

OpenBlocks IoT VX1 Developer's Guide



Ver. 2.0.0

Plat'Home Co., Ltd.

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Notes on Use



Meaning of symbols

The following categories of symbols explain the hazard level in terms of injury and material damage that may occur if instructions are not observed. Please thoroughly understand them before reading this manual.






 DANGER	This symbol indicates that the possibility of death or serious injury is imminent when the product is handled improperly.
 WARNING	This symbol indicates the possibility of death or serious injury when the product is handled improperly.
 CAUTION	This symbol indicates a potentially hazardous situation that may result in minor injury and/or material damage when the product is handled improperly.










Meaning of pictures

The following categories of pictures explain instructions to follow. Please thoroughly understand them before reading this manual.

 PROHIBITED	This indicates prohibited actions.
 MANDATORY	This indicates mandatory actions that must be followed.

Handling this device, SIM card *3, AC adapter *1, SD card *1 (common information)

 DANGER	 Do not use or place the product in areas of high temperatures (near open flames, near a heating appliance, in direct sunlight or in a car during hot weather etc.)  It may cause modification or failure of the device, or leakage, overheating, ignition or explosion of the built-in battery. Moreover, a part of the case may become hot and cause burns or other injury.
	 Please do not attempt to disassemble, alter or directly solder the device. It may result in fire, injury, electric shock, or equipment damage. It may also cause leakage, overheating, explosion or ignition of the built-in battery*1. Modification of the device is a violation of the radio law and will be penalized.
	 Do not get the device wet. Leaving the device in wet condition after water or other liquid gets inside the device may cause overheating, electric shock, fire, injury or damage to the device. Please pay attention to the handling and the place of use.

 DANGER	 Please do not use other AC adapters than those supplied with this device or those specified*2. Also do not use the supplied AC adapter*2 with other products. It may cause overheating, ignition or failure of the AC adapter*2.
 WARNING	 Do not place the device and/or the AC adapter*2 in a cooking appliance (e.g. microwave oven), a high pressure container (e.g. pressure cooker) or on top of an induction cooker (IH cooker.) It may cause leakage, overheating, explosion or ignition of the built-in battery and/or overheating, smoke, ignition or failure of the device or the AC adapter*2.
	 Do not attempt to drop, throw or subject the device to any other severe impact or force. It may cause leakage, overheating, explosion, ignition, fire, electric shock or failure of the built-in battery.
	 Do not let liquid such as water or conductive materials (e.g. a pencil lead or a piece of metal) touch external I/O port, plug of AC adapter*1, USB charging console cable*3 or plug of micro USB cable*2. Also, do not allow them enter into the device. They may cause fire or failure due to a short circuit.
	 Make sure to turn off the device beforehand when it is placed in locations subject to flammable gases such as propane gas or gasoline, or dust particles (like a gas station.) Gases may ignite. It may cause explosion or fire when it is used in locations subject to flammable gases such as propane gas or gasoline, or dust particles.
	 If you notice anything unusual such as noise, smoke or odor while using, charging or storing the device, take the following steps. 1. Turn off the device. 2. Unplug all the power cords. Unplug the AC adapter*2, holding the adapter body. Using the device in abnormal state may cause fire, electric shock, etc.
	 When putting the battery in the device*1, make sure to put the positive (+) and negative (-) ends of it in appropriate direction as it is shown. Putting it in the wrong direction may cause explosion, leakage or fire.

CAUTION	⊘	Do not place it on unstable surfaces such as wobbling table or inclined surface. It may drop and cause injury or failure.
	⊘	Hold the plug when you disconnect the device from a power supply device, and do not pull the cord. Pulling the cord may damage the cord or the port and cause fire or electric shock.

Handling the device

The specifications of the built-in battery of the device is as follows*1 :

Note	Type of battery
BR1225	Lithium coin cell

WARNING	⊘	Do not put it into fire. It may cause leakage, explosion or ignition of the built-in battery*2.
	⊘	Do not put foreign substances such as liquid (e.g. water), piece of metal or anything flammable in the SIM card slot*3 or micro SD card slot*4 of the device. It may cause fire, burns, injury or electric shock.
	ⓘ	Make sure the device is turned off or is in flight mode when boarding an airplane. As use of the device in airplanes is limited, please follow the instructions of each airline. It can have a detrimental effect on electronic devices on airplanes. Committing a prohibited act while using the device on an airplane may be punished by law.
	ⓘ	Follow the instructions of each healthcare facility for using the device in it. Turn off the device in locations where its usage is prohibited. It can have a detrimental effect on electronic devices or electronic medical equipment of healthcare facility.
	ⓘ	Turn off the device near the electronic devices using high-precision control or weak signals. It can have a detrimental effect on the operation of electronic devices. * Examples of electronic devices which require extra attention Hearing aids, implantable cardiac pacemakers, implantable cardioverter defibrillators and other medical electric devices, fire alarms, automatic doors and other automatic control devices.
CAUTION	⊘	Please do not use it in case it has a detrimental effect on an electronic device in a vehicle. Using the device in an automobile could impair safe driving for some type of vehicles by having detrimental effect on its electronic device.
	⊘	Do not place magnetic cards or some other products near the device. Magnetic data on bank cards, credit cards, telephone cards, floppy disks, etc may be lost.

CAUTION	⊘	Use specified batteries only.*2 There are risks of leakage, explosion or fire.
	ⓘ	Do not charge or disassemble a battery*1 after use or throw it into fire. There are risks of leakage, explosion or fire. Please dispose batteries*1 in accordance with your local government regulations.

Handling the AC adapter*2

WARNING	⊘	Do not cover or wrap the device with cloth, quilt or blanket. It may cause fire or failure because the heat does not dissipate.
	⊘	Use only with specified power source and voltage. Using with other power source or voltage may cause fire or failure. AC adapter: 100 VAC to 240 VAC (household AC power outlets only) Do not use transformers on the market for international travels. It may cause fire, electric shock or failure.
	⊘	Do not use it in case the cord of the AC adapter is damaged. It may cause fire, burns or electric shock.
	⊘	Do not touch the AC adapter when you hear thunder. It may cause electric shock.
	⊘	Do not plug or unplug the AC adapter or touch the port with a wet hand. It may cause electric shock or failure.
	ⓘ	In case dust is adhering to the plug, unplug it from the outlet while holding the AC adapter, and wipe it with a dry cloth. It may cause fire.
	ⓘ	Make sure the plug and terminal of AC adapter do not contact conductive materials (e.g. a pencil lead or a piece of metal) when plugging the AC adapter into the outlet, and make sure it is firmly plugged. Such contact may cause fire, burns or failure due to electric shock or a short circuit.
	ⓘ	Plug or unplug the AC adapter straight and level, without applying excess force. Not doing so may result in fire, burns, injury or electric shock.
	ⓘ	Unplug the AC adapter from the outlet while holding the AC adapter body when not using it over a long period of time. Not doing so may result in electric shock, fire or failure.
	ⓘ	Immediately unplug it from the outlet while holding the AC adapter in case liquid such as water gets inside of it. Not doing so may result in electric shock, smoke or fire.

CAUTION	⊘	Do not attempt to subject the device to severe impact or force such as letting your foot catch the cord. It may cause injury or failure.
	⊘	Be careful not to let a part of the body such as a hand or a finger touch the plug. It may cause burns, electric shock, injury or failure.
	!	Unplug the AC adapter from the outlet while holding the adapter body, and do not pull the cord. Pulling the cord may damage it and cause fire or electric shock.

*1 applies to OpenBlocks IoT BX0 / OpenBlocks IoT EX1

*2 applies when using the AC adapter

*3 applies to all but OpenBlocks IoT BX0

*4 applies to OpenBlocks IoT EX1

Precautions on handling Bluetooth®/Wi-Fi (Wireless LAN)

● Precautions on handling Bluetooth®/Wi-Fi (Wireless LAN)

[The actual product]

Bluetooth® function: 2.4 FH1/XX8

The device uses 2.4GHz band. FH1 uses FH-SS modulation method, and its interference range is approximately within 10m. XX8 uses another modulation method, and its interference range is approximately within 80m.

Wi-Fi (wireless LAN) function: 2.4 DS4 / OF4

The device uses 2.4GHz band. It uses DS-SS method and OFDM method as its modulation methods. Its interference range is approximately within 40m.

It uses the entire bandwidth from 2,400MHz to 2,483.5MHz, and it can avoid bandwidth of moving body identification device.

- The bandwidth of this device is also used by industrial / scientific / medical devices such as microwave oven, in-house radio station e.g. in factory production lines (radio stations which require a license) for moving body identification or specific low-power radio station (radio stations which do not require a license.)
 - (1). Make sure there is no in-house radio station for moving body identification or specific low-power radio station operating nearby before using this product.
 - (2). In case radio wave of this product interfered with an in-house radio station for moving body identification, immediately stop transmitting radio wave and contact the following address to consult us for necessary measures to avoid the interference (e.g. placing partitions.)
 - (3). Also, if there are other troubles, such as radio wave of the product interfered with a specific low-power radio station, please contact the following address.
- Contact address : Plat' Home Co., Ltd. TEL: 03-5213-4372 E-Mail : support@plathome.co.jp

The device can use W52 channel in 5GHz bandwidth. The Radio Act prohibits using W52 outdoor.

Usage of Bluetooth®/Wi-Fi (wireless LAN) functions of the device may be limited in some countries / regions. Please check the local laws and regulations when using it outside Japan.

Other reminders

- The device is class B Information Technology Equipment. Even though the device is designed to be used in a domestic environment, it may cause harmful interference to receivers of radio or TV if they are close to the device. Install and use the device according to the instruction manual.
- This product is designed on the assumption that it will be used in Japan. Using the product outside Japan shall be at the customer's own risk.

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Chapter 1 Introduction

This document is a developer's guide for the OpenBlocks IoT VX1.

For user manual please refer to the OpenBlocks IoT VX1 Web UI Setup Guide.

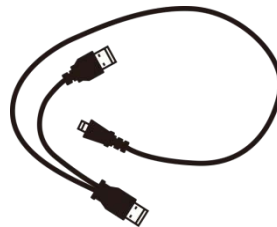
1-1. Contents of VX1 Package

The standard configuration of the OpenBlocks IoT VX1 is as shown below.

BX1 main unit x 1



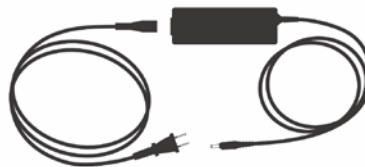
USB console cable for debug x 1



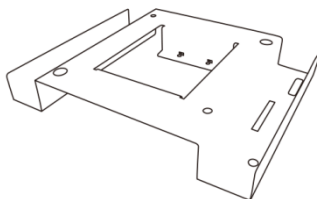
User's Guide x 1



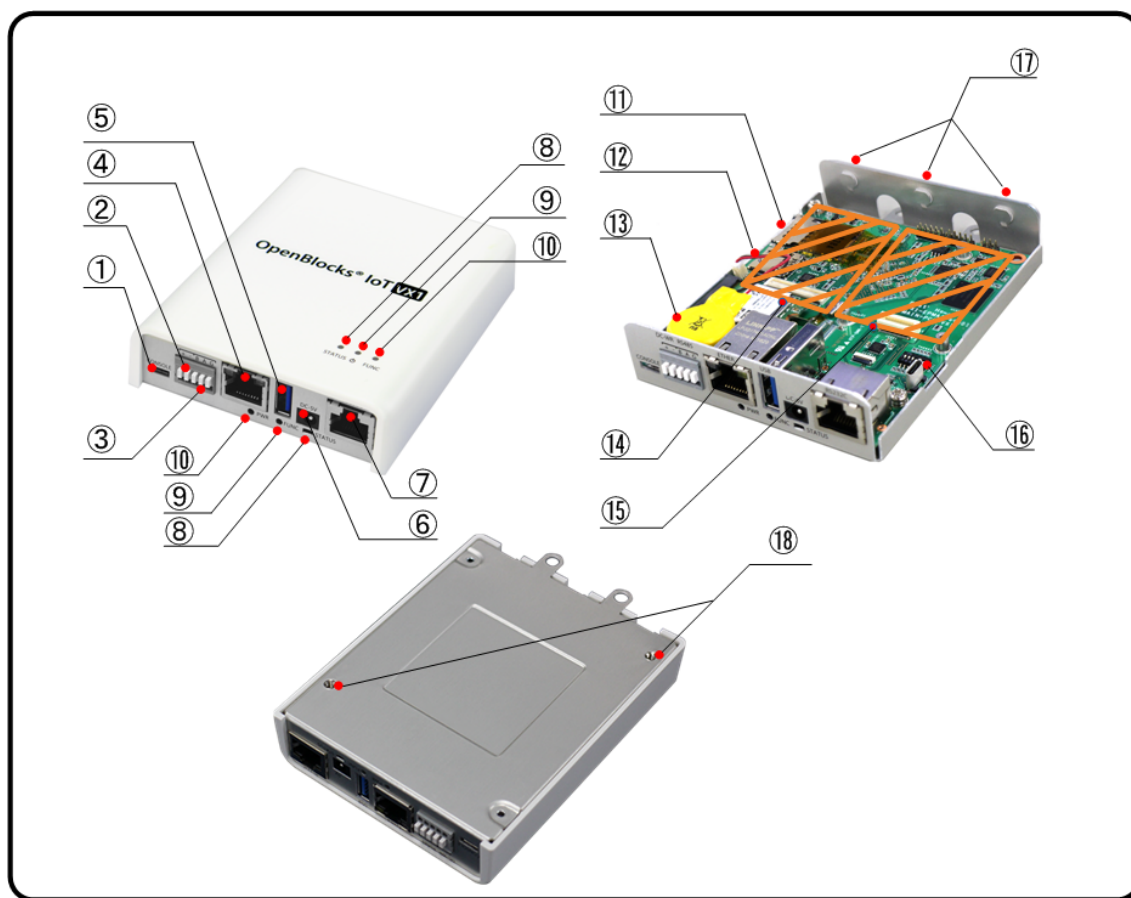
AC adapter x 1



Bracket x1



1-2. Name of Each Section (BX1 Main Unit)



No.	Name	Description
①	USB serial console port	Micro USB typeB
②	Wide-range power supply input	7 to 48 VDC supported.
③	RS-485 (half-duplex) connector	
④	Ethernet port	10Base-T/100Base-TX/1000Base-T Auto-MDX compatible
⑤	USB host mode port	A-Type / USB3.0
⑥	Dedicated AC adaptor input	5 VDC
⑦	RS-232C port	RJ-45. The connector to connect the D-Sub9 pin is optionally available. A general straight network cable can be used for

No.	Name	Description
		connection.
⑧	Status indicator	The LED lights up or flashes in seven colors.
⑨	Power switch	Power on and boot the OS. Shutdown the OS and power off, if during operation.
⑩	FUNC switch	OS specified function will work.. See also section 7-2.
⑪	SIM slot	Slot which you insert the SIM into. * The shape of the supported SIM is mini-SIM (2FF) (standards generally called standard SIM).
⑫	SD card slot	Use the SD card for file exchange, log storage or other purpose because the SD card cannot ensure sufficient reliability for system operation.
⑬	RTC battery holder	Coin type lithium battery (CR2032) connected.
⑭	Expansion slot 1	Expansion slot for mobile adaptor card for mobile line. Attach the mobile adaptor card that supports your carrier. In principle, this is a factory option.
⑮	Expansion slot 2	Expansion slot for EnOcean, Wi-SUN module and so on.
⑯	DIP switch	Normally, do not change these settings. They are configured at the factory.
⑰	External antenna mounting hole	Filled in the image.
⑱	Bracket mounting hole	

* To insert the SIM, reverse the VX1 main unit and insert the SIM until the end of the SIM slot.
Likewise, reverse the VX1 main unit when removing the SIM.

Chapter 2 Before Use

2-1. Product Overview

The OpenBlocks IoT VX1 is a general-purpose server product that uses Debian GNU/Linux operating system. Although it is customized to fit with the hardware requirement, but additionally it can work on other Debian or general Linux features too.

Initially this device supposed to be used as M2M gateway. That is why it is recommended to use it in the RAM disk mode while in production. In the RAM disk mode, data in internal storage is not corrupted even if power is disconnected or other problem occurs.

The initial setting is storage combination use mode. However, it is assumed that the WEB UI will be used to change the settings.

2-2. Note in SSD-based system development

In recent years, SSD(Solid State Drive) has been adopted on smartphones and laptop PCs and various devices, in place of conventional hard disks due to cost reduction of flash memory. In addition, the eMMC used in this product is a type of SSD.

The SSD has high random access performance, and because of its solid state advantage, the mechanical fault tolerance and environmental performance are greatly improved, but on the other hand, the data rewrite limitation is significantly reduced compared with the hard disk .

SSD is roughly divided into SLC and MLC, SLC type with tens of thousands of rewrite performance was mainstream in the capacity band of several gigabytes, but low cost MLC with rewrite frequency of several thousand times with multi-bit cell has become large capacity It has become popular for smartphones and PCs, and now the SSD of SLC is beginning to disappear gradually.

Even with our microserver product options, SLC products are only partly left in small capacity.

Therefore, micro server operation with MLC's SSD becomes very much.

There are about 3000 rewriting performances in MLC, and bit errors start to occur from around 3000 times, ECC error recovery is done.

However, if ECC recoverable conditions are exceeded, a read error will occur.

Therefore, it is necessary to create a system that will not drive into this situation.

- Number of rewrite per cell and flash memory block size.

Even if it says 3000 times per cell, even if writing to SSD is 1 byte it will be once in 1 time. Recent flash memory is read and written with a large block of about 512 KB to support large capacity with few address lines.

In other words, even if you write 1 byte or write 512 KB in rewrite, rewrite is 1 time.

Therefore, writing to the SSD can minimize the number of times of writing to the SSD if it is small data size and finely stored data as much as possible in the buffer as much as possible and writing at once with a large data size.

- Wear leveling function

SSD has less rewrite limitation, so it is averaged so as not to concentrate rewriting to the same real block address for rewriting the same block address many times.

This is achieved by virtualizing the block address.

The OS notifies the block used and the unused block for the SSD, and when the SSD writes next, the OS prepares the block with the smallest number of rewriting for that write.

As a result, the rewrite count is averaged as a result.

- Static wear leveling

In the case of conventional wear leveling, in the used area, for example, if there is almost 50% of unwritten data, 50% of blocks written only once from OS installation occupy almost new items. As it is, the remaining 50% area being reused is rapidly rewritten and the service life of the SSD will come two times faster than when averaging over the whole. The idea of this measure is static wear leveling, moving data of a block which has hardly been rewritten to a block with many reuse, and puts the block which was almost brand new to the reuse area.

As a result, even if there are almost 50% unwritten blocks, you can almost catch the SSD life.

- Assume the total rewrite frequency of the SSD

For example, in the case of 512 KB block type with 4 GB SSD, assuming 3000 times of rewriting per cell and writing data of 512 KB or less, assuming the SSD total rewrite frequency is as follows.

$$4294967296\text{Byte} \div 524288 = 8192 \text{ (4GB} \div 512\text{KB)}$$

There are 8192 physical blocks.
If each were rewritten 3000 times,

$$8192 \times 3000 = 24576000 \text{ times}$$

In other words, if you write 1 byte of data each time, writing only 18.4 MB will result in a lifetime. (In fact, these writes are streamlined on the SSD side.)

Assuming a 512 KB size write, if the block segment does not cross the 512 KB boundary, it is a single write, but in case of file access from the OS, there are cases where it is written from the middle of the block, so 512 KB. Although it writes the following data, it is written twice with half probability.

Therefore,

$$24576000 \text{ times} \times 75 \% = 18432000 \text{ times (This assumes only 512 KB of writing)}$$

In the case of access from the OS, another number of rewriting is added.

It is rewritten at least once when updating the file control block by closing the file.

Of course, SSD uses caches to reduce the number of times of rewriting, but basically it will be such a processing system.

- Use as large SSD as possible

For example, in the above 4 GB SSD, there are 8192 blocks, but in 8 GB, the number of rewrites simply doubles because there are 16384 blocks twice that number.

If the SSD has the same block size, the number of times of rewriting is simply increased in proportion to the size.

Therefore, if you use as large a SSD as possible, the resistance to trouble due to the number of rewrites will increase.

- Reduce SSD writing by using RAM disk

In the case of Linux systems, if you develop your system without considering anything, storage will be used as a premise as an infinitely usable device.

Even if there is no need to store data, the swap area will be used normally as a buffer for working.

In order to avoid shortening the lifetime of the SSD in this way, we will design the system considering that the storage required for the working process should be placed in the

RAM disk as much as possible.

In addition, even open source software often uses the storage area reserved for yourself as temporary, in which case you will deal with that file by linking to the area of RAM disk. Some software can specify the storage area used temporarily by environment variable. In order to find unexpected storage access such as open source, iotop command is recommended.

- Logging

In Linux systems, it is common to leave logs in storage in any situation, but in cases where there is a process to leave logs very finely, after devising to write to RAM disk once, periodically collect logs to SSD etc. Is required.

Although these countermeasures can not cope with sudden power interruption, it is necessary to consider this point as to whether to trade-off or give up or for example to send a log to a syslog server that was countermeasures against UPS There is.

2-2. About the SIM

The OpenBlocks IoT VX1 supports mini-SIM (2FF) as the SIM shape. When using the micro-SIM or nano-SIM, use the adaptor that can fix the SIM with the fall prevention film or adhesion tape. For reference, repair is charged if the SIM slot is broken when the SIM adaptor is used.

2-3. eMMC Storage Partition Information

Information about the eMMC partition used for this device is as show below.

No.	Format	Size	Usage	Device name
1	Fat16	1.5Gbytes	Boot partition	mmcblk0p1
2	Ext4	5.7Gbytes	Primary partition	mmcblk0p2
3	Ext4	0.5Gbytes	Swap area	mmcblk0p3

2-4. RAM Disk Mode

The basic FW is deployed from the boot partition of eMMC to the RAM disk and everything including Linux user land operates on that RAM disk. Therefore, even if power is

unexpectedly disconnected, files in the physical storage are not corrupted and the service can be restarted just by turning the power on again.

If it is not necessary to accumulate data, this usage allows for more robust system.

Use aufs (Another Unionfs) in the RAM disk mode or in the storage combination use mode described later.

In the RAM disk mode, /.rw is mounted as tmpfs and each directory under /.rw/ is copied to each directory under / by using aufs. (Example: /.rw/usr is copied to /usr.)

All the changes aggregated under /.rw are saved in the eMMC by using the dedicated command, flashcfg.

These changes are written from eMMC back to the RAM disk at startup to restore the environment when they were saved.

*Execution result of the mount command

```
/dev/ram on / type ext2 (rw,relatime)
devtmpfs on /dev type devtmpfs (rw,relatime,size=406232k,nr_inodes=101558,mode=755)
sysfs on /sys type sysfs (rw,relatime)
tmpfs on /run type tmpfs (rw,nosuid,noexec,relatime,size=91028k,mode=755)
tmpfs on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
tmpfs on /run/shm type tmpfs (rw,nosuid,nodev,noexec,relatime,size=182040k)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,gid=5,mode=620)
tmpfs on /.rw type tmpfs (rw,relatime,size=393216k)
aufs on /etc type aufs (rw,relatime,acl,si=c6ae681c99b813d6,trunc_xino)
aufs on /bin type aufs (rw,relatime,acl,si=c6ae681cab8423d6,trunc_xino)
aufs on /home type aufs (rw,relatime,acl,si=c6ae681ca2b173d6,trunc_xino)
aufs on /lib type aufs (rw,relatime,acl,si=c6ae681cab8463d6,trunc_xino)
aufs on /sbin type aufs (rw,relatime,acl,si=c6ae681ca2b163d6,trunc_xino)
aufs on /usr type aufs (rw,relatime,acl,si=c6ae681cab8453d6,trunc_xino)
aufs on /var type aufs (rw,relatime,acl,si=c6ae681cab8413d6,trunc_xino)
aufs on /root type aufs (rw,relatime,acl,si=c6ae681c99b753d6,trunc_xino)
aufs on /opt type aufs (rw,relatime,acl,si=c6ae681c925403d6,trunc_xino)
aufs on /srv type aufs (rw,relatime,acl,si=c6ae681c925463d6,trunc_xino)
aufs on /media type aufs (rw,relatime,acl,si=c6ae681c93ede3d6,trunc_xino)
```

*Example of canceling the label


```
# e2label /dev/mmcblk0p2 ""
```

2-5. Storage Combination Use Mode

In this operation mode, the RAM disk area for /.rw in the RAM disk mode is changed to storage such as eMMC. This allows files updated after the system on the RAM disk starts up to remain in the eMMC storage. Therefore, unlike in the RAM disk mode, it is not necessary to write back files to the eMMC storage every time files are changed. On the other hand, updated files in the user partition in the eMMC storage could be corrupted if power is unexpectedly disconnected.

In the storage combination use mode, the label formatted with ext2/ext3/ext4 with the label DEBIAN is mounted at /.rw and each directory under /.rw/ is copied to each directory under / by using aufs.

Because the real storage is accessed, data is applied to the storage when written or otherwise processed. It is, therefore, not necessary to save the data with the flashcfg command.

*The RAM disk mode is activated as a result of restart or other certain process after the DEBIAN label is erased or changed.

*Execution result of the mount command

```
/dev/ram on / type ext2 (rw,relatime)
devtmpfs on /dev type devtmpfs (rw,relatime,size=406232k,nr_inodes=101558,mode=755)
sysfs on /sys type sysfs (rw,relatime)
tmpfs on /run type tmpfs (rw,nosuid,noexec,relatime,size=91028k,mode=755)
tmpfs on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
tmpfs on /run/shm type tmpfs (rw,nosuid,nodev,noexec,relatime,size=182040k)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,gid=5,mode=620)
/dev/mmcblk0p2 on /.rw type ext4 (rw,relatime,discard,data=ordered)
aufs on /etc type aufs (rw,relatime,acl,si=690779f766ddec20,trunc_xino)
aufs on /bin type aufs (rw,relatime,acl,si=690779f751446c20,trunc_xino)
aufs on /home type aufs (rw,relatime,acl,si=690779f772170c20,trunc_xino)
aufs on /lib type aufs (rw,relatime,acl,si=690779f751442c20,trunc_xino)
aufs on /sbin type aufs (rw,relatime,acl,si=690779f762015c20,trunc_xino)
aufs on /usr type aufs (rw,relatime,acl,si=690779f751445c20,trunc_xino)
```

```
aufs on /var type aufs (rw,relatime,acl,si=690779f751440c20,trunc_xino)
aufs on /root type aufs (rw,relatime,acl,si=690779f76219fc20,trunc_xino)
aufs on /opt type aufs (rw,relatime,acl,si=690779f762016c20,trunc_xino)
aufs on /srv type aufs (rw,relatime,acl,si=690779f762013c20,trunc_xino)
aufs on /media type aufs (rw,relatime,acl,si=690779f762199c20,trunc_xino)
```

***Example of setting the label**

```
# e2label /dev/mmcblk0p2 DEBIAN
```

2-6. Other Operation Methods

You may want to operate the basic part of an app in the RAM disk mode and only store logs in the eMMC storage. In this case, you can initialize the home partition with the `mkfs` command or other means and mount it at an arbitrary directory. In this case, data written in the directory remains undeleted even if power is disconnected.

However, file check (`fsck`) may apply only to that part, delaying startup, at restart after power is unexpectedly disconnected.

***Initialization example**

```
# yes | mkfs -t ext4 -L "" /dev/mmcblk0p2
```

2-9. Connection between PC and OpenBlocks IoT VX1

Use the attached USB console cable to connect the OpenBlocks IoT VX1 and your PC.

In addition, it is necessary to connect the AC adapter to OpenBlocks IoT VX1 and supply power.



For Windows PC, when the OpenBlocks IoT VX1 is connected to the USB port, the USB serial driver is automatically installed (when the Windows PC is connected to the Internet environment).

When installation of the driver is completed, terminal software such as TeraTerm or PuTTY can be used for serial port connection.

Default communication parameters for the serial port of the OpenBlocks IoT Family are as shown below.

Communication speed: 115200 bps

Data length: 8 bits

Parity: None

Stop: 1 bit

When the startup is completed after successful terminal connection is established, the login prompt appears. Start the login operation with the default root privilege.

Login: root

Password: xxxxxx

*The password depends on your environment. When using the Web UI, use the password set on the Web UI. In the RAM disk mode, the default is "root."

2-10. Web UI

This system incorporates the Web UI for basic system setup.

Use the Web UI to set up the network, control the mobile line or for other purpose.

If you want to implement a function that fundamentally interferes with some function of the Web UI, it is recommended to develop that function in the RAM disk mode.

* For setting items on the Web UI or other information, see the Web UI Setup Guide for OpenBlocks IoT VX1.

Because the Web UI resides on the storage side, you can format the storage that contains the Web UI and so on with the following procedure.

```
# e2label /dev/mmcblk0p2 ""  
  
# reboot  
  
Log in after reboot.  
  
• For operation in the RAM disk mode  
# yes | mkfs -t ext4 -L "" /dev/mmcblk0p2  
  
• For operation in the storage combination use mode  
# yes | mkfs -t ext4 -L DEBIAN /dev/mmcblk0p2
```

Chapter 3 How to Use

This device is a general-purpose server product that employs Debian GNU/Linux. Therefore, you can use this device in the same way as when using a standard Debian device. This chapter provides information specific to this device.

3-1. Display Color of Status Indicator

The LEDs on the front of the OpenBlocks IoT VX1 lights up are seven colors combining R, G, and B. Flashing and other operations in each display color are controlled by the script.

When the Web UI is used, the default LED lightup specifications are as shown below. Note that the mobile line does not interlock with the LED in the RAM disk mode.

Status	Color	Lighting state	Remark
BIOS starting up	Yellow	On	When the startup of the BIOS is complete, migrate to OS starting up status.
OS starting up	Yellow	On	When the OS starts up is complete, radio reception check for the mobile line starts. * The LED flashes in green if the SIM is not inserted.
When the SIM slot is not in use	Green	Flash	Normal operation if the SIM is not in use, or wait for checking the status of radio field.
Mobile line radio field: Strong	White	Flash	Radio field strength of -87 dBm or more in 3G line. For 4G line, corresponds to the display of the antenna two or three of the mobile phone.
Mobile line radio field: Middle	Light blue	Flash	Radio field strength of -88 to -108 dBm in 3G line. For 4G line, corresponds to the display of the antenna one or two of the mobile phone.
Mobile line radio field: Weak	Blue	Flash	Radio field strength: -109 to -112 dBm in 3G line. For 4G line, corresponds to the display of the antenna zero or one of the mobile phone. * Communication may be retried many times with this radio field strength. Therefore, use the medium or strong radio field strength when using the mobile line as much as possible.

Status	Color	Lighting state	Remark
Mobile line radio field: No service	Purple	Flash	Radio field strength of -113 dBm or less in 3G line. For 4G line, indicating that it is out of service.
During process any function which assigned FUNC switch.	Yellow	Flash	It will be the status indicator and flash alternately in mobile line or SIM slot when not in use.
During OS shutdown	Yellow	On	You must hold down the INIT switch until the LED goes out.

LED lightup control script when the Web UI is used

/var/webui/bin/set_signal_value.sh

/var/webui/scripts/led_updater.sh

- LED control

To change the display color or lighting state of LED, edit the /tmp/.runled file.

When the SIM is inserted and the Web UI is used, this file is periodically updated to be in line with the radio field strength. Therefore, to intentionally change the settings, disable the Web UI or terminate the LED lightup control script.

Line	Setting	Remark
Line 1	On for time 1 (msec)	1 or more
Line 2	On for time 2 (msec)	1 or more
Line 3	Color number for time 1	See the table below.
Line 4	Color number for time 2	See the table below.(if omitted, 0)

Color number.	Color
0	Not lit
1	Red
2	Green
3	Yellow
4	Blue
5	Purple
6	Light blue
7	White

* Flashes in yellow every second.

```
# echo -e "1000¥n1000¥n3" > /tmp/.runled
```

* Flashing yellow / green alternately every second.

```
# echo -e "1000¥n1000¥n3¥n2" > /tmp/.runled
```

3-2. Modem Control for Mobile Line

A tool is provided to check whether the modem module incorporated in this device is turned on or off and the radio wave condition.

Command name: atcmd

Start procedure 1: atcmd [Command]

Start procedure 2: atcmd [Command 1] [Command 2] [Command 3]

Start procedure 3: atcmd -d [Device file] [Command]

You can enumerate and execute commands in order as in Start procedure 2.

You can specify a device file to be used and execute a command as in Start procedure 3.

Command	Function	Remark
PON	Turns on the modem.	
POFF	Turns off the modem.	
PRST	Reboots the modem.	Resets software. (Resets part of hardware.)
HRST	Reboots the modem.	Resets hardware.
SMONI	Acquires the radio field strength.	Usage prohibited.
CSQ	Acquires the radio field strength.	
SIND	Acquires the time from the base station.	Usage prohibited.
CCLK	Acquires the time from the base station.	Usage prohibited.
CCID	Acquires the SIM number.	
CTZU 1	Automatically acquires the time zone.	
ATI	Acquires the modem model number.	
CGSN	Acquires the modem serial number.	

Specify commands seeing the above table.

*To turn the power on, acquire the SIM number, and turn the power off

```
# atcmd PON CCID POFF  
xxxxxxxxxxxxxxxx
```

*To turn the power on, acquire the radio field strength, and turn the power off

```
# atcmd PON SMONI POFF  
-86
```

The Web UI always occupies the device file to acquire the radio wave condition. Therefore, specify a device file not used on the Web UI to execute this command. This restriction does not apply to the environment where the Web UI is not used or user control.

The device file that can be used in atcmd differs depending on each communication module.

- LTE/3G module for NTT docomo

Device file	Whether to be used in atcmd
/dev/ttyACM0	Can be used.

- LTE/3G module for Softbank

Device file	Whether to be used in atcmd
/dev/ttyACM0	Can be used.

- LTE module for KDDI

Device file	Whether to be used in atcmd
/dev/ttyACM0	Can be used.

- LTE module for NTT docomo

Device file	Whether to be used in atcmd
/dev/ttyACM0	Can be used.
/dev/ttyACM1	Can be used.

3-3. Mobile Line Connection

When the Web UI is used, use the Web UI to control the mobile line modem.

Web UI supports the method to connect the mobile line only when needed for Web UI control (on-demand connection) and the user control method to completely exclude modem control from the Web UI.

*This does not apply to the RAM disk mode where the Web UI is not used.

3-3-1. On-demand Connection

Access [Network] → [Basic] tab on the Web UI and specify information required to connect to the mobile line.

Service Network (Mobile Communication) (?) ☐ Want to display the modem control items?

Setting use ☒ To use ☐ Do not use

APN

User name

Password ☐ Indicate Password

Authentication method

Auto connection ☐ Enable auto connect ☒ Disable auto connect

Host for communication confirmation (?)

Periodic re-connection settings ☒ To periodically reconnection ☐ Not regular reconnection

Mobile line reconnection time[min] (?)

SMS control (?) ☒ Disable ☐ Enable

The following information is required:

- APN (This item does not exist when the LTE module (KDDI 4G LTE) is used.)
- User name
- Password
- Authentication method
- Auto connection: **Select "Disable auto connect."**
- Host for communication confirmation
- Mobile line reconnect time
- SMS control (This item does not exist when the LTE module (KDDI 4G LTE) is used.)

*Set SMS control only when using it.

Click the [Save] button and restart the modem to complete application to the mobile line modem.

The following are the commands for connecting and disconnecting the mobile line.

- To connect the mobile line

```
# /var/webui/scripts/mobile_control.sh con 1
```

- To disconnect the mobile line

```
# /var/webui/scripts/mobile_control.sh coff 1
```

A shell script sample combining the above commands is shown below.
Details are as follows.

1. Connect to the mobile line.
2. Execute the ping command for the DNS server.
3. Disconnect from the mobile line.

```
#!/bin/bash

echo "#-----#"
echo "# Connect (`date`)"
echo "#-----#"
/var/webui/scripts/mobile_control.sh con 1
sleep 2
echo ""
echo "#-----#"
echo "# Command Exec (`date`)"
echo "#-----#"
ping -c 3 8.8.8.8
echo ""
echo "#-----#"
echo "# Disonnect (`date`)"
echo "#-----#"
/var/webui/scripts/mobile_control.sh coff 1
sleep 2
exit 0
```

3-3-2. User Control of Mobile Line Modem

Access [Network] → [Basic] tab on the Web UI and specify information required to connect to the mobile line. The LTE module for KDDI does not support this function.

To execute this item, select the [Want to display the modem control items] check box.

Service Network (Mobile Communication) (?) ☒ Want to display the modem control items?

Setting use ☒ To use ☐ Do not use

Modem control (?) ☒ User control ☐ WEB UI control

APN

User name

Password ☐ Indicate Password

Authentication method

The following information is required for setup.

- Modem control: **Select "User control."**
- APN
- User name
- Password
- Authentication method

Information specified on the Web UI can be applied to the modem with the following command.

- Command for applying modem settings

```
# /var/webui/scripts/setapn.sh
```

The command for applying modem settings uses the following configuration files.

- Configuration files for applying modem settings

```
/var/webui/config/ppp0_device.sh  
/var/webui/upload_dir/modem.sh
```

If you further change setting information, you can overwrite information by creating and setting up the following file.

- File for overwriting information

```
/var/webui/upload_dir/user_modem.sh
```

- Details of variables

Variable name	Description	Remark
modem_ppp0_apn	APN	
modem_ppp0_user	User name	
modem_ppp0_pass	Password	
modem_ppp0_authtype	Authentication method	PAP or CHAP
modem_ppp0_provider	Provider name	Use the pon/poff command to specify this item.
DEVICE_CONNECT	Device file for connecting the mobile line	/dev/ttyACM[0-9]*.
DEVICE_SETTING	Device file for setting up the mobile line	/dev/ttyACM[0-9]*.

- Sample settings

```
modem_ppp0_apn="iixxxx.jp"
modem_ppp0_user="test@iixxxx"
modem_ppp0_pass="xxxx"
modem_ppp0_authtype="PAP"
modem_ppp0_provier="usermobile"
```

Each of the following commands can be used to connect to or disconnect from the mobile line.

- Command for connecting to the mobile line

```
# pon <modem_ppp0_provier>
```

- Command for disconnecting from the mobile line

```
# poff <modem_ppp0_provier>
```

*<modem_ppp0_provier> is the value specified with the variable. This is mobile if not changed in user_modem.sh.



- Use atmcd to acquire the radio field strength or other information.

Note that the information about the device file connected to the line cannot be acquired.



- Information is not applied when the mobile line is connected if the default gateway is specified before the mobile line is connected. Therefore, disable the default gateway before connecting the mobile line.

The default gateway is disabled after the mobile line is disconnected. Therefore, specify the default gateway before accessing the Internet environment, for instance.

3-4. Dedicated Command (flashcfg)

A dedicated command, flashcfg, is provided to set up the operations of this device. You certainly use this command to save added software or changed settings when using the device in the RAM disk mode. In the storage combination use mode, you do not have to use this command as long as you perform basic operations. When you execute this command without specifying any option, simple help for executable commands is displayed.

■ To save changes in eMMC - All

To save all changes, specify the -S (capital S) option. All data under /.rw is saved in eMMC. In addition, the -s (lower-case s) is internally called. Specify -S (capital S) and execute the command unless there are special reasons.

```
# flashcfg -S
```

```
Overwrites the current data.
```

```
Are you ok? [y|N] y
```

```
Archiving userland files... done (Approximately 0 MBytes)
```

```
done (Approximately 0 MBytes)
```

■ To save changes in eMMC - /etc only

To save changed settings (under /etc only), specify the -s (lower-case s) option. Only data under /.rw/etc is saved in eMMC. As the data under /etc directory is saved only, the save operation is very quick. However, you should not use this option without special reasons otherwise this may cause inconsistency with other areas.

```
# flashcfg -s
```

```
Overwrites the current data.
```

```
Are you ok? [y|N] y
```

```
Archiving userland files... done (Approximately 0 MBytes)
```

■ To delete changes saved in eMMC

To initialize the settings deleting saved changes, specify the -e option. This option deletes data from the user area in eMMC making it impossible to restore data at startup. To delete data from all the areas, specify the -E option.

```
# flashcfg -e
```

```
Erase userarea).
```

```
Are you ok? [y|N] y
```

■ To display the size saved last time

You can display the information about the size used for the last save operation to see whether you can add software in the RAM disk mode.

```
# flashcfg -l
```

```
Show FlashROM last saved size
```

```
Use userland(-S) : 0 KBytes (MAX: unknown MBytes)
```

```
Use /etc config(-s) : 0 KBytes (MAX: unknown MBytes)
```


3-5. Backup

In the combined storage mode, you can acquire the back of the data stored on the storage side by the following method.

* It is a prerequisite when you customize in storage combined mode.

1. Canceling storage combined mode and reboot.

```
# e2label /dev/mmcbk0p2 ""  
  
# sync  
  
# reboot
```

2. Login and backup in RAM Disk mode.

```
obsiot login: root  
  
Password: root  
  
# mount /dev/mmcbk0p2 /mnt && cd /mnt  
  
    * Please remove the files which depends on hardware in under the /mnt.  
  
# tar --exclude=lost+found --exclude=<tgz file> -cpzf <tgz file> .
```

/mnt/<tgz file> is the backup file.

Note)

There are files in under the /var/lib/bluetooth/ directory too that depends on hardware.

Also, it is recommended to remove temporary files created by customization for backup.

3-6. Restoration

You can restore the backed up <tgz file> to the /dev/mmcbk0p2 area by using init.sh as described next section for storage(USB memory formatted with ext2,ext3 or vfat) with "DEB_CONFIG" set as the volume label.

Note)

- Format the /dev/mmcbk0p2 area before unpacking the backed up file.
- The backed-up file and kernel-image must be consistent. Therefore, check the kernel-image of the enclosure to be restored separately.

3-7. Application

In addition to backup files, scripts can be executed by preparing files with "DEB_CONFIG" as volume label with a predetermined file name. Both are valid only when the file exists.

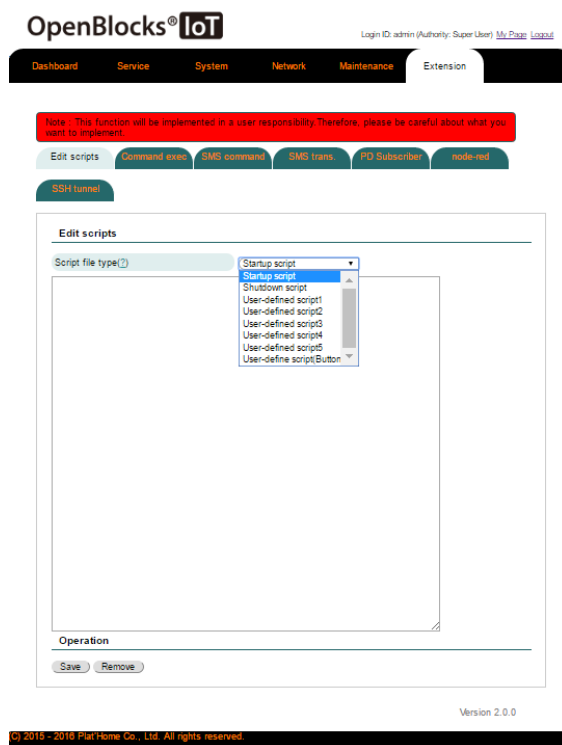
- init.sh (sh script. The line feed code is LF only.)
Executed before aufs is mounted.

- post-init.sh (sh script. The line feed code is LF only.)
Executed after aufs is completely mounted.

3-8. Web UI Extended Functions

The following extended functions are available on the Web UI.

3-8-1. Scripts Editing Function



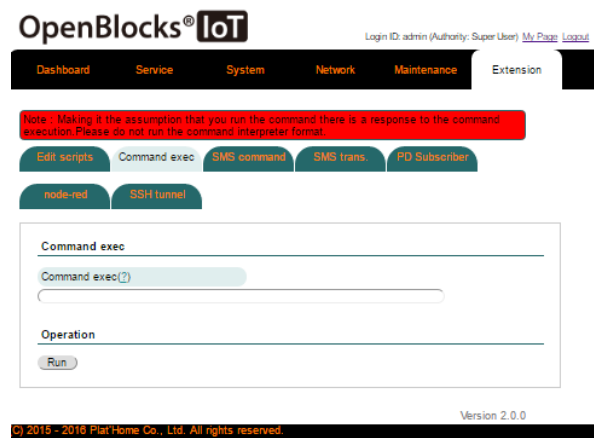
From the [Extension] ⇒ [Edit] tab of the Web UI, you can create and edit the following scripts.

- Startup script
- Shutdown script
- User defined script 1 - 5
- User defined script (button)

Please note that this function depends on the implementation content of the user.

#	Type of script	Execution timing	Remarks
1	Startup script	It is executed after completion of WEB UI startup processing at startup.	
2	Shutdown script	It is executed immediately after the end of WEB UI termination processing at the shutdown.	
3	User defined script	It is not executed during normal processing. It is carried out when an instruction is applied by the SMS control function.	
4	User define script (button)	When setting by the Function assignment in the [System] ⇒[Detail] tab, it is implemented by pressing the FUNC switch.	

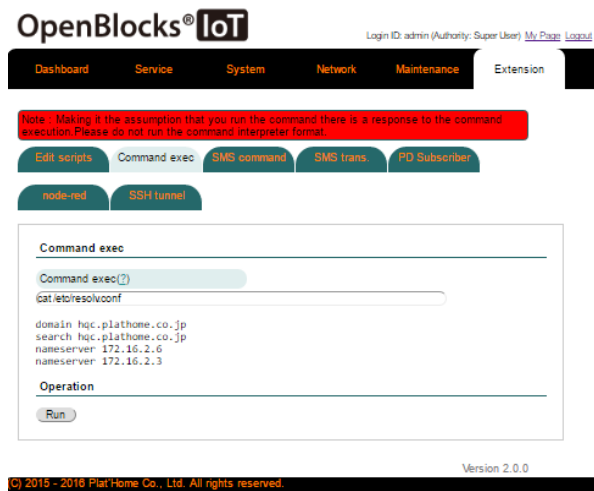
3-8-2. Command Execution



From the [Extension] ⇒ [Command exec] tab of the Web UI, Simple command can be executed.

When the command is executed, the response result is displayed.

Please note that if you execute a command that permanently operates in the foreground with this function, the web response will stop responding.



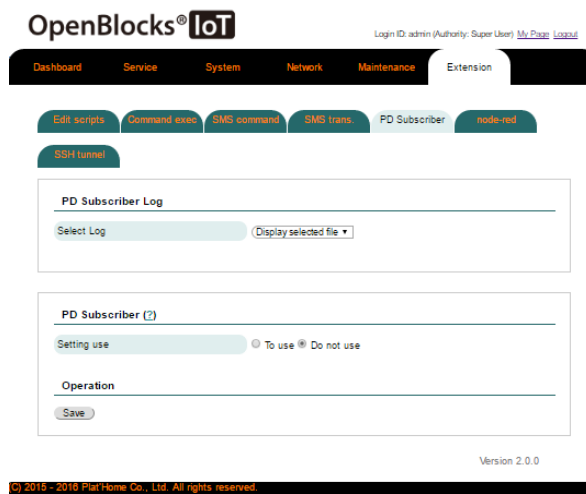
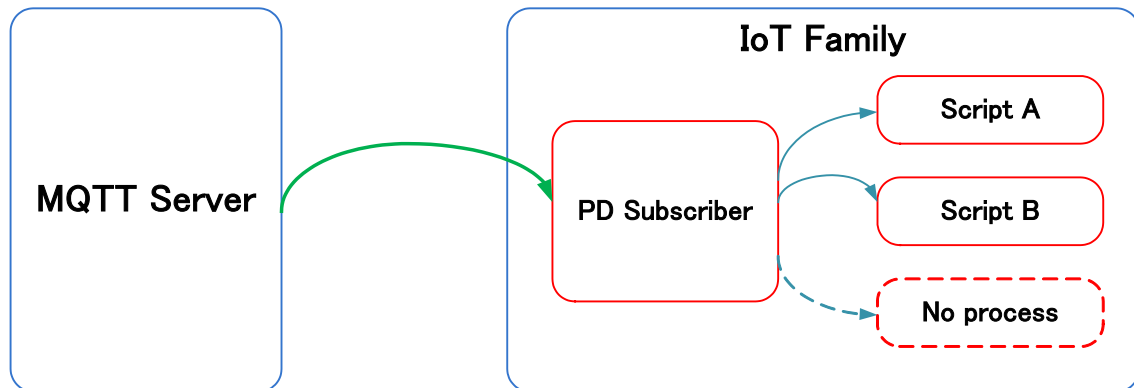
3-8-3. SMS Control

This section is described in the Chapter 4 of OpenBlocks IoT VX1 WEB UI Setup Guide, so please refer to that.

3-8-4. PD Subscriber

This product has a function that can receive a publish message from the MQTT server and execute a preset command or script.

In the JSON message sent from the MQTT server to a specific topic, if it matches the condition, execute the preset script or command.



When accessing the [Extension] ⇒ [PD Subscriber] tab, it is displayed as shown on the left.

To use PD Subscriber, please select "To use".

PD Subscriber (?)

Setting use ☒ To use ☐ Do not use

Communication host

Communication host

QoS

Client ID

User Name

Password

Protocol

Truststore

Keystore

Privatekey

Processing function definition (?)

Add

Processing Name

Topic

JSON key

Judgment value

Run command

Run command argument

PD Subscriber (?)

Setting use ☒ To use ☐ Do not use

Communication host

Communication host

QoS

Client ID

User Name

Password

Protocol

Processing function definition (?)

Add

Processing Name

Topic

JSON key

Judgment value

Run command

Run command argument

Specify the MQTT server information of communication destination.

The setting information is as following.

- Communication host
- Communication port
- QoS
- Client ID
- User Name
- Password
- Protocol (tcp or ssl)
- Truststore (when selected ssl)
- Keystore (when selected ssl)
- Privatekey(when selected ssl)

Processing function definition:

Set up a script to execute when the conditions are matched. In addition, up to 8 can be added by the add button.

Processing Name:

Define the name of the operation to be executed. It is automatically set as "No. X".

Topic:

Specify the topic as the judgment of the object to be processed. In addition, "#" becomes a wild card.

JSON key:

Specify the key for condition judgment in the message received from the MQTT server.

Judgment value:

Specify the value of the key to make judgment in the message received from the MQTT server.

* Since it treats it as a character string in the message from the MQTT server and this setting, it becomes judgment by exact match.

Run command:

Specify the command to be executed, when it matches the set JSON key and processing judgment value.

* Because you are checking the existence of the file, please prepare the script file from the file management of the system beforehand.

Run command argument:

Specify the command arguments as necessary.

Execute by setting and pressing save button.



When PD Subscriber is running, a log is generated.

Logs can be viewed from the “PD subscriber Log” section of [Extension]⇒[PD Subscriber] tab.

❗ The JSON key and value contained in the message received from the MQTT server are handed over to the command to be executed as the environment variable and its value.

For example, if following message present

```
{ "TEST1" : 1, "FILE": "foo.txt", "COUNT": 20 }
```

The environment variables passed to Command are as follows

```
TEST1=1
FILE="foo.txt"
COUNT=20
```

❗ This function is a pilot implementation. When using it, please use after verification more than enough.

3-8-4. Using Node-RED

This section is described in the Chapter 7 of OpenBlocks IoT VX1 WEB UI Setup Guide, so please refer to that.

3-8-5. SSH Revers tunnel

This section is described in the Chapter 7 of OpenBlocks IoT VX1 WEB UI Setup Guide, so please refer to that.

3-9. Web UI filter table special setting

If the file "/var/webui/local/bin/iptables-ext.sh" exists, the "Expanded filter configuration file editing" section will be displayed on the [System] ⇒ [Filter] tab of the Web UI.

This item assumes that you customize the filter settings with the iptables and ip6tables commands.

The contents of this item is a shell script.

Please make edits with the iptables or ip6tables command as appropriate.

3-10. SMS Transmit

If you are using Web UI and a modem module except KDDI is installed and SIM capable SMS is inserted, you can send SMS from the command line.

Use the following command to create a skeleton of SMS data.

* After skeleton data is created, it will be sent automatically.

- For LTE module of NTT docomo.

```
# /var/webui/bin/create_sms_um04.php <Destination phone number > <message body>
```

* Example

```
# /var/webui/bin/create_sms_um04.php 09012345678 "TEST MESSAGE"
```

- For LTE module other than NTT docomo

```
# /var/webui/bin/create_sms.py <Destination phone number > <message body>
```

* Example

```
# /var/webui/bin/create_sms.py 09012345678 "TEST MESSAGE"
```

3-11. Switching SIM operation of LTE module for KDDI

The LTE module of KDDI has a function to have the SIM function to the module itself.

With the following command, you can switch between the SIM function of the module itself and the SIM inserted in the SIM slot.

- Switch to the SIM function of the module itself

```
# /var/webui/scripts/kym_set_mode.sh in
```

- Switch to the SIM inserted in the SIM slot

```
# /var/webui/scripts/kym_set_mode.sh out
```

Chapter 4 Product Specifications

4-1. Specifications of OpenBlocks IoT VX1 Main Unit

Model number		OBSVX1
CPU	Model	Intel® Atom™ E3805 processor
	Operation speed	1.3GHz (dual core)
	Internal 2 nd Cache	1024KB/Core
Main memory	On-board	1 GB (64bit bus DDR3L)
Flash ROM		8 GB (eMMC)
Additional storage		microSD card slot x 1
Wireless interface		Bluetooth 4.0 + 2.1 EDR
		Wi-Fi (IEEE802.11a/b/g/n/ac)
SIM interface		miniSIM for communication (25 mm x 15 mm x 0.76 mm) card slot
Wired interface	USB (HOST)	3.0 x 1 (type-A) ※2
	USB (Console)	Micro USB (type-B) x 1 ※2
	Ethernet	10Base-T/100BASE-TX/1000BASE-T x 1
	RS-232C/RS-485	RJ45 connector x 1
	RS-485	Terminal block x 1
Dimensions		91.9 mm (W) x 114.8 mm (D) x 25 mm (H) (except for the protrusion)
Weight		160 g
Power supply		DC-Jack: 4.75 to 5.25 VDC Wide-range power terminal block: 10 to 48 VDC ※3
Power consumption	In the idle mode	5.1 W
	When the load is high	8.2 W
MTBF		432,644 h
EMC standards*1		VCCI class A FCC part15 class A EN55022 class A
Energy consumption efficiency based on the Energy Saving Act		Section: H
		0.48

[Unit: W/GTOPS]*1	
Environmental protection	RoHS Directive
Authentication	JATE / TELEC
RTC backup time	10 Year
OS at shipment	Debian GNU/Linux

*1: The energy consumption efficiency can be calculated by dividing the power consumption measured with the measurement method defined in the Energy Saving Act by the composite theoretical performance defined in the Energy Saving Act.

*2: Supported cable length is less than 3 m.

*3: When using this function, it is necessary to connect an external noise filter (NAC-04-472 (COSEL)) or equivalent noise filter

4-2. Specifications of OpenBlocks IoT VX1 Option

4-2-1. LTE/3G Module for NTT DOCOMO

Supported frequencies		W-CDMA: 850/900/2100 MHz LTE: Frequency Band (1)/(3)/(5)/(8)/(19)
Data communication speed		Downstream: 150Mbps Upstream: 50Mbps *Theoretical values
Control method		AT commands and special commands
Authentication		JATE/TELEC
Power consumption	In the idle mode	0.19 W
	When the load is high	2.51 W

4-2-2. LTE/3G Module for SoftBank

Supported frequencies		GSM: 850/900/1800/1900 MHz W-CDMA: 850/900/1900/2100 MHz LTE: Frequency Band (1)/(3)/(5)/(7)/(8)/(20)
Data communication speed		Downstream: 150Mbps Upstream: 50Mbps *Theoretical values
Control method		AT commands and special commands
Authentication		JATE/TELEC
Power consumption	In the idle mode	0.19 W
	When the load is high	2.51 W

4-2-3. LTE Module for KDDI

Supported frequencies		Reception: 860.0 MHz to 875.0 MHz Transmission: 815.0 MHz to 830.0 MHz
Data communication speed		Downstream: 75Mbps Upstream: 25Mbps *Theoretical values
Control method		AT commands and special commands
Authentication		JATE/TELEC
Power consumption	In the idle mode	0.16 W *Average power
	When the load is high	2.4 W *Average power

4-2-4. LTE Module for NTT DOCOMO

Supported frequencies		LTE: 2GHz/800MHz
Data communication speed		Downstream: 112.5Mbps Upstream: 37.5Mbps *Theoretical values
Control method		AT commands and special commands
Authentication		JATE/TELEC
Source voltage		3.3 to 4.4 VDC
Power consumption	In the idle mode	0.0185 W
	When the load is high	3.7 W

4-4-4. EnOcean Module

Frequency		928.35 MHz
Data communication speed		125 kbps
HOST I/F		UART
Authentication		TELEC
Source voltage		2.6 to 5.0 VDC
Power consumption	In the idle mode	0.13 W
	When the load is high	0.11 W

4-4-5. Wi-SUN Module

Frequency		922.5 to 927.9 MHz (28 ch)
Data communication speed		100 kbps
HOST I/F		UART
Authentication		TELEC
Source voltage		2.7 to 3.6 VDC
Power consumption	In the idle mode	0.1 W
	When the load is high	0.15 W

Plat'Home Co., Ltd.

Nihon Building Kudan Bekkan 3rd floor, Kudan-kita 4-1-3, Chiyoda-ku, Tokyo, 102-0073,
Japan