

# **PRIME Products**

# **PRIME Manager User Guide**

### Overview

The PRIME Manager is a PC software application that connects to Service or Base Nodes allowing easy management of the device functionality.

### Features

- Connection by USI Protocol to PRIME Devices
- Supports PRIME 1.3 Service Nodes with Firmware Version 1.3.9.0 or Later
- Supports PRIME 1.3 Base Nodes with Firmware Version 1.3.10.0 or Later
- Supports PRIME 1.4 Service or Base Nodes with Firmware 1.4.1.0 or Later
- Multi-Client Connection
- PRIME API Management
- Manage Certification
- Manage MTP
- Embedded Sniffer Support
- Run DLMS Over TCP Protocol as Application (Base Node)
- Run PRIME Over UDP as Application (Base and Service Node, PRIME 1.3 Only)
- USI Serial Profile Certification Bridge
- Firmware Upgrade with Signature Options (PRIME 1.4)
- Python Script Example to Sign Firmware Files

# **Table of Contents**

Ov	erview	1								
Fea	atures	1								
1.	Introduction 1.1. Description 1.2. Application Structure									
2.	Initial Steps.         2.1.       Software Installation.         2.2.       Target Firmware.         2.3.       Starting.	5 6 6								
3.	Network Topology View.         3.1.       Info Request Dialog.         3.2.       Network Management Dialog.         3.3.       Firmware Upgrade Management Dialog.	11 12 12 								
4.	Base Management View.      4.1.    Signing Firmware.	14 15								
5.	PRIME Management View.5.1.PLME/MLME PIBs.5.2.Serial Profile.5.3.PRIME Profile.5.4.MAC.5.5.4-32.5.6.PLME.5.7.MLME.5.8.Certification.5.9.Manufacturing (MTP) Test.5.10.PRIME over UDP (PRIME 1.3 only).									
6. 7.	Sniffer Window.         Revision History.         7.1.       Rev A - 02/2015.         7.2.       Rev B - 01/2016.         7.3.       Rev C - 09/2016.         7.4.       Microchip Rev A - 06/2018.	24 25 25 25 25 25								
The	e Microchip Web Site									
Cu	stomer Change Notification Service	26								

Customer Support	. 26
Microchip Devices Code Protection Feature	. 26
Legal Notice	.27
Trademarks	27
Quality Management System Certified by DNV	.28
Worldwide Sales and Service	.29

## 1. Introduction

#### 1.1 Description

The PRIME Manager is used to monitor and manage PRIME power line networks. This tool requires a hardware device connected to the power line.

The PRIME Manager can be used for:

- PIB management
- Testing embedded firmware
- Monitorizing embedded Sniffer

The USI messages are processed and the results displayed in the different views of the main window (see Figure 2-9).

#### 1.2 Application Structure

The application is designed with the following structure:

#### Figure 1-1. Application Structure



The *PRIMEManager* is the main application – it configures and launches the *PLCUSIServer* application and its USI connection. The *PLCUSIServer* allows connection of several *PRIMEManager* instances.

# 2. Initial Steps

#### 2.1 Software Installation

To install the software, execute the provided installation wizard.

First, select between multiuser support or current user.

#### Figure 2-1. First Wizard Window

G Microchip PRIME Manager Setup	- • •
Choose Users Choose for which users you want to install Microchip PRIME Manager.	
Select whether you want to install Microchip PRIME Manager for yourself only of this computer. Click Next to continue.	y or for all users
<ul> <li>Install for anyone using this computer</li> <li>Install just for me</li> </ul>	
Nullsoft Install System v2.46	Cancel

Next, select the components to install.

#### Figure 2-2. Select Components

🕞 Microchip PRIME Manager S	etup	
Choose Components Choose which features of Micro	ochip PRIME Manager you want to	install.
Check the components you wa install. Click Next to continue.	nt to install and uncheck the comp	onents you don't want to
Select components to install:	Microchip PRIME Manager	Description Position your mouse over a component to see its description,
Space required: 180.0MB	4 III +	
Nullsoft Install System v2,46	< <u>B</u> ack	Next > Cancel

And finally, select the folder where the software must be installed or just simply use the default location.

#### Figure 2-3. Select Folder

Microchip Prime Manager Setup	
Choose Install Location	NUI
Choose the folder in which to install Microchip PRIME Manager.	
Setup will install Microchip PRIME Manager in the following folder. To install folder, click Browse and select another folder. Click Install to start the insta	in a different Ilation.
Destination Folder	
:\Program Files\Microchip\Microchip PRIME Manager_x64_2.1.0	Browse
Space required: 180.0MB	
Space available: 26.0GB	
Space available: 26.0G8 Illsoft Install System v2.46	

The installation does not require any other configuration.

#### Figure 2-4. Installation Completed



The installation procedure generates a desktop link and start menu link. Use any of them to start PRIME Manager.

#### 2.2 Target Firmware

Along with the Microchip PLC Kit, you have received the instructions to build/install the appropriate firmware in your hardware devices. Refer to the "Kit User Manual" to install the appropriate Base/Service Node firmware.

#### 2.3 Starting

First, plug the hardware device to the power line. Then, connect the USB cable to the host computer. Finally, start the PRIME Manager using, for example, the link created on your desktop during the install process. This opens the main window.

Figure 2-5. PRIME Manager Main Window



In order to connect, the user needs to setup input and log parameters through the settings window. To modify the settings, click File>Settings on the menu and the settings window will be shown (Figure 2-6). First, choose between running a local USI server (PLCUSIServer) instance or connecting to a remote USI server.

Image: Service of Connect to remote USI server         Server options         Device type: <ul> <li>Service</li> <li>Service</li> <li>Service</li> <li>BaudRate 115200</li> <li>TCP/IP Host 10.140.228.11</li> </ul> Port 8216         Protocol used for application requests       Protocol used for application requests         PLME/MLME       Serial Profile         Log Options       Image: C:/USI_Log.txt         Browse       Sniffer Options         Image: Platabase:       C:/Siffer_DB.sql         Browse       Browse	Server options       Device type:       O Service       O Serial       Port       COM43 Enhanced       Port       8216	Rate 115200
Service type:       Service <ul> <li>Serial</li> <li>Port</li> <li>COM43 Enhanced</li> <li>BaudRate 115200</li> <li>TCP/IP</li> <li>Host</li> <li>10.140.228.11</li> <li>Port</li> <li>8216</li> </ul> Protocol used for application requests <li>PLME/MLME</li> <li>Serial Profile</li> Log Options           V USI         c:/USI_Log.txt               Sniffer Options               Enable Sniffer               Sniffer Database:               c:/Sniffer_DB.sql	Service type:      ● Service       ● Serial     Port       ○ TCP/IP     Host       10.140.228.11     Port       8216	Rate 115200 •
Device type:       Service <ul> <li>Serial</li> <li>Port</li> <li>COM43 Enhanced</li> <li>BaudRate 115200</li> <li>TCP/IP</li> <li>Host</li> <li>10.140.228.11</li> <li>Port</li> <li>8216</li> </ul> <li>Protocol used for application requests</li> <li>PLME/MLME</li> <li>Serial Profile</li> <li>Log Options</li> <li>USI</li> <li>c:/USI_Log.txt</li> <li>Browse</li> <li>Sniffer Options</li> <li>Enable Sniffer</li> <li>Sniffer Database:</li> <li>c:/Sniffer_DB.sql</li> <li>Browse</li>	O Service     Service     Service     Service     Service     TCP/IP Host 10.140.228.11     Port 8216	Rate 115200
Serial Port COM43 Enhanced  BaudRate 115200 TCP/IP Host 10.140.228.11 Port 8216 Protocol used for application requests PLME/MLME   Serial Profile Log Options USI c:/USI_Log.txt Browse Sniffer Options Enable Sniffer Sniffer Database: c:/Sniffer_DB.sql Browse	Serial Port COM43 Enhanced Baud     TCP/IP Host 10.140.228.11 Port 8216 Port 8216	Rate 115200 •
TCP/IP Host 10.140.228.11 Port 8216 Protocol used for application requests PILME/MLME      Serial Profile Log Options USI C:/USI_Log.txt Browse Sniffer Options F Enable Sniffer Sniffer Database: c:/Sniffer_DB.sql Browse	TCP/IP Host 10.140.228.11     Port 8216	
Protocol used for application requests  PLME/MLME Serial Profile  USI C:/USI_Log.txt Browse  Sniffer Options Fenable Sniffer Sniffer Database: c:/Sniffer_DB.sql Browse Browse	Protocol used for application requests	
<ul> <li>PLME/MLME          <ul> <li>Serial Profile</li> </ul> </li> <li>Log Options         <ul> <li>USI</li> <li>c:/USI_Log.txt</li> <li>Browse</li> </ul> </li> <li>Sniffer Options         <ul> <li>Enable Sniffer</li> <li>Sniffer Database: c:/Sniffer_DB.sql</li> <li>Browse</li> </ul> </li> </ul>	Protocol used for application requests	
PLME/MLME      Serial Profile  Log Options  USI  c:/USI_Log.txt  Browse  Sniffer Options  Enable Sniffer  Sniffer Database: c:/Sniffer_DB.sql Browse		
Log Options       USI     c:/USI_Log.bxt     Browse       Sniffer Options           Enable Sniffer         Sniffer Database:       c:/Sniffer_DB.sql	PLME/MLME     Image: Serial Profile	
✓ USI       c:/USI_Log.txt       Browse         Sniffer Options          ✓ Enable Sniffer          Sniffer Database:       c:/Sniffer_DB.sql       Browse	Log Options	
Sniffer Options Thable Sniffer Sniffer Database: c:/Sniffer_DB.sql Browse	USI c:/USI_Log.txt Brow	se
Sniffer Options          Image: Sniffer Sniffer Sniffer Database:       c:/Sniffer_DB.sql         Browse       Browse	_	
Enable Sniffer Sniffer Database: c:/Sniffer_DB.sql Browse Browse	Sniffer Options	
Sniffer Database: c:/Sniffer_DB.sql Browse	Enable Sniffer	
	Sniffer Database: c:/Sniffer_DB.sql Browse	
<ul> <li>Overwrite</li> </ul>	(i) Over	write 🔘 Apper
	Sniffer Options          Image: Sniffer Database:       c:/Sniffer_DB.sql         Image: Sniffer Database:       C:/Sniffer_DB.sql	

# PRIME Products Initial Steps

The normal usage is to run a local server and connect by USB (PC1 in Figure 2-7). After that, choose between serial and TCP/IP link for the hardware connection. When running a local server, the TCP/IP option allows the connection to a UART Hub or USI Splitter.





When connecting to remote server (PC2 in Figure 2-7), the TCP/IP option requires the IP address of the server (PC1) and the opened port by the server. Note that the opened port is shown in the status bar of the tool.

If the COM port is not known, it can be located at the Windows Device Manager in the Port (COM & LPT) section. In this example, COM69 is used:

Figure 2-8. Windows Device Manag	ger
----------------------------------	-----

File Action View Help
ZARDT0027         Batteries         Computer         Display adapters         DVD/CD-ROM drives         Display drives         DVD/CD-ROM drives         Modems         Modems         Moditors         Ports (COM & LPT)         Communications Port (COM2)         Silicon Labs Dual CP210x USB to UART Bridge: Enhanced COM Port (COM70)         Processors         Sound, video and game controllers         System devices         DV         Universal Serial Bus controllers

# Note: Some Microchip kits use a dual USB UART Bridge providing two COM devices on the same USB cable. Firmware is configured to use the "Enhanced COM Port" by default.

Sniffer options (Figure 2-6) allow enabling the embedded sniffer. The database to store the sniffer log can be selected. Furthermore, overwrite or append options can be selected.

It is also possible to enable a USI log (see Figure 2-6). If it is enabled, all USI traffic from PC to device and from device to PC will be written on the selected text file. It can be useful for debugging.

The protocol used for application requests (see Figure 2-6) can be chosen (PLME/MLME or Serial Profile). This is the protocol that will be used to get/set PIBs automatically by the tool. If both PRIME API and MNGP (Serial Profile) are serialized, this option is not of relevance, but it can be useful if one of those protocols is not serialized.

Now, the tool is ready to connect. Accept the changes and click on menu Connection>Connect in the Main Window to start. The status bar at the bottom of the window will show the current setup and the status of the tool. The Main Window is shown in the next figure.

🔛 Microchip PRIME Manager 2.1.0				- • •
File Connection View Help				
PRIME Management				
PLME/MLME PIBs Serial Profile M	AC 4-32 PLME	MLME Certification	MTP Prime Over UDP	Prime Debug
macVersion (0x0001)	•	Get PIB		
0 🚔 Set PIB				
1 byte				
Connected TCP IP: 10.140.30.22: 13052	Server:9098	PRIME: 1.4	MAC State: Term	ninal 🕂 MICROCHIP

Figure 2-9. Main Window when Connected to a Service Node

When clicking Connect, if the sniffer was enabled in the settings dialog, a new window would be shown with the sniffer (see section 3. Network Topology View). Such window is similar to the PLC Sniffer tool. Note that once the tool is connected, it is not possible to show the sniffer if it was not activated before clicking Connect.

# **PRIME Products**

**Initial Steps** 

Connection View	Help										
odes	MAC 01:02:03:00:00:01 01:02:03:00:00:06 01:02:03:00:00:0C 01:02:03:00:00:02	SID 0 1 2 3	LNID 751 753 761 769	LSID 1 2 3 255	fuState	Version	Vendor/Model	4-32.	ALV Rx/Tx 4/4 (100%) 7/7 (100%) 1/1 (100%) 1/1 (100%)	Coverage 100% 100% 100% 100%	Base Management           2018-04-19 09:12:25 >> NetEvent] MAC: 01:02:03:00:12 Event: bring_register_event           2018-04-19 09:12:25 >> NetEvent] MAC: 01:02:03:00:01 Event: bring_abs_event Alves: 1/1 (100%)           2018-04-19 09:12:35 >> NetEvent] MAC: 01:02:03:00:00 Event: bring_abs_event Alves: 2/2 (100%)           2018-04-19 09:12:35 >> NetEvent] MAC: 01:02:03:00:00 Event: bring_abs_event Alves: 2/2 (100%)           2018-04-19 09:12:35 >> NetEvent] MAC: 01:02:03:00:00 Event: bring_abs_event Alves: 2/2 (100%)           2018-04-19 09:12:32 >> NetEvent] MAC: 01:02:03:00:01 Event: bring_abs_event Alves: 2/2 (100%)
	01:02:03:00:00:12 01:02:03:00:00:13 01:02:03:00:00:13 01:02:03:00:00:01 01:02:03:00:00:00 01:02:03:00:00:00 01:02:03:00:00:00 01:02:03:00:00:00	3 3 2 2 2 2 2	768 767 766 765 764 763 762	255 255 255 255 255 255 255 255		1			1/1 (100%) 1/1 (100%) 1/1 (100%) 2/2 (100%) 2/2 (100%) 2/2 (100%) 2/2 (100%) 2/2 (100%)	100% 100% 100% 100% 100% 100%	2019-01-19 09:12:32 >> NetEvent] MAC: 01:02:03:00:00:14Event: bmrg_ailve_event Alves: 1/1 (109%) 2019-01-19 09:12:33 >> NetEvent] MAC: 01:02:03:00:00:00 Event bmrg_ailve_event Alves: 2/2 (109%) 2019-01-19 09:12:41 >> NetEvent] MAC: 01:02:03:00:00:03 Event: bmrg_ailve_event Alves: 4/4 (100%) 2019-01-19 09:12:41 >> NetEvent] MAC: 01:02:03:00:00:03 Event: bmrg_ailve_event Alves: 6/6 (100%) 2019-01-19 09:12:41 >> NetEvent] MAC: 01:02:03:00:00:03 Event: bmrg_ailve_event Alves: 6/6 (100%) 2019-01-19 09:12:41 >> NetEvent] MAC: 01:02:03:00:00:03 Event: bmrg_ailve_event Alves: 6/6 (100%) 2019-01-19 09:12:41 >> NetEvent] MAC: 01:02:03:00:00:03 Event: bmrg_ailve_event Alves: 6/6 (100%) 2019-01-19 09:12:41 >> NetEvent] MAC: 01:02:03:00:00:03 Event: bmrg_ailve_event Alves: 6/6 (100%) 2019-01-19 09:12:41 >> NetEvent] MAC: 01:02:03:00:00:03 Event: bmrg_ailve_event Alves: 6/6 (100%) 2019-01-19 09:12:41 >> NetEvent] MAC: 01:02:03:00:00:03 Event: bmrg_ailve_event Alves: 6/6 (100%) 2019-01-19 09:12:41 >> NetEvent] MAC: 01:02:03:00:00:03 Event: bmrg_ailve_event Alves: 6/6 (100%)
25: 19 Switches: 3	01122030000000 0112203000000 01102203000000 0102203000000 0102203000000 0102203000000 0102203000000 0102203000000 01022030000000	1 1 1 0 0 0 0	759 758 754 752 755 756 757 760	235 255 255 255 255 255 255 255			•		5/5 (100%) 4/4 (100%) 8/8 (100%) 8/8 (100%) 8/8 (100%) 5/6 (100%) 5/5 (100%) 3/3 (100%)	100% 100% 100% 100% 100% 100% 100% 100%	File Configuration Select File C:/ Match Rules Vendor Model Signature No Signature ▼ Size: 0 Page Size AUTO ▼ ARQ ♥ Multicon Start Stop
E Management											
ME_MLME_PIBs Serial adListRegDevices (0x005 Set PIB Is cannot be set RegDevice	Profile PRIME Profile 0) Switch Capabilities- (ULI18-01:02-03:00:00: UNID =755 State-1 LSID =255 SID =2 Level-2	4-3	2 M	t PIB	MLME	PLME	Certification	MTP	Prime Over	3	REBOOT
	Terminal Capabilities Switch Capabilities=	= 101 0									

Figure 2-10. Main Window when Connected to a Base Node

- Network Topology view. This is the basic presentation in the main application window and it is always visible when connected to a Base Node. It is not available when connected to a Service Node. This view displays the logical network structure. The structure is inferred analyzing the network events received from the Base Node. In addition, this view shows node information such as MAC, LNID, LSID, SID, firmware upgrade state, firmware version, model and vendor, 4-32 address, ALV message count and coverage
- 2. **Firmware Upgrade view.** This view displays firmware upgrade options and information about the current upgrade process. It is not available when connected to a Service Node
- 3. **PRIME Management.** This view allows requesting information and other functionalities provided by the different protocols available in the tabs. It is available in both Base and Service Node connection, but there are some differences (to be described in section 5. **PRIME Management** View)

## 3. Network Topology View

The Network Topology View looks like this:

Figure 3-1.	Network Topology	View Showing a	27-node Network
-------------	------------------	----------------	-----------------

Nodes	MAC S	SID	LNID	LSID	fuState	Version	Vendor/Model	4-32 Address	ALV Rx/Tx	Coverage
4 •	01:20:30:71:00:90 0	)	10005	1					1/1 (100%)	10
4 •	01:20:30:71:01:07 1	L	10006	2					1/1 (100%)	10
⊿ ●	01:20:30:71:01:17 2	2	10015	3					1/1 (100%)	10
4 •	01:20:30:71:01:21 3	3	10018	4					1/1 (100%)	10
4 😐	01:20:30:71:01:32 4	1	10024	5					0/0 (0%)	0
•	01:20:30:71:01:45 5	5	10026	255					1/1 (100%)	10
•	01:20:30:71:01:47 5	5	10025	255					1/1 (100%)	10
•	01:20:30:71:01:51 5	5	10027	255					1/1 (100%)	10
•	01:20:30:71:01:30 4	1	10019	255					0/0 (0%)	0
•	01:20:30:71:01:42 4	1	10023	255					1/1 (100%)	10
•	01:20:30:71:01:43 4	1	10022	255					1/1 (100%)	10
•	01:20:30:71:01:44 4	1	10020	255					1/1 (100%)	10
•	01:20:30:71:01:19 3	3	10017	255					0/0 (0%)	0
•	01:20:30:71:01:22 3	3	10014	255					0/0 (0%)	0
•	01:20:30:71:01:26 3	3	10021	255					0/0 (0%)	0
•	01:20:30:71:01:29 3	3	10011	255					1/1 (100%)	10
•	01:20:30:71:01:08 2	2	10013	255					1/1 (100%)	10
•	01:20:30:71:01:11 2	2	10012	255					1/1 (100%)	10
•	01:20:30:71:01:12 2	2	10010	255					0/0 (0%)	0
•	01:20:30:71:01:18 2	2	10016	255					0/0 (0%)	0
•	01:20:30:71:01:01 1	L	10009	255					0/0 (0%)	0
•	01:20:30:71:01:02 1	L	10007	255					1/1 (100%)	10
•	01:20:30:71:01:03 1	L	10004	255					1/1 (100%)	10
•	01:20:30:71:01:06 1	L	10008	255					1/1 (100%)	10
•	01:20:30:71:00:15 0	)	10001	255					1/1 (100%)	10
•	01:20:30:71:00:47 0	)	10002	255					0/0 (0%)	0
•	01:20:30:71:00:89 0	)	10003	255					1/1 (100%)	10
odes: 27 Switches: 5										Reload Tr

This view shows the current status of the network inferred by the tool. It is automatically refreshed every time a change in the network is detected; for example, a new device is registered or promoted to switch. It is also possible to refresh this view with the Reload Tree button, which requests to the Base Node the list of registered nodes in order to rebuild the network structure. This is useful if network events were lost and thus the topology is not up-to-date.

This view displays the following information:

- Node State. A green dot is a terminal node and a yellow dot is a switch node
- MAC address
- SID (Switch Identifier)
- LNID (Local Node Identifier)
- LSID (Local Switch Identifier)
- fuState (Firmware Upgrade State)
- Firmware version
- Firmware vendor and model
- 4-32 Address
- ALV Rx/Tx (number of ALV messages received and transmitted)
- Coverage (moving average with the last three ALV messages)

There is a right-click menu in this view with further options, as shown in the following figure:

#### Figure 3-2. Right-Click Menu



#### 3.1 Info Request Dialog

This dialog allows requesting information from the Service Nodes by means of the Base Management Protocol.

Available information to be requested is firmware version, model and vendor, and firmware state. The firmware state is only returned when a firmware upgrade process is running. The responses will be shown in the rows of Figure 3-1.

The information can be requested to all registered nodes or just to selected nodes (multiple selection is enabled in Network Topology View).

#### Figure 3-3. Info Request Dialog

			01:20:30:71:00:90 0	10005	1	🔛 Info Request 🛛 🔗 💌
			01:20:30:71:01:07 1	10006	2	Info requested:
٠			01:20:30:71:01:21 3	10018	4	FW Version/Model/Vendor
⊿	٠		01:20:30:71:01:32 4	10024	5	
		•	01:20:30:71:01:45 5	10026	255	FU State
		•	01:20:30:71:01:47 5	10025	255	To:
		•	01:20:30:71:01:51 5	10027	255	Selected Nodes
	٠		01:20:30:71:01:30 4	10019	255	
	٠		01:20:30:71:01:42 4	10023	255	All Nodes
	٠		01:20:30:71:01:43 4	10022	255	01:20:30:71:01:47
	٠		01:20:30:71:01:44 4	10020	255	01:20:30:71:01:51
•			01:20:30:71:01:19 3	10017	255	01:20:30:71:01:30
•			01:20:30:71:01:22 3	10014	255	01:20:30:71:01:43
•			01:20:30:71:01:26 3	10021	255	
•			01:20:30:71:01:29 3	10011	255	
			01:20:30:71:01:08 2	10013	255	OK Cancel
			01-20-30-71-01-11 2	10012	255	

#### 3.2 Network Management Dialog

This dialog lets the user manage the network with functions Unregister, Promote, Demote and Reboot.



🔛 Network Mana 🍞 💌
Actions:
O Unregister
Promote
Demote
Reboot
To:
Selected Nodes
All Nodes
01:20:30:71:01:47 01:20:30:71:01:51
01:20:30:71:01:30 01:20:30:71:01:42
01:20:30:71:01:43
OK Cancel

#### 3.3 Firmware Upgrade Management Dialog

The available options in this dialog depend on whether or not a firmware upgrade process is running. When not running, nodes can be added to and removed from the list. When the process starts, the Remove option is disabled but the Abort option is enabled so that the upgrade process can be cancelled at any time. It is always possible to add nodes to the list.

#### Figure 3-5. Firmware Upgrade Management Dialog

🔣 FU Manageme 📪 💌
Action:
Add to FU list
Remove from FU list
Abort FU
To:
Selected Nodes
All Nodes
01:20:30:71:01:47
01:20:30:71:01:31
01:20:30:71:01:42
01:20:30:71:01:43
•
OK Cancel

This dialog only adds the nodes to the Firmware Upgrade, but the process does not start when the OK button is clicked. The next section describes how to start the Firmware Upgrade Process.

### 4. Base Management View

This view allows the configuration of the firmware upgrade parameters:

- **Delay Restart.** Number of seconds that a device must wait before performing a restart after receiving the new firmware
- **Safety Timer (in seconds).** If an upgraded node cannot register before this timer expires, it will return to the last firmware version
- File. File with the new firmware version
- **Match Rules.** When marked, the Base Node checks that vendor and model firmware of the Service Node match those of the new firmware. If they do not match, the Base Node will not upgrade this node
- Signature Type (PRIME 1.4 only): No signature, RSA3072+SHA256 or ECDSA256+SHA256
- Signature Size (PRIME 1.4 only): Size of the signature data that is appended to firmware binary file
- **Page size.** Size of the data packets sent through the PLC line. By default the AUTO option is 64 bytes
- ARQ. Enable or disable the ARQ protocol in the Base Node
- **Multicast.** Enable or disable PRIME multicast capabilities to transfer the firmware to a list of devices

ase Management	
Firmware Llograde	
Time Configurations	
Time Cornigurations	
Delay Restar	60 Safety Timer 21600
File Configuration	
Select File C:/	
	Match Rules Vendor Model
	Signature: No signature  Size: 0
	Page Size AUTO  ARQ Multicast
	Start Stop

Figure 4-1. Base Management View

If you already selected the devices to be upgraded in the Network Topology View (see section 3.3 Firmware Upgrade Management Dialog), click the Start button to start the firmware upgrade process. If not, go to select the devices.

To cancel a firmware upgrade process, use the Stop button or abort it from the Network Topology View (see section 3.3 Firmware Upgrade Management Dialog).

The upper text browser in Figure 4-1 shows real-time changes in topology (Network Events) and the stages of the firmware upgrade process.

#### 4.1 Signing Firmware

In order to test signed firmware upgrades, this tool provides a Python<sup>®</sup> script that will sign a binary using Microchip's test keys. The script and test keys are located at *{Install-dir}\signature-scripts*. ECDSA algorithm has been chosen to perform this test. Elliptic curve private and public keys are provided to sign and verify. Remote nodes performing the firmware upgrade must also know the public key to verify the signature. Also, remote nodes must know the ECC curve chosen. Microchip ECC test keys use the standard curve SECP256k1. The provided Python script will create a file concatenating the original file and its signature (coded in ASN.1 format). The signed file will have the same name with the extension "ECDSAxx.bin", where "xx" is the signature length. In a command line window, execute the command (or edit and execute the batch file provided):

```
C:\>cd "C:\Program Files (x86)\Atmel\Atmel PRIME Manager_2.0.8\signature-scripts"
C:\ ...s>c:\python34\python.exe prime-fw-sign.py -f C:\temp\prime_service_bin.bin \
-k ecc_secp_256k1_atmel_private.pem \
-p ecc_secp_256k1_atmel_public.pem
```

It is also possible to sign the firmware binary with your own keys (as long as Service Nodes know your public key) or use a different software. For example, follow the next steps to sign with OpenSSL:

1. Generate (if needed) ECC private key with OpenSSL using SECP256k1 curve (256 bits key):

openssl ecparam -out private\_key.pem -name secp256k1 -text -genkey

2. Generate ECC public key from private key (if needed). Service Nodes performing the signature verification must know this key and the curve used to generate it:

openssl ec -in private\_key.pem -pubout -text

3. Show ECC key parameters (curve, public/private):

openssl ec -in private\_key.pem -text

4. Calculate SHA256 digest for your firmware file:

openssl dgst -sha256 -binary -out hash\_sha256.md file.bin

5. Sign SHA256 digest with ECDSA:

openssl pkeyutl -sign -inkey private\_key.pem -in hash\_sha256.md  $\$  -out signature\_asn1.bin

6. Print binary data, concatenate input file and signature: (LINUX)

\$ cat signature\_asn1.bin | xxd \$ cat file.bin signature\_asn1.bin > prime\_fw\_sig.ECDSA.bin

#### (WINDOWS)

c: <> type file.bin signature\_asn1.bin > prime\_fw\_sig.ECDSA.bin

7. Find out the size of signature, parameter needed by the PRIME Manager (LINUX)

\$ls -l signature asn1.bin

#### (WINDOWS)

C:\> dir signature\_asn1.bin

## 5. **PRIME Management View**

This view has several tabs with different functionalities. As shown in Figure 5-1, there are several tabs:

- PLME/MLME PIBs. Get or set PIBs through PLME or MLME
- Serial Profile. Get or set PIBs through the Serial Profile
- MAC. Send and receive messages through null convergence sublayer
- 4-32. Send and receive messages through IEC-432 convergence sublayer
- PLME. PHY Layer Management Entity functions
- MLME. MAC Layer Management Entity functions
- Certification. PIB management for certification
- Manufacturing (MTP) Test. PIB management for manufacturing test
- **PRIME over UDP.** PRIME "Ticket 65" interface through PRIME Manager

Note that each tab has its own text browser to show its corresponding protocol information. Messages can appear on a text browser even if its tab is not selected, e.g. when a 4-32 message is received but another tab is selected.

The following subsections describe each tab in detail.

#### 5.1 PLME/MLME PIBs

This tab allows getting or setting a PIB from the connected device through PLME (for PIBs belonging to the PHY layer) or MLME (for PIBs belonging to the MAC layer). Figure 5-1 shows the tab appearance.

Note: The device's firmware must support this feature. Base/Service Node's firmware must be configured to support MLME/PLME serialization. Otherwise, commands executed from this window will not have any effect.

Figure 5-1. PLME/MLM	ME PIBs Tab
----------------------	-------------

The PIB is selected from the combo box.

Clicking the Get PIB button, a message similar to the one in Figure 5-1 appears in the text browser showing the result. The PIB value is displayed both in hexadecimal and decimal base (only for PIB attributes up to 32 bits).

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In order to set a PIB, write the value and then click the Set PIB button. The comment below the line edit shows the length of the PIB selected. The new value must be coherent with such length, but if such new value is out of the range, the tool will inform in the text browser. If the length is 1, 2 or 4 bytes, the value must be given in decimal base, otherwise hexadecimal (with 0x...) base must be used.

#### 5.2 Serial Profile

This tab allows getting or setting a PIB from the connected device through the Serial Profile. The Figure 5-2 shows the tab appearance. The list of PIBs is the same as in PLME/MLME PIBs.

For PIB management, this tab is used like the previous one. Apart from that, it is also possible to send *reset statistics* and *reboot* commands to the connected device.

Figure 5-2. Serial Profile Tab

	Cardal Das file									
PLME/MLME PIBs	Serial Profile	PRIME Profile	4-32	MAC	MLME	PLME	Certification	MTP	Prime Over UDP	
macVersion (0x0001	)	•	Get PIB							RESET
0 🌲 🛛 Set PII	3									REBOOT
1 byte										
07-06-2016 13:25:5 pib	8.534 [MNGP_G _attrib=0x0001	ET_RSP] received								
pib	_value=0x01(1	)								
pib	_value=0x01(1	Л								
pib,	_value=0x01(1	JI								
pib.	_value=0x01(1	I								

#### 5.3 PRIME Profile

This tab allows getting or setting PIBs to remote nodes through PLC's PRIME Profile. Also, it allows sending a remote Reset (of statistics) and reboot signal to a registered node.

Figure 5-3. PRIME Profile Tab



#### 5.4 MAC

This tab allows sending messages through null convergence sublayer. It is the interface with MAC primitives (see PRIME specification). Such primitives are:

- Establish. Send establish request or respond to an establish indication
- Release. Send release request or respond to a release indication
- Join. Send join request or respond to a join indication
- Leave. Send leave request
- Data. Send data request

Functionalities are dynamically enabled/disabled with received/sent commands, e.g. when a connection is opened, it will be possible to close the connection (release/leave) or send a message through the corresponding connection handler.

Figure	5-4.	MAC	Tab
--------	------	-----	-----

RIME Management
PLME/MLME PIBs Serial Profile PRIME Profile 4-32 MAC MLME PLME Certification MTP Prime Over UDP
Binary data
REQUEST
EUI48: 00:00:00:00:00 Type: 0 🚔 data: Num Chars: 0 🗐 ARQ cfbytes: 0 🖨 Request
RESPONSE
Handle: Answer: ACCEPT Data: Num Chars: 0 Response
MAC_RELEASE
Handle: Request Handle: ACCEPT T
MAC 10TN
REQUEST
Multicast         Handle:         0         EUI48:         00:00:00:00:00         Type:         0         Data:         # chars:         0         Request
RESPONSE
Handle: EUI48: 00:00:00:00:00 Answer: ACCEPT  Response
MAC_LEAVE
con_handle: v EUI48: 00:00:00:00:00:00 Request
MAC_DATA
con_handle: v data: Num Chars: 0 prio: 0 定 Request

#### 5.5 4-32

This tab allows sending messages through the IEC-432 convergence sublayer. The Service Node can connect, disconnect and send messages to the Base Node. Figure 5-5 shows the appearance of this tab.

When the option Binary format (DATA) is marked, the messages must be introduced in hexadecimal format, otherwise ASCII format is used. The received messages are also shown in such format.

Furthermore, if the option Ping – Pong is marked, a message is automatically sent whenever a message is received. Thus, if an instance of the PRIME Manager (version 1.x.x or later) is connected to a Base

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Node, another one is connected to a Service Node and Ping - Pong is marked in both, the Base and the Service Node will be continually sending messages to each other.

Base Node tab also permits enabling the DLMS over TCP protocol. This allows a remote concentrator to connect the PRIME Manager/Base Node and gather DMLS/COSEM data directly from the service nodes that implement such layer. When enabled, PRIME Manager opens a TCP server in port 4059 and waits for a connection from a remote concentrator. Only one remote connection is allowed.

Figure 5-5. 4-32 Tab for a Base Node

PR	IME Management										X
ļ	PLME/MLME PIBs	Serial Profile	PRIME Profile	4-32	MAC	MLME	PLME	Certification	MTP	Prime Over UDP	Prime Debug
	Broadcast 💌	Ping - Po	ong 📃 E	Binary form	mat (DATA	)		Enable DLMSoTC	P DLMS	GoTCP port: 4059	
						Num	Chars: 0	Send			
	15-09-2016 09:42: 15-09-2016 09:43: ds sru ds sru ds	53.385 [CL432_J :13.583 [CL432_I :1.sap: 1 c_lsap: 16 :t_address: 0 c_address: 1004	IOIN_INDICATE] S DL_DATA_indication	erial#: AT n] 20 byte	MService( s received	)1 Address d	:: 1004 MA	C: 01:02:03:00:0	0:04		
		12:001020304	10101000000010101	01020304	03060760	17					

Figure 5-6. 4-32 Tab for a Service Node

PLME/MLME PIBs	Serial Profile	4-32	MLME	Certification	MFG Test			
Disconnect	Ping-Po	ng	🕅 Bin	ary format (DATA	0			
abcdefgh					Num	Chars: 8	Send	
27-03-2014 13:22	:04.201 [CL432_	RELEASE_	request] s	ent				-
27-03-2014 13:22	:29.364 [CL432_	RELEASE	confirm] re	eceived				
27-03-2014 13:22	:50.751 [CL432_6	ESTABLISH	-request	sent				
27-03-2014 13:23	20 005 [DI 432 1	DATA DEC	LIEST1 8 h	received				E
27-03-2014 13:23	:30, 160 [DL 432 ]	DATA CO	NEIRM] SU	ccess in message	to base			
27-03-2014 13:24	:02.069 [DL432 ]	DATA IND	ICATION]	10 bytes receive	d from base:			
	122456790							

#### 5.6 PLME

This tab is the interface with PHY Layer Management Entity primitives (see PRIME specification). Such primitives are:

- **Reset.** Reset PHY layer
- Sleep. Sleep PHY layer. The node will not be able to transmit/receive packets

• **Resume.** Wake up PHY layer

#### Figure 5-7. PLME Tab

PRIME Management
PLME/MLME PIBs     Serial Profile     MAC     4-32     PLME     MLME     Certification     MFG Test       PLME_RESET_REQUEST     PLME_SLEEP_REQUEST     PLME_RESUME_REQUEST     PLME_RESUME_REQUEST
19-02-2015 17:41:07.173 PLME_RESET_request sent 19-02-2015 17:41:07.313 [prime_d_null_plme_reset_confirm] Result=0 (PLME_RESULT_SUCCESS) 19-02-2015 17:41:08.021 PLME_SLEEP_request sent 19-02-2015 17:41:08.178 [prime_d_null_plme_sleep_confirm] Result=0 (PLME_RESULT_SUCCESS) 19-02-2015 17:41:08.429 PLME_RESUME_request sent 19-02-2015 17:41:08.504 [prime_d_null_plme_resume_confirm] Result=0 (PLME_RESULT_SUCCESS)

#### 5.7 MLME

This tab allows sending MLME commands. The commands are different depending on the connected device.

Available commands for the Base Node are:

- **Promote.** Promote a terminal node to switch. The Base Node sends the command to the selected Service Node
- **Demote.** Demote a switch node to terminal. The Base Node sends the command to the selected Service Node
- **Unregister.** Unregister a registered node. The Base Node sends the command to the selected Service Node

# Info: Note that these commands in the Base Node are also available in the Network Topology View (see section 3.2 Network Management Dialog).

Available commands for the Service Node are:

- Promote. Promote the connected node to switch
- **Demote.** Demote the connected node to Terminal state
- **Unregister.** Unregister the connected node

Additionally, there is a common command – Reset MLME – to reset the MAC of the connected device.

Figure 5-8 and Figure 5-9 show the appearance of this tab for a Base Node and a Service Node, respectively.

Figure 5-8. MLME Tab for a Base No
------------------------------------

PLME/MLME PIBs	Serial Profile	PRIME Profile	4-32	MAC	MLME	PLME	Certification	MTP	Prime Over UDP
			Unregist	er Node					
Registered N	lodes: 01:02:	03:00:00:01 👻	Promote	e Node					
			Demote	Node					
		RESET MLM	E						
15-09-2016 09:46 15-09-2016 09:46 15-09-2016 09:46 15-09-2016 09:46 15-09-2016 09:46 15-09-2016 09:46	21.843 [MAC_AC 22.125 [prime_d 23.507 MLME Re 23.573 [prime_d 27.307 [MAC_AC 27.309 [MSGTYP	TION_DEMOTE] f _null_mime_set_or quest: MSGTYPE_ _null_mime_promo TION_UNREGISTI E_CL_NULL_MLME	for node 0 onfirm] Re CL_NULL_ ote_confin ERBN] for E_UNREGI	x0102030 sult=0 (M MLME_PR m] Result node 0x0 STER_REC	000009 sen ILME_RESU OMOTE_RI = 10 (MLME 102030000 2] sent	t ILT_DONE) EQ sent _RESULT_ 001 sent	REDUNDANT)		

Figure 5-9. MLME Tab for a Service Node

ne management					-				
LME/MLME PIBs	Serial Profile	MAC 4-3	2 PLME	MLME	Certification	MTP	Prime Over UDP	Prime Debug	
SNA: 00:00:	00:00:00:00	SID:	A R	EGISTER					
	(0) -	OMOTE							
DCIN_MODE_NULL		UMUTE							
UNREGISTER	DEMOTE	SET MLME							
19-04-2018 09:10 S	0:06.758 [MLME_RE	GISTER_indica	tion]						
S	ID=0	ouorr is to	P1						
19-04-2018 09:10	1:30.057 [MLME_PH	COMOTE_INDICa	tionj						

#### 5.8 Certification

This tab is used to help during the certification process. The PIB handling could be done in the PIB management tabs but in this tab only certification-related PIBs are handled. The following options are available:

- Set Cert Mode. PIB *mngCertMode* (0x8120) is set to the mode selected in the combo box (IDLE, PHY v1.3.6, MAC or PHY v1.4)
- Start Transmission. Transmit the required number of PHY Test Case type PPDU messages with the selected modulation scheme, signal attenuation and duty cycle (PIB *phyCertTx*, 0x8121). It is required to set PHY mode before
- **Run AppEmu.** Starts/Stops the AppEmu application as defined in the PRIME Certification Test Cases documents

• Enable Serial Profile Bridge/Port. This check box enables a TCP server (in the selected port) to which the Certification Tool will connect using Management Plane Interface commands

Note: Serial Profile Bridge/Port option is designed to allow external certification tools to communicate with Base/Service Nodes under test. While this option is enabled, do not use PRIME Manager to perform any task as it may interfere with any external tests.

PRIME Management	X
PLME/MLME PIBs Serial Profile PRIME Profile 4-32 MAC MLME PLME Certification MTP Prime Over UDP	
IDLE 🔻 Set Cert Mode 🗌 Run AppEmu 🕼 Enable Serial Profile Bridge Port: 8000 Current Certifica	ation state: Unknown
#msg: 2000 🚔 Att (dB): 0 🚔 Duty: 50 🚔 Modulation: DBPSK 🔻	Start Transmission
07-06-2016 13:47:28.759 [MNGP_SET_REQUEST] sent pib_attrib=0x8120 pib_value=0x01 07-06-2016 13:47:41.768 [MNGP_SET_REQUEST] sent	
pib_attrib=0x8120 pib_value=0x00 07-05-2015 128-475 1-08 PTUREOUT_NNCPI No response received	
07-06-2016 13:48:00.330 [CertBridge] Certification Bridge App initialized.	

Figure 5-10. Certification Tab

### 5.9 Manufacturing (MTP) Test

This tab can be used for manufacturing tests. The following options are available:

- Enable/Disable. Enable/disable the MTP mode (*phyMtpEnabled*, 0x808E)
- Get/Set MAC. Get and set the MAC address of the connected device
- Get/Set SNA. Get and set SNA
- · Get version and ID information. Get SW versions, product ID and vendor ID
- Get/Set PHY parameters. Get and set Tx Channel, Load Thresholds and Impedance Branch
- **Transmission Test.** Set PIB *phyTxParams* (0x8089) according to the selected parameters. Len (bytes) is the length of the payload. If random is 0, the content of packets is fixed, otherwise the content is random (the lower the value, the more random is the message)
- Get Stats. Get PHY stats. Mean RMS calc retrieves 0 if transmission test is running

#### Note: Set operations are only allowed when MTP mode is enabled.

							,		
PLME/MLME PIBs Seria	Profile	PRIME Profile	4-32	MAC	MLME	PLME	Certification	MTP	Prime Over UDP
Enable Disabl	e								
MAC		Vendor ID			PHY	SW versior	1	Tx C	hannel
Get Set		Get				Get			Get
01:02:03:00:00:00	_	ID:	,		Versi	op: 0x230	00204	1	Set
01.02.00.00.00.00						011. 07200	00201		V OCC
SNA		Product ID			MAC	SW versio	n	Load	Thresholds
Get Set	]	Get	]			Get		Thre	eshold 1 🔻 Get
01:02:03:00:00:00		ID: 0x3730			Versi	on: 0x501	40101	390	D 💌 Set
		FW version			432 9	SW version	1	Impe	dance Branch
		Get	]			Get			Get
		Version: 01.	03.10.00	1	Versi	on: 0x501	40101	Auto	o 🔻 Set
Transmission Test Modulation: DBPSK	Att (dB):	0 🚔 Len (by	tes): 16	🗧 Inte	erval (ms):	100	Random: 0	Num	Msgs: 40 🚖 Start Tx
Stats									
Get Tx Time	Get R	x Params	G	et Rx Tot	al Count		Get Instant RM	4S Calc	Get Mean RMS Calc
pib_attrib pib_value 15-09-2016 09:58:05.981 pib_attrib	=0x8003 =0x0f3c (3 [MNGP_GE =0x8301	900) T_confirm]							A

#### Figure 5-11. MTP Tab

# 5.10 PRIME over UDP (PRIME 1.3 only)

This tab window allows to start/stop the PRIME over UDP gateway through the PRIME Manager. It is enabled for both Base and Service node as both could perform as a slave UDP device. The Default IP Address corresponds to a multicast IP address, allowing multiple slave devices to communicate with a master concentrator node.

Figure 5-12. PRIME over UDP Tab

PRIME Management					
PLME/MLME PIBs Serial Profile	PRIME Profile 4	H-32 MAC MLME	PLME	Certification MTP Prime Over UDP	
Enable Prime Over Udp	IP Address:	224.0.0.1	Port:	7919	

## 6. Sniffer Window

This window uses the same sniffer widgets (used in PLC Sniffer). That way, it is possible to use all the functionalities of PRIME Manager and at the same time, monitorize the PLC packets with the sniffer, all using the same COM port.

View																	
Packet View			8	-												Nod	es/Switches Plot
			1	00	(н1 т												
Field	Value	leit		Idframe	TimeSterne	Madulation	Simboli	65.00	0.010		Channel	Duration	Date CD	Lin Down	Ind	-	-
Packet #	30	DRESK CC 1/2		1001000	2014-04-1	LIDERSA C.L	2 Symbols	2 Print	24	130	v	11	010 1	LOWN	U		200 j
Symbol #	2	and an one aya		139	2014-04-1	DBPSK CC	2	7	59	136	0	11	618 1	Down	0		17.5
Timestamp	2014-04-15T16:27-56	)		1.00	2014-04-1	Depay or	-	-	50	126			619 1	Denne	0		
SNR	7	PRIME SNR				Der all com		1		1.50				-			15
Extended SNR	59	dB	-	141	2014-04-1	DBPSK CC	2	7	59	136	0	11	618, 1	Down	0		
Time ML END	0-83555000	0-82834000		142	2014-04-1	DBPSK CC	2	7	59	136	0	11	618, 1	Down	0	-	12,5
Duration	11	ms		143	2014-04-1	DBPSK CC	2	7	59	136	0	11	618, 1	Down	0	3	
Delta	618.24	mi		144	2014-04-1	DBPSK CC	2	7	59	136	0	11	168,8 1	Down	0	1	10
RSSI	136	dBuV		145	2014-04-1	DRESK CC	2	6	20	83	0	11	23 37 1	Down	1		E E
Direction	1	DOWNLINK		4.45		DODAY CC			47				177 4				7,5
* Pdu Type	BEACON			140	2014-04-1	DBPSK CC	2	1	1/	85	0	11	135, 1	Up	0		
Count	3			147	2014-04-1	DBPSK CC	2	7	59	136	0	11	290, 1	Down	0		
Position	0			148	2014-04-1	DBPSK CC	2	7	59	136	0	11	618, 1	Down	0		
CFP	0		-	149	2014-04-1	DBPSK CC	2	7	59	136	0	11	618, 1	Down	0		Connected Nodes
	33			150	2014-04-1	DBPSK CC	2	7	59	136	0	11	618 1	Down	0		a ferritori and and and and and
Packet View Hex	a Wew			151	2014-04-1	DEDKKCC	-	-	50	136			619 1	Denne	0		0 8 16 24 32 40 48 56
Column Settings			8			DOPOR COLL		2			ž			Down	č.		time (s)
				132	2014-04-1	DBPSK CC	2	0	13	85			22,52 1	Down	1		5
Show idFrame				153	2014-04-1	DBPSK CC	2	7	59	136	0	11	595, 1	Down	0		
Show SyncTime				154	2014-04-1	DBPSK CC	2	7	59	136	0	11	618, 1	Down	0		
Show TimeStam	p			155	2014-04-1	DBPSK CC	2	7	59	136	0	11	618, 1	Down	0		4
Show Modulatio	n			156	2014-04-1	DBPSK CC	2	7	59	136	0	11	618 1	Down	0		
Show Symbols				157	2014-04-1	DRESK CC	,	7	50	136	0	11	618 1	Down	0		
Change SAR				150	2014 04 1	DODGY CC		÷.					c10 1	D		1	3
Chose ExCMD				130	2014-04-1	DBPSK CC	2	<u> </u>	20	130			010, 1	Down		3	<u>i</u> t
C Show Exsien				159	2014-04-1	DBPSK CC	2	7	59	136	0	11	618, 1	Down	0	1	5
Show RSSI				160	2014-04-1	DBPSK CC	2	7	59	136	0	11	618, 1	Down	0	1	
Show Channel				161	2014-04-1	DBPSK CC	2	7	59	136	0	11	618, 1	Down	0	. 2	2-,
Show TimeIni				162	2014-04-1	DBPSK CC	2	7	59	136	0	11	618 1	Down	0		
Show TimeEnd				163	2014-04-1	DRESK CC	2	7	60	136	0	11	618 1	Down	0		
Show Duration				1.5.4	2014 04 4	DODGH CC		-	10				C10 4	0		1	
Show Delta				104	2014-04-1	DBPSK CC	2	1	20	130		11	010, 1	Down	u		Number of switches
Show CBC En.				165	2014-04-1	DBPSK CC	2	1	20	136	0	11	618, 1	Down	0		
C Charle Course				166	2014-04-1	DBPSK CC	2	7	59	136	0	11	618, 1	Down	0	-	0 8 16 24 32 40 48 56
C and 070000			-	+			12								P		Time (s)

Figure 6-1. Sniffer Window

At the beginning, the sniffer table view is shown. Such view shows the PLC packets in real time.

Furthermore, more widgets can be selected to be shown in the view menu:

- Packet View: The selected packet in the table is decoded
- Hexa View: The selected packet in the table is shown in hexadecimal, byte by byte
- Column Settings: Additional columns can be selected to be shown
- Nodes/Switches plot: Shows the number of nodes and switches as a function of the time

For more information, see the PLC Sniffer documentation.

Note: The device's firmware must have the embedded sniffer option enabled. Otherwise, no frames will be shown.

# 7. Revision History

**Note:** Revisions 7.1-7.3 (Rev A-C) refer to Atmel document number 43089. With the 06/2018 revision, the document was converted to the Microchip format and assigned DS number 50002766, beginning with Rev A.

#### 7.1 Rev A - 02/2015

Document	Initial release.	

#### 7.2 Rev B - 01/2016

Document	Updated for software release v2.0.7.
Document	Updated for software release v2.0.7.

#### 7.3 Rev C - 09/2016

Document	Updated for software release v2.0.8. (Firmware versions: 1.3.9.x SN, 1.3.10.x BN, 1.4.2.1 SN and BS).
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#### 7.4 Microchip Rev A - 06/2018

Document	<ul> <li>Updated to new Microchip document number DS50002766.</li> <li>Updated for software release v2.1.0.</li> </ul>
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