not more than 30% of the project total for projects such as clean rooms, electromagnetic compatibility rooms, etc. For companies that open these test rooms to other enterprises, a maximum of ¥2M per year in subsidies will be provided at 5% of actual annual service income. Companies building infrastructure for testing, certification, simulation experiments, etc., can receive a subsidy of 20% of the fixed asset investment up to ¥5M
    vi. "Encourage Coordinated Development of Industries", providing subsidies of 5% for companies that purchase products or services of ¥10M or more from "upstream and downstream companies for their own operation", with a maximum subsidy of ¥5M.
    vii. "Encourage Acquisition of Access Qualifications", offering subsidies of up to ¥1M per certification and ¥5M per enterprise for getting certification

[3] https://www.ndrc.gov.cn/xxgk/zcfb/ghwb/202109/P020210910639035516208.pdf
[4] https://www.shanghai.gov.cn/nw12344/20221011/3c8c02700bfd400293faf955bc33e6af.html
[5] https://www.shanghai.gov.cn/nw12344/20231120/5e53f1fe1b1543f38a49153eb563cfbb.html
[6] https://mp.weixin.qq.com/s/hJ5tBfyAp7PZyYofk_lsXw

from entities such as the American Bureau of Shipping, Norwegian Classification Society, European Aviation Safety Administration, etc.

viii. "Support Expansion of Demonstration Applications", offering subsidies of up to ¥500,000 per application/use-case in areas such as agriculture, natural resources, transportation and logistics, etc.

ix. "Support Large-Scale Development of Enterprises", with a one-time subsidy of ¥1M based on "comprehensive development in terms of scale"

3) What is your assessment of China's domestic space talent, what factors are driving the development of its space talent?

China's state-owned apparatus, including CASC, CASIC, CETC, and the Chinese Academy of Sciences, are home to tens of thousands of competent engineers and researchers. The same can be said of their top space/aerospace-focused universities, e.g. Beihang University, Harbin Institute of Technology, Northwest Polytechnical University. For a long time, these employees had no other employment options beyond SOEs. Over the past 10 years this has changed radically as commercial space has emerged, and today, there is a vibrant ecosystem of talent moving between commercial companies. The movement and development of talent is increasingly being dictated by commercial forces, and it is easier than ever before to change company.

To take an early example, in 2018, Deputy Director of Rocket Design from the Xi'an Space Propulsion Research Institute Zhang Xiaoping was hired by commercial launch firm Landspace for a rumored 10x his previous salary. At the time, the Xi'an Space Propulsion Research Institute attempted to sue Landspace, describing in a leaked legal document[7] that Zhang was ""most crucial to the development process", had "irreplaceable" talents and argued that his departure could affect China's race to send people to the moon". At that time, the rumor in China was that the decision went all the way to the level of Xi Jinping, who allegedly said that as long as Zhang stayed in China, he could do what he wanted.

Conversely, a recent piece published by Chinese space industry blogger Hello Space asked "Who is the Whampoa Military Academy of China's Commercial Launch Sector" , referring to the military academy in Guangzhou that produced many of the leaders of early PRC and ROC. The article focuses on Landspace and OneSpace, two of the first commercial launch companies in China, and how they have been sources for talent for many of China's later-established launch startups. Shu Chang, Founder of OneSpace, was originally in the founding team of Landspace. Kang Yonglai, former CTO of Landspace, is the founder of Space Pioneer. In 2024, Ge Minghe resigned from Landspace to establish Xiandeng Aerospace.

Huo Liang, Founder of Deep Blue Aerospace, was an early employee at OneSpace. Chen Xiaojun, former CTO of OneSpace, left the company in February 2017 to establish Shenzhou . Chen's successor as OneSpace CTO, Wang Yudong, left the company in 2018 to establish Space Transportation. Space Trek founder Liang Jianjun was also an early employee at OneSpace, while

[7] https://www.scmp.com/news/china/society/article/2166233/how-chinese-rocket-scientists-resignation-started-nation-talking

former OneSpace propulsion director Shen Yongbin left the company to join Jiuzhou Yunjian as Technical Director.

4) What is the projected trajectory for the growth of China's commercial space industry, and which specific sectors (such as satellite manufacturing, launch services, or space-based technologies) are expected to see the most significant expansion?

Rapid growth due to the launch of the "Chinese version of Starlink". There are two main non-geostationary communications constellations likely to launch, namely "Guowang" (国网, lit: national net) and Thousand Sails (千帆). The former is fully central government-owned, and the latter is nominally commercial but financially backed by the Shanghai municipal government and Chinese Academy of Sciences. Both constellations will likely launch hundreds of satellites in the coming couple of years, with Thousand Sails likely to launch hundreds of satellites in 2025 (they currently have 90 on-orbit).

These constellations, and in particular Thousand Sails, are driving substantial industrial development of the commercial sector: those satellites need to get built, and they need lots of systems, subsystems, components, etc. They also need to be launched, and while up to now, all of these constellation launches have been done by Long March rockets, in the future they represent an important source of demand for commercial launch vehicles. They also need to be accessed from the ground, so we've seen a growing number of commercial firms, sometimes from outside the space sector, developing user and gateway terminals.

For at least the next several years, these two constellations will be the biggest driver by far for China's commercial space sector, largely because they represent two huge pots of Government money with strong political backing to be spent.

Other areas of likely expansion moving forward include meteorology. There are two major commercial meteorology constellations being deployed today, and both have ambitions for more satellites to be launched[8].

5) How does China's commercial satellite industry compare to that of the United States, particularly in terms of technological advancements, market scale, and international competitiveness?

There are similarities and differences across different sectors:

Communications

GEO: there are basically zero Chinese commercial firms building GEO satellites, this is unlike the US where Boeing, Astranis, and others build GEO. The reason in China is that most (effectively all) GEO satellite missions are China Satcom or other state-run missions, and the state-owned satellite manufacturer China Academy of Space Technology (CAST, aka CASC 5th Academy)

[8] https://chinaspacemonitor.substack.com/p/chinas-commercial-meteorological

makes GEO satellites pretty competently. The number of GEO launches from China remains relatively small, making the marginal demand that might be captured by commercial firms zero.

LEO: highly fragmented industrial base with some 10 companies trying to build LEO communications satellites. Since 2023, there has been consolidation around Shanghai Engineering Center for Microsatellites (SECM) and its JV subsidiary Genesat, with both entities building the Thousand Sails constellation. The other main force in the LEO satellite manufacturing space is the China Academy of Space Technology (CAST), who will almost certainly be the prime manufacturer of the Guowang constellation. All other LEO communications manufacturers are likely to fall into one, or both, of these larger camps, probably as system suppliers. For example, Galaxy Space, who has for some time been calling for their own constellation, will almost certainly be relegated to a provider of Q/V-band payloads and other communications products in satellites and ground equipment.

Remote sensing

China has a substantial commercial remote sensing industrial base, with CGSTL being arguably the most advanced remote sensing company in the world. The company is a spinoff from the CAS Changchun Institute of Optics and Precision Mechanics (CIOPM), established in 2014 with substantial financial and technology assistance from CIOPM and the government of Jilin Province/Changchun City. Since then, the company has built what they describe as Asia's largest remote sensing satellite factory, and has built and launched ~160 of their own satellites, as well as ~40 satellites for other customers. These satellites range from ~40kg in mass (most are this size) up to ~1 ton. Due to their technology heritage from CIOPM, CGSTL is highly vertically integrated, building their own optical payloads. The company has more recently (starting around 2020/2021) made a move into laser communications, typically for either inter-satellite communications or for free-space optical (downlinking large amounts of remote sensing data from space to earth).

Launch

China has a far "deeper bench" than the United States. While SpaceX is clearly far ahead of the most developed Chinese commercial launch company (likely Galactic Energy), and Rocket Lab is likely far ahead of the 2nd most-developed Chinese commercial launch company, China has some 50 commercial launch companies. The 5th most-developed Chinese commercial launch company is likely about as developed as their counterpart in the US. There are more companies in China developing next-generation rocket engines, 3D-printed rocket parts, and other upstream components, than there are in the US.

Other technologies

Laser communications is an area of emphasis in China, and there are at least 10 firms developing laser communications terminals. A handful of these companies have already launched laser terminals and are conducting tests on-orbit. I believe the industry is considerably larger than that of the US.

Relay satellites, with several commercial companies planning to develop relay satellites over the coming years, either in GEO or MEO.

Tracking, Telemetry, & Control (TT&C): there are at least 3 commercial TT&C companies in China that have served hundreds of satellites each. These companies are building out global networks of ground stations, and while they have run into some obstacles (most recently Emposat being denied entry into the Czech Republic[9]), they are growing quickly.

Meteorology. Since mid-2022, Chinese companies have launched ~70 "commercial" meteorology satellites. The two main projects are Yunyao Yuhang and Aerospace Tianmu, with both having recently been included in the China Meteorological Administration's weather monitoring datasets[10].

6) What obstacles, limitations, or vulnerabilities does China face within its commercial space industry, and how might these challenges affect its long-term competitiveness and growth?

The challenge of subsidizing supply, not subsidizing demand. The Chinese government at a national, provincial, city, and district level is more than happy to give commercial space companies free land, subsidized factories, subsidized labor, etc. They are less happy to give them contracts for products and services. This makes it easy for companies to grow, and in the long-run, it can make it cheaper for them to survive downturns, but it makes it hard for them to see real revenues.

SOEs remain a very powerful force in the sector, which can hinder commercial development. Today there is still no "Chinese version of SpaceX", i.e. there is no commercial firm trying to build very big reusable rockets. This is because, the bigger the rocket, the more directly firms are competing with SOEs, and the more directly firms are competing with SOEs, the more political hot water they could find themselves in. Bigger picture, the state still exercises a lot of control over what commercial space companies can and cannot do, which makes it hard for companies to confidently articulate their value proposition. As a result, Chinese space companies are notoriously vague in their business thrust; they claim to be able to do all things for all people, and pivot regularly. This is because ultimately, it's not 100% clear what they are or are not "allowed" to do.

International cooperation is a helpful case study when looking at the challenge posed by SOEs. China Great Wall Industry Corporation (CGWIC) has an effective monopoly over international space projects in China. A subsidiary of CASC that acts as a trading company, CGWIC is the international broker for Chinese launches, satellites, and other projects. While this monopoly has begun to erode in recent years, CGWIC remains a very powerful force. For Chinese companies trying to do business abroad, they need to go through CGWIC. I spoke with a representative of a Chinese commercial satellite manufacturer in around 2022, he was explaining that CGWIC-led projects go through ministerial-level. His example was, if Egypt buys a satellite from China, and the Egyptian engineer has a question or issue with the satellite post-launch, he or she needs to send that issue up through the Egyptian Ministry of Foreign Affairs (or similar), who then sends the issue to the Chinese Ministry of Foreign Affairs, who then sends the issue all the way down the

[9] https://www.euractiv.com/section/politics/news/czech-government-blocks-chinese-investment-over-spy-fears/
[10] https://www.cma.gov.cn/2011xwzx/2011xmtjj/202412/t20241231_6767359.html

ladder to the engineer within CASC or subsidiaries that can answer the question. The engineer then sends the answer all the way up the ladder to MoFA. The process can take weeks.

A final challenge is the arbitrary and uncertain nature of regulations in the Chinese space sector. Typically the government opens the sector in steps: for example, in 2020 Satellite Internet was added to the "New Infrastructures" list of the National Development and Reform Commission[11], in 2023 MIIT published the "Opinions on Innovating the Management of Information and Communication Industry to Optimize the Business Environment" [12], which included calls for **coordinated opening of the telecommunications business to private capital**, increasing support for private enterprises to participate in mobile communications resale and other businesses and services, **and promote the reform of the satellite internet business in steps and stages.** This provided a tailwind to satellite internet companies, but still does not give them full transparency about the government's plans. As a result, constellations such as SpaceSail have allegedly been told by the government that they will not get domestic market access for the foreseeable future.

7) Which critical minerals and rare earths are necessary for U.S space supply chains? Does the PRC hold leverage over any of these inputs? If so, what U.S. policy mechanisms are needed to alleviate this potential chokepoint?

I am not familiar with rare earths/minerals, and therefore do not feel qualified to answer this question

8) The Commission is mandated to make policy recommendations to Congress based on its hearings and other research. What are your recommendations for Congressional action related to the topic of your testimony?

1) We need a broader space industrial base. One of China's strengths vis-à-vis the US in commercial space is breadth: there are ~50 companies in China competing to be the "Chinese version of SpaceX". As we've seen in electric vehicles, Tesla took a big lead, but got complacent, and now BYD is making similar cars to Tesla at half the price. In the space domain, we put all our eggs in the SpaceX basket at our own peril. China, to their credit, seems to understand that a broad industrial base with many companies trying many things, and more importantly, competing with one another, leads to better outcomes.

2) We should provide different incentives for our space companies. The US Government and various entities therein have done well to give contract opportunities to commercial space, this is a helpful demand signal and helps companies to make rent and payroll every month. We should be doing a better job of providing financial and other indirect support on the supply side. Many large cities in the US have a problem with vacant office space. Is there a way to give companies subsidized or free office space to tinker with space technologies? There's a lot of open land in parts of the US. Is there a way to allow space companies (and frankly, companies in other industries) to make use of it for little or no money? There are many small towns that are seeing declining population. Is there a way for the Federal Government to offer subsidies, matched by these small

[11] https://www.gov.cn/zhengce/2020-04/29/content_5507396.htm
[12] https://www.gov.cn/zhengce/zhengceku/202408/content_6966820.htm

towns, to attract talent and cultivate industrial clusters? These are all things that China is proactively doing for commercial space, and while it has its drawbacks (wastefulness being one of them), it also creates a sort of "sandbox mode" whereby companies can experiment with new technologies and commercialization methods, and the downside risks if they fail are manageable.

3) Help close the information asymmetry gap. There are a lot of articles in Chinese press providing information about Starlink, SpaceX, and other leading American firms. Chinese firms are developing impressive technology, and best I can tell, there is not very much written about it. Last month we saw a piece in Chinese media doing a complete tear-down of a Starlink 3rd-gen antenna (photo at right)[13]. With the title "**I don't understand, I can't understand at all. After dismantling the third-generation Starlink terminal, I still can't understand the phased array antenna**", the author provides detailed images of various layers of the terminal. The article thanked a "Shenzhen Weiligu Radio Technology Company" (aka Shenzhen VLG Wireless, 深圳市维力谷无线技术股份有限公司) for providing the terminal and technical support.

4) Have a more unified and better-organized space strategy. For better or worse, China has a very unified and well-organized space strategy: the government makes policies and strategies in their Five-Year Plans and other documents, commercial companies broadly follow their lead, and everyone is more or less on the same page about who is in charge. As best I can tell, in the United States we have a billionaire entrepreneur trying to dismantle our space agency, everyone is trying to develop their own technologies, Starlink is not adopting standards for things like laser communications technologies, possibly as a way of cornering the market. No one has any idea who is in charge or what the long-term plan is, and the tail is wagging the dog with the private sector pushing the government to abandon Artemis in favor of Mars.

5) More encouragement for international cooperation. China has high-level nebulous concepts like the Belt and Road that provide guidance for companies to expand abroad. Having such concepts makes it easier for state-owned banks to justify loans for projects, and provides a signal to commercial companies to go abroad.

[13] https://mp.weixin.qq.com/s/XtL4Ano8fIXOLxekQqKySg