TRANSCRIPT OF

# SPACE STATION PROGRAM INTERNATIONAL SIGNING CEREMONY

HELD AT THE

# U.S. DEPARTMENT OF STATE WASHINGTON, D.C.

SEPTEMBER 29, 1988

**Remarks of**
**DR. FREDERICK M. BERNTHAL**
**Assistant Secretary of State for Ocean, International Environment, and Scientific Affairs**
**Government of the United States**

Ladies and gentlemen, distinguished visitors, on behalf of Secretary Shultz, I would like to welcome you to the Department of State on the occasion of the signing of this important set of agreements on cooperation among the United States, Europe, Japan, and Canada in the detailed design, development, operation, and utilization of the permanently manned civil Space Station. It is fitting that on the day that NASA successfully launched the Space Shuttle Discovery, we too here will launch the Space Station partnership.

There are four agreements that will be signed today: First; the Intergovernmental Agreement which will be signed by the representatives of the United States, by nine members of the European Space Agency -- Belgium, Denmark, France, the Federal Republic of Germany, Italy, the Netherlands, Norway, Spain, and the United Kingdom -- and by Japan and Canada. Second; an Arrangement on Interim Cooperation to be signed by the United States, the European governments, and Canada. Third; an implementing Memorandum of Understanding between NASA and the European Space Agency. And finally, an Implementing Memorandum of Understanding between NASA and the Ministry of State for Science and Technology of Canada.

I now invite the government representatives to sign the Intergovernmental Agreement. (Signing is conducted).

Next, the government representatives will sign the Arrangement on Interim Cooperation. Each signer has in front of him a binder containing a signature page which he should sign below the signature block. (Signing is conducted).

I would now like to invite representatives of the four Space Station partners, the United States, Canada, Europe, and Japan to say a few words. (Speeches are given by George Shultz, Robert de Cotret, Heinz Reisenhuber, and Nobuo Matsunaga and are attached).

I would like now to invite the NASA and European Space Agency representatives to sign their Implementing Memorandum of Understanding. (Signing is conducted).

I would now like to invite the representatives of NASA and the Ministry of State for Science and Technology of Canada to sign their Implementing Memorandum of Understanding. (Signing is conducted).

## Remarks of
## DALE D. MYERS
## Deputy Administrator of the National Aeronautics and Space Administration - Government of the United States

Mr. Secretary, distinguished Ministers, honored guests, ladies, and gentlemen. Boy it's a great pleasure to be here today. We've had a historic set of events; first the Discovery launch this morning and then being able to attend this wonderful and distinguished activity here this afternoon. It's a historic beginning for the future of the free world and I, for one, feel very honored to be a part of it.

You know, we've worked with the Europeans, with the Japanese, and with the Canadians before in several elements of the space program. We've really never had, though, the opportunity here to make a contribution to the world that we're able to make with the Space Station and it is a tremendous thrill to be involved in the beginning of a historic, international, important program of this nature. More than 2,000 years ago, the Greek Playwright, Euripides, wrote, "joint undertakings stand a better chance when they benefit both sides."

We've forged a genuine partnership that's strong, I believed will be enduring, based on mutual respect, mutual dedication, and mutual understanding of a great challenge and a challenge that we all understand the benefits of. The scientific, commercial, and technical benefits of the Space Station will enhance the lives of millions in the world and will bridge new understandings that will benefit future generations based on the activities we're starting now.

A new chapter in the history of the space age is begun and I'm excited and very pleased to have been a part of the beginning of that. I know a lot of people have put a lot of work in putting together a working relationship that to me appears to be a model of what can be done in major international, technical projects of this nature.

Now, on behalf of the NASA family, I'd like to present to each of the signing countries and agencies a picture -- we won't make you take it home with you, we'll get it to you -- but a picture of the Space Station as it has developed out of these many years of study with the international partners. We'll be making these available to all of you.

Thanks very much.

<u>SPACE STATION COOPERATION</u>

The permanently manned civil space station is an international space facility being built by the United States, Europe, Japan and Canada. The United States is providing $16 billion worth of hardware to the program; the other partners are contributing in excess of $7 billion worth.

The space station, which has been named Freedom by the President of the United States, is a truly international venture--a genuine partnership. It will be designed, developed, operated and used by all of the partners. A multilateral management organization will oversee its operation; it's crew will be provided by all of the partners. A major element in the space programs of each of the four partners, the permanently manned civil space station will be used for peaceful purposes, in accordance with international law. It will provide the space infrastructure necessary to enable scientific, technological and commercial research and activities in space. The space station will provide a focal point for space operations among the partners well into the next century, and it will serve as a stepping-stone for human exploration of the solar system.

In January 1984, President Ronald Reagan directed NASA to develop a permanently manned space station. At the same time, he invited friends and allies of the United States to join this ambitious endeavor so as to share in its benefits. In spring 1985, NASA signed Memoranda of Understanding (MOU's) with the European Space Agency (ESA), the Japanese Science and Technology Agency (STA), and the Canadian Ministry of State for Science and Technology (MOSST) on cooperation in the detailed definition and preliminary design (Phase B) of the program. Negotiations on the agreements covering cooperation in the detailed design, development, operation and utilization (Phase C/D/E) of the program began in late 1985 and were completed in June 1988. The documents being signed today are:

- A multilateral intergovernmental agreement (IGA) among the United States, Japan, Canada and the nine member states of ESA participating in the program (Belgium, Denmark, France, Italy, the Federal Republic of Germany, the Netherlands, Norway, Spain, and the United Kingdom). The IGA is an umbrella agreement which sets out the broad principles of the rights and obligations of the partners, including the legal regime within which the program will operate.

- Two bilateral MOU's between NASA and ESA and NASA and MOSST. (NASA and the Government of Japan will sign their MOU next spring). The MOU's focus on programmatic and technical aspects of the cooperation and establish the management mechanisms necessary to implement the program.

The international space station complex is unique. It will be comprised of a combination of permanently manned, man-tended and unmanned elements that are being designed to grow and evolve as requirements change; the current configuration represents a starting point selected to best satisfy the broad range of scientific, engineering and commercial users.

The Space Station Freedom will provide a permanent presence in space, thus permitting men and women to work around the clock with the equipment and experiments on-board--to react, to analyze, to fix, to innovate. The space station will be in a sense a new laboratory in space. There will be many applications for automation and robotics on-board the space station, but--just as with every laboratory on Earth--human brains and hands are needed to deal with complex tasks and unanticipated events.

The space station's manned base will be an international facility in a low-inclination orbit. The basic structure of the manned base, including the power system and the habitation module which will provide living quarters for the crew, will be provided by the United States. Canada will provide a mobile servicing center which will be used in station assembly, maintenance and servicing. The manned base will have three pressurized laboratories (provided by the United States, Europe and Japan) permitting astronauts to work in a shirt-sleeves environment conducting research in such important areas as materials processing and life sciences. The truss structure of the manned base will also provide points for the attachment of Earth, solar and celestial observation instruments which can be tended by the crew. A man-tended free flyer provided by Europe will operate mainly in an unmanned mode, but will visit the manned base periodically. The polar platforms in the program (provided by the United States and Europe) will be unmanned. Their polar orbit will make them ideal for a wide variety of Earth atmospheric, oceanic and land observations.

Freedom will offer a unique opportunity for scientific research in an extended-duration microgravity environment. The space station will enable researchers to initiate comprehensive studies on a wide range of materials and processes that could never have been realized in ground-based facilities. Only when scientists can live and work in space for extended periods of time with sufficient power and other resources, will they be able to test new ideas and develop new processing techniques that will take full advantage of the microgravity environment. For example, materials research on Freedom could have enormous implications for understanding the biological function of important proteins at the molecular level. In addition to fundamental knowledge, such information will provide the basis for rational drug design, the development of new vaccines, and protein engineering. Likewise, scientists will be able to fabricate large, defect-free crystals, such as gallium arsenide, that may lead to the development of advanced computers.

Looking to the future, before a human colony on the Moon can be established or before people can undertake a mission to Mars, the space station will be needed to study the effects of prolonged weightlessness on humans, to develop and test the necessary advanced technologies, to create a reliable, space-based self-contained life support system for long space voyages, and to develop and prove the techniques necessary to assemble large structures and future lunar and planetary spacecraft. By enabling the necessary early research, the space station will make such future voyages possible. And because it is being designed to evolve and grow, this station can become the facility which will serve as the point of assembly, test and departure for future missions to the Moon or to Mars.

The construction of the space station on-orbit will begin in the first quarter of 1995. Twenty Space Shuttle flights and two Ariane flights over a period of three years will be required to launch all of the flight hardware. Construction will be completed in the first quarter of 1998, although the facility will be permanently inhabited from late 1996 on.

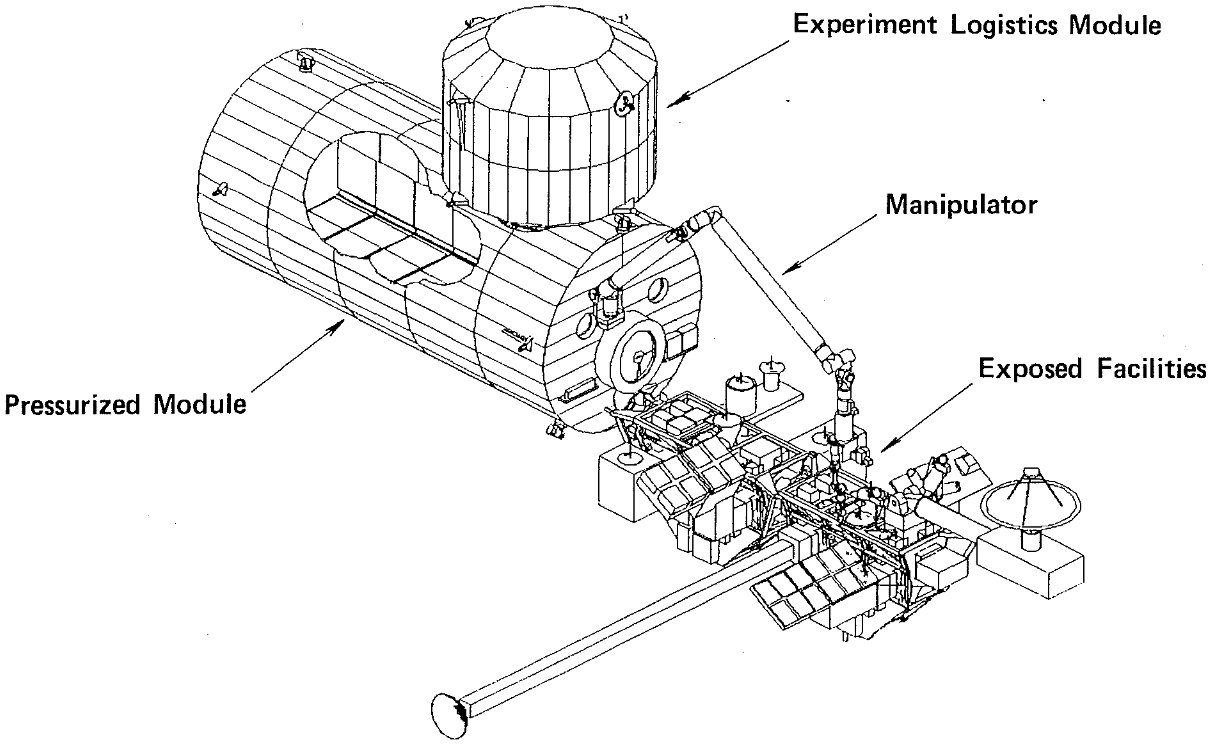
# JAPAN PARTICIPATES IN THE PROGRAM WITH JAPANESE EXPERIMENT MODULE (JEM)

The Japanese Experiment Module consists of a Pressurized Module, an Experiment Logistics Module, and an Exposed Facility.

The Pressurized Module is a multipurpose laboratory in which experiments concerning such disciplines as material processing, life science are going to be performed.
The Exposed Facility is a working station for scientific observation, communication experiments, science and engineering experiments, material experiments, and so on.
These experiments will be performed mainly using remote manipulator.
The Experiment Logistics Module is a container which will be used to resupply JEM with experimental specimens, various kinds of gases and consumables. These materials will be stored in this Module and will be transported between the JEM and the Earth.

Utilizing the functions of JEM, we are able to accommodate users' needs for various kinds of experiments in a variety of disciplines.

## JEM Baseline Configuration




## JEM Primary Characteristics

| | Pressurized Module | Experiment Logistics Module | | Exposed Facility |
|---|---|---|---|---|
| | | Pressurized section | Exposed section | |
| Shape | Cylinder | Cylinder | Box | Box 2 unit |
| Size | 4m Dia. | 4m Dia. | 4m × 4m | 2.5(H) × 1.4(W) m |
| Length | 10m | 4m | 2m | 4m |
| Number of mission payloads | Payload Rack 10 | Rack 8 | | Payload 10 |
| Average power | Housekeeping 6kW Mission 9kW | | | |
| Data transfer rate | 32 Mbps. (Max.) | | | |

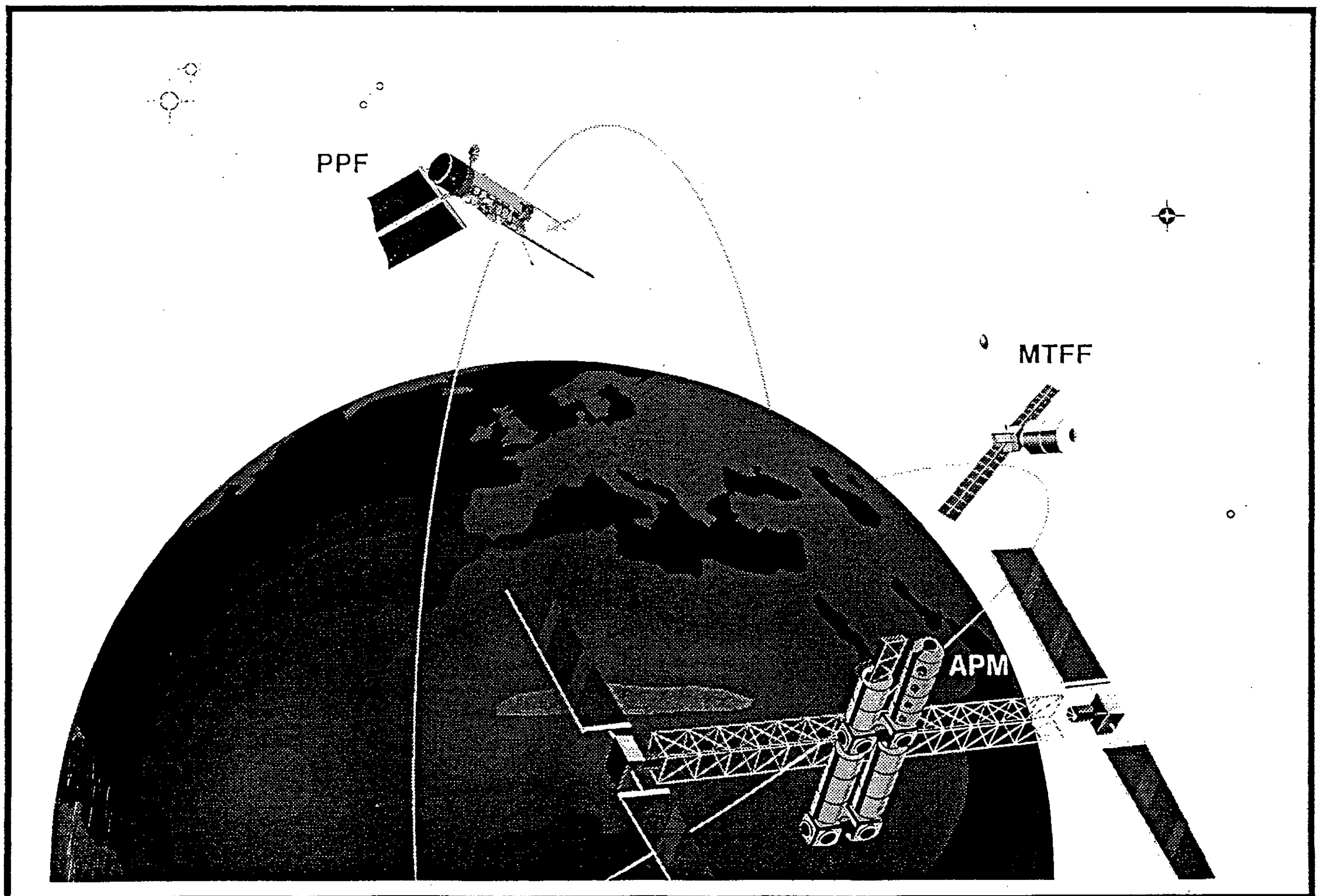
Note : Values in this table are approximate.

# THE COLUMBUS PROGRAMME

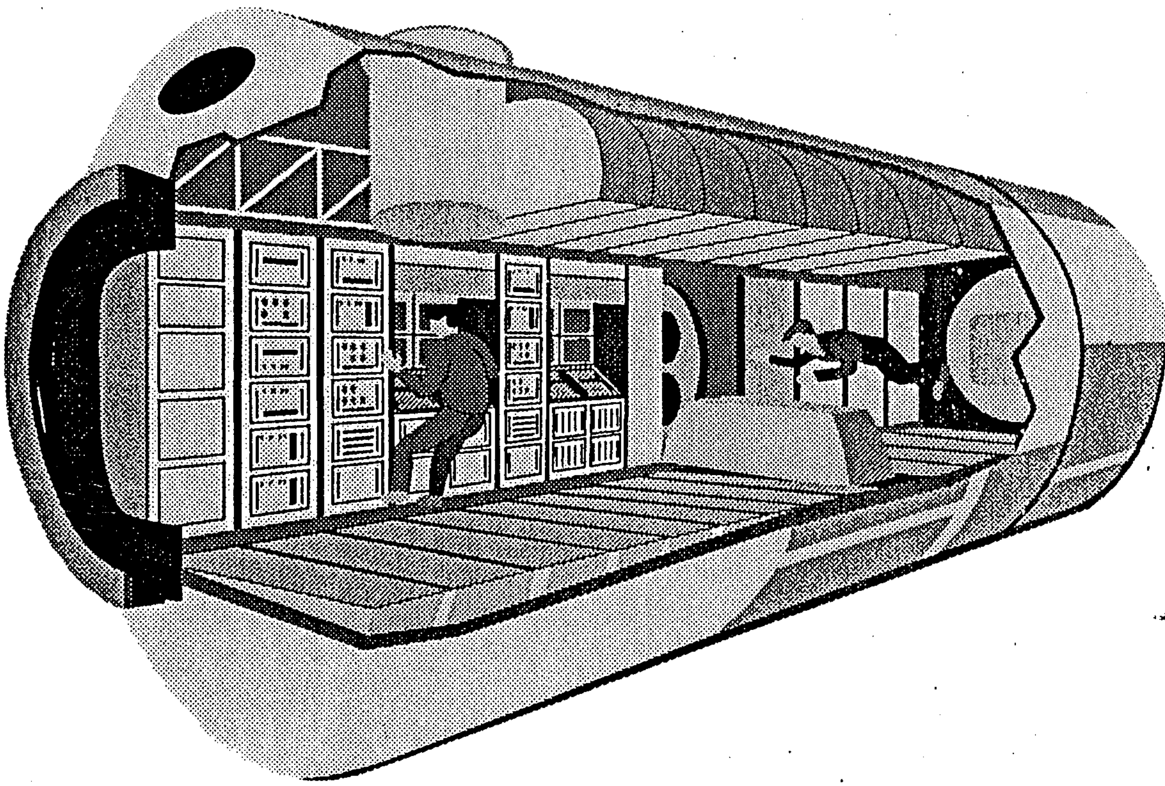
APM : Attached Pressurised Module, European contribution to the International Space Station.

MTFF : Man-Tended Free-Flyer.

PPF : Polar Platform.



# ATTACHED PRESSURIZED MODULE (APM)



| CHARACTERISTICS | | (4 SEGMENTS) |
| --- | --- | --- |
| DIMENSIONS | : | 12.8 m LENGTH<br>4.0 m DIAMETER |
| LAUNCH MASS | : | 14 400 Kg min. |
| PAYLOAD MASS | : | 3 – 10 000 Kg |
| PAYLOAD VOL. | : | 23 $m^3$<br>(40 SINGLE RACKS) |
| **PERFORMANCE** | | |
| GRAVITY LEVEL | : | UP TO $10^{-5}$g |
| POWER | : | 20 Kw TOTAL<br>10 Kw Avg. TO P/L |
| DATA RATE | : | 100 Mbps DOWNLINK<br>25 Mbps UPLINK |
| **LAUNCH** | | |
| VEHICLE | : | SPACE SHUTTLE<br>450 Km, 28.5 ° |
| DATE | : | 1996 |
| SERVICING | : | AT THE STATION |

# COLUMBUS

*The* ***European Space Agency's*** *contribution to the INTERNATIONAL SPACE STATION*

### *What is the ISS?*

The Space Station programme is a complex made of manned base and separate elements. This is the result of an unprecedented international cooperation agreement involving the United States, the majority of Member States of the European Space Agency, Japan and Canada.

It will comprise a manned base and separate elements. Two unmanned platforms in polar-orbit *(for Earth Observation and scientific missions)* are provided by NASA , one by ESA, plus a Man-Tended Free-Flyer Laboratory developed by ESA able to dock with the manned base.

When, in the late 1990s, assembly of the Space Station manned base in space has been completed, a mass of about 220 tonnes will be in orbit. This mass includes three large laboratories and accommodation facilities for a crew of eight astronauts.

The main facilities will include :

- *a laboratory for Materials Sciences and Life Sciences*
- *an in-orbit support for developing and testing new technologies*
- *an observatory base for Astronomy and Earth observation*
- *a transportation and communication node for manned and unmanned planetary missions.*

### *What is Columbus ?*

Columbus is the name of ESA's programme to develop the three elements representing Europe's contribution to the Space Station programme.

- *the Columbus Attached Laboratory (APM) once assembled in orbit to the manned base, will become an integral part of it. The APM will accommodate the European experiments to be performed on the manned base.*

- *the Columbus Free-Flyer Laboratory (MTFF) will fly close to the manned base and will operate autonomously. It will, however, dock with the manned base (or with the European space plane HERMES) at regular intervals for inspection and servicing by astronauts.*

- *the Columbus Polar Platform (PPF) which, from a higher and near polar-inclination orbit, will perform Earth observation and space science missions in coordination with another platform launched by NASA.*

The Columbus philosophy aims at providing Europe, through international cooperation, with expertise in manned, man-assisted and fully automatic space operations, as a basis for future autonomous missions. In this respect, the development of the Columbus space elements and associated ground infrastructure is closely linked to that of other ESA programmes such as Ariane 5, HERMES and the European Data Relay Satellite.

The concept of Columbus was initially studied in the early 1980s as a follow-up to the successful development of Spacelab. The design definition and technology preparation phase was completed at the end of 1987. The development phase is planned over a duration of ten years *(1988-1998)* and will be completed by the initial launch of the three elements.

The Columbus development programme was endorsed during the ESA Council meeting at Ministerial level at The Hague - November 1987 as an important part of the European long-term space programme.

## COLUMBUS ATTACHED LABORATORY (APM)

The Columbus Attached Laboratory (APM) is a pressurised cylindrical laboratory module, which will be permanently attached to the International Space Station manned base. It has a diameter of about 4m, a length equivalent to 4 standard Spacelab segments and will be used primarily for Materials Sciences, Fluid Physics and compatible Life Sciences missions.

The internal architecture of the module, which provides a 'shirt- sleeve' environment for the crew, is arranged in a configuration which reflects the working environment in 1g condition, i.e. with lateral racks, a floor/subfloor area and an overhead area. The subsystems required to sustain the module functions and to provide the necessary payload services and crew life support are accommodated under the floor in standard side-mounted single or double equipment racks. All subfloor subsystem equipment and the standard racks can be exchanged in-orbit. Additional features provided by the module are two viewports for external viewing and a scientific airlock for small experiments which require exposure to the vacuum of space.

The module will be launched from the NASA Kennedy Space Center (KSC) on a dedicated Shuttle flight, removed from the Shuttle Orbiter payload bay and berthed at its manned base.

## COLUMBUS FREE-FLYER LABORATORY (MTFF)

The Columbus Free-Flyer Laboratory (MTFF) will be operated in a microgravity optimised orbit with 28.5 ° inclination, centred on the altitude of the International Space Station manned base. It will accommodate automatic and remotely controlled payloads primarily from the Materials Sciences and Technology disciplines together with its initial payload, and will be launched by Ariane 5 from the Centre Spatial Guyanais (CSG) in French Guiana.

It consists of a 2-segment Pressurised Module for the accommodation of payloads and an unpressurised Resource Module which provides the main utilities and services required by the MTFF and its payloads.

It will be routinely serviced in-orbit by Hermes at approximately 6-month intervals. Initially this servicing will be performed at the Space Station manned base, which the MTFF will also visit every 3-4 years for major external maintenance events.

## COLUMBUS POLAR PLATFORM

The unmanned Polar Platform will be stationed in a highly inclined sun-synchronous polar orbit with a morning descending node and will be used primarily for Earth observation missions. The platform is planned to operate in conjunction with one or more additional platforms provided by NASA and/or other international partners and will accommodate European and internationally provided automated payloads.

The third element - the Columbus platform - is an unmanned and non serviceable platform designed to operate over a minimum of 4-years lifetime in a highly inclined sun-synchronous polar orbit with a morning mode. It will be used primarily for Earth observation missions to serve the needs of the Europeans, other Partners and the rest of the world ; utilisation arrangements are planned, whereby both platforms will be used in a coordinated manner to achieve the maximum scan of Earth resources.. The platform is planned to operate in conjunction with one or more additional platforms provided by the international partners and will accommodate between 1700 and 2300 kg , European and internationally provided payloads.

# SPACE STATION

## *The Mobile Servicing System*

### MSS FACTS

| | |
|---|---|
| **Weight:** | • 4 800 kg |
| **Dimensions:** | • Main platform, 5m x 5m<br>• Remote Manipulator System (arm), 17.6m long<br>• Special Purpose Dextrous Manipulator (SPDM) with two arms, each two metres long |
| **Payload capacity of arm:** | • 100 000 kg |
| **Roles:** | • Assemble Space Station<br>• Berth and deploy vehicles including the orbiter<br>• Load and unload Shuttle<br>• Exchange logistics modules<br>• Service payloads anywhere aboard Space Station<br>• Perform station maintenance operations<br>• Move payloads and cargo around the Station<br>• Support Extra-Vehicular Activity (EVA) around Space Station |
| **Technologies:** | • Automation and robotics, including artificial intelligence<br>• Large-scale telerobotic systems design, management and operations<br>• Advanced control systems<br>• Remotely-controlled dextrous manipulators and tools<br>• Voice-activated control<br>• Computer space vision systems<br>• Design and integration of force and tactile sensing systems<br>• Expert systems |

Government of Canada    Gouvernement du Canada

Canada

# SPACE STATION...

while working. They will also feed the arm's robotic vision system the data it will use to recognize, automatically track and handle objects such as the Shuttle orbiter or a satellite.

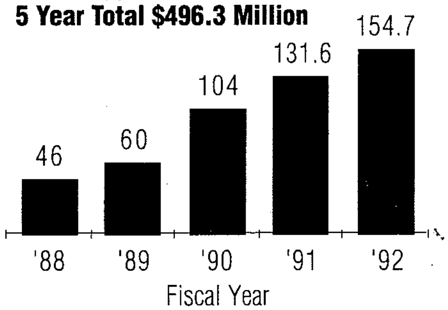
A separate smaller robot, called the Special Purpose Dextrous Manipulator (SPDM), will have two arms (each two metres long) for more delicate jobs such as cleaning surfaces, replacing faulty components and working on the Station's electrical circuits, fuel lines and cooling systems. The SPDM can work either as a companion to the big arm (connected to its end) or alone (attached to the Station's truss structure). Its arms can work together or separately.

The combination of the two robots gives the MSS the skill to do many kinds of work aboard Space Station, from handling massive satellites to small repair jobs... from the heavy work of a stevedore to the delicate touch of a surgeon.

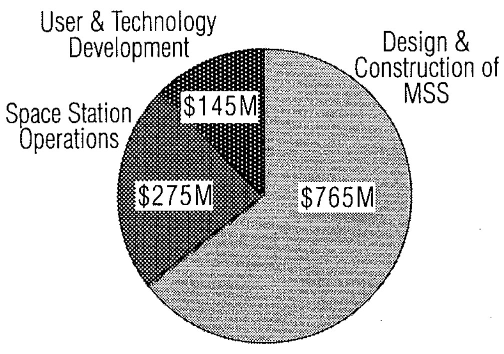
## AN INVESTMENT IN KNOWLEDGE

**Canada's investment to participate in the Space Station project will be just under $1.2 billion, spread over a period of 17 years. Most of it will be spent in Canadian industry and universities.**

**PROGRAM COSTS**
**5 Year Total $496.3 Million**




This cost covers several aspects of the Space Station project, including the design and construction of the Mobile Servicing System; the development of the strategic technologies necessary for the project; the operations costs associated with MSS; Canada's share of the common systems operating costs of the entire Space Station; and a User Development Program to build up the national capability for space-based research needed to exploit future Space Station opportunities.




**PROGRAM COSTS: 15 Year Total $1.185 B**

Canada's investment will be repaid in several ways throughout the lifetime of the program. First, designing and building the MSS will enable industry to develop numerous advanced technologies (automation, robotics, artificial intelligence, for example) recognized as strategically important for Canada's future. The same advanced capability will also be adapted and applied to traditional industrial activities at home , making them more competitive and providing an opportunity for commercial spin-off. Finally, when Space Station is up and running, Canadian research teams from industry, universities and governments will have access to space laboratories offering experimental conditions impossible to duplicate on earth.

**Estimated revenues generated from our investment in the MSS and the use of Space Station are more than $5 billion along with 80,000 person-years of employment.**

# SPACE STATION...

**Hardware:**

IN SPACE

- Space Station Remote Manipulator System (SSRMS)
- MSS Maintenance Depot (MMD)
- Special Purpose Dextrous Manipulator (SPDM)
- MSS work and control stations
- Power Management and Distribution System (PMDS)
- Data Management System (DMS)

ON THE GROUND

- Manipulator Development and Simulation Facility (MDSF)
- Mission operations facility and equipment

**Project Management:**

- National Research Council, with policy guidance from the Ministry of State for Science and Technology

**Prime Contractor:**

- Spar Aerospace Limited

**Team Contractors:**

- IMP Group Limited, Halifax
- CAE Electronics Ltd., Montreal
- Spar Aerospace Limited, Montreal and Toronto
- Canadian Astronautics Limited, Ottawa
- SED Systems Inc., Saskatoon
- MacDonald, Dettwiler & Associates Ltd., Richmond, British Columbia