

## Answers to Questions of Germany

### **1. ESA Launcher Corridor 750 M€/year**

All figures included in the hand-out of 23 September are in 2014 economic conditions (e.c.), as explicitly mentioned in several pages of the hand-out, in particular page 17 where Ariane 6 development and investments costs are presented.

Constant e.c. are used for all and every ESA programme and they are all subscribed in constant e.c.

Obviously, the “payment tables per Member State” are preliminary, since they depend upon:

- the scale of contributions to each programme. The range of scale of contributions which is associated to the launcher corridor of 750 M€/year in the conclusions of Ministers of 8 July can lead to a range of money available for launchers starting from 675 M€ (by using the lower scale for each Member State) to 877 M€ (by using the upper scale for each Member State).
- the payment plans which have still to be negotiated and agreed with industry.

### **2. ESA Launcher Corridor of 800 M€/year**

Apart from the effect of the scale of contributions on availability of money underlined above, the “800 M€ corridor” was associated to savings which could be expected from 2021 onwards in launch costs of institutional missions.

In order to evaluate these savings, we have to compare the launch prices of Ariane 62 with Soyuz and of Ariane 64 with Ariane 5 (ECA and ME since the launch costs are the same).

The current Ariane 5 launch prices (standard) are 165 M€ (e.c. 2014) according to the last offers made for ESA missions (Bepi-Colombo, JWST). The expected launch prices of Ariane 64 are 115 M€ (e.c. 2014). It is recalled that the launch costs of Ariane 64 are expected to be 90.6 M€, but the expected revenues for a full Ariane 64 are 115 M€. For our evaluation, we shall therefore assume a saving of 50 M€ for a full Ariane 64 compared to a full Ariane 5 and of 25 M€ for one passenger of a dual launch. This assumption is conservative.

For the Soyuz launch prices, the evaluation is more difficult because of the significant evolution of these prices, which may continue and which creates uncertainties on the evaluation of savings. As a matter of fact, the “reasonable price” for a Soyuz launch was fixed at the C/M05 at 40 M€ (e.c. 2002), which makes 51.6 M€ (e.c. 2014). The offers made for Galileo missions were for the five Baseline Soyuz Launch Services at a price of 69.3 M€ (e.c. 2010), i.e. 74.7 M€ (e.c. 2014) and for the eight Optional Soyuz Launch Services at a price of 74.1 M€ (e.c. 2012), i.e. 78 M€

(e.c. 2014). The last offer concerning the launch of PROBA 3 in 2018 indicates a rough order of magnitude of 85 M€. The expected launch price of Ariane 62 is 70 M€ (e.c. 2014). Even though the launch costs of Ariane 62 may be higher, the target price is fixed to industry at 70 M€ in order to take into account the results of exploitation of Ariane 62 and Ariane 64 together, as the exploitation of a single launcher Ariane 6 (see below under point 3). For our evaluation, and taking into account the higher performance of Ariane 62 compared to Soyuz (which can provide much more flexibility for some institutional missions planned such as Galileo SG and Plato), we shall therefore assume a saving of 10 M€ for an Ariane 62 compared to Soyuz. This assumption is conservative.

With these assumptions, and taking the institutional missions which are identified from 2021 to 2024, as reported in the presentation made to Ministers on 8 July, we arrive to the following savings:

	Missions	Launcher	Savings	Total
<b>2021</b>	MTG S1	Ariane 64	25	55
	SL-1C	Ariane 62	10	
	MetOp SG	Ariane 62	10	
	Galileo SG	Ariane 62	10	
<b>2022</b>	MTG	Ariane 64	25	130
	Skynet	Ariane 64	25	
	Juice	Ariane 64	50	
	SL-1D	Ariane 62	10	
	MetOp SG	Ariane 62	10	
	Galileo SG	Ariane 62	10	
<b>2023</b>	Sicral	Ariane 64	25	80
	Skynet	Ariane 64	25	
	Cosmo	Ariane 62	10	
	Galileo SG	Ariane 62	10	
	Galileo SG	Ariane 62	10	
<b>2024</b>	Plato	Ariane 62	10	80
	CSO	Ariane 62	10	
	INSPIRE	Ariane 64	50	
	Galileo SG	Ariane 62	10	
				<b>345</b>

Taking into account the potential savings to be expected during these four years on around ten launches of Vega (for which the prices will directly benefit of the cadence of production of P120 but are yet to be consolidated), as well as potential additional institutional missions which could lead to additional launches at the end of the period, we are not far from the amount of savings required for moving to a "800 M€ corridor". Obviously, these savings will continue to accumulate beyond 2024, but are not considered for the corridor 2015-2024.

### **3. Maturity of the Ariane 6 Project. Technical/ Financial/ Scheduling Aspects.**

#### Technical aspects

The current Ariane 62/Ariane 64 technical concept was introduced mid-August 2014. However, it relies upon a substantial heritage which has no equivalent compared to any previous launcher programme, including Ariane 1.

As a matter of fact:

- The architecture (in particular the staging) is the same as for Ariane 5.
- All engines are already qualified: Vulcain 2 in flight, Vinci on ground and the P120 is directly derived from P80 also qualified in flight.
- The upper stage is already in a development phase and a bridging phase was recently decided in order to keep the momentum of industrial activities.
- A significant part of Ariane 6 (upper part, overall structures, Motor Cases etc.) rely upon technical work and activities run since C/M12 on Ariane 6 PPH, including industrial competition made on six Consolidated Launcher Elements (including avionics).
- As for the system activities, the recent additional subscription of 10 M€ on Ariane 6 provides the funding necessary to start system activities before C/M14.

#### Programmatic aspects

- We have received on 27 October, a complete and committing industrial proposal which should be compliant (to be evaluated) with High Level Requirements and thus include targets on exploitation costs. The only ESA programme for which a complete and committing industrial proposal was available before Participating States' subscriptions is Ariane 5 ME. Ariane 6 is therefore an exception in the usual process of decision for new optional

programmes. Member States will have more data and commitments from industry on Ariane 6 than for most ESA optional programmes.

- The industrial proposal relies upon all the work which has been done since two years on Ariane 5 ME, Ariane 6 PPH and VECEP, as well as industrial activities which have led to the unsolicited industrial proposal (Ariane 6.1 and Ariane 6.2) which has been fully evaluated in June 2014.
- The general governing principles for Ariane 6 development and exploitation are under discussions between ESA and industry since two years.
- An MoU between ESA, industry (for the launcher system development) and CNES (for the ground system development) is under negotiation and will be finalised before C/MIN14, providing roles, responsibilities, share of costs and risks of each party upon which development contracts will be based.

#### Financial aspects

- For the first time, ESA, CNES and industry have agreed on all cost data concerning Ariane 62 and 64 (development and exploitation costs), based on the above mentioned heritage and on a common understanding about disagreements on previous versions of Ariane 6 (PPH and unsolicited industrial proposal).
- The credibility of the cost data is therefore based upon:
  - Agreements between the parties, which was not the case before.
  - The heritage coming from all activities performed on relevant part of Ariane 5 ME, Ariane 6 PPH (including the ground segment) and VECEP.
- The cost data included in the presentation of 23 September are accommodating a provision of 215 M€ for uncertainties, on top of the ceiling cost imposed to industry in the High Level Requirements.
- The share of risks as well as the payment plan to industry which is designed upon deliverables rather than activities consolidate the credibility of costs and also of the schedule (see questions 6 and 7).

#### Scheduling aspects

- The schedule offered by industry for the maiden flight of Ariane 6 was 2019. After joint assessment work, we have agreed on 2020, which provides robustness.
- The critical path for mid-2020 is mostly the system activities and relevant tests (and thus, the start of system activities before C/M14). The upper stage and P120 will be ready in 2018.



- Apart from the upper stage and P120, the development activities concern the main cryogenic stage based on Vulcain 2, but does not involve new technologies development, just application of existing technologies. This is the case of GOX pressurisation (with the back-up of keeping the existing Helium pressurisation), as well as Friction Stir Welding which has been developed several years ago, planned (and validated by VKP) to be implemented on Ariane 5ME upper stage and extensively used on Falcon.
- Industry will be incentivised for keeping the schedule by the payment plan based upon deliverables.
- We wish to recall that Ariane 1 which was based upon existing engines, but used on totally new second and third stages, was decided in July 1973 and flew in 1979, at a time when European launcher industry was much less mature than today.

#### Evaluation of the maturity

The complete and committing industrial proposal will be evaluated by two independent committees:

- The TEB, chaired by T. Tolker-Nielsen, Inspector General, with three panels: technical, programmatic and financial.
- An independent Programme Verification Key Point, chaired by M. Courtois and consisting of the same members as the one put in place for Ariane 5 ME (except for those members who are in the TEB).

Results will be made available to Member States before 13 November.

#### Specific questions

- Cost reductions levers (as presented in page 12 of the presentation of 23 September to explain how to reduce the exploitation costs from 158 M€ of Ariane 5 ME to 90.6 M€ of Ariane 64). The main levers are the following:
  - The most important lever is linked to the production rate which is significantly increased as explained in page 10 of the presentation (this lever represents more than 30 M€ of reduction). This lever is very robust since it is based on solid and proven experience in the past, on the increase side when moving from Ariane 1 (production of 5 Viking per launch) to Ariane 44L (production of 9 Viking per launch) and on the decrease side when moving from Ariane 4 to Ariane 5.
  - Another important lever is linked to the reduction of the number of layers of the industrial organisation as well as of the overheads of each layer (this lever represents alone more

than 10 M€ of reduction). This lever is very robust since the relevant costs have been audited in details for the production of Ariane 5.

- The lever of the design to production cost, applied systematically, relies upon 20 years of experience accumulated in the production of Ariane 5.
- Lastly, the lever of competitive bidding has effects which have been measured by ESA, in particular in the CLE's competitions.

In short, the cost reductions levers all rely upon a well-defined experience. In addition, we know very well the limits of all the cost reduction efforts made on Ariane 5 which on the one hand could not rely upon any of the above levers and on the other hand were much more sensitive to a reduction of the rate of production than to all real efforts made by industry in the frame of the little flexibility provided by Member States.

- Additional cost reduction levers (as mentioned in page 11 of the presentation of 23 September).

Several additional levers have already been identified by industry but not included in the presentation made to Ministers on 23 September, such as:

- Further improvement of industrial organisation for liquid propulsion (increased centralisation).
- Improved standardisation between Europe and Guyana.
- Adaptation and rationalisation of launcher integration and operations process.

Additional levers may be also identified when designing the ground segment at CSG for operations.

These additional levers will be assessed on a cost to benefit basis and then proposed according to the capacity of amortisation.

### The case of Ariane 62

Ariane 62 cannot be taken in isolation from Ariane 64. Ariane 62 and 64 are two configurations of the same launcher and will be exploited together. There is a strong link between the two configurations:

- Ariane 62 makes the cadence of the production rate and provides the flexibility in availability since its exploitation is based on single launch. Ariane 62 therefore contributes to cost reduction of Ariane 64.
- Ariane 64 makes the overall exploitation of Ariane 6 profitable thanks to the revenues of double launches and provides therefore the margins for a competitive pricing policy of Ariane 62.

- Ariane 62 and 64 together provide the modularity required to adapt to the uncertainties of the commercial market.

It is on that basis that the price of an Ariane 62 has been set at lower than 70 M€ in the High Level Requirements.

The cost of an Ariane 62 is expected at 79 M€ (e.c. 2014) with the assumption that the MQO is included in this cost. It is recalled that today the MQO is financed by Member States for all Ariane 5 launches and that the cost of Ariane 5 of 158 M€ does not include MQO. This is the reason why, we shall propose that Member States finance the MQO for institutional launches only, as part of the guarantee of access to space. Under this assumption, the costs of Ariane 62 are 73.6 M€ as indicated in page 11 of the presentation of 23 September, which makes the price of 70 M€ at reach when combined with the exploitation of Ariane 64 (today the business model is based on six Ariane 62 and five Ariane 64 per year).

In these conditions, Ariane 62

- is significantly cheaper than Soyuz by at least 10 M€ per launch and provides higher performance (see above)
- makes institutional launches non-dependent on availability and prices of Soyuz
- sustains industrial activities in Member States rather than in Russia.

There is therefore no doubt that Ariane 62 represents a significant progress compared to Soyuz, which is certainly a good launcher but not produced in and controlled by European Actors.

It is clear that Soyuz is not anymore today the cheapest launch service (even if one of the most reliable), and some institutions in Europe have selected in the recent past other services than Soyuz. However, the guarantee of access to space for European institutions is today dependent on Soyuz. Compared to today, Ariane 62 represents a significant progress for the institutional market and a significant support for the competitiveness of Ariane 64 and therefore of Ariane 6.

#### **4. Exclusion of the Usual 120% Rule of ESA**

In principle Art.3.1 of Annex III of ESA Convention is applicable to Ariane 6 development as it has been the case for all ESA optional programmes (with a few exceptions).

However, unlike all ESA optional programmes, the Ariane 6 development programme is based on a risk sharing approach between ESA and the Industrial Prime Contractor in which each Party has to cover its own risks (described in the MoU). As a consequence, ESA will have to cover its own risks only. The 120% rule will not be used to cover the industrial risks and finance the consequent cost overruns, but to manage those risks which are under the responsibility of Participating States: the institutional part of the High Level Requirements, Launcher/Ground interfaces (see question 9), public owned and operated facilities, change of public regulations.

It is recalled that a provision of 215 M€ to be managed by ESA has been accommodated in the total development costs (representing around 5% of the total) for uncertainties. We shall certainly not therefore have to use extensively the 120% rule, but we recommend to keep the rule since the experience has shown that for the selected number of programmes for which the rule was waived, the only effect of the waiver has been to introduce significant delays in the decision making process.

## **5. Decisions in Luxembourg Should Consider Any Uncertainty**

Uncertainties belong to all ESA programmes, from inception to completion and commitments of Member States are usually the first milestone providing the solidity to proceed. As a matter of fact, in all ESA programmes, industry commitments are following Member States commitments. In the case of MTG for example, the programme was subscribed by the Member States in 2008 with full commitment, the industrial proposal for the development phase received in 2010, contract signed in 2012 and conversion of the ceiling price into firm fixed price made in 2014.

In the case of Ariane 6, the sequence of commitments is different in order to balance the respective commitments of Member States and industry, mirroring the respective interests and responsibilities of each party in the development and exploitation of Ariane 6.

- Industry will commit first within a complete proposal on a ceiling price for the development as well as on a ceiling price for the launch costs of institutional missions, as per High Level Requirements.
- On the basis of this commitment, the Member States will be invited, at the C/M14, to subscribe the full development programme, matching the commitment ceiling of industry.

The full commitment from each side is necessary as soon as possible for each party to have full visibility on the other's commitment in order to proceed quickly with the implementation of the programme, in particular with the deployment of the organisation required to keep the schedule of 2020 for the first flight as well as the associated ramp-up of production starting in 2018. This full commitment is also a very important message sent to customers and competitors showing that ESA Member States and European industry together are willing to take up the challenge to stay competitive on the launcher market.

However, in order to maintain the balance of respective commitments, the overall commitment of Member States will be released in two successive steps of commitments and four successive steps of payments consistent with the key milestones of the development of the project. A verification key point will be organised at the end of each step before proceeding to the next step.

Another key element of the approach will be to ensure that, in case a verification key point is unsuccessful, way-outs are possible in order to take benefit of investments made until that key point.

The successive steps will be organised as follows:

Date	Member States	Industry	Member States
Early 2015		1. Invests into a new organisation able to match the ceiling costs of development and exploitation. 2. Improve their commitments according to TEB and VKP recommendations for finalising full contract with ceiling costs (i.e. 100% commitment)	
Early 2015			Commitment: 5% of contract value. Payment: 5%
Mid 2015			CCN for LLi commitment (+5%)
Mid 2016	<p><b>if UNSUCCESSFUL</b></p> <ol style="list-style-type: none"> <li>1) Stop Declaration</li> <li>2) Reimburse costs</li> <li>3) Change Declaration using previous investments</li> </ol>	<ul style="list-style-type: none"> <li>- Commitment into Fixed Price</li> <li>- PDR</li> </ul>	<p><b>if SUCCESSFUL</b></p> <p>Commitment 100% Payment 25%</p>
Mid 2018	<p><b>if UNSUCCESSFUL</b></p> <ol style="list-style-type: none"> <li>1) No payment</li> <li>2) Further work in industry at its expenses until successful CDR.</li> <li>3) Cancellation with fault of the contractor (clause 32.1)</li> </ol>	<ul style="list-style-type: none"> <li>- CDR</li> <li>- Order of the first batch of production at prices within the fixed prices for exploitation</li> </ul>	<p><b>if SUCCESSFUL</b></p> <p>Payment 35%</p>
Mid 2020		Maiden Flight	<p><b>if SUCCESSFUL</b></p> <p>Payment 35%</p>

More details are given on contractual aspects under question 7.



## 6. Governance: Distribution of Responsibilities, Share of Risks

The governance principles, in particular the distribution of responsibilities and the associated share of risks, are under discussion between ESA and industry since two years and with national agencies since July. All these principles are being formalised in four complementary documents:

- The High Level Requirements which will be the basis of the evaluation of the complete and committing industrial proposal;
- The programme Declaration which will be the basis for Participating States to subscribe;
- The MoU between ESA, JV and CNES which will define the key provisions for future development contracts;
- The Resolution on access to space which will set the objectives, principles and calendar of preparation of the exploitation.

The complete set of documents will frame the responsibilities and risks for each party, including at individual Participating State level.

The basic principles of the governance represent a paradigm change compared to the situation of today:

- The Member States have the responsibility of the guarantee of access to space while industry has the responsibility of the commercial market. In other words, Member States are not anymore involved in the risks associated to the commercial market and will not have therefore to provide any support to exploitation on the commercial market.
- In order to be able to take the risks on the commercial market, industry is the Design Authority of the new launcher system and will control its commercial exploitation. Being the Design Authority, industry takes the risks of the design and of the development, limiting the risks for Member States to a short list of changes mentioned under question 4.

In other words, the risks for Member State will be, for sure,

- much more contained
- more under their control

than today where they are exposed to all risks of exploitation of Ariane 5, in particular on the commercial market, without any control.

The remaining risks for Member States will be therefore:

- During development, limited to the above mentioned short list of changes, which will be first managed within the provision of 215 M€ under their control and, if necessary, within the 120% rule of ESA optional programmes (see question 4);

- During exploitation, limited to a potential increase of the costs for institutional launches if the launch rate is much lower than 11 per year. In that case, a programme of support to exploitation for institutional launches only could be envisaged in order to keep the launch prices for institutional launches under the ceiling of 70 M€ per launch (see also question 8).
- In fact the most important risk by far would be to have industry not succeed, because this would put the guarantee of access to space at stake. In order to manage this risk, the stepped approach described above in questions 5 provides key milestones for Member States to take appropriate decisions consistent with the progress of industry, able to maintain the objective of the guarantee of access to space. It is clear that the Member States and industry have a common interest to succeed together.

As for the "cross checking" of the governance scheme by an independent consultant, it should be noted that external consultants were already involved in the development of a European launcher sector governance (e.g. NELs) and that the above new governance is largely based on recommendations from the NELs studies, which have been presented and discussed with Member States at the time.

## **7. Legally Binding Instruments to Guarantee Costs and Prices**

Costs are with industry, prices are with Member States and the difference is either profit for or funding (part of co-funding) from industry.

The legally binding instruments to guarantee prices (but also performances) to Member States are the contracts signed with industry for the development as well as the contracts and the Launcher Exploitation Declaration (LED) signed with the Launch Service Provider for the exploitation.

- As for the development,
  - Before the subscription of Participating States and therefore before the contracts are signed in 2015 within a ceiling price, we shall have available not only a complete and committing industrial offer which will be consistent with the ceiling price specified in the High Level Requirements (which is already unusual for ESA programmes) but also an MoU including the key provisions of the future contract, signed by industry (which is unique for ESA programmes). The funding from industry is expected to be part of their proposal, as a consequence of their responsibilities, cost and risk sharing. This funding will be first evaluated by the TEB and then negotiated between industry and ESA on the basis of this evaluation.
  - After the contracts are signed in 2015 within a ceiling price, a conversion into firm fixed price is planned in 2016. The response to question 6 above defines the levers that Member States could use to make industry respecting its commitments, in particular the payment plan which is based on deliverables rather than on activities.



- As for the exploitation, the objective of Member States is to maintain a guarantee of access to space for institutional missions to match government objectives and for European commercial missions to match economic benefits.

Obviously Member States cannot "force" industry, but they can provide incentive to industry to sustain a guarantee of access to space. Such incentives concern:

- Providing to industry a minimum number of launches per year based on the institutional mission in Europe (see question 8 below), in order to contribute to the launch rate which makes the overall business profitable.
- In case the overall business cannot be profitable, providing support to exploitation for institutional launches only ( see question 6 above).

### Risk Management

In order to contain and manage the risks for Member States and protect their interests, a new contractual scheme will be introduced compared to ESA standard contracts, as follows:

- The contract will be placed with the Joint Venture ADS & SAFRAN only when it will represent a level of guarantees equal to a contract placed directly with Airbus DS.
- From the release of the first Authorisation To Proceed, industry will be committed within a ceiling price. In such contract type, ESA is committed only up to the amount of the progressive release of authorisation while industry is bound to deliver the whole purpose of the contract within the ceiling. Within a ceiling contract, if ESA would decide to terminate the contract, the consequences are for industry like for a cost reimbursement and ESA will pay only the real and audited costs of industry up to the date of cancellation. The risks of the Participating States up to the conversion into a Fixed Price are therefore strictly limited.
- In 2016, industry will deliver a price conversion proposal to transform the ceiling price into a Fixed Price and therefore to reduce the exposure of industry that is maximum in a ceiling price environment. The price conversion offer will have to stay within the limit of the ceiling otherwise there is no advantage for ESA to move to a Fixed Price. In a Fixed Price the exposure of ESA is greater since in case of cancellation with no fault of the contractor the price for ESA may be up to the value of the Fixed Price. At this stage, and in the absence of fault by the contractors, the participating States are really committed vis-à-vis industry because a cancellation would have more severe consequences than a continuation of the contract. Similarly there is no escape possible for industry since in the absence of a Class A change introduced by ESA, industry is committed to deliver irrespective of the cost level.
- The Ariane 6 contract will be very different than the usual development contracts placed by ESA. In Ariane 6, ESA is not buying a development, ESA is buying an access to space. This is reflected in the payment plan. In usual ESA programmes, the payment plan is following the expenditure level of industry with several milestones per year linked to reviews and achievements. The Ariane 6 approach is different since there is no link between expenditures

in industry and the payment plan. The Ariane 6 payment plan is linked to events and deliverables that are key milestones in the fulfilment of the objective of the contract that is access to space. The first milestone is the commitment of industry within a fixed price in 2016 which is following a successful PDR and the existence of a fully consolidated industrial organisation in which each member has accepted a fixed price for what it has to deliver in development and in recurrent production. The second milestone is the placing by the Launch Service Provider (LSP) of the order for a first batch of recurrent launchers at prices within the fixed prices agreed in 2016, after a successful CDR. This milestone is essential since it will represent the guarantee for ESA of the access to space because the LSP is taking the considerable financial risk to place such a contract. It is also the confirmation for ESA that the price of the access to space remains within the agreed ceiling. The third major milestone is the maiden flight that is the confirmation that the design of industry is delivering the performance expected.

- Each deliverable at each milestone will have to be defined in details in the contract in order for ESA to assess without ambiguity if the objectives are met or not by industry and for both parties to avoid unnecessary claims. This will require from ESA a solid capacity of evaluation. The result is for ESA less detailed daily management and more capacity of anticipation and evaluation.

The result of the above contractual scheme is that:

1. Until a full industrial consortium based on Fixed Price at all levels is existing the financial exposure of ESA is limited to the actual level of costs in industry.
2. If no clear A change to the High Level Requirements is introduced by ESA, industry is committed to deliver the deliverables of their respective contracts.
3. The LSP commitment towards the first batch of production launcher is a key milestone of the contract.
4. The performances of the maiden flight are a key contractual milestone associated with a major payment.

## **8. Alternative to Commitment to Purchase Launchers for Institutional Missions**

The guarantee of access to space has been repeatedly mentioned as a key element of the European space policy approved by successive ESA Councils, EU Councils and both Councils in the framework of joint Space Council. This guarantee allows to provide access to space without constraint to governments and to generate significant socio-economic benefits (more than 50 B€ between 2000 and 2012), as recalled in document ESA/C/WG-M(2014)29, rev. 1.

It is impossible to maintain the guarantee access to space without using it. It is much better and cheaper for Member States to maintain such guarantee by using it themselves than by subsidising it for non-European private organisation to use it. It is clear that the European institutional market altogether (i.e. ESA, EU, EUMETSAT and Member States individually or bilaterally) is

not important enough to sustain alone a yearly launch rate able to maintain a guarantee of access to space at minimum prices. But, this institutional market is important enough to provide industry a minimum number of launches per year contributing to the launch rate which makes the overall business profitable (see question 7).

In return,

- the institutional market takes benefit of the effect of the launch rate on launch costs for institutions and,
- the Member States do not bear any risk on the commercial market.

This is the reason why industry, which will take all the risks on the commercial market is asking for a minimum number of institutional launches per year (from four to six with an average of five per year). As demonstrated under question 2, the current list of institutional launches already identified between 2021 and 2024 shows that this average of five launches per year is at reach.

In Europe, no current regulation can force any European institution to use a European launch service, but the objective is important enough to find a way for implementing practically an institutional market in Europe. It is recalled that the guarantee of an institutional market is everywhere else in the world the way for non-European launch service providers to be competitive on the world-wide commercial market (or, even for some of them, to be sustainable without a commercial market).

The pragmatic way to implement in Europe an institutional market should not be too difficult to find, since today, we are not so far from an extensive use of European launch services (including Soyuz from CSG operated by Arianespace) by European institutions. Apart from few (but noticeable) exceptions, a large majority of institutional missions are currently launched by European launch services, missions from ESA, EU, EUMETSAT and several Member States in particular. Since Ariane 6 will be significantly cheaper (see question 2) than Ariane 5 and Soyuz, there is no reason that it will not continue. Therefore, the way to be found concerns more a guarantee required by industry to take risks on the commercial market rather than changing drastically the reality of today.

An approach will be proposed in the Resolution on access to space to be approved by the Council at ministerial level, under which the DG will be invited to propose by 2016 a mechanism where ESA would be mandated by other European organisations willing to join, to negotiate a framework contract with the Launch Service Provider at competitive firm fixed prices. This framework contract will provide each of these European organisations a guaranteed frame within which they could, individually, sign individual work orders for each of their missions. The framework contract would be prepared by ESA for being signed in 2018 when the first batch of Ariane 6 would be ordered at firm fixed prices.

## 9. ESA's Role in Development of Ariane 6

- As already mentioned under question 7, the role of ESA will be instrumental for containing the risks of Member States and protect their interests as well as for anticipating and evaluating the deliveries of industry at each milestone, providing full transparency to Participating States.
- As for its role of launch system architect, it should be recalled that, in general, whether the ESA programmes concern the development of satellites or launchers, in particular when it concerns development leading to services,
  - the responsibilities for the space segment and ground segment are distinct and therefore the contracts and providers are different. This is the case for Galileo, Meteorology and Vega.
  - the Participating States subscribe to both the space and ground segments as a whole, since the resulting service relies upon the two segments.
  - the role and practice of ESA in conducting such programmes are therefore well experienced.
- In the specific case of Ariane 6, industry will have the full responsibility of delivering the launch services in exploitation using the launcher system and the ground system. This will require the full involvement of industry in the qualification of the launch system at the end of development and before starting the exploitation, in order for industry to exert its full responsibility in exploitation.

However for the development,

- CNES is the authority, on behalf of the French government, being the launching state and the owner of the base, in charge of the CSG launch base and therefore must be the design authority of the Ariane 6 launch base. CNES has played this role already for Soyuz (while the launcher system was with Russia) under a fix price contract with ESA.
- During the exploitation, it is planned that the public owned ground assets, i.e. the majority of the launch base assets, will be maintained by the public sector (as part of the guarantee of access to space) while the industry owned ground assets will be maintained by industry. This requires logically that the launch base assets are developed by CNES under a contract with ESA.
- In order to play its role, ESA:
  - will control and maintain, during the development phase, the coherence between the progress of the two contracts, according to the High Level Requirements for the launch system.
  - is relying upon its experience gained during the Vega development for which two separate contracts were signed to the launcher system design authority on the one side and the ground segment design authority on the other side.



- will prepare the qualification of the Ariane 6 launch system with industry and CNES, on the basis of the HLR, with a view to make industry eventually responsible of a qualified launch system.

#### **10. Member States Incentive to Participate to Ariane 6**

The two incentives for Member States to participate to Ariane 6 are:

- the development of a guarantee of access to space (i) consistent with the requirements of institutional missions and (ii) able to be sustained without support to exploitation on the commercial market.
- the industrial activities in development (as for any ESA programmes) and in exploitation (with a guarantee for the first batch of production which provides robust perspectives for the following batches based on competitiveness).

As for any ESA optional programmes, it is the Member States which will decide to subscribe or not to the Ariane 6 programme. The main difference with other optional programmes is that subscription will rely upon a committing industrial proposal which will include around 90% of the complete industrial organisation, the remaining 10% being defined through a competitive process to be completed by mid-2015. This industrial proposal will also include commitments on exploitation prices, providing a guarantee of profitable business without support to exploitation for the commercial market.

The industrial proposal will:

- be consistent with the range of potential contributions defined by Member States in their conclusions of 8 July 2014 (and recalled in the HLR).
- be consistent with the heritage coming from the reuse of the three propulsion systems (Vulcain 2, Vinci, P120 derived from P80), from the reuse of the Ariane 5 ME upper stage and from the results of the competitive bidding organised beginning of 2014 on six Consolidated Launcher Elements of Ariane 6 PPH.

In addition, a number of bilateral meetings with individual Member States are being organised in order to refine potential contribution and perspectives of industrial participation to Ariane 6 development. An iterative process is being organised with the JV accordingly.

The Member States will therefore be able to subscribe to the Ariane 6 optional programme with a level of knowledge on objectives and industrial activities distribution, much higher than for usual ESA optional programmes.

The threshold of total contribution necessary to begin Ariane 6 development will be decided by the Participating States when finalising the Programme Declaration.

# **11. See Ariane 5 ME as Advantage for Ariane 6 and Not as Blocking It**

- a) The on-going development of the Ariane 5 ME upper stage is providing a clear advantage for Ariane 6 which is reusing the same upper stage. This is an advantage for reducing costs and risks and for consolidating the calendar of Ariane 6.
- b) However, the economic advantage of Ariane 5 ME exploitation compared to Ariane 5 ECA depends on the evolution of the commercial market only, which is still associated with many uncertainties. As a matter of fact, Ariane 5 ME will not capture more European institutional missions than the ones which can fly on Ariane 5 ECA. It should be noted also that any cost reduction due to JV effect applicable to Ariane 5 ME can be applied on Ariane 5 ECA as well.

The only potential advantage of Ariane 5 ME compared to Ariane 5 ECA would be to limit the expected reduction of the launch rate of Ariane 5 from 2018 onwards. However, this potential advantage relies upon the increase of performances only and not on costs reduction, since the costs are the same for the two launchers. The advantage of higher performance is uncertain, because it depends on the evolution of the mass of satellites (which is quite uncertain depending on the level of penetration of electric propulsion) and on the capacity to use fully this additional performance (which is also uncertain since based on the pairing of two satellites having a cumulated mass using the full launcher performance). In addition to being uncertain, the potential cost benefit of exploiting Ariane 5 ME could be much smaller than the transition costs between Ariane 5 ECA and Ariane 5 ME.

- c) These uncertainties have led both Arianespace and the JV to conclude that a decrease of the launch rate of both Ariane 5 ECA or Ariane 5 ME down to four per year from 2018 onwards has to be considered as the baseline,
  - requiring to anticipate as much as possible the production activities of Ariane 6 from 2018 and to ramp-up as quickly as possible this production in order to compensate the significant decrease of production activities for Ariane 5. If this decrease of production of Ariane 5 is not timely compensated, industrial production capacities will have first to be reduced and later on to be increased, at high costs from industry.
  - As a result, the decision making process and the industrial activities should be focused on Ariane 6 for matching the start of production in 2018 and for a maiden flight in 2020.
- d) As a matter of fact, compared to Ariane 5 ME, Ariane 6 brings two important advantages:
  - its performance fits with the whole of the European institutional market which brings (see question 8) an average of five launches per year, which is the maximum launch rate considered for Ariane 5 ME. The commercial market will therefore bring a significant increase of cadence which is the main driver of cost reduction (see question 3)

- its modularity provides the capacity to adapt to potential evolutions of the commercial market which is quite uncertain from 2018 onwards.

This is the reason why Ariane 6 must be operational as soon as possible.

- e) As already mentioned, the maiden flight in 2020 is robust since Ariane 6 is reusing existing and already qualified (in flight or on ground) propulsion systems, placing the system activities (and not engines, which is the usual case) on the critical path. Therefore system activities must be focused as soon as possible on Ariane 6 rather than on Ariane 5 ME. Starting by system activities of Ariane 5 ME would definitely delay the system activities of Ariane 6 and therefore the maiden flight by at least two years, with the consequences on exploitation which have been described above. As for the credibility of 2020, the benchmark is Ariane 1, as already mentioned in question 3: the heritage of Ariane 1 from Europa (two upper stages were new) was much less substantial than the heritage of Ariane 6 from existing Ariane 5 and Vega, the industrial file was much thinner and European launcher industry was less mature, and still Ariane 1 flew six years after the decision.
- f) Putting the priority on the development of Ariane 6 does not mean that this choice is irreversible. A milestone in 2016 is being planned (see question 5) at which reorientations can be made, as necessary, in order not to finish in a dead end, depending on the progress of industrial activities.

## **12. Commonalities Ariane 5 ME and Ariane 6**

Since the C/M12, ESA and industry have worked with the clear objective to maximise the commonalities between Ariane 5 ME and Ariane 6.

The most important part of these commonalities has been since then the upper stage of Ariane 5 ME and Ariane 6.

The following principles have been set to Airbus:

1. Fully exploits all the investments done by Germany (and other Member States) in the Ariane 5 ME upper stage programme.
2. Fully respects the Ariane 5 ME German industrial organisation for upper stage, assuming this will be compliant with the Ariane 6 geo-return resulting from the German contribution.
3. No change of interfaces with, and of the design of other elements of the launcher.
4. Confirms the indicated cost levels for Ariane 6, using this upper stage.
5. Confirms the indicated performance level for Ariane 6, using this upper stage.

and recalled in the letter addressed to the German minister.



**13. Commonalities Vega Ariane 6**

Solid Rocket Motors will be identical and common to Vega and Ariane 6. The skirts will be different because of different transfer of loads, but it does not affect the SRMs.