Bringing IOTA Distributed Ledger Technology (DLT) into Yocto/OpenEmbedded

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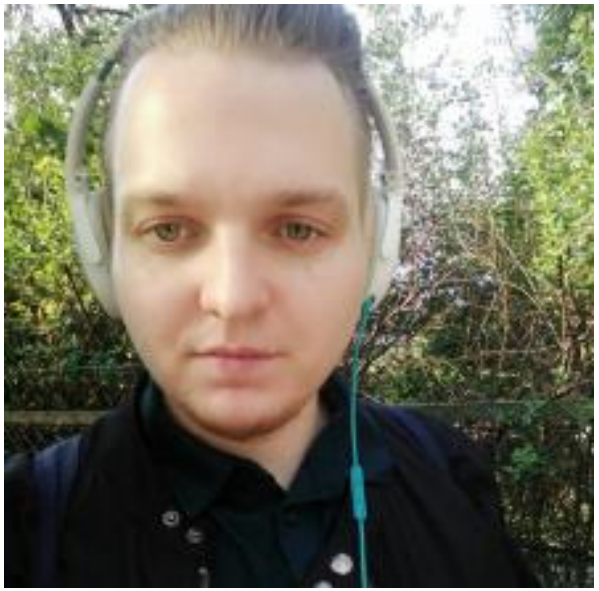

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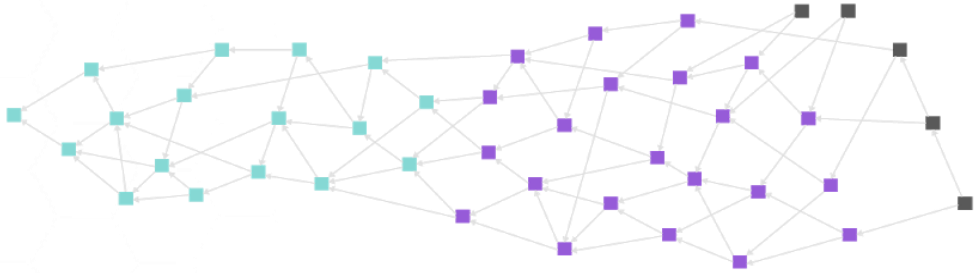
What is IOTA?

Context

Distributed Ledger Technologies

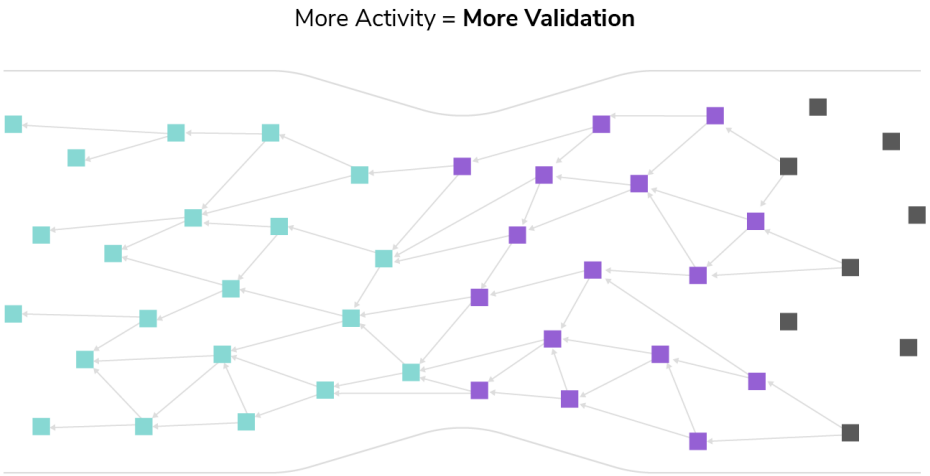


Blockchain

Tangle

(DAG - Directed Acyclic Graph)

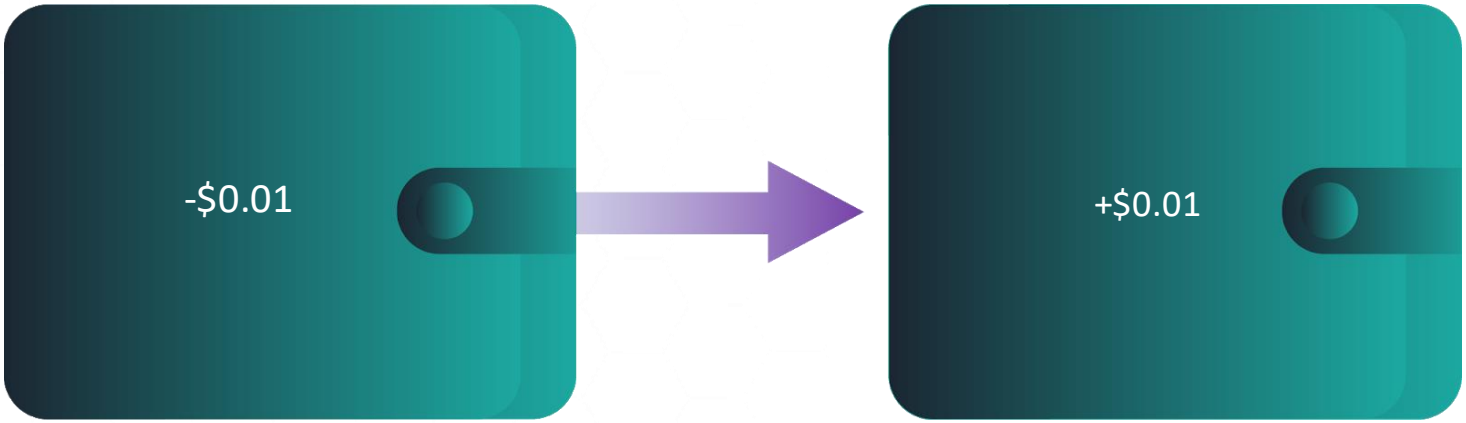
Tangle (DAG)



Each Vertex represents a transaction (squares)

Each Edge represents na approval (lines)

Zero Fee Transactions



No mining = No fees = Zero fee micro-transactions

IOTA Foundation

IOTA FOUNDATION

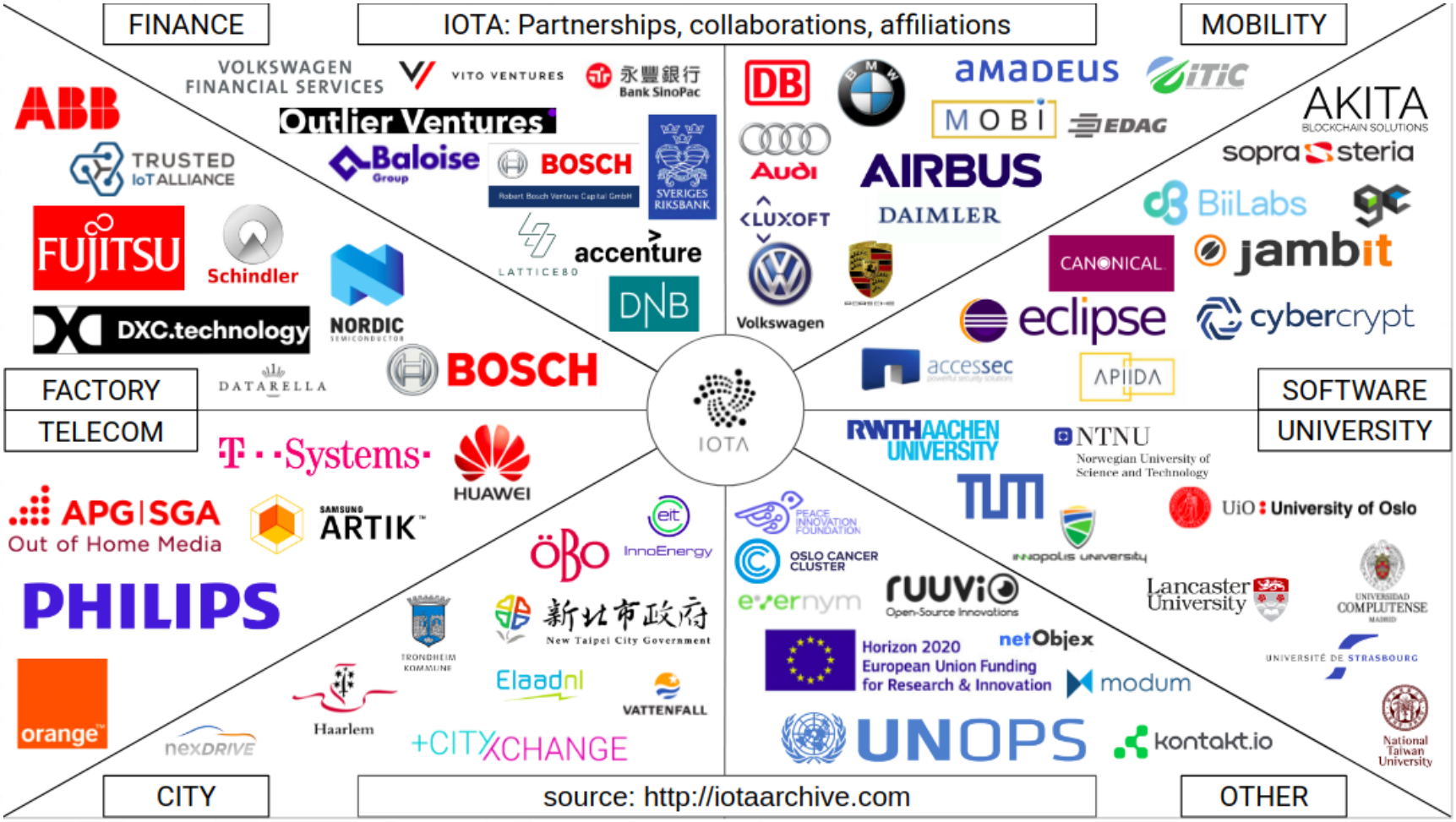
- Non-Profit Foundation registered in Berlin
- ~100 employees in 17 countries
- Funded through donations from IOTA Token holders, Research Grants and Project-based corporate financial support

IOTA Foundation

IOTA FOUNDATION

Vision	Future Machine Economy			
Objective	Grow a vibrant & engaged open source community	Build a decentralized and self-regulated P2P network	Adoption & real world implementation	
Purpose	**Research** Produce a strong theoretical foundation for the core tech, and enable ambitious future use cases in the economy of things ecosystem.	**Technology** Develop production -ready software for the community, partners and ecosystem to use and expand upon.	**Education** Educate and promote technologies and use cases for new generations to understand.	**Standardization** Standardize and ensure the maturity and widespread adoption of the economy of things.
Principles	Co-Creation, Transparency, Decentralization			

IOTA Foundation: Collaborations & Partnerships



IOTA Nodes

Pre Coordicide vs Post Coordicide

IOTA Nodes

- DLT Node:
  - transaction relay
  - ledger copy

IOTA Nodes

- Ethereum, Bitcoin, etc: Nodes on the Cloud (↑ hw resources)
- IOTA: Nodes on the Edge (↓ hw resources)

https://blog.iota.org/towards-open-collaboration-1926e94514b8

Coordicide

- To make it possible for the network to grow and protect it against certain attacks, IOTA currently relies on a coordinator.
- The coordinator checkpoints valid transactions, which are then validated by the entire network.
- The coordinator is being run by the IOTA Foundation.
- Removing the Coordinator from the IOTA network will realize a long sought after goal in the field of DLT: scalability without centralization.
- Coordicide: the death of the Coordinator.

Pre Coordicide vs Post Coordicide

- Pre-Coordicide Node implementation:
  - IRI (Java)
  - cIRI (C)
- Coordicide Proof of Concept Node implementation:
  - GoShimmer (Go)
- Post-Coordicide Node implementation:
  - Bee (Rust)
  - Hornet (Go)

Since Coordicide is still a topic under R&D, meta-iota focuses on Pre Coordicide (for the moment).

meta-iota

Recipes

cIRI

- low level implementation of an IOTA node in C
- Users to become part of the IOTA network:
  - transaction relay
  - network information provider
- JSON-REST HTTP interface
- Suited for Embedded (SoC, SoM):
  - RAM: down to ~140MB RAM for solid node, ~500MB while syncing

cIRI: Bazel

- IF development team chose Bazel as build system for cIRI
- I borrowed the Bazel recipe and bbclass from meta-tensorflow
- Plans to switch to CMake

ciri_0.1.0.bb

- https://github.com/bernardoaraujor/meta-iota/blob/master/recipes-iota/ciri/ciri_0.1.0.bb

Let's ping the cIRI node on the BBB

```
$ curl http://104.155.135.221:14265/ \
       -X POST \
       -H 'Content-Type: application/json' \
       -H 'X-IOTA-API-Version: 1' \
       -d '{"command": "getNodeInfo"}'
```

CClient

- IOTA client library implementation in C.
- Recipe exports libcclient.a into the target rootfs/sysroot.
- CMake support
- Patch CMakeLists.txt to avoid the ExternalProject_add feature of CMake
- Recipe for c-iota-workshop repository as an example of how to integrate with libcclient

libcclient_1.0.0.bb

- https://github.com/bernardoaraujor/meta-iota/blob/master/recipes-iota/cclient/libcclient_1.0.0.bb
- https://github.com/bernardoaraujor/meta-iota/blob/master/recipes-iota/cclient/c-iota-workshop_git.bb

Playing around with c-iota-workshop

- Install Bazel:
  https://docs.bazel.build/versions/master/install.html
- Clone repo:
  ```
  $ git clone https://github.com/iota-community/c-iota-workshop
  ```
- Run an example:
  ```
  $ cd c-iota-workshop
  $ bazel run -c opt examples:[EXAMPLE_NAME]
  ```
- Following examples are available:
  ```
  hello_world
  send_hello
  receive_hello
  generate_address
  check_balances
  send_tokens
  ```

iota.go

- IOTA Go API Library allows:
  - Create transactions
  - Sign transactions
  - Interact with an IRI node
- Recipe written, although more testing is needed for validation.
- Recipe lists all golang package dependencies explicitly.
- Recipe for go-iota-workshop repository as an example of how to integrate with iota.go library

iota.go_1.0.0.bb

- https://github.com/bernardoaraujor/meta-iota/blob/go-dev/recipes-iota/iota.go/iota.go_1.0.0.bb
- https://github.com/bernardoaraujor/meta-iota/blob/go-dev/recipes-iota/iota.go/go-iota-workshop_git.bb

Playing around with go-iota-workshop

- Install Golang (1.10+)
  https://golang.org/doc/install
- Clone repo and download dependencies:
  ```
  $ git clone https://github.com/iota-community/go-iota-workshop
  $ cd go-iota-workshop; go mod download
  ```
- Run an example:
  ```
  $ go run iota_go_[EXAMPLE_NAME]/main.go
  ```
- Following examples are available:

```
helloworld
send_data
receive_data
create_address
check_balance
```

```
send_tx
receive_tx
zmq
```

iota.lib.py / PyOTA

- Official Python library for the IOTA Core.
- Implements both the official API, as well as signing, bundles, utilities and conversion.
- Python 3.6, 3.5 and 2.7.
- inherit setuptools
- Integration is planned for the near future
- https://github.com/iotaledger/iota.lib.py

Playing around with python-iota-workshop

- Install Python 3 and PIP
  https://www.python.org/downloads/
  https://pip.pypa.io/en/stable/installing/

- Clone repo and donwload dependencies:
  ```
  $ git clone https://github.com/iota-community/python-iota-workshop
  $ cd python-iota-workshop; pip install -r requirements.txt
  ```

- Run an example:
  ```
  $ python code/[EXAMPLE_NAME].py
  ```

- Following examples are available:
  ```
  e01_hello_world.py    e04_generate_address.py  e07_send_data.py
  e02_send_hello.py     e05_check_balance.py     e08_receive_data.py
  e03_receive_hello.py  e06_send_tokens.py       e09_zmq_listen.py
  ```

IOTA CLI App

- Command Line wallet and node management tool.
- It is implemented in nodejs, and it's available as a npm package.
- To be integrated with the help of devtool npm functionality.
- Integration planned for the near future.
- https://github.com/iotaledger/cli-app
- https://wiki.yoctoproject.org/wiki/TipsAndTricks/NPM

recipes-support

- In order to fulfill dependencies, I had to write a few support recipes.
  - **nanopb_0.3.9.3.bb**: small code-size Protocol Buffers implementation in ansi C. Especially suitable for use in microcontrollers, but fits any memory restricted system
  - **keccak_git.bb**: keccak sponge function family including SHA3 implementation. Recipe needs improvement to support more architectures)
  - **logger_4.0.0.bb**: simple logging facility for the C language)
  - **libzmq_4.3.2.bb**: ZeroMQ core engine in C++
- Extra contribution to the OE community.

Future of meta-iota (2020-21)

- Bee
  - Post Coordicide Reference Implementation
  - Official IOTA Foundation
  - Rust (meta-rust and meta-rust-bin?)
- Hornet
  - Post Coordicide Implementation
  - Community based (EDF)
  - Go

Ecosystem Development Fund

Boards for Proof-of-Concept

IOTA Ecosystem Development Fund

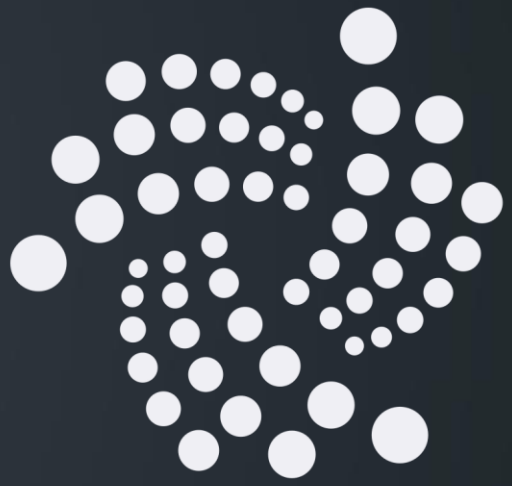
- The IOTA EDF will allow me to validate Proof-of-Concepts on a few different boards with potential for IOTA Industrial applications.
- There is a big interest for FPGA projects in the IOTA Community. This is due to the Quorum Based computations, as well as accelerated Proof-of-Work (PoW), Address Generation and Signing.

Board	Manufacturer	Comment	OpenEmbedded BSP Layer
STM32MP157C-DK2	STMicroelectronics	The discovery SBC for STMicroelectronics STM32MP1 Series microprocessors	meta-st-stm32mp
Colibri iMX6 Solo SoM + Viola Carrier	Toradex	Toradex is a swiss manufacturer of Industrial-grade System on Modules.	meta-freescale-3rdparty
Zynq-7000 SoC ZC702 Evaluation Kit	Xilinx	The Zynq-7000 is a SoC+FPGA with great potential to accelerate PoW, Mini-PoW, Address Generation and Signing, as well as future Qubic implementations.	meta-xilinx

IOTA Ecosystem Development Fund

Board	Manufacturer	Comment	OpenEmbedded BSP Layer
DE10-Nano Development Kit	Terasic Technologies	The E10-Nano Development Kit is built around the Intel/Altera CycloneV SoC+FPGA. Also great potential to accelerate PoW, Mini-PoW, Address Generation and Signing, as well as future Qubic implementations.	meta-de10-nano meta-altera
BeagleBone Black	Texas Instruments	The most popular SBC in the Yocto Community.	meta-yocto-bsp meta-ti meta-beagleboard meta-bbb
DragonBoard 410c	96Boards	SBC with a Qualcomm Snapdragon 400	meta-qcom
Orange Pi Zero	Orange Pi	Popular small SBC with an AllWinner H2 chip.	meta-sunxi meta-allwinner-hx
Raspberry Pi Zero W	Raspberry Pi Foundation	Miniature version of the RPi, with Wireless support.	meta-raspberrypi

Thank you!



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