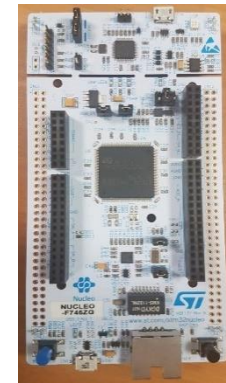


# Quick Start Guide

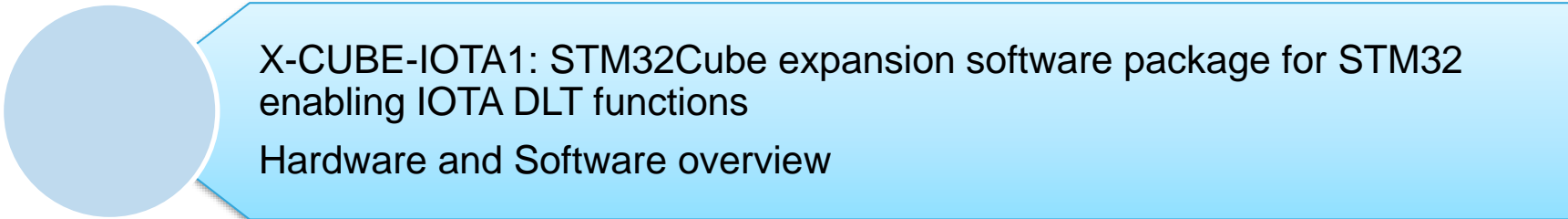
STM32Cube expansion software package for STM32 enabling IOTA  
Distributed Ledger Technology (DLT) functions

(X-CUBE-IOTA1)



Version 1.0 (December, 2019)

# Quick Start Guide Contents



X-CUBE-IOTA1: STM32Cube expansion software package for STM32 enabling IOTA DLT functions

Hardware and Software overview



Setup & Demo Examples

Documents & Related Resources



STM32 Open Development Environment: Overview

# NUCLEO-F746ZG

## Hardware Overview

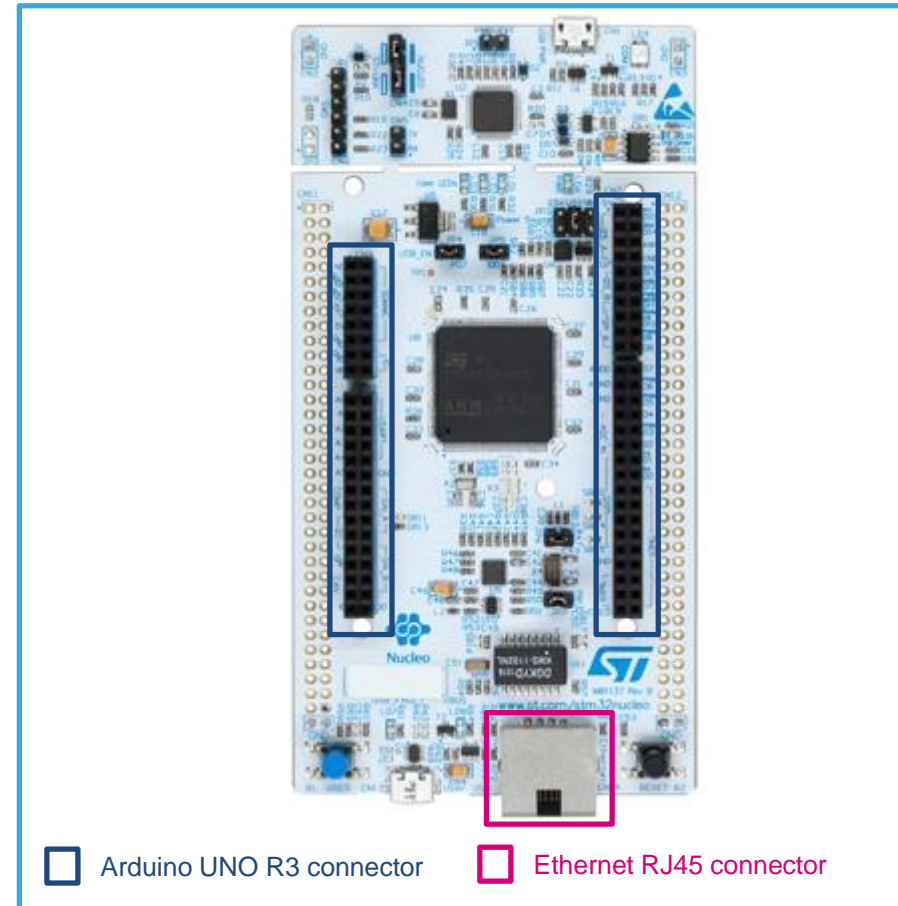
3

### NUCLEO-F746ZG Hardware Description

- The STM32 Nucleo-144 board provides an affordable and flexible way for users to try out new concepts and build prototypes by choosing from the various combinations of performance and power consumption features, provided by the STM32 microcontroller

### Key features

- STM32 microcontroller in LQFP144 package
- 3 user LEDs
- 2 user and reset push-buttons
- 32.768 kHz crystal oscillator
- Board connectors:
  - SWD
  - Arduino™ Uno V3
  - ST morpho
- Flexible power-supply options: ST-LINK, USB VBUS or external sources
- On-board ST-LINK debugger/programmer with USB re-enumeration capability: mass storage, Virtual COM port, and debug port
- Comprehensive free software libraries and examples available with the STM32Cube MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR™, Keil®, and GCC-based IDEs
- External or internal SMPS to generate Vcore logic supply
- Ethernet compliant with IEEE-802.3-2002



Latest info available at [www.st.com](http://www.st.com)  
**NUCLEO-F746ZG**

## Software description

The X-CUBE-IOTA1 expansion software package for STM32Cube runs on the STM32 and includes middleware to enable the IOTA Distributed Ledger Technology (DLT) functions.

The IOTA DLT is a transaction settlement and data transfer layer for the Internet of Things (IoT). IOTA allows people and machines to transfer money and/or data without any transaction fees in a trustless, permissionless and decentralized environment. This technology even makes micro-payments possible without the need of a trusted intermediary of any kind.

The expansion is built on STM32Cube software technology to ease portability across different STM32 microcontrollers.

The software comes with sample implementations to use the IOTA middleware on a NUCLEO-F429ZI or NUCLEO-F746ZG development board.

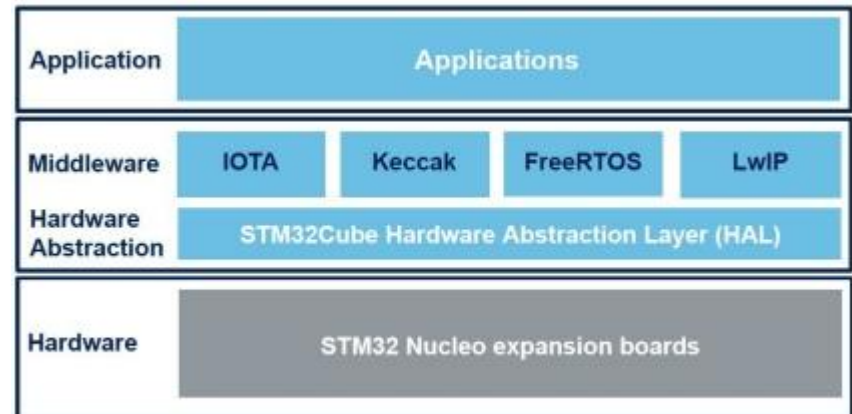
## Key features

- Complete middleware to build IOTA DLT applications for STM32-based boards
- Easy portability across different MCU families, thanks to STM32Cube
- Examples to help understand how to develop an IOTA DLT application
- Includes the STM32CubeMX project file (.ioc) for the graphical visualization of the STM32 microcontroller pins, peripherals and middleware configuration
- Free, user-friendly license terms

# X-CUBE-IOTA1 Software overview

4

## Overall Software Architecture



Latest info available at [www.st.com](http://www.st.com)

**X-CUBE-IOTA1**

# Quick Start Guide Contents



X-CUBE-IOTA1: STM32Cube expansion software package for STM32 enabling IOTA DLT functions

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# Setup & demo examples

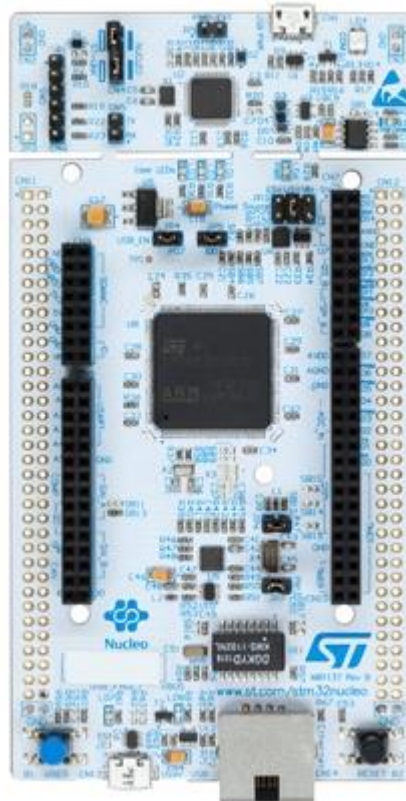
## HW prerequisites

6

- 1 x STM32 Nucleo-144 development board with STM32F746ZG/STM32F429ZI MCU (NUCLEO-F746ZG/NUCLEO-F429ZI)
- 1 x USB type A to Mini-B USB cable
- 1 x Ethernet cable



Mini USB



NUCLEO-F746ZG



Ethernet cable

# Setup & demo examples

## SW prerequisites

7

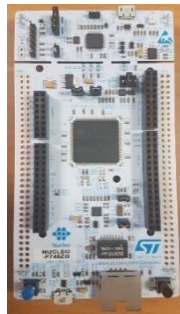
- **STSW-LINK009**: ST-LINK/V2-1 USB driver
- **STSW-LINK007**: ST-LINK/V2-1 firmware upgrade
- **X-CUBE-IOTA1**
  - Copy the .zip file content into a folder on your PC
  - The package contains the source code examples (Keil, IAR EWARM, System Workbench for STM32) compatible with **NUCLEO-F746ZG** (or **NUCLEO-F429ZI**)
  - Serial line monitor – e.g., Tera Term

# X-CUBE-IOTA1 Setup Overview

1 Go to [www.st.com](http://www.st.com)



2 Find X-CUBE-IOTA1

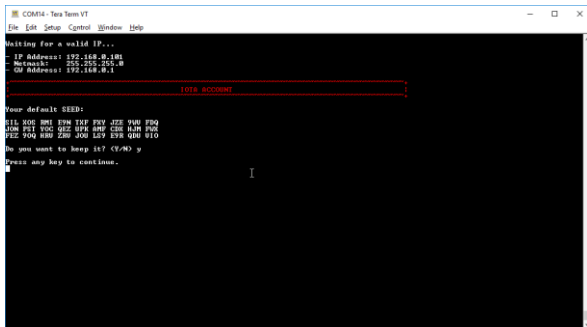


3 Download and unpack

X-CUBE-IOTA1

- \_htmresc
- Documentation ← Docs
- Drivers ← BSP, HAL and drivers
- Middlewares ← IOTA, Keccak, LwIP, FreeRTOS Libs
- Projects ← Application example
- readme.txt
- Release\_Notes.html

6 Evaluate using serial line monitor – e.g. Tera Term



. \Projects\STM32F746ZG-Nucleo\Applications\IOTA-LightNode



5 Build/Flash and Run the project

4

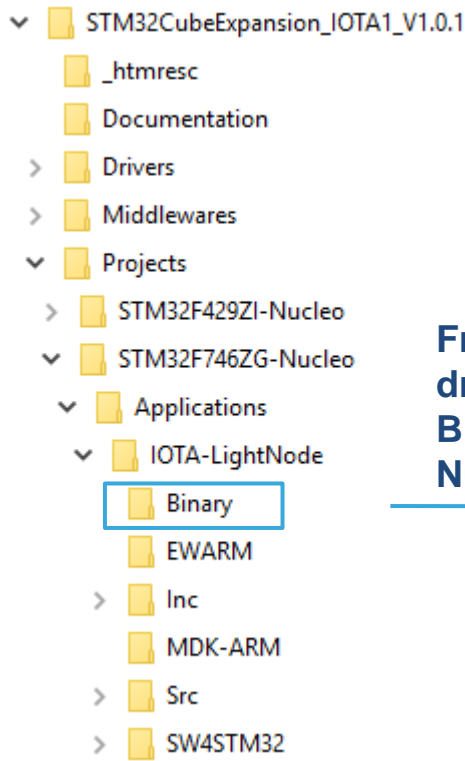




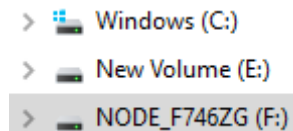
# X-CUBE-IOTA1

## Installation procedure

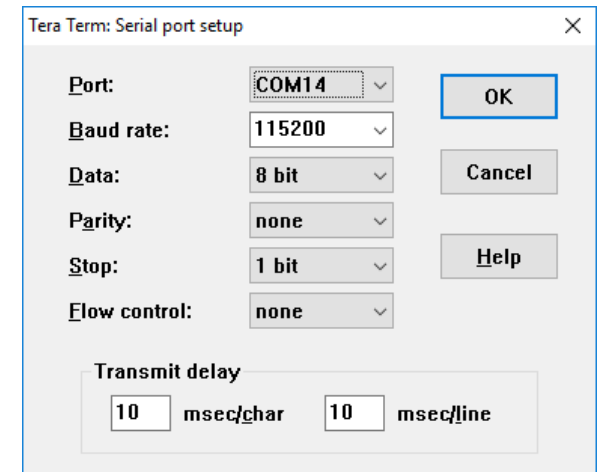
- Plug the Ethernet cable
- Connect the STM32 Nucleo board to your PC



From the software package  
drag and drop the \*.bin (in  
Binary folder) on STM32  
Nucleo drive



When pressing the **RESET** User button on STM32 board, you can see the initialization phase (i.e., IP address setting). Then, you are advised to type a new seed (i.e., the password for your wallet). The seed should be 81 characters long ('9, A-Z').



Configure the serial line monitor

```
VT COM14 - Tera Term VT
File Edit Setup Control Window Help

Waiting for a valid IP...
- IP Address: 192.168.0.101
- Netmask: 255.255.255.0
- GW Address: 192.168.0.1

-----
IOTA ACCOUNT
-----

Your default SEED:
SIL XOS RMI E9N TXF FXY JZE 9WU FDQ
JON PST YOC QEZ UPK AMP CDX HJM FWX
FEZ 9OQ HRU ZRU JOU LS9 E9R QDU UIO

Do you want to keep it? <Y/N> y
Press any key to continue.
█
```

After creating your seed, the screen is refreshed with the list of the main functionalities.

```
COM14 - Tera Term VT
File Edit Setup Control Window Help
IOTA LIGHT WALLET
1. Check your balance;
2. Create a 0-value transaction;
3. Create a transfer;
4. Other functions;
0. Exit.
Choose one of the options: █
```

# X-CUBE-IOTA1

## Check your balance

12

By choosing option 1. from the main menu, the total amount of iotas (wallet balance\*) along with the total balance for each security level are printed out. This information is returned by the Full Node. The current implementation generates a set of 50 addresses for each security level.

```
COM14 - Tera Term VT
File Edit Setup Control Window Help
-----
:                               :
:                               :
-----
Getting the balance from your addresses... (only 50 addresses of each security level)
-> Balance on security level 1: 60i
-> Balance on security level 2: 0i
-> Balance on security level 3: 0i
-> Total balance on the account: 60i

Press any key to continue.
█
```

\* Please, refer to this [tutorial](#) describing how to mine iota for your wallet.





# X-CUBE-IOTA1

## IOTA Transfer (1/9)

By choosing option 3. from the main menu, you can make a iota transfer.

1 Choose the number of receivers

```
COM14 - Tera Term VT
File Edit Setup Control Window Help

IOTA TRANSFER

~ Outputs ~
How many receivers? 1
You chose: 1
Confirm? <Y/N> █
```

2 Enter the receiver address

```
COM14 - Tera Term VT
File Edit Setup Control Window Help

IOTA TRANSFER

~ Outputs ~
-- RECEIVER 1 --
Enter an address: XTCOOTUOKAGMAJUSFSTIWSUYXSGCLAZFIDP9BFIAPHXRTQDWWQTIJYDUNSCGGZXBFFHSDMUNDO9OTNMYZ
You entered: XTCOOTUOKAGMAJUSFSTIWSUYXSGCLAZFIDP9BFIAPHXRTQDWWQTIJYDUNSCGGZXBFFHSDMUNDO9OTNMYZ
Is this address correct? <Y/N> █
```

3 Choose the amount of iota to be transferred

```
COM14 - Tera Term VT
File Edit Setup Control Window Help

IOTA TRANSFER

~ Outputs ~
-- RECEIVER 1 --
Address: XTCOOTUOKAGMAJUSFSTIWSUYXSGCLAZFIDP9BFIAPHXRTQDWWQTIJYDUNSCGGZXBFFHSDMUNDO9OTNMYZ
How many iotas? 60
You entered: 60i
Is this value correct? █
```

# X-CUBE-IOTA1

## IOTA Transfer (2/9)

16

- 4 Choose the security level (set of addresses) with a balance allowing the selected transfer

```
COM14 - Tera Term VT
File Edit Setup Control Window Help

IOTA TRANSFER

Security level

Input addresses security level: 1
Checking balances... enough iota found!

Press any key to continue.
```

- 5 Type a message for the output transaction (identifying the receiver)

```
COM14 - Tera Term VT
File Edit Setup Control Window Help

IOTA TRANSFER

OUTPUTS

- Output 1 -
[Address] XTCOOTUOKAGMAJUSFSTIWSUYXSGCLAZFIDP9BFIAPHXRTQDWWQTIJYDUNSCGGZXBFFHSDMUNDO9OTNMYZ
[Value] 60i
Enter the message:
TxOutput
```

- 6 Type a Tag for the output transaction

```
COM14 - Tera Term VT
File Edit Setup Control Window Help

IOTA TRANSFER

OUTPUTS

- Output 1 -
[Address] XTCOOTUOKAGMAJUSFSTIWSUYXSGCLAZFIDP9BFIAPHXRTQDWWQTIJYDUNSCGGZXBFFHSDMUNDO9OTNMYZ
[Value] 60i
[Message] TxOutput
Enter the tag (only capital letters):TXOUT
```



# X-CUBE-IOTA1

## IOTA Transfer (3/9)

17

- 7 Choose a Tag for the input transaction (identifying the sender)

```
COM14 - Tera Term VT
File Edit Setup Control Window Help

IOTA TRANSFER

-----
OUTPUTS
-----
- Output 1 -
[Address] XTIC00TUOKAGMAJUSFSTIWSUYXSGCLAZFIDP9BFIAPHXRTQDWQTIJYDUNSCGGZXBFPHSDMUNDO9OTNMYZ
[Value] 60i
[Message] TxOutput
[Tag] TXOUT99999999999999999999999999999999

-----
INPUTS
-----
- Input 1 -
[Address] OTPOLDUB9YURGKJM9NWARZNCM9ROUYEYLAZPYBHUXPSUKURAJFFOENWTMPQQZLMGIXYGGBPLHJMKIJYBB
[Balance] 60i
Enter the tag <only capital letters>:TXIN
```

8

- Choose whether:
- Execute local or remote PoW
  - Broadcast the transaction
  - Reattach the transaction (currently disabled)

```
COM14 - Tera Term VT
File Edit Setup Control Window Help

IOTA TRANSFER

Do you want to use local PoW? <Y/N> y
Do you want to broadcast your transaction? <Y/N> y
Do you want to reattach your transaction after 10 minutes? <Y/N> n

-----
PoW and broadcast
-----
! PoW: Local <diver>
! Broadcast: yes
! Reattach: disabled

Proceed with these options? <Y/N> █
```







# X-CUBE-IOTA1

## IOTA Transfer (6/9)

20

It may happen that the transaction is not attached to the Tangle (pending status)...

- 11 Check the status of the transaction on the [Tangle Explorer](#) website searching by IOTA address, transaction, bundle, tag

## Bundle



ZJWFJMHLRBLG9LQZSPABGKLSFUYYXQKWFQJFVBIG9BKCUUZOOJ9KWLTU9GJAIEDQTJAYPUTVAOKIXHIC

December 4, 2019 16:22:41 - 13 minutes and 5 seconds ago

Pending

1 inputs

← OTPOLDUB9YURGKJM9NWARZNCM9ROUYEYLAZPYBHVXPSVKURAJFFOENWTMPQQZLMGIXYGG  
BPLHJMKIJYBBEMSYHZ9BZ  
NOQQAWNLIJHWPKHOKTVDCWGASHDHIHDCNGAGHUNQGMICYLBERYV  
DSEPLPKUFZQFMGSKQL9DQQTWEA9999 -60 i



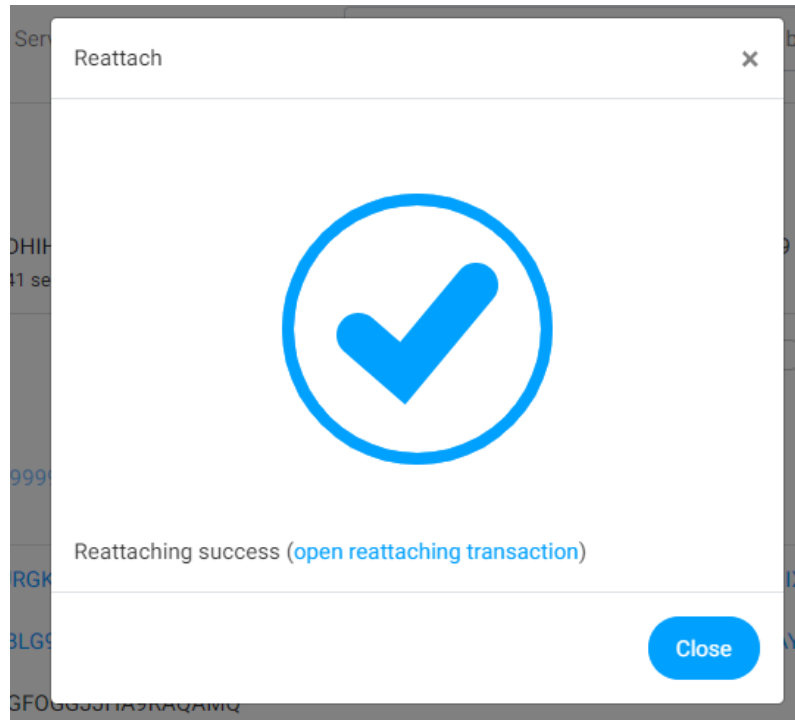
1 outputs

→ XTCOOTVOKAGMAJUSFSTIWSVYXSGCLAZFIDP9BFIAPHXRTQDWWQTIJYDVNSCGGZXBFFHSDMV  
ND090TNMYZDWBVESXBX  
XGPP9ANTAIXJEUWUDNFDZZOVTACPKWCZGTQKIUXDROOQJWRWY  
HRLLOGCKXGETKKCNDRPYZPKBOZ9999 60 i

Visualizer >



A popup informs the user about the result.



# X-CUBE-IOTA1

## IOTA Transfer (9/9)

23

Finally, the reattached transaction is confirmed

### Bundle



ZJWFJMHHLRBLG9LQZSPABGKBLSFUYXQKWFQJFVBIG9BKCUUZOOJ9KWLTU9GJAIEDQTJAYPUTVAOKIXHIC

December 4, 2019 16:37:04 - 1 minute and 29 seconds ago

Confirmed

1 inputs

← OTPOLDUB9YURGKJM9NWARZNCM9ROUYEYLAZPYBHVXPSVKURAJFFOENWTMPQQZLMGIXYGG  
BPLHJMKIJYBBEMSYHIZ9BZ  
REUMXGARON9EJBMKABXBE9NYZRIDADJATHJISYYWDVHELPPXTSSZD  
ZEWZHRKTTGDYMAO9Z9DSNXL9999 -60 i



1 outputs

→ XTC00TVOKAGMAJUSFSTIWSVYXSGCLAZFIDP9BFIAPHXRTQDWWQTIJYDVNSCGGZXBFFHSDMV  
ND090TNMYZDWBVESXBX  
NFODRDCUUAHBBYBIGJN9FECPLNLFNDBUJVLZOYGKDPBRBJVACGNH  
ZNSGVPRYIHILE9V9SGNVVPPFA9999 60 i

Visualizer >

December 4, 2019 16:22:41 - 15 minutes and 52 seconds ago

Reattachment confirmed

1 inputs

← OTPOLDUB9YURGKJM9NWARZNCM9ROUYEYLAZPYBHVXPSVKURAJFFOENWTMPQQZLMGIXYGG  
BPLHJMKIJYBBEMSYHIZ9BZ  
NQQAQWNLJHWPKHOKTVDCWGASHDHIHDCNGAGHUNQGMICYLBERYV  
DSEPLPKUFZQFMGSKQTL9DQQTWEA9999 -60 i



1 outputs

→ XTC00TVOKAGMAJUSFSTIWSVYXSGCLAZFIDP9BFIAPHXRTQDWWQTIJYDVNSCGGZXBFFHSDMV  
ND090TNMYZDWBVESXBX  
XGPP9ANTAIXJEUEWUDNFDZZOVTACPKWCZGTQKIUXDROQOJWRWY  
HRLLOGCKXGETKCCNDRPYZPKBOZ9999 60 i

## Other functions (getNodeInfo)

By choosing option 4. from the main menu, the set of auxiliary functions is listed.

```

COM14 - Tera Term VT
File Edit Setup Control Window Help
-----
FUNCTION SELECTION
-----
1. Get node info;
2. Get transactions to approve;
3. Get balances;
4. Where addresses spent from;
5. Get balances and states;
6. Get inclusion state;
7. Get timestamp;

0. Back to the main menu.
-----
Test choice: █

```

Option 1. from the previous sub-menu allows to get information about the full node.

```

COM14 - Tera Term VT
File Edit Setup Control Window Help
-----
Get node info
-----
Full node: node.deviceproof.org:14265
<
  appName: IRI
  appVersion: 1.8.2-COACH
  jreAvailableProcessors: 48
  jreFreeMemory: 1868004928
  jreVersion: 1.8.0_222
  jreMaxMemory: 7983857664
  jreTotalMemory: 7983857664
  latestMilestone: HXLFZBOEGGDKRZEYNZPOBI CAYMI FUAHCS CYOQWVYOA IWX IGGQUPPOYDUK9ZZQHJTQGYMI XAT9SS99999
  latestMilestoneIndex: 1265539
  latestSolidSubtangleMilestone: HXLFZBOEGGDKRZEYNZPOBI CAYMI FUAHCS CYOQWVYOA IWX IGGQUPPOYDUK9ZZQHJTQGYMI XAT9SS99999
  latestSolidSubtangleMilestoneIndex: 1265539
  milestoneStartIndex: 1050381
  lastSnapshottedMilestoneIndex: 1265332
  neighbors: 12
  packetsQueueSize: 0
  time: 1575458855793
  tips: 2306
  transactionsToRequest: 0
  features: [
  dnsRefresher
  zeroMessageQueue
  RemotePOW
  ]
  coordinatorAddress: EQSAUZKULTTYZCLNJNTXQIQHOMOFZERHTCGTXOLTVAHKS A9OGAZDEKECURBRIXI JWNPFQCI OUFUUXJUD9
  duration: 0
  >
-----
End [Get node info]
-----
Press any key to continue.
█

```



## Other functions (getBalances)

By choosing option 3. from the previous sub-menu, you can get the confirmed balance of an address. You are asked to enter the security level and the number of addresses you are interested in.

```

COM14 - Tera Term VT
File Edit Setup Control Window Help
*****
*                               Get balances                               *
*****
Single address (S) or multiple addresses (M)? m
Security level: 1
Number of addresses to check [max = 50]: 10

-----+-----
| Security level: 1 | Number of addresses: 10 |
+-----+-----
Address 0: OTPOLDUB9YURGKJM9NWARZNCM9ROUYEYLAZPYBHUXPSUKURAJFFOENWTMPQQZLMGI XYGG BPLHJMKI JYBB [60i]
Address 1: XTCOOTUOKAGMAJUSFSTIWSUYXSGCLAZFIDP9BFIAPHXRTQDWJQTIJYDUNSGGGZXBFFHSDMUNDO9OTNMYZ [0i]
Address 2: BFOHRAIGYUNFEMIKM9BEWYUKJDLUJIQSLNEWI ZAHC9LGU9DM9IYQHI C9KLC SHMKMDUTLCHQARWUHLHHTC [0i]
Address 3: XODRUGZJOLOKGCOMPQCT9KTL LHZGUWKFNOEHI SDWLGDGBOCYIFJJI9UCLNBUZKYZHZAJOBFLXUBFDQIUSW [0i]
Address 4: WLYVAETMENLSCFLU9ANZCIEQGTUZUIRIFWJUUKQUMYRABWRMOWWIFJU9QN9CYFH9CAXDONHMRA TA9PHUX [0i]
Address 5: AFARSASIAJITUPRNUUBOZHGMKOUAFTBMUOEELPZXOITSRB9MERFWDZUWDZFMFQSPTSQICL9BLOBDIEC [0i]
Address 6: O9UYIWDPGPHMMLNXQUSFPUQOBAOZEPLSWZB9CI XUQERZWLKPLI BWYSIAE9IHUOZWQA WFOBESAZUNUEAY [0i]
Address 7: PGWPBDUXYDTGXKSEGDICHRAJKUTLRBOZNGJJKJNZFHI ESLWKCTUWUMEMQTPPWUJUOAMCELFJJAABQUMEC [0i]
Address 8: PGUERBDPUUTXEUEBSUBLKZPTZIOXFRBCWODSSXMXHCRA PQFTLRZWYPPFHJUF9DBZDMBDRRUUKHWWEFJNUW [0i]
Address 9: UGXDHXDZXLKLAJBRGHZLCLZQJWOU DWGBWBIJJQD9ZBPHYJ9STIIRTXDQF9HJB9CU9WDUPXZDKJK9UNYJD [0i]
*****
*                               Get balances                               *
*****
Press any key to continue.

```

All documents are available in the DESIGN tab of the related products webpage

## NUCLEO-F746ZG/NUCLEO-F429ZI:

- Gerber files, BOM, and schematics
- **DB3171**: STM32 Nucleo-144 boards – **Data brief**
- **UM1727**: Getting started with STM32 Nucleo board software development tools – **User Manual**
- **UM1974**: STM32 Nucleo-144 boards – **User Manual**

## X-CUBE-IOTA1:

- **DB3959**: IOTA Distributed Ledger Technology software expansion for STM32Cube – **Data brief**
- **UM2606**: Getting started with the IOTA Distributed Ledger Technology software expansion for STM32Cube – **User Manual**
- **AN5359**: How to enable security features when using X-CUBE-IOTA1 – **Application Note**

Consult [www.st.com](http://www.st.com) for the complete list

# Quick Start Guide Contents

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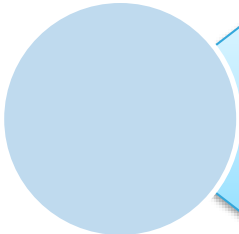
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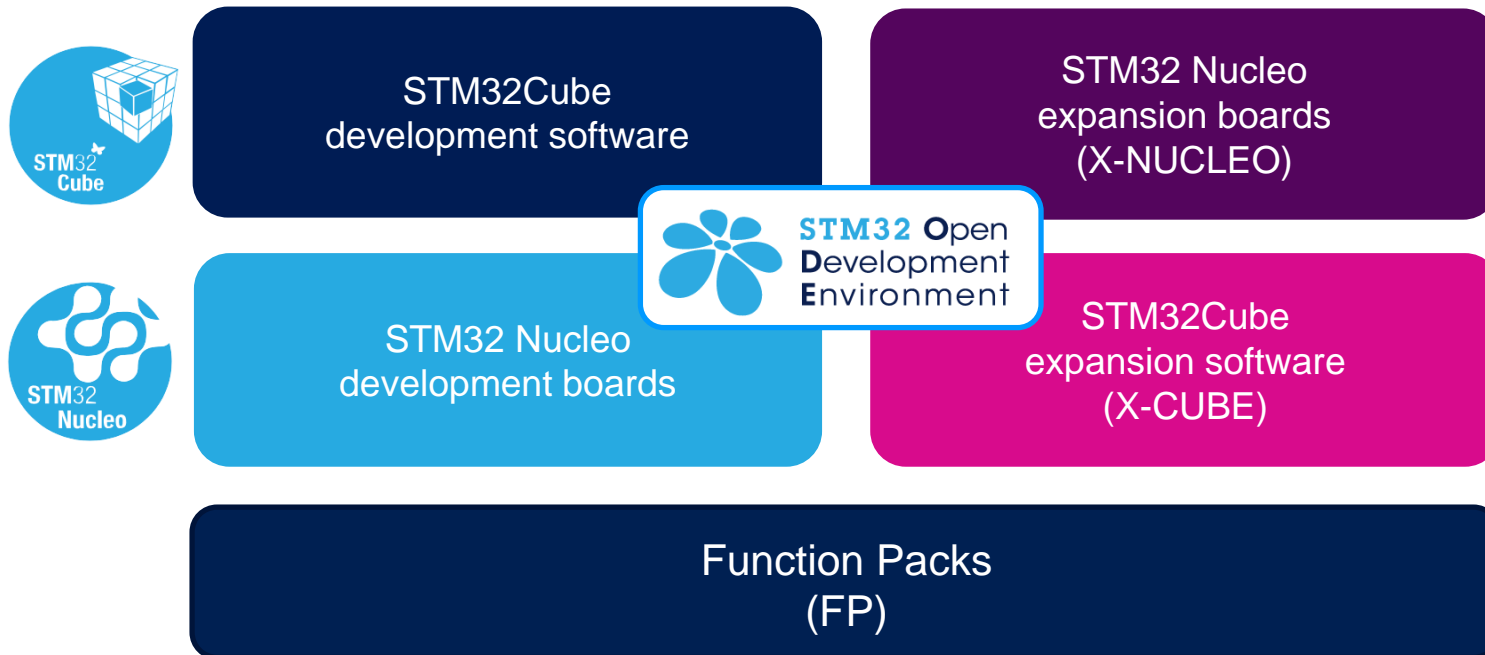
STM32 Open Development Environment: Overview

# STM32 Open Development Environment

## Fast, affordable Prototyping and Development

28

- The STM32 Open Development Environment (STM32 ODE) is an open, flexible, easy and affordable way to develop innovative devices and applications based on the STM32 32-bit microcontroller family combined with other state-of-the-art ST components connected via expansion boards. It enables fast prototyping with leading-edge components that can quickly be transformed into final designs.



For further information, please visit [www.st.com/stm32ode](http://www.st.com/stm32ode)