

IOT OVER SATELLITE: APPLICATION OF BLOCKCHAIN TECHNOLOGIES

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IoT over Satellite: possible application of blockchain technologies

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THE PRESENTER



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Matteo Merialdo specializes in **cybersecurity and model-based system engineering**. He currently manages the technical development of the European Space Agency Cyber Security Centre of Excellence in ESEC, Redu (Belgium), as well as multiple other high-tech security projects for ESA and the European Commission

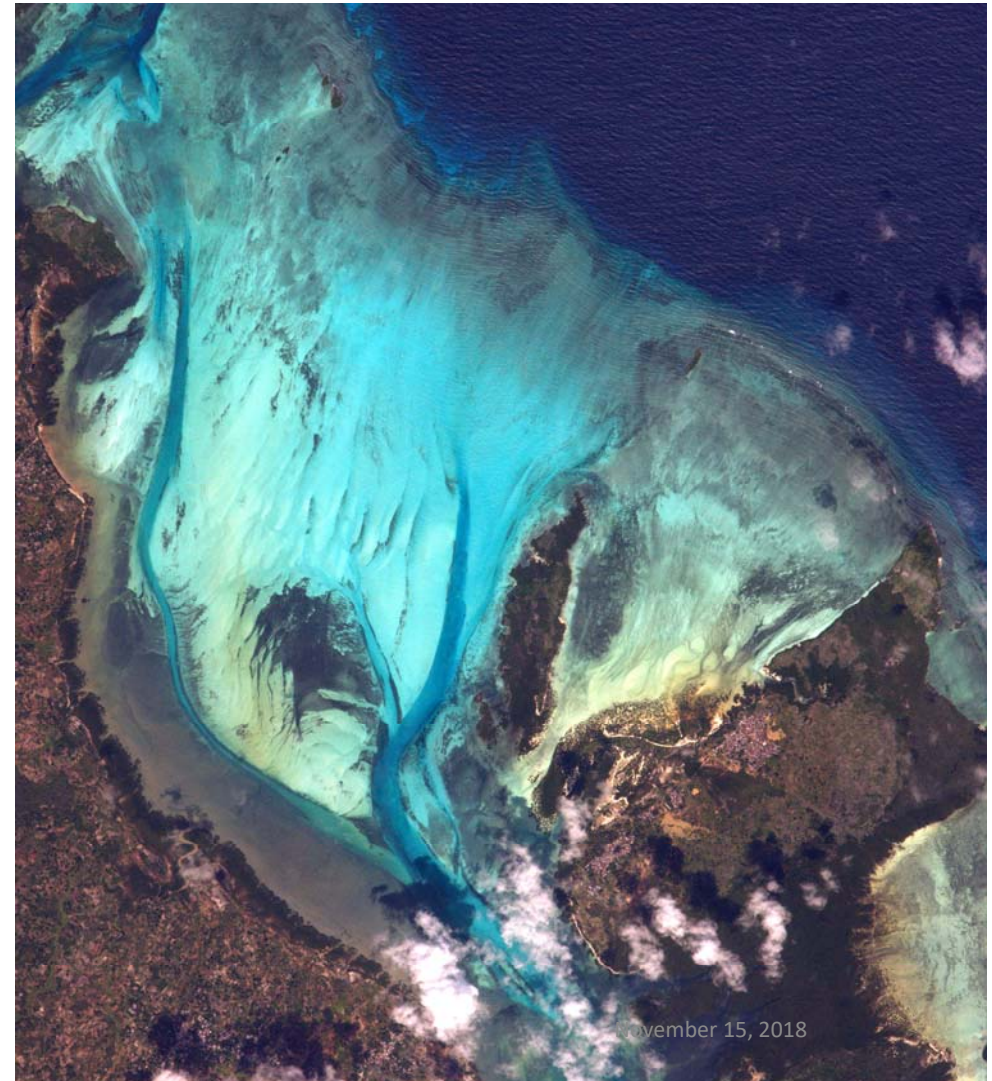
WHAT ARE THE OPPORTUNITIES FOR BLOCKCHAIN IN SPACE?

BLOCKCHAIN FOR SPACE

First experimentations and approaches

- IoT over satellite
- Space missions supply chain
- System engineering design integrity management
- Resilient Networking and Computing Paradigm
- Distributed Spacecraft Mission Definition
- Satcom Pooling and Sharing

IoT over Satellite: possible application of blockchain technologies

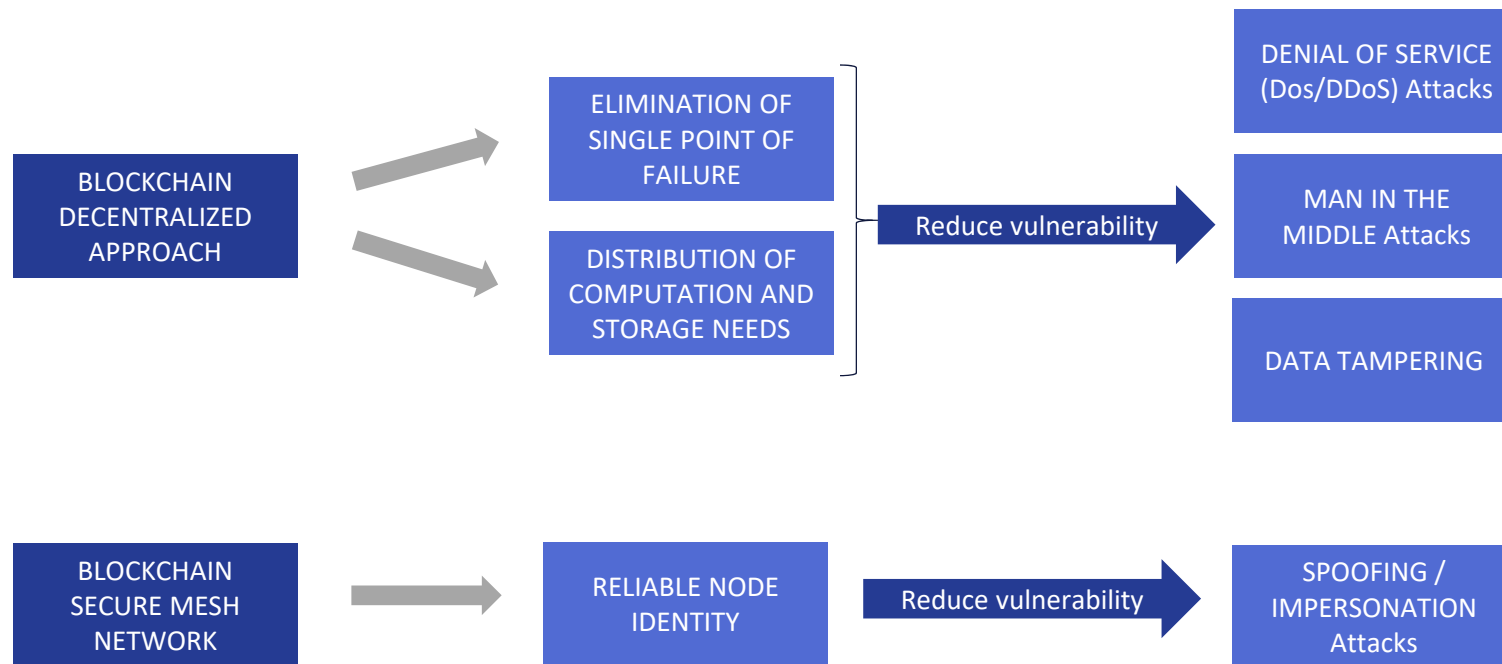




IOT OVER SATELLITE

IoT ecosystems can largely benefit from the application of blockchain technologies.

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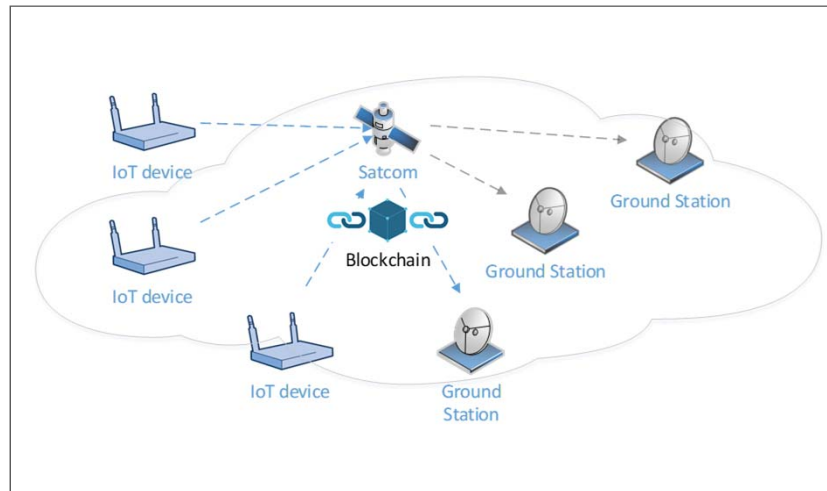


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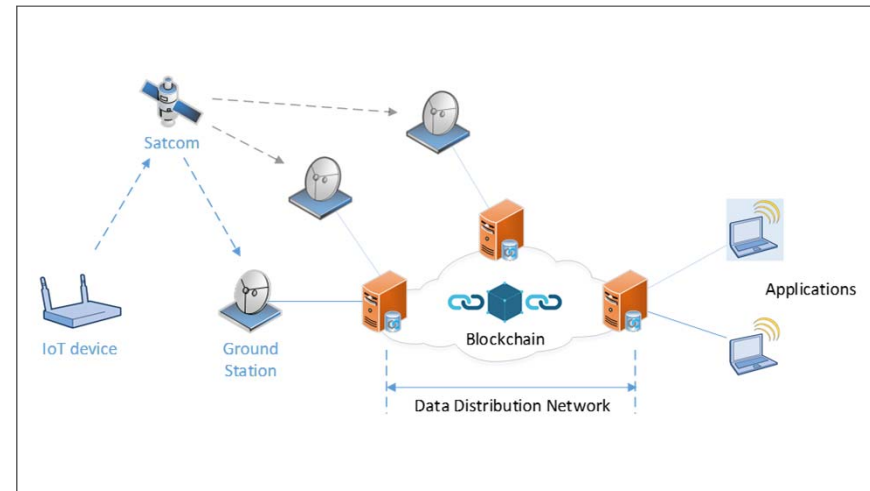


RHEA Group conducted a study and developed a PoC about the application of blockchain technologies to a satcom IoT ecosystem

Blockchain-based IoT ecosystem

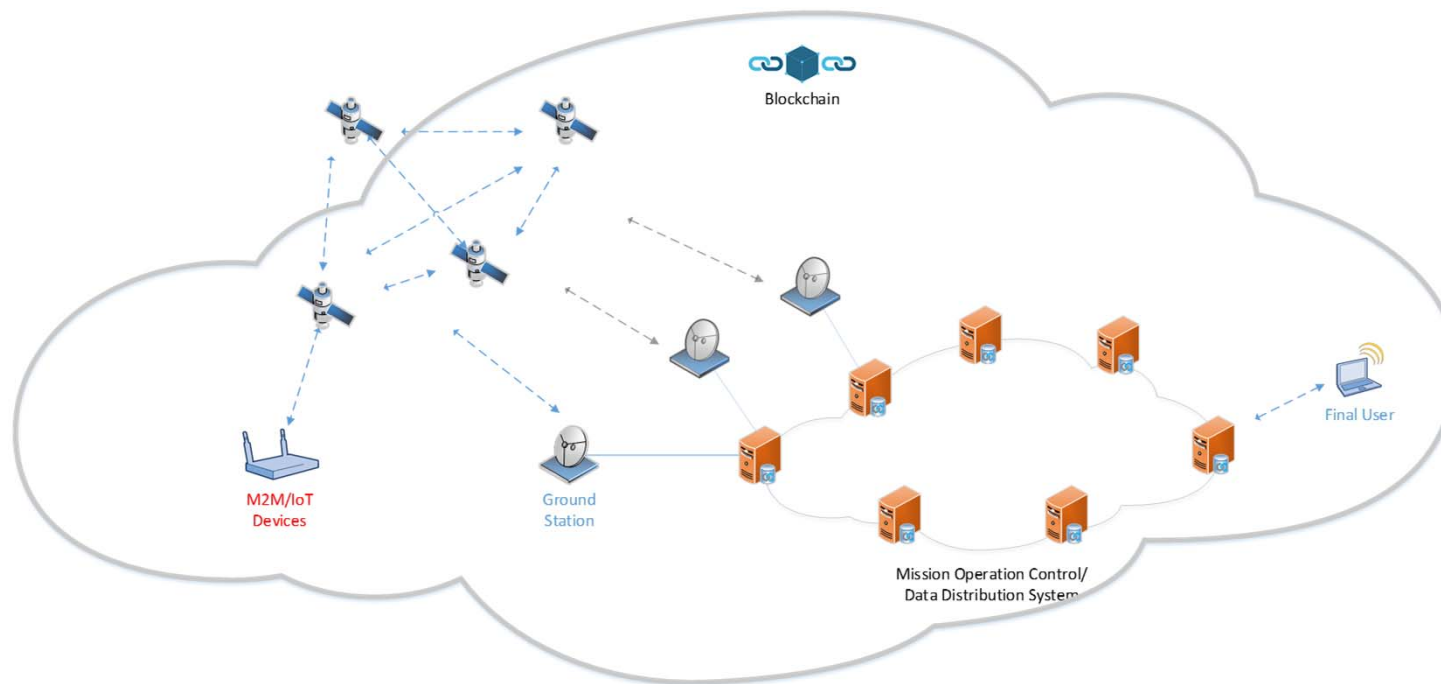


Blockchain in GS network



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Blockchain-based IoT ecosystem



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Blockchain-based IoT ecosystem

Benefits/Limitations

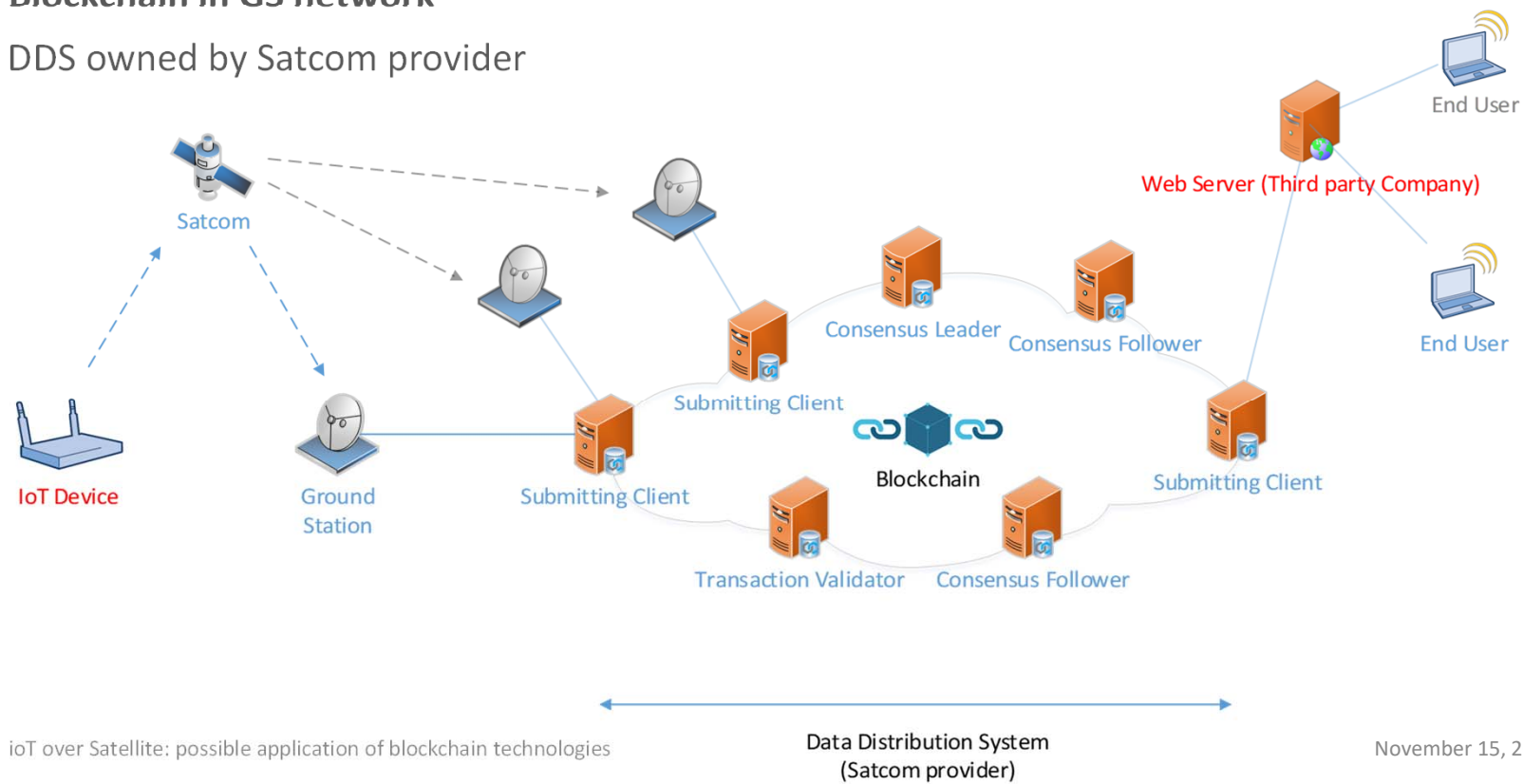
- Data Integrity in the whole IoT ecosystem (potentially including TC/TM for the Satcom)
- Fraud protection in the resulting transactions ledger
- Centralized certificate authority or cross-certification methods not needed
- The IoT network, being distributed, is far less exposed to malicious attacks
- Consensus mechanism could be used to validate data and act as a sort of anomaly detector
- Smart contracts are digitally signed so they cannot be tampered
- Limitations on processing power/storage
- Limitations on bandwidth

To be seen which blockchain technology could be successfully applied to this scenario

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Blockchain in GS network

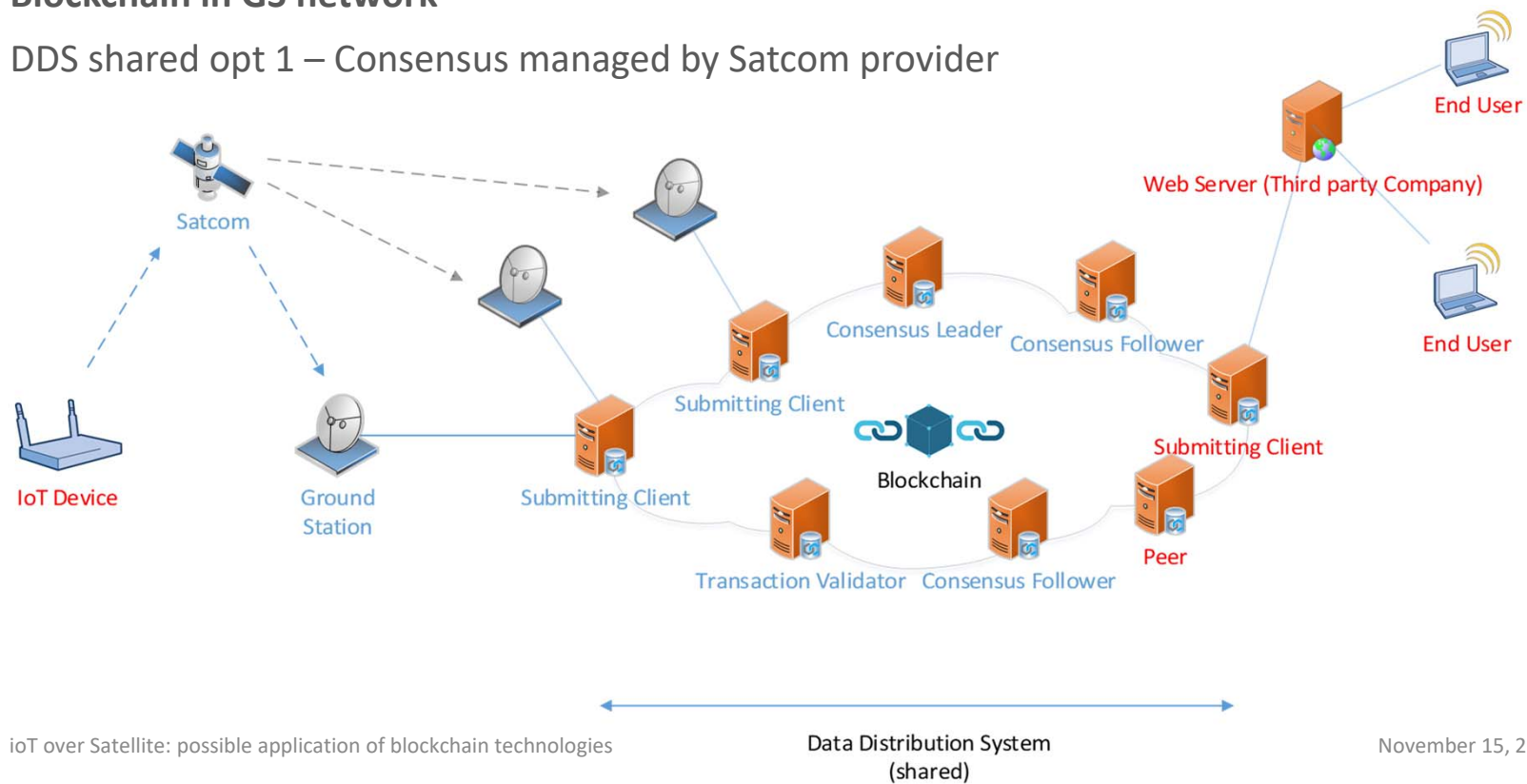
DDS owned by Satcom provider



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Blockchain in GS network

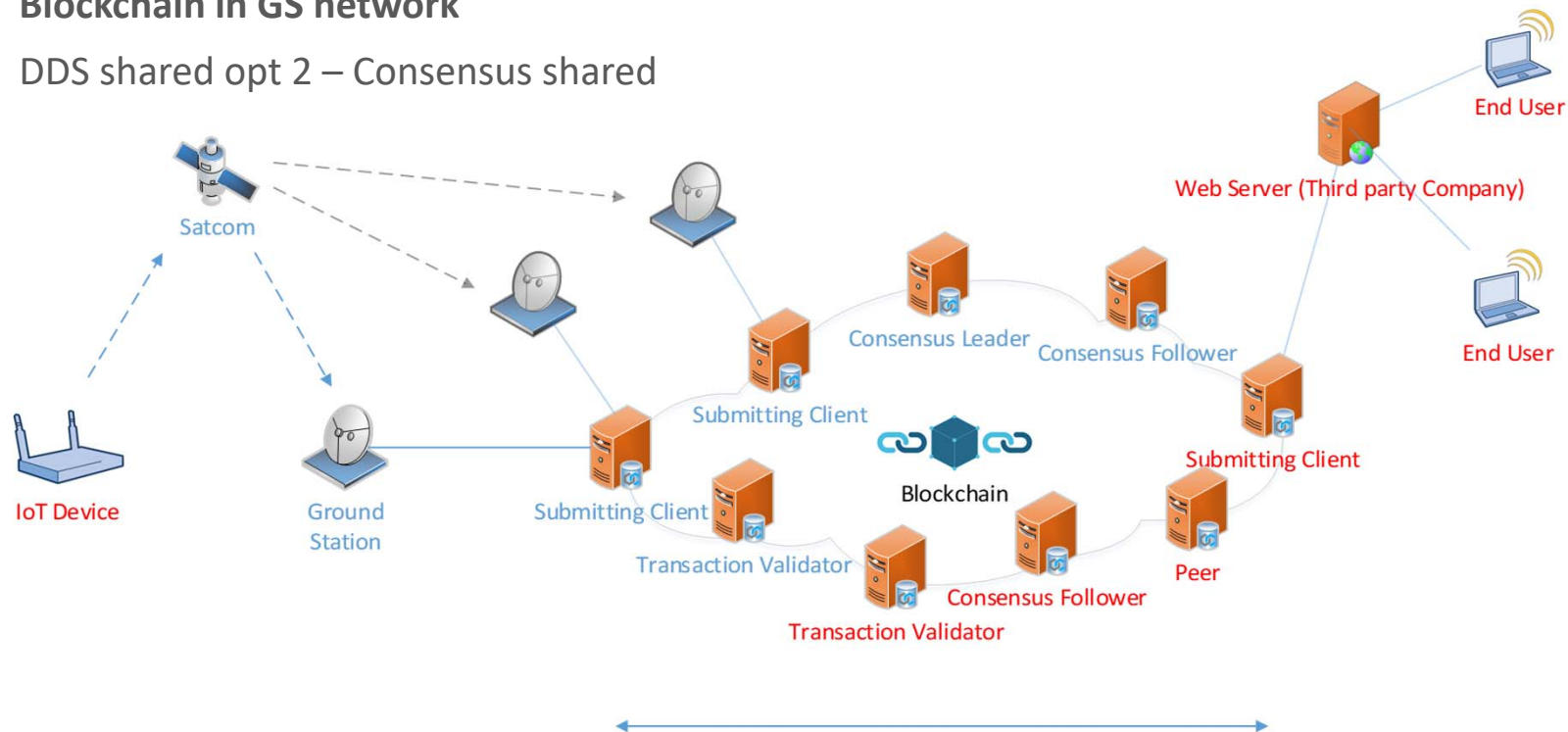
DDS shared opt 1 – Consensus managed by Satcom provider



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Blockchain in GS network

DDS shared opt 2 – Consensus shared



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Security benefits

- Data Integrity in GS network
- Fraud protection in the resulting transactions ledger
- Centralized certificate authority or cross-certification methods not needed
- Data Distribution System network, being distributed, is far less exposed to malicious attacks
- Smart contracts are digitally signed so they cannot be tampered

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Blockchain in GS network

Business benefits

- Auditability
- Satcom provider would improve the level of trust of its service
 - Client/insurances companies could participate the consensus mechanism or access a copy of the ledger
- Smart contracts provide flexibility on data/User Terminals/Final Users management
 - Data validation
 - Billing
 - Automatic actions triggered by IoT device messages

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Blockchain in GS network

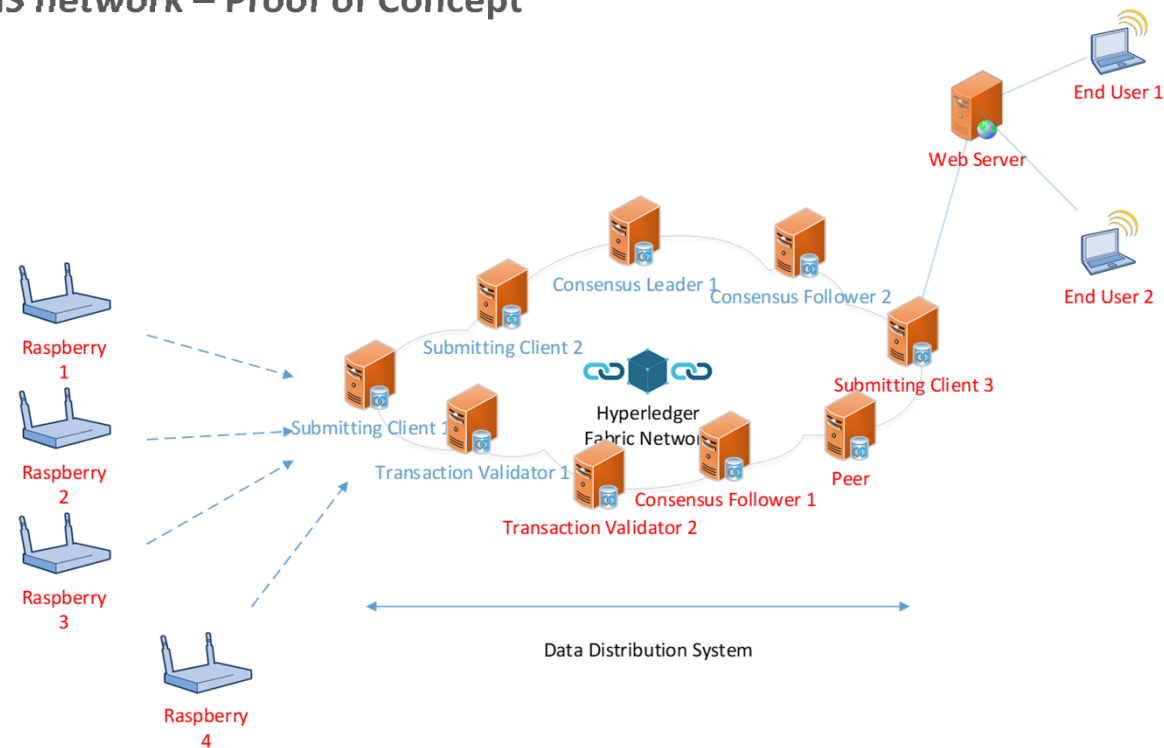
Main objectives of the Proof of Concept

- Analyse maturity of the blockchain technology and its Hyperledger implementation
- Analyse usability, configurability and documentation of the Hyperledger implementation
- Analyse security and business features
- Preliminary evaluation of the applicability within the known IoT context

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Blockchain in GS network – Proof of Concept



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Blockchain in GS network – Proof of Concept

Smart contracts

- IoT Device management
- IoT Devices/Users relationship
- Data storage and monitoring
- Data validation
- Digital signatures

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Blockchain in GS network

The screenshot displays the ICE-M User Dashboard in a Mozilla Firefox browser. The dashboard is divided into several sections:

- User Terminals Management:** A table listing five devices (RSP001 to RSP005) with columns for DeviceID, Latitude, Longitude, Temperature, and DGS Status. All devices are marked as "Not Registered".
- User Terminals Live Location:** A map showing the live location of the user terminals. A red pin is visible in the North Atlantic Ocean.
- RSP001 data History:** A map showing the historical location of device RSP001. A green pin is visible in the North Atlantic Ocean.
- User Terminal History:** A table listing the historical data for device RSP001, including Latitude, Longitude, Temperature, and Status.

DeviceID	Latitude	Longitude	Temperature	DGS Status
RSP001	N/A	N/A	N/A	Not Registered
RSP002	N/A	N/A	N/A	Not Registered
RSP003	N/A	N/A	N/A	Not Registered
RSP004	N/A	N/A	N/A	Not Registered
RSP005	N/A	N/A	N/A	Not Registered

Latitude	Longitude	Temperature	Status
51.865665	2.036255	1	OK
48.813781666666664	-0.013663333333333333	1	OK
40.673683333333334	-1.02402	3	OK
36.601733333333335	-30.502583333333334	2	Thresholds mismatch!
51.861215	4.0667283333333334	1	OK
48.813781666666664	-0.013663333333333333	3	OK
40.673683333333334	-1.02402	2	OK

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Conclusions

- Current hype around blockchain is high
- From this PoC, supply chain benefits are evident
- Current blockchain technologies (especially permissioned) seem to be still a bit immature, but constantly improving
- Several technical aspects need to be further investigated
- Possible benefits applied to IoT ecosystem (and potentially, satellite IoT ecosystems) seem however to be tangible
- Further investigations: feasibility study, bigger scale PoC, additional research on use of consensus mechanisms for anomaly detection, smart contract analysis

CONCLUSIONS



QUESTIONS

THANK YOU



IOT OVER SATELLITE - CHALLENGES

