International iniatitive for a United Nations satellite constellation

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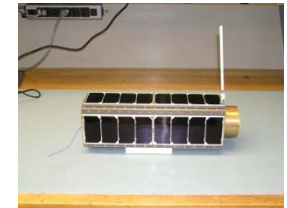
- Project Management and Schedule

- HUMSAT is an international educational initiative for building a constellation of nano-satellites providing communication capabilities to areas without infrastructure.

  - Based on the CubeSat standard and using GENSO as ground segment.

- HUMSAT is meant to provide data-relay services (storage and forward concept) for transfer of data like for example:

  - In-situ Environmental information (uni-directional)

  - Humanitarian (Simple bi-directional data)

  - Possible secondary specific payloads.

- GEOID will be the HUMSAT testbed that ESA intends to launch in support of the project and for educational purposes:

  - Constellation of 9 CubeSats for testing purposes over the European region
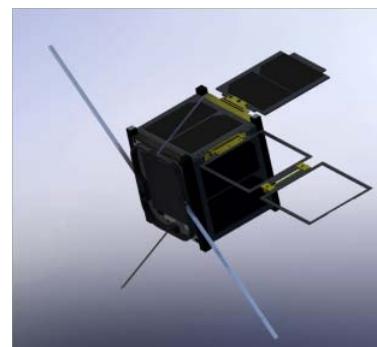
- Concept definition and initiators:
  - University of Vigo (Spain)
    - Xatcobeo
    - European GENSO Operations Node
  - California Polytechnic State University (USA)
    - CubeSat standard definition
    - P-POD development
    - Future US/American GENSO Operations Node
  - Universidad Nacional Autonoma Mexico (Mexico)
    - CubeSat development for HUMSAT
    - Follow up trough SATEX2 project
  - CRECTEALC: Regional Centre for Space Science and Technology Education for Latin America and the Caribbean. Affiliated to the United Nations.

The system is supported by a number of international organizations and countries:

- UNOOSA
  - HUMSAT discussed at UN Symposium on Small Satellites organized in Graz in September 2009 and 2010.
  - HUMSAT to be considered under the United Nations Basic Space Technology Initiative (UNBSTI, http://www.unoosa.org/oosa/en/SAP/bsti/index.html).
- ESA
  - Optional Educational Program for State and Cooperating Members
  - GENSO development and operations node selected.
  - Leading the implementation of the test-bed via GEOID.
- IAF
  - Special discussion on HUMSAT to be held during the International Astronautical Congress organized in Prague in September 2010
  - HUMSAT presented at IAF Workshop on Space Sensors for Climate Monitoring organized in Paris in March 2010
- NASA
  - Educational program to launch US/CubeSats.
  - Use of GENSO for their CubeSat projects.
  - Selection of the US/American GENSO node.
- Promoter Group of AEXA (Mexican Space Agency)
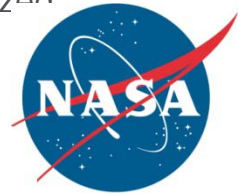
- **ESA**: Educational Program of the European Space Agency to launch 9 nanosatellite.
  - Universidad de Vigo – Spain: ESA Prime.
  - Other Universities have expressed interest:
    - Norway
    - Germany
    - Belgium
    - Italy
    - France
    - …..
- **California Polytechnic University**
  - Coordinates the US participation.

- **UNOOSA** (Through Regional Centers: i.e. CRECTEALC) :
  - Central and South America:
    - Mexico (2 satellites)
    - Colombia (Sequoia Space)
    - Brazil
    - Chile
    - ….
  - Russia
  - South Africa
  - Nigeria
  - Malaysia
  - Vietnam
- Many other countries have expressed interest (e.g. Japan, India, Pakistan, Turkey, Gabon, Indonesia, …).

- **Open for all interested participants.**

UNOOSA

- Provide hands-on-project experience on a space project for engineering/science students.

    – Covering all design, implementation and operations phases.

    – Covering all technical aspects of a space development

- Get students familiarized with ESA project management, standards and procedures for space projects.

- Hands-on experience with universities, institutions and space agencies at worldwide scale.

- Promote international cooperation between universities, space agencies and countries in space.

- Sharing experience with universities/institutions of developing countries.
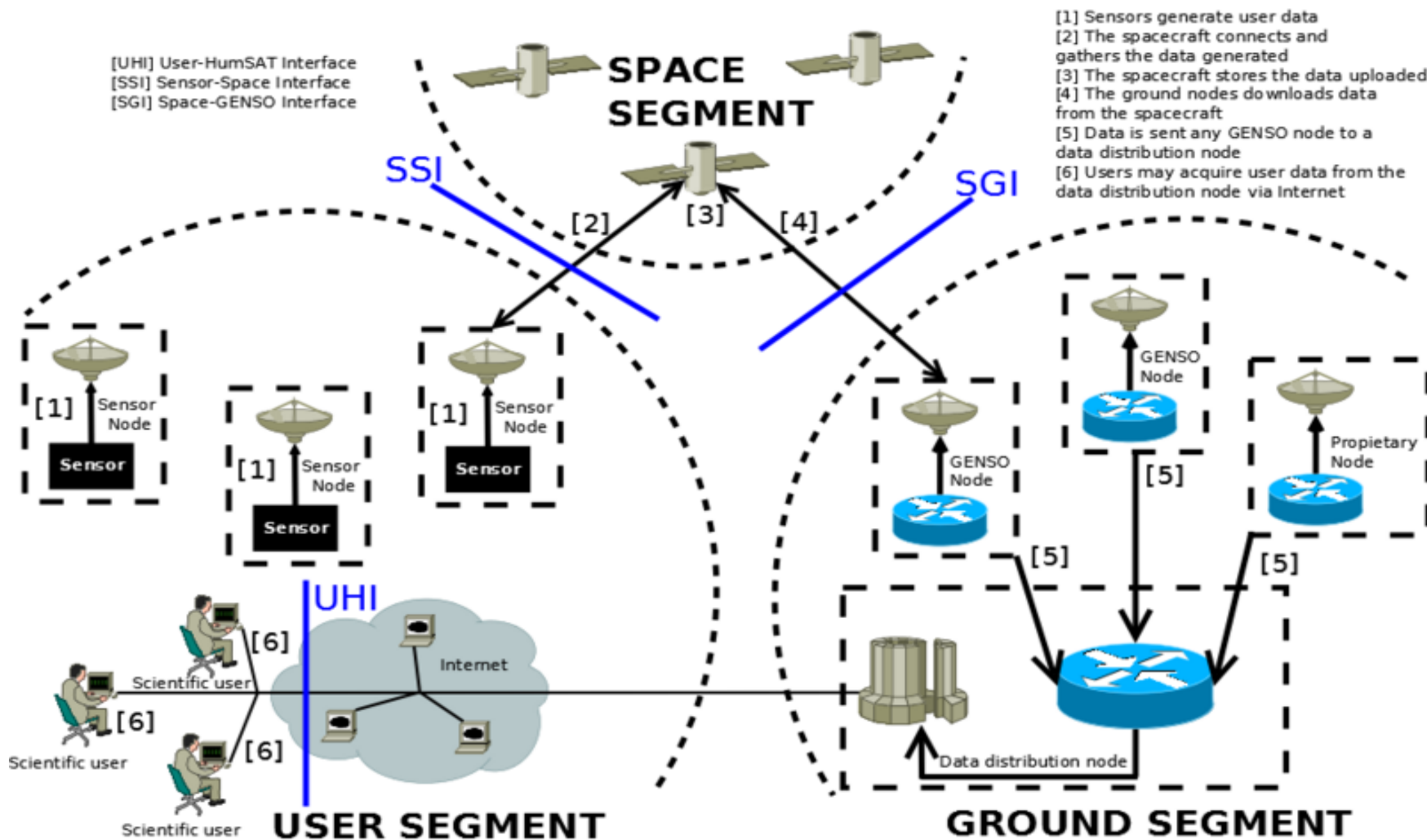
[UHI] User-HumSAT Interface
[SSI] Sensor-Space Interface
[SGI] Space-GENSO Interface

[1] Sensors generate user data
[2] The spacecraft connects and gathers the data generated
[3] The spacecraft stores the data uploaded
[4] The ground nodes downloads data from the spacecraft
[5] Data is sent any GENSO node to a data distribution node
[6] Users may acquire user data from the data distribution node via Internet

- **Space segment** is based on nano-satellites, according to the **CubeSat** standards as baseline.

- **Ground Segment** is based on the GENSO network (near worldwide coverage).

- **User segment** based in low-cost ground sensors:

  - **Up-linking** key information for further release to users,

  - Providing **bi-directional** communication capabilities between users in remote locations.

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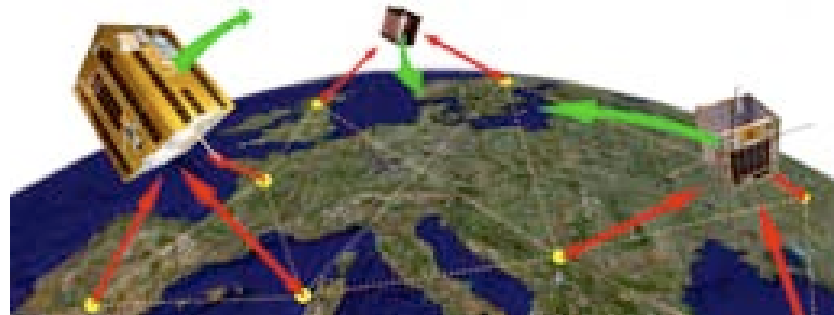
- Constellation of CubeSats, approx. 1.3 to 4.5 Kg. (Open for non-Cube Standards)

- Low Earth orbits, ~600 km.

- User time gap in visibility for any s/c in the constellation < 2 hours.

- GENSO ground station worldwide network used for data downloading and TTC, providing almost continuous visibility on the CubeSats.

- Possible user ground sensors (applications):

    – Public health: providing communication means from remote locations.

    – Monitoring and prevention of natural disasters through a worldwide sensor network.

    – Sensor networks for climate monitoring.

    – Monitoring of environmental pollution: wells, lakes, areas with difficult access, seas...

    – Space pollution: space debris.

    – Use of nano- and micro-technology for the sensors.

- **Possibility to include secondary payloads**:
    - Scientific Sensors,
    - Cameras,
    - GPS,
    - Space weather
    - Debris sensors..
    - ...
- **Possibility to define inter-satellite links between certain HUMSAT satellites.**

- Sensor interface to the constellation will be publicly available.

- Every user can define its own monitoring sensors and locations.

- Once a sensor has sent their data to the s/c, this user data is downloaded through one of the GENSO ground stations and transported to the Data Distribution Center(s) using the Internet.

- Users will need to register and authenticate in order to access their data.

- Access is provided via the Internet to the data collected.

- No proprietary tools required for the access.

- The initial schedule is considering a 4 years project.

- Purpose: build the complete component of the Global constellation

- Promote the concept of HUMSAT through international cooperation with all the Space Agencies

- HUMSAT program coordinated worldwide trough Space Agencies/Universities/Regional Centers:

  - Europe: An ESA Educational Program (GEOID) for supporting HUMSAT has been presented to Member (18) and Cooperating States:

    - An imminent Announcement of Opportunities in the next weeks:

      - 9 Nanosatellites using Vega launcher (TBC)

      - GENSO support and new European GENSO/GS

      - Develop sensors/suit-case GS

      - Compatible with additional Payloads

- **USA**: Coordinated by CALPOLY

- **Central, South America and Caribbean Countries**: CRECTEALC (Regional Centre for Space Science and Technology Education for Latin America and the Caribbean affiliated to the United Nations and UNAM/AEXA coordination

- **Africa**: UNOOSA coordination with the support of the promoter group, IAF and the rest of the Space Agencies

- **Asia Pacific**: UNOOSA coordination with the support of the promoter group, IAF and the rest of the Space Agencies.

- Plan:
  - System design activities are undergoing at present.
  - Release of system documentation for participants expected by September 2010.
  - Possibility to undertake efforts in three areas:
    - Develop a CubeSat
    - Develop the hand-set and sensors for communication with the constellation
    - Join the GENSO network which will provide the ground infrastructure for data relay
- Open for cooperation in the Mission and System Requirement Phases.
- Mandatory use of a tailored version of the different SPACE QUALITY Standards (e.g. ECSS in the case of Europe, ….)
- Debris mitigation.

- GEOID, the HUMSAT test-bed that ESA Education Office will develop is a 4 years project.
- Purpose: build the European component of the Global constellation
- Promote the concept of HUMSAT through international cooperation with other space Agencies
- Plan:
  - System design activities are undergoing at present.
  - Release of system documentation for participants expected by September 2010.
  - Possibility to undertake efforts in three areas:
    - Develop a CubeSat
    - Develop the hand-set and sensors for communication with the constellation
    - Join the GENSO network which will provide the ground infrastructure for data relay
- The System Engineering activities will be led in Europe by University of Vigo which is one of the promoter of the HUMSAT concept under ESA management control.

- HUMSAT - Active support and participation by Space agencies and highly recognized International Organizations.
- Goals: Educational, Research, Humanitarian, Climate monitoring, Non Commercial.
- UNOOSA: United Nations Basic Space Technology Initiative (UNBSTI)
- Any country could join the project in different levels:
  - Nanosatellite development
  - GENSO Ground Segment.
  - Specific User Segment (sensor)
- Capability to design Space Segment (secondary payloads) and Sensors specifically for the local/regional needs.
- Worldwide coverage.
- Open standard.
- Free access to the data through internet.
- WIN-WIN Approach: share satellites, GS, information, ...

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