Captis MQTT Data Specification

FW 1.20.0 to 1.20.6 Version 2.0

23/06/2023

Contents

1 Introduction

The Captis device supports MQTT Specification v3.1.1, acting as a client.

Applicable Captis Device Firmware Version: 1.20.0 and above

2 Socket

The firmware will open a socket to the URL and port specified in the device config. If no port is specified then port 1883 will be used if the protocol is set to MQTT or port 8883 if set to MQTTS.

3 Connection

Connection uses the standard MQTT connection packet with the client ID (default of device CCID), username and password specified in the device config.

- If the “auth_type” is set to “BASIC” in device config then the username and password will be taken from config verbatim.
- If the “auth_type” is set to “SAS” then the username and password will be generated from the SAS key stored in config and the client ID.

The “variant” config item determines both the data format and the clean session flag.

- If the variant is set to “C8Y” then the device will use the Cumulocity data format and the clean session flag will be always set.
- If the variant is “AZURE” then the device will use the Azure data Format and the clean session flag will always be cleared.

The Captis does not use the ‘last will’ functionality.

4 Cumulocity Format

The following section will outline key information regarding the Cumulocity formatting.

4.1 Topics

The Captis has 6 MQTT topics defined in its configuration. They are:

1. **Event** topic – JSON config key ‘al_topic’ – default ‘s/uc/mpa’
2. **Measurement** topic – JSON config key ‘data_topic’ – default ‘s/uc/mpd’
3. **Configuration** topic – JSON config key ‘config_topic’ – default ‘s/us’
4. **Operation** topic
    a. (*upload*) – JSON config key ‘op_topic’ – default ‘s/us’
    b. (*download*) – JSON config key ‘op_topic_sub’ – default ‘s/ds’
5. **Device health** topic – JSON config key ‘dev_health_topic’ – default ‘s/us’

The payload sent to all topics is CSV format with each line in the payload corresponding to one data point. Each line begins with an ID field which tells the server what type of data to except in the following fields.

Timestamps are printed in the ISO8601 format (i.e. 2018-10-10T10:21:03Z). If timestamps are missing, then server is to insert the current time in its place.

4.1.1 Event Topic

This is for posting event/alarms. All events are posted as “ID string, timestamp”. The ID string is the code to a lookup table to get the human readable text. See appendix ‘Events’ for the list.

4.1.2 Measurement Topic

This is for posting most measurement data. See appendix ‘Measurements’ for details. Basic format is “ID string, timestamp, measurement value, units (where appropriate)”.

4.1.3 Configuration Topic

On device boot or successful config apply the device will publish its config to the config topic in the format ‘113,”JSON config string”’. The quotes inside the JSON string will be escaped by another quote ie: “”key””: “”value””. If device fails to publish the current configuration, it will be reattempted on subsequent connections until successfully published.

4.1.4 Operation Topic

The device will subscribe to the ‘operation topic (download)’ and wait for inbound publishes. Any publish packets sent to the device on ‘operation topic (download)’ will be processed according to the following table:

Description	Format
Send config to device	513,<ClientID>,”JSON config string (backslash escaped)”
Change digital output state	518,< ClientID>,OPEN or CLOSED
Device Firmware upgrade	515,<ClientID>,<Name>,<Version>,<URL>

Module Firmware Upgrade	516,<ClientID>,<Name>,<Version>,<URL>
Execute Command	511,<ClientID>,<Command text>

The device will process the operation and then update the status of the operation to executing and then to success or fail, in the following format:

<result code>,<operation string>,<operation text result (optional)>

Where result code is: 501 = executing, 502 = fail, 503 = success. Operation string is:

- “c8y_Configuration” for code 513
- “c8y_Relay” for code 518
- “c8y_Firmware” for code 515
- “c8y_Software” for code 516
- “c8y_Command” for code 511

The operation status update will be a publish to the ‘operation topic (upload)’.

4.1.4.1 Command Operations

Command structure is CSV and starts with the device serial number, then command, then arguments (if applicable). For example:

89610180002841893752,get_pulse_total,1

For commands that support bulk apply you can replace the serial number with a wildcard (Asterix). For example, both the following will do the same thing:

89610180002841893752,rf

**,rf*

All commands will return a success or fail status when processed but some commands will additionally provide a text response.

For a list of available commands please refer to Appendix 1.

4.1.5 Device Health Topic

This topic has a mixture of device info and measurements in the formats listed below:

Description	Format
Send config to device	513,<ClientID>,”JSON config string (backslash escaped)”
Device Type	100,serial number,device type string
Hardware version	110,serialNumber,hardware model,hardware revision
Cellular info	111,imei,iccid,imsi,mcc,mnc,lac,cell id
Position/GPS info	112,lat,lon,alt,accuracy
Device declared list of supported operations	114,list of operations supported (device to submit)

Firmware version running	115,name,version, url location (if applicable)
Software installed	116,name,ver, url location (if applicable)
Device declared connection interval	117,minutes
Named measurement data point*	200,trend group name, trend name, data value, units, timestamp
Signal strength	210,rssi in dB,ber,timestamp
Device temperature	211,deg C,timestamp

**This applies to Modbus, 1-wire, Maxsonar, and Aanderaa 4319*

5 AZURE Format

5.1 Telemetry

Telemetry will be published to topic “devices/<client_id>/messages/events/” and will be in a JSON format. The content will include both measurement data and events. The timestamp is published in the topic name as property %24.ctime from the device and is processed on the platform to become “iothub-creation-time-utc” server side. The format of the timestamp is ISO8601 in UTC. For example, “devices/896101800029024477763/messages/events/%24.ctime=2021-11-08T06:08:36Z”.

JSON keys are described below for measurements:

JSON Key	Description	Comments
I002	Pulse 1 Delta	
I003	Pulse 1 Total	
I004	Analog	
I011	Battery Voltage	
I060	Device Temperature	
I060_1	Device Minimum Temperature	Since last connection
I060_2	Device Maximum Temperature	Since last connection
I060_3	Device Average Temperature	Since last connection
I115_1	Modbus Register 1	
I115_2	Modbus Register 2	
I115_3	Modbus Register 3	
I115_4	Modbus Register 4	
I115_5	Modbus Register 5	
I115_6	Modbus Register 6	
I115_7	Modbus Register 7	
I115_8	Modbus Register 8	
I115_9	Modbus Register 9	
I115_10	Modbus Register 10	
I130	Switch 2	
I137	Pulse 2 Delta	
I138	Pulse 2 Total	
I144	GPS Latitude	
I145	GPS Longitude	
I149	Switch 1	
I174	Module Current	Board current during network connection (mA)
I175	Sensor Current	Board current during measurement (mA)
I176	Sensor Energy Usage	mAhr
I177	Module Energy Usage	mAhr
I189	Digital Output	0 = open, 1 = closed
I203	Charging Voltage	For solar variants (unit: V)
I204	Charging Current	For solar variants (unit: mA)

JSON Key	Description	Comments
l205	Charging State	For solar variants (unit: Boolean)
rsrp	RSRP (signal power)	dB
rsrq	RSRQ (signal quality)	dB
sinr	SINR (signal to noise)	dB
m_sent	Measurements Sent Count	Device flash storage
m_stored	Measurements Stored Count	Device flash storage
tamper	Tamper Tripped State	0 = never tripped, 1 = tripped in the past
tamper	Tamper Tripped State	0 = never tripped, 1 = tripped in the past

JSON keys for events:

JSON Key	Description	Comments
event	Event code as string in the format 'a01234-01234'	See event list in the appendices for details for each event code

Example: {"event": "a00123-00123"}

5.2 Device Twin

The device twin is a JSON document and is separated into 'reported' and 'desired' sections. The reported section contains values submitted from the device and contains information about the hardware, firmware, SIM, cell tower, and device config. The desired section can be updated to change the config on the device. This can be a partial or full config and will remain in the desired section even after the device has accepted it.

The reported section JSON keys are described below noting that the desired section contains only the "config" key:

JSON Key	Description	Comments
iccid	SIM ICCID	
imei	Module IMEI	
imsi	SIM IMSI	
LAC	Cell Tower LAC	Value is in hex as a string
cell_id	Cell Tower Cell ID	Value is in hex as a string
nw_type	Network Type	CAT_M1 or NB1
mcc	Mobile Carrier Code	
mnc	Mobile Network Code	
freq	Radio Channel Frequency (MHz)	
m_hw	Module Part Number	
m_fw	Module FW Version	
blv	Bootloader Version	

JSON Key	Description	Comments
cfg_v	Config Schema Version	
d_fw	Device FW Version	
d_hw	Device HW Variant	
serial	Device Serial Number	
config	Device Config	Contains many values. See config schema document for details.

5.3 Cloud to Device Messaging

The device will listen for incoming commands on the "devices/+/messages/devicebound/#" topic and expects requests to be in JSON format.

Request:

JSON Key	Description	Comments
command	Request command text with command arguments in CSV format	See "6.3 Device Commands"

Response:

JSON Key	Description	Comments
result	Result status of the request	'Success' or 'Failure'
response	Optional response text	

Example request:

{ "command": "get_pulse_total,1" }

Example response:

{ "result": "Success", "response": "P1: 123 L" }

5.4 String Placeholders

You can put placeholders in the MQTT topic strings, MQTT Client ID and Server Username in the device configuration that will be replaced with certain device values during server and MQTT connection. The placeholder is bound by a percent sign on each side. Currently there are 2 supported placeholders:

- CCID – the ICCID of the SIM
- IMEI – the IMEI of the module

You can place these anywhere in the topic string. For example:

- ‘s/uc/mpd/%CCID%’ would become ‘s/uc/mpd/89610180003174295174’
- ‘d/%IMEI%/events’ would become ‘d/357732081910355/events
- ‘dev_%CCID%_post’ would become ‘dev_89610180003174295252_post’

The resolved strings still adhere to the maximum topic length in the config which is currently 100 characters.

5.5 Server Roles

From firmware version 1.19 onwards, servers have roles assigned to them that determine the Captis behaviour when connected to those servers. The roles applicable to MQTT are:

- Info – sends the device health data to this server
- Measurements – sends any unsent sensor data to this server
- Events – sends any unsent events to this server
- Configuration – will accept config operations from this server
- FOTA operations – will accept device firmware and module firmware update operations from this server
- Bootstrap/DPS – will attempt to bootstrap to this server when appropriate
- Shell commands/C2D messages – will accept command operations from this server

6 Appendix 1

6.1 Cumulocity Measurements

Description	Format
Pulse Channel 1	l002,<$.time>,<Pulse.P.value>,< Pulse.P.units>
Pulse Total Channel 1	l003,<$.time>,<Pulse_Total.T.value>,< Pulse_Total.T.units>
Analog	l004,<$.time>,<Analog.A.value>,< Analog.A.units>
Ph	l005,<$.time>,<pH.PH.value>,<pH.PH.unit>
ORP	l006,<$.time>,<ORP.O.value>
Battery Voltage	l011,<$.time>,<Battery.V.value>
Temperature	l060,<$.time>,<DeviceTemperature.T.value>
Minimum Temperature	l060-1,<$.time>,<DeviceTemperature.Min.value>
Maximum Temperature	l060-2,<$.time>,<DeviceTemperature.Max.value>
Average Temperature	l060-3,<$.time>,<DeviceTemperature.Median.value>
Conductivity	l080,<$.time>,<Conductivity.C.value>
Humidity	l121,<$.time>,<Humidity.RH.value>
Switch Channel 2	l130,<$.time>,<Switch.SW2.value>
Pulse Channel 2	l137,<$.time>,<Pulse.P2.value>,<Pulse.P2.units>
Pulse Total Channel 2	l138,<$.time>,<Pulse_Total.T2.value>,<Pulse_Total.T2.units>
Switch Channel 1	l149,<$.time>,<Switch.SW1.value>
Module Current	l174,<$.time>,<Battery.A1.value>
Sensing Current	l175,<$.time>,<Battery.A2.value>
Module Energy Usage	l177,<$.time>,<Battery.C1.value>
Sensing Energy Usage	l176,<$.time>,<Battery.C2.value>
Digital Output State	L186,<$.time>,<Digital_Out.DO1.value>
Solar Charge Voltage	l203,<$.time>,<ChargeVolts.V.value>
Solar Charge Current (mA)	l204,<$.time>,<ChargeCurrent.I.value>
Solar Charge State (1=charging, 0=not)	l205,<$.time>,<ChargeState.S.value>
Cell info	cell,<serial number>,<LAC>,<cellID>,<connection type string(NB1 or CAT_M1)>,<band frequency (MHz)>,<IMEI>,<ICCID>,<IMSI>,<MCC>,<MNC>
RF Info	rf,<$.time>,<RSRP (Signal power)>,<RSRQ (Signal quality)
RF Info 2	radio,<$.time>,<RSRP (Signal power)>,<RSRQ (Signal quality)>,<SINR> (signal to noise ratio)
Log storage	lc,<$.time>,<number of logs sent to server>,<number of logs in memory>
Tamper state	tamper,<$.time>,<tripped state: 0 or 1>

6.2 Events (Cumulocity and Azure)

Cumulocity Event Type	ID String[1]	Description
alarm1-0	a00001-00000	Module failed to boot
alarm5-0	a00005-00000	No signal
alarm7-0	a00007-00000	NTP Error
alarm7-1	a00007-00001	NTP Rate Limit Requested
alarm7-2	a00007-00002	NTP Drop Server Requested
alarm8-0	a00008-00000	No Cellular Network Registration
alarm18-	a00018-00000	Boot
alarm18-1	a00018-00001	Magnet reset
alarm18-2	a00018-00002	Power up
alarm18-3	a00018-00003	Brown out
alarm18-4	a00018-00004	Software reset
alarm18-5	a00018-00005	Watchdog timeout reset
alarm18-6	a00018-00006	Config mismatch reset
alarm18-7	a00018-00007	Trap conflict reset
alarm18-8	a00018-00008	Illegal opcode reset
alarm55-0	a00055-00000	NTP Update high deviation
alarm55-1	a00055-00001	External RTCC oscillator problem. Switched to internal.
alarm55-2	a00055-00002	RTCC Write Failure
alarm55-5	a00055-00005	WDT Tripped
alarm62-1	a00062-00001	Modbus – Illegal function
alarm62-2	a00062-00002	Modbus – Illegal register address
alarm62-3	a00062-00003	Modbus – Illegal data value
alarm62-4	a00062-00004	Modbus – Slave device failure
alarm62-5	a00062-00005	Modbus – Slave request delay
alarm62-6	a00062-00006	Modbus – Slave busy
alarm62-7	a00062-00007	Modbus – Slave cannot process
alarm62-8	a00062-00008	Modbus – Slave memory error
alarm62-2	a00062-00020	Modbus – Float NaN
alarm62-21	a00062-00021	Modbus – No response
alarm62-22	a00062-00022	Modbus – CRC fail
alarm63-1	a00063-00001	Analog – ADC Error
alarm63-2	a00063-00002	Analog – Range Error
alarm63-3	a00063-00003	Analog – ADC data byte error
alarm63-4	a00063-00004	Analog – ADC data not ready
alarm64-0	a00064-00000	Cell Module Error – phone failure
alarm64-1	a00064-00001	Cell Module Error – no connection to phone
alarm64-2	a00064-00002	Cell Module Error – phone adaptor link reserved

[1] ID String is represented in Azure, in the “axxxxx-xxxxx” format.

Cumulocity Event Type	ID String[1]	Description
alarm64-3	a00064-00003	Cell Module Error – operation not allowed
alarm64-4	a00064-00004	Cell Module Error – operation not supported
alarm64-5	a00064-00005	Cell Module Error – PH-SIM PIN required
alarm64-6	a00064-00006	Cell Module Error – PH-FSIM PIN required
alarm64-7	a00064-00007	Cell Module Error – PH-FSIM PUK required
alarm64-1	a00064-00010	Cell Module Error – SIM not inserted
alarm64-11	a00064-00011	Cell Module Error – SIM PIN required
alarm64-12	a00064-00012	Cell Module Error – SIM PUK required
alarm64-13	a00064-00013	Cell Module Error – SIM failure
alarm64-14	a00064-00014	Cell Module Error – SIM busy
alarm64-15	a00064-00015	Cell Module Error – SIM wrong
alarm64-16	a00064-00016	Cell Module Error – incorrect password
alarm64-17	a00064-00017	Cell Module Error – SIM PIN2 required
alarm64-18	a00064-00018	Cell Module Error – SIM PUK2 required
alarm64-2	a00064-00020	Cell Module Error – memory full
alarm64-21	a00064-00021	Cell Module Error – invalid index
alarm64-22	a00064-00022	Cell Module Error – not found
alarm64-23	a00064-00023	Cell Module Error – memory failure
alarm64-24	a00064-00024	Cell Module Error – text string too long
alarm64-25	a00064-00025	Cell Module Error – invalid characters in text string
alarm64-26	a00064-00026	Cell Module Error – dial string too long
alarm64-27	a00064-00027	Cell Module Error – invalid characters in dial string
alarm64-3	a00064-00030	Cell Module Error – no network service
alarm64-31	a00064-00031	Cell Module Error – network timeout
alarm64-32	a00064-00032	Cell Module Error – network not allowed – emergency calls only
alarm64-34	a00064-00034	Cell Module Error – numeric parameter instead of text parameter
alarm64-35	a00064-00035	Cell Module Error – text parameter instead of numeric parameter
alarm64-36	a00064-00036	Cell Module Error – numeric parameter out of bounds

Cumulocity Event Type	ID String[1]	Description
alarm64-37	a00064-00037	Cell Module Error – text string too short
alarm64-38	a00064-00038	Cell Module Error – The GPIO Pin is already used
alarm64-4	a00064-00040	Cell Module Error – network personalization PIN required
alarm64-41	a00064-00041	Cell Module Error – network personalization PUK required
alarm64-42	a00064-00042	Cell Module Error – network subset personalization PIN required
alarm64-43	a00064-00043	Cell Module Error – network subset personalization PUK required
alarm64-44	a00064-00044	Cell Module Error – service provider personalization PIN required
alarm64-45	a00064-00045	Cell Module Error – service provider personalization PUK required
alarm64-46	a00064-00046	Cell Module Error – corporate personalization PIN required
alarm64-47	a00064-00047	Cell Module Error – corporate personalization PUK required
alarm64-49	a00064-00049	Cell Module Error – EAP method not supported
alarm64-5	a00064-00050	Cell Module Error – Invalid EAP parameter
alarm64-51	a00064-00051	Cell Module Error – Parameter length error for all Auth commands
alarm64-52	a00064-00052	Cell Module Error – Temporary error for all Auth command
alarm64-53	a00064-00053	Cell Module Error – not verified hidden key
alarm64-1	a00064-00100	Cell Module Error – unknown
alarm64-13	a00064-00103	Cell Module Error – Illegal MESSAGE
alarm64-16	a00064-00106	Cell Module Error – Illegal ME
alarm64-17	a00064-00107	Cell Module Error – GPRS services not allowed
alarm64-111	a00064-00111	Cell Module Error – PLMN not allowed
alarm64-112	a00064-00112	Cell Module Error – Location area not allowed
alarm64-113	a00064-00113	Cell Module Error – Roaming not allowed in this location area
alarm64-132	a00064-00132	Cell Module Error – service option not supported
alarm64-133	a00064-00133	Cell Module Error – requested service option not subscribed
alarm64-134	a00064-00134	Cell Module Error – service option temporarily out of order

Cumulocity Event Type	ID String[1]	Description
alarm64-148	a00064-00148	Cell Module Error – unspecified GPRS error
alarm64-149	a00064-00149	Cell Module Error – PDP authentication failure
alarm64-15	a00064-00150	Cell Module Error – invalid mobile class
alarm64-257	a00064-00257	Cell Module Error – network rejected request
alarm64-258	a00064-00258	Cell Module Error – retry operation
alarm64-259	a00064-00259	Cell Module Error – invalid deflected to number
alarm64-26	a00064-00260	Cell Module Error – deflected to own number
alarm64-261	a00064-00261	Cell Module Error – unknown subscriber
alarm64-262	a00064-00262	Cell Module Error – service not available
alarm64-263	a00064-00263	Cell Module Error – unknown class
alarm64-264	a00064-00264	Cell Module Error – unknown network message
alarm64-273	a00064-00273	Cell Module Error – Minimum TFT per PDP address error
alarm64-274	a00064-00274	Cell Module Error – Duplicate TFT eval prec index
alarm64-275	a00064-00275	Cell Module Error – Invalid TFT param combination
alarm64-277	a00064-00277	Cell Module Error – Invalid number of parameters
alarm64-278	a00064-00278	Cell Module Error – Invalid Parameter
alarm64-32	a00064-00320	Cell Module Error – Call index error
alarm64-321	a00064-00321	Cell Module Error – Call state error
alarm64-322	a00064-00322	Cell Module Error – Sys state error
alarm64-323	a00064-00323	Cell Module Error – Parameters error
alarm64-55	a00064-00550	Cell Module Error – generic undocumented error
alarm64-551	a00064-00551	Cell Module Error – wrong state
alarm64-552	a00064-00552	Cell Module Error – wrong mode
alarm64-553	a00064-00553	Cell Module Error – context already activated
alarm64-554	a00064-00554	Cell Module Error – stack already active
alarm64-555	a00064-00555	Cell Module Error – activation failed
alarm64-556	a00064-00556	Cell Module Error – context not opened
alarm64-557	a00064-00557	Cell Module Error – cannot setup socket

Cumulocity Event Type	ID String[1]	Description
alarm64-558	a00064-00558	Cell Module Error – cannot resolve DN
alarm64-559	a00064-00559	Cell Module Error – time-out in opening socket
alarm64-56	a00064-00560	Cell Module Error – cannot open socket
alarm64-561	a00064-00561	Cell Module Error – remote disconnected or time-out
alarm64-562	a00064-00562	Cell Module Error – connection failed
alarm64-563	a00064-00563	Cell Module Error – tx error
alarm64-564	a00064-00564	Cell Module Error – already listening
alarm64-565	a00064-00565	Cell Module Error – socket disconnection
alarm64-566	a00064-00566	Cell Module Error – cannot resume socket
alarm64-567	a00064-00567	Cell Module Error – ip version type incompatible
alarm64-568	a00064-00568	Cell Module Error – ipv6 not enabled
alarm64-6	a00064-00600	Cell Module Error – Generic undocumented error
alarm64-61	a00064-00601	Cell Module Error – wrong state
alarm64-62	a00064-00602	Cell Module Error – Can not activate
alarm64-63	a00064-00603	Cell Module Error – Can not resolve name
alarm64-64	a00064-00604	Cell Module Error – Can not allocate control socket
alarm64-65	a00064-00605	Cell Module Error – Can not connect control socket
alarm64-66	a00064-00606	Cell Module Error – Bad or no response from server
alarm64-67	a00064-00607	Cell Module Error – Not connected
alarm64-68	a00064-00608	Cell Module Error – Already connected
alarm64-69	a00064-00609	Cell Module Error – Context down
alarm64-612	a00064-00612	Cell Module Error – Resource used by other instance
alarm64-613	a00064-00613	Cell Module Error – Data socket yet opened in cmdmode
alarm64-614	a00064-00614	Cell Module Error – FTP CmdMode data socket closed
alarm64-615	a00064-00615	Cell Module Error – FTP not connected
alarm64-616	a00064-00616	Cell Module Error – FTP disconnected
alarm64-617	a00064-00617	Cell Module Error – FTP read command closed
alarm64-618	a00064-00618	Cell Module Error – FTP read command error

Cumulocity Event Type	ID String[1]	Description
alarm64-619	a00064-00619	Cell Module Error – FTP write command closed
alarm64-62	a00064-00620	Cell Module Error – FTP write command error
alarm64-621	a00064-00621	Cell Module Error – FTP read data closed
alarm64-622	a00064-00622	Cell Module Error – FTP read data error
alarm64-623	a00064-00623	Cell Module Error – FTP write data closed
alarm64-624	a00064-00624	Cell Module Error – FTP write data error
alarm64-625	a00064-00625	Cell Module Error – FTP host not found
alarm64-626	a00064-00626	Cell Module Error – FTP accept failure
alarm64-627	a00064-00627	Cell Module Error – FTP listen failure
alarm64-628	a00064-00628	Cell Module Error – FTP bind failure
alarm64-629	a00064-00629	Cell Module Error – FTP file create failure
alarm64-63	a00064-00630	Cell Module Error – FTP file get failure
alarm64-631	a00064-00631	Cell Module Error – FTP file put failure
alarm64-632	a00064-00632	Cell Module Error – FTP file not found
alarm64-633	a00064-00633	Cell Module Error – FTP timed out
alarm64-634	a00064-00634	Cell Module Error – FTP login incorrect
alarm64-635	a00064-00635	Cell Module Error – FTP close error
alarm64-636	a00064-00636	Cell Module Error – FTP server not ready
alarm64-637	a00064-00637	Cell Module Error – FTP server shutdown
alarm64-638	a00064-00638	Cell Module Error – FTP unexpected reply
alarm64-639	a00064-00639	Cell Module Error – FTP user ID and password don’t match
alarm64-64	a00064-00640	Cell Module Error – FTP user ID and password don’t match
alarm64-641	a00064-00641	Cell Module Error – FTP user already logged in
alarm64-642	a00064-00642	Cell Module Error – FTP open channel timeout
alarm64-643	a00064-00643	Cell Module Error – FTP communication timeout
alarm64-644	a00064-00644	Cell Module Error – FTP unknown error

Cumulocity Event Type	ID String[1]	Description
alarm64-657	a00064-00657	Cell Module Error – Network survey error (No Carrier)
alarm64-658	a00064-00658	Cell Module Error – Network survey error (Busy)
alarm64-659	a00064-00659	Cell Module Error – Network survey error (Wrong request)
alarm64-66	a00064-00660	Cell Module Error – Network survey error (Aborted)
alarm64-68	a00064-00680	Cell Module Error – LU processing
alarm64-681	a00064-00681	Cell Module Error – Network search aborted
alarm64-682	a00064-00682	Cell Module Error – PTM mode
alarm64-683	a00064-00683	Cell Module Error – Network search terminated
alarm64-684	a00064-00684	Cell Module Error – CSG Search processing
alarm64-69	a00064-00690	Cell Module Error – Active call state
alarm64-691	a00064-00691	Cell Module Error – RR connection established
alarm64-77	a00064-00770	Cell Module Error – SIM invalid
alarm64-9	a00064-00900	Cell Module Error – No Response for AT Command
alarm64-1	a00064-01000	Cell Module Error – SSL not activated
alarm64-11	a00064-01001	Cell Module Error – SSL certs and keys wrong or not stored
alarm64-12	a00064-01002	Cell Module Error – SSL generic error
alarm64-13	a00064-01003	Cell Module Error – SSL already activated
alarm64-14	a00064-01004	Cell Module Error – SSL error during handshake
alarm64-15	a00064-01005	Cell Module Error – SSL socket error
alarm64-16	a00064-01006	Cell Module Error – SSL invalid state
alarm64-17	a00064-01007	Cell Module Error – SSL cannot activate
alarm64-18	a00064-01008	Cell Module Error – SSL not connected
alarm64-19	a00064-01009	Cell Module Error – SSL already connected
alarm64-11	a00064-01010	Cell Module Error – SSL error enc/dec data
alarm64-111	a00064-01011	Cell Module Error – SSL disconnected
alarm64-11	a00064-01100	Cell Module Error – Model not recognized
alarm64-111	a00064-01101	Cell Module Error – Model information missing

Cumulocity Event Type	ID String[1]	Description
alarm64-112	a00064-01102	Cell Module Error – Unable to open the file
alarm64-113	a00064-01103	Cell Module Error – Unable to close the file
alarm64-114	a00064-01104	Cell Module Error – Unable to read the nv file
alarm64-115	a00064-01105	Cell Module Error – Unable to write the nv file
alarm64-116	a00064-01106	Cell Module Error – Input pattern is wrong
alarm64-1113	a00064-01113	Cell Module Error – Call establishment failed
alarm64-1114	a00064-01114	Cell Module Error – File name already exist
alarm66-1	a00066-00001	1-Wire – Calibration Changed
alarm66-2	a00066-00002	1-Wire – Unknown Device
alarm66-4	a00066-00004	1-Wire – Short
alarm66-8	a00066-00008	1-Wire – CRC Address Failure
alarm66-9	a00066-00009	1-Wire – Calibration Not Written
alarm67-0	a00067-00000	5V Output – Short Circuit
alarm68-8	a00068-00008	Flash Memory – Store Header Error
alarm68-13	a00068-00013	Flash Memory – Default Settings Loaded
alarm68-14	a00068-00014	Flash Memory – Hardware Fault
alarm68-16	a00068-00016	Flash Memory – Unable to retrieve stored pulse totals
alarm68-17	a00068-00017	Flash Memory – Unable to store pulse totals
alarm68-18	a00068-00018	Flash Memory – Unable to store measurement
alarm68-19	a00068-00019	Flash Memory – Unable to retrieve measurement
alarm68-2	a00068-00020	Flash Memory – Measurement buffer overrun
alarm68-21	a00068-00021	Flash Memory – Measurement storage 25% used
alarm68-22	a00068-00022	Flash Memory – Measurement storage 50% used
alarm68-23	a00068-00023	Flash Memory – Measurement storage 75% used
alarm69-1	a00069-00001	Battery – Temp Low at send
alarm69-2	a00069-00002	Battery – Temp High at send
alarm69-7	a00069-00007	Battery – Under Voltage
alarm69-13	a00069-00013	Battery – Entering Low Power Full Lockout
alarm69-14	a00069-00014	Battery – Exiting Low Power Full Lockout
alarm69-129	a00069-00129	Failed to Set Solar Charger to Ship Mode

Cumulocity Event Type	ID String[1]	Description
alarm71-1	a00071-00001	GPS – Init Fail
alarm71-3	a00071-00003	GPS – Fix Fail
alarm74-0	a00074-00000	Reed Switch Send Direct
alarm77-1	a00077-00001	Module – Powered off when creating socket
alarm77-3	a00077-00003	Module – FOTA Credentials Not Set
alarm77-4	a00077-00004	Module – FOTA Login Fail
alarm77-5	a00077-00005	Module – FOTA Download Fail
alarm77-6	a00077-00006	Module – FOTA Upgrade Success
alarm77-7	a00077-00007	Module – FOTA Upgrade Timeout
alarm77-8	a00077-00008	Module – Socket hang on creation
alarm77-9	a00077-00009	Module – Network type switching fail
alarm77-1	a00077-00010	Module – No AT response
alarm77-11	a00077-00011	Module – Shutdown Timeout
alarm77-12	a00077-00012	Module – Socket Dropped Unexpectedly
alarm8-1	a00080-00001	Entered fast log mode
alarm8-2	a00080-00002	Exited fast log mode
alarm81-1	a00081-00001	MQTT – Connection Refused
alarm81-2	a00081-00002	MQTT – Client ID refused
alarm81-3	a00081-00003	MQTT – Broker Offline
alarm81-4	a00081-00004	MQTT – Credentials Refused
alarm81-5	a00081-00005	MQTT – Connection Refused – Unknown Reason
alarm82-0	a00082-00000	Legacy device FOTA – Socket fail
alarm82-1	a00082-00001	HTTP Device FOTA Download Fail
alarm82-2	a00082-00002	HTTP Device FOTA File Validation Fail
alarm82-3	a00082-00003	HTTP Device FOTA Download Incomplete - Will Retry Later
alarm83-2	a00083-00002	Config – Unsuported JSON value
alarm83-4	a00083-00004	Config – Fallback to known good
alarm83-7	a00083-00007	Config – JSON config string value too long
alarm83-9	a00083-00009	Config – Main config restored
alarm83-11	a00083-00011	Config – Unsupported schema version
alarm83-12	a00083-00012	Config – Changed
alarm83-13	a00083-00013	Config – Incorrectly formatted or contains invalid values
alarm83-14	a00083-00014	Config – Validation failed
alarm85-35	a00085-00305	BL Msg – Reboot
alarm85-32	a00085-00302	BL Msg – WDT
alarm85-32	a00085-00032	BL Msg – Backup FW fail
alarm85-33	a00085-00033	BL Msg – Backup FW success
alarm85-36	a00085-00036	BL Msg – Restore FW backup fail
alarm85-37	a00085-00037	BL Msg – Restore FW backup success

Cumulocity Event Type	ID String[1]	Description
alarm85-42	a00085-00042	BL Msg – FW apply fail
alarm85-43	a00085-00043	BL Msg – FW apply success
alarm85-6	a00085-00006	BL Msg – Program Memory erased
alarm85-29	a00085-00029	BL Msg – Entered sleep
alarm85-4	a00085-00040	BL Msg – New FW image not present
alarm85-41	a00085-00041	BL Msg – FW flash copy check success
alarm85-34	a00085-00034	BL Msg – FW backup copy check fail/not present
alarm85-35	a00085-00035	BL Msg – FW backup copy check success
alarm87-0	a00087-00000	Process Alarm 1 Set
alarm87-1	a00087-00001	Process Alarm 1 Clear
alarm87-2	a00087-00002	Process Alarm 2 Set
alarm87-3	a00087-00003	Process Alarm 2 Clear
alarm87-4	a00087-00004	Process Alarm 3 Set
alarm87-5	a00087-00005	Process Alarm 3 Clear
alarm87-6	a00087-00006	Process Alarm 4 Set
alarm87-7	a00087-00007	Process Alarm 4 Clear
alarm87-8	a00087-00008	Process Alarm 5 Set
alarm87-9	a00087-00009	Process Alarm 5 Clear
alarm88-4	a00088-00400	HTTP 400 Bad request
alarm88-41	a00088-00401	HTTP 401 Unauthorised
alarm88-43	a00088-00403	HTTP 403 Forbidden
alarm88-44	a00088-00404	HTTP 404 Not Found
alarm88-5	a00088-00500	HTTP 500 Server Error
alarm88-51	a00088-00501	HTTP 501 Not Implemented
alarm88-52	a00088-00502	HTTP 502 Bad gateway
alarm88-53	a00088-00503	HTTP 503 Service Unavailable
alarm88-54	a00088-00504	HTTP 504 Gateway Timeout
alarm89-1	a00089-00001	HTTP File Download Error – Download not started
alarm89-2	a00089-00002	HTTP File Download Error – file size is zero
alarm9-1	a00090-00001	Measurement Start
alarm9-2	a00090-00002	Measurement End
alarm9-3	a00090-00003	Connection Start
alarm9-4	a00090-00004	Connection End
alarm91-X	a00091-0000X	Network X Connection Fail
alarm92-X	a00092-0000X	Server X – Connection Fail
alarm93-X	a00093-0000X	Server X – Setup Fail
alarm94-X	a00094-0000X	Server X – Measurement Push Fail
alarm95-X	a00095-0000X	Server X – Event Push Fail
alarm96-X	a00096-0000X	Server X – Operation Fetch Fail
alarm97-X	a00097-0000X	Server X – Device Health Push Fail

6.3 Device Commands (Cumulocity and Azure)

Command	Description	Arguments	Example Response	Cumulocity bulk operation support
rf	Fetch signal strength values	None	“RSSI: -58 dB, RSRP: -91 dB, RSRQ: -16.0 dB, SINR: 6.6 dB’	**Yes**
tamper	Fetch tamper switch state	None	“SET” or “CLEAR”	**Yes**
battery	Fetch battery values	None	“3.47 V, 102.000 mA, 4361.383 mAhr, 25.2 degC”	**Yes**
vf	Fetch log storage info	None	“2113 stored, 2112 sent, 0.0 % storage used”	**Yes**
get_pulse_total	Fetch pulse total volume	DI channel. If not specified then DI1 returned	“P2: 0 L”	**Yes**
get_switch	Fetch switch state	DI channel. If not specified then DI1 returned	“SW1: OPEN”	**Yes**
live_mode	Listen for operations for a longer time (2 min)	None	None	**Yes**
stop_live	Stop listening for operations	None	None	**Yes**
get_time	Gets the current time in the device	None	“2020-11-18T22:56:16Z“	**Yes**
bootstrap	Tell device to attempt bootstrap/DPS	bootstrap,<server>,<mode> If server is not present, ‘0’ or ‘1’ then the first bootstrap server is used. If server is ‘2’ the second defined bootstrap server is used and so on.	None	**Yes**

Command	Description	Arguments	Example Response	Cumulocity bulk operation support
		If server is ‘s3’ then the server with name ‘s3’ will be used. If the server referenced is not defined or does not have a bootstrap role then if will fail the operation. Both server and mode are optional but you will need to specify server if you want to use mode. The default for server is still the first defined bootstrap server in config. The default for mode is ‘regular’. Descriptions of modes are: • ‘regular’ – if a the server already exists then no roles will be changed. If it is a new server then the previous logic is applied where roles are assigned in the following order (stopping when the selection won’t cause a config validation error: ○ “MEAS”, “CONFIG”, “EVENTS”, “INFO”, “FOTA_OPS”, “SHELL” ○ “MEAS”, “EVENTS”, “INFO” ○ “INFO” • ‘greedy’ – the new server will take the roles “MEAS”, “CONFIG”, “EVENTS”, “INFO”, “FOTA_OPS”, “SHELL” with “MEAS” being removed from this list if there is a data server already and		

Command	Description	Arguments	Example Response	Cumulocity bulk operation support
		"CONFIG" being removed if there is a config server already. No roles from other servers will be modified • 'data' – the server will have the roles "MEAS", "EVENTS", "INFO" added to its current roles and if "MEAS" exists on another server then it will be removed from that server • 'config' – the server will have the roles "INFO", "CONFIG", "FOTA_OPS", "SHELL" added to its current roles and if "CONFIG" exists on another server then it will be removed from that server • 'full' – the server will have the roles "MEAS", "CONFIG", "EVENTS", "INFO", "FOTA_OPS", "SHELL" added to its current roles and if "CONFIG" or "MEAS" exists on another server/s then they will be removed from their respective server/s		
clear_bootstrap	Stop bootstrap attempts	None	None	**Yes**
sleep	Puts device in permasleep	None	None	**No**
reset_settings	Reset settings to default	None	None	**No**
reset_logs	Wipe measurement storage	None	None	**No**
reset_events	Wipe event storage	None	None	**No**

Command	Description	Arguments	Example Response	Cumulocity bulk operation support
get_gps_fix	Tell device to get GPS fix on next connection	None	None	**Yes**
clear_gps_fix	Tell device to stop attempting GPS fix	None	None	**Yes**
pulse_cal	Generate a pulse offset based on meter reading and store in config	Format is <cmd>,<channel>,<volume_total>,<units> e.g. pulse_cal,1,12345,L Units must be present and match	None	**No**
nth_conn_override	Override the nth connection logic for this connection and the one after. i.e connect to all servers	None	None	**Yes**
refresh_info	Tells device to do server setup again	'0' = all servers, '1' to '9' = s1 to s9, 's1' to 's9' = s1 to s9	None	**Yes**
get_analog (Multi Only)	Get analog voltage and scaled value	None	"AI1: 1.050 V, 4.199m"	**Yes**
set_power_out (Multi Only)	Set external 5V and 12V output state	ON or OFF	None	**Yes**
get_power_out (Multi Only)	Get the external 5V and 12V output state	None	ON of OFF	**Yes**
set_digital_out (Multi Only)	Set the digital output state	OPEN or CLOSED	None	**Yes**
get_digital_out (Multi Only)	Get the digital output state	None	OPEN or CLOSED	**Yes**
setup_serial (Multi Only)	Setup the serial modem for duration of operations connection	<protocol>,<baud>,<parity> Protocol: RS232 or RS485	None	**Yes**

Command	Description	Arguments	Example Response	Cumulocity bulk operation support
		Baud: 9600, 19200, 38400, 57600, 115200		
raw_serial_cmd (Multi Only)	Set a serial command and return response	<type>,<message> type is 'HEX' or 'ASCII'	'RX: No response', or 'RX: <serial response>'	**Yes**
modbus_packet (Multi Only)	Send modbus packet and have CRC calculated and appended. Return the response	<type>,<message> type is 'RTU' only	'RX: No response', or 'RX: <serial response>'	**Yes**
modbus_register (Multi Only)	Send a modbus request and return the value	<slave addr>,<register number>,<register type>,<data type>,[<byte order>] register type is "HOLDING_REG", "INPUT_REG" data type is "UINT16", "FLOAT", "UINT32", "SINT16", or "SINT32" byte order is optional and is "ABCD", "DCBA", "CDAB", or "BADC". Will default to ABCD	"Response: <value>"	**Yes**
ow_search (Multi Only)	Search 1-Wire channels and return list of device addresses found	None	Format is "Channel: address list". For no devices it will show "1: None 2: None". E.g. with devices: "1: 28274E4B070 00068 2: 28B21B1B03 000033"	**Yes**
ow_read (Multi Only)	Read the values from a	Probe address	"<probe address> - <part	**Yes**

Command	Description	Arguments	Example Response	Cumulocity bulk operation support
	single 1-wire probe		number>: <values>". E.g. "28274E4B07 000068 – DS18B20: 23.56 degC"	
dfota	Queue a device FOTA download	FW file URL	None	**Yes**
mfota	Queue a module FOTA download	<module part number>,<FW version>,<file URL>	None	**Yes**