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Applications of Blockchain Technology to the Certification of AgriFood Products Chains (CAFCha project and beyond)

Roberto Tonelli

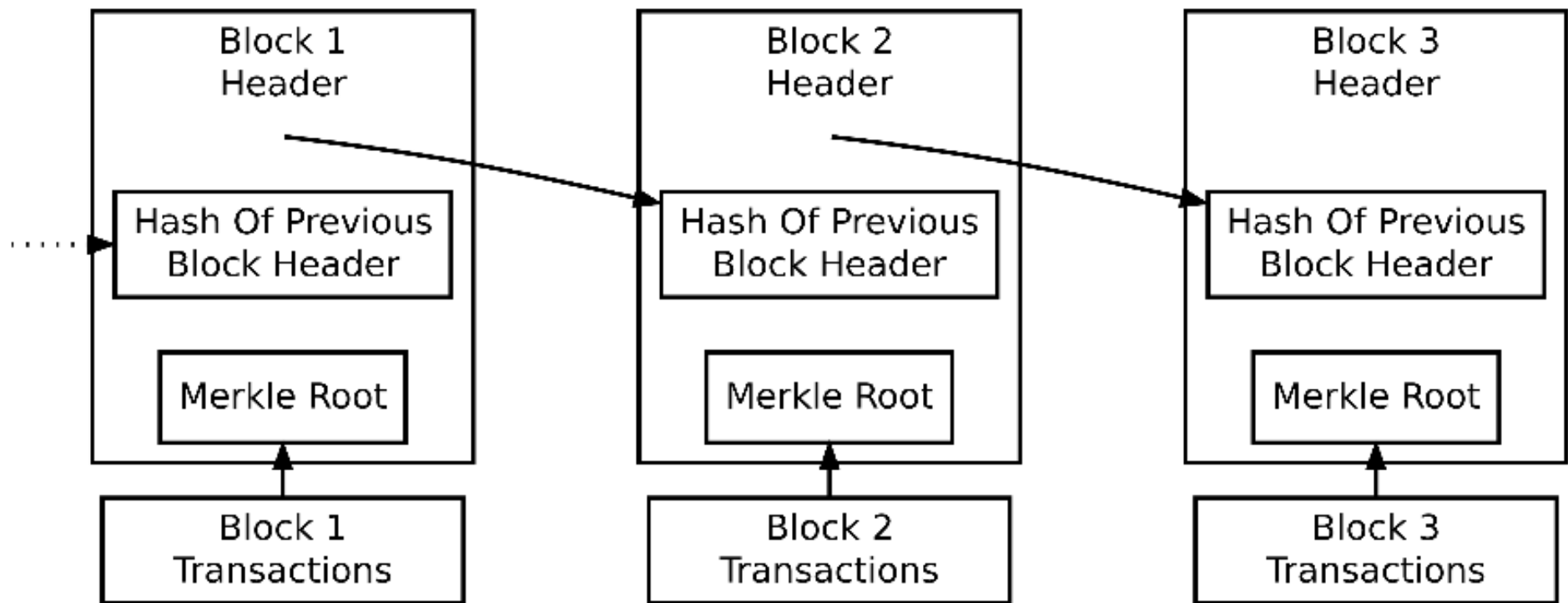
Department of Mathematics and Informatics, University of Cagliari, Italy



Blockchain

- **Is a chain of Blocks maintained on a distributed ledger on nodes which can perform computation**
- **Non modifiable, transparent, distributed, decentralized, on a peer-to-peer network**
- **Can be: Public or Private, Permissionless or Permissioned**
- **Can handle code execution (Smart Contracts) can store information, can emit events**
- **Uses Cryptography and Hashing**

Block Chain

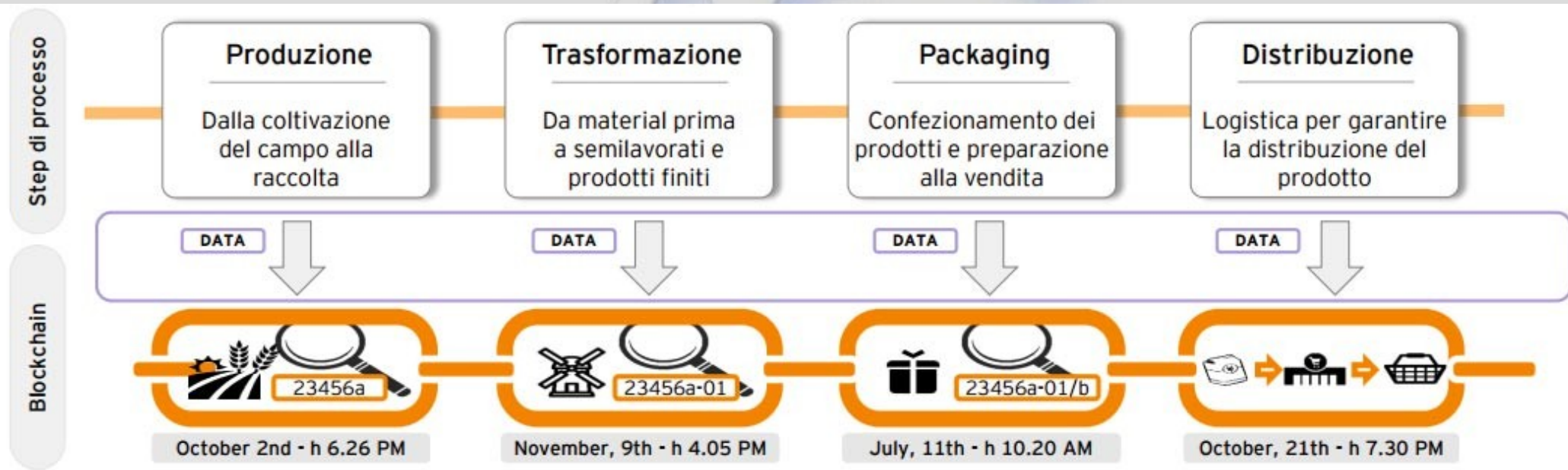


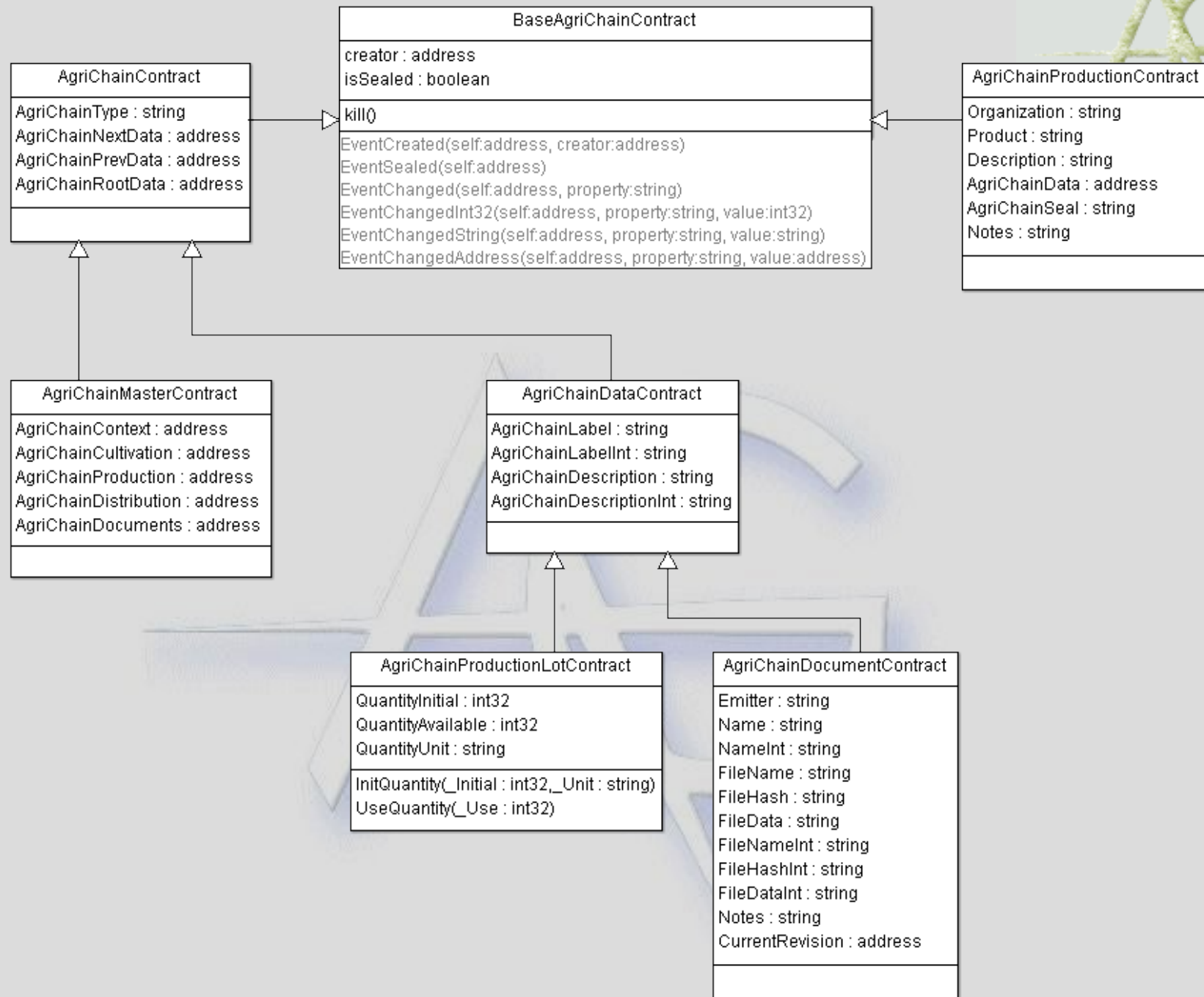
Simplified Bitcoin Block Chain

We started studying Certification of AgriFood Products on blockchain years ago



- *Eg: WINE Blockchain*







```
1 pragma solidity ^0.4.10;
2
3 contract BaseAgriChainContract {
4     address creator;
5     bool public isSealed;
6
7     function BaseAgriChainContract() public    { creator = msg.sender; EventCreated(this,creator); }
8
9     modifier onlyIfNotSealed() {
10         if (isSealed)
11             throw;
12         _;
13     }
14
15     modifier onlyBy(address _account) {
16         if (msg.sender != _account)
17             throw;
18         _;
19     }
20
21     function kill() onlyBy(creator)    { suicide(creator); }
22     function setCreator(address _creator) onlyBy(creator) { creator = _creator;    }
23     function setSealed() onlyBy(creator) { isSealed = true; EventSealed(this);    }
24
25     event EventCreated(address self,address creator);
26     event EventSealed(address self);
27     event EventChanged(address self,string property);
28     event EventChangedInt32(address self,string property,int32 value);
29     event EventChangedString(address self,string property,string value);
30     event EventChangedAddress(address self,string property,address value);
31 }
```

CAFCha: Certification of AgriFood Chain



General

Structured

Customizable

Agile

Purpose



- **reinforce trust among final customer and producers-vendors**
- **provide added value to products by mean of food guaranty, security and safety.**
- **provide transparency on all agriFood chain steps**
- **enable the final consumer or any intermediate actor to access all the needed information**
- **guaranty product provenance**
- **reduce frauds probability**

Steps (1)



- **Development of algorithms for recording information on the food chain on a blockchain**
- **Modeling the general process**
- **Mapping all the elements on the blockchain infrastructure**
- **Determine the most suitable blockchain**
- **Comply with the regulation of the European Union, from "farm to fork" (regulation No 178/2002, Art. 18)**

Steps (2)



- **Define Smart Contracts for automated implementation of all processes**
- **Define IoT integration along the production chain.**
- **Reconstruct representative data for a product/lot**
- **Define a system for interpreting and recording significant events and/or conditions**
- **Define mechanisms for verifications of a product/lot**

The blockchain approach



- **satisfies all traceability rules, creating a close connection among all operators in the supply chain**
- **creates a direct link between producer and consumer.**
- **reduces the complexity of a supply chain through the use of smart contracts.**
- **allows trusted transactions and agreement among parties without the need for a central authority.**
- **transactions are transparent, irreversible and can be automatically verified.**



Modeling a farm production chain

- **Production phase**: all agricultural activities implemented within the farm (uses of raw material and substances, harvesting, ...)
- **Processing**: transformation, total or partial, of a product into one or more other product, packaging with each package uniquely identified trough a production batch code

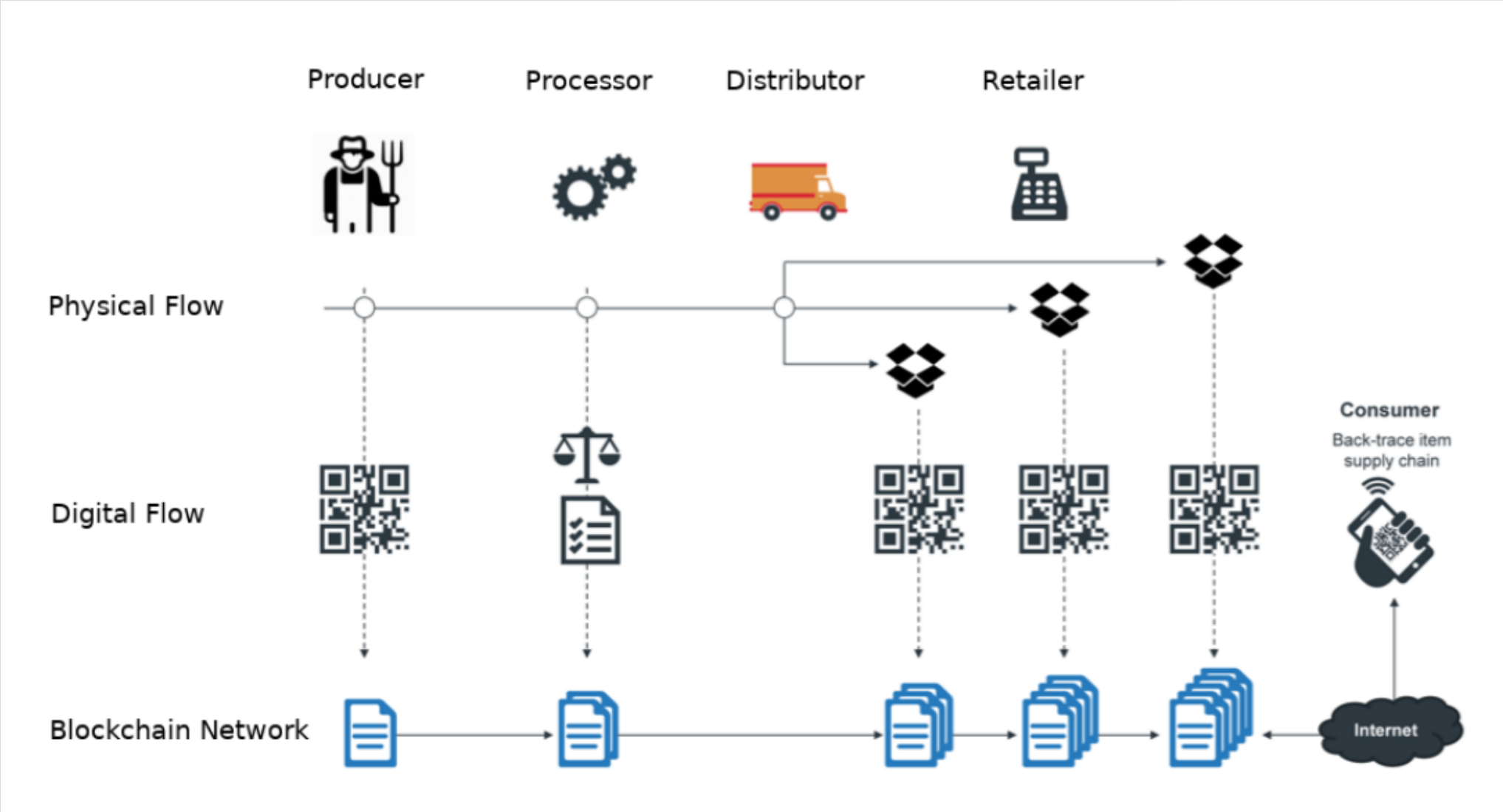


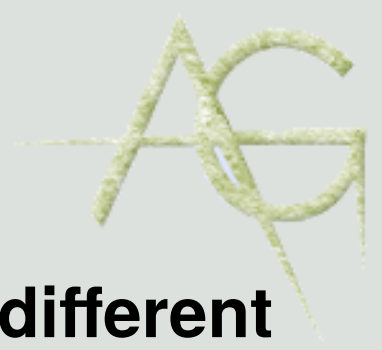
- **Distribution**: the product is released for the distribution phase, delivery time can change and there may be a product storage step (Storage)

- **Retailing**: the products are delivered to retailers who perform the sale of the product. The end-user of the chain will be the customer, who purchase the product.

- **Consumption**: The consumer is the end user of the chain, he buys the product and requires the quality standards verifying traceability.

System Architecture





- **Physical Flow**. It contains products among different organizations within the supply chain.
- **Digital Data**. It includes every single data linked to an asset belonging to the physical level, and useful for the traceability process.
- **Blockchain System**. It represents the blockchain platform used to save each digital data linked to traceability in the entire supply chain.

The consumer can backtrack all product history from its sale to the field using for example a special QR code

UML diagram

