Blockchain for Industrial Applications: use cases

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National Institute of Standards and Technology
U.S. Department of Commerce

Agenda

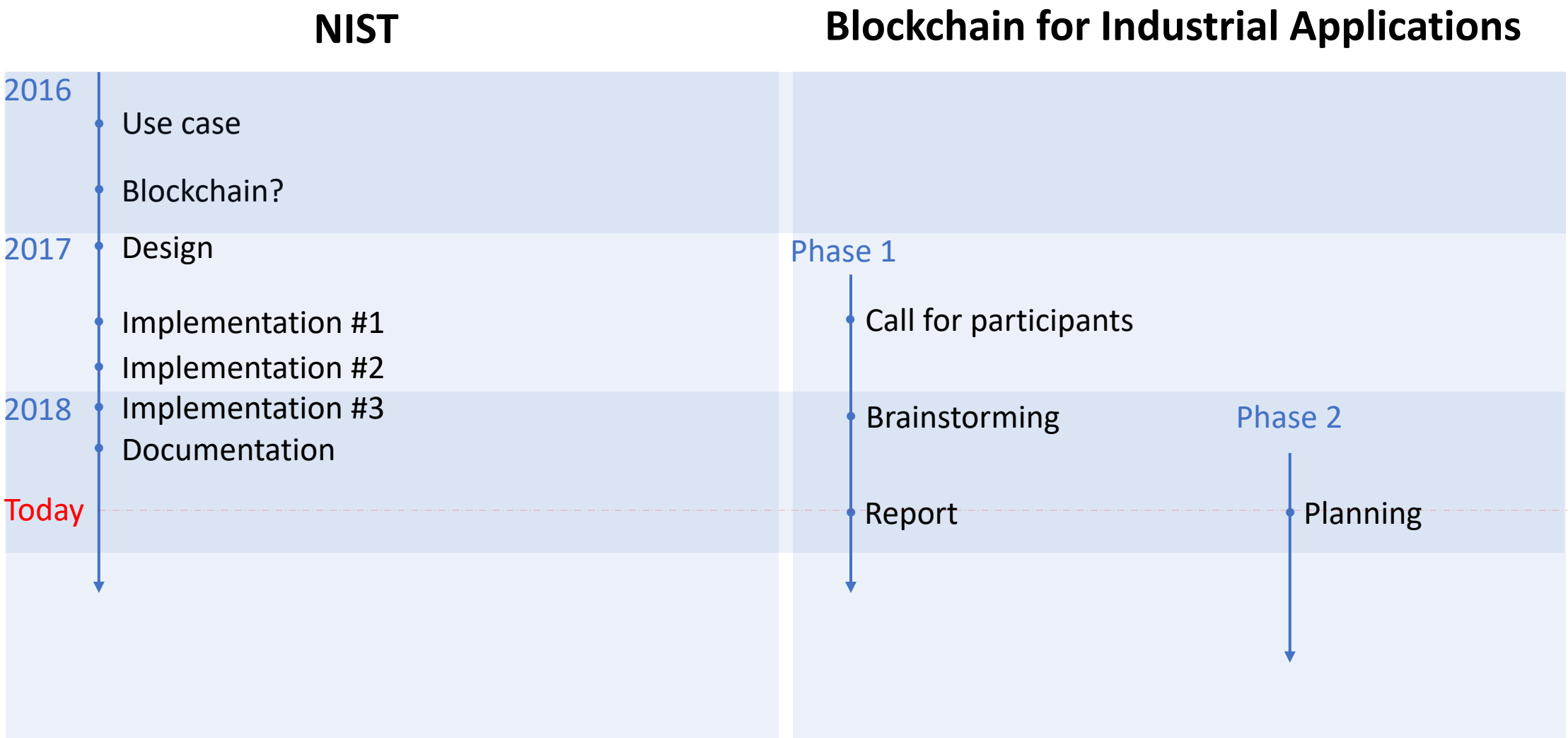
- Introduction
- Blockchain for Industrial Applications COI
- Securing the digital threat for smart manufacturing
- Lessons learned
- Next steps
- Conclusion

Introduction

- Blockchain is often believed to be limited to cryptocurrencies/finance
  - Popularity, visibility, good and bad rep
- Transactions/exchanges of physical and digital assets are omnipresent in a lot/most of industries
  - Manufactured goods
  - Food
  - Medications/pills
  - …
- Identify and explore these use cases
  - Can they benefit from using a blockchain-based solution?

Introduction

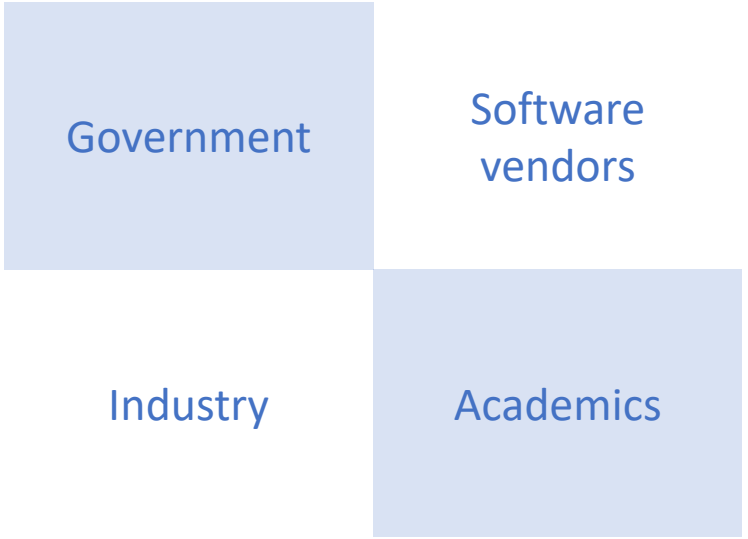
- Two parallel efforts



Blockchain for Industrial Applications COI

- Objectives:
  1. Identify and document industrial use cases
  2. Identify, document and tackle threats and challenges

- Open participation



Blockchain for Industrial Applications COI

Phase 1 looked at:

- Smart manufacturing and its digital thread
- Pharmaceutical supply chain
- Secure messaging
- Healthcare data management
- Resilient Vehicle-Infrastructure System
- Food traceability
- Information asymmetry

Securing the digital threat for smart manufacturing

- CIA triad security model

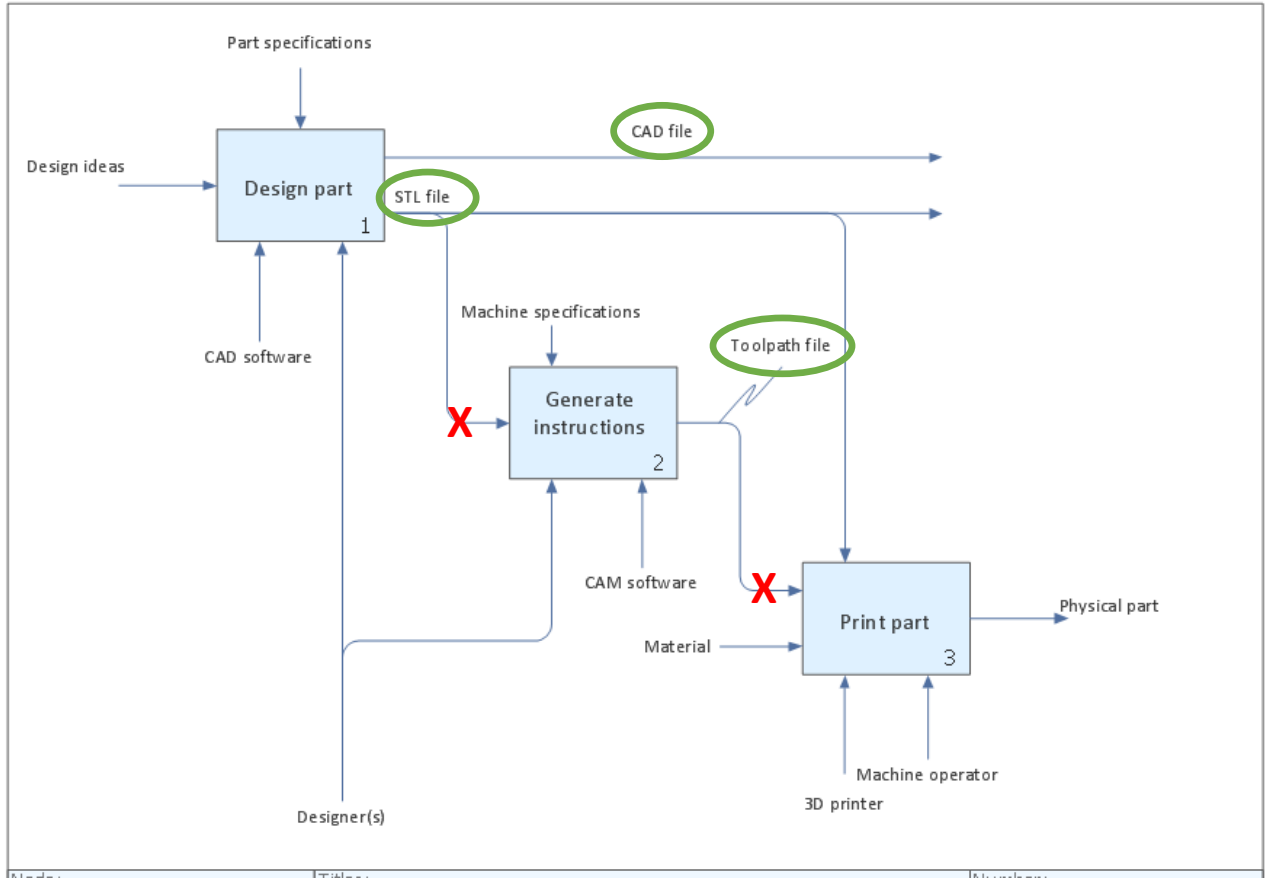
Prevent sensitive information from reaching the wrong people.

Maintain the consistency, accuracy, and trustworthiness of data over its life cycle.

Ensure that the information concerned is readily accessible to the authorized viewer at all times.

Securing the digital threat for smart manufacturing

- Additive manufacturing
  - Cheaper and often easier
  - Can “easily” be hacked
- Product data is key
  - Has the data been tampered with?
- Corrupted data can be catastrophic
  - Loss of revenue, customers …



Securing the digital threat for smart manufacturing

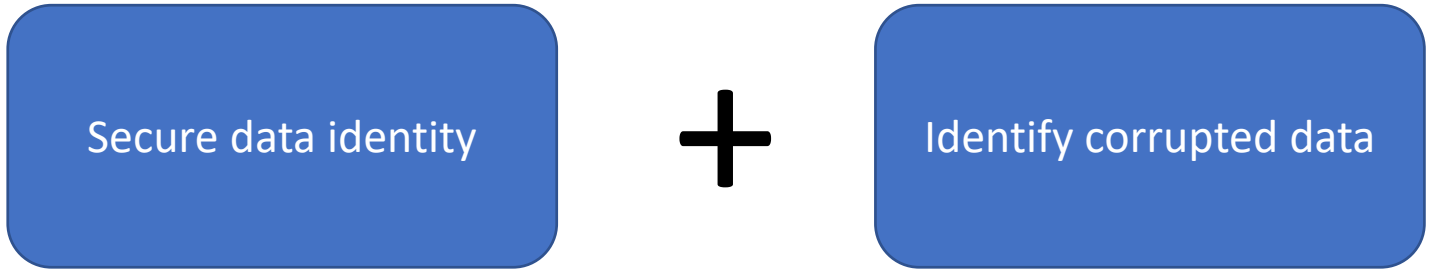
- Tampered data lead to faulty parts
  - Structurally weaker parts (failure)
  - Functionally different parts (physical hijack)
    - PCBs at risk in the future

- Cyber attacks often take time to be identified and fixed
  - In 2016, the Mean Time To Identify (MTTI) was 191 days[1]
  - In 2016, the Mean Time To Contain (MTTC) was 66 days[1]

[1] "2017 Cost of Data Breach Study: Global Overview" by IBM&Ponemon

Securing the digital threat for smart manufacturing

- The objective is to reduce the digital threat



Protect data fingerprints in a tampering-free environment

Trace data transactions between the different actors

Securing the digital threat for smart manufacturing

Secure data identity

(1) → **(2)** → **(3)**

Generate unique identifier for each data set/file

Generate metadata about the data set/file

Record information in the secure registry

Securing the digital threat for smart manufacturing

Identify corrupted data

(1) → **(2)** → **(3)**

Generate unique identifier for each data set/file exchanged

Query registry for the identifier

Retrieve source of corruption

Securing the digital threat for smart manufacturing

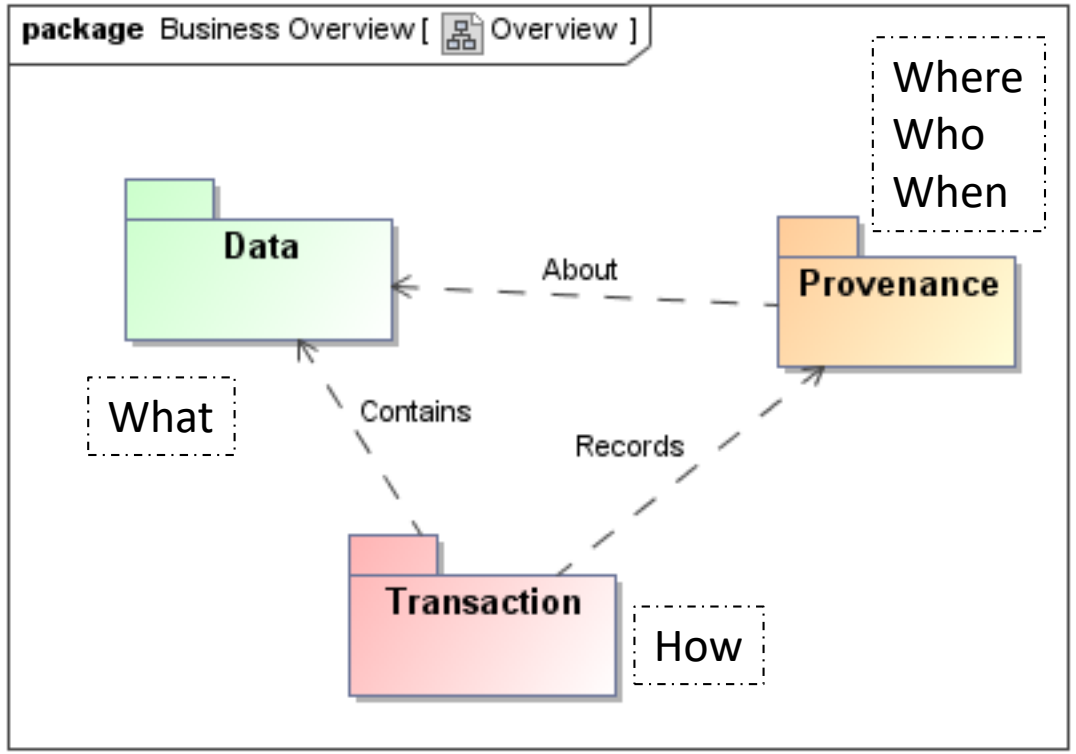
Why Blockchain?

- A replicated source of information that cannot be tampered
  - Secure: replication guarantees availability of the information
  - Trustworthy: data cannot be modified

- Data insertion is controlled by business rules randomly performed by nodes
  - Lack of single source of authority
  - Customizable to different scenario

Securing the digital threat for smart manufacturing

- A set of information (metadata) is required to enable data traceability and identify corrupted data and source(s) of corruption

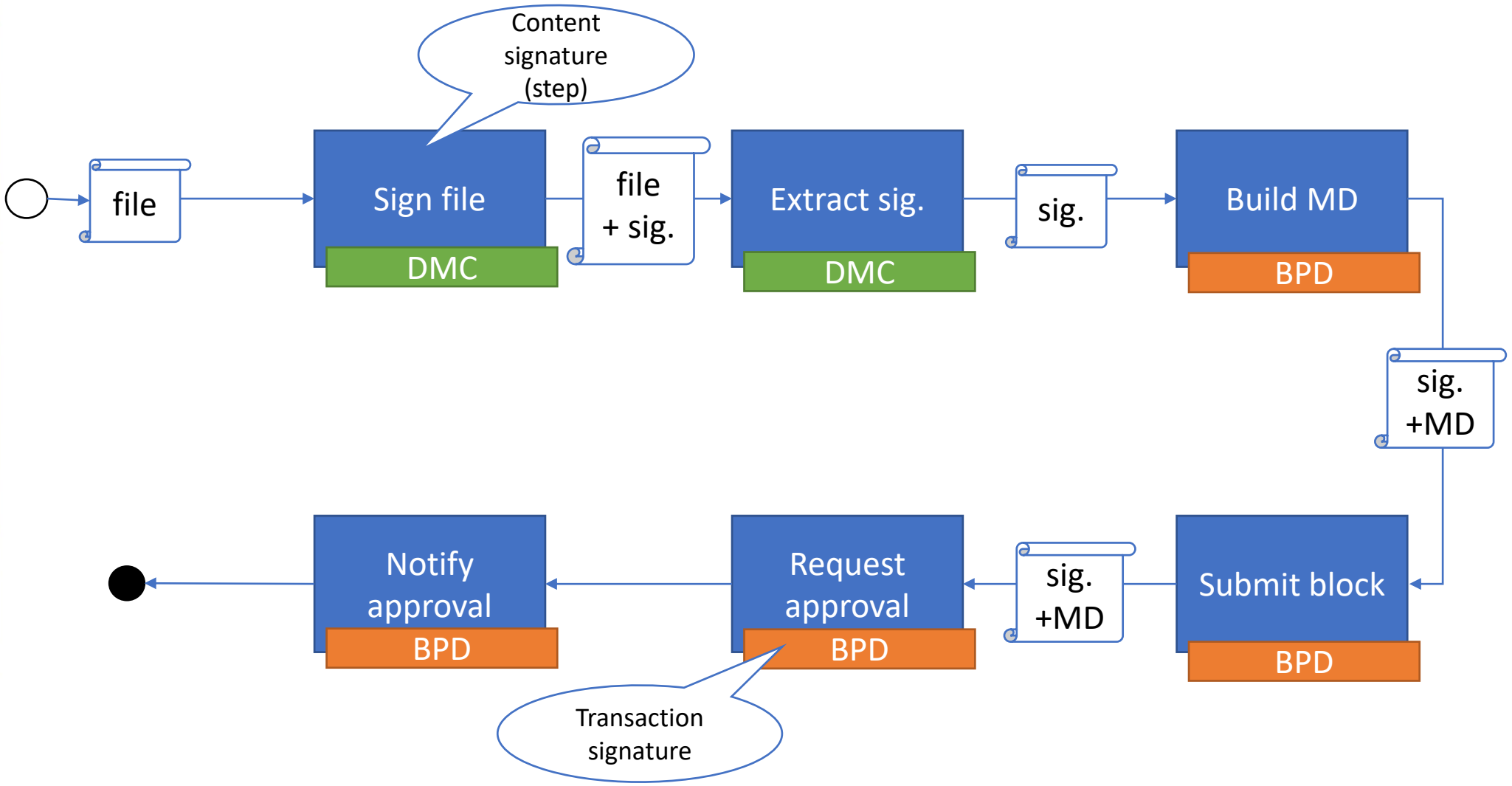


Securing the digital threat for smart manufacturing

Implementation

- Ethereum to implement the blockchain network
- Reuse of our Digital Manufacturing Certificate (DMC) toolkit
  - Generate data fingerprint
  - Digital sign data using software and hardware (PIV/CAC) X.509 certificates
- Development of a client application to record and retrieve data on the blockchain (web3.js)

Securing the digital threat for smart manufacturing



Lessons learned

Three main challenges to solve:

1. Lack of design patterns
2. Need for cross ledgers integration
3. Ledger evaluation

Lessons learned

1. Design patterns

- Different ways to represent data
  - Size of the information
  - Complexity of the data
  - Privacy policy and legal requirements …
- How to identify the best representation?
  - Smart contracts? Zero knowledge proof? …
- Map business requirements to technical features

Lessons learned

2. Cross ledgers integration

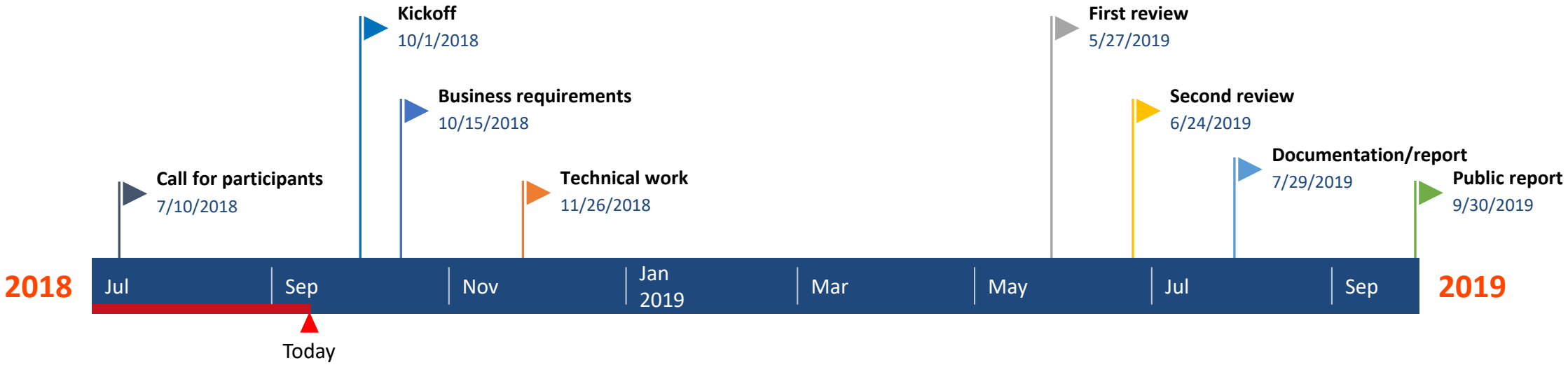
- Heterogeneity of data and transactions in some industries
  - Business data and processes
  - Engineering concepts
  - Financial transaction
  - Logistics …
- Complexity and globalization of the supply chain
  - Data silos organized by geographical regions
- Vertical and industry-specific blockchains need to be integrated to support full lifecycle traceability

Lessons learned

3. Ledger evaluation

- New ledgers/blockchains are flooding the market
- How to pick the right one for your project?
  - This needs to be addressed during the design phase
- Map business requirements to technical features
  - E.g., what design pattern(s) do I need?

Next steps


Kickoff
10/1/2018
Business requirements
10/15/2018
Technical work
11/26/2018
First review
5/27/2019
Second review
6/24/2019
Documentation/report
7/29/2019
Public report
9/30/2019
Call for participants
7/10/2018
2018
Jul
Sep
Nov
Jan
2019
Mar
May
Jul
Sep
2019
Today

Conclusion

- Blockchain is not limited to cryptocurrencies and financial applications
- There are key challenges to solve
- It is not too late to join us

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