



*Associate Administrator for
Commercial Space Transportation (AST)*

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Commercial Space Transportation: 2001 Year In Review



Cover photo credits (clockwise from upper left):

DigitalGlobe (2001): Image is of the QuickBird satellite launched on October 18, 2001 from Vandenberg Air Force Base aboard a Delta 2 (7320).

International Launch Services (2001): Image is of the Atlas 2AS launch on June 19, 2001, Cape Canaveral Air Force Station that lofted ICO F-1 into orbit.

Boeing Launch Services (2001): Image is of the Delta 2 (7320) that launched DigitalGlobe's QuickBird satellite from VAFB.

Sea Launch Company (2001). Image is of the Zenit 3SL launch on May 8, 2001 sending XM Roll into geosynchronous orbit for XM Satellite Radio, Inc.

INTRODUCTION

The Federal Aviation Administration (FAA) licensed six commercial launches in 2001. This total represents three orbital launches from U.S. ranges for commercial and government customers, two orbital launches by the multinational Sea Launch Company and one suborbital launch from Australia.

Overall, 16 commercial orbital launches occurred worldwide in 2001. This number is significantly less than in prior years (35 in 2000 and 39 in 1999). Arianespace captured half of the world market during 2001, the U.S. and Russia each had 19 percent, and the Sea Launch Company had 12 percent. The number of FAA-licensed launches has declined since 1997-1999 when several mobile communications services satellites were orbited. In 2000, there were 10 FAA-licensed launches.

Of the five FAA-licensed launches in 2001, three were on U.S. built vehicles: a Delta 2, Atlas 2AS and a Taurus. The Boeing Delta 2 (7320) carried DigitalGlobe's QuickBird commercial remote sensing satellite, which now occupies the orbit once reserved for QuickBird 1, lost during a Russian launch failure in 2000. Lockheed Martin Corporation's International Launch Services (ILS) successfully flew the Atlas 2AS, this time carrying aloft ICO F-1, a commercial medium

Earth orbit (MEO) communications satellite operated by ICO Global Communications. A Taurus launch vehicle was selected to deploy OrbView 4, developed by Orbital Sciences Corporation (OSC), NASA's QuikTOMS, and Celestis 4. Unfortunately, the launch vehicle experienced a first stage anomaly and the satellites failed to reach orbit.

Sea Launch launched XM Rock and XM Roll for U.S.-based XM Satellite Radio, Inc., on March 18 and May 8, respectively. XM Satellite Radio provides over 100 digital radio stations for subscribers across the United States.

In addition to the orbital launches, the FAA issued one suborbital license in 2001 for the HyShot suborbital hypersonic test launch from the Woomera Protected Area, Australia. The launch was licensed because U.S.-based Astrotech Space Operations provided the Terrier-Orion sounding rocket for the HyShot flight test through a Memorandum of Agreement with the University of Queensland.

The Commercial Space Transportation: 2001 Year in Review summarizes U.S. and international orbital launch activities for calendar year 2001 and provides a historical look at the past five years of commercial launch activities.

ABOUT THE ASSOCIATE ADMINISTRATOR FOR COMMERCIAL SPACE TRANSPORTATION (AST)

The Federal Aviation Administration's Associate Administrator for Commercial Space Transportation (AST) licenses and regulates U.S. commercial space launch activity as authorized by Executive Order 12465, Commercial Expendable Launch Vehicle Activities, and the Commercial Space Launch Act of 1984, as amended. AST's mission is to license and regulate commercial launch and reentry operations to protect public health and safety, the safety of property, and the

national security and foreign policy interests of the United States. The Commercial Space Launch Act of 1984 and the 1996 National Space Policy also directs the Federal Aviation Administration to encourage, facilitate, and promote commercial launches.

Additional information concerning space transportation can be found on AST's web site at <http://ast.faa.gov>.

2001 FAA-LICENSED LAUNCH SUMMARY

Three of the five FAA-licensed commercial orbital launches for 2001 were conducted from U.S. ranges while the remaining two orbital launches were conducted from the Sea Launch Odyssey platform in the Pacific Ocean. All five orbital flights were for commercial customers, with one carrying a secondary government payload. The five FAA-licensed launches are listed in Table 1. Those launches represent a 50 percent decline from the 10 licensed launches in 2000.

The five FAA-licensed orbital launches included the following characteristics:

- All five launches, worth \$336.5 million in revenue, were conducted for commercial clients¹
- Of the five launches, two were conducted by Sea Launch for approximately \$170 million
- One launch included a secondary U.S. Government payload
- Two launches were to geosynchronous orbit (GEO), and three to non-geosynchronous orbit (NGSO)

The FAA also licensed one suborbital launch from Woomera, Australia in support of the HyShot hypersonic test flight series being conducted by the University of Queensland.

FAA-licensed orbital launches have decreased in frequency each year since a high of 22 in 1998 (see Figure 2). Fewer satellite customers have sought launch vehicles. Major reasons for this include: 1) financial impact on new satellite ventures after bankruptcies of high profile NGSO systems such as Iridium LLC, ORB-COMM, and ICO Global and slow customer growth from those companies that have emerged from bankruptcies, 2) competition from those companies that have emerged from bankruptcies, 3) less than expected growth in the overall satellite telecommunications market for new GEO and NGSO services, 4) weaker U.S. economic conditions for start-up companies and 5) competition from other non-satellite sectors for similar services. In addition, current U.S.-built vehicles are “undersized” to launch increased masses of many GEO satellites.

Table 1. 2001 FAA-Licensed Orbital Launch Events

| Date | Vehicle | Payload | Govt/Coml | Launch Outcome | Orbit |
|--------|--------------|------------|-----------|----------------|-------|
| Mar 18 | Zenit 3SL | XM Rock | Coml | Success | GEO |
| May 8 | Zenit 3SL | XM Roll | Coml | Success | GEO |
| Jun 19 | Atlas 2AS | ICO F-1 | Coml | Success | MEO |
| Sep 21 | Taurus | OrbView 4 | Coml | Failure | LEO |
| | | QuikTOMS | Govt | | LEO |
| | | Celestis 4 | Coml | | LEO |
| Oct 18 | Delta 2 7320 | QuickBird | Coml | Success | LEO |

Figure 1. Estimated Revenues for FAA-Licensed Orbital Launch Events

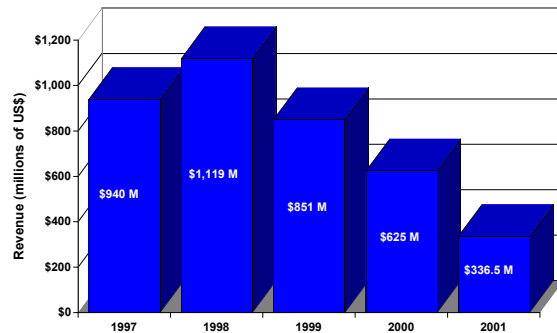
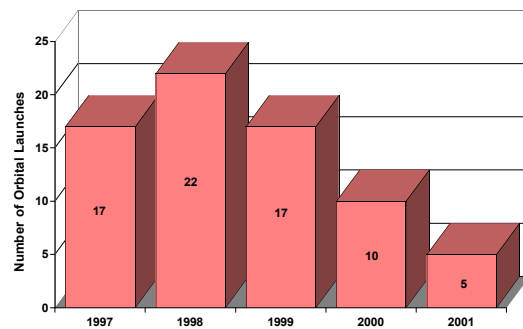


Figure 2. FAA-Licensed Orbital Launch Events



¹Revenues for both U.S. and foreign commercial launches are based on open source information and estimates by AST and are approximations only.

U.S. AND FAA-LICENSED LAUNCH ACTIVITY IN DETAIL

INTERNATIONAL LAUNCH SERVICES (ILS)

ILS, a joint U.S.-Russian partnership, successfully conducted four commercial launches in 2001, three of which used the Russian Proton vehicle. The remaining launch was one of the few remaining Atlas 2AS vehicles, launched from Cape Canaveral Air Force Station (CCAFS). This launch successfully placed ICO F-1 into MEO as part of a planned NGSO telecommunications constellation.

BOEING LAUNCH SERVICES (BLS)

Boeing established BLS in 2001 to market Delta launch vehicles and the Sea Launch Zenit 3SL. Boeing conducted a commercial launch in 2001 using a Delta 2 launch vehicle carrying the QuickBird commercial remote sensing satellite. QuickBird, operated by U.S.-based DigitalGlobe, was successfully placed into LEO on October 18. The satellite replaced QuickBird 1, which was lost when its Russian Cosmos launch vehicle failed in the winter of 2000.

Sea Launch successfully conducted two commercial launches, sending XM Satellite Radio's XM Rock and XM Roll into GEO. Both satellites, which are Boeing 702 models, were launched in the spring. The satellites are currently providing digital radio service to subscribers in the United States. Sea Launch is comprised of commercial partners from the U.S., Ukraine, Russia, and Norway.

ORBITAL SCIENCES CORPORATION (OSC)

OSC launched a Taurus from Vandenberg Air Force Base (VAFB), California. However, due to a first stage guidance problem early in flight, none of the three payloads (OrbView 4, QuikTOMS, and Celestis 4) reached orbit. Telemetry analysis indicates that the launch vehicle was unable to reach the required altitude due to a failed second stage thrust actuator, and the payloads reentered the atmosphere shortly after separation from the third stage.

Table 2. U.S. and FAA-Licensed Launch Vehicle Performance in 2001

| | USA | | | | | | Multinational (Sea Launch) |
|------------------------|-----------------------|---------------|----------------|----------------|-----------------|-----------------|--------------------------------|
| Vehicle | Athena 1 | Taurus | Delta 2 | Atlas 2 | Shuttle | Titan 4 | Zenit 3SL |
| 2001 Total Launches | 1 | 1 | 7 | 4 | 6 | 3 | 2 |
| 2001 Licensed Launches | 0 | 1 | 1 | 1 | 0 | 0 | 2 |
| Reliability 2001 | 1/1 | 0/1 | 7/7 | 4/4 | 6/6 | 3/3 | 2/2 |
| Last 10 Years | 100.0% | 0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| First Launch | 4/5 | 5/6 | 84/85 | 55/55 | 70/70 | 27/31 | 6/7 |
| Launch Sites | 80.0% | 83.3% | 98.8% | 100.0% | 100.0% | 87.1% | 85.7% |
| Launch Sites | 1995 | 1994 | 1990 | 1991 | 1981 | 1989 | 1999 |
| Launch Sites | Wallops, Kodiak, VAFB | VAFB | CCAFS, VAFB | CCAFS, VAFB | KSC | CCAFS, VAFB | Odyssey Pacific Ocean Platform |
| LEO kg (lb) | 360 (792) | 1,437 (3,161) | 4,887 (10,751) | 8,298 (18,256) | 23,435 (51,557) | 20,822 (45,808) | 15,246 (33,541) |
| GTO kg (lb) | -- | 562 (1,236) | 1,769 (3,892) | 3,833 (8,433) | 5,663 (12,459) | 8,276 (18,207) | 5,700 (12,540) |

2001 WORLDWIDE LAUNCH ACTIVITY

Launch providers from the United States, Europe, Russia, and the multinational consortium Sea Launch conducted a total of 16 commercial orbital launches in 2001. The United States and Russia each captured 19 percent of the world's commercial launch market, and Europe's eight launches represented a 50 percent market share. Sea Launch's two commercial launches claimed 13 percent of the market. China did not conduct any commercial launches in 2001.

A detailed list of foreign commercial orbital launches appears in Table 4 on the right. In addition, the Appendix at the end of this report shows all 59 orbital launches worldwide in 2001 for commercial, civil and military missions.

Table 4. 2001 Foreign Commercial Launch Events

| Date | Vehicle | Payload(s) | Launch Outcome | Orbit |
|--------|-------------|-----------------|----------------|-------|
| Jan 10 | Ariane 44P | Eurasiasat 1 | Success | GEO |
| Feb 7 | Ariane 44L | Skynet 4F | Success | GEO |
| | | Sicral 1 | | GEO |
| Feb 20 | START 1 | Odin | Success | LEO |
| Mar 8 | Ariane 5G | EUROBIRD | Success | GEO |
| | | BSat 2A | | GEO |
| May 15 | Proton | PAS 10 | Success | GEO |
| Jun 9 | Ariane 44L | Intelsat 901 | Success | GEO |
| Jun 16 | Proton | Astra 2C | Success | GEO |
| Jul 12 | Ariane 5G | Artemis | Failure | GEO |
| | | BSat 2B | | GEO |
| Aug 30 | Ariane 44L | Intelsat 902 | Success | GEO |
| Sep 25 | Ariane 44P | Atlantic Bird 2 | Success | GEO |
| Nov 27 | Ariane 44LP | DirecTV 4S | Success | GEO |

Figure 3. 2001 Total Worldwide Launch Activity

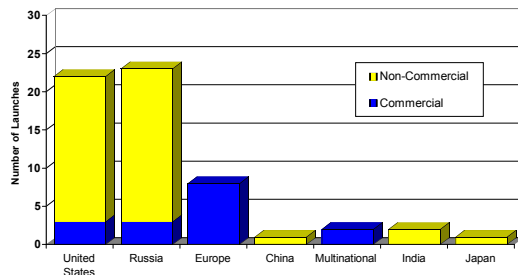


Table 3. 2001 Orbital Launch Events

| | Commercial Launches | Non-Commercial Launches | TOTAL Launches |
|---------------|---------------------|-------------------------|----------------|
| United States | 3 | 19 | 22 |
| Russia | 3 | 20 | 23 |
| Europe | 8 | 0 | 8 |
| China | 0 | 1 | 1 |
| Multinational | 2 | 0 | 2 |
| India | 0 | 2 | 2 |
| Japan | 0 | 1 | 1 |
| TOTAL | 16 | 43 | 59 |

WORLDWIDE LAUNCH REVENUES

Revenues from the 16 commercial launch events in 2001 were an estimated \$1.5 billion, a 44 percent decrease from the 2000 total of approximately \$2.7 billion. European revenues were estimated at about \$948 million, Russian revenues were about \$178 million, Sea Launch earned approximately \$170 million, and U.S. commercial launch revenues were about \$167 million. China did not conduct any commercial launches during the year and therefore recorded no revenues (see Figure 5).

Launch revenues are attributed to the country in which the primary vehicle manufacturer is based, with the exception of Sea Launch, which is designated simply as “multinational.” In the past, this method has worked well because most launch vehicles were manufactured, sold and launched by the same organization within entirely one country or, in the case of Europe, within a particular economic region.

With the rise of multinational launch service corporations, however, a clean division of revenue for particular launches among countries is more difficult to calculate. For example, some Russian launch activity is conducted in partnership with American and European launch service providers through a number of joint ventures. ILS markets launches of the Russian Proton vehicle, and Starsem, the Franco-Russian partnership, conducts launches of the Soyuz vehicle. Sea Launch represents a partnership among four organizations in four countries and uses its own launch facility located, at the time of launch, in international waters.

Because of the proprietary nature of business transactions and the internal financing of each organization, it is very difficult to determine the exact revenue amount for each launch service provider or to characterize them in terms of allocated percentages between international partners. This is also true of some major component suppliers, such as NPO Energomash of Russia, which provides the RD-180 engines used to power the U.S. Atlas 3 and 5 vehicles.

Therefore, it should be recognized that the data presented in Figure 5 do not necessarily represent all of the payments a country might make or receive in the course of its launch activities. Also, prices for individual launches to GEO have dropped significantly during 2000-2001 compared to prior years. As a result, revenue estimates may be somewhat high.

Figure 4. 2001 Worldwide Commercial Market Share

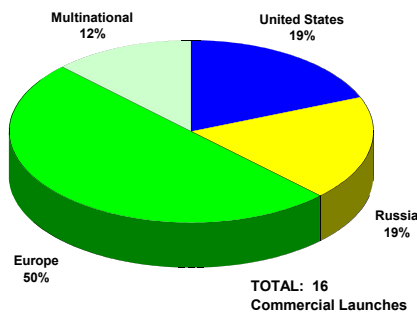
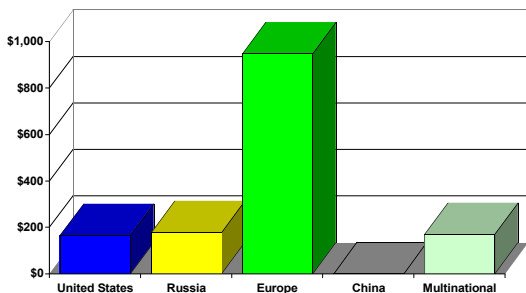


Figure 5. 2001 Commercial Launch Revenues (approximate)



WORLDWIDE PAYLOAD SUMMARY

A total of 81 payloads were launched on 59 launch vehicles in 2001. Of the 81, 20 were for commercial purposes (including four captive satellites from Russia) and 61 were for government or scientific purposes.

Sixteen commercially procured or internationally competed launches were used to send 21 payloads into orbit:

- Twelve payloads were commercially-operated GEO telecommunications satellites
- Five payloads represented a variety of government missions
- Two payloads were commercial remote sensing satellites
- One payload was a MEO telecommunications satellite
- One payload was a LEO burial canister

The United States successfully launched a New ICO satellite (ICO F-1), and QuickBird, a commercial remote sensing satellite with 0.6-meter resolution imaging capability. The third commercial launch from a U.S. launch site used OSC's Taurus launch vehicle, which failed when the vehicle did not reach the proper altitude to deploy its payloads.

Intelsat added two satellites to its fleet with the launch of Intelsats 901 and 902, both by Arianspace. Eutelsat extended its service capabilities with the launch of Atlantic Bird 2 and EUROBIRD, both launched aboard Ariane vehicles. Eurasiasat (Eurasiasat 1), PanAmSat (PAS 10), SES Global (Astra 2C) and Japan's Broadcasting Satellite Systems Corporation (BSat 2A) each added an additional satellite to their operating inventories. Japan's BSat 2B did not reach orbit when its Ariane 5G launch vehicle failed to achieve the necessary altitude for a transfer orbit to GEO. The primary payload on that flight, the European Space Agency's (ESA) experimental Artemis, was salvaged using onboard fuel assets. Unlike Artemis, BSat 2B was designed with only enough fuel to maneuver

Figure 6. 2001 Total Worldwide Launch Activity by Payloads

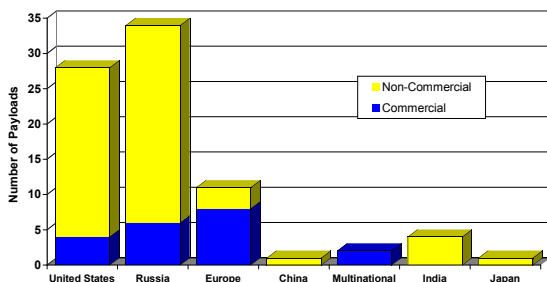


Figure 7. Total Payloads Launched by Country in 2001

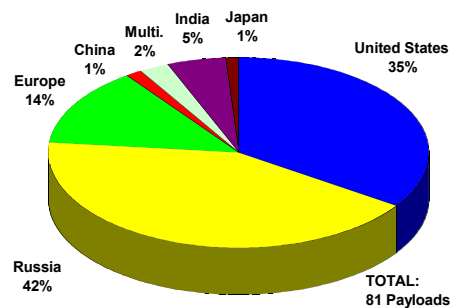
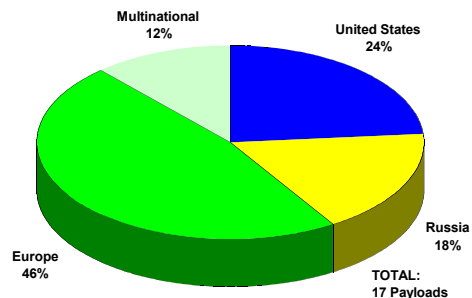


Table 5. Payloads Launched in 2001

| | Commercial Payloads | Non-Commercial Payloads | TOTAL Payloads |
|---------------|---------------------|-------------------------|----------------|
| United States | 4 | 24 | 28 |
| Russia | 6 | 28 | 34 |
| Europe | 8 | 3 | 11 |
| China | 0 | 1 | 1 |
| Multinational | 2 | 0 | 2 |
| India | 0 | 4 | 4 |
| Japan | 0 | 1 | 1 |
| TOTAL | 20 | 61 | 81 |

Figure 8. Commercial Payloads Launched by Country in 2001



in GEO and could not move itself from the lower orbit to GEO. As a result, the satellite was considered a total loss. The British Ministry of Defence, which internationally competed a launch for its Skynet 4F, and the Italian Ministry of Defense (Sicral 1) both had their satellites successfully launched as a pair aboard an Ariane 44L. Finally, DIRECTV welcomed the successful launch of DIRECTV 4S, which was placed into GEO by an Ariane 44LP launch vehicle.

Russia launched Sweden's Odin science satellite aboard a START 1 launch vehicle in early 2001, and two commercial GEO satellites (PAS 10 and Astra 2C) using separate Proton vehicles were launched in May and June, respectively.

Four commercially-operated payloads were deployed on launch vehicles that were not internationally procured; one, Ekran M16, was launched aboard a Proton with a Briz M upper stage to GEO while the others were three LEO store-and-forward Gonet satellites launched together aboard a Cyclone 3 vehicle.

LAUNCH ACTIVITIES BY COUNTRY

Russia - In 2001, Russia launched 23 vehicles; of these, two were commercial launches using ILS Proton vehicles (sending PanAmSat's PAS 10 and SES Global's Astra 2C into GEO) and a third commercial launch was of a START 1 vehicle, which placed Sweden's Odin science satellite into LEO.










Russia also conducted eight launches dedicated to the International Space Station (ISS), sending two crewed Soyuz replacement modules, five Progress supply modules and an airlock compartment called Pirs. Mission ISS 2S, the first Soyuz module launched in 2001, included the world's first paying space tourist, Dennis Tito. Tito paid an estimated \$20 million for a seat on the Soyuz and a week aboard the International Space Station. Of the remaining 12 launches, two involved captive commercial satellites (the aforementioned Ekran M16 and Gonets satellites, the latter set launched with a trio of identical military satellites), two sent Molniya communications satellites into highly-elliptical orbits, four placed

unspecified Kosmos military payloads into a variety of orbits (not including the ones multi-manifested with the Gonets launch), one lofted three Glonass navigation satellites into MEO, and three launch events sent a host of civil science payloads into LEO for operators in Sweden, Pakistan, Morocco, and Germany.

Europe - Europe conducted eight launches, all of which were commercially procured. Six of the launches involved the Ariane 4 series vehicles, which successfully lofted Eurasiasat 1, Sicral 1 and Skynet 4F (dual-manifested), Intelsat 901, Intelsat 902, Atlantic Bird 2, and DIRECTV 4S.

Only two Ariane 5G launches were conducted in 2001, with one success (BSat 2A and EUROBIRD were dual-manifested) and one failure. In the latter case, an upper stage (EPS) engine problem during the launch of ESA's Artemis and Japan's BSat 2B on July 12 halted use of the Ariane 5G vehicle until an investigation determined the cause of the fault (a period

Table 6. Russian and Ukrainian Vehicle Performance in 2001

| |  |  |  |  |  |  |  |  |  |
|---------------------|---|---|---|---|---|---|---|---|---|
| Vehicle | START | Cosmos | Cyclone 2 | Cyclone 3 | Molniya | Soyuz | Zenit 2 | Proton | Proton M |
| 2001 Total Launches | 1 | 1 | 1 | 2 | 2 | 9 | 1 | 5 | 1 |
| Reliability 2001 | 1/1 | 1/1 | 1/1 | 2/2 | 2/2 | 9/9 | 1/1 | 5/5 | 1/1 |
| Last 10 Years | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| First Launch | 1993 | 1964 | 1977 | 1977 | 1960 | 1963 | 1985 | 1967 | 2001 |
| Launch Sites | Svobodny | Plesetsk | Plesetsk, Baikonur | Plesetsk | Plesetsk | Baikonur, Plesetsk | Baikonur | Baikonur | Baikonur |
| LEO kg (lb) | 607 (1,335) | 1,350 (2,970) | 2,820 (6,204) | 3,929 (8,644) | 1,800 (3,960) | 6,708 (14,758) | 13,199 (29,038) | 19,254 (42,359) | 21,000 (46,297) |
| GTO kg (lb) | -- | -- | -- | -- | 1,600 (3,520) | -- | -- | 4,421 (9,726) | 2,920 (6,424) |

lasting through the end of the year). Ariespace officials stated that “combustion instability” during the upper stage Aestus engine’s ignition reduced thrust and also led to the premature shutdown of the engine when it exhausted its propellants. The Ariane 5 has been launched successfully eight times since it was introduced in 1996.

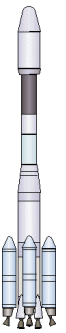
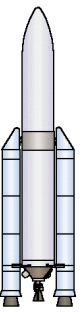

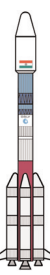
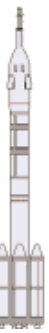

China - China did not conduct any commercial launches in 2001, and has not conducted one since 1999. In 2001, China launched only one payload into orbit, the lowest number since 1993. The single payload was the Shenzhou 2, a space vehicle designed to carry a crew and based loosely on Russian Soyuz designs that were exchanged under certain technology agreements. Shenzhou 2 was launched aboard the Long March 2F vehicle, without a crew, in the second successful launch of that vehicle out of two attempts. China has indicated that several Shenzhou spacecraft will be launched without a crew until the launch vehicle and spacecraft have been declared safe.

India - The Indian Space Research Organization (ISRO) performed two launches in 2001 from its Sriharikota Range launch site. On April 18, India

conducted the successful inaugural launch of its Geosynchronous Satellite Launch Vehicle (GSLV), carrying GSat 1 into orbit. Due to a premature shutdown of the upper stage engine, GSat 1 was placed into a lower-than-desired orbit. The second launch carried ISRO’s TES, Germany’s BIRD, and ESA’s PROBA into orbit using India’s Polar Satellite Launch Vehicle (PSLV).

Japan - The initial launch of the H 2A was successfully conducted by Japan’s National Space Development Agency (NASDA) on August 29. The vehicle, launched from Tanegashima Space Center, placed a vehicle evaluation payload into LEO.

Table 7. European, Chinese, Indian, and Japanese Launch Vehicle Performance in 2001

| | Europe | | India | | China | Japan |
|----------------------------|---|---|---|--|---|---|
| |  |  |  |  |  |  |
| Vehicle | Ariane 4 | Ariane 5 | PSLV | GSLV | LM- 2F | H 2A 202 |
| 2001 Total Launches | 6 | 2 | 1 | 1 | 1 | 1 |
| Reliability 2001 | 6/6 | 1/2 | 1/1 | 1/1 | 1/1 | 1/1 |
| | 100.0% | 50.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Last 10 Years | 92/95 | 8/10 | 2/2 | 1/1 | 2/2 | 1/1 |
| | 96.8% | 80.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| First Launch | 1988 | 1996 | 2000 | 2001 | 1999 | 2001 |
| Launch Sites | Kourou | Kourou | Sriharikota | Sriharikota | Jiuquan | Tanegashima |
| LEO kg (lb) | 9,191 (20,220) | 17,250 (37,950) | 3,700 (8,140) | 5,000 (11,000) | 9,500 (20,900) | 9,940 (21,868) |
| GTO kg (lb) | 4,748 (10,446) | 6,534 (14,375) | 800 (1,760) | 2,500 (5,500) | 3,500 (7,700) | 4,100 (9,020) |

FIVE-YEAR SPACE TRANSPORTATION TRENDS

From 1997 to 2000, total annual launches worldwide have remained essentially constant, with the proportion of commercial launches declining steadily. In 2001, however, total launches dropped by about 31 percent from 85 in 2000 to 59. Commercial launches dropped 55 percent from 35 in 2000 to 16 in 2001. The average for total launches per year between 1997 and 2001 is about 79, with the average number of commercial launches approximately 34.

Revenues worldwide for commercial orbital launches have also shown a gradual decline, with the exception of 2000, the peak year since 1997. Market share for the United States has decreased since 1998, with Europe, Russia, and the multinational Sea Launch Company remaining relatively steady during the five-year period.

Figure 11. Launch Revenues for Commercial Launch Events (approximate, in \$US millions)

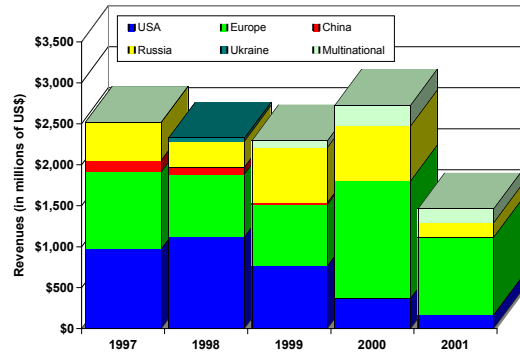


Table 8. Launch Revenues for Commercial Launch Events (approximate, in \$US millions)

| | 1997 | 1998 | 1999 | 2000 | 2001 | Total |
|---------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| United States | \$974 | \$1,120 | \$766 | \$370 | \$167 | \$3,397 |
| Europe | \$940 | \$763 | \$750 | \$1,433 | \$948 | \$4,834 |
| Russia | \$464 | \$313 | \$670 | \$671 | \$178 | \$2,296 |
| China | \$143 | \$90 | \$23 | \$0 | \$0 | \$256 |
| Ukraine | \$0 | \$40 | \$0 | \$0 | \$0 | \$40 |
| Multinational | \$0 | \$0 | \$85 | \$255 | \$170 | \$510 |
| TOTAL | \$2,521 | \$2,326 | \$2,294 | \$2,729 | \$1,462 | \$11,332 |

Figure 9. Five-Year Summary (1997-2001) of Launch Events by Commercial/Non-commercial

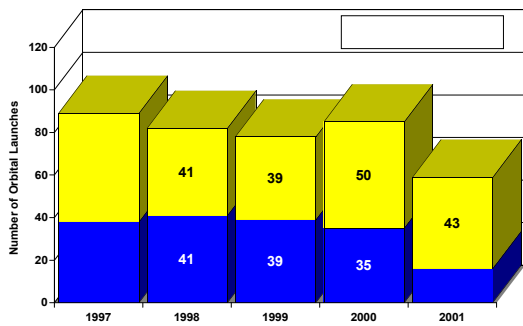


Figure 12. Five-Year Summary (1997-2001) of Commercial Payloads Launched by Orbit

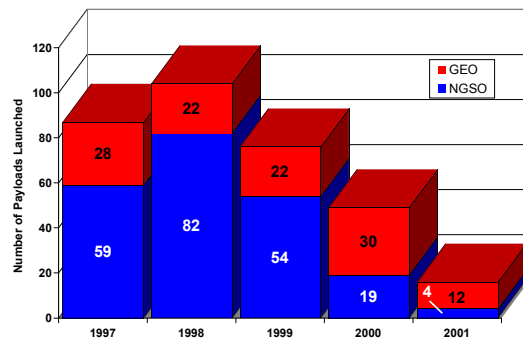


Figure 10. Five-Year Worldwide Commercial GEO and NGSO Launch Events (1997-2001)

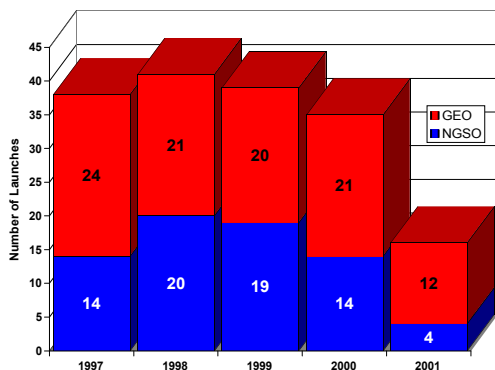


Figure 13. Five-Year Worldwide Orbital Launch Share (1997-2001)

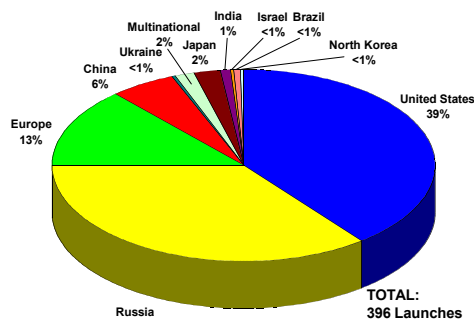
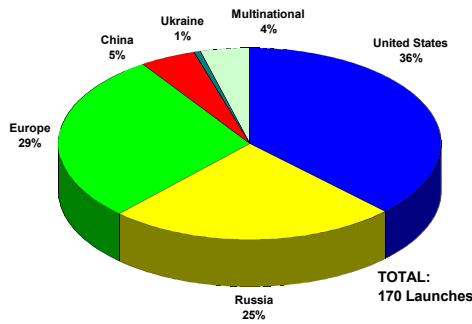


Figure 14 shows all worldwide commercial orbital launches from 1997 to 2001, which totaled 170 launch events. A commercial launch is defined as any launch that is internationally competed or FAA-licensed, or represents privately-financed launch activity.

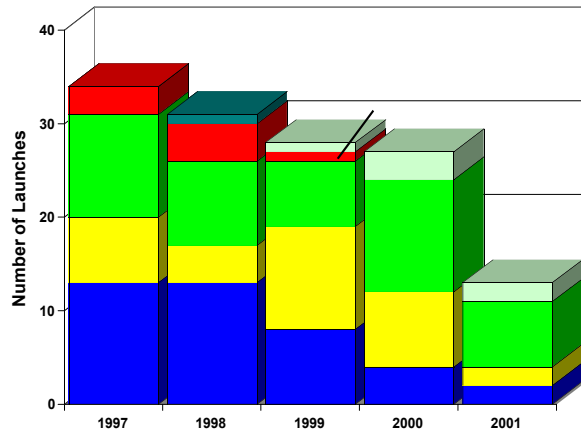
Figure 14. Five-Year Worldwide Commercial Launch Share (1997-2001)



As commercial space business increases and replaces various forms of traditionally government-operated activities, the definitions of “commercial payload” and “commercial launch” become more complex and open to interpretation. Another way to measure commercial launch activity is how companies compete against each other for non-government payloads. Figure 15 reflects launch service providers competing in the international marketplace for open-bid launch services contracts issued by commercial entities. This particular measurement precludes government-sponsored payloads launched commercially (some have been licensed by the FAA) and payloads captive to a countries’ or companies’ own launch providers. It also does not include test or dummy payloads or small secondary payloads.

Using the definition above, from 1997 to 2001, 79 payloads were launched “commercially” and but were not internationally competed; most of these had NGSO destinations. Because of multi-manifesting, this equates to 37 launches. These 37 launches are counted in Figure 14, but not in Figure 15. During this five-year period, Figure 15 shows that Europe captured 35 percent of all internationally competed launches, the United States had 30 percent, Russia 24 percent, China six percent, Sea Launch about four percent, and Ukraine less than one percent.

Figure 15. Five-Year Worldwide Internationally Competed Launch Events*



*An internationally competed launch event is defined as one involving payloads open to international launch service procurement. This chart precludes government-sponsored payloads launched commercially or payloads captive by countries or companies to their own launch providers. It also does not include dummy payloads or small secondary payloads.

The significant reduction in the number of commercial launches during 2001 is due in part to the trend away from LEO communications constellations. This reduction was partially mitigated by launches dedicated to other services such as direct radio broadcasting and commercial remote sensing. In addition, some payloads were not delivered on time due to manufacturing delays, further reducing the number of launches expected to occur during the year.

The commercial space transportation market is driven largely by the demand for launches of telecommunications satellites and, therefore, developments in the industry over the next five years will parallel developments in satellite systems, including:

- Anticipated steady demand for launch of GEO communications satellite systems with a small but steady demand for remote sensing systems.
- A continued trend toward heavier GEO communications satellites supplemented by an emerging market for small GEO satellites.
- Continued lower than originally anticipated demand for LEO deployments due to impact of business difficulties faced by first constellations.

These satellite industry trends will be augmented by new developments in the launch industry within five years, including:

- The introduction of larger launch vehicles to meet the demand for launches of heavier GEO spacecraft (Delta 4 and Atlas 5), and capacity upgrades to existing vehicles (Ariane 5G and others).
- Continued international competition to provide launch services by Europe, Russia, Ukraine, and China. Possible new entrants in the international launch services market include India, Japan, and Brazil.

2001 WORLDWIDE ORBITAL LAUNCH EVENTS

| Date | Vehicle | Site | Payload(s) | Operator | Manufacturer | Use | Comml Price | L | M |
|-----------|-------------------|--------------------------|------------------------------|--|---|----------------|-------------|---|---|
| 1/10/2001 | Long March 2F | Jiuquan | Shenzhou 2 | China National Space Administration | China Research Institute of Carrier Rocket Technology | Development | | S | S |
| 1/10/2001 | / Ariane 44P | Kourou | * Eurasiasat 1 | Eurasiasat SM | Alcatel Espace | Communications | \$80-100 M | S | S |
| 1/24/2001 | Soyuz | Baikonur | Progress M1-5 | RKK Energia | RKK Energia | Mir | | S | S |
| 1/30/2001 | Delta 2 7925-10 | CCAFS | Navstar GPS 2R-7 | DoD | Lockheed Martin Corp. | Navigation | | S | S |
| 2/7/2001 | / Ariane 44L | Kourou | SkyNet 4F | British Ministry of Defence | Matra Marconi Space | Communications | \$100-125 M | S | S |
| | | | Sicral 1 | Italian Ministry of Defense | Alenia Spazio | Communications | | | S |
| 2/7/2001 | Shuttle Atlantis | KSC | STS 98 | NASA | N/A | Crewed | | S | S |
| | | | ISS 5A | NASA | Boeing | ISS | | | S |
| 2/20/2001 | / START 1 | Svobodny | Odin | Swedish National Space Board | Swedish Space Corp. | Scientific | \$8-10 M | S | S |
| 2/26/2001 | Soyuz | Baikonur | Progress ISS 3P | RKK Energia/NASA | RKK Energia | ISS | | S | S |
| 2/27/2001 | Titan 4B/Centaur | CCAFS | Milstar F4 | DoD/USAF | Lockheed Martin Corp. | Communications | | S | S |
| 3/8/2001 | Shuttle Discovery | KSC | STS 102 | NASA | N/A | Crewed | | S | S |
| | | | ISS 5A.1 | NASA | Italian Space Agency-ASI | ISS | | | S |
| 3/8/2001 | / Ariane 5G | Kourou | * EUROBIIRD | Eutelsat | Alcatel Espace | Communications | \$150-180 M | S | S |
| | | | * BSat 2A | Broadcasting Satellite System Corp. (BSAT) | Orbital Sciences Corp. | Communications | | | S |
| 3/18/2001 | / Zenit 3SL | Sea Launch Platform | * XM Rock | XM Satellite Radio, Inc. | Boeing | Communications | \$75-95 M | S | S |
| 4/7/2001 | Proton M | Baikonur | * Ekran M16 | Russia/CIS PTT | NPO Prikladnoi Mekhaniki | Communications | | S | S |
| 4/7/2001 | Delta 2 7925-10 | CCAFS | 2001 Mars Odyssey | NASA | NASA | Scientific | | S | S |
| 4/18/2001 | GSLV | Sriharikota Range (SHAR) | Gsat 1 | Indian Space Research Organization | Indian Space Research Organization | Communications | | P | P |
| 4/19/2001 | Shuttle Endeavour | KSC | STS 100 | NASA | N/A | Crewed | | S | S |
| | | | ISS 6A | NASA | Italian Space Agency-ASI | ISS | | | S |
| 4/28/2001 | Soyuz | Baikonur | Soyuz ISS 2S | ROSAVIKOSMOS/ASA | RKK Energia | ISS | | S | S |
| 5/8/2001 | / Zenit 3SL | Sea Launch Platform | * XM Roll | XM Satellite Radio, Inc. | Boeing | Communications | \$75-95 M | S | S |
| 5/15/2001 | / Proton | Baikonur | * PAS 10 | Pan American Satellite Corp. | Boeing | Communications | \$75-95 M | S | S |
| 5/18/2001 | Delta 2 7925-10 | CCAFS | GeoLite | NRO | TRW | Development | | S | S |
| 5/20/2001 | Soyuz | Baikonur | Progress ISS 4P | RKK Energia/NASA | RKK Energia | ISS | | S | S |
| 5/29/2001 | Soyuz | Plesetsk | Kosmos 2377 | Russian MoD | TsSKB Progress | Classified | | S | S |
| 6/8/2001 | Cosmos | Plesetsk | Kosmos 2378 | Russia | NPO Prikladnoi Mekhaniki | Navigation | | S | S |
| 6/9/2001 | / Ariane 44L | Kourou | * Intelsat 901 | Intelsat | Space Systems/Loral | Communications | \$100-125 M | S | S |
| 6/16/2001 | / Proton | Baikonur | * Astra 2C | SES Astra | Boeing | Communications | \$75-95 M | S | S |
| 6/19/2001 | / Atlas 2AS | CCAFS | * ICO F-1 | New ICO | Boeing | Communications | \$90-105 M | S | S |
| 6/30/2001 | Delta 2 7425-10 | CCAFS | MAP | NASA | NASA Goddard | Scientific | | S | S |
| 7/12/2001 | Shuttle Atlantis | KSC | STS 104 | NASA | N/A | Crewed | | S | S |
| | | | ISS 7A | NASA | Boeing | ISS | | | S |
| 7/12/2001 | / Ariane 5G | Kourou | Artemis | European Space Agency (ESA) | Alenia Spazio | Communications | \$150-180 M | F | S |
| | | | * BSat 2B | Broadcasting Satellite System Corp. (BSAT) | Orbital Sciences Corp. | Communications | | | F |
| 7/20/2001 | Molniya | Plesetsk | Molniya 3K | Russia | NPO PM | Communications | | S | S |
| 7/23/2001 | Atlas 2A | CCAFS | GOES 12 | NOAA | Space Systems/Loral | Meteorological | | S | S |
| 7/31/2001 | Cyclone 3 | Plesetsk | Coronas F | Izmiran and Lebedev Physical Institute | NPO Yuzhnoye | Scientific | | S | S |
| 8/6/2001 | Titan 4B/IUS | CCAFS | DSP 21 | USAF | TRW | Intelligence | | S | S |
| 8/8/2001 | Delta 2 7326-10 | CCAFS | Genesis | NASA/ JPL | Lockheed Martin Corp. | Scientific | | S | S |
| 8/10/2001 | Shuttle Discovery | KSC | STS 105 | NASA | N/A | Crewed | | S | S |
| | | | ISS 7A.1 | NASA | Italian Space Agency-ASI | ISS | | | S |
| 8/21/2001 | Soyuz | Baikonur | Progress ISS 5P | RKK Energia/NASA | RKK Energia | ISS | | S | S |
| 8/24/2001 | Proton | Baikonur | Kosmos 2379 | Russian MoD | NPO Lavotchkin | Classified | | S | S |
| 8/29/2001 | H 2A 202 | Tanegashima | Vehicle Evaluation Payload 2 | NASDA | NASDA | Test | | S | S |

/ Denotes commercial launch, defined as a launch that is internationally competed or FAA-licensed, or privately-financed launch activity.

* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is operated by a commercial entity.

L and M refer to the outcome of the Launch and Mission: S = success, P = partial success, F = failure

Note: All launch dates are based on local time at the launch site

2001 WORLDWIDE ORBITAL LAUNCH EVENTS

| Date | Vehicle | Site | Payload(s) | Operator | Manufacturer | Use | Comml Price | L | M |
|------------|-------------------|--------------------------|-------------------|---|---------------------------------------|----------------|-------------|---|---|
| 8/30/2001 | / Ariane 44L | Kourou | * Intelsat 902 | Intelsat | Space Systems/Loral | Communications | \$100-125 M | S | S |
| 9/8/2001 | Atlas 2AS | VAFB | NRO A1 | NRO | Boeing | Classified | | S | S |
| 9/15/2001 | Soyuz | Baikonur | Pirs | ROSAVIAKOSMOS/NASA | Russian Space Agency | ISS | | S | S |
| 9/21/2001 | / Taurus | VAFB | * OrbView 4 | Orbital Imaging Corp. (Orbimage) | Orbital Sciences Corp. | Remote Sensing | \$20-25 M | F | F |
| | | | * Celestis 4 | Celestis, Inc. | Celestis, Inc. | Other | | | F |
| | | | QuikTOMS | NASA | Orbital Sciences Corp. | Scientific | | | F |
| 9/25/2001 | / Ariane 44P | Kourou | * Atlantic Bird 2 | Eutelsat | Alcatel Espace | Communications | \$80-100 M | S | S |
| 9/29/2001 | Athena 1 | Kodiak Launch Complex | Starshine 3 | NASA | Utah State University | Scientific | | S | S |
| | | | PICOSAT 1 | USAF | Surrey Satellite Technology Ltd. | Development | | | S |
| | | | PCSat | US Naval Academy | US Naval Academy | Communications | | | S |
| | | | SAPPHIRE | Stanford University | Stanford University | Scientific | | | S |
| 10/5/2001 | Titan 4B | VAFB | NRO T3 | NRO | Boeing | Intelligence | | S | S |
| 10/6/2001 | Proton | Baikonur | Raduga 1-06 | Russian MoD | TsSKB Progress | Communications | | S | S |
| 10/11/2001 | Atlas 2AS | CCAFS | NRO A2 | NRO | TBA | Communications | | S | S |
| 10/18/2001 | / Delta 2 7320 | VAFB | * QuickBird | DigitalGlobe | Ball Aerospace and Technologies Corp. | Remote Sensing | \$45-55 M | S | S |
| 10/21/2001 | Soyuz | Baikonur | Soyuz ISS 3S | NASA | RKK Energia | ISS | | S | S |
| 10/22/2001 | PSLV | Sriharikota Range (SHAR) | PROBA | European Space Agency (ESA) | Verhaert | Development | | S | S |
| | | | BIRD | DLR | DLR | Development | | | S |
| | | | TES | ISRO | ISRO | Remote Sensing | | | S |
| 10/25/2001 | Molniya | Plesetsk | Molniya 3-51 | Russia | NPO PM | Communications | | S | S |
| 11/26/2001 | Soyuz | Baikonur | Progress ISS 6P | RKK Energia/NASA | RKK Energia | ISS | | S | S |
| 11/26/2001 | / Ariane 44LP | Kourou | * DirecTV 4S | DirecTV, Inc. | Boeing | Communications | \$90-110 M | S | S |
| 12/1/2001 | Proton | Baikonur | Kosmos 2380 | Russian MoD | NPO PM | Navigation | | S | S |
| | | | Kosmos 2381 | Russian MoD | NPO PM | Navigation | | S | S |
| | | | Kosmos 2382 | Russian MoD | NPO PM | Navigation | | S | S |
| 12/5/2001 | Shuttle Endeavour | KSC | STS 108 | NASA | N/A | Crewed | | S | S |
| | | | ISS UF-1 | NASA | Italian Space Agency-ASI | ISS | | S | S |
| 12/7/2001 | Delta 2 7920 | VAFB | Jason 1 | NASA/CNES | Aerospatiale | Remote Sensing | | S | S |
| | | | TIMED | NASA | Applied Physics Lab./Johns Hopkins | Scientific | | | S |
| 12/10/2001 | Zenit 2 | Baikonur | Meteor 3M N1 | Russia | VNII Elektromekhaniki | Meteorological | | S | S |
| | | | Kompass | Russia | Russia | Scientific | | | S |
| | | | Badr 2 | SUPARCO | SUPARCO | Development | | | S |
| | | | Maroc-Tubsat | Royal Center for Remote Sensing (Morocco) | Technical University of Berlin | Remote Sensing | | | S |
| | | | Reflektor | SRIPDE (Russia) | SRIPDE (Russia) and USAF | Development | | | S |
| 12/21/2001 | Cyclone 2 | Baikonur | Kosmos 2383 | Russian MoD | KB Arsenal | Classified | | S | S |
| 12/28/2001 | Cyclone 3 | Plesetsk | * Gonets D1 9 | Smolsat (NPO PM, et. al) | NPO Prikladnoi Mekhaniki | Communications | | S | S |
| | | | * Gonets D1 7 | Smolsat (NPO PM, et. al) | NPO Prikladnoi Mekhaniki | Communications | | | S |
| | | | * Gonets D1 8 | Smolsat (NPO PM, et. al) | NPO Prikladnoi Mekhaniki | Communications | | | S |
| | | | Kosmos 2384 | Russian MoD | NPO Prikladnoi Mekhaniki | Communications | | | S |
| | | | Kosmos 2385 | Russian MoD | NPO Prikladnoi Mekhaniki | Communications | | | S |
| | | | Kosmos 2386 | Russian MoD | NPO Prikladnoi Mekhaniki | Communications | | | S |

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* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is operated by a commercial entity.
L and M refer to the outcome of the Launch and Mission: S = success, P = partial success, F = failure
Note: All launch dates are based on local time at the launch site