Report

HVAC system at MPC Lab

(2169 Etcheverry Hall – UC Berkeley)

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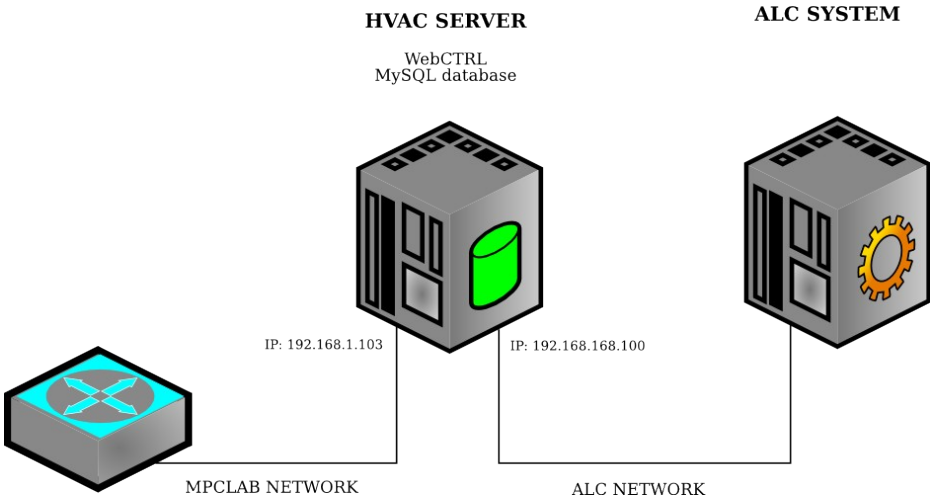
1 Overview of the network



2 HVAC Server configuration

- IP addr. in MPCLAB network: 192.168.1.103 (assigned by DHCP, the mpclab network router is configured to assign always this address)
- *MS Windows Vista Business* account:
  - username: MPC
  - password: MPCserver
- *WebCTRL* admin:
  - username: MPC
  - password: MPCserver
- *WebCTRL* SOAP user:

- username: MPCLABSOAP
- password: mpclabsoap

- MySQL admin account:
  - host: localhost:3306
  - username: MPC
  - password: MPCserver

2.1 WebCTRL SOAP interface

WebCTRL uses **points** and **trends**. Trends are the past points' values. Some of those values (the latest) are stored in the modules, some others (the oldest, called **historian**) in the database on the HVAC Server (we use MySQL). Table 1 lists points and Table 2 lists trends.

Trends are available in read-only mode using the Trend SOAP Service:
`/_common/services/TrendService?wsdl`

Points are available (read and write) using the Eval SOAP Service:
`/_common/services/EvalService?wsdl`

2.1.1 Example of read-write point

Each point has a unique GQL path (e.g. `#etc_fcu_-_sample_equipment/chw_valve`) and it is characterized by 3 values:

- `#etc_fcu_-_sample_equipment/chw_valve/present_value`
  is the read only value currently used by the ALC system;
- `#etc_fcu_-_sample_equipment/chw_valve/locked_value`
  is the writable value;
- `#etc_fcu_-_sample_equipment/chw_valve/locked`
  is a writable binary value. If locked=on, then present_value takes the locked_value, else present_value is determined by the ALC system logic.

2.2 Database dimension

We store approximately 54 entry each minute (see Table 2 for details) => ~77k entry/day.

Each entry occupies ~8.3 * 10^{-5} MB => **~6.5 MB/day** = ~2.4 GB/year.

Available space on the hard disk is today ~178GB => we can store data for more than 70 years.

3 Matlab interface

Matlab communicates using SOAP with the HVAC server.

The following functions allow to get trends and get/set current point values.

3.1 Get trends

```
function trend = get_alc_trend(system,trendname,sTime,eTime)
% Load trend data from ALC system
% input 1 - structure with url, user and pwd of the ALC system
% input 2 - name of trend, such as: '#etc_oa_terminal_-_sample_equipment/oat'
% input 3 - start time as date vector, datenum, or date string
% input 4 - end time as date vector, datenum, or date string
% output - timeseries object containing trend data vs time
%
% example: to get outside ambient temperatures for the past day,
%    system = struct('type', 'soap', 'url','http://192.168.1.103','user','MPCLABSOAP',
      'pwd','mpclabsoap');
%    trend = get_alc_trend(system,'#etc_oa_terminal_-_sample_equipment/oat',now-1,now)
```

4 Get current point value

```
function value = get_alc_value(system, pointname)
% Get the current value of an ALC system point
% input 1 - structure with url, user and pwd of the ALC system
% input 2 - name of point, such as: '#etc_fcu_-_sample_equipment/sf_vfd_output'
% output - current value (double)
```

4.1 Set point value

```
function set_alc_value(system, pointname, value)
% Set an ALC system point to be locked to a value
% input 1 - structure with url, user and pwd of the ALC system
% input 2 - name of point, such as: '#etc_fcu_-_sample_equipment/sf_vfd_output'
% input 3 - value to be set
%
% Example: to set the fan speed to 100%,
%    system = struct('type', 'soap', 'url','http://192.168.1.103','user','MPCLABSOAP',
      'pwd','mpclabsoap');
%   set_alc_trend(system,'#etc_fcu_-_sample_equipment/sf_vfd_output',100)
```

4.2 Unset point value

```
function unset_alc_value(system, pointname)
% Unset the point of an ALC system: the point will be unlocked
% input 1 - structure with url, user and pwd of the ALC system
% input 2 - name of point, such as: '#etc_fcu_-_sample_equipment/sf_vfd_output'
```

Table 1: List of points

Name	Type	I/O Type	Min/Max	Locked	GQL Path
Zone Temp 1	BRS				/#etc_fcu_-_sample_equipment/lstat
Zone Temp 1 / Zone Temp	BAI	1	(45/96)		/#etc_fcu_-_sample_equipment/lstat/zone_temp
Zone Temp 1 / Override Time Remaining	BAV				/#etc_fcu_-_sample_equipment/lstat/override_time_remaining
CHW Coil DP	BAI	0-20 mA	(4/20)		/#etc_fcu_-_sample_equipment/chw_coil_dp
CHWR Temp	BAI	Thermistor	(0.00/120.00)		/#etc_fcu_-_sample_equipment/chwr_temp
CHWS Temp	BAI	Thermistor	(0.00/120.00)		/#etc_fcu_-_sample_equipment/chws_temp
CHW VLV FDBK	BAI	0-10 Volt	(0/100)		/#etc_fcu_-_sample_equipment/chw_vlv_fdbk
Duct Static Pressure	BAI	0-20 mA	(0.00/1)		/#etc_fcu_-_sample_equipment/static
HW Coil DP	BAI	0-20 mA	(4/20)		/#etc_fcu_-_sample_equipment/hw_coil_dp
HWR Temp	BAI	Thermistor	(0.00/120.00)		/#etc_fcu_-_sample_equipment/hwr_temp
HWS Temp	BAI	Thermistor	(0.00/120.00)		/#etc_fcu_-_sample_equipment/hws_temp
HW VLV FDBK	BAI	0-10 Volt	(0/100)		/#etc_fcu_-_sample_equipment/hw_vlv_fdbk
MAT Averging Sensor	BAI	Thermistor	(0.00/120.00)		/#etc_fcu_-_sample_equipment/mat_avg_sensor
MAT Pnt Sensor	BAI	Thermistor	(0.00/120.00)		/#etc_fcu_-_sample_equipment/mat_pnt_sensor
Prefilter DP	BAI	0-20 mA	(0.00/5.00)		/#etc_fcu_-_sample_equipment/pfilter_dp
Ret Air Temp 1	BAI	Thermistor	(0.00/120.00)		/#etc_fcu_-_sample_equipment/ra_temp_1
Ret Air Temp 2	BAI	Thermistor	(0.00/120.00)		/#etc_fcu_-_sample_equipment/ra_temp_2
Ret Dmpr 1 Fdbk	BAI	0-10 Volt	(0/100)		/#etc_fcu_-_sample_equipment/ret_dmpr_1_fdbk
Ret Dmpr 2 Fdbk	BAI	0-10 Volt	(0/100)		/#etc_fcu_-_sample_equipment/ret_dmpr_2_fdbk
Room CO2	BAI	0-20 mA	(0.00/2000)		/#etc_fcu_-_sample_equipment/ra_co2
Sup Dmpr 1 Fdbk	BAI	0-10 Volt	(0/100)		/#etc_fcu_-_sample_equipment/sup_dmpr_1_fdbk
Sup Dmpr 2 Fdbk	BAI	0-10 Volt	(0/100)		/#etc_fcu_-_sample_equipment/sup_dmpr_2_fdbk
Supply Air Temp	BAI	Thermistor	(0.00/120.00)		/#etc_fcu_-_sample_equipment/sa_temp
Zone Temp 2	BAI	Thermistor	(0.00/120.00)		/#etc_fcu_-_sample_equipment/zone_temp_2
Cooling Valve	BAO	Electrical 0-10 Volt	(0.00/100.00)		/#etc_fcu_-_sample_equipment/chw_valve
Heating Valve	BAO	Electrical 0-10 Volt	(0.00/100.00)		/#etc_fcu_-_sample_equipment/hw_valve
Ret Damper 1	BAO	Electrical 0-10 Volt	(0.00/100.00)		/#etc_fcu_-_sample_equipment/rd1
Ret Damper 2	BAO	Electrical 0-10 Volt	(0.00/100.00)		/#etc_fcu_-_sample_equipment/rd2
SF VFD Speed	BAO	Electrical 0-10 Volt	(0.00/100.00)		/#etc_fcu_-_sample_equipment/sf_vfd_output
Sup Damper 1	BAO	Electrical 0-10 Volt	(0.00/100.00)		/#etc_fcu_-_sample_equipment/sd1
Sup Damper 2	BAO	Electrical 0-10 Volt	(0.00/100.00)		/#etc_fcu_-_sample_equipment/sd2
Sup Fan S/S	BBO	Relay / Triac Output			/#etc_fcu_-_sample_equipment/sfan
Active Zone	BAV				/#etc_fcu_-_sample_equipment/active_zones
CLG SAT STP	BAV				/#etc_fcu_-_sample_equipment/clg_sat_stp
Cooling Run Request	BAV				/#etc_fcu_-_sample_equipment/cl_run_for
Cooling Setpoint	BAV				/#etc_fcu_-_sample_equipment/clgstpt
Cool Request	BAV				/#etc_fcu_-_sample_equipment/cool_request
Economizer	BAV				/#etc_fcu_-_sample_equipment/econ
Economizer Setpoint	BAV				/#etc_fcu_-_sample_equipment/ec_setpt
EI Weighting	BAV				/#etc_fcu_-_sample_equipment/ei_weight
Environmental Index Count	BAV				/#etc_fcu_-_sample_equipment/item_count
Heating Run Request	BAV				/#etc_fcu_-_sample_equipment/ht_run_for
Heating Setpoint	BAV				/#etc_fcu_-_sample_equipment/htgstpt
Heat Request	BAV				/#etc_fcu_-_sample_equipment/heat_request
HTG SAT STP	BAV				/#etc_fcu_-_sample_equipment/htg_sat_stp
Max CO2 Level	BAV				/#etc_fcu_-_sample_equipment/co2_stpt
Max SAT STP	BAV				/#etc_fcu_-_sample_equipment/max_sat_stp
Metric	BAV				/#etc_fcu_-_sample_equipment/metric_conv
Min SAT STP	BAV				/#etc_fcu_-_sample_equipment/min_sat_stp
Output Override	BAV				/#etc_fcu_-_sample_equipment/clg_ovrde
Output Override	BAV				/#etc_fcu_-_sample_equipment/econ_ovrde
Output Override	BAV				/#etc_fcu_-_sample_equipment/htg_ovrde
Output Override	BAV				/#etc_fcu_-_sample_equipment/vfd_ovrde
SF VFD Freq	BAV				/#etc_fcu_-_sample_equipment/sf_vfd_freq
Zone EI Time Satisfied	BAV				/#etc_fcu_-_sample_equipment/zn_ei_time_sat
Zone EI Total Weight	BAV				/#etc_fcu_-_sample_equipment/total_weight
Zone Environmental Index	BAV				/#etc_fcu_-_sample_equipment/zn_enviro_indx
Zone Temperature	BAV				/#etc_fcu_-_sample_equipment/zone_temp
Zone Weighted Environmental Index	BAV				/#etc_fcu_-_sample_equipment/enviro_windx
Cooling OK	BBV				/#etc_fcu_-_sample_equipment/clok
Econ Enable Status	BBV				/#etc_fcu_-_sample_equipment/eok
Filter Status	BBV				/#etc_fcu_-_sample_equipment/pfilter_status
Heating OK	BBV				/#etc_fcu_-_sample_equipment/htok
Occ	BBV				/#etc_fcu_-_sample_equipment/occ
Output Override Lock	BBV				/#etc_fcu_-_sample_equipment/clg_ovrde_lock

Name	Type	I/O Type	Min/Max	Locked	GQL Path
Output Override Lock	BBV				/#etc_fcu_-_sample_equipment/econ_ovrde_lock
Output Override Lock	BBV				/#etc_fcu_-_sample_equipment/htg_ovrde_lock
Output Override Lock	BBV				/#etc_fcu_-_sample_equipment/vfd_ovrde_lock
Run	BBV				/#etc_fcu_-_sample_equipment/run
Schedule	BBV				/#etc_fcu_-_sample_equipment/schedule
point name	BMSV				/#etc_fcu_-_sample_equipment/m287
CHW_DP_LO	BALM				/#etc_fcu_-_sample_equipment/chw_dp_lo
CHW_VLV_FAIL_TO_CLS	BALM				/#etc_fcu_-_sample_equipment/chw_vlv_fail_to_cls
CHW_VLV_FAIL_TO_OPN	BALM				/#etc_fcu_-_sample_equipment/chw_vlv_fail_to_opn
CHWST_HI	BALM				/#etc_fcu_-_sample_equipment/chwst_hi
CO2_HI	BALM				/#etc_fcu_-_sample_equipment/co2_hi
HI_STATIC	BALM				/#etc_fcu_-_sample_equipment/hi_static
HW_DP_LO	BALM				/#etc_fcu_-_sample_equipment/hw_dp_lo
HW_VLV_FAIL_TO_CLS	BALM				/#etc_fcu_-_sample_equipment/hw_vlv_fail_to_cls
HW_VLV_FAIL_TO_OPN	BALM				/#etc_fcu_-_sample_equipment/hw_vlv_fail_to_opn
HWST_LO	BALM				/#etc_fcu_-_sample_equipment/hwst_lo
LO_STATIC	BALM				/#etc_fcu_-_sample_equipment/lo_static
MAT_HI_1	BALM				/#etc_fcu_-_sample_equipment/mat_hi_1
MAT_HI_2	BALM				/#etc_fcu_-_sample_equipment/mat_hi_2
MAT_LO_1	BALM				/#etc_fcu_-_sample_equipment/mat_lo_1
MAT_LO_2	BALM				/#etc_fcu_-_sample_equipment/mat_lo_2
PFILTER	BALM				/#etc_fcu_-_sample_equipment/pfilter
RAT_HI_1	BALM				/#etc_fcu_-_sample_equipment/rat_hi_1
RAT_HI_2	BALM				/#etc_fcu_-_sample_equipment/rat_hi_2
RAT_LO_1	BALM				/#etc_fcu_-_sample_equipment/rat_lo_1
RAT_LO_2	BALM				/#etc_fcu_-_sample_equipment/rat_lo_2
RD1_FAIL_TO_CLS	BALM				/#etc_fcu_-_sample_equipment/rd1_fail_to_cls
RD1_FAIL_TO_OPN	BALM				/#etc_fcu_-_sample_equipment/rd1_fail_to_opn
RD2_FAIL_TO_CLS	BALM				/#etc_fcu_-_sample_equipment/rd2_fail_to_cls
RD2_FAIL_TO_OPN	BALM				/#etc_fcu_-_sample_equipment/rd2_fail_to_opn
SAT_HI	BALM				/#etc_fcu_-_sample_equipment/sat_hi
SAT_LO	BALM				/#etc_fcu_-_sample_equipment/sat_lo
SD1_FAIL_TO_CLS	BALM				/#etc_fcu_-_sample_equipment/sd1_fail_to_cls
SD1_FAIL_TO_OPN	BALM				/#etc_fcu_-_sample_equipment/sd1_fail_to_opn
SD2_FAIL_TO_CLS	BALM				/#etc_fcu_-_sample_equipment/sd2_fail_to_cls
SD2_FAIL_TO_OPN	BALM				/#etc_fcu_-_sample_equipment/sd2_fail_to_opn
SF_RNTM	BALM				/#etc_fcu_-_sample_equipment/sf_rntm
ZTMP_HI	BALM				/#etc_fcu_-_sample_equipment/ztmp_hi
ZTMP_LO	BALM				/#etc_fcu_-_sample_equipment/ztmp_lo
Demand Level	ANI				/#etc_fcu_-_sample_equipment/demand_level
OA Temp	ANI				/#etc_fcu_-_sample_equipment/oat
Flow Control	BAF				/#etc_oa_terminal_-_sample_equipment/air_flow
Flow Control / Flow Input	BAI	Flow Input	(45/96)		/#etc_oa_terminal_-_sample_equipment/air_flow/flow_input
OAT	BAI	Thermistor	(45.00/96.00)		/#etc_oa_terminal_-_sample_equipment/oat
Airflow	BAV				/#etc_oa_terminal_-_sample_equipment/flow
Airflow Setpoint	BAV				/#etc_oa_terminal_-_sample_equipment/flow_sp
Damper Position	BAV				/#etc_oa_terminal_-_sample_equipment/dmpr_pos
Run	BBV				/#etc_oa_terminal_-_sample_equipment/run
schedule	BBV				/#etc_oa_terminal_-_sample_equipment/schedule
AIRFLW_HI	BALM				/#etc_oa_terminal_-_sample_equipment/af_hi
AIRFLW_LO	BALM				/#etc_oa_terminal_-_sample_equipment/af_lo
Economizer	ANI				/#etc_oa_terminal_-_sample_equipment/econ
Ext Interlock	BNI				/#etc_oa_terminal_-_sample_equipment/m088
Zone Temp	ANI				/#etc_oa_terminal_-_sample_equipment/m094

Table 2: List of trends

Equipment	Point	Trend Enable	Sample interval	COV Increment	Historian Enable	Sample in DB	GQL Path
FCU - RM 2169	Ave Zone Temp	x	00:01:00		x	11888	/#etc_fcu_-_sample_equipment/avg_zn_tmp
FCU - RM 2169	AVG RAT	x	00:01:00		x	291	/#etc_fcu_-_sample_equipment/avg_rat
FCU - RM 2169	CLG SAT STP	x	00:01:00		x	291	/#etc_fcu_-_sample_equipment/clg_sat_stp_tn
FCU - RM 2169	Clg Stpt	x	00:01:00		x	291	/#etc_fcu_-_sample_equipment/cl_stpt_tn
FCU - RM 2169	CO2 Level	x	00:01:00		x	291	/#etc_fcu_-_sample_equipment/co2_level_tn
FCU - RM 2169	Duct Press Setpoint	x	00:01:00		x	371	/#etc_fcu_-_sample_equipment/dp_stp_tn
FCU - RM 2169	Econ Stpt	x	00:01:00		x	291	/#etc_fcu_-_sample_equipment/econ_stpt_tn
FCU - RM 2169	Eff RAT	x	00:01:00		x	291	/#etc_fcu_-_sample_equipment/eff_rat
FCU - RM 2169	Environmental Index	x			x	40717	/#etc_fcu_-_sample_equipment/zn_enviro_indx_tn
FCU - RM 2169	Hi Zone Temp	x	00:01:00		x	291	/#etc_fcu_-_sample_equipment/hi_zn_tmp
FCU - RM 2169	HTG SAT STP	x	00:01:00		x	291	/#etc_fcu_-_sample_equipment/htg_sat_stp_tn
FCU - RM 2169	Htg Stpt	x	00:01:00		x	291	/#etc_fcu_-_sample_equipment/ht_stpt_tn
FCU - RM 2169	Lowest Zone Temp	x	00:01:00		x	291	/#etc_fcu_-_sample_equipment/lo_zn_tmp
FCU - RM 2169	Override	x		1	x	103	/#etc_fcu_-_sample_equipment/override_tn
FCU - RM 2169	SP Adjust	x		1	x	9	/#etc_fcu_-_sample_equipment/stpt_adj_tn
FCU - RM 2169	Total Weight	x	00:01:00		x	16753	/#etc_fcu_-_sample_equipment/total_weight_tn
FCU - RM 2169	Zone EI Time Satisfied	x			x	40717	/#etc_fcu_-_sample_equipment/zn_ei_time_sat_tn
FCU - RM 2169	Zone Weighted EI	x			x	40717	/#etc_fcu_-_sample_equipment/enviro_windx_tn
FCU - RM 2169	Zone Temp 1 / Zone Temp	x	00:01:00		x	11891	/#etc_fcu_-_sample_equipment/lstat/zone_temp
FCU - RM 2169	CHW Coil DP	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/chw_coil_dp
FCU - RM 2169	CHWR Temp	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/chwr_temp
FCU - RM 2169	CHWS Temp	x	00:01:00		x	14423	/#etc_fcu_-_sample_equipment/chws_temp
FCU - RM 2169	CHW VLV FDBK	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/chw_vlv_fdbk
FCU - RM 2169	Duct Static Pressure	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/static
FCU - RM 2169	HW Coil DP	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/hw_coil_dp
FCU - RM 2169	HWR Temp	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/hwr_temp
FCU - RM 2169	HWS Temp	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/hws_temp
FCU - RM 2169	HW VLV FDBK	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/hw_vlv_fdbk
FCU - RM 2169	MAT Averging Sensor	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/mat_avg_sensor
FCU - RM 2169	MAT Pnt Sensor	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/mat_pnt_sensor
FCU - RM 2169	Prefilter DP	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/pfilter_dp
FCU - RM 2169	Ret Air Temp 1	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/ra_temp_1
FCU - RM 2169	Ret Air Temp 2	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/ra_temp_2
FCU - RM 2169	Ret Dmpr 1 Fdbk	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/ret_dmpr_1_fdbk
FCU - RM 2169	Ret Dmpr 2 Fdbk	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/ret_dmpr_2_fdbk
FCU - RM 2169	Room CO2	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/ra_co2
FCU - RM 2169	Sup Dmpr 1 Fdbk	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/sup_dmpr_1_fdbk
FCU - RM 2169	Sup Dmpr 2 Fdbk	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/sup_dmpr_2_fdbk
FCU - RM 2169	Supply Air Temp	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/sa_temp
FCU - RM 2169	Zone Temp 2	x	00:01:00		x	11889	/#etc_fcu_-_sample_equipment/zone_temp_2
FCU - RM 2169	Cooling Valve	x	00:01:00		x	11898	/#etc_fcu_-_sample_equipment/chw_valve
FCU - RM 2169	Heating Valve	x	00:01:00		x	11898	/#etc_fcu_-_sample_equipment/hw_valve
FCU - RM 2169	Ret Damper 1	x	00:01:00		x	11898	/#etc_fcu_-_sample_equipment/rd1
FCU - RM 2169	Ret Damper 2	x	00:01:00		x	11898	/#etc_fcu_-_sample_equipment/rd2
FCU - RM 2169	SF VFD Speed	x	00:01:00		x	11898	/#etc_fcu_-_sample_equipment/sf_vfd_output
FCU - RM 2169	Sup Damper 1	x	00:01:00		x	11898	/#etc_fcu_-_sample_equipment/sd1
FCU - RM 2169	Sup Damper 2	x	00:01:00		x	11898	/#etc_fcu_-_sample_equipment/sd2
FCU - RM 2169	Sup Fan S/S	x		1	x	11878	/#etc_fcu_-_sample_equipment/sfan
OA Terminal - RM 2169	Dmpr Pos	x	00:01:00		x	9027	/#etc_oa_terminal_-_sample_equipment/dmpr_pos_tn
OA Terminal - RM 2169	Flow Stpt	x	00:01:00		x	9027	/#etc_oa_terminal_-_sample_equipment/flow_stpt_tn
OA Terminal - RM 2169	Heat	x	00:01:00		x	1	/#etc_oa_terminal_-_sample_equipment/heat_tn
OA Terminal - RM 2169	Occupancy	x		1	x	99	/#etc_oa_terminal_-_sample_equipment/occ_tn
OA Terminal - RM 2169	Flow Control / Flow Input	x	00:01:00		x	9028	/#etc_oa_terminal_-_sample_equipment/air_flow/flow_input
OA Terminal - RM 2169	OAT	x	00:01:00		x	7820	/#etc_oa_terminal_-_sample_equipment/oat