商業用 遠隔探査프로그램의 發達

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》紹 介 말《

Patrick A. Salin助教授(캐나다의 몬트리얼 所在, 퀘벡大學校)는 筆者가 五個月年(1990年 8月 17日~1991年 2月 1日)期間동안 캐나다의 몬트리얼에 位置하고 있는 맥길大學校航空宇宙法研究所의 招聘交換教授로 있을 때에 알게 되었으며, 이 분은 多年間 人工衛星通信 및 商業用遠隔探査測定(commercial remote sensing ; 人工衛星에서 보내온 사진 레이다등에 의하여 海洋汚染如否觀測, 農作物作況觀測, 氣象, 氷河 및 地質條件觀測, 環境保護觀測 등)을 同研究所에서 研究한 바 있는데 (이 分野의 實務經驗도 있음)금번 自己研究論文中 一部原稿를 韓國讀者를 위하여 보내어온 바 있다.

이 論文의 題目은 「商業用遠隔探査프로그램(人工衛星)의 發達」이라는 것으로서 그 內容을 要約하여 본다면 ①美國의 Landsat 人工衛星에 의한 商業用 遠隔探査프로그램, ②프랑스의 Spot人工衛星에 의한 商業用遠隔探査프로그램, ③日本의 Mos人工衛星에 의한 商業用遠隔探査프로그램, ④유럽宇宙公社(ESA ; E·C會員國들임)의 ERS人工衛星에 의한 商業用遠隔探査프로그램 ; ⑤캐나다의 Radasart 人工衛星에 의한 商業用遠隔探査 프로그램 등의 發達課程 및 그 內容을 紹介한 論文이다.

특히 先進國의 人工衛星에 의한 商業用 遠隔探査에 관계된 國際條約과 美國등의 國內法을 일부 要約하여 이 論文에서 紹介하였음은 韓國이

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1995年에 人工衛星「무궁화」호를 발사하여 大氣圈의 軌道(orbit)에 進入시키게 되어 있는 時點을 앞두고 우리에게 많은 참고가 되리라고 본다.

우리 航空法學會에서도 外國의 人工衛星(satellite)分野의 最新 發展動向과 國際條約, 關係法規의 알음과 硏究가 필요하다고 보며 各國間에 國際學術硏究論文의 相互交流와 發表, 協力을 함으로서 우리의 航空·宇宙法學分野의 發展이 더욱 拍車를 加하리라고 사료된다.

이러한 時點에서 Salin 助敎授가 人工衛星分野의 오랜 硏究結果中 一部를 우리 航空法學會員 讀者를 위하여 저에게 原稿를 자진하여 보내온 점에 대하여 紙面을 통하여 Salin助敎授에게 謝意를 表하는 바입니다.

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THE DEVELOPMENT OF COMMERCIAL REMOTE-SENSING PROGRAMS

Patrick A. Salin[1)]

Commercial remote-sensing is one of the applied fields of space activities which, like telecommunications but to a lesser extent, is in the process of recording a reapid rate of development. Fields of utilization for spatial imagery are numerous : ocean monitoring, crops monitoring, glaciology, meteorlogy, forestry, environmental watch, geology, etc. All those fields of interest could be gathered under the generic name of "earth-watching activities" which is somewhat larger than "remote-sensing."

This article aims at presenting to Korean readers the main lines of development of five major players in the field, namely : the USA, France, Japan, Europe and Canada. This is not to exclude the role played by other active players such as the former USSR and other smaller though industrious space powers.

I. Commercial remote-sensing is a national activity which is neither totally public, nor totally private

A. Commercialization vs. privatization

Before penetrating into the intricacies of several national systems which

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are under study in this article, a comment should be made on the concept of *commercialization* which must be firmly distinguished from *privatization.* Quite obviously, there are links between these two terms, but they do not totally overlap one another. They fundamentally share in common the fact that they refer to private funding, by opposition to public funding. But they differ in terms of the nature of the control which is exerted by the shareholders. Commercialization refers to a partial or majority public control by means of public bodies, while privatization exclusively refers to private control of the activity by non-public bodies.[2)]

B. Budget considerations

1. Actually, these two concepts refer to an evolution of space activities which were totally under public control and funding up to the late 1970s. The US space program came under mounting financial constraints so that partial private funding started to be considered as an option during the early 1980s, a trend which the concept of commercialization refers to. Privatization therefore represents the other end of the spectrum for control and funding, where those two vital elements of space activities would be under private hands for both control and responsibility, which will presumably never happen since it would be contrary to the spirit and to the terms of Outer Space treaties and conventions.[3)] Undoubtedly, coming

2) That seems to be what is meant in a letter dated April 6, 1982 addressed by NASA to the Indian National Remote Sensing Agency at the time of the extension by mutual agreement of the MOU between the two public bodies and where NASA says "As you already know, the US has begun planning for an operational land remote sensing satellite system to follow the current NASA experimental program. Current plans call for the phased transfer from NASA to NOAA of the Landsat-D and D' system with NOAA interim management until establishment of a private sector system authorized by the US government". See the complete text in the appendix.

3) 1.Michel Bourely-Les tendances actuelles du Droit de I'Espace-Revue Française de Droit Aérien-1988－12/27.

from a total control of space activities by States, "private commercial activities in space will be further developed and will play a still more important part in space undertakings."[4]

2. In addition to US public financial strains, the apparition of SPOT－1 with a dedicated commercializing company, SPOT Image, as the first Western satellite to be openly partially operated as a commercial entity activated the trend towards commercialization in the United States at a time when some observers even thought that the Landsat program could be dropped because of a lack of public funds.

Ⅱ. The American Landsat commercial remote-sensing program

A. Overview of the Landsat set of regulations

1. From science to commerce

1. The first commercial remote-sensing system to be operatd was American, with the Landsat series, of which five satellites have been put in orbit since 1972. This program was originally scheduled for scientific and research purposes under the responsibility of NASA, an agency of the US government endowed with an independent status, and enjoying a statutory dichotomy with the Department of Defense as established in section 102 (b) of the National Aeronautics and Space Act of 1958[5]. NASA conducted this remote-sensing program with a wide autonomy, having been endowed with "unusual shares of authority not otherwise conferred upon agencies in the Executive Brance."[6] NASA initiated in the middle 1970s a

2. Michel Bourély-Quelques réflexions sur la commercialisation des activités spatiales-Annales McGill IASL-1986－171/184.

4) He Qizhi-Certain legal Aspects of Commercialization of Space Activities-Annals of Air and Space Law-1990－p.333/340.

5) National Aeronautics and Space Act of 1958, Pub. L. No 85－568, 72 Stat. 426. Amended in 1985, 1986 and 1989.

slow movement of disengagement from certain aspects of the remote-sensing program with the idea to transfer the commercial responsibilities to industry.

2. This commercialization trend was announced by President Carter in 1979 and transformed into a decision by President Reagan in 1983. The materialization of this decision was accomplished in 1984 through the Land Remote-Sensing commercialization Act [7] (hereinafter identified as the Landsat Act) and the transfer of the system's technical responsibility from NASA to NOAA (National Oceanic and Atmospheric Administration). Bids were requested from the private sector and EOSAT-a consortium of RCA and Hughes Aircraft interests-eventually was the successful bidder and received the administrative control of the system from the Department of Commerce in September 1985.

2. Purpose of the Landsat Act of 1984

1. The Landsat Act has been so far the most elaborate framework of national legislation ever enacted in the field of remote-sensing, and it is still so far the only one of its kind, even though historically the first legally binding text entirely devoted to remote-sensing was the Moscow Convention of 1978 signed by eight socialist countries.[8] Without performing an in-depth analysis of this Act, it is worth mentioning that it is divided into

6) Henry J. Glazer-The Expanded Use of Space Act Commercialization through Advanced Joint Enterprises between Federal and Non-Federal Constituencies-Rutgers Computer & Technology Law Journal-1987-339/405.

7) United States : Public Law 98-365 (H. R. 5155) ; July 17, 1984. Land Remote-sensing Commercialization Act of 1984.

8) The convention on the Transfer and Use of Data of Remote Sensing of the Earth from Outer Space (United nations Docurment A/33/162, June 29, 1978). Usually named "the Moscow Convention of 1978." Signed by Cuba, Czechoslovakia, the German Democratic Republik, Hungary, Mongolia, Poland, Romaina, and the U. S. S. R.

seven parts.[9] Fundamentally, the Landsat Act provides for the smooth transition of the control of the commercial aspect of the Landsat system from public to private hands, while maintaining the control of the US government (namely NOAA, under the Secretary of Commerce) over the destiny of the system for national security reasons as well as for information needs.

2. This legislation has been completed in its regulatory aspect by the National Oceanic Atmospheric Administration (NOAA) licensing rules adopted in July 1987[10] Their purpose is to "estalish the minimum practicable procedures and informational requirements to license and supervise the operation of a remote-sensing space system.··· (which aim at)··· encouraging development of private sector-owned remote-sensing space systems and promotion of commercialization of land remote-sensing systems in the United States···". Their objectives is to (i) preserve and promote the national security of the US, (ii) ensure that data from private operational remote-sensing space systems will be sold on a non-discriminatory basis, and (iii) fulfil the international obligations of the US.

B. Main features of this corpus of rules

1. Definition of *commercial remote-sensing*

1. The scope of remote-sensing activities appears to be wide, since the

9) Land Remote-Sensing commercialization Act of 1984 :
Title I : Declaration of findings, purposes and policies.
Title II : Operation and data marketing of Landsat system.
Title III : Provision of data continuity after the Landsat system.
Title IV : Licensing of private remote-sensing space systems.
Title V : research and development.
Title VI : General provisions.

10) Licensing of private remote-sensing space systems-National Oceanic Atmospheric Administration-15 CFR Ch. IX (1−1−91 Edition)-Part 960−p. 296/305−52 FR 25970, July 10, 1987.

Act's first section identifies this activity as a "major benefit in managing the Earth's natural resources and in planning and conducting many other activities of economic importance." Such broad statement "seems" to confirm congressional intent not to restrict remote-sensing commercial activity solely to environmental protection and land use, but also to enlarge this field to··· the movement of people and goods."[11]

2. No definition is given of the permissible resolution which would be acceptable for private use. This is of relative importance because nothing really distinguishes a *Commercial* use from a *reconnaissance* or a *military* use of remote-sensing, except the picture resolution which is much finer for the latter one (an estimation of 1 meter resolution for US and Soviet military satellites against 10 meter for SPOT which is generally accepted as being the best available commercial remote-sensing satellite). This leaves the definition responsibility to the Department of Defense and all allows us to say that commercial remote-sensing is *a contrario* what is not military or reconnaissance sensing.

2. Types of remote-sensing data

1. Ths US rules identify four types of remote-sensing data and go slightly further than the three types identified by the United Nations Principles.[12]

11) Hamilton DeSaussure-Remote Sensing Satellite Regulation by National and International Law-Rutgers computer & Technology Law journal—1989—p. 351/381.

12) Principle 1 of the Declaration states that :
b) The term "primary data" means the raw data that are acquired by remote sensors borne by the space object and that are transmitted or delivered to the ground from space by telemetry in the form of electromagnetic signals, by photographic film, magnetic tape or any other means ;
c) The term "processed data" means the products resulting from the processing of the primary data, needed to make such data usable ;
d) The term "analyzed information" means the information resulting from the interpretation of processed data, inputs of data and knowledge from other sources ;

our types are referred to as being :

- Basic (collected by the licensees and seclected by the government for storage),
- Experimental (collected by the government for experimental programs),
- Unenhanced (unprocessed or minimally processed),
- or rusulting from a value-added activity (any activity which substantially and irreversibly changes the information content of the unenhanced data).

This refinement of definition is important because it grants the value-adder proprietary rights on the enhanced information which has become personalized through the value-adding process, except for naional security reasons, as will be discussed further down.

3. Registration and liability

1. The obligation to keep the UN Secretary General informed about national remote-sensing activities is an international obligation and is therefore part of US legislation, but it is not clear how private entities may participate in helping the US government fulfil this obligation, as well as it is not clear how the content of enhanced data may be disclosed in order to abide with Principle XII of the 1986 UN Declaration.[13]

2. The registration responsibility is vested by the US rules on the operator of the system and not on the launcher.[14] The generating factor which creates this responsibility twoards US laws is the fact that the operator, whether a US (corporate or private) citizen or not, has substantial connections with or derives substantial benefits from the United States or United

13) Excerpts from U. N. 1986 Declaration, Principle XII : "… The sensed State shall also have access to the available analyzed information concerning the territory under its jurisdiction in the possession of any State participating in remote sensing activities on the same basis and terms…" Please see full text of the Declaration in Annex 2.

14) 15 C. F. R. § 960. 12 (d)(1).

States law. If there are two or more launching states participating to the launching of a remote-sensing satellite, the Registration Convention of 1976 provides that there must be an agreement between the parties in order to determine which of them will officially be considered as the launching state for purposes of registration. But if the satellite has *substantial connections* with the United States, then its operator remains subject to U. S. laws. One may thus find situations where operators could be liable under two different sets of rules : one promulgated by the launching state and one promulgated by the registration states which may be different. This opens the way to possible extraterritorial applications of the US law when a foreign-based operator manages a remote-sensing satellite which has *substantial connjections* with the United States. Such operator must then be licensed by the Secretary of Commerce whose authority is expressly recognized by the Commercial Space launch Act of 1986.

3. International liability relating to a commercial remote-sensing satellite directly belongs to the registration State. However, as it has been explained in the previous paragraph, both the U. S. and a foreign state could be concerned in the case of a foreign satellite having *substantial connections* with the U. S. Damages should then be split between the two States.

Ⅲ. The French SPOT commercial remote-sensing program

A. Overview of the SPOT set of regulatuons

1. Absence of public regulation

1. The particularity of the SPOT system is that there is no specific law which regulates remote-sensing in France. Fundamentally, two sides of the operations have been distinguished : the first one is exploitation, which is under the responsibility of the French equivalent of NASA, Centre National d'Etudes Spatiales (CNES), and the second one is data distribution

which is under the responsibility of SPOT Image, a private company in which is under the responsibility of SPOT Image, a private company in which CNES holds an important share. One can say that such a system is firmly under the control of CNES, itself under the responsibility of the French Ministry of Industry, Research and Technology. But differently from its US equivalent, there is no legislative text of general scope which organizes the commercialization of remotely sensed data in France.[15]

2. the relationship between CNES and SPOT Image is orgainzed around two agreements. The first agreement grants SPOT Image the power to negotiate and sign contracts with ground stations around the world. The second agreement awards SPOT Image with an exclusive distribution right to pass any contract with distributors and users around the world.[16] Lack of access to these two agreements unfortunately does not allow us to comment upon their content.

2. An effort at both levels, national and european

There is an apparent duplication of effort in remote-sensing at national and at a European regional level (ESA). It was in 1976 with the preparation of the next five year plan covering 1977－1982 that CNES made the proposal of an earth observation satellite, capping a six years study program devoted to earth observation techniques. The program was designed to give CNES the capacity to develop a national project in order to help France maintain its position within european space programs,[17] and possibly to have the European Space Agency (ESA) foster part of the project

15) Michel Bourély-Space Commercialization and the law-Space Policy-May 1988-p.131/142.

16) See supra Le Gall.

17) Antoinette Le Gall-La France et al télédétection parsatellite des ressources de la Terre : Le système Spot-Thése de maîtrise-Institut de Droit Aérien et Spatial-Université McGill-Montréal－1986－270 pages.

within the internationalisation of the program.[18] At that time, ESA was supporting a similar project based on the radar technology, while CNES was more in favour of a classical type of sensor. For various reasons, ESA refused to support the French project. Only Sweden showed an interest. The French government gave its OK in February 1978 and Sweden officially signed its participation agreement in October 1978, with Belgium in 1979. SPOT－1 was launched in February 1986 and started being operational in May 1986, while SPOT－2 was launched in October 1989 and became operational in January 1990. SPOT－3 and 4 are scheduled for the mid－1990s and SPOT－5 around 2000. SPOT－1－2－3 are identical in design, the only difference being that SPOT－2 and 3 are equipped with French-made sensors. Increased performance will only appear with improved on-board instruments SPOT－4 and 5.[19]

Following apparent funding difficulties that the US space program was encountering in the mid-eithties, there were rumors that US and French remote-sensing interests were exchanging views about possible cooperation. On January 24, 1989, CNES issued a press release confirming these discussions and designating SPOT Image as the commercial operator of the future system. The discussions were apparently aiming at "opening new per-

18) Annex 1, Article 4 of the European Space Agency Convention : "The principal objective of the internationalisation of national programmes shall be that each Member State shall make available for participation bu other Member States, within the framework of the Agency, any new civil space project which it intends to undertake, either alone or in collaboration with another Member State."

19) Air & Cosmos No 1223－Feb. 4, 1989.
Satellites de teledetection Spot et Landsat. The Spot serie is contemporary to Landsat－4 and 5 which have been respectively launched in July 1982 and March 1984, having both a 2－4 years lifespan. The successor, landsat 6 is planned for 1992.
Spot 1－2－3 were also originally designed with a 3 year lifespan, eventhough Spot－1 substantially outlived original plans.

spectives for the continuity of both the Landsat and SPOT programs after Landsat 6 and SPOT 4" which should be launched in the mid-nineties.[20] Such discussions have, however, not yet led to any publicized achievement.

B. SPOT Image

1. A private corporation with controlling public interest

SPOT Image is a corporation with limited responsibility and has been created in 1981 for a duration of 99 years. Among its founding shareholders, other than CNES, it had other government agencies, such as Institut G éographique National (10%), the equivalent of the US Geological Survery, and Bureau de Recherches Géologiques et Minières (10%), which are both

20) Press Information-Spot Newsletter-June 1989-p.13. "The French CNES and US NOAA have started exploratory discussions on the possibility of cooperation, on an equal partnership basis, in the development of a commercial civil and remote sensing satellite programme. Such a cooperation is one options CNES and NOAA have been considering. One of its objectives is to limit government expenditure necessary in the years ahead to ensure the continuation of the Spot and Landsat civil remote sensing programmes, through the establishment of a shingle space system. This cooperation aims at encouraging the commercialization of remote sensing activities, based on efficient utilisation of comparable and complementary technology acquired through the current Spot and Landsat programmes and on the operational experience gained over several years operation. CNES and NOAA have created a Joint Working Group to investigate the feasibility, expense and development schedule for a remote sensing satellite programme that could be in service by the second half of the 1990s. CNES-NOAA discussions concern the study of a high performance satellite system that would ensure the continuous delivery of remote sensing data, provide improved products and services to the user community and thus boost the commercialization of remote sensing products. This cooperative programme would adhere to the norm of non-discriminatory access to data. The result of the current discussions will, in the course of this year, be put before the French and US Governments for a decision on their commitments to this cooperation. In parallel with these discussions, CNES will consult its partners in France and in Europe, in order to define their possible involvement, through CNES, in this programme."

primarily interested in Earth observations. The remaining part of the capital (30%) was shared between private bodies such as Matra, an French aerospace conglomerate, French banks and a few foreign shareholders (Swedish and Belgian). Since that time, Matra has considerably increased its position. As at December 1990, the split between the various shareholders was the following : CNES (34.5%), Matra Espace (23%), IGN (11.3 %), SEP (11.3%) a company involved in the manufacturing of rocket boosters, Swedish, Belgian and Italian shareholders (11.5%), and French banks (8.5%).[21] One can say that through the shares of CNES, IGN, and partly the banks, SPOT is controlled about equally by public and private bodies. On the other end, SPOT Image S. A. has two affiliated companies, SPOT Image Corportion (SICORP), a US corporation based near Washington, and SPOT Imaging services, an Australian company based in Sidney which has been created in 1987 after the signing of an agreement with the Australian centre of Remote-Sensing (ACRES) to be a distributor of SPOT imagery in Australia.

The statutes of the corporation provide that no transfer of shares may be performed without being approved by the board of administrators.[22]

Due to the particular aspect of SPOT activities and to the strategic interest it may represent for the French government, SPOT's statutes also provide for the buy-back of the shares hold by a shareholder whose control would change and represent a menace for SPOT Image. This buy-back procedure or forced sale would be imposed by the Board of Administrators to such shareholder.[23] The legality of such a clause can hardly be discussed,

21) Spot Newsletter-December 1990-La Société Italienne Telespazio entre dans le capital de Spot Image (the Italian corporation Telespazio buys a share of Spot Image's capital)-December 1990-p.5.

22) Article 10 of the statutes of Spot Image.

23) Article 10B, alinea 1 of spot's statutes : "Afin de préserver l'indépendance de la société et l'intérêt de l'entreprise sociale, il est convenu

at least under French law, since the Civil Code in its article 1832 expressly allows for a disposition of this nature.

Finally, SPOT Image is subject to government financial control, since it is a corporation where public interests held separately or together more than 50% of the capital.[24]

It has been reported that the legal status of SPOT Image was inspired by the status of Arianespace, adopted in 1980, with the idea to build a "well suited structure··· offering large management flexibility, a rapid decistion-making process, efficiency and dynamism," conditions which would not have been possible to meet, had control totally been concentrated within a public body.[25]

2. An exclusive and broad mandate of activity

SPOT Image has a broda mandate which encompasses the dissemination of data, as well as educating and consulting in relation to remote-sensing. It is exclusively endowed with all powers to conduct the operations which are justified by its mandate.[26] Particularly, training courses are organized

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expressément que les actions détenues par une autre société peuvent faire lóbjet dúne cession forée déudée par le Conseil d'Administration lorsque le contrôle de la société actionnaire vient à changer de mains par quelques procédés juridiques et port quelques raisons que ce soient, dans la mesure où le changement de contrôle est susceptible de nuire à la poursuité de l' activité de la société." Cited in Le Gall, see supra.

24) Décret No 55−733, 26 may 1955, Article 3, alinéa 3 which organizes the financial control of French national entreprises.

25) J. Chappez-Arianespace : première société commerciale de transport spatial-Journal du droit international−1983 p. 695/727.

26) Article 3 of Spot Image statutes reads as follows : "La société a pour objet toutes opérations techniques, industrielles et commerciales liées à la promotion, la distribution et la vente des produits, issus des données fournies par le satellite Spot, par ses successeurs éventuels et par tout autre satellite de téledétection de la surface terrestre ainsi que tous les services d'études, de conseil, de formation et d'élaboration de produits spécifiques liés à ces données et à leur utilisation. A cet effet, la société pourra accomplir toutes les opérations industrielles, commerciales,

by "Groupement pour le Développement de la Télédétection Aérospatiale (GTDA)" in Toulouse, France which offers introduction classes in remote-sensing, applications on the SPOT system, advanced training in remote-sensing and customized courses for specific training needs.

SPOT Image is also credited with the intention to develop the value-added market, notwithstanding the presence of a substantial segment of private value-added companies.

In the consulting field, SPOT Image works in association with Scot Conseil. Also based in Toulouse, Scot Conseil has been set up in 1987 as a 100% CNES subsidiary. Its fields of activity are "to provide services including engineering consultancy, advice and technical support, in connection with systems devoted to satellite-based Earth observation,··· project coordination in the promotion of remote-sensing and··· making this technology better known among major international organization."[27]

Ⅳ. The Japanese MOS commercial remote-sensing program

A. Overview of Japanese remote-sensing

Japan has been an aerospace power for a long time, challenging the western countries with sophisticated aerial means since the beginning of the aerospace adventure. In the field of aerial observation Japan has been present since the beginning of the centrury. The first Japanese space endeavour goes back to 1955 with the launch of its first rocket. Its first satellite by the name of Osumi was launched in 1970, and in 1985 was launched its first rocket powered by a liquid oxygen/liquid hydrogen en-

financières, mobilières et immobilières se rattachant directement ou indirectement à son objet ou à tout autre objet similaire ou connexe". (Cited in Le Gall, see supra).

27) Scot Conseil-Spot Newsletter-June 1990-p. 21.

gine.[28] In November 1986 was established the Remote-Sensing Promotion Council (RSPC) "to advance research, development and utilization of remote-sensing". This was done under the responsibility of the Science and Technology Agency "which promotes and coordinates remote-sensing activities in Japan."[29] However, RSPC does not seem to have been formally active, another agency by the name of RESTEC having performed most of RSPC's functions.

Five domains of activity have been identified :

—future applications of remote-sensing ;

—development programs for satellites to succeed the European ERS—1 ;

—development programs for various sensors ;

—development programs for transmission and processing technology for data from earth observation satellites ;

—international cooperation.

In other words, Japan gave itself a full fledged development program in the field of remote-sensing, within a long-term development plan.

B. The MOS remote-sensing program

1. A Scientific program

On February 19, 1987, the first Japanese Marine Observation Satellite was lifted into orbit from NASDA's Tanegashima Sp[ace Center with orbit features similar to those of landsat and SPOT. Right from the first test, excellent quality images were retransmitted from the multi-spectrum electronic self-scanning radiometer (MESSR) carried on MOS—1. Reports

28) Space Development in Japan-Present Status : Earth Observation-Science & Technology in Japan-August/September 19988—p. 12.

29) Establishement of the Remote Sensing Promotion Council-Science & Technology in Japan-April/June 1987—p. 41.

mention that it was a Japancese original technology. General distribution of data by NASDA was scheduled to start in the autumn of 1987.[30] However, it was not until summer 1988 that MOS－1 became fully operational. Its mission was to observe land surfaces as well as the colours and temperatures of oceans in order to monitor marine pollution, fishing grounds and forests and farm products.[31]

MOS-1b, the successor of MOS－1, started to be developed in 1988 with expected launch in winter 1991. With identical capabilities, it is also aimed at establishing a common technology to Earth obserbation satellites.[32] It was expected that MOS－1b would work in conjunction with MOS－1 for some time, pending MOS－1 retirement. MOS－1b was said to be the first satellite to be placed in a sun-synchronous orbit. Its data were deemed to "be made availabel for a wide range of users both in Japan and aborad, as are the data furnished by MOS－1.[33]

At time of launch, an earth observation satellite was on the drawing boards. The mission of such satellite was to explore resources and to carry out land, agricultural, forestry and fishery surveys. It should be equipped with a synthetic aperture radar (SAR) like ESA's ERS－1 and Canada's Radarsat, optical sensors (OPSs), a mission data transmitter (MDT) and a mission data recorder (MDR) like SPOT.[34] The observation system of this satellite will have a great importance and is developed by the Ministry

30) Succesful launch of the First Marine Observation Satellite (MOS－1)-Science & Technology in Japan-April/June 1987－p. 43.
31) Space Development in Japan-Present Status : Earth Observation-Science & Technology in Japan-August/September 1988－p. 12.
32) Satellites under Development-NASDA : MOS－1b-Science & Technology in Japan-August/September 1988－p. 24.
33) NASDA Proceeds with Development of MOS－1b-Science & Technology in Japan-November 1988－p. 46.
34) Earth Resources Satellite－1 (ERS－1)-Science & Technology in Japan-August 1987－p. 40.

of International Trade and Industry (MITI). It is to be "a microwave active sensor which can operate regardless of weather conditions and at night time, while enabling high-resolution two dimensional imaging not only of Earth's surface but also to a shallow depth beneath the surface."[35] JERS－1 is scheduled to be launched in early 1992. This satellite has a two-year life time and is planned to orbit at 570 km. Its data will be dumped to ground stations located in the polar region, with NASA, ESA and CCRS in return for direct data reception by those three agencies. The SAR technique has been validated during the SEASAT experience which ceased soon after launch in 1978. The three SAR satellite planned by Japan, Europe and Canada are deemed to extend this experience.[36]

2. Japan has become major remote-sensing power

It should also be added that NASDA operates a satellite Tracking and Control System composed of two satellites. One is USFB(F)－1 which tracks satellites in low-earth orbit, and the other is USB(F)－2 which tracks satellites in geostationary orbit.[37]

Japan also has an Advancd Earth Observation Satellite (ADEOS) program, the purpose of which is "to maintain and develop remote-sensing technology, to develop technology necessary for platform-type satellites, also to develop technology for relaying data such as Earth observation data, and to ensure the progress of international cooperation in that field." It is an international cooperation project which includes the US and Europe. This program is scheduled for launch into polar orbit originally in

35) Sensors for Earth Resources satellite-Science & Technology in Japan-August/September 1988－p. 29.
36) US to Cooperate in Monitoring of Japan's ERS－1-Science & Technology in Japan-June 1988－p. 55.
37) Improvement of NASDA Satellite Tracking and Control System-Scinece & technology in Japan-August 1987－p. 41.

1993,[38] but most probably delayed until 1995.

Finally, Japan is a full member party to the Space Station agreement of December 1988, supplying an important part of the whole space structure.

Japan stands as a full size member of the group of active space powers. However, it feels it is still suffering from insufficient budgetary means as compared to main compertitiors. Also an issue which is not discussed here is the fuzzy distinction in the Japanese space development program, according to US views, between commercial applications and research and developement which may already add to US/Japan trade friction.[39]

V. The European ERS commercial remote-sensing program

A. Overview of ESA structure

1. An optional multi-government program

1. The European Space Agency (ESA) was established by a Convention signed by 11 European States in 1975.[40] Membership has grown since that time to thirteen members and roughly represents the present European Economic Community. Canda has signed a Cooperation Agreement with ESA and participates to certain programs.

ESA is fundamentally a research and development agency and coordinates the space programs of its member States into its own programs.[41] ESA fosters programs for wich participation of member States is either

38) Satellites under Development-NASDA : ADEOS-Science & Technology in Japan-August/September 1988—p. 25/26.

39) Space Development Systems and Japan's Space-related Budget-Science & Technology in Japana-February 1991, p. 8/11.

40) Convention for the establishment of a European Spaec Agency. Signed on 30 May 1975 and entered into force on 30 October 1980. Original participating member States were : Germany, Belgium, Spain, France, Italy, United Kingdom, Sweden, Switzerland, Norway, Denmark, Netherlands. Austria and Norway were accepted as members by the Council in December 1986. Cannada was later admitted with a special status.

41) Article II of the ESA Converntion : "The purpose of the Agency shall be to provide ofr tna to promote for exclusively peaceful purposes, cooperation among European States in space research and technology and their

mandatory (part of the ESA budget) or optional (for which States are free to contribute financially and up to the amount of their choice).[42] An example of an optial program may be found with the strong support given by Germany to the European participation into the Spacelab program, while France gave a strong support to the development of a European launcher. The development of a radar satellite such as ERS－1 was an optional program.

Optional programs are programs specific to the Agency itself and are implemented though a three steps procedure : [43]

－a Resolution of the Council by which the Board agrees that the planned program will be implemented ;

－a Declaration which is subscribed by those of ESA members which are willing to participate and vote the budget of the specific program ;

－and Implementing rules which are adopted by the same participants.

2. The ERS－1 optional program started with a Resolution taken at a ministerial level Agency Council meeting in February 1977 placing emphasis in a preparatory remote-sensing program. This was followed by a Council Resolution in October 1981 for the implementation of the ERS－1 program.[44]. The Declaration relative to this program was made in March

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space applications, with a view to their being used for scientific purposes and for operational space applications systems."

42) Article V－1 of the ESA Convention · ; "The activities of the Agency shall include mandatory activities, in which all Members States participate, and optional activities, in which all Member States participate apart from those that formally declare themselves not interested in participating therein."

43) Michel Bourély-Legal Problems Posed by the Commercialization of Data Collected by the European Remote Sensing Satellite ERS－1-Journal of Space Law－1988－p. 129/146.

44) This Resolution recalls that "it is important to have a continuing earth observation satellite programme (EOP) which opens opportunities for scientific, experimental and preoperational satellite programmes in such fields as oceanography, land observation, meteorology, climatology and physics of the soilid earth". Resolution concdrning a European Remote Sensing Satellite Programme. ESA/C/L/res. 5 (Final) 30/10/1981.

1982 and complemented by Implementing Rules in July 1983 and amended in October 1983. In stating their objectives, both texts specifically mention the will to place Europe in the management of Earth's resources by using a remote-sensing capacity.[45] The eleven original Agency members participated to the program, with shares varying from 24% (Germany) down to 1.70% (Denmark) while Canada, although not a member of the Agency (Canda has signed a cooperation agreement with ESA), agreed to participate in April 1982 with a 9.10% share of the preparatory program budget. Actually, Canda has a 6.1% share in the development program, amounting to about 900,000 US $. Various decision-making resolutions were subsequently adopted following the pahases of the program, all approved at a ministerial meeting in November 1987. While affirming their will to realize a fair balance between infrastructure programs and utilization programs, the government officials considered that the efforts of their respective countries through the Agency were "a source of new possibilities for the private sector which should be encouraged to use the available potential, to participate in investments and assume responsibilities for the operation of such systems."[46]

2. Environmental research and development

Launched from Kourou, French Guyana, on top of an Ariane rocket at the end of July 1991, after several delays for technical and meteorlogical reasons, the ERS－1 was originally meant to be the third generation of re-

45) Declaration on the European Sensing Satellite Programme. Drawn up 24/03/82, updated 16/06/82, amended 19/07/83. ESA/PB-RS/XVIII/Dec. 1 (Final). Annex A of the Declaration states the programme objectives : "The main objective of the European remote-sensing satellite programme covered by this Declaration is to endow Europe with a capacity to take part in both the management of the planet's resources and the monitoring of its environment. The programme should make it possible for the short-term and long-term cost-effectiveness of the remote-sensing technique to be established while at the same time contributing to a better knowledge of the terrestrial environment. The programme will aim to establish, develop and exploit coastal, ocean and ice applications of remote sensing data."

46) See bourély, supra.

mote-sensing satellites of the Western World, after Landsat and SPOT. It is a multi-disciplinary mission satellite with environmental objectives such as the monitoring of the greenhouse effect, coastal processes and surface pollution and disaster assessment. It also aims at contributing to operational forecasting and derived applications in the geophysics of oceans and of ice. It should also contribute to earth resources management and to the understanding of the solid Earth. Finally, ERS－1 should contribute to the development of remote-sensing operational systeems in cooperation with the various Directorates General of the E. E. C., with the various international development bank, with the various government bodies, and should contribute to ISY and "Mission to planet Earth".[47]

B. Commercial legal aspects of ESA's remote-sensing activity

1. Fundamentally, ESA's mission is one of scientific research and development. However, its Convention provides that the Agency assumes responsibility for the operation of a satellite and for the dissemination of data, in a manner which is quite similar to NASA's role during the first ten years of the Landsat program.[48] It seems nevertheless that ESA does not substitute itself to commercial private industry when it is not required. As an example, the dissemination of Landsat imagery in Europe, as part of the Earthnet program has been performed since 1987 by a group of Eu-

47) 1. G. Duchossois-The ERS－1 Mission Objectives-ESA Bulletin-February 1991－p.16/25.
2. ERS－1 A new tool for global environment monitoring in the 1990s. ESA BR－36－November 1989－38 pages.

48) Article V.2 of ESA's Convention : "In the area of space applications the Agency may, should the occasion arise, carry out operational activities under conditions to be defined by the Council by a majority of allMember States. When so doing the Agency shall :
a. place at the disposal··· such of its own facilities···
b. ensure··· the launching, placing in orbit and control of operational application satellites ;
c. carry out any other activity requested by users and approuved by the Council. the cost of such operational activities shall be borne by the users concerned."

ropean private interests : Eurimage.

2. During the operational phase (two years), ESA assumes all the exploitation of the satellite : data processing, recording, archiving, transmission and dissemination. ESA also develops the ground sector of the program, coordinates the use of the Satellite by all acquisition stations and makes necessary arrangements with the participating States for the use of their processing facilities. ESA is thus performing tasks that would normally be done by Member States.[49]

3. Participating States commit themselves to the financial support of the operational phase, as well as of the different phases of the program. They are also recognized the right to exercise a number of prerogatives which are valid for the whole program : industrial economic return, intellectual property as well as communication and utilization rights, property on facilities and equipement manufactured or purchased and put at the disposal of the Agency.[50]

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49) ESA Remote Sensing Programme Board-European Remote Sensing Satellite Programme-Implementing Rules-Ref : ESA/PBRS(81)23, rev. 5, attached to ESA/C(83)86.

50) Excerpts from ESA Convernton, Article Ⅶ.1 : "The industrial policy which the Agency is to elaborate and apply··· shall be designed in particular to : (a) meet the requirements of the European space programme and the coordinated national space programmes in a cost-effective manner ; (b) improve the world-wide competitiveness of European industry by maintaining and··· encouraging the rationalisation and development of an industrial structure··· making use in the first place of the existing industrial potential of all member States ; (c) ensure that all Member States participate in an equitable manner, having regard to their financial contribution··· ; ··· the Agency shall, for the execution of its programmes, grant preference to the fullest extent possible to industry in all Member States··· ; (d) exploit the advantages of free competitive bidding in all cases, except where this would be incompatible with other defined objectives of industrial policy···".

VI. The Canadian Radarsat commercial remote-sensing program.

A. The Canadian Space program and commercial remote-sensing

1. Earth remote-sensing as an area of dominant govenment concern

1. Canada became the third spacefaring power in 1962 with the launch of its first satellite, Alouette, a communications satellite which was successfully operated until 1972, several years after its projected lifespan had ended. Canada's first formal comprehensive space policy was adopted in 1974. Emphasis was already given to the transfer of space technology from the government to the private sector and from US content to Canadian content. This policy also underlined the need to follow national objectives and to develop partnerships with countries other than the USA where the emergence of space capabilities had been noted.[51]

2. In January 1980, a five-year plan was adopted which confirmed the initial features of the space policy of the early 1970s and indicated that "remote-sensing should replace communications as the dominant area of government concern, and that a stronger partnership with European space programs was necessary."[52] Those objectives have since been reaffirmed with another five year plan in 1985/86.

3. Until now, Canadian space endeavours have been "selective and specialized, oriented almost entirely to te o rrestrially tied missions and to practical, ultimately commercially profitable purposes."[53] Presently, the Canadian space program consists in three major fields of activity :

- —Communications, for which the MAST project is the largest part ($ 126M),
- —Earth-observation, whose flagship project is Radarsat ($ 441M),
- —Robotics, which has benefitted from the Candarm on the US shuttle in

51) John Kirton-Cannadian space policy-space-Policy-February 1990—p. 61 /71.

52) See Kirton, supra.

53) See Kirton, supra.

order to prepare the MSS on the Space Station ($ 1200M).

2. Role of the CCRS

1. This program has benefitted from Canada's experience in adquiring data from orbiting satellites since the beginning of both Landsat and SPOT. Canada contributed by building two ground stations, one in Saskatchewan and one in Quebec, and by developing a "quick look" facility for the rapid processing of Landsat data. "It was this nascent capability in high-speed image processing and the national need for regular surveillance of Canada's vast and forbidding territory that led the government to develop and ultimately finance Radarsat."[54]

2. Unlike the other remote-sensing programs, Radarsat has been conceived right from the beginning as a mixed project borrowing from both its prestigious predecessors, Landsat and SPOT. Remote sensing has been developed by CCRS (Canada Centre for Remote-Sensing) under the responsibility of the Ministry for Energy, Mines and Resources (EMR). Apart from supervising CCRS's activities, EMR also manages financial administration matters. It has adopted several orders during the 1980s prescribing the fees and charges to be paid for the provision of satellite products.[55] Such regulation aims at bringing the pricing of services which are currently offered by CCRS closer to international prices. However, the user group seems to be fairly small in Canada, and such increases in prices (between 20% and 90%) had been notified in advance to these users after consultation with the Canadian Advisory Committee on Remote-Sensing and government Representatives.

3. CCRS was created in 1972 and is located in Ottawa. Its mission was

54) See Kirton, supra.

55) For exemple : SOR/87－96, 18 February, 1987. Financial Administration Act. Satellite Remote Sensing Services Fees Order, 1987. Order prescribing the fees and charges to be paid for the provision of satellite remote sensing imagery, tapes and services. To be sited as the Satellite Remote Sensing Servies Fees Order, 1987. In : Canada Gazette Part Ⅱ, Vol. 121,. No 5. page 652.

to coordinate the government policy in remote-sensing through a national committee network linking departments and agencies. Among its first active missions, it started in 1972 to receive, process and distribute the first remote-sensing data gathered by Landsat, and then later on by SPOT. These data were received by two ground stations, one locatd in Gatineau, Quebec, and the other one in Prince Albert, Saskatchewan, both under the management of CCRS. Over the years, CCRS developed a strong program in technology and applications development and in technology transfer related to resource management. It became rapidly involved in the development program of a national remote-sensing satellite which led to the development of Radarsat.

4. The development of the project was turned over to the responsibility of the Canadian Space Agency after its creation. Commercialization is private under the responsibility of Radarsat International, a private Canadian firms conglomerate. It was also conceived to be established on cooperation basis with the US (launching) and the UK (satellite bus), but the UK participation vanished in 1988. Cooperation is also established in terms of support to and from the regions of Canada : while several provinces would receive a share of the manufacturing part, those same provinces would contribute financially to the program.[56]

5. An internationally balanced cooperation has been embodied by a partnership with the two major space agencies of the Western world, NASA and ESA, with which a new ten year agreement has been signed in 1989. Cooperation is also developed with Japan (remote-sensing data acquistition) and with the USSR (development of the Cospas/Sarsat search and rescue satellite system).

6. From a purely technical point of view, Radarsat has more in common with the European ERS－1 and the Japanese MOS－1 than with Landsat

56) Jocelyn Mallett-Canada's space programme-Space Policy-February 1990 －p. 53/59－Work allocation :
Atlantic 10%, Quebec : 35%, Ontario : 35%, Prairies : 10%, BC : 10%
Global funding participation of $53M for Quebec, Ont., Sack., BC.

and SPOT. Scheduled to be launcheds in 1994 with a lifespan of five years, the project started in 1981 as the first Canadian remote-sensing satellite. It will be placed by the United States on a near-polar sunsynchronous orbit in 1994, at an 800km altitude. It wil circle the globe from pole to pole, scanning the entire surface in swaths ranging in width from 500 km (50m resolution) down to 50km (10m resolution). It will cover most of Canada every 72 hours and the Arctic every 24 hours. It will circle the poles every 100 minutes. It is supposed to provide more detailed information than both Landsat and SPOT. It will use a microwave instrument extrapolated from the radar technology : a SAR or synthetic aperture radar, which is defined as an active sensor which can penetrate clouds and darkness. It is also aimed at producing the first stereoscopic geological map of the Earth. A memory system of its own will enable Radarsat ot supply any type of date concerning any type of ocean within two hours following the sweeping by the satellite.

7. A technical feature to be noticed is that it will be "uniquely steerable an have a zoom lens to permit a detailed sensing of the Earth in various dimensions··· its missions will vary from national surveillance, and ice, shipping and wave reconnaissnace, to forestry and crop monitoring, and geological exploration··· enthusiasts within Otawa are also considering its potential for programs in arms control and environment verification."[57] It is expected that manufacturers of Radarsat will closely monitor the ERS－1 experience after launch so that Radarsat may directly benefit from the Canadian participation in the European satellite venture.[58]

57) See Kirton, supra.

58) Article 2.2 of the EMR/CSA/RSI 1990 MOU : RSI agrees to meet the following obligations : ··· e) in consultation with the CCRS··· to complete a final study after the launch of the ERS－1 satellite in order to take into account the latest SAR user awareness··· f) when firm commitments areestablished by, and acceptable assurances are received from, federal departments and agencies that a high proportion of the processing capacity will be contracted for, to purchase an upgrade to the CCRS ERS－1 facility which upgrade must be tested and commissionned against the mutually agreed final specifications before Radarsat satellite launch, and to operate and maintain the facility and the upgradefw···

B. Commercial aspects of the Radarsat program

1. This aspect of the program is still under development since the satellite is still far from being operationa, not before 1994－95. However, the cornerstone of its commercial dimension rests with two MOUs which have been signed, one between CSA and its American partners (NASA and NOAA) and which sets the whole framework for the Radarsat program, and the second between CSA, EMR and Radarsat International. They will be commented upon from a legal point of view in the second part of this research. These important arrangements have set various objectives, among which :

★ conducting a scientific monitoring of the environment, and

★ managing a financially profitable commercial dissemination of data.[59]

2. In order to reach the financial objectives, it was decided that commercialization would be private under the responsibility of Radarsat International, a private Canadian firms conglomerate (SPAR Aerospace-Montreal, MDA-Vancouver and COMDEV-Cambridge, Ont.). RSI agreed to develop a market of non-government users for Radarsat products, internationally and nationally, to find a US private sector financial partner, to collect all revenues generated by the use of Radarsat SAR data products and services, and to pay royalties to CSA.[60]

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59) Article 1 of the 1990 MOU between EMR, CSA and RSI : "The major objectives of Radarsat SAR data distribution and marketing are as follows : a) to rpomote globally the utilization of Radarsat SAR data and data products··· in such areas as global ice reconnaissance, ets··· b) to contribute to the overall development of a national and international commercially viable remote sensing industry, c) to contribute to the maintenance and improvement of the Canadian industry world leadership and the high quality profile in the field of remote sensing, and d) to generate a revenue stream to the CSA to offset the mission operationg costs.

60) Article 2 of the 1991 IMOU.

CONCLUSION

This brief recap of the regulatory evolution of commercial remote-sensing reveals that it is bound to become a major field of human activity within the next decade.

The USA and the former USSR have opened the way, followed by France, Japan, the European community and Canada as we have seen in this article. Other nations have since developed their own remote-sensing programs, such as India and a few others. It is quite clear that their is a national interest in having a national independent remote-sensing program. However, we have not dealt with an important aspect of remote-sening, since its effectiveness relies on a complementary network of about a dozen ground-stations scattered all over the planet. Besides this complementary network, a remote-sensing nation needs a team of technical experts to analyze and enhance the raw data which are supplied by the satellite.

Such technical considerations give the remote-sensing a high-price ticket outlook which may not place it whithin reach of any nation. The 1986 United Nations Declaration on remote-sensing may then be enhanced as a mean to organize the fair dissemination of earth observation raw data within the international community. This would however require the creation of an international orgaization, such as ICAO for civil aviation, which would regulate space activities, one of which being the use of raw earth-observation data.