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ZEBRA

Building Digital Product Passports Based on Transparent and Trustful Value Chains

Zebra
Developers
Build Your Edge

Who am I?

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José Manuel Cantera

Senior ICT Expert & Consultant

Under the IOTA Foundation his current role is focused on architecture and strategic technical leadership, namely the EU Blockchain Services PCP, sponsored by the European Commission, where different DPP pilots are being developed and evaluated. Expert actively contributing to the GS1 MSWG on "Circular Economy and DPP".

With more than 23 years of experience in the technology sector, he has made significant contributions across standards development organisations, namely NGSI-LD, open API based on linked data, currently adopted by more than 300 smart cities across the world, and recently, he has been part of the core team of international experts that delivered the GS1 EPCIS 2.0 standard, key for future supply and value chain traceability.

About the IOTA Foundation

The IOTA Foundation was founded in 2017 to research, develop and grow the IOTA protocol and ecosystem.

Established as the first regulated DLT non-profit in Germany, we work together with partners in academia, government, and business to develop open source technologies that allow people to live freely, safely and securely in a digital world.

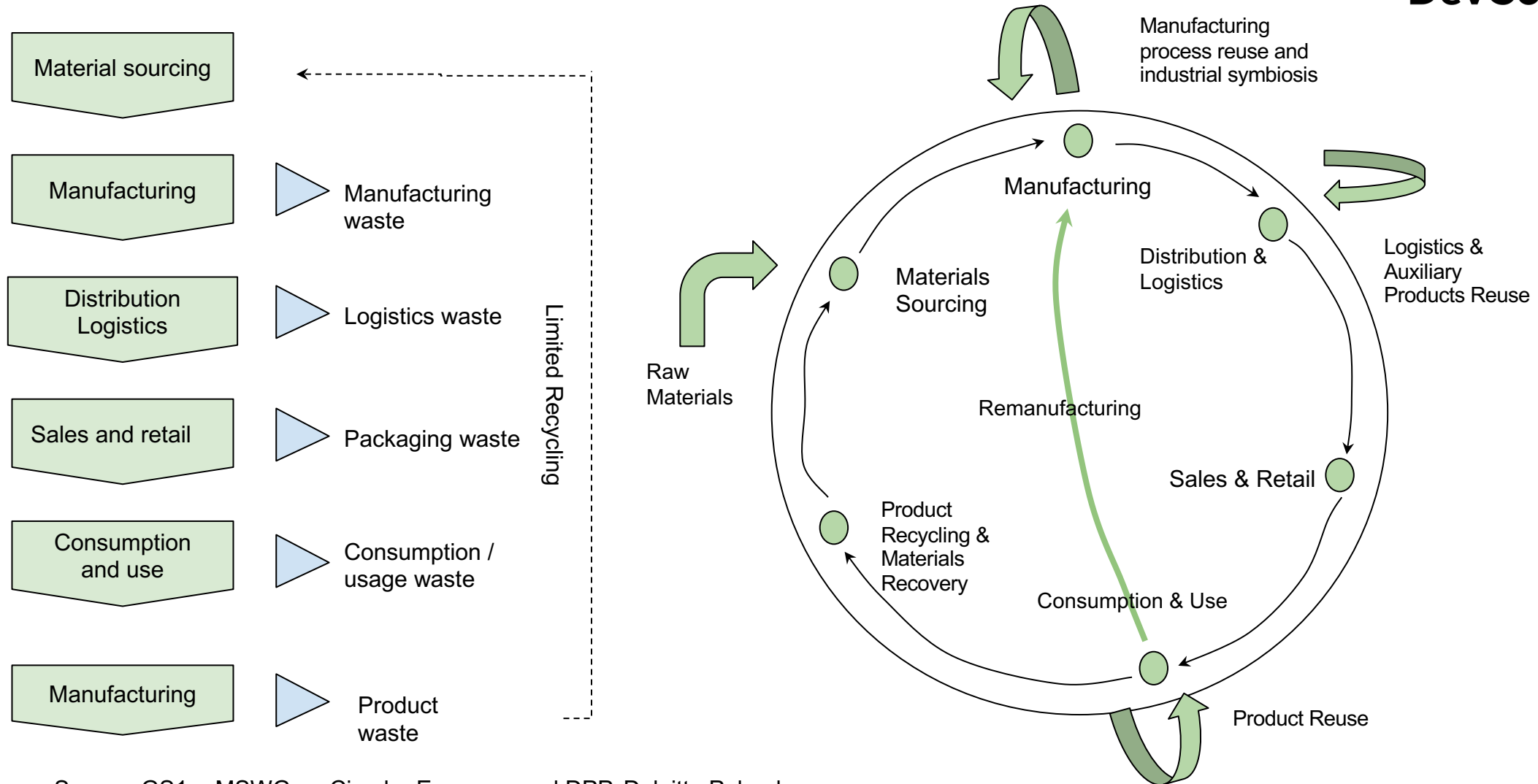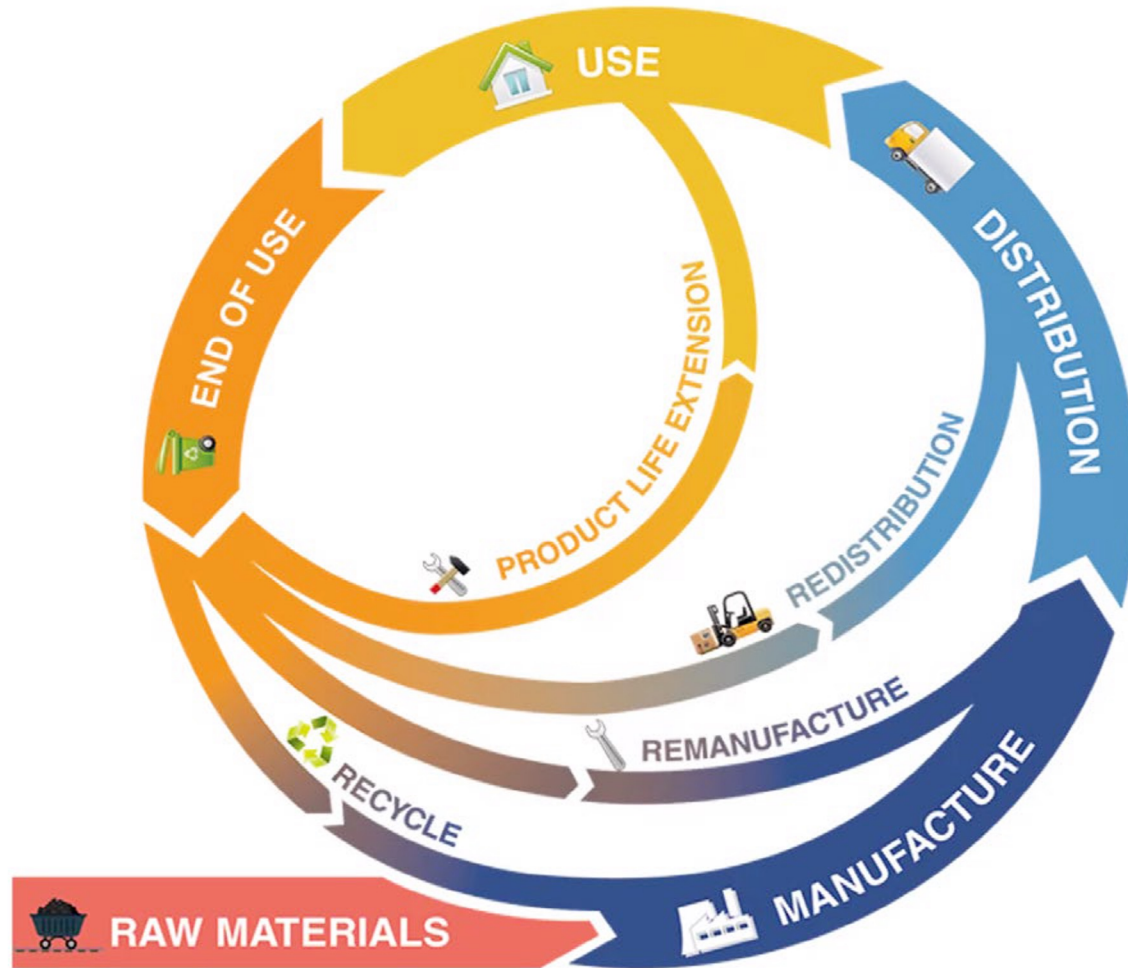We are based in Berlin, Germany with operations worldwide.

Introduction

Linear Value Chain vs Closed Loop Value Chain

Source: GS1 .- MSWG on Circular Economy and DPP. Deloitte Poland

The circular economy model

The circular economy model includes new thinking related to the **management of product data** and resources, which increasingly need to be retained through re-designing, re-manufacturing, re-use and recycling

Source: GS1 .- MSWG on Circular Economy and DPP

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Digital Product Passports

The EU ESPR Regulation

- EU Policies and instruments
  - EU Green Deal → Overarching policy
  - Sustainable Products Initiative (SPI) → Product Framework
  - Circular Economy Action Plan (CEAP)
  - European Dataspace for Smart Circular Applications

- ESPR Eco Design of Products **proposed** Regulation (March 2022)
  - To come into force around **2026**

- *The Commission shall, where appropriate, require supply chain actors to: (a) provide, upon request, manufacturers, notified bodies and competent national authorities with available information related to their supplies or services that is relevant in order to verify compliance with ecodesign requirements*

- **Digital Product Passport** as the key instrument to materialize the new product policy and enable a Circular Economy in the value chain
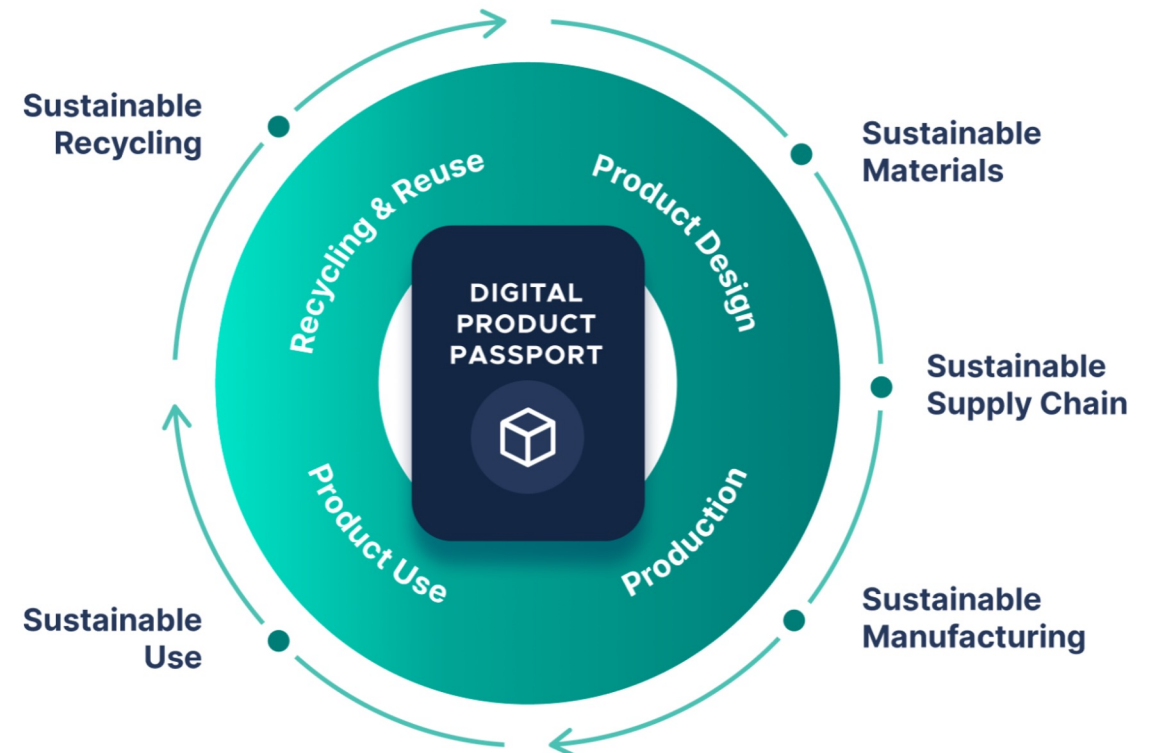
Digital Product Passport - Overview

- DPPs will provide, in a **machine-readable** fashion, both the ability to track products and information on a product's *origin, durability, composition, reuse, repair and dismantling* possibilities, and *end-of-life* handling

- DPP → Common structure and governance + sectoral specific provisions (delegated acts or specific regulations, ex. Battery regulation).

- DPP data (non-exhaustive)
  - Product tech information, hazardous materials, manufacturing procedures, env. footprint, etc.
  - Key tracking events (for instance, configuration changes, transportation conditions, …)
  - Certificates (warranty, test, compliance, …), Labels (ex. EcoLabel)
  - Sustainability information, such as recycling procedures, recycled content, …

- DPP audiences
  - Market Surveillance Authorities (**B2G**) → Verification of compliance
  - Custom Authorities (**B2G, G2G**) → Efficiency of enforcement activities by member states
  - Consumers (**B2C**) (sustainable purchasing choices) and safer purchases, i.e authenticity
  - Businesses (**B2B**)

DPPs - Products under scope

Preliminary selected by JRC: End-use products	Preliminary selected by JRC: Intermediate products	Sectors covered by other EU similar-in-scope legislation
Textiles and Footwear Furniture Ceramic Products Tyres Detergents Bed Mattresses Lubricants Paints Cosmetics Toys Fishing Gears Absorbent Hygiene Products	Iron & Steel Non-Ferrous Metal Products Aluminium Chemicals Plastics Pulp & Paper Glass	Energy-related Products (ErP) Packaging (PPWR) Construction Products (CPR) EVs batteries (and for some extent, all batteries) **Excluded** Motor vehicles (TBC: only in Council document) Food Feed Medicinal products

Source: GS1 .- MSWG on Circular Economy and DPP

DPP Context Overview
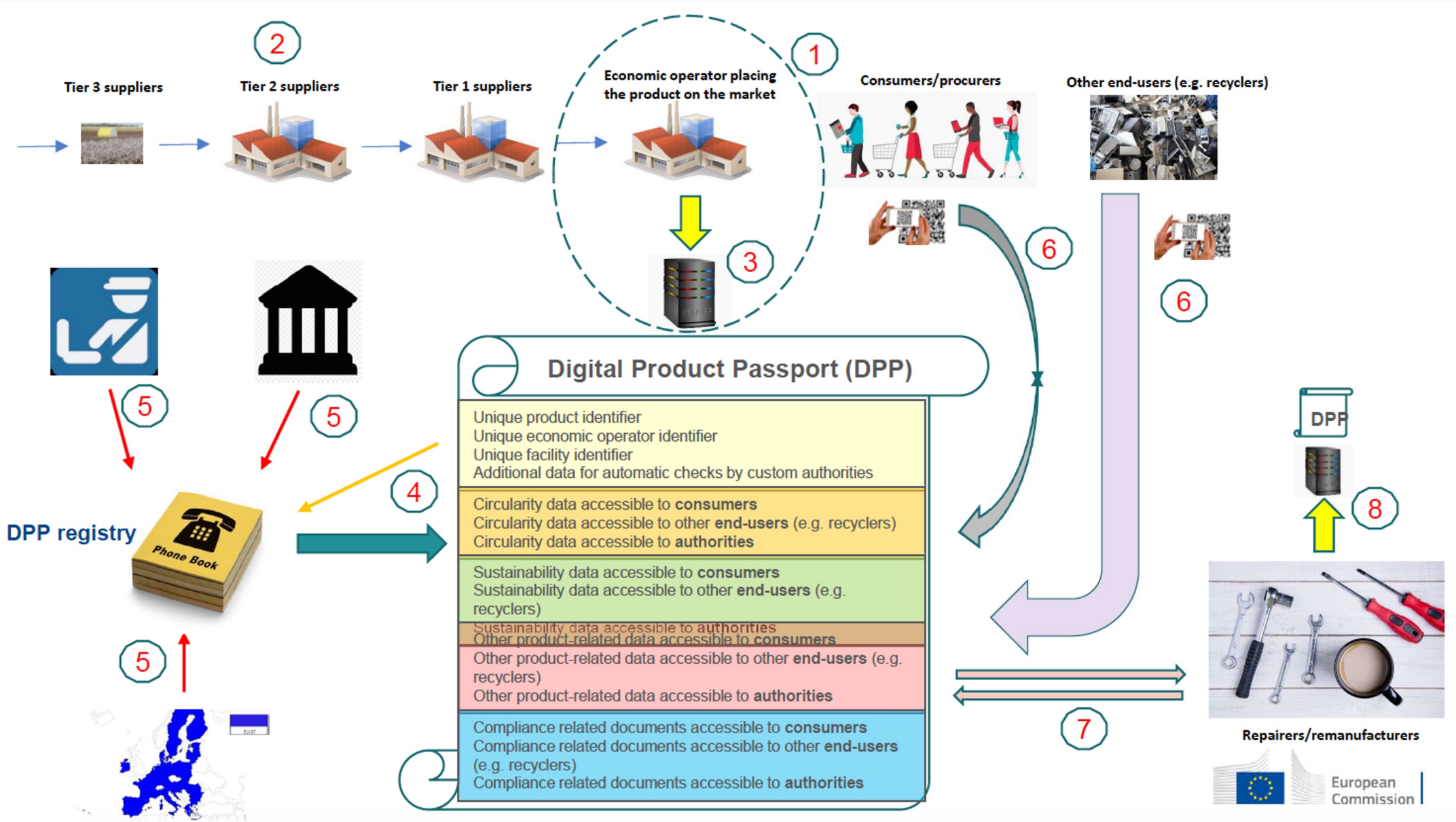
DPP Requirements + Interoperability

|	
Unique identification of products, economic operators or facilities	ISO/IEC 15459:2015
DPP **Web-accessible** through data carrier physically present on the product or packaging	GS1 Digital Link
All information shall be based on open standards, machine-readable, structured, searchable, interoperable (X-Sector)	JSON-LD (Linked Data)
consumers, economic operators and other relevant actors shall have free access to the product passport based on their respective **access rights**	REST / ABAC
the **rights** to access and to introduce, modify or update information in product passport shall be **restricted**	ABAC, others?
data **authentication**, reliability and integrity shall be ensured	W3C DID. W3C VC
the data included in the product passport shall be stored by the economic operator responsible for its creation or by operators authorised to act on their behalf;	For Further Study
product passports shall be designed and operated so that a high level of security and privacy is ensured and **fraud is avoided**	GS1 Digital Signature. For further study

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Building Solutions

Building DPP solutions: Our Assets
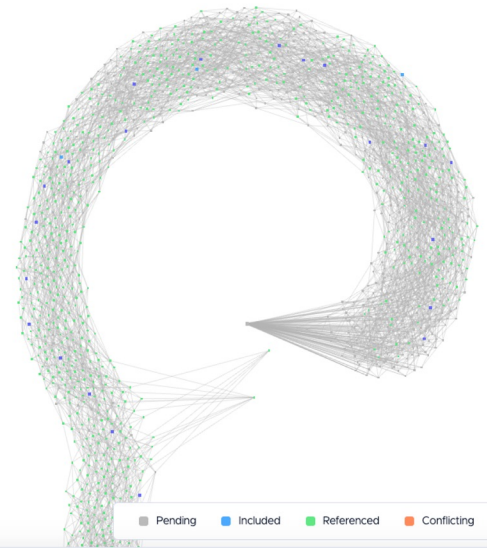
IOTA DLT - Perspective from a technologist

The blockchain bottleneck

More Activity = Same Validation
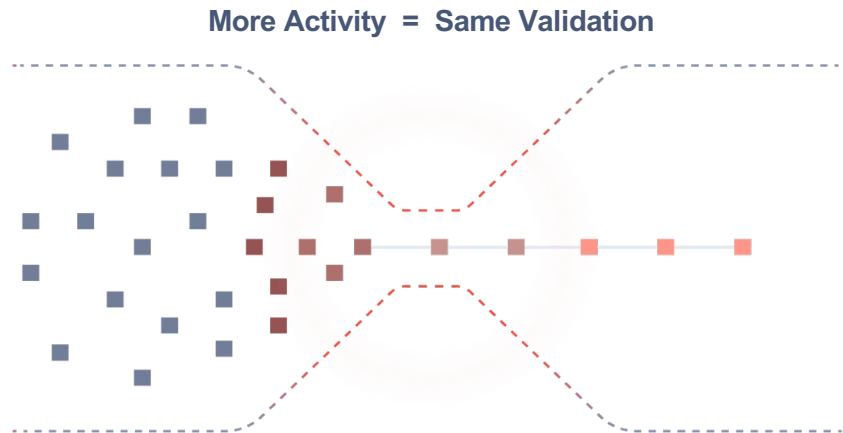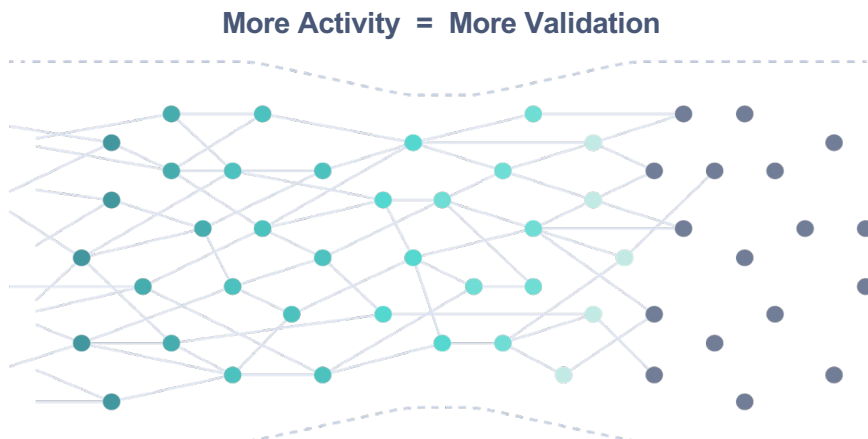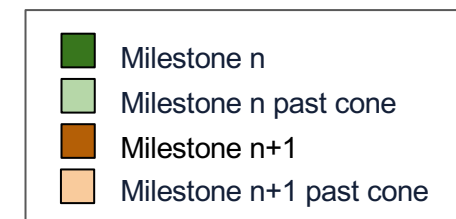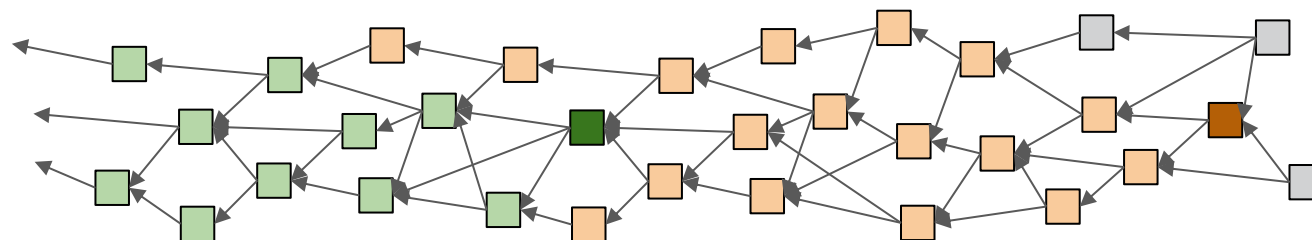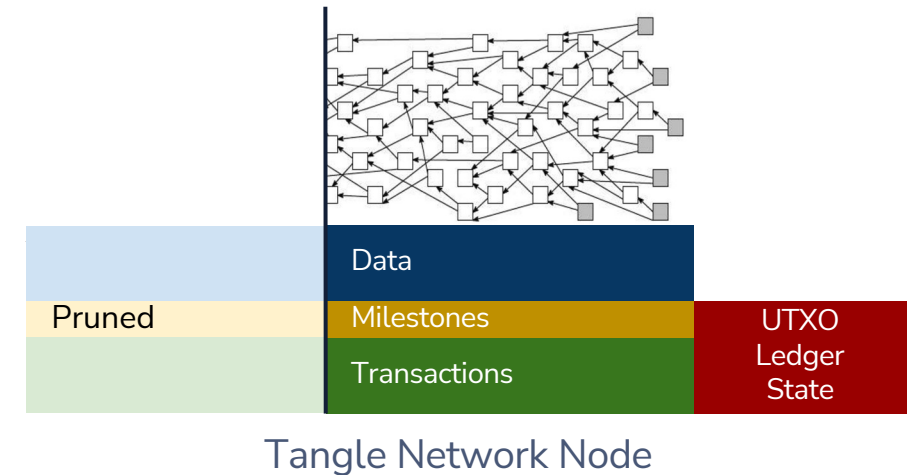

Blockchain-based DLT

- Slow and periodic block creation
  - Tradeoff: fast block creation OR security
- Sequential writing
  - One leader at a time
- Miners
  - Access controlled by small group
  - Fee based incentive structure
- Sequential processing
  - Inefficient

The IOTA Tangle scales

More Activity = More Validation

Direct Acyclic Graph DLT

- Fast and continuous message stream
  - No tradeoff
- Parallel writing
  - Faster
- No miners
  - Many writers
  - More flexible incentive structure
- Parallel processing
  - More efficient

ZEBRA TECHNOLOGIES

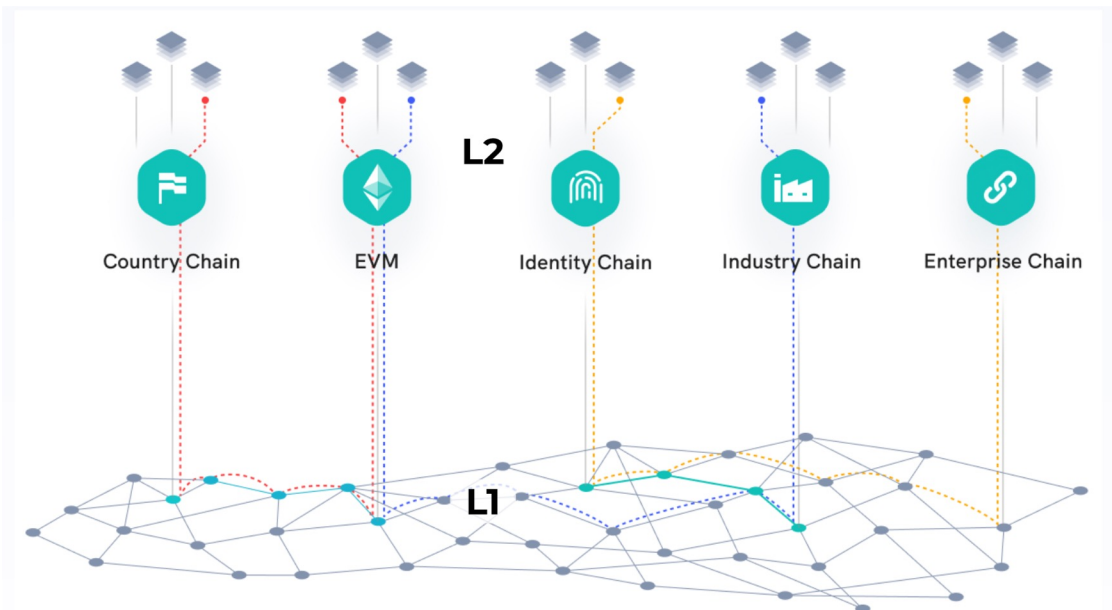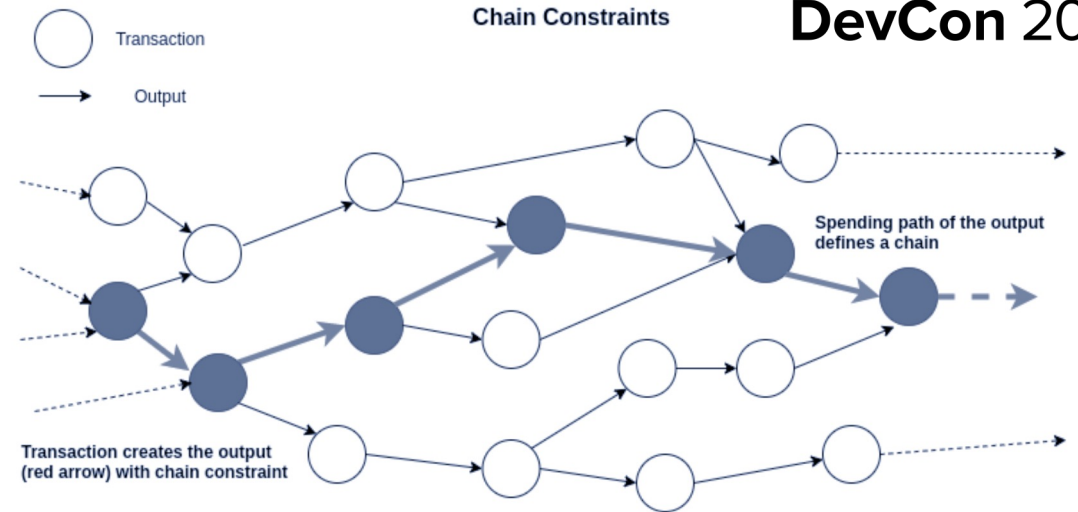# IOTA DLT .- Pragmatic perspective for an app developer

- **Ledger**: information store that keeps final and definitive (**immutable**) records of transactions

- **DLT**: a type of ledger that is **shared, replicated, and synchronized** in a distributed and decentralized manner

- IOTA DLT the ledger is a collection of Outputs (**UTXO**) that can be consumed in a transaction that generates new Outputs. Transactions are wrapped into blocks attached to the Tangle.

- The Transaction has to be signed by the address that can unlock the original output (input)

- The IOTA Proof of Authority **consensus mechanism** confirms blocks (through a milestone issued by several Coos) and the ledger evolves into its new state (all nodes abide to that new state).

Pruned	Data	
	Milestones	UTXO Ledger State
	Transactions	

Tangle Network Node

■ (dark green)	Milestone n
■ (light green)	Milestone n past cone
■ (brown)	Milestone n+1
■ (orange)	Milestone n+1 past cone

IOTA DLT .- Pragmatic perspective for an app developer (II)

Stardust (Shimmer) version

- **Alias Address** → Alias Output → Represents a certain state sequence on the Ledger (chain constraint)
  - State Controller Address (unlocks current Alias Output and generates a new one with new state)

- **Proof of Inclusion** → A cryptographically verifiable proof that the Tangle or the Ledger was in a particular state at a particular point in time

- Plus: Execution of custom protocol logic through **Smart Contracts** compatible with the Ethereum Virtual Machine (ISC Chains)

- IOTA Nodes offer a REST API extended with INX plugins (ex. INX Identity)

- Libraries with bindings in different languages

○ Transaction

→ Output

Chain Constraints

Spending path of the output defines a chain

Transaction creates the output (red arrow) with chain constraint

L2

Country Chain EVM Identity Chain Industry Chain Enterprise Chain

L1

DPP Trust Framework

Enabling ecosystems of trust with IOTA

W3C standards for Decentralized Identifiers and Verifiable Credentials (VC) on top of IOTA

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Issuer

A trustworthy party on a specific subject, with their own digital identity. They verify and digitally sign credentials.

ISSUES
VC

Holder

Usually the subject of the Digital Identity. They acquire, hold and present VC using private keys, which are under their control.

PRESENTS
VC

Verifier

Able to verify credentials shared by the holder, by confirming its authenticity on the ledger.

IOTA Tangle

The Tangle is a scalable, feeless and secure DLT. It serves as a verifiable data registry and a decentralized public key infrastructure.

Example of a Trust Framework instantiation

- **TAO** Trusted Accreditation Organization.
  - Ex Tax Agency is accredited by the Government to accredit Economic Operators as "Legal Entities" by generating a Verifiable Attestation
  - Ex Waste Agency is accredited by the Government to accredit recyclers or waste managers

- **TI** Trusted Issuer.
  - Ex. Economic Operator is accredited by the Tax Agency to attest on products → Attest claims for a DPP

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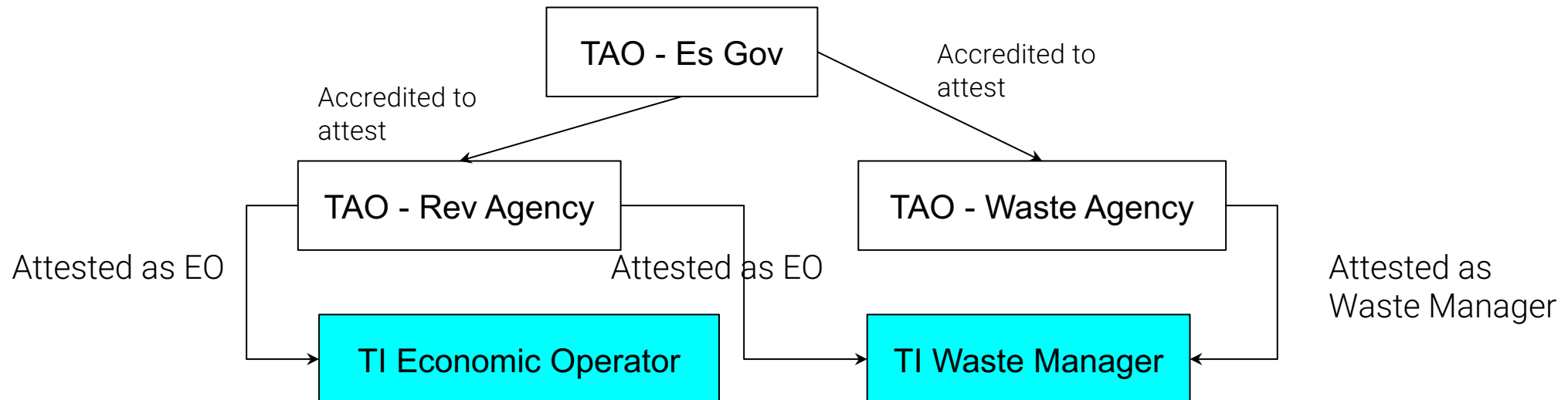
What IOTA + Zebra offer to devs and innovators?

- The framework to implement Trust Frameworks using publicly auditable Decentralized Identities recorded on the Ledger through Alias Output

- The capability to generate and verify VCs through the IOTA Identity Framework

- Node extensions (REST APIs) to
  - publish and resolve DIDs and public credentials
  - to verify VCs taking into account Proof of Inclusion

- A **Zebra-IOTA Edge SDK** that can exploit trust frameworks using unique Zebra capabilities such as **Datawedge**

- Using those assets a simple DPP can be deployed by a manufacturer represented by a cryptographically verifiable JSON-LD document, data integrity proof (digital signature) verifiable through any IOTA Node

- Through a Digital Link a scanner can discover the DPP (through a Web link) and verify it through an IOTA Node

Verifiable DPP data

Enabling verifiable data on DPPs

- A DPP System is a decentralized one with multiple data controllers

- Should be all data in a DLT?
  - DLTs are not good at indexing data
  - There are data in a DPP that might not be public (subject to access rights)

- Solution
  - DPP Data Controllers store data as requested by DPP Writers
  - DPP Data Controllers commit to the data via an entry on the DLT
  - DPP Readers can request data to Data Controllers and verify the data through a DLT Entry (immutability, timestamping, sequencing)
  - Alternatively commitments to the data can be achieved through timestamping (proof of inclusion)

- A commitment can be realized via a DLT Entry representing an Audit Trail or can be the state of a Smart Contract

- A commitment only contains hashes of the real DPP data kept by a Controller

DPP System Architecture with Verifiable Data
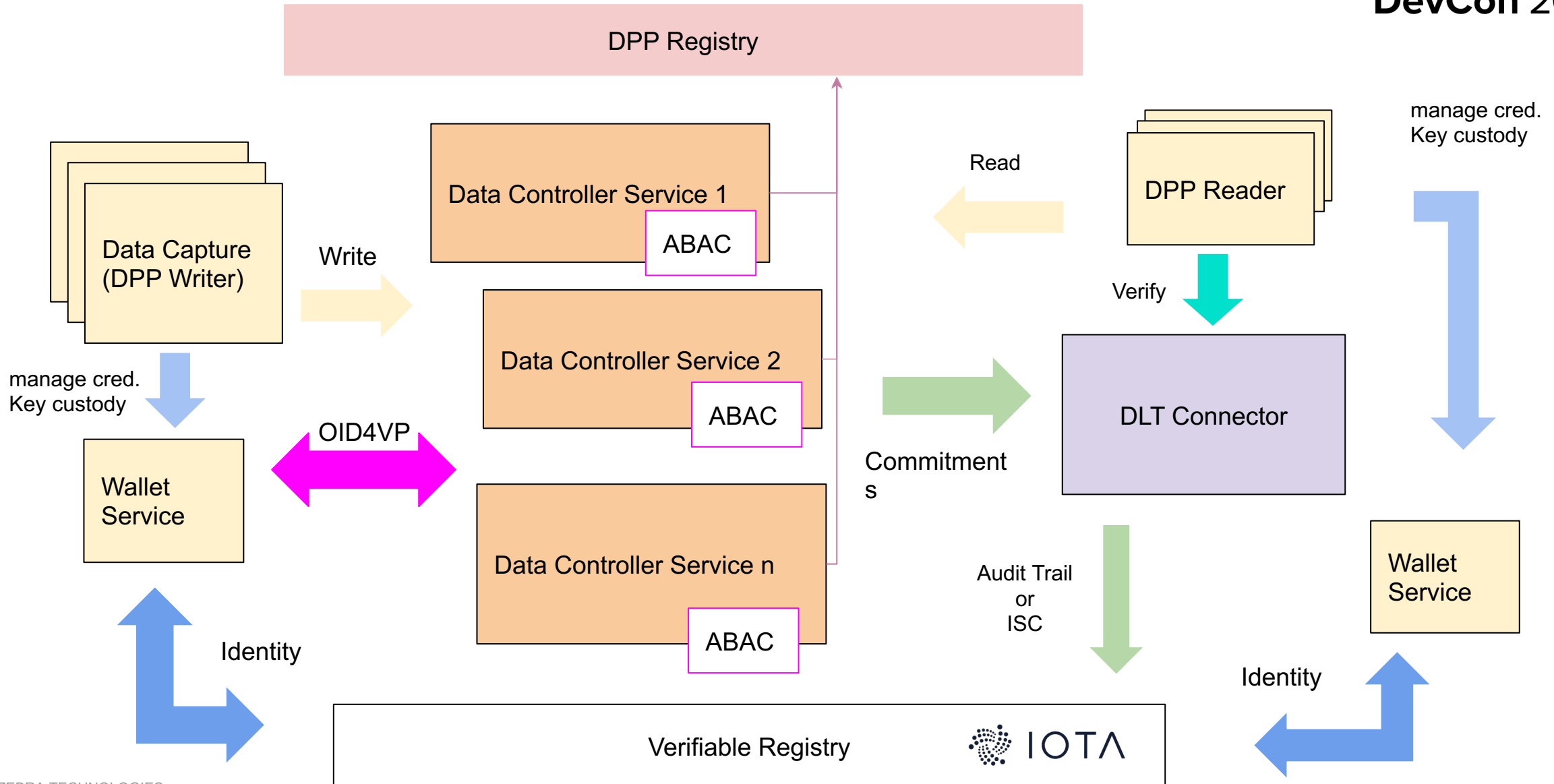
What IOTA + Zebra can offer to devs and innovators?

- The framework to create data commitments through "Audit Trails" implemented as Alias Output. A Trail is a data structure composed of a chain of data records that captures a sequence of states

- An Auditable Item Graph reusable building block that can be used to track the relationships, master data, and the current state of an object and its whole (auditable) history, building the basis of a descriptive Digital Twin. GS1 Digital Link and Linked Data representations (JSON-LD)

- EPCIS 2.0 capabilities

- All the capabilities of Zebra Devices for AIDC turning them into additional proofs for the DPP, together with IOTA

  – Ex. A recycler receiving a pallet of products can automatically read IDs with RFID and timestamp on the Tangle → Proof of Recycling

General

Alias Address
ebsi1pr8d54yknkh0z94dkwv1j640s4setlztdv3p6tgt6x0uv72mkss5xtkn26q

Alias Id
0xceda54969daef116adb399f96aaf856195fc4b6b221d2d0bd19fc6795bb42143

Available Balance   Storage Deposit
0   0

State   Foundries   Transactions   Native Tokens   NFTs   Associated Outputs 1

State Index
0

State Metadata

{
    "meta": {
        "updated": "2023-09-11T07:43:35Z"
    },
    "record": {
        "proof": {
            "value": "1234"
        }
    }
}

{
    "id": "urn:epc:id:sgtin:9524444.100000.15",
    "type": [
        "Item",   "Product"
    ],
    "@context": [
        "https://schema.org",
        "https://w3id.org/opengtsc"
    ],
    "dateCreated": "2023-08-15T10:48:06.851Z",
    "dateModified": "2023-08-15T10:48:06.851Z",
    "creator": "did:iota:DgPHdjyZGACgBjj9kHUMrxbXkWEtAG3VbibXkDYTn189",
    "name": "Alfaten 2000",
    "manufacturer": "Solplast",
    "weight": 50,
    "location": {
        "type": "Place",
        "geo": {
            "type": "GeoCoordinates",
            "latitude": 37.59,
            "longitude": -1.75
        }
    }
}

Experiments

Experiment 1 .- DPP for electronics

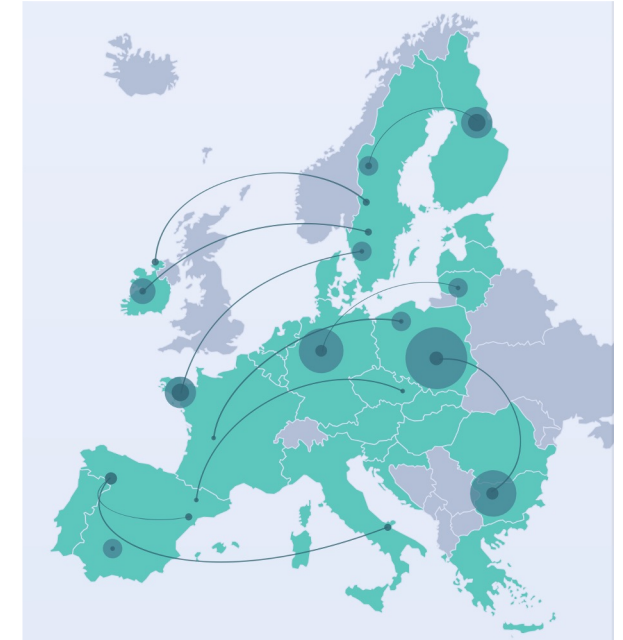https://github.com/eReuse/devicehub-teal

Experiment 2 .- DPP for plastic upcycling
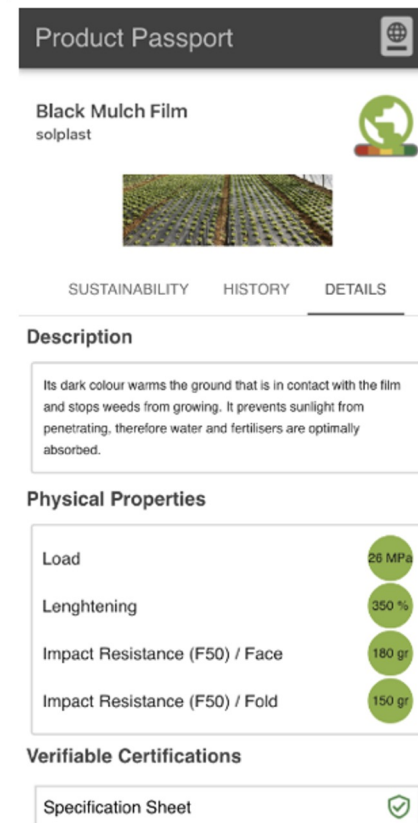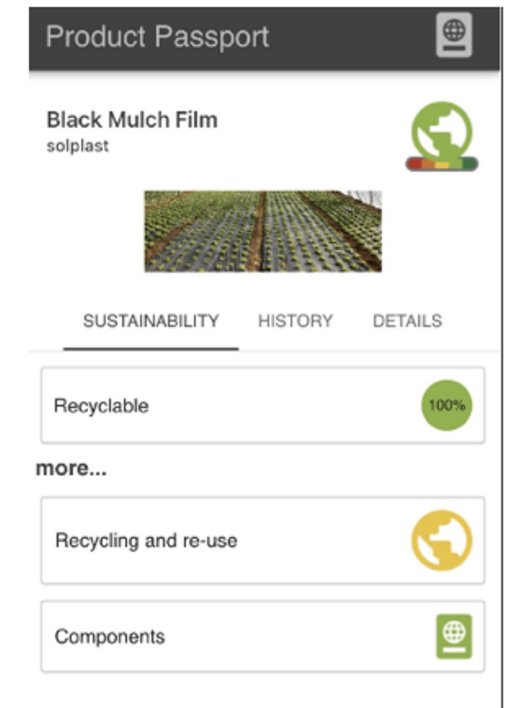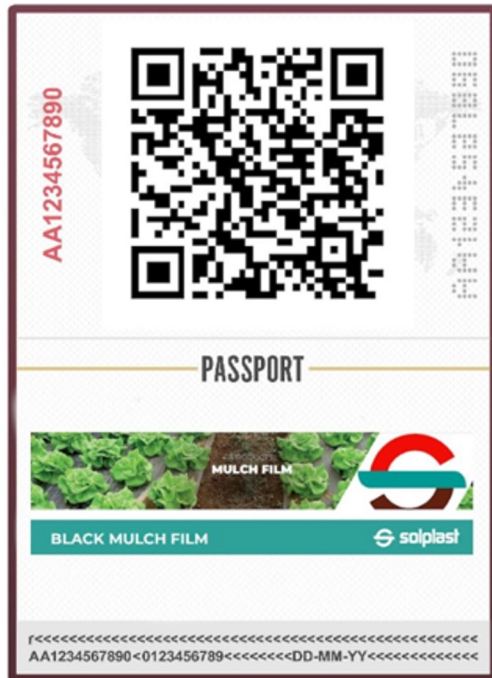
Call to action

IOTA

Next public Blockchain Service Infrastructure for the EU

The IOTA Foundation has been selected as **one of the three** finalists from 30+ applications, to participate in the **final phase** of the EU blockchain services PCP process. This aims to design new DLT solutions to improve the **scalability, energy efficiency and security of EBSI**, *a network of blockchain nodes across Europe*.

Zebra - IOTA Collaboration (Background and Next)

- Generation 1 : Several prototypes developed during 2020-2022 with previous versions of IOTA
  - Track & Trace Ledger APIs (based on Chrysalis) at Zebra Savanna
  - RFID Cloud Services integration
  - Product Authenticity prototype (won Zebra contest for developers)
  - Zebra-IOTA Edge SDK
- Generation 1 → Explore the possibilities and raise awareness of the community
- Generation 2 (2024-) → Towards maturity
  - EU Blockchain Services (EBSI → EDIC → EU Digital Decade 2030)
  - Identity SDK
  - DPP SDK with integration with flagship edge devices
  - DPP solutions with ISVs