HSBC Global Investment Research

Disruptive Technology
Equity Research Report
China |Thematic research

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SPOTLIGHT

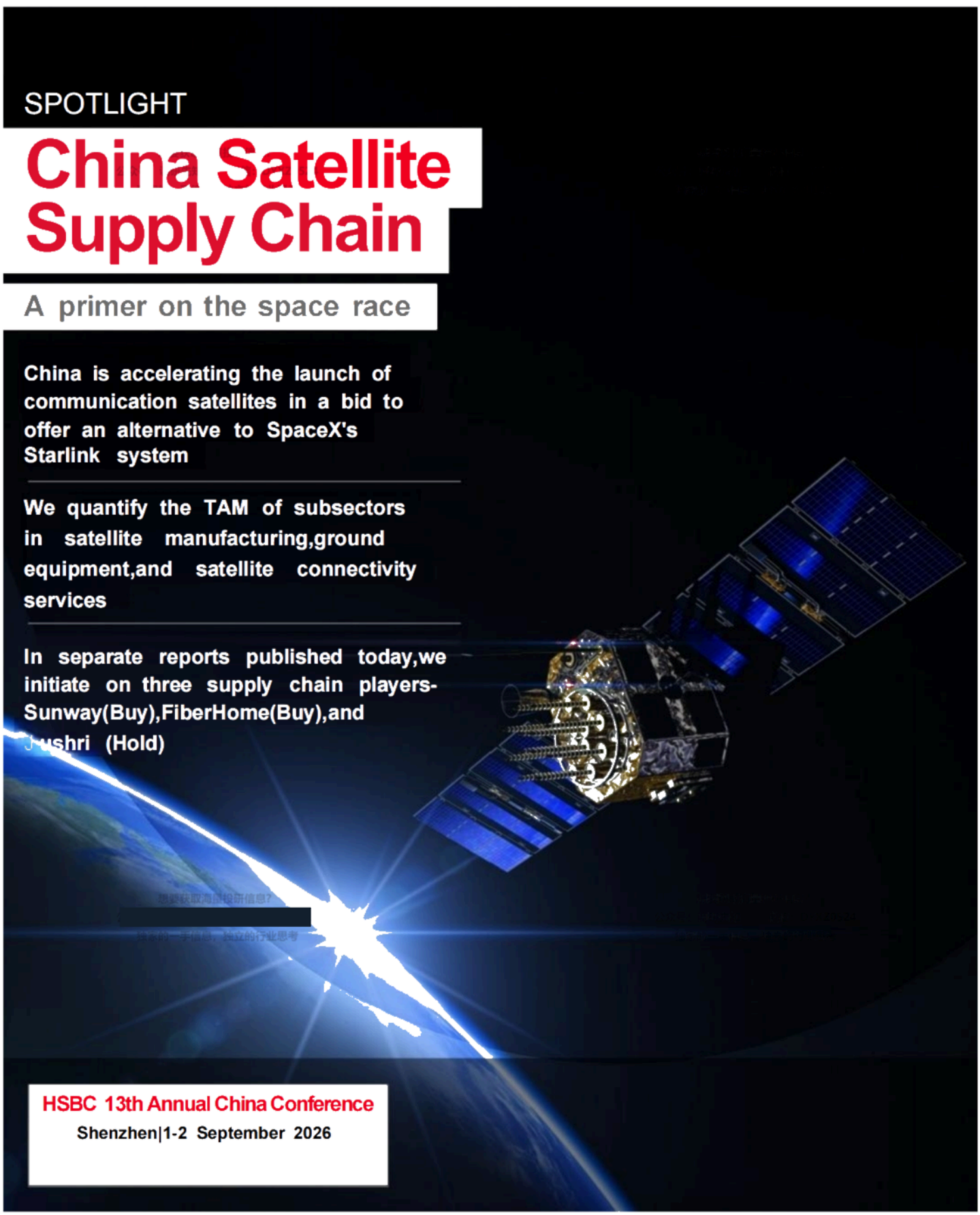
China Satellite Supply Chain

A primer on the space race

China is accelerating the launch of communication satellites in a bid to offer an alternative to SpaceX's Starlink system

We quantify the TAM of subsectors in satellite manufacturing,ground equipment,and satellite connectivity services

In separate reports published today,we initiate on three supply chain players-Sunway(Buy),FiberHome(Buy),and Jushri (Hold)



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Why read this report?

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- We quantify the TAM of subsectors in satellite manufacturing, ground equipment and satellite connectivity services
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The big picture.This report is a primer on the space race.We describe China's efforts to close the gap with Elon Musk's SpaceX,which operates the Starlink system of low earth orbit(LEO) satellites,the implications for the country's vast aerospace supply chain,and the total addressable markets for relevant subsectors.SpaceX,with over 10,000 satellites in orbit,has a huge headstart, but China plans to catch up fast.With the help of supportive government policies,we expect the number of LEO satellites to increase from just 600+today to c10,000 by 2030.That's just the start -the long-term target is up to 200,000.This represents a huge opportunity for companies involved in satellite manufacturing,ground equipment and satellite operations.

A viable alternative to Starlink.The US market leader SpaceX provides global high-speed broadband and internet services to millions of paying customers who subscribe to Starlink. China aims to provide an alternative through Spacecom,a company which is on schedule to provide similar services from early 2027e.The Brazilian government has already given the green light and Spacecom is also in talks with Malaysia,Thailand and other countries in Asia. We expect the TAM for overseas satellite communication services to be RMB37bn by 2030e, implying a 2027-30e CAGR of 215%.We also compare different subsectors with SpaceX.

China has a supply chain advantage. The satellite supply chain has a massive overlap with the semiconductor,communications/electronic equipment,and industrial software sectors.We believe China can leverage its strong manufacturing capabilities to reduce costs and create economies of scale(SpaceX's satellite costs are much lower).We estimate the market for satellite,ground and satellite communications services in China's satellite communications value chain willbe worth RMB194bn 2030e,a 2025-30e CAGR of 88%.While SpaceX is a highly vertically integrated company,it is not entirely isolated from China's supply chain;for example,Sunway provides key radio frequency components for its ground user terminals.

We prefer satellite payload and ground equipment suppliers .Payloads account for 50-70% of the value of LEO communication satellites,and we believe relevant payload suppliers should be early beneficiaries as the pace of satellite launches accelerates.After SpaceSail and GW constellations complete the first phase of buildout in 2027-28e,orders for ground equipment should pick up rapidly,boosting sales for suppliers of communication equipment components.

See our three initiation reports published today: *Sunway (300136 CH),FiberHome (600498 CH),* and *Jushri(300762 CH)*.

This is our latest report on the Disruptive Technology theme.If you want to subscribe to any of our nine big themes, *click here*.

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RMB194bn

China satellite supply chain TAM by 2030e

88%

China satellite supply chain TAM CAGR in 2025-30e

The space race has accelerated the pace of satellite launches in China;companies in the supply chain-satellite manufacturing,ground equipment and satellite connectivity services-should benefit

75%

CAGR of the number of China's LEO satellites launches in 2025-30e-total 9,470 over 2026-30-c19x the total launched in 2020-25

50-70%

The payload has the highest value in a satellite

RMB119bn

China LEO communication satellites'manufacturing TAM in 2030e

76%

China LEO communication satellites'manufacturing TAM CAGR in 2025-30e

RMB45bn

Satellite connectivity TAM in 2030e; CAGR of 197%in 2027-30e

China plans to provide satellite connectivity services to both the domestic and overseas market,and offer an alternative to Starlink

RMB30bn

China LEO satellite communication ground segment TAM by 2030e

91%

China LEO satellite communication ground segment TAM CAGR in 2025-30e

Source:China Aerospace Science and Technology Corporation(CASC),China National Space Administration(CNSA),Hello Space,SpaceX,Jushri,Microsate,HSBC Qianhai Securities estimates

Valuation and risks

	Valuation	Risks
Buy	Current price: RMB62.07 Target price: RMB80.00 Up/downside: 29%	We reference peers' PE multiples to value Sunway. Peer average 2026-28e EPS CAGR stands at 28%, and 2027e average PE at 28x. We expect Sunway's 2026-28e EPS to grow at a CAGR of 50%, hence we apply 50xPE (50/28*28) to value Sunway. Based on 2027e EPS of RMB1.60, we arrive at a TP of RMB80.00, implying 29%upside. We believe Sunway is one of the key beneficiaries of robust growth of Space X terminal users and the upcycle of MLCC. We have a Buy rating on the stock.	Key downside risks: ◆More-intense-than-expected competition ◆ Moderation in MLCC demand growth ◆ US tech restrictions

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Buy	Current price: RMB42.71 Target price: RMB56.00 Up/downside: 31%	We refer to peers' PE multiples to value FiberHome. Peer average 2025-28e EPS CAGR stands at 60%, and 2027e average PE at 28x. We expect FiberHome's 2025-28e EPS to grow at a CAGR of 7.8%, hence we apply a 35xPE (7.3/60*28) to value FiberHome. Based on 2027e EPS of RMB1.60, we arrive at our TP of RMB56.00, implying 31%upside. We have a Buy rating on the stock.	Key downside risks: ◆ Delay in satelite constellation deployment ◆ Moderation in optical fibre demand ◆ More intense competition ◆AI GPU supply shortage

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Hold	Current price: RMB29.25 Target price: RMB30.00 Up/downside: 3%	We reference peers' PS multiples to value Jushri. Peer average 2026-28e revenue CAGR stands at 32%, and 2027e average PS at 20x. We expect Jushri's 2026-28e revenue to grow at a CAGR of 45%, hence we apply 29xPS (45/32*20) to value Jushri. Based on 2027e revenue of RMB664m, we arrive at TP of RMB30.00, implying 3%upside. We have a Hold rating on the stock.	Key upside rsks: ◆ Event driven sentiment on commercial rocket development or satellite connectivity ◆ Faster than expected commercialisation of China Spacecom ◆ Better-than-expected market share gains in satellite payload and ground equipment Key downside risks: ◆ More-intense-than-expected competition ◆ Delay in satellite launch ◆ Uncertainties in downstream demand for customized network

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Priced at close of 27 August 2026.
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Source:Wind,HSBC Qianhai Securities estimates

Related research

Recommended reading.

- *Global Sector Analyst:The space economy's firstjourney will be to Earth*,18 August 2026
- *SpaceX (SPCX US)*,23 July 2026

US Telecoms:Satellite defense,13 August 2026

China Aerospace:Rocketing high,12 February 2026

Investment Summary

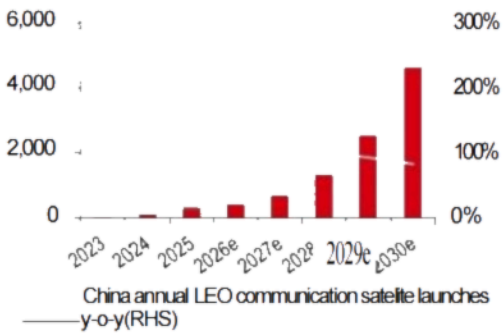
- China to accelerate the pace of satellite launches;supply chain names to benefit
- We quantify the TAM of satellite manufacturing,ground equipment and satellite connectivity services
- In this report,we also compare different subsectors with SpaceX

China's lofty ambitions in space...

China has planned three major low-earth orbit (LEO)satellite constellations,each comprising over 10,000 satellites.GW Constellation and the SpaceSail Constellation have attracted the most attention.Led by China Satellite Network Group(China SatNet),the GW Constellation is designed for a total deployment of 13,000 satellites.The SpaceSail Constellation,spearheaded by Spacecom,aims to deploy 15,000 satellites.The GW Constellation primarily targets domestic users and emergency communications,while the SpaceSail Constellation is positioned to serve overseas markets,aiming to provide an alternative to Starlink.

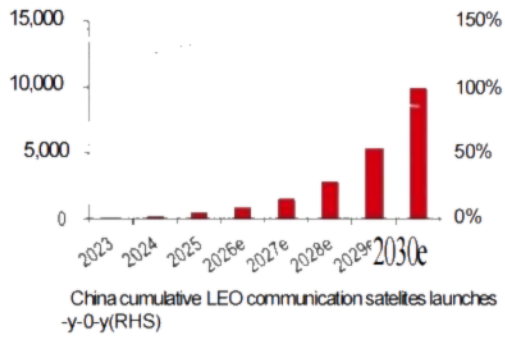
China satellite launches have accelerated significantly in 2026y-t-d.Spacecom plans to complete the deployment of 324 satellites by end-2026 and 648 by the end of 2027.Spacecom had launched 108 satellites as of end-2025 and another 92 in 1H26.Looking ahead,we anticipate an even faster pace of deployment now that reusable rocket technology is increasingly mature in China.We expect the number of annual LEO communication satellite launches in China to grow at a CAGR of 75%over 2025-30e,and total cumulative LEO communication satellites launched to reach close to 10,000 by 2030e(vs c600 as of end-1H26).

Exhibit 1.We expect annual communication satellite launches to grow at a CAGR of 75%over 2025-30e;total 9,470 over 2026-30,c19x the total communication satellites launched over 2020-25



Source:China Aerospace Science and Technology Corporation(CASC),China National Space Administration (CNSA),HSBC Qianhai Securities estimates

Exhibit 2.By end 2030e,China should have c10,000 LEO satellites,10x more than the number in 2026e

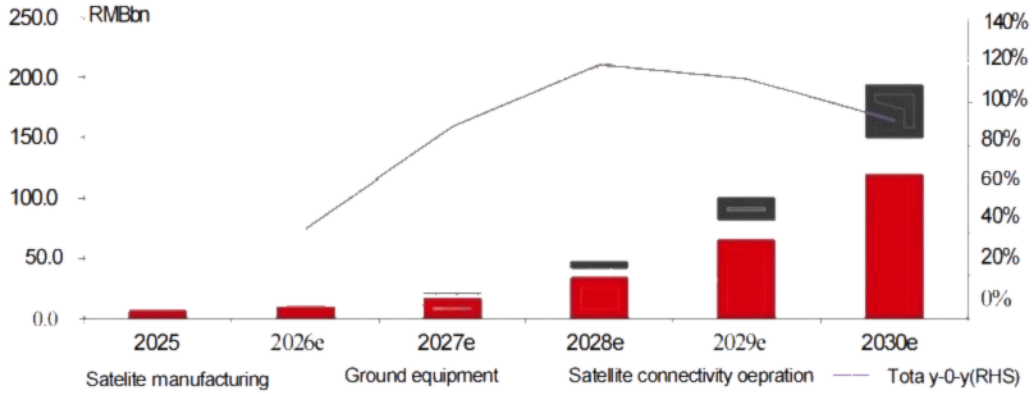


Source:China Aerospace Science and Technology Corporation(CASC),China National Space Administration (CNSA),HSBC Qianhai Securities estimates

. . .bringing opportunities for relevant supply chains

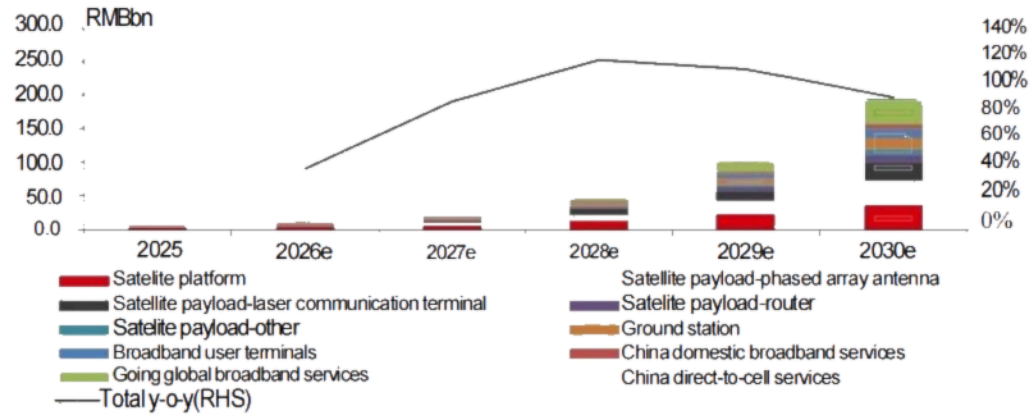
In this report,we lay out the relevant supply chains,including satellite manufacturing,ground equipment,and satellite communication operations.We also identify relevant public and private companies for investors'reference.Based on our analysis,we estimate a total market size of RMB194bn for satellite,ground and satellite communications services in China's satellite internet value chain in 2030e,implying a CAGR of 88%over 2025-30e.

Exhibit 3.We estimate a total market size of RMB194bn for satellite,ground and satellite communications services in China's satellite internet value chain in 2030e,a 88%CAGR over 2025-30e



Source:China Aerospace Science and Technology Corporation (CASC),China National Space Administration (CNSA),HSBC Qianhai Securities estimates

Exhibit 4.Detailed forecasts for each subsegment



Soure:China Aerospace Science and Technology Coporation(CASC),China National Space Administaion (CNSA),SpaceX,HSBC Qianhai Securities estimates

China commercial aerospace industry vs SpaceX

China is a latecomer compared to SpaceX.The key challenges China needs to overcome are:

- Cut satellite costs through mass production.We are optimistic in the longer term,based on China's strong manufacturing capabilities.Note that the average ASP for one communication satellite in China is cRMB25m according to our estimates vs SpaceX's V2 mini satellite of cRMB5m(source:Quality Space).

  Produce sufficient reusable rockets.China is in the process of developing reusable rockets. Recent test rockets launched by Chang Zheng/Long March (national team)and Zhuque (commercial)were successful.

- China should add more rocket launch sites.Regulators plan to mainly add more rocket launch sites on the eastern coast,which is closer to factories and supply chains.New sites will also be added in Hainan province,which is close to the equator.

Exhibit 5.China commercial aerospace industry vs the US-technology and monetisation comparison

Dimension	Specific metrics	China	US(mainly SpaceX)
Rockets	Major launch vehicles	CZ-8A, CZ12, CZ-10B, Zhuque-3	Falcon 9(Block 5)
	LEO payload capacity	CZ-8A/CZ1212 tons, CZ-10B 16 tons, Zhuque-318 tons	15.6-17.5 tons
	Reusability status	Currently mainly using expendable rockets, including CZ-12 and CZ-8A;CZ-10B first booster recovery test by net capture succeeded in July 2026;Zhuque-3 first booster recovery test by vertical landing legs succeeded in August 2026	First booster recovery test success in 2015;561 Falcon 9 launches over 2016-2025:recovery success rate >99%
	Launch cost	RMB50,000-60,000 per kilogram(for CZ-8A and CZ-12)	RMB7,000-10,000 per kilogram
	Annual launch capability	SpaceSail and GW total launched 19 batches of satelites in 2025 and 11 batches in 1H26	SpaceX conducted 165 LEO launches by Falcon 9 in 2025
	Next-gen rocket development	No clear plan yet	The next-generation Starship is designed to offer a LEO payload capacity of c100-150 tons,with both stage of rocket recoverable.Starship's first ever booster (first-stage rocket) recovery test succeeded in October 2024;second-stage rocket achieved a soft splashdown in sea in July 2026, though a successful recovery has not yet been achieved.
Satelites & constellations	Major constellations	SpaceSail, GW	Starlink
	Active satellites in LEO	377 as of end 2Q26	10,200 as of end 2Q26;900 as of end 2020
	Annual satelite launch count	180 in 2025	3,190 in 2025
	Single satellite weight	SpaceSail c270kg;GW c1,000 kg	V2 mini optimised c730 kg
	Single satellite bandwidth	Tens of Gbps	V2 mini:1Tbps(1,000 Gbps);V3 target 10x improvement
	Inter-satelite link capability	Not yet supported;large-scale inter-satellite laser communication terminals not yet deployed	V2 mini each deployed 3×200Gbps inter-satellite laser communication terminals
	Single satellite cost	SpaceSail RMB10-25m GW RMB30-75m	V2 mini RMB5-6m
Connectivity applications	Broadband service	Not yet providing large-scale satellite broadband services; Spacecom SpaceSai achieved >35 min uninterrupted high-speed connection test in HK in January 2025	Starlink broadband subscribers worldwide exceed 12Om as of end 2Q26 with an ARPU of USD66
	Direct-to-device(DTC) service	Not yet launched DTC internet access service	The number of active satelites supporting DTC connectivity has reached 650 as of end 2025. Services have been available in limited countries and regions, currently supporting internet access for specific applications only

Source:SpaceX, Space Stats, China Aerospace Science and Technology Corporation (CASC), Jushui, Landspace, HSBC Qianhai Securities

Exhibit 6.China commercial aerospace industry vs the US-supply chain characteristics

	China	US(mainly SpaceX)	Implications
Vertical integration	The supply chain involves many segments, with SOE and private-owned companies collaborating. There are many players across upstream and downstream.	SpaceX pursues deep vertical integration. Almost all core components including engines, rocket bodies, satellitesand ground terminals are developed and manufactured in-house. Only a small share of standardised parts are procured from suppliers.	In China, investment opportunities are scattered among leaders across different segments in the supply chain. In US, SpaceX stands as the dominant player, with very few supply chain names available.
Marketisation level	Relatively low. Airspace, frequency spectrum and launch resources are subject to strict regulation. SOEs hold a pivotal position in the supply chain	Relatively high. Private enterprises, represented by SpaceX, hold a dominant position.	China enjoys policy tailwinds, but its marketisation level has room for improvement.
Economy of scale/cost	Economies of scale have not yet materialised, leading to relatively high costs in rocket manufacturing and satellite production.	By deep vertical integration, using proven technologies, and large-scale mass production, SpaceX has achieved the world's lowest costs for orbital launch services and satelite manufacturing.	The satellite supply chain has major overlaps with semiconductors, electronic equipment, industrial software, and communication equipment sectors. We believe China can leverage its strong manufacturing capabilities and sufficient supply chain, and the gap with SpaceX should continue to narrow.
Customers	Demand is dominated by government and niche industry clients;consumer segment has yet to gain traction.	In 1H26, consumer and enterprise business accounted for 61%and 39%of SpaceX's connectivity segment revenue, respectively.	Over the short-to-medium term, China's commercial aerospace industry will likely remain reliant on government business. Over the long-term, the consumer segment also holds large market potential.
Development stage	2025-26 is the kick-off phase for SpaceSail and GW constellation deployment;intensive launches are expected to begin after 2027e. Commercial rol-out of satelite broadband service may gradually start in 2027-28e.	Launch service business has entered a steady growth and profitable phase. Starlink has over 10,200 active satelites in LEO and is providing stable commercial satelite broadband services globally.	China's commercial aerospace industry is at an early stage. Chinese players have relatively lower visibility but offer more growth upside.

Source:HSBC Qianhai Securities estimates

We are optimistic about China's satellite supply chain and in separate reports,we initiate coverage of three companies.

- **Sunway(300136 CH,Buy):** Sunway provides radio frequency(RF)connectors &cables and structural components for ground user terminals for SpaceX and Amazon Leo.The company is also breaking into China SatNet and Spacecom's supply chain.The satellite business has become a strong revenue growth driver,with a revenue CAGR of 55%in 2025-28e.

  FiberHome(600498 CH, Buy):FiberHome has years of experience in manufacturing optical communications equipment.The company is a leader in satellite laser communication terminals and on-board routers,key equipment for inter-satellite communication.We believe FiberHome should also benefit from the accelerated pace of satellite launches.

  Jushri(300762 CH,Hold):Jushri is the key commercial satellite payload supplier for Satcom,with c40%market share.Jushri works closely with Satcom on first and second generation satellites and should be the major beneficiary of the SpaceSail constellation.

Sector downside risks

- **Slower-than-expected constellation deployment:**China currently faces constraints in launch capacity and rocket availability.Slower-than-expected progress of satellite launches or slow network formation could pose downside risks.
- **Technology iteration risks**:The iteration of frontier technologies,such as satellite communications and reusable rockets,could disrupt related industry value chains.
  Geopolitical decoupling risks: The industry remains reliant on imported core components (e.g.field programmable gate arrays,or FPGAs)from the US and Europe.Any sanctions or export controls may slow the industry's overall progress while presenting opportunities for domestic players.

Exhibit 7.Wind commercial aerospace concept index has risen 200%since Jan 2019, significantly outperforming the CSI 300(up 56%over the same period)



Source:Wind,HSBC Qianhai Securities

Industry overview

- We lay out China's satellite supply chain and related companies
- Payload contributes more than 50%of LEO satellite value; communication equipment has the highest value in the ground segment
- We expect a LEO satellite launch CAGR of 75%in 2025-30e-9,470 in total-c19x the number in 2020-25

Supply chain overview

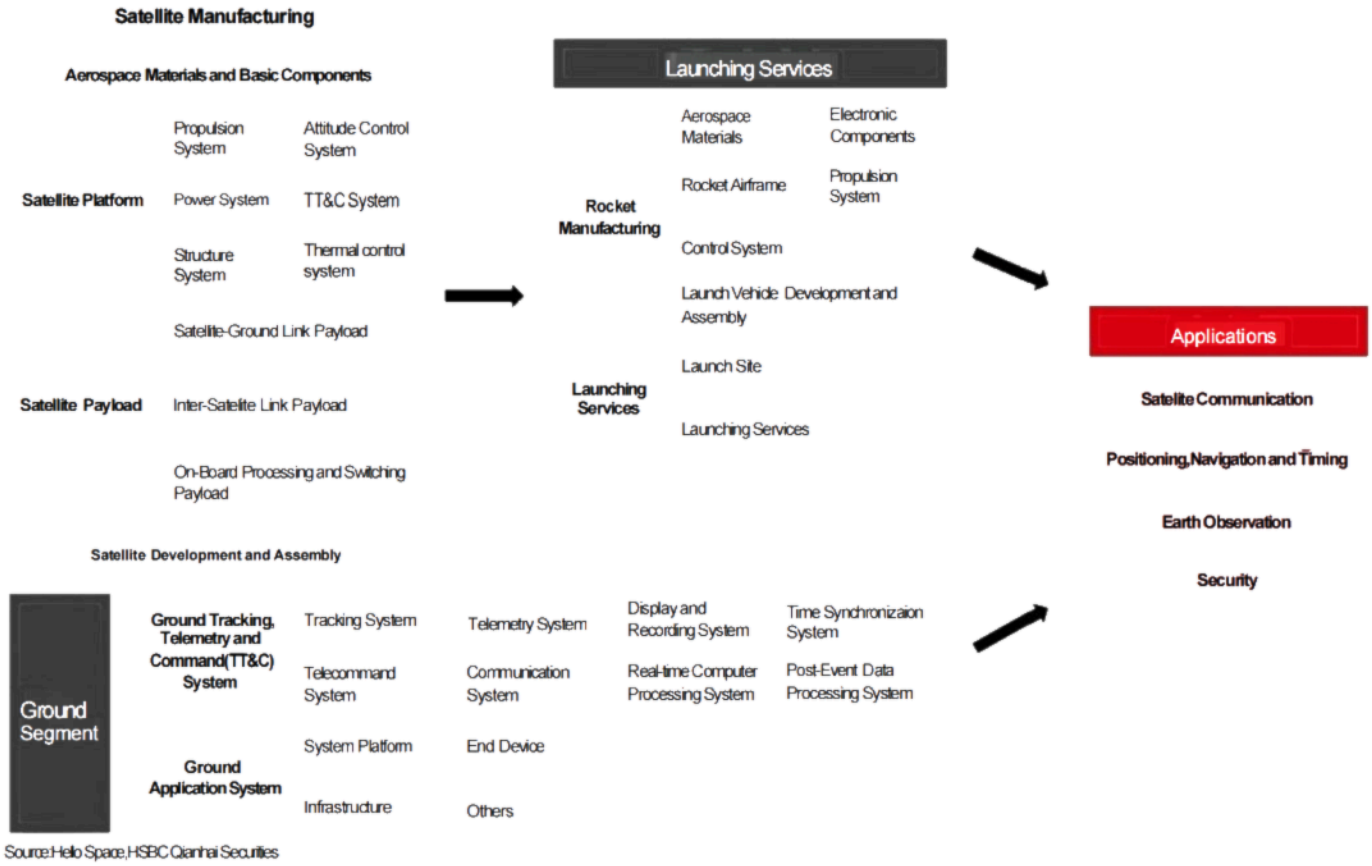
These satellites can deliver high-speed broadband connectivity and direct to device internet access

Four major segments;we lay out relevant companies

LEO communication satellites are deployed in low earth orbit(LEO)with satellite-to-ground, inter-satellite,and on-board switching/routing payloads,forming a meshed data network in space.These satellites can deliver high-speed broadband connectivity and direct-to-device internet access services,serving as an important part of the 6G network in future.While traditional terrestrial cellular communication networks face coverage limitations,especially in remote,desert and marine areas,LEO satellite constellations can provide low-latency and high-bandwidth communication services for end-users in areas devoid of terrestrial telecom operator coverage without extensive ground-based fibre deployment and base station buildout.

The satellite supply chain encompasses four major segments-satellite manufacturing, launching services,ground segment,and satcom applications.At this early stage in the commercial aerospace industry,we believe the primary beneficiaries are suppliers in the satellite manufacturing and ground segment.After constellation network buildout,the satellite communication applications segment may start to ramp up and enjoy a larger long-term TAM.

Exhibit 8.Satellite supply chain overview



Source:Helo Space,HSBC Qianhai Securities

Exhibit 9.China's domestic vendors in the satellite internet supply chain

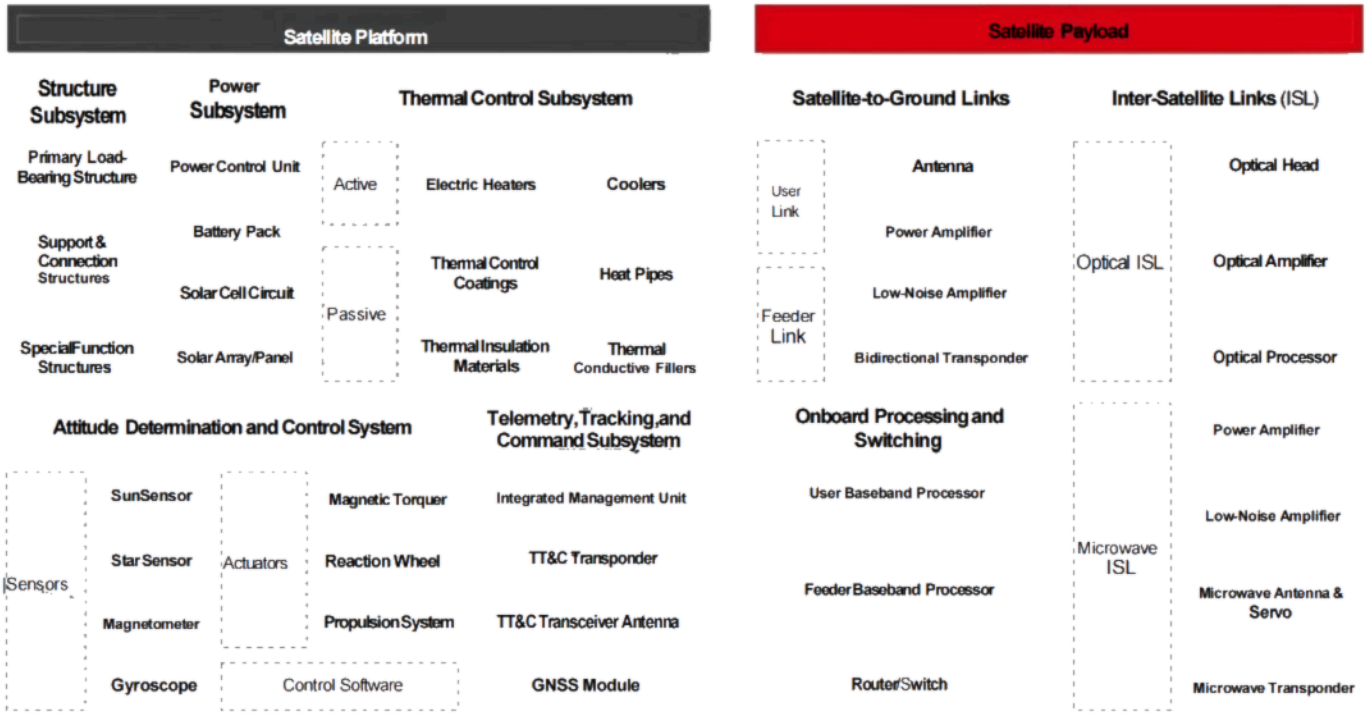
			Vendors
Satellite manufacturing	Satellite AIT	Assembly, integration and test	Chang Guang Satellite, GALAXYSPACE (under A-share pre-IPO guidance), Genesat, China Spacesat (600118 CH), Geespace, CAS Commercial Satellite, MinoSpace (A-share IPO in process), III Satellite, Spacety (under A-share pre-IPO guidance), AIX Space (H-share IPO in process), Hongqing Technology, Comsat, Xian Xice Testing (301306 CH), Suzhou Sushi Testing (300416 CH), Chengdu Screen (688085 CH).
	Raw materials	Materials	China Spacesat (600118 CH), Changchun UP Optotech (002338 CH), Xian Bright Laser (688313 CH), Avicomb, CASC.
	Raw materials	Electronic components	China Aerospace Times Electronics (600879 CH), China Zhenhua (000733 CH), Guobo Electronics (688375 CH), Chengdu Spaceon (002935 CH), Hwa Create (300045 CH), Beijing Yuanliu Hongyuan (600267 CH), Fujian Torch Electron (603678 CH), Yi Guang Technology (300323 CH), Guangdong Shenglu (002436 CH), CETC.
	Satellite platform	Structure system	Changchun UP Optotech (002338 CH), Hunan Aerospace Huanyu (688523 CH), CASC.
	Satellite platfo	Power system	Beijing Relpow (300593 CH), Great Microwave (688250 CH), CETC Lantian (688018 CH), EverLightSpace, CASC.
	Satellite platform	Thermal control system	China Aerospace Times Electronics (600879 CH), Beijing Aerospace Shenzhou Intelligent (300455 CH), Shanghai Hugong Electric (603131 CH), CASC.
	Satelieplattorm	Attitude control system	China Aerospace Times Electronics (600879 CH), Changshu Tianyin (300342 CH), Fu-tai Forecan (688810 CH), CASC, Aotian Technology, Edrive Space, Xingchen Space, Hunan Lanyue.
	Satelite platform	T&C system	China Spacesat (600118 CH), Chengdu Spaceon (002935 CH), Guobo Electronics (688375 CH), Zhejiang Chengchang (001270 CH), Jiavuan Science and Technology (301117 CH), CEIC Cyberspace Security (002268 CH), Jushri Technologies (300762 CH), Chengdu Zhimingda (688636 CH), CASC.
	Satelitepayload	Antennas/transponders	China Aerospace Times Electronics (600879CH), Zhejiang Chenghang (001270 CH), Great Microwave (688270 CH), Trov Information (300336 CH), Jushri Technologies (300762 CH), Tongyu Communication (002792 CH), Jiangsu Cai Qin (688182 CH), Hunan Aerospace Huanyu (688523 CH), Guobo Electronics (688375 CH), Yixin Aerospace (under A-share pre-IPO guidance), CASC, Chinese Academy of Sciences, CETC.
	Satellite payload	Inter-satellite laser communications	FiberHome (600498 CH), Jushri Technologies (300762 CH), Laser Starcom, II StarLink, Blue Star Optics, Shangguang Communication, Yulun Eng Optical, Xingchen Optoelectronics, CAS, Jilian, Nanjing Intine Optical.
	Satellite payload	Spaceborne phased array antenna	Hunan Aerospace Huanyu, Jingji Communication, Startway Communication, Guangzhou Zhongle: Electric Technology, Final Frontier, Star-Seek
	Satelite payload 0	nboard routers/base stations	Sichuan Innogence Technology, TriNexus, Datang Telecom
Launching services	Rocket manufacturing	Materials	Shaanxi Sirui (688102 CH), Western Metal (002149 CH), Tianjin iStar-Space Technology (under A-share pre-IPO guidance)
		Electronic components	Beijing Yuanliu Hongyuan (600267 CH), Guizhou Space Appliance (002025 CH), Jouhon Optronic (002179 CH), Sanjing GNA (688339 CH), Hunan Valin (001208 CH), Nanjing Quanxin Cable (300447 CH)
		Rocket airframe	Wuxi Paike New Materials (605123 CH), Essence Fastening (301005 CH), Guanglian Aviation (300900 CH), Sinomach Precision (002046 CH)
		Propulsion system	Guizhou Aviation Technical (688239 CH), Xian Bright Laser (688313 CH), Wuxi Paike New Materials (605123 CH), AVIC Heavy Machinery (600765 CH), Shaanxi Aerospace Power (600343 CH), Essence Fastening (301005 CH)
		Control system	China Aerospace Times Electronics (600879 CH), Beijing Navigation (688282 CH), Chengdu Zhimingda (688636 CH)
		Launch vehicle development and assembly, launching services	China Rocket, CAS Space (A-share IPO in process), LandSpace (A-share IPO in process), Galactic Energy, Space Pioneer, Expace, Orienspace, i-Space, CALT, Deep Blue Aerospace
	Launching services	Launch site	Hainan International Commercial Aerospace Launch
Ground system	Communication terminals	Ground terminals and components	Sunway Communication (300136 CH), China Satellite Communications (601698 CH), China Spacesat (600118 CH), Guangzhou Haige Communications (002465 CH), Beijing Starnet (002829 CH), Chenglu Mand S Electronics (688311 CH), Kingsignal Technology (300252 CH), Hwa Create (300045 CH), Hunan 712 (603712 CH), Cete Potevio (002544 CH), StarWin, Cowave Communication, Keyidea, Satpro M&C
	T&C system		Genew Technologies (688418 CH), CICT Mobile (688387 CH), Geovis Insighter (874016 CH), China Xian Satellite Control Center, Emposat, Xian Huanyu Satellite, Xingyi Space, Zhongke Tianta, Beijing Tianlian T&C.
Applications	Satelite communications		China Satellite Network, Shanghai Spaceeom Satellite Technology, China Satellite Communications (601698 CH), Sunwave Communications (002115 CH), China Telecom (601728 CH), China Mobile (600941 CH), China United (600050 CH), Space Star, Unicom Air Net, CITIC Satelite, Fu-tai Ocean-Sky Silk Road Satelite Technology, Global Aircom, APT Satellite.
	Positioning, navigation and timing		Beijing Bdstar (002151 CH), Shanghai Huace (300627 CH), Beijing Unistrong (002383 CH), Comnav (688592 CH), Chengdu Spaceon (002935 CH), Fortnetone Technology (H-share IPO in process)
	Earth observations		Geovis Technology (688568 CH), Beijing Supermap (300036 CH), Piesat (688066 CH)

Source: Wind, Company data, Hello Space, HSBC Qianhai Securities

Value proposition:payload contributes more than 50%of satellite value

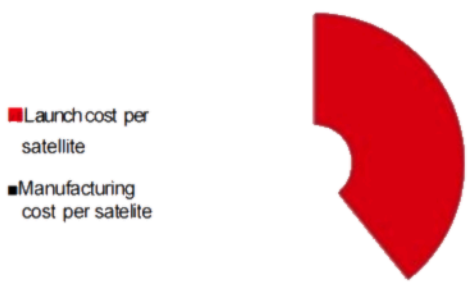
As Starlink enters the era of mass production-with current factory capacity reaching c70 satellites per week,or 10 per day-the fixed costs of satellite platforms are being significantly diluted.In an ideal commercial model,the share of satellite platforms in the total costs is likely to shrink to 30%(vs the current c70%in China),while that of payload,determining the satellite's core communication functions,may rise to c70%.This suggests that the future high-value investment opportunities in the satellite industry chain will be mainly concentrated in the communication payload-related areas.

Exhibit 10.A satellite includes a platform and the payload



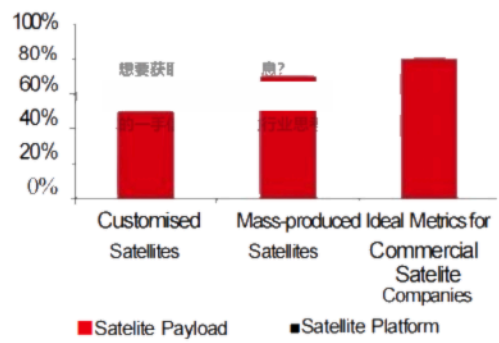
Source:Stellite Internet Technology,HSBC Qianhai Securities

Exhibit 11.Manufacturing cost vs launch cost per LEO communication satellite (Starlink V2 Mini Optimised satellite & Falcon 9 rocket as examples)



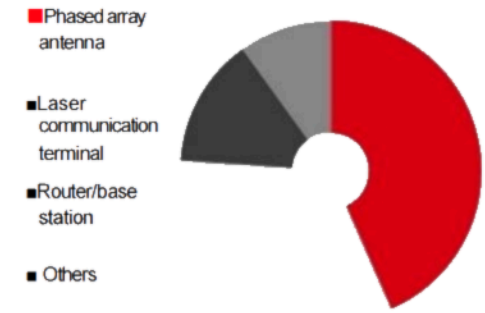
Source:SpaceX,Quality Space,CLS(December 2025),HSBC Qianhai Securities estimates

Exhibit 12.Satellites manufacturing cost breakdown:payload accounts for c50-70% of total manufacturing cost



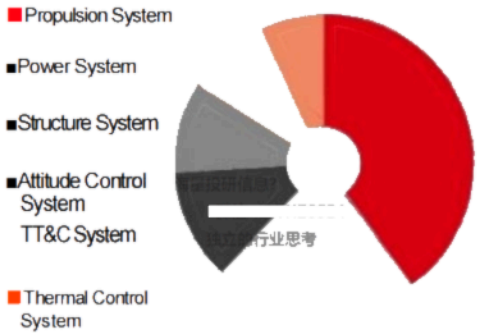
Source:Hello Space,HSBC Qianhai Securities

Exhibit 13.LEO communication satellites payload cost breakdown(2030e)



Source:HSBC Qianhai Securities estimates

Exhibit 14.Satellite platform cost breakdown(2025)



Source:Hello Space,HSBC Qianhai Securities

Satellite connectivity showing upside;China satellite launches to accelerate

Satellite communications offer numerous advantages and have vast application potential
Although China possesses the largest 5G network infrastructure globally,it is difficult for ground base stations to cover oceans,deserts,mountains and remote rural areas economically and efficiently.However,satellite communication is not subject to terrain and can solve the problem of last-mile access,thus achieving global connectivity.Satellites are the only reliable communication lifeline when ground facilities are damaged by disasters such as earthquakes and floods.Building autonomous and controllable systems can ensure the viability of critical information infrastructure under extreme conditions.Furthermore,as a core component of next-generation 6G communication technology,satellite internet is not only the key technology for building a space integration network to achieve widespread interconnection in the real world,but also a vital engine to drive new quality productivity such as low-altitude economy and robotics.

Meanwhile,China's government has announced policies to support the development of the satellite internet industry.

- Under the 15th Five-year Plan,satellite internet is designated as advanced infrastructure and the pace of building LEO satellite internet networks should be accelerated.
- In the Guidelines on Optimising Business Access to Promote the Development of the Satellite Communication Industry,the Ministry of Industry and Information Technology (MIIT)has set goals for China's satellite internet industry:by 2030,satellite communication management systems and regulations should be further improved;the industrial development environment should be continuously optimised;the innovation of operating entities should be fully unleashed;the levels of infrastructure,industry supply,technical standards and international cooperation should be significantly enhanced;new business modes such as mobile phones directly connecting to satellites should be adopted;the number of satellite communication users should exceed 10m.As such,satellite communication should be fully integrated into the new development pattern and serve the high-quality development of the economy and society effectively.

Orbital slots and radio frequency spectrum are limited

The principle of "first come,first served"is adopted globally due to the scarcity of satellite orbits and frequency spectrum.Therefore,early deployment is essential to gain more resources.

Low earth orbit (LEO)satellites,like Starlink,travel at an orbital speed of c27,000 km/h (c7.6 km/s)and complete one full orbit of the earth in about 90-95 minutes.To ensure the operational safety of high-speed satellites,each satellite must maintain a specific safe distance from all other satellites in every direction.Per the ITU,there is a capacity limit of around 60,000 to 100,000 LEO satellites.As of end 2025,there were over 10,000 active LEO satellites,c10-17% of the capacity limit.

In addition,LEO satellite frequency spectrum is extremely scarce.As a single LEO satellite has a limited coverage area,it is necessary to launch hundreds or even thousands of satellites to form constellations to achieve global coverage.This could result in cross flying by satellites from different enterprises and interference for the same frequency.

LEO satellites also suffer from significant space transmission losses,despite low latency.To ensure signals can be received by ground terminals,satellites must adopt higher transmission power and specific frequencies,which could restrict the reusable mode for frequency spectrum and lead to lower utilisation of frequency spectrum compared with ground cellular networks.Due to the fast growth in constellations,traditional low-frequency bands are almost saturated.The industry is making efforts to increase communication capacity potential by expanding into higher frequency bands such as Ka/Ku and dynamic frequency spectrum sharing.

Exhibit 15.Mainstream LEO satellite radio frequency spectrum

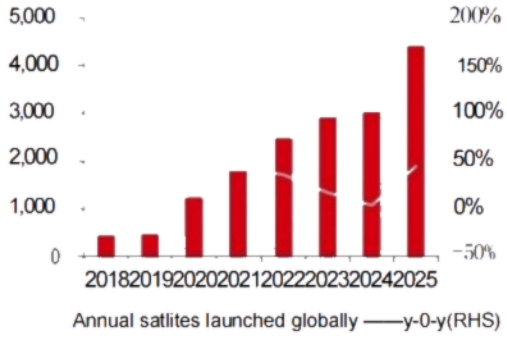
Frequency band	Downlink frequency range(GHz)	Downlink bandwidth (GHz)	Uplink frequency range (GHz)	Uplink bandwidth (GHz)	Features	Supported applications	Examples
L band	1.535-1.56	0.025	1635-1.66	0.025	Strong penetration and low transmission loss. It can be received by an omni-directional antenna,while its bandwidth is relatively narrow.	Monitoring remote devices in a real-time way and realising communication between machines.	Iridium Next
S band	2.5-2.54	0.04	2.65-2.69	0.04		Used for meteorological radar, surface ship radar, NASA communication, satellite television, mobile broadband service, radio broadcasting, and on-board internet.	China Telecom Tiantong-1
C band	3.4-4.2	0.8	5.8-6.725	0.925	Strong resistance to rain attenuation, but susceptible to ground microwave interference;the size of ground receiving antenna is relatively large.	Provides voice and data transmission services from ships to land.	Gaofen-3 satelite, Hemetro C-SAR satellite
X band	7.25-7.75	0.5	7.9-8.4	0.5		Used for satellite communication, military satellite communication and radar applications.	TecSAR
Ku band	10-13	3	14-18	4	Rich frequency bands, antenna equipment miniaturisation,but rain attenuation is slightly higher than C-band.	Used for satellite communication, fixed satellite service and broadcasting satellite service.	Starlink, OneWeb, SpaceSail
Ka band	17.7-21.2	3.5	27.5-31	3.5	Sufficient bandwidth available (thousands of Mhz), supporting extremely high data transmission rates, but technical complexity is high and rain attenuation is significant.	Used for satellite communication, military satellite communication and 5G telecom.	Starlink, Amazon LEO, Telsat, CSCN
QN band	37.5-42.5	5	42.5-51.4	8.9		Used for voice, data, and video communication.	CSCN, SpareSail, Galaxy Space
E band	71-76	6	81-86	5		Provides satellite communication service with extremely high throughput.	Starlink

Source:Qorvo,HSBC Qianhai Securities

The development of overseas LEO communication satellite constellations is outpacing growth in China's domestic market.For example,US SpaceX's Starlink has a first-mover advantage through its leading reusable rocket technology and vertical supply chain integration;as of the end of 2Q26,Starlink had more than 10,200 on-orbit satellites.

China has c600 but wants to close the gap.It is implementing two mega LEO satellite constellation projects:GW Constellation and SpaceSail Constellation.In September 2020, China submitted spectrum applications for GW-A59Q and GW-A2 to the International Telecommunication Union (ITU),for a total number of 12,992 satellites.In April 2021,China Satellite Network (CSCN)was established to serve as the implementing entity for the GW Constellation.In August 2023,Shanghai Spacecom's SpaceSail Constellation applied to the ITU for 1,296 LEO satellites,with a long-term plan to deploy 15,000 satellites.

Exhibit 16.Global annual satellite launches grew at a CAGR of 29%over 2020-25,driven by Starlink



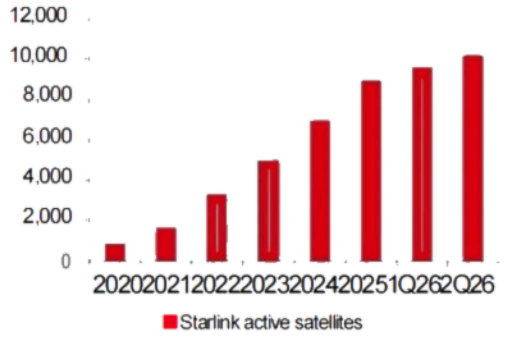
Source:Novaspace,BCG,HSBC Qianhai Securities

Exhibit 17.Global orbital launches by region (2025,number of orbital launches)



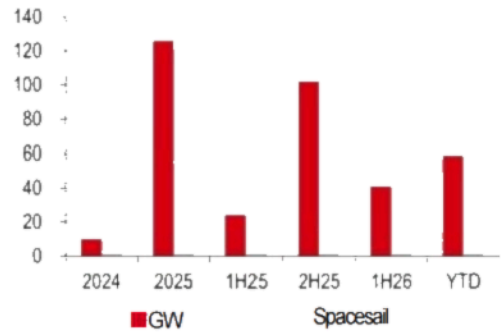
Source:Space Stats,HSBC Qianhai Securities

Exhibit 18.Starlink active LEO satellites totalled 10,200 as of end 2Q26



Source:SpaceX,Union of Concerned Scientists Satellite Database,Cosmo Quest, HSBC Qianhai Securities

Exhibit 19.Chinese GW and SpaceSail constellations'active satellites total 177 and 236,but the acceleration trend is clear



Source:China Aerospace Science and Technology Corporation,China National Space Administration(CNSA),HSBC Qianhai Securities

In December 2025,multiple satellite operators,commercial aerospace enterprises and basic telecom operators in China submitted frequency and orbit applications to the ITU for an additional 203,000 satellites covering 14 satellite constellations,including mid-to low-orbit satellites.While the numbers are large,given the limited rocket capacity in China and the priority assigned to the GW constellation and the SpaceSail Constellation,we believe the market should focus on the progress-of building these two constellations,which will total 28,000 satellites when finished.

Exhibit 20. Major LEO satellite constellations

	Starlink		GW Constellation		SpaceSail Constellation		
	Starlink consumer broadband		GW-A59	GW-A2	Phase1	Phase II	PhaseIII
Operator	Spacex		China satellite network		Shanghai Spacecom satellite technology		
Services	Broadband internet capable of supporting streaming, online gaming, video calls, and more		Broadband/DTC internet access		Broadband/DTC internet access		
Number of active satlites	C10,400 (as of end 2026)		136(as of end 2025)		108(as of end 2025)		
Planned number of satelites	12,000		6,080	6,912	324	648	15,000
Launch time for the first network building satellites	2019/5/23		2024/12/16				2024/8/6
Expected time for completion of launch and network building	N/A		2035		End 2026	End 2027	End 2030
Operational altitude	480-570km	500-600km	500-1145km		300-1000km		
Spectrum	E-band, Ka-band		Ka, QN, etc.		Ku, QN, etc.		
Orbital inclination	53(primary), 43, 70, 97.6		30-85 degrees		30-89 degrees		

Source: SpaceX company data, Jushri, Microsate, HSBC Qianhai Securities

Under the ITU's satellite rules, non-geosynchronous (NGSO) constellations must meet rollout deadlines to keep full spectrum rights. Starting seven years after they apply for spectrum, they must launch:

- 10% of planned satellites within two years (by year 9)
- 50% within five years (by year 12)
- 100% within seven years (by year 14)

If they miss these targets or don't finish within 14 years, their spectrum rights are reduced in line with how many satellites they actually launched in time.

The pace of satellite launches has accelerated significantly this year. Spacecom plans to deploy 324 satellites by end-2026 and 648 by end-2027. The company launched 108 satellites as of end-2025 and 92 in 1H26. Given the maturing reusable rocket technology in China, we expect satellite launches to further accelerate in 2H26e and beyond, bringing incremental business to the companies along the industry value chain.

Domestic reusable rocket technology breakthrough: poised to reduce launch costs and boost mass capacity

Historically, expendable rockets have dominated space access. By reusing boosters - which are generally seen as the most valuable part of a rocket - the cost of satellite launches can be significantly lowered.

According to the China National Space Administration (CNSA), on 10 July 2026, the Long March 10B carrier rocket lifted off from the Hainan Commercial Aerospace Launch Site and successfully sent satellites into a predetermined orbit. The rocket's first stage was recycled by the "Navigator" vessel in a netting mode. The mission marks China's first successful recycling of a rocket's first stage and the world's first successful recycling of a carrier rocket in a netting mode at sea, indicating a breakthrough in China's reusable rocket technology.

In addition, Zhuque-3, developed by commercial rocket company LandSpace, successfully recovered its stainless-steel booster after an orbital launch in August. Looking ahead, as domestic reusable rocket technology matures, China's low-earth orbit capacity is expected to grow significantly, and the launch cost per kg should decline further, supporting the rapid growth in the number of LEO satellites.

Exhibit 21.China reusable rocket progress vs SpaceX

Company	Rocket	Configuration	Propellant	Engine	Recycling methods	LEO carrying capacity when is recycled(tonne)	Progress
SpaceX	Falcon 9 (Block 5)	A two-stage,medium-lift LOX rocket standing 70 metres methane tall with a diameter of 3.7 meters. Stainless steel is used for rocket airframe.		Merlin engines,using 9 on the first stage for liftoff and 1 specialized version on the second stage for in-space manoeuvring. Together, those engines run on liquid oxygen (LOX) and rocket-grade kerosene(RP-1)propellants	Vertical landing legs	17.5	First launch in 2010 and first recycling in 2015. Reaching mature stage that can enable routine launches, with more han 500 cumulative launches and a recycling rate of 90%.
SpaceX	Starship	A fully reusable, two-stage LOX super heavy-lift launch methane vehicle standing c121-124 metres tall with a 9-meter diameter		Booster is powered by 33 Raptor engines, generating over 9,200 tons of total thrust. Starship Spacecraft is powered by 6engines total (3 standard Raptor engines for sea-level manoeuvring and 3 Raptor Vacuum engines optimized for use in space).	Large mechanical arms (the "chopstick" system)	100-150	Starship's first ever booster (first-stage rocket) recovery test succeeded in October 2024; second-stage rocket achieved a soft splashdown in sea in July 2026, though a successful recovery has not yet been achieved.
China Aerospace Science and Technology Corporation (CASC)	Long March 10 (CZ10B)	A two-stage tandem rocket standing c63 metres tall with a diameter LOX of 5 metres. High-strength methane aluminium alloy is used for rocket airframe.	LOX kerosene,	The first stage is powered by seven YF-5et 100K family engines, which are LOX/kerosene high-pressure refuel cycle engines, with a total liftof thrust of 892.2 tonnes. The second stage currently utilises one sea-level YF-219 engine, with a vacuum thrust of 152 tonnes, and will use one vacuum YF-219 engine ahead, which is a LOX/methane open cycle engine, offering a vacuum thrust of 162 tonnes and the capability of multiple restarts.	capture	16	The recycling of first stage rocket achieved successfully in July 2026.
LandSpa	ce Zhuque-3 (ZQ-3)	-Single-core two-stage tandem configuration, the methane first and second stage's diameter at 4.5 metres, fairing's diameter at 5.2 metres, the rocket standing 66.1 metres tall with liftoff weight of c560 tonnes. Stainless steel is used for rocket airframe.	LOX	In-house Tianque series LOX methane engine is used. The first stage employs nine Tianque-12A engines in parallel, while the second stage is powered by one Tianque-15A vacuum engine.	Vertical landing legs	18	On 3 December 2025, the initial orbital flight was successful,but the recycling test failed. The second launch and recycling test is planned to conduct within 2026,with the first attempt of recycling for reusable flight.
CAS Spa	ce Kinetica-2 (PR-2)	The rocket is featured with LOX "Common Booster Core"kerosene (CBC)configuration. The diameter of its common core is 3.35 metres,with a fairing diameter of 4.2 metres for initial flight. The rocket stands 53 metres tall, with liftoff weight of 625 tonnes and liftoff thrust of 753 tonnes.		Nine engines on the first stage and one engine on the second stage. Currently, YF-102 series LOX kerosene engine is used. The company's in-house Tiqing-2 engine will be adopted in its reusable version ahead.	Vertical landing legs	12	On 30 March 2026, the initial orbital flight was successful, but no recycling test was conducted.
Galactic Energy	Pallas-1 (Pallas-1)	The diameter is 3.35 metres for rocket body and 4.2 metres for fairing, with liftoff weight at 283 tonnes and liftoff thrust at 350 tonnes.	LOX kerosene	In-house Cangqiong-50(CQ-50)LOX kerosene engine is used. The first stage employs seven engines of this kind in parallel, while the second stage is equipped with one vacuum engine (CQ-50X).	Vertical landing legs	7	As of July 2026, all major ground tests have been completed. The telemetry-1 rocket has finished final assembly and testing and is ready for its initial flight.
Space Pioneer	Tianlong-3 (TL-3)	The rocket stands 72 metres tall with liftoff weight at c600 tonnes.	LOX kerosene	The first stage is equipped with 9 TH-12V engines and the second stage with one TH-12Vengine.	Vertical landing legs	14	On 3 April 2026, the first flight test was conducted. An unexpected anomaly occurred following normal initial flight, resulting in failure into orbit.
iSpace	Shuangquxia n-3(SQX-3)	The rocket stands 68 metres tall with rocket body's diameter at 4.2 metres and liftoff weight at c600 tonnes.	LOX methane	An in-house Jiandian-2(JD-2)engine is used. The first stage integrates nine engines in parallel, each delivering a sea-level thrust of 85 tonnes, with a total thrust of 765 tonnes; the second stage is equipped with a vacuum engine, with thrust at c105 tonnes, supporting multiple ignitions and varying thrust of 35-110%.	Vertical landing legs	8.5	Since 2026, ground testing and other launch preparations are well on track, with plans to achieve the first orbital flight at end-2026 and recycling at sea.

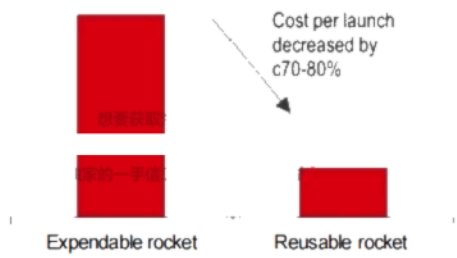
Source:Spacex,China Aerospace Science and Technology Corporation,LandSpace,Cas Space,Galactic Energy,Space Pioneer,-Space,HSBC Qianhai Securities

Exhibit 22.SpaceX Falcon 9vs China orbital annual launches



Source:Space Stats,HSBC Qianhai Securities

Exhibit 23.Reusable rockets enjoy significant cost advantages

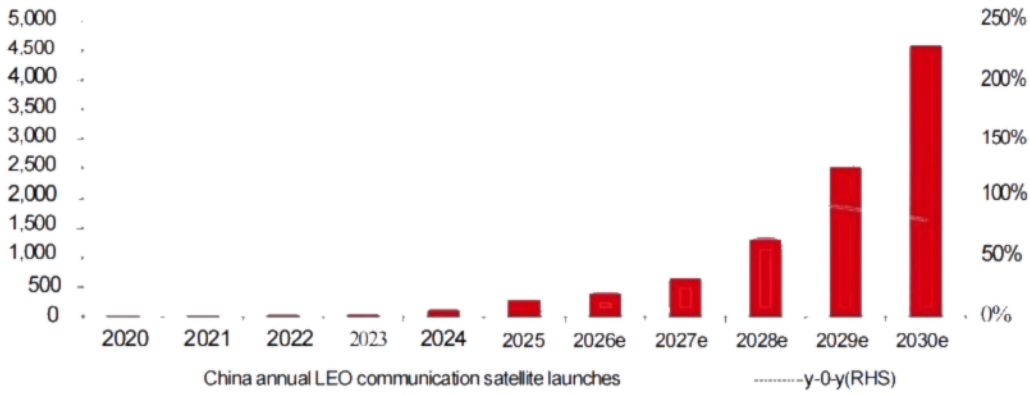


Source:SpaceX,Landspace,HSBC Qianhai Securities estimates

China LEO communication satellite launches to accelerate

Overall,given the vast application prospects of satellite communication,limited satellite orbit slots and frequency spectrum,as well as lower launch costs and higher capacity due to advancements in domestic reusable rocket technology,we expect the development of China's LEO communication satellite industry to accelerate rapidly.Given the ITU filing and the plans for China's two constellations and progress in the R&D and testing of domestic reusable rockets, we expect the annual number of LEO communication satellite launches in China to grow at a CAGR of 75%over 2025-30e,reaching a total of 9,470 over 2026-30,c19x the LEO communication satellites launched over 2020-25.

Exhibit 24.We expect annual communication satellites launches to grow at a CAGR of 75%over 2025-30e-total 9,470 over 2026-30-c19x the number launched over 2020-25



Source:China Aerospace Science and Technology Corporation (CASC),China NationalSpace Administration (CNSA),HSBC Qianhai Securities estimates

Unlocking value:segment TAM and growth

- We forecast the market size of three major segments:satellite manufacturin g,ground equipment,and communication applications
- We conduct a comparative analysis of SpaceX and domestic peers in each segment
- Phased-array antennas,laser communication terminals and on-board routers contribute most value in satellite payloads;broadband services likely to be the first application to be monetised in 2027

Satellite manufacturing:Cost cutting the key to mass production

Satellite manufacturing is a key part of the satellite internet industry,including processes such as overall design,the production of payload and platform components,and satellite AIT(assembly, integration,and testing).As China's LEO satellite constellations expand,satellite manufacturing stands to benefit most from this growth,especially the communication payload segment

China's satellite manufacturing industry has yet to achieve meaningful economies of scale,resulting in higher unit costs than those of leading overseas manufacturers.In June 2026,Hu Haiying,Chief Commander of SpaceSail,stated in an interview with CCTV that a single SpaceSail satellite now costs over RMB10m.By contrast,a Starlink V1 satellite costs USD200k(cRMB1.35m),and a Starlink V2 Mini satellite costs USD800k(cRMB5.4m),well below China's comparable satellite models (source:Quality Space,a space market research and consulting firm).

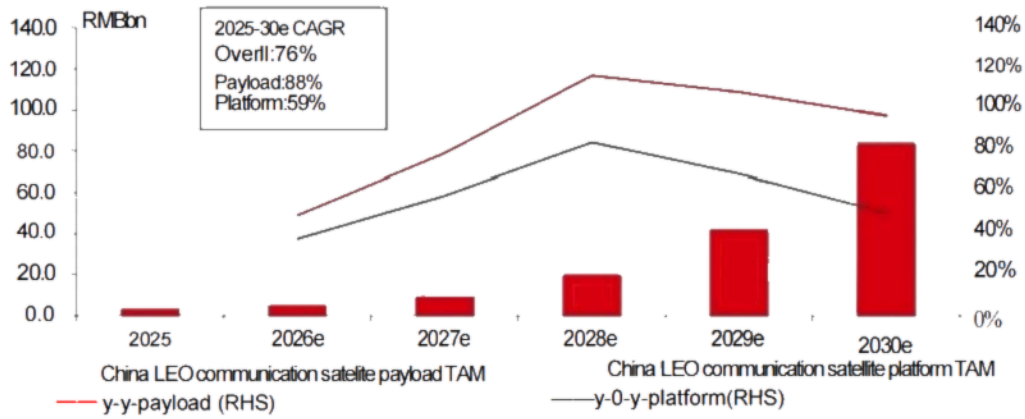
Exhibit 25.China's major LEO communication satellites vs SpaceX's Starlink satellites

	Starlink V1	Starlink V1.5	Starlink V2 Mini	Starlink V2 Mini Optimised	Starlink V3	GW Gen-1 satellites	SpaceSail Gen-1 satellites
First launch time	2019	2021	2023	2024	2026	2024	2024
Satelite weight	260 kg	310 kg	800 kg	575 kg	2,000kg	c1,000kg	c270kg
Launch vehicles	Falcon 9	Falcon 9	Falcon 9	Falcon 9	Starship	CZ-6A, CZ-8/CZ-8A, CZ-12	CZ-6A, CZ-8/CZ-8A, CZ-12
Payload capacity perlaunch	60 satellites	54 satelites	23 satelites	29 satelites	60 satlites	9/5 satelites	18 satellites
Satelite downlink capacity	N/A	24Gbps	96Gbps	96Gbps	1Tbps	N/A	N/A
Satellite uplink capacity	N/A	N/A	6.66bps	6.66bps	200Gbps	N/A	N/A
Support direct-to-cell?	No	No	No	No	Yes	No	No
Support inter-satelite laser communication?	No	Yes	Yes	Yes	Yes	No	No
Inter-satellite laser bandwidth	N/A	100Gbps	200Gbps	200Gbps	400Gbps	N/A	N/A
Key upgrades	Reliance on ground-station-dependent transparent forwarding models	Introduction of inter-satelite laser links to reduce dependence on ground stations	Adoption of E-band backhaul to enhance transmission capacity	Weight reduction to enable more satellites per launch	Significant upgrades in communication capabilities and power systems	N/A	Benchmarking Starlink V1, which relies on a ground-station-dependent transparent forwarding model

Source:SpaceX,China Aerospace Science and Technology Corporation,Jushri,Microsate,HSBC Qianhai Securities

The expansion of China's LEO communication satellite constellation should drive economies of scale and reduce the unit value of satellites with identical configurations.However,the deepening of satellite communication applications is likely to boost demand for uplink and downlink bandwidth capacity per satellite.Next-generation satellites from GW and SpaceSail may benchmark specifications against Starlink V2 Mini or V3,which should push up satellite unit value.We estimate the average unit value of China's LEO communication satellites to remain stable at RMB25m in 2025-30,and expect meaningful cost cutting after 2030e,when mass production is achieved.This implies the size of the satellite manufacturing market will rise to RMB119.4bn,a CAGR of 76%over the same period.

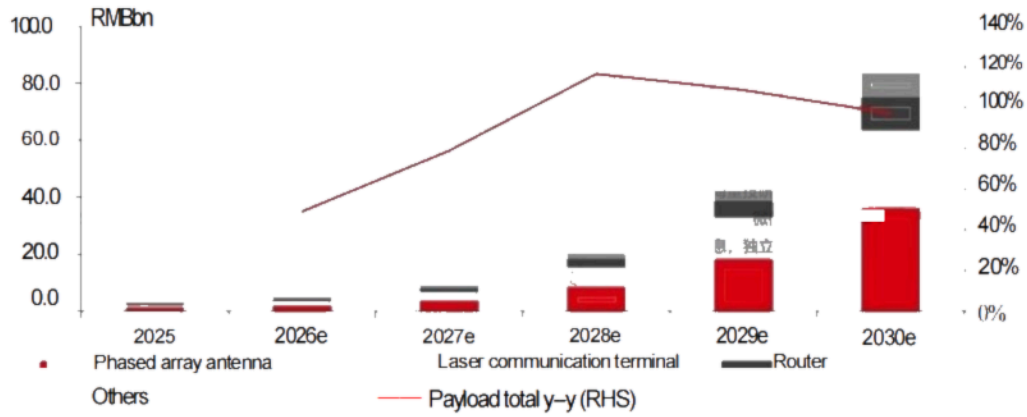
Exhibit 26.We expect LEO communication satellites manufacturing TAM to grow at a CAGR of 76%over 2025-30e and reach RMB119.4bn in 2030e



Source:China Aerospace Science and Technology Corporaion(CASC),China National Space Administration (CNSA),Hel Space,CTV(8 June 2026),HSBC Qianhai Securities estimates

Specifically,within the LEO communication satellite payload market,we expect on-board phased array antennas,space laser communication terminals,and routers to take the most value.

Exhibit 27.We expect China LEO communication satellites payload TAM to grow at a CAGR of 88%over 2025-30e and reach RMB83.6bn in 2030e



Source:China Aerospace Science and Technology Corporation(CASC),China National Space Administation (CNSA),HSBC Qianhai Securities estimates

Phased array antenna:92%CAGR over 2025-30e;RMB36.3bn TAM in 2030e

Phased array antennas serve as critical payloads for establishing satellite-to-ground communications within satellite communication systems.As energy converters,antennas facilitate the bidirectional conversion between high-frequency currents in circuits and wireless electromagnetic waves propagating through free space.A phased array antenna comprises multiple antenna units arranged according to specific patterns on a planar or curved surface, along with phase shifters,feed networks,and other components.The numerous antenna units are typically organized in a regular two-dimensional grid,with each unit capable of independently adjusting the phase of its transmitted or received signals.By controlling the phase differences among these units,the antenna system can form a concentrated beam in a specific direction,also known as a wave beam.Adjusting these phase differences allows for the steering of the wave beam's pointing angle,thereby enabling accurate targeting,tracking,or scanning of specific objectves.

Exhibit 28.Advantages of phased array antenna vs parabolic antenna in satellite

Muli-beamforming and rapid scanning	Phased array antennas can generate multiple T/R beams pointing in different directions within a single repetition cycle by switching beamforming configurations. These beams operate independently and possess rapid scanning agility.
Beamforming	By adjusting the signal amplitude and phase across individual channels within the phased array, the antenna radiation pattern or beam shape can be dynamically altered.
Strong anti-jamming capability	Phased array antennas can concentrate the power of multiple radiating units to form high-power nodes. Alternatively, through adaptive control of energy distribution and main lobe gain, they can direct required energy toward specific directions, thereby significantly enhancing anti-jamming performance.
High reliability	By eliminating the mechanical drive systems found in traditional parabolic satellite communication antennas, phased array antennas reduce failure rates. Furthermore, given the large number of antenna units within a single array, the failure of a few units does not impact the overall functionality.

Source:Chengchang Technology,Ansys,HSBC Qianhai Securities

Exhibit 29.Starlink satellites antenna specifications

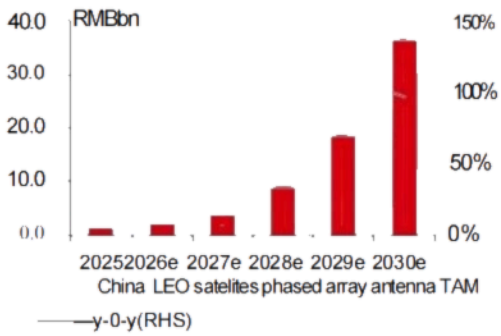
Satellite model	Antenna specifications
Starlink V1.5	4 phased array antennas and 2 parabolic antennas
Starlink V2 Mini	5 advanced Ku-band phased array antennas and 3 Doppio dual-band(Ka-band and E-band)antennas

Source:SpaceX,HSBC Qianhai Securities

We assume an average of five phased array antennas per satellite and an ASP of RMB1m for China's LEO communication satellites in 2025.We also anticipate that both the number of phased array antennas required per satellite and the ASP willcontinue to rise,driven by improving per-satellite bandwidth as wellas the growing number of antenna units and Transmitter/Receiver (T/R)modules.We expect China's LEO satellite phased array antenna TAM to grow at a CAGR of 92%over 2025-30e and reach RMB36.3bn in 2030e.

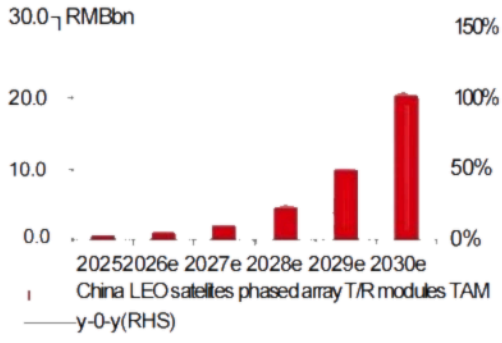
T/R modules serve as the core in phased array antennas,connecting the antenna array and radio frequency(RF)front-end.These modules integrate transmission channels(for signal amplification and control),reception channels (for signal amplification and frequency conversion),and control circuits.Currently,on-board phased array antennas are mostly active phased arrays,wherein each antenna unit is equipped with an independent T/R module. Therefore,a single phased array antenna typically incorporates dozens,or even hundreds,of T/R modules.We expect the number of T/R modules per satellite for China's LEO communication constellation to continue to grow.We estimate China LEO communication satellite phased array T/R module TAM to grow at a CAGR of 96%over 2025-30e and to reach RMB20.4bn in 2030e.

Exhibit 30.We expect China LEO satellite phased array antenna TAM to grow at a CAGR of 92%over 2025-30e and to reach RMB36.3bn in 2030e. .



Source:SpaceX,Guobo Electronics,HSBC Qianhai Securities estimates

Exhibit 31....in which phased array antenna Transmit/Receive module TAM is expected to grow at a CAGR of 96%over 2025-30e and to reach RMB20.4bn in 2030e



Source:Guobo Electronics,HSBC Qianhai Securities estimates

Laser communication terminals:100%CAGR over 2025-30e;RMB27.3bn TAM in 2030e

Inter-satellite laser communication terminals are critical payloads to support high-speed data transmission between satellites.In 2022,SpaceX's Starlink V1.5 first adopted laser communication terminals to interconnect LEO satellites,reducing reliance on ground stations and marking the beginning of large-scale deployment.The domestic market for space laser communication terminals is still at an early stage.As of 1H26,the 400+satellites in orbit launched by China's two major constellations,GW and SpaceSail,have yet to see large-scale application of inter-satellite laser communication.However,both constellations are actively advancing on-orbit validation.We anticipate SpaceSail's second-generation constellation to start large-scale adoption of the solution,which should start launching in 2028e.

Exhibit 32.Advantages of inter-satellite laser communication

Features	Description
Strong anti-jamming capability	As a monochromatic light, a laser's photons maintain high consistency in optical properties such as frequency and amplitude across both time and space. When used as an information carrier, lasers offer longer transmission distances and superior stability, significantly reducing signal interference during data transmission. This results in more effective communication performance in the high electromagnetic radiation environment of space.
High communication capacity	Lasers operate at significantly higher frequencies, typically achieving data rates from hundreds of Gbps to Tbps. This capacity far exceeds the capabilities of traditional satellite microwave communication equipment.
Superior directionality	Lasers exhibit a much smaller divergence angle, enabling ultra-long-distance point-to-point data transmission. This capability not only ensures secure networking between satellites but also addresses the scarcity of frequency resources in space communications.
Lightweight payload	The antenna for laser communication, serving as the optical lenses, is considerably smaller in volume compared to phased array or parabolic antennas. This allows the weight of spaceborne laser communication terminals to be controlled within a range of tens of kilograms.

Source:Hello Space,HSBC Qianhai Securities

Exhibit 33.Core components of space laser communication terminals

Core components	Description
Narrow-linewidth laser	Responsible for outputting a light source with an extremely narrow spectral linewidth. Its high coherence is fundamental to satellite-to-ground laser interferometric ranging, hyperspectral resolution remote sensing, and coherent laser communication.
IQ modulator	An optoelectronic device used to modulate the amplitude and phase of a laser carier. It is a critical component for generating high-order modulation format signals in inter-satelite coherent laser communication systems.
Grating encoder	A high-precision angular sensor that converts the rotation angle and speed of a motor or shaft into electrical signals based on the Moiré fringe principle of gratings, serving satelite payload precision servo control.
Fast steering mirror (FSM)	A high-speed precision deflection miror used to rapidly compensate for satelite platform jiter within the optical path, ensuring stable line-of-sight and precise target pointing.
Short-wave infrared(SWIR) detector	A photoelectric sensor that converts incident infrared radiation signals into electrical signals, primarily utilised in infrared tracking cameras.
Secondary power supply	A power module that converts the satelite's primary power into stable, clean, specific voltage levels required by various load devices, such as detectors and processors.

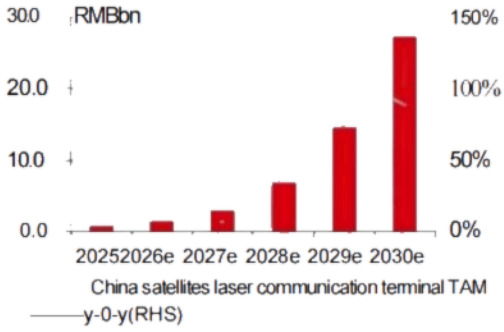
Source:Hello Space,HSBC Qianhai Securities

Each Starlink satellite (V2 Mini)contains three space lasers operating at up to 200Gbps. Assuming the average number of lasers per domestic LEO communication satellite increases from two in 2025 to four in 2030,with an estimated average unit cost of cRMB1.5m,we expect China's LEO communication satellite space laser terminals TAM to grow at a CAGR of 100% over 2025-30e and reach RMB27.3bn in 2030e.

On-**board routers:84%CAGR over 2025-30e;RMB11.7bn TAM in 2030e**

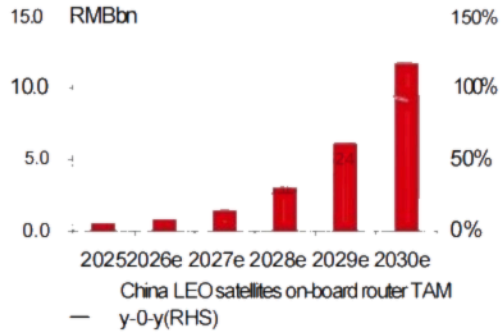
On-board routing and switching are key technologies underpinning space-based information networks.Their key functions include wireless access for ground mobile users via satellite nodes,autonomous routing between satellite nodes,and high-speed data switching on board. As the core equipment for inter-satellite communication,on-board routers differ from terrestrial routers;they are required to withstand high radiation and extreme temperatures in space,and to meet stringent requirements for low power consumption and high integration.Assuming the average value of on-board routers per satellite is cRMB2m,we estimate China LEO communication satellite on-board router TAM to grow at a CAGR of 84%over 2025-30e and reach RMB11.7bn in 2030e.

Exhibit 34.We expect China LEO communication satellite laser terminal TAM to grow at a CAGR of 100%over 2025-30e and reach RMB27.3bn in 2030e



Source:SpaceX.FiberHome,SpaceNews(20 December 2021),HSBC Qianhai Securities estimates

Exhibit 35.We estimate China LEO communication satellite on-board router TAM to grow at a CAGR of 84%over 2025-30e and reach RMB11.7bn in 2030e



Source:ICT Biaoju,HSBC Qianhai Securities estimates

Ground segment:key infrastructure for smooth satellite communications

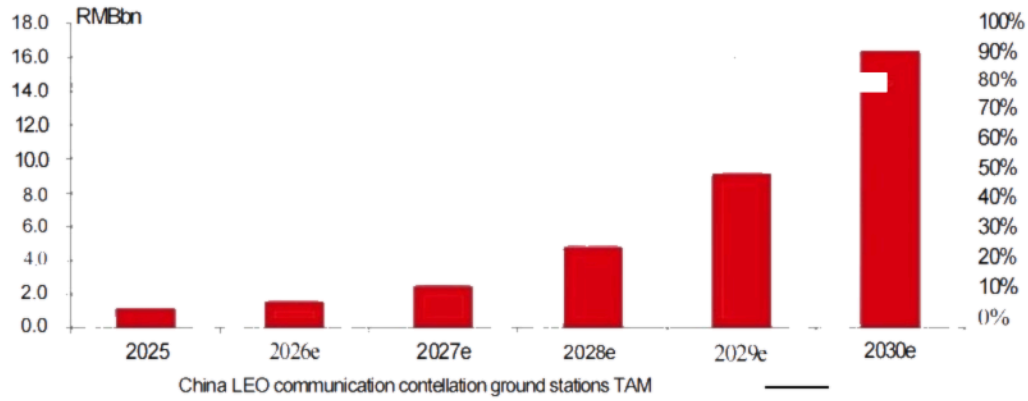
Ground side equipment and systems act as the bridge connecting satellites and existing networks on earth as well as satellite telecommunication users.The ground segment includes ground stations and user terminals.

Ground stations:CAGR of 70%over 2025-30e;RMB16.4bn TAM in 2030e

A ground station is a terrestrial relay station that communicates with satellite constellations. These stations usually deploy large-size high-speed antennas,transmitting data between satellites and terrestrial internet networks.

As per SpaceX,it operates ground stations around the world,with over 400 sites to support its c10,200 Starlink satellites as of end 2Q26.In March 2024,the Fuyuan (抚远) government signed a cooperation agreement with Shanghai Spacecom to invest RMB223m in the construction of a satellite ground station.Assuming the ratio of ground stations required for low orbit satellite constellations to that of active satellites is close to Starlink's current level,and the average cost per station is RMB100m,we estimate China LEO communication satellites ground stations'TAM to grow at a CAGR of 70%over 2025-30e and to reach RMB16.4bn in 2030e.

Exhibit 36.We expect China LEO communication satellites ground stations TAM to grow at a CAGR of 70%over 2025-30e and reach RMB16.4bn in 2030e



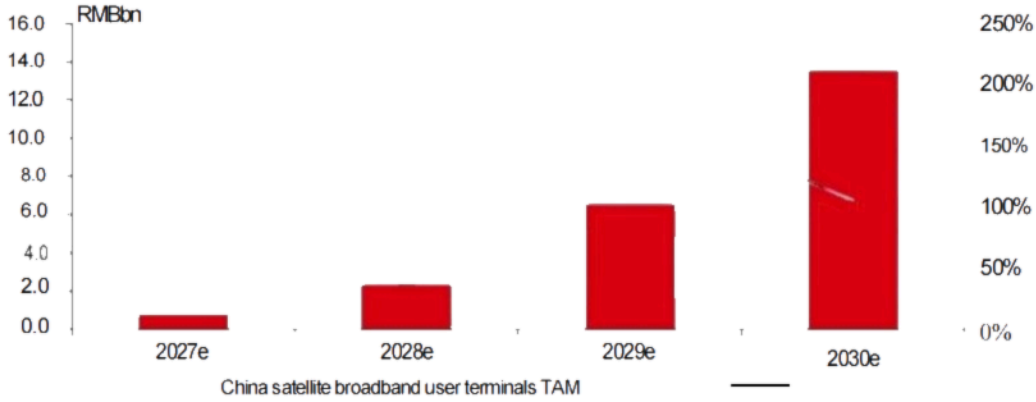
Source:SpaceX.ST Daily (December 2024),HSBC Qianhai Securities estimates

Broadband user terminals:CAGR of 161%over 2027-30e:RMB13.5bn TAM in 2030e

Satellite broadband service user-side also requires terminals deployment.Starlink's portable flat panel terminal has become the mainstream satellite broadband service ground terminal;its core components include phased array antennas,server power systems,industrial routers and shells. Low-orbit communication satellites move at high-speed relative to the ground,resulting in only 5-15 minutes of visible time for a single satellite over a ground antenna.Plus,a large range of motion angles means that multi-beam phased array antenna technology is required to enable the ground antenna to keep the target satellite in line and switch between different satellites.

Starlink's user terminal prices range from USD199-1,999 depending on the size of the phased array antenna and other configurations.According to CNBC(13 September 2023), management said that Starlink's initial user terminal cost was USD3,000 before 2021,which has gradually fallen to below USD600 in 2023 after mass production was achieved.Assuming that China's current satellite broadband ground terminal unit value is close to Starlink's 2023 level, the unit cost will gradually decrease with the mass production of satellites.We estimate China LEO satellite broadband user terminals'TAM to grow at a CAGR of 161%over 2027-30e and reach RMB13.5bn in 2030e.

Exhibit 37.We expect China LEO communication satellites broadband user terminals' TAM to grow at a CAGR of 161%over 2027-30e and reach RMB13.5bn in 2030e



Source:SpaceX.CNBC(13 September 2023),HSBC Qianhai Securities estimates

Satellite connectivity:China has opportunities in both the domestic and overseas markets

Broadband service:an alternative to Starlink

Satellite broadband service,the main application of low-orbit communication satellites,refers to the large satellite network built by satellite communication operators through the deployment of thousands of communication satellites in low earth orbit.They provide high-speed and low latency broadband access services to remote areas,marine,aerospace and other locations that are difficult for traditional networks to cover.Users need to track satellites overhead automatically through a receiver antenna and a dedicated router to achieve high-speed internet access.

We expect China's satellite broadband service to enter the commercialisation stage from 2027e, driven by the accelerated constellation buildout by Spacecom and China SatNet and the growing number of on-orbit satellites.Spacecom and SatNet's progress in satellite broadband user terminals serves as one of the key pieces of evidence supporting our forecasts.

◆ According to the SASAC of Shanghai,Shanghai Spacecom debuted its standard satellite terminals and aviation terminals at the 2026 Mobile World Congress in June 2026;both apply advanced electronic phased array antenna technology,integrating high-performance specialty baseband processing chips.The standard version of the terminal is only 30mm thick,with a simple design for entry-level industry and individual users.It supports fixed and mobile access,which can apply in high temperatures,cold,strong wind and other harsh conditions,to meet the needs of a variety of use cases.Users can automatically access the SpaceSail constellation with a download speed of up to 450 Mbps and upload speed of up to 150 Mbps.

◆According to China Telecom World,in February 2026 China Satellite Network launched a hardware procurement project for low orbit satellite internet terminals and initiated supplier invitation negotiations for core access devices for low orbit satellite internet users(phased array broadband terminals with an equivalent calibre of 0.45 metres).

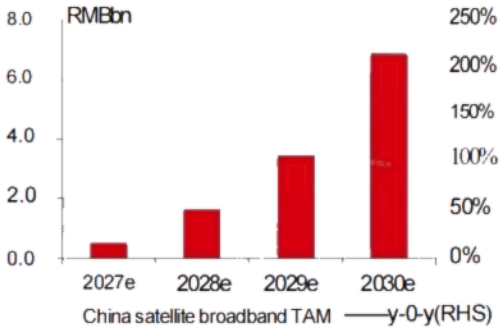
In reference to Starlink's pricing,we expect the TAM of China satellite broadband services to reach RMB6.8bn by 2030e,implying a 134%CAGR over 2027-30e.In our blue-sky scenario, where we assume LEOs serve as the dominant communication infrastructure for society(i.e., 80%of broadband subscribers use satellite broadband),we estimate the blue-sky long-term TAM of China satellite broadband services could reach RMB1,807bn,c264x of our 2030e TAM.

Exhibit 38.Starlink's broadband plans and pricing

	Personal_		Business_	
	Residential	Roam	Local priority	Global priority
Target customers	Households	RVs, nomads, and campers, and working on the go	Fixed and mobile businesses on land	Maritime and global connectivity
Monthly fees	100Mbps-USD55	100GB-USD55	50GB-USD55	50GB-USD250
	200Mbps-USD85	300GB-USD80	500GB-USD155	500GB-USD650
			1TB-USD280	1TB-USD1150
			2TB-USD530	2TB-USD2150
	Max-USD130	Unlimited-USD175	+50GB-+USD25	+50GB-+USD100
			+500GB-+USD125	+500GB-+USD500

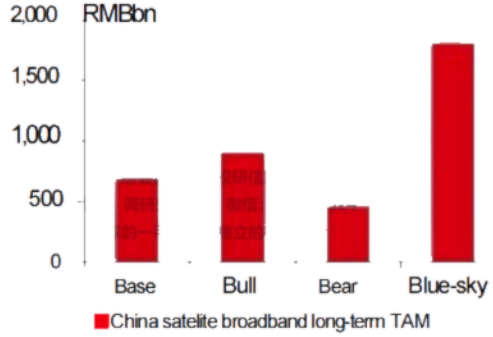
Source:SpaceX,HSBC Qianhai Securities

Exhibit 39.We expect China satellite broadband service TAM to grow at a CAGR of 134%over 2027-30e and reach RMB6.8bn in 2030e



Source:MIT,China Mobile company data,SpaceX,HSBC Qianhai Securities estimates

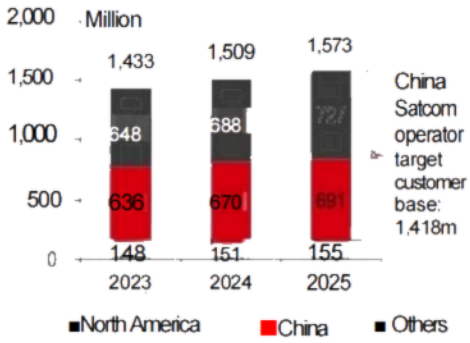
Exhibit 40.We estimate long-term China LEO broadband service TAM to reach RMB1,807bn,c264x of our 2030e TAM



Source:MIT,China Mobile company data,SpaceX,HSBC Qianhai Securities estimates

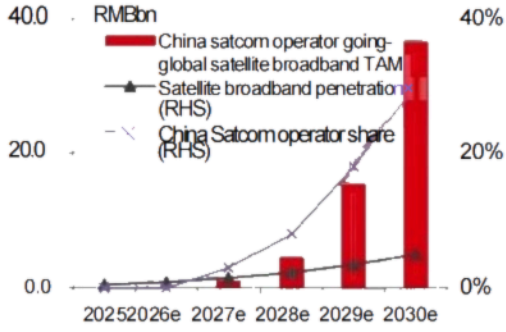
In addition,offering satellite broadband services to overseas markets is key for the development of China's satellite internet industry.Only Starlink has achieved a large-scale low-orbit satellite network that provides stable global satellite broadband services.As per the US Federal Communications Commission,Starlink has over 7m US subscribers in August 2026,c58%of its end 2Q26 total broadband subscribers.Non-US subscribers account for over 40%of its subscribers.Despite Starlink's significant first-mover advantage,against the backdrop of a diversifying global supply chain,we think the introduction of SpaceSail as a pivotal secondary supplier can reduce the risk of vendor lock-in and bolster the stability of national communication systems for most countries outside North America.

Exhibit 41.Global broadband subscribers: China Satcom operator's total target customer base reached 1,418m in 2025



Source:Point Topic,MIT,ITU,HSBC Qianhai Securities

Exhibit 42.We estimate China Satcom operators targeted overseas satellite broadband service TAM to reach RMB37bn in 2030e



Source:Point Topic,SpaceX,HSBC Qianhai Securities estimates

DTC service:SpaceX leads,China should achieve commercialisation in 2028e

Direct-to-cell(DTC)service enables voice,text or data communication from standard smart phones directly through a satellite without relying on ground base stations or special satellite terminals.

Exhibit 43.Current technical routes and cases of DTC

Technical routes	Description	Examples
Based on existing ground telecom system(cell+new satelite)	Based on the existing ground based mobile communication system(such as 4G and 5G) to directly connect to existing mobile phones, users do not need to replace or configure their existing mobile phones. Instead, the modification and enhancement will be made on the satellite and the network side. The remodified 4G/5G base station connecting to satelite is designed to meet the challenges of deep fade, high latency, high frequency deviation and switching control in satellite communication scenarios.	Starlink DTC
Based on existing satelite communication system(new cell+satelite)	Based on the existing satellite communication system, a dual mode cell with satellite communication modules will be launched, and mobile phone makers integrate special satelite communication chips into their terminals handset	Huawei Mate60/70 connecting China Telecom's Tiantong-1 mobile communications satelite system; iPhone 14 and subsequent models directly connecting to GlobalStar constellations
Based on 5G NTN system	The cell phone and satelite network side conducts systematically optimization to tackle the issues of synchronization, Doppler frequency deviation and wireless signal loss. It achieves a systematic balance between the complexity and cost of system performance (user speed, satellite capacity) between mobile phones and satelites, which is a relatively optimal solution. This route has more advantages than existing mobile phone solutions, which can reduce the size of the satellite phased array antenna.	Still in the stage of standard building, technology research and development, and verification, and has not yet been applied

Source:Analysis and Suggestions on Mobile Phone Direct Linked Stelite System and Its Array Antenna, Chen Zhishan and Wang Ce.

SpaceX is currently the global leader in DTC service.It has cooperated with
OPTUS in Australia,KDDI in Japan,New Zealand ONE NZ,Chile ENTEL,C
and other carriers since 2022 to provide DTC services with the ground cellul
bands it holds.In early 2024,SpaceX launched the first batch of six satellites
As of mid-2025,SpaceX has 650 DTC satellites in orbit,completing the depl
generation DTC mobile network.



As the number of satellites increased and power restrictions eased,Starlink's DTC services expanded from SMS messages to providing internet access in outdoor scenarios by 2H25, supporting apps such as WhatsApp,Google Maps,Apple Maps,AccuWeather and X.At present, SpaceX does not directly provide DTC service to consumers but indirectly charges through cooperating carriers.Pricing varies by carrier,ranging from free on premium mobile plans to about USD10-20 per month as an add-on.For example,T-Mobile's Starlink service is free on T-Mobile's Experience Beyond(pricing starts at USD105/month for one line)and Go5G Next (pricing starts at USD100/month for one line)plans.

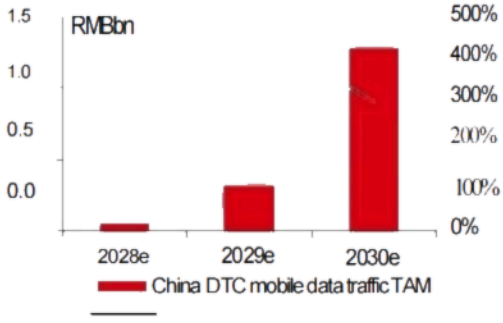
In addition,SpaceX started to apply for or acquire cellular communication spectrum in several countries in 2025.For example,SpaceX reached an agreement with North American telecom operator EchoStar to acquire its Global Mobile Satellite Service(MSS)spectrum license,the exclusive S band for 50 MHz in the US,and the 15 MHz AWS spectrum for 1695-1710 MHz at USD17bn in September 2025(source:SpaceX).SpaceX's spectrum is located around 2GHz which is well positioned for satellite network coverage and means SpaceX can provide direct satellite services to users without traditional carriers.

China's DTC service is still limited to voice and SMS services supported by high-orbit satellites. China Telecom Tiantong-1 is China's first self-developed satellite mobile communication system, supported by three Tiantong satellites in geosynchronous orbit.It offers DTC service to specific types of smartphones,such as Huawei's Mate60/70 series,with a monthly service package of RMB10,including two minutes of satellite calls.If exceeded,domestic calls are charged at RMB9 per minute and RMB5 per text message,which is expensive with limited application.

Looking ahead,we expect China's DTC service to be commercialised from 2028e,with the buildout of next-generation satellite constellations by Spacecom and China SatNet from 2028e. Both are very likely to adopt inter-satellite laser communications.We believe that,given China's well-developed and extensively covered terrestrial wireless network,satellite data traffic is likely to remain a supplement to,rather than a primary source of,data traffic in the foreseeable future. In China,the rollout of mobile satellite data services will likely take the form of partnerships between satellite operators and terrestrial network providers.In this model,traditional terrestrial operators(such as China Mobile,China Telecom,and China Unicom)would deliver services to end customers,incorporating satellite data into their premium packages or offering it as a separate add-on.Under this arrangement,terrestrial operators would remunerate the satellite operators accordingly.

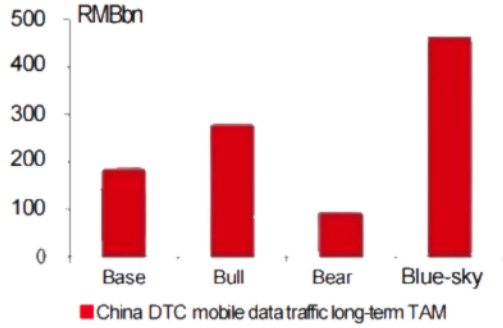
We expect China LEO satellite direct-to-cell TAM to reach RMB1.3bn in 2030e.Assuming 10%/20%/30%of China's total mobile subscribers subscribe to DTC add-on services over the long term,our bear/base/bull cases suggest RMB93bn/RMB185bn/RMB278bn long-term satellite DTC TAM.In our blue-sky scenario,where we assume 50%of China's total mobile subscribers use DTC add-on services,we estimate the long-term TAM of China satellite broadband service could reach RMB463bn,c363x of our 2030e TAM.

Exhibit 44.We expect China LEO satellite direct-to-cell TAM to reach RMB1.3bn in 2030e



Source:MIIT,China Mobile company data,HSBC Qianhai Securities estimates

Exhibit 45.We estimate long-term China LEO satellite direct-to-cell TAM to reach RMB463bn,c363x of our 2030e TAM



Source:MIIT,China Mobile company data,HSBC Qianhai Securities estimates

Space computing:Still early days

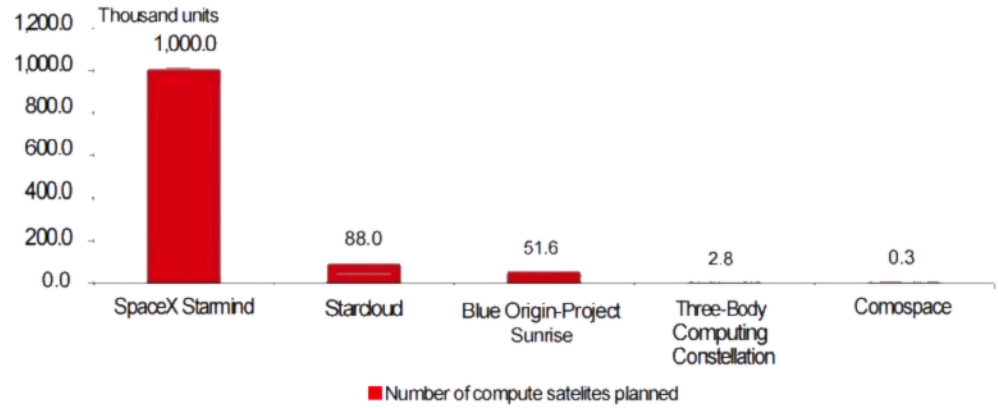
Space computing power(orbital data centre)refers to the deployment of computing power infrastructure(AI accelerators,storage,servers,switches)to satellite platforms,and the traditional computing tasks performed by terrestrial data centres,especially AI intelligent computing tasks(including large model training and inference),which will be completed in the computing power satellite cluster in space.

Exhibit 46.Advantages and challenges of space computing

	Descriptions
Advantages	◆ **Energy:**Rich solar energy in space,which can provide sustainable energy and is not afected by day and night,weather,seasons and other factors. ◆ Environment:Space is a vacum,ultra-low temperature,dust re,and vibration free making it suitable for high-precision computing device operation. ◆ **Construction cost:** The deployment of space computing power requires no land acquisition,building construction and path paving,which saves the investment in civil construction and infrastructure of the ground data centre and avoids the problem of land resource tension. **Strategic security:** f major disasters or wars happen on the ground,the ground data centre and the network are vulnerable to damage,and the space computng power can serve as computing power supplement for emergency.
Challenges	**Space PV and satelite platform technology:** The theoretical value of the solar iradiance is 1367W/sqm,the mainstream gallium arsenide battery efficiency is 28-34%,the peak power per unit area is 340-410Wsqm.The power consumption of computing power equipment is high,requiring large photovoltaic panel size,which puts extremely high requirements on the physical strength of the photovoltaic panel and the reliability of the folding/lunfolding mechanical structure.SpaceX unveiled its AI1 orbital data centre satlite n June 2026,featuring a peak computing capacity of 150KW and an average load of 120KW per satelite.The spacecraf features a 70-metre wingspan and a 20-metre deployed height,roughly yielding a total footprint area of 1,400 square metres (power output of 200w/sqm). **Heat dissipation:** Space is a vacuum and can only dissipate heat through thermal radiation.Computing power satelite power consumption is high, requiring a large area of heat panel for dissipation.Taking SpaceX A1 satelite as an example,it uses a 110 sqm liquid-cooled radiator,double-sided, with a power density of 1400W/sqm.This will ignificanty increase the size and launch weight of the satelite and require higher mechanical strength and reliability.In addition,high-performance heat conduction is required between a chip and a heat radiator through high thermal interface materials, microchannel cooling plates or phase change heat storage structures.These materials are prone to malfunction or ageing failure under launch vibration, orbital impact,long-term space radiation,microgravity and repeated heat cycles. **Space radiation:** High energy particles and cosmic rays exist in space.Some particles may penetrate the spacecraffs protective shield layer to damage the electronic components inside the spacecraf,causing hardware breakdown or hurting the calculation accuracy.**This would requie compute power** satelites to ad redundant systems or adopt radiation resistant chips,which could significantly increase chip costs.SpaceX launched its D3 chip in April 2026,which uses a radiation hardening system from"hardware +architecture +packaging"three aspects,with cicular gate layout,SEL hardware blocking circuit,full storage ECC fault tolerance,triple modular redundancy,rail correction algorithm and tantalum metal composite shielding layer introduced.

Source:SpaceX,Hello Space,HSBC Qianhai Securities

Exhibit 47.Global compute satellite constellation plan



Source:SpaceX,Stardoud,Blue Origin,Zhejiang Lab,Comospace,HSBC Qianhai Securities

Satellite data centres are still in the early stage of industrial development.The key supporting technology is immature and the commercial prospects are not clear.However,leading overseas players such as SpaceX have developed technology and completed the application to the FCC, while domestic companies are catching up.We think orbital data centres will likely enter the technology R&D and verification stage in 2030.We see limited commercialisation prospects in the short to medium term,but they may emerge in the long run.

Appendix

Exhibit 48.Descriptions of key systems in satellite platform and payload

			Functions and characteristics
Satelite platform	Structural system		Supports and secures various instruments and equipment on the satelite, integrating them into a unified structure capable of withstanding the mechanical environments during ground transportation, carrier rocket launch, and space operations, as well as the space operational environment. It includes overall structure, sealed compartment structure, common compartment structure, payload compartment structure, and deployable structures.
	Thermal control system		Ensures that various instruments and equipment operate within allowable temperature ranges under complex environmental conditions. It can be divided into passive thermal controls and active thermal controls.
	Power supply system		Provides the required electrical power to allsatelite instruments and equipment. It typically employs a combined power supply system of solar cells and rechargeable batteries.
	Attitude control system		Maintains or alters the satelite's operational orientation. It includes gravity-gradient stabilisation, spin stabilisation, and three-axis stabilisation.
	Orbit control system		Maintains or alters the satelite's operational orbit.
	Telemetry, tracking, and command (TT&C) system		Telemetry section:Measures and transmits engineering parameters and other data from various satelite instruments to the ground. It is composed of sensors, modulators, and transmitters. Command section:Receives remote command instructions from the TT&C station on the ground and transmits them to relevant systems for execution. It is composed of receivers and decoders. Tracking section:Receives remote command instructions from the ground TT&C station.Composed of beacon and transponders.
Satelite payload	Inter-satlite communication	Inter-satelite microwave communication	Inter-satelite microwave link technology is relatively mature, with high reliability, broader beamwidth, and easier tracking and acquisition. It is unaffected by rain or atmospheric attenuation. It can utilise microwave frequency bands such as Ka, QK, or even terahertz bands. However, its data transmission rate is relatively low, and the anti-interference capability o its beam is moderate.
		Inter-satellite laser communication	With increasing demand for data transmission in satelite communications, modern satelite communication requires not only accuracy, but also massive data volume, real-time performance, and long transmission distances, which demand higher transmission rates. Inter-satellite laser communication adopts laser frequencies that are 3-4 orders of magnitude higher than microwave frequencies. Higher frequency implies greater variation over the same time, enabling higher "data load capacity". Inter-satellite laser communication does not require frequency licensing, which means it can bypass "regulated airspace"and gain broader operational flexibility.
	Satelite-to-ground communication	User link payload	A user link is the communication channel between the satelite and ground terminal equipment (e.g. mobile phones, portable stations, vehicle-mounted terminals), responsible for bidirectional transmission of user data(e.g. voice, text, internet traffic). Its transmission characteristics are affected by atmospheric conditions and free-space path loss, requiring signal stability and low latency. Due to significant atmospheric interference affecting satellite-to-ground laser communication, microwave communication remains the primary method.
		Feeder link payload	A feeder link is the communication channel between the satellite and ground gateway stations, and it is responsible for forwarding user data to the ground core network and transmitting satellite control commands. Due to significant atmospheric interference affecting satellite-to-ground laser communication, microwave communication remains the primary method.
		Multi-beam antenna	Multi-beam antennas offer advantages such as high communication capacity, simple ground receiving equipment, and high system flexibility. In recent years, satellite mobile communication systems have widely adopted multi-beam antenna technology to achieve higher-gain regional coverage and meet growing demand for channel capacity and multi-target regional communication, while resolving the contradiction between expanding communication coverage and maintaining high-gain radiation. Based on antenna type, they can be classified as reflector antenna, lens antenna, and direct radiating array(DRA) antenna. Due to volume and weight constraints, lens antennas are rarely used in communication satelites.
	On-board processing and switching	Transparent payload / transparent transponder/bent-pipe transponder	Performs only low-noise amplification, frequency conversion, and power amplification on received signals, simply relaying them without processing signal content. Transparent transponders are "transparent"to any signal within their operating bandwidth. Due to their flexibility in beam coverage, beam bandwidth, beam power, and uplink/downlink connectivity, they are widely used in satellite mobile communication and broadband satellite communication. Before technologies matured-such as on-board routing and switching, on-board network control, and inter-satelite link transmission-traditional satellite communications predominantly adopted transparent forwarding.
		Regenerative payload / regenerative transponder	In addition to signal relaying, it includes signal processing functions. Built on the transparent transponder, it is also equipped with on-board demodulation, baseband processing, and remodulation functions, with some also incorporating on-board switching capabilities. With increasing on-board processing demands and continuous improvements in the performance of payload processing component, functions such as modulation/demodulation, encoding/decoding, and frequency conversion/filtering are now completed via digital signal processing. This consolidates multiple analogue component functions into a single processing platform, significantly reducing hardware scale and on-board energy consumption. Furthermore, the programmable and reconfigurable nature of digital components enables on-orbit changes to multiple waveforms, systems, and protocols, significantly enhancing its processing flexibility and overall satllite network performance and efficiency.

Source:Helio Space,HSBC Qianhai Securities

Exhibit 49.Descriptions of key systems in ground segment,launching services,and applications

			Functions and characteristics
Ground system	Ground TT&C system	Tracking and measurement system	Acquires orbital parameters and physical characteristic parameters and captures and records images of the targets flight status (including attitude). It includes optical measurement systems and radio measurement systems.
		Telemetry system	Receives and demodulates telemetry signals transmitted from the target to obtain operational status parameters and environmental data. It includes satellite data acquisition equipment, encoders, modulators, transmitters, and ground-based receiving, demodulating, recording, and display equipment.
		Command system	Controls satlite orbit, attitude, and the operational status of onboard instruments and equipment, and injects data into the target's computer. It includes ground-based command generators, encoders, modulators, transmitters, transmitting antennas, and onboard command receivers and decoders.
		Real-time computer processing system	Processes information acquired by the measurement system in real time, provides display data to the command-and-control centre, and supplies guidance information to TT&C equipment. It comprises central computers, TT&C station computers, microcomputers, and corresponding software and peripheral devices.
		Display and recording system	Enables personnel to monitor satelite launches and real-time flight conditions for command-and-control purposes. Includes monitoring display stations, large screens, television monitors, and various recording equipment.
		Time synchronization system	Provides a unified time and frequency reference to various TT&C equipment. It comprises timing receivers, standard frequency sources, and time code generators.
		Communication system	Connects command centres at all levels and TT&C sites to transmit various information including data, voice, and image. Includes source terminals, user terminals, data transmission equipment, communication lines, and switching equipment.
		Post-flight data processing system	Precisely processes orbital and telemetry data, providing processed data reports to various R&D departments. This system includes computers, interpretation equipment, tape/disk recording and playback equipment, printing and display equipment, spectrum analysis equipment, data storage equipment, and corresponding software.
Launching services	Rocket manufacturing	Aerospace materials	Materials used for rocket manufacturing must possess characteristics such as lightweight, high strength, and high-temperature resistance. Rocket body structures commonly use aerospace-grade aluminium alloys and titanium alloys. fairings often adopt carbon fibre composites and polyester films. engines and heat shields usually employ Inconel, ceramics, and phenolic resins. Propellants are primarily liquid or solid chemicals.
		Electronic components	Rocket navigation, propulsion, communication, and power management systems require highly reliable aerospace-grade electronic components capable of withstanding severe vibrations during launch, extreme temperatures, and the harsh space environment. Examples include SoC chips, DSPs and FPGAs used in onboard computers, aerospace-grade multilayer ceramic capacitors (MLCCs), high-frequency connectors, and special relays.
		Rocket body structure	The supporting structure assembly that bears various loads on the rocket. It integrates the payload, electrical systems, and propulsion systems into a streamlined whole. Taking liquid-propellant launch vehicles as an example, the structure mainly consists of the fairing, instrument compartment, propellant tanks, thrust structure, and aft section.
		Propulsion system	Generates high-speed jets by combusting propellants, producing thrust via Newton's third Law(action and reaction). It typically comprises the main propulsion system(generating massive lift-off thrust), pressurisation and feed system(supplying fuel), and auxiliary propulsion system (for attitude adjustment and final velocity correction).
		Control system	Primarily consists of guidance and navigation systems, attitude control systems, and timing and power distribution systems. Through onboard computers and sensors (e. g. gyroscopes), it calculates the flight trajectory in real time and sends commands to engine servo mechanisms to adjust thrust direction, ensuring stable rocket flight and accurate orbital insertion.
	Launch services	Launch site	A rocket launch site (or spaceport) is a dedicated facility for assembling, testing, and launching carrier rockets into space. To leverage Earth's rotational speed and reduce fuel consumption, most launch sites are located in low-latitude regions or oriented for eastward launches.
		Launch service	Refers to the service of delivering various artificial satelites, payloads, or spacecraft into their designated orbits. A complete launch service process includes not only rocket transportation but also integrated technical support such as satelite-rocket matching, launch site coordination, TT&C, and insurance.
Applications	Satellite communication		Satelite communication is a wireless communication method that uses artificial Earth satelites as relay stations to forward radio waves, thereby enabling communication between multiple Earth stations. It can provide multimedia access including voice, video, data, and internet connectivity, offering advantages such as flexible networking, reliable links, wide signal coverage, and no geographical restrictions. It is widely used in sectors such as public security, emergency response, television media, maritime, and energy. In recent years, with advancements in aerospace and satelite technologies, satelite communication services targeting individual consumers have also expanded.
	Positioning, navigation, and timing (PNT)		Positioning refers to calculating and determining the absolute geographical location (longitude, atitude, altitude) of a person or object through a specific coordinate reference system. Navigation refers to determining the current position and desired destination, and continuously providing direction, heading, speed, and path guidance to steer a vehicle from one point to another. Timing refers to acquiring, maintaining, and distributing a precise time reference synchronised with Coordinated Universal Time (UTC), providing a unified time stamp for various systems.
	Earth observation		Earth observation (or remote sensing of Earth) is a scientific and technological discipline that utilises remote sensing sensors mounted on satelites, aircraft, or other platforms to detect, monitor, and collect information about the physical, chemical, and biological systems of Earth's surface, atmosphere, and oceans from space. By acquiring multi-spectral and multi-temporal imagery and data, it is widely applied in resource surveys, environmental monitoring, urban planning, disaster prevention and mitigation, and climate change research.

Source: Helio Space, HSBC Qianhai Securities