Tuning Drone Data Delivery and Analysis on the Public Cloud

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INTRODUCTION

There has been great growth in the use of drones for research. The drone is "a remote-controlled pilotless aircraft or missile" capable of visualizing extended areas of study in less time than the human eye (OxfordDictionaries.com, 2018). Many drones can send live video streaming to mobile phones or computers. Data collected by drones provides useful information and patterns to deploy new technologies and generate deeper data analysis. These data, including information on movement, color, or area patterns, can be processed per frame and mapped as color pixels or represented as a set of Extensible Markup Language (XML) files.

According to Mell and Grance (2011, p. 2) from the National Institute of Standards and Technology (NIST):

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

The public cloud, such as Amazon Web Services (AWS) or the Google Cloud Platform (GCP), offers reliable and nearly unlimited storage (www.aws.amazon.com). Paid on-demand services can be used as additional storage or compute services. Users can create several parallel virtual machines and process data loads through the public cloud. It is possible to automatically scale the use of virtual machines depending on resource needs (www.aws.amazon.com).

Photogrammetry is the use of photography in surveying and mapping to ascertain measurements between objects (OxfordDictionaries.com, 2018) and is an example of how a machine can be used to process images collected from drones. Monthly data can be efficiently processed by integrating and analyzing terabytes (TB) or petabytes (PB) from drones on the public cloud. However, there is not a faster way to send large amounts of data from a premise server to the public cloud.

The current method of processing data from drones on the cloud use raw data and these were sent in sequential order. This method depends on the speed of transference of every packet from the base station to the cloud. Also, if the company use only one node in the cloud for processing, then the overall process is sequential and very slow. This amount of time could be very long with a regular video of 300 MB. Using a set of videos of regular size can take several hours or days, depending on the bandwidth and the flow between the intermediate network devices.

In this article, the researcher will use a set of tools and an automation process to study a unique method of compress the output of drone videos and improve the transference of data from the on-premise base station to the cloud to analyze them in a concurrent environment on the public cloud. After discussing alternatives, the chapter will review process data calculations to compare faster methods. With modifica-

DOI: 10.4018/978-1-7998-3479-3.ch016

tions to upload times, the analyzed data time is reduced by an average of 78% as compared to a common sequential process. This valuable time can be used by companies to be focused on their experiment and business results instead of the processing of the data sets.

BACKGROUND

Several studies have discussed the integration of drones or robots and the public cloud. In the internet of drones theory (Gharibi, Boutaba, & Waslander, 2016), the authors created a system to manage and control access to drones and their activities to navigate service locations. A study by Yinong and Garcia (2010) reviewed the field of robots as a service in cloud computing. Through distributed systems, the researchers controlled a network of segregated robots and sent various programs to the robots to deliver different services.

In a service-oriented architecture (SOA) study, researchers created a Web-based system hosted in the public cloud to manage drone networks (Koubaa, Qureshi, Sriti, Javed, & Tovar, 2017). In a robust study by Mahmoud, Mohamed, and Al-Jaroodi (2015), the authors designed a technological system using unmanned aerial vehicles (UAVs) as nodes based on the theory of the internet of things (IoT). Using the RESTful HTTP technology and Arduino boards, the UAVs transmitted data with the internet.

Just a few years before these studies, pilots could not use drones from a distance. However, distance no longer limits the user. It is common practice to use data collected by sensors in wireless devices. For example, Lo, Lopez, Goncalves, and Perera (2015) fetched data with several types of sensors analyzed with the Skyline algorithm. This study had collected a large amount of data from sensors and stored them in local systems to be analyzed with the algorithm. Although, with this method the researchers had to have the hardware to process the data. Nowadays, data scientists have the option to take advantage of the better and on demand resources in the cloud to analyze faster and a huge quantity of data. For example, in a research made by Saleem, Salim, and Rehmani (2014) they explain the integration between Wireless Sensor Networks (WSN) and the public cloud. Applications of WSN over the cloud are then described in that study.

The development of theories about the improvement of the work done on the cloud was studied in different researches. For instance, the research made by Bitam (2012) where the author has been studied and solved, with the Bees Life Algorithm, the job scheduling problem in the cloud using a method simulating the behavior of the bees in the nature. Another interesting study can be found in the research about a cloud-enabled robotic system for real-time video tracking applications made by Liu, Chen, Pham, Shen, and Chen (2014). In this study, the researchers used effectively the cloud computing resources to accomplish more computationally intensive tasks of a set of robotic systems. They used a cloud enabled robotic system (CERS) framework to process images from a processing application.

There are some studies about the processing of images on the cloud with the security as the main concern. For example, in the research conducted by Sattar, Adnan, and Kali (2017), the focus of the experiment is maintaining a secure environment inside the cloud when processing a data set. In a research developed by Welsh (2016), the author compares the processing time of a big set of images in local hardware (8 weeks) and the same data set in a server farm on the cloud (few hours). He used high quality images in different formats as 3D or 4K.

Although researchers have studied image processing, drones and the public cloud before, they have not mentioned the latency and time to send data from on premise to the cloud. This may be due to small data samples or the exclusion of this information from their studies. When research includes large amounts of