

Communication logistics

Communications department

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1 Aim of the document

In this document it will be described how the information travels since the client asks for information of its satellite until it receives the information. This process will be divided in 3 segments:

- **Ground Segment:** is the logistics from the client to the corresponding Ground Station and vice versa.
- **Sky Segment:** is the logistics through the constellation for communicating with the client's satellite.

2 Ground segment

2.1 Ground characteristics

In order to define the logistics in the ground segment it has to be defined which nodes compose it and its characteristics.

- It will be at least 3 Ground Stations with the capacity to communicate in every moment with, at least, one satellite of the constellation.
- The Ground station will be in a latitude between $+80^\circ$ and -80° in three separated longitudes of the globe.
- The client could ask for and receive information every where in the planet where he/she could connect to internet.
- In order to increase the capacity of the communication it will be possible to add more Ground Stations around the world.

2.2 Ground logistics

At first, when a client wants to contract our service he/she will have to describe as the orbital and technical characteristics of its satellite. Then he/she has to ask for downloading data of its satellite. This application will be sent, by internet, to the nearest to the satellite Ground Station. If we have GS in Terrassa, Beijing and Lima and the satellite is over Mexico, the application will be sent to Lima GS, wherever the client is.

When the application arrives to the GS it will code it according to the communication protocol. This coded application will include where is the client's satellite and in what GS has to be downloaded the data. It will not include the path.

When the information is downloaded to the GS, it will be decoded and sent to the client. It will be also done by internet

3 Sky segment

3.1 Constellation characteristics

In order to define the logistics of the communications, it is needed to take into account the different characteristics of the constellation and the satellites that are part of it.

- The constellation is formed by a series of polar, or near polar, orbital planes, covering the whole world.
- Satellites in neighbouring planes move in the same direction (from north to south, or from south to north), creating two hemispheres. In one, satellites move from the south towards the north, and in the other satellites move from the north towards the south.
- Each satellite can communicate with a potential client upwards, with a ground station downwards, with the next and the previous satellites in the same orbital plane, and with a satellite in each neighbouring plane. If the adjacent plane moves in the opposite direction, the satellites will not communicate between them.
- Each communication link is independent, therefore, a satellite can communicate across the orbital plane while at the same time is communicating across planes.
- Moreover, each communication link has different channels to communicate, resulting in different communications happening in the same direction at the same time.
- The constellation can be used to communicate two nodes, which can be either satellites or ground stations.

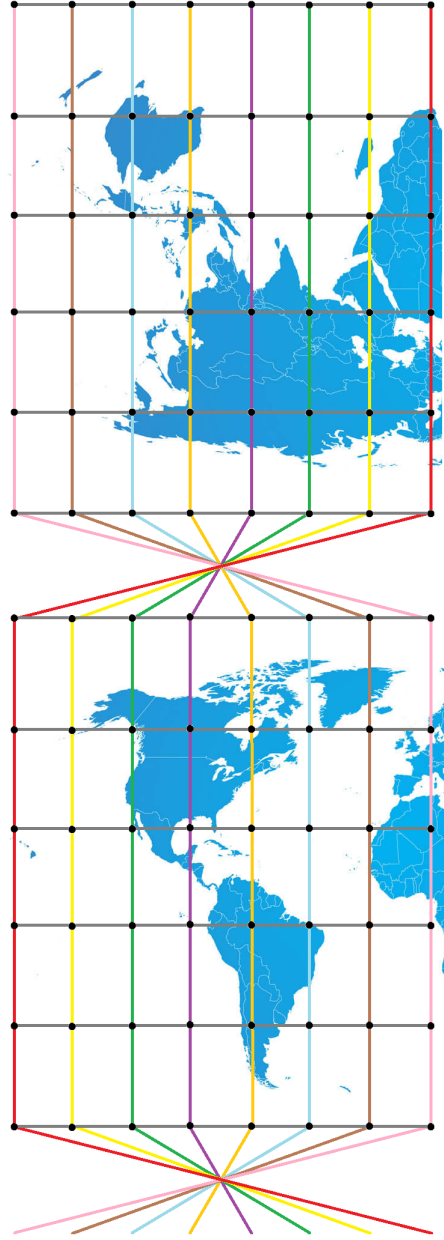


Figure 1: Scheme of the constellation. Black dots are satellites. Color lines are communication links in the same orbital plane. Grey lines are links between orbital planes.

3.2 Constellation logistics

In order to communicate properly within the network, the data to deliver will have a introductory sequence indicating its origin and its destination. *Each satellite will have a map of the constellation, with the variation of the positions of each satellite and ground station over time.* Before transmitting the data, a satellite will emit a signal to the following satellite to check its status and to indicate the intention of using any of the satellite links. If the satellite is active and it is available for communications, it will return a signal to indicate the availability.

The path that will follow the data will be the following: in the network map, the data will first travel along the orbit upon reaching the closest satellite at the destination latitude, then, it will change orbital planes upon reaching the closest satellite to the destination.

In case a satellite is inactive, it can not return a signal, and the emitting satellite will not transmit to that satellite and will find an alternative route. If the satellite is active, but the intended route for the emitting satellite is already being used in all of the channels, it will return a signal saying that is occupied.

When a satellite cannot transmit in the regular path, it will use the alternate path. The alternative path consists in first transmitting in the different orbital planes upon reaching the satellite closest to the target longitude, and then traveling along the orbital plane upon reaching the closest satellite to the target. If the alternate path is also unable of being used, the satellite will try to use the regular path once again, and will alternate with the two paths until one of them is able. Meanwhile, the satellite will store the data.

From all the channels in each link, one of them will be reserved. This is the channel that will be used for the company's ground station to check the status of the constellation and giving orders to the satellites of the constellation.