Cambium
PTP 600 Series Point to Point Wireless Ethernet Bridges
FIPS 140-2 Security Policy
System Release 600-10-07-FIPS
CONTENTS

1 Introduction ............................................................................................................................ 5
  1.1 Purpose ............................................................................................................................. 5
  1.2 Anti Tamper Label Placement ......................................................................................... 6
  1.3 Port Identification ............................................................................................................ 8
  1.4 The PTP 600 Series .......................................................................................................... 8
  1.5 References ...................................................................................................................... 11
  1.6 Acronyms ........................................................................................................................ 12

2 Security Level ....................................................................................................................... 12

3 Mode of Operation ................................................................................................................ 13
  3.1 Prerequisites for the Approved Mode of Operation ...................................................... 13
  3.2 Configuring the Approved Mode of Operation .............................................................. 14
  3.3 Checking that the unit is in the Approved Mode of Operation ..................................... 16
  3.4 Approved and non-approved modes of operation ......................................................... 16

4 Ports and Interfaces .............................................................................................................. 18

5 Identification and Authentication Policy .............................................................................. 19

6 Access Control Policy ............................................................................................................ 19
  6.1 Authentication Strength ................................................................................................ 19
  6.2 Roles and Services ......................................................................................................... 20
  6.3 Unauthenticated Services ............................................................................................. 22
  6.4 Service I/O Specification .............................................................................................. 23
  6.5 Definition of Critical Security Parameters .................................................................... 24
  6.6 CSP Encrypted by Key of Keys ...................................................................................... 26
  6.7 Definition of Public Keys .............................................................................................. 26
  6.8 Definition of CSP Modes of Access ............................................................................. 27
  6.9 CSP Access Rights within Roles and Services .............................................................. 27

7 Operational environment ...................................................................................................... 27

8 Security Rules ..................................................................................................................... 27
  8.1 Self Tests ........................................................................................................................ 27
  8.2 Firmware Self Tests ..................................................................................................... 28
8.3 FIPS Integrity Test Error Indicators ................................................................. 28
9 Identification of FIPS Mode of Operation ........................................................... 28
10 Physical Security Policy ...................................................................................... 28
  10.1 FIPS Boundary and Frequency Variants ...................................................... 29
11 Mitigation of Other Attacks Policy .................................................................... 29

TABLES
Table 1 – The Cambium Networks PTP 600 Series .................................................. 9
Table 2 – Module Security Level Specification ....................................................... 12
Table 3 – FIPS approved and allowed algorithms .................................................. 17
Table 4 – Management protocols in FIPS mode ..................................................... 17
Table 5 – Ports and interfaces ................................................................................ 18
Table 6 – Roles and authentication ....................................................................... 19
Table 7 – Role-based services and CSP access ...................................................... 21
Table 8 – Authenticated services ......................................................................... 22
Table 9 – Unauthenticated services ....................................................................... 22
Table 10 – Specification of service inputs and outputs ......................................... 23

FIGURES
Figure 1 – PTP 600 Wireless Units ....................................................................... 6
Figure 2 – Anti-tamper label placement ................................................................. 6
Figure 3 – Port identification ................................................................................ 8
Figure 4 – Connectorized PTP 600 Unit ................................................................. 10
Figure 5 – Integrated PTP 600 Unit ..................................................................... 11
Figure 6 – Indication of FIPS 140-2 capability ..................................................... 13
1 INTRODUCTION

1.1 Purpose

This non-proprietary document describes the security policy for Cambium Networks PTP 600 Series Point to Point Wireless Ethernet Bridges.

The Cambium Networks PTP 600 Series (hereafter the PTP 600 or PTP 600 Series) devices are multi-chip standalone cryptographic modules encased in hard opaque commercial grade metal cases. Operating in the 2.5, 4.5, 4.8, 4.9, 5.5 and 5.9 GHz frequency bands at Ethernet data rates up to 300 Mbps, the systems are designed for virtually any environment – non-line-of-sight, line-of-sight, and high interference – where high throughput is a major requirement and/or single or dual T1/E1 capability is needed.

Through Cambium Network’s unique combination of technologies, PTP 600 Series solutions enhance link performance in a variety of applications, including T1 replacement, Voice-over-IP, video surveillance, distance learning, telemedicine, and high-speed backhaul.

The cryptographic boundary of the wireless unit is the unit’s external casing. There are two product variants that have a different casing arrangement. Firstly the Integrated wireless units as the name suggests has an integrated RF antenna. The second product variant is named the Connectorized product variant which is identical to the Integrated product except the antenna is replaced by a metal plate with two ‘N’ type RF connectors. For the purposes of FIPS Approval the integrated antenna is excluded from the cryptographic boundary.

The purpose of this security policy is to validate the Cambium PTP 600 Series (HW P/Ns BP5830BHC, BP5830BHC15, BP5530BHC, BP5530BHC15, WB2781, WB3039, WB3037, WB3092, WB3094, WB3387, WB3389, WB3222, BP5830BH, BP5830BH15, BP5530BH, BP5530BH15, WB2780, WB3036, WB3038, WB3091, WB3093, WB3386, WB3388, WB3221, WB3760, WB3761, WB3762, WB3763, WB3776, WB3777, WB3778, and WB3779 with Firmware Versions PTP600-10-00-FIPS, PTP600-10-05-FIPS and PTP600-10-07-FIPS submitted for FIPS 140-2 Level 2 validation.
Figure 1 – PTP 600 Wireless Units

Integrated  

Connectorized  

1.2 Anti Tamper Label Placement

Figure 2 – Anti-tamper label placement

Connectorized PTP 600 Unit (2 Labels Wrapping around Enclosure Edge)
Note: The two anti-tamper labels on the Integrated module are affixed around the edge of the cover so that they make contact with both metal surfaces.

The anti-tamper labels must be installed for the module to operate in a FIPS Approved mode of operation.

The module is delivered to the operator with the anti-tamper labels applied. A hardware security upgrade kit containing additional anti-tamper labels may be obtained from Cambium Networks. The hardware security upgrade kit is P/N WB3593.

The Crypto-Officer is the role responsible for:

- Securing and controlling any unused anti-tamper labels.
- Controlling and observing module reconfigurations (i.e., firmware updates) during which the anti-tamper labels would be removed and reinstalled to verify that the module remains secure during such updates and that it is returned to the FIPS Approved mode after the updates are complete.

Before the anti-tamper labels can be replaced, the module surface must be prepared using the following procedure:

All positions where labels are to be placed must be cleaned with a cloth wetted with Isopropyl Alcohol (IPA)\(^1\) before the labels can placed.

\(^1\) IPA is a solvent/cleaner.
The glued side of the label must not be touched during the label placement. If it is inevitable, tweezer must be used for handling.

Cambium recommends that the operator inspects the integrity of the anti-tamper labels a minimum of every 30 days.

**1.3 Port Identification**

**Figure 3 – Port identification**

The module ports are as follows:

- **E1/T1**: RJ45 socket for optional E1 or T1 network connection.
- **AUX**: Auxiliary RJ45 socket for out-of-band management interface (Management Port) or GPS connection (Sync Port).
- **FIBER**: Fiber optic socket for optional network connection. Subsequently referred to as the Fiber Data Port.
- **PIDU+**: RJ45 socket for connecting to power supply and network via the PIDU Plus. Referred to as the Copper Data Port.

**1.4 The PTP 600 Series**

The product family consists of integrated (RF antenna built in) and connectorized (RF connectors to external antennas) variants. In addition each product variant can be purchased as a sub-variant of full or lite (when the full version offers 50% more Ethernet throughput for the same RF propagation conditions. And finally the PTP 600 can be purchased in the following frequency variants: 2.5, 4.5, 4.8, 4.9, 5.4, 5.5, 5.8 and 5.9 GHz. Table 1 lists the frequency ranges supported by each PTP 600 module.
## Table 1 – The Cambium Networks PTP 600 Series

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Integrated / Connectorized</th>
<th>Product Variant</th>
<th>HW Part Number</th>
<th>Frequency Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Full</td>
<td>BP5830BH</td>
<td>5725 5850</td>
</tr>
<tr>
<td>PTP58600</td>
<td>Integrated</td>
<td>Lite</td>
<td>BP5830BH15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>OOBM</td>
<td>WB3760</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ATEX/HAZLOC</td>
<td>WB3776</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connectorized</td>
<td>Full</td>
<td>BP5830BHC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lite</td>
<td>BP5830BHC15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>OOBM</td>
<td>WB3761</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ATEX/HAZLOC</td>
<td>WB3777</td>
<td></td>
</tr>
<tr>
<td>PTP54600</td>
<td>Integrated</td>
<td>Full</td>
<td>BP5530BH</td>
<td>5470 5725</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lite</td>
<td>BP5530BH15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>OOBM</td>
<td>WB3762</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ATEX/HAZLOC</td>
<td>WB3778</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connectorized</td>
<td>Full</td>
<td>BP5530BHC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lite</td>
<td>BP5530BHC15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>OOBM</td>
<td>WB3763</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ATEX/HAZLOC</td>
<td>WB3779</td>
<td></td>
</tr>
<tr>
<td>PTP25600</td>
<td>Integrated</td>
<td>Full</td>
<td>WB2780</td>
<td>2496 2690</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connectorized</td>
<td>WB2781</td>
<td></td>
</tr>
<tr>
<td>PTP45600</td>
<td>Integrated</td>
<td>Full</td>
<td>WB3036</td>
<td>4400 4600</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lite</td>
<td>WB3038</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connectorized</td>
<td>Full</td>
<td>WB3037</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lite</td>
<td>WB3039</td>
<td></td>
</tr>
<tr>
<td>Product Name</td>
<td>Integrated / Connectorized</td>
<td>Product Variant</td>
<td>HW Part Number</td>
<td>Frequency Range</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------</td>
<td>-----------------</td>
<td>----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bottom (MHz)</td>
</tr>
<tr>
<td>PTP48600</td>
<td>Integrated</td>
<td>Full</td>
<td>WB3386</td>
<td>4700</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lite</td>
<td>WB3388</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connectorized</td>
<td>Full</td>
<td>WB3387</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lite</td>
<td>WB3389</td>
<td></td>
</tr>
<tr>
<td>PTP49600</td>
<td>Integrated</td>
<td>Full</td>
<td>WB3221</td>
<td>4900</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connectorized</td>
<td>Full</td>
<td>WB3222</td>
<td></td>
</tr>
<tr>
<td>PTP59600</td>
<td>Integrated</td>
<td>Full</td>
<td>WB3091</td>
<td>5825</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lite</td>
<td>WB3093</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connectorized</td>
<td>Full</td>
<td>WB3092</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lite</td>
<td>WB3094</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 4 – Connectorized PTP 600 Unit**
Figure 5 – Integrated PTP 600 Unit

1.5 References

(a) FIPS PUB 186-2, Federal Information Processing Standards Publication 186-2, Feb 2000.


(d) FIPS PUB 197, Federal Information Processing Standards Publication 192, 26th November 2001.

(e) DSAVS, Digital Signature Algorithm Validation Suite, 10th March 2004.

(f) PTP 600 Series User Guide. phn-0896 007v001, Monday 30th June 2008

(g) X.680, ASN.1 Encoding Rules: specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER), (07/02)

(h) PKCS #8: Private-Key Information Syntax Standard, Version 1.2, November 1, 1993

(i) PKCS #1: Public Key Cryptography Standards (PKCS), Version 2.1, June 14 2001


1.6 Acronyms

CA  Certification Authority  
CO  Cryptographic Officer  
CSP  Critical Security Parameter  
DER  Distinguished Encoding Rules  
DES  Data Encryption Standard  
DSA  Digital Signature Algorithm  
FIPS  Federal Information Processing Standard  
HMAC  Hashed Message Authentication Code  
KAT  Known Answer Test  
PTP  Point to Point  
SA  System Administrator  
SNMP  Simple Network Management Protocol  
TLS  Transport Layer Security  

2 SECURITY LEVEL

The cryptographic module meets the overall requirements applicable to Level 2 security of FIPS 140-2.

Table 2 – Module Security Level Specification

<table>
<thead>
<tr>
<th>Security Requirements Section</th>
<th>FIPS 140-2 Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cryptographic Module Specification</td>
<td>3</td>
</tr>
<tr>
<td>Module Ports and Interfaces</td>
<td>2</td>
</tr>
<tr>
<td>Roles, Services and Authentication</td>
<td>3</td>
</tr>
<tr>
<td>Finite State Model</td>
<td>2</td>
</tr>
<tr>
<td>Physical Security</td>
<td>2</td>
</tr>
<tr>
<td>Operational Environment</td>
<td>N/A</td>
</tr>
<tr>
<td>Cryptographic Key Management</td>
<td>2</td>
</tr>
</tbody>
</table>
Security Policy

Security Requirements Section | FIPS 140-2 Level
--- | ---
EMI/EMC | 2
Self-Tests | 2
Design Assurance | 3
Mitigation of Other Attacks | N/A

3 MODE OF OPERATION

3.1 Prerequisites for the Approved Mode of Operation

A user can verify that the wireless unit is capable of operating in FIPS mode by visually inspecting any management webpage and looking for the FIPS logo:

Figure 6 – Indication of FIPS 140-2 capability

The FIPS logo on its own is not an indicator of correct FIPS configuration. The logo is present when the operator has a correct hardware, software and license line-up to allow FIPS mode. The operator must follow the procedure outlined in Section 3.2 to enter approved mode. When in approved mode, the FIPS logo will be displayed and the alarm that is used to indicate incorrect configuration will not be asserted.

If the FIPS logo is not displayed, proceed as follows:

(a) Check that the hardware is capable of supporting FIPS 140-2. This includes checking the silver tamper-evident labels, the hardware platform part number and the hardware version.

(b) If the hardware does not support FIPS 140-2, apply the hardware security upgrade kit.
(c) Check the capability summary in the Software License Key page to ensure that the current license key supports AES and FIPS 140-2. If necessary, obtain an access key and generate a new license key.

(d) Check the installed software version in the System Status page to ensure that the software image is FIPS validated. If necessary, upgrade to the latest FIPS validated image.

3.2 Configuring the Approved Mode of Operation

If the FIPS logo is displayed, the approved mode of operation can be configured using the Security Configuration Wizard.

3.2.1 Obtaining cryptographic material

Before starting the Security Configuration Wizard, ensure that the following cryptographic material has been generated using a FIPS-approved cryptographic generator:

- Key Of Keys
- TLS Private Key and Public Certificates
- Entropy Input
- Wireless Link Encryption Key for AES

3.2.2 Starting Security Configuration Wizard

To start the wizard, proceed as follows:

(a) Select menu option Security. The Security Configuration Wizard page is displayed.

(b) Review the summary of HTTPS/TLS security related parameters.

(c) If any updates are required, select Continue to Security Wizard.

3.2.3 Step 1: Enter key of keys

To enter the Key Of Keys via the Security Wizard, proceed as follows:

(a) The Step 1: Enter Key of Keys page is displayed.

(b) Enter the generated key of keys in both the Key Of Keys and Confirm Key Of Keys fields.

(c) Select Next.

3.2.4 Step 2: TLS private key and public certificate

To enter the TLS Private Key and Public Certificate via the Security Wizard, proceed as follows:

(a) The Step 2: TLS Private Key and Public Certificate page is displayed.
(b) If a valid TLS private key exists, then an SHA-256 thumbprint of the key is displayed. If this key is correct, then take no action. Otherwise, select **Browse** and select the generated private key file (.der).

(c) If a valid TLS public certificate exists, then an SHA-256 thumbprint of the certificate is displayed. If this certificate is correct, then take no action. Otherwise, select **Browse** and select the generated certificate file (.der).

(d) Select **Next**.

### 3.2.5 Step 3: User security banner

To enter the user security banner via the Security Wizard, proceed as follows:

(a) The Step 3: User Security Banner page is displayed.

(b) Update the User Defined Security Banner field.

(c) Select **Next**.

### 3.2.6 Step 4: Random number entropy input

To enter the Entropy Input via the Security Wizard, proceed as follows:

(a) The Step 4: Random Number Entropy Input page is displayed.

(b) If valid entropy input exists, then an SHA-256 thumbprint of the input is displayed. If this input is correct, then take no action. Otherwise, enter the generated input in the Entropy Input and Confirm Entropy Input fields. If the two values are not identical, an error message is displayed.

(c) Select **Next**.

### 3.2.7 Step 5: Enter the wireless link encryption key

To enter the wireless link encryption key via the Security Wizard, proceed as follows:

(a) The Step 5: Enter The Wireless Link Encryption Key page is displayed.

(b) Select the applicable value in the Encryption Algorithm field.

(c) If a valid encryption key exists, then an SHA-256 thumbprint of the key is displayed. If this key is correct, then take no action. Otherwise, enter the generated key in the Wireless Link Encryption Key and Confirm Wireless Link Encryption Key fields. If the two values are not identical, an error message is displayed.

(d) Select **Next**.

### 3.2.8 Step 6: HTTP and Telnet settings

To configure HTTP and Telnet via the Security Wizard, proceed as follows:

(a) The Step 6: HTTP and Telnet Settings page is displayed.
(b) Review and update the HTTP and Telnet attributes. If the unit is required to operate in FIPS 140-2 secure mode, HTTP, Telnet and SNMP Control must all be disabled.

(c) Select **Next**.

### 3.2.9 Step 7: Commit security configuration

Review all changes that have been made in the Security Wizard. To ensure that the changes take effect, select **Commit Security Configuration**. The unit reboots and the changes take effect.

### 3.3 Checking that the unit is in the Approved Mode of Operation

The unit is ready to operate in FIPS 140-2 secure mode when both of the following conditions apply:

- The FIPS 140-2 capability logo is displayed in the navigation bar.
- The FIPS Operational Mode Alarm is not present in the Home page.

If the FIPS 140-2 capability logo is not displayed in the navigation bar, then return to Section 3.1 and check that all prerequisites are fulfilled.

If the FIPS 140-2 Operational Mode Alarm is present in the Home page, take action depending upon the alarm setting as follows:

- If the alarm is ‘FIPS mode is not configured’, then return to Section 3.2 and check that all Security Wizard settings are correct for FIPS 140-2.

- If the alarm is ‘FIPS mode is configured, but not active’, then return to Section 3.2.8 and set the following attributes to ‘No’:
  
  - HTTP Access Enabled
  - Telnet Access Enabled
  - SNMP Control of HTTP And Telnet

### 3.4 Approved and non-approved modes of operation

#### 3.4.1 Approved mode of operation

In the non-approved non-FIPS mode of operation it is possible to use all the approved algorithms of FIPS mode and also to use in the clear management protocols. No CSPs are shared between these modes of operation. A zeroize CSPs is forced if a user causes the unit to transit between modes.

In FIPS mode, the cryptographic module only supports FIPS Approved and allowed algorithms as follows:
### Table 3 – FIPS approved and allowed algorithms

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>NIST Certificate Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHA-1 and SHA-256 for hashing. See Reference (b).</td>
<td>1101</td>
</tr>
<tr>
<td>DSA for digital signature verification of uploaded firmware images 2048/256. See Reference (e).</td>
<td>569</td>
</tr>
<tr>
<td>AES 128 and 256 for SNMP, TLS and DRBG. ECB, CBC modes</td>
<td>1144</td>
</tr>
<tr>
<td>AES 128 &amp; 256 for wireless link encryption</td>
<td>708</td>
</tr>
<tr>
<td>SP800-90 DRBG, CTR_DRBG see Reference (k) section 10.2.1</td>
<td>21</td>
</tr>
<tr>
<td>HMAC-SHA-256</td>
<td>1070</td>
</tr>
<tr>
<td>Triple-DES</td>
<td>863</td>
</tr>
<tr>
<td>Note that 2-Key TripleDES is not used on the PTP600, so the 2-key restrictions (see Reference (l) Section 3.3) do not apply.</td>
<td></td>
</tr>
<tr>
<td>RSA for key unwrapping during TLS Handshake (unapproved algorithm allowed in FIPS mode; key wrapping, key establishment methodology provides 80 bits of encryption strength)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Table 4 – Management protocols in FIPS mode

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Cipher Suites supported by the module</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLS v1.0 &amp; HTTP over TLS (HTTPS),</td>
<td>TLS_RSA_WITH_3DES_EDE_CBC_SHA</td>
<td>The module acts as the server endpoint in the TLS communication. The clients are authenticated at the application layer using passwords</td>
</tr>
<tr>
<td></td>
<td>TLS_RSA_WITH_AES_128_CBC_SHA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TLS_RSA_WITH_AES_256_CBC_SHA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 3.4.2 Non-FIPS modes of operation

The following algorithms and protocols are available in the Non-FIPS mode of operation:

- Custom RNG
- HTTP
- Unencrypted Wireless
- RADIUS
- MD5

### 4 PORTS AND INTERFACES

The cryptographic module provides the following physical ports and logical interfaces:

**Table 5 – Ports and interfaces**

<table>
<thead>
<tr>
<th>Port</th>
<th>Data Input</th>
<th>Data Output</th>
<th>Status Output</th>
<th>Control Input</th>
<th>Power Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber Data Port</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>E1/T1 A</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1/T1 B</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUX Port</td>
<td></td>
<td></td>
<td>The AUX physical connector provides access to the Management Port and the Sync Port (see below).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sync Port</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Management Port</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>PIDU+/Copper Data Port</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>RF Horizontal*</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>RF Vertical*</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Earthing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>

---

2 A custom RNG is included in the operational code. This RNG is not utilised in FIPS mode.
5 IDENTIFICATION AND AUTHENTICATION POLICY

The PTP 600 supports identity-based authentication. The following table outlines the roles that can be assigned to each operator.

Table 6 – Roles and authentication

<table>
<thead>
<tr>
<th>Role</th>
<th>Type of Authentication</th>
<th>Authentication Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security Officer (Crypto-Officer)</td>
<td>Username and password verification</td>
<td>Username and password entered over a TLS socket to the HTTPS server and verified by wireless unit.</td>
</tr>
<tr>
<td>System Administrator</td>
<td>Username and password verification</td>
<td>Username and password entered over a TLS socket to the HTTPS server and verified by wireless unit.</td>
</tr>
<tr>
<td></td>
<td>Remote Username and password verification</td>
<td>The username and password are passed to a remote authentication server using a secure TLS tunnel</td>
</tr>
<tr>
<td>Read-only user</td>
<td>Username and password verification</td>
<td>Username and password entered over a TLS socket to the HTTPS server and verified by wireless unit.</td>
</tr>
<tr>
<td></td>
<td>Remote Username and password verification</td>
<td>The username and password are passed to a remote authentication server using a secure TLS tunnel</td>
</tr>
</tbody>
</table>

6 ACCESS CONTROL POLICY

6.1 Authentication Strength

In FIPS mode password complexity is enforced:

The complexity rules are:

The password must contain at least two characters for each of the four groups:

(a) lowercase letter
The password must have a minimum length of 10 characters

The passwords must not contain the user’s username.

The maximum number of repeated characters in a password is 2.

When passwords are changed at least four distinct character MUST change

Password must not be reused for the next 10 passwords.

Only three authentication attempts are permitted for any user within any one minute period.

A password with minimum complexity can be constructed by selecting, 2 lowercase, 2 uppercase, 2 special characters and 4 numeric characters. The strength of this combination is calculated as follows:

\[
p = \frac{1}{26^2} \cdot \frac{1}{26^2} \cdot \frac{1}{32^2} \cdot \frac{1}{10^4} = \frac{1}{4.7 \times 10^{12}}
\]

<table>
<thead>
<tr>
<th>Test</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in 100,000 in any minute</td>
<td>Pass strength is 1 in 4.7 x 10^{12}</td>
</tr>
<tr>
<td>1 in 1,000,000 at any attempt</td>
<td>Pass strength is 1 in 1.5 x 10^{12}</td>
</tr>
</tbody>
</table>

### 6.2 Roles and Services

The services available to authenticated users are summarised in Table 7 and Table 8. These roles and services are also available in non-FIPS mode.

Table 7 also identifies the CSP access type for each CSP in braces after each CSP. \{R\}ead, \{W\}rite and \{Z\}eroize.

---

3 Allowable special characters are: `!"#$%&'()*+,./;<>?@\^_`{|}~`
### Table 7 – Role-based services and CSP access

<table>
<thead>
<tr>
<th>Role</th>
<th>Service</th>
<th>CSPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>RO, SA, CO</td>
<td>Authentication</td>
<td>Authenticate, password {R,W}, HMAC session key {W}, key of keys {R}&lt;br&gt;The CO has R and W access to all user passwords, CO password, SA password and RO password.&lt;br&gt;Users with the SA or RO role only has R and W access to their associated passwords&lt;br&gt;Operator password management.</td>
</tr>
<tr>
<td>SA, CO</td>
<td>Firmware Upgrade</td>
<td>DSA Public key {R}</td>
</tr>
<tr>
<td>CO</td>
<td>Encrypt</td>
<td>Encrypt / Decrypt wireless traffic using wireless encryption key {R}, key of keys {R}</td>
</tr>
<tr>
<td></td>
<td>TLS</td>
<td>Authenticate and key exchange using TLS private key {R}, entropy seed {R}, key of keys {R}&lt;br&gt;TLS pre-master secret {R, W}, TLS master secret {R, W} and TLS keyset {R}</td>
</tr>
<tr>
<td>CO</td>
<td>Zerose</td>
<td>Key of keys {Z}&lt;br&gt;(Also initiates system reboot, which zeroizes all CSPs in volatile memory.)</td>
</tr>
<tr>
<td></td>
<td>Self Test</td>
<td>N/A</td>
</tr>
<tr>
<td>CO</td>
<td>Cryptographic Key Management</td>
<td>Key of keys, TLS X509 private key {R, W}, wireless link encryption key {R, W}, entropy seed {R, W}</td>
</tr>
<tr>
<td>CO, SA</td>
<td>Module Configuration</td>
<td>N/A</td>
</tr>
<tr>
<td>CO, SA</td>
<td>Reboot</td>
<td>HMAC Session Key {Z}, TLS Key Set {Z}</td>
</tr>
<tr>
<td>CO, SA, RO</td>
<td>View Status</td>
<td>N/A</td>
</tr>
<tr>
<td>CO, SA, RO</td>
<td>View Configuration</td>
<td>N/A</td>
</tr>
<tr>
<td>CO, SA, RO</td>
<td>Logout</td>
<td>HMAC session key {W}</td>
</tr>
<tr>
<td>CO, SA, RO</td>
<td>SNMP (view of status and configuration)</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Table 8 – Authenticated services

<table>
<thead>
<tr>
<th>Service</th>
<th>Role</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authentication</td>
<td>CO, SA, RO</td>
<td>Authenticate user logins</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operator password management</td>
</tr>
<tr>
<td>Firmware Upgrade</td>
<td>CO, SA</td>
<td>Upgrade operational firmware</td>
</tr>
<tr>
<td>Encrypt</td>
<td>CO</td>
<td>Encrypt / Decrypt wireless traffic</td>
</tr>
<tr>
<td>Zerise</td>
<td>CO</td>
<td>Zerise Key of Keys (Also initiates system reboot, which zeroizes all CSPs in volatile memory.)</td>
</tr>
<tr>
<td>Cryptographic Key</td>
<td>CO</td>
<td>Cryptographic key data entry and CSP zeroisation</td>
</tr>
<tr>
<td>management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module Configuration</td>
<td>CO</td>
<td>A selection of standard wireless unit configuration settings</td>
</tr>
<tr>
<td>Reboot</td>
<td>CO</td>
<td>Reboot the wireless unit</td>
</tr>
<tr>
<td>View Status</td>
<td>SA, CO, RO</td>
<td>View module status including hardware and firmware versions</td>
</tr>
<tr>
<td>View Configuration</td>
<td>RO, SA, CO</td>
<td>View all system administrative configuration</td>
</tr>
<tr>
<td>Logout</td>
<td>RO, SA, CO</td>
<td>Invalidate any previously HMAC signed cookies by regenerating the HMAC session key</td>
</tr>
</tbody>
</table>

6.3 Unauthenticated Services:

The services available to unauthenticated users are summarised in Table 9.

Table 9 – Unauthenticated services

<table>
<thead>
<tr>
<th>Service</th>
<th>Role</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self Test</td>
<td>-</td>
<td>This service executes a suite of cryptographic self tests as required by FIPS 140-2 level 2. (Power up self test)</td>
</tr>
</tbody>
</table>
### 6.4 Service I/O Specification

#### Table 10 – Specification of service inputs and outputs

<table>
<thead>
<tr>
<th>Service</th>
<th>Control Input</th>
<th>Data Input</th>
<th>Data Output</th>
<th>Status Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authentication</td>
<td>Authentication request</td>
<td>Username &amp; password Or HMAC signed cookie</td>
<td>HMAC signed cookie</td>
<td>Status OK if username and password match plain text username and password CSP</td>
</tr>
<tr>
<td>Firmware</td>
<td>Upgrade request</td>
<td>Plaintext header + BZIP2 compressed image</td>
<td>DSA verification 'v' vector</td>
<td>Status OK if 'v' = 'r'</td>
</tr>
<tr>
<td>Zerose</td>
<td>Zerose Request</td>
<td>None</td>
<td>None</td>
<td>True if key of keys removed from non-volatile storage and system reboot</td>
</tr>
<tr>
<td>Self Test</td>
<td>System reboot</td>
<td>Self Test keys and test vectors</td>
<td>None</td>
<td>True if algorithm self test successful. Otherwise false</td>
</tr>
<tr>
<td>Cryptographic Key</td>
<td>Data Entry</td>
<td>Key of Keys, TLS Private</td>
<td>None</td>
<td>True if key correctly</td>
</tr>
</tbody>
</table>
### 6.5 Definition of Critical Security Parameters

The following CSPs and public keys are contained in the modules FLASH memory. These are NOT read into SDRAM by the FIPS module.

#### 6.5.1 Key of Keys

The key of keys is stored as a 128/256-bit AES key and is stored in the CSP FLASH bank. The key of keys is read during the DMGR initialisation procedure and the key expansion is stored in SDRAM. All DMGR attributes that are marked as CSPs are encrypted/decrypted as they are written/read from the configuration FLASH banks using the key expansion.

The integrity of the key of keys is validated by the user with a CRC32.

The key of keys can be configured or erased by a user with the security officer role.

#### 6.5.2 TLS X509 Private Key

TLS private key is used by the HTTPS server. The private key is designated as a DMGR CSP and is encrypted using the key of keys.
A key size of 1024-bits is supported
Entered via a secure webpage upload
Generated by a FIPS approved algorithm outside the module
Validity checked by performing a modulus check on private and associated public certificate.
The X.509 private key can be configured or erased by a user with the security officer role.

6.5.3 RNG Entropy

SP800-90 DRBG entropy string is used by the TLS stack and other random processes. The entropy string is designated as a DMGR CSP and is encrypted using the key of keys.
A key size of 512-bits is supported
Entered via a secure webpage upload
Generated by a FIPS approved algorithm outside the module
The entropy string can be configured or erased by a user with the security officer role.

6.5.4 HMAC Session Key

The HMAC session key is used by the authentication process to sign and verify HMAC signed web authentication cookies
The HMAC session key is generated using the FIPS approved DRBG. The session key is overwritten every time a user successfully authenticates to the PTP 600 module.
The authentication cookie is used by the PTP 600 module to create and store session information. Each time a webpage is clicked by an authenticated user the session cookie is replayed by the browser to the PTP 600 module. After receiving the cookie the PTP 600 module uses the HMAC session key and arguments extracted from the cookie to regenerate the HMAC. If the HMAC is successfully regenerated the user is allowed access to the module otherwise the user is forced to re-authenticate.

6.5.5 Wireless Encryption Key

The wireless encryption key is used to encrypt/decrypt all control and data sent over the wireless MAC layer.

6.5.6 TLS Key Set

The TLS keyset comprises of the session keys. The TLS service is used for authenticity and privacy when transporting CSPs from the user’s browser to PTP 600 module. The CSPs that are protected are detailed in Section 6.5.
The TLS keyset is generated by TLS “Approved“ PRF with the help of TLS Master secret and server and client random.
The server random is generated using the approved DRBG. The client random is generated by the operator’s browser.

**6.5.7 TLS pre-master secret and TLS master secret**

The 46 byte pre-master secret is generated by the operator’s browser, PCKS#1 v1.5 encoded, wrapped with RSA 1024.

The master-secret is generated using TLS PRF:

```
master_secret = PRF(pre_master_secret, "master secret", ClientHello.random + ServerHello.random)
```

The TLS Pre-Master Secret and TLS Master Secret are zeroized after use.

**6.5.8 Passwords**

The PTP 600 has 10 configurable user accounts. Each user account has an associated password. All passwords are designated as DMGR CSPs and are encrypted using the key of keys.

A user with the security officer role can reset all user account passwords. Users with system administrator or read only user roles can reset their own passwords.

**6.6 CSP Encrypted by Key of Keys**

The following CSPs are AES encrypted (See Reference (i)) using a key of keys approach and are not zeroised.

- Wireless Encryption Key – This key is used for the Encryption/Decryption of all traffic over the wireless link.
- System passwords
- TLS X.509 private key
- DRBG Entropy seed

**6.7 Definition of Public Keys**

The following are the public keys contained in the module:

- TLS X509 Public Certificate (located in the configuration FLASH bank). The certificate can be modified by a user uploading a new valid certificate. The longevity of the key is encoded in the X509 certificate expiry time.
- Firmware DSA 2048-bit public key (p, q, g and y vectors) (located in the FIPS module code and defined as static const unsigned char arrays). The DSA public key cannot be erased and can only be replaced by upgrading the firmware.
- TLS Private Key / Public Certificate Modulus Check
6.8 Definition of CSP Modes of Access

- Validate an uploaded firmware images digital signature
- TLS Authentication

6.9 CSP Access Rights within Roles and Services

The CSPs are not accessible from any management interface.

7 OPERATIONAL ENVIRONMENT

The FIPS 140-2 Area 6 Operational Environment requirements are not applicable because the PTP 600 device does not contain a modifiable operational environment.

8 SECURITY RULES

This section documents the security rules enforced by the cryptographic module to implement the security requirements of this FIPS 140-2 Level 2 module.

- The cryptographic module provides three roles: Security administrator, system administrator and read-only user.
- The cryptographic module provides identity based authentication.
- Concurrent operators support no bypass states; no maintenance roles
- The cryptographic module performs the power up self tests listed in Section 8.1.

8.1 Self Tests

The operator shall be capable of commanding the module to perform the power-up self-test.

Data output shall be inhibited during key cryptographic self-tests, zeroisation, and error states.

Status information shall not contain CSPs or sensitive data that if misused could lead to a compromise of the module.

After FIPS configuration the module performs a reboot and subsequent FIPS self test.

The image will perform the following tests:

8.1.1 Cryptographic Power-up Self Tests

- SHA-256 known answer test
- DSA signature verification known answer test
- AES (FPGA used for wireless link encryption). Encryption and Decryption KAT
- AES (DSP TLS and SNMPv3). Encryption and Decryption KAT
8.1.2 Firmware Integrity Test (CRC32)

- A firmware integrity test is performed before booting the FIPS module.

8.2 Firmware Self Tests

- A DSA signature verification is performed before upgrading operational firmware
- Prior to each use, the internal DRBG shall be tested using the conditional test specified in FIPS 140-2 §4.9.2.
- RSA decrypt
- Firmware non-volatile storage integrity check
- CSP integrity self test is performed when reading CSPS from non-volatile storage.

8.3 FIPS Integrity Test Error Indicators

All FIPS integrity test failures will result in a watchdog reset of the module. The integrity test failure messages are:

- FIPS Cryptographic Self Test Failure
- FIPS DRBG Failure
- FIPS RSA Decrypt Self Test Failure
- DSA Pair Wise Consistency FIPS Self Test Failure
- Bootcode Integrity Check Failure

9 IDENTIFICATION OF FIPS MODE OF OPERATION

Correct configuration of the module can be confirmed by observing the FIPS 140-2 label on the webpage navigation frame and that the FIPS Operational Mode Alarm is not present in the Home page.

10 PHYSICAL SECURITY POLICY

The PTP 600 is a multi-chip standalone cryptographic module and includes the following physical security mechanisms:
• Production-grade components and production-grade opaque enclosure with tamper evident labels.
• Protected, opaque vent.

The tamper evident labels on the module enclosure must be checked every 30 days. If tamper evidence is observed, the module should be removed from service and inspected more closely.

10.1 FIPS Boundary and Frequency Variants

All frequency and bandwidth limited variants of the PTP 600 wireless products are encased using an identical cast metal casing and cover plate. The only exception to this is statement is the difference between connectorized and integrated wireless units which have differing types of cover plates.

11 MITIGATION OF OTHER ATTACKS POLICY

No other attacks have been identified.
Cambium Networks

Cambium Networks provides professional grade fixed wireless broadband and microwave solutions for customers around the world. Our solutions are deployed in thousands of networks in over 153 countries, with our innovative technologies providing reliable, secure, cost-effective connectivity that’s easy to deploy and proven to deliver outstanding metrics.

Our award-winning Point to Point (PTP) radio solutions operate in licensed, unlicensed and defined use frequency bands including specific FIPS 140-2 solutions for the U.S. Federal market. Ruggedized for 99.999% availability, our PTP solutions have an impeccable track record for delivering reliable high-speed backhaul connectivity even in the most challenging non-line-of-sight RF environments.

Our flexible Point-to-Multipoint (PMP) solutions operate in the licensed, unlicensed and federal frequency bands, providing reliable, secure, cost effective access networks. With more than three million modules deployed in networks around the world, our PMP access network solutions prove themselves day-in and day-out in residential access, leased line replacement, video surveillance and smart grid infrastructure applications.

Cambium Networks solutions are proven, respected leaders in the wireless broadband industry. We design, deploy and deliver innovative data, voice and video connectivity solutions that enable and ensure the communications of life, empowering personal, commercial and community growth virtually everywhere in the world.