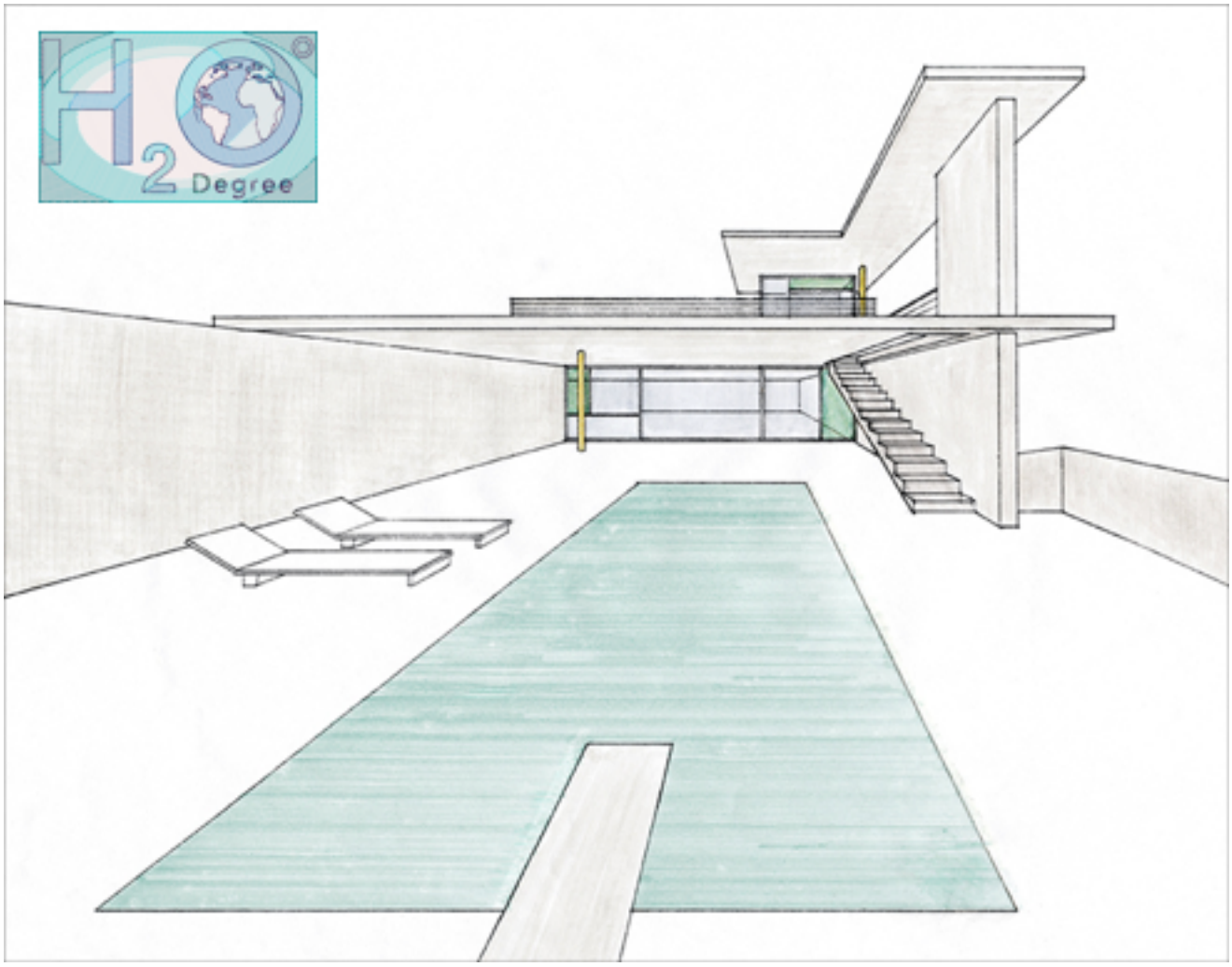

Data Conduit Options and Capabilities

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SUMMARY

Goal

This document communicates the various methods of data delivery and formats available to our end users or data partners.

Objectives

Describe the various data delivery methods and provide benefits of choice as well as potential problems.

Provide examples of the data formats for the different data delivery methods.

Revision	Date	Who	Reason
01901706-1	7/6/2019	Bill Wild	Initial
0191025-1	10/25/2019	Bill Wild	Minor changes to format
200124-1	01/24/2020	Bill Wild	Clarity on data push/pull in chart

DATA DELIVERY METHODS AND FORMATS

Periodic CSV Read File

TIP: There are almost no limitations to the configuration of the CSV file. If you have any questions about customization please contact your sales representative or contact data management support.

A CSV file can be delivered via various methods and at different intervals with daily being the most frequent. The data that is delivered in a CSV file is aggregated at the apartment level separated by the commodity and / or equipment type depending on the install configuration or requirements. This removes the need for the recipient to keep track of equipment swap outs and equipment status. The aggregated data is a read and is not representative of consumption.

We provide an apartment ID that is globally unique and non repeating which can be used to relate to the mailing address of the tenant. The CSV file is by default set to provide the configuration file in each file so that any changes can be communicated to the receiving software in an automated fashion if the software being used is able to parse format automatically. If the data partner already has an ID that they wish to use we can include this along with or in stead of the H2O Degree ID.

Our system processes millions of records a day and provides many essential and value added calculations to each read we receive. After processing the final daily read is determined and any post processing calculations occur. For this reason the CSV file can be sent as often as once a day or as infrequently as needed. If you need more frequent or real time data our Real Time Data Push may be more appropriate. File delivery time is roughly 9AM UTC.

Below is a chart of the various data delivery methods that are available for the CSV file.

CSV Delivery Method	Secure	Frequency	Direction
sFTP	Yes	Daily to Infinity	Push from H2O
FTP	No	Daily to Infinity	Push from H2O
EMail	No	Daily to Infinity	Push from H2O
Manual Pull from Portal	Yes	Daily	Pull from H2O Portal

Calculated Use Reports

H2O Degree currently provides usage reports for data partners that do not use billing software. We currently only make water use available from our portal using a certified report but other commodities can be made available upon request. Currently the calculated use reports are only available via a manual pull.

Calculated use reports are most frequently used by end users who choose to bill their residents directly.

Running a calculated use report is as simple as logging in to the portal , selecting the appropriate property and date range. The report can be exported to a CSV to be used in Excel or various other tools commonly used for data.

Real Time Data Push

H2O Degree offers an option for real time data push to an external receiving API. This offers the data partner the opportunity to see data in real time as it arrives.

Typically our data partner creates an HTTPS endpoint API for us to push data to. We primarily use Python to develop our data push workers so that a wide variety of available secure delivery methods are available to use if desired. We currently do not offer an API to pull data.

Data arriving from the real time push will have all of the same information that is included in the CSV file along with various other elements that can assist the receiver with troubleshooting. Any factoring or other data normalizing will already be done before pushing the data.

The data will include appropriate IDs to allow a positive relationship. Some partners have developed methods of building the property configuration from just this data. If this is not possible or desired we can establish a back channel for delivery of a configuration file.

Data frequency is determined by many factors such as number of nodes , types of nodes and local environment. Line powered devices and battery powered pulse counters will send one commodity packet an hour by default. Battery powered Aqura water meters send one packet every 12 hours by default. Aqura meters can be configured to send once an hour for more granular data analysis. If a power outage occurs at the site the line powered devices will "synch" up when the power returns but we use a jitter which will assist in spreading them out over time.

If for some reason our system cannot contact your server data delivery will pause and resume where it left off when communication was lost.

Our Zigbee gateway systems retain a buffer of up to 300,000 records locally. If the gateway loses connection to our server for a period of time that does not allow the buffer to overrun no data will be missed. Buffer overrun is dependent upon the number of nodes per gateway and other factors such as real time control which increases the data load. This does not apply to LoRa systems. If the packet forwarder loses connection to the data broker any data sent during that time will be lost.

DATA FORMAT SAMPLES

CSV Read File

The CSV file contains a header section that has each lone prefixed with a hash sign. This is used to communicate information about the file format and also allow for data importation processes to easily identify and strip out these lines since they do not contain any data relevant to any commodity measurements.

```
#, , , , , , , , ,
# read file for,Sutton_Towers, , , , , , ,
# using name for file of,Sutton_Towers, , , , , , ,
#, , , , , , , , ,
# prepared on,Apr 23 2019  8:45AM, , , , , , ,
# read date,04/22/2019, , , , , , ,
#, , , , , , , , ,
#,default filename format (excluding date):,{property_name}_{billing co property id}, , , , , ,
#,contact h2o to update,billing co property id number, , , , , ,
# please note electric meter scale, , , , , , , ,
#, , , , , , , , ,
# column key, , , , , , , ,
#, , , , , , , , ,
#     apartment id -,this is a unique id assigned by H2O.,this will never repeat.,this is not a device serial number., , , , ,
#     apartment_account_number -,an id number that can be assigned by,the billing co or management, , , , , ,
#     commodity -,verbal description of the commodity, , , , , , ,
#     reading -,current total apartment register,for commodity, , , , , ,
#     estimate_flag -,are the readings an estimate. 1 = yes 0 = no.,only applies to non pulse water meters, , , , , ,
#     date -,date of the reads, , , , , , ,
#     building_name -,common name of building.,can change.,do not key on this value, , , , ,
#     apartment_number -,common name of apartment.,can change.,do not key on this value, , , , ,
#     property_name -,common name of property.,can change.,do not key on this value, , , , ,
#     building_name -,common name of building.,can change.,do not key on this value, , , , ,
#     billing_co_assigned_property_id -,same as value in filename.,can be changed., , , , , ,
#, , , , , , , , ,
#, , , , , , , , ,
#
apartment_id,apartment_account_number,commodity,reading,estimate_flag,date,building_name,apartment_number,property_name,billing_co_
assigned_property_id
#, , , , , , , , ,
#, , , , , , , , ,
31455,0,cooling_runtime_hours,8594,0,04/22/2019,1,101,Sutton Towers,14529
31456,0,cooling_runtime_hours,8816,0,04/22/2019,1,102,Sutton Towers,14529
31457,0,cooling_runtime_hours,6457,0,04/22/2019,1,103,Sutton Towers,14529
31455,0,electric_100_watt_hours,747942,0,04/22/2019,1,101,Sutton Towers,14529
31456,0,electric_100_watt_hours,513282,0,04/22/2019,1,102,Sutton Towers,14529
31457,0,electric_100_watt_hours,440687,0,04/22/2019,1,103,Sutton Towers,14529
```

331455,0,heating_runtime_hours,3925,0,04/22/2019,1,101,Sutton Towers,14529
31456,0,heating_runtime_hours,2533,0,04/22/2019,1,102,Sutton Towers,14529
31457,0,heating_runtime_hours,5407,0,04/22/2019,1,103,Sutton Towers,14529
31455,0,water_gallons,295178,0,04/22/2019,1,101,Sutton Towers,14529
31456,0,water_gallons,175867,1,04/22/2019,1,102,Sutton Towers,14529
31457,0,water_gallons,187999,0,04/22/2019,1,103,Sutton Towers,14529

Real Time Data Push

JSON Sample


```
{   “post_timestamp":1486403957,
    "h2o_worker_id":"test_wall_1486403920",
    "config_update_timer":86365,
       "dataset": {    "000D6F000542FCB3-14557":
                    {   "header":
                        {   "serial_number":"000D6F000542FCB3",
                            "timestamp":"2017-02-04 20:03:13",
                            "gateway_hostname":"joes_green_2",
                            "tx_count":14557,
                            "data_interval":3600,
                            "reset_count":31,
                            "unit_code":190,
                            "bedroom_count":2.0,
                            "bathroom_count":1.0,
                            "location_assignment":
                              {   "property_name":"Joes Village Green",
                                  "building_name":"Kingstop Ave 123",
                                  "apartment":"4",
                                  "property_id":528,
                                  "building_id":3199,
                                  "apartment_id":50292,
                                  "unique_id":246654 },
                            "meter_type":"submeter",
```

```
            "attached_to":"Main Feed Single",
            "commodity":"aqura_water" },
        "payload": {    "gallons":35909,
                    "events":25737,
                    "flow_time":21381 }
    },
"000D6F00055C2DE3-7328":
    {   "header":
        {   "serial_number":"000D6F00055C2DE3",
            "timestamp":"2017-02-04 20:03:30",
            "gateway_hostname":"joes_green_1",
            "tx_count":7328,
            "data_interval":3600,
            "reset_count":20,
            "unit_code":190,
            "bedroom_count":2.0,
            "bathroom_count":1.0,
            "location_assignment":
              {   "property_name":"Joes Village Green",
                  "building_name":"Southside Drive 5203",
                  "apartment":"4",
                  "property_id":528,
                  "building_id":3218,
                  "apartment_id":51030,
                  "unique_id":253798
              },
            "meter_type":"submeter",
            "attached_to":"Main Feed Single",
            "commodity":"aqura_water" },
        "payload": {    "gallons":14197,
```

```
                    "events":11472,
                    "flow_time":7889 }
                }
            }
}
```


Element Definitions

unique_id - a non repeating id that identifies a device in our database

packet_key - eui + tx_count for JSON validation

serial_number - serial number of the device

meter_type - sub meter, master , common

unit_code - defines the packet content and relates to the commodity - not used outside of H2O very often but helpful when discussing specifics about payload and payload options

install_date - AKA provisioning date - date it was provisioned in our system

attached_to - description of what the device is monitoring - toilet , main feed cold , electric meter , shower etc...

tx_count - tx counter from our device . for most this is a perpetual register

reset_count - number of times the device has reset . has some diagnostic value

packet_timestamp - timestamp from the gateway on site . this is when the gateway received the packet. it is local to the gateway timezone.

commodity - gallons, 100_watt_hours , ccf_gas etc

data_interval - configured number of seconds that the device will transmit a packet . useful in determining if there was a missed packet.

gateway_hostname - hostname of the gateway that the device is reporting to. useful to see if the device is switching networks in a multi network location. necessary or sending any data to a device such a a thermostat to change the current set point

Device / Commodity Specific

Aqura water meter:

gallons - perpetual gallons register

events - perpetual events register - event example would be a toilet flush

flow_time - minutes the device has seen water flow

Pulse water

gallons - perpetual gallons register

Pulse Gas

ccf

Thermostat

heat_runtime_seconds

cool_runtime_seconds

fan_runtime_seconds

Electric

kwh

REVISION GLOSSARY

01901706-1 - Initial release and consolidation from multiple data sources.
0191025-1 - Removed prepared for and changed format of revision