Eaton Software Development Kit

REVISION HISTORY			
NUMBER	DATE	DESCRIPTION	NAME
0.4	2012-02-01	Add usage notes on LD_LIBRARY_PATH, libeaton_dump_all and libeaton_debug_level.	A. Quette
0.3	2012-01-17	Complete the "Support information" with an URL, and mention Beta publication.	A. Quette
0.2	2012-01-09	Clarify wording, complete legal information and add the "Support information" paragraph.	A. Quette
0.1	2011-11-21	First release of Eaton Software Development Kit.	F. Bohe, A. Quette

Contents

1 Introduction

The Eaton Software Development Kit ("SDK") allows your applications to connect to certain Eaton devices and retrieve certain internal data. Eaton SDK extensively uses the NUT - Network UPS Tools Opensource framework (supported by Eaton), to do so.

Warning
This version of Eaton SDK is tagged Beta, and is currently only intended for evaluation purpose.

This document provides the documentation for using the Eaton SDK libraries integration, on Linux and Microsoft Windows platforms, in chapter 3.

In case using the SDK libraries is not possible in your project (refer e.g. to the Legal limitations and SDK limitation), you will find alternatives methods on using the NUT framework with your application in the following chapters:

- Chapter 4 describes how to interact with the full NUT framework,
- Chapter 5 explains how to use directly NUT drivers,
- Chapter 6 contains some hints on how to re-implement the device specific protocol.

2 Legal limitations

The Network UPS Tools Opensource framework is a GNU General Public License (GPL) software that provides support for many different UPSs and PDUs. We expressly make the license terms of the GNU GPL applicable to this SDK solution, and by using the SDK you also accept to abide by these license terms; please see below.

GPL software have legal and technical implications, and generally can not be used with proprietary software. You should consider these very seriously before making a choice and using the present SDK.

Warning
Eaton recommends to use this SDK or the other documented approaches only as described in this document or the attached documentation. Eaton does not warrant completeness, correctness and permanent availability of the data and information retrieved by using the SDK (unless required by applicable law). Eaton does not assume any liability (unless required by applicable law), for damages resulting from the use of the SDK, or data or information retrieved by using SDK.

Here are some references that may help you understand these limitations and constraints: GPL FAQ.

Please also respect the following notice, which is compulsory for using the GPL:

3 Support information

In case you become aware of any malfunctions of this solution, we kindly ask you to inform us using the following support form:

http://pqtools.eaton.com/form/support/index_soft.php?lang=eng.

In this case, please use *Eaton Open Source* as *Software used*, and mention *Eaton SDK* in your message, with the details of your issue.

We recommend to only obtain this software from original Eaton sources, and to check for updates regularly, so that you can enjoy the latest functionalities.

4 Eaton SDK

Note
before using the Eaton SDK, please review secion 2 regarding legal limitations. If in doubt, chapter 2 references several documents to guide you through the licensing. chapter 2.

4.1 Limitation

Using the Eaton SDK library approach, an application can only manage one device! If you need to manage more than one device, please contact the Eaton Opensource team, or refer to the other possible approaches detailed in other chapters of this user's guide as shown in the Introduction chapter.

Please, also note that Eaton SDK is not yet Multi thread safe. Thus, you need to pay attention to have at most one thread that call Eaton SDK functions.

4.2 How does it work?

The SDK consists of several libraries allowing access to Eaton's UPS/PDU in several ways. Your application may link to one of those libraries to access a UPS/PDU.

To use this library, your application must initialize it first by calling libeaton_init function.

```
void libeaton_init(char * device)
```

The device parameter depends on the library you are using and is discussed in the relevant in following chapters.

Now you can call function to read or write variables of your device. You can also request your device to execute instant commands. Each of these functions gets the variable name or command name. A list of all existing variables and commands can be found in appendix A. Note that this gives all existing variables and commands, not all available variables and commands, which depend on the device type.

To have the list of available commands and variables of your device you can use the libeaton_dump_all function.

To read a variable, use the libeaton_read function in conjunction with the libeaton_update function:

```
void libeaton_update(void);
const char *libeaton_read(const char *varname)
```

libeaton_read returns a pointer to a string containing the value of the variable or NULL if an error occurred. It points to a string managed by the library you must not try to free it. libeaton_read returns data which were gathered in the last call to libeaton_update. It's up to your application to call libeaton_update in order to have fresh data (but remember this may be time consuming, especially for serial connections). You must call libeaton_update at least once before calling libeaton_read or it will fail.

To write a variable, use the libeaton_write function:

```
int libeaton_write (const char *varname, const char *val)
```

libeaton_write returns 0 if the variable was successfully written.

To call an instant command, use the libeaton_command function:

```
int libeaton_command(const char *cmdname, const char *extradata)
```

libeaton_command return 0 if the command was successfully issued.

To list available commands and variables:

```
char * libeaton_dump_all()
```

libeaton_dump_all returns a pointer to a buffer containing the available commands and variables for the current device. This list contains several strings in the form :

type<tab>command or variable name<tab>value

- type is one of VAR_RO, VAR_RW or CMD
- value is only available for variable

This is a sample output:

```
VAR_RO  ups.mfr Eaton
VAR_RW  outlet.1.delay.shutdown 10
CMD     outlet.1.shutdown.return
```

Once done with your device you should call libeaton_free function to free internal data.

```
void libeaton_free()
```

This is for debugging and support purpose :

```
int libeaton_debug_level
```

You can set this variable to a value from 1 to 5 for more or less verbosity of the library (0 is no debug output). If you ask for support you will probably be asked to set this variable to a value of 3 or above.

4.3 Building your application with the SDK

For all environments and all type of connections, you need all of the following files available in your include path: attribute.h, common.h, config.h, libeaton.h, proto.h and timehead.h. You may need to add the -I<path-to-include> option to the build command lines provided in this document to point to those header files.

You may have to link with libeaton shared libraries. To do so the relevant libeaton shared library must be available for your compiler. So you have to add the correct "-L <path-to-library>" to the build command lines provided in this document to point to those libraries.

Depending the type of connection, you may need additional external libraries (net-snmp, neon...) which are described in the relevant chapter.

4.3.1 Linux build

On Linux, building with the SDK has been tested using GCC.
For static link you will need the corresponding ".a" file.
For dynamic link you will need the corresponding ".so" file for compilation and ".so", ".so.0" and ".so.0.0.0" in you libs path for execution.

For dynamic link, you will also need to point the system linker at Eaton SDK library. To do so, just use the environment variable *LD_LIBRARY_PATH* the following way:

```
$ export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/path/to/eaton_so_libraries
```

For example, if Eaton SDK dynamic libraries reside in /opt/eaton/lib, use:

```
$ export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/opt/eaton/lib
```

4.3.2 Windows build

On Windows, building with the SDK has been tested with GCC in MinGW environment and CL in MS Visual Studio 10 environment.

4.4 Building SNMP application

You must call libeaton_init with your device's IP.

This is a sample code displaying the device status:

```
#include "common.h"
#include "libeaton.h"

int main(void)
{
        /* This contains the result of our request to the device */
        const char * status;

        /* init the library */
        libeaton_init("192.168.0.17");

        /* This is the real request to the device to update internal database.
        This may be time consuming */
        libeaton_update();

        /* Here we get the status of the device from the database */
        status = libeaton_read("ups.status");

        printf("%s\n",status);

        /* Free SDK internals */
        libeaton_free();

        exit(EXIT_SUCCESS);
}
```

Save this code in the file test.c

4.4.1 Linux build

You need net-snmp library available on your system. Make sure "net-snmp-config" command is available. Building statically:

```
gcc test.c -I<path-to-include> <path-to-lib>/libeaton_snmp.a `net-snmp-config --base-lib- ↩
    cflags --libs` -o test
```

Building with shared object:

```
gcc test.c -I<path-to-include> -L <path-to-lib> -leaton_snmp `net-snmp-config --base-lib- ↩
    cflags --libs` -o test
```

4.4.2 Windows build

With MSVC

You will need the libeaton_snmp.lib file. This is how to create it from libeaton_snmp-0.dll.

```
pexports libeaton_snmp-0.dll > libeaton_snmp.def
lib /machine:i386 /def:libeaton_snmp.def
```

Then you can link it to your application.

```
cl test.c -DWIN32 libeaton_snmp.lib
```

You need libnetsnmp-30.dll, libregex-1.dll and libeaton_snmp-0.dll in your path to run the resulting executable.

With MinGW

Building statically:

```
gcc test.c -I<path-to-include> libeaton_snmp.a libnetsnmp.a libregex.a -lws2_32
```

Building with shared object:

```
gcc test.c -I<path-to-include> libeaton_snmp.dll.a libcommon.dll.a
```

You need libnetsnmp-30.dll, libregex-1.dll and libeaton_snmp-0.dll in your path to run the resulting executable.

4.5 Building XML/HTTP application

You must call libeaton_init with your device's URL.

This is a sample code displaying the device status:

```
#include "common.h"
#include "libeaton.h"

int main(void)
{
        /* This will contain the result of our request to the device */
        const char * status;

        /* init the library */
        libeaton_init("http://192.168.0.17");

        /* This is the real request to the device to update internal database.
        This may be time consuming */
        libeaton_update();
```

```
        /* Here we get the status of the device from the database */
        status = libeaton_read("ups.status");

        printf("%s\n",status);

        /* Free SDK internals */
        libeaton_free();

        exit(EXIT_SUCCESS);
}
```

Save this code in the file test.c

4.5.1 Linux build

You need neon library available on your system. Make sure “pkg-config neon” command is available.

Building statically:

```
gcc test.c -I<path-to-include> <path-to-lib>/libeaton_xmlpdc.a `pkg-config --cflags --libs ↩
    neon` -o test
```

Building with shared object:

```
gcc test.c -I<path-to-include> -L <path-to-lib> -leaton_xmlpdc `pkg-config --cflags --libs ↩
    neon` -o test
```

4.5.2 Windows build

With MSVC

You will need the libeaton_xmlpdc.lib file. This is how to create it from libeaton_xmlpdc-0.dll.

```
pexports libeaton_xmlpdc-0.dll > libeaton_xmlpdc.def
lib /machine:i386 /def:libeaton_xmlpdc.def
```

Then you can link it to your application.

```
cl test.c -DWIN32 libeaton_xmlpdc.lib
```

You need libneon-27.dll, libeaton_xmlpdc-0.dll, libexpat-1.dll, libiconv-2.dll, libintl-8.dll and libz-1.dll in your path to run the resulting executable.

With MinGW

Building statically:

```
gcc test.c -I<path-to-include> libeaton_xmlpdc.a libneon.a libintl.a libexpat.a libiconv.a ↩
    -lws2_32
```

Building with shared object:

```
gcc test.c -I<path-to-include> libeaton_xmlpdc.dll.a
```

You need libneon-27.dll, libeaton_xmlpdc-0.dll, libexpat-1.dll, libiconv-2.dll, libintl-8.dll and libz-1.dll in your path to run the resulting executable.

4.6 Building USB HID application

You must call libeaton_init with NULL as a parameter.

This is a sample code displaying the device status:

```
#include "common.h"
#include "libeaton.h"

int main(void)
{
        /* This will contain the result of our request to the device */
        const char * status;

        /* init the library */
        libeaton_init(NULL);

        /* This is the real request to the device to update internal database.
        This may be time consuming */
        libeaton_update();

        /* Here we get the status of the device from the database */
        status = libeaton_read("ups.status");

        printf("%s\n",status);

        /* Free SDK internals */
        libeaton_free();

        exit(EXIT_SUCCESS);
}
```

Save this code in the file test.c

4.6.1 Linux build

You need libusb library available on your system. Make sure "pkg-config libusb" command is available. Building statically:

```
gcc test.c -I<path-to-include> <path-to-lib>/libeaton_usbhid.a `pkg-config --cflags --libs  ↩
    libusb` -o test
```

Building with shared object:

```
gcc test.c -I<path-to-include> -L <path-to-lib> -leaton_usbhid `pkg-config --cflags --libs  ↩
    libusb` -o test
```

4.6.2 Windows build

You must install a libusb driver for your device. You can either install the device driver (NOT the filter driver) from the official libusb-win32 binaries or use the wdi-simple.exe of the NUT Windows' package which install it automatically.

With MSVC

You will need the libeaton_usbhid.lib file. This is how to create it from libeaton_usbhid-0.dll.

```
pexports libeaton_usbhid-0.dll > libeaton_usbhid.def
lib /machine:i386 /def:libeaton_usbhid.def
```

Then you can link it to your application.

```
cl test.c -DWIN32 libeaton_usbhid.lib
```

You need libeaton_usbhid-0.dll, libregex-1.dll and libusb0.dll in your path to run the resulting executable.

With MinGW

Building statically:

```
gcc test.c -I<path-to-include> libeaton_usbhid.a libusb.a libgnu.a -lws2_32
```

You need libusb0.dll in your path to run the resulting executable.

Building with shared object:

```
gcc test.c -I<path-to-include> libeaton_usbhid.dll.a
```

You need libeaton_usbhid-0.dll, libregex-1.dll and libusb0.dll in your path to run the resulting executable.

4.7 Building USB XCP application

You must call libeaton_init with NULL as a parameter.

This is a sample code displaying the device status:

```
#include "common.h"
#include "libeaton.h"

int main(void)
{
        /* This will contains the result of our request to the device */
        const char * status;

        /* init the library */
        libeaton_init(NULL);

        /* This is the real request to the device to update internal database.
        This may be time consuming */
        libeaton_update();

        /* Here we get the status of the device from the database */
        status = libeaton_read("ups.status");

        printf("%s\n",status);

        /* Free SDK internals */
        libeaton_free();

        exit(EXIT_SUCCESS);
}
```

Save this code in the file test.c

4.7.1 Linux build

You need libusb library available on your system. Make sure “pkg-config libusb” command is available. Building statically:

```
gcc test.c -I<path-to-include> <path-to-lib>/libeaton_usbxcp.a `pkg-config --cflags --libs ↩
    libusb` -o test
```

Building with shared object:

```
gcc test.c -I<path-to-include> -L <path-to-lib> -leaton_usbxcp `pkg-config --cflags --libs  ↩
    libusb` -o test
```

4.7.2 Windows build

You must install a libusb driver for your device. You can either install the device driver (NOT the filter driver) from the official libusb-win32 binaries or use the wdi-simple.exe of the NUT Windows' package which install it automatically.

With MSVC

You will need the libeaton_usbxcp.lib file. This is how to create it from libeaton_usbxcp-0.dll.

```
pexports libeaton_usbxcp-0.dll > libeaton_usbxcp.def
lib /machine:i386 /def:libeaton_usbxcp.def
```

Then you can link it to your application.

```
cl test.c -DWIN32 libeaton_usbxcp.lib
```

You need libeaton_usbxcp-0.dll, libregex-1.dll and libusb0.dll in your path to run the resulting executable.

With MinGW

Building statically:

```
gcc test.c -I<path-to-include> libeaton_usbxcp.a libusb.a libgnu.a -lws2_32
```

You need libusb0.dll in your path to run the resulting executable.

Building with shared object:

```
gcc test.c -I<path-to-include> libeaton_usbxcp.dll.a
```

You need libeaton_usbxcp-0.dll, libregex-1.dll and libusb0.dll in your path to run the resulting executable.

4.8 Building serial XCP application

You must call libeaton_init with the name of the serial port device. On Linux, it is something like "/dev/ttyS0" or "/dev/ttyUSB0". On windows, it is something like "COM1".

Note that the initialization phase may be very long (about 30 seconds).

This is a sample code displaying the device status:

```
#include "common.h"
#include "libeaton.h"

int main(void)
{
        /* This will contains the result of our request to the device */
        const char * status;

        /* init the library */
        libeaton_init("/dev/ttyS0");

        /* This is the real request to the device to update internal database.
        This may be time consuming */
```

```
        libeaton_update();

        /* Here we get the status of the device from the database */
        status = libeaton_read("ups.status");

        printf("%s\n",status);

        /* Free SDK internals */
        libeaton_free();

        exit(EXIT_SUCCESS);
}
```

Save this code in the file test.c

4.8.1 Linux build

Building statically:

```
gcc test.c -I<path-to-include> <path-to-lib>/libeaton_serialxcp.a -o test
```

Building with shared object:

```
gcc test.c -I<path-to-include> -L <path-to-lib> -leaton_serialxcp -o test
```

4.8.2 Windows build

With MSVC

You will need the libeaton_serialxcp.lib file. This is how to create it from libeaton_serialxcp-0.dll.

```
pexports libeaton_serialxcp-0.dll > libeaton_serialxcp.def
lib /machine:i386 /def:libeaton_serialxcp.def
```

Then you can link it to your application.

```
cl test.c -DWIN32 libeaton_serialxcp.lib
```

You need libeaton_serialxcp-0.dll in your path to run the resulting executable.

With MinGW

Building statically:

```
gcc test.c -I<path-to-include> libeaton_serialxcp.a -lws2_32
```

Building with shared object:

```
gcc test.c -I<path-to-include> libeaton_serialxcp.dll.a
```

You need libeaton_serialxcp-0.dll in your path to run the resulting executable.

4.9 Building SHUT application

You must call libeaton_init with the name of the serial port device. On Linux, it is something like "/dev/ttyS0" or "/dev/ttyUSB0". On windows, it is something like "COM1".

Note that the initialization phase may be very long (about 20 seconds).

This is a sample code displaying the device status:

```
#include "common.h"
#include "libeaton.h"

int main(void)
{
        /* This will contains the result of our request to the device */
        const char * status;

        /* init the library */
        libeaton_init("/dev/ttyS0");

        /* This is the real request to the device to update internal database.
        This may be time consuming */
        libeaton_update();

        /* Here we get the status of the device from the database */
        status = libeaton_read("ups.status");

        printf("%s\n",status);

        /* Free SDK internals */
        libeaton_free();

        exit(EXIT_SUCCESS);
}
```

Save this code in the file test.c

4.9.1 Linux build

Building statically:

```
gcc test.c -I<path-to-include> <path-to-lib>/libeaton_shut.a -o test
```

Building with shared object:

```
gcc test.c -I<path-to-include> -L <path-to-lib> -leaton_shut -o test
```

4.9.2 Windows build

With MSVC

You will need the libeaton_shut.lib file. This is how to create it from libeaton_shut-0.dll.

```
pexports libeaton_shut-0.dll > libeaton_shut.def
lib /machine:i386 /def:libeaton_shut.def
```

Then you can link it to your application.

```
cl test.c -DWIN32 libeaton_shut.lib
```

You need libeaton_shut-0.dll in your path to run the resulting executable.

With MinGW

Building statically:

```
gcc test.c -I<path-to-include> libeaton_shut.a -lws2_32
```

Building with shared object:

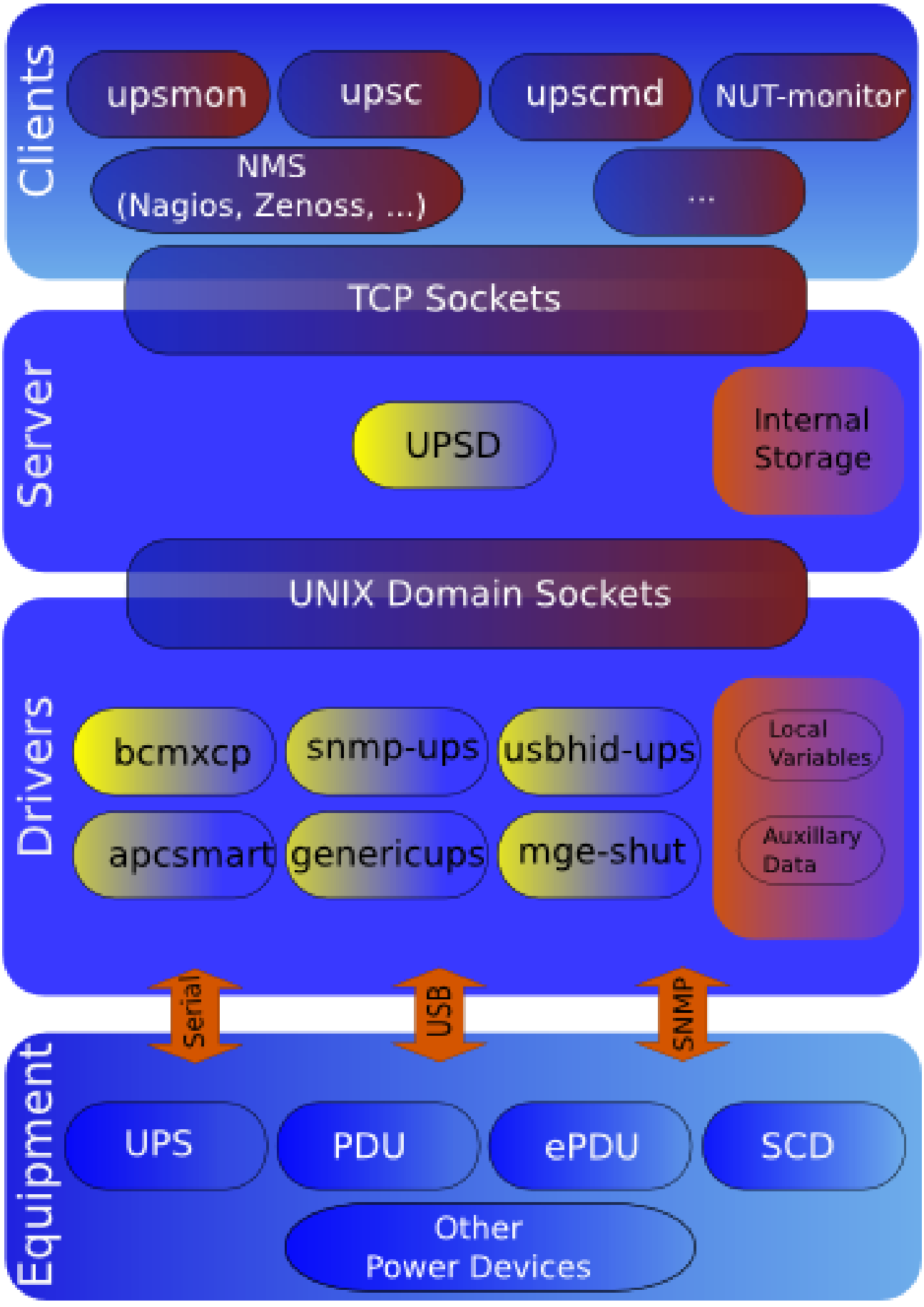
```
gcc test.c -I<path-to-include> libeaton_shut.dll.a
```

You need libeaton_shut-0.dll in your path to run the resulting executable.

5 Using the complete NUT framework

Note
This approach does not suffer the limitation of the *library SDK*, as presented in the SDK limitation chapter!

The NUT framework basically consists in a server (upsd) connected to drivers (which are themselves connected to device). Once this framework is running, clients can access device data and send commands via the upsd server.


Clients
upsmon
upsc
upscmd
NUT-monitor
NMS
(Nagios, Zenoss, ...)
...
TCP Sockets
Server
UPSD
Internal
Storage
UNIX Domain Sockets
Drivers
bcmxcp
snmp-ups
usbhid-ups
apcsmart
genericups
mge-shut
Local
Variables
Auxillary
Data
Serial
USB
SNMP
Equipment
UPS
PDU
ePDU
SCD
Other
Power Devices

There is a number of client applications available with NUT (upsc, upsmon...), which can serve as reference implementations. You can also write your own using the upsclient library. This is discussed in the NUT documentation.

Warning
NUT libupsclient is licensed under GNU GPL. Refer to the chapter Legal limitations for more information.

As stated in the above link, if you can't use the upsclient library, you can still directly access the nut server by implementing the *client - server* protocol which is documented here.

6 Using part of the NUT framework

Note
This approach does not suffer the limitation of the *library SDK*, as presented in the SDK limitation chapter!

As presented in the previous chapter, the NUT framework consists of driver(s) connected to a server.

You may choose to not use the server and to connect directly to the driver. For information on how to interface with the NUT drivers, refer to the protocol.

For a Linux minimalistic implementation of this method, you can also refer to the server/sockdebug.c debug program, that can be found in the NUT sources.

7 Protocol re-implementation

You may choose not to use NUT at all and directly re-implement the communication protocol with the device. In this case you may find useful information hereafter.

7.1 USB and shut

Example of specific protocol reimplementation, for USB/HID with an Eaton Protection Station

1) Get the data topology

Using the NUT - Network UPS Tools *usbhid-ups* driver, launch it with debug level 1:

```
$ /path/to/usbhid-ups -D -a <device name>

   2.632336     Using subdriver: MGE HID 1.27
   (...)
   3.432575     Path: UPS.PowerSummary.PresentStatus.ACPresent, Type: Feature, ReportID: 0 ↩
       x01, Offset: 0, Size: 1, Value: 1
   3.432618     Path: UPS.PowerSummary.PresentStatus.ACPresent, Type: Input, ReportID: 0x01 ↩
       , Offset: 0, Size: 1, Value: 1
   (...)
   3.569335     Path: UPS.PowerSummary.RunTimeToEmpty, Type: Feature, ReportID: 0x06,  ↩
       Offset: 8, Size: 32, Value: 1171
   3.569357     Path: UPS.PowerSummary.RunTimeToEmpty, Type: Input, ReportID: 0x06, Offset: ↩
        8, Size: 32, Value: 1171
   3.671941     Detected a UPS: EATON/Protection Station 650
```

The above is only a small excerpt of data provided by USB/HID devices. It shows the various data that are available for a specific device, and how to request these and extract the result.

You can then switch to debug level 3 (ie "-DDD") to see the raw USB frames:

```
$ /path/to/usbhid-ups -DDD -a <device name>

   2.623379     Using subdriver: MGE HID 1.27
   (...)
   3.425409     Report[get]: (4 bytes) => 01 25 00 00
   3.425454     Path: UPS.PowerSummary.PresentStatus.ACPresent, Type: Feature, ReportID: 0 ↩
       x01, Offset: 0, Size: 1, Value: 1
   (...)
```

2) Understand how to use these information

```
Report[get]: (4 bytes) => 01 25 00 00
```

This line means that the device send us 4 bytes. The first one is the ReportID (here : 0x01), then we have 3 data bytes.

```
Path: UPS.PowerSummary.PresentStatus.ACPresent, Type: Feature, ReportID: 0x01, Offset: 0,  ↩
    Size: 1, Value: 1
```

This line is the interpretation of the above data by NUT. It says that it is the ReportID 0x01 and that at offset 0 (in bits) we have a data of size 1 (in bits) with a value of 1 (0x25 = 00100101). This data HID path is UPS.PowerSummary.PresentStatus.ACPresent. This means that this device is on-line . "Type: Feature" means that this data is a "status" data which is fetched by the application. On the contrary you can have "Type: Input" which are "events" sent asynchronously by the UPS. This tutorial will focus on "Feature" data as it is simpler to implement.

Let’s see another example.

```
Report[buf]: (6 bytes) => 06 64 93 04 00 00
Path: UPS.PowerSummary.RunTimeToEmpty, Type: Input, ReportID: 0x06, Offset: 8, Size: 32,  ↩
    Value: 1171
```

This is the reportID 0x06, in which we have at offset 8 (bits, so the third byte of the frame after the reportID byte and the 8 first data bits) 32 bits of data (4 bytes) with a value of 1171 (0x00000493).

3) Sample code

This example illustrate the retrieving of the power status, that is to say if the device is operating on battery or from line power.

```
#include <stdio.h>
#include <usb.h>        /* libusb header file */

#define EATON_MGE_VENDORID              0x0463

int main()
{
        unsigned char buf[20];
        struct usb_device *dev;
        struct usb_bus *bus;
        usb_dev_handle *usbdev;
        int ret, reportId;

        /* libusb base init */
        usb_init();
        usb_find_busses();
        usb_find_devices();

        /* Enumerate USB busses to find the right device */
        for (bus = usb_busses; bus; bus = bus->next) {
                for (dev = bus->devices; dev; dev = dev->next) {
```

```
                        if (dev->descriptor.idVendor == EATON_MGE_VENDORID) {
                                /* You may also want to check the device identifier using
                                        dev->descriptor.idProduct */

                                printf("USB UPS found\n");

                                /* Now open the device */
                                usbdev = usb_open(dev);

                                /* And claim the first interface.
                                This may need several tries, and (for Linux) a call to
                                usb_detach_kernel_driver_np()
                                to replace the Integrated power management */

#ifdef WIN32
                                usb_set_configuration(usbdev,1);
#endif

                                usb_claim_interface(usbdev, 0);

                                /* Send a request to get UPS.PowerSummary.PresentStatus. ↩
                                    ACPresent */
                                reportId = 1;
                                ret = usb_control_msg(usbdev,
                                        USB_ENDPOINT_IN + USB_TYPE_CLASS +  ↩
                                            USB_RECIP_INTERFACE,
                                        0x01, /* HID_REPORT_GET */
                                        reportId+(0x03<<8), /* HID_REPORT_TYPE_FEATURE */
                                        0, buf, 128, /* ask for a large ReportSize */
                                        5000); /* 5 seconds timeout */

                                printf("Received %i bytes\n");

                                /* Now process the answer, and get the power status */
                                if (ret > 0) {
                                        /* Data bit extraction logic :
                                        /* First byte of report is report ID:
                                           Bit = bufOffset + 8; */
                                        /* Offset: 0, Size: 1 (in bit(s)) */
                                        /* Buf[Bit >> 3] & (1 << (Bit & 7)); */
                                        if ((buf[1] >> 0 & 01) == 1)
                                                printf("UPS is online\n");
                                        else
                                                printf("UPS is on battery\n");
                                }
                        }
                }
        }
        exit (EXIT_SUCCESS);
}
```

Note
in order to execute this program, you will need to have proper permissions to access the device. Either run it as *root*, or preferably use udev (on Linux) or equivalent system to set the proper rights to access the device.

Compile with *gcc testusb.c -lusb...*
Test by running the program, a first time with AC present:

$ sudo ./a.out
USB UPS found
Received 4 bytes
UPS is online

Then a second time after having removed the main power:

$ sudo ./a.out
USB UPS found
Received 4 bytes
UPS is on battery

Note
Another approach to communicate directly with USB devices is to use convenient HID library such hidapi.

4) SHUT implementation

For SHUT reimplementation, you may have a look in the Simplified SHUT protocol document.

You should also have a look at libshut.c file for a reference implementation.

7.2 XCP

XCP protocol specifications are on line here.

You can find a reference implementation in the NUT source tree in bcmxcp* files.

7.3 SNMP

You can find useful lookup table in the NUT source tree in *-mib.c files.

A NUT command and variable naming scheme

This is a dump of the standard variables and command names used in NUT. Don't use a name with any of the dstate functions unless it exists here.

If you need a new variable or command name, contact the Development Team first.

Put another way: if you make up a name that's not in this list and it gets into the tree, and then we come up with a better name later, clients that use the undocumented variable will break when it is changed.

Note
"opaque" means programs should not attempt to parse the value for that variable as it may vary greatly from one UPS to the next. These strings are best handled directly by the user.

A.1 Variables

A.1.1 device: General unit information

Note
these data will be redundant with some ups.* information during a transition period. The ups.* data will then be removed.

Name	Description	Example value
device.model	Device model	BladeUPS
device.mfr	Device manufacturer	Eaton
device.serial	Device serial number (opaque string)	WS9643050926
device.type	Device type (ups, pdu, scd)	ups

A.1.2 ups: General unit information

Name	Description	Example value
ups.status	UPS status	OL
ups.alarm	UPS alarms	OVERHEAT
ups.time	Internal UPS clock time (opaque string)	12:34
ups.date	Internal UPS clock date (opaque string)	01-02-03
ups.model	UPS model	Eaton 5PX 1500
ups.mfr	UPS manufacturer	EATON
ups.mfr.date	UPS manufacturing date (opaque string)	10/17/96
ups.serial	UPS serial number (opaque string)	WS9643050926
ups.vendorid	Vendor ID for USB devices	0463
ups.productid	Product ID for USB devices	0001
ups.firmware	UPS firmware (opaque string)	50.9.D
ups.firmware.aux	Auxiliary device firmware	4Kx
ups.temperature	UPS temperature (degrees C)	042.7
ups.load	Load on UPS (percent)	023.4
ups.load.high	Load when UPS switches to overload condition ("OVER") (percent)	100
ups.id	UPS system identifier (opaque string)	Sierra
ups.delay.start	Interval to wait before restarting the load (seconds)	0
ups.delay.reboot	Interval to wait before rebooting the UPS (seconds)	60
ups.delay.shutdown	Interval to wait after shutdown with delay command (seconds)	20
ups.timer.start	Time before the load will be started (seconds)	30
ups.timer.reboot	Time before the load will be rebooted (seconds)	10
ups.timer.shutdown	Time before the load will be shutdown (seconds)	20
ups.test.interval	Interval between self tests (seconds)	1209600 (two weeks)
ups.test.result	Results of last self test (opaque string)	Bad battery pack
ups.display.language	Language to use on front panel (* opaque)	E
ups.contacts	UPS external contact sensors (* opaque)	F0
ups.efficiency	Efficiency of the UPS (ratio of the output current on the input current) (percent)	95
ups.power	Current value of apparent power (Volt-Amps)	500
ups.power.nominal	Nominal value of apparent power (Volt-Amps)	500
ups.realpower	Current value of real power (Watts)	300

Name	Description	Example value
ups.realpower.nominal	Nominal value of real power (Watts)	300
ups.beeper.status	UPS beeper status (enabled, disabled or muted)	enabled
ups.type	UPS type (* opaque)	offline
ups.watchdog.status	UPS watchdog status (enabled or disabled)	disabled
ups.start.auto	UPS starts when mains is (re)applied	yes
ups.start.battery	Allow to start UPS from battery	yes
ups.start.reboot	UPS coldstarts from battery (enabled or disabled)	yes

A.1.3 input: Incoming line/power information

Name	Description	Example value
input.voltage	Input voltage	121.5
input.voltage.maximum	Maximum incoming voltage seen	130
input.voltage.minimum	Minimum incoming voltage seen	100
input.voltage.nominal	Nominal input voltage	120
input.voltage.extended	Extended input voltage range	no
input.transfer.reason	Reason for last transfer to battery (* opaque)	T
input.transfer.low	Low voltage transfer point	91
input.transfer.high	High voltage transfer point	132
input.transfer.low.min	smallest settable low voltage transfer point	85
input.transfer.low.max	greatest settable low voltage transfer point	95
input.transfer.high.min	smallest settable high voltage transfer point	131
input.transfer.high.max	greatest settable high voltage transfer point	136
input.sensitivity	Input power sensitivity	H (high)
input.quality	Input power quality (* opaque)	FF
input.current	Input current (A)	4.25
input.current.nominal	Nominal input current (A)	5.0
input.frequency	Input line frequency (Hz)	60.00
input.frequency.nominal	Nominal input line frequency (Hz)	60
input.frequency.low	Input line frequency low (Hz)	47
input.frequency.high	Input line frequency high (Hz)	63
input.frequency.extended	Extended input frequency range	no
input.transfer.boost.low	Low voltage boosting transfer point	190
input.transfer.boost.high	High voltage boosting transfer point	210
input.transfer.trim.low	Low voltage trimming transfer point	230
input.transfer.trim.high	High voltage trimming transfer point	240

A.1.4 output: Outgoing power/inverter information

Name	Description	Example value
output.voltage	Output voltage (V)	120.9
output.voltage.nominal	Nominal output voltage (V)	120
output.frequency	Output frequency (Hz)	59.9
output.frequency.nominal	Nominal output frequency (Hz)	60
output.current	Output current (A)	4.25

Name	Description	Example value
output.current.nominal	Nominal output current (A)	5.0

A.1.5 Three-phase additions

The additions for three-phase measurements would produce a very long table due to all the combinations that are possible, so these additions are broken down to their base components.

Phase Count Determination

input.phases (3 for three-phase, absent or 1 for 1phase) output.phases (as for input.phases)

DOMAINs

Any input or output is considered a valid DOMAIN.

input (should really be called input.mains, but keep this for compat) input.bypass input.servicebypass

output (should really be called output.load, but keep this for compat) output.bypass output.inverter output.servicebypass

Specification (SPEC)

Voltage, current, frequency, etc are considered to be a specification of the measurement.

With this notation, the old 1phase naming scheme becomes DOMAIN.SPEC Example: `input.current`

CONTEXT

When in three-phase mode, we need some way to specify the target for most measurements in more detail. We call this the CONTEXT.

With this notation, the naming scheme becomes DOMAIN.CONTEXT.SPEC when in three-phase mode. Example: `input.L1.curre`

Valid CONTEXTs

```
L1-L2  \
L2-L3   \
L3-L1    for voltage measurements
L1-N    /
L2-N   /
L3-N  /

L1  \
L2  for currrent and power measurements
L3  /
N  - for current measurement
```

Valid SPECs

Valid with/without context (ie. per phase or aggregated/averaged)

Name	Description
current	Current (A)
current.maximum	Maximum seen current (A)
current.minimum	Minimum seen current (A)

Name	Description
peakcurrent	Peak current
voltage	Voltage (V)
voltage.nominal	Nominal voltage (V)
voltage.maximum	Maximum seen voltage (V)
voltage.minimum	Minimum seen voltage (V)
power	Apparent power (VA)
power.maximum	Maximum seen apparent power (VA)
power.minimum	Maximum seen apparent power (VA)
power.percent	Percentage of apparent power related to maximum load
power.maximum.percent	Max seen percentage of apparent power
power.minimum.percent	Min seen percentage of apparent power
realpower	Real power (W)
powerfactor	Power Factor (dimensionless value between 0.00 and 1.00)
crestfactor	Crest Factor (dimensionless value greater or equal to 1)

Valid without context (ie. aggregation of all phases):

Name	Description
frequency	Frequency (Hz)
frequency.nominal	Nominal frequency (Hz)

A.1.6 EXAMPLES

Partial Three phase - Three phase example:

```
input.phases: 3
input.frequency: 50.0
input.L1.current: 133.0
input.bypass.L1-L2.voltage: 398.3
output.phases: 3
output.L1.power: 35700
output.powerfactor: 0.82
```

Partial Three phase - One phase example:

```
input.phases: 3
input.L2.current: 48.2
input.N.current: 3.4
input.L3-L1.voltage: 405.4
input.frequency: 50.1
output.phases: 1
output.current: 244.2
output.voltage: 120
output.frequency.nominal: 60.0
```

A.1.7 battery: Any battery details

Name	Description	Example value
battery.charge	Battery charge (percent)	100.0
battery.charge.low	Remaining battery level when UPS switches to LB (percent)	20
battery.charge.restart	Minimum battery level for UPS restart after power-off	20

Name	Description	Example value
battery.charge.warning	Battery level when UPS switches to "Warning" state (percent)	50
battery.voltage	Battery voltage (V)	24.84
battery.capacity	Battery capacity (Ah)	7.2
battery.current	Battery current (A)	1.19
battery.temperature	Battery temperature (degrees C)	050.7
battery.voltage.nominal	Nominal battery voltage (V)	024
battery.runtime	Battery runtime (seconds) Remaining battery runtime	1080
battery.runtime.low	when UPS switches to LB (seconds)	180
battery.alarm.threshold	Battery alarm threshold	0 (immediate)
battery.date	Battery change date (opaque string)	11/14/00
battery.mfr.date	Battery manufacturing date (opaque string)	2005/04/02
battery.packs	Number of battery packs	001
battery.packs.bad	Number of bad battery packs	000
battery.type	Battery chemistry (opaque string)	PbAc
battery.protection	Prevent deep discharge of battery	yes
battery.energysave	Switch off when running on battery and no/low load	no

A.1.8 ambient: Conditions from external probe equipment

Name	Description	Example value
ambient.temperature	Ambient temperature (degrees C)	25.40
ambient.temperature.alarm	Temperature alarm (enabled/disabled)	enabled
ambient.temperature.high	Temperature threshold high (degrees C)	40
ambient.temperature.low	Temperature threshold low (degrees C)	5
ambient.temperature.maximum	Maximum temperature seen (degrees C)	37.6
ambient.temperature.minimum	Minimum temperature seen (degrees C)	18.1
ambient.humidity	Ambient relative humidity (percent)	038.8
ambient.humidity.alarm	Relative humidity alarm (enabled/disabled)	enabled
ambient.humidity.high	Relative humidity threshold high (percent)	80
ambient.humidity.low	Relative humidity threshold high (percent)	10
ambient.humidity.maximum	Maximum relative humidity seen (percent)	60
ambient.humidity.minimum	Minimum relative humidity seen (percent)	13

A.1.9 outlet: Smart outlet management

Note
n stands for the outlet index. For more information, refer to the NUT outlets management and PDU notes chapter of the user manual. A special case is "outlet.0" which is equivalent to "outlet", and represent the whole set of outlets of the device.

Name	Description	Example value
outlet.n.id	Outlet system identifier (opaque string)	1
outlet.n.desc	Outlet description (opaque string)	Main outlet
outlet.n.switch	Outlet switch control (on/off)	on
outlet.n.status	Outlet switch status (on/off)	on
outlet.n.switchable	Outlet switch ability (yes/no)	yes
outlet.n.autoswitch.charge.low	Remaining battery level to power off this outlet (percent)	80
outlet.n.delay.shutdown	Interval to wait before shutting down this outlet (seconds)	180
outlet.n.delay.start	Interval to wait before restarting this outlet (seconds)	120
outlet.n.current	Current (A)	0.19
outlet.n.current.maximum	Maximum seen current (A)	0.56
outlet.n.realpower	Current value of real power (W)	28
outlet.n.voltage	Voltage (V)	247.0
outlet.n.powerfactor	Power Factor (dimensionless value between 0 and 1)	0.85
outlet.n.crestfactor	Crest Factor (dimensionless, equal to or greater than 1)	1.41
outlet.n.power	Apparent power (VA)	46

A.1.10 driver: Internal driver information

Name	Description	Example value
driver.name	Driver name	usbhid-ups
driver.version	Driver version (NUT release)	X.Y.Z
driver.version.internal	Internal driver version (if tracked separately)	1.23.45
driver.parameter.xxx	Parameter xxx (ups.conf or cmdline -x) setting	(varies)
driver.flag.xxx	Flag xxx (ups.conf or cmdline -x) status	enabled (or absent)

A.1.11 server: Internal server information

Name	Description	Example value
server.info	Server information	Network UPS Tools upsd vX.Y.Z - http://www.networkupstools.org/
server.version	Server version	X.Y.Z

A.2 Instant commands

Name	Description
load.off	Turn off the load immediately
load.on	Turn on the load immediately
shutdown.return	Turn off the load possibly after a delay and return when power is back
shutdown.stayoff	Turn off the load possibly after a delay and remain off even if power returns
shutdown.stop	Stop a shutdown in progress

Name	Description
shutdown.reboot	Shut down the load briefly while rebooting the UPS
shutdown.reboot.graceful	After a delay, shut down the load briefly while rebooting the UPS
test.panel.start	Start testing the UPS panel
test.panel.stop	Stop a UPS panel test
test.failure.start	Start a simulated power failure
test.failure.stop	Stop simulating a power failure
test.battery.start	Start a battery test
test.battery.start.quick	Start a "quick" battery test
test.battery.start.deep	Start a "deep" battery test
test.battery.stop	Stop the battery test
calibrate.start	Start runtime calibration
calibrate.stop	Stop runtime calibration
bypass.start	Put the UPS in bypass mode
bypass.stop	Take the UPS out of bypass mode
reset.input.minmax	Reset minimum and maximum input voltage status
reset.watchdog	Reset watchdog timer (forced reboot of load)
beeper.enable	Enable UPS beeper/buzzer
beeper.disable	Disable UPS beeper/buzzer
beeper.mute	Temporarily mute UPS beeper/buzzer
beeper.toggle	Toggle UPS beeper/buzzer