

CB-XEO: Consensus Based eXplainable Earth Observation

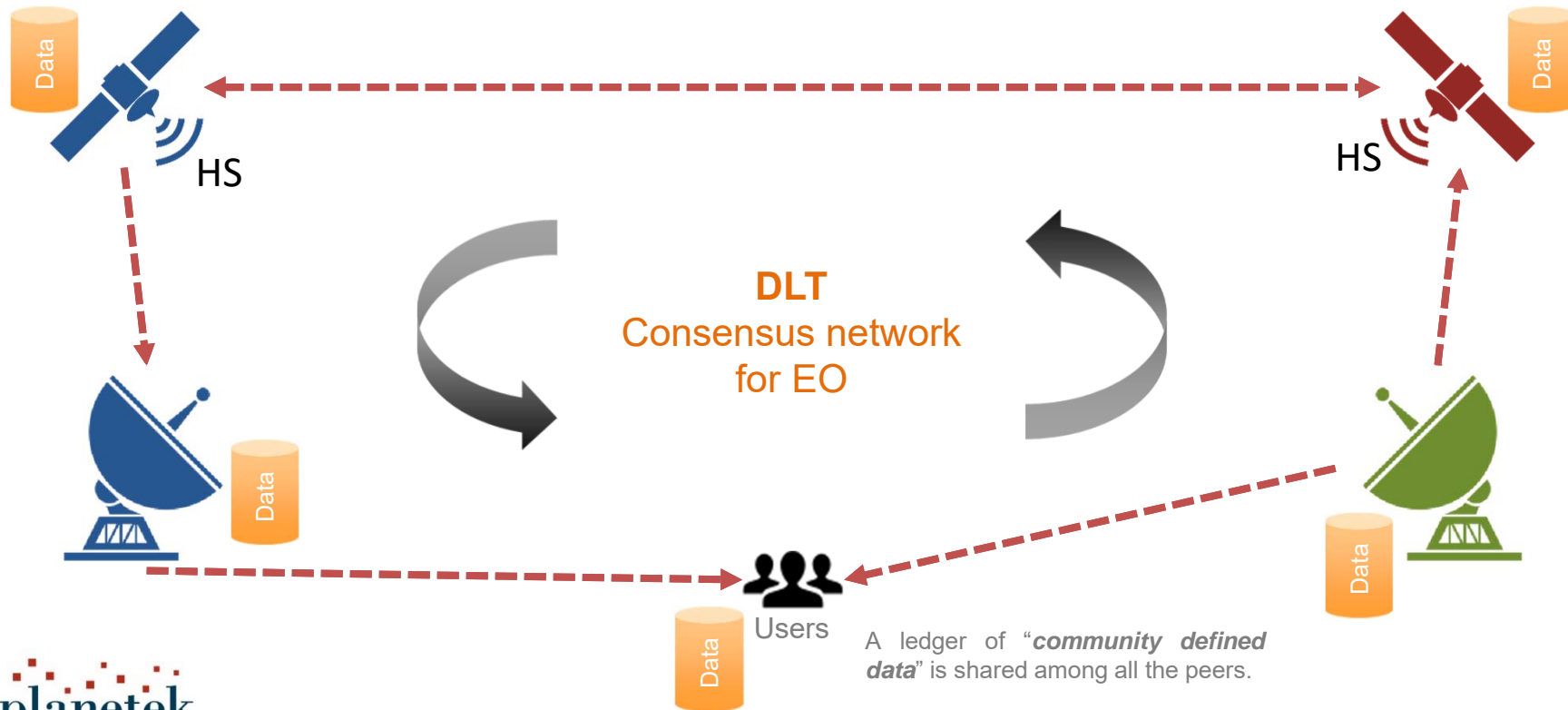
Applications of Blockchain and XAI Concepts to
Reliability and Security



C.Abbattista, A. Amodio, L.Amoruso,
V.Fortunato, **M. Iacobellis**

φ-Week, Side Events
ESRIN, Frascati
09-13 September 2019

Extracting actionable in the Explainable SpaceStream



Why Explainable AI (XAI) ?

We can trust only Truth

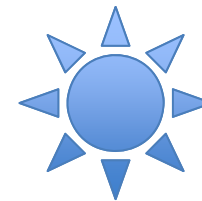
Why Explainable AI (XAI) ?

We can trust only Truth

It seems something simple

How far are we from Truth ?

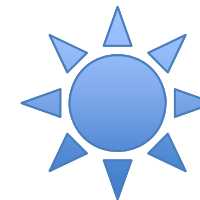
Human Example



Truth

How far are we from Truth ?

Human Example

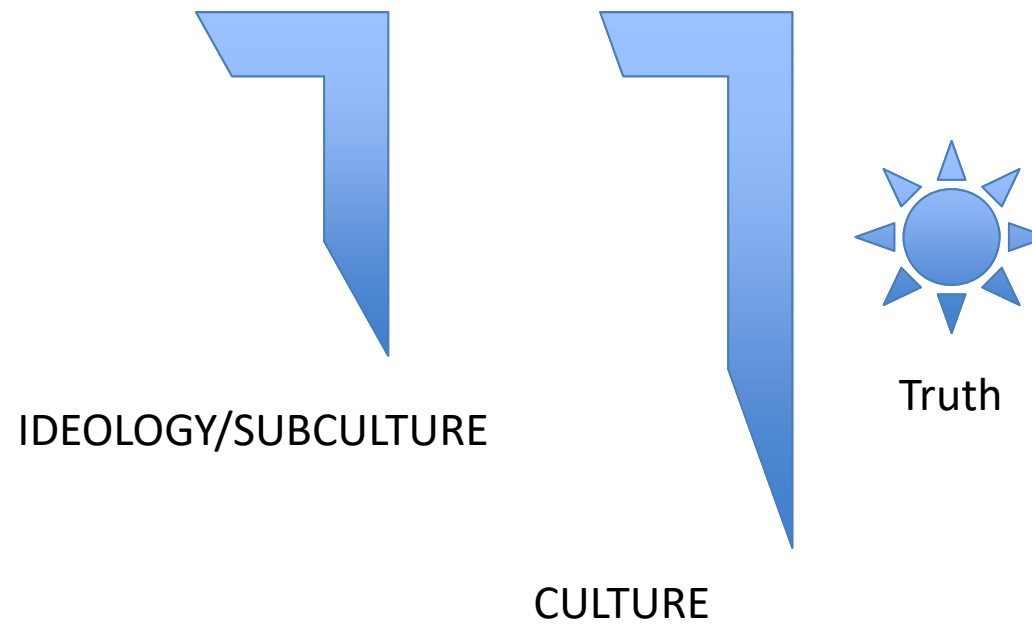


Truth

CULTURE

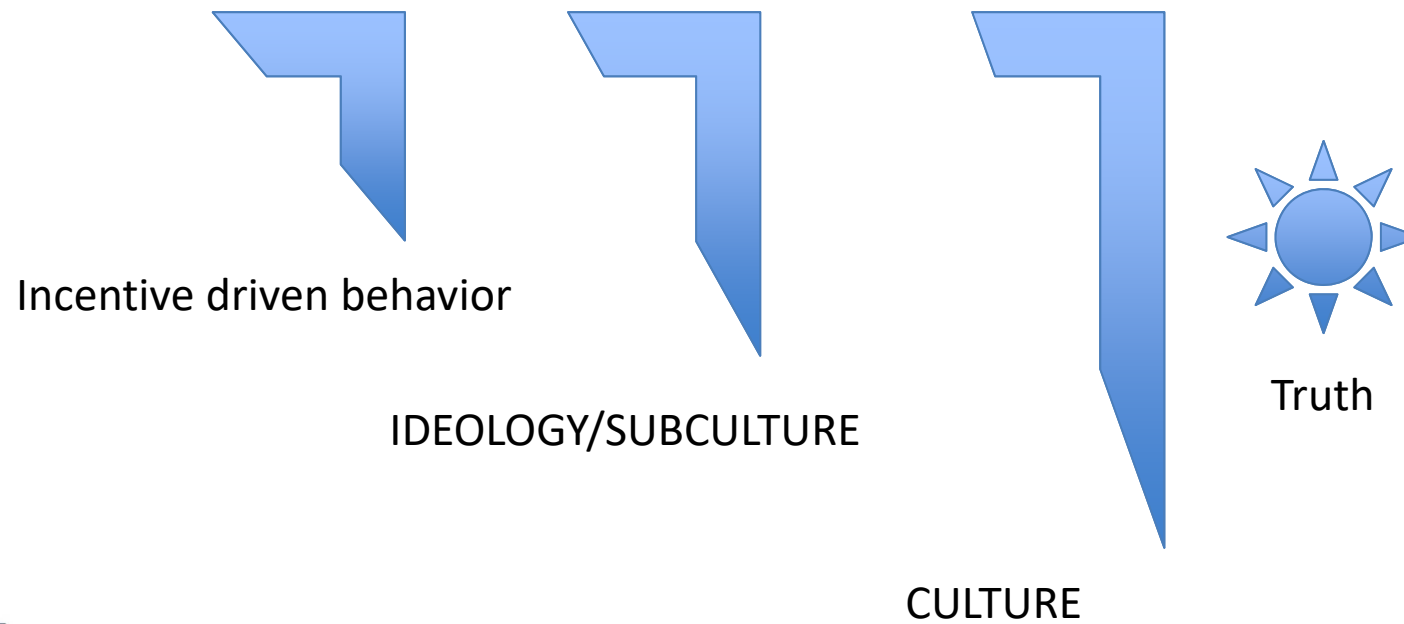
How far are we from Truth ?

Human Example



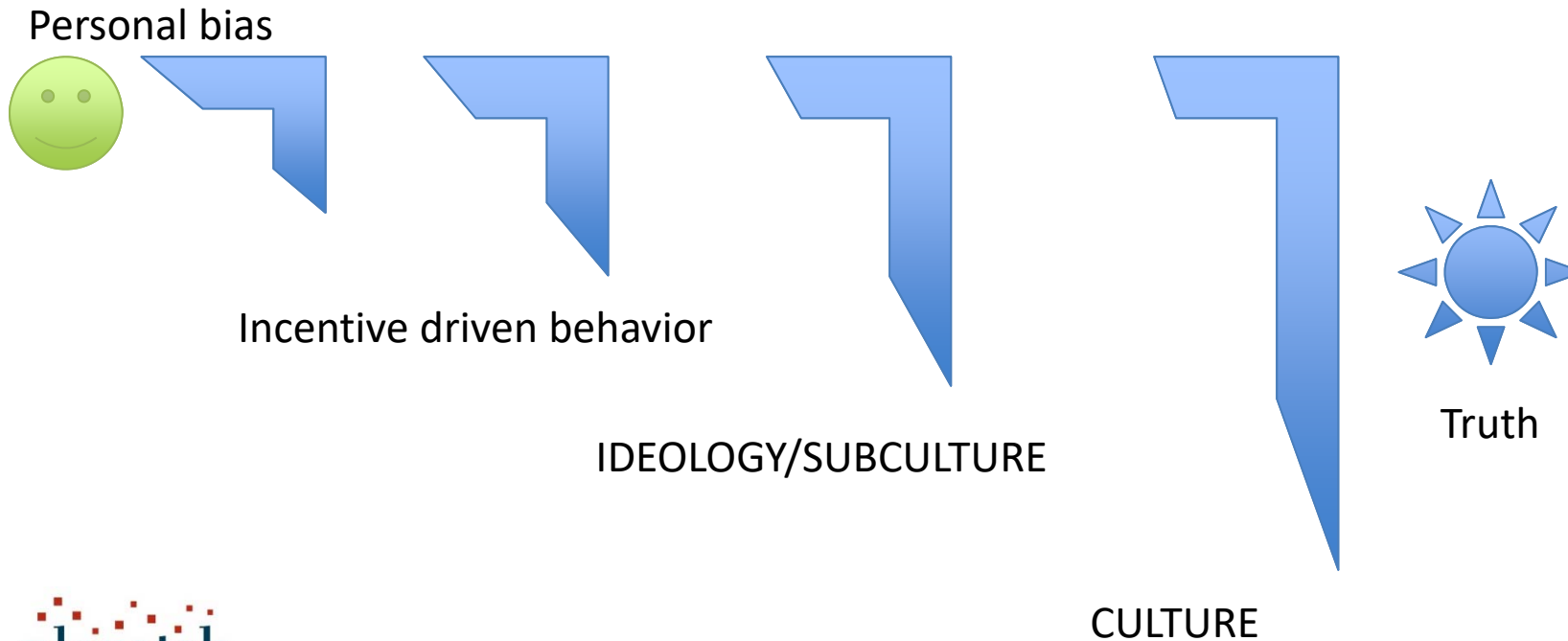
How far are we from Truth ?

Human Example

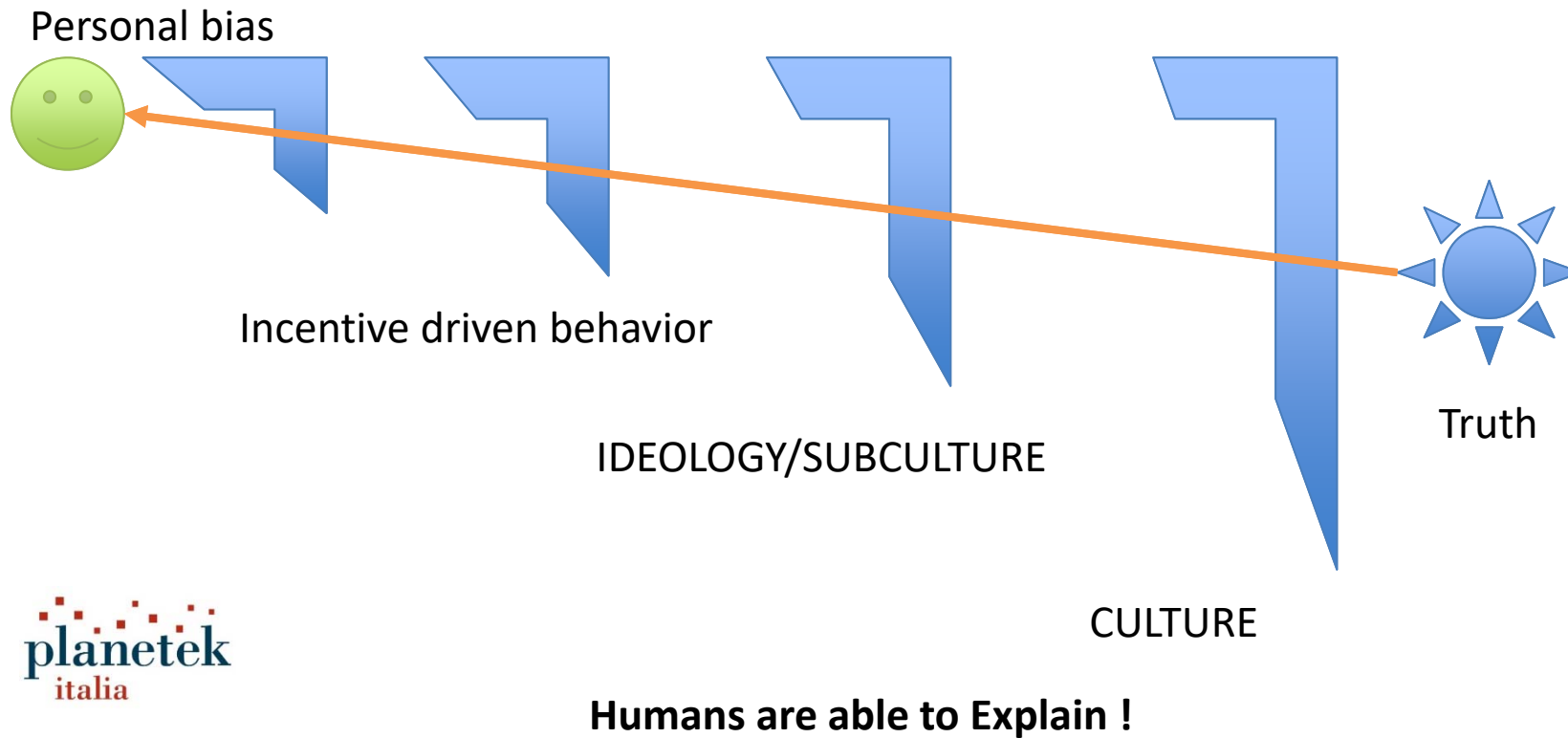


How far are we from Truth ?

Human Example



We are very far from Truth !



Why Explainable AI (XAI) ?

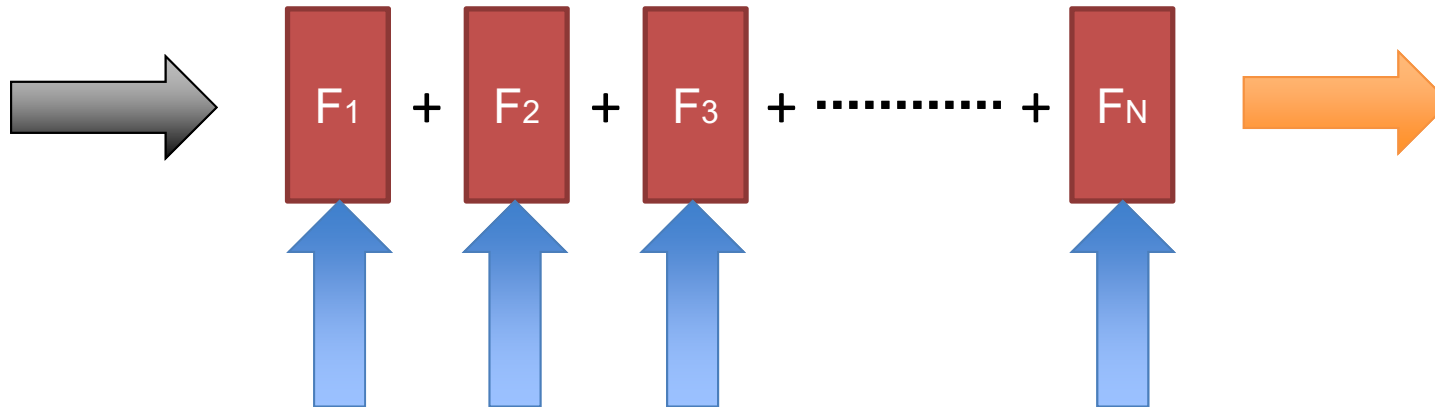


- We train AI algorithms with data that we Humans produce
- Training data may be affected by BIASES
- AI may give responses that we cannot understand (including wrong ones)
- The «this black box does work but it is very black» is not scientific



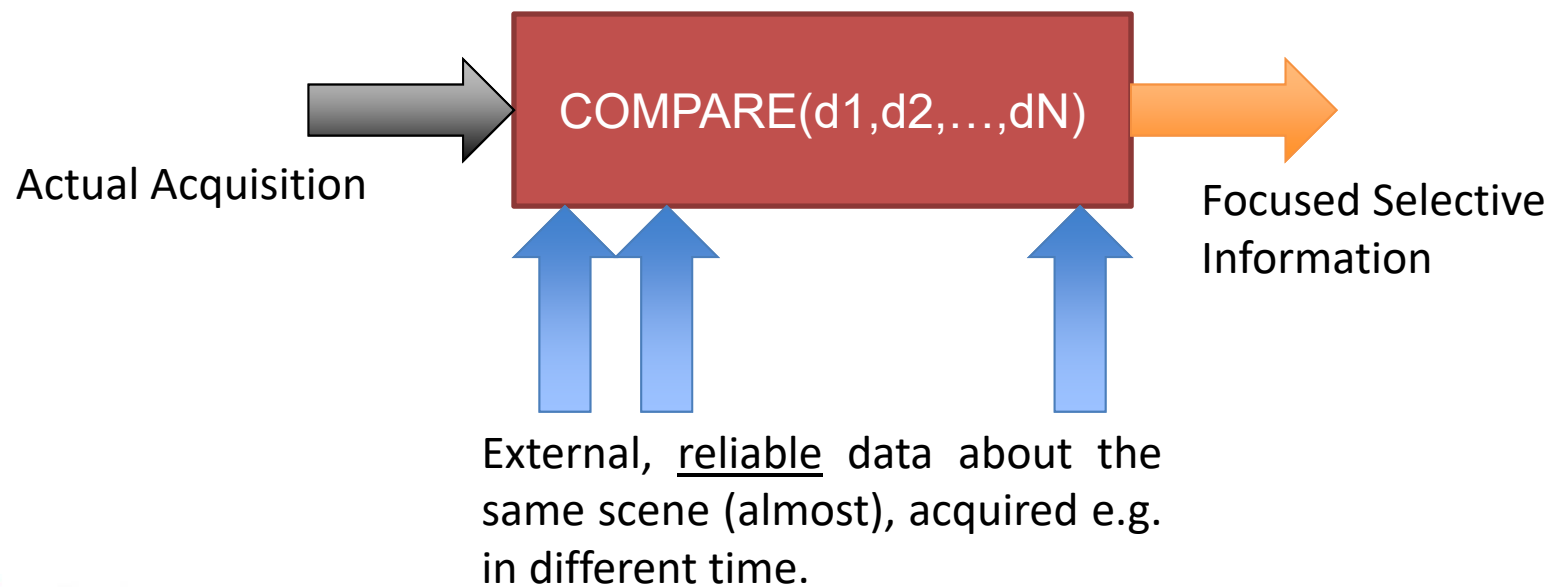
What if we combine wisdoms ?

Actual Acquisition



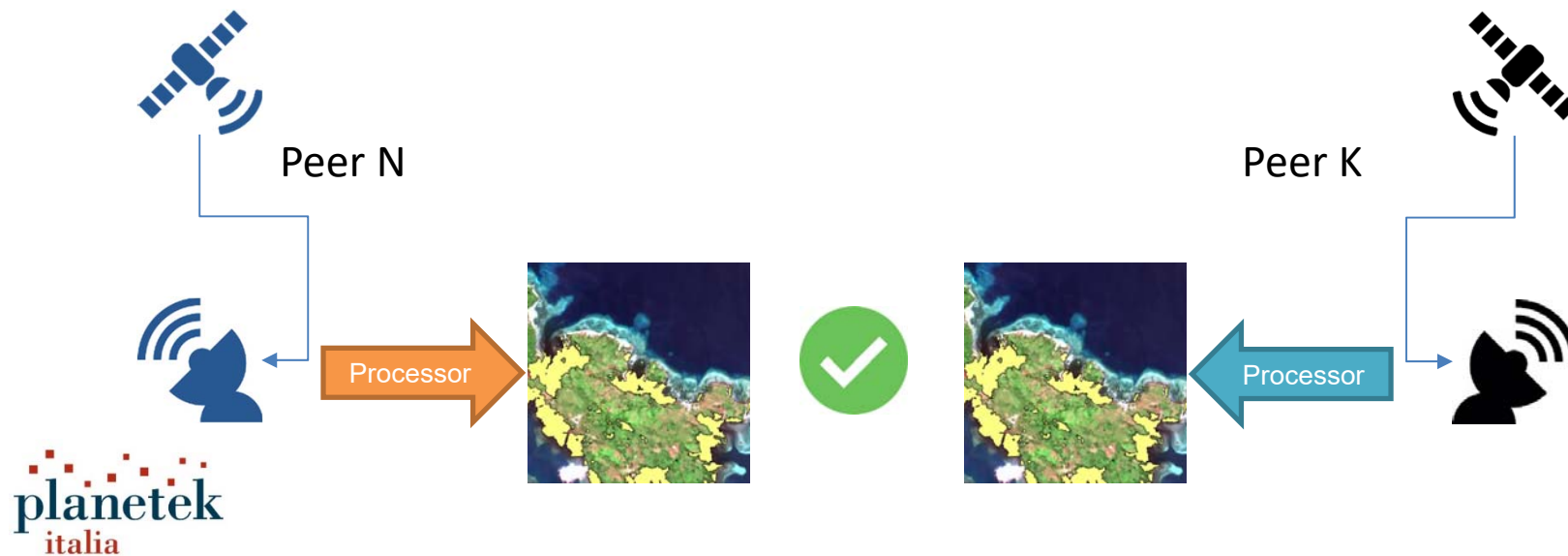
Reliable, alternate information sources, based on reliable consensus mechanism

Example: compressing input by comparison with other **reliable** information



What if we combine wisdoms ?

- Cross Validation through distribution and composition,
- Composition triggered by request.
- Guide principle: “**reproducible results**” have more Value.



The buzz-word “blockchain” (What’s that)

A combination of:

- Peer to Peer Networking,
- Public-Key Cryptography,
- Distributed Consensus (fault tolerance),
- Deterministic execution of code (Smart Contracts),
- Business logic based on value exchange,
- Reputation management.



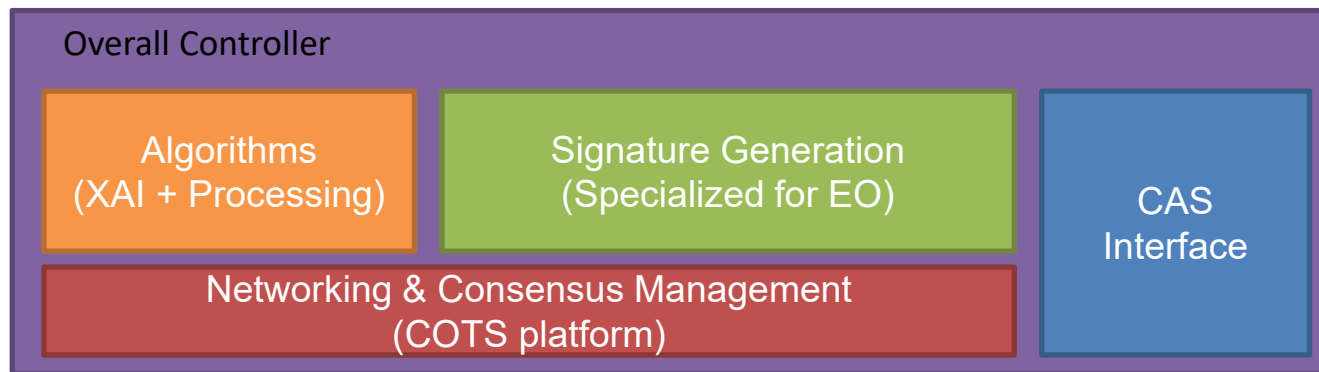
What we designed.



The Actual System (some details)
We just designed



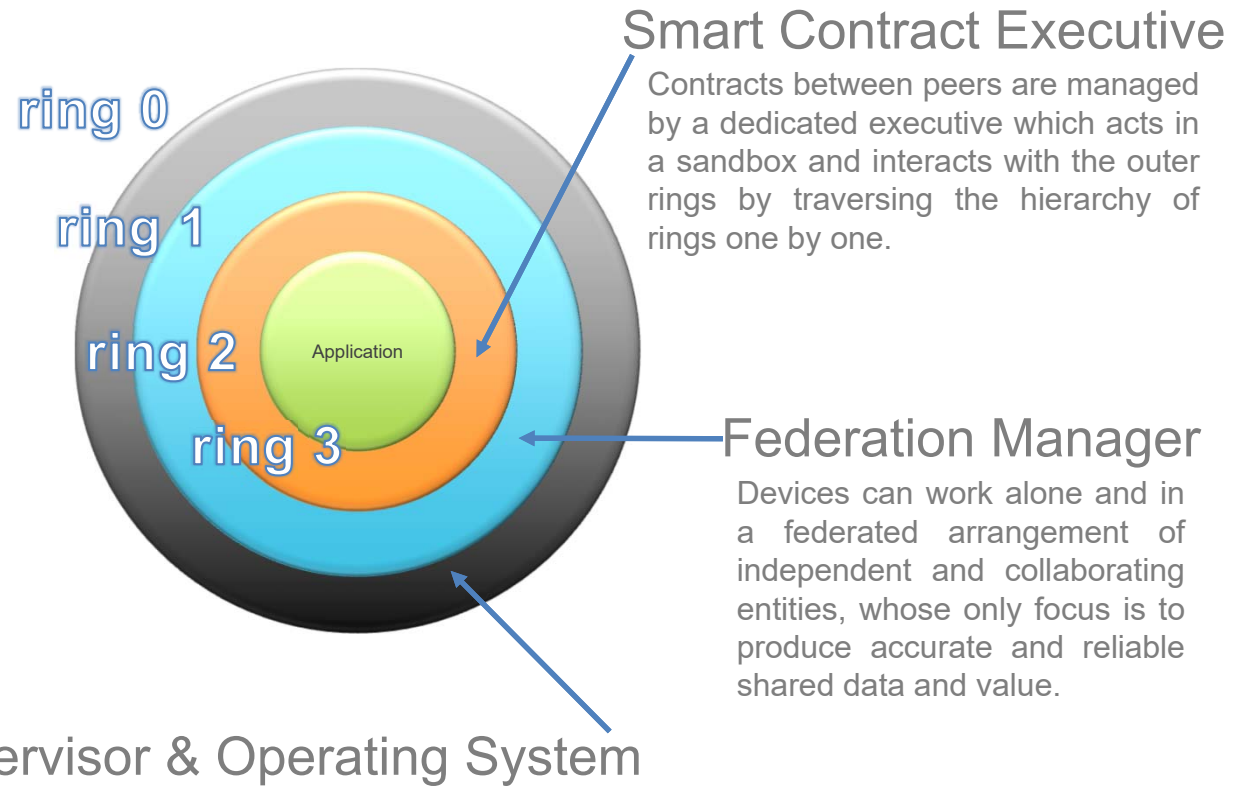
We designed a node in this way



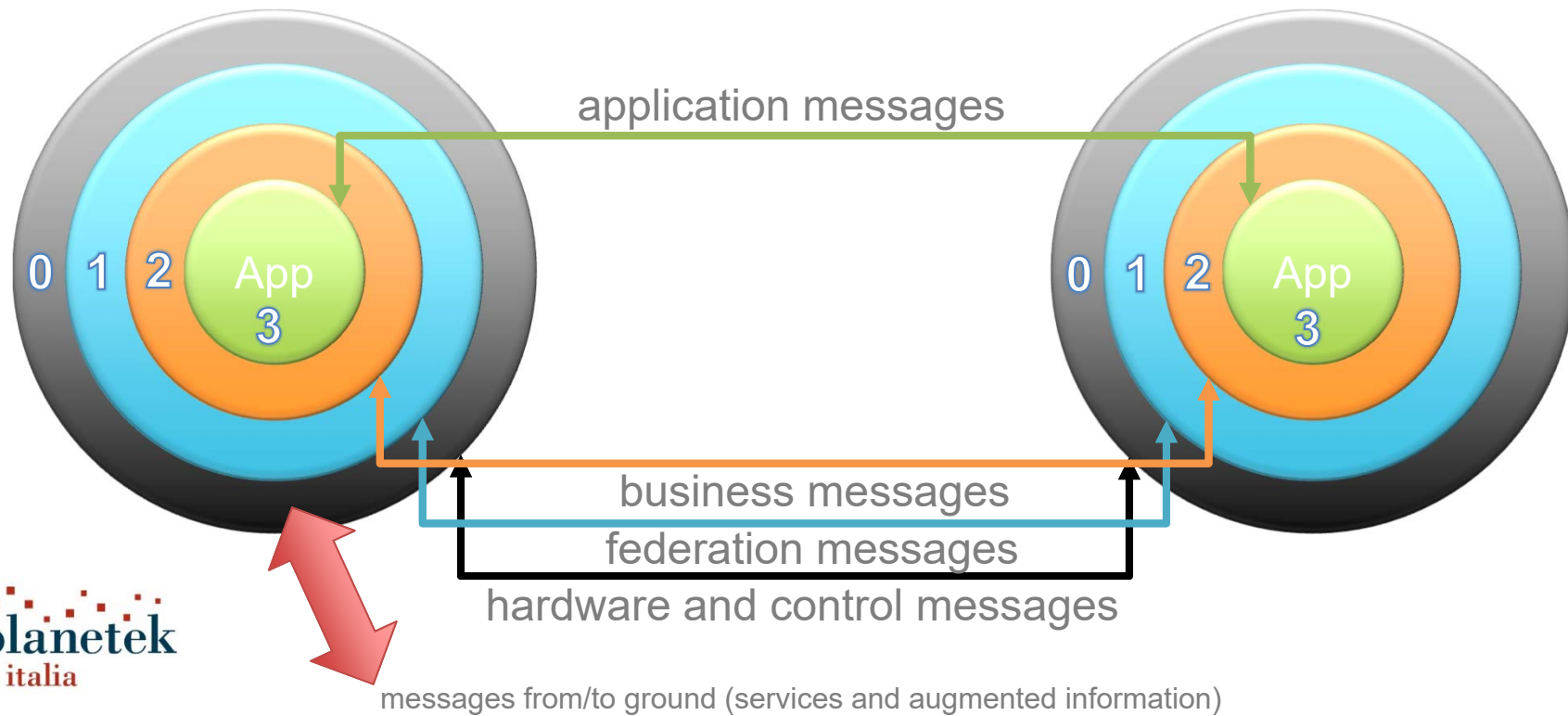
An overall controller contains specialized functionalities. Some of them are delegated to COTS components. Functions specifically made vertical for EO are “Algorithms” and “Signature Generation”. CAS (Content Addressable Storage) is made accessible by a dedicated interface.

XAI+CB Enabled Devices

Internal hierarchical structure of space devices with smart contract runtime and a federation manager.



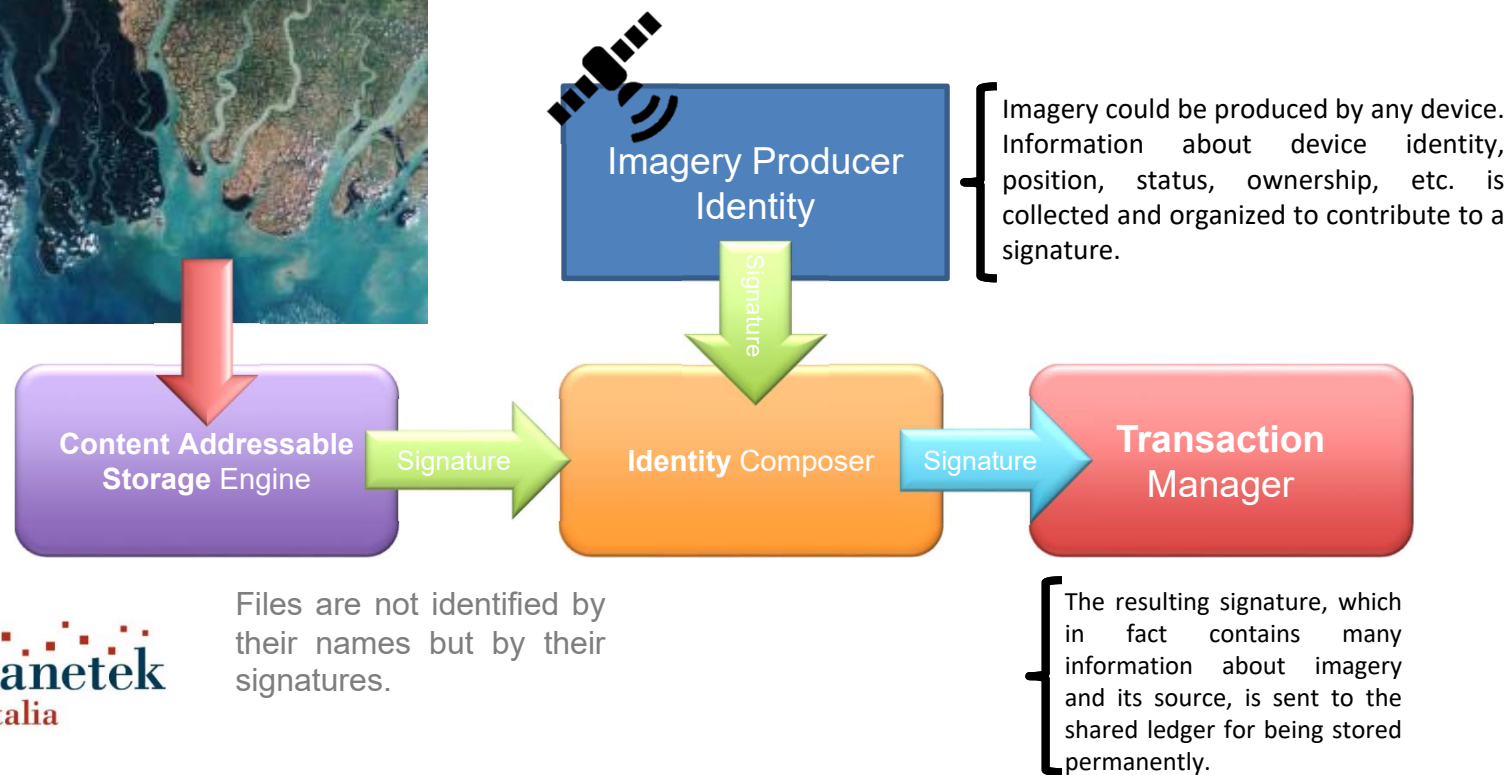
XAI+CB Enabled Devices



XAI in the Consensus Network

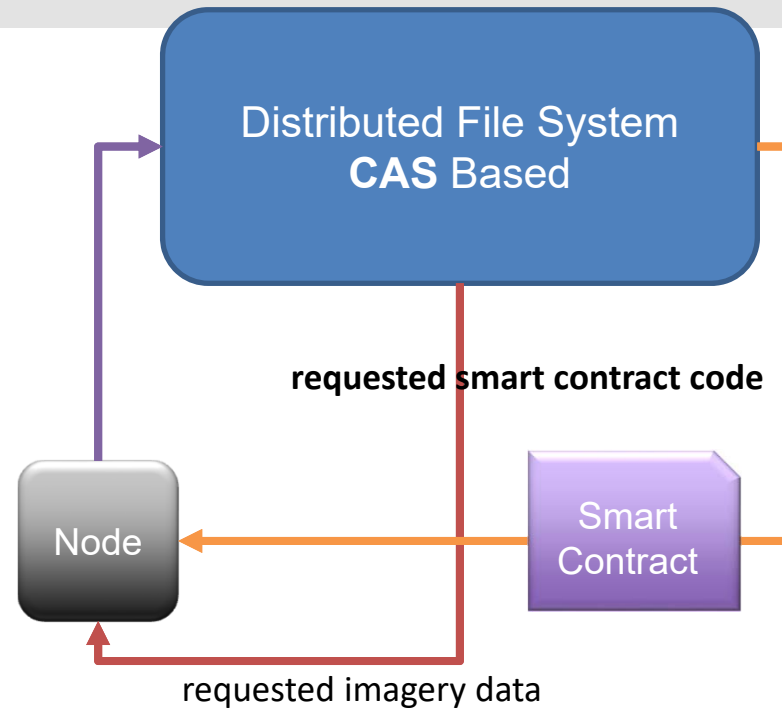


Original EO Imagery

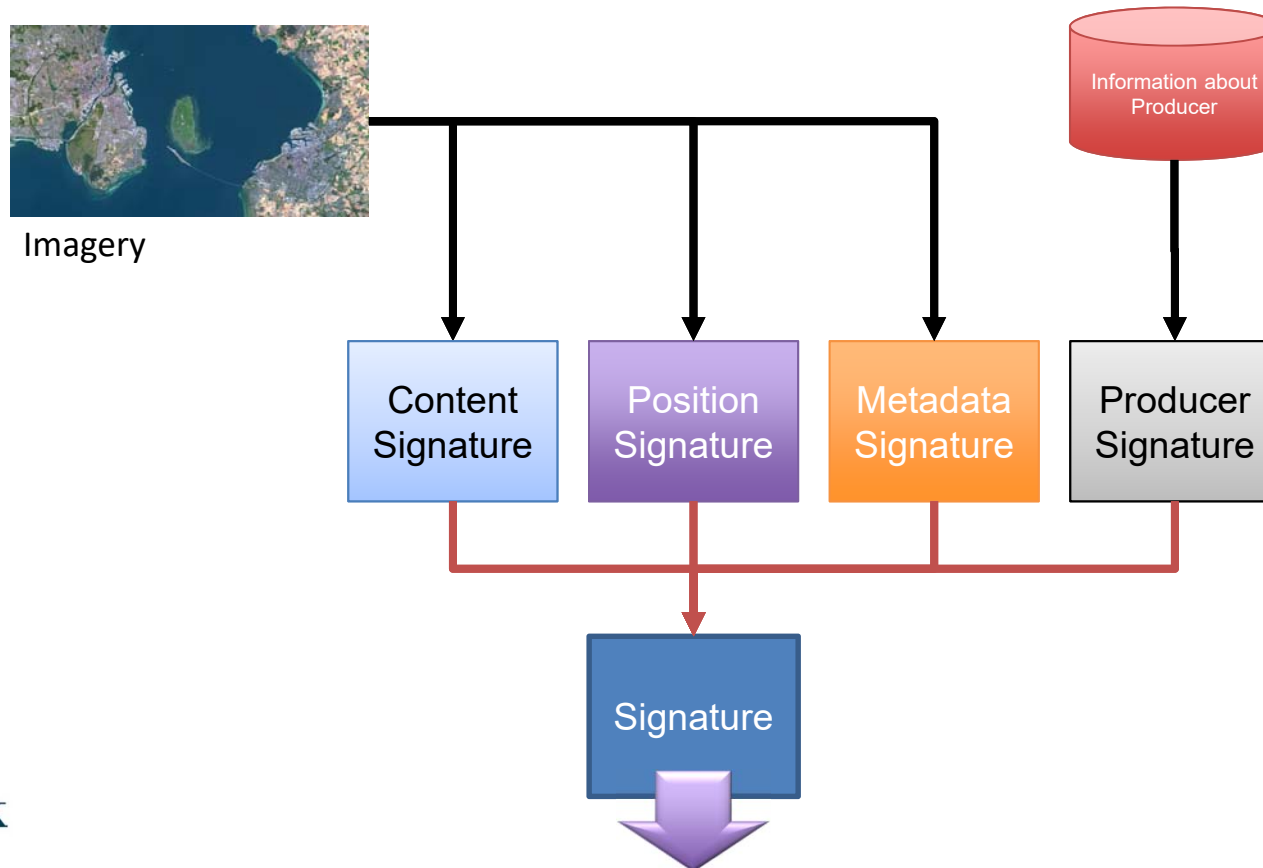


XAI in the Consensus Network

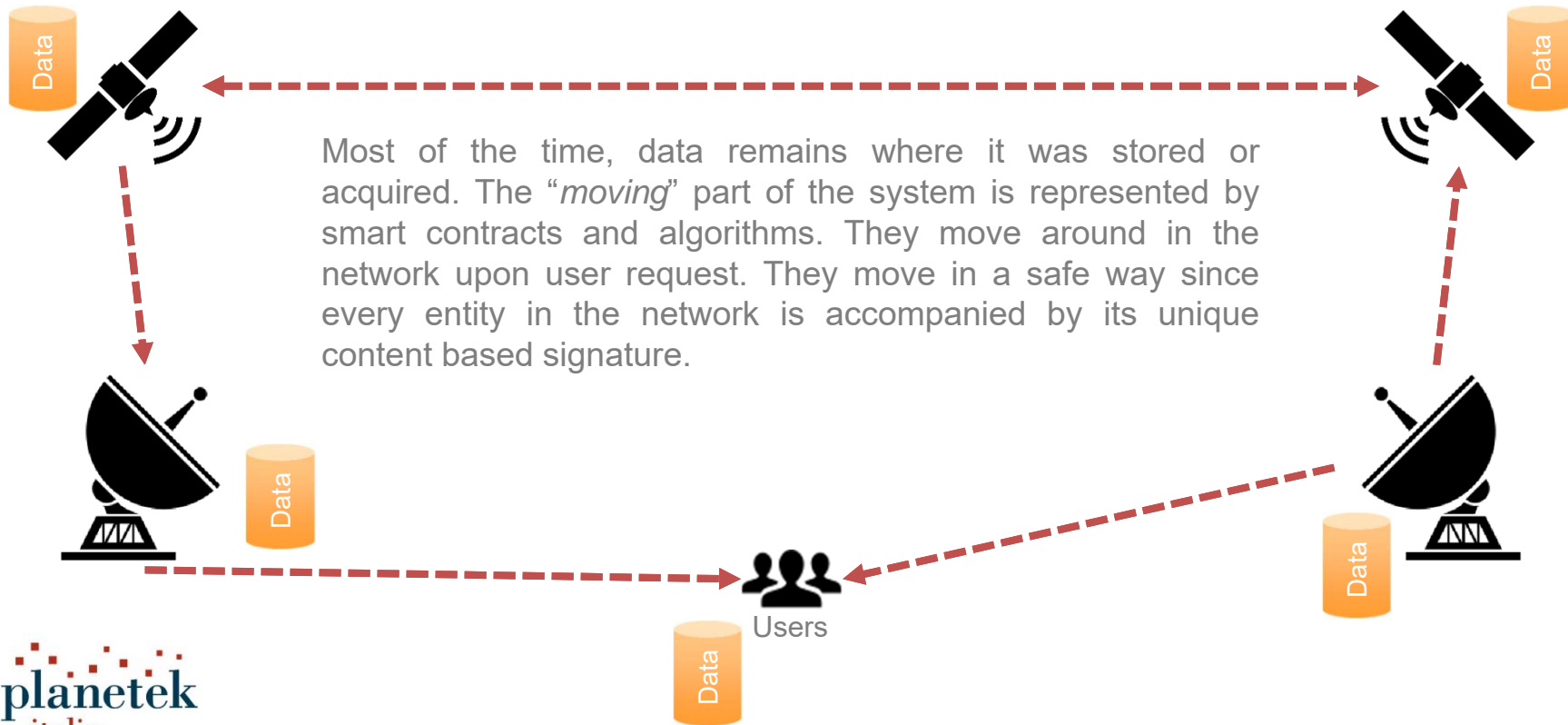
Code components that run inside a Node and implement business logic, including algorithms: for example, compression, classification, etc.



Example: Signature Generation is Compressing



The “moving” parts...



In the SpaceStream

- We are migrating from a single processor to an orchestrated cooperation of processing nodes.
- From raw, abundant, redundant data to refined, highly significant, actionable information...
- ...Resulting from the composition of multiple, interacting, mainly cooperating and constructively competing (when needed) nodes.

The «SpaceStream» paradigm

- EO systems will enforce **Wisdom Services**
- Nodes in a networks of “*heterogeneous, distributed Ground Segments*”
- Swarms of “*cooperative and competitive Space Agents*”
- *UpStream and DownStream mixed in the shades of the Continuous SpaceStream*

Conclusions

- *Exploiting the Relevant-Information-Extraction Process*
- *Composition of Pluggable Contributing Nodes*
- *Peer Enhanced Environment Reliability*
- *On Demand Deploy-Ability*

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