Open diverter protocol by 2MuchSun, LLC

Basic Theory of Operation

The PowerMC is the "brains" behind the power diversion process. It communicates to each diverter through a MQTT broker using a diverter protocol developed by 2MuchSun. The protocol is free to use and allows any device to become a power diverter by interfacing with the PowerMC. The diverter protocol is very simple requiring only 5 payloads (figure 1). There are also 4 optional payloads to improve response time and flexibility.

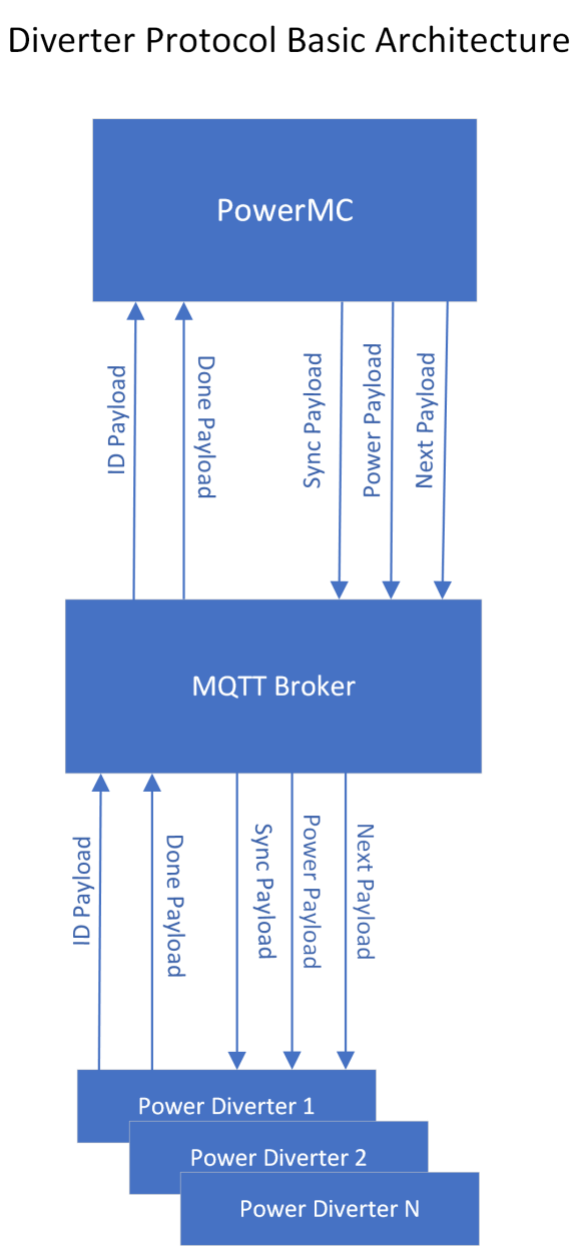

Figure 1

The PowerMC is responsible for:

- measuring and providing power data to all the diverters (Power Payload)

- notifying each diverter (up to 30) when it is their turn to act using a proven proprietary algorithm based on priorities and limits set by the user (Next Payload)

- generating a sync signal for when each diverter should send its information (Sync Payload)

- identifying itself (PM Payload)

- providing a lightweight internal MQTT broker that is limited to 4 connections if not connected to WiFi or 8 connections with WiFi. If you need more connections, use an external MQTT broker.

Each diverter is responsible for:

- determining when and how much to divert when it is its turn (Next Payload)

- sending a done signal when its turn has been completed (Done Payload)

- periodically sending its information at the proper calculated time slot (ID Payload)

How to Use

If you want to make your device into a power diverter, then do the following to use our diverter protocol:

1. Connect your device to the same MQTT broker that PowerMC XX (device number) is connected to. PowerMC has a lightweight internal broker that is limited to 4 connections if not connected to WiFi or 8 connections with WiFi. If you need more connections, use an external broker. If your device cannot communicate using MQTT, then you can program your home automation software to communicate using MQTT on behalf of your device.

2. Subscribe to the following topics at a QOS 0 and process the following payloads accordingly. XX is the device number for the PowerMC.

    - Power data - frequency of update is defined by the "uprate" key (set at PowerMC).
      Power Topic: 2ms/PM/XX/st - **Power Payload:** JSON DICT main:[int W], solar:[int W], extra:[int W], gen:[uint W], imp:[uint W], exp:[uint W], uprate:[uint secs].
      The keys "main", "solar", "gen", "imp", "exp" and "uprate" are not used for the power diverter. They are used for information purposes to display the power usage in other applications. The specific meaning of each one is in the operating manual for the Power MC. The only key that is relevant for the power diverter is the "extra" key. This number can be either positive or negative. If it is negative, then it means your device needs to conserve power. This can be achieved by adjusting it to use less power or turn off. If it is positive, it means your device needs to consume power. This can be achieved by turning on the power or adjusting it to use more power. The goal is to try to adjust your device so that the extra is as close to zero as possible when the PowerMC notifies your device it's time to adjust (Figure 3).

    - PowerMC sync data – alternates between 0 and 1 every 35 seconds.
      Sync Topic: 2ms/PM/XX/s - **Sync Payload:** (int 0-1).
      Use this data to ensure your device's calculated slot time is in sync with the other devices on the network. Every time your device detects a transition from 0 to 1 which is about every 70 seconds, then reset a timer (Figure 2).

    - Next device's turn to respond data - asynchronous based on PowerMC's algorithm.
      Next Topic: 2ms/PM/XX/next - **Next Payload:** JSON DICT NOD:[uint 1-30 number of devices], idx:[uint (0-29) device's assigned index], m:[string to

identify device], d:[int 0 - above reference power, 1 - below reference power] (reference power is the key “offset”), o:[-32,768 to + 32,768 - offset] limit in watts to import to (-) or export from (+) grid, to:[uint 0-255].
This payload data is how your device knows when to respond to adjusting the power usage (Figure 3). Only respond if the key “m” has a string that matches your device’s key “mac” sent in the ID payload. For example, it can be the MAC address of your device. The key “idx” is the assigned index that the PowerMC has been assigned your device. Use the assigned index to indicate to the PowerMC that your device has completed its adjustment when sending the Done Payload. The key “o” (offset) is used to adjust the extra power usage as the target goal to this number. The key “d” (down scan) is used to determine if the adjustments are finished by understanding if the objective is to conserve or consume. A ‘1’ is to conserve and a ‘0’ is to consume which also dictates scan direction of each device with down being from lowest to highest priority. The key “to” used set a time out for the optional temporarily-on feature while waiting on a higher priority device to start using power. If it is 0, it means there is no time out. If it is non-zero, the number is the maximum number of seconds your device should remain on before turning off. Use the non-zero number to start a countdown timer. When the countdown timer reaches zero, send a turn off command to turn off your device regardless of the on/off state or if it is your device’s turn to act.

- Connected PowerMCs data (optional) – updated every 5 seconds.
  PM Topic: 2ms/PM/devs - **PM Payload:** JSON DICT ip:[string],dnum:[int 0-9], mac:[string].
  This allows automatic detection of the PowerMC and selection of PowerMC if you have multiple PowerMC’s. This will determine XX PowerMC device number from the key “dnum” so your device can determine the topic to subscribe to, but you can also hard code it. The key “ip” is the IP address of the PowerMC and the key “mac” is the MAC address of the PowerMC.

- Network’s power usage response time data (optional) - updates asynchronously by a device.
  Response Topic: 2ms/PM/XX/slow_load - **Response Payload** is a number, either 0 for fast or 1 for slow device.
  If your device responds slowly to the actual change in power after an adjustment is made such as a mini split, you can either wait for the power changes before the next adjustment is made or if the key “slow_load” is 0 at any time during the 35 second device reporting in period, your device can continue to adjust as if your device is fast reacting because the other devices with a fast response can cover it to be more efficient in using up the power.

3. Publish to the following topics with the following payloads when the criteria are met

    - Device's ID data - Publish about every 35 seconds at the assigned time slot.
      ID Topic: 2ms/PM/XX/devs - **ID Payload:** JSON DICT dpriority:[int 1-254], dname:[string], mdns:[string], mac:[string], ipower:[int 0 - 65000], ip:[string], tempon[int 0-65535].
      Uses the following ID and Syncing Method depicted below (Figure 2):
      dpriority: device's priority – a lower number means higher priority. If two devices have the same priority, PowerMC will use the key "ipower" next with the lower number means higher priority. The next tie break is the key "mac" with whichever is lower alphabetically is higher priority.
      dname: device's name
      mdns: device's or home automation software computer's mDNS name
      mac: device's MAC address or unique identifier
      ipower: device's power usage when turn on at its lowest setting in W
      ip: device's or home automation software computer's IP address
      tempon: (optional) used for the temporarily-on feature. This is the amount of expected delay in seconds before power is used when your device is commanded to turn on. For advanced users, this is used if you have a device like an EV charger that can have a 10 second delay (depending on EV) before charging starts so specifying this parameter tells the PowerMC how long to temporarily turn on the next device. It is used with the Done Payload.

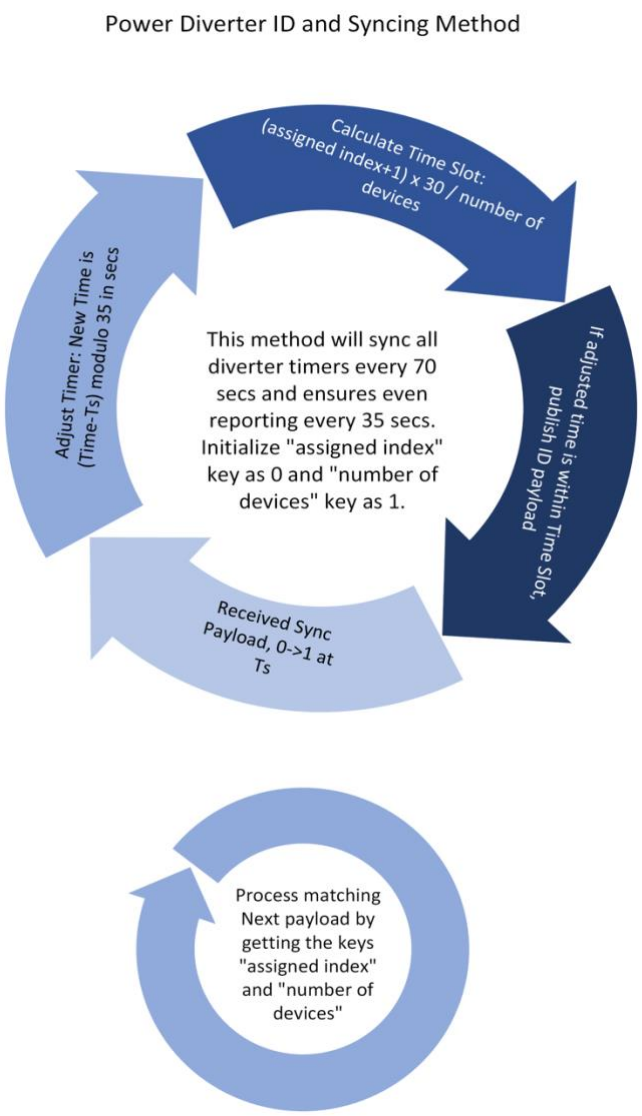

Figure 2

- Device's task completed data – Publish asynchronously when adjustment is finished by following the flow chart below (Figure 3).
  Done Topic: 2ms/PM/XX/done - **Done Payload** is a number that is the [device's assigned index]. If you want to signal a temporary finish and use the optional key "tempon" feature from the ID Payload, then offset the Done Payload by adding 200. This will signal the PowerMC to temporarily turn on the next priority load while waiting for your device to start using power and then return to your device.

How to Handle a Next Payload

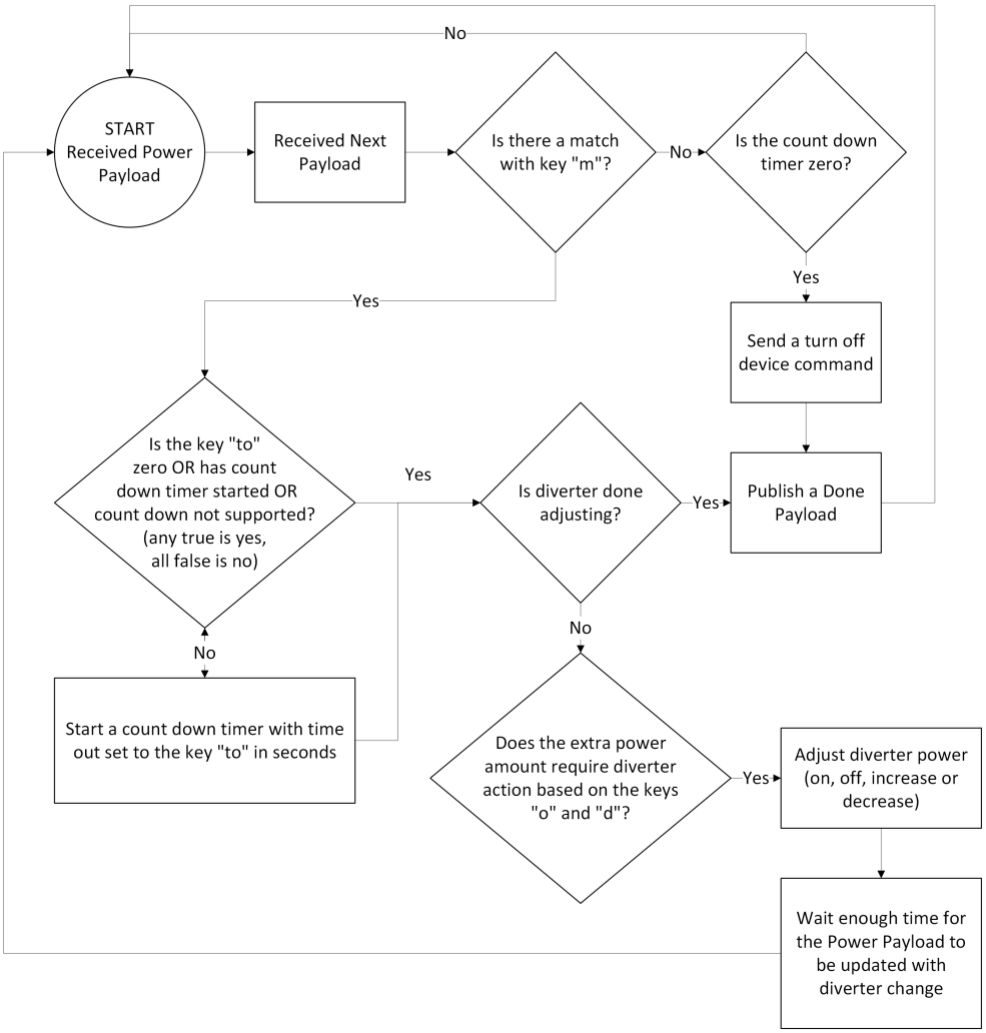

Figure 3

- Device's power usage response data (optional) – publish every 35 seconds on during the same time slot as the ID payload.
  Response Topic: 2ms/PM/XX/slow_load - **Response Payload** is a number either 0 for fast or 1 for slow.
  When your device is ready to react fast when turned on, then publish a 0 otherwise publish a 1.

- Reset priority scanning data (optional) – publish asynchronously whenever device needs the PowerMC to reset current priority.
  Reset Priority Topic: 2ms/PM/XX/rp – **Reset Priority Payload** is 1
  Use this to ensure when the device is set to power diversion mode, it will immediately adjust to the priority order. It will reset to either the lowest priority if the key "d" from the Next Payload is 1 or to the highest priority if the key "d" from the Next Payload is 0.