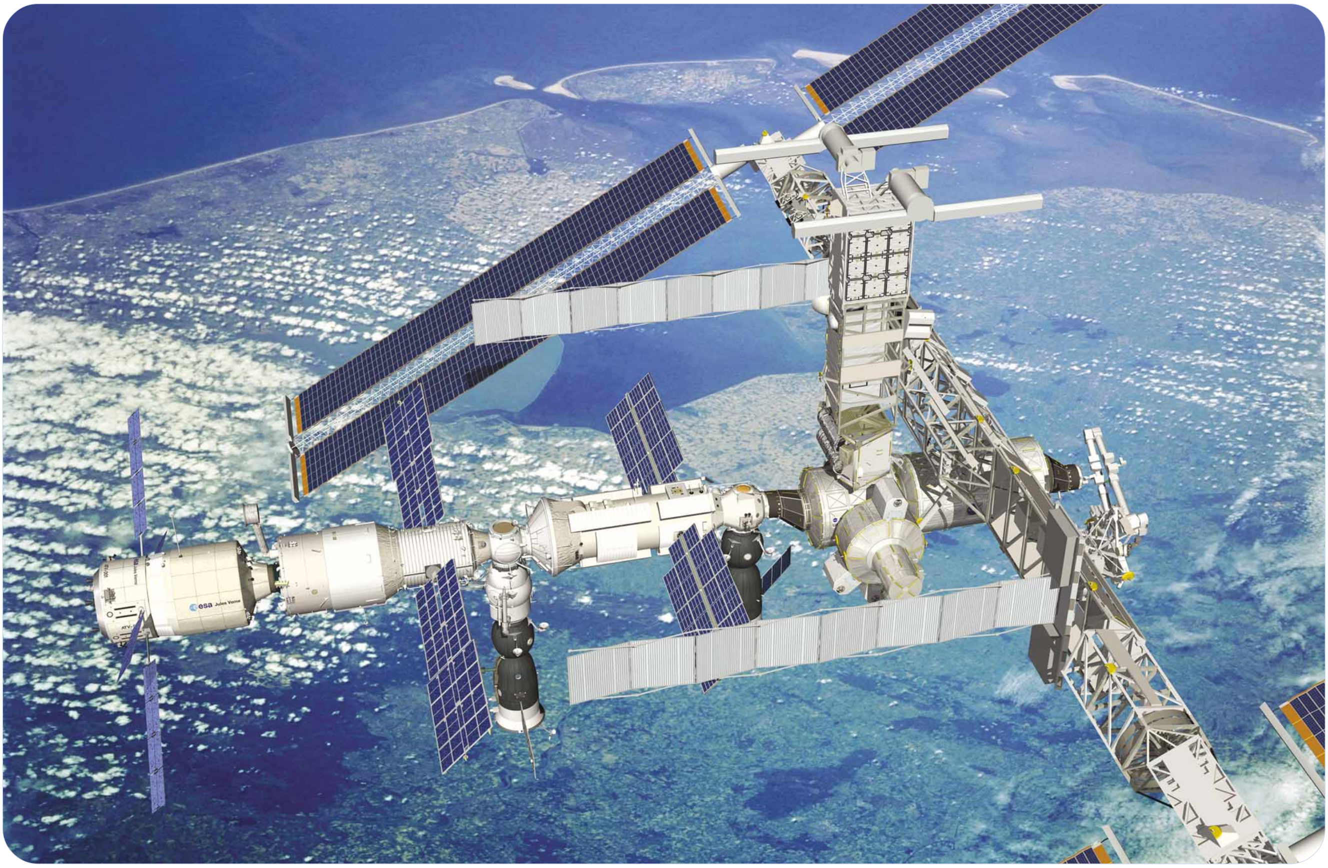

ATV docked with ISS. Photo courtesy of ESA.

Safeguarding Europe's access to Space

Helen Jameson spoke to Guy Pilchen, the Programme Manager of the FLPP to find out more about their work, their processes, and why a next generation of launchers will be necessary in the future.

The European Space Agency's pledge to guarantee access to space is no more evident than in the Future Launchers Preparatory Programme. Started in February 2004, the FLPP aims to create a Next Generation Launcher for operation by around 2020. The FLPP will conduct system studies and technology activities, including ground and in-flight tests, to foster new technology capabilities within Europe to enhance the reliability and competitiveness of European launchers.

Question: Many thanks for your time and for taking my questions Mr. Pilchen. Can you begin by telling us about ESA's Future Launchers Strategy?

Guy Pilchen: It is my pleasure to answer to your questions and to give you some details on future launchers. When talking about ESA's Future Launchers Strategy, we must recognise that guaranteeing access to space is a strategic goal for Europe. We believe that there are three basic pillars that will help secure guaranteed access to space for Europe in the long-term: (1) the exploitation of operational launch systems; (2) the development activities linked to the near-term future and aimed at preparing the next step ahead; and, (3) the activities in preparation for the long-term future.

This third pillar is essential not only in order to prepare the future European launch systems, but also in developing and safeguarding European systems and technological capabilities all across Europe in order to enhance the long-term competitiveness of European launchers.

Question: Why is a next generation of launchers necessary?

Guy Pilchen: Preparation for the long-term future is one of the three pillars that will guarantee European access to space, so the preparation of a Next Generation Launcher is also necessary to cope with this evolving situation. This evolution in launch systems is happening for two main reasons: it is driven by the payload needs, in the context of competition, where it is necessary to offer increasing performance and new functions, with the associated reliability; and it is also driven by the evolution of technologies. Some new technologies must be considered and some may even become obsolete, thus necessitating innovation.

Bearing in mind this evolving context, one must also understand the importance of time for the development of a new launch vehicle. In the case of Ariane 5, the first qualification flight took place nine years after the development decision was first made. The decision to develop a new launch vehicle must be based on a well-informed foundation, and this justifies preparatory activities to gather technical and programmatic elements for this kind of decision.

In the case of Ariane 5, preparatory activities lasted several years, mainly on the engine for the main stage, and this provided the developers with sufficient technical knowledge to make decisions on the project. It is the main objective of the Future Preparatory Programme (FLPP) to run these necessary preparatory activities for the Next Generation Launchers.

Question: Can you please take us through the different stages of a launcher and the jobs they do?

Guy Pilchen: The final objective of the launcher is to place a payload (meaning one or more satellites with their associated mass) in a given position in space with a given attitude and speed.

The launcher is composed of stages. Each stage will contribute to the overall speed increase of this payload from the ground to its orbit.

To simplify to the extreme, we will say that each stage is composed of an engine and propellants with their tanks and supporting structures.

The main characteristics of a stage are its dry mass, the quantity of useful propellants and the thrust and efficiency of the engine.

The staging of the launcher is vital in determining an optimum decomposition of different stages to provide the overall speed increase required. We must keep in mind that a stage is jettisoned once all the propellants have been burnt; this enables it to lighten the rest of the launcher.

Payload faring of Soyuz for the ATV launch. Photo courtesy of ESA.

At take-off and during first phase of flight where gravity force is still significant, the stage must provide a high thrust. This is provided by the first stage, which can be complemented by boosters. Besides liquid propulsion with high thrust engines, solid propulsion can be used for its high thrust capability.

We usually call the last stage of the launcher the “Upper Stage”. It provides the final speed increase and the required attitude to the payload before its separation. Knowing that the speed increase is provided to the set composed of the Upper Stage and the payload, we aim at minimising the mass of the upper stage enabling us to maximise the mass of the payload. Then for the Upper Stage, we are looking for a highly efficient stage, minimising the ratio propellant mass over dry mass, and with a highly efficient engine. In order to reach the injection speed of the payload, liquid propulsion engines are used as they can be cut off precisely. Engines with highly efficient cycles (so called closed cycles) are of interest to us for these stages.

To provide the correct attitude of the payload before it’s jettisoning, a dedicated system is used to give the necessary low thrust impulses.

The Future Launchers Preparatory Programme is studying these different launcher concepts, in particular two stage configurations where performance flexibility can be provided by the addition of strap-on boosters. The Future Launchers Preparatory Programme is also investigating high thrust engines, as well as closed cycle upper stage engines including tests and re-ignition capabilities.

Question: Creating a new generation of launchers is a massive challenge to undertake and very complex. You are in the process of developing an intermediate experimental vehicle for the validation of re-entry technologies. Are you on schedule for the first orbiting flight in 2010?

Guy Pilchen: It is true that creating a new generation of launchers is always a challenge, especially when putting new technologies on board to benefit the performance. This is the reason why we count on the IXV development and flight experience, to increase the European know-how in re-entry systems integrating frontier technologies at system level, to support informed decision making on long-term operational developments, not only for future launchers but for space transportation systems in general, including those currently under discussion in Europe for manned exploration. We see this intermediate step as necessary to mitigate risks, to allow progressive financial efforts and to ensure that bigger challenges rely on previous achievements.

The first lesson learnt is the time necessary to organize industries and federate European efforts behind a new space transportation challenge… we have passed the system requirements review successfully and we are now going full-speed with a consolidated schedule planning for a flight in 2012.

Question: We are all aware of the need for the development of ‘greener’, more environmentally friendly technologies. What considerations are you making to ensure that this next generation of launchers are more environmentally friendly?

Guy Pilchen: Yes, environmental issues are important and must be considered, and legislation on this topic evolves and will apply to the development of future launchers. We are concerned that the electronic units of future launchers will contain no more lead, thus relying on a greener manufacturing process. Recovery of the first stage and booster will also avoid any wreckage. In terms of propellants, alternative solid propellants as well as advanced Reaction Control Systems based on non-toxic and green propellants shall also be considered.

Question: What work are you doing in terms of the development of new propellants?

Guy Pilchen: To make a link with the environment, I would like to remind you that any engine using liquid oxygen and liquid hydrogen is producing water which is very satisfactory in terms of the environment. The use of these very efficient propellants is well mastered in Europe but some other propellants are also being investigated. In particular, in comparison with liquid hydrogen, liquid methane presents some advantages in terms of mass and storage temperature that may lead to different sizes of vehicles.

We are considering this propellant in the studies of system concepts. Besides these system studies, we will also acquire experience with this propellant by performing tests on a combustion demonstrator. Some tests are already scheduled for this year.

Question: The question of re-usable launchers is often debated and at present the Shuttle (although only partly re-usable) is the only one in service, soon to be retired. Do you think that we will see a new and successful re-usable launch vehicle in use in the near future (e.g. Falcon 9)? What kind of work is ESA doing on re-usable launch vehicles?

Guy Pilchen: Considering that on an Expendable Launch Vehicle, each stage is used only once, this may be not considered very cost efficient! Thus, the idea of the Re-usable Launch Vehicle is to save cost by using it several times or re-using several stages.

A re-usable stage requires additional systems to be in place to recover the stages in good condition; this represents an additional mass to the stage thus requiring an increased performance of the launcher that is not used for the payload. Furthermore, we understand that, in order to maintain the same reliability after several flights, the sizing margins of the vehicle must be higher than for an Expendable launch vehicle and the inspection process is also of the utmost importance. These are some of the high challenges linked to re-usable vehicles.

To have a successful re-usable launch vehicle, there are not only many technical challenges to overcome but economical challenges too. An economically viable system is critically important. I am not sure this will be possible in the near future.

Nevertheless, re-usability concepts remain interesting for the longer term, and as the Future Launchers Preparatory Programme prepares for the future, we are studying some re-usable and semi-reusable concepts.

Generally speaking, and this is also a strong structuring element of FLPP, a stepped approach is often a reasonable way to advance significantly in new concepts, and in this sense semi-reusable vehicles with for instance re-usable first stage or boosters are of interest. Moreover, we must understand that all the technologies under investigation in FLPP which are targeting an increase of performance of the launcher will have applications not only on expendable launch vehicles but will also prepare the way for long term future re-usable vehicles.

Question: How long will the remainder of the Programme run for and what will happen once it is over? Will ESA continue to conduct research and development into launchers?

Guy Pilchen: One major objective of the Future Launchers Preparatory Programme is to bring technical and programmatic elements to ground a decision for the development of a future launcher. In terms of technical elements, we often define target on a scale of Technology Readiness Levels. This is where we target a maturation corresponding to the test of technologies in representative environment.

When this is achieved for all the enabling technologies, the programme will be in the position to hand over to a development program.

We believe that this level will be achieved for some important technologies around 2015. And then, what will happen once a development decision is taken? ESA will continue to conduct Research & Development activities into launchers to safeguard this guaranteed access to space.