STIMSON

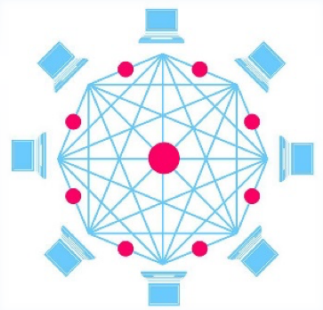
Prospect of Blockchain to Strengthen Nuclear Security

Lovely Umayam & Cindy Vestergaard
10 February 2020
IAEA - ICONS

Release: PNNL-SA-150314

STIMSON

What is “blockchain” ?



Distributed-ledger technology (DLT)
is the use of replicated, synchronised data shared across multiple ‘nodes’ to track the transaction of assets. Blockchain is a subset of DLT.

PUBLIC
anyone can join;
vast amount of
stakeholders

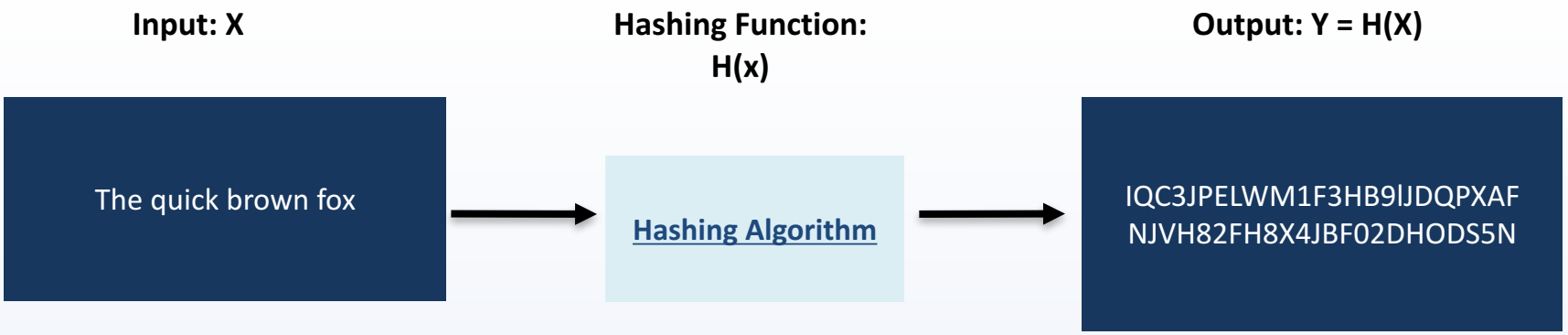
vs.

PRIVATE
select stakeholders;
“permissioned”

Release: PNNL-SA-150314

STIMSON

A Simplified Explanation: Building a "trust machine"



Understanding blockchain requires understanding hashing algorithms

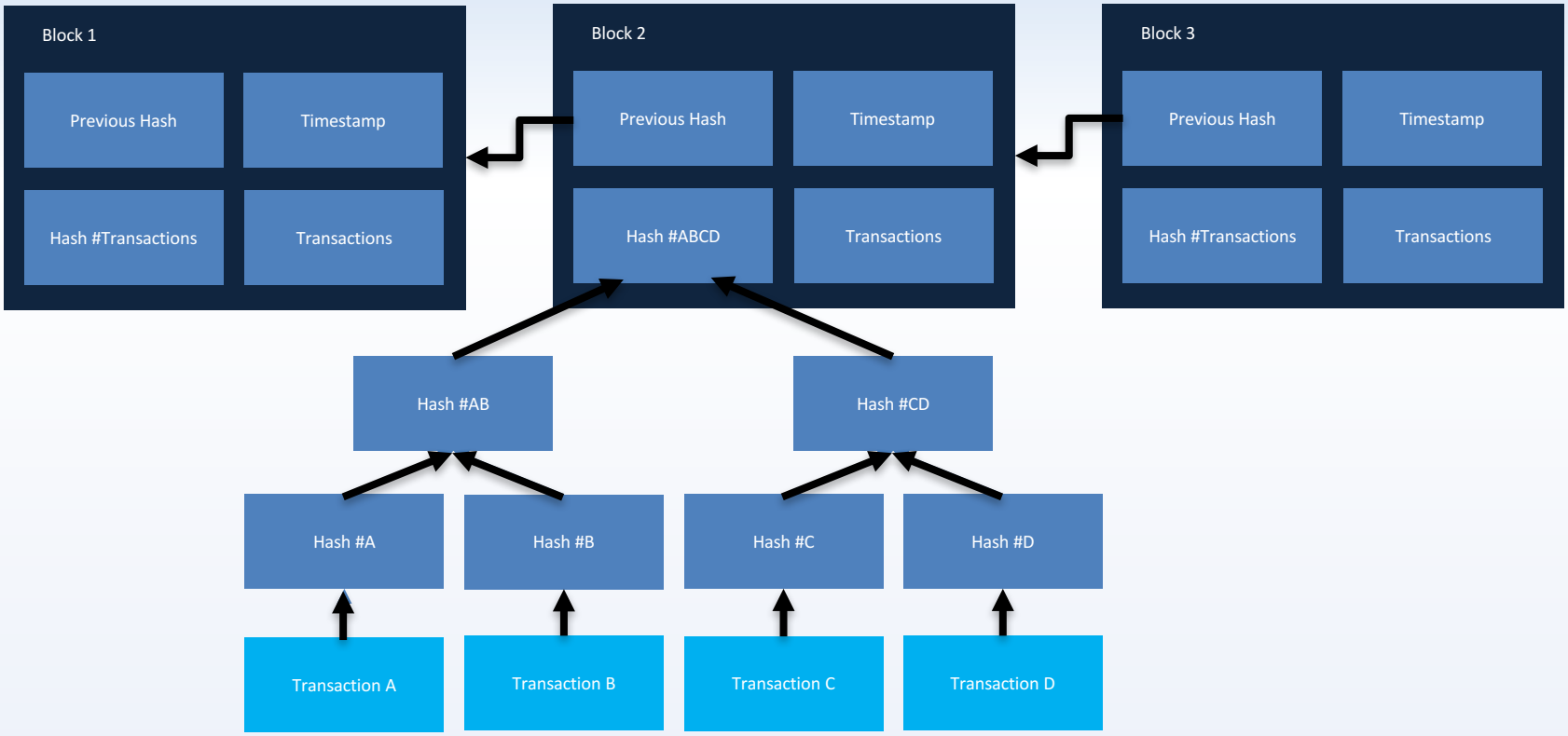
A Hashing Algorithm is a mathematical function which takes an input and generates a 'hashed' output

It is extremely difficult to reverse engineer the input from the output

Release: PNNL-SA-150314

STIMSON

Blockchain Immutability - I



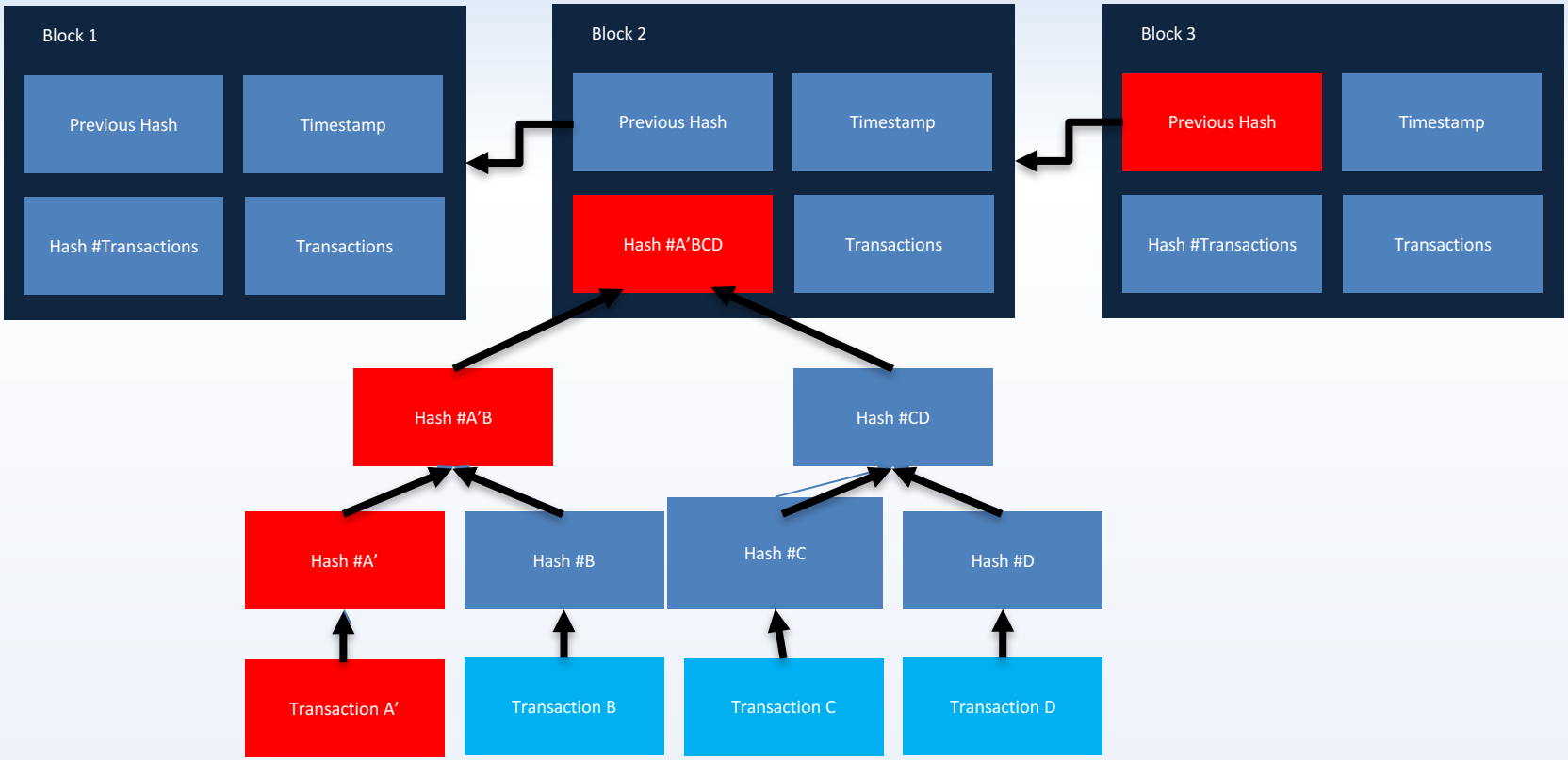
A blockchain is made up of multiple blocks linked together (hence 'blockchain')

Each block is a collection of transactions as well as certain pieces of metadata, including **a hash of the transactions within it and a hash of the previous block**

Release: PNNL-SA-150314

STIMSON

Blockchain Immutability - II



If someone tried to modify Transaction A to Transaction A', Block 2 will instead store #A'BCD

Block 2 will no longer correspond with the previous hash stored in Block 3

Release: PNNL-SA-150314

STIMSON

Nuclear Security at the Technological Frontier

Physical protection
computer security

PERIMETER-CENTRIC

Self-interrogating systems?
Proactive approach?

PERIMETER-LESS

UPHOLD A-CPPNM FUNDAMENDTAL PRINCIPLES

F- Security Culture; I - Defense in Depth;
J - Quality Assurance; L - Confidentiality

What are some potential pathways?

Release: PNNL-SA-150314

STIMSON

Insider Threat Mitigation

DLT Application

- Monitoring activities related to personnel, operations, documents and data
- Pairing DLT with “Internet of Things” (IoT)
- Firmware transparency: Validating data provenance (source code?), as seen in other sectors in the context of video / image editing

Release: PNNL-SA-150314

Transport Security

DLT Application

- Providing fidelity of tracking spent nuclear materials (or other sensitive assets in transit) by:
  - Streamlining transactions that could potentially provide information on all locations during transport in real-time
  - Paired with IoT: capturing conditions of immediate environment for additional layer of data / analysis of risk

Release: PNNL-SA-150314

STIMSON

Nuclear Material Accounting and Control (NMAC)

DLT Application

- Streamline and secure accounting information
- Improve information sharing across appropriate stakeholders and transparency among actors
- Mitigate threats (e.g. data manipulation)
- Potential applications to material in transit
- Customizable interface showing “where/what/when” of a product in a moment of time

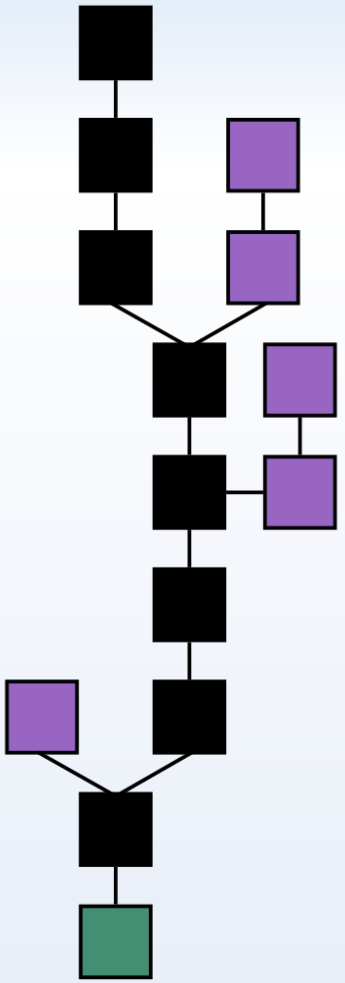
Release: PNNL-SA-150314

STIMSON

Key Takeaways

DLT has the potential to…

- Monitor and verify data related to personnel, operations, and documents
- Build trust among skeptical parties and improve information sharing
- Implement self-interrogating systems to drive accountability



But questions remain…

- Costs?
- Are there existing low-tech applications?
- Sustainability?

Release: PNNL-SA-150314

STIMSON

STIMSON

Blockchain Lunchtime Event

13 Feb - VCDNP
12:30

CONTACTS

lumayam@stimson.org
cvestergaard@stimson.org

This research is supported by the
U.S. Department of Energy – National Nuclear Security Administration

STIMSON