CHAPTER 1 INTRODUCTION

The development of Long March (LM) launch vehicle family can be traced back to the 1960s. Up to now, the Long March family of launch vehicles has included the LM-2C Series, the LM-2D, the LM-4 Series, the LM-3A Series and the LM-2F launch vehicles for LEO, SSO and GTO missions. With the further expanded launch capability developed over the last few years, the Long March launch vehicle family has successfully launched a series of manned spacecraft.

The LM launch vehicle family is shown in Figure 1-1.

Figure 1-1 Long March Family of Launch Vehicles

The LM-1, LM-2, LM-2E, LM-2E/EPKM and LM-3 are no longer in service. Currently, the LM-3A Series launch vehicles, including LM-3A, LM-3B, LM-3BE and LM-3C, are the workhorse launch vehicles for China's GTO launch missions.

The main characteristics of Long March launch vehicle family in service are shown in Table 1-1.

Table 1-1 The Main Characteristics of Long March Family

Items	LM-2C	LM-2C/ CTS1	LM-2C/ CTS2	LM-2D	LM-4B/ LM-4C	LM-2F	LM-3A	LM-3B	LM-3BE	LM-3C
Height (m)	43.0	43.0	43.0	41.0	48.0	58.3/ 52.0	52.5	54.8	56.3	54.8
Lift-off Mass (t)	245	245	245	250	250	497.9	241	425.8	456	345
Lift-off Thrust (kN)	2,962	2,962	2,962	2,962	2,962	5,923	2,962	5,923	5,923	4,443
Fairing Diameter (m)	3.35	3.35	3.35	3.35/3.80	2.90/3.35/ 3.80	3.80/ 4.20	3.35	4.00	4.00/4.20	4.00
Stage-1 Propellant	N_2O_4 / UDMH									
Stage-2 Propellant	N_2O_4 / UDMH									
Stage-3 Propellant	N/A	Solid propellant	Solid propellant	N/A	N_2O_4 / UDMH	N/A	LOX / LH_2			
Main Mission	LEO/SSO	SSO	GTO	LEO/ SSO	SSO	LEO	GTO			
Launch Capability (kg)	3,850/ 900	2,100	1,250	4,000/ 1,150	2,230/ 2,950	8,080/ 8,600	2,600	5,100	5,500	3,800
Launch Site	JSLC/ TSLC/ XSLC	JSLC/ TSLC/ XSLC	JSLC/ TSLC/ XSLC	JSLC/ TSLC	JSLC/ TSLC	JSLC	XSLC			

1.1 Long March Family of Launch Vehicles - Development History

The development of the Long March (LM) launch vehicles began in the mid-1960s and has resulted in the establishment of a family of launch vehicles suitable for a full range of missions and payloads. The LM launch vehicles have a long list of successful launches and this record is attributed to the fact that the launch vehicle development has been based on mature and proven technologies, which includes using the same product at subsystem level, wherever possible among the members of the LM family. This has resulted in an improved reliability and a high launch success rate as demonstrated by the whole LM launch vehicle family. The members of LM family that have been used for international commercial launch services include LM-2C and its enhanced version LM-2C/CTS1, the LM-2E, the LM-2E/EPKM, the LM-3, the LM-3B and the LM-3BE.

Figure 1-2 Long March Flights

The LM-1 performed its first flight successfully in April 1970, sending the first Chinese satellite into a low earth orbit. After the second flight in 1971, the LM-1 was phased out.

The LM-2 is a two-stage launch vehicle developed based on LM-1. Its upgraded version, the LM-2C successfully made its first flight in November 1975. The enhanced versions of the LM-2C are designated as the LM-2C/CTS1 and LM-2C/CTS2, which are three-stage launch vehicles capable of delivering heavier payloads into the orbits that require greater launch capability. The LM-2C, LM-2C/CTS1 and LM-2C/CTS2 have a record of 32 consecutive successful flights from the maiden flight in 1975 as of the end of 2010.

The LM-2E and LM-2E/EPKM use the LM-2C as their core stage, around which there are four strap-on boosters. The LM-2E and LM-2E/EPKM has been phased out since the end of 1995.

The LM-3 is a three-stage launch vehicle, of which the first and second stages were derived

from the LM-2C. The third stage has a cryogenic engine, using LOX and LH_2 as the propellants, which gives the third stage engine a re-start capability, thus providing greater flexibility in the mission. The first flight of the LM-3 was in January 1984, and in the middle of 2000 after 13 flights, the LM-3 launch vehicle has been phased out.

The LM-3A launch vehicle is also a three-stage launch vehicle based on the mature technologies of the LM-3. A newly designed third stage, which also uses LOX and LH_2 as propellants, was used by the LM-3A. The LM-3A third stage can also perform attitude adjustment maneuvers to orient the payloads and to provide adjustable spin-up operations. The first LM-3A launch took place in February 1994 and as of the end of 2010 had flown 19 times, all of which were successful.

The LM-3B employs the LM-3A vehicle configuration as the core stage plus four strap-on boosters on the first stage. The first LM-3B launch was conducted in February 1996, and it has been launched 10 times as of the end of 2010. Besides the failure of the maiden flight and the anomaly that occurred in the Palapa-D mission in 2009, all other LM-3B flights were successful. (In Palapa-D mission, the satellite was sent into a GTO with an apogee altitude lower than specified due to an anomaly on the third stage engine and as a result the expected satellite in orbit life was reduced from 15 years to approximately 11 years).

The LM-3BE was developed based on LM-3B with a lengthened first core stage and strap-on boosters. The launch capability was improved for LM-3BE and the first flight took place in May 2007. As of the end of 2010, the LM-3BE had made three successful fights.

The LM-3C is a simplified version of LM-3B with only two strap-on boosters on the first stage. The first LM-3C launch was conducted in April 2008 and there have been six LM-3C launches as of the end of 2010, all successful.

The LM-2D and LM-4 Series launch vehicles are both developed and manufactured by Shanghai Academy of Spaceflight Technology (SAST). As of the end of 2010, all the 14 LM-2D flights and 22 LM-4 Series flights are successful.

Please refer to summary Table 1-3 on page 1-10.

1.2 Long March Launch Services

1.2.1 Overview

CGWIC, a wholly-owned subsidiary of CASC, was established in 1980. CGWIC is the sole

commercial organization authorized by the Chinese government to provide commercial launch services to international customers. Over the past decades, CGWIC has provided the international launch services with support from CALT and CLTC. The relationship among these organizations is illustrated in Figure 1-3. To implement the launch services for the customer, CGWIC organizes and coordinates the joint team comprising CALT and CLTC for the execution of the launch service contract. Table 1-2 summarizes the main responsibilities of these organizations.

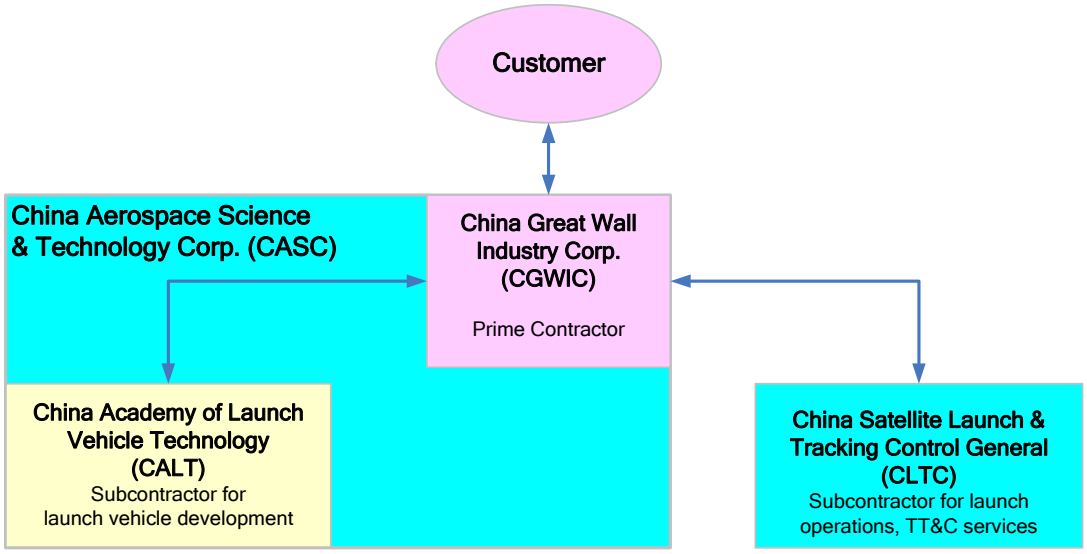

Figure 1-3 The Organization of Long March Launch Services

Table 1-2 Responsibilities of the Launch Services Related Organizations

Subcontractor	Prime Contractor	Subcontractor
CLTC	**CGWIC**	**CALT**
◆ Launch Site Technical Interface Coordination ◆ Launch Campaign Planning & Organization ◆ Launch Site Operations ◆ TT&C ◆ Launch Site & Launch Safety ◆ Flight Safety Engineering	◆ Marketing and Sales of Long March launch services ◆ Program management ◆ Interaction with customers ◆ Insurance and financing services on case by case basis	◆ Launch vehicle - Design, - Development, - Manufacture, and - Testing ◆ Mission Analyses ◆ LV Technical Interface Coordination ◆ LV Quality Control

CALT is one of the main subsidiaries of CASC, and is the leading company engaged in the development and production of launch vehicles. CALT is located in Beijing and has a total staff of 25,000, which includes 8,000 engineers and 1,800 senior engineers and scientists. The LM-1, LM-2, LM-2C Series, LM-3A Series and LM-2F are all designed and

manufactured by CALT.

Figure 1-4 Long March LV Assembly and Test Workshop

CLTC is the organization that performs the launch operations and provides the launch facilities including the telemetry and tracking ground station network for the launch. CLTC manages three independent satellite launch centers, a global TT&C network that includes tracking ships, and two research institutes. CLTC has a team of 5,000 technical staff to support the launch and tracking operations.

1.2.2 Customer Interfaces

CGWIC is the single point of contact with the customer. When a launch services contract is signed, CGWIC nominates a Program Manager who is responsible for implementing the launch services contract.

1.3 Overview of the Launch Centers

There are three launch centers in China, i.e. Xichang Satellite Launch Center (XSLC), Jiuquan Satellite Launch Center (JSLC) and Taiyuan Satellite Launch Center (TSLC). Figure 1-5 shows their locations. Wenchang Spacecraft Launch Center (WSLC) in Hainan Province is under construction.

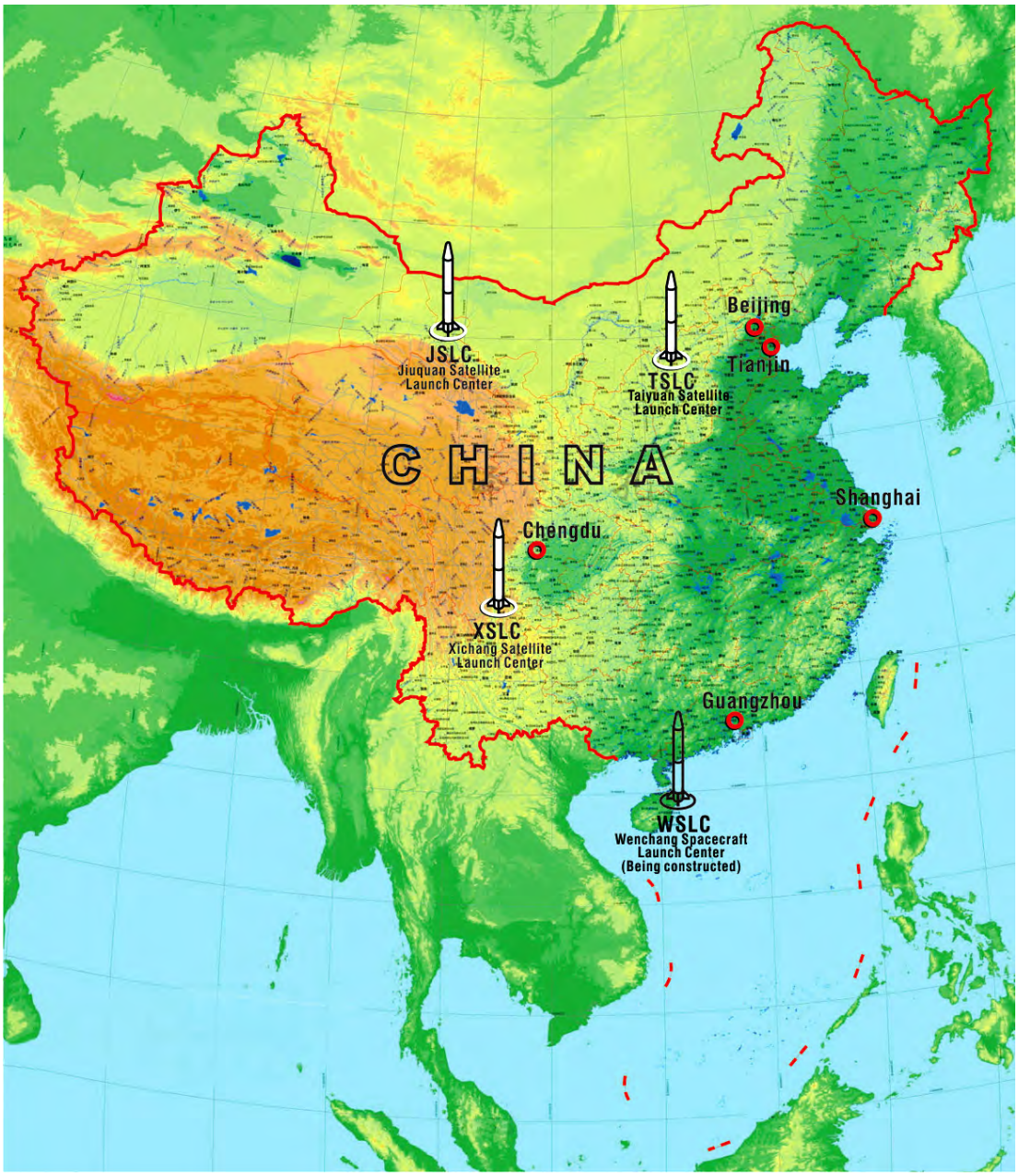

Figure 1-5 Satellite Launch Centers

1.3.1 Xichang Satellite Launch Center (XSLC)

XSLC is located in Sichuan Province, southwestern China, and is primarily used for GTO missions. The launch center comprises processing buildings for the pre-launch preparation of the launch vehicles, satellites and solid motors as well as the ground support equipment. XSLC has two launch complexes (LC), one of which (LC-3) is primarily used for LM-3A launch operations and the other one (LC-2) is for LM-3B, LM-3BE and LM-3C launch operations.

Figure 1-6 Xichang Satellite Launch Center

1.3.2 Taiyuan Satellite Launch Center (TSLC)

TSLC is located in Shanxi Province, northern China, and is primarily used for LEO missions utilizing the LM-2C Series and SSO missions utilizing the LM-4 Series.

Figure 1-7 Taiyuan Satellite Launch Center

1.3.3 Jiuquan Satellite Launch Center (JSLC)

JSLC is located in Gansu Province, northwestern China. It is the first launch site in China. It is mainly used for LEO launch missions and MEO launch missions using the LM-2C Series, LM-2D and LM-4 Series launch vehicles. It is also used for China's manned space missions with the LM-2F launch vehicles.

Figure 1-8 Jiuquan Satellite Launch Center

1.4 Launch Record of Long March

The Long March series of launch vehicles has been undergoing continuous development in China since the mid-1960s. Different launch vehicles with various capabilities have been developed, which has enabled China's launch business to enter into both domestic and international markets and to accomplish different LEO, GTO and SSO satellite launch missions.

The Long March launch vehicle spectrum and their track record are summarized in Table 1-3 below:

Table 1-3 Flight Record of Long March (As of January 1, 2011)

	Launch Vehicle	Success/ Flight	Total Success/ Total Flight	Status
LEO & SSO Missions	LM-1	02/02	07/10	Out of Service
	LM-2	00/01		
	LM-2E	03/05		
	LM-4A	02/02		
	LM-2C & LM-2C/CTS	32/32	73/73	In Service
	LM-2D	14/14		
	LM-4B & LM-4C	20/20		
	LM-2F	07/07		
GTO Missions	LM-2E/EPKM	02/02	12/15	Out of Service
	LM-3	10/13		
	LM-3A	19/19	36/38	In Service
	LM-3B	11/13		
	LM-3C	06/06		
Total			128/136	

1.5 Long March Launch Services Advantages

The selection of the Long March launch services provides the customer with some key advantages:

a) Long March launch vehicles are flight proven, highly reliable and compatible with all major satellite platforms.

b) The system, sub-systems and major equipment production of the Long March family is wholly controlled within CASC group, which facilitates the launch vehicle hardware and software development process.

c) The Long March launch is conducted on a dedicated basis with no risk of launch delay by co-passengers and scheduling flexibility can be arranged to the customer's benefit.

d) As it is a dedicated launch, any residual margin in the launch capability can be used to optimize the injection parameters in order to extend the satellite's in-orbit life. This is without any additional cost to the customer. If the additional margin in launch vehicle

capability is identified early in the launch services program, it could provide the customer with greater flexibility in the satellite design.

e) The state-of-the-art ground support facilities are purpose built, and the satellite processing facility at the launch site is handed over to the customer for the duration of the launch campaign.

f) The security of the customer's satellite technology is regarded as paramount and all necessary security measures are implemented and reviewed with the customer. The security measures include an exemption for the customer's satellite from the Chinese customs inspection and the full control of access to the satellite processing facility by the customer throughout the launch campaign.

g) CGWIC procures the launch vehicles in bulk which allows the lead time to meet the customers launch schedule requirements. The launch vehicle is subject to comprehensive tests and checkouts at the launch vehicle manufacturing facility before shipment to the launch site, which allows the launch vehicle processing at the launch site to be streamlined for completion in approximately 24 days. This provides additional schedule flexibility for the launch vehicle up to combined operations. In addition, the use of two launch complexes and two satellite processing facilities makes it possible for two launch campaigns to be conducted in parallel, which further increases the schedule flexibility of Long March launch services.

h) CGWIC has full support from the Chinese government for the provision of launch services to international customers, and there are no obstacles for CGWIC in obtaining the Chinese government's approval to perform the launch services for an international customer.

i) A fully equipped modern hotel is located at the launch site providing comfortable living conditions and easy access to the processing facilities.

j) CGWIC demonstrated its abilities and proved its competence in over 20 years of space-related activities and has a dynamic and experienced engineering and management team.