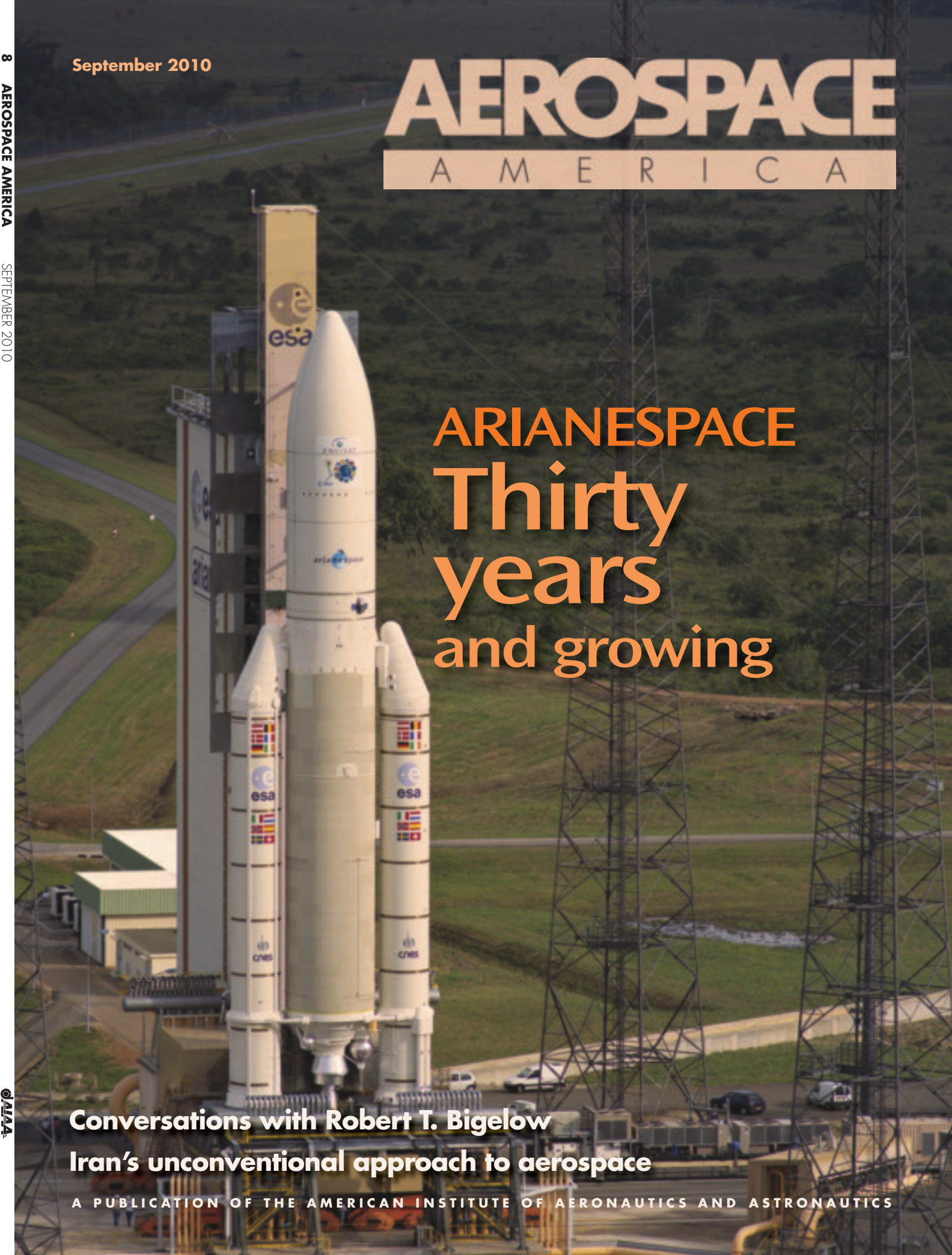
September 2010

AEROSPACE AMERICA



ARIANESPACE
Thirty years and growing

Conversations with Robert T. Bigelow

Iran's unconventional approach to aerospace

A PUBLICATION OF THE AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

ARIANESPACE

Thirty years and growing…

Since its founding in 1980, Arianespace has developed its launch vehicles in tandem with the satellite industry, enabling them to lift heavier and heavier payloads into orbit. Over half the commercial satellites now in service were launched by Ariane rockets, says the company, whose order book is now larger than ever.

by Mark Williamson
Contributing writer

March 2010 marked the 30th anniversary of the creation of Arianespace, the space launch provider that bills itself as "the world's first commercial space transportation company." Although 30 years is a relatively short time in the context of terrestrial freight transportation systems, it represents a significant portion of the Space Age and a considerable heritage for Europe's leading rocket company.

Numbers announced to commemorate the anniversary tell a story of success. As of April 2010, Arianespace had launched a total of 277 satellites (plus 51 auxiliary payloads) for 73 customers. According to company spokesman Mario de Lepine, this accounts for "more than half of the commercial satellites" now in service worldwide.

Arianespace's current order book stands at an "all-time record" of €4.3 billion, and includes 34 geostationary satellites, six Ariane 5 launches of ESA's automated transfer vehicle to the international space station, and 17 launches of the Russian-built Soyuz, soon to be flown from the Guiana Space Center. It is clear that the development of Arianespace is

Arianespace's December 18 daytime mission with Helios 2B was the company's seventh flight in 2009 and the 35th success in a row.

far from complete. On the contrary, the clock reads "30 years and counting."

Great minds, great location

So how did it all begin? Why does Arianespace exist at all?

Like the U.S., Europe began its development of satellite launch vehicles as a spinoff of its ballistic missile programs of the 1950s. For example, when the U.K. abandoned the concept of an independent nuclear deterrent in April 1960, its delivery system, the Blue Streak missile, was proposed as the first stage of a European three-stage satellite launcher. Originally called ELDO-A after the newly created European Launcher Development Organisation, it was later renamed Europa.

The failure of Europa pushed France to suggest a "substitution launcher" that would become Ariane. (Courtesy ESA, CNES.)

Unfortunately, a number of demoralizing failures of the various stages, and the ever-present pressures to cut costs, eventually led to the abandonment of Europa, and ELDO itself was disbanded in 1973. ELDO's activities were amalgamated with those of the European Space Research Organization to form the European Space Agency in May 1975.

This placed Europe in the position of being totally reliant on its Cold War ally, the U.S., to deliver its satellites to orbit. However, the French space agency CNES came to the rescue with its proposal for a new three-stage launch vehicle, known as L3S. Thus in 1973, when ESA initiated the Ariane launch vehicle program (based on the L3S), it delegated its management to CNES, giving France a leading role in the project.

The first flight of an Ariane 1, from a French-run launch site near Kourou, French Guiana, occurred in December 1979, and the operation of the vehicle was handed over to an international partnership company, Arianespace, the following

At 14:14 local Guiana time on December 24, 1979, the first Ariane blasted off. (Courtesy ESA, CNES.)

year. In fact, the Ariane was the first rocket designed from the outset as a commercial satellite launch vehicle, in contrast with its competitors—such as Atlas and Delta—which had been developed from existing ICBMs.

According to Arianespace Chairman and CEO Jean-Yves Le Gall, writing about the company's 25th anniversary in *International Space Review* magazine in 2005, "The creation of Arianespace in March 1980 brought an entirely new perspective to commercial launch services. Our founders believed that satellite operators could best be served by a truly business-oriented access to space, run by a company that was totally dedicated to its customers from the moment of contract signature to the postlaunch supply of orbital injection parameters."

In fact, a key advantage of Ariane in terms of injection parameters arose from the location of its launch site, which, at a latitude of 5.2° N, on the northeast coast of South America, is one of the closest fixed launch sites to the equator. Equatorial launches are the most efficient for delivery of satellites into geostationary orbit, as they avoid the need to carry extra propellant to change the orbit's inclination. This means, quite simply, that for the same launch vehicle, about 12% more payload can be launched from Kourou than from Cape Canaveral in Florida, at 28.5° N, and nearly 30% more than from Baikonur, the main Russian launch site, at 46° N.

Ariane 4, which could lift satellites weighing up to about 4.5 tons to GTO, was introduced in 1988.

Interviewed for *Aerospace America* on the occasion of the 30th anniversary, Le Gall was asked to recall some of the individuals who helped form the company we know today. He paid tribute to his three predecessors: Frédéric d'Allest, "who had the imagination to create the company at a time when nobody believed in it"; Charles Bigot, who served through "the golden age of Ariane 4 and led the company to its success in the marketplace due to this launcher"; and Jean-Marie Luton, who "bet on Ariane 5 when he was director-general of the European Space Agency" and then "won this bet as the chairman and CEO of Arianespace" when Ariane 5 became "the world's most reliable and available launcher."

As Le Gall suggests, the evolution of the Ariane family has been a key factor in its success. In response to the development of larger and heavier satellites, the launcher evolved through several variants, leading by 1988 to the Ariane 4, which could lift satellites weighing up to about 4.5 tons to geostationary transfer orbit (GTO), the most common delivery orbit for commercial satellites.

Ariane 5, the current vehicle, was introduced to launch still larger and heavier payloads. It was initially capable of launching 6.8 tons to GTO; enhancements have since increased this to 10 tons. Unfortunately, its first demonstration launch, in June 1996, was a complete failure, destroying a payload of four science satellites named Cluster and delaying its commercial inauguration to 1999.

Requiem for Ariane 4

As the main causes of launch failures have historically involved either propulsion systems or stage separation events, the engineering fraternity has striven to design simpler vehicles, which are inherently more reliable. This was the design philosophy for the Ariane 5, for example, which has far fewer engines and stage separations than the now-defunct Ariane 4. Theory aside, it remains to be seen when, or whether, Ariane 5 will reach the 74 consecutive successful launches and 2.59% overall failure rate of the much-vaunted Ariane 4.

Interestingly, not everyone in the industry was convinced of the need to graduate from Ariane 4 to Ariane 5, including a former Arianespace marketing executive, Ralph Jaeger, who led the call to "save Ariane 4." Citing the vehicle as "the most flexible launch system ever built [because of its] kit-like system, which allows different configurations to be built from one set of elements—stages, boosters, fairings, and adapters," he asked why the two vehicles

could not be operated together as part of "a chain of European-produced vehicles."

With equal amounts of prescience and insider knowledge, Jaeger suggested that retaining Ariane 4 could "at least protect Arianespace against competition from Soyuz." Another reason to keep the Ariane 4 lines running, in Jaeger's view, would be to allow the Ariane 5 to demonstrate its reliability, which he said "could take more than three years." The V157 failure less than two years later made his point better than any op-ed ever could.

Of course, there are many factors in a company's decision to progress from one variant to another, presumably more advanced, more efficient, and more marketable product. For Ariane, other factors included the apparently inexorable rise in satellite mass and the need to support Arianespace's dual-launch philosophy, as well as pressures from ESA and European industry to develop new technology and preserve an active workforce.

Although the Ariane 5 has dominated Le Gall's term at the helm of Arianespace, he is clear about the importance of Ariane 4 in the company's history. Asked for his views on the highlights of the past 30 years, he says that Arianespace has seen three main periods of development: the first 20 years (1980-2000), which included what he terms "the golden age of Ariane 4"; a second period from 2000 to the present, including "the ramp-up of Ariane 5 operations"; and a third period that he says begins this year. It will see the introduction of a "complete family of launchers," he notes, "as Soyuz and Vega join Ariane 5."

New challenges, new solutions

For the first two decades of Arianespace's existence, the trend in commercial satellites and launchers was fairly predictable: Satellites were getting bigger, and placing them in orbit required more powerful launch vehicles. However, the market has become diversified, with a resurgence of medium-sized satellites and the introduction of smaller geostationary platforms. It is difficult to predict how this diversified market for satellites will evolve, but launch providers are obliged to find cheaper, more efficient ways of deploying them.

The solution, which became clear several years ago, was to diversify the fleet, maintaining the Ariane 5 for the larger payloads while adding the Russian-built Soyuz for medium-sized satellites and the ESA-developed Vega for smaller payloads. In a sense, the company was forced into this solution by the inability of the Ariane 5 to carry two of the larger communications satellites, thus limiting the company's long-held dual-launch philosophy.

Adding Soyuz to the manifest has not been a quick fix, however: The agreement between Arianespace and Roskosmos, the Russian space agency, was signed in April 2005, but its introduction to the Guiana Space Center—with a launch of Avanti's HYLAS-1 satellite—is not expected to occur much before the end of the year. Vega, meanwhile, is not expected to debut until 2011, more than two years later than originally planned.

Reliability is key

Ariane 5 and Soyuz models were on display at the Paris Air Show in 2009. (Photo by Mark Williamson.)

The aerospace consulting and information firm Ascend provides independent analyses of the international launch industry. Asked how Arianespace had performed over its 30-year history, senior space analyst David Todd confirms that "Arianespace is one of the two major launch providers of the commercial market, the other being International Launch Services [ILS]," which operates the Proton.

In terms of historical performance, figures from the Ascend SpaceTrak online database show that care should always be taken when comparing launch vehicle statistics. While early versions of Ariane experienced the usual problems, reliability improved substantially with the Ariane 4 variant, with just three failures among 116 launches, for an overall failure rate of just 2.59%. Ariane 5, by contrast, has experienced three or four failures in 49 flights, depending how one reads the data.

Ascend, which tailors its advice to the space insurance industry, quotes four failures, giving a failure percentage of 8.16%, while Arianespace recognizes three failures (giving 6.1%). The discrepancy involves the V101 mission of October 1997, which carried two "mass dummy" payloads as part of a test launch. Unfortunately, the vehicle's main engine was shut down by the onboard computer several seconds prematurely, resulting in an apogee 9,000 km less than the planned 36,000-km GTO. According to Ascend, had the payload been a commercial geostationary satellite, it would have had to use its own propellant to boost its orbit, thus losing "about 10-15%" of its in-orbit design life.

While Arianespace agrees that the consequence of the vehicle's underperformance would have been "13 instead of 15 years of lifetime in orbit," according to de Lepine, "If we'd had commercial satellites on that launch, they could have reached the final orbit" using their own propulsion systems. Given that this procedure has since been demonstrated, it seems harsh to class the launch as an outright failure that degrades the overall statistics.

Indeed, Todd readily admits that "the overall failure rate does not tell the whole story." For the insurance community in particular, it is the recent record that counts, he says, citing the 35 consecutive Ariane 5 successes since the V157 mission of December 2002, which carried the Hotbird 7 and Stentor satellites into oblivion. "The rocket has now settled into that 'nirvana' state of having a long uninterrupted run of successful flights," says Todd.

Todd describes the insurance community's current view of Arianespace as "very good," adding, "The space insurance market rewards this recent good record with a very low premium rate." Indeed, comparing Ariane with other launch vehicles, Ascend contrasts an overall reliability figure of 6.22% for 193 Ariane flights with 11.30% for 354 Proton flights and 8.8% over 34 launches of the Zenit 3 (currently used by Sea Launch).

Asked to compare Arianespace with other commercial launch vehicles in terms of reliability, Mario de Lepine says flatly, "we do not like to compare," but continues to point out that Arianespace has experienced "no failures since 2003, [whereas] Proton failed in 2006, 2007, and 2008, Sea Launch in 2008, Long March in 2009, and GSLV in 2006 and 2010."

The Vega, to be provided by ESA, is a brand-new, unproven rocket.

Says Le Gall, "Soyuz and Vega are in the process of changing the scope of our company, since we will be going from six or seven launches a year with Ariane 5, to a total of 10 or 12," including three or four Soyuz launches a year and one or two Vega launches.

He also expects the diversification of payload capabilities to expand the company's client base. "This is extremely important, since with Soyuz and Vega we will be able to launch all types of satellites for all customers, especially those European governmental satellites that are too small to use Ariane 5," Le Gall explains. "This comprehensive launch capability will be our calling card," he adds.

How is the insurance market likely to view these developments? Ascend consulting analyst David Todd expects Soyuz to provide competition "for the Land Launch version of the Zenit 2 and 3 rocket systems, for smaller GEO satellites and LEO constellations." Moreover, he does not expect the Soyuz to reduce Ariane 5's market share, because "its payloads tend to be much larger satellites."

Vega, on the other hand, is a "brand new rocket," says Todd, "and our records show that maiden flights have failure rates in excess of 60%." So customers flying payloads on Vega should not expect the low insurance rates associated with Ariane 5, warns Todd, "at least not until Vega proves itself."

Le Gall admits that maintaining the company's leadership position is "a real challenge," but sees more uncertainty outside the company than within: "Will Sea Launch resume service or not? Will SpaceX be a success? Will China make a market breakthrough? How about India?"

Ascend recognizes these and other potential competitors. "While unimportant individually," advises Todd, "if all the minor players in the commercial launch market take one or two satellite payloads apiece from the total available, this may have major implications for the viability of the major launch providers such as Arianespace and ILS.

"Nevertheless," he adds, "with its reputation for a good quality of service and good recent reliability, for the time being at least, Arianespace remains the launch provider that the others have to beat."

Mission success

For Europe, the road to space has been somewhat long, especially in providing its own access to orbit. But within a little more than 30 years, its commercial launch industry—embodied in Arianespace—will have gone from the first launch of an Ariane 1 to the operation of a family of vehicles designed to access all types of orbits, providing Europe with the autonomy it has long desired.

Understandably, the commercial success of Arianespace instills feelings of pride among its workforce and across a wider European space community. "From the political standpoint," states Le Gall, "it's because we are so successful commercially that we can guarantee independent access to space for Europe, which is Arianespace's 'raison d'être' in the final analysis. In short, we are successful in both of our assigned missions."

However, Le Gall is keen to stress the international aspects of his company. "Arianespace may be a European company," he says, "but we're also American. We have a subsidiary in the United States [and] we launch a lot of satellites either for American operators or built by American manufacturers." And while it is clear that the U.S. is "a key to Arianespace's success," he believes that Arianespace is "a key to the success of the commercial space market in the United States."

So, three decades after the first Ariane thundered into the French Guiana skies, the CEO of Arianespace has reasons to celebrate. Thirty years ago, says Le Gall, "Arianespace was a pioneer in space transportation. Today, we are very proud of the fact that Arianespace has launched over half of all commercial satellites now in orbit. With the success of Ariane 5, including a perfect record for the last 35 launches, and the advent of a complete family of launchers, that's an excellent way to celebrate our 30th anniversary."

Ariane 6

Europe plans to replace the workhorse Ariane 5 with a new heavy-lift vehicle sometime around 2025. As with other variants, the vehicle will be studied and developed under the auspices of ESA and funded by its member states. Currently part of ESA's Future Launcher Preparatory Program and dubbed Next Generation Launcher or NGL, it is more commonly referred to as Ariane 6. According to Jean-Jacques Dordain, ESA's director general, the intention is to arrive at the next ministerial summit in 2011 with a firm definition proposal for the new booster.

Once again, the French government is providing the political impetus for Ariane 6, which it expects to cost between €3.5 billion and €8 billion to develop, and has issued a special bond to provide €250 million to begin the definition phase.

Although many of the design choices remain to be confirmed, including the type, or types, of propellant to be used, the vehicle is expected to be capable of launching a single 6-7-ton satellite, thus shifting the focus from dual launches. Arianespace CEO Jean-Yves Le Gall has been quoted as saying that a price reduction from the €150 million-€160 million for an Ariane 5 "would be very helpful to develop space applications." Of course, the cost to roll an Ariane 6 off the production line depends on many things, and it remains to be seen whether European industry can produce the new vehicle for less than the Ariane 5.