

ATHENA POWER

Detroit Edison Sensor Pilot
Data Analysis 2022



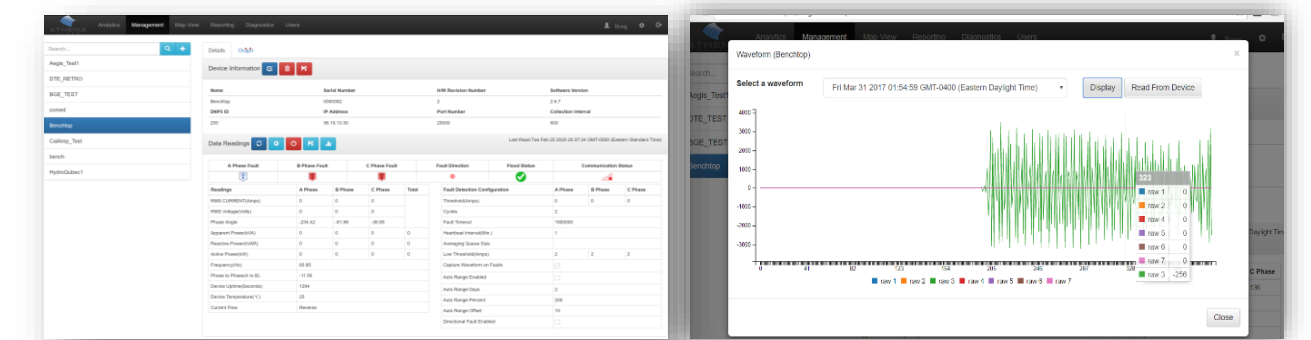
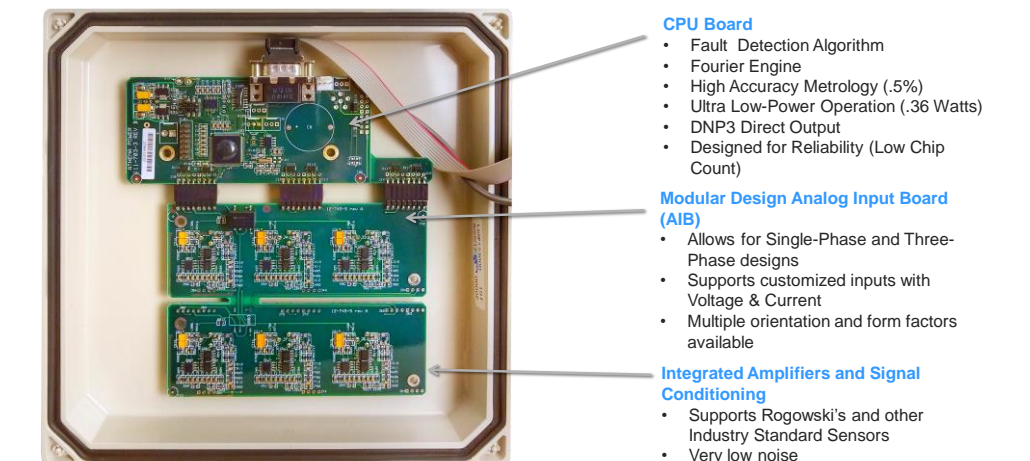
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Pilot Overview

Detroit Edison (DTE) and Athena Power deployed (7) UFD sensors throughout downtown Detroit. The sensors were primarily deployed on Netbanks and Switchgear to monitor and detect faults.

The sensors were custom developed for DTE and were primarily oriented for fault detection. The sensors are three-phase oriented with power harvesting technology and direct DNP3 output. Cellular connectivity (utilizing the Sierra Wireless RV 50) were equipped on each Athena UFD Sensor. Custom Antennas and cables were developed for the netbank asset class to demonstrate strong connectivity and uptime

The majority of the sensors were deployed in 2021 and 2022. The sensor management system from Athena, known as Aegis, was used to manage the sensor. Aegis was also used to manage the data and analyze trends and report the data findings



DTE Deployment Photos

Detroit Edison (DTE) and Athena Power deployed (7) UFD sensors throughout downtown Detroit. Below are photos of the installations that took place in 2021 and Q1 2022



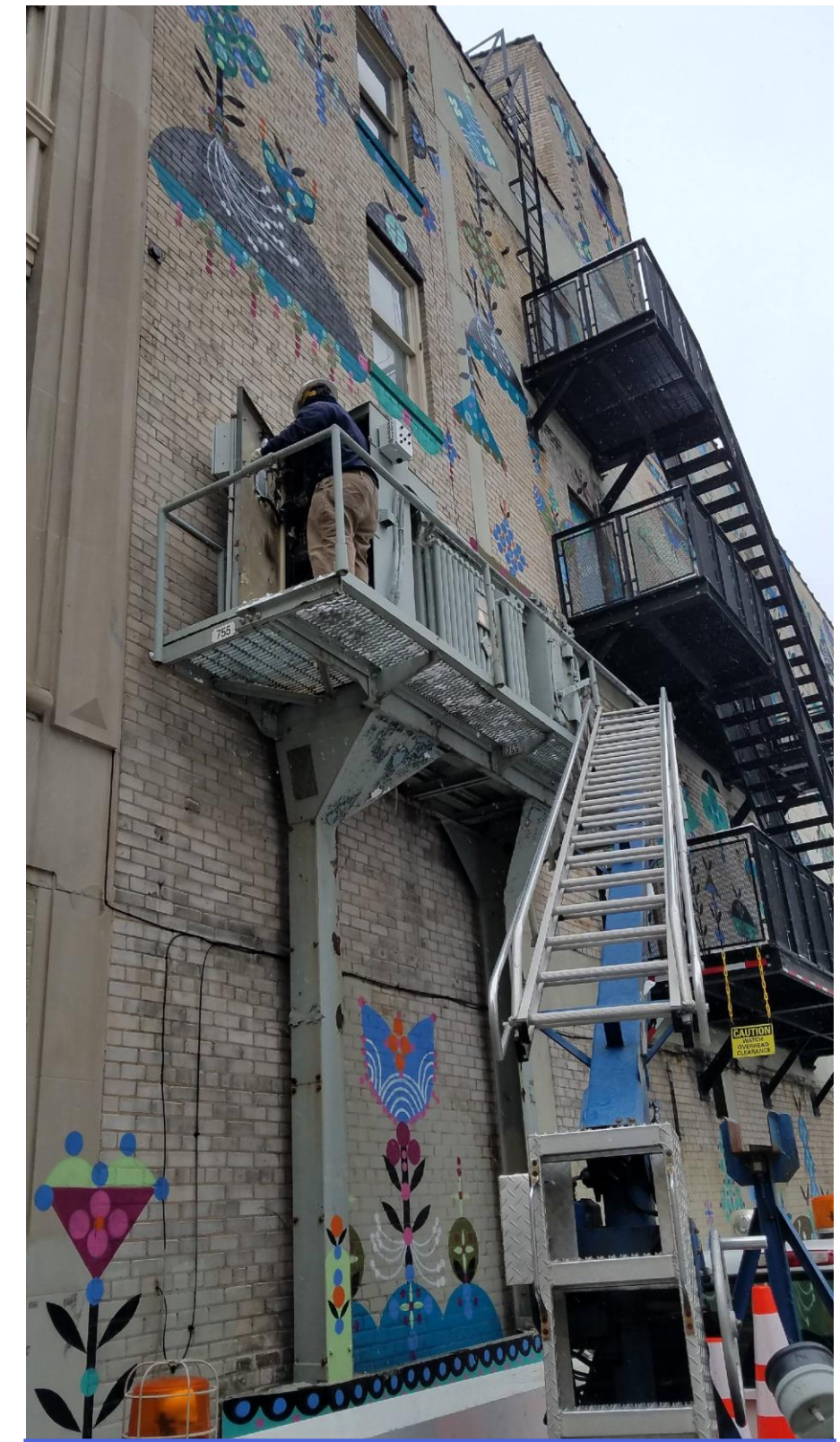
Netbank Installation

Three-phase Current + Neutral was installed on netbanks throughout downtown Detroit. Secondary Power was used to power the unit



Switchgear Installation

Athena sensors were also installed on switchgear at the Detroit Institute of Art. The sensors were utilizing power harvesting technology

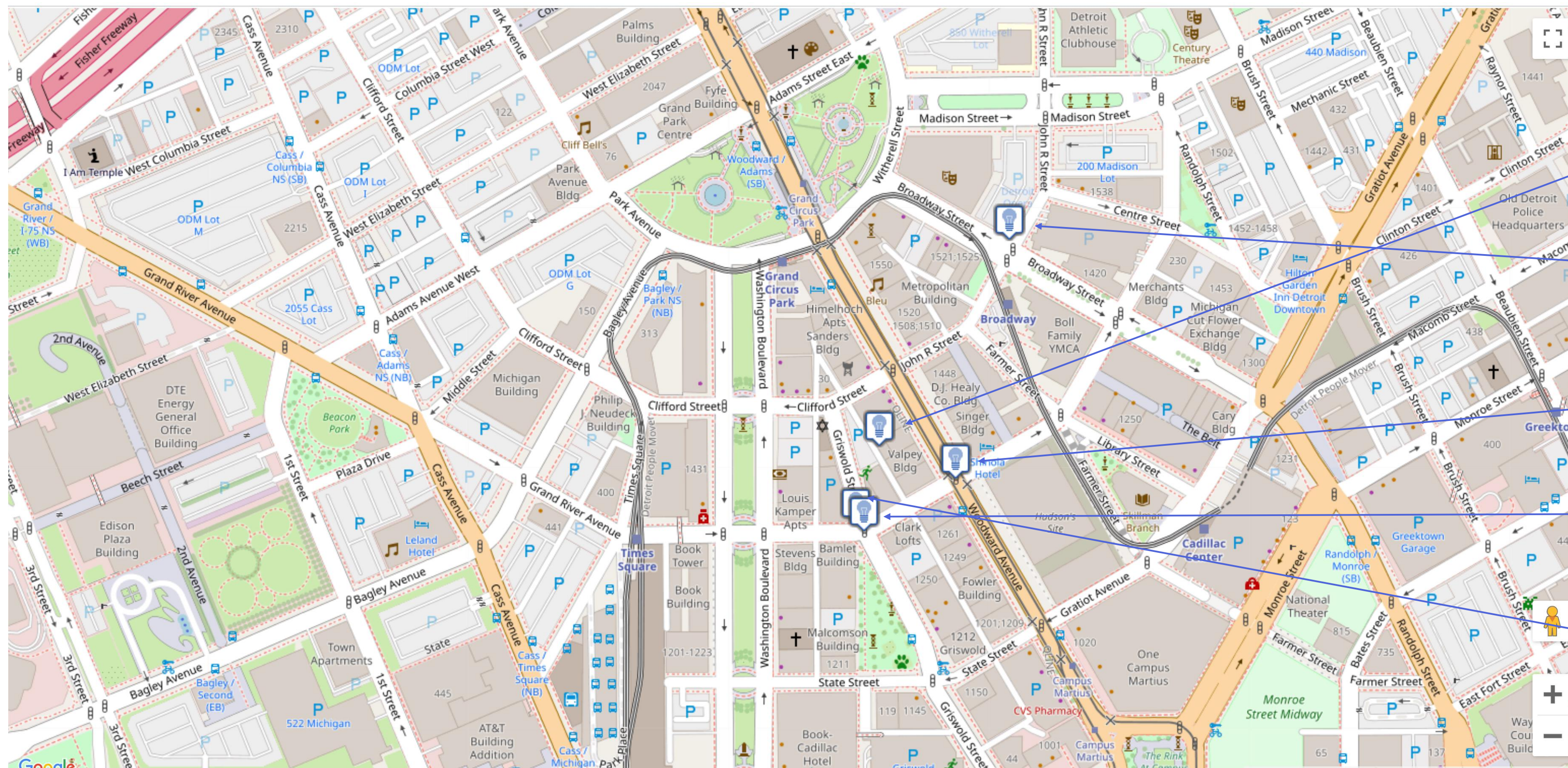


Netbank Installation at John R and Broadway

Deployment Map

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Athena UFD Deployment – Map Topology



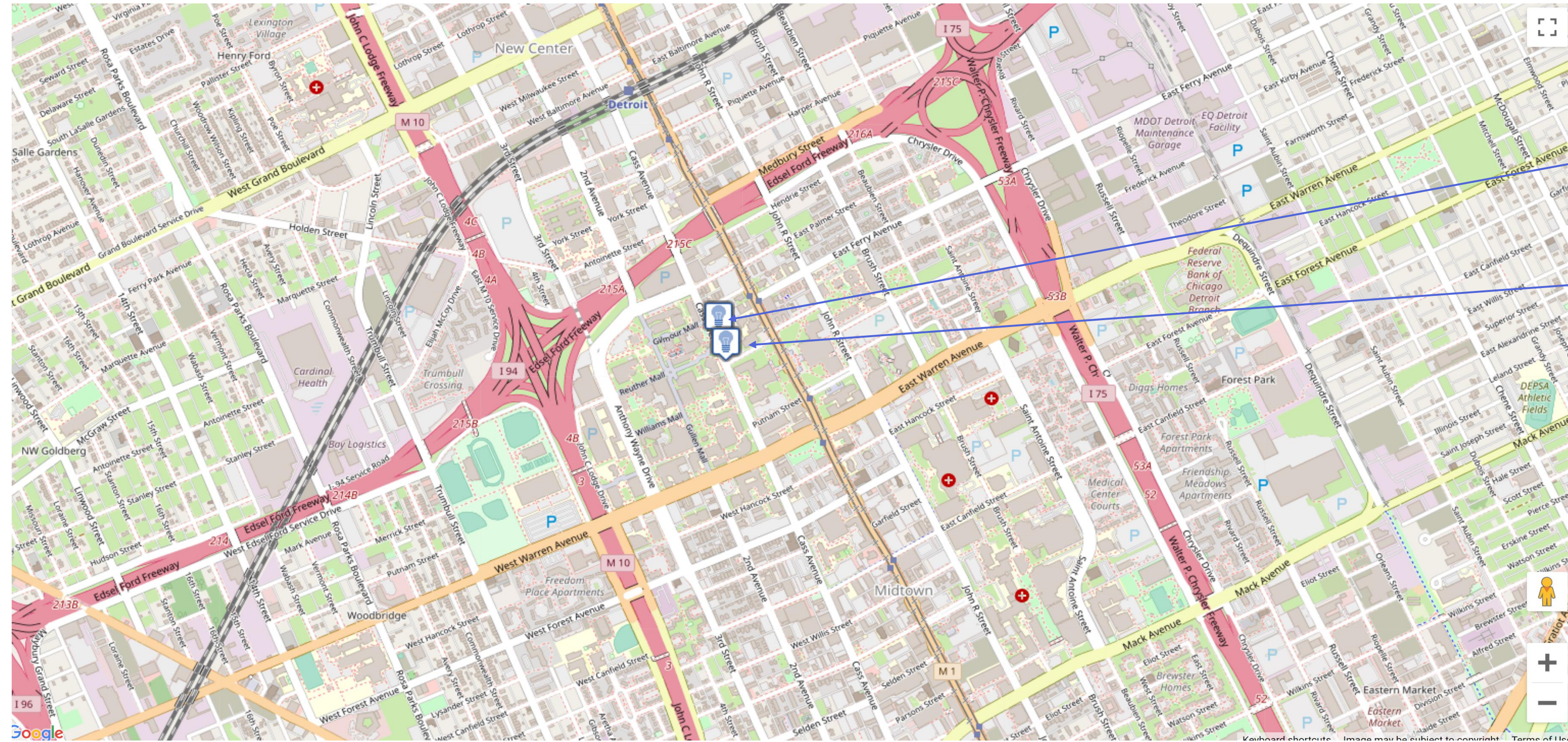
- DTE 1 /NB 755 (Shelby & John R)
- DTE 4 /NB 822 (Broadway & John R)
- DTE 5 /NB 741 (Woodward & Grand River)
- DTE 6 /NB 757 (Griswold & Grand River)
- DTE 7 /NB 748 (Shelby & Grand River)

Downtown Detroit

Asset Class: Netbank



Athena UFD Deployment – Map Topology



DTE 2 (Detroit Institute of Art)

DTE 3 (Detroit Institute of Art)

Asset Class: Switchgear

Downtown Detroit

Pilot Settings

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Monitoring Highlights

DTE Pilot Settings

Configure Device DTE1-NB755-Shelby-John-R

Phase A Threshold: 1000
Phase B Threshold: 1000
Phase C Threshold: 1000
Cycles: 2
Fault Timeout(ms): 40000
 Enable Low Threshold
Current A Low: 50
Current B Low: 50
Current C Low: 50
Heartbeat Interval(Min.): 60
Averaging Queue Size: 5
 Capture Waveform on Faults
 Enable Auto Range
Auto Range Days: 3
Auto Range Percent: 200

	Flood Status	Communication Status		
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Configuration	A Phase	B Phase	C Phase	
Threshold (Amps)	1000	1000	1000	
Cycles	2			
Fault Timeout (ms)	40000			
Heartbeat Interval (Min.)	60			
Averaging Queue Size	5			
Current Low (Amps)	50	50	50	
Capture Waveform on Faults	<input checked="" type="checkbox"/>			
Auto Range	<input type="checkbox"/>			
Auto Range Days	3			
Auto Range Percent	200			

Resolution

- Resolution capture of 1200Hz and 20 samples per cycle
- Scanning/Intervals at every 15min
- Three Phase Current-Only Monitoring

Fault Detection Settings

- High Current threshold set at 1000amps
- 2 Cycles
- Low Current threshold at 50amps

Communications

- 4G Verizon Cellular
- Sierra Wireless RV 50/55 low power radio

Additional Information

- Netbanks powered through secondary power
- Switchgear powered through power-harvesting

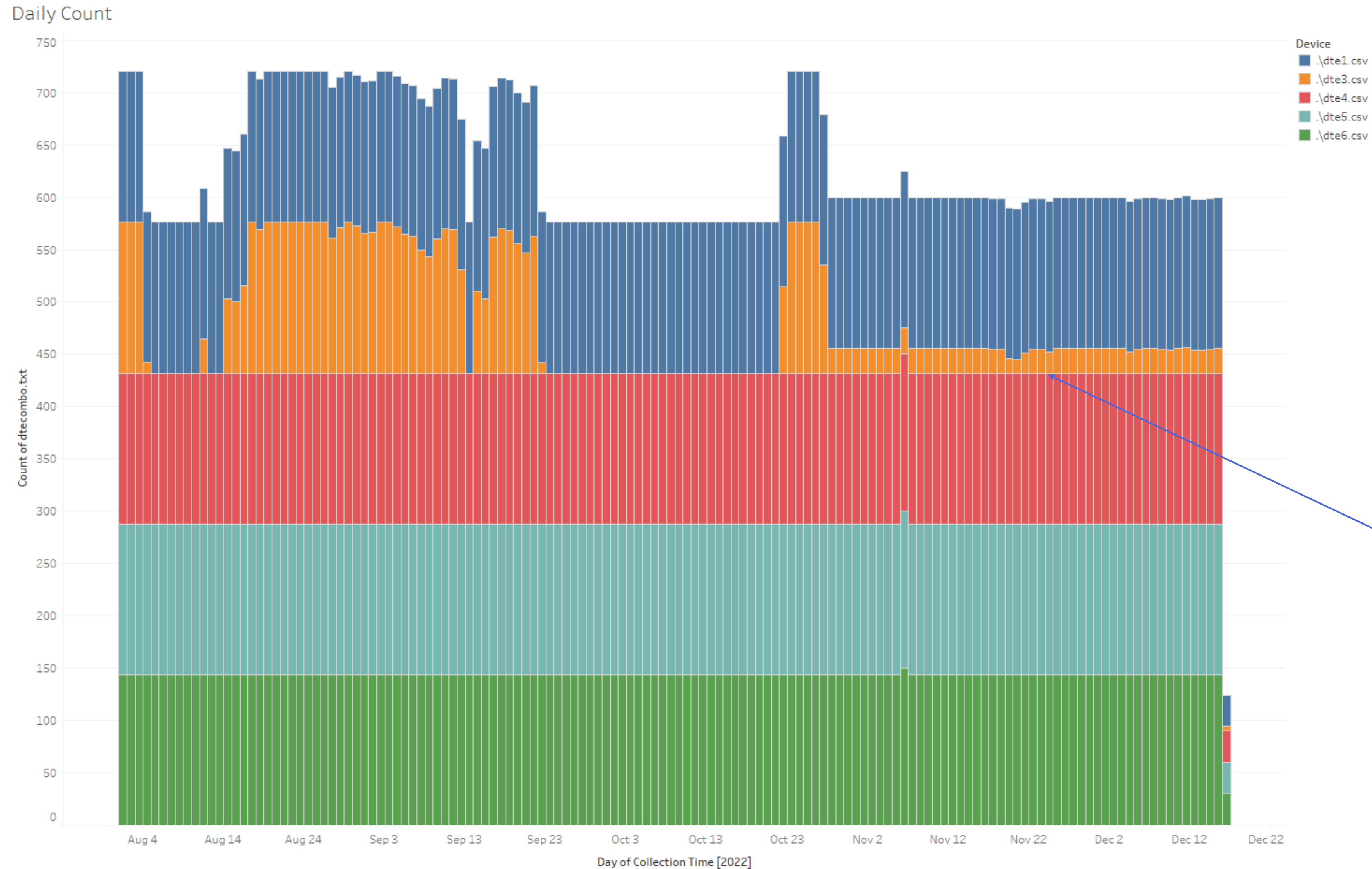


Average Device Uptime: **13,686 Hours / 228 Days**

Data Analysis 2022

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Sensor Daily Count / Collection

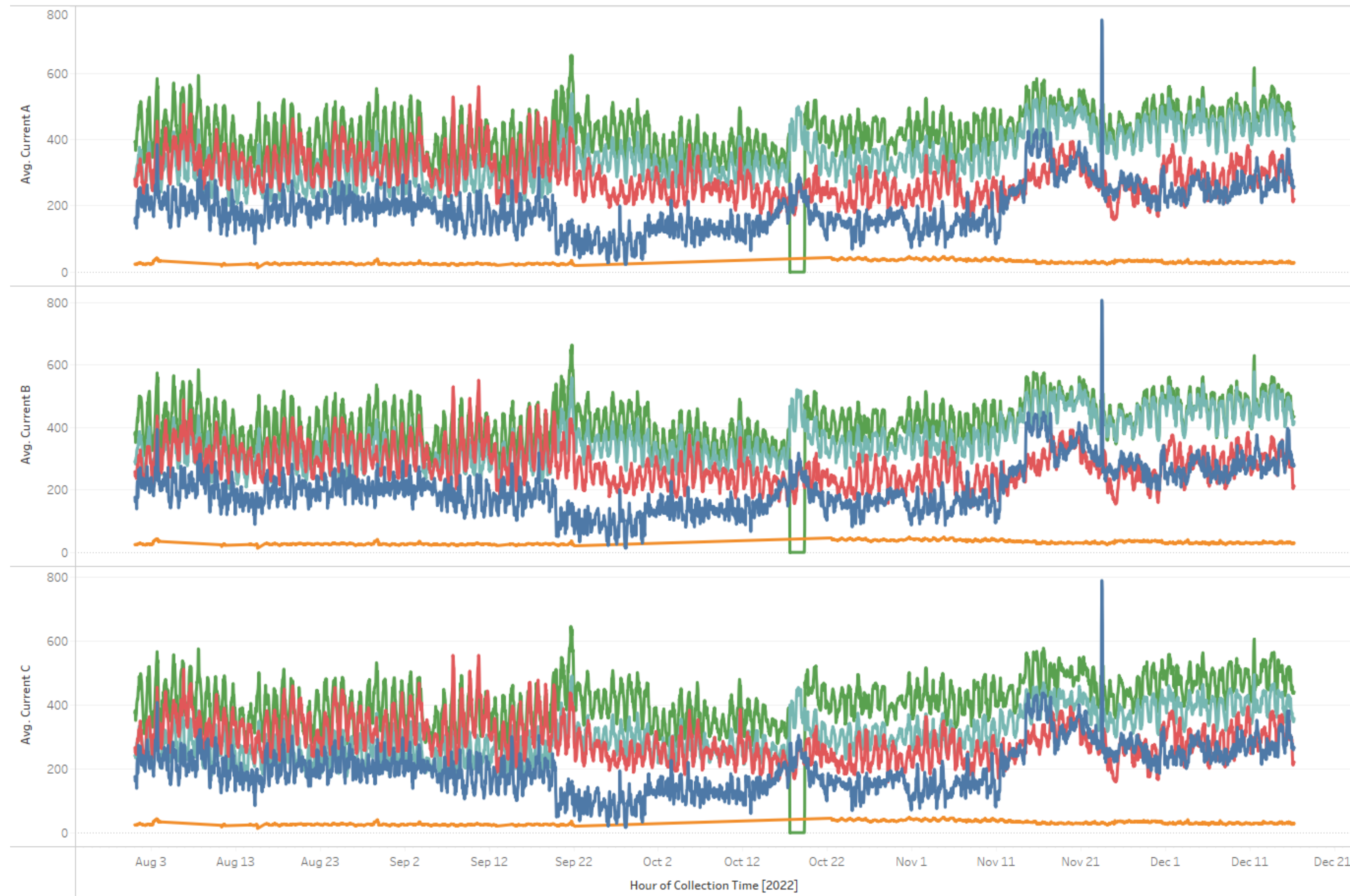


Data Analysis

- 1) Healthy/Consistent Readings from Netbank UFD sensors
- 2) DTE 3 Sensor (orange) readings have gaps due to inadequate power (periods of below 20amps) from power-harvesting operation of switchgear

Average Current Trends

current



Device
 .\dte1.csv
 .\dte3.csv
 .\dte4.csv
 .\dte5.csv
 .\dte6.csv

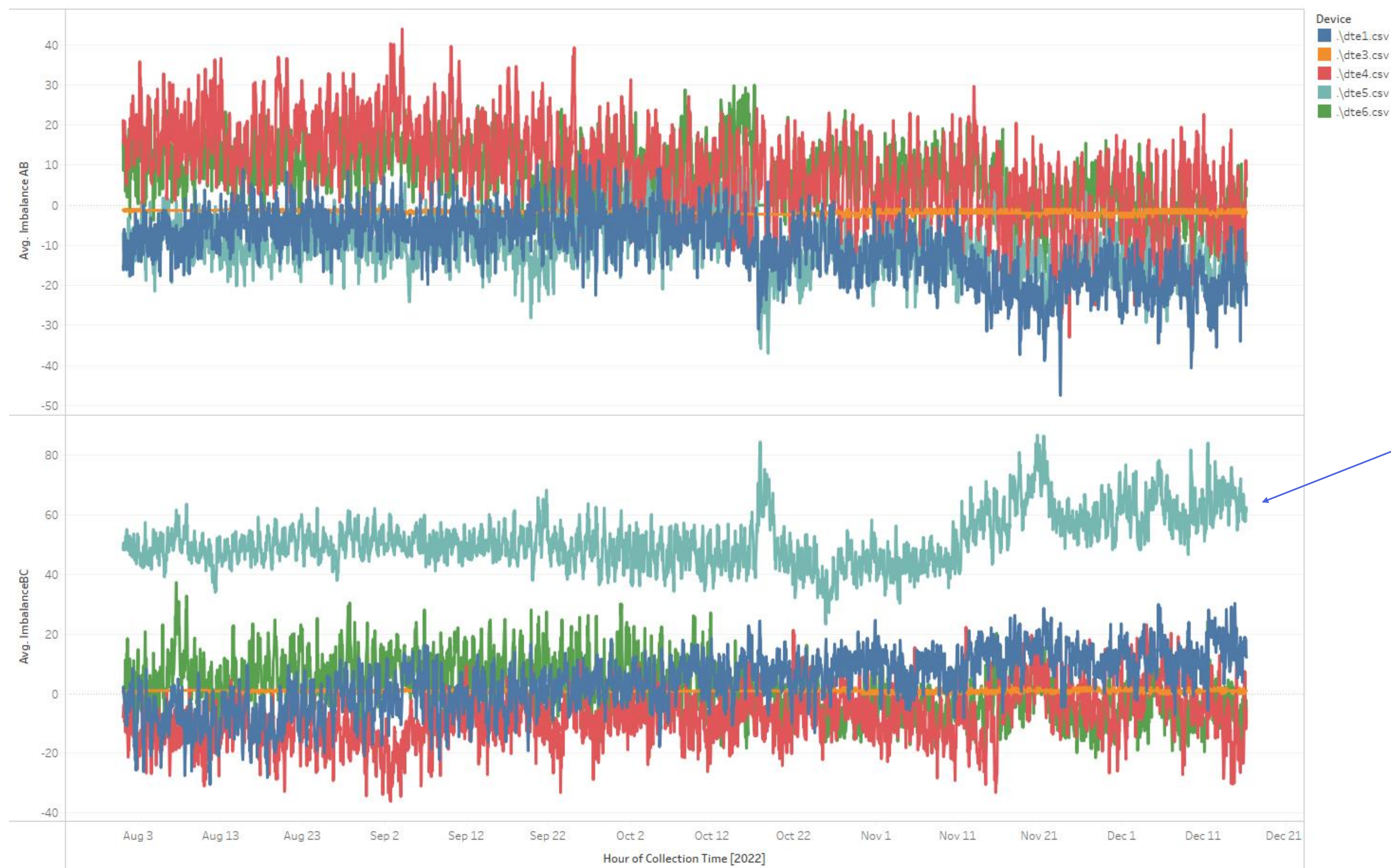
Data Analysis

- 1) Line Current from Sensor 4 & 6 went up (around Sept 22). Line Current for Sensor 1 went down
- 2) Event driven alarm notifications from sensors were sent due to the following Line Current threshold breaches
 - Sensor 6 detected a major drop in Current back in Oct 17th-19th
 - Sensor 1 detected a major spike in Current in Nov 23rd

The trends of average of Current A, average of Current B and average of Current C for Collection Time Hour. Color shows details about Device. The view is filtered on Device, which keeps .\dte1.csv, .\dte3.csv, .\dte4.csv, .\dte5.csv and .\dte6.csv.

Trends of Average Imbalance

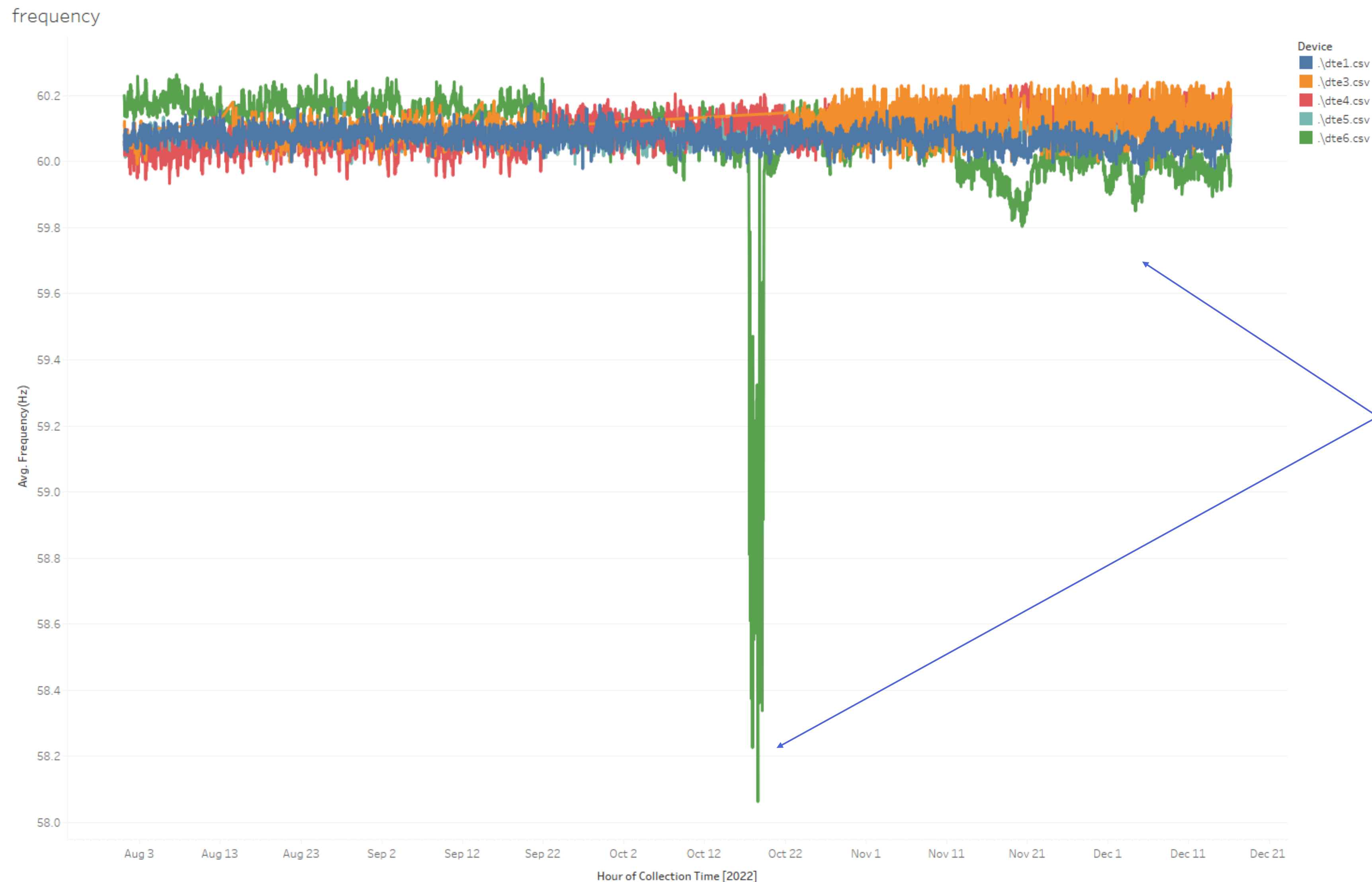
imbalance AB



Data Analysis

- 1) A to B Phases well-balanced through-out sensor readings
- 2) B to C Phases on Sensor 5 unbalanced, based on readings

Trends of Average Frequency

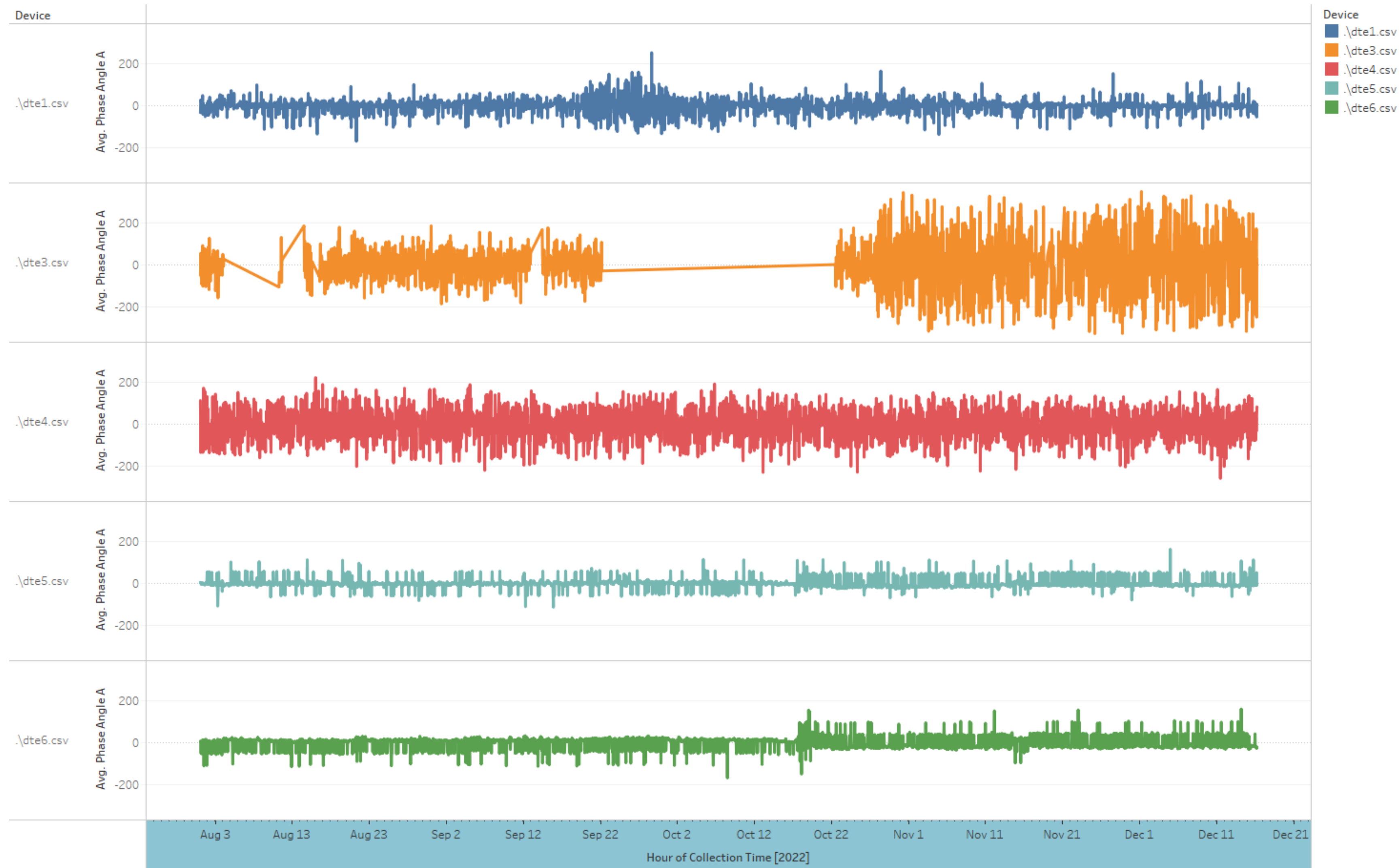


Data Analysis

- 1) Sensor 6 frequency is low, struggling. See Nov timeframe
 - FREQUENCY SHOULD NEVER BE DOING THIS
 - Harbinger of bad things to come

Trends of Average Phase Angle A to B

phase angle

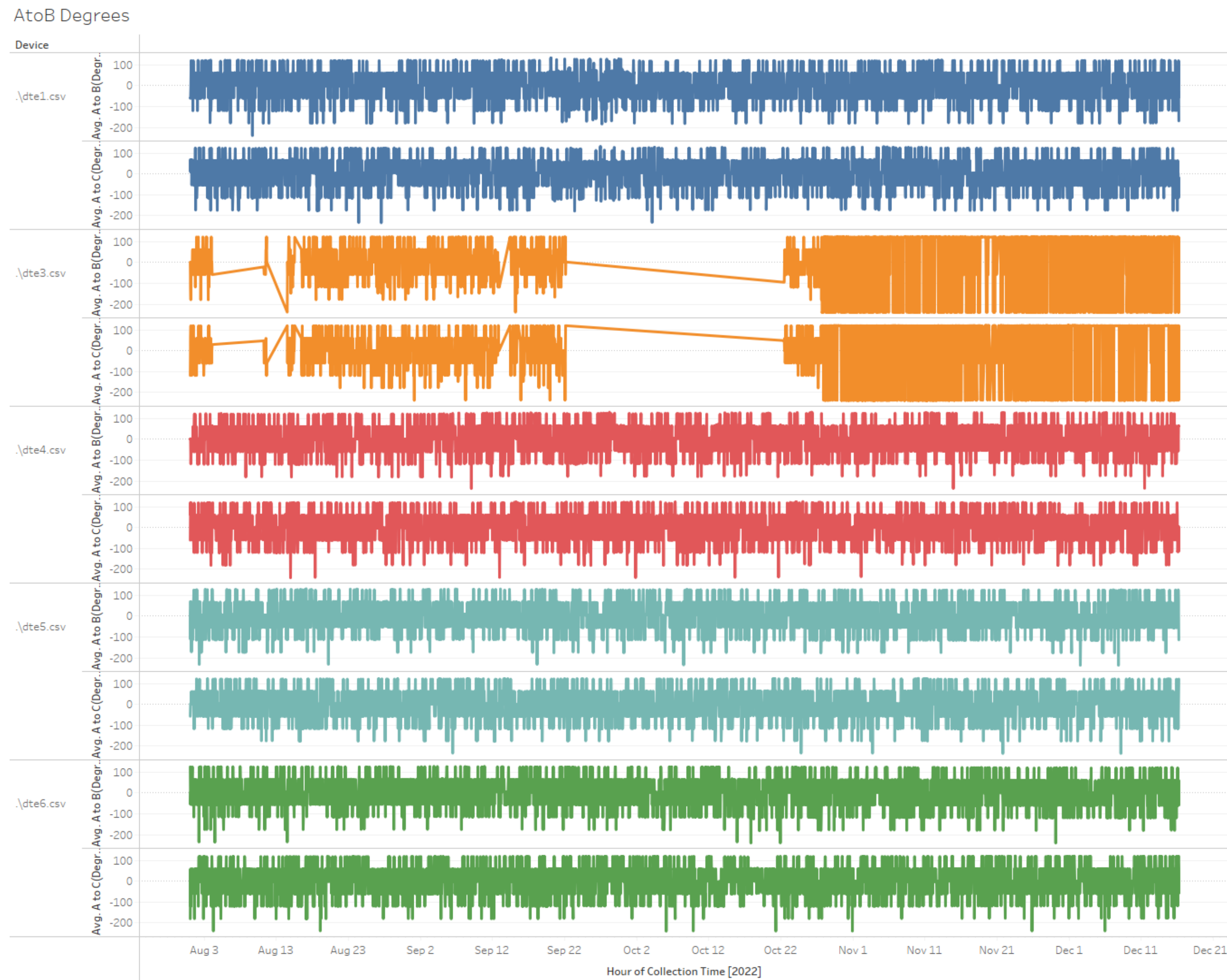


Data Analysis

- 1) No unusual activity in phase angle analysis

The trend of average of Phase Angle A for Collection Time Hour broken down by Device. Color shows details about Device. The view is filtered on Device, which keeps .\dte1.csv, .\dte3.csv, .\dte4.csv, .\dte5.csv and .\dte6.csv.

Trends of A to B and A to C



Data Analysis

- 1) No unusual activity in phase angle analysis

Preliminary Conclusions

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Major Findings from Sensor Readings - 2022

Importance hierarchy:

- 1) Athena recommends looking at Netbank NB 757 (Griswold & Grand River) / Sensor 6
 - Such wild fluctuations going down to 58hz could indicate serious problems
 - The frequency is overall drifting lower, compared to other sensor locations is also unusual
- 2) The major drop in Current from Sensor 6 (NB 757) in Oct and the major spike in Current from Sensor 1 (NB 755) in Nov should be further examined
 - Such fluctuations on either side cause erosions and long-term damage to the equipment