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## RESEARCH REPORT

# Hardware Supply on Blockchain

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# Chapter 1

## Introduction

### 1.1 Report Overview

In this report we aim to prove the advantages of using Hyperledger Fabric by building a supply chain system that is transparent for all the entities involved in this process and to reduce the time consumption of the acquisition procedures. Ixia has an exhausting CAPEX process for acquiring the hardware devices needed by the development and QA teams so we believe that building a system based on Blockchain that solves the transparency and bottleneck issues is the perfect fit for replacing the existing procedures.

#### 1.1.1 Project Description

Hyperledger Fabric is a opensource framework developed by IBM and supported by the Linux Foundation that offers a permissioned private Blockchain solution. The framework is developed for private companies that know exactly the type of entities that are involved in their processes and what are their roles. Therefore the Hyperledger Fabric is suitable for solving the hardware devices supply chain transparency and bottleneck issues and to restrict the access of the participants involved in accordance with their position in the company. The hardware supply chain is CAPEX process that requires special approvals and priority analysis which is time consuming and often hard to track.

#### 1.1.2 Project Objectives and Motivation

Hardware supply is an important aspect of the Ixia's employee daily work. Many software applications developed by Ixia teams run on dedicated hardware and in many situations only one employee can use that hardware at a time. The existing CAPEX procedure is very complicated and the time between ordering a new device and receiving it can be really long. It may happen that the team doesn't need it anymore at the time the device was received. The dedicated hardware is expensive (some chassis may cost up to \$50000) so not receiving it on time may cost the department a lot of money and it can also delay the releases.

On each quarter, the manager has the responsibility of determining what are the hardware needs of the team and send the list to her/his superior for approval. Also, the manager has to check the price of the devices requested and if the costs are over the CAPEX budget, the hardware list should be prioritized. After completing the list and set the priorities if needed, the manager has to fill an *Internal Sales Order* on an internal platform. The hardware manufacturing managers

have to check if there're are new ISOs for their teams to build or if they have the devices on stock. If the hardware machines are on stock they will be delivered to the department/manager that requested them. If there's no hardware with the desired specification on stock, the manager has to schedule it for manufacturing. Also, the manufacturing managers need to make sure that the financial transaction was done successfully before delivering the hardware so they have to discuss with the financial department and validate that everything is ok. A huge disadvantage of this procedure is the lack of transparency regarding the status of the order and the time estimation until receiving the order. In addition to this the costs may differ due to the international tax changes.

The **Hardware Supply Chain on Blockchain** project is a supply business network that solves both the transparency and the access' restrictions. This system is using Hyperledger Composer framework for modeling the business network: participants, transaction and assets and connects to the Hyperledger Fabric via its API to add transactions in the Blockchain database and to manage participants's access accordingly with their roles in the network.

## Chapter 2

# Project Technologies and Software

### 2.1 Hyperledger Project

Hyperledger is an open source project focused on Blockchain technology that aims to bring IoT, supply chain, finance, banking and manufacturing together. It is hosted by the Linux Foundation and includes leaders from all the mentioned areas.

The Blockchain is a peer-to-peer distributed network, each participant of the network has its own copy of the ledger, and any transaction is validated by the majority of participants. The validation is done by solving Byzantine Generals Problem via consensus. The Hyperledger project offers solutions based on Blockchain with additional features such as the *smart contracts* and it has a large number of assistive tools to facilitate the embrace of Blockchain. All projects developed under the umbrella of Hyperledger and Linux Foundation are applications that use a ledger of transactions to establish transparency, accountability and trust. These projects are for a wide variety of business areas by providing the infrastructure, tools and frameworks to build applications based on Blockchain easily and in a short period of time. Additionally these applications follow the legal constraints by keeping the network closed to authorized participants that can be made accountable for their actions.

The project was launched in 2016 under the guidance of many important corporations such as IBM, Intel, etc. The first codebases that were released to the public were Hyperledger Fabric - a product that was the work result of three organizations (OpenBlockchain from IBM, libconsensus from Blockstream and the smart contracts from Digital Asset) and Hyperledger Sawtooth from Intel. These two frameworks were offering support for growing the development of Blockchain business solutions. Later on, there were other projects released that continued to offer assistive tools to support this growth. All projects that were released under the Hyperledger project were supervised by the Hyperledger Technical Steering Committee, a group of eleven specialists that were elected from the technical contributor community. In May 2016 the Linux Foundation and the corporate members involved in Hyperledger project elected an Executive Director to make sure that this idea has all the resources needed to be successful. In this position was placed the co-founder of Apache Software Foundation - Brian Behlendorf. The project became so successful so at the end of the next year the Hyperledger counted seven more projects and the number of members increased to more than 200.

The most successful projects were Hyperledger Sawtooth - multi-language support for distributed ledger, Hyperledger Fabric - the distributed ledger written in GO language, Hyperledger Composer - framework for accelerating the process of developing Blockchain applications, Hyperledger Iroha - the distributed ledger written in C++ and Hyperledger Indy - distributed ledger for decentralized identities. All these frameworks and tools are used in real-life applica-

tions except for Hyperledger Composer which is still in incubation. The Hyperledger Composer is an assistive tool for developers to facilitate the process of building a business network using the Hyperledger Fabric. It was proven that Hyperledger Composer is hard to maintain so the Hyperledger board decided to stop the development of new features and to keep the existing functionalities compatible with the new versions of Hyperledger Fabric. The main focus of the community is to add more features to Hyperledger Fabric framework which has a modular architecture so adding new features can be done quickly and without affecting the pre-existent functionalities.

In the following sections we are going to describe the Hyperledger Fabric and Composer frameworks. The Blockchain technology promises a revolution as big as the Web and the Hyperledger group understood its potential so they formed a Blockchain incubator to offer support to any bright idea related with Blockchain technology, smart contracts and the business world.

## 2.2 Hyperledger Fabric

Hyperledger Fabric is an implementation of a distributed ledger developed mostly in Golang. The framework uses also other languages and technologies such as Javascript, Go or Java for smart contracts (chaincode), SDK in Node.js, Python, Java, Go and Rest. It is a solution for a secure, high-performance and permissioned Blockchain based network that has a modular architecture that allows plugins for any new features with no impact on the core functionalities.

Before getting into more details about the features provided by this framework it is important to mention that it is developed for enterprise use cases so the solution must solve the identity issue for transaction of type know-your-customer or the money laundering issue by offering transparency to authorities as participants with advanced permissions in the network. Thus this framework is permissioned which means that the participants are not anonymous, their identity is known by the other participants so they can be made accountable for their actions. The framework network is private and the transaction content is confidential so it can contain business sensitive information. In [2], Elli Androulaki and others are presenting the Hyperledger Fabric as a distributed operating system with all characteristics from the following paragraphs.

More than that the framework offers the possibility of selecting a consensus protocol based on the business needs. For example, if the business network is used by a single enterprise or it is governed by a authorized identity there's no need for using the Byzantine Fault Tolerant (BFT) protocol so it may sufficient to go with a simplified version such as Crash Fault Tolerant (CFT) consensus protocol. As a result, the Hyperledger Fabric eliminates the low latency of transaction validation and improves the network performance. The framework doesn't required CPU power for mining or for smart contract execution so the cost is similar with any distributed system.

The Hyperledger Fabric has a wide community of developers and activists that help with the development of new features and maintain the Fabric codebase. The number of contributors has grown to more than 200 members and the organizations involved to 35 so the project benefits of a diverse set of skills. With such a support the future of this project is really promising. It has modular and pluggable architecture so it can bring innovation to many industries.

## 2.3 Hyperledger Composer

## Chapter 3

# Project Implementation

### 3.1 Functionalities



## Chapter 4

# Project Use Cases

### 4.1 ISG CAPEX Procedure

The *Hardware Supply on Blockchain* use cases are ordering a new hardware device or returning the merchandise authorization(RMA). ISG(Ixia Solution Group) teams are focused on developing software solutions starting with testing the network performance, getting network visibility by monitoring the traffic or finding security threats before compromising any data. Therefore teams need specialized hardware devices such as routers, gateways, switches to more powerful machines as packet brokers, ESXI servers, clusters, etc. The ISG division offers deep expertise in network testing, security and visibility which requires investing in powerful hardware equipment. In each quarter of the financial year the ISG division has a CAPEX budget to invest in hardware so each team can request new hardware devices. Each manager has the responsibility of identifying the hardware requirements by consulting his/her team and assuring that the total cost doesn't exceed the budget in which case the devices list should be prioritized.

When the CAPEX requirements list is completed, the manager can proceed to order them. For ordering the equipment he/she will use the *Hardware Supply on Blockchain* system.

The RMA procedure can be performed by the team manager as soon as he/she is informed about the hardware malfunction. Most hardware devices have an warranty period where they can be replaced or repaired free of charges by the manufacturing divisions.

### 4.2 Use Case Description

Chapter 5

Conclusion

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