Agile, Elastic and Flexible: Incorporating AWS's Cloud-Based Technologies with Ground Systems

Spectral Ocean Color Imager (SPOC) and Multi-view Onboard Computational Imager (MOCI)

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Overview

Cloud computing in research and industry is becoming inescapable, claiming roles in reliable file storage, analytics, and rapid development for a wide variety of solutions. As these technologies advance, they are also being utilized in more robust applications such as spacecraft data handling on the ground. With the expectation of high reliability and quick adaptability, a low-risk ground system capable of scaling up or down depending on the needs of the mission. Automatic self-management of data volume and scaling based upon an application's needs both reduce the requirement of human intervention. This differs from the maintenance required by personal ground stations, which only begins with the buying of necessary hardware and the creation of a client-to-client network. Even if properly configured, however, a cloud-based ground station can continue to pose challenges that are difficult to solve for spacecraft missions: the functionalities will remain limited after the initial setup due to a lack of flexibility of the system. Thus, we propose an incorporation of the Amazon Web Services (AWS) suite, a cloud computing platform that emphasizes flexibility, into ground systems, and assess its characteristics in serving as an accessible yet secure ecosystem for mission operators. This ground system would mitigate the issues presented by both personally maintained ground stations and cloud-based systems, opening a new range of flexibility for data handling within the space industry.

Approach

Searching for flaws within existing ground systems aids in understanding the necessities of operation when it comes to deciding upon the integration of a new ground system. Needs, such as bandwidth capabilities, physical ground station locations, and data amounts for downlinking and processing, must be able to be handled and met appropriately to prevent mission failure. An untrustworthy ground system risks the likelihood of continuous satellite communication. Such a ground system could face problems like improperly configured security or even extreme pricing, both potentially resulting in the inability to continue the existing mission. Targeting Amazon, one of their newer products, AWS Ground Station, is one that seems to have reliable structuring and helpful capabilities and could be considered for usage within a university setting. The interest lies in whether AWS has created something too focused on a customers being larger companies or if it truly is a multifaceted product.

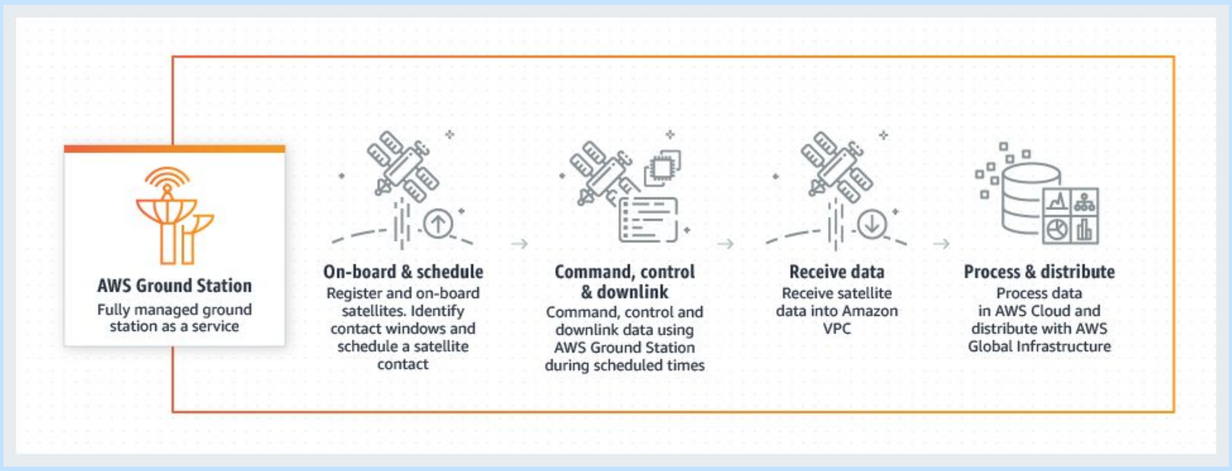

Figure 1: AWS Ground Station's flow of operations.

Results

In an attempt to integrate the AWS suite into an existing mission with NASA, an understanding of AWS and its complications were required and gained after being engrossed in their hands-on training courses online to become educated before interacting with their employees themselves, the infrastructure appeared sound and versatile for varying missions and their differing data sizes since the service is advertised to be pay-as-you-go. Unfortunately, AWS Ground Station does not prove to be a sturdy backbone for universities and research laboratories with a relatively small amount of satellites and/or small amount of data being downlinked. The data is unprotected, and, although Amazon claims their architecture is built to prohibit their ability to view any downlinked data, they have yet to implement their ground system as a trustworthy communicator to use for beaconing data to a location other than their information databases, which must also be paid for based upon data usage and demand.

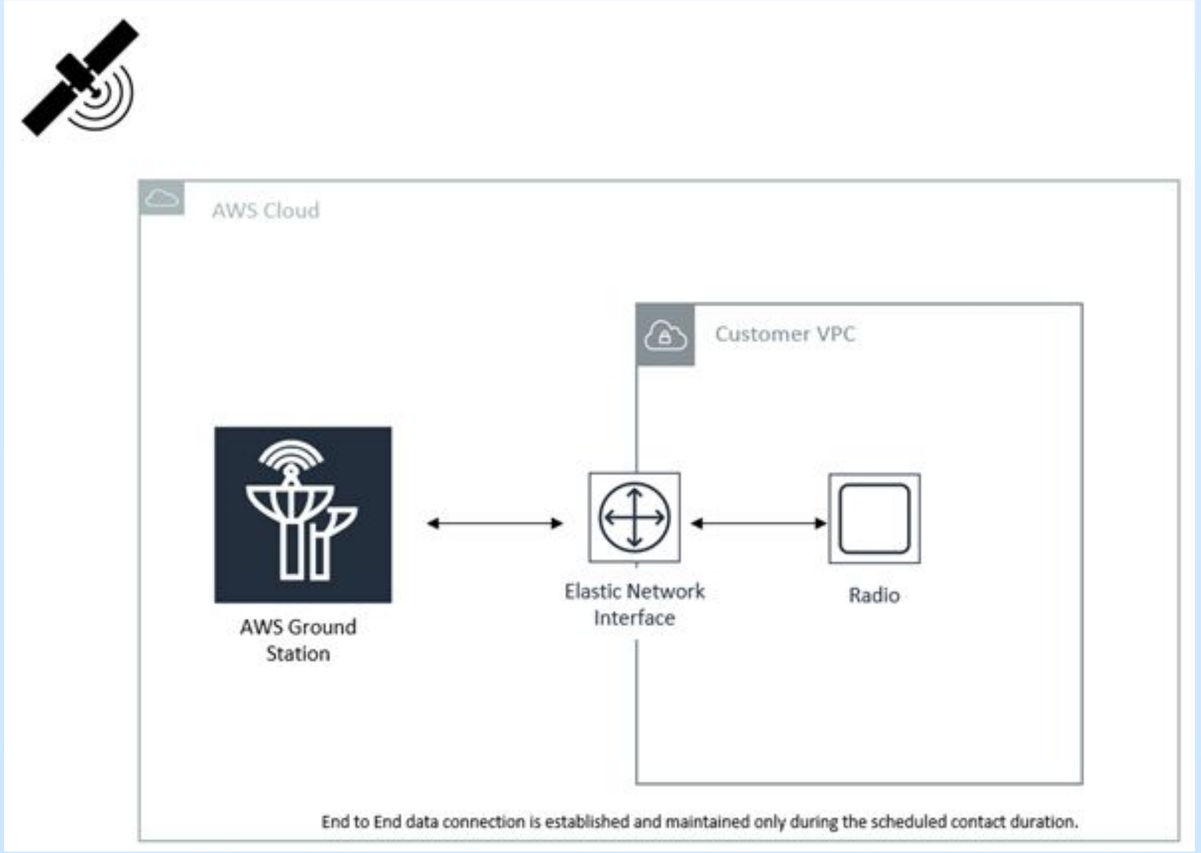

Figure 2: AWS Ground Station integrated with AWS Elastic Beanstalk and AWS VPC, one of many possible set-ups.

Phone meetings were held with members of the AWS where specifics were pushed aside, such as streaming capabilities and real-time data access/delays, and the information shared was that of a business man's, lacking in a holistic view of satellite communication. As AWS continues to advertise NASA's involvement with them and their usage of the AWS software, this proves to be true for potential missions that will process and generate data in large volumes, the AWS Ground Station product is too new and the capabilities too limited to benefit other NASA groups. Furthermore, it would not be appropriate for use by university research laboratories nor would it be helpful for startup companies.

References

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