



Survey On Convergence Of Blockchain With IoT

Group 16
Abdullah & Osama



Agenda

- Introduction
- B-IoT Overview
- B-IoT Deployment
- B-IoT Applications In Different Industries
- Discussion & Conclusion

Research Questions

- RQ#1: What are the challenges of adopting Blockchain with IoT?
- RQ#2: What is the convergence feasibility of B-IoT in different industry?



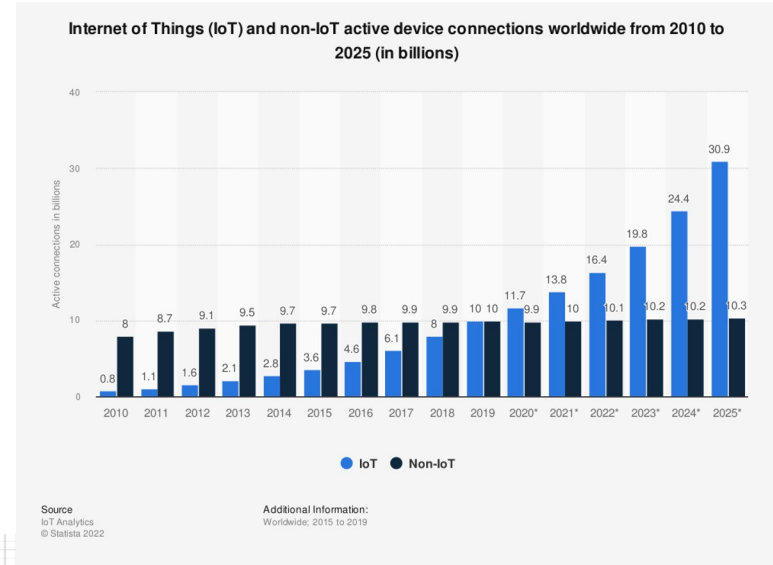


Introduction



What is Internet Of Things (IoT)?

The total installed base of **Internet of Things (IoT)** connected devices worldwide is projected to amount to 30.9 billion units by 2025, a sharp jump from the 13.8 billion units that are expected in 2021.



What is Internet Of Things (IoT)?

IoT System Layers:

3 Application Layer



2 Network Layer



1 Perception Layer



IoT Systems General Challenges

1. **Security & Privacy Vulnerabilities:** IoT devices usually are associated with Increased risk of data breaches and impersonations
2. **Traceability & Reliability of Data:** Managing IoT devices communication and status is complex and hard to verify
3. **Difficult to Automate IoT Interactions:** Direct ratio of number of IoT devices with interaction complexity



B-IoT

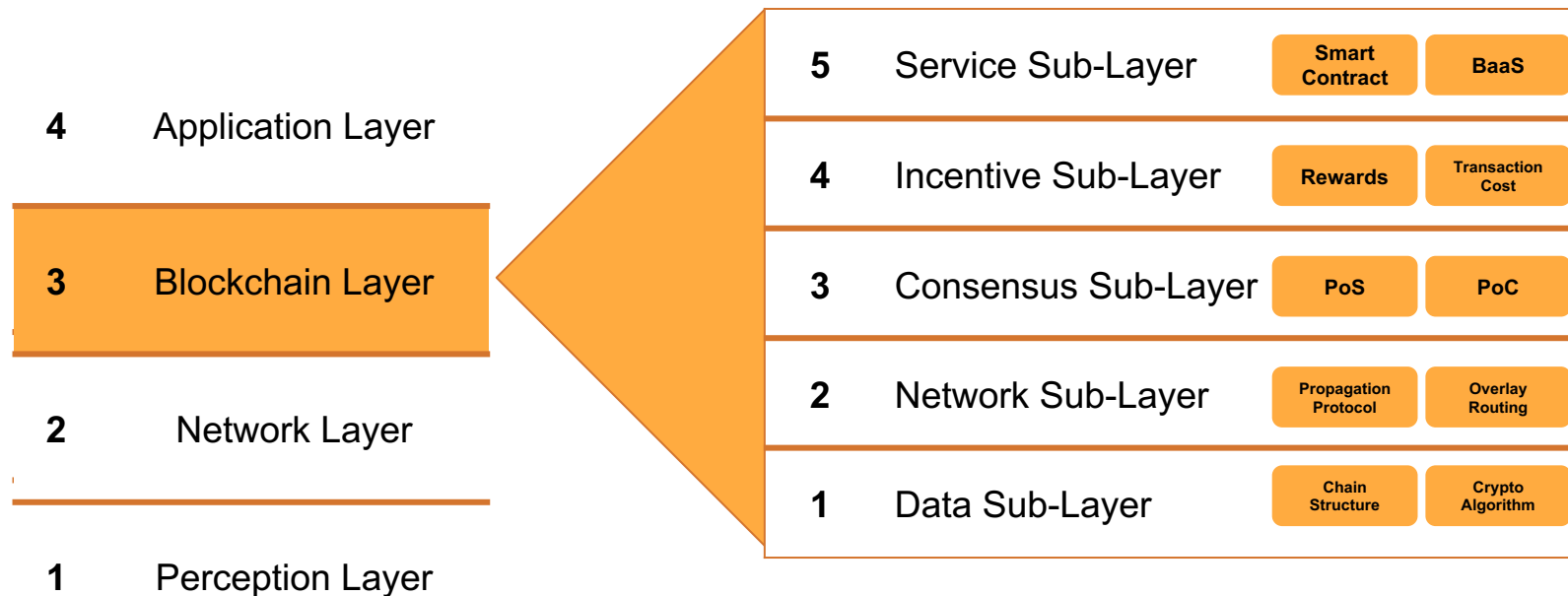


Introduction to B-IoT

- Blockchain IoT enables IoT devices to send data to create tamper resistant records of shared transactions.
- Provides an immutable records of transactions without the need for central control and management.



Introduction to B-IoT



Addressing IoT Challenges With Blockchain

Traditional IoT Systems	B-IoT Systems
Security & Privacy Vulnerabilities	Blockchain Cryptographic Algorithms and Consensus Mechanisms
Traceability & Reliability of Data	Blockchain Immutability
Difficult to Automate IoT Interactions	Smart Contracts

Deployment Of B-IoT: Challenges

- **Limited Resource Capability:**

- Cannot handle heavy mining process (ex. PoW)
- Limited data encryption capabilities
- Data storage scalability

- **Difficulty in Scalability:**

- IoT networks require continuous changes
- Some consensus mechanisms (ex. PBFT) require fixed-size number of nodes

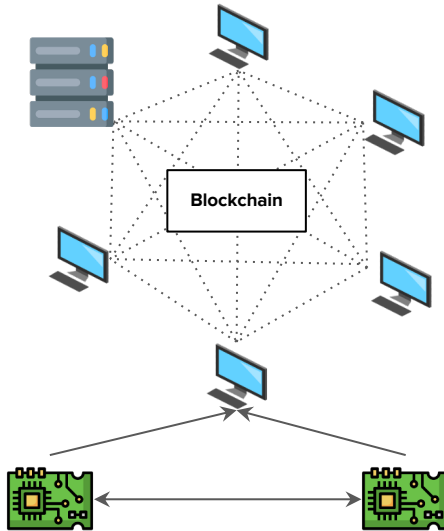
Deployment Of B-IoT: Consensus in B-IoT

- PoW requires high computing and storage capabilities that are not usually found in IoT devices

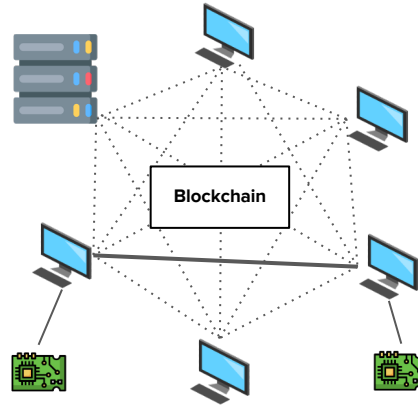
Characteristics	B-IoT System	Consensus
High Energy Efficiency	Helium	Proof-of-Coverage
	Ambrosus	Proof-of-Authority
Lightweight Mechanism	Blockcloud	Proof-of-Service
	WaltonChain	WaltonChain Proof-of-Contribution

Deployment Of B-IoT: Communication Architecture

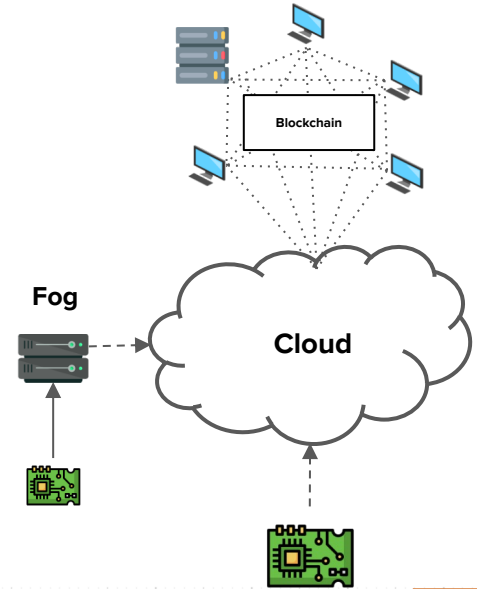
Direct IoT Communication



Blockchain Communication



Cloud/Fog Communication



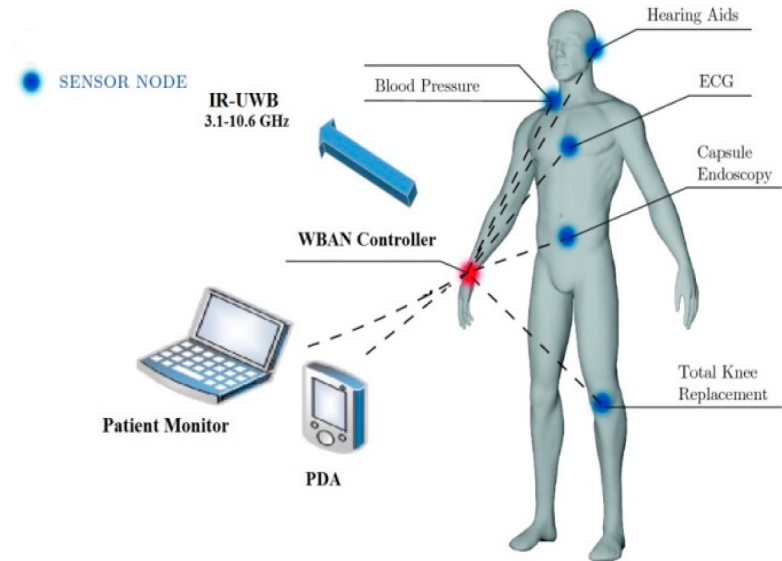


B-IoT Application In Industry



Application In Healthcare

- Wireless Body Area Networks Issue:
 - Privacy Concerns
 - Reliability of logged information
 - Data trust



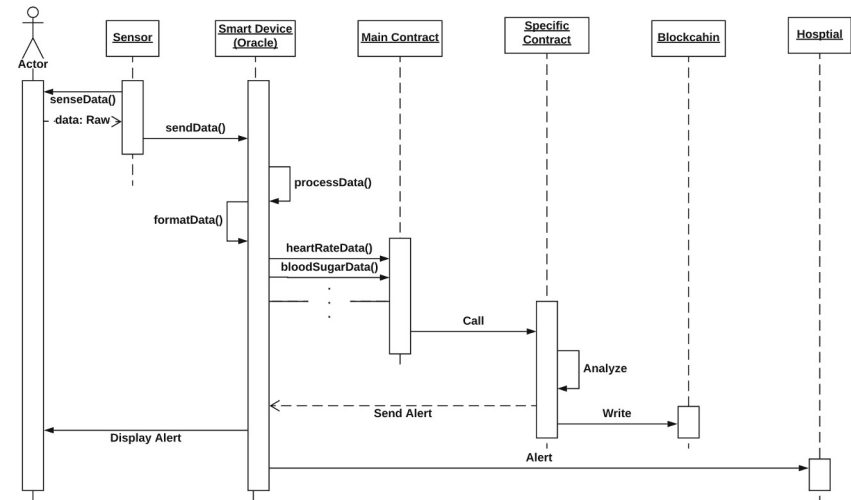
Application In Healthcare

- Proposed Solution:

- Collect patient readings and store them in an immutable ledger
- Leverage smart contracts to automate privacy-preserving functions

- Blockchain Design:

- Consensus used PBFT
- IBM Hyperledger
- SmartContract (using Solidity)



Griggs, Kristen N., et al. "Healthcare blockchain system using smart contracts for secure automated remote patient monitoring." *Journal of medical systems* 42 (2018): 1-7.

Application In Healthcare - A Comparison

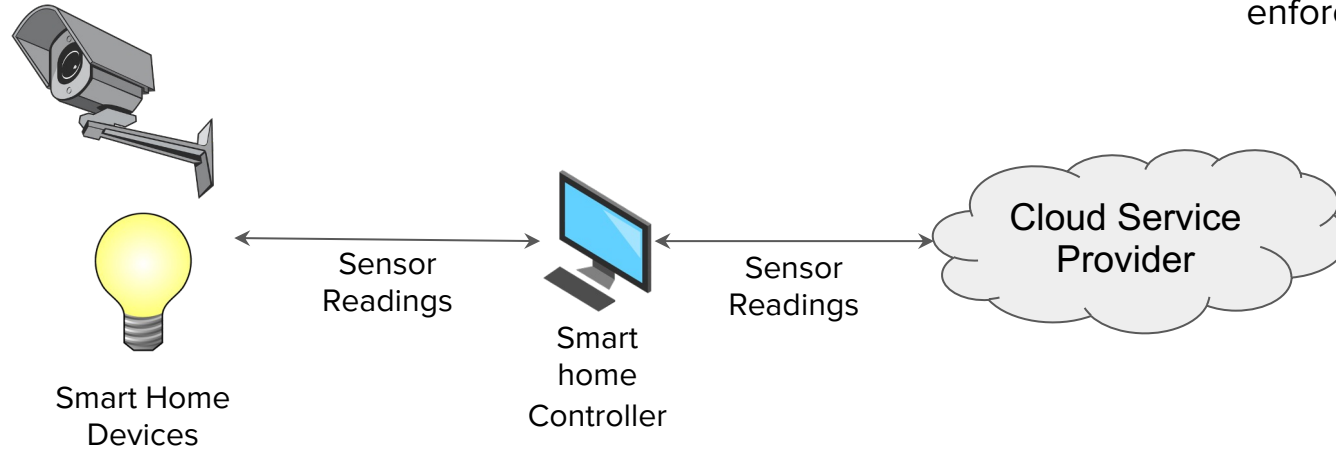
Traditional Method	B-IoT
Lack of reliable data recovery	Data is stored within the Blockchain and shared between nodes.
Prone to accidental data manipulation	Data is immutable
Transaction speeds are limited by the network bandwidth (Usually Fast)	Transactions speeds are limited by the processing time of smart contract and the network bandwidth (Usually Slow)
Single-point of failure	Distributed design

Application in Smart home

- Smart home IoT systems suffers from security vulnerabilities, especially when they are connected to the cloud
- To achieve a secure and reliable smart home system:
 - Recorded transactions must be immutable for traceability
 - Sensor readings must be protected from unauthorized access
 - The system can handle large number of readings



Application in Smart home

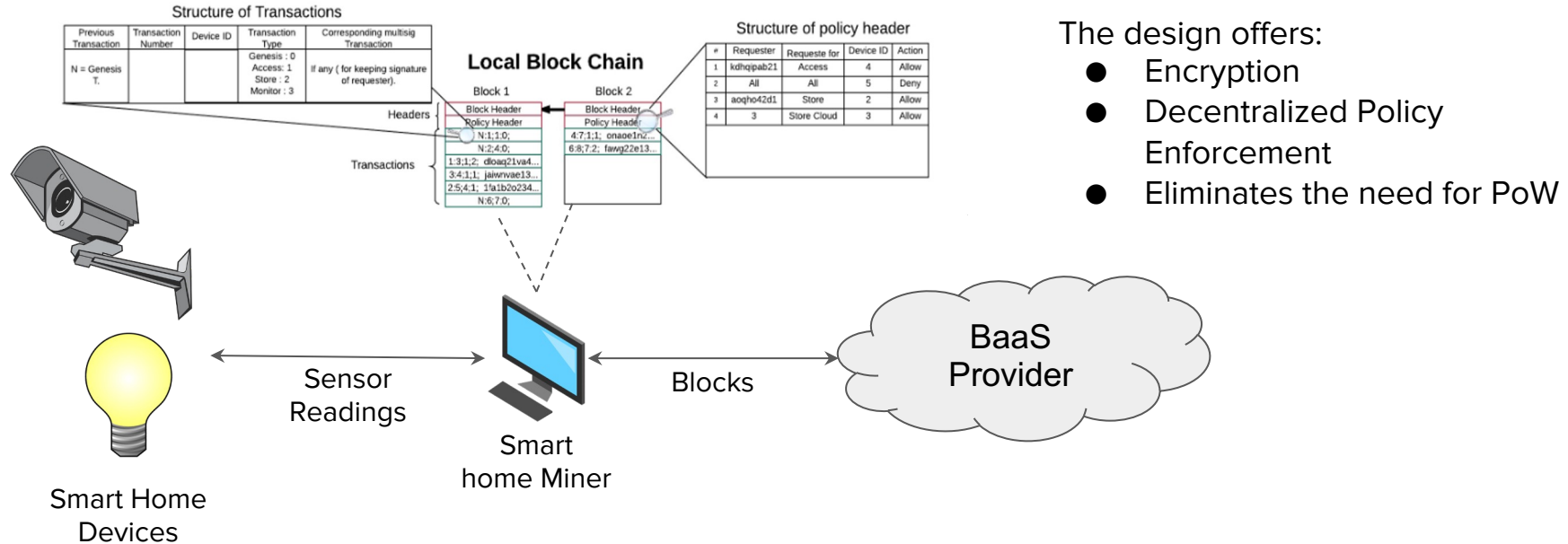


Limitations:

- Unsecure data transmissions
- Central controller for policy enforcement

Dorri, S. S. Kanhere, R. Jurdak and P. Gauravaram, "Blockchain for IoT security and privacy: The case study of a smart home," 2017 IEEE International Conference on Pervasive Computing and Communications Workshops (PerCom Workshops)

Application in Smart home

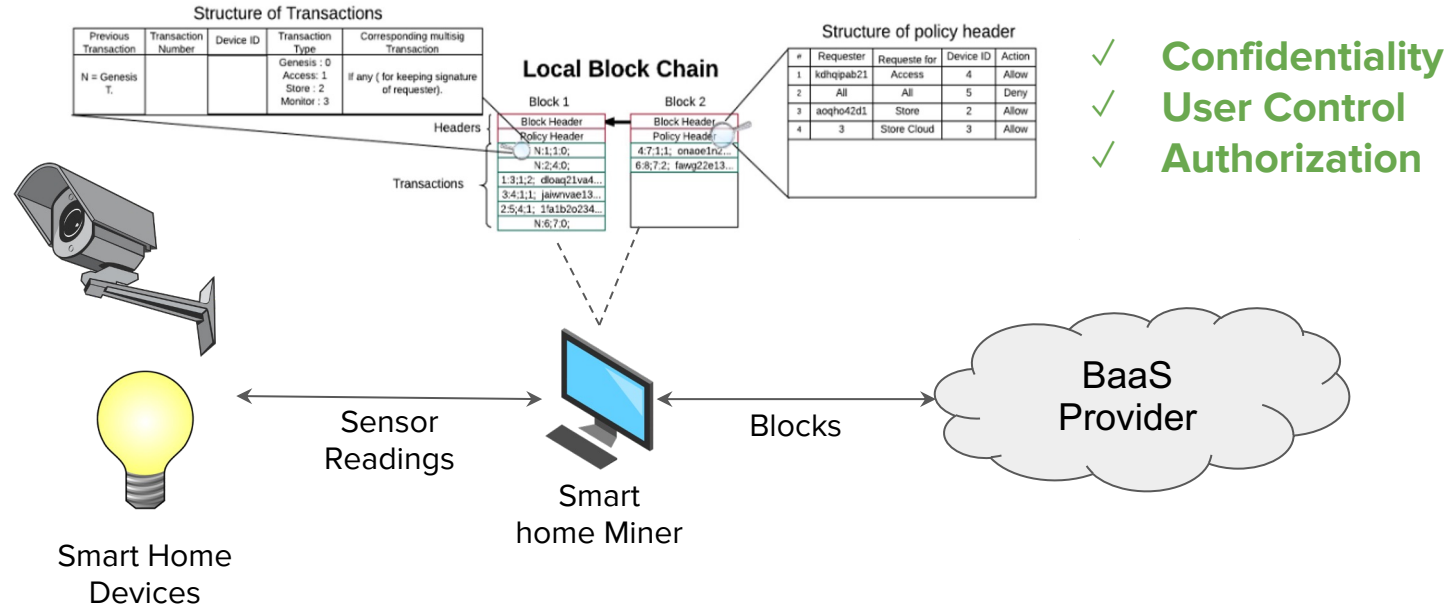


The design offers:

- Encryption
- Decentralized Policy Enforcement
- Eliminates the need for PoW

Dorri, S. S. Kanhere, R. Jurdak and P. Gauravaram, "Blockchain for IoT security and privacy: The case study of a smart home," 2017 IEEE International Conference on Pervasive Computing and Communications Workshops (PerCom Workshops)

Application in Smart home



**Packet
Overhead
Performance
Overhead**

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Discussion & Conclusion

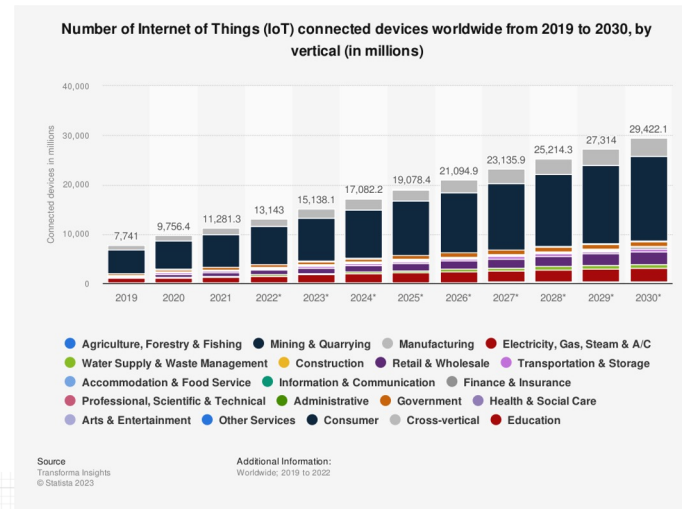


Research Question (Answered)

- RQ#1: What are the challenges of adopting Blockchain with IoT?
 - Limited resource capabilities
 - Lightweight consensus mechanisms
 - Different B-IoT communication architectures
 - Difficulties in scalability
 - Adopt more scalable consensus algorithms
 - Leverage private blockchains for large IoT systems (for more scalability)

Research Question (Answered)

- RQ#2: What is the convergence feasibility of B-IoT in different industries?
 - Multiple Application in many industries
 - “The consumer sector is anticipated to dominate in terms of number of *Internet of Things (IoT)* connected devices in 2030, with 17 billion connected devices worldwide.”





Questions & Answers

