



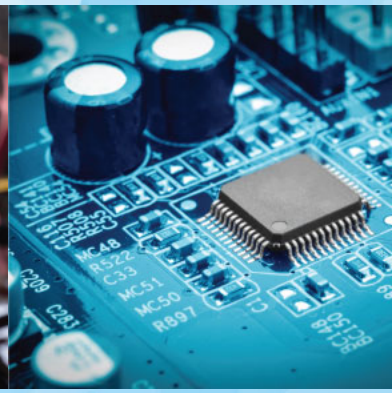

# Why Blockchain and Reliability

## Distributed Ledger Integrity, Security, and Reliability

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IEEE Reliability Society

IEEE BLOCKCHAIN™

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# Outline

# What is what?

Ledger

Distributed

Locked

?

Blockchain

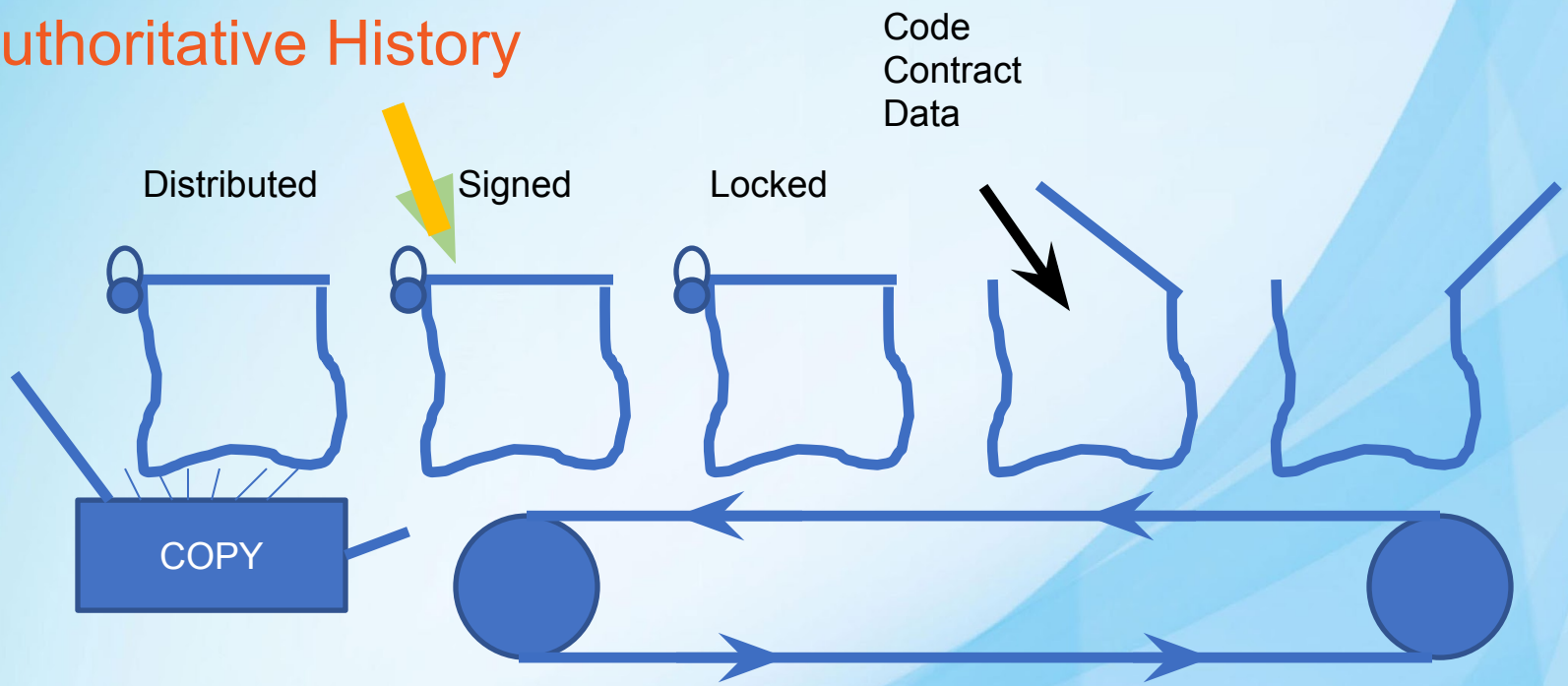
?

Signed

Cryptographic Hash

?

# Authoritative History



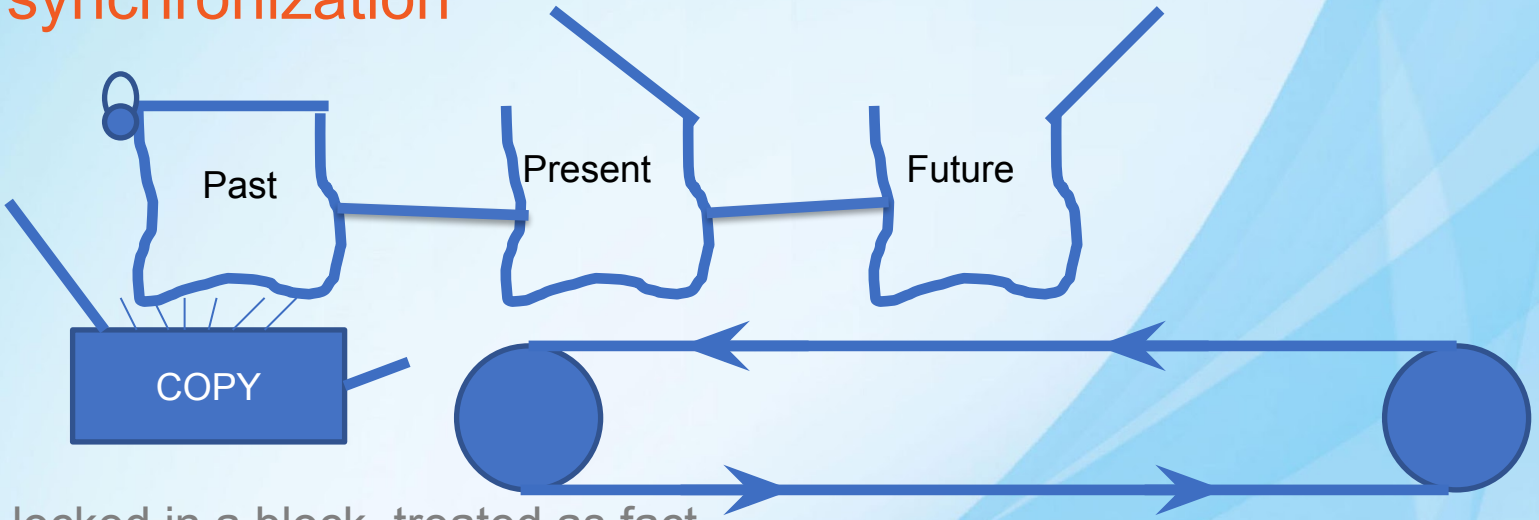
## Identity management and anonymity

**Trust ≠ Identity**

**Transaction ≠ Accuracy**

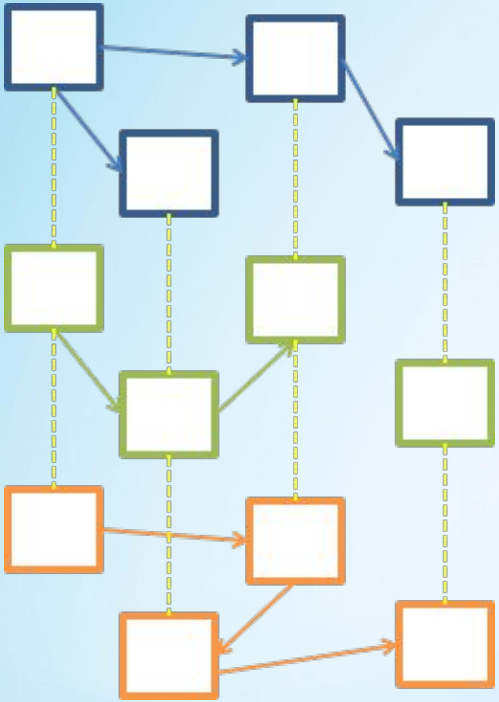
You can have these things, but one does not guarantee the other, and you must design to what you require!

# Event synchronization




- Once locked in a block, treated as fact.
- Blocks are ordered.
- Visible to all.

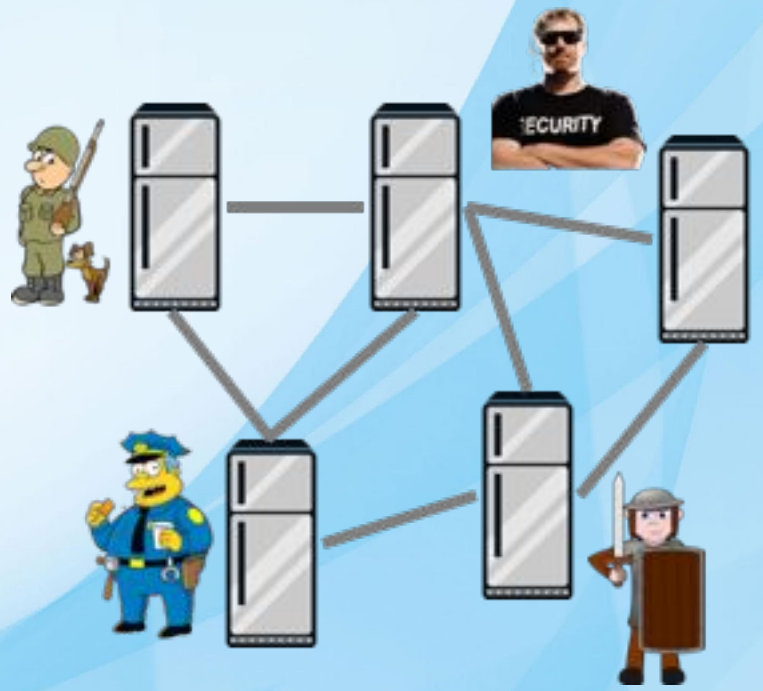
# Traffic flow management and message flow



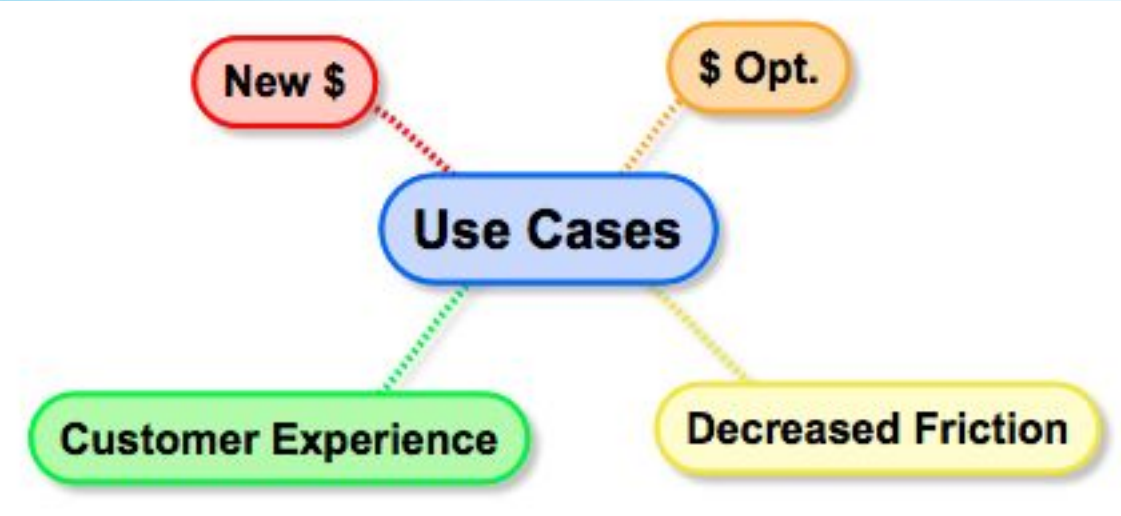
- Complex network control is possible.
- A node or client can follow different rules based on the transaction details.
- Blockchain networks can thus be used to send complex, conditional information.
- By nature, strong reliability and security can be designed into the system, and directly controlled.

# Information reliability

- Once in the blockchain network, information remains as entered.
- Reliable information in means reliable information is kept.
- Likewise, unreliable information can be equally treated as fact, if allowed to enter.
- Some sort of security measures to assure reliable information enters the system is advised.



# Use Case Summary

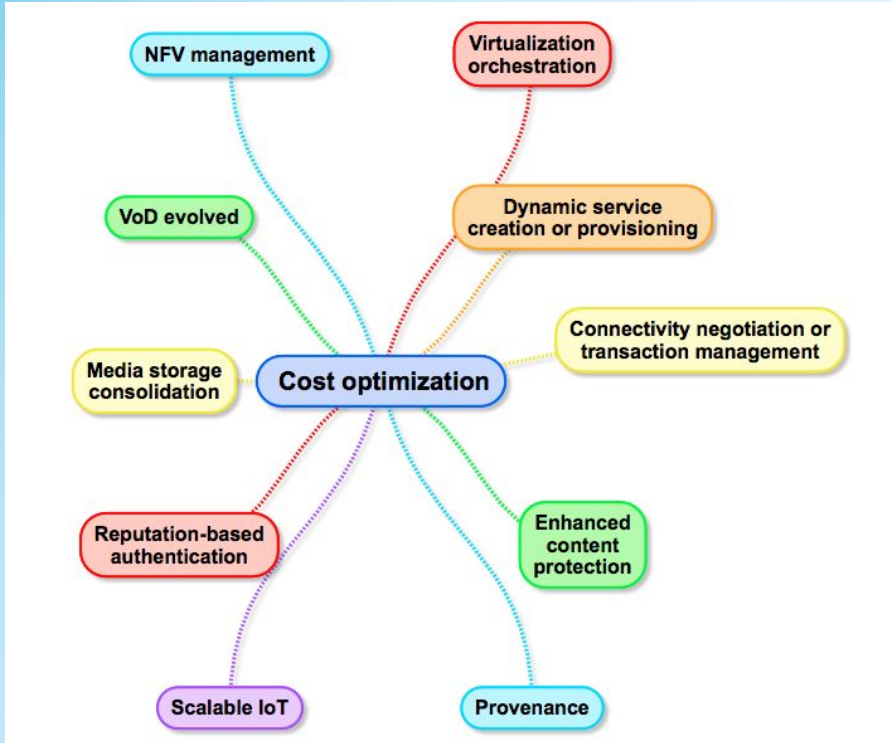



- New and direct revenue
- Cost optimization
- Customer experience
- Reduce ecosystem friction
- The future may hold more!

# New and direct revenue

Blockchain can play a pivotal role in enabling new revenue opportunities for operators in existing and new markets.

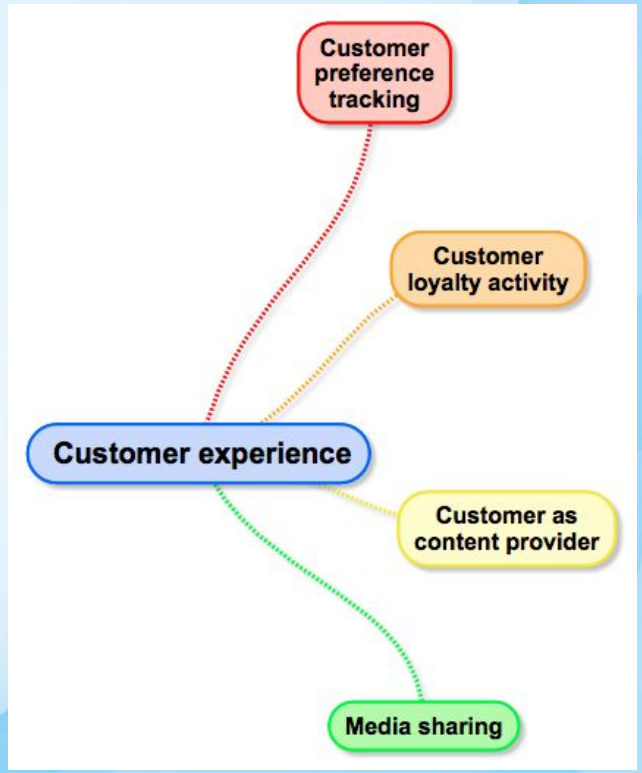
# Cost optimization



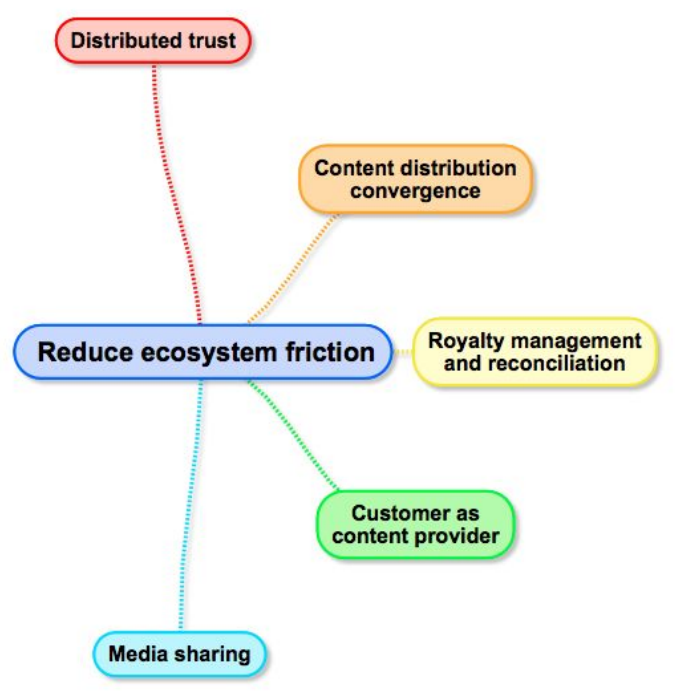

In network operations, service creation and management, security and ownership, and even the customer experience, blockchain networks and distributed ledgers can help operators be more cost optimal.

# Customer experience

Blockchain and distributed ledgers can enable many customer management capabilities. And as customers evolve in ways they are already ready to consume, it can be a layer of service and control they need.



# Reduce ecosystem friction




This is fancy talk for just making things easier to do. Some things might be easy enough that you can do them for the first time. As a result, this category could be a ramp to many new capabilities not yet envisioned. More may come of this!

# IEEE Explorer search for Blockchain or Distributed Ledger Technology, and Reliability

- 487 papers
- Most focused on applications, some on enhancements to DLT
- Many relating to transactive energy, IoT, supply chain, food integrity
- Assurance, integrity, security are about the reliability of what is held on the ledger, and how to make reliable the features provided by the DLT solution
- Very few deal with how to make DLT more reliable… why is that?

"The reliability of blockchain-enabled applications is based on the innate immutability of stored data, maintained through cryptographic means, which enables blockchains to provide transparency, efficiency, auditability, trust, and security." - K. Zhang; H. Jacobsen, "Towards Dependable, Scalable, and Pervasive Distributed Ledgers with Blockchains"

# Components of a Distributed Ledger

Application
software, hardware, design
Network
access, routing, transport, design, p2p
Data
information, code, hash
Compute
consensus algorithms,
Store
ledger, code, data, etc.
Humans
users, miners, verifiers, more
Verification, monitoring, etc.

Security

Privacy - Transparency

Trustworthiness

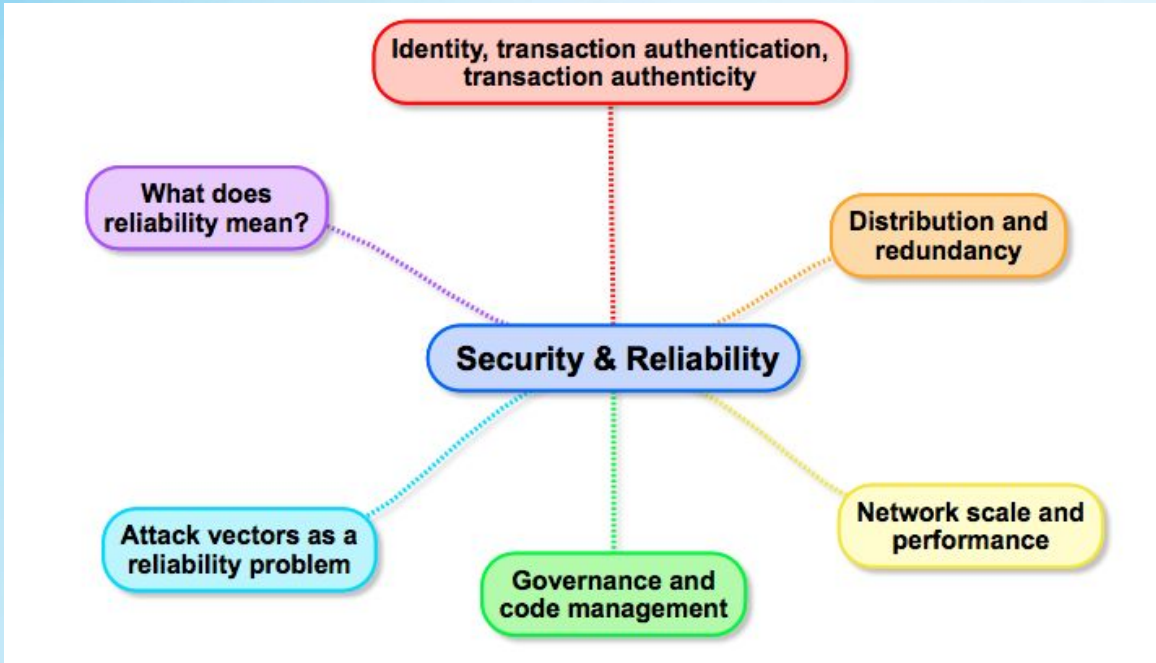
Reliability

Public – Private

Auditability

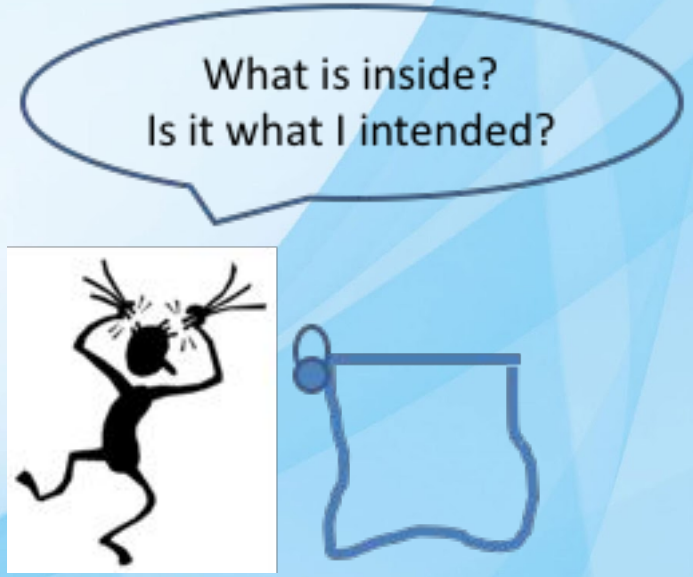
etc.

# Complex Security and Reliability Design Concerns




# Identity, transaction authentication, and transaction authenticity

- Are the parties who they say they are?
- Is what is in the blockchain what has been agreed to?
- Given the methods and tools available, can the design assure anything?
- Is a central authority needed?



# Distribution and redundancy

- Byzantine General's Problem
- Distribute authoritative copies widely
- A majority may not be sufficient
  - Higher certainty needed in some applications
  - Consideration of the nodes and their conditions

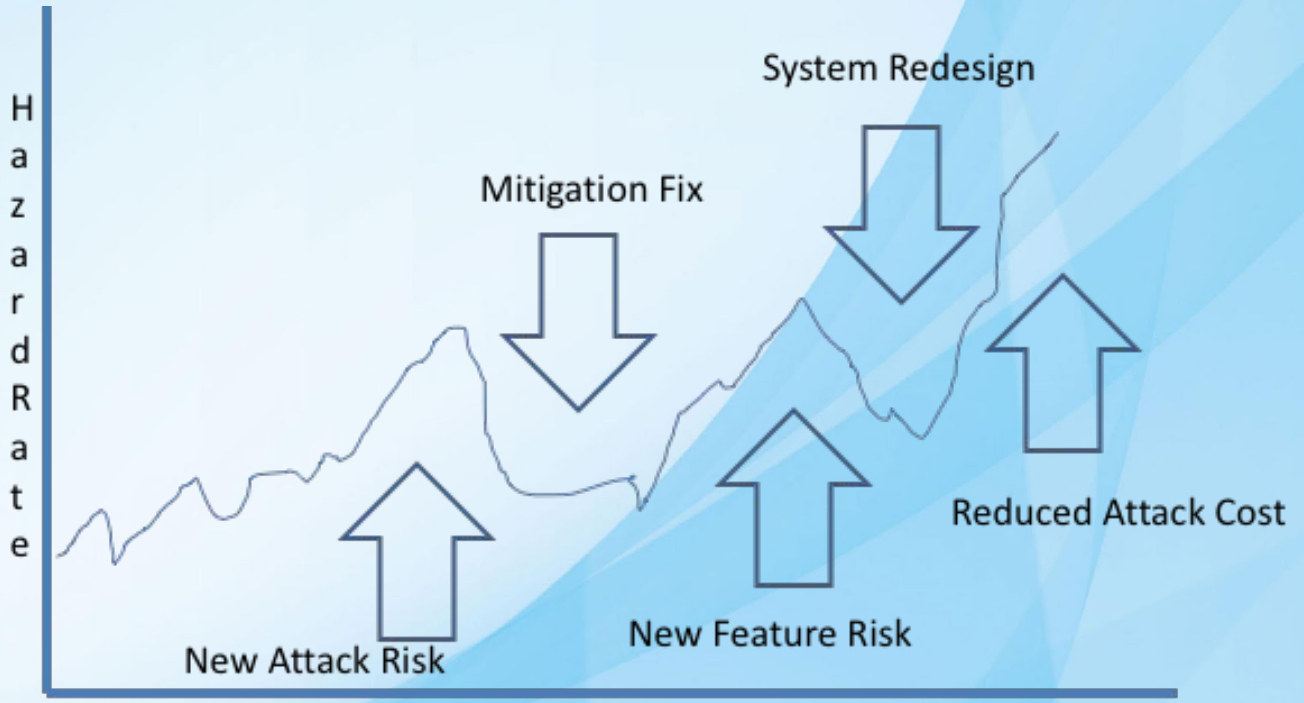
# Network scale and performance considerations

| Measure | Small BC | Large BC |
|---|---|---|
| Time to get in | - | + |
| Time to propagate | + | - |
| Time to lock | - | + |
| Likelihood to split | + | - |
| Bad actors | + | - |
| Exposure risk | + | - |
| Reliability | ? | ? |

- As blockchain networks get larger, depending on the design, certain performance and reliability issues are important considerations

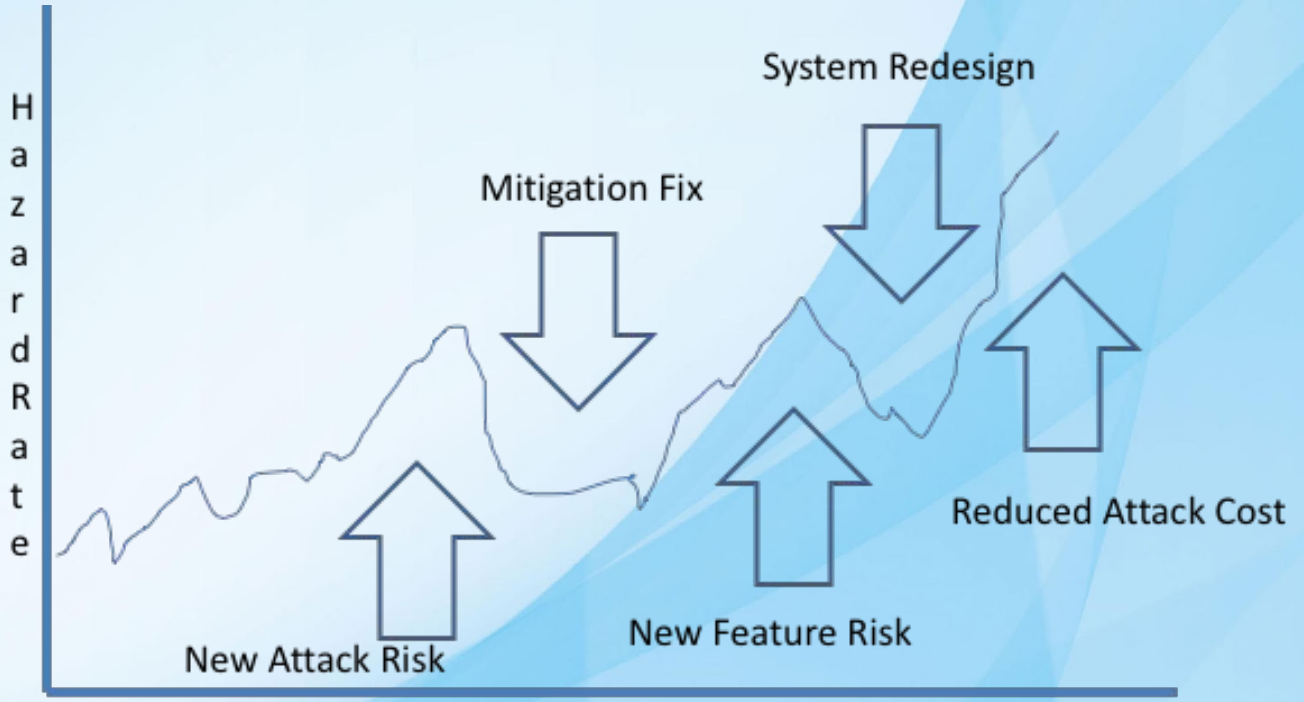
# Governance and code management

- Blockchain networks are complex systems, not always under authority or control.
- Software best practices are important, but are a double edged sword too.

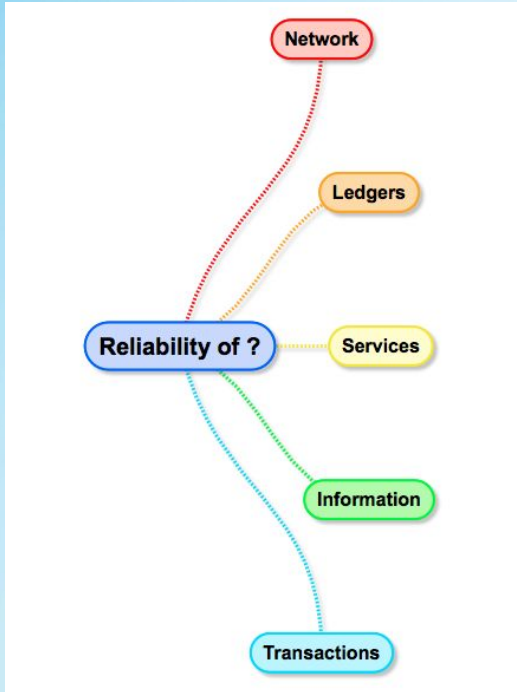


# Attack vectors as a reliability problem

- Blockchain networks age
  - New risks and attacks force changes.
  - Reality shifts from design and requirements.
  - All this impacts reliability.



# What is the meaning of reliability for blockchain?




- As complex systems, it is important to consider the reliability (and security) of all the elements of the system.
- Each of these elements of the overall system has importance toward the overall mission of the blockchain network.
- Not well managed, and the system will have unintended consequences, including runaway costs or catastrophic failures.

# What have we learned?

- Blockchains are networks of applications and functions
- Blockchains are designed for specific purposes
- Distributed ledgers are in use, built for a broad base of uses
- Blockchains create histories of transactions called distributed ledgers – how secure and reliable they are is designed according to the needs of the use case
- There is research being done that scratches the surface
  - Basic modeling for reliability and assurance
  - Nothing service specific being defined
  - Ripe for traditional approaches to be retuned to the new
- As complex systems, distributed ledger technology can borrow and build on our decades of knowledge for hardware, software, systems, and human reliability, with consideration to what is new
- Security and reliability must be designed into these systems, which means they must be purpose built, and design choices must be considered carefully!

# Thank You,

## For More Information Please Contact,

Blockchain.IEEE.org

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