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Enhance IoT System Performance with Blockchain: An Overview

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Topics

- IoT - Overview
- Blockchain - Overview
- Merge IoT with Blockchain: How
- Merge IoT with Blockchain: Benefits
- Current Research

IoT – Overview

- Connected Things
- Smart Things
- What IoT Brings to Us:
  - ✓ Efficiency
  - ✓ Effectiveness
  - ✓ Convenience
  - ✓ Comfort

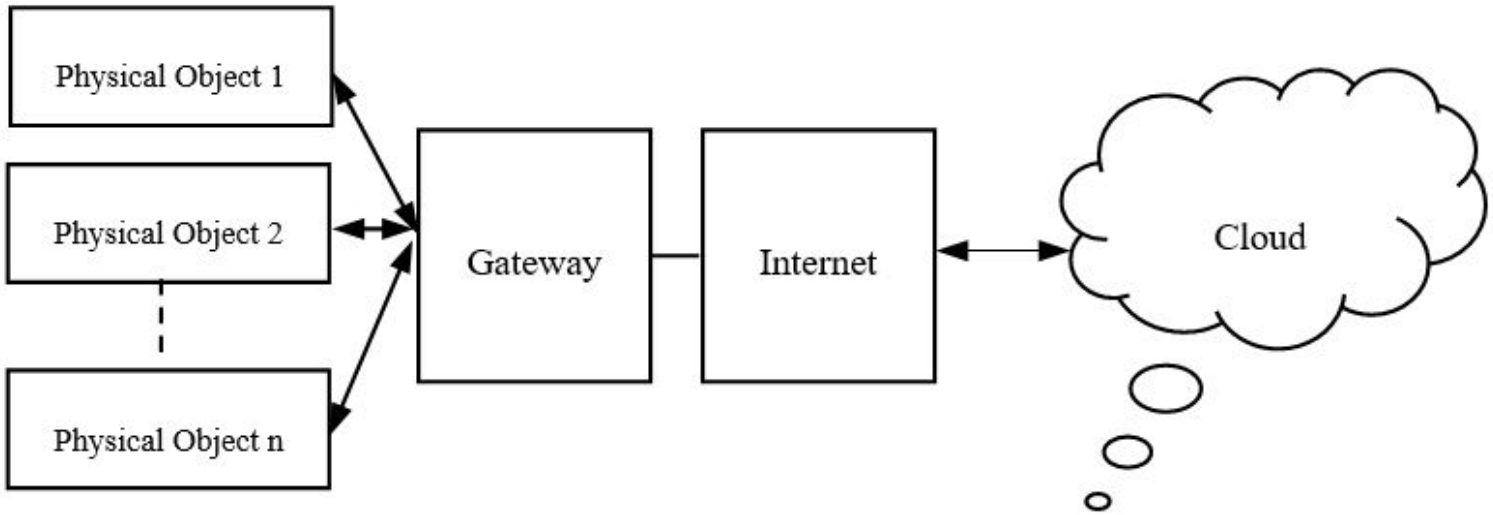
IoT for manufacturing: Survey by American Society for Quality (ASQ):

- 82% rise efficiency
- 49% decrease in product defects
- 45% increase in customer satisfaction

The Department of Energy reports

- IoT can reduce a customer's monthly energy costs by 30% on average
- Note: HVAC accounts for 42% of Americans' utility bills

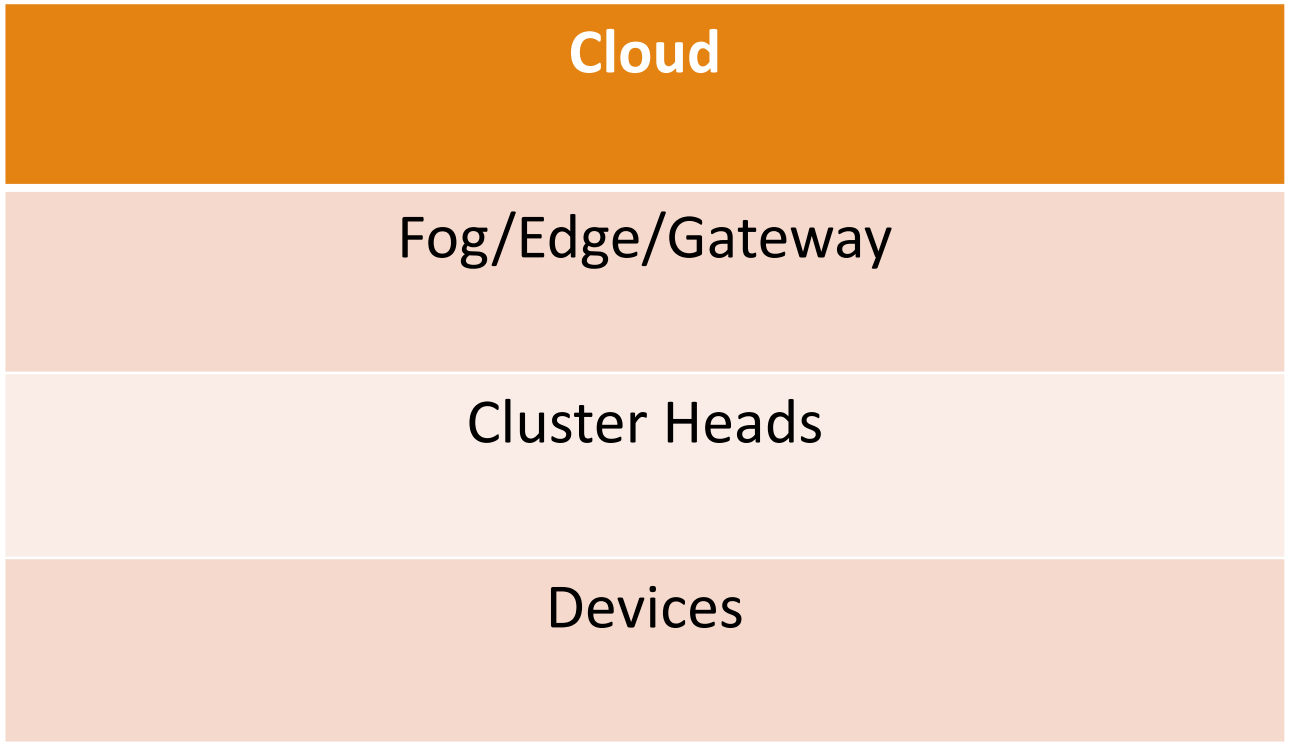
IoT – Architecture View 1



Typically found in

- Smart homes

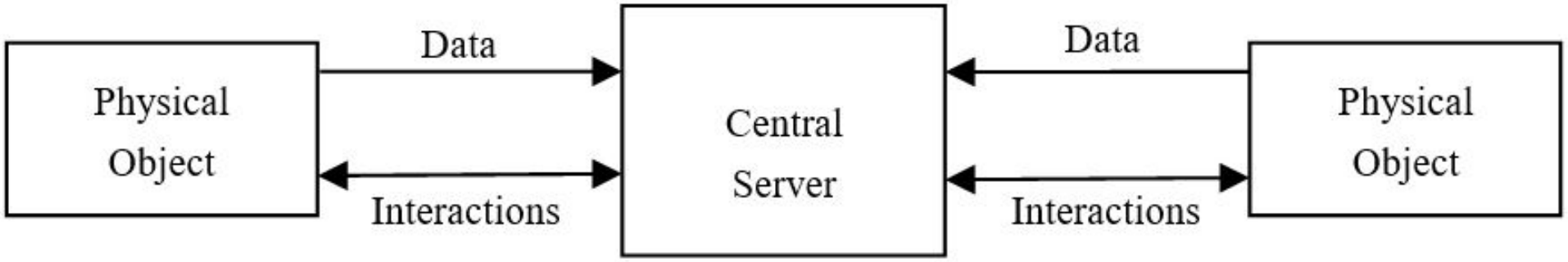
IoT – Architecture View 2



Typically found in

- Smart buildings
- Smart cities

IoT – Architecture View 3



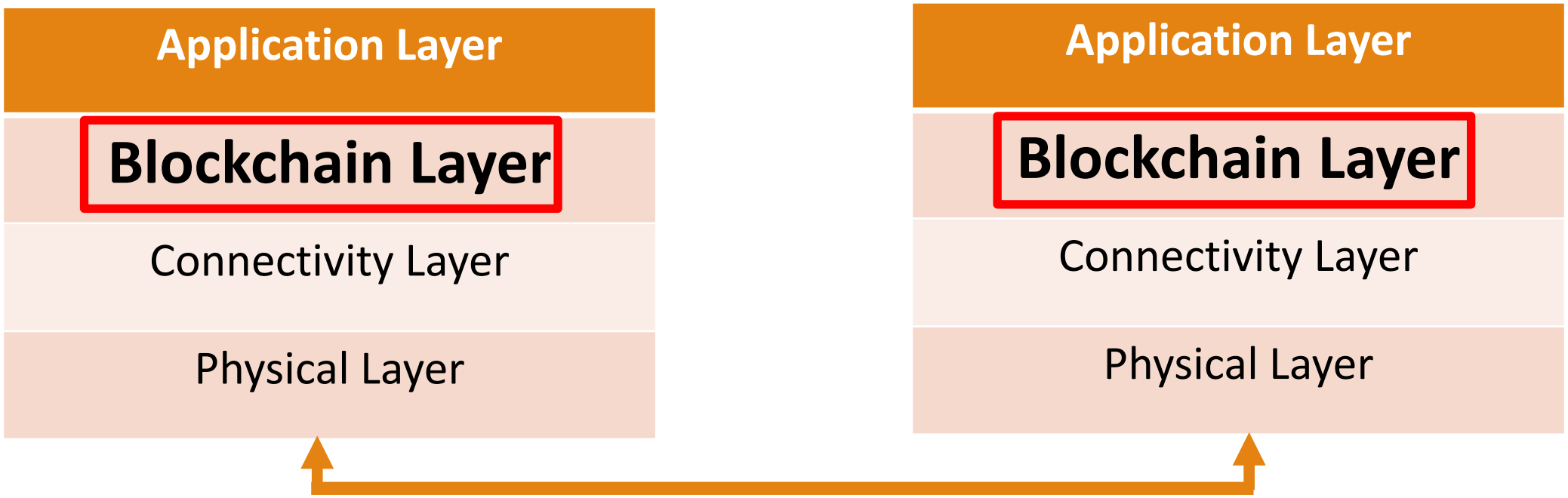
The data communication and interactive control perspective:

- Data sensing and monitoring (e.g. Google Home; environmental applications)
- Automatic system control (e.g. HVAC systems, industrial IoT)

Blockchain - Overview

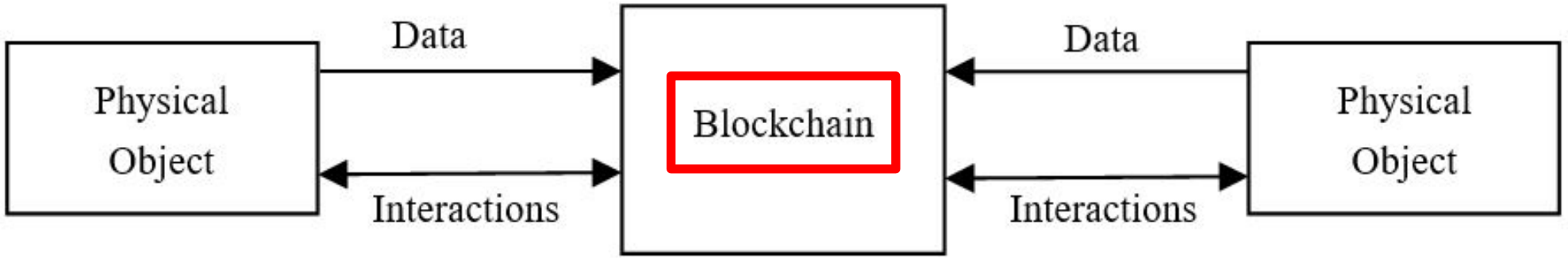
- **Chained** Data Blocks
- **Distributed** Ledger
- **Encrypted** Data
- Data **Immutability**
- Data **Traceability**
- **Consensus** Algorithms

Merge IoT with Blockchain: How (1)



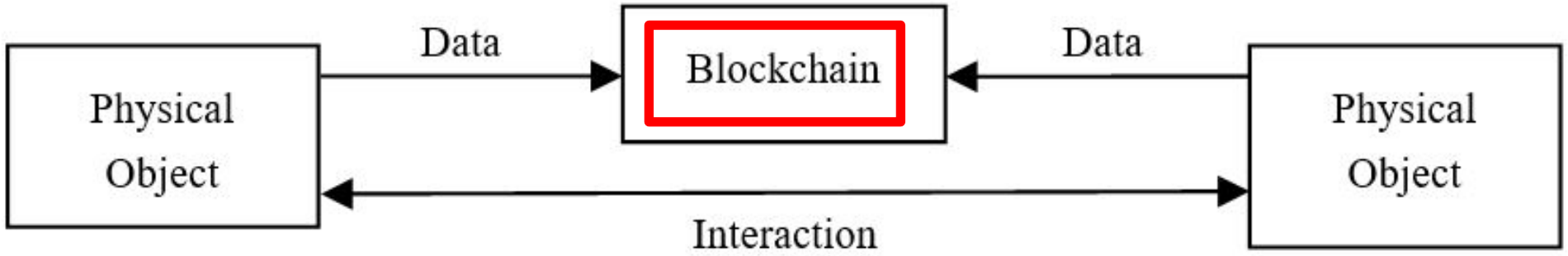
- **General computer networking perspective**
- **Blockchain sits between application layer and connectivity layer**
- **All application data are secured by the Blockchain**

Merge IoT with Blockchain: How (2)



- **Industrial IoT / control system perspective**
- **Blockchain secures both sensor data and control commands**
- **Suitable for both data and control links are wireless**
- **More demanding for data processing capability, and real-time responsiveness**

Merge IoT with Blockchain: How (3)



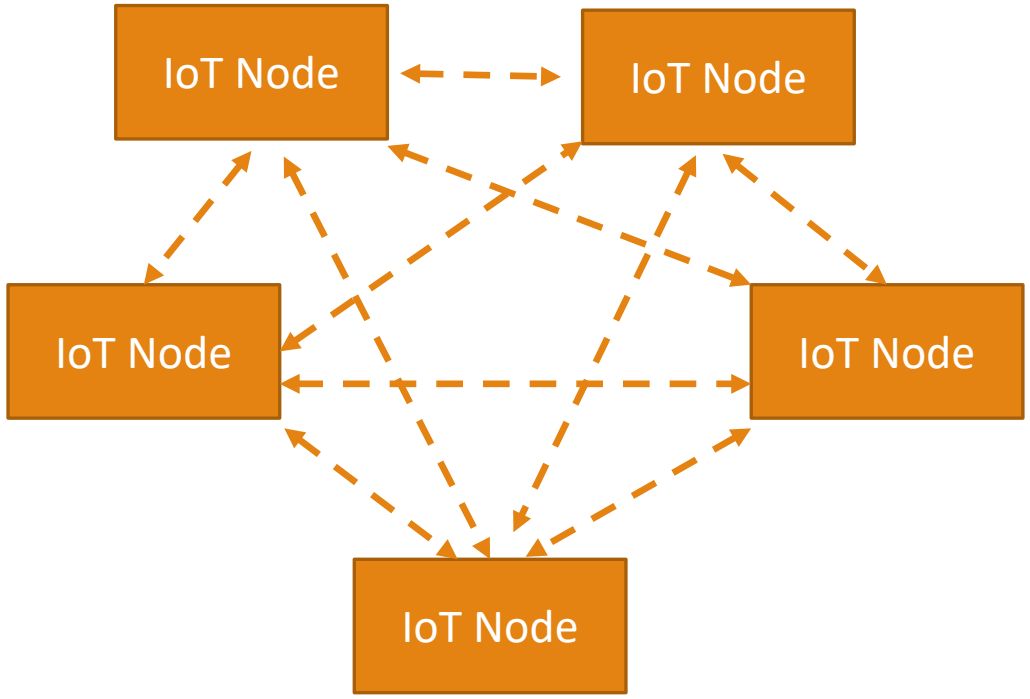
- **Industrial IoT / control system perspective**
- **Blockchain secures sensor data only**
- **Suitable for wireless data link and wired control link**
- **Real-time control responsiveness not impacted by Blockchain**

Merge IoT with Blockchain: How (4)

- **Pieces of Blockchain Ideas** Applied to Different Parts of IoT System
  - Only encrypt data? Data validation only? Consensus for selected parts?
- **Multiple Chains**
  - Different chains for different parts of a system?
- **Coordinated Defence**
  - Consensus applied to system data contributors to prevent the “bad ones”

Merge IoT with Blockchain: How (5)

Distributed Implementation Perspective:



- **A node is a "Thing"**
- **Every node has a copy of the ledger**
- **Validation mechanism built into node**
- **All nodes participate in Consensus process**

Merge IoT with Blockchain: Benefits

- Enhanced Data Integrity
- Enhanced System Security
- Enhanced System Defence
- Enhanced System Reliability

Current Research

- Response Time
- Data Storage
- Consensus Algorithms
- Device Level Implementations
- Application Domains

References

1. How Internet of Things Improves the Industrial Efficiency in Manufacturing Sector? https://toptechpublisher.com/how-iot-improves-industrial-efficiency/

2. Internet of Things Improves HVAC Efficiency and Effectiveness https://www.achrnews.com/articles/143912-internet-of-things-improves-hvac-efficiency-and-effectiveness

3. Reyna et al, On Blockchain and its integration with IoT, Challenges and Opportunities. *Future Generation Computer Systems*, 88, 173–190 (2018).

4. Ali Dorri et al: Blockchain for IoT security and privacy: The case study of a smart home, 2017 *IEEE International Conference on Pervasive Computing and Communications Workshops.*

And more ……