An overview of the Alfa Crux CubeSat mission for narrowband communication

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How to meet data and voice communication demands in remote areas?

5th IAA Conference on University Satellite Missions and CubeSat Workshop
The AlfaCrux nanosatellite mission is twofold:

1 - Provide mobile or fixed satellite narrowband communication links for tactical and strategic applications mainly in regions with low infrastructure, forest environments and countryside;

2 - Promote regional development through applied research focused on the NewSpace industry.
AlfaCrux System would meet the following characteristics:

1. Small and lightweight terminals with low power consumption;
2. Reduced latency;
3. Interconnection with existing communication systems;
4. Satellite link on the move;
5. Communication link to cover hard to reach regions, where it is not possible to install ground infrastructure, such as the Brazilian Amazon;
6. Communication link for detached groups operating in isolation; and
7. Communications link to cover regions affected by disasters, natural or not, in which the local infrastructure was damaged.
Such solution would immediately bring the following advantages:

1. Improve the communication capacity in critical situations and tactical applications;
2. Lighter terminals compared to equipment used in SHF/EHF satellite communication systems;
3. Enable the use of the system in UN Peacekeeping Missions;
4. Mitigate the attenuation caused by rain, tree canopy foliage or elevated metal structures when compared to SHF/EHF solutions;
5. Cheaper terminals when compared to SHF/EHF equipment;
6. Greater mobility than SHF/EHF satellite systems due to their lower weight; and
7. Stimulate the national industry with a high degree of innovation.
The technical objectives to be addressed include:

1. Compatibility with radios available in the market (to be specified);
2. Voice and text messaging service;
3. Point-to-point communication (data relay framework);
4. Data storage and retransmission (store and forward);
5. Reception of ADS-B signals;
6. Ham radio repeater;
7. Spectrum monitoring.
The Alfa Crux 2021 system will consist of the following:

- A CubeSat (the α-Crux nSat) with omnidirectional antenna and software defined radio solution for payload and ground station;
- Its own control, tracking and command ground station;
- User segment solutions.
TTC communication system in the UHF band (437 MHz) and in the S band (2.1 GHz) based on:

- Omnidirectional antenna for communication with terminals on the ground. A possible option is the UHF Turnstyle antenna for 400 MHz communication band, 18.8 cm wavelength, remote control binary data rate and 9.6 Kbps telemetry;

- Patch antenna for S band (2.1 GHz) for high-speed transmission of 1-2 Mbps;

- Software-defined radio for data relay communication between tactical radios, data collection system, and command and control backup interface with the ground station, high frequency S-band communication system, reception of ADS-B signals and spectrum monitoring.
The α-Crux CubeSat

- On-board computer for control and management of satellite data (computer with on-board software development process).

- EPS power system, consisting of:
  - Control of storage, distribution and energy communication card;
  - Batteries for energy storage;
  - Solar panels for recharging batteries.
  - Power distribution network to the different satellite subsystems.
The α-Crux CubeSat will be placed in a heliosynchronous low orbit at an altitude of approximately 500 km.

The footprint of the satellite on the ground will have a radius of approximately 2500 km, equivalent to an area of 36 million km².

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Larger semi-axle</td>
<td>6878 Km (500 Km altitude)</td>
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<tr>
<td>Eccentricity</td>
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<tr>
<td>Slope</td>
<td>97°</td>
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<tr>
<td>Orbital Period</td>
<td>94.5 minutes</td>
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</tbody>
</table>
Alfa Crux Timeline

- **Conception**: 2019
- **Design**: 2020
- **Launch**: 2021
- **Operation**: 2021
- **AlfaCrux II**: 2022

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Thank you!