



Experiments in using
blockchain technology for
satellite and ground station
communications

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Agenda

- What is Blockchain?
- Experiments
- Conclusions

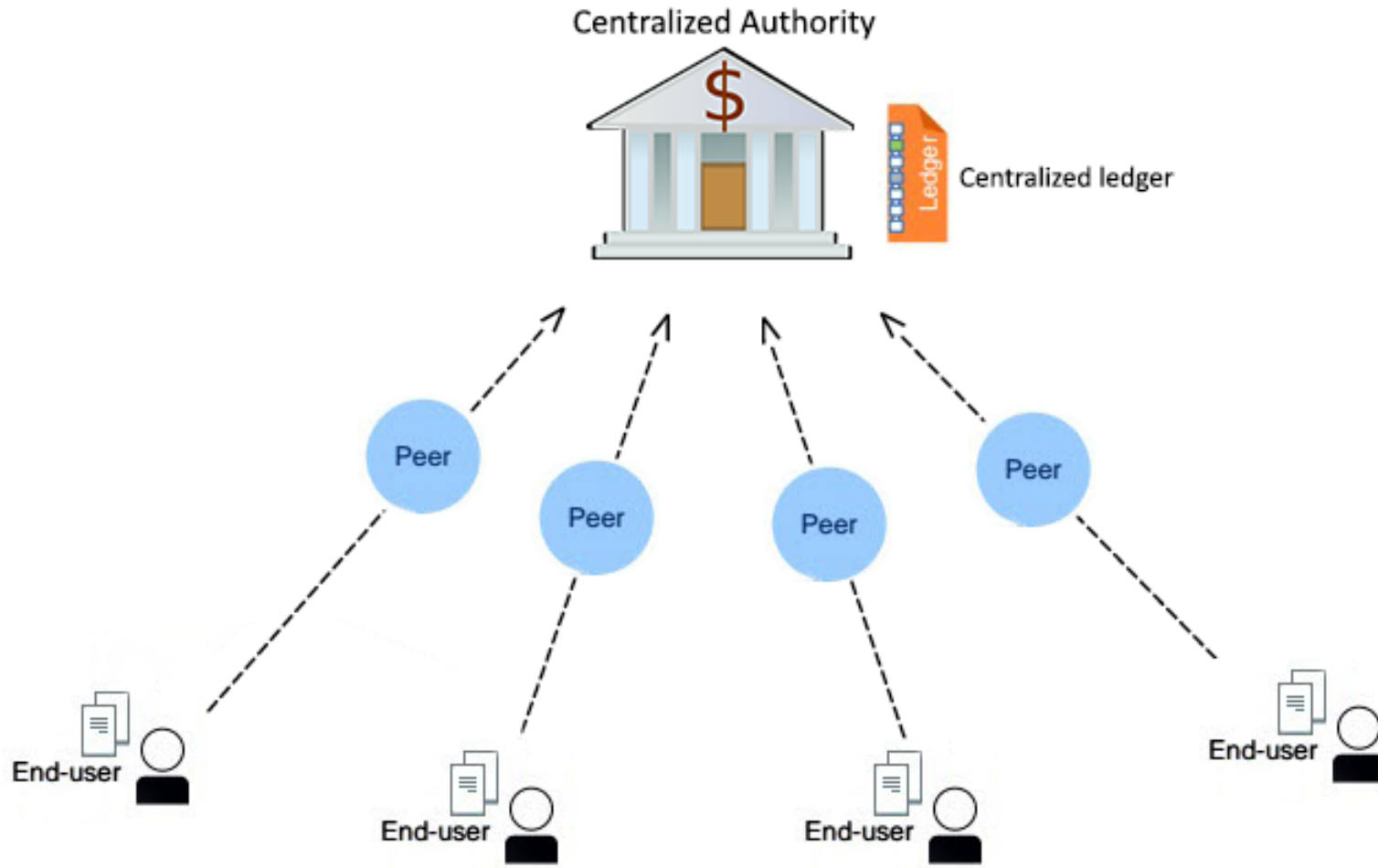
WHAT IS BLOCKCHAIN?

Definitions

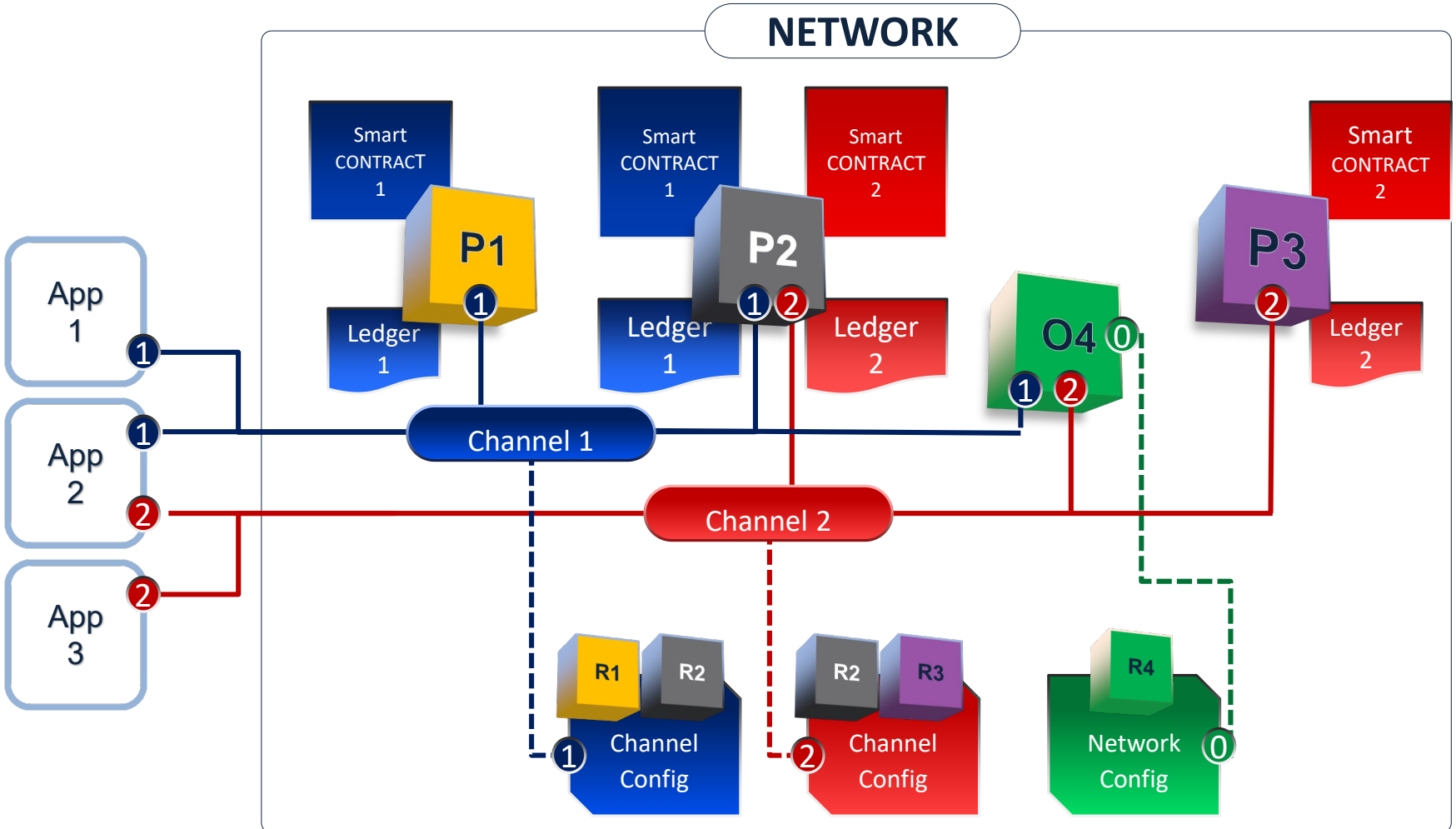
- Blockchain is a **cryptographically** secured, **immutable** and **distributed** ledger of **transactions** stored in data structures called "**blocks**."
- Supporting technologies
 - Smart contract
To enable a whole host of ledger functions (transacting, querying, etc.) – a blockchain network uses smart contracts to provide controlled access to the ledger.
 - Consensus
The process of keeping the ledger transactions synchronized across the network.
 - Peer node
Peer nodes make up the physical structure of the network.

The blockchain, peers, consensus and smart contracts come together in creating a block chain network.

Centralized model



Hyperledger Fabric implementation



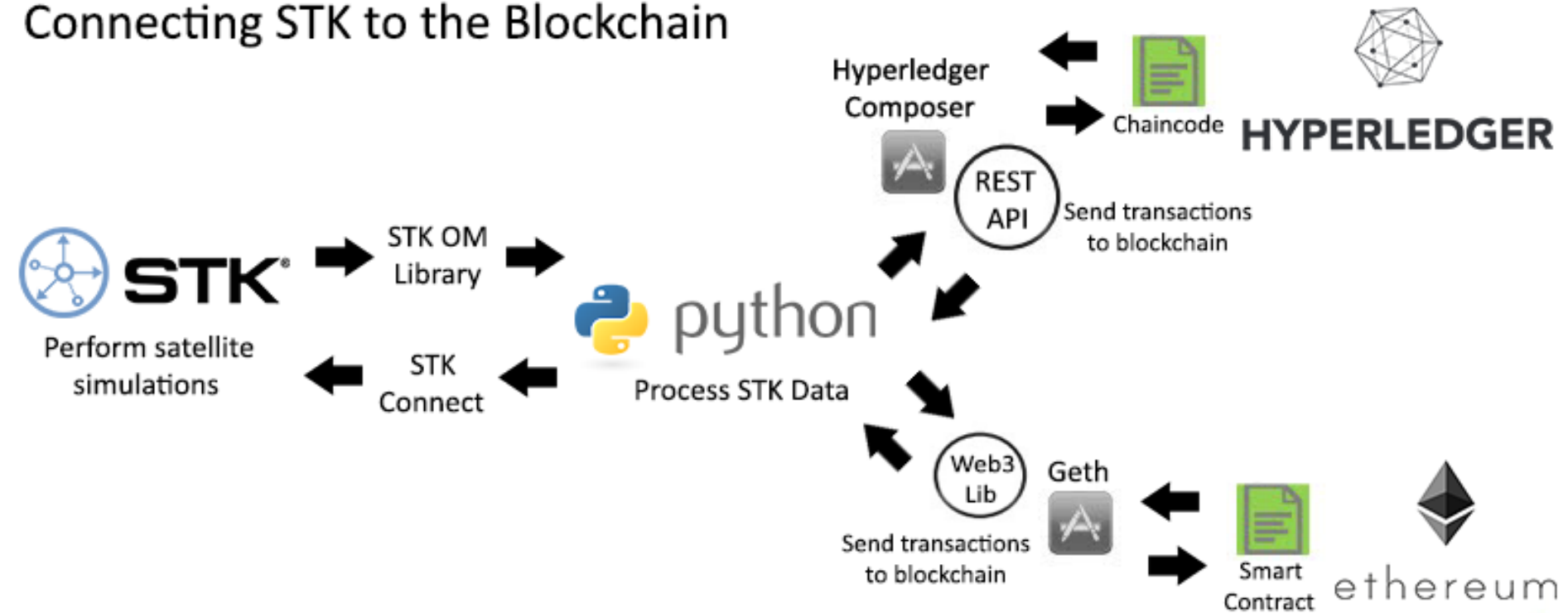
R* Organization
 P* Peer nodes
 App* Client applications



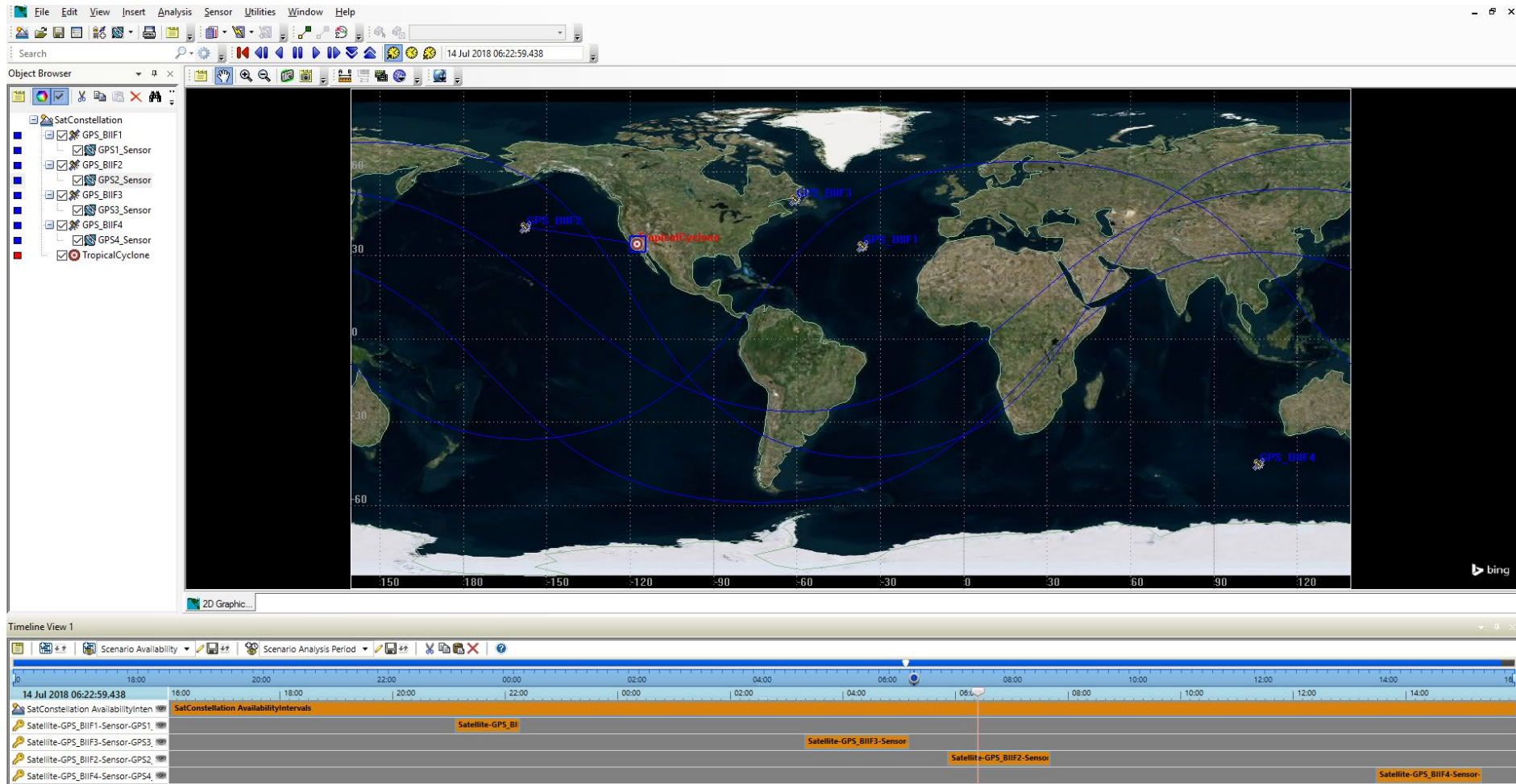
EXPERIMENTS

Technology setup

Connecting STK to the Blockchain



Screenshot of simulated satellites



Experiments performed

- Access Control
- Encryption
- Prioritization of commands
- Distributed observation
- SQL integration
- Chain trimming
- Event capture

Access Control

- Multiple ground stations are on the same network, but some should not have access to some information and commands
- Built-in Access Control List (ACL) functionality in Hyperledger Composer can limit access to network resources based on participant ID

Encryption

- Sensitive data needs to be passed through unsecured ground stations
- Hyperledger Fabric automatically encrypts data in motion, and encryption can be added for data at rest

Sending/Receiving Data

Prioritization of commands

- Ground station sends commands that could be carried out by multiple satellites
- Smart contract code determines which satellite is best suited for a command and which command each satellite should prioritize

Distributed observation

- First satellite in a string detects some phenomena, posts information on it to the blockchain
- Smart contract code is triggered, automatically directing following satellites to observe phenomena

Legacy integration

SQL Integration

- The blockchain still needs to be able to interact with legacy software and hardware
- Data contained in blockchain ledger was retrieved, formatted, and stored in a SQL database

Chain Trimming

- The size of the blockchain ledger grows over time, requiring more storage and more computation from peers
- The blockchain is archived at a ground station and a new blockchain is started on the same network

Event Capture

- Events that occur on the blockchain need to be recorded or acted upon elsewhere
- Hyperledger Composer provides an event listener library that can automatically run code based on a transaction's result when it completes

CONCLUSIONS

Takeaways from Blockchain experiments

The distributed nature of blockchain provides some **unique advantages**:

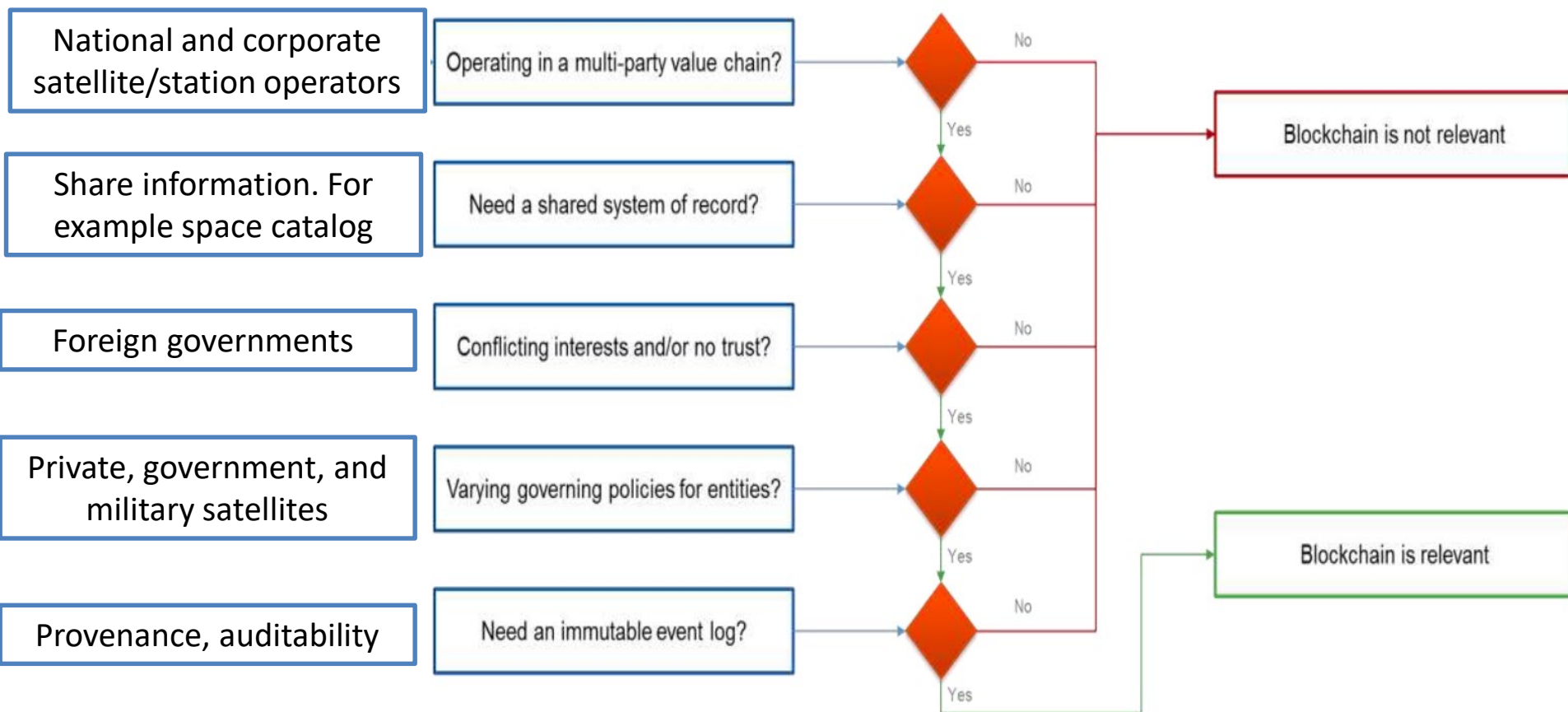
- **Distribution** of information to all network participants simultaneously (with access control available)
- **Autonomous handling** of satellite commands using blockchain's smart contract capabilities
- **Provenance** and **Immutability** of transactions

Current **limitations** of the blockchain include

- Ledger **grows in size** over time and must be stored in its entirety on all peers
- Consensus **expends** significant computational power
- Commands must be **validated for consensus** before they can be transmitted

Focus on learning rather than immediate business value

When should Blockchain be used ?



Gartner Presentation: The Next Evolution of Blockchain and Distributed Ledger Technology, Lyn Robinson, Aug 20-23 2018

Q&A