Comparing and Contrasting Power Quality Issues between Kyushu University and the University of Hawaii at Manoa.

Anthony Christe, Sergey Negrashov, Philip M. Johnson
Information and Computer Sciences Department
University of Hawaii at Manoa
achriste@hawaii.edu

Introduction

Electrical power grids are transitioning from centralized to distributed energy generation. Photovoltaics, wind, geothermal, wave, and other sources of renewable energy generation are becoming quite common. However, the intermittent nature of these energy sources can cause imbalances between generation and consumption which in turn can cause power quality (PQ) issues in your home, your neighborhood, or across the entire electrical grid.

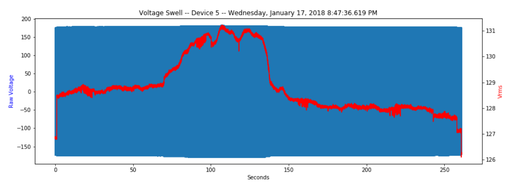
The Open Power Quality project provides a cost effective, scalable, open source hardware and software for collecting, analyzing, and reporting on power quality issues both locally and distributed across the electrical grid.

We propose a collaboration between the University of Hawaii and Kyushu University that would take into consideration the differences between the University of Hawaii's electrical grid and Kyushu University's electrical grid to determine how those differences impact effective and efficient power quality monitoring, collection, and analysis.

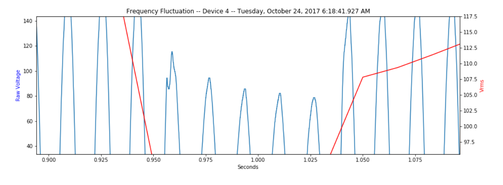
What is Power Quality?

A set of metrics that define the "goodness" of a power supply.

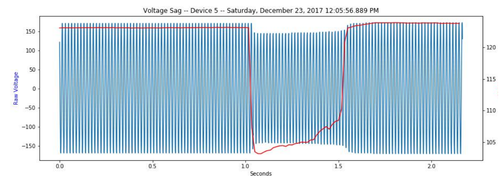
U.S.A 120V@60Hz **W. Japan** 100V@60Hz **E. Japan** 100V@50Hz



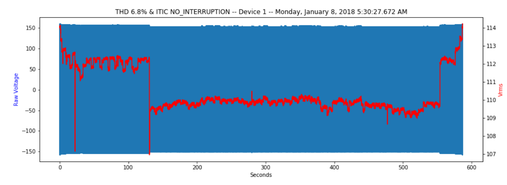
Voltage Swell



Frequency Fluctuation



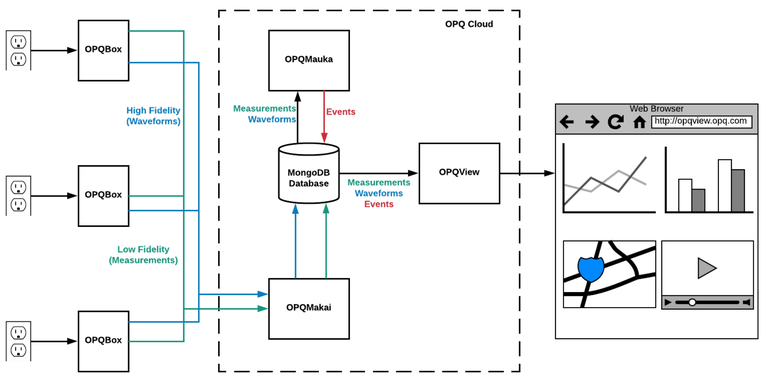
Voltage Sag



THD and ITIC Levels

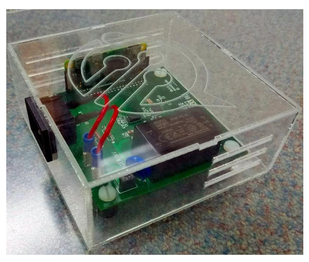
OPQ System Architecture and Components

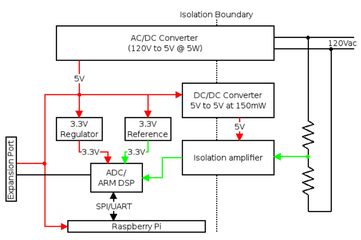
OPQ System



- Distributed Collection of **Open Source** Hardware and Cloud Services that allow for scalable
  - Acquisition
  - Storage
  - Analysis
  - Reporting
  - Analytics

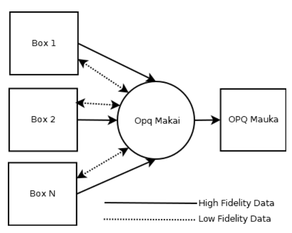
Box





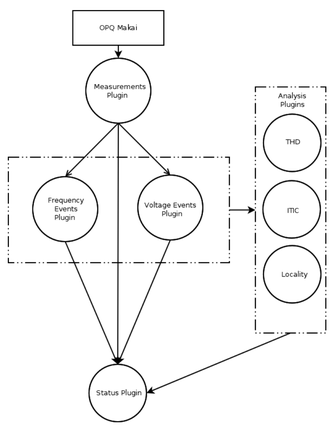
- Open Source Power Quality Monitor
  - Plugs into wall
  - Connects over WiFi
  - Measures Voltage, Frequency, THD
  - Can store raw waveform on board for detailed analysis
  - Inexpensive

Makai



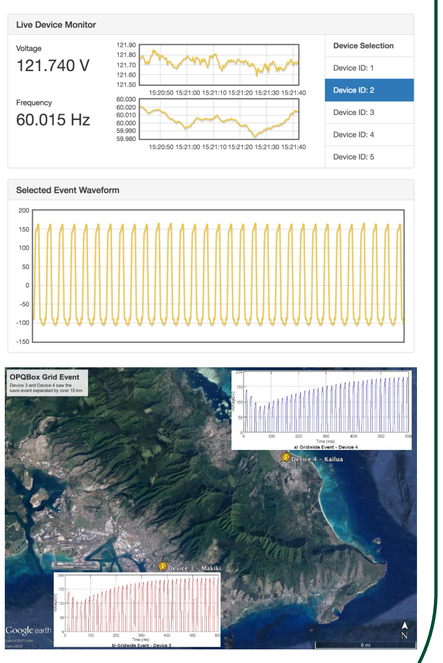
- Monitors low-fidelity feature stream
- Encrypted communications between boxes and Makai
- Triggers on interesting features
  - Requests raw data
  - Stores raw data
  - Forwards raw data to OPQ Mauka for further analysis

Mauka



- High-level Analysis
  - THD
  - ITIC
  - Localization
- Scalable Architecture
  - Distributed Plugins
  - D.A.G. Semantics

View



- Cloud Based Interface for Analysis and Reporting

Collaboration with Kyushu University

We propose a collaboration that would compare and contrast power quality (PQ) between the University of Hawaii and Kyushu University. The collaboration provides opportunities for **hardware design, big data management, data analytics,** and **front end web design.** The intended outcome of this collaboration would be several joint papers, conferences, and progress towards a degree for those involved.

University of Hawaii Provides...

- A set of OPQBoxes
- Full access to data and servers
- Support

Kyushu University Provides...

- Space to install a set of OPQBoxes
- Access to the Kyushu University's WiFi for each Box
- A student to maintain the OPQBoxes at Kyushu University for the duration of the collaboration

And Together We Can...

- Develop algorithms that can characterize PQ
  - Detection
  - Classification
  - Transduction
  - Localization
- Assess how differences in electrical grids impact on the design and implementation of the OPQ system architecture
  - Grid size
  - Voltage / Frequency standards
  - Energy generation
- Assess how differences in renewable energy density contribute to PQ
- Assess how differences in yearly weather patterns contribute to PQ
- Update Open Power Quality to work internationally
  - Update Views for Japanese Users
  - Language Internationalization