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ADVANTAGES OF INTER-SATELLITE CONNECTIVITY FOR EARTH OBSERVATION  
CONSTELLATIONS DEDICATED TO DISASTER RESPONSE

**Abstract**

The use of data collected in-situ is a typical choice in case of disaster response situations, but it requires the presence of a pre-existing infrastructure, preventing interventions in remote or developing areas. Satellite data are a valuable alternative, as they provide information from any point on Earth regardless of the ground equipment availability. Traditional Earth observation systems are usually based on few large satellites. This implies that a large amount of time can be needed from the request of data access to the communication of the requested data back to Earth. More recently, small satellite LEO constellations are being deployed, allowing for an increased revisit rate at comparable performances. Nevertheless, current architectures do not provide real-time access to the acquired data. The deployment of relatively large constellations of small satellites supplied with inter-satellite connectivity could allow to achieve quasi-global coverage and real-time data access at the same time. In this paper, the performance of Earth observation constellations based on small satellites provided with inter-satellite link connectivity is analysed from a data communication point of view. In particular, performance is evaluated in terms of delay and throughput of the constellation, depending on several parameters such as the data rate of inter-satellite links and downlinks, the constellation parameters and the availability of ground stations. The analysis is carried out by propagating the constellation for a given time interval of interest and defining its network structure dynamically, in order to calculate relevant network metrics and derive constellation performance. Scenarios in which real-time data are specifically required have been considered, focusing on disaster response applications in which a fast action is vital, such as floods, fires and oil spills. The results of the paper will allow to define trends and requirements for the technological development of inter-satellite telecommunications terminals suitable for constellations aiming at providing global-coverage and real-time data access. At the same time, the analysis allows to assess the increase in value of information of Earth observation data offered by the implementation of inter-satellite connectivity.