Honorable Maxime Bernier, Minister of Industry and Minister responsible for the Canadian Space Agency, has announced an investment of $10.3 million in 36 research and development contracts awarded to Canadian industry for designing new space technologies and applications.

“Investments announced are crucial for supporting Canada’s leadership position in niche markets such as robotics, remote sensing, satellite communication components, and radar, and for making groundbreaking technologies market-ready. These are technologies that respond to Canadian needs and those of our international partners,” says Bernier.
Companies Awarded Contracts

ABB Bomem
Compact Imaging Spectrometer - Phase 2

ABB Bomem Inc. will validate the functionality and the performance of an extremely compact and lightweight interferometer module when it is coupled to a thermal infrared camera. Project will address the technology’s ability to acquire spectral data cubes and to maintain good wave front quality in realistic application environments. It will demonstrate suitability of the compact interferometer for use in a hyperspectral thermal imaging spectrometer.

MEMS-based Spectrometer for Water Content and Chirality Measurement

ABB will determine the feasibility of an instrument that simultaneously measures water content and the presence of chiral molecules in soil on Mars and other planets. This instrument will help in the preliminary analysis of possible biological compounds on site without contact and without any chemical reactant. Improvement of the in-situ pre-selection of significant exobiological samples will extend the operational lifetime of more sophisticated systems. This very rugged instrument will require low resources (mass, power, volume) and can be integrated with various mission concepts.

Advantech Satellite Networks
Adaptive Coding and Modulation Satellite Networks With Optimized Quality of Service

Advantech Satellite Networks will enable and enhance the commercial application of the powerful adaptive coding and modulation techniques previously developed for enterprise solutions. These were based on the DVB-RCS (digital video broadcast—return channel satellite) two-way satellite standard. Project will enable certain improvements in the cost effectiveness of such systems. This endeavor is for developing resource management techniques that ensure quality of service and service level agreements in DVB-RCS networks employing adaptive transmission techniques.

A.U.G. Signals
Novel Approach to Fusion of Hyperspectral Features and Algorithms for Improved Detection and Classification

A.U.G. Signals will develop an advanced data-processing technology for enhancing the data quality of space-borne sensors. Hyperspectral imagery will be the focus of the inquiry, but the framework and methodology of the research will be applicable to other sensor types. Improved detection and classification is useful for a variety of applications including environmental monitoring, natural resource management, agriculture, and military/defence.

Blakemere Technologies
Agile IP Layer Traffic Control for DVB-RCS and DVB-S2

Blakemere Technologies Inc. will develop a bandwidth management device suitable for performing Layer 3 traffic control within DVB-RCS and DVB-S2 based networks (digital video broadcast—return channel satellite and second generation digital video broadcast). Device will address aspects of classifying traffic, partitioning bandwidth, and enforcing service level agreements, while providing a configuration interface agile enough to accommodate the use of advanced coding and modulation under DVB-S2. Device will significantly reduce costs and improve capabilities for vendors and integrators of any Internet-over-satellite system, including systems based on DVB-RCS using either DVB-S or DVB-S2. In particular, the device will enable the exploitation of bandwidth efficiencies offered by DVB-S2.

Blue Sky Spectroscopy
Data Processing Algorithms for Space-based Imaging Fourier Transform Spectrometers

Blue Sky Spectroscopy Inc. will develop and evaluate a novel mid-infrared hyper-spectral imaging spectrometer for remote sensing applications. This technology will provide a spectral window for Earth Observation projects related to forestry, oceanography, meteorology, geology, mineral exploration, resource management, and environmental monitoring.

Investment in long-term space technology research and development is key to the success of the Canadian space industry in the next decade. This support maintains a level playing field, since other countries invest heavily in their own areas of industry expertise and technologies are evolving quickly.
Compact Redundancy Switches for Flexible Payloads

COM DEV will develop a novel topology using highly miniaturized actuators combined with an optimized microwave circuit for a redundancy switch network. Resulting networks will be simpler and more compact than existing products that employ discrete components, potentially yielding a 60 percent mass reduction and commensurate volume reduction.

Advanced Test Capabilities for Multi Beam and GNSS Payloads and Subsystems

COM DEV plans to develop test capabilities for subsystems and payloads for high performance navigation payloads and the next generation of global navigation satellite system (GNSS) equipment. Once developed, these new capabilities will form a solid base for COM DEV to address the markets of the new generation GNSS and communications satellites.

High Power Wideband Switch Technology Development

COM DEV will develop a waveguide switch that can be used anywhere in a communication satellite, improving satellite reliability, enhancing radio frequency performance, and also resulting in lower costs and reduced cycle time for the satellite payload integrator. This technology can be used in the waveguide switches required for transmit switching networks.

Tuneable Filters for Flexible Payloads

COM DEV will develop the critical elements for a new class of microwave filter: one that is tuneable on-orbit, over center frequency and bandwidth, so that flexible payloads are possible for the next generation of communication satellites. This technology can be used for flexible payload satellites that would retain and expand Canadian global market share, while providing the best possible technical solutions for next generation Canadian commercial, government, and military communications satellites.
Verification of a Pointing Mirror System for Ground Motion Compensation

COM DEV will demonstrate a space-qualifiable design of a pointing mirror system, suitable for performing the ground motion compensation for the Measurements of Pollution in the Troposphere (MOPITT-2) instrument. The MOPITT-2 program has baselined such a mechanism, and the proposed work will reduce the risk for this program and other future science missions.

EION
Adaptive Capacity Optimization for Multiple Beam Satellite Systems

EION Inc. will provide the world’s first intelligent optimization emulator for multiple spot-beam bandwidth management with quality of service. With this technology, satellite communications operators can deliver advanced services centered on capacity planning and quality of service without incurring large capital expenses. It will also introduce a significant differentiating technology to the satellite industry that will revolutionize spot-beam management.

EMS Technologies Canada
MEOSAR Digital Beam-Forming Antenna

EMS SATCOM will design a highly sophisticated, compact, digital beam forming, multi-faced active phased-array antenna for the MEOSAR system. This antenna will produce the large number of simultaneous tracking beams required to obtain data for accurately resolving beacon locations. It will also provide the ability to adaptively nullify sources of interference. MEOSAR system will radically reduce search and rescue response times by providing near instantaneous distress alerts globally, even in the far North.

Flywheel Energy Systems
Mk5 Flywheel Rotor Accelerated Life Testing (Continuation)

Flywheel Energy Systems Inc. will evaluate the effects of cyclic fatigue and accumulated damage on a scale version of the Mk5 flywheel rotor. Three of these flywheel rotors will be delivered to Honeywell Engines, Systems and Services, which will use the flywheel rotors to build up three flywheel systems for a ground demonstration of an integrated power and attitude control system (IPACS). The work will be augmented by rotor-accelerated life cycle testing projects supported by Honeywell and the Canadian Space Agency (CSA).

GAIN Microwave
Evaluation of Gallium Nitride Technology for Application in Single Stage Power Amplifiers (SSPAs)

Overall objective of this program is to undertake a preliminary evaluation of current gallium nitride semiconductor technology for potential application in monolithic microwave integrated circuit (MMIC) high power amplifiers for space applications. Evaluation will be carried out through: characterizing devices representative of the current start-of-the-art; designing devices optimized for power applications and characterization of test structures; studying current status of technology; evaluating commercial potential; and evaluating the potential for application of gallium nitride SSPAs for space applications. Where appropriate, the technology program will leverage existing Canadian expertise in gallium nitride material and device technology.

INO (National Optics Institute)
Radiometric Packaging for Uncooled Bolometric 512 x 3 Pixel IR FPA

INO will design a radiometric package to be integrated with a 512 x 3 pixel microbolometer focal plane array (FPA), sensitive in the mid- and long-wave infrared part of the spectrum, which has been designed, fabricated and tested under a previous CSA contract. Package will extend significantly the application range for the FPA to absolute temperature measurement and radiometry. State-of-the-art combination of the FPA and radiometric package will provide a unique combination of high performance, low cost, light weight, small size, and low power consumption that’s ideal for the micro-/nano-satellite context.

McGill University
Hypervelocity Launcher for Laboratory Testing of Orbital Debris and Micrometeoroid Impact

McGill University will develop a new technology for accelerating one-centimeter objects to velocities in the 10-to-15-kilo-
Meter-per-second range, so the vulnerability of spacecraft structures to hypervelocity impact can be directly measured in the laboratory. Canadian industries and institutional laboratories involved in the design, manufacture, and testing of spacecraft and spacecraft components can utilize this technology.

MDA

SDR-based High-Speed Architecture for Reconfigurable Payloads

MDA will build upon its existing software-defined radio (SDR) capability to develop a proof-of-concept for high-speed reconfigurable satellite receiver. This receiver will be specifically developed to work with future missions incorporating reconfigurable payload technology, with the added advantage of working with a large number of existing and planned payloads.

On-Board Stereo Vision (OBSV)

MDA will develop novel computer-vision algorithms for estimating the pose of known satellites using their three-dimensional models and images from stereo cameras. This project will change the current operating mode of space vision systems from “acquire the pose once and track using previously computed pose” to “acquire pose continuously.” It will also increase the reliability of system operations.

In-Orbit Reconfigurable Antennas

MDA will identify and analyze a commercially and technically viable hybrid antenna configuration. MDA believes the completion of this development program will enable new business models and applications, and will help maintain Canada’s leading role in the rapidly evolving market of broadband flexible satellite payloads. Other applications include emergency response, national security, and geo-clusters. This capability will distinguish MDA strategically and help maintain its leading edge in antenna products.

Underactuated Versatile End Effector

Future plans of all space agencies around the world contain significant portions dedicated to robotics. Current end effectors and designs (shuttle remote manipulator system end effectors and latching end effectors, and special purpose dextrous manipulator orbital tool changeout mechanisms) are all very specialized units that can only grapple highly specialized fixtures. Whether it is to service Earth orbiting satellites, perform remote exploration, or prepare the terrain for manned missions to the Moon or Mars, there is always a need for an end effector that is more versatile than the current versions. It could grapple objects of different shapes and forms instead of specific grapple fixtures. This project will determine the configuration of a very flexible, underactuated robotic hand developed at Université Laval (Laval Hand) that will most likely be used in space missions and design it using space materials, processes, margins, and reliabilities.

MPB Communications

Integrated Miniature Instrument Suite for Planetary Explorers Using a High-sensitivity Binary-Coded Infrared Spectral Processor

MPB Communications Inc. will develop a laboratory breadboard of an instrument suite for Mars lander or rover platforms. Instrument suite could be interfaced with robotic drilling and sample handling equipment to provide onsite support analysis of the extracted samples (rock specimens and/or soil) and some in-situ bore-hole analysis capability.

Miniature FP/IOSPEC High-Resolution Integrated-Optic Infrared Spectrometer for Planetary Atmospheric Studies and Earth Observation

MPB Communications Inc. will prototype an innovative spectrometer concept that combines the broadband spectral operation of MPB’s patent-pending compact IOSPEC IR guided-wave spectrometers with advanced, narrow-band tuneable Fabry-Perot technologies. This will provide a miniature, high-resolution spectrometer weighing under 2.5 kg for accommodation on a low-cost microsatellite platform.

Neptec Design Group

3Di Hybrid Processing

Neptec will address shortcomings of available sensor technology for autonomous rendezvous and docking as part of a larger strategy towards developing smart sensor technology for a variety of space and terrestrial applications. Project builds upon CSA-funded TECSAS stereovision feasibility project, where the first attempt was performed to combine Neptec’s Three Dimensional Intelligence (3Di) tracking algorithms with Xiphos’ Q-Card.

NGC Aerospace

FFSAT (Coupled Attitude and Orbit GNC Algorithms for Small Satellites in Formation)

The concept of satellites flying in close formation is an emerging space technology that has great potential for future scientific and communication missions. NGC Aerospace Ltd will develop guidance, navigation, and control (GNC) algorithms for autonomously performing the coupled attitude/translation maneuvers on small satellites in a formation-flight mission in the most complex orbital environment, that is, eccentric orbit with perturbations. Resulting GNC algorithms, mission-analysis tools, and simulation tools will be integrated into NGC’s existing formation-flight simulator to assess the feasibility and performance of future formation-flight missions. Long-term goal is to validate these GNC techniques in orbit, on the European PROBA-3 mission.

LOCOOS (Low-Cost Orbit and Orientation State Estimation)

With the trend towards smaller and cheaper satellites of the micro/nano/pico category, there is also a trend to reduce the mass, volume, cost, and complexity of the on-board navigation system. NGC Aerospace Ltd. will develop intelligent and autonomous guidance, navigation, and control software for such applications. As improving the autonomy, safety, and reliability of space systems, while reducing costs, is part of the company’s mission, NGC will assess innovative techniques for autonomously determining the orbit and attitude of a spacecraft using only simple, low-cost, low-mass sensors such as those that measure the magnetic field of the Earth and the temperature of the space-
craft. Goal is to develop a highly reliable, low-cost, low-mass, primary navigation system for micro/nano/pico satellites which could also be used in a back-up/degraded mode aboard a larger, commercial satellite.

**Northern Centre for Advanced Technology (NORCAT)**

Drill Unit Superstructure and Rod Handling System in Support of a Class N or M (1.5- to 15-meter) Subsurface Sampling Drill

NORCAT will advance drill superstructure, drill rod handling, and autonomy towards a low mass and power efficient design that can be used for various planetary exploration scenarios. Project will further develop critical components and subsystems in preparation for development and testing.

**Passat**

Pico-Second Compact Laser Emitter for Space Laser Induced Breakdown Spectroscopy

Passat will develop a pico-second laser source with an output power of 10 MW and pulse repetition rate of up to 100 Hz, and with low power consumption, weight, and volume. This laser is intended for future missions to Mars, the Moon, possible asteroids, or to artificial space station missions involving rovers with a light laser for induced breakdown spectroscopy.

**Sensor Technology**

Developing a Miniature Piezoelectric Motor for Space Applications

Sensor Technology Ltd. will develop innovative ultrasonic micro-motors for robotic end effectors to be used in space. Company will review scientific and patent literature to identify the most promising concepts, design a micro-motor and electronic system, fabricate hardware, and characterize prototype devices.

**Telesat Canada**

Dynamic Traffic Management for Broadband Spot Beam Satellites

Telesat Canada will assess algorithms and protocols for managing traffic in advanced on-board satellite and associated ground terminals and test their performance on software emulators, thereby reducing associated uncertainties prior to finalizing designs for the next major Canadian satellite launch. The project is critical in developing advanced spacecraft payloads and hubless distributed intelligence ground segments.

**University of Toronto**

Refining the Concept of Combining Hyperspectral and Multi-angle Sensors for Land Surface Applications

University of Toronto will refine a current hyperspectral remote-sensing measurement strategy by testing a system that acquires hyperspectral signals in the nadir direction, but also measures in two additional directions in two spectral bands. System can be used as an additional feature to the proposed Hyperspectral Environmental and Resource Observer (HERO) Mission or may be considered by other land observation missions for acquiring vegetation structure information. Such advanced technology may improve how biophysical and biochemical parameters of vegetation are derived.

**York University**

Slab Waveguide Spatial Heterodyne Spectrometer

York University, in collaboration with the National Research Council Canada Institute for Microstructural Sciences and COM DEV International Ltd., will design and simulate a detailed slab waveguide implementation of the Spatial Heterodyne Spectrometer (SHS) technology, at the same wavelengths as used in the Spatial Heterodyne Observations of Water (SHOW) instrument. Slab waveguide technology will significantly simplify and reduce resource requirements of the SHOW instrument by etching the main spectrometer onto a small, thin silicon wafer.