EtherTrust CryptoTerminal
V1.01
Firwmware 1.01h’

1 Content

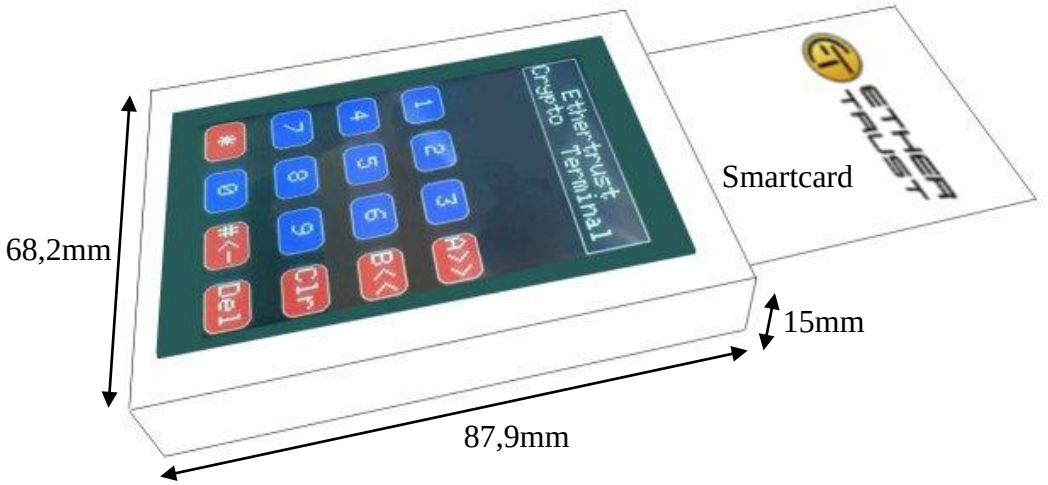
2 Introduction

Blockchain and its distributed ledger architecture will bring spectacular disruption across all industries. However, security, specifically key protection, remains a crucial challenge, as demonstrated by recent hacks.

Leveraging its extensive expertise in cryptography and secure element technologies, Ethertrust brings proven bankcard security to Blockchain transactions. With Ethertrust Crypto Terminal, Blockchain transactions are authorized through an *off-line* (*cold mode*), or *on-line* (*hot mode*), with "*Chip and PIN*" validation.

Keys operations are processed entirely within the smartcard secure element, furthermore the terminal firmware can be securely flashed in seconds, prior the transaction for added protection.

2.1 The Crypto Terminal

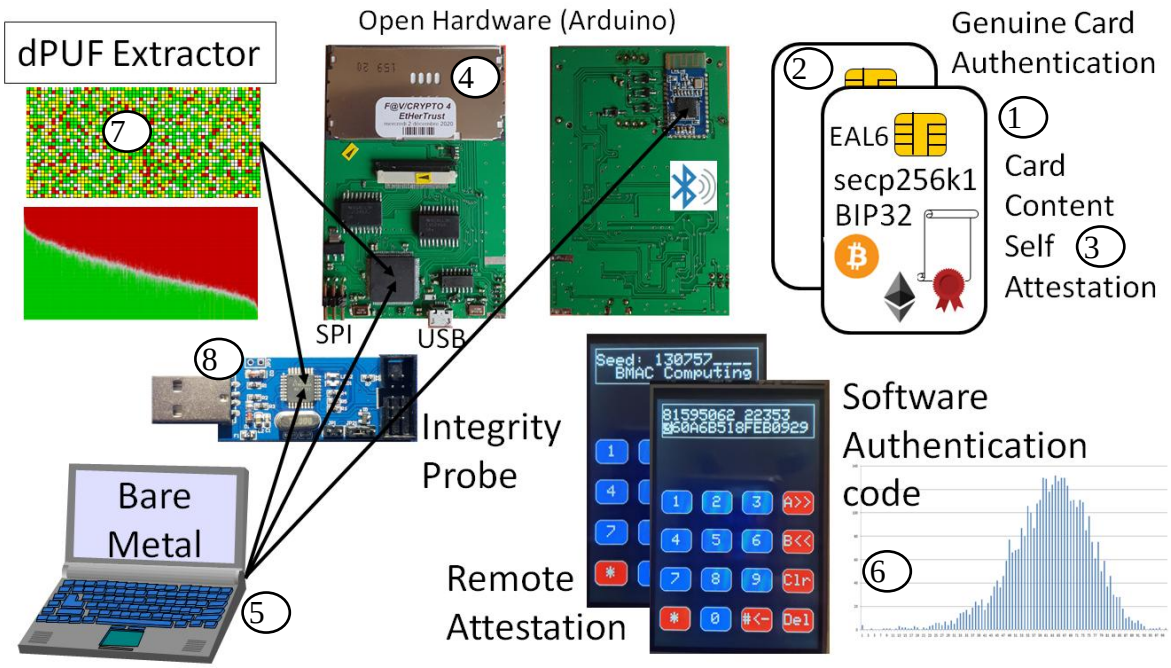


The Crypto Terminal is equipped with an USB port supporting the *USB Serial* protocol, and a *Bluetooth Low Energy* (BLE) module with the RFCOMM profile. It includes a smartcard reader, and delivers the following services:
- Generation and secure storage of cryptographic keys;
- Generation of cryptographic signature in synchronous mode (driven from PC or mobile), or in asynchronous mode (without connection to PC or mobile);
- All PINs are entered (like in the case of bank card terminals) on the Crypto Terminal;
- All signatures are acknowledged by the Crypto Terminal;
- Very High Security:
    - *Removable Secure Element* (smartcard) has EAL5+/EAL6 certification
    - *Bare Metal*, Crypto Terminal firmware, and the BLE module firmware can be flashed at any time.

The CryptoTerminal is compatible with OTG (On The Go) functionality available on most of Android phones.

The power consumption is about 150mA under 5V (0,75W). Physical dimensions are 87,90mm x 68,20mm x 15mm, i.e. a bank card size which 15mn thickness.

2.2 The Crypto Terminal Security Model



1) The security core is a removable EAL5+/ EAL6 secure element (javacard), which stores keys and performs transaction signatures. Smartcard access is protected by PIN codes.

2) The crypto terminal can duplicate secure element content. Smartcard content is self attested, i.e. hashed and signed by smartcard.

3) Smartcard authenticity is guaranteed by an anti-cloning mechanism, in order to detect "Evil Maid" attacks. The idea of such attacks is to use a cloned card, and thereafter to collect user's keys. The smartcard public key is at index 0, and is signed by Ethertrust.

4) The crypto terminal acts as a firewall between the secure element and "*hot*" environments connected to the Internet. It also performs operations (generation of keys, signatures, …) in "*cold*" mode, without any connection to Internet.

5) Our security model is based on the concept of "bare metal", i.e. the terminal is delivered without firmware, as well as the Bluetooth module. The user can flash these devices at any time, using a programming token.

6) Firmware's are authenticated by an embedded algorithm known as "Remote Attestation". Such algorithm produces a result (the authentication code) which cannot be guessed in advance, and requires a computing time dependant on the result. The Ethertust server can generate these codes, but also legitimate user; this allows creating personal and unique authentication codes.

7) Physical authentications of crypto terminal processor and programming token processor are performed by using SRAM dynamic PUF (*Physical Unclonable Function*) techniques (*d*PUF). A software memory probe extracts SRAM fingerprints, after powering up. Ethertrust developed innovative procedures for acquiring such fingerprints, including singular points

called "flipping-bits" Flipping-bits cannot formally be cloned by software. This technique ensures that devices received by customers are genuine.

8) The programming token is a root of trust. It manages the crypto terminal processor firmware download. Ethertrust inserts bootloader software within the programming token processor. The authenticity of this software is proven by a remote attestation algorithm generating authentication codes, displayed using flashing LEDs. As previously mentioned, the physical (*dPUF*) identity of this token allows detecting clones.

2.3 The Crypto Currency SmartCard (CCSC)

The Crypto Currency smartcard (CCSC) is able to generate, to compute (according to the BIP32 standard), or to import elliptic curve keys (up to 15), used for the generation of ECDSA signatures for crypto currencies such as Bitcoin and Ethereum.
The Crypto Currency smartcard (CCSC) application, of which AID is *010203040500*, has three PINs, administrator, user, and user2. The default values are 8 zeros for administrator and 4 zeros for user and user2.
A Read/Write non volatile memory (16KB), protected by a dedicated PIN (User2), is available for the storage of any sensitive information.

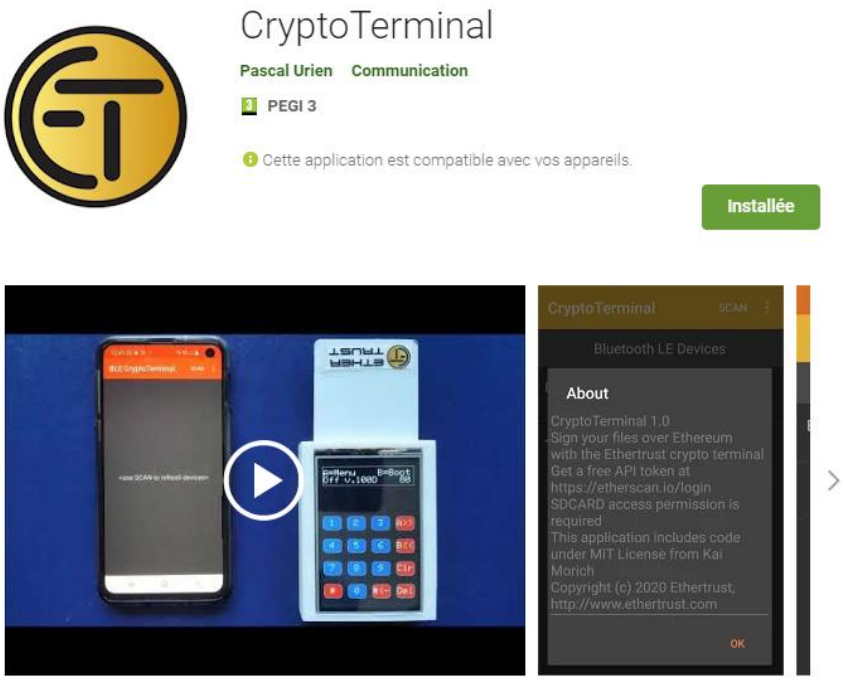
2.4 Generating Ethereum transaction from the crypto terminal

The serial command "*settransf*" generates an Ethereum transaction according to the seven following parameters:
- Key index, the key to be used for the transaction signature
- Nonce, the nonce of the transaction, an integer positive value, starting from zero, and incremented by one after every transaction.
- GasPrice, the gas price to be used for the transaction in GWEIs
- GasLimit, the maximum instructions to be computed for the transaction, leading to a maximum cost of GasLimit x GasPrice
- Recipient Address, the Ether address (20 bytes, 40 hexadecimal digits) of the transaction recipient
- Amount, the amount of the transaction (in Ether) in decimal format, such as 0.0.
- Data, the data associated to the transaction, at the most 448 ASCII characters (# prefix) or 224 bytes represented in hexadecimal format (#$ prefix).

The "*settransf*" returns the Ethereum transaction in hexadecimal format.

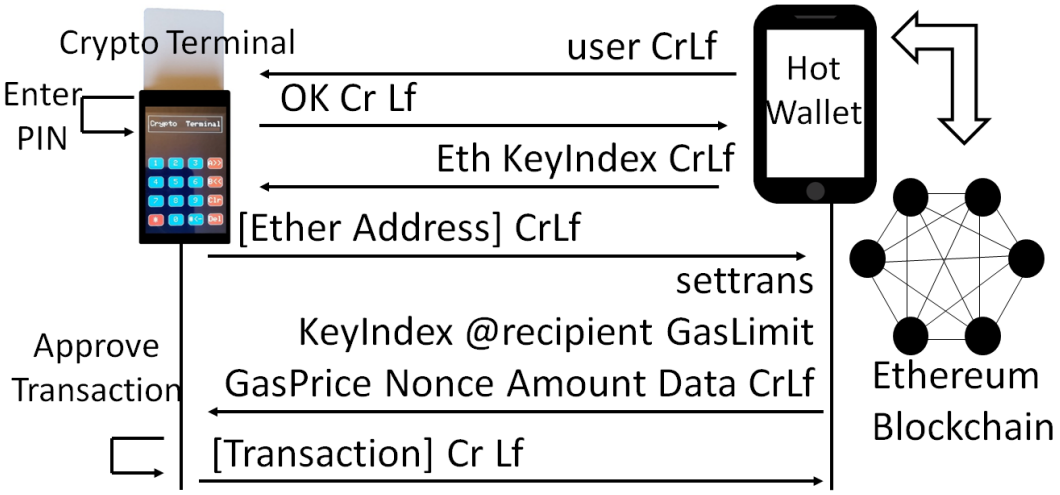
2.5 Generating transactions from Android mobile

A CryptoTerminal application for Android is available on PlayStore. This application "*signs*" a mobile file thanks to an Ethereum transaction.



https://play.google.com/store/apps/details?id=com.ethertrust.simple_terminal

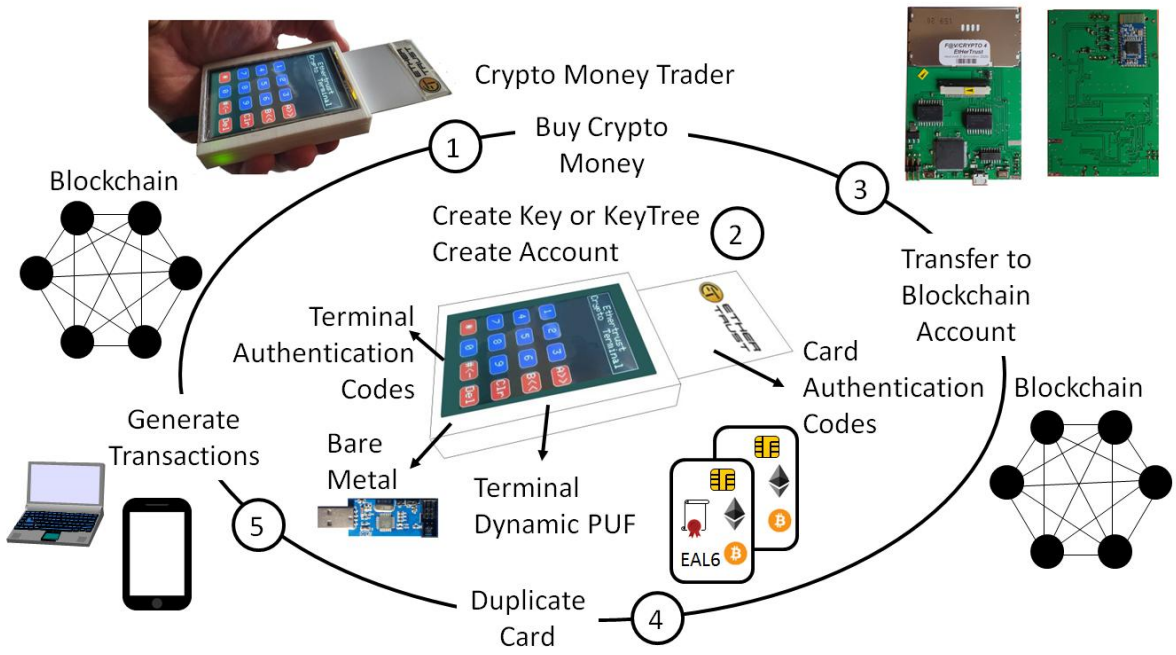
A serial (RFCOMM) communication is opened between the crypto terminal and an Android mobile phone. The *App* sends the "user" command that trigs PIN entering by the user; this operation unlocks the smartcard. Afterwards it collects Ethereum addresses bound to cryptographic keys, and finally requests (via the "settransf" command) the generation and signature of a transaction, which must be approved by the user



2.6 Generating transactions with BTOOLS

BTOOLS (https://github.com/purien/btools) is open software available for Windows or Linux (btools 1.0 and 1.1 only), which generates transactions for Bitcoin and Ethereum crypto currency platforms. In order to provide a strong security it supports the Crypto Terminal, used for secret key generation and storage, and for the computing of elliptic curve (ECDSA) signature. It is based on the OPENSSL library.

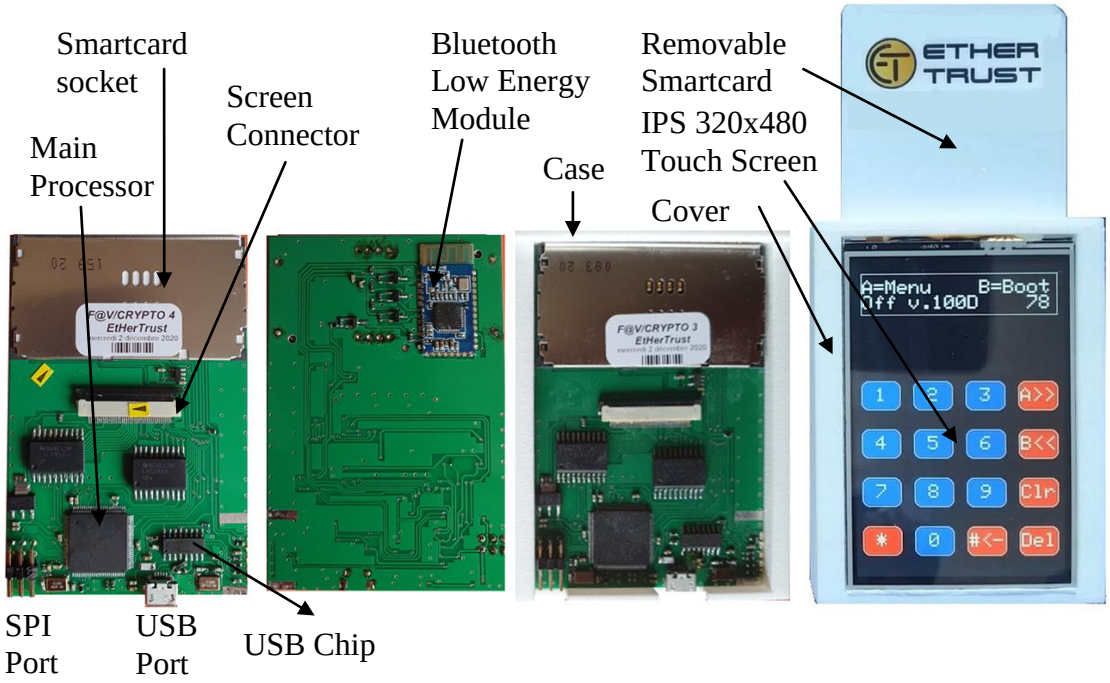
BTOOLS provides the following services:
- Bitcoin address generation (mainnet and testnet);
- Ethereum addresses generation;
- Bitcoin transaction generation;
- Ethereum transaction generation;
- Simple Bitcoin node client;
- Bitcoin transaction (via the Bitcoin client);
- Ethereum transaction (via WEB APIs);
- Crypto Terminal scripts for key generation and transaction signature (hot or cold).



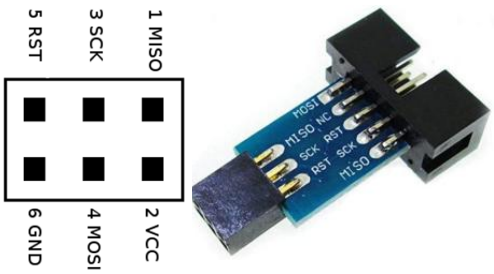
We suggest the following use case:

(1) Buy crypto money
(2) Create blockchain account (Key or KeyTree) thanks to the CryptoTerminal and smartcard
(3) Transfer crypto money to blockchain account
(4) Duplicate smartcard
(5) Generate transaction thanks to software tools such as BTOOLS or smartphone application.

2.7 Overview of the ECTv2 crypto terminal board



3 Uploading Firmware

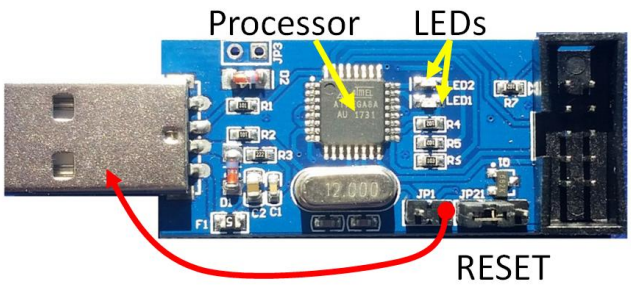


ICSP Port, Front View
and 6Pins/10Pins connector.

The Crypto Terminal firmware can be downloaded with any ISP Programmer. The Crypto Terminal ICSP port has 6 pins.

We recommend using the open USBASP ISP programmer for which Ethertrust has developed strong security features. This programmer is equipped with an open bootloader customized by Ethertrust.

3.1 USPASP Security procedure



- Make a shortcut between RESET pin and ground.
- The green LED blinks (three times), what indicates that the bootloader is unlocked, and ready to upload a firmware during 5 seconds.
- Download the bootloader static integrity probe firmware. If the test is OK green and red LEDs are blinking alternatively.
- Download the bootloader dynamic integrity probe firmware. After 20 seconds a five digit security code is displayed by blinking LEDs. Check the security code.
- If the two previous tests are OK, download the USBASP firmware.

3.2 Downloading the Crypto Terminal firmware

Connect the 6 PINs ISP cable to the crypto terminal ICSP port. A 6 PINs to 10 PINs adapter is needed for ISP programmer.

Download the CryptoTerminal.hex file. The processor is ATMEGA2560.

3.3 Downloading the Bluetooth Low Energy firmware

Connect the CryptoTerminal to a PC, via an USB cable.

Start the BLE-Loader software (CCLoader.exe) on the PC and select the COM port used by the CryptoTerminal.

When asked by the BLE-Loader, press the key 3 on the CrytoTerminal in order to enter the *Load-BLE-Firmware* mode.

4 Checking Firmware Integrity

The Crypto-Terminal firmware and the BLE-module firmware integrity may be checked at any time.
On the main menu press the '7' key.

```
1=bMAC 3=bMACble
2=bMAC+EEPROM  ?
```

Press '1' for checking Crypto-Terminal firmware integrity. Key '2' performs the same operation, but the EEPROM is erased.
Press '3' for checking BLE-Module firmware

```
Seed: ----------
#=Ok  D=Del C=No
```

Enter a *seed* value, an integer value between 0 and 2147483647 (2^{31} -1).

The displayed result comprises three data:
- the computing time (in 4µs unit for Crypto-Terminal, 64 µs for BLE-Module) first line, left part- the security code (first line, right part), a five digit number (16 bits). The security code is the XOR of MAC and computing time.
- the MAC value (32 bytes) expressed in hexadecimal.

```
81586363 57820
4FE958A1BF7C8658
```

Crypto-Terminal Checking
(computing time about 326 seconds)

```
1165679 34846
EA2C02C71657BD04
```

BLE-Module Firmware Checking
(computing time about 70s)

We recommend using the seed 0 for BLE-Module checking. When the seed 0 is used, BLE-Module checking runs a legacy sha256 procedure. In that case the MAC returned value should be: EA2C02C71657BD04AE7527007D11FAF6436E76225AEA7A15806C5D55C94F881E

For BLE-Module, the computing time may have some time jitter (+- 256 µs), therefore the security code can take a few values.

In summary the procedure that checks the terminal firmware integrity is the following
- Enter the seed for Crypto-Terminal integrity, and check the security code.
- Enter seed 0 for BLE-Module integrity and check the MAC.

5 Checking Smartcard Authenticity

Ethertrust smartcards can be authenticated. They store a certificate and a private key. The smartcard public key is at index 0

First enter the smartcard User'Pin (A/1/4/PIN#). Then press the Key 0.

Check Card	**Reading Cert**	**Reading Pub**
Challenge	**Genuine Card**	

The card authentication procedure realizes the following operations.
- Reading of the card certificate (signature of the card public key by Ethertrust)
- Reading of the card public key (at index 0)
- Sending of a 32 bytes challenge, to be signed by the card private key
- Reading and checking of the ECDSA signature

Upon success the *Genuine Card* message is displayed

6 Checking Card Content

Ethertrust smartcard can generate content self attestation.
Private keys and associate labels are hashed, and signed.

First enter the smartcard User'Pin (A/1/4/PIN#). Then press the Key 4

Reading Pub	**Reading Content**	**Checking Content**
1234567890ABCDEF Content		

The card content procedure realizes the following operations.
- Reading of the card public key (at index 0)
- Sending a32 bytes challenge (r) and reading the card content hash.
- Checking of the ECDSA signature, signature = ECDSA(sha256(card-content-hash || r))

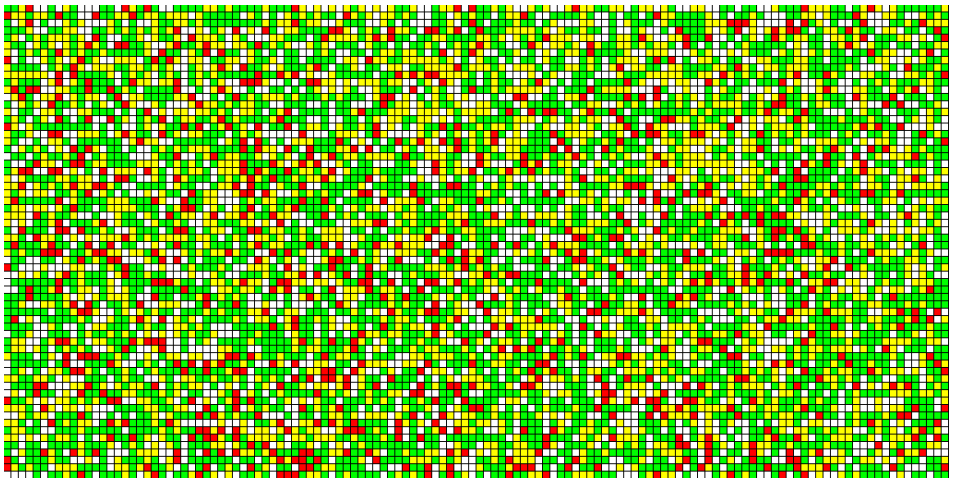
Upon success the card content hash is displayed

The Ethertrust public key (SECP256k1) is :

046099836D971593AAA2C1C32B6DB9EF9521041795E21CF1E7511DF3BD358F97DF35
8B33A875E359CBE236163D6DBAEDFEC6C9393522C7EBC25A7CC85E1F0A7D67

7 Checking Main Processor Identity

The main processor identity is checked by a *Dynamic Physical Unclonable Function* (*d*PUF) procedure (see https://github.com/purien/DynamicPuf). First a memory probe firmware is downloaded in the Crypto Terminal. Second a dedicated device (*PUF Extractor*) measures or checks the physical identity of the crypto terminal based on SRAM PUF. A SRAM memory is made with 6 CMOS transistors.
Due to transistors physical and electrical dissymmetry, some memory cells take a fixed value (non random) after powering up. Furthermore some SRAM cells, referred as *flipping-bits*, have a fix content dependant on the voltage rising time. The processor identity is a set SRAM cell with a fix value at power-up (colored in green=1 and 0=yellow), and flipping-bits (colored in red). Other cells are referred as noisy (and colored in white)



8 KeyPad

The ten digit keys ('0' to '9') are used to enter decimal digit.

The '#' key is used for ENTER operation.
The 'A' key is used as FORWARD operation.
The 'B' key is used as BACKWARD operation.
The 'C' key is used as CANCEL operation.
The 'D' key is used as DELETE operation.

The '*' key is used as ESCAPE operation.
For hexadecimal representation the sequence '*A' '*B' '*C' '*D' '*#' '**' are used for entering A,B,C,D,E,F hexadecimal digits.

For telephone keypad , the sequences '*1x' '*2x' '*3x' '*4x' are used, x being the character index for the decimal key (ranging from 1 to 9)

For ASCII the '*0xyz' sequence is used, xyz being the ASCII code of the character.

For special character, sequences '*91', '*92' and '*93' are respectively used for space, dot and '@ '.

For example a line editor can be start from the main menu, by typing /A/2/2/0#/4', what starts the label setting associated to a cryptographic key.

8.1 Root Menu (Iddle Menu) Keys

Key '0' : Check Card Authenticity
Key '1' : Serial USB activation
Key '2' : Bluetooth Low Energy activation
Key '3' : BLE-Module Loader activation
Key '4' : Card Content
Key '5' : Bluetooth options: PIN and Name
Key '7' : Firmware Integrity Check
Key '9' : Elliptic Curve Test
Key 'A' : Main Menu
Key 'B' : Boot Menu
Key 'D' : Product Name

9 Crypto-Terminal Serial Commands

The Crypto-Terminal is equipped with an USB port supporting the *USB Serial* protocol, and a *Bluetooth Low Energy* Module with the *RFCOMM* stack.

- **Serial Configuration: 9600 bauds, 8 bits, 1 Stop, No Parity**
- **All commands end by the Cr (Carriage Return) Lf (Line Feed) characters.**
- **An error occurred, if the first token of the response is the string ERROR.**

9.1 Wrong Command

Action: Command Error

Cmd: WrongCommand CrLf
The first token of error response is **ALWAYS** ERROR
Response: ERROR WrongCommand CrLf

9.2 Empty Command

Action: Empty Command

Cmd: CrLf
Response: ERROR No Command ! CrLf

9.3 reboot

Action: Reboot the Crypto Terminal
Cmd: reboot CrLf
Response: Boot label
Boot label*: OK Ready EtherTrust Terminal v.101hL EEPROM Size: 4096 MaxRec* CrLf

9.4 echo

Action: Terminal Test, force the *nodebug* mode, *prompt* (if any) remain unchanged.

Cmd: echo CrLf
Response: OK CrLf

9.5 disp

Action: test LCD for debugging purposes, display a text at x,y coordinates during 5s

Cmd: disp x-value (0..15) y-value (0...1) text CrLf
Response: OK CrLf
Response: ERROR CrLf

9.6 edit

Action: test LCD text editor for debugging purposes.

Cmd: edit number-of-characters [Optional text]
Response: [text] CrLf
Response: ERROR CrLf

9.7 enter

Action: test KEYPAD for debugging purposes, enter data at x,y coordinates (timeout 60s).

Cmd: enter x-value (0..15) y-value (0...1) number-of-characters CrLf
Response: [text] CrLf
Response: ERROR CrLf

9.8 debug

Action: Switch to Debug Mode

Cmd: debug CrLf
Response: OK CrLf

9.9 nodebug

Action: switch to non debug (normal) mode.

Cmd: nodebug CrLf
Response: OK CrLf

9.10 prompt

Action: display the prompt character at response end (>).

Cmd: prompt CrLf
Response: OK CrLf

9.11 noprompt

Action: remove the prompt character (>) at response end.

Cmd: noprompt CrLf
Response: OK CrLf

9.12 on

Action: Power the Secure Element

Cmd: on CrLf
Response: OK CrLf

9.13 off

Action: Unpower the Secure Element

Cmd: off CrLf
Response: OK CrLf

9.14 status

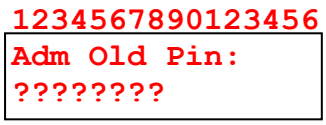
Action: read the Secure Element (SE) status parameter (10 bytes).
At least one PIN code must have been provided.

Cmd: status CrLf
Response: [SE Status Parameter, 10 bytes] CrLf
Response: ERROR CrLf

9.15 changeadm

Action: Modify Administrator PIN
This command powers the SE if needed.
Upon success the terminal in the On Mode

Terminal Display:



Cmd: changeadm CrLf
Response: OK CrLf
Response: ERROR CrLf

9.16 changeuser

Action: Modify User PIN
This command powers the SE if needed.

Upon success the terminal in the *On* mode

Terminal Display:

```
1234567890123456
User Old Pin:
????
```

```
1234567890123456
User New Pin:
????
```

Cmd: changeuser CrLf
Response: OK CrLf
Response: ERROR CrLf

9.17 changeuser2

Action: Modify User2 PIN
This command powers the SE if needed.
Upon success the terminal in the *On* mode.

Terminal Display:

```
1234567890123456
User2 Old Pin:
????
```

```
1234567890123456
User2 New Pin:
????
```

Cmd: changeuser2 CrLf
Response: OK CrLf
Response: ERROR CrLf

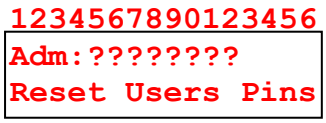
9.18 adm

Action: Enter the Administrator's PIN on the crypto terminal (8 digits), and optionally reset the user's PINs (user1 and user2).
This command powers the SE if needed.

Terminal Display (default):

```
1234567890123456
Adm:????????
D=Del C=No  #=OK
```

Terminal Display (with the reset option):

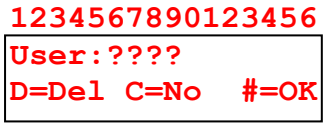


Cmd: adm [reset] CrLf
Response: OK CrLf
Response: ERROR CrLf

9.19 user

Action: Enter the user's PIN on the crypto terminal (4 digits).
This command powers the SE if needed.

Terminal Display:

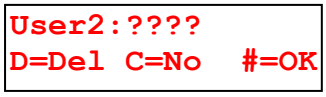


Cmd: user CrLf
Response: OK CrLf
Response: ERROR CrLf

9.20 user2

Action: Enter the user2's PIN on the crypto terminal (4 digits).
This command powers the SE if needed.

Terminal Display:



Cmd: user2 CrLf
Response: OK CrLf
Response: ERROR CrLf

9.21 computekey

Action: Compute a key pair (private/public), from a key tree, with "hardened keys" only according to the BIP32 BITCOIN recommendation.
Administrator or User mode is required; the key generation MUST be confirmed.

Terminal Display:

```
1234567890123456
CKey iii: yes=#?
.x1.x2...xn time
```

Cmd: computekey iii x1.x2…xn CrLf
- iii an integer value between 0 and 15);
- xi integer value (between 0 and 2^{31}-1), the hardened key path in the key tree.

Response: OK CrLf
Response: ERROR CrLf

9.22 genkey

Action: generate a key pair (private/public)
Administrator mode is required; the key generation MUST be confirmed.

Terminal Display:

```
1234567890123456
GenK iii: yes=#?
Adm          time
```

Cmd: genkey iii CrLf (iii an integer value between 0 and 15)
Response: OK CrLf
Response: ERROR CrLf

9.23 setseed

Action: initiate a key tree with a seed or generate a tree with a random seed size
Administrator mode is required; the key tree initialization MUST be confirmed.

Terminal Display:

```
1234567890123456
Seed iii: yes=#?
Adm          time
```

Cmd: setseed iii seed CrLf (iii an integer value between 0 and 15)
Or
Cmd: setseed iii yy CrLf (iii an integer value between 0 and 15, yy integer the size of the random seed))

Response: OK CrLf
Response: ERROR CrLf

Seed: up to 128 hexadecimal digits (64 bytes)

9.24 getseed

Action: read a tree seed.
Administrator mode is required; the reading MUST be confirmed.

Terminal Display:

```
1234567890123456
Seed iii: yes=#?
Adm          time
```

Cmd: getseed iii CrLf (iii an integer value between 0 and 15)
Response: [Length (2 bytes), Seed Value (up to 64 bytes) Ascii Encoded] CrLf
Response: ERROR CrLf

9.25 getpub

Action: read a public key.
Administrator or User PIN must have been provided.

Cmd: getpub iii CrLf (iii an integer value between 0 and 255)
Response: [Length (2 bytes), Public Key Value(65 bytes) Ascii Encoded] CrLf
Response: ERROR CrLf

9.26 btc

Action: compute a Bitcoin address.
Administrator or User PIN must have been provided.

Cmd: btc iii [xxx] CrLf (iii an integer value between 0 and 255, xxx the network ID an integer value between 0 and 255)
Response: [the Bitcoin address ascii encoded] CrLf
Response: ERROR CrLf

9.27 hash160

Action: compute a hash160.
Administrator or User PIN must have been provided.

Cmd: hash160 iii CrLf (iii an integer value between 0 and 255)
Response: [the hash160, 40 hexadecimal digits, ascii encoded] CrLf
Response: ERROR CrLf

9.28 eth

Action: compute an Ehereum address.
Administrator or User PIN must have been provided.

Cmd: eth iii CrLf (iii an integer value between 0 and 255)
Response: [the Ether address, 40 hexadecimal digits, ascii encoded] CrLf
Response: ERROR CrLf

9.29 clear

Action: clear a pair of private and public key.
Administrator PIN must have been provided.

Terminal Display:

```
1234567890123456
Clear iii:yes=#
Adm          time
```

Cmd: clear iii CrLf (iii an integer value between 0 and 255)
Response: OK CrLf
Response: ERROR CrLf

9.30 setkey

Action: set private and public key.
Administrator PIN must have been provided.

Terminal Display:

```
1234567890123456
SetK iii:yes=#
Adm          time
```

Cmd: setkey iii PrivKey PubKey CrLf (iii an integer value between 0 and 255)
Response: OK CrLf
Response: ERROR CrLf

PrivKey: 64 hexadecimal digits (32 bytes)
PubKey: 130 hexadecimal digits (65 bytes), point encoded with uncompress format.

Action: set private and public key.
Administrator PIN must have been provided.

Terminal Display:

```
1234567890123456
SetK iii: yes=#?
Adm          time
```

9.31 setpp

Action: ***set*** private key and ***compute*** public key.
Administrator PIN must have been provided.

Terminal Display:

```
1234567890123456
SetK iii: yes=#?
Adm          time
```

Cmd: setpp iii PrivKey CrLf (iii an integer value between 0 and 15)
Response: OK CrLf
Response: ERROR CrLf

PrivKey: 64 hexadecimal digits (32 bytes)

9.32 getpriv

Action: read a private key.
Administrator PIN must have been provided.
The command must be confirmed.

Terminal Display:

```
1234567890123456
Priv iii: yes=#?
Adm          time
```

Cmd: getpriv iii CrLf (iii an integer value between 0 and 15)
Response: [Length (2bytes) Private Key(32 bytes), Ascii Encoded] CrLf
Response: ERROR CrLf

9.33 setlabel

Action: Set a key label.
Administrator PIN must have been provided.
The command must be confirmed.

Terminal Display:

```
1234567890123456
Label iii:yes=#?
>text
```

Cmd: setlabel KeyIndex (integer 0…15) "text" CrLf
Response:OK
Response: ERROR CrLf

9.34 getlabel

Action: Get a key label.
Administrator or User PIN must have been provided.

Cmd: getlabel KeyIndex (integer 0…15) CrLf
Response: [keylabel] OK
Response: ERROR CrLf

9.35 sign

Action: Generate a Signature.
User or Administrator PIN must have been provided.
The command must be confirmed.

Terminal Display:

```
1234567890123456
Sign iii: yes=#?
User         time
```

Cmd: sign iii [hash value, Ascii Encoded] CrLf (iii an integer value between 0 and 15)
Response: [Length(2bytes), Signature (in ASN.1 syntax), Ascii Encoded] CrLf
Response: ERROR CrLf

9.36 recover

Compute and return the last recovery value (0 or 1).

Cmd: recover iii CrLf (iii an integer value between 0 and 15)
Response:[0 or 1] CrLf
Response: ERROR CrLf

9.37 signr

Action: Generate a Signature and compute the recover value
User or Administrator PIN must have been provided.
The command must be confirmed.

Terminal Display:

```
1234567890123456
Sign iii: yes=#?
User         time
```

Cmd: signr iii [hash value, Ascii Encoded] CrLf (iii an integer value between 0 and 15)
Response: [Length(2bytes), Signature (in ASN.1 syntax), Ascii Encoded] RecoverValue (0/1) CrLf

Response: ERROR CrLf

9.38 signin

Action: Remote Signature Request.
The command must be confirmed.

Terminal Display:

```
1234567890123456
Sign iii: yes=#?
Off          time
```

Cmd: signin iii [hash value, Ascii Encoded] record CrLf
- iii an integer value between 0 and 255
- hash value, the value (up to 32 bytes) to be signed
- record: the record number (default=0, integer 0...20)
Response:OK CrLf
Response: ERROR CrLf

9.39 signout

Action: Read Remote Signature
The command must be confirmed.

Terminal Display:

```
1234567890123456
Sign iii: yes=#?
Off          time
```

Cmd: signout iii [HashValue, Ascii Encoded]
- iii an integer value between 0 and 15
- HashValue, the value to be signed
Response: : [Length (2bytes), Signature (in ASN.1 syntax) Hexa Ascii Encoded] [Length (2bytes), Public Key value uncompress format Hexa Ascii Encoded] CrLf
Response: ERROR CrLf

9.40 signoutr

Action: Read Remote Signature and compute the recover value
The command must be confirmed.

Terminal Display:

```
1234567890123456
Sign iii: yes=#?
Off          time
```

Cmd: signoutr iii [HashValue, Ascii Encoded]
- iii an integer value between 0 and 15
- HashValue, the value to be signed
Response: : [Length (2bytes), Signature (in ASN.1 syntax) Hexa Ascii Encoded] [Length (2bytes), Public Key value uncompress format Hexa Ascii Encoded] RecoverValur (0/1) CrLf
Response: ERROR CrLf

9.41 signdo

Action: Do Remote Signature
User or Administrator PIN must have been provided
The command must be confirmed.

Terminal Display:

```
1234567890123456
Sign iii: yes=#?
User         time
```

Cmd: signdo iii [hash value, Ascii Encoded] record
- iii an integer value between 0 and 255
- hash value, the value to be signed
- record: the record number (0...20)

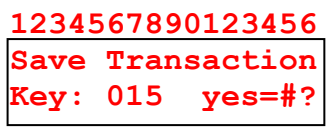
Response: : OK CrLf
Response: ERROR CrLf

9.42 settrans (generation of ether transaction)

Action:
The serial command "settrans" generates an Ether transaction according to the seven following parameters:
- Key Index, the key to be used for the transaction signature
- Nounce, the nounce of the transaction, an integer positive value, starting from zero, and incremented by one after every transaction.
- GasPrice, the gas price to be used for the transaction in GWEIs
- GasLimit, the maximum instructions to be computed for the transaction, leading to a maximum cost of GasLimit x GasPrice
- Recipient Address, the Ether address (20 bytes, 40 hexadecimal digits) of the transaction recipient
- Amount, the amount of the transaction (in Ether) in decimal format, such as 0.0.
- Data, the data associated to the transaction (text or hexadecimal, up to 448 characters)
    - Text example: "Hello World"
    - Text example: #Hello World
    - Hexadecimal example: $313233

The command must be confirmed.

Terminal Display



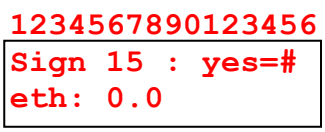
Cmd: settrans KeyIndex Nounce GasPrice GasLimit RecipientAddress Amount Data CrLf
Response: :OK CrLf
Response: ERROR CrLf

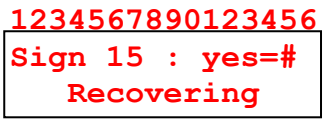
9.43 signt

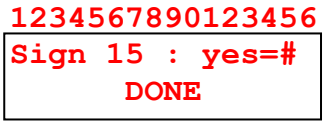
Action:
The serial command "signt" generates the signature of an ether transaction previously created

The command must be confirmed.

Terminal Display





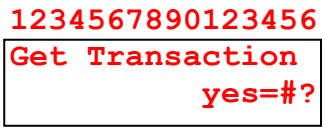


Cmd: signt
Response: :OK CrLf
Response: ERROR CrLf

9.44 gettrans

Action: read a signed transaction
The command must be confirmed.

Terminal Display



Cmd: gettrans CrLf

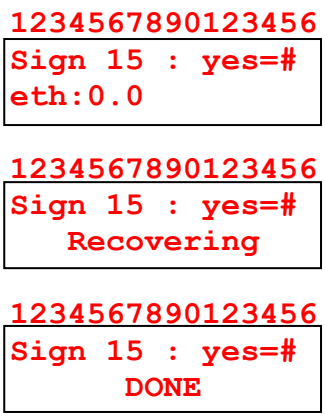
Response: : [Transaction encoded in hexadecimal] CrLf
Response: ERROR CrLf

9.45 settransf (generation and signature of ethereum transaction)

Action:
The serial command "settrans" generates an Ethereum transaction and associated signature according to the seven following parameters:
- Key Index, the key to be used for the transaction signature
- Nounce, the nounce of the transaction, an integer positive value, starting from zero, and incremented by one after every transaction.
- GasPrice, the gas price to be used for the transaction in GWEIs
- GasLimit, the maximum instructions to be computed for the transaction, leading to a maximum cost of GasLimit x GasPrice
- Recipient Address, the Ether address (20 bytes, 40 hexadecimal digits) of the transaction recipient
- Amount, the amount of the transaction (in Ether) in decimal format, such as 0.0.
- Data, the data associated to the transaction (text or hexadecimal, up to 448 characters)
    - Text example: "Hello World"
    - Text example: #Hello World
    - Hexadecimal example: $313233

The command must be confirmed.

Terminal Display



Cmd: settrans KeyIndex Nounce GasPrice GasLimit RecipientAddress Amount Data CrLf
Response: : [Transaction encoded in hexadecimal] CrLf
Response: ERROR CrLf

9.46 duplicate

Action: Duplicate a CCSC smartcard to another SCSC device.
Administrator PIN MUST have PIN provided.
The command must be confirmed.

Cmd: duplicate CrLf
Response: :OK CrLf
Response: ERROR CrLf

Terminal Displays:

```
1234567890123456
Remove Card
#=Confirm ?
```

```
1234567890123456
Insert new card
#=Confirm ?
```

```
1234567890123456
Adm:????????
D=Del C=No  #=OK
```

9.47 read

Action: Read data from smartcard non volatile user memory
User2 PIN or Administrator PIN MUST have PIN provided

Cmd: read address size
address: data address (0...16383, decimal value), 16 KB available.
size: size of data to be read (1..256, decimal value)
Response: : [data (up to 256 bytes), hexadecimal ascii encoded] CrLf
Response: ERROR CrLf

9.48 write

Action: Write data in smartcard non volatile user memory
User2 PIN or Administrator PIN MUST have PIN provided

Cmd: write adr [data]
adr: data address (0...16383, decimal value), 16 KB available.
data: data to be written (1..255 bytes, hexadecimal ascii encoded)
Response: :OK CrLf
Response: ERROR CrLf

9.49 bMAC

Action: Check the Crypto Terminal firmware integrity.
Cmd: bmac seed [eeprom]
seed, an integer value between 0 and 2^{31}-1
eeprom, an option that erases EEPROM

Response: :ComputingTime MAC CrLf

ComputingTime: the computing time value in 4µs unit
MAC: the 32bytes bMAC value
Response: ERROR CrLf

Terminal Displays:

```
1234567890123456
Seed: 1234567890
              bMAC
```

9.50 check

Action: Check a CCSC smartcard authenticity.
Adminstrator or User PIN MUST have been provided.
The command must be confirmed.

Cmd: check CrLf
Response: :OK CrLf
Response: ERROR CrLf

9.51 tecc

Action: Test ECC firwmare.

Cmd: tecc CrLf
Response: :OK CrLf
Response: ERROR CrLf

9.52 binder

Action: build cryptographic binder for TLS 1.3.
Administrator or User PIN MUST have been provided.

Cmd: binder 32bytes_hexadecimal_value CrLf
Response: 32bytes_hexadecimal_value CrLf
Response: ERROR CrLf

9.53 derive

Action: compute handshake secret for TLS 1.3.
Administrator or User PIN MUST have been provided.

Cmd: derive 32bytes_hexadecimal_value CrLf
Response: 32bytes_hexadecimal_value CrLf
Response: ERROR CrLf

9.54 content

Action: Read and check the card content

Administrator or User PIN MUST have been provided.

Cmd: content CrLf
Response: 32bytes_hexadecimal_value CrLf
Response: ERROR CrLf

10 CryptoTerminal Menus

The CryptoTerminal is equipped with an IPS touch screen whose resolution is 320x480. It emulates a 16 keys keypad, and a 2x16 characters LCD display.

10.1 Boot Message (BM)

```
1234567890123456
   EtherTrust
Crypto  Terminal
```

10.2 Idle Menu (IM)

Root Menu

```
1234567890123456
A=Menu     B=Boot
Mode         time
```

Mode: Off/On/Adm/User/User2/User1&2
Time: Local time in seconds, since power on

10.2.1 CheckCard Menu

Path IM.0

```
1234567890123456
CHECK Card
```

```
1234567890123456
Reading Pub
```

```
1234567890123456
Reading Cert
```

```
1234567890123456
Challenge
```

```
1234567890123456
Genuine Card
```

10.2.2 Serial USB Mode

Path IM.1

```
1234567890123456
Serial USB
```

10.2.3 Bluetooth Mode

Path IM.2

```
1234567890123456
Bluetooth
```

10.2.4 BLE Loader Mode

Path IM.3

```
1234567890123456
BT Loader
```

10.2.5 Card Content

Path IM.4

```
1234567890123456
Reading Pub
```

```
1234567890123456
Reading Content
```

```
1234567890123456
Checking Content
```

```
1234567890123456
1234567890ABCDEF
          Content
```

10.2.6 Bluetooth Menu (BTM)

Path IM.5

```
1234567890123456
1=AT       AT=off
2=btPIN 3=btNAME
```

10.2.7 BMAC Menu (BMM)

Path IM.7

```
1234567890123456
1=bMAC 3=bMACble
2=bMAC+EEPROM  ?
```

10.2.8 Boot Menu (BM)

Path: IM.B

```
1234567890123456
Reboot(type B)=?
Mode          time
```

10.2.9 A Menu (AM)

Path: IM.A

```
1234567890123456
1=Mode     2=Key?
3=PIN 4=Dup 5=Tr
```

10.3 Bluetooth Setting Menu (BSM)

10.3.1 AT mode

Path: BTM.1

```
1234567890123456
Trying
OK
```

10.3.2 BT Pin

Path: BTM.2

```
1234567890123456
000000
btPIN
```

10.3.3 BT Name

Path: BTM.3

```
1234567890123456
ECTv2
btNAME
```

10.4 bMAC Run Menu (BRM)

10.4.1 Run bMAC

```
1234567890123456
Seed: 1234567890
#=OK  D=Del Time
```

```
1234567890123456
Seed: 1234567890
  BMAC Computing
```

```
1234567890123456
81586363 57820
4FE958A1BF7C8658
```

10.4.2 Run bMAC+EEPROM

```
1234567890123456
Seed: 130757
#=OK  D=Del Time
```

```
1234567890123456
Seed: 130757
     BMAC+EEPROM
```

```
1234567890123456
81776880 08341
F11E62C62DAD1793
```

10.4.3 Run bMAC BLE

```
1234567890123456
Seed: 0
#=OK  D=Del Time
```

```
1234567890123456
Seed: 1234567890
   BLE Computing
```

```
1234567890123456
1165679 34846
EA2C02C71657BD04
```

10.5 Mode Menu (MM)

Path: AM.1

```
1234567890123456
1=ON 2=OFF 3=ADM
4=USER 5=USER2 ?
```

10.5.1 Mode ON

Path MM.1

```
1234567890123456
  Starting SE
?              OK
```

10.5.2 Mode OFF

Path MM.2

```
1234567890123456
  Stopping SE
?              OK
```

10.5.3 Mode ADM

Path: MM.3

```
1234567890123456
  Starting SE
```

```
1234567890123456
Adm:????????
D=Del C=No  #=OK
```

```
1234567890123456
                Adm
?                OK
```

```
1234567890123456
                Adm
?             ERROR
```

10.5.4 Mode User

Path: MM.4

```
1234567890123456
  Starting SE
```

```
1234567890123456
User:????
D=Del C=No  #=OK
```

```
1234567890123456
               User
?               OK
```

```
1234567890123456
               User
?             ERROR
```

10.5.5 Mode User2

Path: MM.5

```
1234567890123456
  Starting SE
```

```
1234567890123456
User2:????
D=Del C=No  #=OK
```

```
1234567890123456
              User2
?               OK
```

```
1234567890123456
             User2
?            ERROR
```

10.6 Key Menu (KM)

Path AM.2

10.6.1 Key Index

```
1234567890123456
KeyIndex: ???
#=OK D=Del  C=No
```

```
1234567890123456
1=Sign 2=Gen 4=C
Key:iii 3=Rec A>
```

10.6.1.1 Sign

Path: KM.1

```
1234567890123456
Sign iii: yes=#?
Record: yy
```

```
1234567890123456
    sign iii rec
?             OK
```

```
1234567890123456
    sign iii rec
?          ERROR
```

10.6.1.2 Genkey

Path: KM.2

```
1234567890123456
GenK iii: yes=#?
#=OK D=Del  C=No
```

```
1234567890123456
      genkey iii
?             OK
```

```
1234567890123456
      genkey iii
?          ERROR
```

10.6.1.3 Record Index

Path KM.3

```
1234567890123456
RecordIndex: ??
#=OK D=Del  C=No
```

10.6.1.4 Clear Key

Path KM.4

```
1234567890123456
Clear iii yes=#?
```

```
1234567890123456
       clear iii
?             OK
```

10.6.2 Key Menu2 (KM2)

Path: KM.A

```
1234567890123456
1=CKey 2=SetTree
3=GetL 4=SetL A>
```

10.6.2.1 CKey (Compute Key)

Path: KM.2.1

```
1234567890123456
1234.10---------
 ComputeKey: dec
```

```
1234567890123456
CKEY iii: yes=#?
.1000.10
```

```
1234567890123456
ComputeKey
DONE           ?
```

```
1234567890123456
ComputeKey
ERROR              ?
```

10.6.2.2 SetTree

Path: KM2.2

```
1234567890123456
1=SetTree 2=Read
3=Generate Tree
```

10.6.2.2.1 SetTree

Path: KM2.2.1

```
1234567890123456
1234_____________
   SetSeed: hexa
```

```
1234567890123456
Seed iii: yes=#?
Col:005 n:004 U
```

```
1234567890123456
SetSeed
DONE               ?
```

```
1234567890123456
SetSeed
ERROR              ?
```

10.6.2.2.2 Read

Path: KM2.2.2

```
1234567890123456
Seed iii: yes=#?
Getseed 3          ?
```

```
1234567890123456
GetTreeSeed
ERROR              ?
```

```
1234567890123456
0123456789ABCDEF
  TreeSeed: hexa
```

10.6.2.2.3 GenerateTree

Path: Path: KM2.2.2

```
1234567890123456
Length 32 number
#=OK D=Del  C=No
```

```
1234567890123456
Seed iii: yes=#?
Col:005 n:004 U
```

```
1234567890123456
SetSeed
DONE               ?
```

```
1234567890123456
SetSeed
ERROR              ?
```

10.6.2.3 GetL (Get Label)

Path: KM2.3

```
1234567890123456
Hello World !
                   ?
```

```
1234567890123456
GetLabel
ERROR              ?
```

10.6.2.4 SetL (Set Label)

Path: KM2.4

```
1234567890123456
Hello World !
Setlabel 3
```

```
1234567890123456
Label iii:yes=#?
>Hello World!
```

```
1234567890123456
SetLabel
DONE               ?
```

```
1234567890123456
SetLabel
ERROR              ?
```

10.6.3 Key Menu3 (KM3)

Path: KM2.5

```
1234567890123456
1=SetPr   2=GetPr
3=GetPub  4=GetT
```

10.6.3.1 SetPr (Set Private Key)

Path KM3.1

```
1234567890123456
0123456789ABCDEF
SetPrivKey: hexa
```

```
1234567890123456
SetK iii: yes=#?
```

```
1234567890123456
SetPrivKey
DONE               ?
```

```
1234567890123456
SetPrivKey
ERROR              ?
```

10.6.3.2 GetPr (Get Private Key)

Path: KM3.2

```
1234567890123456
GetPrivKey
ERROR              ?
```

```
1234567890123456
Priv iii: yes=#?
getpriv 3
```

```
1234567890123456
0123456789ABCDEF
   PrivKey: hexa
```

10.6.3.3 GetPub (get public key)

Path KM3.3

```
1234567890123456
1=Raw       2=BTV
3=H160      4=ETH
```

10.6.3.3.1 Raw

Path KM3.3.1

```
1234567890123456
GetPubKey
ERROR              ?
```

```
1234567890123456
0437A4AEF1F8423C
    PubKey: hexa
```

10.6.3.3.2 BTC

Path KM3.3.1

```
1234567890123456
ID:0??   integer
#=OK  D=Del C=No
```

```
1234567890123456
1Mf9gx8gF9ocM42b
BTC Address 000
```

10.6.3.3.3 Hash160

Path KM3.3.2

```
1234567890123456
1234567890ABCDEF
 HASH160 Address
```

10.6.3.3.4 Ethereum Address

Path KM3.3.3

```
1234567890123456
1234567890ABCDEF
   ETHER Address
```

10.6.3.4 GetT (Get Tree Seed)

Path KM3.4

```
1234567890123456
Seed iii: yes=#?
Getseed 3      ?
```

```
1234567890123456
GetTreeSeed
ERROR          ?
```

```
1234567890123456
0123456789ABCDEF
  TreeSeed: hexa
```

10.7 Duplicate Card Menu (Dup)

Path AM.4

10.7.1 Remove Card

```
1234567890123456
Remove Card
#=Confirm ?
```

10.7.2 Insert New Card

```
1234567890123456
Insert new card
#=Confirm ?
```

10.7.3 Enter ADM PIN

```
1234567890123456
Adm:????????
D=Del C=No  #=OK
```

10.8 Transaction Menu (Tr)

Path AM.5

```
1234567890123456
KeyIndex: ???
#=OK D=Del C=No?
```

```
1234567890123456
Transaction  015
Eth=1          ?
```

10.8.1 Ethereum Menu (EM)

Path AM.5.1

```
1234567890123456
1=Create   2=Del
3=Edit    4=Sig?
```

10.8.1.1 Create transaction

Path EM.1

```
1234567890123456
1=@ 2=Eth 37=Dat
4=N. 5=Gas 6=Lim
```

```
1234567890123456
Save Transaction
          yes=#?
```

10.8.1.1.1 Recipient Address
Path EM.1.1

10.8.1.1.2 Ether Amount
Path EM.1.2

10.8.1.1.3 Tx Data (text)
Path EM.1.3

10.8.1.1.4 Transaction Nonce
Path EM.1.4

10.8.1.1.5 Gas Price
Path EM.1.5

10.8.1.1.6 Gas Limit
Path EM.1.6

10.8.1.1.7 Tx Data (Hexadecimal)
Path EM.1.7

10.8.1.2 Delete

Path EM.2

```
1234567890123456
Transaction
Delete     #=yes?
```

10.8.1.3 Edit

Path EM.3

```
1234567890123456
1=@ 2=Eth 37=Dat
4=N. 5=Gas 6=Lim
```

```
1234567890123456
Save Transaction
          yes=#?
```

10.8.1.3.1 Recipient Address
Path EM.3.1

10.8.1.3.2 Ether Amount
Path EM.3.2

10.8.1.3.3 Tx Data (Text)
Path EM.3.3

10.8.1.3.4 Transaction Nonce
Path EM.3.4

10.8.1.3.5 Gas Price
Path EM.3.5

10.8.1.3.6 Gas Limit
PATH EM.3.6

10.8.1.3.7 Tx Data (Hexadecimal)
Path EM.3.7

10.8.1.4 Sign

Path EM.4

```
1234567890123456
Sign 015: yes=#?
      DONE
```

11 BTOOLS Script commands

BTOOLS (2.0) is open software (*https://github.com/purien/btools*) available for WINDOWS and LINUX and RASPBERRYPI, which generates transactions for Bitcoin and Ethereum crypto currency platforms. It is based on the OPENSSL library. In order to provide a strong security, it supports it the Crypto Currency SmartCard (CCSC) uses to generate and store secret keys, and to compute cryptographic (ECDSA) signature.

BTOOLS (3.0) is compatible with the CryptoTerminal.

It supports two facilities, a serial terminal for manual interactions and scripts for programmed interactions.

11.1 Starting a serial terminal

A serial terminal is started by the command line:

btools –terminal delay.

The typical value for delay is 2000 (ms)

11.2 CryptoTerminal Script

A *CryptoTerminal* script has a name that begins by the "_" character.

It is a set of command lines ending by the CrLF characters.

11.2.1 Index Array

An integer value can be stored in an *Index Array* (IA[256]), whose index is %xy, where xy is an hexadecimal two digit integer. For example %A0 (160 in decimal) means that index = TA[160].
An index affectation in done in the transaction script, for example %A0 4, means that KA[160].= 4

11.2.2 start

Action: start a session with the CryptoTerminal

Cmd: start [optional COM port number] [optional delay in ms]

11.2.3 on

Action: power the CryptoTerminal secure element

Cmd: on

11.2.4 off

Action: unpower the CryptoTerminal secure element

Cmd: off

11.2.5 adm

Action: set the CryptoTerminal in Administrator mode

Cmd: adm

11.2.6 user

Action: set the CryptoTerminal in User mode

Cmd: adm

11.2.7 user2

Action: set the CryptoTerminal in User2 mode

Cmd: user2

11.2.8 getpub

Action: get the public key.

Cmd: getpub KeyIndex
- KeyIndex is a decimal value (0...255)

11.2.9 sign

Action: compute an ECDSA signature.

Cmd: sign KeyIndex
- KeyIndex is a decimal value (0...255)

11.2.10 signout

Action: export a ValueToSign for offline signature

Cmd: sign KeyIndex RecordIndex
- KeyIndex: a decimal value (0...255)
- RecordIndex: the record index to be used (0..20)

11.2.11 setpub

Action: set the public key value needed for offline signature
This command is used only for bitcoin family transactions, before signout and signin commands.

Cmd: setpub PublicKeyValue

11.2.12 signdo

Action: compute the offline signature

Cmd: signdo KeyIndex RecordIndex
- KeyIndex: a decimal value (0...255)
- RecordIndex: the record index to be used (0..20)

11.2.13 signin

Action: read an offline signature

Cmd: signin KeyIndex RecordIndex
- KeyIndex: a decimal value (0...255)
- RecordIndex: the record index to be used (0..20)

11.2.14 raw

Action: send a command to the CryptoTerminal

Cmd: raw [CryptoTerminal Command]

Examples:
raw setseed TreeIndex SeedValue
raw compute TreeIndex KeyPath

12 BTOOLS CryptoTerminal Transaction Script Examples

12.1 Ethereum Transaction Generation

btools -genethtrans escript.txt ecsript.bin

12.1.1 CryptoTerminal script

```
//////////////////
// _term.txt    //
//////////////////
start 2 1000
user
getpub %A0
sign   %A0
off
```

12.1.2 EthereumTransaction Script

```
////////////////////////
//    escript.txt     //
////////////////////////
%A0 5
apdu_script _term.txt
nonce     14
gasPrice  30000000000
gasLimit  80000
to         6BAC1B75185D9051AF740AB909F81C71BBB221A6
value      0
data       "Hello World"
// dataf   file.txt
```

12.2 Bitcoin Transaction Generation

btools -gentrans bscript.txt bscript.bin

12.2.1 CryptoTerminal script

```
//////////////////
// _term.txt    //
//////////////////
start 2 1000
user
getpub %A0
sign   %A0
off
```

12.2.2 Bitcoin Transaction Script

```
//////////////////
// bscript.txt //
//////////////////

sequence ffffffff
locktime 00000000

%A0 4

nb_input 1

input
transaction     3573f3007a83db8b0eb04a808bf76983dba8270be9c2df44a196
                97517ab2c062
index 1
apdu_script _term.txt

nb_output 2

output "Hello Ethertrust Crypto Terminal !"
output
fee 0.0010
btc 0.5270
adr mtekQi1EPrxo5TngwipB31VJTihSCTjxjk
```

13 The Crypto Currency SmartCard

The Crypto Currency smartcard (CCSC), of which AID is 010203040500 has three PINs, administrator, user, and user2. The default values are 8 zeros (3030303030303030) for administrator and 4 zeros (30303030) for user and user2.

It is able to generate, to compute according to the BIP32 standard, or to import elliptic curve keys (up to 16), used for the generation of ECDSA signatures used by Bitcoin and Ethereum crypto currencies.

A Read/Write non volatile memory (16KB), protected by a dedicated PIN (User2), is available for the storage of any sensitive information.

13.1 The Select Command

This command starts the Crypto Currency smartcard application
Upon success it returns the status word SW1 SW2 = 9000

Command

CLA	INS	P1	P2	P3	AID
00	A4	04	00	06	010203040500

Response

SW1	SW2
90	00

13.2 The Verify UserPin Command

This command verifies the user pin. The UserPin is required for the signature operations.

Upon success it returns the status word SW1 SW2 = 9000
Otherwise it returns SW1=63, SW2=number of remaining tries (3 at the most)

Command

CLA	INS	P1	P2	P3	UserPin
00	20	00	00	04	3030303030

Response

SW1	SW2	Comment
90	00	Success
63	Number of remaining tries	Fail
67	00	Wrong Length
6B	00	Wrong P1P2

13.3 The Verify UserPin2 Command

This command verifies the second user pin. The UserPin2 is required for the memory reading and writing operations.
Upon success it returns the status word SW1 SW2 = 9000
Otherwise it returns SW1=63, SW2=number of remaining tries (3 at the most)

Command

CLA	INS	P1	P2	P3	UserPin2
00	20	00	02	04	3030303030

Response

SW1	SW2	Comment
90	00	Success
63	Number of remaining tries	Fail
67	00	Wrong Length
6B	00	Wrong P1P2

13.4 The Verify AdminPin command

This command verifies the administrator pin. It gives access to all available features of the crypto currency application. If P2 is set to FF UserPin and UserPin2 are reset to the default value (four zeros).

Upon success it returns the status word SW1 SW2 = 9000
Otherwise it returns SW1=63, SW2=number of remaining tries (ten at the most)

Command

CLA	INS	P1	P2	P3	AdminPin
00	20	00	01 FF Reset to default	08	30303030303030303030

Response

SW1	SW2	Comment
90	00	Success
63	Number of remaining tries	Fail
67	00	Wrong Length
6B	00	Wrong P1P2

13.5 The ChangePin command

This command sets a PIN (UserPin, UserPin2, AdminPin) to a new value
The P2 value is respectively 00, 02, 01 for UserPin, UserPin2, AdminPin.
Upon success it returns the status word SW1, SW2 = 9000.
Otherwise it returns SW1=63, SW2=number of remaining tries.

Command

CLA	INS	P1	P2	P3	OldPin	NewPIN
00	24	00	00	10	30303030FFFFFFFF	31313131FFFFFFFF
00	24	00	02	10	30303030FFFFFFFF	30303030FFFFFFFF
00	24	00	01	10	3030303030303030	3131313131313131

Response

SW1	SW2	Comment
90	00	Success
63	Number of remaining tries	Fail
67	00	Wrong Length
6B	00	Wrong P1P2

13.6 The GetStatus command

This command returns the current state of the crypto currency application. It required at least the previous checking of one PIN (UserPin, UserPin2, AdminPin).

Command

CLA	INS	P1	P2	P3
00	87	00	00	0A

Response

SW1	SW2	Comment
90	00	Success
63	80	PIN required

This command returns 10 bytes.

byte0: b0= ECDSA, b1=DH, b3=SHA256, b4=HMAC-512, b5= BigNumber (OK= 0x07)
byte1: The maximum number of keys that can be used by the crypto currency application (16)
byte2, byte3: The CCSC application version 0x0007 = v0.7)
byte4, byte5: The size of the user memory (for example 4000 for 16 KB)
byte6, byte7: 16 bits (b15...b1b0) indicating the index (bi) of defined keys, for example 0003 for key1 (bit1) and key0 (bit0)
byte8, byte9: 16 bits (b15...b1b0) indicating the index (bi) of defined key trees, for example 0003 for tree1 (bit1) and tree0 (bit0)

13.7 The Write Command

This command writes data in the non volatile memory. This service could be used for the secure storage of any information in the area [0000, 0C00[.

It requires the previous checking of PINs UserPin2 or AdminPin.
Upon success it returns the status word SW1, SW2 = 9000.
Otherwise it returns SW1=63, SW2=80 (PIN required).

Command

CLA	INS	P1	P2	P3	Data
00	D0	AdrMSB	AdrLSB	Data Length	Data to be written

The starting address ranging from 0000 to 10FF is encoded by two bytes (P1, P2), P1 being the *most significant byte* (MSB) and P2 the *less significant byte* (LSB).

Address Mapping

Start Address	Length	Comment	PIN required
0000	0C00	Data Area	User2 or Admin
0C00	0400	Key Dump Area	Admin
1000	0100	Key Label - 32 bytes/key	Admin

Response

SW1	SW2	comment
90	00	OK
63	80	PIN required
6D	02	Invalid Address

13.8 The Read Command

This command reads data in the non volatile memory.
It requires the previous checking of PINs UserPin2 or AdminPin.
Upon success it returns the status word SW1,SW2 = 9000.
Otherwise it returns SW1=63, SW2=80 (PIN required).

Command

CLA	INS	P1	P2	P3
00	B0	AdrMSB	AdrLSB	Length to be read

The starting address ranging from 0000 to 10FF is encoded by two bytes (P1, P2), P1 being the most significant byte (MSB) and P2 the less significant byte (LSB).

Address Mapping

Start Address	Length	Comment	PIN required
0000	0C00	Data Area	User2 or Admin
0C00	0400	Key Dump Area	Admin
1000	0100	Key Label - 32 bytes/key	Admin

Response

Body	SW1	SW2	comment
Data	90	00	OK
Empty	63	80	PIN required
Empy	6D	01	Invalid Address

13.9 The Clear KeyPair & InitCurve Command

This command MUST be used before any key setting or key generation operation.
This command clears the curve parameters.
The InitCurve command is required to configure the EllipticCurve, excepted when the InitCurve option is used.

It requires the Admin PIN, or for P1=10 (Reset Key Tree) User or Admin PIN.

The P1=80 option is used to clear either the public or the private, and to initialize the associated curve. Here are some examples

- P1=C0, clear public key and initialize curve SECP256k1.
- P1=A0, clear private key and initialize curve SECP256k1.

The P1=10 option resets and initializes a KeyTree.

Upon success it returns the status word SW1, SW2 = 9000.
Otherwise it returns SW1=63, SW2=80 (PIN required).

Command

CLA	INS	P1	P2	P3	PIN required
00	81	00 – Clear Keys 10 – Clear Keys & KeyTree			
00	81	SECP256k1 80 – ClearKeys & InitCurve 40 - Clear Public Key Only 20 - Clear Private Key Only 10 - Reset KeyTree	Key Index [0,15]	00	Admin

Response

SW1	SW2	Comment
90	00	Key Reset Done
63	80	PIN required
69	85	Bad index

13.10 The InitCurve & InitTree Command

This command initializes the elliptic curve parameters and optionally a KeyTree.

The KeyTree is initialized by a seed according to the BIP32 specification. Two mode of seed generation are available:
- The seed value is imported;
- The seed value is randomly generated.

The keys MUST be cleared before this operation.

It requires the Admin PIN.

Upon success it returns the status word SW1, SW2 = 9000.
Otherwise it returns SW1=63, SW2=80 (PIN required).

Command

CLA	INS	P1	P2	P3	PIN required
00	89	00 - SECP256k1	Key Index [0,15]	00	Admin
00	89	00 - SECP256k1	Tree Index [0,15]	Seed Length If P3=1, the payload is the size of the seed to be randomly generated	Admin

Response

Data	SW1	SW2	Comment
	90	00	Key Reset Done
TreeStatus 2 bytes b_i= TreeIndex	90	00	KeyTree initialized
	63	80	PIN required
	69	85	Bad index
	64	01	Public Key is defined
	64	02	Private Key is defined
	6A	86	Incorrect P1P2
	69	85	KeyTree initialization error

13.11 The Generate KeyPair Command

This command generates the elliptic curve public and private keys or computes a key according to the BIP32 specification

The keys MUST be cleared before this operation.

It requires the Admin PIN or for KeyTree (P2 is a KeyTree index and P3#0) User PIN or Admin PIN

If P3 is set to zero a private public key pair is randomly generated.

If P3 is a multiple of 4, a hardened private key is generated whose index a list of n 32 bits word, $IH_1/IH_2/\ldots/IH_n$.. The public key is not computed. The MSB bit of IHi 32bits word MUST be set.

Upon success it returns the status word SW1, SW2 = 9000.
Otherwise it returns SW1=63, SW2=80 (PIN required).

Command

CLA	INS	P1	P2	P3	PIN required
00	82	00	Key Index [0,15]	00	Admin
00	82	00	Tree Index [0,15]	4 n	Admin

Response

SW1	SW2	Comment
90	00	OK
63	80	PIN required
69	85	Bad index
64	01	Public Key is defined
64	02	Private Key is defined
6D	10	Key Generation Error

13.12 The Dump KeyPair Command

This command dumps the elliptic curve public and private keys.
It returns the size of the data written in the non volatile memory, in the *Key Dump* area whose address starts at 0C00

It requires the Admin PIN.
Upon success it returns the status word SW1, SW2 = 9000.
Otherwise it returns SW1=63, SW2=80 (PIN required).

Command

CLA	INS	P1	P2	P3	PIN required
00	83	00	Key Index [0,15]	02	Admin
00	83	FF Reset DUMP Area	Not Used	00	Admin

Response

Body	SW1	SW2	Comment
Total Length 2 bytes SECP256k1 0185 SECP256v1 0201	90	00	Key Reset Done
	63	80	PIN required
	69	85	Bad index
	64	01	Public Key is not defined
	64	02	Private Key is not defined
	6A	86	Incorrect P1P2

Dump KeysPair: Memory Mapping

Address = 0C00	Comment
Total Length, 2 bytes	
PubKey A Length, 2 bytes	The length of the A parameter
PubKey A parameter value	The value of the A parameter
PubKey B Length, 2 bytes	The length of the B parameter
PubKey B parameter value	The value of the B parameter
PubKey G Length, 2 bytes	The length of the Generator
PubKey G value	The value of the Generator
PubKey R Length, 2 bytes	The length of the R parameter
PubKey R value	The value of the R parameter (Order of the Generator)
PubKey W Length, 2 bytes	The length of the W parameter
PubKey W value	The value of the W Public Key (EC Point)
PubKey Field Length, 2 bytes	The length of the Field parameter
PubKey Field Value	The value of the prime p of the field Z/pZ
PubKey Size, 2 bytes	The size of the Public Key object
PrivKey A Length, 2 bytes	The length of the A parameter
PrivKey A parameter value	The value of the A parameter
PrivKey B Length, 2 bytes	The length of the B parameter
PrivKey B parameter value	The value of the B parameter
PrivKey G Length, 2 bytes	The length of the Generator
PrivKey G value	The value of the Generator
PrivKey R Length, 2 bytes	The length of the R parameter
PrivKey R value	The value of the R parameter (Order of the Generator)
PrivKey S Length, 2 bytes	The length of the S parameter
PrivKey S value	The value of the S, Private Key (32 bytes)
PrivKey Field Length, 2 bytes	The length of the Field parameter
PrivKey Field Value	The value of the prime p of the field (Z/pZ)
PrivKey Size, 2 bytes	The size of the Private Key object

13.13 The GetInfo command

This command collects a list of information for a given key index, including key label, tree seed and private key.
It requires the Admin PIN, or the user PIN for the *CardContent* option.
Upon success it returns the status word SW1, SW2 = 9000.
Otherwise it returns SW1=63, SW2=80 (PIN required).

Command

CLA	INS	P1	P2	P3	PIN required
00	86	00	Key Index [0,15]	00	Admin

CLA	INS	P1	P2	P3	Payload	PIN required
00	86	FF CardContent	00	0 to 32	xx random bytes (r)	User or Admin

Response

Body	SW1	SW2	Comment
If P1=0 Status 2 bytes 0x0000: no tree or key 0x0001: Tree 0x0002: Key 0x0003: Tree & Key Label Length (2 bytes) Label Value TreeSeed Length (2 byte) TreeSeed value Private Key Length (2 bytes) Private key value	90	00	 If status # 0 (tree or key) If tree If key
If P1=FF hash length 2 bytes hash value signature length 2 bytes signature value (ASN.1 encoded)	6C 90	xx 00	Read the signed card content sign(sha256(hash-value || r))
	63	80	PIN required
	69	85	Bad index

13.14 The Get KeyParameter Command

This command collects the elliptic curve public and private keys parameters.

It requires the User or the Admin PIN.
Upon success it returns the status word SW1, SW2 = 9000.
Otherwise it returns SW1=63, SW2=80 (PIN required).

Command

CLA	INS	P1	P2	P3	PIN required
00	84	00 Parameter A	Key Index [0,15]	00	Admin or User
		01 Parameter B		00	Admin or User
		02 Parameter Field (Z/pZ)		00	Admin or User
		03 Parameter G (generator)		00	Admin or User
		04 Parameter K (cofactor)		00	Admin or User
		05 Parameter R (order of G)		00	Admin or User
		06 Parameter W (Public Key)		43	Admin or User
		07 Parameter S (Private Key		22	Admin
		08 Key Label		20	Admin or User
		09 x value of the public key		00	Admin or User
		0A TreeSeed		00	Admin

Response

Body	SW1	SW2	Comment
Param0 Length – Param0 value Param1 Length – Param1 value Param2 Length – Param2 value Param3 Length – Param3 value Param4 Length – Param4 value Param5 Length – Param5 value Param6 Length – Param6 value Param7 Length – Param7 value	90	00	Response includes a 2 bytes length field for parameters 0 to 7
Param8 (Key Label) Value	90	00	OK
Param9 Length – Param9 value	90	00	The x value of the public key
	63	80	PIN required
	69	85	Bad index
	64	01	Public Key is not defined
	64	02	Private Key is not defined
	6A	86	Incorrect P1P2
	6D	30	Javacard Exception
ParamA Length – ParamA value	90	00	OK

13.15 The Set KeyParameter Command

This command sets the elliptic curve parameters, including public and private keys parameters It requires the Admin PIN excepted for Parameter 6 (Public Key) for which User or Admin PIN is required.

Upon success it returns the status word SW1, SW2 = 9000.
Otherwise it returns SW1=63, SW2=80 (PIN required).

Command

CLA	INS	P1	P2	P3	PIN required
00	88	00 Parameter A	Key Index [0,15]	Length	Admin
		01 Parameter B		Length	Admin
		02 Parameter Field (Z/pZ)		Length	Admin
		03 Parameter G (generator)		Length	Admin
		04 Parameter K (cofactor)		Length	Admin
		05 Parameter R (order of G)		Length	Admin
		06 Parameter W (Public Key) The public key is checked according to the private key, and is reset in case of error		41	Admin
		07 Parameter S (Private Key The private key MUST be initialized before setting the public key		20	Admin
		08 Key Label		20	Admin

Response

SW1	SW2	Comment
90	00	OK
63	80	PIN required
69	85	Bad index
64	01	Public Key is defined
64	02	Private Key is defined
6A	86	Incorrect P1P2
6D	40	Javacard Exception

13.16 The SignECDSA command

This command generates an ECDSA signature.

It requires the AdminPin or UserPin.

Upon success it returns the status word SW1, SW2 = 9000.
Otherwise it returns SW1=63, SW2=80 (PIN required).

Command

CLA	INS	P1	P2	P3	Data	PIN required
00	80	00 Signature without digest	Key Index [0,15]	Length 20	Data to be signed	Admin or User
00	80	21 Signature with SHA256	Key Index [0,15]	Length	Data to be hashed and signed	Admin or User

Response

Body	SW1	SW2	Comment
Length (2 bytes) ASN.1 ECDSA Signature Encoding	90	00	OK
	63	80	PIN required
	69	85	Bad index
	64	01	Public Key is not defined
	64	02	Private Key is not defined
	6A	86	Incorrect P1P2
	6D	20	Signature Error

13.17 The GetCertificate command

This command reads the card certificate.
It requires the Admin or the User PIN.
Upon success it returns the status word SW1, SW2 = 9000.
Otherwise it returns SW1=63, SW2=80 (PIN required).
The card certificate is the ECDSA SHA256 signature over the secp56k1 curve, of its public key (in full representation, i.e. 65 bytes) located at index 0. This certificate is the concatenation of two 32 bytes integers value r, s.

The experimental Ethertrust public key, on the curve secp256k1, is:
04
6099836D971593AAA2C1C32B6DB9EF9521041795E21CF1E7511DF3BD358F97DF
358B33A875E359CBE236163D6DBAEDFEC6C9393522C7EBC25A7CC85E1F0A7D67

Command

CLA	INS	P1	P2	P3	PIN required
00	8E	00	00	00	Admin or User

Response

Body	SW1	SW2	Comment
64 bytes certificate	90	00	Two 32 bytes integers r,s
Empty	63	80	PIN required

13.18 The SetCertificate command

This command sets the card certificate.
It requires the Admin PIN.
Upon success it returns the status word SW1, SW2 = 9000.

Two working mode are supported. The certificate (64 bytes) is imported or the certificate is internally computed from an embedded key (auto signing)

Command

CLA	INS	P1	P2	P3	Payload	PIN required
00	8F	00	00	40	64 bytes certificate	Admin
00	8F	FF	KeyIndex	00	Empty	Admin

Response

SW1	SW2	Comment
90	00	Certificate loaded or generated
63	80	PIN required
69	84	Certificate Already Set
69	85	Wrong Certificate Length
64	03	Private Key is not set