VirtualHub, User's guide

Table of contents

1. Introduction

VirtualHub is a software destined mainly to manage USB modules conceived by Yoctopuce. It is a kind of toolbox which aims at

- providing access to USB modules from languages, such as Javascript and PHP, which do not allow you to control hardware layers of a computer.
- providing access to USB modules through a network connection, and this from all the available languages.
- configuring and testing Yoctopuce USB modules.
- providing required connectivity for interaction between Yoctopuce devices and cloud-based services.

The *VirtualHub* is **not** mandatory for driving Yoctopuce USB devices with programming languages allowing to access to hardware layers, such as C++, Delphi, Python, Visual Basic, C#, Android, API , Command line API. With these languages Yoctopuce USB devices can be driven **directly**, you will not even need a driver.

VirtualHub is available for Windows, Mac OS X, and Linux (both intel and ARM) operating systems. It works in the same way on all three systems.

2. Installation

VirtualHub does not require a true installation. It is a simple executable file. Copy it wherever you want, and run it from a command line. You do not need any driver.

Under Windows, if you do not wish to explicitly run *VirtualHub* each time you need it, you can install it as a service: you only need to run it once with the `-i` option and *VirtualHub* launches itself automatically each time the computer starts.

VirtualHub needs to save a few parameters, these parameters are saved in a `.virtualhub.dat` file which located in the *AppData* directory of the user under Windows, in the *homedir* of the user under Linux and Mac OS X. This behavior can be modified with the help of an option in the command line.

2.1. Linux and USB

To work correctly under Linux, the VirtualHub needs to have write access to all the Yoctopuce USB peripherals. However, by default under Linux, USB privileges of the non-root users are limited to read access. To avoid having to run the *VirtualHub* as root, you need to create a new *udev* rule to authorize one or several users to have write access to the Yoctopuce peripherals.

To add a new *udev* rule to your installation, you must add a file with a name following the "`##-arbitraryName.rules`" format, in the "`/etc/udev/rules.d`" directory. When the system is starting, *udev* reads all the files with a "`.rules`" extension in this directory, respecting the alphabetical order (for example, the "`51-custom.rules`" file is interpreted AFTER the "`50-udev-default.rules`" file).

The "`50-udev-default`" file contains the system default *udev* rules. To modify the default behavior, you therefore need to create a file with a name that starts with a number larger than 50, that will override the system default rules. Note that to add a rule, you need a root access on the system.

In the `udev_conf` directory of the *VirtualHub* for Linux[1] archive, there are two rule examples which you can use as a basis.

Example 1: 51-yoctopuce.rules

This rule provides all the users with read and write access to the Yoctopuce USB peripherals. Access rights for all other peripherals are not modified. If this scenario suits you, you only need to copy the

[1] http://www.yoctopuce.com/FR/virtualhub.php

"`51-yoctopuce_all.rules`" file into the "`/etc/udev/rules.d`" directory and to restart your system.

```
# udev rules to allow write access to all users
# for Yoctopuce USB devices
SUBSYSTEM=="usb", ATTR{idVendor}=="24e0", MODE="0666"
```

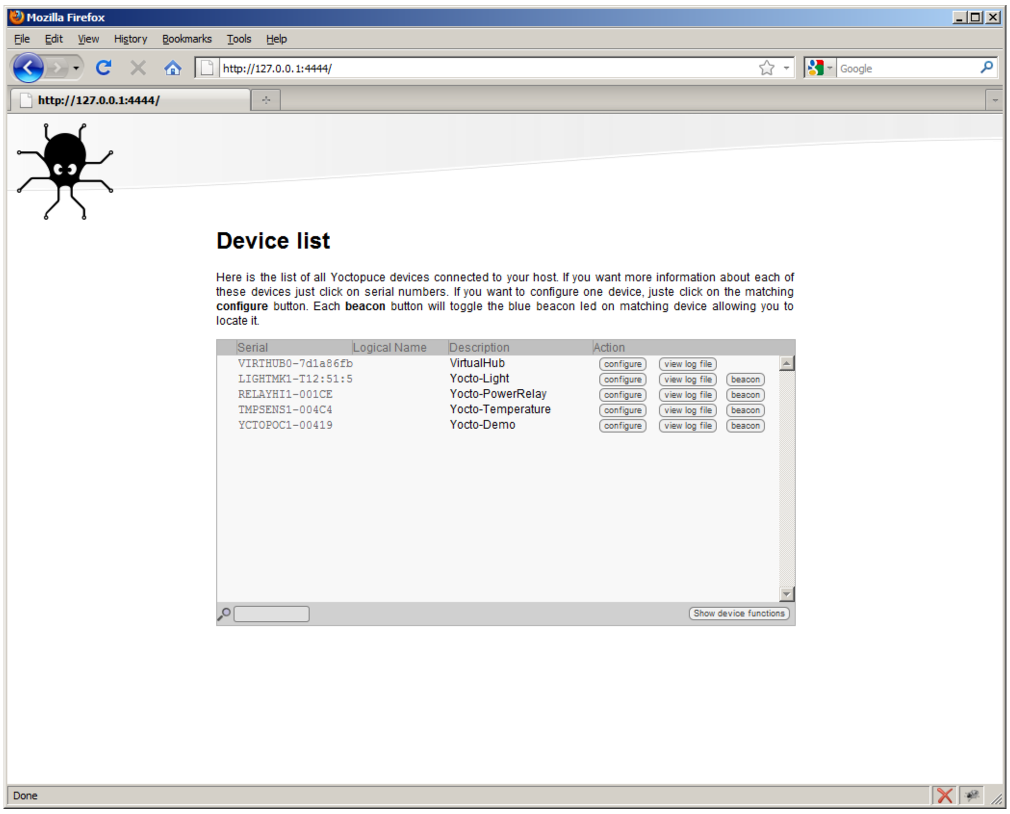
Example 2: 51-yoctopuce_group.rules

This rule authorizes the "yoctogroup" group to have read and write access to Yoctopuce USB peripherals. Access rights for all other peripherals are not modified. If this scenario suits you, you only need to copy the "`51-yoctopuce_group.rules`" file into the "`/etc/udev/rules.d`" directory and restart your system.

```
# udev rules to allow write access to all users of "yoctogroup"
# for Yoctopuce USB devices
SUBSYSTEM=="usb", ATTR{idVendor}=="24e0", MODE="0664", GROUP="yoctogroup"
```

3. Configuring and testing the modules

VirtualHub allows you to test and configure your Yoctopuce modules. To do so, make sure that you have *VirtualHub* running on the computer to which your modules are connected, then open your favorite web browser[1]. Get an *HTTP* connection to port 4444 of the machine on which *VirtualHub* is running. If it is the local machine, use the `http://127.0.0.1:4444` address. The list of your connected modules should appear.



Device list

Here is the list of all Yoctopuce devices connected to your host. If you want more information about each of these devices just click on serial numbers. If you want to configure one device, juste click on the matching **configure** button. Each **beacon** button will toggle the blue beacon led on matching device allowing you to locate it.

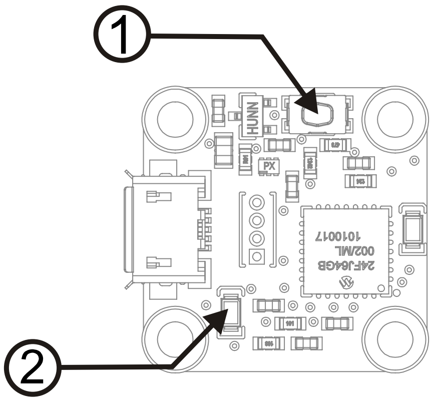
Serial	Logical Name	Description	Action		
VIRTHUB0-7d1a86fb		VirtualHub	configure	view log file	
LIGHTMK1-T12:51:5		Yocto-Light	configure	view log file	beacon
RELAYHI1-001CE		Yocto-PowerRelay	configure	view log file	beacon
TMPSENS1-004C4		Yocto-Temperature	configure	view log file	beacon
YCTOPOC1-00419		Yocto-Demo	configure	view log file	beacon

VirtualHub web interface

[1] The *VirtualHub* interface is regularly tested with Internet Explorer 6+, Firefox 3.5+, Chrome, and Safari. It does not work with Opera.

3.1. Locating the modules

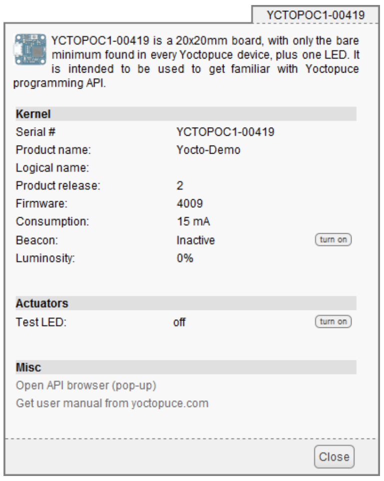
The main interface displays a line per connected module; if you have several modules of the same model, you can locate a specific module by clicking on the corresponding **beacon** button: it makes the blue led of the module start blinking and displays a blue disk at the beginning of the corresponding line in the interface. Pressing the Yocto-button of a connected module has the same effect.



Yocto-button (1) and localization led (2) of the Yocto-Demo module. These two elements are always placed in the same location, whatever the module.

3.2. Testing the modules

To test a module, simply click on the serial number of a module in the interface, a window specific to the module opens. This window generally allows you to activate the main functions of the module. Refer to the User's guide of the corresponding module for more details [2].



YCTOPOC1-00419

YCTOPOC1-00419 is a 20x20mm board, with only the bare minimum found in every Yoctopuce device, plus one LED. It is intended to be used to get familiar with Yoctopuce programming API.

Kernel		
Serial #	YCTOPOC1-00419	
Product name:	Yocto-Demo	
Logical name:		
Product release:	2	
Firmware:	4009	
Consumption:	15 mA	
Beacon:	Inactive	turn on
Luminosity:	0%	

Actuators		
Test LED:	off	turn on

Misc

Open API browser (pop-up)

Get user manual from yoctopuce.com

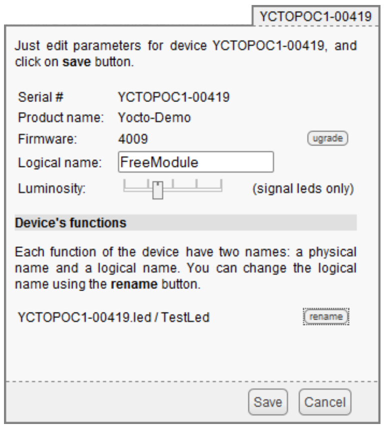
Close

"Details" window of the Yocto-Demo module.

3.3. Configuring modules

You can configure a module by clicking on the corresponding **Configure** button in the main interface. A window, specific to the module, then opens. This windows allows you minimally to assign a logical name to the module and to update its firmware. Refer to the User's guide of the corresponding module for more details.

[2] *VirtualHub* does not need to be more recent than the module you want to test and configure: all the elements specific to the module interfaces are kept in the module ROM, and not in *VirtualHub*.


YCTOPOC1-00419

Just edit parameters for device YCTOPOC1-00419, and click on **save** button.

Serial #	YCTOPOC1-00419	
Product name:	Yocto-Demo	
Firmware:	4009	ugrade
Logical name:	FreeModule	
Luminosity:		(signal leds only)

Device's functions

Each function of the device have two names: a physical name and a logical name. You can change the logical name using the **rename** button.

YCTOPOC1-00419.led / TestLed

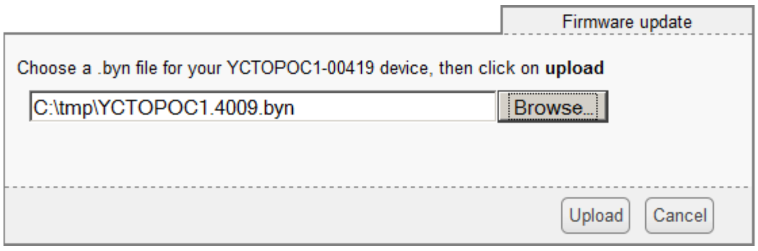
"Configuration" window of the Yocto-Demo module.

3.4. Upgrading firmware

The Yoctopuce modules are in fact real computers, they even contain a small web server. And, as all computers, it is possible to update their control software (firmware). New firmware for each module are regularly published, they generally allow you to add new functionalities to the module, and/or to correct a hypothetical bug[3].

Recommended method

To update a module firmware, you must first get the new firmware. It can be downloaded from the module product page on the Yoctopuce web site[4]. The interface offers also a direct link if it detects that the firmware is not up-to-date [5]. Firmware is available as `.byn` files of a few tens of kilobytes. Save the one you are interested in on your local disk.


Firmware update

Choose a .byn file for your YCTOPOC1-00419 device, then click on **upload**

C:\tmp\YCTOPOC1.4009.byn

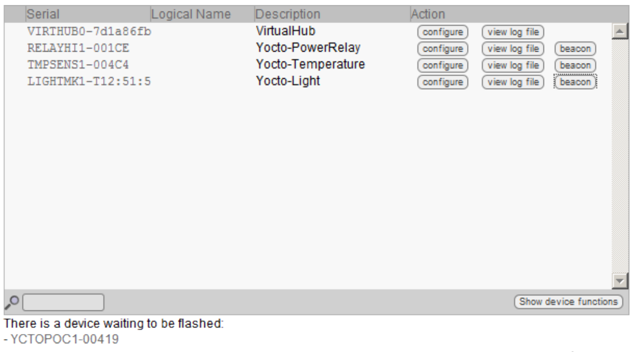
Firmware update window.

Once the firmware file is locally available, open the module **configuration** window and click on the **upgrade** button. The interface asks you to select the firmware file you wish to use. Enter the file name and click on **Upload**. From then on, everything is automatically performed: *VirtualHub* restarts the module in "update" mode, updates the firmware, then restarts the module in normal mode. The module configuration settings are kept. Do not disconnect the module during the update process.

Alternative method 1

If a module update went wrong, in particular if the module was disconnected during the update process, there is a strong risk that it does not work anymore and that it does not appear in the module list. In this case, disconnect the module, wait a few seconds, and reconnect it while keeping the yocto-button pressed. This starts the module in "update" mode. This working mode is protected against corruptions and should always be accessible. When the module is reconnected, request a refresh of the module list in the *VirtualHub* interface and your module should appear at the bottom of the interface. Click on it to update its firmware. This update method is a recovery method, it does not preserve the module settings.

[3] Never trust people telling you that their software does not have bugs :-)
[4] www.yoctopuce.com
[5] On the condition that the interface could access the Yoctopuce web site.



Serial	Logical Name	Description	Action
VIRTHUB0-7d1a86fb		VirtualHub	configure / view log file
RELAYHI1-001CE		Yocto-PowerRelay	configure / view log file / beacon
TMPSENS1-004C4		Yocto-Temperature	configure / view log file / beacon
LIGHTMK1-T12:51:5		Yocto-Light	configure / view log file / beacon

There is a device waiting to be flashed:
- YCTOPOC1-00419

The modules in "update" mode are listed in the interface.

Alternative method 2

You can also update a module firmware by using the *VirtualHub* in command line. Connect the module while pressing its yocto-button and then run the following command line:

```
virtualhub -f serial_number firmware_file.byn
```

Note that this requires you to know the serial number of your module. This update method is a recovery method, it does not preserve the module settings.

4. Using the VirtualHub as a gateway

The less spectacular, but nevertheless the most useful function of *VirtualHub* consists in providing a network gateway to control the modules. Firstly, it provides an access to languages such as Javascript which, by nature, prevent you from accessing the physical resources of a machine. Secondly, it provides access to the modules through the network for all languages: Yoctopuce libraries are indeed able to connect themselves to *VirtualHub* through the network.

To use *VirtualHub* as a gateway, you need only to run it in a command line or as a service on the machine on which the modules that you want to control are connected. Applications wanting to connect themselves to *VirtualHub* must initialize the API by calling the `yRegisterHub` function with the IP address of the machine running *VirtualHub*, the default port is 4444. For example:

```
yRegisterHub("http://192.168.1.6:4444",errmsg);
```

If the application and *VirtualHub* run on the same machine, use the 127.0.0.1 address. Refer to the programming API documentation[1] for more details.

4.1. Limitations

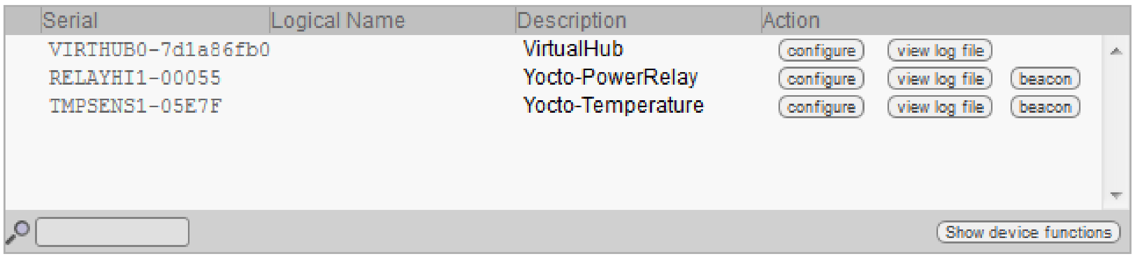
Yoctopuce USB modules have a limitation: on a given machine, you can have only one application at a given time that natively controls them. And it so happens that *VirtualHub* counts as a native application. Therefore, if you try to run an application which natively controls Yoctopuce USB modules, make sure that *VirtualHub* is not running, neither in a command line, nor as a service.

Note that from a programming standpoint, you can easily work around this limitation by making sure that your application uses *VirtualHub* as a gateway to control the modules, rather than controlling them directly. To do so, you only need to change one parameter when calling `yRegisterHub`.

[1] http://www.yoctopuce.com/EN/libraries

5. Access control

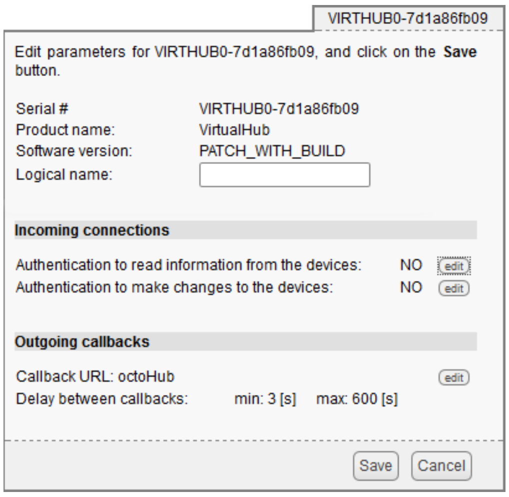
The *VirtualHub* is able to perform access control to protect your Yoctopuce devices. Click on the **Configure** button on the line matching the *VirtualHub* in the user interface.



Serial	Logical Name	Description	Action
VIRTHUB0-7d1a86fb0		VirtualHub	configure view log file
RELAYHI1-00055		Yocto-PowerRelay	configure view log file beacon
TMPSENS1-05E7F		Yocto-Temperature	configure view log file beacon

Click on the "configure" button on the first line

Then the configuration window for the *VirtualHub* will show up



VIRTHUB0-7d1a86fb09

Edit parameters for VIRTHUB0-7d1a86fb09, and click on the **Save** button.

Serial #	VIRTHUB0-7d1a86fb09
Product name:	VirtualHub
Software version:	PATCH_WITH_BUILD
Logical name:	

Incoming connections

Authentication to read information from the devices:	NO	edit
Authentication to make changes to the devices:	NO	edit

Outgoing callbacks

Callback URL: octoHub edit
Delay between callbacks: min: 3 [s] max: 600 [s]

The VirtualHub configuration window.

Access control is can be configured from the **Incoming connections** section. There are two levels of access control

5.1. Admin access

The *admin* access locks write access to the yoctopuce devices. When the admin password is set, only users using the admin login will be allowed to configure the devices seen by the *VirtualHub*.

5.2. User access

The *user* access locks read access to the Yoctopuce devices. When set, the *user* password prevent any user from consulting any device properties without the proper credentials.

If you configure an *admin* access, without configuring a *user* access, users will still be able to read your devices values without any password, but they wont be able to change any device setting.

5.3. Access control API

Warning, the access control have an impact on Yoctopuce API behavior when trying to connect to a *VirtualHub* with access control enabled. With Yoctopuce API, access control is handled at `RegisterHub()` level. You need to to provide the *VirtualHub* address as follow: *login:password@adresse:port*, here is an exemple:

```
yRegisterHub("admin:mypass@127.0.0.1:4444",errmsg);
```

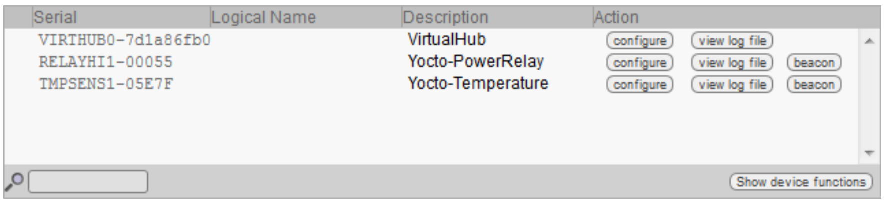
If you forget your *VirtualHub* password, the only way to regain control of your *VirtualHub* is to delete the *VirtualHub* configuration file (`.virtualhub.dat`).

6. Interaction with external services

The *VirtualHub* software can publish the state of connected devices on any Web server, using an HTTP POST. The values are posted on a regular basis and each time one of them changes significantly. This feature will allow you to interface your Yoctopuce devices with many web service.

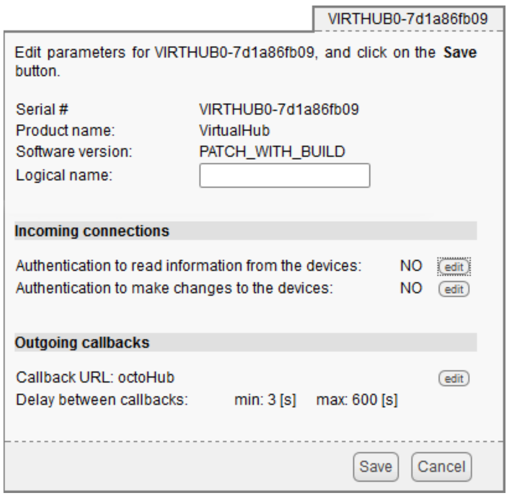
6.1. Configuration

To use this feature, just click on the **configure** button located on the line matching the **VirtualHub** on the main user interface. Then look for the **Outgoing calback** section and click on the **edit** button.



Serial	Logical Name	Description	Action
VIRTHUB0-7d1a86fb0		VirtualHub	configure view log file
RELAYHI1-00055		Yocto-PowerRelay	configure view log file beacon
TMPSENS1-05E7F		Yocto-Temperature	configure view log file beacon

Just click on the "configure" on the first line.



VIRTHUB0-7d1a86fb09

Edit parameters for VIRTHUB0-7d1a86fb09, and click on the **Save** button.

Serial #	VIRTHUB0-7d1a86fb09
Product name:	VirtualHub
Software version:	PATCH_WITH_BUILD
Logical name:	

Incoming connections

Authentication to read information from the devices: NO edit
Authentication to make changes to the devices: NO edit

Outgoing callbacks

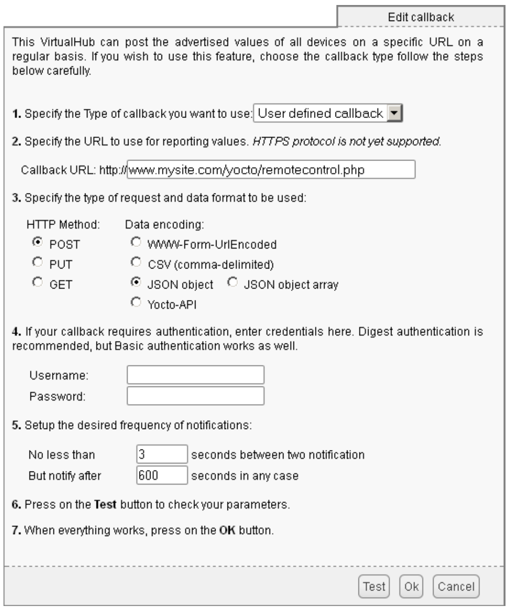
Callback URL: octoHub edit
Delay between callbacks: min: 3 [s] max: 600 [s]

Then edit the "Outgoing callbacks" section.

The callback configuration window will show up. This window will allows you to define how your virtual hub will interact with an external web site. Several interaction types are at your disposal.

6.2. User defined callback

This is the most generic type. this allows to fully customize the way the *VirtualHub* will interact with an external web site. You need to give the URL of the web server where you want the *VirtualHub* to post data. Note that only HTTP protocol is supported (no HTTPS).



Edit callback

This VirtualHub can post the advertised values of all devices on a specific URL on a regular basis. If you wish to use this feature, choose the callback type follow the steps below carefully.

1. Specify the Type of callback you want to use: User defined callback

2. Specify the URL to use for reporting values. *HTTPS protocol is not yet supported.*

Callback URL: http://www.mysite.com/yocto/remotecontrol.php

3. Specify the type of request and data format to be used:

HTTP Method:	Data encoding:	
[✓ POST]	WWW-Form-UrlEncoded	
PUT	CSV (comma-delimited)	
GET	[✓ JSON object]	JSON object array
	Yocto-API	

4. If your callback requires authentication, enter credentials here. Digest authentication is recommended, but Basic authentication works as well.

Username:
Password:

5. Setup the desired frequency of notifications:

No less than 3 seconds between two notification
But notify after 600 seconds in any case

6. Press on the **Test** button to check your parameters.

7. When everything works, press on the **OK** button.

The callback configuration window.

If you want to secure access to your callback script, you can setup a standard HTTP authentication. The VirtualHub knows how to handle standard HTTP authentication schemes: simply provide the user and and password fields needed to access the URL. Both Basic and Digest authentication are supported. However, Digest authentication is highly recommended, since it uses a challenge mechanism that avoids sending the password itself over the Internet, and prevents replays.

The *VirtualHub* posts the advertised values[1] on a regular basis, and each time one of these values significantly change. You change change the default delay between callbacks calls.

Tests

The *VirtualHub* can help you to debug the scripts run by the web server each time a callback is sent. Click on the **test** button (once all required fields are filled), and look at the output of your script as it is run. When the result meets your expectations, close the debug window and then click on the "OK" button.

Format

Values are posted with the following format:

1. If the function has been given a logical name:

```
FUNCTION_NAME = VALUE
```

2. If the module has been given a logical name, but not the function:

```
MODULE_NAME#HARDWARE_NAME = VALUE
```

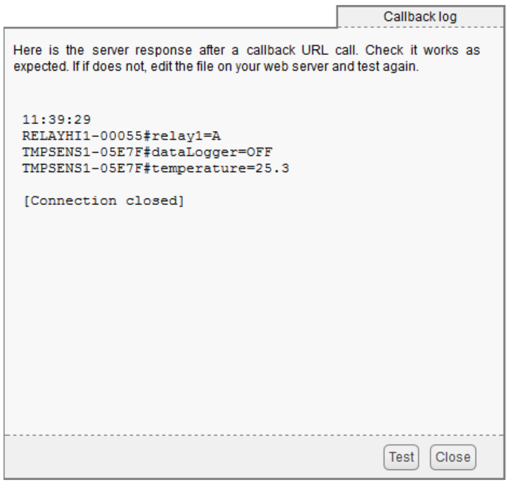
3. If no logical name was set:

```
SERIAL_NUMBER#HARDWARE_NAME = VALUE
```

[1] Advertised values are the ones you can see on the *VirtualHub* main interface when you click on the *show functions* button.

Here is a little PHP script allowing you to visualise the data posted by the call back and the result in the debug window:

```
<?php
  Print(Date('H:i:s')."\r\n");
  foreach ($_POST as $key=>$value) {
      Print("$key=$value\r\n");
  }
?>
```



Here is the server response after a callback URL call. Check it works as expected. If if does not, edit the file on your web server and test again.

```
11:39:29
RELAYHI1-00055#relay1=A
TMPSENS1-05E7F#dataLogger=OFF
TMPSENS1-05E7F#temperature=25.3

[Connection closed]
```

Callback results with a Yocto-PowerRelay and a Yocto-Temperature.

6.3. Yocto-API callback

The PHP yoctopuce API is able to work on *callback* mode. This way, a PHP script can gain control of Yoctopuce devices installed behind a NAT filter without having to open any port. Typically, this allows to control Yoctopuce devices from a public web site when the *VirtualHub* is running on a LAN behind a private ADSL router. The *VirtualHub* will then act as a gateway. All you have to do is to define the PHP script URL and, if applicable, the credentials needed to access it. You will find more information about this callback mode in your Yoctopuce devices user manual.

6.4. Cosm

Cosm[2] is a free cloud based service allowing to draw graphs. You can interface your Yoctopuce sensors with Cosm without having to write a single line of code. To achieve that, You need to create a Cosm account, then to define a feed ID and a Cosm API key. Then enter those two parameters in the *VirtualHub* user interface. That's it. If needed you will find more informations about Cosm on Yoctopuce's Blog[3]. Yoctopuce is not affiliated to Cosm.

2 www.cosm.com
3 http://http://www.yoctopuce.com/EN/article/connect-your-sensors-to-the-cloud

7. Command line parameters

VirtualHub accepts several parameters in the command line.

-h : help

Forces *VirtualHub* to display a short help.

-c : configuration file

By default, *VirtualHub* stores its configuration file in AppData under Windows, and in the Home directory under Linux and Mac OS X. This option allows you to change this location. For example:

```
>virtualhub -c C:\tmp\mysetting.bin
```

-p : port modification

By default, *VirtualHub* uses TCP port 4444, this option allows you to use another one. For example:

```
>virtualhub -p 8889
```

-v : version

Displays the *VirtualHub* version number. For example:

```
>virtualhub -v

Version v1.0 (4237)
```

-i : service installation

Under Windows, *VirtualHub* can work as a service, this option installs the service and starts it. Thus, *VirtualHub* is always available, even if the machine restarts.

-u : service uninstallation

Uninstalls the service previously installed with the -i option (Windows only).

-d : starting as a service/deamon

Under Linux starts *VirtualHub* in background mode.

-f : firmware update

Updates the firmware of a Yoctopuce module.To do so you need to know the serial number of the module and to have a `.byn` file locally available. These firmware files are available in the product pages on the Yoctopuce web site. Command line example:

```
>virtualhub -f serial_number firmware_file.byn
```

-o : osControl feature activation

Adds the *osControl* feature to the VirtualHub. This features allows to remotely shut down the computer running the VirtualHub using the Yoctopuce API.

-A : automatic firmware update

Updates the firmware of all connected Yoctopuce module compatible with the firmware file given. firmware files are available in the product pages on the Yoctopuce web site. Command line example:

```
>virtualhub -A firmware_file.byn
```

Index