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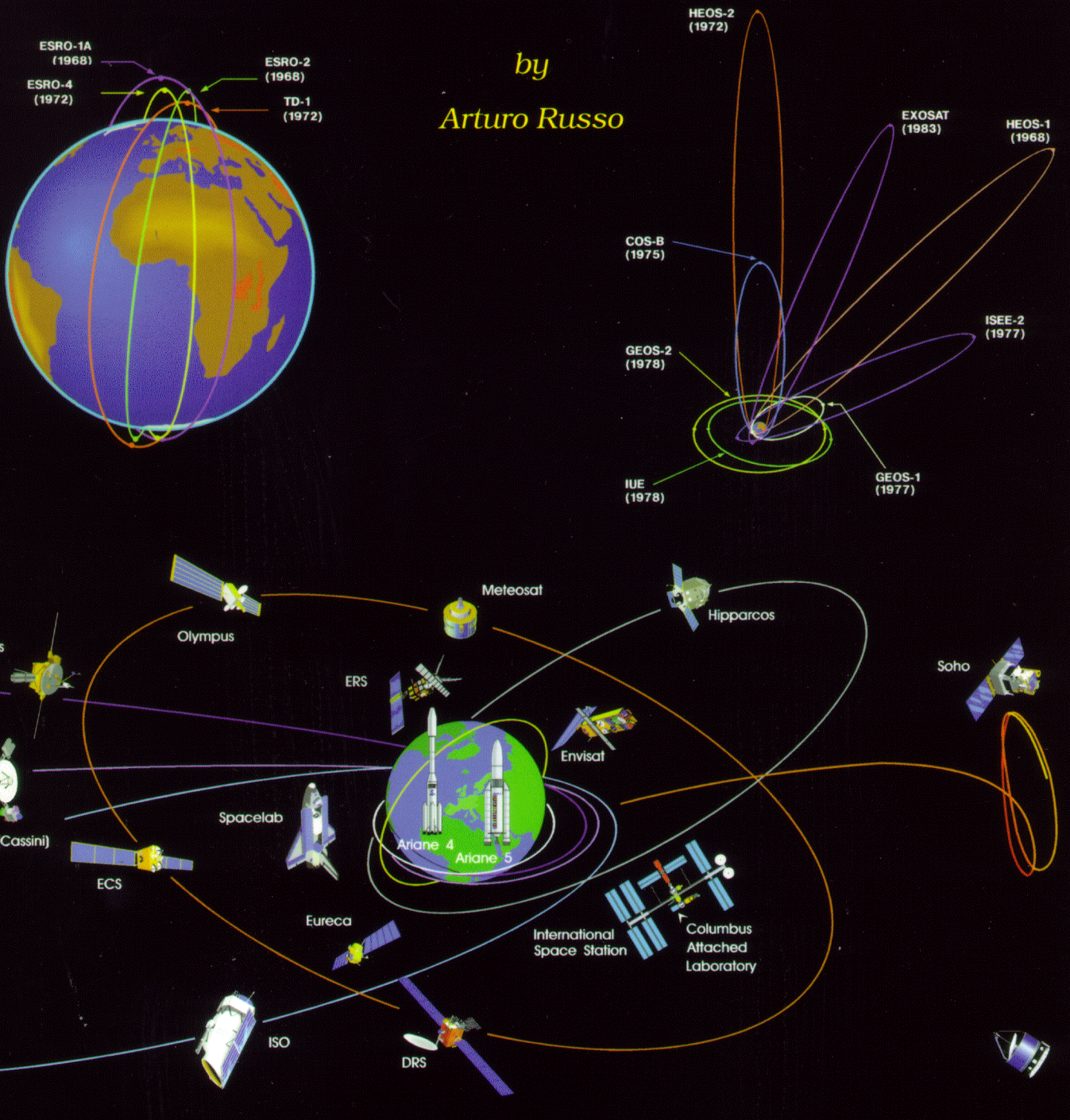

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The ESA History Study Reports are preliminary reports of studies carried out within the framework of an ESA Contract. As such, they will form the basis of a comprehensive study of European space activities covering the period 1958-1987. The authors would welcome comments and criticism, which should be sent to them at the appropriate address below.

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International space cooperation is not a charitable enterprise; countries cooperate because they judge it in their interest to do so.

K. Pedersen
Former NASA Director of International Affairs
May 1983[1]

Introduction

In two previous reports we have discussed the origin and early development of ESRO/ESA's telecommunications satellite programme (Telecom Programme).[2] The programme was approved in principle by the ESRO Council in December 1971, after five years of preliminary studies, within the framework of the first "package deal". Its overall aim was to develop a communications satellite meeting the needs of the European Conference of PTT administrations (CEPT) and the European Broadcasting Union (EBU). This included the routing by satellite of a sizeable portion of the total amount of intra-European telephone traffic managed by the PTTs, and the total replacement of the terrestrial circuits for the EBU Eurovision system. In September 1973 the so-called Telecom Arrangement entered into force, i.e. a formal agreement between ESRO and the governments of the nine participating member states, defining the institutional and financial aspects of programme implementation. In fact, all ESRO member states but Spain agreed to participate, their delegates sitting in the Communications Satellite Programme Board.

According to the Telecom Arrangement, the programme was split into two phases. The first phase, called Phase-2 as it followed the study phase developed in the period 1971-1973 (labelled Phase-1), was essentially devoted to the development of an experimental satellite, called OTS (Orbital Test Satellite), whose launch was planned for the end of 1976. The participating states agreed to finance this phase on the basis of a firm financial envelope of 115.1 MAU (at 1972 prices), the scale of contributions being essentially based on their gross national products (GNP), but with two important limitations. Firstly, no country was to contribute more than 25 % to the programme; secondly, the Netherlands contribution share was fixed at 2.5 %, i.e. about half the amount resulting from the GNP formula.[3]

The following phase (Phase-3) was to be devoted to the development of two flight units of the operational European Communications Satellite (ECS) to be made available to the users; one in orbit, the launch being foreseen for 1980, the other on the ground. The financial envelope of this phase was estimated at 160 to 283 MAU, depending on the configuration of the satellite and on the possible additional launching of a prototype. Decisions on the start, precise content and financial envelope of this phase were to be taken in 1975 or 1976 by a *double two-thirds majority*, i.e. a two-thirds majority of participating states representing at least two-thirds of contributions.

With the approval of the second "package deal", in 1973, a new element was added to ESRO's (eventually ESA's) communications satellite programme, namely the Marots project. This was an experimental satellite for maritime communications based on the OTS platform, to be launched by end 1977. Eight member states (Belgium, France, Germany, Italy, Netherlands, Spain, Sweden and the United Kingdom) plus Norway supported the Marots programme, whose financial envelope was established at 75 MAU (1973 prices). The United Kingdom provided by far the largest contribution

1 Quoted in Logsdon (1984), p. 16.
2 Russo (1993) and (1994).
3 The initially agreed on contribution scale is reported in Table 8 of Russo (1994). This was slightly revised subsequently, as reported in ESRO/PB-TEL/XIV/Res. 1, [28/2/75], and ESA/JCB(77)38, 2/11/77.

(about 56 %). A Maritime Satellite Programme Board was initially set up as the body responsible for directing the Marots programme, but in June 1975 the ESA Council decided that a Joint Board on Communication Satellite Programmes (JCB) should be set up, responsible for directing both the OTS/ECS and Marots programmes.[4]

Although Marots was originally conceived as an experimental satellite, its design had, from the very beginning, taken full account of the guidelines for operational satellites evolved by the Intergovernmental Maritime Consultative Organisation (IMCO), under whose aegis discussions on a global maritime satellite system had been proceeding for some years. In particular, it was envisaged that a new international organisation, named Inmarsat, should be created to implement and manage such a system. At an Intergovernmental Conference on Maritime Satellites, held in London in February 1976, Marots was offered by the states participating in the programme as part of an embryo maritime satellite system prior to the establishment of the Inmarsat system. This system would include Marots, positioned over the Indian Ocean and operated by a newly created organisation of the European PTT administrations called Eutelsat, together with two American Marisat satellites, positioned over the Atlantic and Pacific Oceans and operated by Comsat General Company.[5]

In this report we shall discuss the development of ESA's communication satellite programmes in the period 1976-1981, i.e. from the first discussions on the content of the Telecom Programme Phase-3 until the approval of the Olympus programme. Three parallel stories are to be analysed in this framework. First is the ECS project itself, i.e. the logical follow-up of the OTS programme and the basic space segment element of the envisaged European communications satellite system. The approval of the ECS development programme by ESA member states depended on a clear commitment from the PTT authorities represented in the CEPT to eventually use the system, i.e. to procure, operate and maintain the whole space segment (four to five satellites), as well as to implement the necessary earth segment elements (20 to 25 ground stations and associated network). While interested in the research and development programme conducted by ESA in the framework of the OTS programme, the future users of the ECS system were not at all convinced of the economic viability of satellite communications in Europe, and insisted that governments should subsidise the use of the system in the first phase of operation.

The second story concerns the development of the Marots programme, eventually renamed Marecs. In this case, an interested user community did exist, which in fact drove the programme towards the development of an operational satellite which could be offered on the world-wide market of maritime communications satellites. Several players were active in this market, however, including American industry, telecommunications authorities from all over the world, and non-member-state governments. In the event, Marecs was the first European satellite which won a place in the international market of commercial satellites, but the harsh opposition of the U.S. Inmarsat signatory made the end of the story less successful than had been expected.

Finally, we shall follow the story of the H-Sat (Heavy Satellite) project, a proposal for a new communications satellite programme aimed at qualifying European industry in the future market for direct television broadcast satellites. This was hardly a success story, as we shall see. In fact, diverging opinions and interests among ESA member states, regarding both the satellite's mission and ESA's industrial policy, led eventually not only to the abandonment of the H-Sat project, but also to the end of the joint European approach to communications satellite programmes. In fact, ESA's new Olympus programme was not supported by France and Germany, which instead decided to develop a bilateral programme for an operational direct broadcast satellite.

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4 ESA/JCB-C(75)6, 4/8/75. It was also envisaged that the JCB should eventually take responsibility for the aeronautical satellite programme (Aerosat).

5 ESA Annual report 1976, 35-38; ESA/JCB(76)33, 29/10/76, annex II. See also Dumesnil (1981), Galligan (1981). Three Marisat satellites had been developed by Hughes Aircraft Company for Comsat and were scheduled for launch in 1976, their main user in the first period of operation being the U.S. Navy.

The unifying theme which underpins these three stories is the critical passing from research and development activity to commercially oriented programmes. As an R&D organisation, ESA was essentially driven by the need to provide the technology push for qualifying the European space industry. As a multinational organisation, the Agency was bound to comply with the fair return industrial policy which formed the core of the solidarity link between its member states. However, in order to transform a good technology into a successful commercial product (such as a communications satellite, the Ariane launcher, or Spacelab), two conditions must be fulfilled: firstly a strong market pull capable of supporting a viable work level in industry; secondly, a competitive price *vis-à-vis* similar products available on the market. Both conditions were far from being realised in Europe in the late 1970s and early 1980s, as regards satellite telecommunications. Satellite links for telephony services were not considered economically attractive by European operators, as the heavy investments required in the earth segment substantially exceeded the savings in the terrestrial network. Direct broadcast had a still uncertain future and one could hardly foresee at that time the dramatic growth of direct-to-home and cable television prompted by the success of the Astra system. Even where a demand did exist, as in the case of global maritime communications, the market was rather limited (only few satellites were required) and highly competitive. This situation implied that, as in the case of Ariane and Spacelab, ESA member states needed to make a vigorous promotion effort in order to have the new space technology, developed in the framework of the Agency's programmes, moved to the commercial sector. This promotion effort was successful in the case of Ariane; it was not even implemented in the case of Spacelab; it was painfully accepted in the case of ECS (by subsidising satellite procurement and operation) and Marecs (by accepting marginal cost payments for ESA services); it was nonsense in the case of Olympus.

As regards industrial policy, it was soon evident that the strict enforcement of the fair-return principle ran against the general objective of reducing costs. On the other hand, all Member States insisted that their industry should contribute as much as possible to the new development programmes, in order not to be left out of the future market. Interests diverged, of course. Those countries which had a more advanced industry argued that ESA's commercially-oriented projects should be based on the optimisation of industrial capabilities in Europe, avoiding interface costs and preventing the selection of "second best" companies in order to comply with the fair-return requirements. The others, on the contrary, insisted that the solidarity link embedded in the collaborative effort should not be relaxed in such a crucial passage as moving from research and development to commercialisation. A compromise was possible in the case of ECS, as it was to be implemented within the framework of the existing Telecom Programme, with a definite mission of Europe wide service. It was not possible in the case of H-Sat, when divergences emerged regarding the satellite mission (experimental vs operational) and only national services were envisaged.

Discussing Phase-3 of the Telecom Programme

In May 1976, the Executive presented to the JCB its proposal for Phase-3 of the Telecom Programme, covering the period January 1977 to end 1980. Its main objective, according to the 1973 Arrangement, was to develop the operational ECS spacecraft and to deliver two flight units to the CEPT, one in orbit and one on the ground. Alongside this objective, two other important lines of activity were suggested: a technology research programme in the area of communications systems, spacecraft subsystems and microwave technologies (eventually known as ASTP: Advanced Systems and Technology Programme); and the development of a spacecraft platform of the 800 kg class, compatible with the Ariane launcher, to be used in support of a wide spectrum of future communications missions such as a direct television broadcast satellite or a second generation ECS. It was foreseen that the first version of the heavy platform should be launched in December 1980 on the last qualification flight of Ariane, labelled L04, in association with a typical communications payload developed outside the framework of the Telecom Programme. A further and somewhat separate component of the programme was the procurement at low marginal price of an additional OTS platform, to be launched on a no-cost basis by the L03 Ariane qualification launch. This platform

Programme elements	MAU (1975 prices)
ECS	85.65
Heavy platform	68.46
ASTP	36.20
L03 satellite	8.97
Contingency	3.72
Total	203.00

Table 1: First proposal for Phase-3 of the Telecom Programme

would be identical to that provided for the OTS and MAROTS spacecraft (a third platform was already under development as a back-up), but suitably modified for making it compatible with Ariane launch. It would support a communications payload funded from outside the Telecom programme.[6]

The feasibility of such a programme, the Executive explained, derived from three main reasons. Firstly, following the decision (taken in 1974) to use the more powerful Delta 3914 rocket for launching the OTS instead of the standard 2914 model, the OTS design had been upgraded, thus making the satellite much closer to an operational vehicle than initially expected. As a consequence, the development of the ECS could be carried out at substantially less cost than the guiding financial envelope planned in 1973. Secondly, the original estimates for Phase-3 had been rather conservative, while increased efficiency could now be assumed both within industry and within ESA. Finally, full advantage could be taken of the L03 and L04 Ariane qualification launches. All this made it possible to keep the overall cost estimate of the programme within the limit of the minimum figure of 203 MAU (at 1975 prices) originally envisaged in the Telecom Arrangement for Phase-3 (Table 1).

The Executive's proposal envisaged this phase as a necessary step in a long-term European R&D effort in space telecommunications, whose rationale derived from three main considerations. Firstly, it was to be expected that by the second half of the 1980s, new applications would become economically and operationally attractive, in particular regarding direct television broadcasting to end users and specialised communications services (communications to offshore oil pumping facilities, data transmission and computer communication networks, remote printing, teleconference service, electronic mail, etc.). While the OTS/ECS programme was aiming at providing traditional services such as fixed-point telephony and television distribution, larger and more sophisticated satellites would be required by the end of the decade to meet the new demands.[7]

The second consideration regarded the future market of satellite communications. In addition to the established market of trans-oceanic communication services, institutionally covered by the Intelsat system, national and regional systems were also being set up, representing a new, rapidly expanding market for communications satellites and associated technologies. The first domestic systems in Canada and the United States had been operating since 1972 and 1974, respectively (Anik A and Westar satellites), while the first Indonesian communications satellite (Palapa A) was scheduled for launch in July 1976. Moreover, Japan, India, Australia, Brazil and the Arab countries had embarked on plans to establish national or regional systems. Thanks to the European OTS/ECS programme and the Franco-German Symphonie programme, the European space industry was reaching maturity, bridging the technology gap with the U.S. (ECS in fact would be comparable with the forthcoming Intelsat V satellite), and it could compete with American manufacturers in the new international market for satellite communications. In fact, the MESH industrial consortium, responsible for the OTS development, was tendering for the Brazilian communications satellite (Brasilsat) with a proposal based on a vehicle derived from the OTS platform. At the same time, the core industrial

6 ESA/JCB(76)7(C), 20/4/76, and ESA/JCB(76)7(C), corr., 11/5/76. The financial and legal background of the Telecom Arrangement for Phase-3 is discussed in ESA/JCB(76)10(C), 3/5/76.

7 Howell & Hånell (1976); Rosetti (1976).

companies of the Symphonie programme, the German MBB and the French SNIAS (Aérospatiale), had succeeded in securing a substantial share of the Intelsat V development contract.[8] In the Executive's view, a continuing effort in research and development activities was required in order to ensure that the technology gap did not reopen, and to guarantee European industry a competitive position in the future fields of commercial applications.

Finally, the third consideration regarded the availability after 1980 of the Ariane vehicle, which would provide Europe with independent launch capability into geostationary orbit. With unrestricted access to Ariane, the Executive argued, it was desirable to plan future satellite programmes around the capability of this European launcher, and according to the schedule of its production programme. The heavy platform programme was proposed in this light, its aim being the development of a multi-purpose spacecraft platform compatible with Ariane, to which a variety of different communication payloads could be attached. The parallel effort in spacecraft sub-systems, communication technologies and space transportation systems would lead the European aerospace industry to an early operational availability of large geostationary systems for the future world-wide market.

The JCB did not endorse the Executive's plan, three main arguments being raised by delegations.[9] The first concerned the still uncertain situation regarding the future utilisation of the ECS system. While most PTT administrations had expressed themselves in favour of the implementation of the system, the economic aspects of its eventual operation were far from being settled.[10] A study prepared by CEPT's Comité de Coordination des Télécommunications par Satellite (CCTS) had showed that the costs of the satellite system would be significantly higher than the equivalent terrestrial circuits, even taking into account the ESA subsidies covering the cost of two satellites and one launch. The PTTs, in fact, were to provide for the construction and operation of the earth stations, as well as for the replenishment satellites and launches needed to provide adequate transmission capacity over the period 1980-1990 (4 or 5 satellites were considered necessary to fulfil the CEPT communications needs in the decade).[11] For the CEPT to agree to use the ECS system, it was necessary that ESA (i.e. the space budgets in its member states) undertake to subsidise adequately the establishment of the system beyond the provision of the Telecom Programme and to guarantee that a given maximum cost for maintaining the space segment over a certain number of years would not be exceeded. Negotiations on these issues, whose economic implications were still to be assessed, were continuing between ESA and the CCTS (we shall deal with this aspect later).

The strongest opposition against the ECS project came from Germany, based on the Deutsche Bundespost refusal to participate in the operational use of the ECS system. As a similar refusal had been expressed by the British Post Office, the German delegation argued, the expected volume of the international telephony traffic within Europe to be routed via the satellite system would amount to only 50 per cent of the total originally envisaged. For this requirement, the capacity of OTS would be wholly adequate until at least the mid-1980s and therefore, ESA should simply undertake to plan the operational use of the OTS spacecraft, and to build two additional flight units (one in orbit and one on the ground) to cover the operational needs of the interested CEPT members over the whole decade. Much more interesting, according to the German delegation, were the prospects of maritime communications; it in fact proposed to extend the Marots programme by the construction of two additional satellites (one in orbit and one on the ground), in order to ensure the service continuity necessary for an operational maritime service.[12] The other delegations did not share this negative attitude and were generally in favour of undertaking the ECS programme as proposed by the

8 ESA/JCB(76)21(C), 26/7/76; Müller (1990), p. 250.
9 JCB, 5th meeting (13/5/76), ESA/JCB/MIN/5, 4/6/76.
10 ESA/JCB(76)8(C), 12/4/76.
11 The results of the CCTS' economic analysis are summarised in the appendix of document ESA/JCB(76)18(C), 21/7/76. The document itself presents the Executive's criticism of this study.
12 ESA/JCB(76)20(C), 20/7/76. The Executive's commentary to the German proposal is in ESA/JCB(76)20(C), add. 1, undated (a hand-written note on this draft document specifies that it was not published).

Executive, but the majority of them considered that it was not possible to take a decision at such an early stage, pending the negotiations with the CEPT on the operational use of the system.

The second argument regarded the further development of the telecommunications programme and the heavy platform proposal. According to the German delegation, the development of a multi-purpose platform suited to the Ariane launcher should be the main object of a forward-looking Phase-3 of the Telecom Programme, and it agreed with the Executive that this platform should undergo its first flight testing on the L04 launch, with payload elements provided by the member states. Most of the other delegations, on the contrary, felt it was premature to develop the heavy platform in time for the L04 Ariane launch. The French delegation, in particular, argued that only in 1980 would it have been reasonable to begin development of a new satellite platform, "with a view to having available a heavy experimental satellite in 1985 and an operational satellite in 1990".[13]

The third argument regarded the industrial policy aspects of the Telecom Programme, i.e. the implementation of the fair return concept in the geographical distribution of industrial contracts. The delegations of the smaller Member States were particularly sensitive to this issue. Switzerland, in particular, whose industrial return figure during Phase-2 had remained extremely low and would probably become even lower in Phase-3, noted that Swiss industry had been entirely left out of the MESH tender for developing the Brasilsat satellite: "The commercial benefits of the Agency's programmes [should] not be reserved to only some of the participants in the programmes", the delegation argued, insisting that the Executive should make every effort to remedy any imbalance in the geographical distribution.[14]

In conclusion, the JCB chairman summarised the discussion by stating that the Board had expressed little interest in supporting the OTS derivative platform and the heavy platform for the L03 and L04 Ariane launches, respectively, while no decision could be taken regarding the ECS project and the ASTP before September that year.

The H-Sat Proposal and the Telecommunications Package Deal Concept

While the Executive was preparing its revised proposal for Phase-3, a new element had to be considered. On 10 July 1976, the Director General received a letter signed jointly by three important European aerospace companies, the French SNIAS, the German MBB and the Belgian ETCA, proposing to develop a multi-purpose satellite platform of the Ariane class, called Phebus X, whose preliminary studies were already under development with their own funding. More specifically, they wanted to involve the Agency in the implementation of this project, regarding both the technical specification of the platform and the realisation of an experimental payload for its first test flight on L04. The financial contribution required from ESA was estimated at a maximum of 30 MAU, not including the costs of adapting the platform to a specific payload or of developing and qualifying such a payload.

The three companies' proposal derived from their previous experience in the space field as core members of the Cosmos industrial consortium. Moreover, SNIAS and MBB had been the main contractors for the development of the Symphonie spacecraft, and the former was the industrial architect of the Ariane launcher programme. Phebus X was thus considered as the first step towards the future development and commercialisation of heavy communications satellites of the Ariane class. In order to pool the industrial property and to better coordinate the efforts, they envisaged setting up a new joint legal entity, eventually called Eurosatellite, which would supersede the Cosmos consortium. The Eurosatellite group was to be organised as a "Groupement d'Intérêt Economique" (GIE), contemplated under French law as a type of international association and already experimented with in the Airbus programme. Whereas the traditional consortia system was characterised by the prime

13 ESA/JCB/MIN/5, cit. (n. 9), p. 7.
14 *Ibidem*, p. 5. Industrial return figures for Phase-2 are reported in ESA/JCB(76)22(C), 28/7/76.

Programme elements	MAU (1975 prices)
ECS	85.65
Marots extension	40.40
ASTP	36.20
H-Sat	50.00
Contingency	8.00
Total	220.25

Table 2: New proposal for Phase-3 of the Telecom Programme

contractor/subcontractor relationship, the GIE arrangement provided for joint sharing of management responsibility, risks and profits.[15]

Following the Eurosatellite proposal, the Executive worked out a new plan for Phase-3 of the Telecom Programme. It included again four lines of activities, two of which were the ECS programme and the ASTP as in the former proposal. A third line of activity consisted in the operational extension of the Marots programme, as suggested by the German delegation, foreseeing the construction of one or two additional satellites. Finally, there was a detailed proposal for a large experimental satellite, to be launched on L04 and intended as a forerunner of the operational broadcast satellites of the 1980s. This satellite, eventually called H-Sat, was based on the use of the Phebus X platform supporting a payload for experimental tests in direct television broadcasting and high-power telecommunications. The cost of this project was estimated at 50 MAU, including 30 MAU to Eurosatellite for developing the platform and 15 MAU for the payload (Table 2).[16]

An important aspect of the envisaged H-Sat programme was that a major part of ESA's responsibility for its implementation would be transferred to industry, which implied, on the one hand a reduction in the non-fixed common costs relating to the programme, but on the other that the Agency would not be in a position to impose any *a priori* geographical distribution on industrial contracts for the Phebus X platform. It was still possible to achieve a fair geographical distribution of contracts relating to the payload, the Executive explained, but it also insisted on two main points: firstly, "each advanced equipment should, if possible, be procured from the supplier or Agency whose development programme is the most advanced or whose relevant technology base is the soundest"; secondly, "a geographical distribution of work must be achieved which matches the interest and ability of the relevant countries to pay for the work given to their particular industry". In order to avoid any imbalance in the industrial return, it was proposed that each participating country should contribute to the costs of H-Sat in proportion to the amounts of the contracts received by its own industry (the "fair contribution" concept).[17]

The Executive's plan required a new legal framework for implementation. According to the 1973 Telecom Arrangement, in fact, the aim of Phase-3 was the development of the ECS satellite within an overall financial envelope to be agreed by the participating states by a double two-thirds majority. While the principle of flying a heavy platform for communications satellites on the L04 test launch had been accepted by the Ariane Programme Board and the Council in the framework of the APEX (Ariane passenger experiment) programme, the development of such a platform within the framework of the Telecom Programme could only be realised if all participants agreed on a liberal interpretation of the Arrangement, otherwise an additional protocol had to be negotiated. This was only part of the problem, however. Another legal arrangement covered the Marots Programme, which did not foresee

15 Müller (1990), p. 250. The letter from the three industrial companies is reported as annex I to ESA/JCB(76)23, 31/8/76. A comprehensive survey of the European space industry in the late 1970s and early 1980s is in Dondi (1981). The evolution of the consortium concept is also discussed in Dondi (1980).

16 ESA/JCB(76)23, 31/8/76.

17 *Ibidem*, annex II, pp. 4-5.

any operational phase following the development and launch of the satellite, and whose participating states were not the same as in the Telecom Programme. The latter, in fact, did not include Spain and Norway, which however participated in Marots, and it included Switzerland and Denmark, which did not participate in the maritime satellite programme. New legal arrangements or protocols had therefore to be negotiated in order to cover both the extension of the Marots programme and its eventual inclusion in a comprehensive telecommunications programme. In conclusion, the Executive's proposal envisaged a kind of "package deal" in the communications satellite field, which required a general agreement between all ESA member states and a new legal framework, defining for each programme element the participating states, the technical content, the financial envelope and the contribution scale.[18]

The telecommunications package was discussed by the JCB at its September 1976 meeting and endorsed in principle, but with some reservations regarding three main topics. First was the opportunity to speed up the H-Sat project in order to comply with the time schedule of the L04 launch: some delegations, notably Italy and the Netherlands, noted that "the main point seemed to have been not so much to work out a valid programme as to take advantage of the L04 flight, thus imposing very severe constraints on the timetable", and wondered whether the development of a heavy platform could be justified on the grounds of foreseeable requirements up to 1985. Second was the "revolutionary" nature of the proposed management method in relation to the critical issue of the Agency's industrial policy, which caused some concern among the smaller country delegations. Belgium, Denmark, Sweden and Switzerland expressed their support to the H-Sat project, but insisted that a satisfactory solution should be found in respect of the geographical distribution of industrial work; Italy stated that "the action proposed by the Executive would be unacceptable unless the Agency continued to exercise control in management and industrial policy matters as usual". Third was the question of the economic aspects of the operational use of the ECS system: no delegation was prepared to approve this part of the programme "unless the users undertook to use the system operationally on acceptable terms". The quotation is from the statement of the French delegation, the most convinced supporter of the ECS programme. Germany, for its part, repeated its arguments against the economic viability of the envisaged system, insisting that even if the PTT administrations in all member states were to participate in the programme, "the ratio between the cost of the space system and that of the earth system during the ten-year period 1980-1990 would remain of the order of 2 to 3 to 1", and in Germany it would be even higher.[19]

In conclusion, the Board invited the Executive to prepare detailed proposals for each element of the programme, taking into account the legal aspects and the geographical distribution considerations. The Executive was also invited to place feasibility studies of H-Sat with interested industrial groups, "with a view of giving the programme an adequate European basis [i.e. acceptable geographical distribution of work], and so that the detailed content of this particular programme element may be approved by delegations in February 1977".[20]

The first ESA Council meeting at ministerial level was scheduled for 14th-15th that month and in view of this important event the Executive, in consultation with the JCB, undertook three main lines of action. Firstly, it placed feasibility (Phase-A) studies on the H-Sat project with three industrial groups: SNIAS and Matra were awarded study contracts for the platform, on behalf of the Eurosatellite and MESH groups, respectively; AEG was put in charge of studying the payload. In addition, Eurosatellite and MESH were also invited to tender for the development contract of H-Sat, assuming that both offers should include AEG as a co-contractor for payload development. It was foreseen that, following Council approval in February, the final decision on the prime contractor could be taken in mid-June,

18 ESA/JCB(76)25, 9/9/76.

19 JCB, 8th meeting (16/9/76), ESA/JCB/MIN/8, 5/10/76, pp. 3, 5, 6.

20 ESA/JCB/VIII/Res. 1, 16/9/76, annex to ESA/JCB/MIN/8, cit.

Programme elements	MAU (1975 prices)	MAU (1976 prices)
ECS	88.65	102.8
Marots extension	25.77	29.4
ASTP	25.00	28.4
H-Sat	50.00	55.1
Indirect H-Sat costs	13.58	18.3
Total	203.00	235.0

Table 3: Package deal proposal for the telecommunications programme

thus enabling the immediate start of the programme in order to comply with the L04 launch schedule.[21]

The second line of action was the working out of a revised package deal proposal, on the basis of three new assumptions. Firstly, the need to provide for commercial insurance for the ECS and Marots launches; secondly, a reduction in the hardware required to implement an operational Marots space segment, assuming that only one additional satellite would be launched (Marots B); thirdly, a significant reduction of the ASTP, by eliminating payments previously envisaged in 1981 and 1982. The overall cost of the programme was thus brought back to 203 MAU in 1975 price terms, corresponding to 235 MAU at 1976 prices (Table 3). A tentative scale of contributions for each programme element was also worked out, essentially based on the contribution scales for Phase-2 and the Marots programme for the ECS and the Marots extension elements respectively; on GNP percentages for the ASTP element and on a preliminary assessment of industrial interest and capability in the various member states for H-Sat.[22]

The third line of action regarded the definition of a suitable arrangement with the CEPT regarding the operational use of the ECS system during the decade 1980-1990. On the one hand, such an arrangement was a *sine qua non* condition for the member states to approve this core element of the programme: in fact there was no point in developing the ECS satellite if the PTT administrations did not undertake to implement the whole ECS system, i.e. to build the necessary earth stations and to procure the other satellites required to maintain the space segment. On the other hand, the PTTs wanted a commitment for an ESA contribution towards the total investment in the space segment and its operation for a ten-year period. This contribution should include the provision of additional satellites and launches besides those foreseen in Phase-3 of the Telecom Programme; the operation and in-orbit control of the ECS satellites; and the continuation of technological and experimental activities preparing for second-generation satellites. ESA's eventual activity related to the setting up and operational use of the ECS system in the 1980-1990 period could not be included in Phase-3 of the Telecom Programme, but would form the content of a new optional programme, called Phase-3-bis. The Council was not requested, at this stage, to take a decision on this programme, but its definition and eventual implementation of course represented an intrinsic element in the overall discussion on the proposed telecommunications package deal. We shall deal with this aspect in more detail in the following section.

ECS Operations in the 1980s and Phase-3-bis of the Telecom Programme

In March 1976, a large majority of the European PTT administrations, with the notable exception of the Deutsche Bundespost and the British Post Office, had expressed their intention to participate in the setting up and utilisation of a regional system of satellite telecommunications based on the future ECS spacecraft, and undertook to build the necessary earth stations and other terrestrial infrastructure. These administrations, however, made their participation conditional "on the costs chargeable to them

21 ESA/JCB(76)38, 13/12/76; ESA/JCB(77)1 (Part B), 12/1/77.
22 ESA/JCB(76)33, 29/10/76; ESA/C-M(77)11, 27/12/76; add. 1, 12/1/77; add. 2, 27/1/77; ESA/JCB(77)4, 8/2/77.

for such participation remaining within acceptable limits".[23] Following this preliminary position, negotiations started between the ESA Executive and a group of CEPT representatives in order to define the conditions on which the PTTs would agree to use the ECS system.

As a preliminary conclusion of these negotiations, it was agreed that the national PTT administrations would set up and maintain some 20 to 25 earth stations required to receive satellite signals to be channelled in the telephone and the Eurovision networks. The management of the space segment of the ECS system would be delegated to a new international organisation, called Eutelsat, which the PTTs would create. During an initial period of ten years (1980-1990), Eutelsat would entrust ESA with the procurement and launches of the satellites necessary to maintain the planned space segment over the decade, i.e. two satellites in orbit and in working order at all times, and with the required control operations (telemetry, telecommand and tracking). ESA, in other words, would act as a technical manager of the space segment on behalf of Eutelsat. For these services, Eutelsat would pay a fixed price each year, eventually adjusted to take into account inflation effects, but not to be modified in the event of a launch failure, or an in-orbit satellite failure before the end of its design lifetime, or an increase in satellite and launcher costs. Moreover, ESA was requested to undertake a technology research programme aimed at developing a second generation ECS spacecraft. A legal agreement between ESA and Eutelsat would provide for the technical and financial aspects of the cooperation between the two organisations.[24]

On the basis of these principles, and taking into account the considerable investments for setting up the earth stations, the PTTs assumed that Eutelsat should pay, for the ESA services, no more than 55 MAU (at 1975 prices) in the ten-year period 1980-1990.[25] It was up to the space authorities in ESA member states to cover any shortfall between this amount and the actual costs to be borne by the Agency in order to fulfil its obligations. Assuming that at least four successful launches were necessary in order to maintain the space segment over the decade, the programme content and cost estimate for Phase-3-bis was presented by the Executive as follows (1975 prices):

a) procurement of two additional satellites (two already planned under Phase-3), at a cost of 30 MAU, plus 1 MAU for storage;

b) three launchers (one already planned under Phase-3), at a cost of 36 MAU (based on the cost of a Delta vehicle);

c) technical management, acceptance trials, launch and in-orbit control operations during the decade, at a cost of 20.8 MAU;

d) launch insurance, at an estimated cost of 7.5 to 9 MAU;

e) construction of a back-up satellite, at a cost of 15 MAU, which would however be repaid either by the insurance, in the event of a launch failure, or by the users after the initial ten-year period;

f) a technology research programme, worth some 4.8 MAU per year.[26]

Taking into account the Eutelsat contribution of 55 MAU, ESA Member States were thus requested to contribute 12 MAU of capital investments (satellites and launchers) and the whole of operating costs for establishing and maintaining the ECS space segment during the first decade of operations; in addition, they had to pay for the insurance premiums and the R&D activity, and to advance the money for the fifth satellite. In other words, while approving the ECS programme within the framework of

23 Letter of the chairman of the CCTS, F. Locher, to the ESA Director General, dated 2/4/76, annex to ESA/JCB(76)8(C), 12/4/76.

24 ESA/JCB(76)15(C), 15/7/76, and add. 1, 26/7/76.

25 The total investments of Eutelsat PTT administrations for building, maintaining and operating the required earth stations over a ten-year period was estimated at about 250 MAU: ESA/JCB(78)57, add. 1, p. 2.

26 ESA/JCB(77)33, 29/10/76, annex I; ESA/JCB(76)34, 3/12/76, annex III. Revised figures taking into account January-1977 price levels are in ESA/JCB(77)4, 8/2/77. A first draft of the envisaged ESA/Eutelsat legal arrangement is in ESA/JCB(77)2, 14/1/77, annex I.

the telecommunications package, ESA Member States had to accept that a further financial commitment would be required in the near future in order to grant this satellite a viable operational future.

The First Council Meeting at Ministerial Level

The first ESA Council meeting at ministerial level convened in Paris on 14th and 15th February 1977, its agenda covering all the outstanding financial and programme problems of the Agency in the second year of its lifetime. In particular, it was asked to take decisions on the continuation of current programmes and the start of new projects, on the role of ESA in the operational fields, on the relations with non-member states and other international organisations, and on the next three-year level of resources. A major item in the agenda was the telecommunications package deal proposal. No commitment was requested yet for the support of the ECS system in the 1980s (Phase-3-bis), but delegations were advised that a further financial guarantee would later be necessary in order to meet the CEPT conditions.

The discussions in the meeting involved three important issues. First, the question relating to the future operational use of the space systems developed within the framework of the Agency's programmes: Spacelab, Ariane and ECS were all expected to be available by the early 1980s, but it was evident that a promotional effort was required in order to persuade potential users of their merits and to initiate a real commercial space activity in Europe. What role should ESA play in this promotional effort? How long and how much should member state space budgets (i.e. R&D money) subsidise operational systems meant for commercialisation? At which point should the space agency withdraw from applications programmes, leaving all responsibility for future development to industry? How should suitable contribution scales be defined for promotional programmes whose benefits would eventually go to industries in one or another country? These problems underlay discussions on such issues as the Ariane production phase, for which it was proposed that ESA should undertake a promotion programme of six operational launchers; the Spacelab utilisation programme, with at least two demonstration missions to be funded by ESA; the operational use of Meteosat, for which ESA was to act as an operating agency in the absence of an international entity representing European meteorological authorities; and Phase-3-bis of the telecommunications programme we have already discussed.[27]

Member states had different views on these questions, representing their different political priorities and economic interests. For France, as was to be expected, support to the Ariane production programme was an absolute priority: "Our activity in the telecommunications field is pointless unless a launch capability is freely available to us - the French delegation argued - and we therefore consider that the decisions to be taken on the extension of the telecommunications programme are inseparable from these on the production of Ariane".[28] On condition that ECS and H-Sat would be launched by Ariane, France was in favour of the overall telecommunications programme and agreed that the Agency should also provide guaranteed ECS service for 10 years under an arrangement between ESA and Eutelsat. For France, it was a matter of long-term industrial policy:

> *For the time being, traffic was obviously not such as to warrant a communications satellite; it was likewise certain that once the satellite was operational, traffic routed via space would be light during the first year and increase progressively, becoming economically viable after ten years, while at the same time promoting the development of European space industry. [...] Whatever the system was called, whether OTS, ECS or something else, the main thing was that it should be operational, and that the PTT administrations should make the necessary investments in respect to the ground equipment and then derive sufficient profit to finance the space segment in its entirety.*

27 On Spacelab, see Russo (1997); on Meteosat, Krige (1998).
28 Council meeting at ministerial level (14-15/2/77), ESA/C-M(77)19, 3/3/77, annex VIII, p. 1.

[...] Europe should not leave its space industry to face a situation that might become catastrophic.[29]

Other delegations did not share the same views. The Netherlands, for example, "found it surprising" that, under the terms of the draft ESA/CEPT agreement, "all the risks were to be borne by ESA while any profit would go to the national administrations". The quotation is from a statement at a JCB meeting; at the ministerial meeting, the Netherlands representative insisted that any reference to a further financial guarantee following the completion of Phase-3 should be deleted.[30]

The German minister, for his part, argued that ESA should not be involved in any operational activity or commercial undertaking:

Where application satellites are concerned, ESA should be considered primarily as a typical development organisation. It should in future only undertake the development and testing of new systems when the users demand them and when requirement studies guarantee their use. The marketing of space systems, however, is not one of ESA's tasks.[31]

For Germany, it was up to national governments and national agencies to support commercially oriented space systems developed within the ESA framework. They opposed the concept of ESA supporting an Ariane production programme while, in the case of Spacelab, insisting that ESA's role should be limited to providing reimbursable services to outside users. As regards the ECS project, the German delegation reiterated its opposition to the Executive's plan, insisting that ESA should rather develop a satellite deriving directly from OTS, at a cost of about 75 MAU. Germany, of course, was not prepared to participate in the Phase-3-bis programme, considering that the users should cover the costs of the operational system. Priority was to be given to the H-Sat project, whose costs were estimated by the German authorities at 60 MAU, while the whole telecommunications programme could be carried out within a ceiling of 200 MAU. The delegation concluded with a warning note:

Should the Executive consider that it was impossible to contain the overall communications programme within an envelope of 200 MAU, *Germany would take part exclusively in the extension of the Marots programme and would invite all the countries that so wished to take part in its national heavy platform programme.*[32]

The second issue was the question of ESA's industrial policy and the fair return principle, particularly regarding the H-Sat project. According to the preliminary contribution scales suggested by the Executive, the industrial participation of the smaller countries in this programme element would have been well below that foreseen in the programme as a whole, as a consequence of the fact that the H-Sat programme was to make use of the various national capabilities in the most effective way. This approach towards a commercially oriented industrial policy was a necessary condition for Europe to compete successfully in the world market of communications satellites, and it was obviously supported by those countries whose space industries were already well advanced, notably France and Germany. The German minister was quite explicit in this respect:

Linked to the need for the cost-effective and economical use of ESA's resources is the question of member states' "fair return" on industrial contracts. This return is a regulator rightly recognised by the Convention with a view to the uniform increase of competitivity all round. In this connection, some member states are justifiably concerned about their unsatisfactory returns. On the other hand, a too timid approach to this important principle, with the emphasis on short-term goals, is also fraught with risks: risks of fragmenting projects and making them more costly. which should not be underestimated, in view of the keen competition for the limited world market. The ESA

29 JCB, 9th meeting (12/11/76), ESA/JCB/MIN/9, 3/12/76, p. 7.
30 ESA/JCB/MIN/9, cit, p. 6; ESA/C-M(77)19, cit., p. 9.
31 ESA/C-M(77)19, cit., annex VII, p. 2.
32 ESA/C-M(77)19, cit., p. 10.

Council will shortly be faced with the hard task of finding satisfactory solutions to the problems of how our collaboration may become more cost-effective and economic.[33]

France too advocated a market-oriented approach to ESA's industrial policy in the coming decade. In particular, it insisted that the H-Sat project should not be implemented as part of an overall telecommunications programme, where it would hardly be possible to diverge significantly from a contribution scale based on the OTS and Marots programmes, but as a real new independent programme, solely devoted to direct television broadcasting, in which France was prepared to participate to the extent of 35 %.[34]

This approach, however, was opposed by those member states which had not managed to establish a competitive industrial capability and therefore risked being left out of the most promising technical developments. For them, a strict enforcement of the fair return concept in all future ESA programmes should remain the linchpin of the European joint effort in space. As the Dutch minister put it:

In respect of the heavy platform, [...] the industrial return [must] be based on a formula in which the industrial distribution of work was adapted to the financial contributions of the member states, and not the other way round.[35]

The Italian delegation, for its part, stated that Italy would support the extension of ESA's telecommunications programme on condition that its scientific and industrial capacity could be fully used within this framework and that its national activities in the space communications field could be integrated within the Agency's programme. The delegation insisted that the H-Sat programme should not be confined to direct television broadcasting, as requested by France and Germany, but should also include experiments in the 20/30 GHz band which were being planned in Italy, the participation of Italy being dependent on the inclusion of the 20/30 GHz experimental package.[36]

The divergences relating to industrial policy emerged also in the third issue under discussion, i.e. the research activities to be performed within the framework of the telecommunications programme (ASTP). This programme element was supported by those member states which did not have national space programmes, and therefore depended on ESA for advancing their industrial competence and training their engineers. France and Germany, on the contrary, which supported strong R&D activities in the framework of their national programmes, did not like devoting so many resources to this part of ESA's activities which, in their opinion, resulted in a duplication of effort and a waste of money. Why not use national capacity for common programmes, they argued, rather than undertaking expensive technology research projects within ESA? France, in fact, announced that it would not participate in the ASTP, at least until the specifications of the direct television broadcasting project were known and the ECS project frozen. Germany, for its part, expressed its willingness to participate in the programme, "in order to meet the smaller nations half-way", but insisted that its budget should be set around 15 MAU, which "would already allow a considerable amount of work to be done" and in any case not exceed 20 MAU.[37]

The only programme element which was not controversial, receiving in fact unanimous support, was the operational extension of Marots. In order to understand this position, we need a short digression. In January 1977, just before the ministerial meeting, Comsat contacted both ESA and the European PTT administrations, in order to investigate the possibility of using Marots satellites to provide service continuity to their users after the end of life of their Marisat satellites, whose design life was five years. A total of four Marots spacecraft were required to provide reliable service continuity, and Comsat was prepared to pay 40 to 50 % of the costs of the third and fourth flight units, provided that

33 ESA/C-M(77)19, cit., annex VII, pp. 1-2.
34 JCB, 10th meeting (15/12/76), ESA/JCB/MIN/10, 12/1/77, p. 7; 11th meeting (24-25/1/77), ESA/JCB/MIN/11, 22/2/77, pp. 3, 6.
35 ESA/C-M(77)19, cit., p. 9.
36 ESA/C-M(77)19, cit., p. 8; ESA/JCB/MIN/9, cit., p. 5; ESA/JCB/MIN/11, cit., p. 11.
37 ESA/JCB/MIN/11, cit., p. 4; ESA/C-M(77)19, cit., p. 9.

it would have access to those two launched under the ongoing Marots programme (Marots A) and the proposed extension under approval by ESA Member States (Marots B).

The Comsat proposal was extremely interesting, the Executive explained, as it implied the setting up in the early 1980s, of a world-wide maritime system entirely based on the Marots spacecraft, which would be used not only by Europe but also by the United States and probably Japan: "Such a major extension of the Marots programme would place European space industry in an extremely competitive position prior to the procurement of the satellites for a definitive Inmarsat world-wide maritime system which may be foreseen for the middle of the 1980 decade". A great deal of urgency was however attached to the examination of this possibility:

> *Comsat General have clearly indicated the need for a firm position from Europe by April [1997]; if this is not forthcoming, then the pressure for them to provide follow-on Marisat space segment is such that Comsat General would be forced to consider other solutions, both in terms of spacecraft hardware and in terms of prospective partners.*[38]

Without approval by the ministerial Council of the Marots B extension proposed in the framework of the telecommunications package deal, further discussions with Comsat would not be possible and this opportunity would definitely be lost.

All delegations agreed that positive action should be taken on this part of the telecommunications package. "On no account must we miss this opportunity of making one of our systems operational", the German minister argued; and the British added: "The American offer represents an opportunity for Europe to get its satellites into a world system within five years from now and I am sure delegates will agree we must not let this opportunity slip."[39]

In the event, the divergence of views that had emerged on the other elements of the package prevented the ministers from adopting a formal resolution. Only a declaration of intent was approved, in which they expressed their interest in ESA to undertake the overall telecommunications programme including the four elements proposed by the Executive and instructed the Director General to submit to the next meeting of the JCB "his proposals for the next measures to be taken regarding all elements of the overall programme, including such interim measures as he may feel necessary." The DG was however authorised to proceed forthwith with the initial steps for the industrial development of the additional hardware envisaged for the Marots programme extension. The final decision on the telecommunications package deal was deferred to the next Council meeting, scheduled for 30th June and 1st July 1977.[40]

Negotiations on all Fronts

Discussions about the telecommunications package deal continued throughout the year in the JCB, the June meeting of the Council having been unable to take a decision. Four main areas of controversy remained, i.e. the financial commitments relating to the use of the ECS system in the first decade of operations (Phase-3-bis); the compatibility of the Marots satellite with the Marisat system; the adjustment of industrial return and the contributions of participating states; and the mission specifications of H-Sat. We shall discuss these issues in turn.

ESA-Eutelsat Negotiations for Funding ECS Operations

In May 1977, the European PTT administrations set up, on an interim basis, the Eutelsat organisation, responsible for the management of the space segment of European communications satellite systems,

38 ESA/JCB(77)1, 12/1/77, part A. See also ESA/JCB(77)4, 8/2/77, pp. 3-4.
39 ESA/C-M(77)19, cit., annex VII, p. 3; annex IX, p. 1.
40 ESA/C-M(February 77)Dec. 1, 15/2/77, attached to ESA/C-M(77)19, cit.

Cost elements	MAU (1976 prices)
Investments	78.4
- 2 satellites	*33.5*
- 3 launchers	*43.5*
- storage	*1.4*
Insurance	7.5
Operations	23.2
Total	109.1
Eutelsat contribution	65.0
ESA contribution (Phase-3-bis)	44.1

Table 4: Estimated costs of the ECS system space segment in the 1980s

including in a first phase the ECS and the Marots satellites.[41] Later that year, those Eutelsat members interested in the ECS system started negotiations for the definition of the legal and financial framework for their participation in the establishment, operation, maintenance and utilisation of the ECS space segment. This depended, in turn, on the successful outcome of negotiations with ESA regarding the commitment from the Agency to contribute to the procurement and operation of the required space segment for the first ten-year period. The total cost of this effort was estimated by the Executive at about 44 MAU, in 1976 prices (Table 4). This figure, however, was calculated on the basis of the cost of a shared Ariane launcher and did not include the sum (28.5 MAU) to be advanced for the procurement and launch of a fifth (back-up) satellite.[42] The ESA member states, with the important exception of Germany, were generally willing to accept the principle of subsidising the ECS operational use in its initial phase (they had no other choice, in fact!), but urged the Executive to negotiate more favourable conditions before approving this part of the telecommunications package.[43] The German authorities, for their part, considered that only a few PTT authorities were actually going to use the system in the years 1981 to 1985; therefore Eutelsat would probably not be in a position to pay the annual utilisation cost of 6.5 MAU until the mid-1980s. Thus they made it clear that Germany's participation in the ECS development was conditional upon Eutelsat's undertaking to bear the utilisation costs from the time the first satellite became operational in 1981. Otherwise, they stated, "the starting-up date must be put back".[44]

The situation was on the edge of an impasse: on the one hand, the PTTs would not undertake to use the ECS system, and make the necessary investments in the earth segment, unless the governments accepted to heavily subsidise the space segment operations; on the other hand, many governments would not accept to support the ECS development programme within ESA unless the PTTs accepted to commit themselves on the use of the system. As a matter of fact, the CEPT and Eutelsat held a strong negotiating position, since the European communications satellite system was not emerging from a real demand of potential users but rather from the governments' interest in supporting advanced space technologies. Now, for ESA's research and development programmes giving rise to an operational system, they had to sell the satellites to lukewarm users holding a monopolistic position, and it was the latter who fixed the price.[45]

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41 ESA/JCB(77)15, 5/4/77; ESA/JCB(77)18, 31/5/77. The formal Agreement on the constitution of Interim Eutelsat entered into force on 30 June 1977. Eutelsat's initial member states were Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxemburg, Monaco, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom.

42 ESA/JCB(77)43, 17/11/77. A preliminary version is ESA/JCB(77)8, 7/4/77.

43 JCB, 17th meeting (16-17/11/77), ESA/JCB/MIN/17, 5/12/77.

44 ESA/C(77)93, 4/10/77, p. 1, *Text of a letter from the German Federal Ministry of Science and Technology to the Director General of ESA, dated 24 August 1977.*

45 The difficult relationship with the user is also evident in the case of the meteorological satellite programme, as discussed by Krige (1998).

Changes in the Marots Specifications

The negotiations between ESA, Interim Eutelsat and Comsat (on behalf of the Marisat consortium) led to the concept of the so-called Joint Venture, i.e. a formal agreement between Eutelsat and other parties interested in the procurement of a global maritime system before the establishment of Inmarsat. The space segment of such a system would comprise two Marots spacecraft made available by ESA to Eutelsat under the proviso of the on-going Marots programme and its eventual extension, plus two other spacecraft procured by the Joint Venture. During the year, the discussions broadened to include not only the U.S.A. but also Canada, Japan and other countries.

A major technical problem arose in this context, relating to the frequencies used for the links between the satellites and the shore stations. At the start of the Marots programme, frequencies in the 11/14 GHz bands (Ku-band) had been selected, as for the OTS and ECS fixed service systems. On the contrary, the Marisat satellites used frequencies in the conventional 4/6 GHz bands (C-band), and the Marisat consortium would not accept shore-to-satellite links at the higher frequency bands for this implied expensive conversion of the existing ground station equipment. Moreover, during discussions in preparation for Inmarsat, it became clear that most countries had a clear preference for the 4/6 GHz bands, which were therefore likely to become the international standard. "The prospects of using the 11/14 GHz bands for maritime purposes [are] nil, at least during the lifetime of the present generation of satellites", the chairman of Eutelsat's Marots Council explained to JCB delegations, pointing out that Eutelsat had no choice but to request ESA to modify Marots A and B to the 4/6 GHz bands.[46]

The consequences for the Marots programme of a change to C-band frequencies were rather severe. This change, in fact, implied an extensive redesign of the payload; a minimum two-year delay in the launch of Marots A (from December 1978 to December 1980 if work in industry on the new design was initiated immediately) and an extra cost of 18 MAU (1976 prices). Moreover it meant that the two Delta launchers procured under the programme could no longer be used at reasonable cost, since NASA was contemplating closing their launch pads at Cape Kennedy by early 1980, and therefore another launch vehicle would have to be used. Both Ariane and the Shuttle could be considered in principle, but the Marisat consortium insisted that the allegedly expensive Shuttle should anyway be used for Marots C and D, whose procurement it was due to support.

In September 1977, the Executive requested the JCB to endorse its plans for reorientating the Marots programme. Firstly, Marots A and B would be modified as requested by Eutelsat, by changing from Ku- to C-band frequencies. Secondly, steps would immediately be taken to recover as much as possible of the already incurred cost for the procurement of the two Delta launchers. Finally, the Marots A prime contractor (Hawker Siddeley Dynamics) would be invited to make a competitive offer for a total of four spacecraft, which would form the basis for ESA to make a firm proposal to Eutelsat and the Marisat Consortium. The Executive believed that, "notwithstanding the fundamental reorientation required to the programme, and the consequent losses which would inevitably result from it", it was possible to limit the financing by ESA to the 120 % ceiling of the on-going Marots A programme (approximately 120 MAU at 1976 prices) plus the 30 MAU foreseen for the Marots B extension. It underlined, however, that industry had been asked to make its offer on the basis of four Shuttle launches: "It will be for the European side to decide whether and how Ariane launches may be financed, since these will inevitably be more expensive than Shuttle launches in the time-frame being considered".[47]

There was no choice for the JCB but to endorse this course of action: "If the Board did not take the decisions recommended by the Executive [...], ESA and the whole of European industry would lose all credibility", the chairman warned, insisting that "to refuse the change of frequencies would be to abandon all hope of dealing with the Marisat consortium and would not even permit European PTT administrations' requirements to be satisfied". Two important qualifications were associated to this

46 JCB, 16th meeting (22-23 /9/77), ESA/JCB/MIN/16, 2/11/77, p. 7. Cf. ESA/JCB(77)19(M), 7/7/77.
47 ESA/JCB/(77)30(M), 2/9/77, pp. 3-4.

decision, however. Firstly, the French delegation insisted that the Marots spacecraft had to be launched by Ariane, the launches being eventually subsidised by ESA. The Agency is pursuing and expanding a technological programme, they argued, "therefore the criteria of the research and development programmes should be applied, and not purely commercial ones". Secondly, the German delegation considered that if the tender for four satellites was not successful, the Marots programme would be devoid of any commercial interest and should therefore be abandoned.[48]

By the end of the year, HSD submitted its proposal for the provision of four maritime communications spacecraft, the first two of which would be funded by ESA and then put at the disposal of Eutelsat, whilst the third and fourth would be procured, via ESA, by the partners of the Joint Venture. The first spacecraft would be based on the OTS platform while the three others would use the upgraded ECS platform. In order to comply with the French request regarding the launch vehicle and to keep the costs within previously indicated estimates, it was assumed that Marots A should be launched by the Ariane L04 test flight and Marots B by means of an operational Ariane, shared with another spacecraft. The launch costs for both spacecraft, in this case, would not exceed 7.25 MAU. The third and fourth spacecraft could be launched by either Ariane or the Shuttle.[49]

Eutelsat confirmed its interest in a two-satellite programme covering the Atlantic and Indian oceans, but the implementation of the global four-satellite system depended on a successful outcome of the negotiations for setting up the envisaged Joint Venture. A major problem in this context was that the Marisat consortium insisted that the third and fourth spacecraft should use a Hughes-developed communications payload derived from the Marisat payload instead of the payload under development by the European Marconi company for Marots A and B. The JCB then authorised the Executive to pursue anyway the Marots A/B programme with the Marconi payload while, at the same time, continuing negotiations with the Marisat consortium for the procurement of the two additional spacecraft with the Hughes payload.

The juridical framework of the envisaged Joint Venture and the conditions of an ESA offer for the space segment of a pre-Inmarsat world-wide maritime satellite system were discussed at a meeting in London on 20th and 21st December 1977. Present at the meeting, in addition to representatives of ESA, Eutelsat and the Marisat consortium (Comsat and Western Union), were delegates from Canada, Greece, Japan, Bulgaria and the Soviet Union, together with the chairman of the Inmarsat Preparatory Committee. Messages apologising for their absence, but expressing interest in the proposals under discussion at the meeting, were received from Australia, New Zealand and Kuwait. After discussions on a number of technical and financial aspects, ESA undertook to provide, by end of March 1978, a formal proposal for participation in the third and fourth satellite procurement, based on a firm fixed-price offer from industry. A number of working meetings would be arranged meanwhile to discuss problems and queries relating to this proposal and to consider the necessary formal agreements between the Joint Venture participants on the one hand, and between the Joint Venture and ESA on the other.[50]

The link between the evolution of the Joint Venture and the ESA Marots programme was a major issue in the discussions over the possible extension of the latter. The Executive insisted that a positive decision on Marots B should be taken as soon as possible in order to strengthen the European position in the negotiations with the Joint Venture partners, but opinions diverged among member ESA states. France and Britain, on the one hand, argued that the European maritime programme should be dissociated from these negotiations; Germany however insisted that it should be implemented only on the condition that four European maritime satellites would eventually be incorporated in a world-wide operational system.

48 ESA/JCB/MIN/16, cit., pp. 8-9.
49 ESA/JCB(77)39(M), 14/11/77; JCB, 17th meeting (16-17/11/77), ESA/JCB/MIN/17, 5/12/77.
50 ESA/JCB(78)4, 12/1/78.

The MESH Offer for the ECS Development Contract

Pending final approval of the telecommunications package deal by the JCB and the Council, the Executive undertook to get preliminary approval from the Industrial Policy Committee (IPC) of the prime contractorship for the development of ECS and H-Sat. This made it possible, on the one hand to establish a definite baseline for the geographical distribution of industrial work and on the other to maintain the industrial capability which had developed in the previous years around the OTS and *Symphonie* programmes. Many companies in Europe had already performed preliminary studies of next-generation communications satellites on behalf of ESA, and now they needed a more definite prospect of future work. Pending formal approval of the ESA programme, the choice of the prime contractor and associated industrial group would keep project teams in place and allow a limited release of funds to cover procurement of long-lead hardware parts and the initiation of some critical developments. In this and the following sections, we shall discuss the events leading, in the summer of 1977, to the choice of the industrial groups responsible respectively for the development of ECS and H-Sat.

In July 1976, the JCB had approved the principle that the ECS spacecraft should be procured directly through Hawker Siddeley Dynamics (HSD), prime contractor for OTS on behalf of the MESH industrial consortium.[51] It was assumed, in fact, that ECS should draw heavily on the OTS project so as to eliminate unnecessary risks in this initial operational system and to minimise recurring costs. Preliminary studies up to system design level (Phase-B) had been performed during that year, firstly assuming a Delta vehicle for the initial launch, but subsequently making Ariane the baseline launch vehicle for the whole production run. The Phase-B study was completed in March 1977, defining a configuration essentially compliant with the requirements of the CEPT, i.e. a 7-year lifetime satellite carrying 12 communications channels and with the power capability of running 9 channels in sunlight and 5 in eclipse.[52]

In parallel with these study activities, HSD prepared a preliminary offer for the production of the first two satellites, which was the subject of an exhaustive review by the Executive. As a result of negotiations, mostly regarding the geographical distribution of industrial work, MESH submitted a revised offer for the development and construction of the first flight unit at the price of 59.9 MAU (1976 prices), with an option for three additional flight units at a total price of 44.9 MAU. The proposed geographical distribution of industrial work is shown in Table 5.[53]

Belgium	2.09	Prime contractor	HSD (UK)
Denmark	0.40	Co-contractors	Matra (F)
France	20.80		ERNO (D)
Germany	26.90		SAAB (S)
Italy	11.40		AEG (D)
Netherlands	1.75		Selenia (I)
Spain	0.40		Aeritalia (I)
Sweden	3.63		
Switzerland	1.99		
United Kingdom	16.80		
USA/others	9.20		
Unallocated	4.64		

Table 5: Proposed distribution of industrial work for ECS (%)

51 JCB, 7th meeting (27/7/76), ESA/JCB/MIN/7, 3/9/76, with attached ESA/JCB/VII/Res. 1, 27/7/76. The reference document is ESA/JCB(76)16(C), 13/7/76.

52 Bartholomé (1978).

53 ESA/IPC(77)70, 21/6/77 (also attached to ESA/JCB(77)22, 21/6/77); add. 2, 12/7/77.

An important aspect of the MESH offer was that this distribution did not match the contribution scale of Phase-2. If the latter was to be confirmed for this programme element in the telecommunications package, as had generally been assumed, all countries but France, Germany and the United Kingdom would have had an unacceptably poor industrial return. As it was hardly possible to modify the geographical distribution proposed by the contractor, there was no choice but to agree on a modification of the contribution scale, e.g. by extending to the ECS project the method envisaged for H-Sat, that is a contribution scale proportionate to the work obtained by industry in the participating states. This, of course, did not please those countries which wanted to maintain their industrial capability in the communications satellite field. Italy, in particular, expressed its dissatisfaction, for its participation in ECS was much lower than in the OTS programme, and explicitly requested that it should be improved, "in view of the interest Italy had always shown in the telecommunications programme".[54]

Notwithstanding these reservations, the IPC unanimously approved the award, in July 1977, of the ECS development contract to the MESH consortium, subject to the approval of the overall telecommunications package. Since such approval was not expected in the near future, the JCB and the IPC authorised the support of interim MESH work on ECS until the end of September, at the level of 6.5 MAU.[55]

54 IPC, 16th meeting (25-26/7/77), ESA/IPC/MIN/16, 28/7/77, p. 5. Cf. also Council, 18th meeting (30/6-1/7/77), ESA/C/MIN/18, 18/7/77, p. 5.

55 ESA/IPC/MIN/16, cit, p. 10. JCB, 15th meeting (26/7/77), ESA/JCB/MIN/15, 17/8/77, pp. 3-4. The content of this preliminary contract is presented in ESA/IPC/70, add. 1, 13/7/77 (also attached to ESA/JCB(77)26, 13/7/77). The payments concerned were to be provisionally paid from the Phase-2 budget for 1977, being subject to repayment from the Phase-3 budget once the latter was formally approved.

	Eurosatellite	MESH
Price in MAU	59.73	65.73
Overall mark (%)	54.75	54.81
Geographical distribution (%)		
Belgium	4.87	0.45
Denmark	0.86	1.36
France	26.00	28.81
Germany	35.17	29.02
Italy	17.92	18.60
Netherlands	0.15	1.39
Spain	0.38	0.30
Sweden	6.21	8.16
Switzerland	1.70	0.00
United Kingdom	3.77	5.82
United States	2.82	3.96
Canada	0.15	0.13
Other or to be allocated	0.00	2.00
Industrial structure		
Prime contractor	SNIAS (F)	Matra (F)
Co-contractors	SNIAS (F)	Matra (F)
	MBB (D)	ERNO (D)
	ETCA (B)	HSD (UK)
	Dornier (D)	SAAB (S)
		Aeritalia (I)
		MBB (D)
		Fokker (NL)
		BTM (B)
	AEG-Telefunken (D)	AEG-Telefunken (D)
	Selenia (I)	Selenia (I)
	Ericsson (S)	Ericsson (S)

Table 6: H-Sat Tenders

Selection of the H-Sat Contractor

Much more controversial was the award of the development contract for H-Sat. As we have anticipated, two industrial groups had been requested to tender and in April 1977 SNIAS and Matra, on behalf of Eurosatellite and MESH respectively, submitted their offers. These were subsequently revised as a result of some changes in the specifications, primarily in the area of the payload, and new tenders were finally submitted on 13th June. The main features of both bids are shown in Table 6, together with the evaluation results.[56]

The MESH and Eurosatellite groups, the Executive pointed out, "taken together, represent the essential part of European capacity in the matter of communications satellites, [...] but neither group,

56 ESA/IPC(77)68, 16/6/77 (also attached to ESA/JCB(77)21, 17/6/77); add. 1, 13/7/77; add. 2, 19/7/77 (also attached to ESA/JCB(77)25, 19/7/77); add. 2, corr. 1, 21/7/77.

taken separately, represents that capacity in a satisfactory way".[57] The former was one of the three consortia traditionally involved in ESA programmes (together with Cosmos and Star), and it had acquired its capability in communications satellite technology through its involvement in the OTS programme. The latter had emerged from the experience of MBB and SNIAS (the core members of the Cosmos consortium) with Symphonie and Intelsat V. According to the Executive, the qualitative and quantitative evaluation of the two offers had not revealed any significant preference if one did not take into account price and geographical distribution, both proposals being judged acceptable and compatible with the mission and project requirements. In the area of costs, the Eurosatellite offer had a significant advantage (about 6 MAU), while the difference in the proposed geographical distribution of work was not supposed to constitute a determining factor in the choice of the contractor, since it was assumed that contributions would be linked to the share of industrial work. Neither of the two tenders was wholly satisfactory as regards geographical distribution, the Executive concluded, but both groups had declared their intention of improving their proposal in this respect, on the basis of further negotiations.

In view of these considerations, the Director General recommended that Eurosatellite should be selected for the H-Sat contract. This recommendation, he added, was also consistent with a sound industrial policy. In fact, in view of the intention to award the ECS programme to MESH by direct negotiation, a satisfactory balance in the use of existing European capability would be achieved by awarding the H-Sat programme to Eurosatellite. On the contrary, "the award of this contract to MESH would have put this group in a monopolistic position in Europe, even beyond the telecommunications programmes, as there are no other programmes of comparable dimensions to counterbalance this and to give sufficient work to the companies of the losing group".[58]

When the matter came to be discussed in the IPC, however, the Swedish delegation contested this approach: the market potential was not great enough to maintain two consortia in the space telecommunications field, they argued, therefore ESA had to foster the creation of a monopoly situation by placing the H-Sat contract with MESH (of which, it should be remembered, the Swedish SAAB company was a core member). The Danish delegation, for its part, pointed out that the geographical distribution of the MESH offer was better for smaller member states and that, even if the contract were awarded to Eurosatellite, the Executive had to impose on this group "an obligation to increase the industrial return to smaller countries such as Denmark".[59] Other delegations, both in the IPC and the JCB, expressed their dissatisfaction with the geographical distribution proposed in the Eurosatellite offer. The United Kingdom, the Netherlands, Sweden, Italy and Switzerland recalled that they were prepared to contribute with a higher percentage to the H-Sat programme, in consideration of its importance for the future of the European space industry. The Swiss delegation, in particular, called into question the industrial policy approach adopted by the Executive, whereby the contribution scale had to be aligned to the geographical distribution resulting from the tender offers:

> *The result was that some countries (for example Denmark, Netherlands and Switzerland) were "bought out" of the telecommunications programmes because the overall contributions came down to less than half of what they intended to contribute. The Executive had not accepted the Swiss proposal to pay up to 3 % of the Heavy Satellite programme; this was an important point which went beyond the programme itself since the Heavy Satellite was the programme which had the greatest chance of having a commercial follow-up.*[60]

In the event, by a majority of 6 votes in favour and four against (Italy, Netherlands, Sweden and United Kingdom), the IPC approved the choice of Eurosatellite as prime contractor for the H-Sat project, but only on the condition that it undertook to improve the geographical distribution of work, "particularly in respect to Denmark, the Netherlands, Switzerland and the United Kingdom." The

57 ESA/IPC(77)68, add. 1, cit., p. 4.
58 ESA/IPC(77)68, cit., annex, p. 33.
59 ESA/IPC/MIN/16, cit., p. 6.
60 JCB, 14th meeting (21/6/77), ESA/JCB/MIN/14, 5/7/77, p. 4.

revised contractual baseline would be submitted again to the IPC in September 1977 and, should it not constitute a satisfactory solution to the majority of delegations, the choice of the prime contractor would have to be reconsidered.[61]

In the following two months, negotiations were developed between ESA and Eurosatellite, aiming at modifying the geographical distribution of work in compliance with the IPC resolution. The new offer was presented on 15th September and eventually submitted to the Committee (Table 7).[62] The new baseline contract price was slightly higher than the original offer, owing to the re-allocation of some tasks in order to improve the geographical distribution and to changes in the payload specifications. In addition to the baseline contract, the Executive recommended the approval of two other items, namely the electric propulsion experiment, already included in the original Eurosatellite offer, and the magnetic bearing momentum wheels, a new type of attitude control system whose testing in the space environment was worth doing. Finally, the IPC was requested to decide whether to replace the MAGE 3 solid propellant apogee boost motor assumed in the baseline satellite configuration with a liquid propellant motor under development in MBB. The cost increase implied by this option was estimated at 1.16 MAU.

This latter point deserves a few comments. The MAGE (Moteur d'Apogée Géostationnaire Européen) programme was under development since 1974, under contract to ESA, by the French Société Européenne de Propulsion (SEP), in collaboration with the Italian SNIA-Viscosa and the German Maschinenfabrik Augsburg Nürnburg (MAN). Its aim was to provide a European apogee boost motor (ABM) capable of supporting ESA's geostationary missions. Performance specifications were initially centred on the needs of Delta-launched satellites (MAGE 1), but the development of the Ariane launcher and the evolution of ESA's programmes in the applications satellite field subsequently led to the development of a "family" of MAGE motors.[63] The MAGE 3 version, in particular, was planned at that time for eventual use in H-Sat missions. At the July meeting of the IPC, however, the German delegation insisted that H-Sat should integrate the liquid propellant ABM under development at MBB as an upgraded version of the motor used in the *Symphonie* satellite. The delegation also stated that it would ensure that the costs would not be greater than those of the solid propellant MAGE system. The Committee took note of this offer and instructed the Executive to examine the introduction of this proposal as an alternative in the contractual baseline with Eurosatellite. The results of this study, as reported by the Executive, showed that both solutions were technically acceptable, the integration of the MBB motor implying however a cost increase due to design development and qualification, and a modification of the geographical distribution, mainly to the advantage of Germany and disadvantage of Italy (Table 7). A political constraint had meanwhile been added, however: in a letter to the ESA Director General, the German Federal Ministry of Science and Technology stated that the integration of the liquid-propellant ABM was a *sine qua non* condition for Germany to participate in the H-Sat programme. A further compelling condition was that the payload should carry two supplementary 200 watt travelling wave tube amplifiers (TWTAs), in addition to the baseline 450 watt and 150 watt TWTAs, in order to flight test this technology extensively developed by AEG in the framework of the German national space programme. The letter specified that "the Federal Republic [was] prepared to bear any additional costs involved by providing equipment developed under its national programme".[64]

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61 ESA/IPC/MIN/16, cit., annex I.

62 ESA/IPC(77)88, 19/9/77.

63 Asad (1983). On the early history of the MAGE programme, in relation to the OTS/ECS and Marots/Marecs programmes, cf. ESA/JCB(80), 14/5/80.

64 ESA/C(77)93, 4/10/77, p. 2.

Baseline contract price	**60.03**	MAU
Electric propulsion option	1.15	MAU
Magnetic wheel option	1.20	MAU
TOTAL	**62.38**	MAU
Liquid ABM Option (if selected)	1.16	MAU
TOTAL	**63.54**	MAU

Geographical distribution (%)

	Baseline	Including Recommended Options	
		Solid ABM	Liquid ABM
Belgium	5.50	5.22	5.12
Denmark	0.94	0.89	0.87
France	26.39	26.92	26.91
Germany	30.28	30.61	31.54
Italy	17.00	16.14	15.65
Netherlands	0.15	0.14	0.14
Spain	1.81	1.72	1.69
Sweden	8.57	8.14	7.98
Switzerland	1.71	1.61	1.58
United Kingdom	3.77	3.58	3.51
U.S.A	3.88	3.68	3.61
Unallocated	---	1.35	1.40

Industrial structure

Prime contractor	SNIAS (F)
Co-contractors	SNIAS (F)
	MBB (D)
	SAAB (S)
	Marconi (UK)
	CASA (E)
	ETCA (B)
	SEP (F) (solid ABM option)
	MBB (D) (liquid ABM option)
	AEG-Telefunken (D)
	Selenia (I)
	Ericsson (S)

Table 7: Revised Eurosatellite offer (1976 price level)

The reaction of the IPC to Eurosatellite's revised offer was negative, with most smaller state delegations expressing their persisting dissatisfaction with the geographical distribution of work. Criticism went as far as blaming the Executive or the prime contractor for not taking into consideration offers from some companies to work on specific pieces of hardware. The various cases made at the meeting for changing the baseline work distribution often involved little money, at the level of a few hundreds of KAU. They demonstrate both the importance attached to the H-Sat contract

for the future of space industry in Europe and the lobbying activities of many companies on IPC delegations.[65] "It was very regrettable that the discussions had barely improved the overall position for Denmark", the Danish delegation said. It argued that improvements could be achieved, firstly, by increasing the part relating to the ground support equipment to be contracted with Christian Rovsing by about 100 KAU; secondly, by requesting SAAB to provide the same company with a sub-contract for certain TTC sub-systems; and thirdly, by re-awarding to Danneborg the 300 KAU sub-contract for instrumentation existing in the original offer but deleted in the new one. The Netherlands delegation, recalled that it had formally proposed that its country should participate in the H-Sat programme with a percentage identical to the one received in Phase-2 (2.5 %) and "very strongly deplored the unsatisfactory result of negotiations for the improvement of the share of work entrusted to its industry". The offer by Fokker to work in the area of thermal control had not been taken into consideration by SNIAS, the delegation noticed with regret. The Swiss delegation explicitly blamed the Executive for not taking into consideration options which would improve the industrial return to its country, warning that "a condition for the choice of Eurosatellite was that its authorities must imperatively obtain a return of at least 2 % of the contract". Finally, not surprisingly, Italy opposed reconsidering the choice of the apogee motor and stated that the new proposal was unacceptable as the percentage of work to be entrusted to Italian industry had been reduced.

No decision could be agreed on at the meeting, not only because of the need to reopen negotiations for the improvement of the geographical distribution, but also because the conditions indicated by the German government for their participation in the programme required a political decision at JCB or even Council level. The Committee thus agreed that a new proposal should be worked out by the Executive, after further negotiations with Eurosatellite.

We have reasons to believe that the new round of negotiations sometimes had the character of horse-trading, with the Executive having to assume more responsibility in driving the bargain than had been the case within the consortia framework, where the firms themselves agreed on a certain distribution of work. In order to improve the situation for Switzerland and the Netherlands, responsibility for the structure sub-system was transferred from Dornier to Contraves, and a major sub-contract to Fokker was introduced for the service module structure design and manufacture. These measures, however, called for a compensation to Dornier, which was definitely given responsibility for the orientation and power transfer mechanism (the British HSD was also a candidate for this sub-system), for the complete antenna structure (part of this work being previously being offered to Contraves) and for a Dornier-developed antenna pointing system originally suppressed by Eurosatellite as a cost-reduction measure. "Dornier no doubt considers it has suffered in this affair", the Executive commented, but it was confident that "this would be an acceptable situation". The housekeeping electronics was transferred from CASA to Danneborg, as a measure to improve the Danish share, the harness remaining however with the Spanish company. Other proposals for changing the geographical distribution were also discussed, particularly regarding the possibility of improving the situation for the U.K., but could not be implemented either for technical reasons or because they would have been to the detriment of the shares of Italy and Belgium.[66]

The outcome of this horse-trading (Table 8) was a 1 MAU increase in the baseline contract price and a new geographic distribution which the Executive now wisely calculated after excluding the contract share going to non-member states and the unallocated work (about 6 MAU in total). The adoption of all the recommended options implied a cost increase of 5.09 MAU, mostly to the advantage of German and French industry. As regards the controversial liquid propellant ABM option, this was not included in the new proposal for it would have to be resolved in the Council.

Presenting the new proposal to the IPC, the Executive insisted that "significant improvements in geographical distribution" had been achieved, with the notable exception of the U.K. and that "there

65 IPC, 17th meeting (19-20/9/77), ESA/IPC/MIN/17, 5/10/77. Following quotations are from pp. 12-14.
66 ESA/IPC(77)88, add. 1, 13/10/77; the foregoing quotation is from p. 2.

Baseline contract price	61.05	MAU
Electric Propulsion option	1.15	MAU
Magnetic Wheel option	1.10	MAU
Supplementary 200 W TWTAs	2.84	MAU
Total	**66.14**	MAU

Baseline geographic distribution (%)		
	before adjustment	**after adjustment**
Belgium	5.53	5.44
Denmark	0.98	1.42
France	27.45	27.10
Germany	31.69	30.43
Italy	17.69	17.34
Netherlands	0.16	1.78
Spain	1.88	1.37
Sweden	8.92	8.77
Switzerland	1.78	2.43
United Kingdom	3.92	3.92

Table 8: Eurosatellite offer for H-Sat development (second adjustment)

[was] no chance of going any further". As regards the unsatisfactory position of the U.K., the Executive recalled that this situation stemmed from the fact the British authorities had originally underestimated their participation in the H-Sat programme, and that the large industrial return in the Marots programme largely made up for the overall geographical distribution of work in the telecommunications field. Only at a later stage had the U.K. communicated its intention to participate in the programme at a higher contribution level. The conclusions were in the form of an ultimatum:

> *Either all the changes described should be implemented as a whole, or, if they are not found to be acceptable by the delegations, the original distribution of work [...] should be retained. An "in-between position" is not considered tenable since the changes are the result of a complex "package deal" negotiated with Eurosatellite and its sub-contractors and any change may invalidate the deal.*[67]

During its October 1977 meeting, the IPC was requested to approve the revised offer, thereby confirming the selection of Eurosatellite as the contractor for the H-Sat project. While most delegations found the proposal acceptable, this was criticised by the Italian and U.K. delegations. The former keenly regretted that certain Italian firms had not been awarded the share of the work they had expected, and protested against "Eurosatellite's attempt to impose a price reduction on the Selenia offer, in what the delegation considered to be an arbitrary manner". The latter insisted that the contract share envisaged for British industry was appreciably lower than the envisaged percentage contribution and regretted that "the enthusiasm aroused by the programme at the beginning had somewhat abated". Referring to the rejection of those measures intended to increase the industrial return to Britain, the delegation blamed "the attitude of certain industrial firms that appeared to seek to impose their viewpoint, while the Agency was unable to win acceptance for that of the delegations". It was regrettable, it concluded, that "the Executive did not, as in other cases, accept a

67 *Ibidem*, pp. 3 and 5.

certain cost increase where such cost increase made it possible to achieve more satisfactory geographical distribution of work".[68]

A different position was taken at the meeting by the German delegation, which recalled the conditions its authorities had laid down for them to participate in the programme, particularly regarding the ABM, and stated that no further decision should be taken on H-Sat until the overall telecommunications package had been approved by the Council. This attitude was harshly criticised by other delegations. Italy and France argued that the solid propellant apogee motor was technically preferable for H-Sat, and that the use of this technology for Ariane-launched satellites was consistent with the decision to develop the MAGE 3 motor.[69] Sweden, supported by the Netherlands, expressed its disapproval as follows:

> *While [the delegation] readily accepted that a country like Germany should exercise a profound influence on the orientation of the European space programme, it would regret it if that country was to forgo assuming its responsibilities; the delegation was indeed extremely surprised that the German delegation, after urging the Committee to vote in favour of Eurosatellite, was not prepared to confirm this attitude.*[70]

In the event, with Italy, Germany and the U.K. voting against, the IPC confirmed the selection of Eurosatellite as contractor for the H-Sat programme, and authorised the Executive to award the contract to this industrial group, subject to a positive decision on the execution of this programme in the framework of the overall telecommunications package deal.

Which Mission for H-Sat?

The crisis of the H-Sat project put into evidence by the German attitude had its origin in a meeting of the World Administrative Radio Conference (WARC) held in Geneva in February 1977. This Conference established the basic regulations and technical parameters for future direct broadcasting satellite (DBS) systems for all European, African and Asian countries, with a plan of utilisation of the geostationary orbit and of frequency bands allocated to the transmissions from satellites to Earth (11.7 to 12.5 GHz). The WARC plan envisaged that each country would manage its own national DBS service, based on the use of high-power (about 200 watts) transponders on board geostationary satellites, capable of transmitting signals that could be received by small "household" dishes in an area with the dimensions of a typical European state. The frequency spectrum was split into 40 adjacent channels all used twice (with opposite polarisations), and each European country was assigned a number of channels (typically 5), as well as an orbital position, beam shape and transmission power. This assignment assured each country of the ability to deploy a DBS system and limited inter-system interference to an acceptable level. This approach was quite different from the typically international set-up of a telecommunications system such as ECS, whose signals were received by large PTT-owned antennas and distributed to end users via terrestrial networks. In fact, subsequent to the WARC meeting, a few European nations, notably Germany, France, Italy and the Scandinavian countries (Nordsat concept), started planning operational DBS systems, while all others expressed an interest in DBS experiments and demonstrations with a view to the future introduction of a national system. The need for adequate experimentation in this new field was particularly important, as it involved both technical aspects (development by industry of low cost, mass-produced home receivers) and "sociological" aspects (creation of new programmes and market promotion among the public at large).[71]

How did H-Sat fit into the new framework? This question involved two different aspects. Firstly, the WARC plan was based on the concept of strictly national systems while the H-Sat system had been

68 JCB, 18th meeting (18-19/10/77), ESA/JCB/MIN/18, 11/11/77, pp. 3-4.
69 The Italian position was subsequently spelled out in a note reported in ESA/C(77)100, 15/11/77, also attached to ESA/JCB(77)41, 15/11/77.
70 ESA/JCB/MIN/18, cit., p. 5.
71 ESA/JCB(77)6, 4/3/77; ESA/SBAG(77)1, 28/3/77.

designed to permit direct TV broadcasting experiments and demonstrations in all parts of Europe, and was in consequence not specifically tailored to the needs of any particular country. The satellite's antenna pattern (beam width and orientation) did not coincide with the WARC pattern for any country; transmissions were restricted to a single sense of circular polarisation whereas this varied from country to country in the plan; only two channels were available on the satellite, which were to serve all experimenters but could only be selected among those assigned to one or two specific countries. All this made it difficult to define an experimental mission serving several countries, for the technical characteristics of the satellite could comply with the WARC plan specifications for only one or two countries.

Secondly, we should recall that broadcast experimentation was not the only mission of H-Sat. In fact, the main objective of the H-Sat programme was the development and in-orbit demonstration of a multi-purpose heavy platform, able to make maximum use of the Ariane launcher capabilities and to support a range of future communications payloads. The satellite's mission, as originally conceived, included the in-orbit test of various repeater and antenna technologies relevant to future communications satellites and a specific payload element for experimentation in the 20/30 GHz bands. H-Sat, in other words, had been designed as a large experimental satellite covering a wide spectrum of future broadcast and telecommunication systems. As a consequence of the results of the Geneva WARC meeting, however, the requirements of operational broadcast missions had been well defined, and the need for an experimental mission was less stringent for those countries which aimed at an early development of a national system. The link between the H-Sat concept and future operational DBS satellites was called into question.

Following the WARC meeting, the Executive, in consultation with the European Broadcasting Union (EBU) and ESA's Satellite Broadcasting Advisory Group (SBAG), identified a number of solutions for the choice of the frequency channels, orbital position and pointing parameters for H-Sat.[72] The H-Sat channels could only be selected among those assigned to one or the other Western European countries in the WARC plan, it being assumed that the national authorities concerned agreed that these channels be made available for the experimental activity in other countries. The solution envisaged was one channel among those assigned to Scandinavia and the other among those assigned to Germany or France. The suggested orbital position was 19° West, i.e. the one assigned by WARC to most European nations (Germany, France, Italy, etc., but not the British Isles nor the Scandinavian countries). By in-orbit pointing of the satellite body it was possible to illuminate different areas in Europe or Northern Africa, so that a large scale experimental programme could be carried out, on the basis of an utilisation plan to be defined by the 25 EBU member authorities interested in performing broadcast experiments by H-Sat.

This planning effort, however, could not conceal the weakness of the H-Sat concept *vis-à-vis* the new situation determined by the establishment of the WARC plan. Most EBU members did not envisage the introduction of an operational system in the short term and were therefore interested in an extensive experimental phase carried on by H-Sat. Others, on the contrary, wanted to pursue an early development of national DBS systems and insisted that H-Sat should definitely be given a clear pre-operational character. The group of Scandinavian countries envisaged the introduction of a dual satellite operational system (Nordsat) in the short term; France envisaged a national mission providing five channel operation in accordance with the WARC plan; Germany, for its part, announced at the June meeting of the Council that their national space organisation was studying a national DBS satellite, and adumbrated the possibility of withdrawing from participation in the H-Sat programme.[73] The majority of the other delegations expressed concern about the new situation and the prospects that Germany might not participate in the H-Sat programme. Recalling that the heavy platform had been envisaged at the outset as the basis of a new family of satellites, the Italian delegation stressed

72 ESA/SBAG(77)3, 5/4/77; ESA/JCB(77)24, 13/7/77. The SBAG included national delegates from all ESA member states except Switzerland and Denmark, plus the observers of Austria, Norway and the EBU.

that it would be impossible to reach agreement on the overall telecommunications package deal if one of its components was called into question. The French delegation remembered that it was partly at the instigation of the German authorities that it had been agreed to prepare "a rather ambitious satellite, with an experimental role, that would enable Europe to demonstrate its competence". The ESA Director of Planning and Future Programmes invited the German authorities "to state whether, and if so to what extent, the new concept it wished to promote was capable of leading to a European programme to be undertaken by the Agency."[74]

The German reservations notwithstanding, the Council invited the IPC to examine the MESH and Eurosatellite offers for the H-Sat development contract, and the latter, as we have seen, managed to select Eurosatellite. Pending a decision on the overall programme, the Executive requested the JCB to unblock the interim funding of 1 MAU in order to start some immediate work in industry and keep the project teams in place. The divergences on the technical options, however, prevented the Board from approving this request and it eventually decided to wait for Council decisions.[75]

The New Package Deal Proposal

In parallel with these developments, the Executive had, during most of 1977, been re-drafting new versions of its package deal proposal for an overall telecommunications programme.[76] These were discussed during several JCB meetings, but no final decision could be taken, the outstanding difficulty being the critical question of financial contributions and industrial return. The Executive was faced with irreconcilable restrictions. On the one hand, there was the obligation to keep within the ceiling of 200 MAU for the overall programme, which the German government considered a *sine qua non* condition for its participation. On the other hand, there were the wishes of the member states concerning their degree of participation in the Heavy Satellite programme: "If all wishes were to be satisfied then the ceiling would have to be lifted", the Executive argued.[77] The industrial offers for the ECS and H-Sat added a further restriction since, contrary to the fair-return concept, one had to adjust contributions to industrial return rather than the other way around. This approach was strongly opposed by the smaller member states, the Netherlands delegation being particularly sanguine in this regard.[78] Moreover, those member states whose industrial return had been unsatisfactory in the Agency's past programmes insisted that the balance should be recovered in the future. This principle had been agreed on by the ministerial meeting in February, but it was up to the Executive to work out a formula whereby the more favoured nations, i.e. France, Germany and the U.K., accepted an industrial return less than 100 % (80 to 95 % being proposed) in order to redress past imbalance of less favoured countries, notably Italy, the Netherlands, Sweden and Switzerland.[79]

Finally, there was the problem of the launcher. Due to the delay in the start of the H-Sat programme, the use of L04 for launching this satellite was no longer feasible, and a commercial Ariane launch had to be considered, for which the full price would have to be paid. However, the Marots A development schedule was compatible with an L04 launch, indeed it was the only satellite within the telecommunications package which could take advantage of this opportunity. The question was whether L04 should definitely be awarded to the Marots programme, the other satellites within the telecommunications package (ECS, Marots B and H-Sat) then paying full price for their launches, or a free ride on the last Ariane test launch should be considered a 'gift' for the whole of the telecommunications programme, thus allowing a reduction of the launch costs for the other parts of

74 *Ibidem*, pp. 7-8.
75 JCB, 17th meeting (16-17/11/77), ESA/JCB/MIN/17, 5/12/77. The reference document is ESA/JCB(77)35, 4/11/77.
76 ESA/JCB(77)17, 20/6/77; rev. 1, 13/7/77; rev. 2, 20/9/77; ESA/JCB(77)34, 4/11/77.
77 JCB, 14th meeting (21/6/77), ESA/JCB/MIN/14, p. 6.
78 Cf. the Netherlands delegation's statement at the 16th JCB meeting (22-23/9/77), ESA/JCB/MIN/16, 2/11/77, annex IV.
79 During the ministerial council a consensus had been reached over the principle of an 80 % minimum industrial return, the remaining 20 % remaining available for compensating past imbalance. The Executive then proposed a 90 to 95 % minimum industrial return for the three larger countries.

Programme elements	Programme cost	Launch cost	Total
ECS	98.0	14.5	112.5
H-Sat	89.0	24.9	113.9
Marots B	33.6	14.5	48.1
ASTP	8.0	--.-	8.0
Total	228.6	53.9	282.5

Table 9: Package deal proposal (December 1977)

the programme. "It would be paradoxical for the Marots programme to benefit from the L04 launch", the Belgian delegation pointed out, "since the largest contributor and consequently beneficiary, was the United Kingdom, which did not participate in the Ariane programme".[80]

By the end of 1977, the JCB had taken the discussions as far as it was practicable, on the basis of the resolution of the February Council meeting at ministerial level. The time was ripe to go back to Council for taking major decisions on such important issues as the starting of new major projects, launcher utilisation principles and industrial policy. "There remained only a very little time in which to take these decisions, which were essential for the future of the telecommunications programme", the Director General warned. "If this telecommunications programme was not approved at the next [December 1977] Council session, then the Agency might as well abandon it".[81] The Board having been unable to approve a definite proposal to be recommended to the Council, it was agreed that the chairman should present a document summarising the Executive's latest proposal, together with the positions of the various member states regarding the various elements of the telecommunications package. The Council was requested to approve a guideline resolution which would enable the JCB to implement the various package deal elements.

The main financial aspects of the proposal presented to the Council by the JCB chairman are summarised in Table 9.[82] The total cost of the telecommunications package was now estimated at 282.5 MAU in 1977 prices (corresponding to 243.6 MAU in 1976 prices), covering the period from 1977 to 1982. The launch of Marots B was foreseen in 1981 or 1982, ECS in the second half of 1981 and H-Sat in late 1981 or early 1982. It was assumed that all satellites would be launched by operational Ariane vehicles, the L04 test launch being definitely assigned to Marots A. The estimated costs for the commercial Ariane launches were 18 MAU for ECS and Marots B, assuming a double launch for each of them, and 31 MAU for the single launch of the 800 kg H-Sat. The figures shown in Table 9 take account of the fact that the savings resulting from the use of the L04 launch were distributed equitably among the various programme elements.

80 JCB, 18th meeting (6-7/12/77), ESA/JCB/MIN/18, 3/1/78, p. 7.
81 *Ibidem*, p. 3.
82 ESA/C(77)127, 12/12/77; ESA/JCB(78)2, 12/1/78. The figure corresponding to 1976 prices is given in ESA/JCB(77)34, 4/11/77.

Country	ECS	H-Sat	Marots	Total
Belgium	2.07	5.20	0.19	3.37
Denmark	0.42	1.27	0.60	0.84
France	24.02	26.48	7.18	23.54
Germany	32.76	32.80	11.75	30.74
Italy	14.42	16.90	4.12	14.59
Netherlands	2.08	2.33	2.53	2.24
Spain	0.44	1.28	0.63	0.86
Sweden	3.87	7.83	8.44	6.18
Switzerland	1.69	2.29	2.34	2.04
United Kingdom	18.23	3.62	62.14	15.60
Norway	---	---	0.1	0.01
Total	100.0	100.0	100.0	100.0

Table 10: Geographical distribution of main industrial contracts in Europe (%)

It was assumed that, over the whole programme, each participating state would receive a minimum of 92 % in industrial return, with the exception of the ASTP element where a return of 100 % was guaranteed. The remainder would be used to help restore the balance in the overall distribution of industrial contracts. The geographical distribution of the main industrial contracts was presented as in Table 10.[83]

After extensive discussions, the Council adopted by 10 votes to 1 (Germany) a resolution which finally approved the principle that the four-element telecommunications programme be performed within the framework of the Agency. All delegations except that of Germany and Ireland subscribed to a declaration by which they undertook to participate in one or more elements of the overall programme, on certain conditions associated with total contributions, yearly contributions and industrial return. The JCB was requested to pursue matters further at its first meeting of 1978, taking into account the declarations and reservations made by the participants during the meeting. Italy, in particular, insisted that the value of the minimum return coefficient should be 90 %, in order to have more money to restore past imbalance and that H-Sat should incorporate the MAGE 3 apogee motor. Final approval of the four programme elements was foreseen for the following Council meeting in February 1978.[84]

Germany was the only member state which voted against the resolution, a negative position which indeed jeopardised the actual possibility of starting the programme. Several reasons were listed by the German delegation for it refusing to join its ESA partners, the most important being that the cost of the overall programme had greatly exceeded the limit of 200 MAU. Moreover, the delegation regretted that H-Sat could no longer be launched on L04, thus missing the opportunity to enter the future market of DBS technology at an early stage and pointed out the still confused situation on Marots. Finally, Germany was unable to consider participation in Phase-3-bis (ECS operation) and insisted that contractual agreements with the users should ensure the full funding of the utilisation phase of the ECS system.

As a matter of fact, Germany was increasingly doubtful about the capability of ESA to manage commercially-oriented application satellite programmes. The cumbersome procedures of a large multinational organisation, the strict enforcement of the fair return concept, and the orientation

83 ESA/C(77)127, add. 1, 12/12/77.

84 Council, 22nd meeting (12-14/12/77), ESA/C/MIN/22, 4/1/78, with attached ESA/C/XXII/Res. 1, 14/12/77. A summary of the Council meeting, prepared by the JCB chairman, is in ESA/JCB(78)1, 3/1/78. In addition to ESA member states, Norway declared its intention to participate in the Marots extension programme, and Austria and Canada expressed their interest in participating in the ASTP to levels of 0.5 MAU and 1.0 MAU, respectively.

towards experimental projects rather than operational systems contrasted dramatically with the requirements of efficiency and frugality which are peculiar to market-oriented undertakings. Germany was now able to run successful application satellite programmes, alone or in collaboration with a few other spacefaring nations; why get involved in lengthy negotiations on how to re-allocate a few MAU's or even less in order to fit a complex fair return formula? As a senior German official in the Ministry of Research and Technology put it:

> *All our practical space applications which worked were national, bi-national or tri-national. In a wider framework, with many nations, only scientific programmes work.*[85]

With hindsight this statement may appear unfair, considering the eventual successes of Ariane and Meteosat, but it nonetheless reflects the feelings of many German space policy makers at that time.

The End of the Package Deal Concept

In the view of the ESA Director General, Roy Gibson, the February 1978 meeting of the Council was truly to be regarded as "the last opportunity" to launch the new telecommunications programme:

> *Quite apart from the damage - both material and psychological - that such prolonged uncertainty causes to the Agency, one cannot expect industry endlessly to remain suspended in the starting blocks.*[86]

Subsequent events fell short of Gibson's expectations. On February 2nd, in fact, the German delegation informed the Council Bureau that Germany did not in principle intend to participate in the H-Sat programme, adding that the German government was funding studies in German industry on a pre- or semi-operational DBS project which they envisaged to offer, around the end of the year, for limited Europeanisation. No further expenditure for H-Sat or related activity would therefore be accepted by the German authorities until then.[87] In the light of the stance taken by the German delegation at the December meeting, this decision did not come as a surprise, but it implied a complete re-assessment of the H-Sat project, from both the technical and industrial points of view. A possible course of action was suggested by the French delegation, whereby the other member states should re-affirm their commitment to undertake the H-Sat programme but, in the first instance, financing should be limited to a six-month period during which preliminary Phase-B studies and some limited industrial work could be performed. A new geographical distribution of industrial work was also to be defined in this period, taking into account the withdrawal of Germany.[88]

With Germany's decision to withdraw from the H-Sat programme, the telecommunications package deal concept was definitely jeopardised. It was evident that each element of the overall programme had to proceed at its own speed, within a specific legal and institutional framework.[89] The decision to start the ECS programme, in particular, could, according to the 1973 Telecom Arrangement, be taken by the JCB on a *double two-thirds* majority, subject however to unanimous agreement that the scale of contributions should be different from that of Phase-2 in order to make it proportional to the geographical distribution of work. Moreover, participating states had to subscribe to a declaration bearing on Phase-3-bis, which would provide the basis for the exploitation of the ECS system in the first ten years. The ESA/Eutelsat negotiations were not yet concluded but a successful outcome seemed possible in the near future and in any case the PTTs were adamant in requesting preliminary ESA guarantees for them to undertake to use the ECS system. The other elements of the telecommunications package could be implemented as optional programmes, on the basis of the resolution of the ministerial Council meeting. The member states wishing to participate in each of

85 Quoted in Müller (1990), p. 277.
86 R. Gibson, "Introduction", *ESA Annual Report 1977*, 7-15, p. 11.
87 ESA/C(78)14, 7/2/78.
88 ESA/JCB(78)10, 7/2/78; ESA/C(78)14, cit., annex III.
89 The various legal instruments required to implement the different elements of the telecommunication package, as worked out at this stage, were presented in ESA/JCB(77)12, rev. 3, 25/11/77.

them should adopt a declaration defining the programme content, its financial envelope and the corresponding contributions.

At the February 1978 meeting of the JCB, the Executive proposed that the Board approve the immediate start up of ECS, and that the states participating in the Marots programme take those decisions regarding its extension (Marots B) which would facilitate final approval of this element by the Council. In both cases a provision was foreseen whereby the industrial contracts would be cancelled if the relevant agreement between ESA and Eutelsat were not approved by the end of 1978. As regards H-Sat, only preliminary studies worth some 6.1 MAU were foreseen for a period of six months from 1st April, in order to enable the Council to decide in September on whether and how to proceed with this programme on the basis of their results. Finally, a review of the cost and scope of the technology programme (ASTP) would be carried out, taking into account the absence of contributions from France and Germany.

This approach was approved in principle by most JCB delegations, but the Italian delegation took a very strong negative stance:

> *This situation has arisen partly because of the conflicting interests of the larger countries and partly because the Executive cannot be relied upon to support the views of the countries whose contributions are smaller. It is clear that, whereas near unanimity has been reached on the ECS and Marots B programmes, thus giving the go-ahead to the maritime programme and providing payloads for a number of Ariane launches, Germany's position vis-à-vis H-Sat has provoked a crisis in this latter project, and, with regard to the ASTP, the negative stances of two delegations have nullified the initiative of the others.*

The delegation regretted that Italy was suffering the greatest damage for this situation, as it had "always made its participation in the H-Sat payload and the ASTP a major condition", and warned that "if a vote was taken on Phase-3 of the Telecom Arrangement, our vote would be negative".[90]

The delegations of the smaller member states also expressed their concern about the limitation in the ASTP *vis-à-vis* ESA's overall industrial policy, regretting that past development efforts in the space telecommunications field seemed to have favoured the major contributors. In the words of the Swiss delegation:

> *The Agency's previous policy had in fact led the "small countries" to contribute towards the development of certain specialisations in the industry of the major contributors without themselves being in a position to gain a capability in interesting areas.*[91]

After a long discussion, the conditions required for a two-thirds majority vote on transition to Phase-3 of the Telecom Programme could not be met. The delegations acknowledged that, following the German withdrawal from H-Sat, the original package deal concept endorsed at the ministerial meeting did not hold any longer and a fresh consideration from the Council was required, prior to which a decision of the JCB on the ECS programme was premature. The chairman was then requested to report to the Council and to suggest those actions and resolutions that would finally give the green light to the new phase of the European effort in space telecommunications. Here is the conclusion of his report:

> *The structure of this European Satellite Communications Programme is fragile and it is probably possible for any single Member State to make it to collapse. It is, however, based on the assumption that all want the programme to go ahead, reserving their right to tailor their participation to each part to suit their specific wishes by means of their vote on the [various] items.*[92]

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90 JCB, 19th meeting (8-9/2/78), ESA/JCB/MIN/19, 10/3/78, annex II.
91 ESA/JCB/MIN/19, cit., p. 5.
92 ESA/C(78)14, add. 1, 16/2/78, p. 3.

The 23rd meeting of the Council and the 20th meeting of the JCB were both held on 28th February and 1st March, in order to make possible the adoption of all the necessary documents enabling the start of the various programme elements. After many discussions, bouncing from one body to the other, and from one draft document to the other, the ECS development programme, the Marots extension (Marots B) and the interim Phase-B studies of H-Sat were finally approved. The ASTP programme, in which France and Germany confirmed that they would not take part, was deferred to a later meeting, pending a definition of its content and means of execution.[93]

The German delegation reserved its position on ECS and Marots B, however, arguing that "a pre-condition for a programme decision is a binding utilisation commitment on the part of Eutelsat". This in fact was not yet at hand, at least in the case of ECS, as several PTTs, including the Deutsche Bundespost, still opposed such an early commitment.[94] Germany's hard line on the telecommunications programme also aimed at urging the other member states to positively resolve outstanding problems in other areas of ESA activities. These were the Spacelab programme, whose cost was escalating beyond 120 % of the established ceiling; the financial problems deriving from the different inflation and exchange rates of ESA member states; and the Ariane production programme.

The other delegations having accepted that the vote of the German delegation would be valid if presented before the next JCB meeting on 20th March, a second session of the 23rd Council meeting was scheduled for 6th and 7th April in order to finally endorse the relevant documents. In the event, Germany lifted its reservations and agreed to both the resolution on the ECS development programme and the declaration on the Marots extension. It also accepted to participate in the H-Sat interim studies at the ceiling level of 1 MAU.[95] A compromise was also reached on the ASTP, the early start-up of which was a condition for Italy to lift its own reservation on the other elements of the programme. As most delegations were still unable to take a decision on the content, financial envelope and work distribution of the ASTP, it was accepted that those participating states which so wished could subscribe to the relevant declaration and provide the necessary funding, in order to enable the programme to be started up. It was understood that the declaration remained open to later subscription by other member states. Italy, Switzerland and Denmark subscribed to the declaration, the first undertaking to contribute 4 MAU, the others 0.5 MAU each. It was also agreed that Austria might participate in the programme from the very beginning, at the level of 0.5 MAU.[96]

93 Council, 23rd meeting, part I (28/2-1/3/78), ESA/C/MIN/23(I), 7/3/78; JCB, 20th meeting (28/2-1/3/78), ESA/JCB/MIN/20, 13/3/78. Reference documents are ESA/C(78)14, add. 1 to 5, with several revisions and corrections. From the formal point of view, the ECS programme (Phase 3 of the Telecom Programme, covered by the 1973 Arrangement) was approved by a JCB resolution (ESA/JCB/XX/Res. 1 (Final), rev. 1, 1/3/78); The Marots extension (Marots B) and H-Sat interim studies were approved by Council declarations (ESA/C/XXIII/Dec. 1 and 2, 1/3/78).

94 ESA/C/MIN/23(I), cit., annex II, p. 1.

95 ESA/JCB(78)18, 20/3/78; ESA/C(78)39, 6/4/78. JCB, 21st meeting (21/3/78), ESA/JCB/MIN/21, 7/4/78; Council, 23rd meeting, part II (6-7/4/78), ESA/C/MIN/23(II), 20/4/78, with attached ESA/C/XXIII/Res. 9. Austria was also associated in the H-Sat preliminary study: ESA/C(78)37, 3/4/78.

96 ESA/JCB(78)21, 10/4/78. The programme content and work distribution proposed by the Executive is presented in ESA/JCB(78)11, 14/3/78.

Space segment	69.7
Tests	8.2
Ground operations	10.9
Management	12.2
Launch insurance	3.5
Launch (single Ariane launch)	24.4
Total	128.9

Table 11: Financial envelope of the ECS programme (MAU at 1977 prices)

The ECS Programme and the Approval of Phase-3-bis

The total cost of the ECS programme, as approved by the JCB on 1 March 1978, was 128.9 MAU (Table 11). The programme included the development of two ECS spacecraft, one Ariane launch, ground support equipment and the first six months of in-orbit control. Both satellites would eventually be made available to Eutelsat for regular operational use within the framework of a European communications satellite system. The Board also accepted that Spain be included in the programme with a contribution of 0.17 % (this country did not participate in Phase-2).[97] The contributions to the ECS project and the geographical distribution of the industrial work to be performed in Europe are presented in Table 12. It shows the effect of the so-called "92 % rule", i.e. the proviso that "those participants which in the overall industrial return statistics have a return exceeding the factor 'one', shall receive a 92 % industrial return and that the remainder shall be used to redress the imbalance of the overall industrial return of the other member states".[98]

When the JCB adopted the resolution enabling the ECS programme to be started, the agreement between ESA and Eutelsat on the operational use of the ECS system had not yet been concluded. The resolution, in fact, foresaw that in the event that a satisfactory agreement had not been concluded by 1st October 1978 (this date was eventually postponed until 31st December), it should cease to have effect, and provided for a cancellation clause to be included in the industrial contract should this situation occur. A few days after the JCB meeting, most Eutelsat member PTT administrations finally signed the Agreement relating to the ECS system. By this agreement, the signatories agreed "to

	Contributions	Work distribution	
		initial	revised
Belgium	3.27	3.01	3.18
Denmark	0.33	0.40	0.41
France	25.93	23.92	23.12
Germany	30.68	28.40	29.21
Italy	14.78	17.07	16.52
Netherlands	0.94	2.04	1.98
Spain	0.17	0.42	0.41
Sweden	1.62	3.76	3.77
Switzerland	2.13	1.61	1.62
United Kingdom	20.15	19.37	19.78
Total	100.00	100.00	100.00

Table 12: ECS programme contributions and work distribution (%)

97 ESA/JCB(78)13, 10/3/78; ESA/JCB/MIN/21, cit. p. 5.

98 ESA/JCB/XX/Res. 1 (Final), rev. 1, 1/3/78, p. 2. The figures on the geographical distribution reported in this document were later revised, following negotiations with British Aerospace: ESA/JCB/MIN/25, 23/8/78, Annex III, p. 1.

	MAU (1977 prices)
Satellite procurement (ECS 3, 4, 5)	68.9
Launchers (ECS 2, 3, 4)	73.5
Management and in-orbit control	27.4
Insurance	32.0
Total	201.8
Eutelsat contribution	80.0
ESA contribution	121.8

Table 13: Financial envelope of Phase-3-bis

participate in the establishment, operation, maintenance and utilisation of the ECS space segment, and to undertake all the obligations and responsibilities relating thereto".[99] The Deutsche Bundespost was among the signatories, this being the basis for Germany's positive vote on the resolution, as we have discussed above. At the same time, however, the PTTs informed ESA that, owing to the difficulties that most administrations had in putting their earth stations into service, the operational use of the ECS system could not start before 1983, and therefore Eutelsat could not foresee any payment to ESA before that year. In order to cope with this delay, it was agreed that the launch date of the first ECS spacecraft should remain unchanged (end of 1981) and that the satellite should be made available to Eutelsat in 1982. Full operational use would start only in January 1983, after the launch of the second ECS spacecraft, but Eutelsat would pay an additional 2.5 MAU to cover partial utilisation in 1982. Subsequently, Eutelsat would pay for ESA services: 7.2 MAU per year during the first five years and 8.3 MAU in the following five-year period, thus making the total amount to be paid by Eutelsat for the operation of the ECS system space segment over the ten-year period 1983-1992 equal to 80 MAU (all figures at 1977 price levels).[100]

In order to arrive at a final approval of the ESA/Eutelsat arrangement and of Phase-3-bis of the ECS programme, three outstanding problems had to be resolved. The first regarded the pricing policy of Ariane launches for the ECS satellites. The production cost of an Ariane vehicle was estimated at about 32 MAU, but a "market" price of 24.44 MAU had been decided by the Council for launching the ECS 1 spacecraft (assuming single launch). The extension of this price to the three others ECS launches, which was considered unavoidable in the prevailing situation, required of course that those states which participated in the Ariane programme undertake forthwith to guarantee cover of any eventual difference between the production cost and the selling price of the launcher.[101] As this issue was still under discussion at national level in various countries, the French delegation announced that, in order to promote a speedy solution, its authorities were prepared to guarantee such a cover for those states which were not yet in the position to take an immediate decision. On this basis, the Council finally approved a resolution whereby the ceiling price for each of the ECS 2, ECS 3 and ECS 4 (single) Ariane launches was definitely fixed at 24.44 MAU. At the same time, the delegations of France, Germany, the Netherlands, Sweden and Switzerland subscribed to a declaration whereby they agreed that the corresponding additional funds should be shared in proportion to their industrial return on the manufacture of these three launchers. The other participating states, whose industry would also carry out work on the provision of these launchers, were invited to subscribe to the declaration as soon as possible. The financial envelope of Phase-3-bis was thus definitely set at 121.8 MAU (Table 13).[102]

99 ESA/JCB(78)15, 17/3/78, annex, p. 16.
100 ESA/JCB(78)42, 17/7/78.
101 ESA/JCB(78)46, 11/9/78; ESA/JCB(78)57, 9/10/78, with add. 1, 20/11/78.
102 Council, 28th meeting (12-13/12/78), ESA/C/MIN/28, 26/1/79, with attached ESA/C/XXVIII/Res. 9 and ESA/C/XXVIII/Dec. 3. Reference documents are ESA/C(78)161, 8/12/78, and ESA/C(78)166, 11/12/78.

	Work distribution (%)		Contributions
	Europe	Overall	%
Belgium	3.33	2.75	3.19
Denmark	0.92	0.75	0.74
France	26.84	22.10	26.52
Germany	31.95	26.35	30.42
Italy	15.59	12.86	13.85
Netherlands	1.93	1.60	1.77
Spain	0.55	0.45	0.53
Sweden	3.99	3.30	3.97
Switzerland	0.68	0.56	0.55
United Kingdom	14.22	11.75	18.46
US/Others	---	13.13	---
Reserve	---	4.40	---
Total	100.00	100.00	100.00

Table 14: Work distribution and contribution scale for Phase-3-bis

The second problem was of course that of the scale of contributions. According to the Executive, this should be proportional to the distribution of industrial work for the procurement of the three satellites, the highest contributions coming from Germany (33.4 %), France (23.4 %), Italy (16.9 %) and the United Kingdom (14 %).[103] This proposal, however, met with strong opposition on the part of the Italian and Swiss delegations, which argued that the "92 % rule" should be applied to Phase-3-bis as in the case of the ECS programme. It took many negotiations between the Executive and the national delegations as well as many discussions during two JCB meetings and three Council meetings in order to find an acceptable compromise, which was finally approved in April 1979 (Table 14).[104]

Finally, the third problem regarded the guarantee, requested by Eutelsat, of ten years of satellite continuity of service, i.e. two working satellites in orbit. In order to protect themselves against the apparently unlimited financial risk deriving from this obligation, ESA member states had accepted that the financial provisions of Phase-3-bis should include an insurance cover for both the launch and in-orbit operations during the whole design life (5 years) of the four ECS satellites. However, the terms by which in-orbit insurance could be procured left a residual risk since, owing to customary practice in aeronautical insurance matters, it was possible to insure a fourth and fifth year of in-orbit performance of the ECS satellites only two years after launch. At the urging of the German delegation, the Council considered that Eutelsat should recognise this residual risk and accept that ESA's unconditional guarantee of service continuity could be assured only when this additional insurance cover was obtained. In order to avoid amending the text of the Arrangement between ESA and Eutelsat, it was suggested that this issue should be settled by means of an official exchange of letters between the ESA Director General and the Secretary General of Eutelsat. The Director General was authorised to sign the Arrangement as soon as this exchange of letters had occurred.[105]

Eutelsat did not concur. Firstly, they did not like it that a complementary letter was handed over at the time of signature of an Arrangement which had taken almost three years of negotiations. Secondly, in

103 ESA/JCB(78)57, 9/10/78.

104 JCB, 28th meeting (5-6/12/78), ESA/JCB/MIN/28, 17/1/79; 30th meeting (1-2/2/79), ESA/JCB/MIN/30, 12/3/79. Council, 28th meeting (12-13/12/78), ESA/C/MIN/28, 26/1/79; 29th meeting (27-28/2/79), ESA/C/MIN/29, 4/4/79; 30th meeting (3-4/4/79), ESA/C/MIN/30, 5/4/79, with attached ESA/C/XXX/Dec. 1. The various contribution scales discussed during these meetings are reported in ESA/JCB(79)1, 16/1/79; ESA/C(79)25, 9/2/79; with add. 1 and 2, 27/2/79; add. 3, 26/3/79; add. 4, 3/4/79. The work distribution is reported in ESA/JCB(79)2, 16/1/79.

105 ESA/C/XXVIII/Res. 10, 12/12/78, attached to ESA/C/MIN/28, cit.; ESA/JCB(79)3, 17/1/79. The German position is reported in ESA/JCB(78)57, add. 2, 29/11/78, annex 1. The various draft versions of the ESA/Eutelsat Arrangement are reported in ESA/JCB(77)2, with rev. 1 to 6. The final text, as approved by Eutelsat and the ESA Council, is attached to ESA/C(78)90, rev. 1, 22/11/78.

consideration of their heavy investments in the earth segment, the Eutelsat member administrations could not accept that ESA might not be able to provide and maintain the space segment, and guarantee continuity of service. Again, the strong negotiating position of the PTT administrations became evident: "ESA was created to develop European space industry", Eutelsat's Secretary General wrote to the Director General, adding: "After years of work in this area, it would seem likely that ESA together with European space industry are capable to guaranteeing the life of a space system for telecommunications". In any case, he concluded, Eutelsat was not prepared to accept the suggested exchange of letters and would proceed to sign the Arrangement as it stood.[106]

After several negotiations, which involved not only ESA and Eutelsat, but also "space" and "postal" authorities at national level, an agreement was finally reached, whereby the Director General, on behalf of the member states participating in the programme, officially informed Eutelsat of the risks of premature termination of the Arrangement in the unlikely, but unfortunately not to be excluded, case that three satellites supplied for launching "either do not attain their planned orbit, cannot be brought into operation or can only be kept in operation for a period of less than 5 years". ESA would use its best endeavours to obtain adequate insurance covering the events causing the failure, he continued, but, "should, against all present reasonable expectations, such insurance not be possible, ESA will inform Eutelsat of this forthwith, without the other obligations of the Agency under the Arrangement being affected".[107] On this basis, the ESA/Eutelsat Arrangement was finally approved by the Council in April 1979.[108]

The ASTP Programme

The Declaration on the ASTP programme was adopted at the April 1978 Council meeting by the delegations of Denmark, Italy, the Netherlands, Sweden, Switzerland, the United Kingdom, and Austria (a non-member state). Only four countries, however, declared their readiness to embark on the programme and formally subscribed to the Declaration, namely Austria, Denmark, Switzerland and Italy, the latter with a contribution of 4 MAU and the other three with contributions of 0.5 MAU.[109] Subsequently, Belgium and Spain decided to participate in the programme, while France and Germany confirmed their intention not to take part in it.

The general objectives of the programme, extending over the 4-year period 1978-81, were defined as follows:

1. to keep the European *state of the art* in line with general progress, in terms of both system configuration and actual technologies;

2. to define and promote new activities relating to advanced missions in the field of communications satellites (data transmission, mobile communications, direct satellite-to-satellite transmissions, new public services such as electronic mail, evolution to higher frequency bands etc.);

3. to improve the competitiveness of European industry in the international market by studying, preparing and funding the technical activities that should be undertaken in anticipation of the most promising satellite procurement actions foreseen in the world;

4. to introduce technological improvements in later flight models resulting from the ECS, Marots and H-Sat projects.

106 ESA/JCB(79)3, cit., annex III, p. 1.
107 ESA/C(79)25, add. 3, annex II, p. 2.
108 Council, 30th meeting (3-4/4/79), ESA/C/MIN/30, 5/4/79.
109 ESA/JCB(78)21, 10/4/78.

More specifically, three lines of activities were identified, i.e. communications systems and associated spacecraft configurations; communications equipment technology (satellite payloads and ground stations) and spacecraft subsystem technology (platforms).

While being a logical follow-up of the Supporting Technology Programme (STP) developed within the framework of Phase-2 of the Telecom Programme, the ASTP presented two important differences. Firstly, in comparison with the STP, whose aim was specifically the support of the OTS project (e.g. 3-axis stabilisation, 11/14 GHz communications payloads), the ASTP was conceived as a coherent R&D programme relating to the short- and medium-term development of space telecommunication technologies. It involved both the modernisation of existing communications satellite systems and the preparation of new missions. Moreover, it made provision for supporting export-promotion activities in the non-European market. Secondly, the ASTP was adopted as an independent optional programme within the framework of ESA's overall telecommunications programme, funded on an *à la carte* basis by the participating member states. It was based on the concept that contributions from each participating country should be used to support activities to be developed in its own territory, the technical orientation of these activities being established in agreement with the national authorities. Concluding a presentation of the ASTP in the ESA Bulletin, an ESA officer involved in the programme defined it as "an *à la carte* technology research programme in a particular field":

> *For most participating countries, it is a substitute for activities which could have been developed at national level, and one would be inclined, in the case of the ASTP, to consider the Agency as the manager of national programmes. Nevertheless, it is a real programme of the Agency, that must be conceived and managed as such, though complying with the objectives established by each participant.*[110]

Following the adoption of the Declaration, the Executive organised bilateral discussions with the delegations of participating countries, with the aim of determining their financial contributions and the corresponding activities to be carried out in their respective countries. As a result of these discussions, the Executive submitted to the JCB a list of activities that could be undertaken in the first phase (1978-79) of the programme in each participating state, as well as a proposal for the scale of contributions (Table 15).[111] This proposal was generally accepted by the delegations of the participating states, but some of them stated that they were unable to enter into a financial commitment for the programme as a whole and could therefore not subscribe officially to the Declaration. The JCB, however, approved the rules for the implementation of the ASTP and the budget for 1978, thus enabling the Executive to make a start to the programme in 1978.[112]

Belgium	0.8
Denmark	0.5
Italy	4.0
Netherlands	1.0
Spain	1.0
Sweden	1.0
Switzerland	0.5
United Kingdom	4.0
Austria	0.5
Total	13.3

Table 15: Contribution scale for the ASTP (MAU 1977)

110 Imbert (1978), p. 39. The STP programme is described in Blondin & Dickinson (1978). Cf. also Müller (1990), pp. 170-181.
111 ESA/JCB(78)25, 16/5/78.
112 JCB, 23rd meeting (30-31/5/78), ESA/JCB/MIN/23, 27/6/78, pp. 7-10.

The overall ASTP work-plan for the period 1979-1981 was subsequently worked out by the Executive and approved by the JCB, within whose framework a few dozens of specific studies were undertaken in the participating countries. Some of them eventually decided to increase their contribution to the programme in order to maintain the work in their national industry. Italy, in particular, approximately doubled the level already approved, as an important effort was devoted in this period to satellite communications in the 20/30 GHz bands, in which Italy had a strong interest.[113] Another important area covered by ASTP activities was the study of second-generation maritime communications systems, which received support from the other main contributor to the programme, the United Kingdom.

During 1981, discussions took place on the extension of the programme for a further four years. In the event, a new four-year programme (ASTP-2) was approved in July 1982, in which all ESA member states except Ireland participated, plus Austria and Norway. In 1984, the ASTP-2 budget stood at 55 MAU. A further extension, called ASTP-3, was adopted by the participating states in 1986, with a programme envelope of 130 MAU.[114]

From Marots to Marecs

The Declaration adopted by the participants in the Marots programme at the March 1978 Council meeting made provision for an extension of the programme aimed at procuring and launching a second flight unit of the Marots spacecraft. Both Marots A, scheduled for launch for October 1980 by the Ariane L04 test launch, and Marots B, to be launched in mid-1981 by an Ariane operational vehicle, would eventually have been made available to Eutelsat for use as the space segment of its maritime communications satellite system. The two satellites were to be placed in geostationary orbit over the Atlantic Ocean and the Indian Ocean, respectively. The extension of the Marots programme was to be carried out within a firm financial envelope of 34 MAU (1977 prices), plus 24.4 MAU for Ariane launch services. The latter figure could be reduced to 18 MAU in case a double launch was arranged. The initial scale of contributions and industrial work allocation (taking into account the "92 % rule") was approved as in Table 16.[115]

Participating states	Contribution (%)	Work share (%)
Belgium	0.14	0.14
Denmark	-.--	0.55
France	5.74	5.09
Germany	13.29	11.75
Italy	1.28	3.95
Netherlands	1.49	2.73
Spain	0.34	0.62
Sweden	6.61	8.83
Switzerland	-.--	3.33
U. K.	69.89	61.78
Norway	1.22	1.23
Total	100.00	100.00

Table 16: Contributions and work distribution for the Marots extension programme

113 ESA/JCB(79)10, 30/3/79; add. 1, 21/6/79; add. 2, 11/9/79.

114 *ESA Annual Report*, 1982, p. 42; 1984, p. 55; 1986, p. 61.

115 ESA/C/XXIII/Dec. 1, 1/3/78, approved at the 23rd Council meeting, part I (28/2/78-1/3/78), ESA/C/MIN/23(I), 7/3/78. Cf. also ESA/C(78)14, add. 2, rev. 1, 1/3/78. The Declaration was slightly amended by the JCB, 21st meeting (21/3/78), ESA/JCB/MIN/21, 7/4/78, and the new version (ESA/C/XXIII/Dec. 1, rev. 1) finally endorsed at the 23rd Council meeting, part II (6-7/4/78), ESA/C/MIN/23(II), 20/4/78.

Following Council approval of the dual-satellite maritime programme, it was decided to modify the satellite design in order to meet the new operational requirements, in particular by switching from the OTS platform to the more capable ECS platform. The programme's name was accordingly changed from Marots to Marecs. A contract for the development of Marecs A and B was then placed with British Aerospace Dynamics (formerly Hawker Siddeley Dynamics), leading the MESH consortium.

The development of the Marecs A/B programme in this phase was strongly affected by the Joint Venture negotiations for the envisaged pre-Inmarsat world-wide maritime services. At the beginning of these negotiations, as discussed above, it was hoped that the Joint Venture (including PTT authorities from both European and non-European countries) would implement the space segment of such a system by using the Marecs A and B satellites made available by Eutelsat and by procuring two further Marecs spacecraft from ESA. In spring 1978, however, when ESA presented its offer for Marecs C and D to the Joint Venture, Intelsat entered the game, offering the lease of a maritime communication payload fitted into the forthcoming Intelsat V spacecraft, whose first launch was scheduled for 1980. More specifically, Intelsat suggested that a low-cost space segment for a world-wide maritime network could be realised by using the dedicated Marecs A and B satellites (provided free of charge by ESA through Eutelsat) plus four Intelsat V maritime payloads. In this case, both European satellites were to be positioned over the Pacific Ocean, contrary to their original mission which was to cover maritime traffic off the European and African coasts.

ESA and the JCB national delegations obviously did not like this proposal which, however, attracted several PTT administrations of ESA Member States, whose delegates sat in Intelsat governing bodies. In other words, space and postal authorities in various European governments again had diverging interests in the critical field of satellite telecommunications. Introducing a nervous discussion on these new developments, the JCB Chairman emphasised "the fragility of the European position, in which the solidarity of Member States could easily be upset by the diversity of the various interests involved". The Director General, for his part, concluded the discussion urging the delegations "to keep close contact with their own national authorities responsible for dealing with the various aspects of the matter, in particular so as to ensure that they were informed of the 'space' elements of the problem".[116] All decisions, in fact, were well beyond the capacity of the Agency and the Board.

The pre-Inmarsat Joint Venture was established at a Constitutive Conference held in Bergen, Norway, from 25th September to 5th October 1978. Seventeen countries approved the Constitutive Agreement, i.e. all ESA member states except Switzerland, plus Australia, Canada, Greece, India, Japan, Kuwait, Norway and the USSR. The United States, which had participated in the preparatory meetings, was not present at the Bergen conference and did not join the new organisation. An important outcome of the conference was the definition of a procurement policy. Three alternative options were considered: the first foresaw a space segment consisting of four Marecs satellites, as in the original European proposal; the second foresaw two dedicated maritime satellites provided by Intelsat and three Intelsat V maritime payloads leased from Intelsat; the third foresaw three Marecs and three Intelsat V maritime payloads. Of these options, the second was definitely rejected, while a preference was expressed for the third one compared to the first. It was assumed that Marecs A and B would be made available through Eutelsat, and Marecs C (plus Marecs D in case option one was selected) would be procured under contract with ESA.[117]

The Constitutive Agreement adopted at the Bergen conference was opened for signature until 16th February 1979, and only after that date would the Joint Venture become a legal entity, having the appropriate power to decide on procurement contracts. Pending this decision, the Executive requested the participants in the Marecs programme to finance the procurement of long-lead items on Marecs C (and D), in order to avoid a price increase due to delays in contract initiation and to maintain the

116 JCB, 23rd meeting (30-31/5/78). ESA/JCB/MIN/23, 27/6/78, pp. 4-5. The reference document is ESA/JCB(78)WP/4, 30/5/78 (by mistake originally issued as ESA/JCB(78)WP/2).

117 ESA/JCB(78)60, 10/10/78. Cf. also ESA/JCB(78)45, 24/7/78.

competitivity of the European proposal. Interim funding of 3 MAU was requested for this activity, which would eventually be reimbursed after contract signature. "It is only if the Joint Venture were not to be created that this interim funding would be at risk", the Executive argued, stressing however that such pre-financing of Marecs C/D hardware procurements was necessary, "in order further to improve the chances of the European proposals, particularly against possible last minute delaying tactics from certain potential members of Inmarsat who have not been represented at recent Joint Venture meetings".[118] Implicit reference is made here to the United States, whose interest was now to sabotage the Joint Venture and delay the establishment of a global maritime satellite system until Inmarsat was formally established and American industry became competitive. In fact, maritime satellite communications appeared as an important new market for space technologies, in which Europe could still legitimately claim a leading role, thanks to the Marots/Marecs programme.

The Executive's request was approved in principle by the JCB, with the German delegation taking a strong negative stance however, both because of its pessimistic vision about the future of the Joint Venture and because it considered that the bridging funding should be provided by industry. Belgium and Sweden, for formal reasons, could not take a stance at that meeting either, and therefore the British delegation, which was the main supporter of the Marecs programme, stated that its authorities would be prepared to underwrite temporarily the financial contributions of these three countries. It warned however the German delegation about the solidarity link which should hold together the major contributors to the 1973 package deal programmes:

> *The [British] delegation particularly invited the German delegation to adopt a positive stance, reminding it that the United Kingdom authorities were pursuing their efforts to lift the ad referendum which they had entered when the decision was taken on the overrun of the 100 % cost-to-completion of Spacelab.*[119]

In the event, France, Italy, the Netherlands, Norway, Spain and the United Kingdom subscribed to a declaration whereby they authorised the Agency to place orders worth 3 MAU for long-lead Marecs C hardware items. The other participants in the programme, i.e. Belgium, Germany and Sweden, were invited to adhere to the declaration "at the earliest possible opportunity", the United Kingdom undertaking to make up any shortfall resulting from the eventual non-participation of these countries.

The German delegation's pessimism proved to be well founded. At the second Joint Venture conference, held in Brighton in January 1979, it was agreed to definitely confirm the commitment to procure three maritime packages on Intelsat V satellites while only two Marecs in orbit were considered necessary to complete the space segment of a global system at a realistic cost. The implementation of this concept meant in fact that ESA was to provide the Joint Venture (and later Inmarsat) with two satellites free-of-charge (Marecs A and B), the Agency being re-paid only for the services relating to the procurement and launches of the satellites, the procurement of earth stations, and in-orbit operations. The Conference asked ESA to provide an offer for this dual-Marecs element of the space segment but after the Director General warned the participants that he felt obliged to give the JCB a negative opinion on this solution, a second offer was also requested for an alternative solution, i.e. the provision of three Marecs spacecraft, one of which was to be a spare on the ground.[120]

The Brighton conference dramatically put into evidence the diverging interests existing between European governments. On the one hand, the space authorities of ESA member states advocated the promotion of the Marecs spacecraft in view of the future development of the maritime communications market. On the other, the state-owned PTT administrations insisted on the most economic solutions. "The national PTT authorities had not always shown as much cohesion as one might have wished", the Executive complained to the JCB. "Eutelsat [should] be invited to assume its

118 ESA/JCB(78)61, 10/10/78, p. 2. Also ESA/JCB(78)50, 14/9/78.
119 JCB, 27th meeting (23-24/10/78), ESA/JCB/MIN/27, 22/11/78, p. 9. The following quotation is from the attached ESA/JCB/XXVII/Dec. 1.
120 ESA/JCB(89)7, 22/1/79.

responsibilities fully", argued the French delegation, adding that, "when an Ariane launch was sold to Intelsat, the national PTT authorities very effectively demonstrated their European solidarity". The delegation also stressed the political importance of the stakes, over and above the maritime programme:

> *Neither the technical quality of the offer nor even its price constituted fundamental criteria for choice. The essential was that Europe should give proof of its determination, but it was clear that the European PTTs had not always been fully aware of space problems. It was at government level that a consensus must be achieved. The principle of solidarity governing ESA's actions therefore required that the member states most directly interested in the programme should pursue their efforts vis-à-vis their partners in order to achieve this consensus.*[121]

The JCB finally agreed that ESA should not submit an offer limited to two satellites and decided to increase interim funding for the Marecs C procurement from 3 MAU to 5.7 MAU, as requested by the Executive, in order to maintain the validity of the new ESA offer for three satellites until the end of August, when the Joint Venture would finally make a decision. Belgium and Germany, however, stated they were still unable to adhere to the declaration, while Italy stated that it would contribute to the interim funding only in respect of the part of the work carried out in that country.[122]

ESA's offer for the provision of three Marecs spacecraft and the associated earth segment was discussed at the third session of the Joint Venture Conference in The Hague in March. Here it was decided that it was no longer necessary to establish the Joint Venture since Inmarsat would soon come into being, and all decisions regarding the setting up of the first world-wide maritime system were thus delegated to the new organisation. At the close of the discussion, however, 16 out of the 18 delegations present, representing prospective Inmarsat members whose assessed contributions amounted to 72 %, adopted a resolution whereby they confirmed their support for a space segment consisting of three Intelsat V maritime payloads and three Marecs satellites. Canada and the United States did not adhere to this resolution, the former arguing that the ESA offer still required further development on the aspects of price and contractual terms, the latter insisting that other possible alternatives (i.e. all-American) should continue to be given serious consideration.[123] The position of Canada came as a surprise, showing that divergences between PTT authorities and space authorities did not exist only in Europe. In fact, the Canadian delegation which participated in the JCB meetings with observer status stressed that "the Canadian authority present at The Hague [...] did not emanate from the Canadian government [and] had adopted an attitude that did not reflect its country's official position when the resolution was voted".[124]

Subsequently, it was agreed that ESA should present the three Marecs together as a package directly to Inmarsat, rather than presenting Marecs A and B to Eutelsat, which would in turn transfer them to Inmarsat. This would in fact ease negotiations by eliminating an unnecessary step, the European PTTs being at one at the same time represented both in Eutelsat and in Inmarsat.[125]

Inmarsat came officially into being on 16th July 1979, and in August ESA submitted its offer for three Marecs spacecraft.[126] Assuming that the Joint Venture's decisions had set the basic principles for the procurement of the first space segment, the Executive expected that the offer would eventually be accepted and a contract signed between ESA and the new organisation. It, however, did not conceal the difficulties which were ahead, deriving from the fact that "this negotiation will, for the first time, be influenced by the basically hostile American (Comsat) participation".

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121 JCB, 30th meeting (1-2/2/79), ESA/JCB/MIN/30, 12/3/79, pp. 6-7.
122 ESA/JCB/XXX/Dec. 1, attached to ESA/JCB/MIN/30, cit.; ESA/JCB(79)9, 2/2/79. Sweden eventually adhered to the interim funding of Marecs C: ESA/JCB(89)11, 7/2/79.
123 ESA/JCB(79)13, 2/4/79.
124 JCB, 31st meeting (9/4/79), ESA/JCB/MIN/31, 14/6/79, p. 4.
125 JCB, 32nd meeting (4-5/7/79), ESA/JCB/MIN/32, 26/7/79; Council, 33rd meeting (25-26/7/79), restricted session, ESA/C(79)R/23, 12/9/79.
126 Galligan (1981).

One factor that Comsat will seek to exploit will be the credibility of the Agency in providing Inmarsat with a space segment on cost and on time [...] It may be argued that any delay in the programme will, apart from any resulting cost increase, tend to harm the chances of the sale of the third satellite (and a third launcher). Such delay will be (deliberately) misinterpreted by Comsat and would be presented as an inability of ESA to deliver any spacecraft or services in time. [127]

Thanks to the effort developed in the Marecs A and B programmes, the Executive continued, the Agency had been able to present "a very competitive proposal" to Inmarsat, while interim funding allocations had also enabled the programme for Marecs C to remain on time. However, during the negotiations with Inmarsat it was necessary to keep the Agency in some position of strength, and the Executive recommended that, pending eventual reimbursement from Inmarsat on the basis of a contract presumably to be concluded in spring 1980, the JCB approve the financing of the Marecs C programme and of the Pacific Ocean control station. This would place the Agency on the same footing as Intelsat, whose Board of Governors had recently decided to purchase four maritime packages and to incorporate three of them in the last three Intelsat V satellites on order. Intelsat, the Executive advised, "has no more commitment from Inmarsat than has the Agency".[128]

Two main reasons were given for recommending such a course of action. Firstly, the Marecs C programme was entering an equipment manufacturing stage and should the continuity of this manufacture be interrupted, re-start would be extremely costly, thereby destroying the price competitivity of the ESA offer. Secondly, by the time the Inmarsat Council would be called to take its final decision, "[it] would be faced with the inevitability of a Marecs C spacecraft being ready. Such psychological factors are not without their importance in a contract negotiation situation".[129] "There was an element of risk involved - the Director General acknowledged - but an 'act of faith' on the part of the Marecs participants would have a favourable psychological impact on Inmarsat".[130] The total funding requirement was estimated at 28.4 MAU, of which 3.2 MAU would have been required in 1979.

The JCB having been unable to reach general agreement on the "act of faith", the matter was discussed at a restricted session of the Council during its 33rd meeting in July 1979. Here, the German delegation confirmed it would not participate in the Marecs C programme, as "the risk of Inmarsat not accepting the European offer was too high for undertaking supplementary financial commitments". The British delegation declared that their authorities were prepared to make up for the German withdrawal, but this implied that they would not accept an increase in their contribution to the scientific programme.[131] Following these discussions, during a brief JCB meeting held on that same day, five participating states in the Marecs programme (France, Italy, the Netherlands, Sweden and the United Kingdom) subscribed to a declaration whereby they agreed to support the Marecs C programme and the Pacific control station, pending reimbursement from Inmarsat on the basis of the contract to be concluded. Britain accepted to contribute as much as 72.2 % of the expenditure required in 1979.[132] Subsequently, owing to delays in Inmarsat decisions, new funding was approved in order to support work in industry during 1980.[133] At the same time, in view of the important meeting of the Inmarsat Council scheduled for 6th February 1980, the ESA Director General wrote to the newly elected Director General of Inmarsat, Olof Lundberg, that "in the absence of a positive

127 ESA/C(79)R/19, 12/7/79, p. 2.
128 ESA/JCB(79)21, 20/6/79, p. 1.
129 ESA/JCB(79)34, 12/7/79, p. 1.
130 ESA/JCB/MIN/32, cit., p. 3.
131 ESA/C(79)R/23, cit. p. 2 (our translation from French).
132 JCB, 33rd meeting (26/7/79), ESA/JCB/MIN/33, 25/9/79, with the attached resolution ESA/JCB/XXXIII, Dec. 1.
133 JCB, 36th meeting (7-8/1/80), ESA/JCB/MIN/36, 3/3/80. Reference documents are ESA/JCB(79)58, 22/11/79, and add. 1, 20/12/79.

attitude to the use of Marecs", it would hardly be possible to maintain the validity of the ESA offer beyond May that year.[134]

The course of events frustrated ESA's expectations. The Inmarsat Council, in fact, decided not to procure a space segment for providing services in the 1980s, but rather to lease maritime communications capacity on existing satellites or those or under development. A second generation (Inmarsat II) space segment would be procured at a later stage, designed to provide services in the following decade. A call for tenders based on a leasing approach was then issued by Inmarsat in March.[135]

While, in principle, leasing could be very similar to the sale of satellites, ESA had to cope with three main problems in this respect. Firstly, the Agency was called to make a bid for a "sale of services". This kind of activity was contemplated indeed by the Convention (Article V.2), but its implementation required a decision by the Council. Moreover, it was specified in the Convention that "the cost of such operational activities shall be borne by the users concerned". The Executive warned however that an offer respecting the ESA internal charging policy would have "extremely negative consequences regarding price", therefore it proposed to adopt a marginal cost approach, i.e. to charge Inmarsat for only the additional costs arising directly out of such provision of services by ESOC and the Villafranca station.[136]

The second problem regarded the insurance policy, a crucial aspect in a situation where ESA was to make a proposal for providing service continuity over a period of 5 years. Adopting a leasing philosophy, in fact, meant that less payment or no payment at all would be forthcoming from Inmarsat in case of failure during launch or in orbit. The then recent loss of an RCA satellite insured for 78 million dollars, together with the immediate prospect of only small amounts of premium income, had "destabilised" the insurance market, the Executive advised. Moreover, the Ariane vehicle would only have flown once (its maiden flight was scheduled for December 1979) before ESA's bid would be submitted to Inmarsat in May 1980, and brokers could hardly offer attractive insurance premiums for an Ariane launch of Marecs. Two options existed for ESA: either to make an offer without insurance, thus assuming in full the risk of failure, or to negotiate with Inmarsat a possible equal sharing of insurance costs, tentatively determined at 17.5 MAU.[137]

Finally, there was the problem of recovering the investments already made in the Marecs C programme, its participants having agreed that it was no longer wise to go on constructing a third spacecraft. In this respect, the Executive proposed that ESA undertake to procure elements for such a third spacecraft, in particular a complete payload. This additional spare hardware would be included in the Inmarsat bid and reimbursed by Inmarsat over the five-year period. Pending such reimbursement, the expenditure incurred in the period 1979-1983 would be covered by the participants in the Marecs A and B programmes from the 20 % margin of their financial envelope.

In the event, the Executive proposed to offer Inmarsat the leasing of the maritime communications capacity of two satellites (Marecs A and B) for five years (1982-1987), with spare hardware on the ground. The first satellite was to be placed in geostationary orbit above the Atlantic Ocean region and controlled by ESA's existing station at Villafranca, near Madrid; the second was to be placed above the Pacific Ocean region and controlled via a new station to be procured for that purpose by ESA, and eventually built in Ibaraki, Japan. The total cost to Inmarsat was fixed at $62.5 million, equivalent to 46.7 MAU (1980 prices).[138] This covered the provision of communication services over a five-year

134 ESA/JCB(80)6, 5/2/80.
135 ESA/JCB(80)9, 12/3/80. Cf also Galligan (1981).
136 ESA/JCB(80)17, 14/4/80, p. 3. The comparison between the full costs and marginal costs options is presented in ESA/JCB(89)32, 15/7/80.
137 *Ibidem*, p. 4. Also ESA/JCB(80)17, add. 1, 16/4/80.
138 ESA/JCB(80)21, 13/5/80; ESA/JCB(80)32, 15/7/80. The corresponding figure at 1979 prices, given in ESA/JCB(80)17, cit., is 40.68 MAU.

period, manpower and facilities supplied by the Agency on a marginal cost basis only, and a recovery of expenditure on the spare hardware over five years. In case only one satellite should achieve operational status the quoted price was $35.0 million (26.2 MAU), while no payment could be claimed from Inmarsat if both satellites failed.

The JCB endorsed this proposal, but many delegations in the Council then complained about the marginal cost policy adopted in the Inmarsat bid, which in their opinion "was liable to have direct repercussions on the level of the scientific programme". In the event, there was no choice for the Council but to approve the offer, prepared by the Executive, which was formally submitted to Inmarsat on 2nd May 1980.[139] At the same time, Inmarsat received proposals from Intelsat for the lease of maritime communications capacity on board its future Intelsat V spacecraft, as well as from the Marisat consortium for the lease of its in-orbit satellites. These offers were "highly comparable" with ESA's, the Executive warned, underlining that the charging of only marginal costs was "an essential condition of European competitivity". The JCB chairman, for his part, expressed his hope that "the Member States and Canada would be able to give the European offer their full support at the [forthcoming] Inmarsat meeting.[140] After many negotiations, both between ESA and Inmarsat (regarding technical and financial aspects of the leasing action) and between ESA member states (regarding pre-financing schemes of the programme), the lease contract was eventually signed in November 1980.[141]

Marecs A was successfully launched on 20th December 1981 by the Ariane L04 vehicle and two weeks later it reached its final position over the Atlantic. Following the commissioning and testing phase, the satellite started operational services for Inmarsat on 1st May 1982. Marecs B was lost in an Ariane launch failure on 10th September that year, resulting in a serious shortage of communications capacity over the Pacific region. The participating states agreed to procure and launch a replacement satellite (Marecs B2), taking advantage of the critical hardware for a third spacecraft already procured within the framework of the Marecs A/B programme. Marecs B2 was successfully launched by Ariane on 10th November 1984 and placed in its final orbital position over the Pacific. It went into operational service for Inmarsat by the end of the year, thus allowing ESA to fulfil its contractual obligations with the users.

The ESA/Inmarsat contract marked ESA's entry into the international commercial satellite market, confirming that government support to the Marecs programme had actually resulted in a product which was technologically and financially competitive with American products. The Marecs spacecraft, in fact, was specifically designed for maritime services in the 1980s, providing Inmarsat's first space segment with the largest communications capacity and a special search-and-rescue channel in ship-to-shore direction. Intelsat V, on the contrary, carried a maritime communications subsystem in addition to its basic fixed service communications payload. The experience with the Marecs programme was also very important in consolidating European capability in the maritime communications field. This was confirmed when, in 1985, an industrial consortium led by British Aerospace won the contract for developing the second generation Inmarsat II satellites. The Inmarsat II platform was essentially based on the ECS and Marecs design, while the payload was developed by Hughes Aircraft Company using a new design.

The End of the H-Sat Concept and the Start of Two DBS Programmes in Europe

On 1st March 1978, as discussed above, the Council and the JCB had approved a preliminary Phase-B study on H-Sat, pending a final decision on the start of the programme. The main objective of this six-

139 JCB, 38th meeting (15-16/4/80), ESA/JCB/MIN/38, 14/5/80; Council, 41st meeting (20/5/80), ESA/C/MIN/41, 6/6/80, with attached ESA/C/XLI/Res. (Final). ESA/JCB(80)21, 13/5/80.

140 JCB, 39th meeting (28-29/5/80), ESA/JCB/MIN/39, 10/7/80, pp. 6, 9.

141 ESA/JCB(80)31, 16/7/80; ESA/JCB(80)48, 26/9/80; ESA/JCB(80)52, 26/10/80. JCB, 40th meeting (30-31/7/80), ESA/JCB/MIN/40, 22/9/80; 41st meeting (16-17/10/80), ESA/JCB/MIN/41, 28/11/80; 42nd meeting (4-5/11/80), ESA/JCB/MIN/42, 26/11/80.

month study was the improvement of the H-Sat design in view of its adaptability for future operational DBS missions, according to the WARC plan. This involved, in particular, the change from Ariane L04 to an operational Ariane launcher, the prolongation of the satellite lifetime to 7 years, and the modification of the antenna configuration to give two separately steerable single-beam antennas instead of a dual-beam single antenna.[142] It was moreover decided that two alternative satellite designs would be studied, corresponding to two possible schemes for participation of member states in the development phase, i.e. with or without the participation of Germany. First results of this study were available in early October, showing that, "the satellite design had proved to be fully compatible with the H-Sat mission objectives and - in particular - both platform and payload elements have been proved to match the stringent requirements for demonstrable growth potential and adaptability to the needs of future pre-operational and operational missions".[143]

On this basis, the Executive presented a proposal for "an integrated European approach to the development of operational broadcast systems". This represented a difficult compromise between the diverging interests of those countries which pursued an early development of an operational system, notably France, Germany and the Scandinavian countries, and those which advocated an initial mission mainly devoted to experimental activity. The plan envisaged a joint effort for the development of a common European platform designed to accommodate (with minor modifications) all foreseen operational missions. This effort had to be complemented by the continuing development of communications in the framework of both national and ESA programmes:

> *The future space segments for operational systems could then be readily furnished by the combination of the basic common platform with the relevant assembly of payload equipment adapted to specific mission requirement.*[144]

There were many important advantages in the concept of a European platform, the Executive argued. Firstly, from the technical point of view, the bulk of the necessary development would be done only once, minimum modifications being required to match the needs of each specific mission. The risk for individual users would also be reduced for any technical bug would be uncovered by a single development and test programme on ground, and during in-orbit operations. Secondly, from the financial point of view, the development of a single common platform at European level would eliminate wasteful parallel development of similar products, and permit the initial development costs to be shared between a number of countries. Thirdly, from the industrial policy point of view, this approach would foster the creation of one industrial consortium in Europe able to produce platforms of this class in a cost-effective manner, thus helping European space industry to compete successfully in the world-wide market. On the contrary, parallel development of several platform concepts on a national or bilateral basis within Europe would lead to wasteful competition for external markets. Finally, the common platform would be developed and eventually upgraded in coherence with planned improvements in Ariane performance capability, so that the European launcher/platform combination could be successfully marketed externally.

A "logical sequence" for the development of an integrated European programme in the DBS field was then outlined, consisting of an initial satellite (H-Sat) with operational elements but limited capacity, closely followed by the procurement of one or more operational systems. More specifically, such a programme would consist of three phases. The first would be devoted to the prompt development (starting in early 1979) of H-Sat, suitably modified in order to provide for a limited pre-operational service for those countries that envisaged rapidly setting up an operational service. The satellite was to be launched in 1982, and its technical specifications were defined as far as possible according to the wishes of Germany as regards orbital position (19° W), frequency allocation (one channel), polarisation, and maximum conformity with the German coverage allocated at the WARC conference. The second phase, to be developed within a period of 18 months to 2 years, would be devoted to the

142 ESA/JCB(78)22, 28/4/78.
143 ESA/JCB(78)55, 9/10/78, p. 26.
144 ESA/JCB(78)67, 20/11/78, p. 8. See also ESA/SBAG(78)10, 12/10/78 (also attached to ESA/JCB(78)63, 23/10/78).

manufacture of an operational satellite, to be launched in 1984, providing coverage of those European countries that wished to have a DBS system in the short period. Several options existed regarding the payload of this satellite, e.g. a French dedicated payload, a German dedicated payload, a payload matched to Nordsat requirements, and a mixed payload for a multinational mission. Finally, fully national systems based on the standard European platform would be developed in the third phase, whose development depended on national plans as well as on the achievements of the two preceding phases. In this plan, the Executive stressed, the Agency would be responsible for the definition and the procurement of the initial satellite, in close collaboration with future users, while during the subsequent procurement of operational satellites, the Agency's role would be limited to "that of coordination and technical support when requested by users".[145]

The Executive's plan was discussed at two SBAG meetings, on 13th October and 4th December 1978, respectively, after extensive consultations with the national broadcasting authorities represented in the EBU had showed that all were interested in using H-Sat for carrying out experiments in direct broadcasting. Here it was evident that all efforts to reconcile the experimental and operational requirements were doomed to failure. All ESA member states other than France and Germany supported the common European platform concept. The Swedish delegation, in particular, insisted that such a platform had to be developed as soon as possible in order to be used in the Nordsat project. France and Germany, on the contrary, stated that they were not interested in H-Sat and would eventually implement an operational satellite on a national or bilateral basis, outside the ESA framework.[146]

The French position came as a novelty, this country having been until then a convinced supporter of the H-Sat concept, both within ESA and within the EBU. The change of attitude, in fact, reflected ongoing bilateral consultations between the two major ESA member states on the possibility of developing a Franco-German system. By taking advantage of the experience that MBB and SNIAS had acquired in the Symphonie programme and in the development of the Intelsat V satellite, the two countries envisaged merging their industrial capabilities in the most efficient way, without being encumbered by geographical distribution constraints, in order to secure their leading aerospace industries a competitive position in the future market of DBS systems.

As core members of Eurosatellite, MBB and SNIAS were thus in the embarrassing situation of being involved in the study of two potentially competing programmes, i.e. ESA's H-Sat and the envisaged Franco-German project. The embarrassment became evident when, at the conclusion of the interim study, the Executive requested a detailed financial offer for the development of H-Sat from Eurosatellite. The latter prepared a budgetary offer which the Executive considered of very little meaning, "since the prices submitted by certain contractors are artificial and without any supporting detail or any reference to the previous financial baseline". The lack of interest on the part of industry could easily be explained by: "The general political environment surrounding the programme and the fact that some industries have allowed themselves to be influenced by parallel national activities".[147]

In what appears to be a deliberate attempt to keep France linked to the ESA programme against Germany's centrifugal pull, the Executive suggested a possible modification in the H-Sat concept, i.e. the introduction of an alternative payload with one or two channels for French operational use, a channel for pre-operational services in Germany and other interested countries (Scandinavian countries and Italy), and the Italian 20/30 GHz experiment payload. This modification, however, was not accepted by the other member states, which confirmed their interest in the current H-Sat design and the experimental mission being studied by a joint ESA-EBU working group. France and Germany, on the other hand, rejected a possible compromise suggested by the EBU observer in the

145 ESA/JCB(78)67, cit. p. 10.
146 ESA/JCB(78)63, 23/10/78); ESA/JCB(78)76, 5/12/78. For the German position, see also ESA/SBAG(79)1, 2/2/79.
147 ESA/JCB(79)4, 11/1/79, p. 3.

SBAG, which consisted in using H-Sat for two years for joint experimentation, and then making it available to countries with operational requirements.[148]

At the JCB meeting of 5th and 6th December 1978, the split between France and Germany, on the one hand, and the other member states, on the other, became dramatically evident. The Executive had proposed a complementary study programme (Phase-B2) at a cost of 4.5 MAU in order to ascertain whether the current H-Sat concept could be modified in order to meet the needs of all interested parties, but the French and German delegations stated that they would not approve any further funding of the H-Sat programme until the results of their on-going national studies were available. The other delegations, on the contrary, strongly supported the Executive's proposal, some of them harshly reminding that "the obligations imposed by the Convention for the harmonisation of national programmes with those of the Agency and for the Europeanisation of national activities also covered application satellites". France and Germany being unable to approve even a reduced (1 MAU budget) study programme proposed by the Executive during the meeting, the chairman concluded that "there was no point in continuing the discussion", and announced that a report would be submitted to the next Council meeting, scheduled for 12th and 13th December.[149]

The Council, however, was also unable to overcome the deadlock in the H-Sat programme. Despite the appeal to the French and German delegations "to reverse the stance they had taken and thus keep open the option for a European programme", these reaffirmed that they could not approve any commitments concerning H-Sat until the national studies had been finalised. In view of this situation, the Director General proposed to defer all decisions to February 1979, thus allowing the French and German authorities to arrive at a final decision. In order to keep the ESA H-Sat team together until then, the remaining delegations immediately approved an amount of 0.3 MAU to support additional studies.[150]

The new document which the Executive submitted to the JCB and the Council had the tone of an ultimatum, starting with "the three fundamental questions posed by the development of direct television broadcasting satellite systems in Europe":

> *Is it desirable for Europe to tackle this problem by means of collective actions? Should such action be determined by the ESA Council? What should be the role of the Agency, as an Executive entity, in the execution of this action?*[151]

The document continued by presenting again the case for a coordinated European approach, against the adoption of "uncoordinated [national] lines which would [...] have adverse consequences both for the individual countries concerned and for Europe as a whole". A coordinated European industrial effort, leading to the efficient development and manufacture of the complete series of operational broadcast satellites required by the different user organisations, would be of benefit to all concerned in both technical and financial terms. As regards the H-Sat programme, it was recognised that "controversy exists over the nature of the payload and mission for the initial satellite", i.e. between those who believed that this should carry an operational payload and be immediately put into service, and others who insisted that the initial mission should be of an experimental character. Both viewpoints could be accepted, the Executive argued, stating that it could go along with either approach. It therefore proposed to leave open for the moment the question of the payload, in order to ensure that the platform development programme could be started immediately under ESA responsibility. Regarding the payload, the Agency's responsibility would depend on whether it was of an operational or an experimental nature. In the former case, one or two users could be entirely

148 ESA/JCB(78)67, cit. ESA/JCB(78)76, cit. (fn. 146)

149 JCB, 28th meeting (5-6/12/78), ESA/JCB/MIN/28, 17/1/79, pp. 2-3. The Executive's proposal for a complementary study programme is described in ESA/JCB(78)68, 20/11/78; ESA/JCB(78)71, 21/11/78, and ESA/JCB(78)78, 5/12/78. The JCB chairman's report to the Council is in ESA/C(78)162, 8/12/78

150 Council, 28th meeting (12-13/12/78), ESA/C/MIN/28, 26/1/79, p. 19. The declaration relating to these additional studies was subscribed on 16th May and reported in ESA/C/XXXI/Dec. (Final).

151 ESA/JCB(79)6, 12/1/79, p. 1. The following quotations are from pp. 9-10 and 12-13.

responsible for payload development and for the utilisation of the satellite, "while collaborating with ESA, EBU and other users in the execution of a minimal in-orbit test programme". In the other case, ESA would be responsible for payload development and procurement within the framework of the overall contract and all European users would be invited to participate in the experimental programme. The procurement of subsequent operational satellites would in any case be managed by the users, which could delegate certain technical and managerial tasks to national space authorities such as the French CNES or the German DFVLR, or to ESA. The latter should remain however responsible for certain coordination tasks in the domain of payload development as well as for launching, injection into geostationary orbit and in-orbit operations of future operational satellites.

Concluding its document, the Executive urged the JCB and the Council to answer the fundamental questions posed at the beginning. The urgency of these questions, it argued, was linked to the emergence of operational requirements and to the fact that national initiatives were being undertaken to meet them in competition with ESA's programme. Should Europe undertake a DBS development programme by means of collective action? Should such action be determined by the ESA Council? What should the role of ESA be? Delegations were strongly invited to adopt a clear position on these questions:

> *The Director General feels it his duty to state that any other course of action would constitute a violation of both the spirit and the letter of the ESA Convention. [...] In the absence of clear answers to these questions, ESA will be unable to progress in planning European collective action in this field.*

Neither the JCB nor the subsequent Council meeting were able to answer these questions, as France and Germany said that the studies undertaken at national level had not been completed and therefore no decision could be taken for the time being. In view of this attitude, the JCB chairman asked the Executive to study to what extent a European television broadcasting satellite could be developed without the participation of these two countries. The other delegations were upset, most of them feeling that it would be unrealistic to undertake such a programme without two major contributors. The Swiss delegation reminded that the H-Sat programme had originally stemmed from the resolve to develop a platform using the capacity of Ariane, and from the very beginning it had been studied within a European framework. The competent European authorities should take their decision advisedly, it added for the benefit of the French delegation, "without forgetting either their obligations under the Convention or the acts of solidarity demanded of member states in connection with the Ariane follow-on development activities and the maintenance of the Guyana Space Centre".[152]

At the subsequent Council meeting of 28th February, seven member states (Denmark, Italy, Netherlands, Spain, Sweden, Switzerland and the United Kingdom) plus Austria approved a new study programme at a cost of 0.55 MAU to cover work during the period March-July 1979. The H-Sat concept being definitely jeopardised, the aim of the study was to investigate a wider range of future telecommunication missions, including fixed, broadcast and mobile services. These missions were to be studied *vis-à-vis* their compatibility with the large platform studied within the framework of the former H-Sat programme. A market survey was to proceed in parallel.[153]

While these studies were under development, the British delegation informed the Executive that from national studies and informal contacts with other member states it appeared that considerable interest remained in a European large communications satellite programme, based on the multi-purpose platform concept, even without the participation of France and Germany. It therefore urged the Executive to table a new programme proposal for at the next JCB meeting on 4th and 5th July.[154]

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152 JCB, 30th meeting (1-2/2/79), ESA/JCB/MIN/30, 12/3/79, p. 5.

153 Council, 29th meeting (27-28/2/79), ESA/C/MIN/29, 4/4/79, with attached ESA/C/XXIX/Dec. 5 (Final). Cf also ESA/C(79)26, 9/2/79. A detailed definition of the tasks of the study were subsequently described in ESA/JCB(79)14, 27/3/79.

154 ESA/JCB(79)27, 8/6/79.

The failure to achieve a joint European approach to future space telecommunications programmes did not go unnoticed by the public or European political organisations. The chairman of the Committee on Science and Technology of the Council of Europe's Parliamentary Assembly commented on these events as follows:

> *The Committee heard with some concern [...] that a coherent multilateral approach within the framework of the European Space Agency might be endangered by a bilateral initiative on the part of France and Germany. This initiative, though highly commendable in substance, risks leading to other bilateral or trilateral initiatives by other countries - and thus to a general fragmentation of the European effort.*[155]

The L-Sat Concept and the Adoption of the Olympus Programme

The ESA study was duly completed by the end of June and reports of its conclusions were distributed to JCB and Council delegations.[156] The Executive had undertaken a market survey of several future telecommunications missions, including European broadcast services (DBS systems) and fixed services (regional trunk services, national inter-city trunk services, specialised services); global fixed services (Intelsat transponder leasing) and mobile services (maritime, aeronautical and land); and non-European regional and domestic services (mainly in Third World countries). The conclusion of this survey was that in every sector there was a clear potential market for large telecommunications satellites of European origin, the date for market materialisation for most of them falling in the 1984-87 period. As a consequence, in order for European industry to succeed in fulfilling the foreseen European domestic demand economically and to win orders for global and non-European regional or national systems:

> *it is considered essential that the necessary space segment elements be available "off-the-shelf" at the moment when each market manifests itself in the form of an invitation to tender from the national user authority, government, or international organisation. This means [...] that there should be developed in good time a suitable multipurpose platform of the appropriate class needed to fulfil most of the foreseen demands and the complete range of payload technologies and equipments matched with the predicted mission requirements* [underlined in the original text].[157]

According to the Executive, the number of large platforms European industry could reasonably hope to sell was in the range 20 to 30. It then proposed that ESA undertake a "multi-mission service demonstration satellite", based on the large platform studied in the framework of the H-Sat programme in association with a multi-element payload, each element demonstrating a particular future service type. The selection of the payload elements would be based on the strength of market predictions for each payload type, the interest in demonstrating certain new service, the benefit of in-orbit demonstration and qualification of the relevant technologies, and the willingness of participating member states (governments and/or user authorities) to finance both payloads and corresponding earth segment elements. As an example of such a complex payload, the Executive suggested the following six elements:

a. a single channel direct broadcast payload with a steerable antenna for demonstration in all parts of Europe;

b. a payload dedicated to the pilot provision of special services primarily for business users over the whole European coverage area;

c. a payload for demonstration of future national inter-city telecommunications and special services in the 20/30 GHz bands;

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155 ESA/JCB(79)29, 28/6/79.

156 ESA(JCB(79)28, 19/6/79. The full report is ESA/EXEC(79)3; July 1979, presented to Council under cover ESA/C(79)82, 27/6/79. A summary report for the JCB is ESA/JCB(79)28, 19/6/79.

157 ESA(JCB(79)28, cit., p. 11.

d. a 20/30 GHz propagation beacon package;

e. a single channel UHF sound broadcast payload;

f. a C-band fixed service payload intended to test new techniques relevant to satellite applications in developing countries.

On this basis, the Executive proposed a new optional programme, called L-Sat, consisting of:

- the development of a multi-purpose large platform, compatible with both Ariane and the Space Shuttle;
- the development of a multi-element payload;
- the procurement and launch of a single flight model (supported by a flight spare);
- operations support for the satellite lifetime;
- supporting earth segment equipment.

Assuming that the project definition phase would start in October 1979, and that the decision on the development phase would be taken in November 1980, the launch of L-Sat was scheduled for the end of 1983. The industrial cost of the platform was estimated at 40 to 50 MAU (including the procurement of the first flight model), while the average development cost of each payload element was estimated at 10 MAU.

The proposed implementation policy for this programme was strongly oriented towards preparing industry for future cost-competitive satellite production, in order to satisfy the market outlined in the survey. In particular, it was proposed to depart from the conventional consortium arrangements and select only the prime contractor. The latter would be encouraged to invest in the programme, to take maximum initiative and full responsibility for its actions, and to promote the future sale of the product. The prime contractor would select subcontractors by competition, with development and recurring price as main criteria, while ESA's role would be limited to general supervision. The participating member states would contribute to the programme in proportion to their industrial return, "in turn reflecting relative industrial competitivity".[158]

At the JCB meeting of 4th-5th July 1979, France and Germany confirmed that they did not intend to participate in the ESA project, their national authorities being in fact on the verge of agreeing to carry out a bi-lateral DBS development programme. The other delegations were generally positive towards L-Sat, but some of them expressed concern about the possibility of funding the programme if France and Germany did not participate. In the event, it was agreed that the proposal should go forward to the Council for consideration and eventual approval.[159] During the subsequent Council meeting, the L-Sat programme was finally approved and five member states (Denmark, Italy, the Netherlands, Switzerland and the United Kingdom) agreed to embark immediately on the project definition phase (Phase-B study).[160] They were joined by Belgium and Spain in October. One month later, British Aerospace was selected as prime contractor for the Phase-B study. Subsequently, Austria and Canada were also associated to the study programme.[161]

158 *Ibidem*, p. 28.
159 JCB, 32nd meeting (4-5/7/79), ESA/JCB/MIN/32, 26/7/79.
160 Council, 33rd meeting (25 - 26/7/79), ESA/C/MIN/33, 20/9/79; ESA/C(79)92, 10/7/79.
161 ESA/JCB(80)10, 12/3/80; ESA/JCB(80)16, 31/3/80.

Country	%
Austria	0.75
Belgium	3.7
Canada	9.0
Denmark	1.3
Italy	32.8
Netherlands	11.8
Spain	2.6
United Kingdom	34.3
Unallocated	3.75
Total	100.00

Table 17: L-Sat contribution scale

The project definition phase was completed in June 1981, when British Aerospace submitted its proposal for the development phase. Following some technical and financial negotiations between the prime contractor and ESA, and the submission of a new proposal, the L-Sat development programme was finally approved in December by all the countries which had participated in the study phase, except Switzerland. The financial envelope of the programme was established at 388.5 MAU (at 1980 prices); the initial scale of contribution, which corresponded to the estimated percentage shares of industrial work among the participants, is shown in Table 17, the unallocated amount reflecting the unforeseen withdrawal of Switzerland.[162]

The two objectives of the L-Sat programme were: (a) the development and launch of a multi-purpose large platform designed for a range of future telecommunications applications and (b) the development, in conjunction with the space platform, of a series of telecommunications payloads and their in-orbit operations. The general aims were to advance the European space industry in order to maximise its competitiveness in the world market and to stimulate users and promote new market applications. Four payloads were eventually approved for inclusion in the first L-Sat, which was eventually named *Olympus*. These were:

1. A direct broadcast service (DBS) payload with two channels, one for pre-operational use in Italy (RAI), and the other for European use (EBU);
2. A 12/14 GHz specialised services payload for communications experiments between small earth terminals;
3. A 20/30 GHz communications payload for experiments in new communications applications;
4. A propagation package for gathering new information on the propagation of radio waves in the atmosphere at 12, 20 and 30 GHz.

Several research laboratories as well as telecommunications and broadcast authorities were to be involved in the experimental programme.[163]

Following the departure of France and Germany from the programme, the sharing of industrial work was reorganised. As the United Kingdom and Italy were now the main contributors, British Aerospace was selected as the prime contractor for Olympus development, while the Italian Selenia Spazio was responsible for coordination of the four communications payloads, including the design and development of the DBS and the 20/30 GHz Communications payloads. Marconi Space System (UK) and Bell Telephone Manufacturing (B) were responsible for the Specialised Services and the

162 ESA/JCB(81)33, rev. 1, 26/10/81; ESA/JCB(81)34, rev. 1, 15/10/81. JCB, 48th meeting (14-15/10/81), ESA/JCB/MIN/48, 10/11/81, with attached ESA/JCB/XLVIII/Dec. 1 (Final), rev. 2. Apparently, it was "for financial reasons" that Switzerland had to forgo participation in the L-Sat programme: Council, 51st meeting (9-10/12/81), ESA/C/MIN/51, 18/1/82, p. 37.

163 Hughes & Bartholomé (1987).

Propagation Package payloads, respectively, while the Canadian SPAR Aerospace had overall responsibility for the solar arrays. Originally scheduled for launch in early 1986, Olympus was eventually launched by an Ariane vehicle on 12 July 1989.[164]

Olympus' orbital life was unfortunate. In January 1991, the satellite lost the use of one of its solar arrays, but sufficient power was delivered from the other array for the satellite to continue operations with all the payloads. It was however necessary to implement complex operating procedures which resulted eventually in a faulty operation and a loss of all attitude and orbit control of the satellite in May. The satellite began spinning and drifting along its orbit, internal temperatures dropped, and the batteries were completely discharged. A major recovery operation was developed in the following months, and the satellite was gradually brought back into operation by the end of the year.[165] It was expected to remain in operation until July 1994, but in August 1993 service from the satellite was interrupted for reasons which remain unclear (probably meteorite showers) and the satellite lost its Earth-pointing attitude and began spinning. All attempts to retrieve the satellite having failed, Olympus was finally turned off and its mission ended.

Epilogue

In May 1980, France and Germany signed a memorandum initiating their collaboration on the development of an operational DBS system. The programme began in 1981, and included development work and assembly of three 5-channel satellites, one flight unit for each country and one spare. Later, it was expanded to four satellites, one flight unit and one spare for each country. The spacecraft serving Germany was called TV-Sat, that for France was called TDF (Télédiffusion de France, the name of the national broadcasting company). Both satellites were developed by the Eurosatellite consortium, MBB being the prime contractor for TV-Sat and SNIAS for TDF. In 1983, Eurosatellite (SNIAS prime contractor) was awarded a contract to develop Tele-X, a satellite derived from the former Nordsat project and sponsored by Sweden together with Norway and Finland. Tele-X was essentially identical to TV-Sat/TDF, but supporting a payload with three broadcasting channels and two channels for data transmission. TV-Sat was launched in November 1987 but it failed during initial deployment and was definitely abandoned in the spring of 1988. The second flight unit was successfully launched in August 1989. Two TDF spacecraft were launched, in October 1988 and July 1990, respectively, but each of them experienced two TWTA failures. Tele-X was launched in April 1989.

By the mid-1980s, two distinct DBS development programmes were thus under development in Europe, with two industrial groupings emerging in a potentially competitive position with each other in commercial markets. By the end of the decade however, both programmes proved to be obsolete compared to the new technology adopted by a dynamic private company, Societé Européenne des Satellites (SES), set up in 1985 in Luxembourg with partial support from the government of the Grand-Duchy. In contrast to the high-powered Olympus and TV-Sat/TDF satellites, which were based on the use of 230 watt TWTAs driving up to five DBS channels for national use, according to the WARC plan, the new concept took advantage of rapid advances in receiving technology to provide acceptable television broadcasting, at a much lower cost per channel and over a much larger geographical area, to domestic customers and cable-TV operators equipped with cheaper and smaller receivers than envisaged in the late 1970s. The DBS system set up by SES was based on the Astra satellite, developed by the American RCA company and used sixteen 45-Watt transponders capable of covering the whole of Western Europe. Astra 1 was launched in December 1988, its primary service area including England, France, Germany, Denmark, the Netherlands, Switzerland, Austria and northern Italy. A second, larger and more powerful Astra satellite was launched in March 1991.

164 Paul (1989).
165 Wilkins (1991).

The advent of the Astra system and its commercial success made the high-power DBS technology at the heart of both the Olympus and TV-Sat/TDF programmes obsolete prior to its introduction. As an informed observer remarked in 1990:

> *Advances in ground-based receiving technology have meant that there is no demand for a high-power satellite providing a small number of channels to cover a small area. Instead, future DBS markets are seen to be for medium-powered satellites with 100 Watt transponders, and to make TV-Sat/TDF and Olympus not much more than a fruitful, expensive effort.*[166]

As a matter of fact, both TDF and Tele-X had great difficulties in finding paying customers, and concerns about the viability of the TDF system almost led to its cancellation by the French government. After launch, the objectives of the project were redefined, the TDF satellites being no longer considered as an operational but as a pre-operational system assisting in the introduction of high-definition television. Initial plans for building a third TDF spacecraft were abandoned and the French government rather decided to participate in a new low-powered DBS project planned by Eutelsat, known as Europesat (eventually Hot Bird, developed by SNIAS and launched in March 1995).

Given its experimental and pre-operational character, Olympus was mainly used free of charge by a large number of PTT administrations, scientific laboratories and technical establishments for broadcast and communications experiments. One DBS channel was assigned to the Italian broadcasting authority (RAI) for pre-operational services under the terms of a special ESA/RAI Agreement; the other (EBU) channel was allocated to BBC Enterprises during the prime time period each day, the remaining daytime usage being allocated to the transmission of educational programmes from many organisations. The 20/30 GHz Communications payload and the Specialised-Services payload were used by some sixty organisations, including PTT administrations, private service providers, scientific and educational establishments. Applications with international character were coordinated by Eutelsat within the terms of an ESA/Eutelsat agreement. Finally, an Olympus Propagation Experimenters (OPEX) group was set up, for coordinating the activity of approximately thirty scientific and technical establishments involved in propagation experiments.[167] In view of future commercialisation, a multinational marketing team was formed to promote Olympus throughout the world, but in fact no Olympus derivative was sold.[168]

As a result of the split between the two DBS programmes, two main industrial groups evolved further in Europe, sharing the communications satellite market. The first, called Satcom International, emerged from the experience of the MESH consortium in the OTS/ECS programmes, and included as its main members British Aerospace (BAe) and Matra. They jointly developed a standard platform for communications satellites called Eurostar. The second was the Eurosatellite group, including SNIAS and MBB as its core members, which took advantage of the two companies' experience in the Symphonie project and marketed their Spacebus platform. These two groups were in direct competition for a share of the international market of civilian communications satellites both with each other and with American industry. Besides developing the Marecs spacecraft, the first group was successful in securing contracts for the development of Inmarsat 2 (BAe prime contractor), the French satellite Telecom (Matra), the military communications satellites Skynet 4 and Nato IV (BAe), the Spanish satellite Hispasat (Matra) and the private transatlantic communications satellite Orion (BAe). Eurosatellite was able to secure contracts for the development of Eutelsat II and Arabsat (SNIAS), in addition to the bilateral TV-Sat/TDF. Moreover, we should remember the Kopernikus satellite, based on ECS and TV-Sat technology and developed by MBB/ERNO for Deutsche Bundespost; the Italsat

166 Müller (1990), p. 334. See also Müller (1991), pp. 291-292.

167 Paul (1989).

168 Italy had initially planned to use a refurbished version of the Olympus satellite, known as Sarti, as a follow-up of its national communications satellite (Italsat), based on the ECS platform. The first Italsat was launched in January 1991, but delays in the procurement of the second spacecraft (eventually launched in August 1996) caused the abandonment of the Sarti project.

satellite developed by Selenia for the Italian Space Agency and operated by Telespazio; and the important MBB and SNIAS participation in the Intelsat V contract.

While being successful in the European "protected" market, European industry was not equally successful in those markets where they had to cope with the strong competition of American companies. Indeed, in the period between 1991 and 1993, European companies participated as candidate prime contractors in 16 calls for tenders on the international market for civilian communication satellites but all contracts with the exception of Arabsat were won by American industry. Two main reasons for this rather disappointing performance were acknowledged in a report prepared for ESA by a Working Group on Satellite Telecommunications Policy.[169] First was the important U.S. government-sponsored market (Department of Defence and NASA), which represented a major source of R&D funds and a powerful way of amortising development costs. This captive market was equivalent to some 14 times the European market. Second was the large dispersion of European industry and a captive market consisting of too many small series: "Hence it cannot realise economies of scale as can, for instance, Hughes Aircraft, which has so far succeeded in selling 39 satellites of the same type." A great concern was then expressed about the prospects of opening the European market to international competition, as envisaged at that time by the European Commission:

> *It is clear that, should the European market be totally opened to international competition, European space industry would have great difficulty in surviving and, if Eutelsat were to procure its next generation of satellites from US suppliers, the chances of survival would be next to nil.*[170]

ESA's fair-return industrial policy was blamed in this report as "counter-productive in the telecommunications programmes that have close links with commercial markets". It is practically impossible, the authors argued, to reconcile the objective of rendering the European space industry competitive on the world market, "whilst at the same time respecting the sacrosanct principle of the fair return". While recognising that this principle was deeply entrenched in the ESA tradition and strongly supported by the smaller countries concerned about the survival of their industry, the report insisted that "this survival depends much less on the application of ESA's rules than on the ability of the European industrial leaders to keep themselves competitive". The only way to reconcile competitiveness and fair return objectives, in a spirit of European solidarity, was the adoption of the so-called principle of fair contribution, i.e. that each country's contribution should be consistent with its own industrial capability.[171]

It is far beyond the scope of this report to discuss the arguments and recommendations presented in the Working Group's report. In fact, this is not a matter of history but rather of today's policy discussions about a general strategy for Europe in space. Several players are involved in these discussions, including ESA and its member state governments as well as the European Commission, telecommunications operators, industrial groups, financial institutions, international regulatory organisations, etc. It is however fair to conclude that ESA's telecommunications programme was an important element for qualifying the European space industry in this important world-wide market. In fact, the communications satellite output from Europe is largely dominated by the ECS family and Eurostar derivatives, with about 25 satellites successfully launched. According to a recent study conducted by a consultancy firm on behalf of ESA, the direct economic effect of the ECS/Marecs programme amounts to 3250 million ECU (1980 prices), this figure representing the business that would have been lost in the baseline scenario had the ESA programme not taken place.

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169 *Europe at the crossroads: the future of its satellite communications industry*, ESA SP-1166, November 1993.
170 *Ibidem*, pp. 15-16.
171 *Ibidem*, pp. 25-26.

This must be compared with the total ESA expenditure on the programme itself, estimated at about 1060 million ECU (1980 prices).[172]

The satellite industry benefitted from work to a value of 1900 MECU relative to the baseline scenario without the ESA Telecom Programme, while the launch services benefit was estimated at 210 MECU (a relatively low impact because substitution of US satellites for European satellites was assumed not to affect the use of Ariane). As regards the telecommunications services, the business activity resulting from the operation of ECS and Marecs was estimated at 1140 MECU relative to the baseline scenario. The PTT administrations however, were right in their lukewarm attitude towards the use of satellites for intra-European telephony. Against all expectations, in fact, the ECS satellites were used mainly for television distribution rather than telephony and business data traffic (Fig. 1). The use of ECS for telephony resulted in the PTTs spending about 90 MECU more than on an alternative terrestrial system; in other words, if ECS had not gone ahead, the PTTs would have saved money without losing services.

Alongside this consideration, one should also recall that the ECS satellites were remarkably successful and reliable from the technical point of view, and enabled Eutelsat to establish itself as an increasingly profitable organisation. The success of television distribution by satellite, pioneered by Astra, led to a dramatic expansion of media activity throughout Europe. This also made use of Eutelsat facilities, from the ECS system to the present Hot Bird satellites. Eutelsat would never have existed had the ECS programme not been carried out by ESA

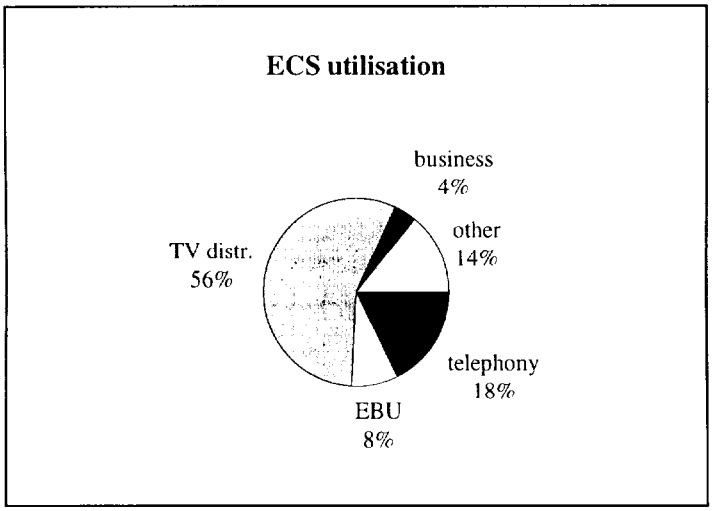

Fig. 1: Utilisation of the ECS Satellites

172 Bramshill Consultancy Ltd., *Study on the direct economic effects of the ECS programme*, Basingstoke, Hants, April 1995. The baseline scenario assumed that France continued anyway its national programme with the development of a less advanced version of Telecom 1, which partly substituted for ECS. A "pessimistic scenario" was also considered, with France not proceeding with a national programme.

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