esa
European Space Agency

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Space-based "Digital Twin" of Earth

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esa earth observation φ-week 2018

About Me

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WORLD ECONOMIC FORUM

SPHERITY

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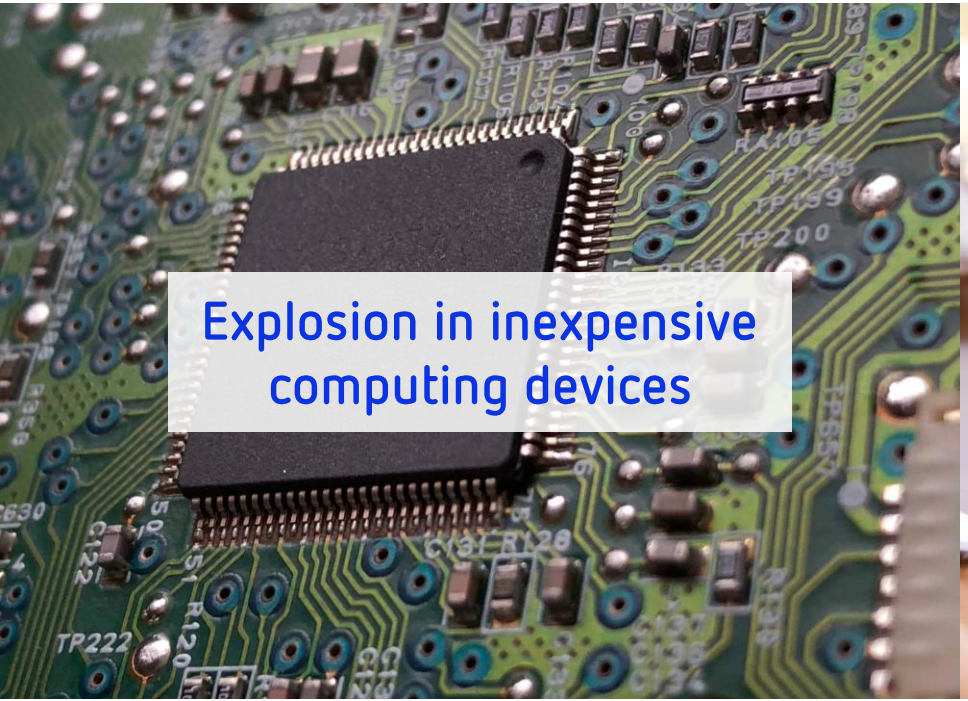
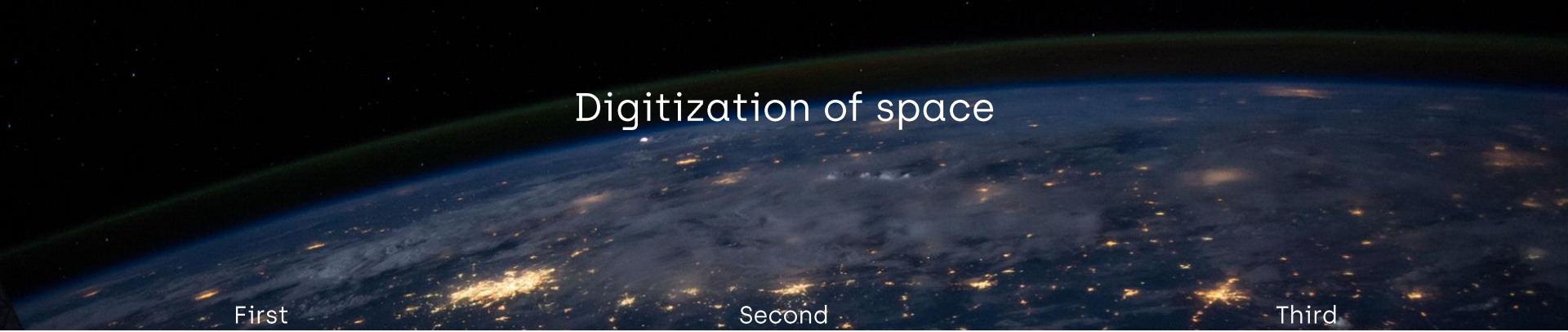
Today's digital economy is driven by

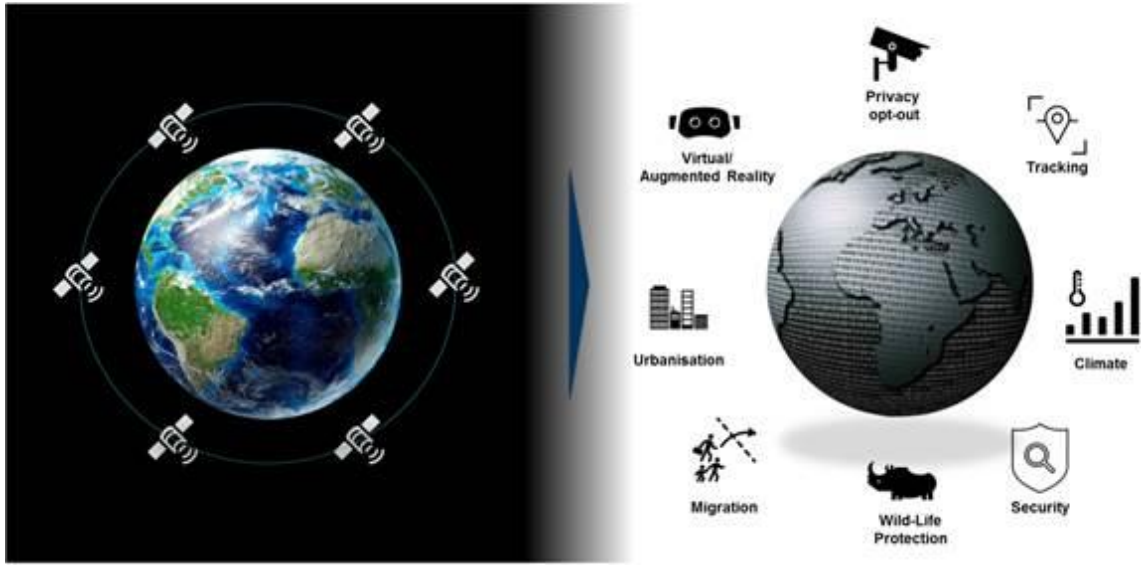




Digitization of space

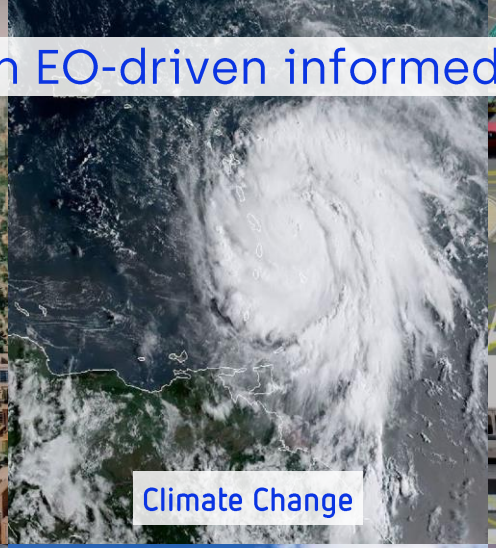
First	Second	Third
Dramatic and ongoing reductions in the cost to launch satellites	Development of “nano sats” that are smaller and lighter	Evolution of new services in space
Example: SpaceX	Example: इसरो ISRO	Example: Space Robotics

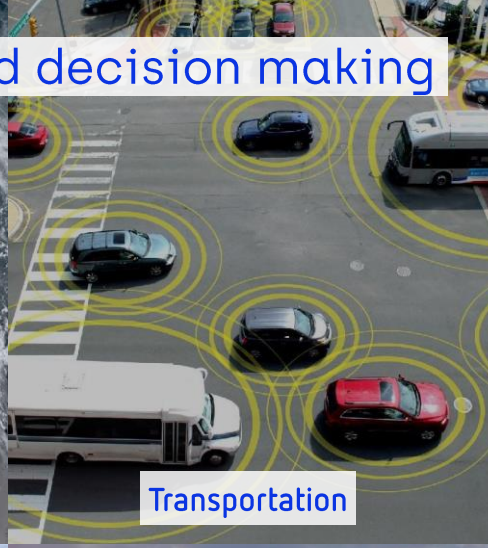
… the falling barriers to space access are creating global space-related supply chains and skill sets …



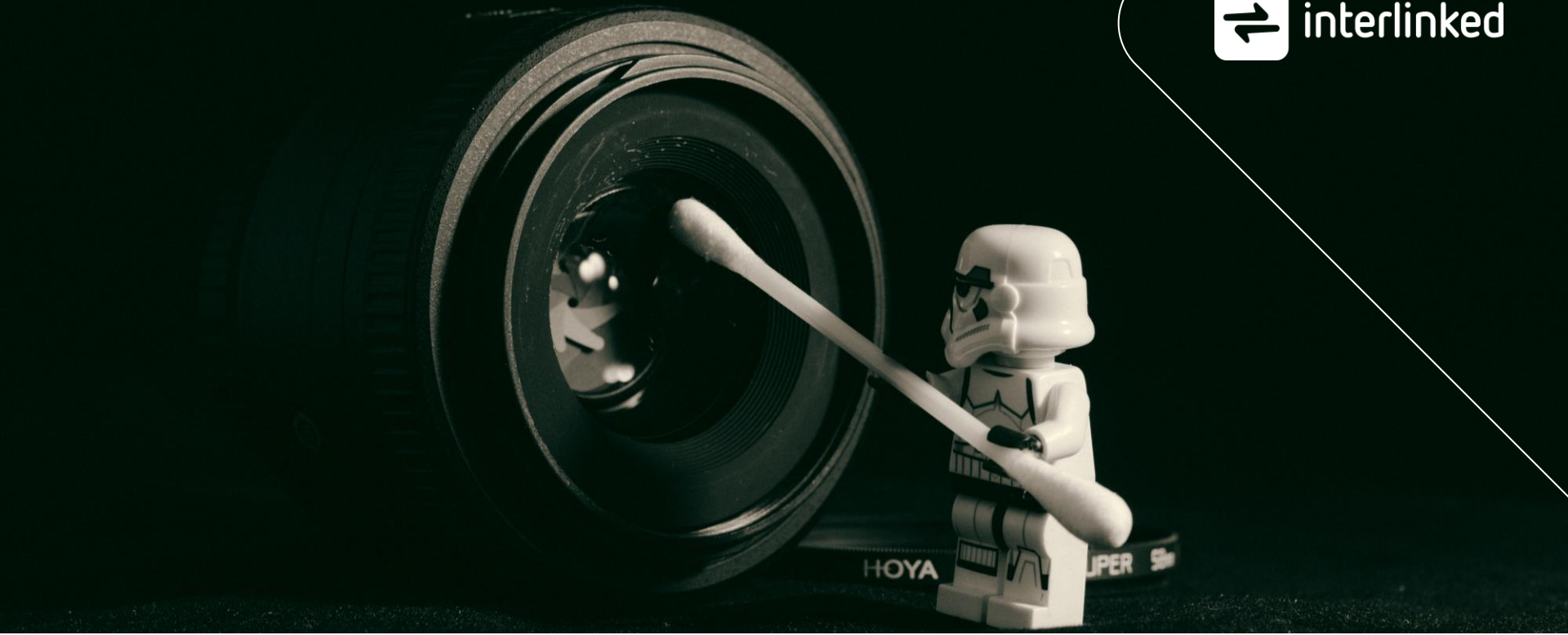
Source: https://medium.com/@cstoecker/space-based-digital-twin-of-earth-brings-affordable-insights-and-web-connectivity-to-the-other-83428572b92a

… and plenty of opportunities through EO-driven informed decision making





"Generational advantage with EO when lots of clean data come together with benchmarked algorithms"



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Problems to be solved

- Provenance of EO or terrestrial data
- “Goodness” of the input data
- Accuracy benchmarking of machine learning algorithms, training data
- Set-up of image processing pipe
- Aggregated accuracy and trustability of predicted labels or attributes

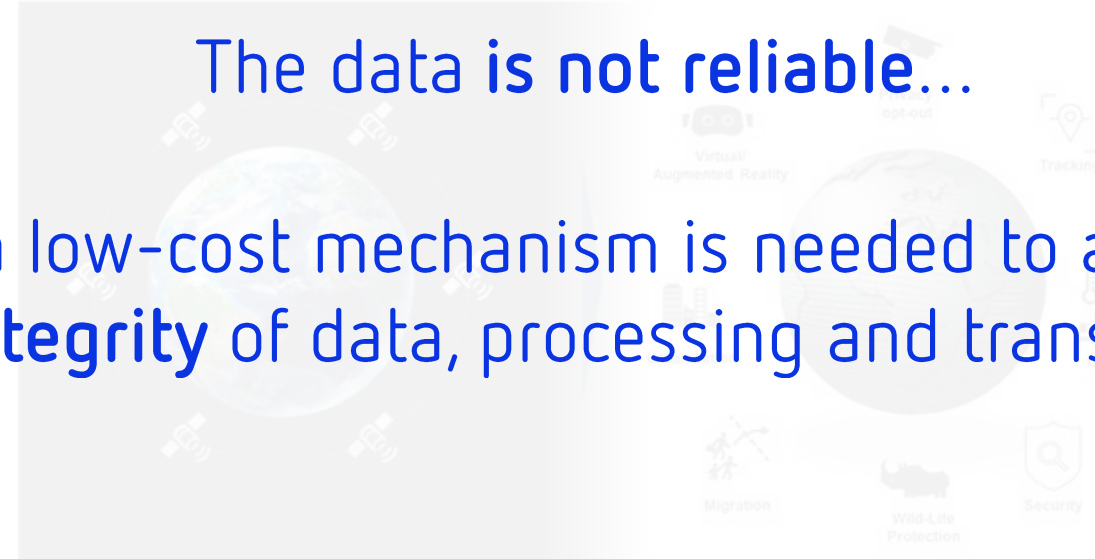
Key question:

- Can I really make a sound business decision based on the output attributes of my EO data processing pipe?
- How do I transfer or reinsure the remaining risk?

... the falling barriers to space access are creating global space-related supply chains and skill sets

The data **is not reliable**...

... a low-cost mechanism is needed to assure the **integrity** of data, processing and transactions.



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Now add...

By providing low cost, assured trust in the integrity of data and transactions, blockchain can make it dramatically easier to trust, own, share and sell services from this exploding new sensing, communication and data processing infrastructure.

Opportunity domains for blockchain in space

Crowdfunding & -sourcing

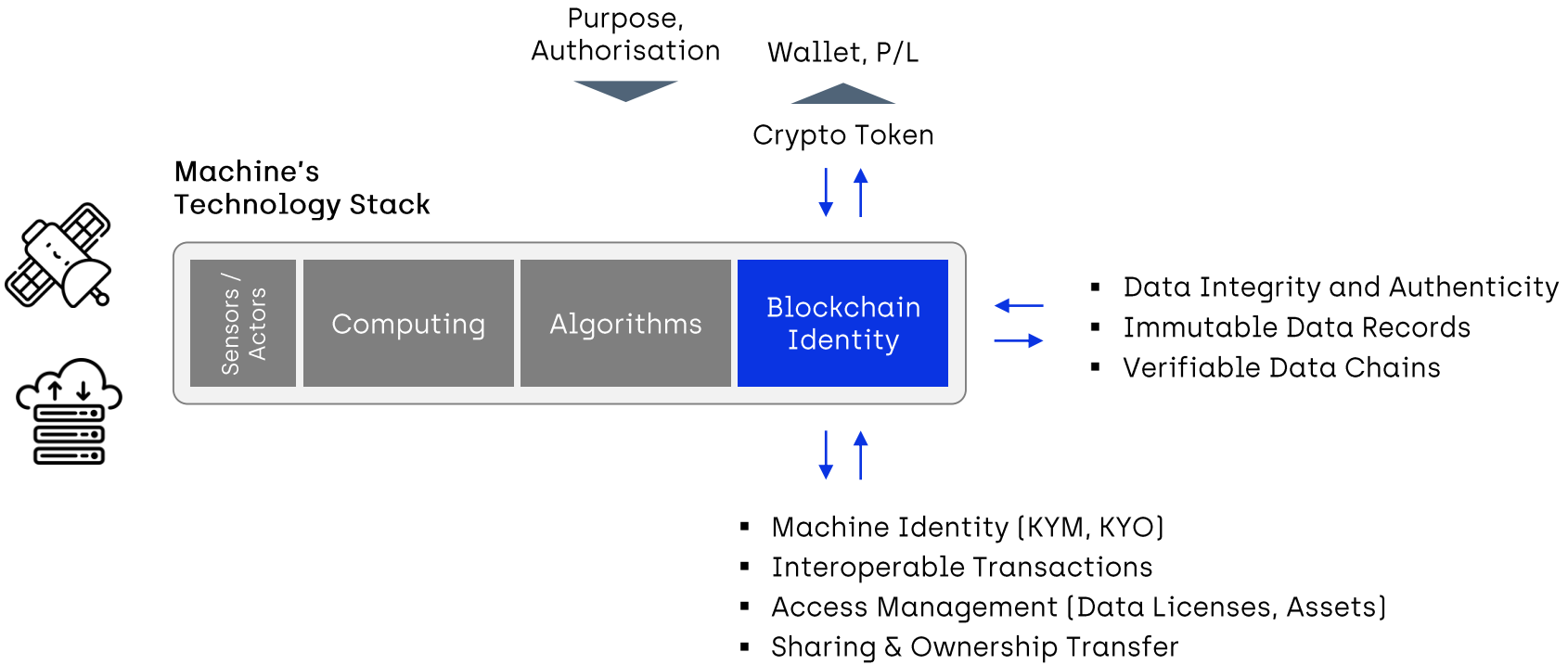
Space Asset Tokenization

Economically Independent Devices

Sharing Economy in Space

Verifiable Data Streams & Data Compute Chains

Economically independent machines



The Earth Observation Value Chain

Earth Observation Ecosystem

Upstream	Midstream	Downstream
Space Infrastructure	**Data Distribution**	**Value-Adding Services**
Manufacturing of satellites, ground systems, launchers, ground operations	Data acquisition, -processing, -archiving, -distribution, -delivery Data Marketplaces	Data processing, adaption to users' need, fusion with data from other sources Aggregated data for decision making Risk transfer / reinsurance

Decentral Trust Layer

- Data Provenance
- Algorithm, training data benchmarking
- P2P Transactions
- Access control

* **Source Earth Observation Market:** European Commission – Big Data in Earth Observation

Earth observation data chain

Decentral Trust Layer

- Manufacturer
- Accuracy
- Calibration
- Mission parameter
- …

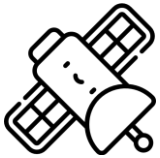
- Longi- & Altitude
- Resolution
- Ownership
- Access license
- …

- Ownership transfer
- Data life-cycle
- Time-series
- …

- Algorithm
- Knowledge base
- Benchmarking data
- Meta data, semantic classification, …

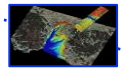
- Attribute accuracy
- Trustability metric
- Risk impact metric
- …

EO Asset Registry



Satellite / Sensors

EO Data Streams



Terrestrial Communication Infrastructure

Big Data / Cloud

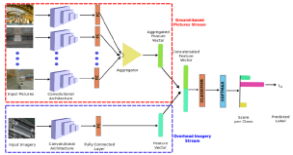


Image Processing Pipe

Business & Risk Systems

Image Recognition Attributes

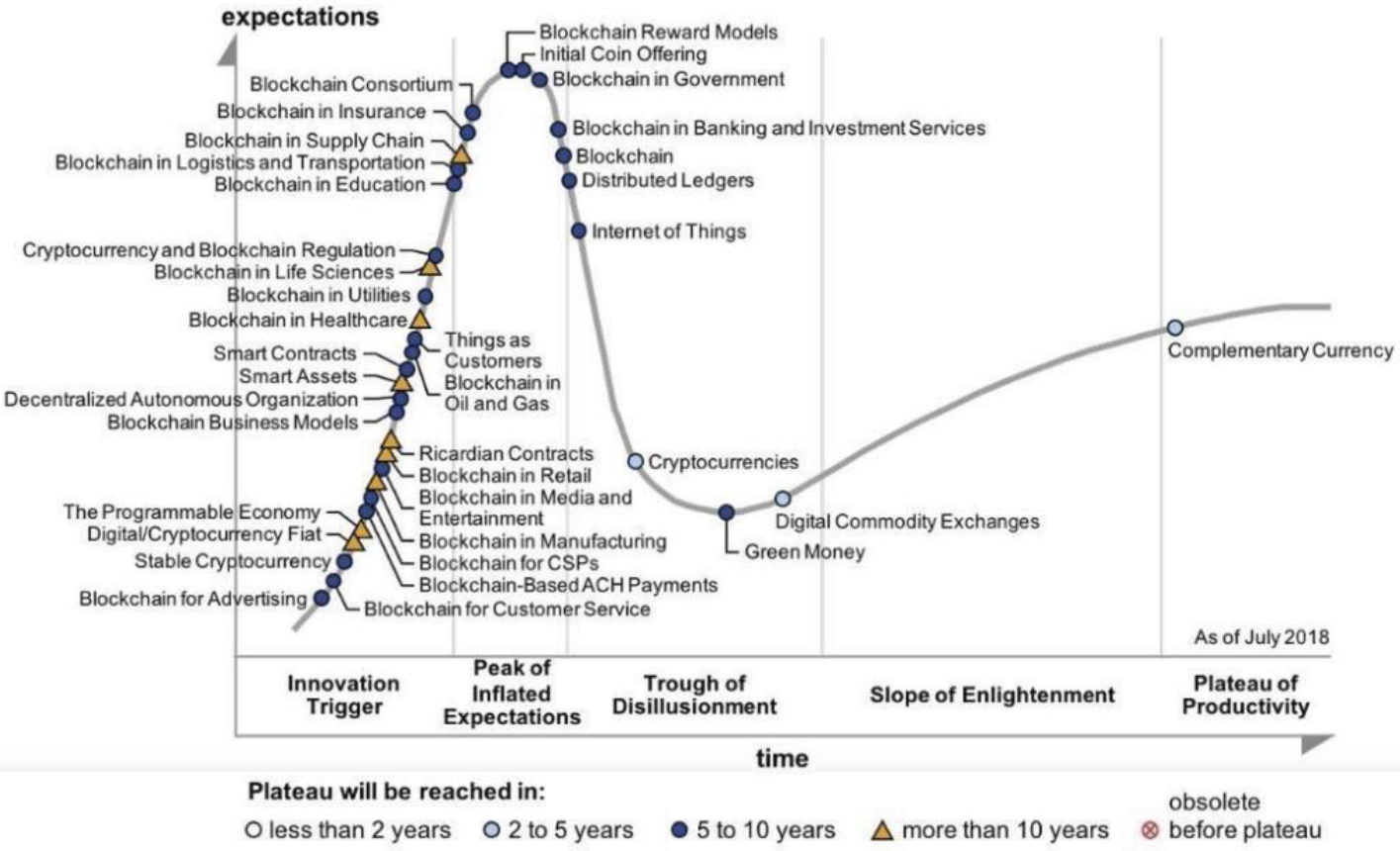
- Semantic classification
- Cloud removal
- Bare soil index
- Vitality index , land use
- Change detection
- Object detection
- Asset tracking ,…

Other Sources

Terrestrial Data Stream

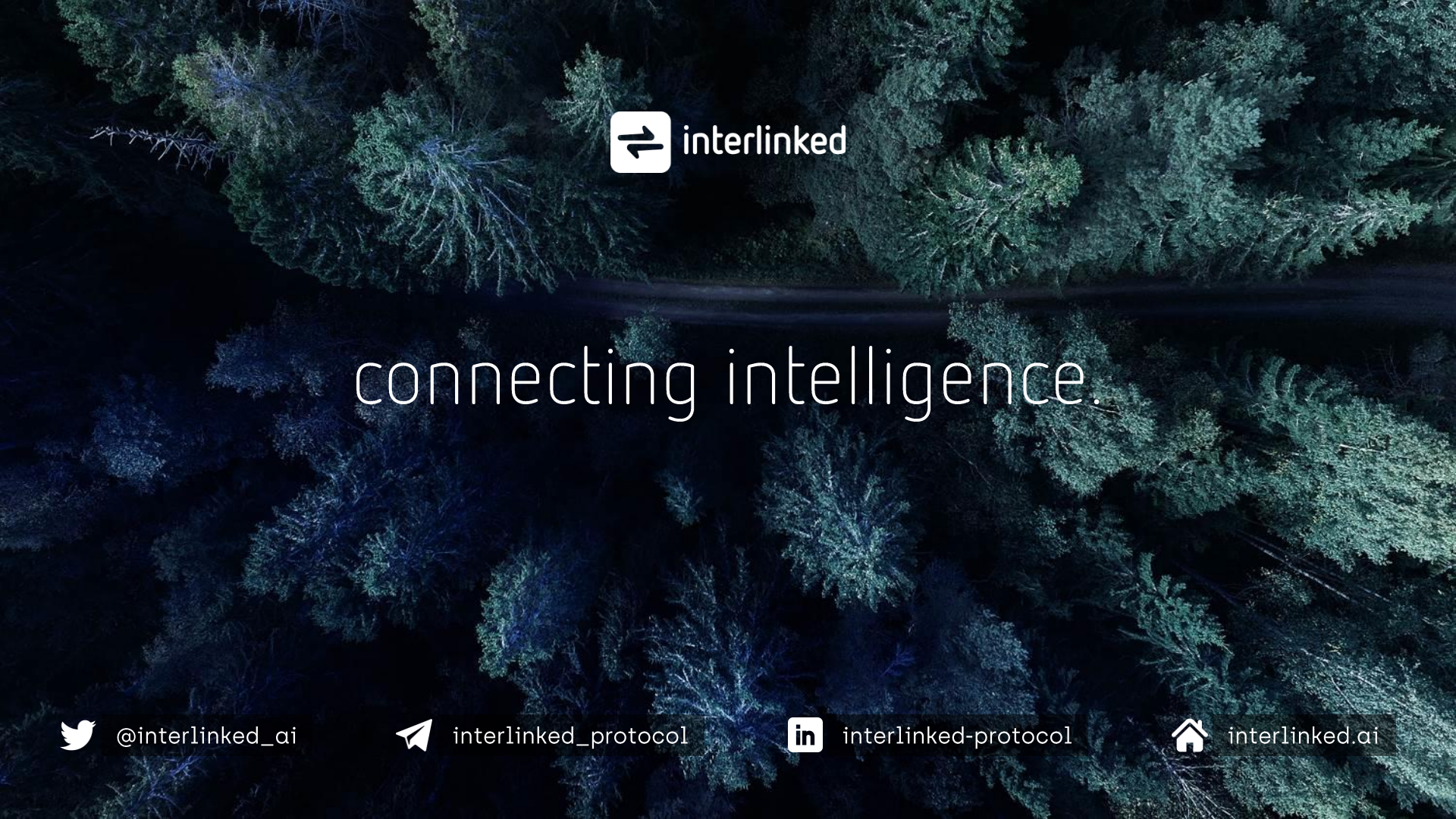
Interlinked EO Verifiable Attributes and Data Chains

Gartner hype cycle for blockchain



Challenges

- Moving beyond the hype with real deep tech engineering
- Deploying a common trust and risk management infrastructure
- Regulating infrastructure to prevent its misuse by governments, businesses, criminals and/or terrorists without stifling innovation like blockchain
- Creating practical, workable management and regulation of markets for either services or data, and developing and proving the security capabilities of blockchain
- Agreeing standards for its use and for resolution of disputes and recovery of losses in case blockchain security is breached
- Answering who should own the data, and the resulting analyses, and how to balance private ownership of data one group has paid for against its value to the public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A protocol connecting human and non-human intelligence.

- Decentralised identity
- Digital twinning
- Connecting physical and digital worlds
- Bridging existing enterprise systems
- Privacy-preserving agent-to-agent transactions
- Tokenised ownership, service & value exchange
- Interlinked layer 1 blockchain network

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