



Nis Jespersen

# Sustainability Trust Graphs

with UN/CEFACT Linked Data and Verifiable Credentials





## About the Presenter

Nis Jespersen

- Solution Architect at Transmute
- Editor UN Linked Data Web Vocabulary

Transmute

- Holds Editor and Author roles on the W3C Decentralized Identifiers and Verifiable Credentials Specifications
- Transmute contributes significant open source tooling in the Linked Data, DID and VC space

US DHS SVIP

- Transmute is contracted by US DHS SVIP to design Linked Data Verifiable Credential schemas, ensuring that appropriate UN terms are used in digital communication with the US government: <https://w3id.org/traceability>

Verifiable Data Platform

- Our Verifiable Data Platform guarantees standards compliance, sign up for free now and start building Trust Graphs immediately: <https://platform.transmute.industries/>



## Agenda

In this session we will explore UN/CEFACT's role in enabling interoperability amongst established sustainability certificate issuers; and how it enables deep supply chain traceability, building Trust Graphs from Verifiable Credentials.

- Background:
  - Linked Data, Semantic Web Vocabularies and Knowledge Graphs
- Introduction to Trust Graphs
  - Constructed from Verifiable Credentials
  - Building upon Trust anchors
- Introduction to the Draft UN/CEFACT Sustainability Web Vocabulary
- Constructing Trust Graphs with Verifiable Credentials
  - Choosing Trust Anchors
  - Enabling Sustainability Semantic Interoperability
  - Enforcing Sustainability Trust Graph Policies





https://vocabulary.uncefact.org/



# TradeParty

An individual, a group, or a body having a role in a trade business function.

## Object Properties

URI	Type	Comment
<a href="#">unece:applicableServiceCharge</a>	<a href="#">unece:ServiceCharge</a>	A logistics service charge applicable to this trade party.
<a href="#">unece:associatedParty</a>	<a href="#">unece:TradeParty</a>	A party associated with this trade party, such as a local agent of a shipping line.
<a href="#">unece:definedContact</a>	<a href="#">unece:Contact</a>	A trade contact defined for this trade party.
<a href="#">unece:endPointURICommunication</a>	<a href="#">unece:UniversalCommunication</a>	The communication address of the end point URI for this trade party.
<a href="#">unece:logoAssociatedBinaryFile</a>	<a href="#">unece:BinaryFile</a>	A file containing a specified binary representation of a logo associated with this trade party.
<a href="#">unece:ownedFinancialAccount</a>	<a href="#">unece:CreditorFinancialAccount</a>	The creditor financial account owned by this trade party.
<a href="#">unece:postalAddress</a>	<a href="#">unece:TradeAddress</a>	The postal address for this trade party.
<a href="#">unece:providedService</a>	<a href="#">unece:Service</a>	A transport service provided by this trade party.
<a href="#">unece:specifiedAuthoritativeSignatoryPerson</a>	<a href="#">unece:AuthoritativeSignatoryPerson</a>	A person specified to sign on behalf of this trade party.
<a href="#">unece:specifiedFinancialIdentity</a>	<a href="#">unece:FinancialIdentity</a>	The financial identity specified for this trade party.
<a href="#">unece:specifiedGovernmentRegistration</a>	<a href="#">unece:GovernmentRegistration</a>	A governmental registration specified for this trade party.
<a href="#">unece:specifiedIdentity</a>	<a href="#">unece:ProprietaryIdentity</a>	A proprietary identity specified for this trade party.



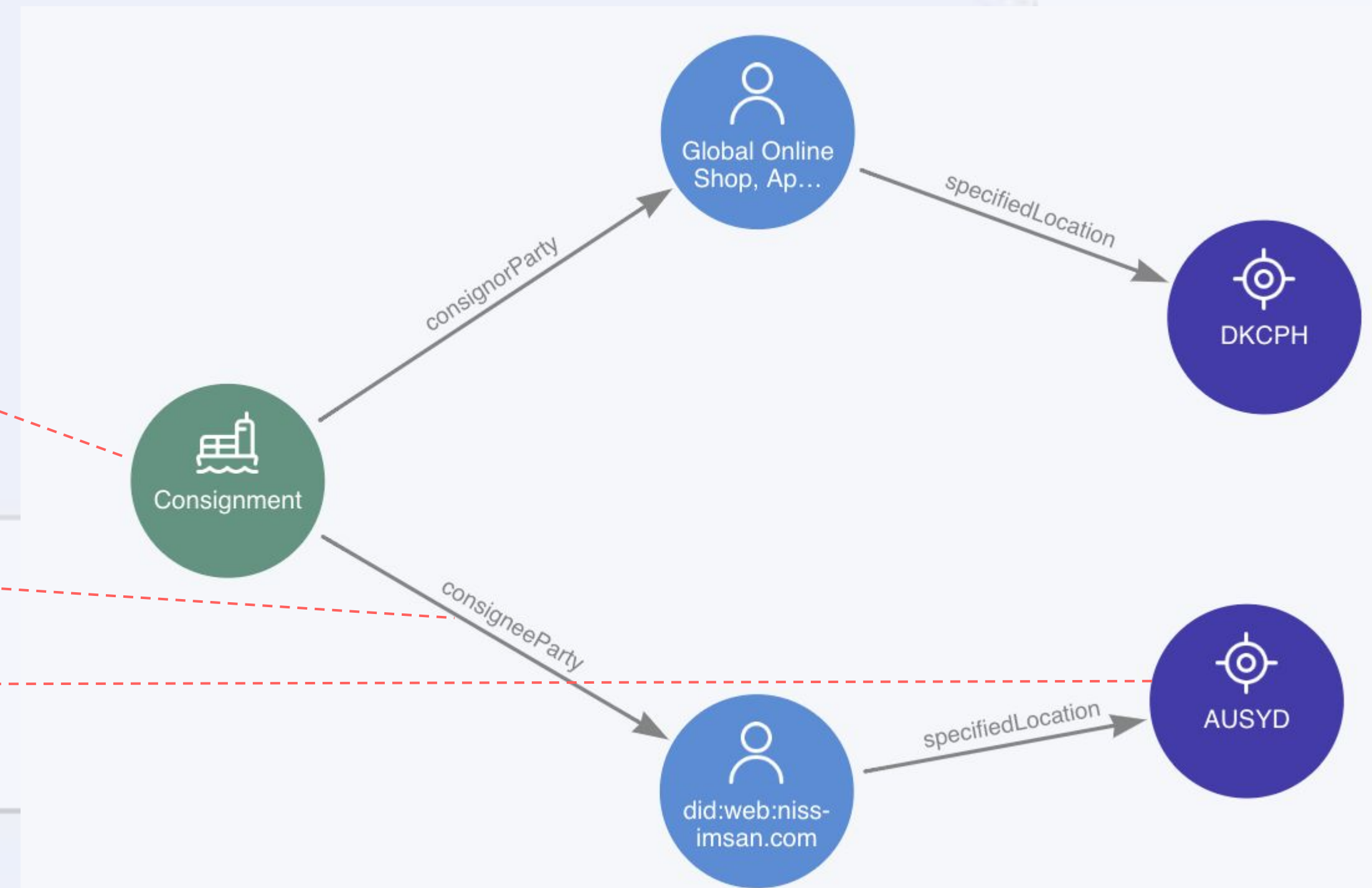


# RDF is Graph Data

JSON-LD is a serialization format of RDF, a first order logic knowledge representation.

A JSON-LD file is in fact a data graph.

```
{
  "@context": [
    "https://vocabulary.uncefact.org/unece-context.jsonld",
    "https://vocabulary.uncefact.org/unlocode-vocab-context.jsonld"
  ],
  "@id": "https://7Cs-carrier.com/bl/12345678",
  "@type": "Consignment",
  "consignorParty": {
    "@id": "did:web:online-shop.global",
    "@type": "TradeParty",
    "name": "Global Online Shop, Aps.",
    "specifiedLocation": {
      "@type": "https://vocabulary.uncefact.org/LogisticsLocation",
      "unlcdv:UNLOCODE": "DKCPH"
    }
  },
  "consigneeParty": {
    "@id": "did:web:nissimsan.com",
    "@type": "TradeParty",
    "specifiedLocation": {
      "@type": "https://vocabulary.uncefact.org/LogisticsLocation",
      "unlcdv:UNLOCODE": "AUSYD"
    }
  }
}
```





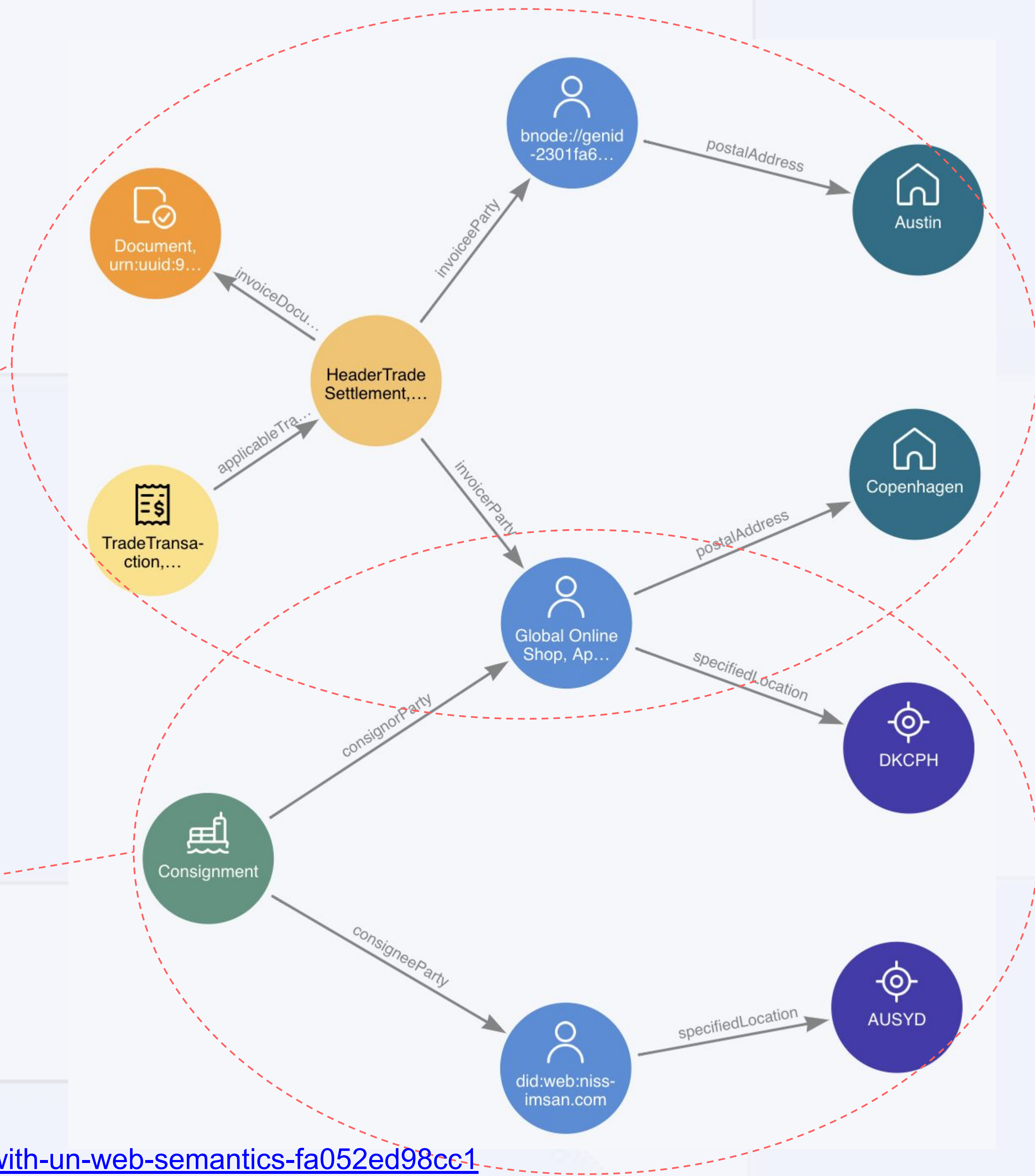


# Knowledge Graph Assembly

Multiple JSON-LD “snap” together, forming a knowledge graph.

```
{
  "@context": ["https://vocabulary.uncefact.org/unece-context.jsonld"],
  "@id": "https://sales.online-shop.global/inv/0000112318",
  "@type": "TradeTransaction",
  "applicableTradeSettlement": {
    "@type": "HeaderTradeSettlement",
    "invoiceDocument": {
      "@id": "urn:uuid:9c3c66a6-f49f-485e-a7b2-013fb4a0e0a8",
      "@type": "Document"
    },
    "invoicerParty": {
      "@id": "did:web:online-shop.global",
      "@type": "TradeParty",
      "postalAddress": {
        "@type": "TradeAddress",
        "attentionOf": "Nis",
        "streetName": "Runebergs Alle",
        "cityName": "Copenhagen",
        "countryName": "Denmark"
      }
    },
    "invoiceeParty": {
      "@type": "TradeParty",
      "postalAddress": {
        "@type": "TradeAddress",
        "streetName": "Sunshine Ave",
        "cityName": "Austin",
        "countrySubDivisionName": "Texas",
        "countryName": "USA"
      }
    }
  }
}
```

```
{
  "@context": [
    "https://vocabulary.uncefact.org/unece-context.jsonld",
    "https://vocabulary.uncefact.org/unlocode-vocab-context.jsonld"
  ],
  "@id": "https://7Cs-carrier.com/bl/12345678",
  "@type": "Consignment",
  "consignorParty": {
    "@id": "did:web:online-shop.global",
    "@type": "TradeParty",
    "name": "Global Online Shop, Aps.",
    "specifiedLocation": {
      "@type": "https://vocabulary.uncefact.org/LogisticsLocation",
      "unlocdv:UNLOCODE": "DKCPH"
    }
  },
  "consigneeParty": {
    "@id": "did:web:nissimsan.com",
    "@type": "TradeParty",
    "specifiedLocation": {
      "@type": "https://vocabulary.uncefact.org/LogisticsLocation",
      "unlocdv:UNLOCODE": "AUSYD"
    }
  }
}
```





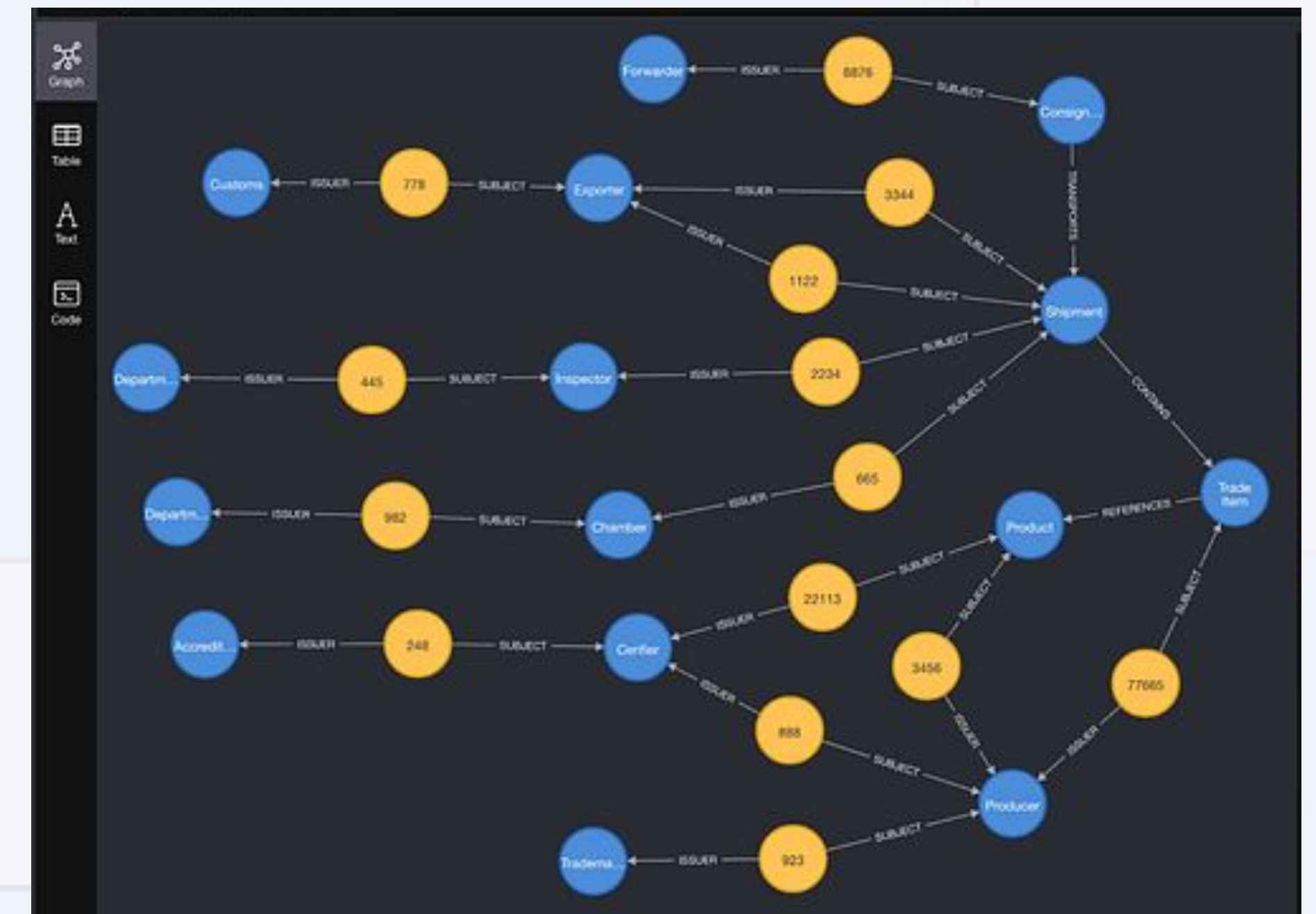
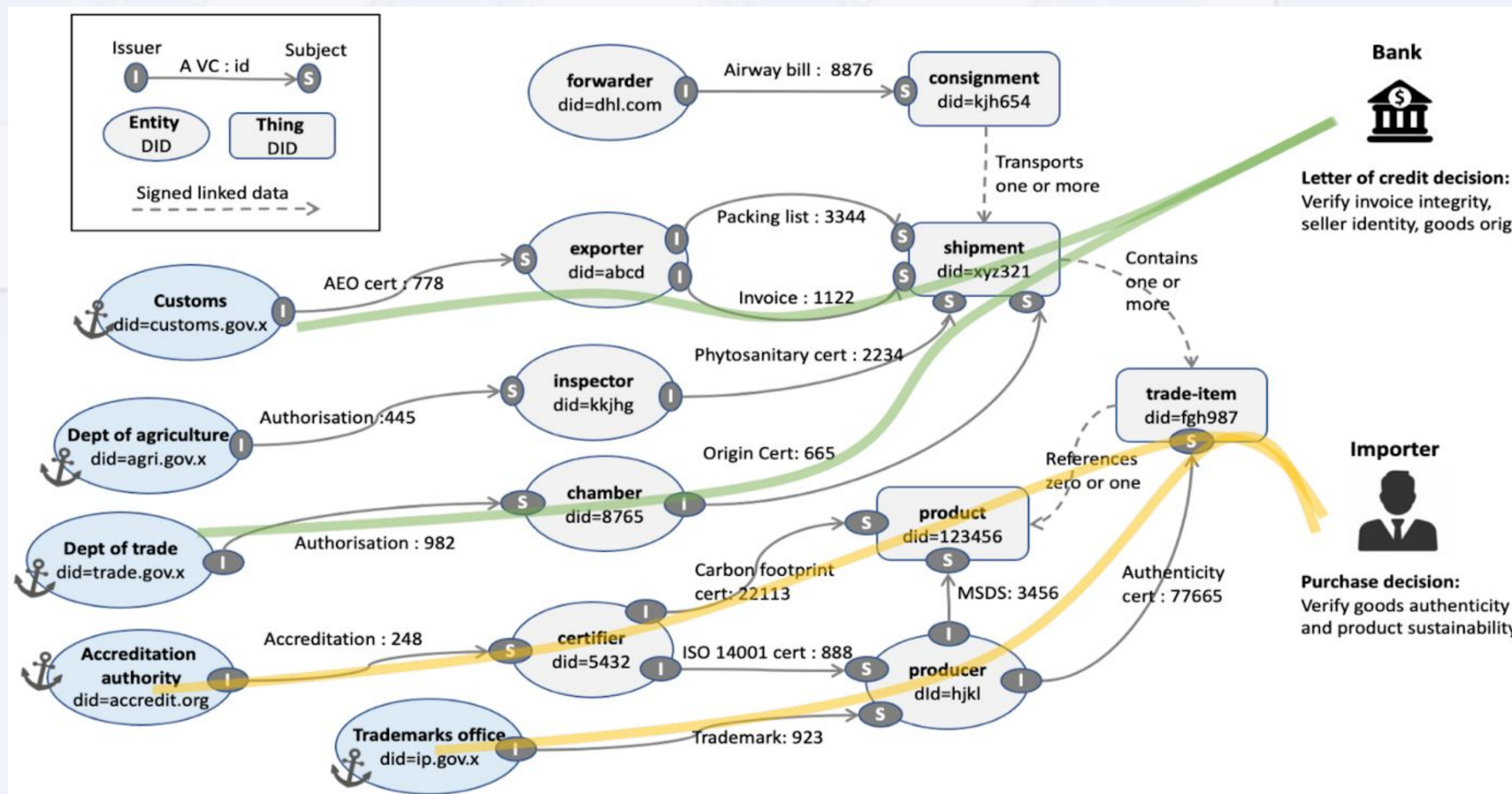


# A Trust Graph is a Knowledge Graph constructed from Verifiable Credentials

Verifiable Credentials and Linked Data work well together: data linked with UN/CEFACT terms, can be cryptographically verified to originate from the issuer.

A Trust Graph comprises of “chains” of such cryptographic claims, which can be traced through multiple links back Trust Anchors: an issuer I can trust as an authority for a particular domain.

“You can trust my claims because you trust the upstream, relevant claims which have been made about me”.





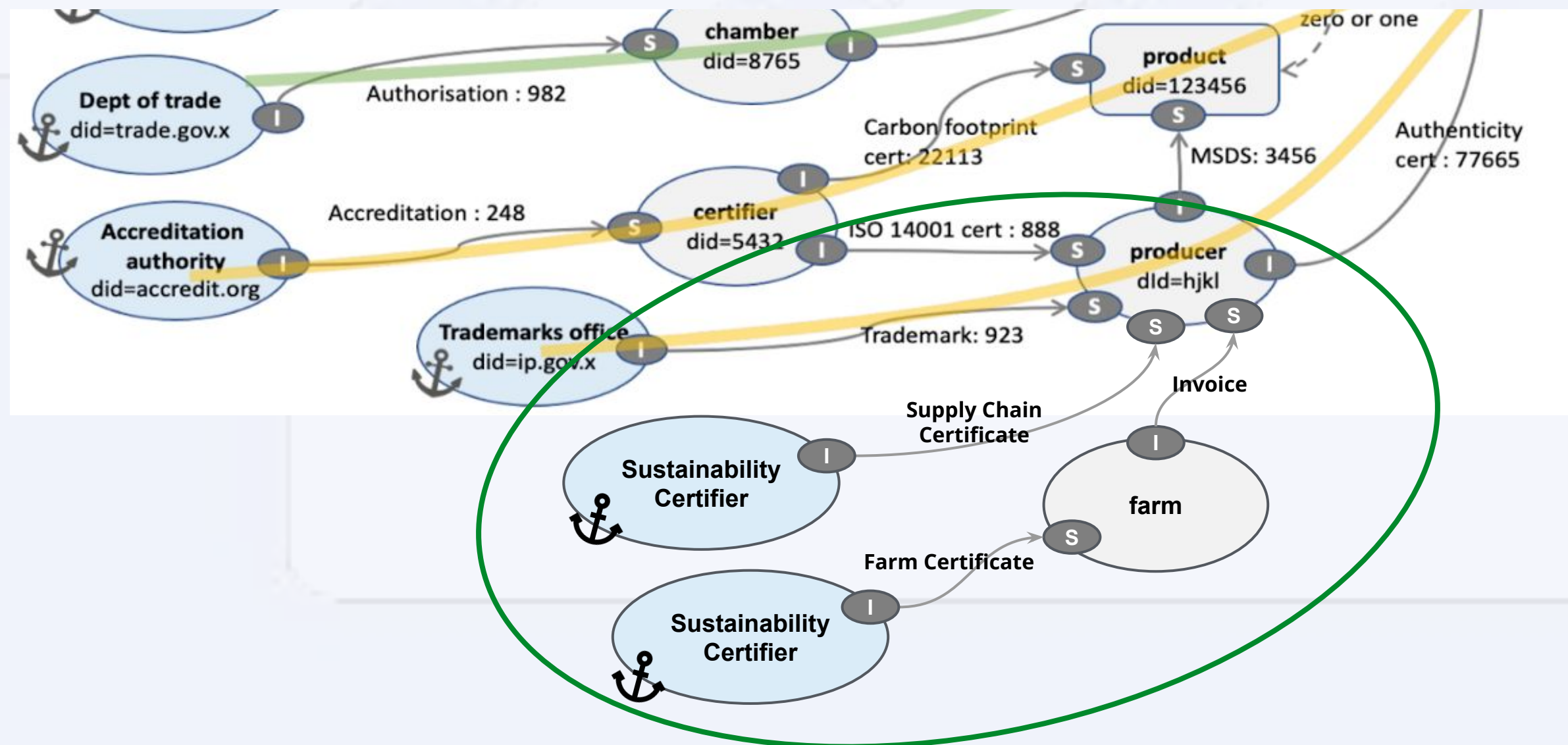


# UN/CEFACT Sustainability Vocabulary (Unstable Early Draft!)

Introducing the UN/CEFACT Sustainability Web Vocabulary; a linked data representation of the International Trade Centre (ITC) harmonised sustainability criteria.

Developed from an analysis of over 300 sustainability standards in use around the world and represents a harmonised language for Environmental and Social Governance (ESDG) sustainability criteria.

Let's use this to add a verifiable sustainability traceability to the Trust Graph...



<https://vocabulary.uncefact.org/sustainability/>





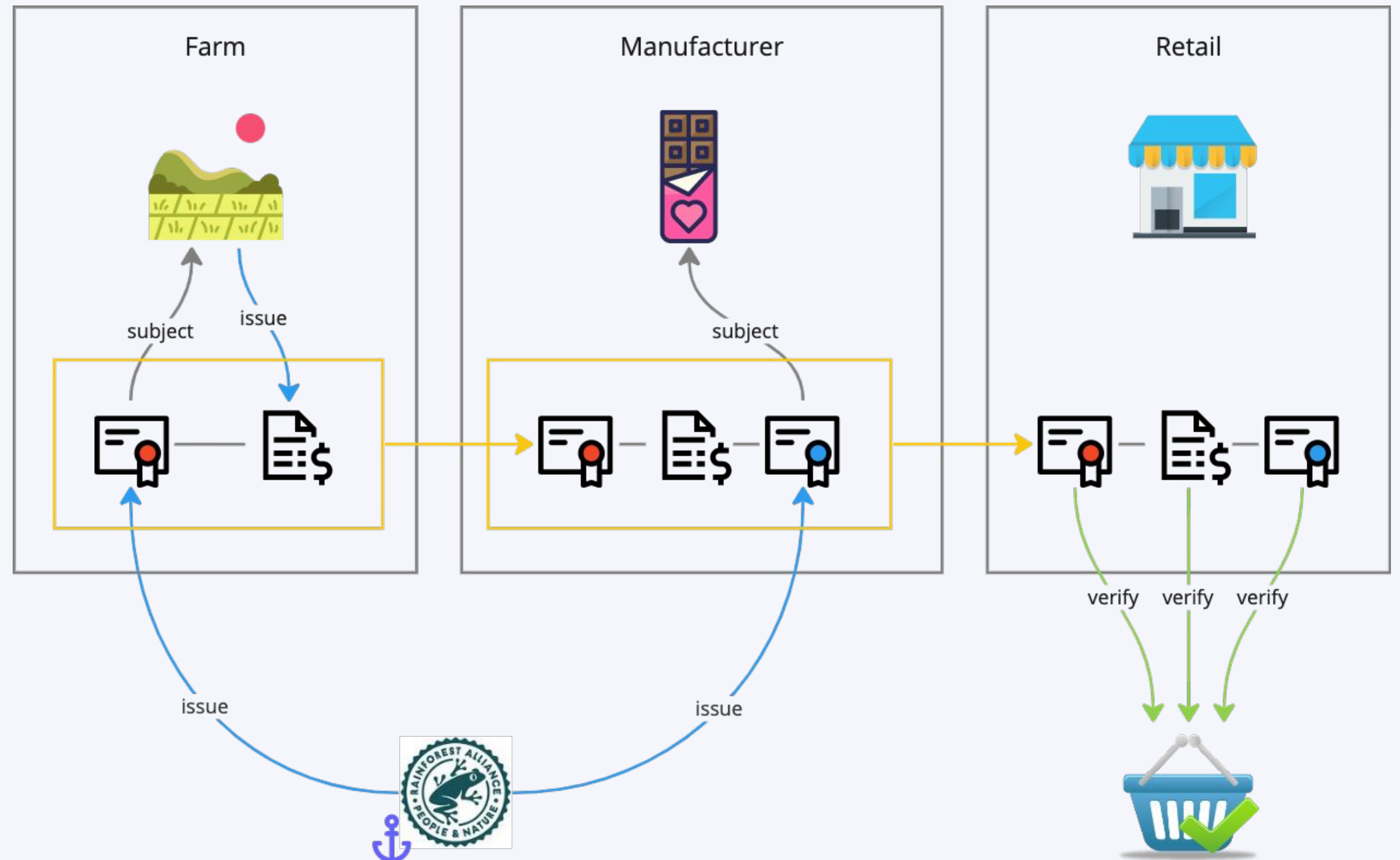
# Basic Sustainability Supply Chain “Branch” of the Trust Graph

Simplified example:

- Cocoa bean farm
- A chocolate manufacturer
- And end-consumer verifying sustainability when purchasing.

Depending on type of product, traceability is established through redacted invoices or dedicated transactional credentials.

Rainforest Alliance certifies **farms** and **supply chain** participants - they are an excellent Trust Anchor!

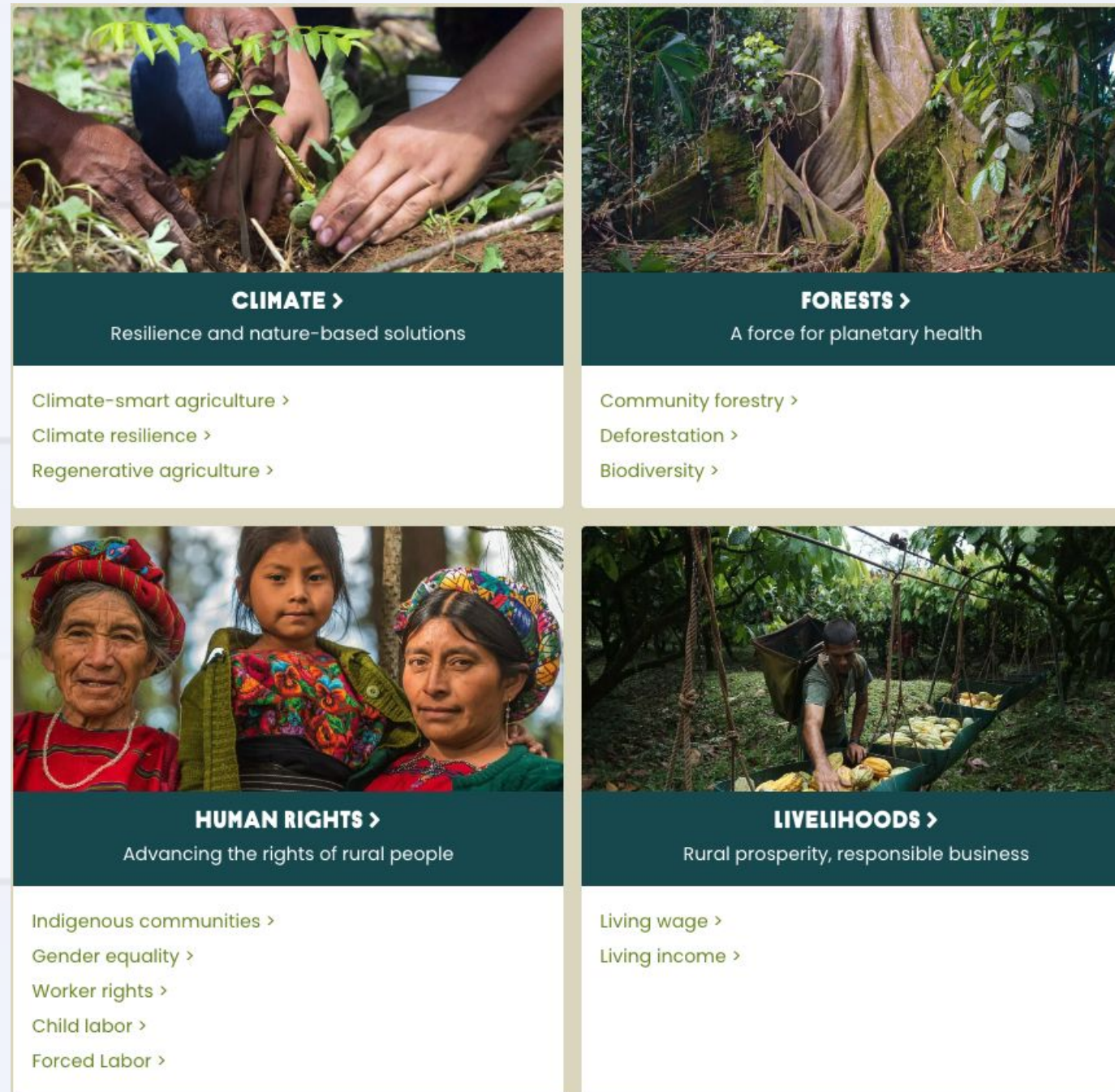






# Choosing Trust Anchors - Example Sustainability Credential

Rainforest Alliance issues claims in areas of Climate, Forest Preservation, Human Rights and Livelihoods.



<https://www.rainforest-alliance.org/about/>

To the right is an example of that a credential could look like, containing such claims.

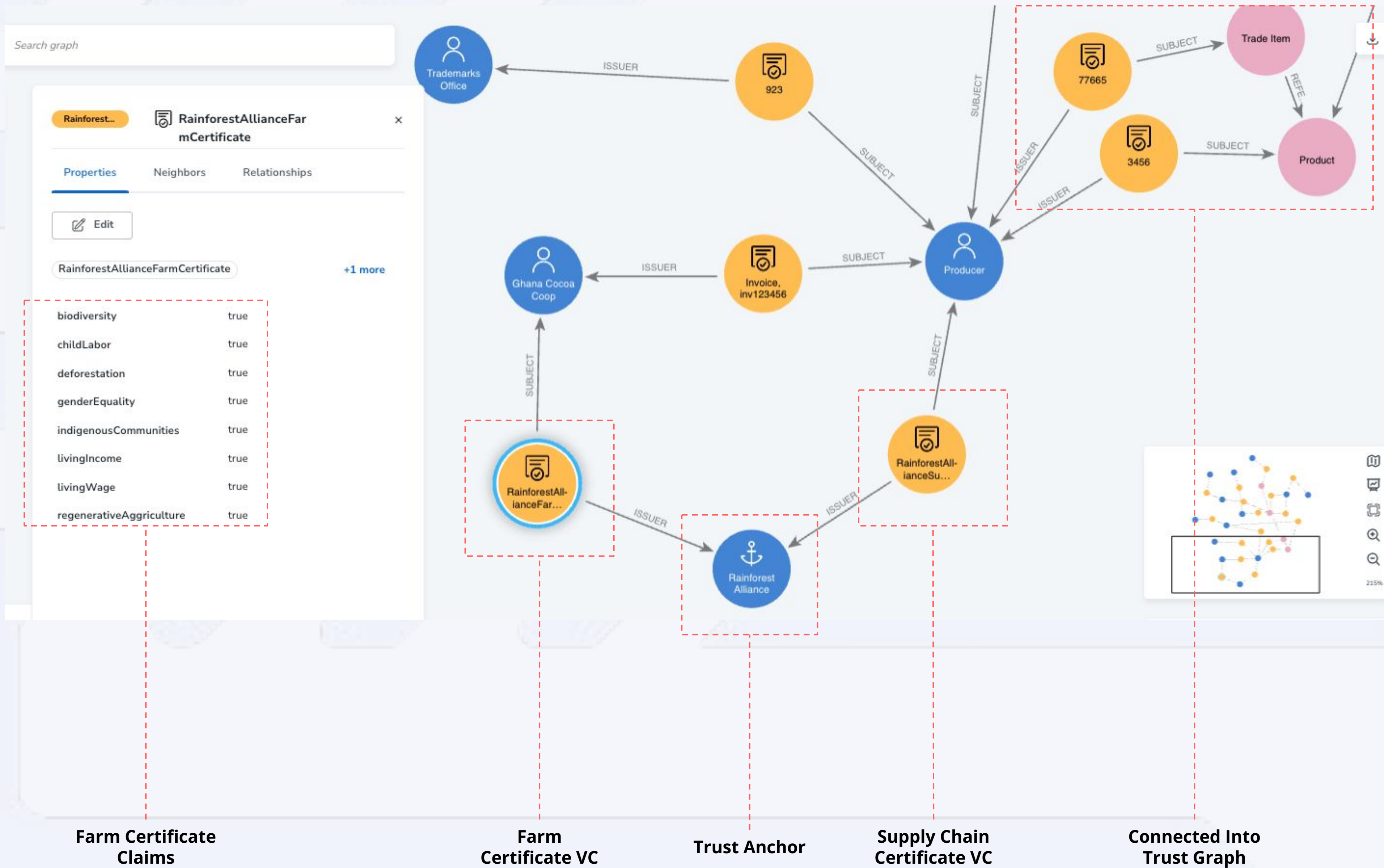
```
{
  "@context": "https://www.w3.org/2018/credentials/v1",
  "type": "VerifiableCredential",
  "issuer": {
    "type": "Organization",
    "id": "did:web:ghana.rainforest-alliance.example.com",
    "name": "Rainforest Alliance"
  },
  "issuanceDate": "2023-05-03T15:20:00Z",
  "credentialSubject": {
    "type": "Organization",
    "id": "did:web:ghana-cocoa-coop.example.com",
    "name": "Ghana Cocoa Coop",
    "applicableOrganizationalCertificate": {
      "deforestation": true,
      "biodiversity": true,
      "regenerativeAggriculture": true,
      "indigenousCommunities": true,
      "genderEquality": true,
      "workerRights": true,
      "childLabor": true,
      "livingWage": true,
      "livingIncome": true
    }
  }
}
```

Note: in this and the following slides I use Rainforest Alliance as an example of an organization establishing trust. These are just simplified examples, and do not reflect real Rainforest Alliance certificates! ❤️





# Basic Trust Graph Sustainability Branch





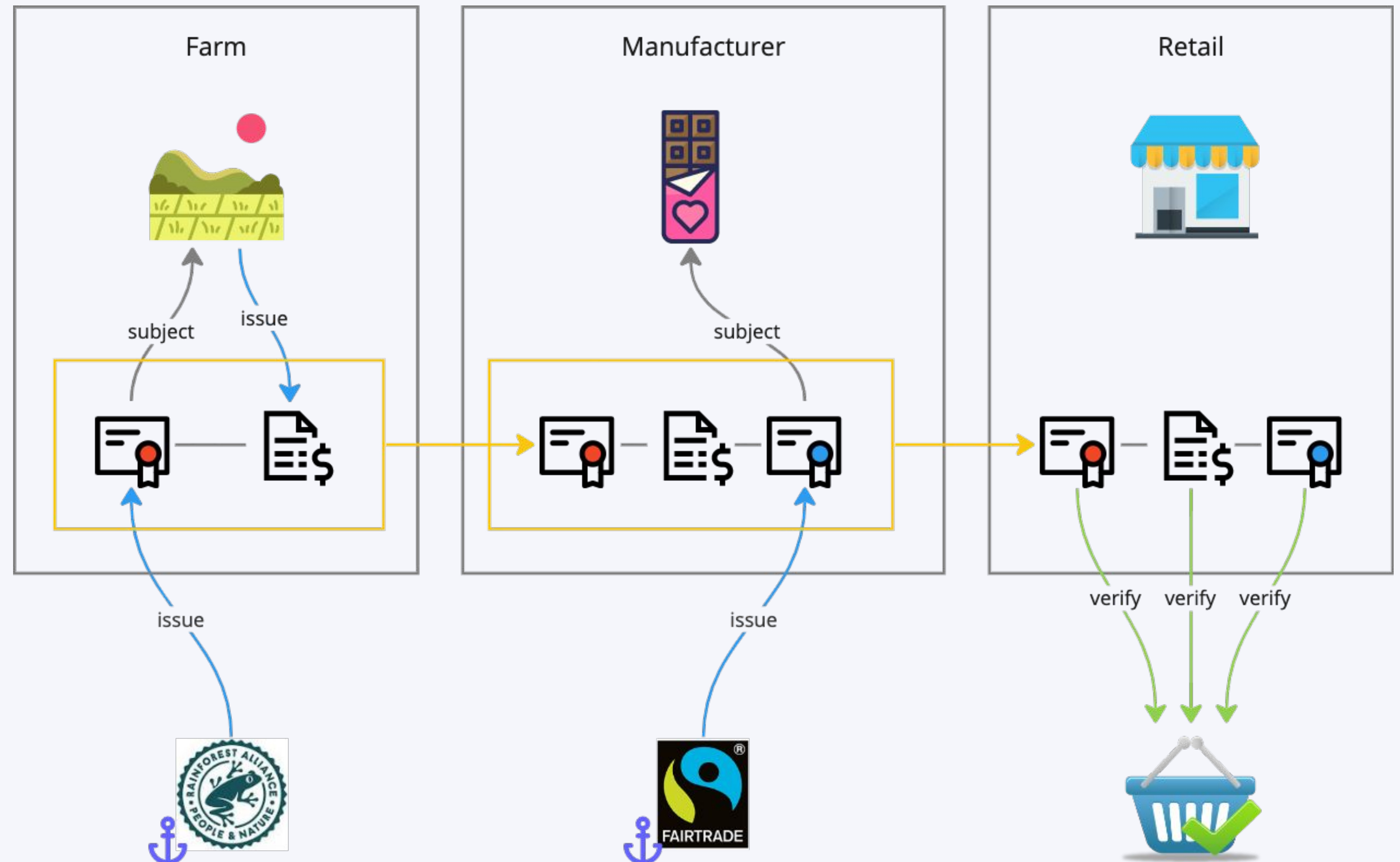


# Interoperability Based on VCs and UN/CEFACT Sustainability Semantics

The common UN/CEFACT Sustainability Web Vocabulary allows for certificate issuers to express claims using **standardized semantics**.

This enables **interoperability** amongst differing certificate issuers, establishing more Trust Graph links.

Trust anchorage is still on a per-certifier basis, cryptographically chained through Verifiable Credentials. Policies controls the specific claims for which an issuer organization is considered a Trust Anchor.







# Adding UN/CEFACT Sustainability Context

```
{
  "@context": [
    "https://www.w3.org/2018/credentials/v1",
    "https://vocabulary.uncefact.org/unece-context.jsonld",
    {
      "sustainability": "https://vocabulary.uncefact.org/sustainability/",
      "deforestation": "sustainability:sustainable_harvesting",
      "biodiversity": "sustainability:Biodiversity",
      "regenerativeAggriculture": "sustainability:regeneration_of_tree_cover_after_logging_e_g_to_pre_harvesting_situation",
      "indigenousCommunities": "sustainability:activities_not_adversely_affecting_local_communities_access_to_livelihoods",
      "genderEquality": "sustainability:gender_policies_and_best_practices",
      "workerRights": "sustainability:existence_of_publicly_available_policy_defining_workers_rights",
      "childLabor": "sustainability:child_labour_legal_compliance_policy",
      "livingWage": "sustainability:fair_and_timely_payment_of_wages",
      "livingIncome": "sustainability:living_wage_based_on_sector_or_region_specificities"
    }
  ],
  "type": "VerifiableCredential",
  "issuer": {
    "type": "Organization",
    "id": "did:web:ghana.rainforest-alliance.example.com",
    "name": "Rainforest Alliance"
  },
  "issuanceDate": "2023-05-03T15:20:00Z",
  "credentialSubject": {
    "type": "Organization",
    "id": "did:web:ghana-cocoa-coop.example.com",
    "name": "Ghana Cocoa Coop",
    "applicableOrganizationalCertificate": {
      "deforestation": true,
      "biodiversity": true,
      "regenerativeAggriculture": true,
      "indigenousCommunities": true,
      "genderEquality": true,
      "workerRights": true,
      "childLabor": true,
      "livingWage": true,
      "livingIncome": true
    }
  }
}
```

Trust the data:  
[DID Actor](#).

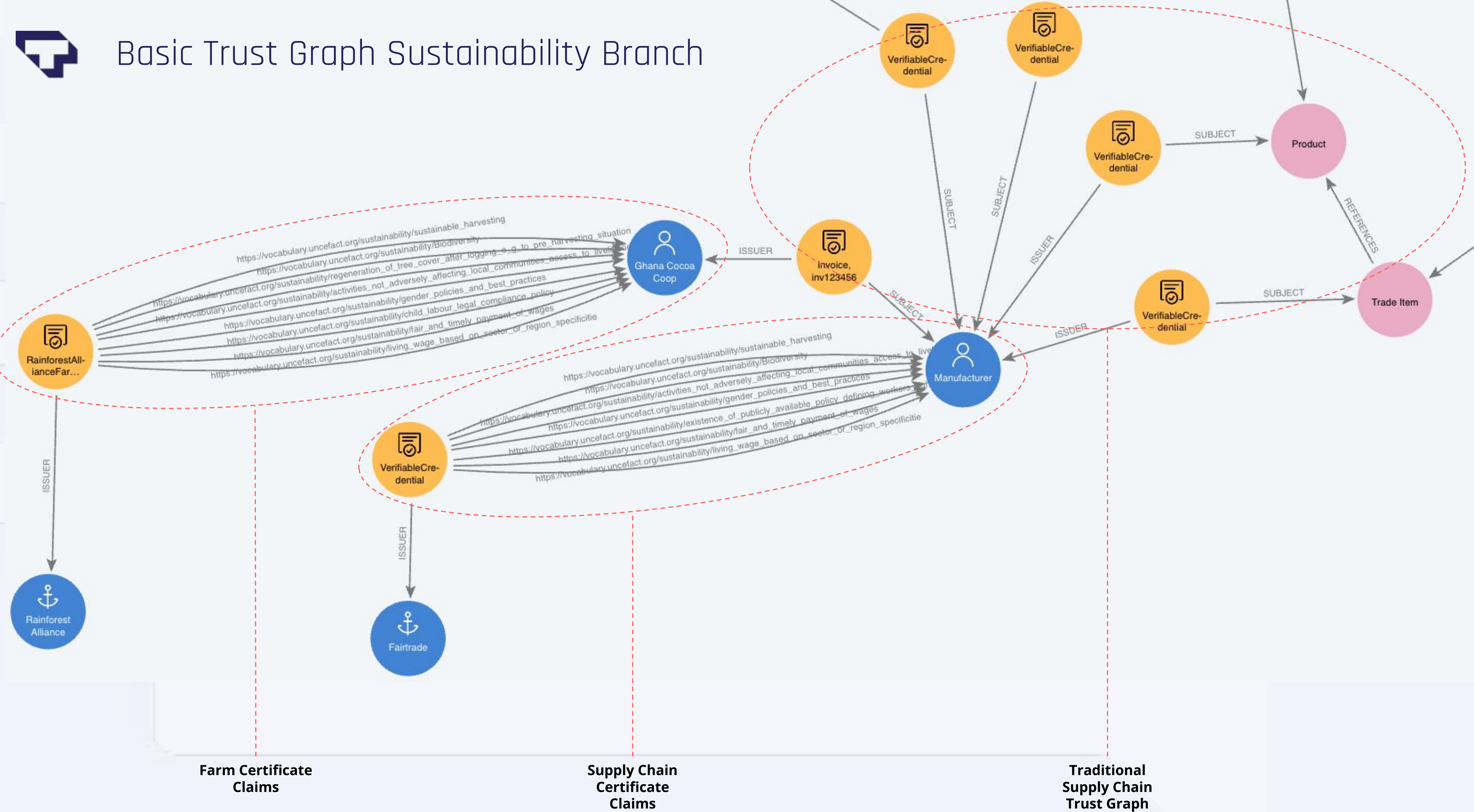
Understand the data:  
[LD Playground](#).

Subject	Predicate	Object
_:b0	<a href="http://www.w3.org/1999/02/22-rdf-syntax-ns#type">http://www.w3.org/1999/02/22-rdf-syntax-ns#type</a>	<a href="https://www.w3.org/2018/credential">https://www.w3.org/2018/credential</a>
_:b0	<a href="https://www.w3.org/2018/credentials#credentialSubject">https://www.w3.org/2018/credentials#credentialSubject</a>	<a href="did:web:ghana-cocoa-coop.example.com">did:web:ghana-cocoa-coop.example.com</a>
_:b0	<a href="https://www.w3.org/2018/credentials#issuanceDate">https://www.w3.org/2018/credentials#issuanceDate</a>	2023-05-03T15:20:00Z
_:b0	<a href="https://www.w3.org/2018/credentials#issuer">https://www.w3.org/2018/credentials#issuer</a>	<a href="did:web:ghana.rainforest-alliance.example.com">did:web:ghana.rainforest-alliance.example.com</a>
_:b1	<a href="https://vocabulary.uncefact.org/sustainability/Biodiversity">https://vocabulary.uncefact.org/sustainability/Biodiversity</a>	true
_:b1	<a href="https://vocabulary.uncefact.org/sustainability/activities_not_adversely_affecting_local_communities_access_to_livelihoods">https://vocabulary.uncefact.org/sustainability/activities_not_adversely_affecting_local_communities_access_to_livelihoods</a>	true
_:b1	<a href="https://vocabulary.uncefact.org/sustainability/child_labour_legal_compliance_policy">https://vocabulary.uncefact.org/sustainability/child_labour_legal_compliance_policy</a>	true
_:b1	<a href="https://vocabulary.uncefact.org/sustainability/existence_of_publicly_available_policy_defining_workers_rights">https://vocabulary.uncefact.org/sustainability/existence_of_publicly_available_policy_defining_workers_rights</a>	true
_:b1	<a href="https://vocabulary.uncefact.org/sustainability/fair_and_timely_payment_of_wages">https://vocabulary.uncefact.org/sustainability/fair_and_timely_payment_of_wages</a>	true
_:b1	<a href="https://vocabulary.uncefact.org/sustainability/gender_policies_and_best_practices">https://vocabulary.uncefact.org/sustainability/gender_policies_and_best_practices</a>	true
_:b1	<a href="https://vocabulary.uncefact.org/sustainability/living_wage_based_on_sector_or_region_specificities">https://vocabulary.uncefact.org/sustainability/living_wage_based_on_sector_or_region_specificities</a>	true
_:b1	<a href="https://vocabulary.uncefact.org/sustainability/regeneration_of_tree_cover_after_logging_e_g_to_pre_harvesting_situation">https://vocabulary.uncefact.org/sustainability/regeneration_of_tree_cover_after_logging_e_g_to_pre_harvesting_situation</a>	true
_:b1	<a href="https://vocabulary.uncefact.org/sustainability/sustainable_harvesting">https://vocabulary.uncefact.org/sustainability/sustainable_harvesting</a>	true
<a href="did:web:ghana-cocoa-coop.example.com">did:web:ghana-cocoa-coop.example.com</a>	<a href="https://vocabulary.uncefact.org/applicableOrganizationalCertificate">https://vocabulary.uncefact.org/applicableOrganizationalCertificate</a>	_:b1
<a href="did:web:ghana-cocoa-coop.example.com">did:web:ghana-cocoa-coop.example.com</a>	<a href="https://vocabulary.uncefact.org/name">https://vocabulary.uncefact.org/name</a>	Ghana Cocoa Coop
<a href="did:web:ghana.rainforest-alliance.example.com">did:web:ghana.rainforest-alliance.example.com</a>	<a href="https://vocabulary.uncefact.org/name">https://vocabulary.uncefact.org/name</a>	Rainforest Alliance





# Basic Trust Graph Sustainability Branch



Farm Certificate Claims

Supply Chain Certificate Claims

Traditional Supply Chain Trust Graph





# Sustainability Policy Enforcement

Policy definition:

Trust Anchors

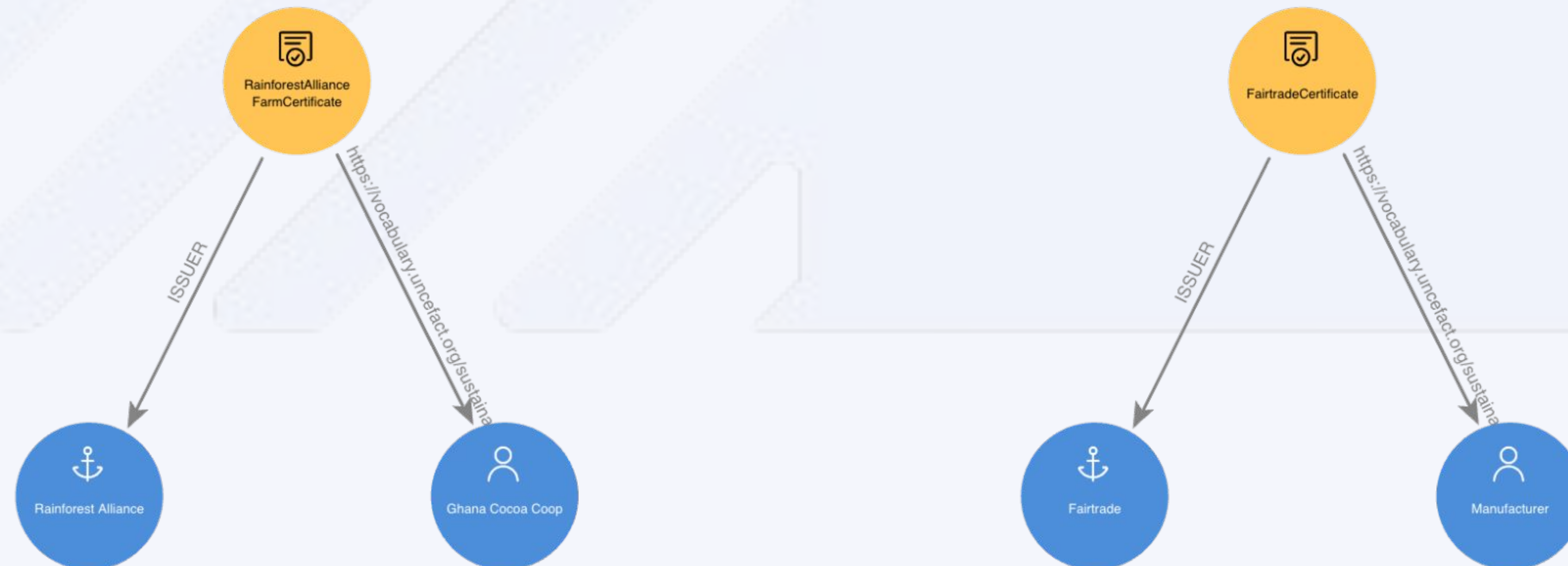
Certificates

Sustainability Policies

Suppliers

```
MATCH (anchor:TrustAnchor) - [issuer:ISSUER] - (certificate:VerifiableCredential) - [policy:`https://vocabulary.uncefact.org/sustainability/sustainable_harvesting`] - (supplier:Entity)
RETURN policy, certificate, supplier, anchor, issuer
```

In-Policy Suppliers:







## Conclusion

UN/CEFACT is the established authority for semantic terms in **international trade** and is similarly a natural authority for **sustainability** terms.

Verifiable Credentials is the standards-based, globally scalable solution establishing **supply chain trust**.

In combination, Trust Graphs are established from verifiable **traceability** chains, linking back to trust anchors.

Keep in touch:

- [nis@transmute.industries](mailto:nis@transmute.industries)
- <https://www.linkedin.com/in/nis-jespersen/>
- <https://github.com/nissimsan>
- Sample presentation data: <https://github.com/nissimsan/sustainability-trust-graph>