Report

Iran's Space Program: Timeline and Technology

29 Apr. 2020

RASANAH
المعهد الدولي للدراسات الإيرانية
International Institute for Iranian Studies

RASANAH
المعهد الدولي للدراسات الإيرانية
International Institute for Iranian Studies

Contents

Iran successfully launched its first dual purpose military-non-military *Noor* satellite into orbit on April 22, 2020. Produced domestically, the satellite was launched by a new Space Launch Vehicle (SLV), the *Qased*. The launch publicly disclosed military aspects of Iran's space program that were previously denied.

Noor has increased international concerns over Iran's hidden Inter-Continental Ballistic Missile Program (ICBM). Iran's latest satellite technological and military advancement is a far cry from its early commitment to United Nations treaties and principles promoting the peaceful use of space. Iran is a founding member of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) launched in December 1958.

The following sections review the timeline and technology of Iran's space program, to show that it had a military component that evolved over time.

I- Iran's Space and Satellite Program's Timeline

Set up over a decade ago, Iran's satellite and inter-continental missile technology was launched by the Islamic Revolutionary Guard Corps (IRGC)-affiliated Self-Sufficiency Jihad Organization (SSJO). The components of the program were laid out as early as 2004, when Iran established a Supreme Space Council chaired by its sitting president, and monitored by the Iranian Ministry of Communication and Informational Technology.[1]

In the early stages of Iran's space program, communication satellites were developed jointly at lower cost with foreign space agencies. The aim was to study and monitor natural disasters, human crises, and public health pandemics, and expand the use of internet, television and radio broadcast systems.

In 2005, the Kosmos-3M booster rocket launched *Sina-1*, and the *Zohreh* communication satellite, through a joint Iranian-Russian project. Three years later, Iran, China and Thailand jointly launched

(1) Brian Harvey, Henk Smid and Theo Pirard, Emerging Space Powers: The New Space Programs of Asia, the Middle East, and South America (Chichester: Praxis Publishing 2010), 264-268 & 286; Parviz Tarikhi, "Iran's space program: Riding High for Peace and Pride," Space Policy International Journal (Elsevier) 25, no. 3, (August 2009): 160-173, DOI: 10.1016/j.spacepol.2009.05.010).

on a Chinese Long March 2C carrier the Environment 1 satellite to boost natural disaster cooperation.

For the next seven years, Iran gradually developed the research components of its space program. In 2007, the Iran Space Agency (ISA) tested the *Safir-e-Omid* SLV satellite launcher for its short-range ballistic missile *Shahab*, designed jointly by the SSJO and IRGC Missile Forces. Reports indicated that the design of the launcher began a decade earlier in 1997.

In 2009-2013, Iran launched a series of data processing and telecommunications satellites to space including the *Omid, Rasad-1* and *Fajr*. Its first domestically built satellite *Omid* was launched into orbit in 2009. It also initiated the design of several other unlaunched satellites, some of which became operational later. These satellites include *Saar*, *Rasad*, *Nahid, Nasir 1, Zafar 1, Mesbah, Mesbah 2, Qaem Pars Sepehr, Pars-2, ZS4, Sina-2,* and *SM2S*. Iran implemented 10 satellite projects with the Asia-Pacific Space Cooperation Organization (APSCO), and in collaboration with a number of the Organization of Islamic Cooperation (OIC) member states designed *Besharat*.

In 2010 during the presidency of the hardline Mahmoud Ahmadinejad who actively supported the space program, Iran set up a new aerospace force, and Amir Ali Hajizadeh, the commander of the IRGC missile program, has since commanded the force. Early on, the aerospace force said it would design three-stage rockets to carry satellites 1,000 km into space. The *Simorgh* SLV was unveiled the same year to carry heavier satellites into orbit. The aerospace force later unveiled three heavier satellites, *Toloo, Mesbah* 2 and *Navid Elm Sannat* or *Ya Mahdi*, and a bio capsule *Kavoshgar* 3 rocket. In 2012, the IRGC announced plans to launch new satellites to Geostationary Equatorial Orbits (GEO) by solid-fueled rocket, which has a better military function, and upgraded the first version of *Safir-2 (Simorgh)* to place satellites at 36,000 km GEO.

During the presidency of Hassan Rouhani, Iran's space program was briefly suspended as the country led sensitive nuclear talks with world powers in 2014-2015. Earlier in February 2013, the Iranian Space Agency said a new SLV, *Qoqnoos* will be used for heavier payloads.

In 2015, Iran tested the *Safir-2* (*Simorgh)* at low Earth orbit (LEO)

elevation. In the next two years, Iran improved the design to produce the *Simorgh A-1* missile. But under pressure by local authorities, it unsuccessfully used the improved design to launch the small *Amir Kabir* satellite system, without previous testing, from the Imam Khomeini Semnan Space Station. *Amir Kabir* was initially designed for launch by foreign satellites, through negotiations with Russia, China, India, and the European Space Agency, but international sanctions against Iran's missile program and technical problems forced Iran to use *Simorgh* to launch *Amir Kabir*.

Simultaneously, Iran unveiled the *Payam* satellite, which took 2-2.5 years to reach orbit. Its development involved design work by four space engineering university departments, a university electrical department, a university computer science department, and a mechanical engineering department, under the supervision of 16 Amir Kabir university professors.

On the 40th anniversary of its Islamic Revolution in 2019, Iran unveiled its remote-sensing Dousti (Friendship) microsatellite to conduct agricultural and geological studies. It may have been launched by the Safir SLV according to intelligence reports and failed to reach LEO. The Safir rocket was designed to place the microsatellite in space and it was launched from the Semnan station. However, it fell out of orbit and its mission collapsed.

Immediately after, Iran used *Safir 1-B* to successfully launch the *Fajr* satellite. Although *Safir* delivers satellite into orbit, its technology is transferrable to Iran's ballistic missile program given that it is a two-stage variant of the Iranian mid-range missile *Shahab-3*.

In February 2020, Iran failed to launch the missile carrying the *Zafar 1* satellite to survey oil reserves, mines, forests and natural disasters. *Zafar* 2 will be launched within months. The *Noor* military satellite is considered an advanced model, developed by the IRGC and Iranian scientific companies. On April 22, 2020, Iran successfully launched Noor into a 426 * 444 km / 59.8 orbit.

II- Satellite and SLV Technology in Iran

Iran's main space centers are the Imam Khomeini Spaceport in Semnan, severely damaged due to failed testing of unnamed satellites

in 2012 and 2013, and the Space Agency in Shahrud. It also has other multiple satellite launch facilities in Tehran Province, Alborz Province and the Qeshm Island in the Strait of Hormuz. Iran has managed to build other complex satellite launch facilities in Qom, and the Delijan and Markazi Province. Since 1990, Iran has aimed to send a human to space with help from Russia and possibly China by 2021-2025.

Iran's early satellite technology was for low orbit. *Tolou* was designed for low-earth orbit at 500 km, and charged by solar cells and secondary batteries. *Mesbah 2* is a telecommunication satellite, and *Ya Mahdi* is aimed to send photos to earth. *Simorgh* satellite carrier can carry up to 100 kg of weight and reach 500 km from earth, and its engine can load 700 kg and reach 1000 km into space.

The IRGC solid fuel rockets, with more advanced designs for dual purpose military functions, have since evolved to send 100 kg into GEO at 35,786 km above the equator.

The *Fajr* has a GPS system, with a life span of 1.5 years, operated through a cold gas thruster and solar cells, and entered into orbit in 2015.

The satellite carrier *Simorgh* rocket is 27 meters long, and has a mass of 87 tons. Powered by four engines, each with a thrust of 29,000 kg, it has a fifth engine for altitude control of 13,600 kg. In 2015, Israeli media said it could carry a manned space craft.

Amir Kabir is a small satellite, with a mass of 52 kg, and carries one camera.

The *Nahid*'s imaging satellite was Iran's first folding solar panel satellite, and had a perigee of 250 km, and an apogee of 370 km.

Iran subsequently launched *Payam* and Friendship. Friendship was to reach 250-310 km, with an orbit angle of 55, to orbit the earth for 2-2.5 years.

The *Safir SLV* measures 22 meters in length with a diameter of 1.25 meters, and has two liquid propellant stages, a single thrust chambered first stage, and a two-thrust chambered, step-throttled second stage. With a payload of 50 kg, the first stage carries an updated *Shahab-3C* missile, a medium range liquid filled rocket. *Safir -1B* carries a weight of 60 kg into elliptical orbit of 300-450 km, while its thrust is 32-37 tons. It is believed that Iran developed the *Safir* indigenously through

a propulsion system to place satellites into LEO.

Safir-1 Islamic Republic of Iran Launch Vehicle (IRILV) has parts similar to the *Shahab-3* missile, but is assembled as a two-part rocket, composed of a stretched *Ghadr-II* (similar to Nodong) as first stage and a shorter second stage of equal diameter. More specifically, it appears like a compact design of the Teap'o-dong-1 North Korean space booster based on Scud technologies. The second stage is liquid-propellant and has two engines similar to the small Russian vernier (R-27) with nozzle extension. The Safir IRILV is 23 meters in length with a diameter of 1.35 meters. The IRILV weighs 26 tons. It uses liquid fuel, which makes it of low value as a military purpose satellite, and reaches orbits of 280 km, good for launching the *Omid* satellite.

Safir-1B has greater propulsion power (with tested cold gas propulsion subsystem for orbit transferring) and lifts double payload of *Safir-1,* but both *Safir* models carry smaller fins and the N204 Oxidizer. *Safir-1B* sends small satellites more than 60 kg to 350-450 km into orbit, and was used to launch at a reduced weight of 50 kg the *Navid* imagery satellite. It has a class booster using Scud C and *Qiam-1* propellants, and the nozzle has AK-plume similar to *Shahab-3*. It was made in cooperation with North Korea, but designed and built by affiliated IRGC air and space organizations including the Bagheri Industries.

Safir 2, named also the Simorgh-1A, is a small satellite launcher potentially linked to the *Shahab-5* ballistic missile technology and based on the model North Korean Unha launch vehicle, with a lift mass of 100-250 kg, and carries heavier motor models built in 2010-2011. It has transitioned from the Scud-B propellant in earlier *Safir* models, demonstrating Iran's ability to use Scud-C and *Qiam-1* together. Its earlier motor models were built a decade ago, and named *Sepehr* or *Safir,* with a small satellite launch capacity but at larger weights at altitudes of 1000 km into space. *Safir* led to *Simorgh*'s advanced model, launched in 2016, as a two-stage vehicle. Its first stage of 2.5 meters in diameter was built in North Korea with four *Safir-1* engines. The main engines are fixed, and steering is by four vernier engines. The liquid fueled second stage four-engine part is an enlarged *Safir-1* model, and there could be a third stage small solid fuel component. It was

built in Iran during the presidency of Mahmoud Ahmadinejad, with a 25-meter launcher weighing 87 tons. The first *Simorgh* launched a year earlier was shorter. *Safir 2* launch took place in March 2016 on a suborbital trajectory, with a first failed orbit attempt launch in July 2017.

The *Noor* satellite launch into orbit inclined 59.8 degrees to the equator showed the *Qased* rocket lifting off from a mobile transporter, erector and launch vehicle at the Shahrud space site. Its first stage could be liquid-fueled, and western intelligence believes it could have a solid-fueled upper stage. The launch pointed to Iran's secret military space program and was condemned by the United States. *Noor* has reconnaissance and strategic military goals, but it will also assist Iran in civilian and humanitarian fields. According to the IRGC-affiliated *Tasnim* News Agency, there are plans to launch another satellite into higher orbit. The engine of *Noor,* a three-staged carrier dubbed *Qased* and developed by the Defense Ministry, is similar to ground-to-ground missiles. Iran says *Noor* carries only liquid fuel, but the next launch to take place soon will be solid fuel. *Noor* was launched in Dasht-e Kavir, Iran's large central desert.

Conclusion

Iran has promised to continue its military satellite launches, as part of its higher orbit mega-projects, including Noor 2. This is despite a United Nations ban on Iran testing ballistic missile capabilities. More specifically, through satellites, Iran can enhance its knowledge of the use of inter-continental ballistic missiles that can endanger countries in Europe and the United States.

Iran has never quite hidden its space ambitions, and its active collaboration with North Korea should have raised flags that the Iranian space program will have military components. But characteristically, the United States did not identify the Iranian space program's threat early enough and was unable to halt it.

info@rasanahiiis.com

@rasanahiiis

www.rasanah-iiis.org