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Implementation Plan for International Cooperation on Small Satellite Development

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Executive Summary

An implementation plan for Small Satellite development within the international cooperation framework of the CANEUS network is described and its funding requirements estimated. The plan will be implemented via six principal tasks through the efforts of the CANEUS Small Satellite Working Group (SSWG). The SSWG has three sub-groups dedicated, in turn, to developing standards so as to ensure international interoperability, to identifying launch opportunities and services and to provide governmental liaison and strategic development. International cooperation is a common element in all activities and tasks. An estimated U.S. \$ 1,000,000 over three years is deemed required to sustain the implementation actions to realize a Small Satellite industrial sector based on Micro – Nano technologies.

The principal tasks constituting the plan are:

- Task 1:** coordinate and oversee the activities of the sub-groups to achieve their objectives and goals;
- Task 2:** organize expert teams from international partners to define interoperability of instruments, launch arrangements and test demonstration of function, viability and benefits;
- Task 3:** prepare and convene a series of symposia to identify data and components for transition to operational satellites;
- Task 4:** establish a 'one-stop-shop' technology monitoring, reporting and advisory service for stakeholders;
- Task 5:** commission an education and training element focused on Small satellites; and
- Task 6:** provision of satellite services to a range of end-users, be they commercial, scientific or security related.

By utilizing recent breakthroughs in nanotechnologies and micro-electrical mechanical systems, the Small Satellites developed through the coordination efforts of the CANEUS SSWG would be considered a 'disruptive technology' on par with the information technology revolution that has propelled new industries, services and capabilities for society.

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Implementation Plan for International Cooperation on Small Satellite Development

1.0 Introduction

This document describes the implementation plan for Small Satellite development within the international cooperation framework of the CANEUS network. The purpose is to indicate the way forward and funding requirements to create and sustain a robust Small Satellite industry sector, the stakeholders of which being drawn from several countries on a shared task, collaborative basis. The attractiveness of Small Satellites, particularly those incorporating next-generation MNT (Micro-Nano Technologies), is the potential to provide users with specific data on a competitive, faster responsive and lower cost basis.

2.0 Background

CANEUS Corporation is a non-profit organization catering primarily to the needs of the aerospace sector by fostering the coordinated international development of MNT (Micro-Nano Technologies) for aerospace and defence applications. CANEUS focuses on the practical aspects of transitioning MNT rapidly and efficiently from the concept to the system level, that is, in a seamless manner through Technology Readiness Levels (TRL) 1 to 9. Particular attention is paid to transiting TRL levels 4 to 7, commonly known as the 'Valley of Death' for technology development. It does this by bringing together developers, aerospace end-users, governmental agencies and investors from, initially, Canada, Europe and the U.S (hence the acronym CANEUS). Organizations from other countries, namely Japan and Brazil, have now joined in CANEUS activities. The motivation is collectively to mitigate the risks and costs for stakeholders to deploy next-generation Small Satellites.

To achieve its objectives, CANEUS has formed several working groups, one of which is the CANEUS Small Satellite Working Group (SSWG). The members of this working group are listed in Appendix A.

3.0 CANEUS Small Satellite Working Group (SSWG)

Following meetings convened October 2006 in Montreal, Quebec, April 2007 in Colorado and January 2008 in El Segundo, California, the vision, missions, objectives and structure of the SSWG have been defined as follows:

3.1 Vision of CANEUS SSWG

The SSWG has been organized in response to stakeholder needs to create and sustain a robust Small Satellite Industry Sector that does not currently exist. It will apply the CANEUS principles of coordinated development to create a SEMATECH-like structure to promote the growth of the Small Satellite industry sector by bringing together all of the stakeholders, individuals and organizations that can benefit from a sustainable Small Satellite industry sector. The SSWG will consider and prioritize the key technological elements required for the Small Satellite sector. The elements will be defined in the context of compelling business models for creating and sustaining the sector.

3.2 Mission of CANEUS SSWG

The mission of the SSWG has three elements:

- provide advocacy for its members and foster the advancement and increased use of MEMS and Nano Technology toward the expansion of the small satellite market;
- be the world's catalyst for the small (Micro/Nano/Pico) satellite industry to bring breakthrough (disruptive) technologies to the space sector by ensuring space qualification, reliability, lower cost and added-value; and
- by setting a global direction, create opportunities for the flexible collaboration and conduct of strategic research and development (R&D) so as to yield a significant return on investment (ROI) to the Small Satellite industry partners.

3.3 Objectives of CANEUS SSWG

The core objectives of the CANEUS SSWG include:

- advance the maturity of emerging MNT concepts via the development of end-to-end system development strategies;
- encourage an attractive investment environment focused on the rapid, cost-effective development of MNT and related technologies that will lead to an expansion of the Small Satellite market;
- foster increased access to space by enabling the periodic and routine availability of primary and secondary space lift opportunities for Small Satellites;

- lead in the development of functional and performance standards for Small, Micro and Nano-Satellites;
- work with members to be a rapid and cost-effective mechanism that drives the pervasive use of next-generation Micro/Nano/Pico space satellite systems;
- address critical challenges in advanced Micro/Nano/Pico satellite technologies, and to find ways to speed development, reduce costs, share risks, and increase utilization;
 - mitigate risks and costs collectively for the Small Satellite stakeholders by:providing space flight arrangements to validate MNT and related technologies;
 - arranging NPS satellite constellations, and
 - expediting launch on demand.

3.4 Structure of CANEUS SSWG

The CANEUS SSWG is overseen by an Executive Board composed of 48 representatives drawn from key stakeholders organizations. The board provides executive direction to each of the three following sub-groups:

- Sub-group # 1: Develop Standards for Micro / Nano / Pico Satellites on an international scale;
- Sub-group # 2: Identify launch services for Micro / Nano / Pico Satellites; and
- Sub-group # 3: Governmental liaison and strategic development.

4.0 Objectives and Goals of SSWG Sub-groups

The objectives and goals orienting the modus operandi and tasks of the sub-groups are listed below:

4.1 Sub-group # 1: Standards Development

The objectives are to:

1. define form factors for nano and micro platforms;
2. develop a collection of existing/emerging standards relevant to the sector;
3. establish onboard data interface requirements; and
4. ensure interoperability for international operations.

The goals include:

1. identify task-groups around technology/platform areas, such as:
 - a. electrical interfaces;
 - b. physical form factors;
 - c. plug-and-play formats;
 - d. data formats; and
 - e. systems engineering.
2. define technical requirements for each technology/platform area;
3. survey the existing standards landscape within other sub-groups; and
4. perform gap analysis.

4.2 Sub-group # 2: Launch Services

Objectives:

The objectives of the Launch Services Sub-Group are to define:

1. Advocate to the Primary P/Ls (PP) to fly secondary P/Ls (SP)

- a. Appeal to the funding sources of those primaries P/Ls
- b. Acquire agency-level mandates (directives) to fly secondary P/Ls

2. Assist SPs in getting rides on Primary missions

- a. Establish Executive Committee to rank/recommend SPs for rides
This will act as broker between PP and the SP community to manage the SP roster
- b. Certify Evaluation-Agency to score SPs for competencies
This agent will do the leg-work to evaluate the SPs and report to the executive committee
- c. Help fund SPs standards for development and verification
- d. Acquire funds to assist in the integration costs for SPs
There are funds to build SPs, but not to cover the integration costs to ride on primary missions
- e. Fund CANEUS sponsored SPs Missions in the future

3. Sponsor Standards and Qualification specifications

- CANEUS to own and publish standards
- Owns certification process
- Owns list of Venders that can assist in the certification process.

4.3 Sub-group # 3: Governmental Liaison and Strategic Development

The objectives are to:

1. bring together all the stakeholders, individuals and organizations (such as in the U.S.A., the DDR&E, ORS, NASA, ULA, AFRL, NRL, etc.) that could benefit from a sustainable Small Satellite industry sector;
2. identify and prioritize the key technology elements required for the Small Satellite sector; and
3. develop and maintain the supply chain infrastructure

The goals are oriented to benefiting governmental laboratories and university research groups and include:

1. ensuring greater mission assurance through improved reliability;
2. providing an alternate means to rapidly qualify new technologies;
3. lowering cost to demonstrate new technologies in space;
4. expanding launch opportunities;
5. supporting plug-and-play developmental efforts;
6. advancing concepts in modular design methods;
7. accelerating technology maturity up the TRL curve;
8. enabling university TRL 3 projects to get flight experience and facilitating moving to TRL 6 and beyond;
9. helping with efforts to shorten the acquisition timelines;
10. improving the alignment with emerging technology development cycle;
11. enhancing the space industrial base; and
12. supporting educational outreach and human capital for future jobs in the space industry

5.0 Implementation Plan

A key characteristic of the CANEUS process is international cooperation. It is a cross-cutting element for the implementation of all SSWG tasks in the plan. The principal tasks constituting the plan are:

- Task 1: coordinate and oversee the activities of the sub-groups to achieve their objectives and goals;
- Task 2: organize expert teams from international partners to define interoperability of instruments, launch arrangements and test demonstration of function, viability and benefits;
- Task 3: prepare and convene a series of symposia to identify data and components for transition to operational satellites;

Task 4: establish a 'one-stop-shop' technology monitoring, reporting and advisory service for stakeholders;

Task 5: commission an education and training element focused on Small Satellites; and

Task 6: provision of satellite services to a range of end-users, be they commercial, scientific or security related.

6.0 Funding Requirements to Realize Principal Tasks

The chart below displays the estimated funding required to sustain the CANEUS SSWG so that it can realize the principal tasks identified in Item 5.0:

Task	Estimated Amount Sought (U.S. dollars)	Timeframe in force
1	\$150,000	3 years
2	60,000	3 years
3	200,000	2 years
4	225,000	3 years
5	300,000	3 years
6	<u>65,000</u>	3 years
Total:	\$1,000,000	

7.0 Contracting and Funding Distribution Arrangements

It is foreseen that the funding organization would enter into a contract with CANEUS Corporation so as to implement the above-mentioned tasks. CANEUS Corporation would act as the implementing authority for the coordination and distribution of funds to the organizations and individuals performing the tasks.

8.0 Deliverables

CANEUS Corporation would issue to the funding organization a report annually describing the activities performed under each task, the accomplishments and the value-added as a result of international cooperation.

9.0 Conclusion

The proposed CANEUS SSWG program aims to realize Small Satellites based on MNT that can be deployed faster, more flexibly and at lower cost and risk. By utilizing recent breakthroughs in nanotechnologies and micro-electrical mechanical systems, the Small Satellites developed would be considered a 'disruptive technology' on par with the information technology revolution that has propelled new industries, services and capabilities for society.

Appendix A List of CANEUS SSWG Members and Affiliations

First Name	Last Name	Organization	Email
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