

VRI SPACE UPDATE

N°6 – March/April 2009

1. Commercial space ventures facing the economic crisis with innovating and integrated applications by satellites	2
Satellite 2009 : the great successful demonstration of the durability in space business developments worldwide	2
The good financial results of SES and Eutelsat, mainly due to direct-to-home broadcasts of digital bouquets, HDTV channels and interactive broadband connections	5
2. Strategic challenges in the world for innovations within development and utilization of space systems	6
The ITAR dilemma	6
The SSA initiative	8
The ORS (Operationally Responsive Space) impact	9
The signal interference problem	10
3. Access to space, the key factor for satellite business and manned operations in space	12
Arianespace offer of high-quality launch services - a worldwide reference - to be supported by further ESA investments	12
2009, the crucial year for the (r)evolutionary approach of Space X launch services	13
4. The Belgians in space odyssey: microgravity experiments, excellence centers for applications	15
The OasISS long-duration flight of astronaut Frank De Winne: fluid science and crystals in space, foam tested in microgravity	15
Mol (VITO/CVB) and Redu (ESA station) becoming Belgian reference sites for satellite applications	16

**Fifth Flemish Astronautics Days,
in Brabant, Leuven, on 8, 9 and 10 May 2009
(www.vlaamseruimtevaartdagen.be)**

The event is organized every two years by VRI to discover the know-how, the competences, the achievements, the careers and studies of space systems in Flanders, through the ESA and Belgian space programmes.

Mrs Sabine Laruelle, federal Minister of SME's, Independants, Agriculture and Science Policy (which includes the Belgian space programme) shows a real interest for the development of space systems and activities, giving products and services of high added value. Many VRI members got recently her visit: Newtec (18 March – broadband links by satellites), von Karman Institute (27 March – aerospace and hypersonic tests), VITO (1st April – remote sensing from air and space).

Note the next rendez-vous of Flanders with space applications: the Third International Workshop The Future of Remote Sensing, 20-21 October, in Antwerp, organized by VITO.

<p>1. Commercial space ventures facing the economic crisis with innovating and integrated applications by satellites</p>

Satellite 2009 : the great successful demonstration of the durability in space business developments worldwide

Each year, in February-March, Access Intelligence LLC, the publisher of *Satellite Today* and *Via Satellite*, organizes Satellite, a very well attended conference and exhibition to present and discuss the new trends and challenging changes in space business. The 4-day event Satellite 2009, which took place in Washington D.C. from 24 to 27 March, was attended by some 9,300 professionals from institutions, operators, industrial players of some 65 countries: it fully displayed the promising durability of the global satellite-enabled marketplace. More than 300 exhibitors - among them, Newtec from Belgium with new and advanced products on a very attractive booth - demonstrated the hopeful vitality of satellite capabilities and end-users solutions. Space business appears as a stable niche to develop innovating and promising ways with value-added systems and services around the world.

While the global economies are affected by a dramatic downturn, the sector of satellite systems for telecommunications, broadcasts, remote sensing navigation

and security remains sound with engines of growth down the road. Almost all the players in space business, attending Satellite 2009, agreed that the sector's fundamentals are in good shape, in spite of bad indicators for market capitalization and with merger standstill: strong revenues, little sign of slowing for the ground segment, mobile systems, video and broadband applications. Innovation is still very active for a more efficient use of geosynchronous satellites and of satellite constellations. The specialists admit that the satcom sector typically lags behind the economy as a whole by 2 to 3 years but has the quick capacity to recover after a long crisis. The small operators at regional level or with modest revenues will encounter difficulties to find fresh money for new investments.

SES Chairman Romain Bausch, as a representative of big satellite operators, predicted no likely impact from the financial downturn. He noted that his company managed a substantial refinancing of debt without any difficulty and at favourable terms. However, he admitted: *"The industry is not immune to the crisis and if it continues through the end of 2010-11, we will definitely see an impact. But if the recovery starts in the second half of 2009 and the market stabilizes by the first half of 2010, as most economists are predicting, then the satcom sector will be one of the few segments of the economy not to be touched by the crisis."*

The operators of satellite systems - mainly on the geostationary arc - see some new growth opportunities they did not anticipate.

1. The digital divide problem to be solved via space.

In this time of economical crisis, there is the political push to extend broadband to rural areas as part of economic stimulus infrastructure initiatives. The European Commission is proposing to invest up to 825 million € in rural areas for an economic programme to provide them with broadband access to worldwide Internet services as part of an economic recovery plan. *"Although nothing in the decision specifies the use of satellites, it will be virtually impossible to reach the objective without them"*, says R. Bausch. Also Eutelsat, which is investing in the development of a Ka-band satellite (while SES Astra is still evaluating and hesitating to make such an ambitious investment), and the other satellites operators in Europe - Hispasat, Hellasat, Telenor Satellite, as well Amos-Spacecom from Israel and Avanti Communications in 2010 - will contribute to the pan European initiative to bridge the digital divide in a quick mode with broadband links by space. In USA, the Obama administration has a plan to stimulate the access to high-speed Internet connections. This project will be a strong incentive for satellite operators - Wildblue, Hughes Network Systems (Spaceway), Telesat, Viasat (with first satellite in 2010), Intelsat - which are developing broadband links with compact and efficient terminals in Ka-band frequencies.

For Magali Vaissiere, ESA Director Telecommunications & Integrated Applications, “*public and private European investments have delivered satellites in space, ready to efficiently connect Europe’s citizens to broadband today.*” Europe is mainly divided among two satellite broadband services which were developed through the technological ARTES (Advanced Research in Telecommunications Systems) programme of ESA: the **Astra2Connect** of SES in Ku-band which uses the attractive ‘plug & play’ Sat3Play terminal made by Newtec, the **TooWay** of Eutelsat in Ka-band with high-capacity interactive terminals based on the Viasat technology in North America. Newtec is looking for the near future – the early 2010s – with its **Beamsat** project in order to meet the revolution of Ka-band spotbeam satellites. Many satellite operators (Eutelsat, Intelsat) are looking for Ka-band satellites for broadcasts and broadband connections. For Beamsat, the budget of 30 millions €, mainly supported by Belgian Science Policy Office, is allocated to technology investigation (Phase I), then to product development (Phase II).

2. From HDTV to 3DTV broadcasts by satellites.

The operators of broadcasting satellites are making high profits with digital bouquets of television and with high-definition TV channels, especially in USA. The number of HDTV channels is growing up: a choice of nearly 100 HDTV channels is available throughout Europe, but their development is slower than expected. For Giuliano Berretta, CEO of Eutelsat (which is competing with SES Astra), “*HDTV is an evolutionary development; 3DTV will be a real revolution*”. In March, at Rome, Eutelsat made demonstrations of a 3DTV system, initially earmarked for movie theatres. Hispasat also made 3DTV tests by satellite. First, the theatres will be equipped to receive 3DTV channels, but in a near future, these channels will be available in homes with specific screens identical to conventional flat screens. SES Astra is looking for the next step of 3DTV: the use of MPEG 4 standard that does not require the use of special glasses to perceive the three-dimensional effect. The advent of 3DTV will impact the multimedia industry within 3 to 5 years. Because 3DTV needs more bandwidth, satellite operators have to invest in new satellite capacity. Together, the big four satellite operators with global coverage – Intelsat, SES, Eutelsat, Telesat – have more than 30 spacecrafts under construction to meet HDTV and 3DTV needs!

3. Mobile video and broadband services with powerful spacecraft.

In USA, Sirius XM Satellite Radio operates the combined fleet of seven S-band radio-broadcasting satellites (4 XM on geosynchronous positions, 3 Sirius in highly inclined orbit) to deliver commercial-free music channels, sports, news, entertainment, traffic and weather information to nearly 20 million subscribers. Other ventures for mobile satellite services are taking form: SkyTerra with

powerful satellites in L-band frequencies, ICO and TerreStar with high-power satellites in S-band frequencies. In Japan and in South Korea, Mobile Broadcasting Corporation uses the “made in USA” S-band MBSat-1 to transmit more than 50 digital channels of audio and video programmes for reception with handsets. In Europe, the European Commission (Directorate for Information Society and Media) launches a competitive call for proposals to select pan European operators for mobile satellite services in the S-band spectrum. Solaris Mobile (a joint venture of Eutelsat and SES, with first S-band payload on Eutelsat W2A satellite which was launched on 4 April 2009) and Inmarsat (with the project of Europasat planned for launch in 2011) appear as the winners of the competition, but no official announcement has been made about the final selection of the European Commission.

The good financial results of SES and Eutelsat, mainly due to direct-to-home broadcasts of digital bouquets, HDTV channels and interactive broadband connections

SES in Grand Duchy and Eutelsat in Paris, European leaders for global satellite broadcasts and communications, recorded high revenues and net profits in 2008. They predicted 2009 as a great profitable year because of continued growth opportunities, with new satellites, in the business of direct-to-home channels and 2-way broadband services.

SES revenues in 2008 reached more than 1.6 billion € with operating profit of 625 million € reduced to 387.5 million € after finance charges and tax impact (a lot of money being paid to the Treasury of Luxembourg: this explains the substantial participation of Grand Duchy to ESA technological programmes!). Recently, reporting about the operational performances for the 1st quarter 2009, SES confirmed the announced trend of growth potential: some 424 million € with a net profit of 121.8 million € for the first three months of this year.

The group, consisting of SES Astra and SES Sirius for European operations, of SES Americom-New Skies for North American and worldwide operations, of Canadian Ciel Satellite and Mexican Quetzsat subsidiaries, launched three geosynchronous satellites (AMC-21, Astra-1M, Ciel-2) and has a total of nine satellites in construction during the period 2009-2011. It is cooperating with Eutelsat for the Solaris Mobile venture which is headquartered in Dublin and whose first S-band high-power payload is onboard W2A satellite successfully launched on 4 April. SES Americom will host an experimental infra-red sensing payload for the US Air Force on its AMC-5R satellite to be launched in 2010. In order to improve its influence in the Middle East for satellite broadcasts, SES Astra has entered a partnership with the private Arab satellite operator Al Yah Satellite Communications Company (Yahsat) to create a new company under the

name of YahLive. This new entity, in which SES will have 35 % of equity, is dedicated to direct-to-home market with 23 transponders on the powerful Yahsat-1A satellite to be launched in late 2010.

Eutelsat for which the accounting year is from 1st July to 30 June announced revenues of 463.5 million € (with 135.2 million € of net profit) for the second half of 2008. These results, when they are translated with the results of the first six months of 2008, give 911.7 million € with 212.8 million € of net profit. Eutelsat has some relationship with Hispasat through Abertis Telecom : this Spanish infrastructure and services group holds 32 % of Eutelsat and 28.4 % of Hispasat (whose 27.60 % are owned by Eutelsat). Hispasat operates satellites covering Spain, Latin American countries and offering transatlantic links. The Eutelsat constellation received three new satellites (Hot Bird 9, Hot Bird 10, W2A), launched between December 2008 and April 2009; five further satellites (W7, Ka-Sat, W3B, W3C and Atlantic Bird 4-R) are under construction for planned launches until mid-2011. Eutelsat has a strategic partnership with Egyptian Nilesat company which operates broadcasting satellites covering the Middle East and North Africa.

2. Strategic challenges in the world for innovations within development and utilization of space systems

The ITAR dilemma

The business of satellites for commercial applications (telecommunications, television, earth observations) and of the launch services is affected by the export-control regime imposed by US Department of State under the strategic name of ITAR (International Traffic in Arms Regulations). These regulations implementing the provisions of the Arms Export Control Act treat satellites as weapons, so that the marketing of “made in USA” components and systems is strictly controlled and restricted in order to avoid proliferation and transfer into hostile or terrorist hands. The authorization imposing severe conditions must be given to US satellite-component providers in order to equip any Western satellite. ITAR export control rules forbid American, European and Japanese satellites containing US components to be launched with Chinese Long March rockets. They represent a hard bureaucratic process which still takes time (1 month minimum) and money (with specific team to solve problems).

The impact of ITAR constraints on space business was a sensitive subject of discussions during Satellite 2009 conference in Washington, D.C. First, China offering the cheapest opportunity for access to space is not allowed to freely market its satellite launch services. The only companies that have adopted an entirely ITAR-free approach are Chinese and Russian satellite manufacturers. In

Europe, Thales Alenia Space (Cannes) has decided to manufacture ITAR-free or “non restricted” satellites with the possibility for customers to launch them from China.

Reynald Sezec, CEO of Thales Alenia Space, noted in a March 26 media presentation during Satellite 2009, said his company has fully informed the U.S. government about what it does with its “non-restricted” spacecraft: *“We have to put strong internal rules for the process inside the company. We are absolutely transparent and candid with the US authorities and our dialogue with the French authorities is permanent.”* He specified that his company is manufacturing one ITAR-free Spacebus-4000 satellite per year: this represents only 5 % of the market. Thales Alenia Space has sold this product only to customers that have specifically requested it so that they can take advantage of China's less-expensive and, in recent years, reliable launch vehicle. Palapa D-1 for Indonesia (to be launched this year) and W3B for Eutelsat (planned for launch in 2010) will use long March 3B launchers.

Second effect of ITAR: export restrictions are negatively impacting the health of the US space & security industries, following AIA (Aerospace Industries Association). A statement published by the CSIS (Center for Strategic and International Studies) in February 2008 criticized ITAR: *“The current export control policy has not prevented the rise of foreign space capabilities and in some cases has encouraged it. [...] [It] is constricting US engagement and partnership with the rest of the global space community and fed a growing separation between the US and an merging non-US space community.[...] The US share of the foreign space markets is steadily declining and US companies are finding it increasingly difficult to participate in foreign markets”.* More dramatic is the fact that US pre-eminence in space is under challenge in many areas. The Obama Administration and the Congress are pressed to relax some ITAR elements of the current licensing regime, because of the potential loss of jobs among US satellite-component providers. During his campaign, President Obama made it clear that the new administration would, *“direct a review of the ITAR to re-evaluate restrictions imposed on American companies, with a special focus on space hardware that is currently restricted from commercial export,”* according to his white paper entitled, *“Advancing the Frontiers of Space Exploration”*.

What's the position of Europe about ITAR restrictions? The reactions are diversified. ESA is gradually adopting an ITAR-free posture for sensitive satellite components. Despite the quality and often the low cost - the advantage of the dollar compared to the euro - of “made in USA” satellite components, they are encouraging all-European supply sources to avoid the delays and general hassle that is ITAR. *“With ITAR, it's the black-box theory,”* said Jack

Bosma, head of ESA's quality department. *"You have no access to what is in there. You cannot open it or look at it. ESA is not allowed to open those components."* In addition to Thales Alenia Space, OHB-System of Bremen, Germany, is developing a commercial telecommunications satellite product that is intended ultimately to be ITAR-free. With development funded by ESA and the DLR (German Aerospace Center), OHB's SmallGEO program is expected to result in the launch of what OHB calls its Luxor satellite design starting in 2012. Hispasat of Spain is the first customer of the SmallGEO platform. Another candidate is the EDRS (European Data Relay Satellite), but some 150 million € are still missing to go ahead with its development.

However, Arianespace remains in favour of the status-quo for ITAR rules, because their application protects it from the seriously competitive offer of China Great Wall Industry Corp with the - now reliable - Long March launch services. Arianespace has won business that, without ITAR, would have gone to China. The choice of Eutelsat to launch W3B with a Chinese Long March 3B shocked Jean-Yves Le Gall, CEO of Arianespace: *"It leaves us extremely perplexed.[...] Various governments - most notably the US - have good reasons for wishing that there not be a technology transfer to China"*.

The SSA initiative

The environment of space, made of radiation, debris, particles and meteors, has to be constantly monitored in orbit and from the ground, because of the strategic importance to protect satellites for vital applications on our planet. "Space for a safe and secure world" was the theme of the 13th ISU Annual International Symposium, 18-20 February, at the International Space University, Strasbourg. This excellent conference highlighted the dramatic collision, on 10 February, between Russian Cosmos-2251 wreckage in orbit and American Iridium-33 used for mobile phone services around the globe. How to avoid that crucial spacecraft (especially when they are manned spaceships) can be suddenly jeopardized or destroyed?

ESA, at Ministerial Council of The Hague, decided to go ahead with the preparatory programme of the SSA (Space Situational Awareness) system with a budget of nearly 50 million €. This system would cover four distinct domains: survey & tracking of pieces in orbit, space weather (Sun-Earth relations), near earth objects (asteroids, comets, ...), imaging of orbital objects. During the preparatory phase 2009-2011, only the first three domains will be addressed. *"The imaging of space targets, especially from sensors in space, will be addressed in a Phase 2, as from 2012, once the governance, data policy and data security matters will have been solved"*,

specifies Erwin Duhamel, Security Strategy & Partnership Development Office, ESA DG Policy Office.

In a recent presentation about “Keeping the space environment safe for civil and commercial users”; Lieutenant General Larry James, Commander, Joint Functional Component Command for Space (JFCC Space) in USA, specifies that space traffic has quadrupled since 1980: 19,000 objects, including 1,300 active payloads and 7,500 pieces of debris, are tracked. About SSA in USA, he states: *“We need to understand the location, status and purpose of these objects, their capabilities, and their owners’ intent. This comprehensive knowledge enables decision-makers to rapidly and effectively select courses of action to ensure our sustained freedom and action and safety in what is clearly a contested environment. To get there, we require more automated, net-centric capabilities to command and control space forces, and networked sensors and information systems that seamlessly share information to more effectively use our current resources.”* He refers to new systems in the US space surveillance architecture to address critical gaps for the full tracking and characterization of all on-orbit objects, especially for SSN (Space Surveillance Network) operations in the southern hemisphere: a very accurate dedicated radar “Space Fence”, and the Space-Based Space Surveillance (SBSS) satellite for an uninterrupted scan of the entire geostationary belt. *“The US must continue to lead the community of space-faring nations and encourage responsible behaviour in the space environment”*.

The ORS (Operationally Responsive Space) impact

In the case of emergency in orbit, because of destruction or failure of satellite, how to replace it in a quick mode? The challenging tasks are to design, to develop, to integrate, to test to launch and to operate a spacecraft for an efficient and reliable mission in space. To meet such a challenge, the Pentagon has created at the Kirtland Air Force Base (New Mexico) the ORS Office for Operationally Responsive Space activities. This small “space agency” is a joint initiative of several agencies within DOD (Department of Defence) to demonstrate the capacity to respond to unexpected loss or degradation of selected capabilities around the globe, to ensure affordable access to the space-based capabilities for national security purposes, to provide timely availability of tailored or new capabilities. The ORS’ rapid innovation process, focusing on small satellites and launchers, is to understand the need of the customer, to control the drivers for innovation lead-time, to utilize new systems around modular and open standards. This process aims at introducing a

(r)evolutionary approach of new and low-cost technologies for on-demand missions in space.

The ORS Office, with a modest budget - around some 150 million € for FY 2009 - is working on the technological Tacsat programme of communications and remote sensing mini satellites (less than 500 kg). Until now, only Tacsat-2, based on a MicroSat Systems bus, was launched in December 2006 from Wallops (Virginia) for 1-m resolution earth observations, with signals intelligence payload and innovative propulsion and control technologies. Tacsat-3 will be launched in early May 2009 to test an innovative hyper spectral imager. The main problem for the ORS programme is to have launch services quickly available for orbital operations. It currently uses solid launchers, like the Minotaur series, derived from existing missile hardware. Next spacecraft developed under the ORS programme will be the operational ORSSat missions with launches starting in 2011: electro-optical infra-red sensors, first alert capability, SSA payload, earth mapper, SAR (Synthetic Aperture Radar)... ORS studies HawaiiSat to be ready for launch within a few hours after a possible earthquake with tsunami. It also envisions to deploy an ORS constellation of small satellites.

An ORS-type programme does not yet exist in Europe. Since a decade, ESA, at ESTEC (European Space Research & Technology Centre), operates the CDF (Concurrent Design Facility) with software methodology to stimulate and accelerate an integrated design environment with multidisciplinary approach and for interdirectorate applications. The implementation of the CDF started in November 1998 with the support of the General Studies Programme (GSP). Among CDF achievements: more than 80 studies of potential missions (pre-phase A, concept), 3 new launcher concept designs... Study duration (design phase) has been reduced in time (from 6-9 months to 3-6 weeks) and in cost (2 times less expensive approach). The CDF is an essential tool for the ESA decision making and risk management processes.

The signal interference problem

The growth in satellite communications, broadcasts, broadband connections is increasing the risks of signal interferences between satellite services and ground systems. This is particularly the dramatic case in emerging countries of Africa and Latin America, where the terrestrial wireless infrastructure, for the use of frequencies, is competing with space segment links. National regulators encounter some difficulties to respect the ITU (International Telecommunications Union) regulations. Another

kind of interference is related to companies which build, install and operate two-way satellite antennas and terminals. Industry associations such as the Satellite Users Interference Reduction Group (SUIRG) and the Global VSAT Forum (GVF) anxiously consider that the growth of the commercial satellite business stimulated by privatization has been accompanied by an increase in haphazard ground antenna installation and operating techniques.

The world's two largest operators of commercial satellite fleet in geosynchronous orbit, Intelsat and SES, are embarking on a joint effort to fight the problem of unintentional satellite signal interference. A badly pointed satellite antenna can cause signal interference on a neighbouring transponder on the satellite the antenna is supposed to connect to, or on a spacecraft located at an adjacent slot in geostationary orbit. Together, Intelsat and SES are creating an industry-wide database to collect information on interference and establishing a partnership to train people for installing and operating satellite uplink facilities. In addition to training, the Intelsat-SES initiative seeks to encourage manufacturers of satellite Earth stations to include carrier-ID technology in their products. This would give operators the exact location of the antennas, enabling a quicker response to interference.

3. Access to space, the key factor for satellite business and manned operations in space

Arianespace offer of high-quality launch services - a worldwide reference - to be supported by further ESA investments

In order to efficiently compete with Russian (Proton) and Russian-Ukrainian (Zenit Sea Launch and Land Launch) launchers whose prices are attractive, Arianespace highlights the quality and the reliability of its space transportation services with Ariane 5, the most powerful commercial launcher. Its offer of launch opportunities will be improved and become more flexible in 2010 and after with the medium-class Soyuz and small Vega vehicles. Recently, ESA has agreed to make supplemental investments of 100 million € in the Soyuz and Vega programmes to take account of development delays. There are some additional charges for completion of the new launch pads (ELS, SLV) at Europe's spaceport in French Guiana. French space agency CNES is acting as prime contractor for the development of the Soyuz launch complex. France is paying the majority of the costs of the program, whose total ESA budget was estimated at 223 million € (2002 economic conditions). An additional 121 million € of Soyuz-related financing is paid by Arianespace through a 10-year loan from the European Investment Bank. The loan will be repaid from Soyuz launch revenue.

For the heavy-lift Ariane 5 rocket, ESA plans to conduct an audit in 2011 to determine whether Ariane 5 contractors have done all they could to cut their own operating costs before agreeing to finance the maintenance of certain ESA-owned Ariane 5 production facilities. While these facilities belong to ESA, they are located at the production sites owned and operated by the different Ariane 5 contractors. The ESA ministerial Council in November accepted to spend about 100 million Euros on MCO (Maintenance des Conditions Opérationnelles) expenses for these facilities through 2011. That period corresponds to the date of production of the first 10 of 35 Ariane 5 rockets Arianespace ordered from industry in February in a contract valued at more than 4 billion Euros. For the remaining 25 rockets, ESA governments ordered Ariane 5 contractors to find savings in their operations equivalent to ESA's past payment of the MCO costs paid through the ARTA (Ariane 5 Research and Technology Accompaniment) programme.

In its annual report 2008, Arianespace states that the company, with six launch campaigns last year - ATV "Jules Verne" flight to ISS plus 5 flights for commercial payload -, records a net profit of 2.5 million € on 2008 revenue of 955.7 million. It is its sixth consecutive profitable year: *"Three main performance indicators apply to Arianespace: the order book, the number of launches and net income."* Most of Arianespace's shareholders are the French

government and industrial manufacturers of Ariane 5 rocket hardware (SABCA in Brussels and Lummen, Thales Alenia Space ETCA in Charleroi, Techspace Aero in Herstal-Liege). The company uses its cash to purchase hardware and services from these companies rather than to pay shareholder dividends.

On 30 January, it ordered a batch of 35 Ariane 5 ECA rockets from an industrial consortium led by Astrium Space Transportation, a contract the company valued at more than 4 billion Euros. But only 10 of these vehicles were firmly financed, with dollar-euro exchange-rate coverage to protect against a further decline in U.S. dollar values. The first 10 launches, according to Jean-Yves Le Gall, are covered by an ESA contribution of *"several million Euros per launch"* for the MCO costs to assure that the Ariane 5 vehicle's ground-test facilities are kept up to date. Arianespace, its industrial contractors and ESA are negotiating whether ESA will fund MCO costs — and if so at what level — for the remaining 25 vehicles in the 35-rocket order. For Arianespace, some unspecified *"consolidation measures"* would be completed by the end of this year.

At the same time, Arianespace is making some minor adjustments to the performances of its workhorse, the Ariane 5 ECA rocket: a 400-kilogram increase in the payload capability will be available for flights after late 2010, enabling the Ariane 5 ECA to lift two telecommunications satellites weighing a combined 9,100 kilograms into GTO (Geostationary Transfer Orbit), the most usual trajectory of Arianespace launch services. During the presentation of the annual report, Jean-Yves Le Gall, CEO of Arianespace, specifies that the performance enhancements don't include any hardware changes, but are based upon only minor modifications in how the vehicle is flown, such as letting the upper-stage engine burn longer before releasing the satellites. The objective, the company said is to *"[facilitate] passenger pairings for each mission and also more completely [fill] the available capacity."*

2009, the crucial year for the (r)evolutionary approach of Space X launch services

Recently, Technology Review (April 7, 2009) interviewed Lawrence Williams, vice president of Space Exploration Technologies (Space X) - an ambitious private venture established by Elon Musk, the creator of mass-media software, especially the Paypal system - which is developing the Falcon family of low-cost launch vehicles and a Dragon recoverable spacecraft which could be upgraded for manned operations (carrying up to 6 astronauts). Space X insists on its capacity, with the COTS-D option of the COTS/CRS (Commercial Orbital Transportation System/Commercial Resupply Service), to provide NASA with systems and services for the replacement of the Space Shuttle. Up to 8 to 9 flights are still planned until mid-2011 with the Space Transportation System –

using a reusable 100-t Orbiter – which was developed in the 70's for missions since 1981.

The first customer of Space X for GTO (geostationary transfer orbit) mission is an European one: a new comsat operator, Avanti Communications in the United Kingdom, will use the third Falcon 9 to launch HYLAS-1 for broadband services in Ku- and Ka-bands in Europe. However, the Falcon 9, described as a low-cost space launcher, has still to demonstrate its reliability with a successful flight. When the success will be there, it can be considered as a serious rival of the European Ariane 5 rocket of Arianespace.

What about your relationship with NASA ?

Laurence Williams: We have been awarded a contract to develop first the capability to just do cargo, and eventually demonstrations with crew, although NASA has yet to exercise that part of the contract. But we are developing our system with the plan in the future to evolve into carrying crew. The capsule that we have designed is a flexible system, so basically instead of carrying cargo to the space station you put in seats and a crew life-support system. The second part of the contract is for \$ 1.6 billion for 12 flights of actual cargo. In other words, the first three flights are demonstration missions as part of the COTS program, and the 12 flights are actual cargo supply, and they start at the end of 2010.

What's your schedule for the flight-demonstration missions?

Laurence Williams: We are flying the booster later this summer without the cargo capsule on it. Then, we will fly booster with the cargo capsule for our first demonstration flight the last quarter of this year [launching from] Cape Canaveral. We won't actually dock to the station, but we will be doing a demonstration flight of our capsule design and are scheduled to do the first docking with the station in the beginning of 2011. If we started doing crew development today, we think we could do the crew demonstration in 24 months.

How is your rocket designed?

Laurence Williams: We developed a booster called the Falcon 9. On top of that booster, you can put large satellites, up to a five-meter fairing, or you can replace that fairing with a capsule called the Dragon. The Dragon is like a Gemini or Apollo capsule design, so it is a proven system, but we also have a unique trunk section that allows us to carry unpressurized cargo outside of the pressurized capsule.

How does your approach stand out from those of other commercial space companies?

Laurence Williams: The difference between our approach and what everyone else is trying to do is that we are so vertically integrated. We manufacture most of the vehicle, the booster as well as the Dragon, in house. We don't have a large number of subcontracts, so we can do things much more efficiently, and we control the quality and cost of the manufacturing process.

Note: NASA acting administrator Christopher Scolese announced on 29 April a plan to spend \$ 150 million to “jump-start commercial efforts” to deliver astronauts to the ISS (International Space Station). The money would come from a \$ 1 billion boost to NASA as part of the American Recovery and Investment Act signed into law on 17 February. That’s good news for the COTS-D initiative of Space X to demonstrate a crewed capability of the Dragon spacecraft. Questions remains. How will a privately-financed manned spaceship be able to fill the gap between the Space Shuttle end in 2011 and the Orion era planned to start in 2015? In which matter can the European aerospace industry be involved in the COTS/CRS development, despite ITAR constraints?

4. The Belgians in space odyssey: microgravity experiments, excellence centres for applications

The OasISS long-duration flight of astronaut Frank De Winne: fluid science and crystals in space, foam tested in microgravity

On 27 May (12 h 34 precisely), ESA astronaut Frank De Winne, carrying the Belgian and European flags on his spacesuit, will be launched aboard the Soyuz TMA-15 spaceship. He will arrive at the International Space Station (ISS) two days later for 6-month mission which is planned to end during the last week of November. Member, then commander - in October-November - of the first 6-people permanent crew of ISS, De Winne will be concerned by many microgravity experiments (technology, physiology, biology...) inside the Columbus module.

- Two fluid science experiments in the Microgravity Science Glovebox are developed by scientists of the MRC (Microgravity Research Centre), Université Libre de Bruxelles, with the technical support of Lambda-X in Nivelles: Diffusion and Soret Coefficient measurements for improvement of oil recovery (DSC) and The Influence of Vibrations on Diffusion in Liquids (VIDIL).
- The multi-user Protein Crystallisation Diagnostics Facility (PCDF) in the European Drawer Rack was brought to ISS by STS-119 flight in March. It consists of four reactors containing protein solutions prepared by Vrije

Universiteit Brussel and B.USOC (Belgian Users Support Operations Centre) in Uccle. It uses an original, compact and sophisticated optical system which was designed and developed by Lambda-X, while its mechanical design is made by Verhaert Space. Without the convection and sedimentation effects induced by gravity on Earth, the accurately visual analysis of the protein experiment will help to understand the fundamental processes that occur during crystal growth. The processed crystals will return to Earth in June with the STS-127 mission.

- **Foam Stability**, a scientific and educational experiment of the GRASP (Group for Research & Applications in Statistical Physics) laboratory of the Université de Liège, will test some 60 aqueous samples to produce foams and to view their evolution in microgravity environment. Five units of 12 tubes containing the samples were designed and developed by Verhaert Space. They will be carried to the ISS under the seat of Frank De Winne inside the Soyuz TMA-15 capsule.

Mol (VITO/CVB) and Redu (ESA station) becoming Belgian reference sites for satellite applications

Federal Minister Sabine Laruelle, during her visit in April of two public facilities concerned by space activities, announced the support of the government to make them two excellence centres for satellite applications.

- **VITO in Mol** is concerned, since a decade, by the processing and archiving of the multispectral images collected by Vegetation radiometers on French SPOT-4 and SPOT-5 earth observation satellites. Its Centrum Voor Beeldverwerking (CVB), formerly named Centre de Traitement des Images Végétation (CTIV), got a federal funding of 17 million € for the next five years (until 2013) to reinforce and improve its know-how for imagery interpretation and to become a generic platform for geo-information with air and space imagery. In the framework of the GMES (Global Monitoring for Environment and Security) programme of the European Union, it will continue the use of Vegetation/Proba V images to rapidly monitor the natural resources and environmental risks.
- **ESA Station of Redu**, operated by Redu Space Services (RSS), a joint venture of SES Astra Techcom Belgium and Verhaert Space, plays a major role for the IOT (In Orbit Test) of communications and navigation satellites, for the control of autonomous microsattelites to be used for scientific missions and remote sensing operations. The station has to evolve into an excellence centre for integrated applications, combining telecommunications, navigation and earth observations. It is getting a financial support of 9.2 million € from the Belgian Policy Office (3.7 million €) and from ESA (5.5 million €) to improve the facilities and to



proceed with extension of the site for the Galileo system and for commercial activities. Near the Euro Space Center Belgium in Transinne-Libin, the Galaxia high-tech incubator which welcomes new SME's to develop applications with satellite systems is a “plus” for Redu-Libin development.

