# Trust, Semantics and Blockchains: Food safety in the age of IoT

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# Core Challenges for the Food System

- **(An arbitrary selection …)**
- Climate change and environmental  impact
- Soil degradation and loss of agricultural land
- Food Waste
- Food and health - obesity and malnutrition
- Food security - food security in complex supply conditions
- **Food safety and food crises**
  - For Europe and UK - food crises have hit us with E.Coli crisis (2011) and horse meat Scandal (2013)

# Food Crises: Tracking and Tracing

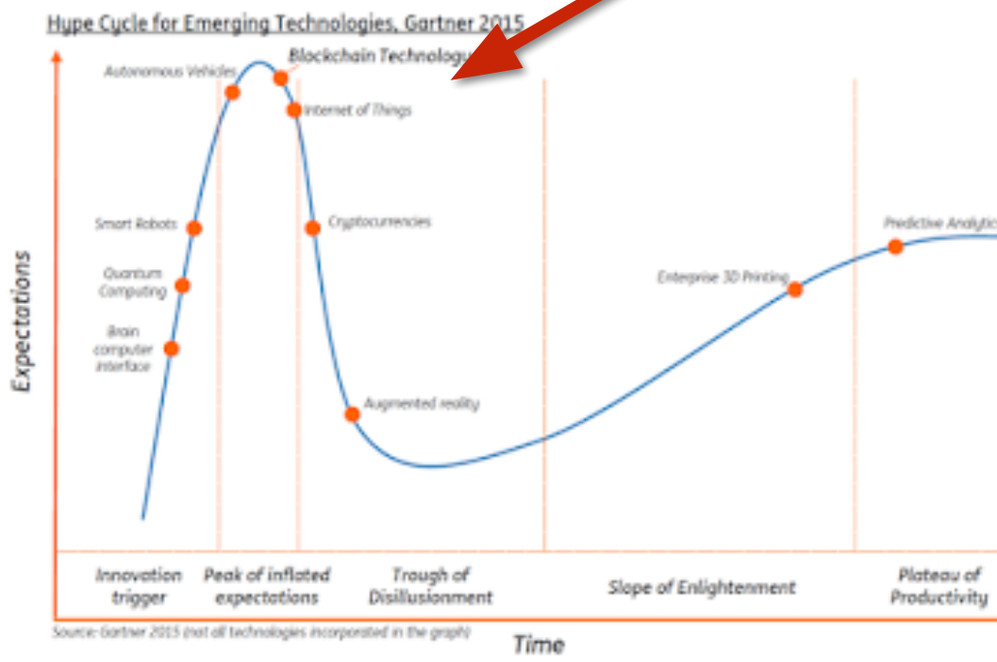
- T&T necessary both for accidental (E. Coli) and criminal (horse meat) crises
- Number of issues:
  - How to detect food fraud …
  - How to track where food came from OR is going to
- Key issue is sharing of data across the supply chain
- “The willingness by industry to share sensitive information with a regulator will be required to deliver a national food crime prevention framework.” -- Elliot Review 2014

# Trust (or rather its absence)

- Traditional lack of trust in agrifood - very limited sharing of data
- Privacy and data protection
  - (A real challenge for IoT based solutions)
- Business imperatives and conflicts
  - Huge power grab by supermarkets in last 30+ years
  - Danger of further power grab by other actors in a "big data" driven revolution
- How to enable data sharing when there is no trust?

# Blockchains?

- A great deal of hype
- A lot of venture capital




- Major claims to solve all kinds of problems *partly* because “it is a machine for creating trust” (Economist)
- Major claimed potential in finance, insurance, manufacturing, registries/certificates, etc.


http://ericsammons.com/what-is-the-blockchain

http://ibsintelligence.blogspot.nl/2015/12/untangling-blockchain-real-game-changer.html

# Blockchains?

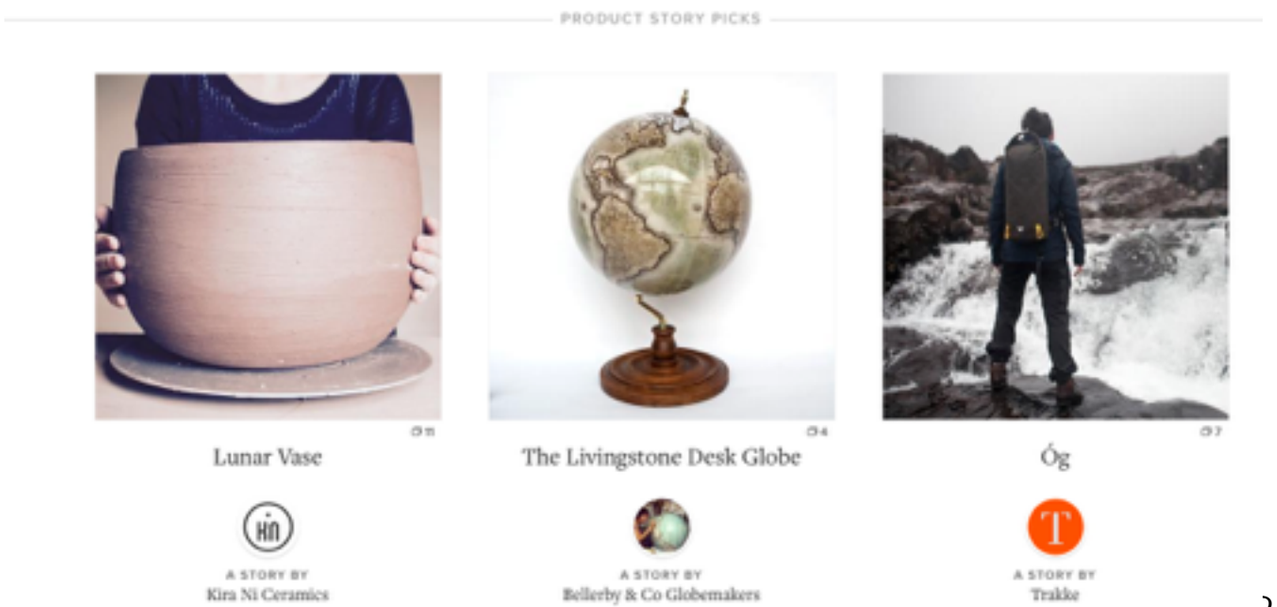
- Blockchain technology (or Distributed Ledger Technology) provides:
  - an integration of networks with databases resulting in a peer-to-peer based distributed database spread across multiple entities
  - a permanent record because no record is ever deleted
  - no single entity that can stop or control operations on the blockchain (“unpermissioned ledgers”)
  - uses cryptography to prove identity and authenticity using digital signatures
  - (versions like Ethereum) a distributed computer capable of running (relatively simple) programs called “smart contracts”

# Simple Examples

- Everledger (http://www.everledger.io/) - company provides permanent record of diamond transactions
  - In agrifood - provide a permanent record of certification (Organic/Fairtrade/etc.)
- OpenBazar (https://openbazaar.org/ ) - company providing a decentralised marketplace (disintermediating Ebay)
  - In agrifood - multiple low cost local online food market places

# Blockchain in the supply chain

- Not my idea! Other people have thought of this!
- Startup provenance.org wants to use the blockchain to “tell a story” about a product from producer to end consumer. Currently focussing on certification data!
- Still working on on what data to represent ….




# How can BCT/DLT help in food system?

- Provide trusted database for data management
- Provide a permanent record e.g. for supply chain transactions or for certification
- Enable **differential data** access - for different actors, different times, different conditions (e.g. an oracle declares a food crisis) —-> using **smart contracts**
- ….many other possibilities ….

# Technological Solutions to lack of trust/ Need for info sharing

**Open Data:**
**- Linked Data**
**- common ground**
**- infrastructure**

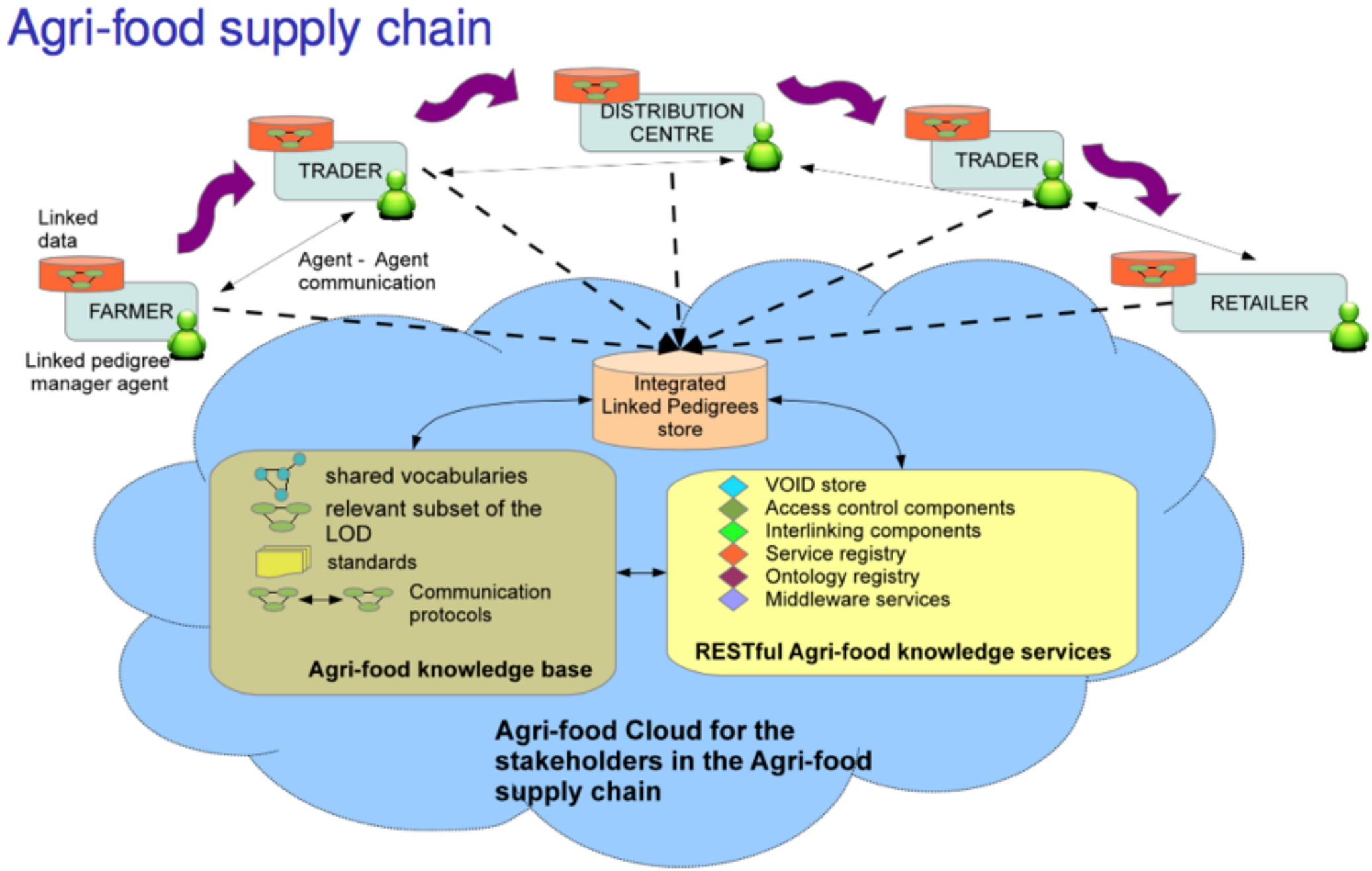
**Standards for Interoperability:**
**- GS1 EPCIS**
**- Ontologies/ Vocabularies**

**How to integrate?**

**Blockchains:**
**- permanence**
**- trust (less)**
**- smart contracts**

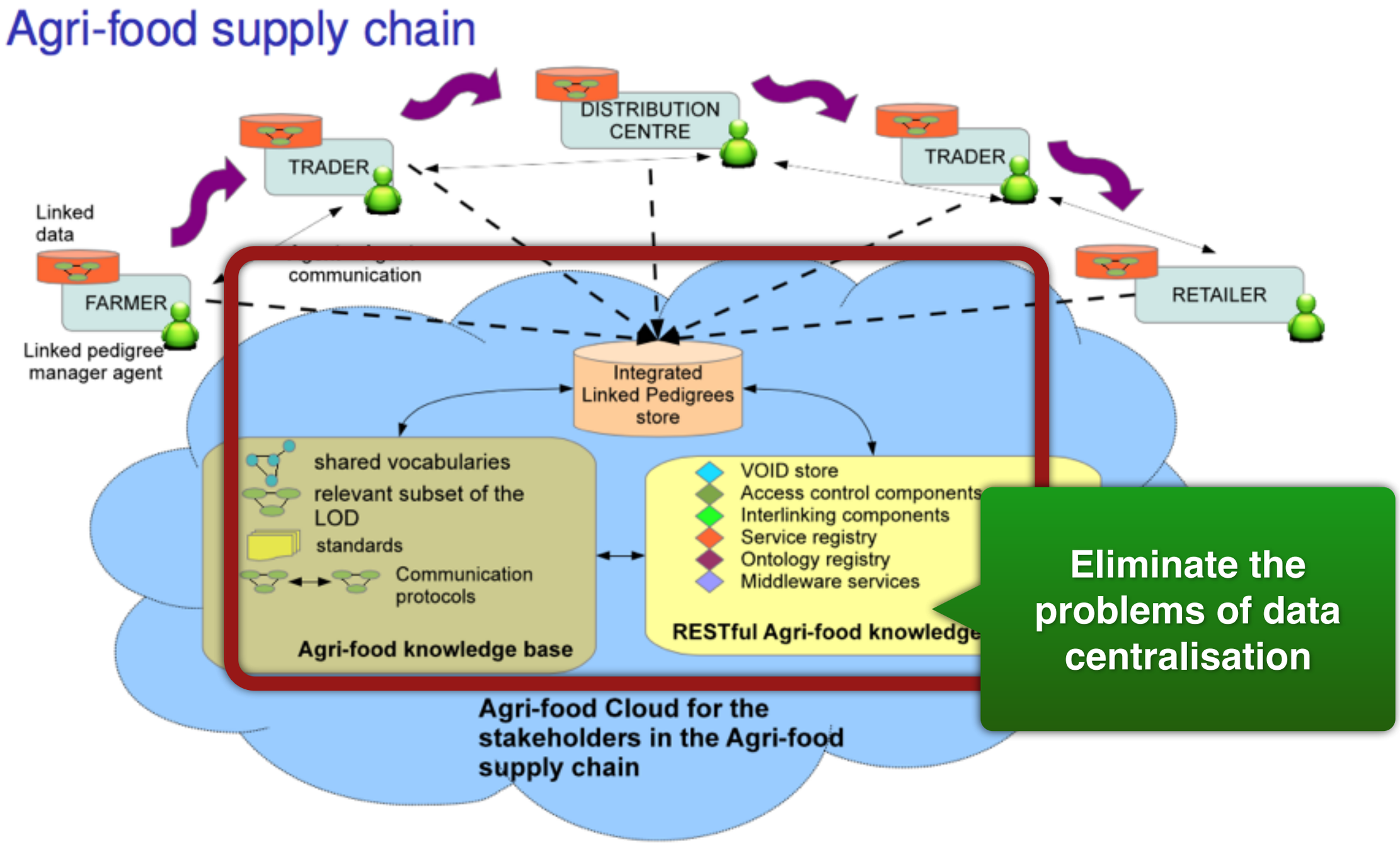
**Interoperability Architectures:**
**- Semantic Architectures (Linked Pedigrees)**
**?? - Platforms (Infobroker, FIspace etc.)**

# An integrated approach? Linked Pedigrees ….




Monika Solanki & Christopher Brewster (2015) Enhancing visibility in EPCIS governing Agri-food Supply Chains via Linked Pedigrees International Journal on Semantic Web and Information Systems, , 10, 45-73 URL: http://cbrewster.com/papers/Solanki_IJSWIS15.pdf

# Linked Pedigrees with added blockchain …



# Conclusions

- Blockchain technologies may help with problems of trust in the food system
- An integration of standards, semantics technologies including linked data principles and blockchain
- May possibly be able to answer such questions:
  - “Where did the food that this E.Coli victim has eaten come from?”
  - “Who supplied the horse meat in this burger?”