



Cavli Hubble (Version 1.4)

Documentation



Cavli
Hubble



Re-imagining Cellular IoT Solutions



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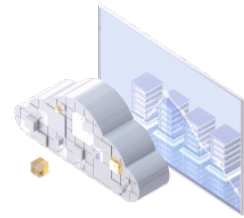
Cavli Wireless is an Internet of Things enabler and we aim to democratize the IoT sector with our Software to Hardware product suite which includes Smart Connectivity & Compute Modules, eSIM solutions and Connectivity & Device management Platform. We directly work with telecom operators around the world to facilitate local IoT connectivity, thereby ensuring that any IoT product maker or enterprise in any industry can easily build, connect and scale their IoT solutions to any geography in the world in the most secure, and seamless manner possible.



The Hardware



The Connectivity



The Platform



A transformative IoT solution that can be scaled globally, Cavli will give flexibility, agility and power to companies setting out to deploy their IoT solutions.

Our Markets

Our solutions have applications across industries like Logistics & Transportation, Industrial IoT & Smart Manufacturing, Smart City, Safety & Monitoring and others.



Automotive & Logistics



Smart City



Energy & Utilities



Safety & Security



Manufacturing



Agriculture



Health Care & E - Health



Retail



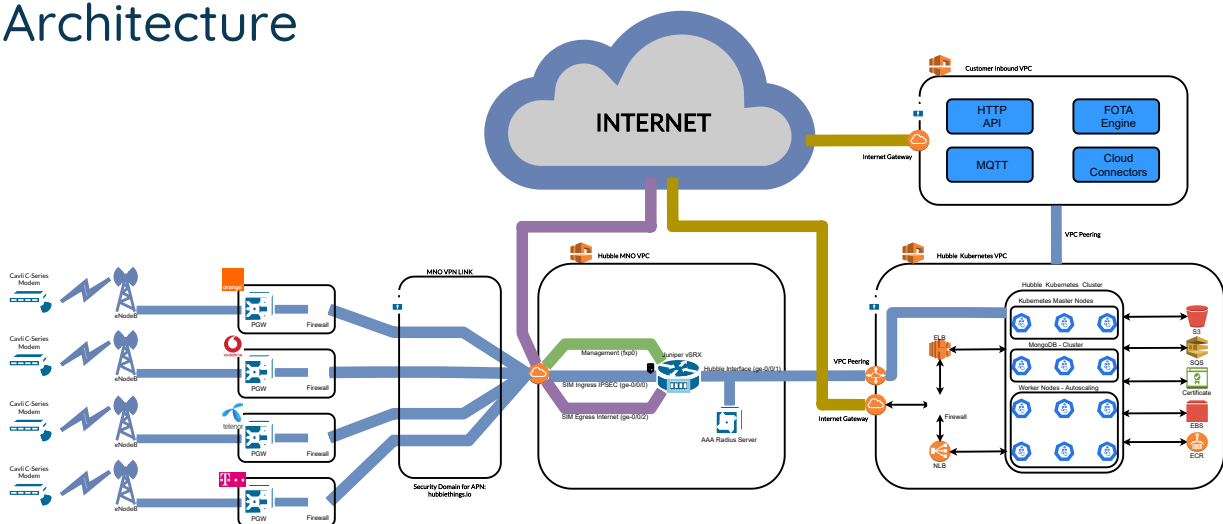
Smart Home

Cavli Hubble Platform and Architecture

1. Cavli Hubble Platform and Architecture

Cavli Hubble is our global connectivity management platform which securely manages and controls all your connected devices and data subscriptions. For the sake of effective management of devices, Cavli Hubble platform has five sections-Dashboard, Inventory, Groups, Devices, & Data.

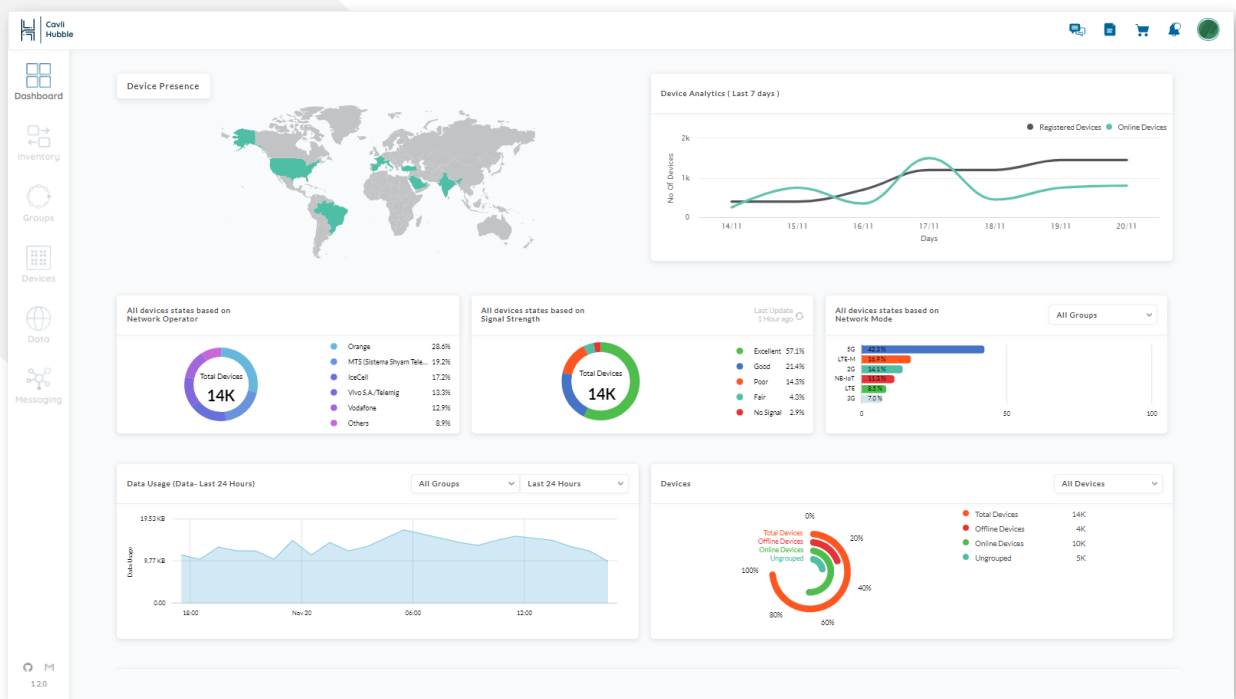
Architecture



1.1 Dashboard:

Consolidated information and analytics regarding the devices, data subscription, authentication logs etc. can be accessed in Cavli Hubble platform dashboard. The dashboard comprises of following sections:

- ▶ Device's Presence
- ▶ Device's Analytics
- ▶ Devices network operator information
- ▶ Device's signal strength information
- ▶ Devices information based on network type
- ▶ Device's data usage
- ▶ Offline / Online device's information
- ▶ Data Session logs



Device Presence:

Current geographical locations of your devices based on the latest session will be plotted here. Along with the location, the network type of those devices will also be listed.

Device Analytics:

Over the period of the last 7 days, the count of devices that have been registered and been online will be plotted in this section. The registered device count displayed in the chart will be incremental.

Devices network operator information:

Cellular network operator's information based on the current session, which is connected to the devices, will be listed in this section. The top 5 operators' names will be listed specifically, and the rest of them will be listed as others.

Devices signal strength information:

In one hour interval Cavli Hubble server will establish connection with your devices and will fetch the signal strength of the devices. signal Strength in percentage value will be displayed as a legend beside the chart.

Devices information based on network type:

Percentage analytics of the device's network type is plotted in this section. The device network type data will be fetched from the latest session of the device. Users can also view the network type information of devices which belong to a specific group's too, by sorting the data based on the group selection.

Devices data usage:

Consolidated data usage of the devices in the account will be plotted in this section. Data can be sorted based on 24 hrs , 48 hrs , & 7 day filter options. Along with this, users can view the data usage of specific groups by selecting the groups from the filter drop-down field.

Offline / Online device's information:

Percentage-wise listing of total devices, online, offline devices and devices in the ungrouped group are plotted in this section. In the legend area, actual device count is displayed.

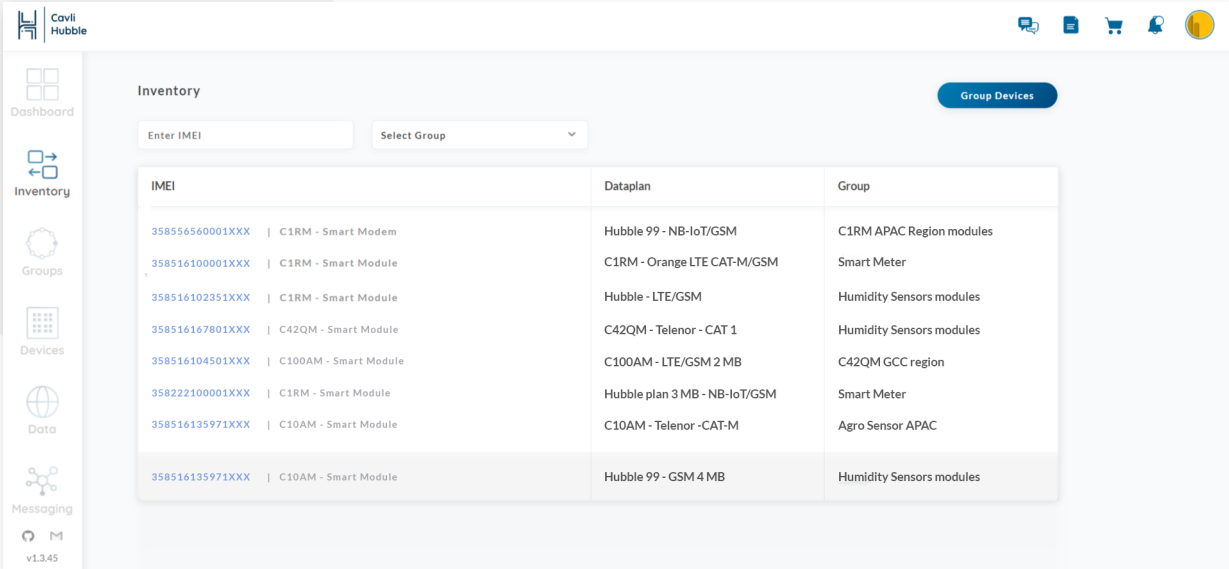
Data session logs:

In the chart, based on the device's access log, the result is plotted. Device access response from the server i.e. " Access-Accept " or " Access-Reject " information analytics is displayed. Users can sort data based on Last 24 hrs, 7 days, & 30 days. Upon hovering through the bar chart, success-failure access result count can be viewed.

In the data session logs section, session based device information can be accessed, including session start time, device id etc. Upon clicking the session ID, in the displayed pop-up consolidated device information like uploaded/downloaded data, network type, device unique IDs etc. based on the session ID will be displayed.

1.2 Inventory

Consolidated information and analytics regarding the devices, data subscription, authentication logs etc. can be accessed in Cavli Hubble platform dashboard. Dashboard comprises of following sections:



The screenshot displays the 'Inventory' section of the Cavli Hubble dashboard. It features a search bar for 'Enter IMEI' and a 'Select Group' dropdown menu. A 'Group Devices' button is located in the top right corner. The main content is a table with three columns: 'IMEI', 'Dataplan', and 'Group'. The table lists several devices with their respective IMEI numbers, model names, and associated dataplans and groups.

IMEI	Dataplan	Group
358556560001XXX C1RM - Smart Modem	Hubble 99 - NB-IoT/GSM	C1RM APAC Region modules
358516100001XXX C1RM - Smart Module	C1RM - Orange LTE CAT-M/GSM	Smart Meter
358516102351XXX C1RM - Smart Module	Hubble - LTE/GSM	Humidity Sensors modules
358516167801XXX C42QM - Smart Module	C42QM - Telenor - CAT 1	Humidity Sensors modules
358516104501XXX C100AM - Smart Module	C100AM - LTE/GSM 2 MB	C42QM GCC region
35822100001XXX C1RM - Smart Module	Hubble plan 3 MB - NB-IoT/GSM	Smart Meter
358516135971XXX C10AM - Smart Module	C10AM - Telenor -CAT-M	Agro Sensor APAC
358516135971XXX C10AM - Smart Module	Hubble 99 - GSM 4 MB	Humidity Sensors modules

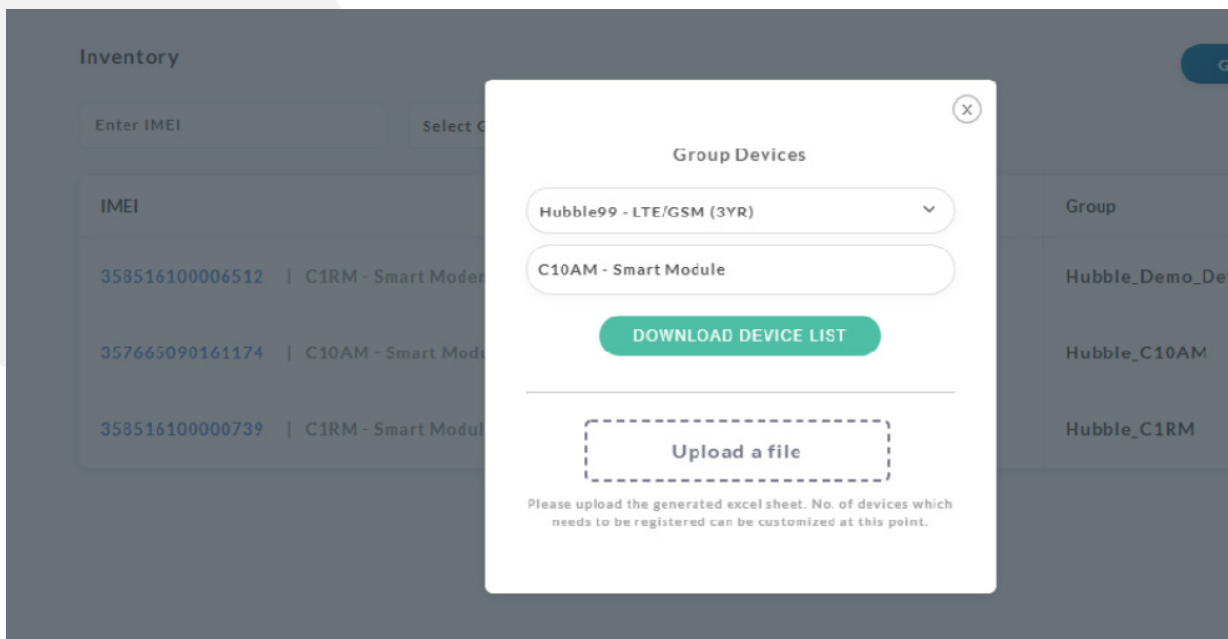
Upon clicking on the listed device IMEI, the application will redirect to the devices section where specific device information can be viewed. Based on the IMEI, group selection users can filter the data listed.

Group Devices:

Percentage-wise listing of total devices, online, offline devices and devices in the ungrouped group are plotted in this section. In the legend area, actual device count is displayed.

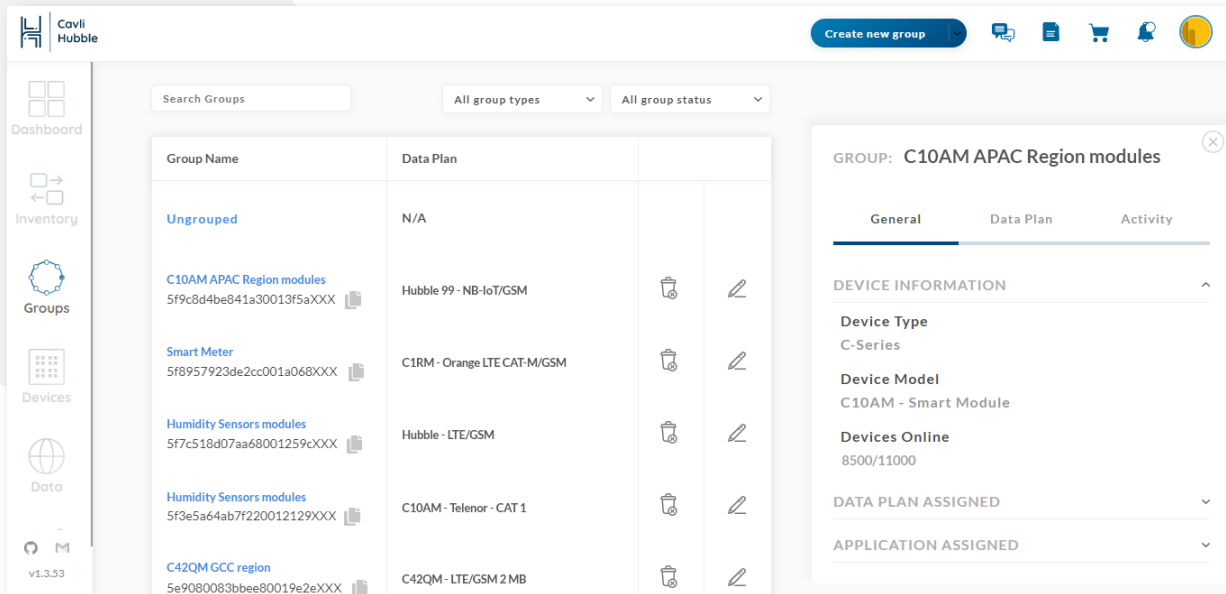
Upon registration if the device grouping is not done, then those devices will be listed in the “Ungrouped” group. If a user wishes to group the ungrouped group devices, they can opt the “Group Devices” option on this page. Devices belonging to the ungrouped group can be assigned to new groups or groups previously created by following these steps:

- ▶ Select the data plan.
- ▶ Devices applicable to that data plan will be listed and the user can select among those.
- ▶ Upon “Download Device List” button action, all devices based on the selected data plan will be listed in the generated sheet.
- ▶ Based on the requirement, users can re-upload the sheet with the devices which have to be grouped.
- ▶ Users can create a group or can assign devices to an pre-existing group. Please note that among the created groups only ones which have the same data plan and product model will be listed for selection.
- ▶ Upon selection of a group devices will be assigned to that group. In the inventory page, the device and its assigned group name can be viewed.



1.3 Group:

All the groups which belong to the users account will be listed in the Groups section. Along with the user created groups, “ Ungrouped “ group will be listed atop, this is a by default group which will be having devices which are not assigned to any groups yet, and this group's devices will be of different data plans.



Group name and its assigned data plan are listed in the left panel. Users can edit the group name at any point of time, but deletion of a group is only possible when there are no devices in it. Listed groups can be sorted based on group name, group types i.e C-Series, P-Series and group status i.e. Active, Inactive.

All groups related information can be viewed in the right panel by clicking on the group name. Group information including device type, device model, assigned data plan information including monthly data quota , network type etc. can be accessed.

On the group right panel's general tab, under the manage section, features of group suspend and termination is available. Users can suspend all of the devices in the group, if required. With the Terminate feature, users can initiate a terminate request, and our support team will review the request and will contact you.

Create new group:

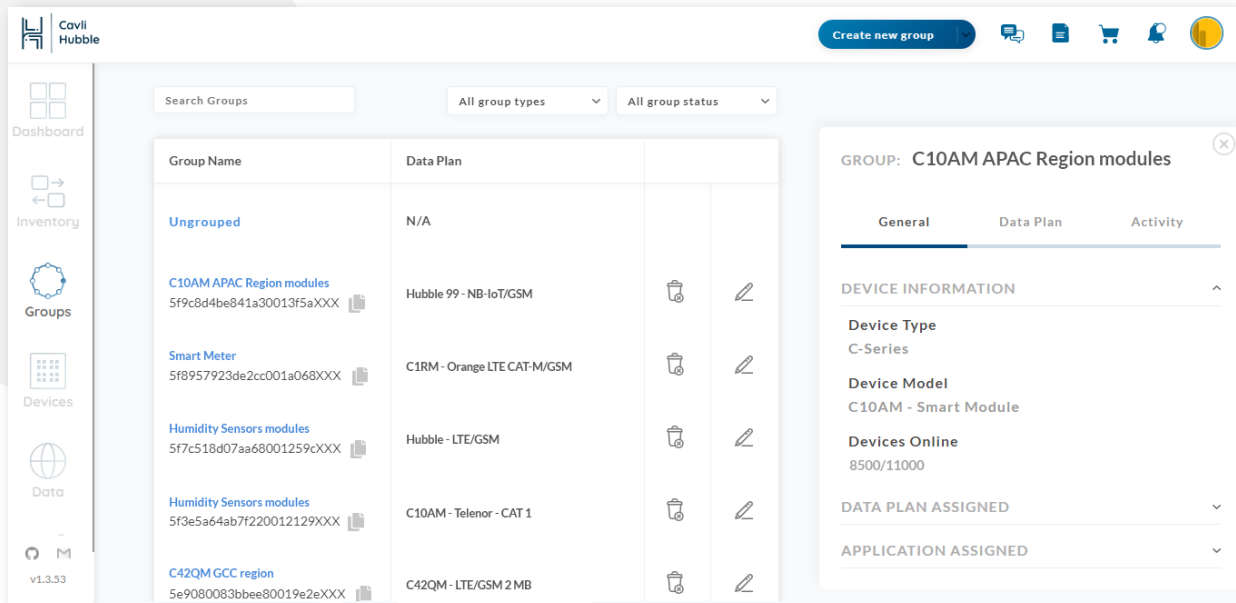
Users can create groups by entering the group name and a basic description regarding the group. Created new groups will be listed when the user tries to change the assigned devices to a new group from the devices section. These newly created groups will also be listed during the grouping of ungrouped group devices.

Group overage limit:

Users can set the Hubble data transfer monthly overage limit per device. In the group's right panel, users can view the overage limit setting feature. Upon exhaustion of the data limit of the overage limit set devices, those will become inactive.

1.4 Devices:

Specific device information which belongs to the Ungrouped group or user created groups can be viewed in the Devices page. Group's name, it's assigned data plan, and consolidated data usage of all devices in the group based on the total data quota of the devices are listed. Upon expanding this group tab, individual device information can be viewed.



In the left panel, below the group tab, all the individual device's information including IMEI, connected network operator, & country of the device based on the recent session, data usage based on the monthly data quota and current device status i.e. active, inactive or terminated are displayed.

Upon clicking the device unique ID value i.e. the IMEI, the right panel will be expanded with more device related information. Specific device type, its model, assigned group, assigned data plan, current status etc. will be listed. Following features are available in the devices right panel section:

Change group:

Users can change the individual devices to another group based on the following criteria, the group to which the device is being changed should be having the same data plan and devices with the same model type as of the current group. Only those groups will be listed in the groups drop down for the selection.

Suspend device:

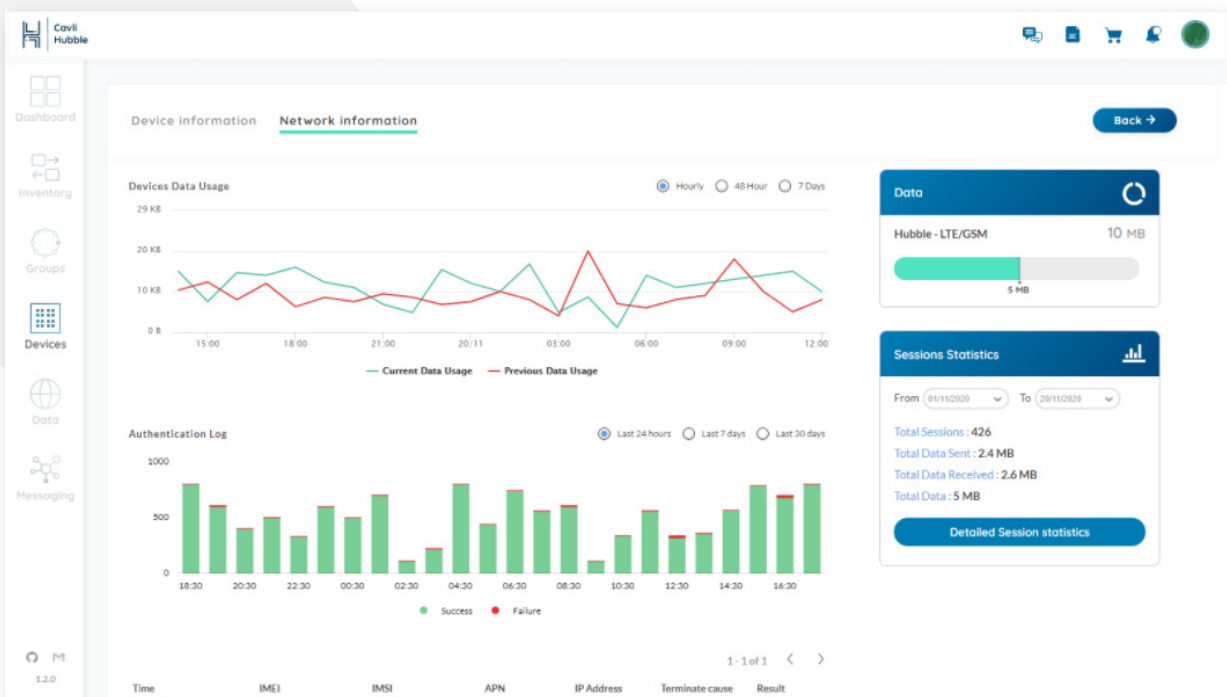
Along with the suspension of the group as a whole, users can also suspend individual devices from the devices page. Upon suspend action of a specific device, it will become inactive and the device's packet data will be disconnected.

Terminate device:

Users can initiate a termination request for the device except during the terminate lock period, that will be normally from 6 to 12 months. Upon termination toggle action, a termination request will be raised, and Cavli support team will review the request and will contact you as a part of the device termination process.

Device network information:

In the device right panel below the network tab, upon clicking the view more button, users can access the network information panel which lists all the network related information of a specific device.

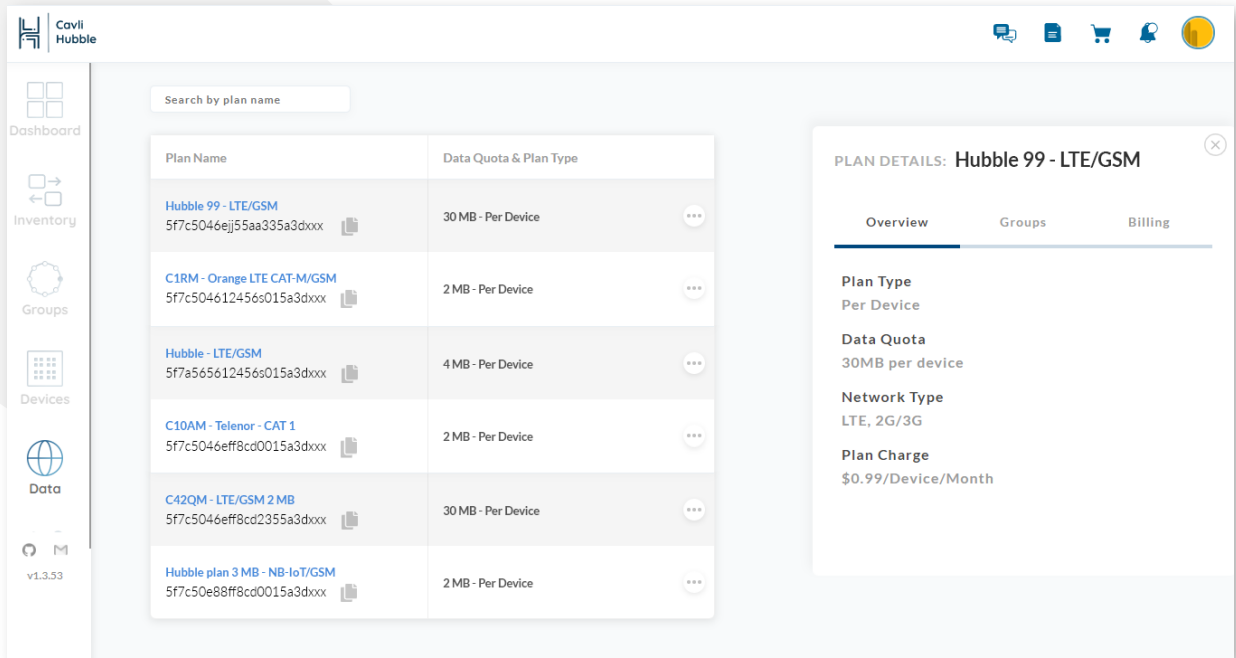


Data usage of devices in an hour, 48 hours, 7 days will be plotted in a chart. Monthly data quota of a device and the current usage is plotted in the Data section. Monitoring of data based on the session, access logs etc. can be tracked in this network information panel.

1.5 Data:

Assigned data plans for the user account will be listed in the data page. Data quota of a specific data plan, count of the assigned groups and the devices involved has been listed in the right panel.

Upon selecting the data plan name, the right panel section is being expanded which will display the data plan monthly charge information, network type applicable, names of the assigned groups etc.

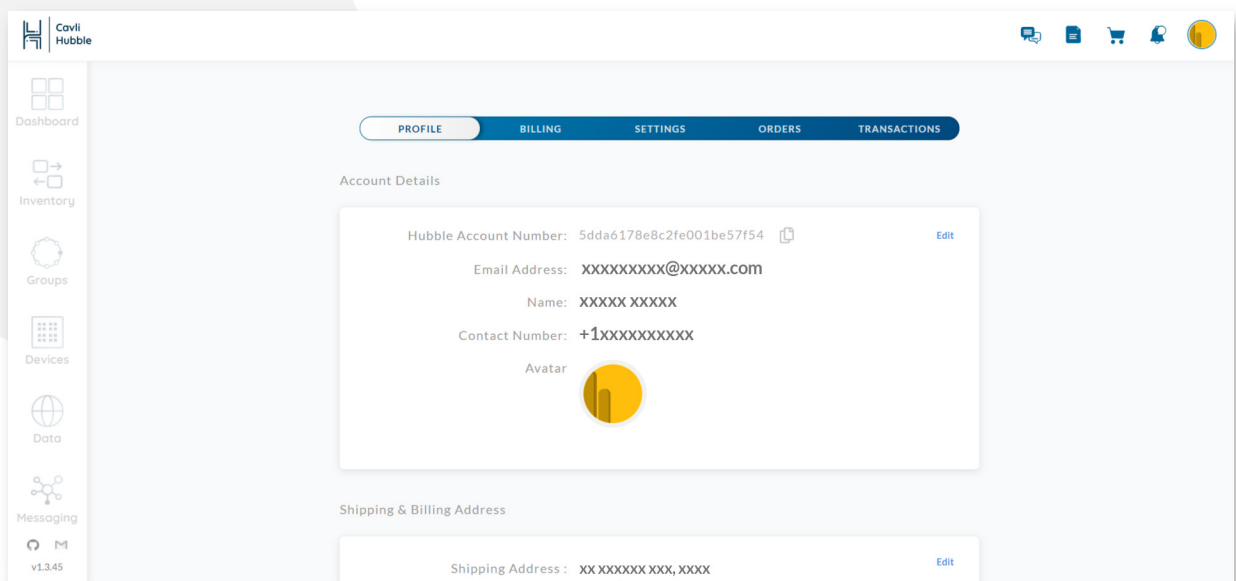


1.6 User Profile:

Users profile related information including basic details, order details etc. can be accessed in this section. User profile page has following sections, Profile, Billing, Settings, Orders, Transactions.

1.6.1 Profile:

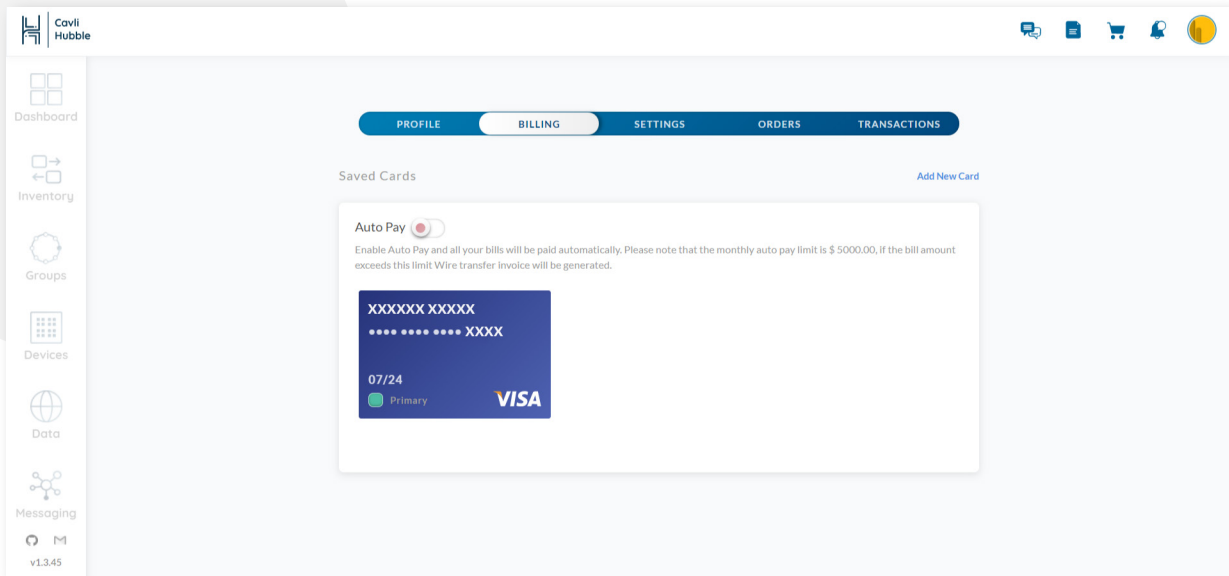
All user related information can be accessed in the profile section including the unique Hubble account number, Shipping & Billing address details can be accessed here.



Users can change the cavli hubble password in the profile password settings section.

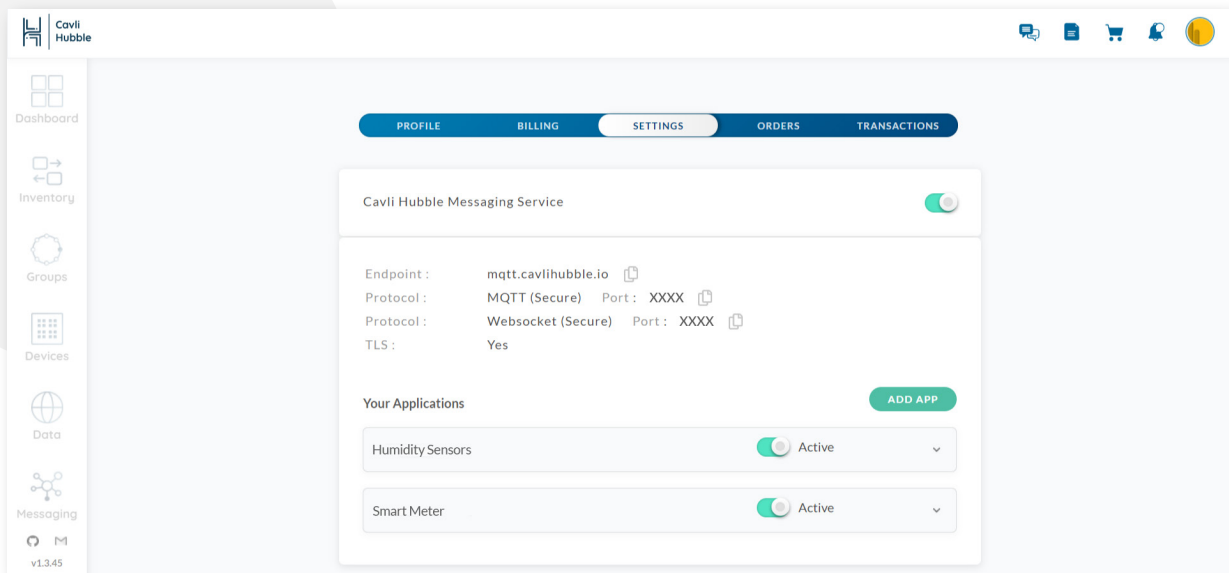
1.6.2 Billing:

Users can save the payment cards under the billing section. They can add multiple cards and can select one as primary. Upon enabling the auto pay feature, billing of account devices can be automated. Please note that the auto payment limit of saved cards is limited to \$5000.



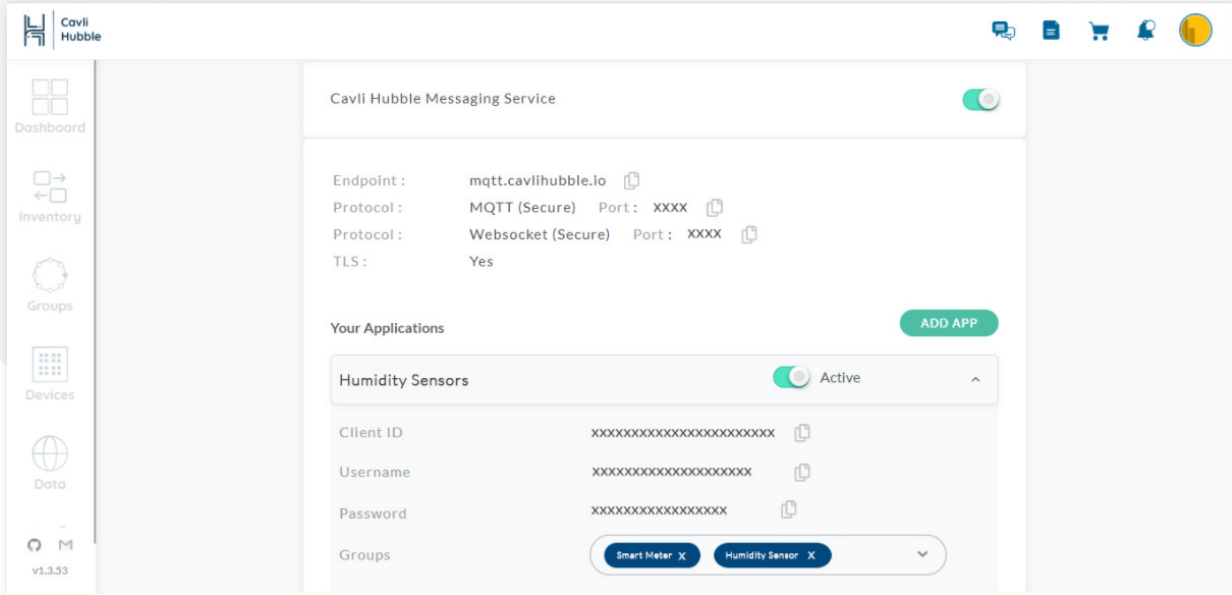
1.6.3 Settings:

Cavli hubble MaaS and API service can be subscribed in this section. Cavli Hubble Messaging Service :



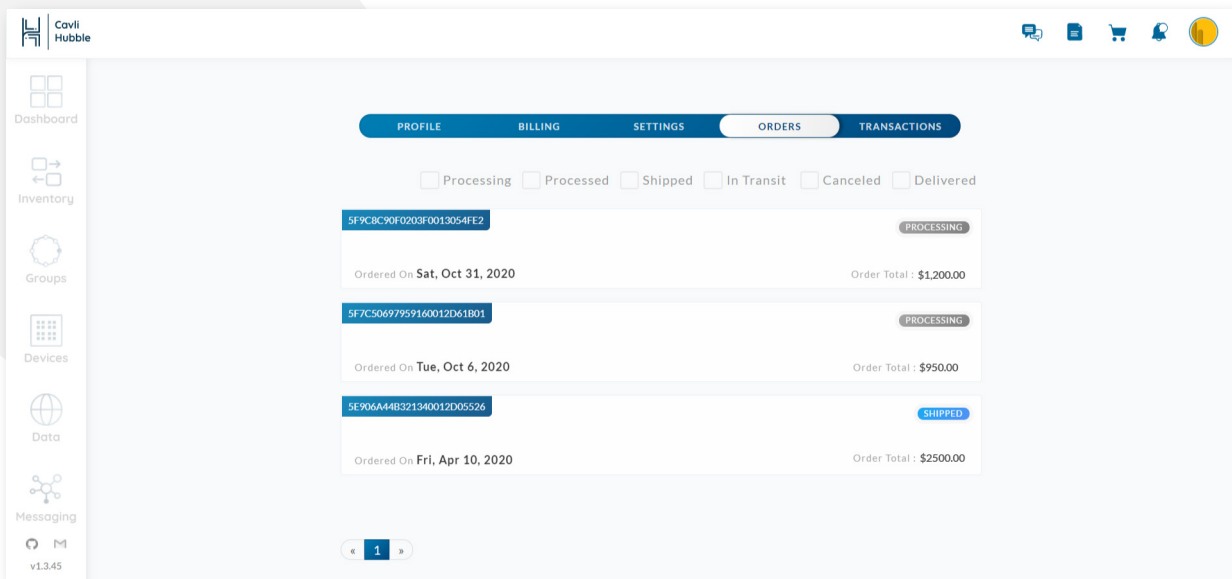
Upon subscribing to the Cavli Hubble MaaS, users can access endpoint and port ID based on the required protocol. With this information users can authenticate and can establish connection with their devices through the existing Cavli messaging infrastructure, thus negating the customer's cost for setting up and maintenance of self hosted or third-party messaging brokers or services.

Users can create applications and can add multiple groups under that application. With the Client ID, username and password, the group's devices belonging to that application can establish connection with users' portals.



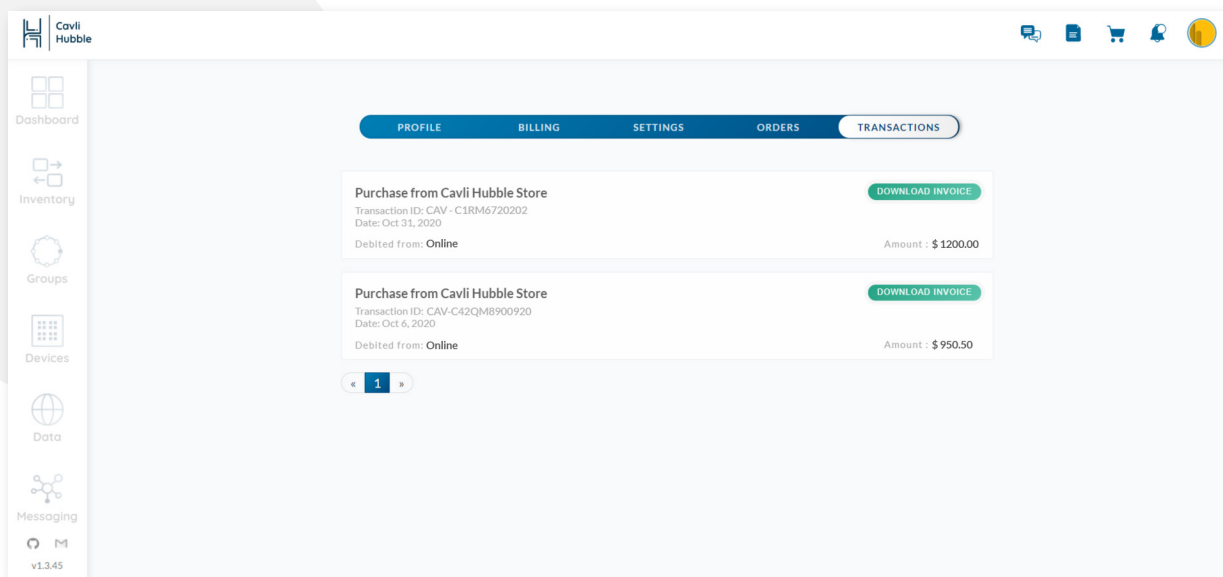
1.6.4 Orders:

Details of orders done by the account user can be accessed in this section. Users can track the order status here. All order related information including order date, purchased items etc. can be viewed as order details in this section.



1.6.5 Transactions:

All the monetary transactions done by the account users will be listed under the transactions section. Users can download the transaction invoice here.



2. Switching between internal Hubble eSIM and external SIM channel.

Hubble eSIM is embedded inside the cellular modem. Most of the modules from Cavli support dual SIM channel and single standby. With AT commands, the MCU can control which SIM channel needs to be used. Some modules will require a reboot after switching the SIM channel, refer to the module datasheet on the behavior of the specific module which is used. Internal SIM channel is designated with identifier 0 and external as 1. It is recommended to verify the SIM channel check on every bootup by external MCU, for a seamless Hubble platform and data services.

AT Commands

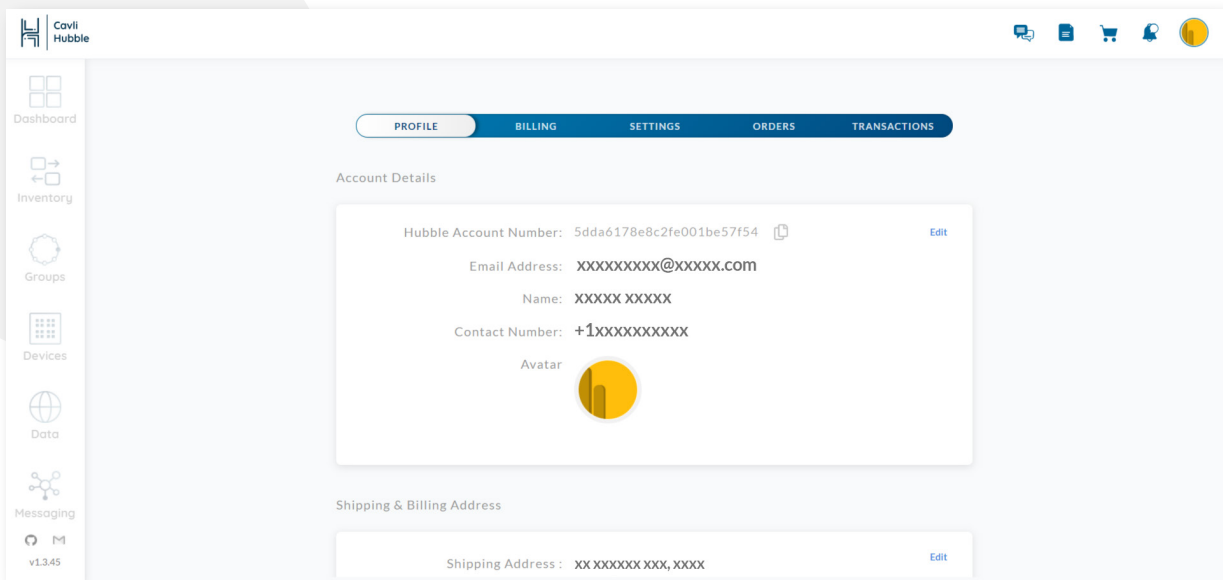
- i Check Syntax
Command: AT^SIMSWAP=?
Response: ^SIMSWAP=(0-internal,1-external)
- ii Check Status
Command: AT^SIMSWAP?
Response: ^SIMSWAP=0
- iii Set Internal SIM Channel
Command: AT^SIMSWAP=0
Response: OK

3. Hubble Device Onboarding

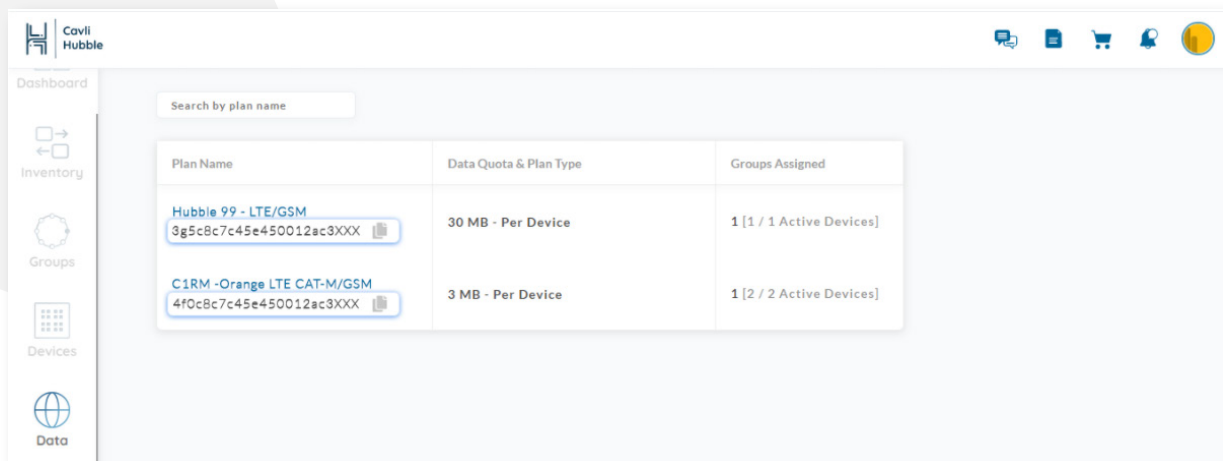
3.1 Device Registration Process

By default, all Cavli cellular modems/modules will be allowed to register to the network with a restricted network access limitation. Full internet service and platform services will be available after the successful device registration only. After the device purchase, either with a standalone data plan or on Hubble99 data plan, customers should get at least 2 information specific to their Hubble account and the third parameter is optional. Parameters required for device registration are, Hubble Account ID <cust_id>, Hubble Data Plan ID <plan_id> and Device Group ID (Optional) <group_id>. Any device registered to the platform without the optional parameter group ID, will be grouped under ungrouped devices section, wherein it can be assigned to another group in future, either by issuing +HUBBLEREG AT command from modem with group ID or can be individually or in a batch assignment from the platform. Hubble registration will fail, if the device is configured to use an external SIM channel and registered with a non-Hubble eSIM.

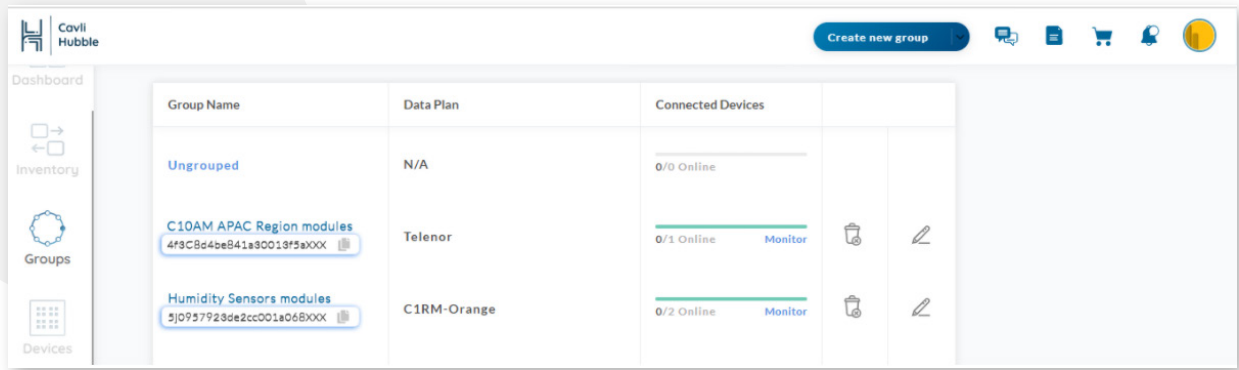
Hubble Account ID <cust_id> can be accessed from the profile section of the console.



Hubble Data Plan ID <plan_id> can be accessed from the Data section of the console.



Device Group ID (Optional) <group_id> can be accessed from the groups section.



```

AT+HUBBLEREG=?
+HUBBLEREG: <account_id>,<plan_id>[,<group_id>]
OK

AT+HUBBLEREG="5c71f4a123d7040019bdfb0l","5c71f401d1ba6b0010d0ff7e","5c71f97dee4bf6001oda60t8"

+HUBBLEREG: REGISTER SUCCESS
OK

```

3.2 AT Commands

Hubble device registration command works only when there is an active PDP context and connected to the network. Details required for the PDP context creation and activation is described under the section 3.A. This command should be used in the application firmware (external MCU) with parameter values stored in NV (Non-Volatile) storage as global variables. On each bootup, the device should check the registration status and if found unregistered, then invoke the registration AT command. It is not recommended to invoke registration API on every bootup. On every successful registration, the modem will receive a unique token for communicating with the Hubble platform. Token will not be visible to the external MCU or on AT command interface. Once the Hubble registration process is successful, PDP context needs to be deactivated and activated again to get new full network access.

- i Check Command Syntax.
Command: AT+HUBBLEREG=?
Response: +HUBBLEREG: <acct_id>,<plan_id>,<group_id>
Acct_ID: Required
Plan_ID: Required
Group_ID: Optional
- ii Check Registration status.
Command: AT+HUBBLEREG?
Response: +HUBBLEREG: (Unregistered|Registered)
- iii AT Command Flow with Group ID.
Command: AT+HUBBLEREG=""ACCT_ID"" ""PLAN_ID"" ""GROUP_ID""
Response: +HUBBLEREG: (Success|Failed)

- iv AT Command Flow without Group ID.
Command: AT+HUBBLEREG=""ACCT_ID"" ""PLAN_ID""
Response: +HUBBLEREG: (Success|Failed)
- v AT Command Flow without Group ID.
Command: AT+HUBBLEREG=""ACCT_ID"" ""PLAN_ID""
Response: +HUBBLEREG: (Success|Failed)

3.3 Network Access Topology

- 3.3.1 Intranet: Before the device is registered to the platform, though the device registers to the network and the PDP context can activate successfully, the device will be getting a limited internet service with having access to only Hubble registration interface and DNS service. All other networks will be in a restricted state. A device can continue to be in the intranet state for 90 days only from the date of first network attach. After 90 days, the PDP activation on intranet state will fail and the customer needs to contact the customer support for a full activation.
- 3.3.2 Internet: After successful Hubble registration, devices will be allowed for full internet service. At this state, devices will also be able to use other Hubble services like Device Management, Network/Data Management and Hubble Messaging service.

4. Network and Data Management

4.1 APN Configuration

APN config to connect to Hubble Service and Internet service.
APN Name: hubblethings.io
Username: <blank>
Password: <blank>
IP Type: IPv4

4.2 AT Commands

- i Check Syntax
Command: AT+CGDCONT=?
Response: +CGDCONT=(Context-ID),(IP-Type),(APN Name)
- ii Check Status
Command: AT+CGDCONT?
Response: +CGDCONT=1,""IP"" ""hubblethings.io"" ""10.254.10.22"" ,0,0,0
- iii Configure APN
Command: AT+CGDCONT=1,""IP"" ""hubblethings.io""
Response: OK
- iv Activate PDP Context
Command: AT+CGACT=1,1
Response: OK

4.3 AAA Service (Authentication, Authorization and Accounting)

Hubble AAA server monitors and allows access for the device to the network. As traditionally AAA Radius server will authorize the device based on the SIM credentials only. In the case of Hubble AAA server, it is fully integrated to Hubble Platform, taking optimal decisions based on the modem and SIM lifecycle, device registration status. It is connected to Mobile Operator EPCs for real-time accounting and analysis, enabling the platform to give more real-time information of the authentication logs and IP address allocation, alarms and billing.

4.4 IP Addressing Scheme

Hubble networking system has three sets of IP addressing policy based on the services allowed from the platform.

4.4.1 INTRANET IP Address

Before the device is registered with the +HUBBLEREG AT command, any PDP context activation will provide the device intranet access and the IP address in the 172.X.X.X. Using +CGPADDR, currently received IP address can be viewed. If the address starts with “172”, means the device is having limited network access and needs to proceed with +HUBBLEREG command. Even after registration, the device is receiving intranet IP, meaning the +HUBBLEREG was unsuccessful or corrupted. In this event, contact the customer support center for resolution.

4.4.2 INTERNET DYNAMIC IP Address

On successful device registration, the device will get a full network service IP address on the next PDP context activation, which starts with 10.X.X.X. By default, a device will be assigned with a dynamic addressing policy.

4.4.3 INTERNET STATIC IP Address

A device registered in the Hubble platform can be configured to get a static IP for internet access. Static IP needs to be assigned from the platform and from API only. This can be configured on a specific device level or on entire devices in a group.

4.5 DNS Management

The Hubble network system uses redundant DNS service from Google. By default, the DNS IP address will be issued to devices as follows,

Primary DNS Address: 8.8.8.8

Secondary DNS Address: 8.8.4.4

4.6 PDP Session information

Hubble platform provides detailed Packet Data Session information for troubleshooting, analytics, billing and monitoring. The information provided for a session is detailed below as attributes.xInbound and Outbound Traffic Rule

During intranet sessions, as described in 4.d, the network firewall will be allowing, access only on the Hubble Registration interface. And subsequently during internet sessions, the device will have full outbound access to all public internet IP ranges and Hubble service interfaces. But for inbound, all the inbound access initializations from any public internet IP address ranges will be restricted to prevent and protect devices from DDoS or brute-force access attacks, thereby not consuming unwanted data traffic, thus avoiding data billing on non-intended traffic. For inbound traffic, a device needs to establish TCP/UDP connection to the required server/IP and within that connected session, any inbound traffic can be established from server to the device.

IMSI	IMSI of the eSIM Module
ICCID	ICCID of the eSIM Module
IMEI	IMEI of the Cellular Module
MSISDN	MSISDN of the eSIM Module
Session Unique ID	Unique Session ID generated by the network
Session Start Time	Network Data session start time
Session Stop Time	Network Data session stop time
Session Time	Total the duration the session was active
GGSN IP Address	Access network node IP address
Radio Access Type	Network technology Type (LTE/NB-IoT) etc.
Device IP Address	IP address issued to device for PDP service
Data Download Bytes	Total bytes downloaded during this session
Data Upload Bytes	Total bytes uploaded during this session
Data Total	Total bytes uploaded and downloaded in this session
Terminate Cause	Session termination reason

Inbound and Outbound Traffic Rule

During intranet sessions, as described in 4.d, the network firewall will be allowing, access only on the Hubble Registration interface. And subsequently during internet sessions, the device will have full outbound access to all public internet IP ranges and Hubble service interfaces. But for inbound, all the inbound access initializations from any public internet IP address ranges will be restricted to prevent and protect devices from DDoS or brute-force access attacks, thereby not consuming unwanted data traffic, thus avoiding data billing on non-intended traffic. For inbound traffic, a device needs to establish TCP/UDP connection to the required server/IP and within that connected session, any inbound traffic can be established from server to the device.

5. Hubble Device Management

Hubble device management uses MQTT 3.1.1 version to communicate with devices. If the device successfully completes the Hubble registration AT command, device management service will be automatically invoked and will establish the connection with the platform. If the customer wishes to deactivate the connection, it can be achieved by passing the AT command; AT+HUBBLEDM=0. This command stores the value persistently and it will keep the disabled state even after a reboot. So if it needs to be activated again, it has to be done by passing command AT+HUBBLEDM=1. After the service gets connected with Hubble, the devices will subscribe to required topics to listen to requests from the cloud and this is a background non-blocking process.

5.1 Authentication

Each device will receive a unique PSK (Pre-Shared Key) from Hubble after a successful +HUBBLEREG AT command. Devices will store this PSK in a non-volatile memory location for future use. Hubble uses a custom authentication scheme to reduce data consumption and to have an enhanced security layer. Devices will use these PSK to hash many device specific static parameters and use the hash key to encrypt/decrypt the payload to and from the platform.

5.2 AT Commands

- i Check Syntax
Command: AT+HUBBLEDM=?
Response: +HUBBLEDM=<execution status (1:start|0:stop)>[,<network type (1:private|2:public)>]
- ii Check Status
Command: AT+HUBBLEDM?
Response: +HUBBLEDM: 1
- iii Activate DM
Command: AT+HUBBLEDM=1
Response: OK

5.3 READ Parameters

Cavli hubble server establishes connection with the devices and fetch device management parameters information. Following parameters are listed in the device management panel and users can get real time data through clicking the refresh icon beside each parameter.

Manufacturer	Clock Time
Model Name	Radio Fallback
Serial Number	Radio Priority
Firmware Version	RF Bands
IMEI	SIM Status
ICCID	Network Attached
IMSI	Network Mode
PLMN	Cell-ID
TIME ZONE	NEARBY CELL ID
Description	Signal Strength
Hardware Version	RSSI



- BER
- PSM Status
- eDRX Status
- IP Mode
- SMSC Number
- APN Name
- GPRS Status
- IP Address

- DNS Address
- Coverage Enhancement Status
- Battery Report
- Memory Total
- Battery Level
- Memory Free
- Ping Report
- Mobile Carrier

Device ID : 358516100000192		
MANUFACTURER : Cavli Wireless Inc.	MODEL NAME : C1RM	SERIAL NUMBER : CC02000019
FIRMWARE VERSION : C1RM V2.1.0	BATTERY LEVEL : 0%	MEMORY FREE : 0 KB
CLOCK TIME : 01/01/1970, 5:30 AM GMT+5	TIME ZONE : UTC+08:00	MOBILE CARRIER : Orange
DESCRIPTION : NB-IoT/GPRS Dual Mode Module	HARDWARE VERSION : C1RM-EMAP_1.6	BATTERY REPORT : No Charger
MEMORY TOTAL : 0 KB	IMEI : 358516100000192	ICCID : 89330129536000111750
IMSI : 208011408170302	PLMN : 21403	RADIO FALLBACK : Disabled
RADIO PRIORITY : GSM	RF BANDS : 3,5,8,20,28	SIM STATUS : USIM NORMAL
NETWORK ATTACHED : Registered, roaming	NETWORK MODE : GSM	CELL-ID : 00abffff
NEARBY CELL ID : 171,2086,295,287	SIGNAL STRENGTH : Poor	RSSI : -87 dBm
BER : 0	PSM STATUS : Enabled	EDRX STATUS : Enabled

5.4 WRITE Parameters

Following are the WRITE Parameters.

- Radio Fallback
- Radio Priority
- RF Bands
- Network Mode
- PSM Status
- eDRX Status
- IP Mode
- Reboot

6. Hubble Messaging Service

6.1 MQTT Protocol Specification

MQTT used to stand for MQ Telemetry Transport, but is today referred to simply as MQTT and is no longer an acronym. It is an extremely simple and lightweight Publish/Subscribe messaging protocol invented at IBM and Arcom (now Eurotech) to connect restricted devices in low bandwidth, high-latency or unreliable networks. Hubble MQ Service supports MQTT 3.1, 3.1.1 and 5.0 protocol specifications.

Dashboard:

MQTT Version	3.1, 3.1.1 or 5.0
Topic Prefix	None
Message Quota Per Month	Unlimited
Payload Size	64Kb
Topic Length	256 Characters
Security	TLS 1.2
Message Expiration	Yes
QoS	Yes
Max Device per App	No Limit
Session Cleanup	Yes
Enhanced Authentication	Yes
Remote Disconnect	Yes
Keep-Alive	Yes
Shared Subscription	Yes
Broker Redundancy	Geo Redundant
Auto Scaling	Yes
Session Aware (Multi Broker)	Yes

6.2 AT Commands

- i Check Syntax
Command: AT+HUBBLEMAAS=?
Response: +HUBBLEMAAS: <execution status (1:start|0:stop)>
- ii Check Status
Command: AT+HUBBLEMAAS?
Response: +HUBBLEDM: 1
- iii Activate MAAS
Command: AT+HUBBLEMAAS=1
Response: OK

- iv Check Publish Message Syntax
Command: AT+HMPUB=?
Response: +HMPUB: <topic>,<message>,<qos>,<duplicate>,<retain>
- v Publish Message
Command: AT+HMPUB="topic/","Test Message",0,0,0
Response: +HMPUB: PUBLISH SUCCESS
- vi Check Subscribe Topic Syntax
Command: AT+HMSUB=?
Response: +HMSUB: <topic>,<qos>
- vii Subscribe Topic
Command: AT+HMSUB="topic/",0
Response: +HMSUB: SUBSCRIBE SUCCESS
- viii Check Unsubscribe Topic Syntax
Command: AT+HMUNSUB=?
Response: +HMUNSUB: <topic>
- ix Unsubscribe Topic
Command: AT+HMUNSUB="topic/"
Response: +HMSUB: UNSUBSCRIBE SUCCESS

6.3 Authentication

Each device will receive a unique PSK (Pre-Shared Key) from Hubble after a successful +HUBBLEREG AT command. Devices will store this PSK in a non-volatile memory location for future use. Hubble uses a custom authentication scheme to reduce data consumption and to have an enhanced security layer. Devices will use these PSK to hash many device specific static/dynamic parameters and use the hash key to encrypt/decrypt the payload to and from the platform.

6.4 Service Access - Best Practice

Hubble Messaging service is an MQTT messaging service for the Cavli C-Series modem products. Modem can directly connect to the MQTT broker on behalf of the customer settings and the broker can forward the messages to customer cloud servers on the interfaces like MQTT or Websocket by default. This service can also be enabled with cloud connectors which is described in 6.f. The access details for this service is listed below.

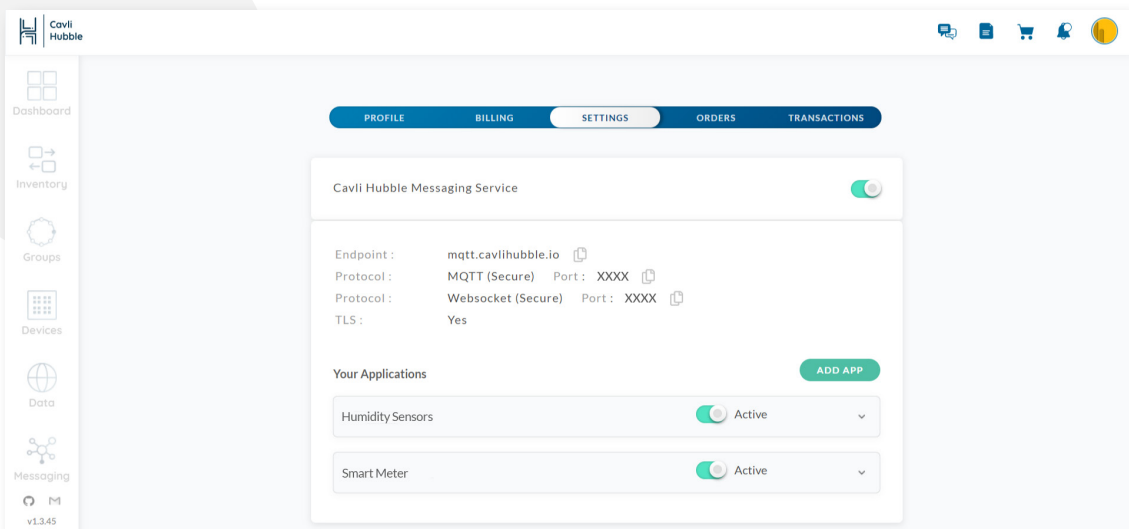
Endpoint: mqtt.cavlihubble.io

Protocol: MQTT (TLS)

Port: 8886

Protocol: Websocket (TLS)

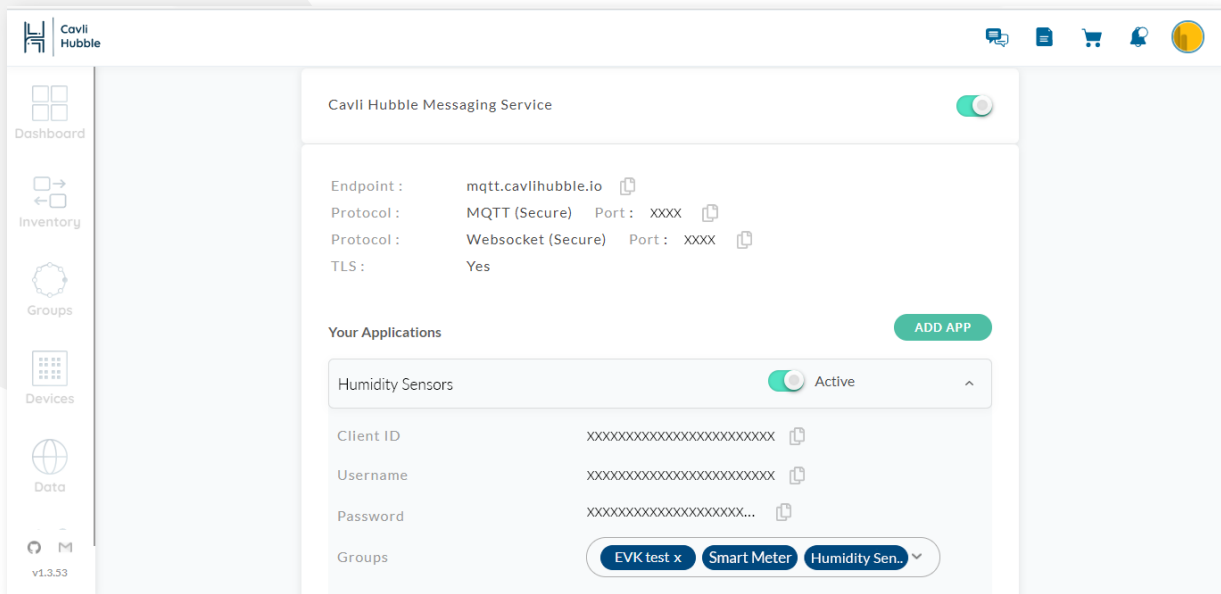
Port: 8887



Messaging service gives access to customers on a secure interface only. To enable and create the first messaging credentials, an app needs to be created. An app will hold the MQTT/Websocket credentials to access the virtualized broker and it will also contain which device group can have the access to each virtualized app container. This technique is explained in the below section 6.e. Once the app is created, it will provide the user with the following access information which is auto-generated by the system.

Client-ID: xxxxxxxxxxxx
Username: xxxxxxxxxxxx
Password: xxxxxxxxxxxx


Mostly, the client-id and the username generated will be of the same string. On the service access application at the customer end, the client-id should be used, even if the data is the same as the username. The client app should support TLS 1.2 with certificate key bits of 2048 bits. Messaging broker will not initiate any client certificate request for verification.



Currently this service supports only a single client to access the broker, if you try to access the broker with multiple client requests, only the latest client will be considered online and any topic subscription will be forward to the latest client only. We are working on this architecture and will soon be making it available for the customers to connect to the service from a distributed architecture. If you want to use this service in a distributed environment today, you can choose to subscribe for cloud connector service explained in 6.f.

6.5 Apps and Virtualization

Hubble messaging service is designed in such a way that each customer will have a virtualized broker containing multiple apps as a sub-system inside the broker. Users need to create a new app and assign required device groups to the app to start messaging between the device and the customer platform. After the app is created, Hubble will from then will route the device messaging request to the customer virtualized broker and this process is fully automated between device and the platform. Customers are not required to give any info relating to the messaging app to the device while connecting to the messaging service on the modem. All the devices in a group and all the groups which are assigned to an app will now be in a single messaging realm and can communicate with each other and can communicate with any external client connected with the app credentials. Once the app is assigned to a messaging app, it can't be assigned to another app at the same time. To move to a different app, first the group needs to be removed from the first app and then it can be added to the second app.



If the user needs to enable messaging service for devices in two different groups and does not want the devices to communicate between both the groups, he needs to create two apps and each group needs to be assigned separately in the two apps. So fundamental architecture is each app is considered as a separate realm, devices in the same realm can communicate with each other and are not allowed to communicate with other realms.

6.6 Cloud Connectors

Cloud connector service is in beta phase with customers. This feature enables customers to connect the virtualized MQTT broker directly to their cloud provider service endpoints like AWS SQS, SNS. This means that customers can get the data directly injected from the broker to the customer application database or feed provisioned dedicated datastore engine by Hubble platform directly, without having an MQTT client connecting to the Messaging service brokers. This service will be a full-duplex two-way communication connectors, allowing customers to send and receive data from devices. The virtual microservices will be launched, as soon as the customer creates connector apps and will establish a connection to cloud endpoint with the credentials provided for the connection. This microservice will be launched by default with 3 instances for redundancy purpose and can be enabled with auto-scaling for the increasing or decreasing the pods based on the number of devices connected to the respective connector app. Cavli will be releasing new connectors on a timely interval. For more detailed information on the cloud connector endpoint availability, please check with the respective sales account manager.

7. Billing and Accounting

Hubble device management uses MQTT 3.1.1 version to communicate with devices. If the device successfully completes the Hubble registration AT command, device management service will be automatically invoked and will establish the connection with the platform. If the customer wishes to deactivate the connection, it can be achieved by passing the AT command; AT+HUBBLEDM=0. This command stores the value persistently and it will keep the disabled state even after a reboot. So if it needs to be activated again, it has to be done by passing command AT+HUBBLEDM=1. After the service gets connected with Hubble, the devices will subscribe to required topics to listen to requests from the cloud and this is a background non-blocking process.

7.1 Standalone Billing

Our billing structure is prepaid, the bill amount for the monthly hubble data transfer has to be prepaid, incase of overage usage, users have to pay at the end of the month. Please note that the suspended devices i.e. the inactive devices will also be billed. When a device is terminated, that one will be excluded from the billing cycle. Generation of bills, payment completion, payment failure etc. will be communicated through mail.

7.2 Hubble99 Billing

Hubble 99 billing belongs to the combo plan of Cavli. Users are engaged for an annual term. Users will pay 12 months hubble data transfer price upfront. Overage usage of data will be billed monthly. If the overage bill amount is less than 10\$, overage monthly bill will not be generated on that month, unbilled amount will be charged in the next billing cycle. Please note that the suspended devices i.e. the inactive devices will also be billed. When a device is terminated, that one will be excluded from the billing cycle. Generation of bills, payment completion, payment failure etc. will be communicated through mail.

7.3 Payment Processing Methods

3 mode of payment method is currently implemented in cavli hubble, they are

- i **Wire Transfer**

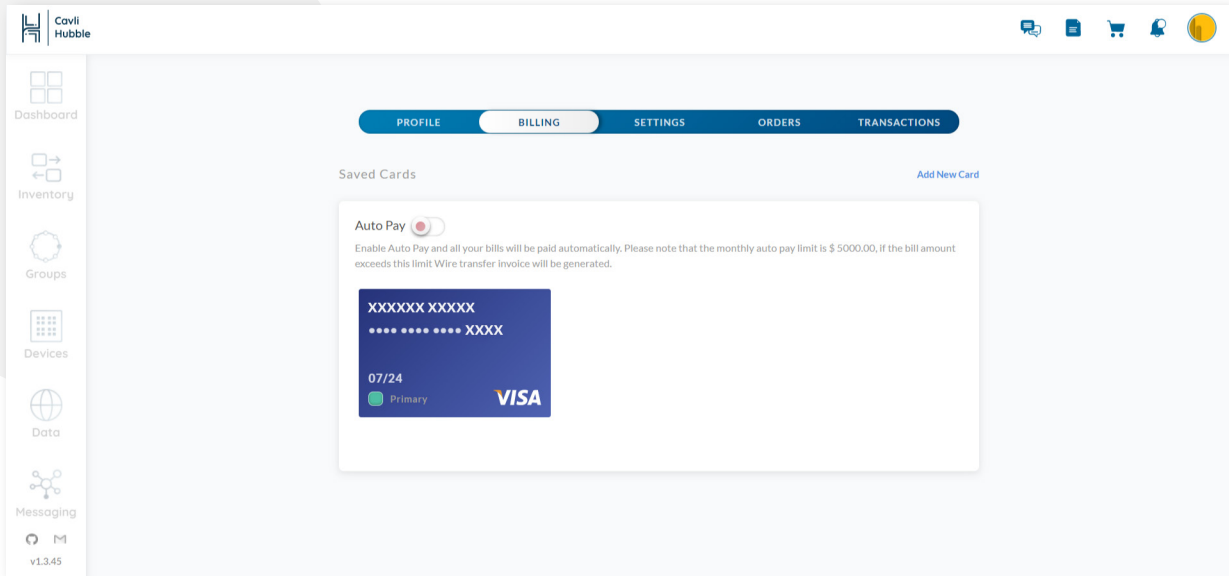
In the mail wire transfer information will be provided thus users can pay bills via wire transfer.

ii **Online payment**

For the bill amount of less than \$5000.00 users can opt the online payment method. In those scenarios pay now option will be available in the received mail.

iii **Card Payment**

In the profile section billing tab, users can enable auto pay of the bill amount of below \$5000. Hubble data transfer billing process will get automated once users enable this feature. If the user has enabled auto pay feature and the bill amount generated exceeded \$5000 limit, then the user will receive an email with wire transfer details and they can pay through that.



8. Glossary

IoT	Internet of Things
SIM	Subscriber Identity Module
eSIM	Embedded Subscriber Identity Module
UICC	Universal Integrated Circuit Card
eUICC	Embedded Universal Integrated Circuit Card
APN	Access Point Name
IP	Internet Protocol
IPV4	Internet Protocol Version 4
IPV6	Internet Protocol Version 6
DNS	Domain Name Server
HLR	Home Location Registrar
VLR	Visited Location Registrar
GGSN	Gateway GPRS Serving Node
IMSI	International Mobile Subscriber Identity
ICCID	Integrated Circuit Card Identifier
MSISDN	Mobile Station International Subscriber Directory Number
M2M	Machine to Machine
MNC	Mobile Network Code
MCC	Mobile Country Code
PLMN	Public Land Mobile Network
GPRS	General Packet Radio Service
LTE	Long Term Evolution
AAA	Authentication, Authorisation, Accounting
PDP	Packet Data Protocol
NAT	Network Address Translation
NAPT	Network Address Port Translation
PS	Packet Data Service
CS	Circuit Switched Service
TCP	Transport Control Protocol
UDP	User Datagram Protocol
SGSN	Serving GPRS Support Node
QoS	Quality of Service
SMS	Short Message Service
SMSC	Short Message Service Centre
VPN	Virtual Private Network
MQTT	Message Queuing Telemetry Transport
CoAP	Constraint Application Protocol
LwM2M	Lightweight Machine to Machine
DRX	Discontinuous Reception
eDRX	Extended Discontinuous Reception
PSM	Power Save Mode
BER	Bit Error Rate
RSSI	Received Signal Strength Indicator
SNR	Signal to Noise Ratio
GPS	Global Positioning System
GLONASS	Global Navigation Satellite System
CE Mode	Coverage Enhancement Mode



TECHNOLOGY FOR THE CONNECTED TOMORROW



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