Contribution ID: **20** Type: **Poster**

Distributed Delay Tolerant Protocol

A cubesat is a very small, low cost, artificial satellite designed for space research purposes, very popular in the academic community. Cubesats are normally deployed in Low Earth Orbit (LEO), which can be defined as orbits up to 1000 km above the earth surface, with an orbital period of approximately 90 minutes at a speed of 7.8km/s. However, a big consequence of this, is that a particular ground-station only has a very small time-window of line-of-sight to communicate with the satellite. Offering even more obstacles, space-link communications are very unstable, error prone, and of low debit. The challenges in space-link communications are not traffic congestion (like on earth), but long propagation delays and high bit-error rates. This motivated the creation of Delay/Disruptive Tolerant Network (DTN) protocols, a concept designed to deal with the characteristic problems of disruptive environments. However, even with DTN, the transmission of big data files can be difficult. This is specially true in the case of cubesats, working typically in Low Earth Orbits (LEO), which suffer from very long disruptions periods with the Ground Stations (GS) on Earth.
The ISTsat-1 is the first cubesat being developed at the Instituto Superior Tecnico (IST), with a 1U size (103cm cube). For this project we intend to create an enhanced solution. A new approach that will tackle this difficulties in a new, more powerful way. To create a distributed protocol capable of expanding a single transmission session over several links and hosts (ground-stations in this particular case). This means that the satellite, after starting a transmission with a given Ground Station (GS), leaving its line-of-sight and consequently disconnecting the link, does not need to perform a full orbit to resume the transmission. It can just continue the transmission with the next GS available in its orbit. This can result in a very significant performance enhancement, both due to the very limited available time-windows and the typical characteristics of space communications, like high delays and low throughputs.
A particular interesting use case, that may be possible with this distributed approach, is the enabling of communications between clusters of cubesats. Since these clusters are randomly deployed in an area of interest, communications links are not constant. The flexibility of a distributed approach allows to compensate for this, since there is no fixed route or peer through which a transmission must go.

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Session Classification: Posters and Demos

Track Classification: Ground Networks, Launchers, and Operations