

## **Eaton Data Management Project Summer Internship**

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The Eaton logo is displayed in a large, bold, blue font. The word "EATON" is written in a sans-serif typeface, with a solid blue dot for the letter "O". The logo is centered on a light blue rectangular background.

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**UAF** UNIVERSITY OF  
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## **Introduction**

Transient events can cause damages to equipment, and they can trigger unplanned islanding. To help Eielson Airforce Base manage transient events, this project is designed to collect data that can be used to help detect transient events (Broderson & Swedberg, 2020).

For the first part of this project, data was collected from a variety of sources and inputted into a “TIG” (Telegraf, InfluxDB, and Grafana) stack on a Raspberry Pi. Telegraf collects the data and sends the data to InfluxDB. InfluxDB is a Time Series Database that can then be used as a data source for Grafana. Grafana is then used to visualize that data (Nagaraj, 2019).

## **Purpose**

The purpose of the overall project is to “help the power plant operator at Eielson Airforce Base to detect, manage, and recover from transient events” (Broderson & Swedberg, 2020). The purpose of Phase 1 is to review, understand, and create tools to organize and visualize data collected from the Eaton meters at Eielson AFB. This summer’s project was focused on understanding data collection & handling techniques and methods for adding data collections to databases and visualization platforms. (Broderson & Swedberg, 2020).

## **Methodology**

To start gaining the skills needed for Phase 1 of the Eaton Project, data from a Shelly 1PM meter was inputted into the TIG stack. After installing the Shelly 1PM meter to an extension cord, the power consumption of a load could be viewed from the Shelly

Cloud app and the web interface for the device. On the web interface, a Message Queuing Telemetry Transport (MQTT) server was enabled. The MQTT server allows users to publish messages that others can subscribe to (Gibb, 2019). By setting up the MQTT server on the Shelly meter's web interface, the data containing the power consumption and the internal temperature of the Shelly meter was published to an MQTT server. That data could then be sent to Telegraf by subscribing Telegraf to the MQTT topic that contains the data. Telegraf was programmed to output that data to InfluxDB. These settings for Telegraf were made by editing a config file for Telegraf. Grafana took the data from InfluxDB, as a data source, and plotted the data as a function of time. This process was completed, so that data collection skills could be learned. This is important because having those skills are necessary to collect and organize the data from the Eaton meters at Eielson Airforce Base as efficiently as possible.

To analyze and visualize the sample datasets that were received from Eaton, some Jupyter Notebook Python scripts were written. Each Python script first reads the data from the sample dataset. The dataset is then formatted into a Pandas DataFrame. After confirming that all the values in the DataFrame are numeric and that the timestamp is a format that InfluxDB will recognize, the DataFrame was visualized.

## **Results**

The visualized voltage data from the Foreseer is shown in Figure 2. The script for the Visual T&D meter rebuilt the dataset, so that the dataset would be understandable and usable by InfluxDB and Grafana. The visualized voltage data for

the Visual T&D is shown in Figure 3. The data for the meter event files included a starting and ending timestamp, instead of a timestamp column. As a result, an approximate timestamp column was generated for the meter event files. The resulting visualization is shown in Figure 4. These plots were generated using the Jupyter Notebook scripts. Part of the reason why the plots look different is that the sampling rate of the meters is different. The Foreseer has the slowest sampling rate, and it takes one measurement every minute. The meter event files have the fastest sampling rate, and they take 61440 measurements every second.

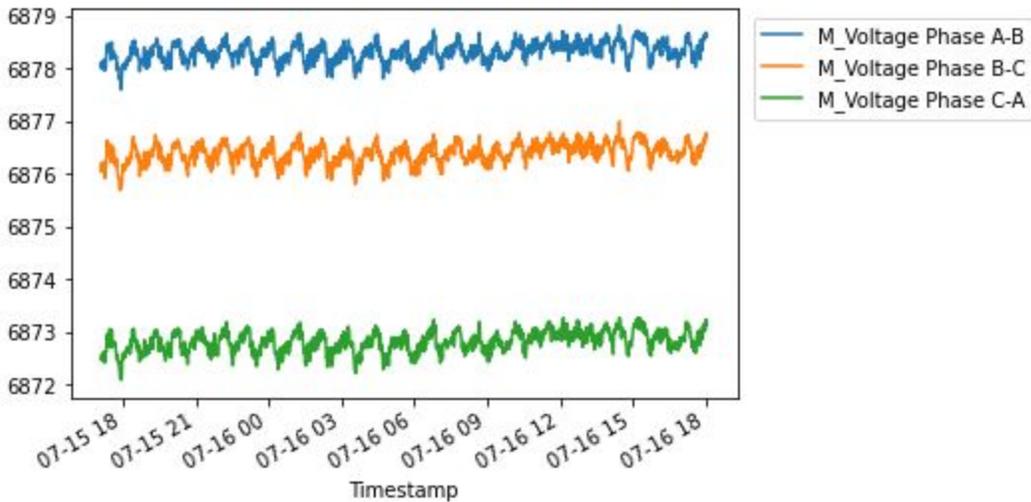


Figure 2: The voltage data from the Foreseer

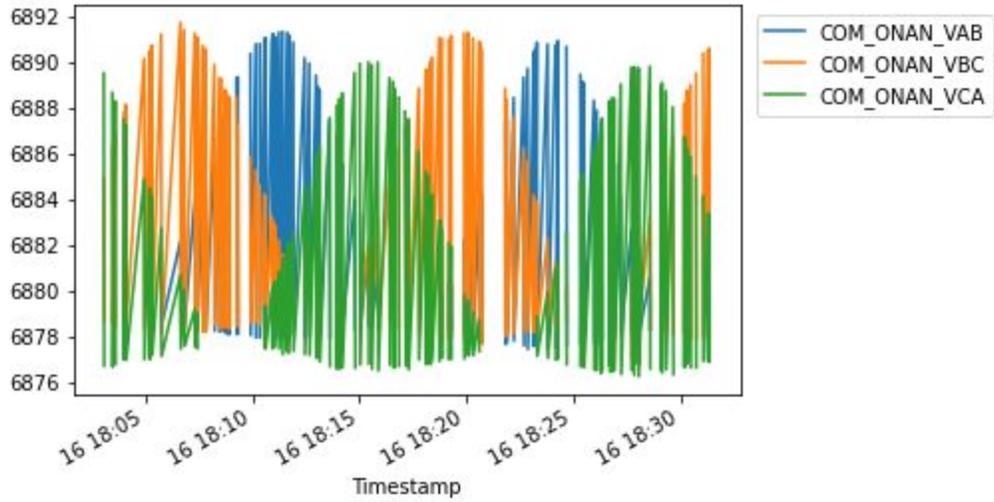


Figure 3: The voltage data from the Visual T&D

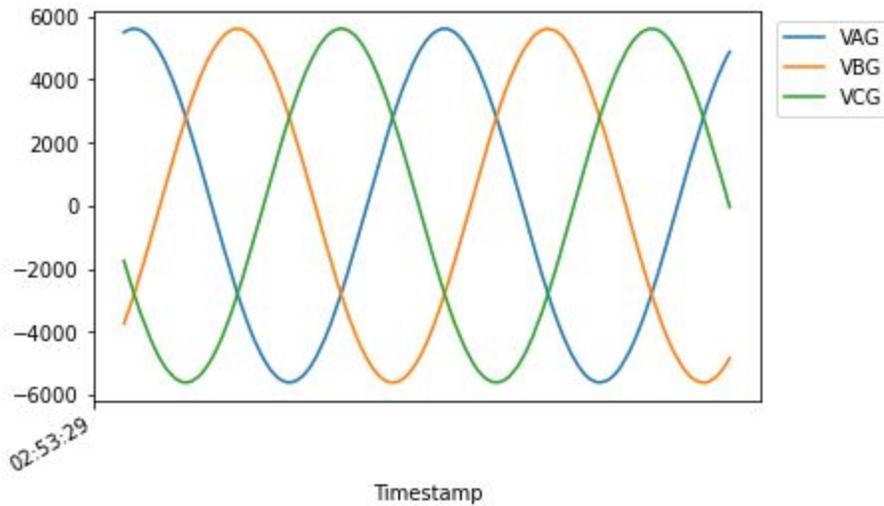


Figure 4: The voltage data from meter event d0

## Discussion

A challenge that power plant utilities, like Eielson Airforce Base, face are transient events. When a transient event occurs, equipment can be damaged and a power outage can occur (Broderson & Swedberg, 2020). This can create expenses for utilities, since equipment must be either fixed or replaced.

To prevent the expenses that result from transient events, data is being collected and analyzed (Broderson & Swedberg, 2020). In the future, this enables us to help Eielson Airforce Base create procedures that can help prevent power outages and damaged equipment resulting from those transient events, by solving the issues before the transient events cause damage.

The main source of energy encountered is AC power (typically 120 VAC) from a power outlet. The voltage, current, and power pulled from a power outlet by a load were measured throughout the summer by different meters. The advantage of an AC source is that it can power household appliances. The Raspberry Pi takes that AC power and powers pins and ports that then can power plug-ins by converting the AC power to DC. A disadvantage of AC power is that it varies throughout time, since it is a sinusoidal signal. Multimeters measure its root-mean-square (RMS) value, but its peak value must also be accounted for.

## **Conclusion**

This project first involved learning about using data collection tools and Python programming. Then, a Jupyter Notebook script was written that reformatted datasets into a DataFrame to be visualized. Some next steps for this project are to create procedures on retrieving the data from the Eaton meters and transferring the data to Eaton.

## **Acknowledgments**

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## References

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