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# Internet of Hyperconnected Things

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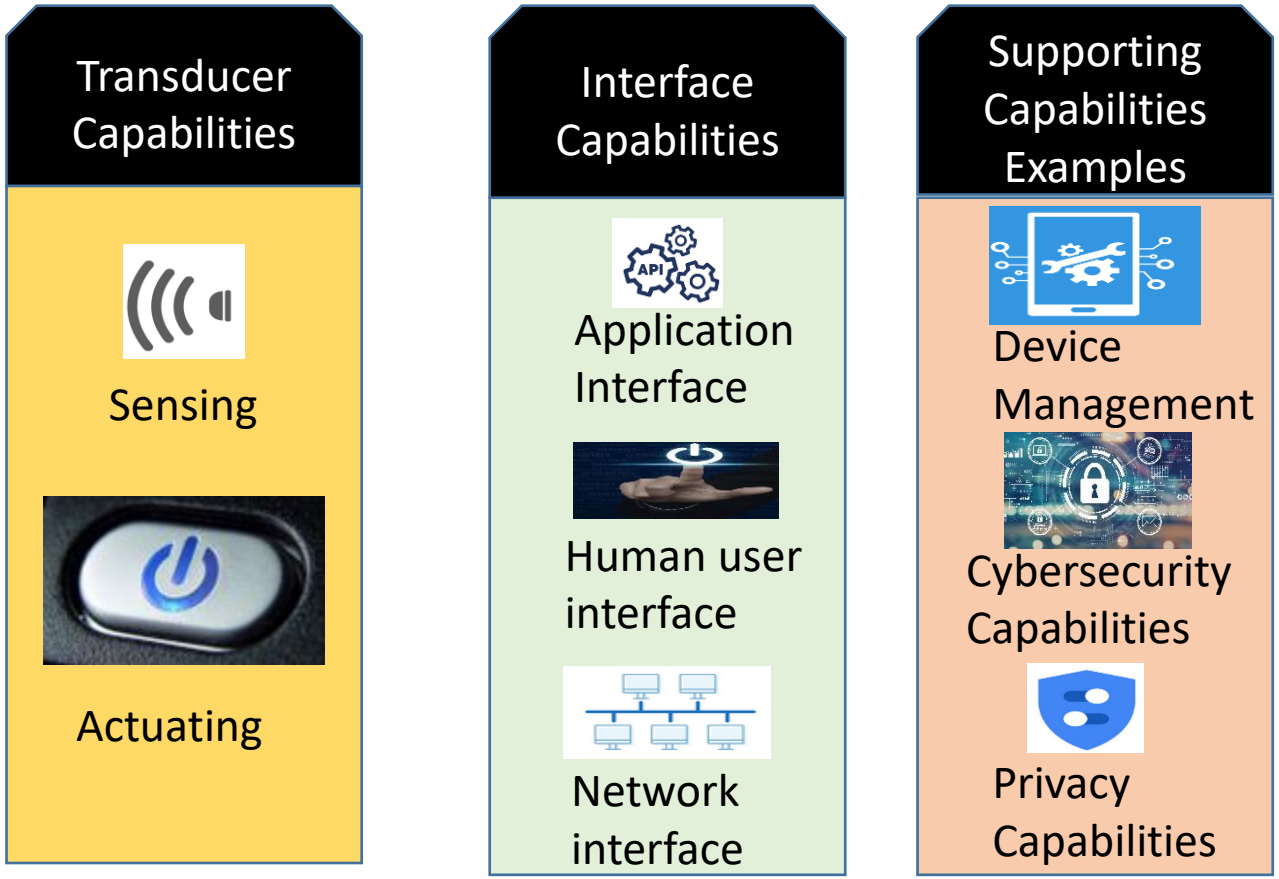
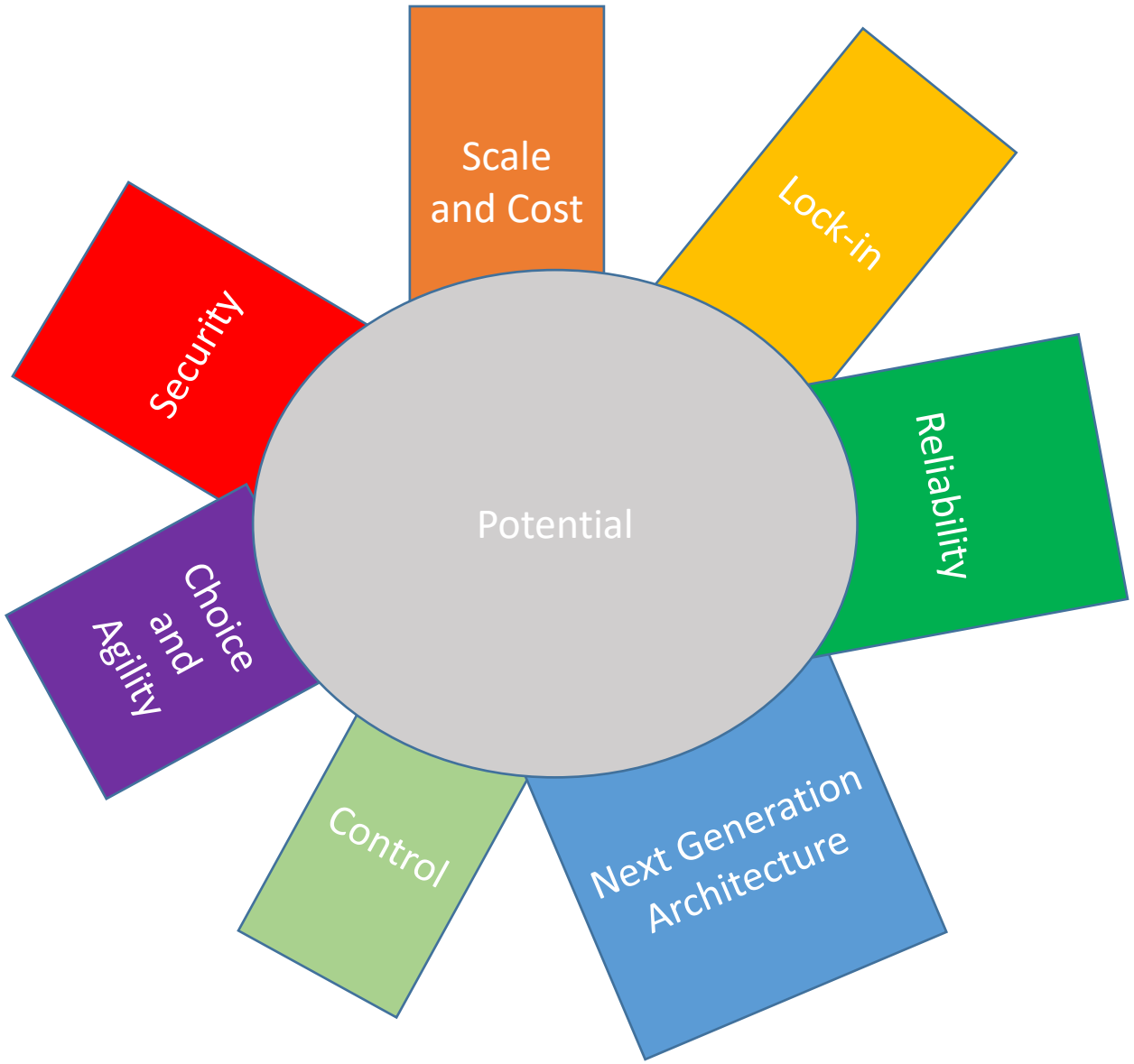
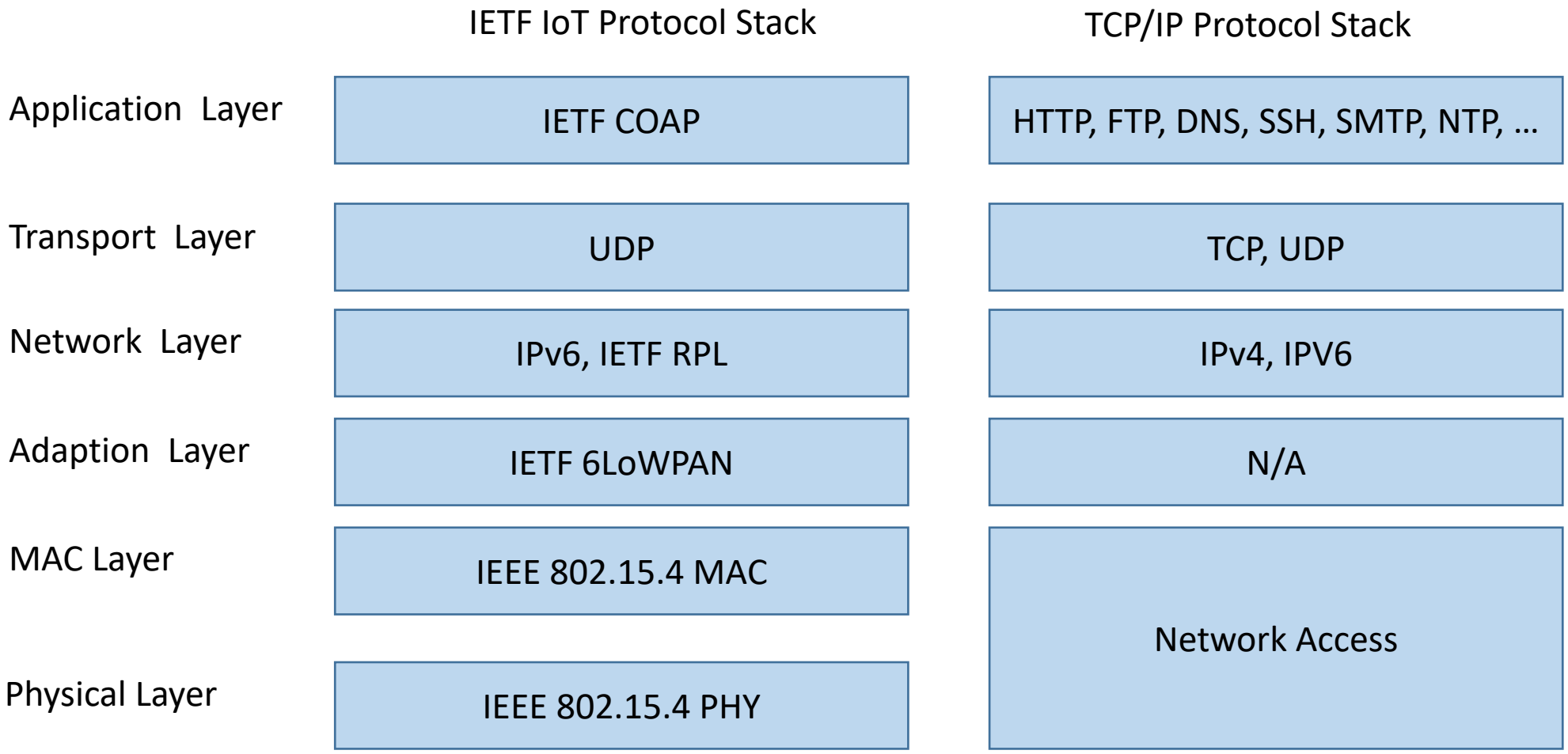
IoT refers to systems that involve computation, sensing, communication, and actuation (Ref. NIST SP 800-183)

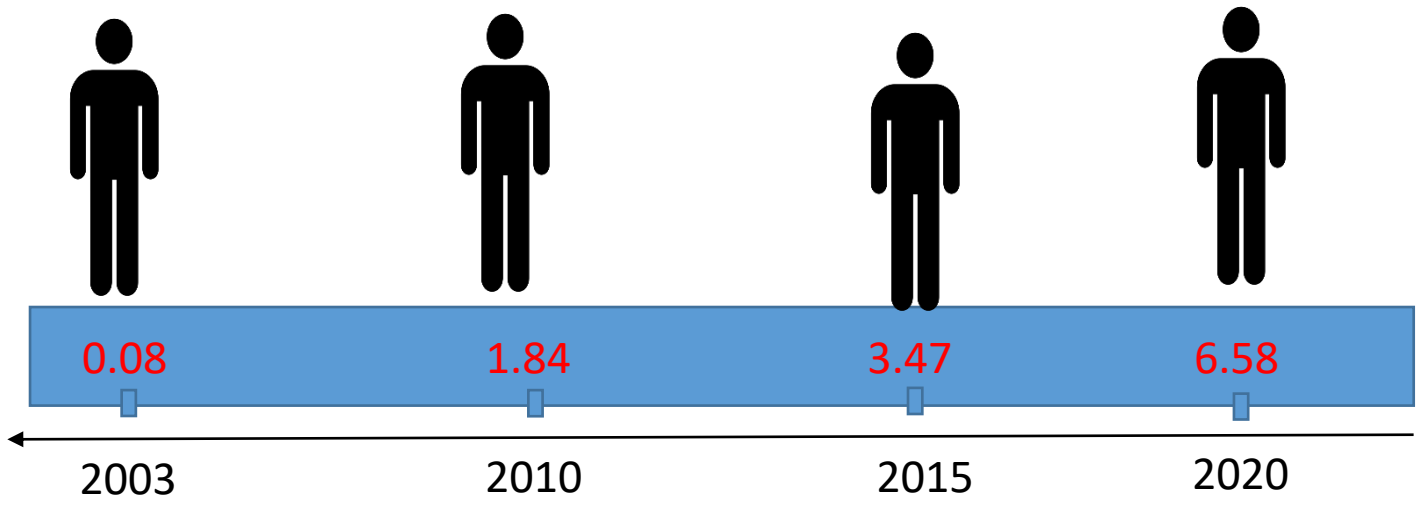



Scale and Cost
Lock-in
Security
Reliability
Potential
Choice and Agility
Control
Next Generation Architecture

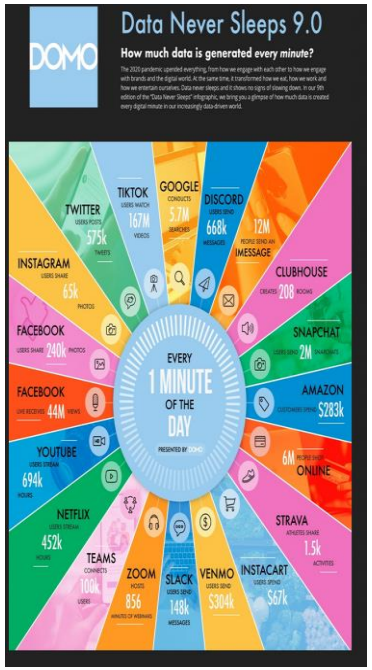

IETF IoT Protocol Stack
TCP/IP Protocol Stack
Application Layer
IETF COAP
HTTP, FTP, DNS, SSH, SMTP, NTP, …
Transport Layer
UDP
TCP, UDP
Network Layer
IPv6, IETF RPL
IPv4, IPV6
Adaption Layer
IETF 6LoWPAN
N/A
MAC Layer
IEEE 802.15.4 MAC
Network Access
Physical Layer
IEEE 802.15.4 PHY

| | | | | |
|---|---|---|---|---|
| World Population | 6.3 Billion | 6.8 Billion | 7.2 Billion | 7.6 Billion |
| Connected Devices | 500 million | 12.5 Billion | 25 Billion | 50 Billion |

Connected Devices Per Person




Source: Cisco IBSG April 2011




| Rank | Country/Territory | Unconnected People | % of Population |
|---|---|---|---|
| 1 | India | 685,591,071 | 50% |
| 2 | China | 582,063,733 | 41% |
| 3 | Pakistan | 142,347,735 | 65% |
| 4 | Nigeria | 118,059,352 | 58% |
| 5 | Bangladesh | 97,427,352 | 59% |
| 6 | Indonesia | 96,709,226 | 36% |
| 7 | Ethiopia | 92,385,728 | 81% |
| 8 | Democratic Republic of Congo | 71,823,319 | 81% |
| 9 | Brazil | 61,423,295 | 29% |
| 10 | Egypt | 46,626,170 | 46% |

Current radio technologies

Source: Lux Research

**By 2022, Narrowband IoT (NB-IoT) will be the winner due to the ability of its MNOs to deliver reliability and coverage**

sigfox

2 Countries

عمانتل Omantel

LoRa

34 Countries

orange™

TATA

NB-IoT™

79 Countries

vodafone

Deutsche Telekom

AT&T

There is a small- and rapidly closing-window to ensure that IoT is adopted in a way that maximizes security and minimizes risk. If the country fails to do so, it will be coping with the consequences for generations

- Incorporate Security at the Design Phase
- Advance Security Updates and Vulnerability Management
- Build on Proven Security Practices
- Prioritize Security Measures According to Potential Impact
- Promote Transparency across IoT
- Connect Carefully and Deliberately

# WHAT IS SECURITY

**DICTIONARY SAYS:**

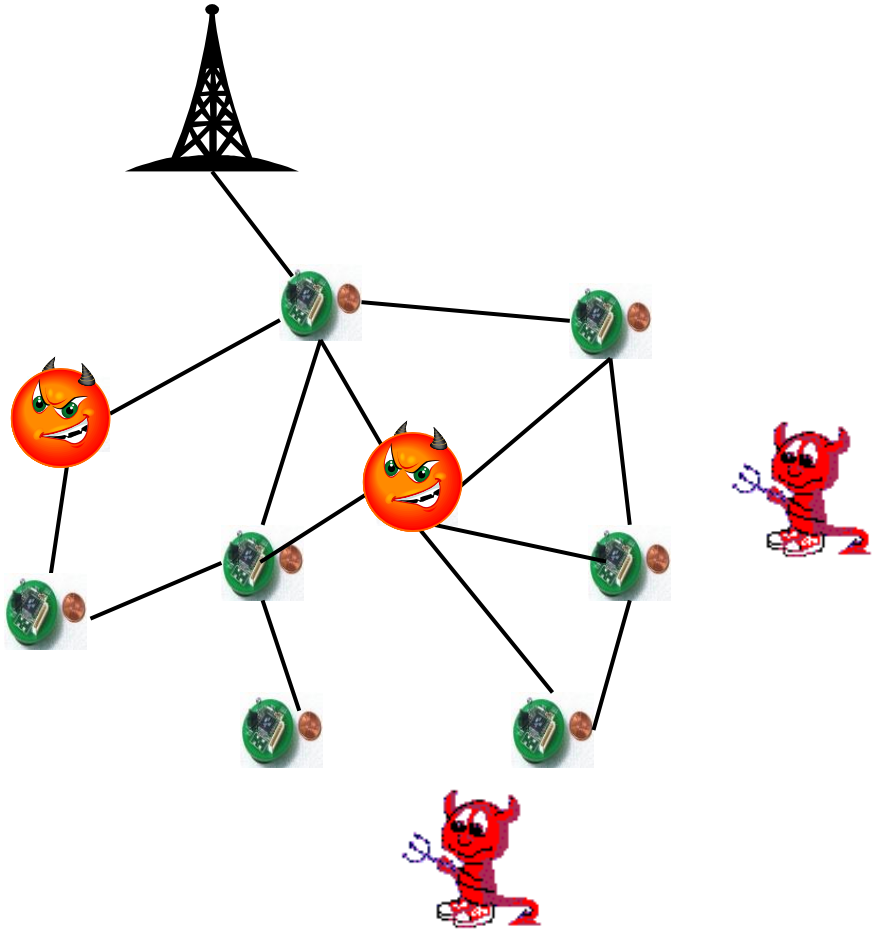
1. Freedom from risk or danger ; safety.
2. Freedom from doubt, anxiety and fear ; confidence.
3. Something that gives or assures safety , as:
    1. A group or department of private guards.
    2. Measures adopted by a government to prevent sabotage or attack.
    3. Measures adopted , as by a business or homeowner , to prevent a crime.

    …….. ETC

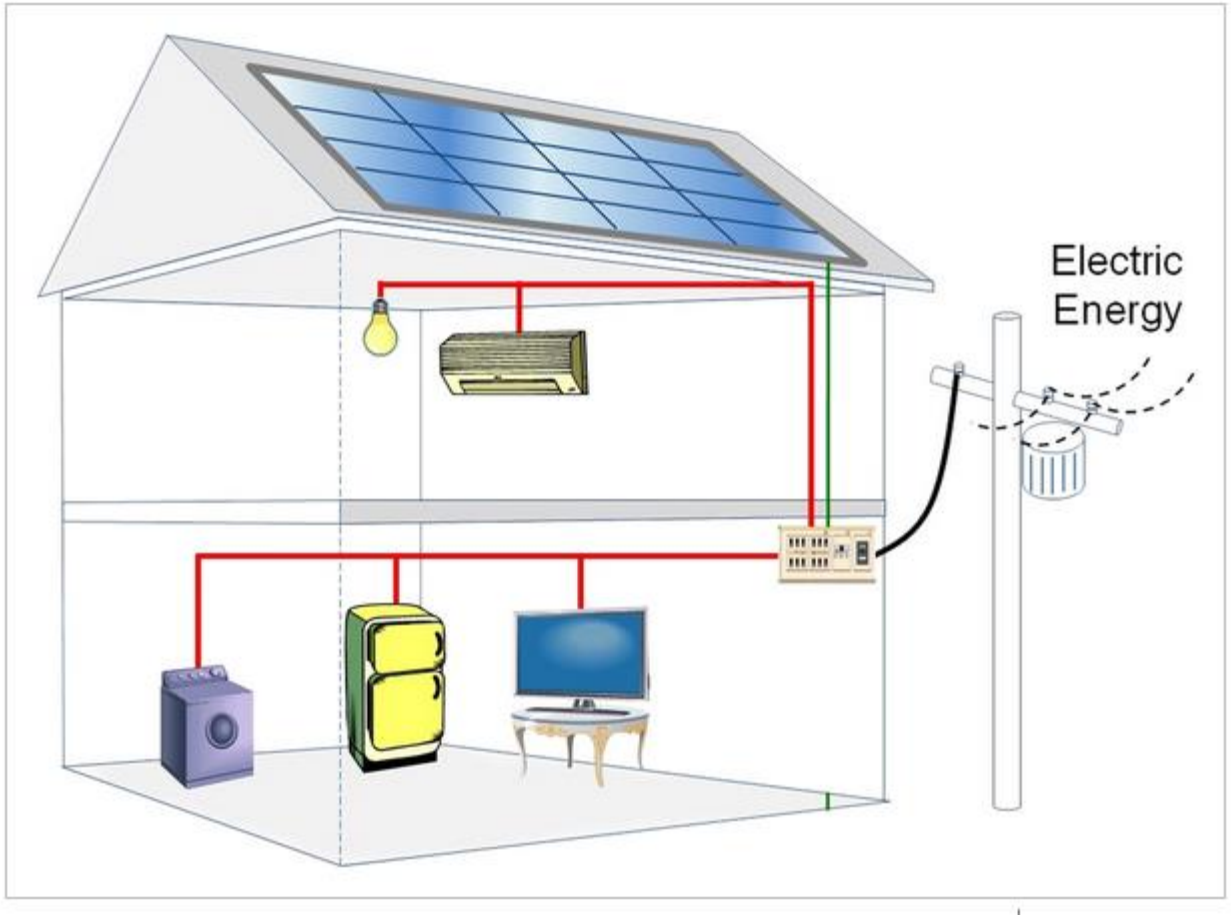
# WHO IS VULNERABLE?

- Financial institutions and banks.
- Internet service providers.
- Pharmaceutical companies.
- Government and defense agencies.
- Contractors to various government agencies.
- Multinational corporations.
- **ANYONE ON THE NETWORK…..**

IoT security is the **practice that keeps your IoT systems safe**

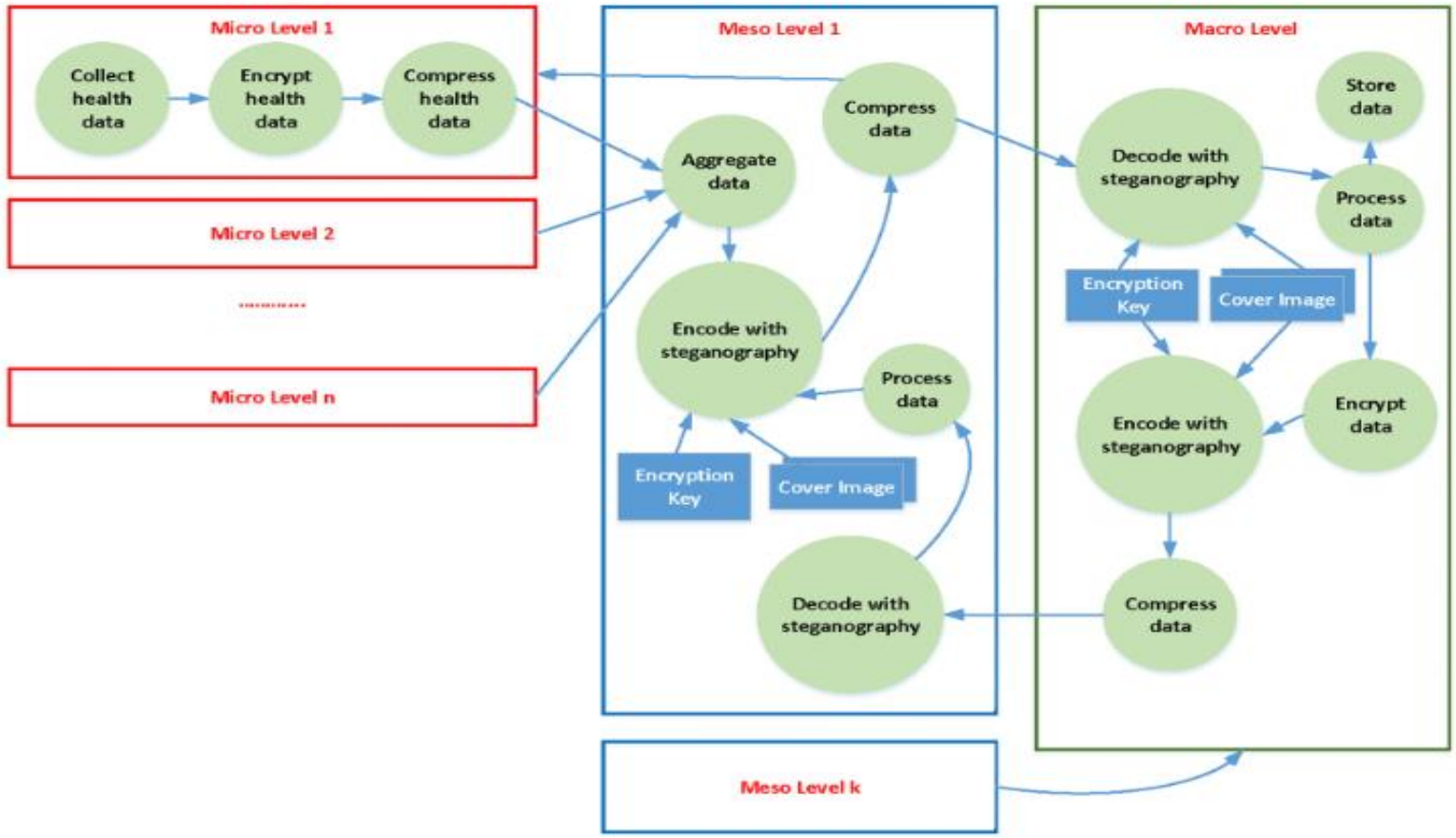


# A secure electric energy management in smart home




Bacem Mbarek, Aref Meddeb, Wafa Ben Jaballah, Mohamed Mosbah: A secure electric energy management in smart home. Int. J. Commun. Syst. 30(17) (2017)

# ECASS: an encryption compression aggregation security scheme for secure data transmission in ambient assisted living systems




Bacem Mbarek, Nafaâ Jabeur, Ansar-Ul-Haque Yasar: ECASS: an encryption compression aggregation security scheme for secure data transmission in ambient assisted living systems. Pers. Ubiquitous Comput. 23(5-6): 793-799 (2019)

# An Efficient Mutual Authentication Scheme for Internet of Things

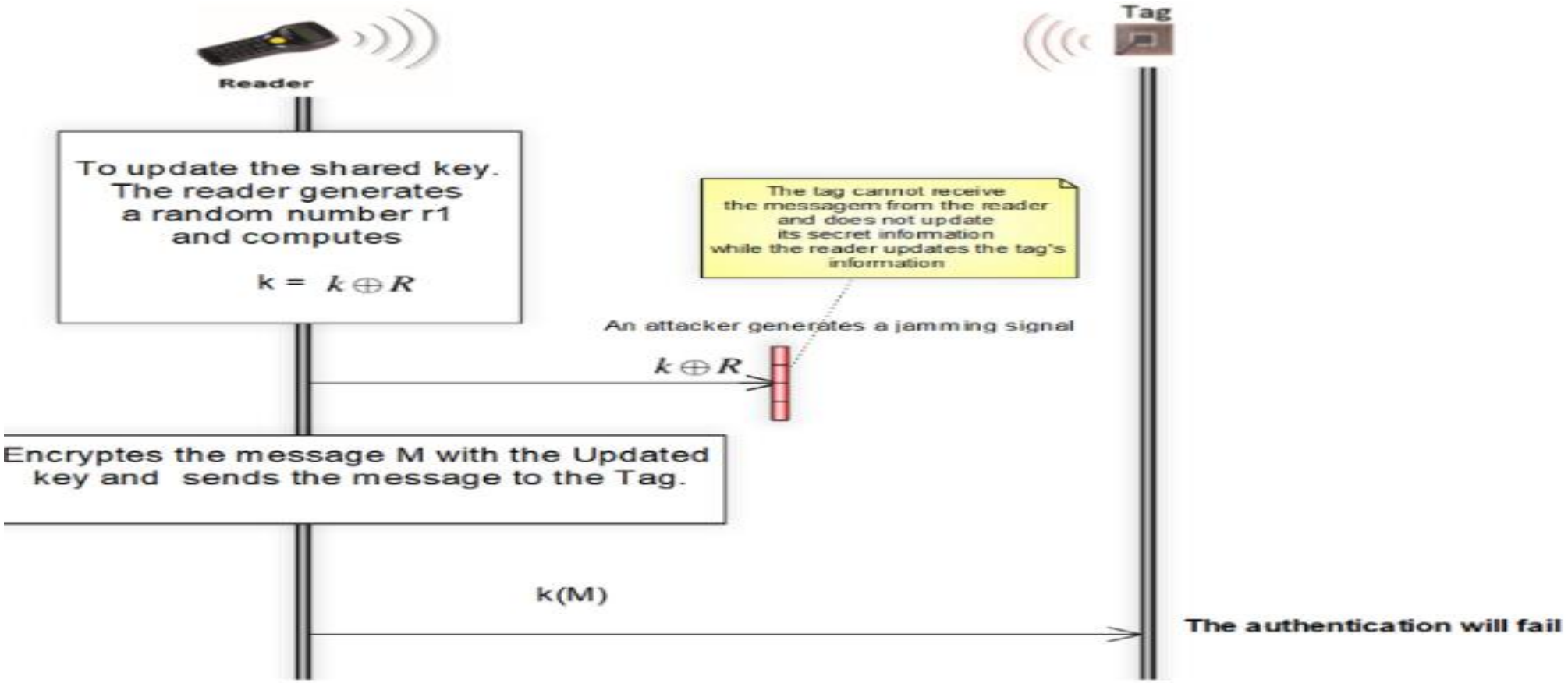
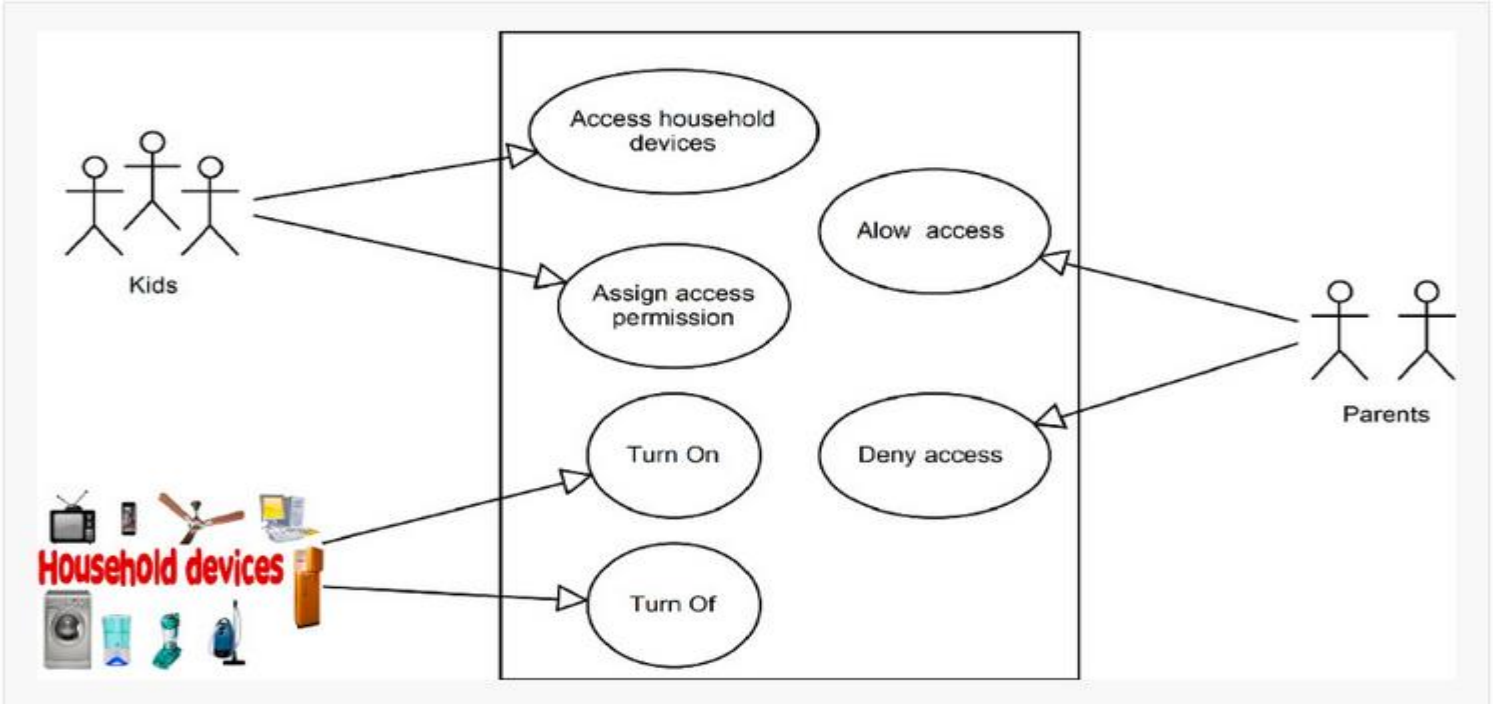



**Fig. 1.** RFID protocols with a key update phase that suffer from jamming attack

Bacem Mbarek, Mouzhi Ge, Tomás Pitner: An Efficient Mutual Authentication Scheme for Internet of Things. Internet Things 9: 100160 (2020)

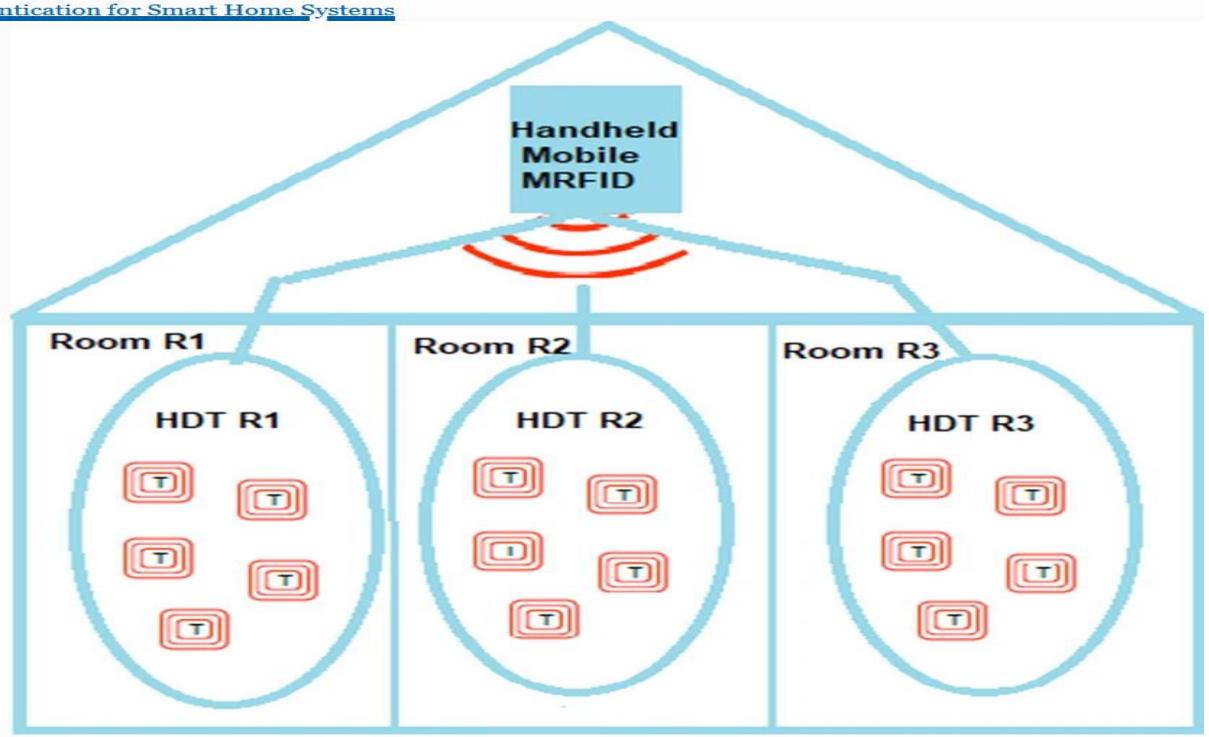
# Blockchain-Based Access Control for IoT in Smart Home Systems.




Bacem Mbarek, Mouzhi Ge, Tomás Pitner: Blockchain-Based Access Control for IoT in Smart Home Systems. DEXA (2) 2020: 17-32

# *Trust-Based Authentication for Smart Home Systems*

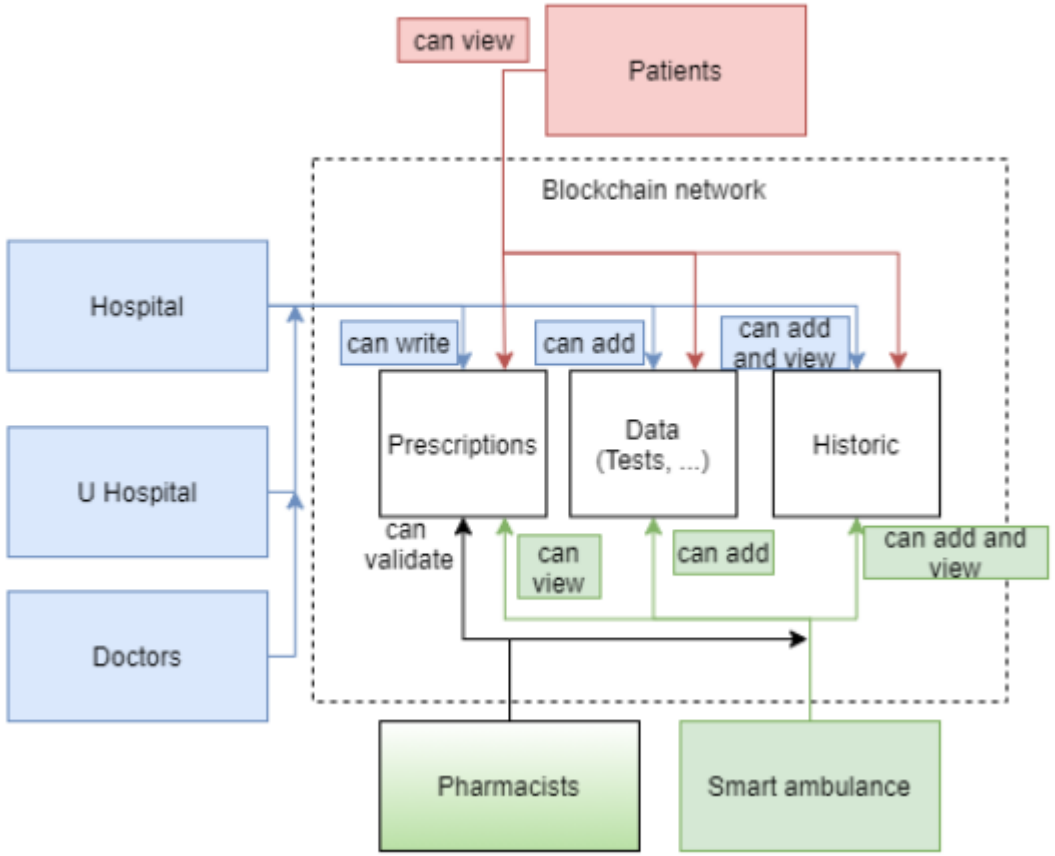
From: Trust-Based Authentication for Smart Home Systems




Smart home master-slave RFID system architecture

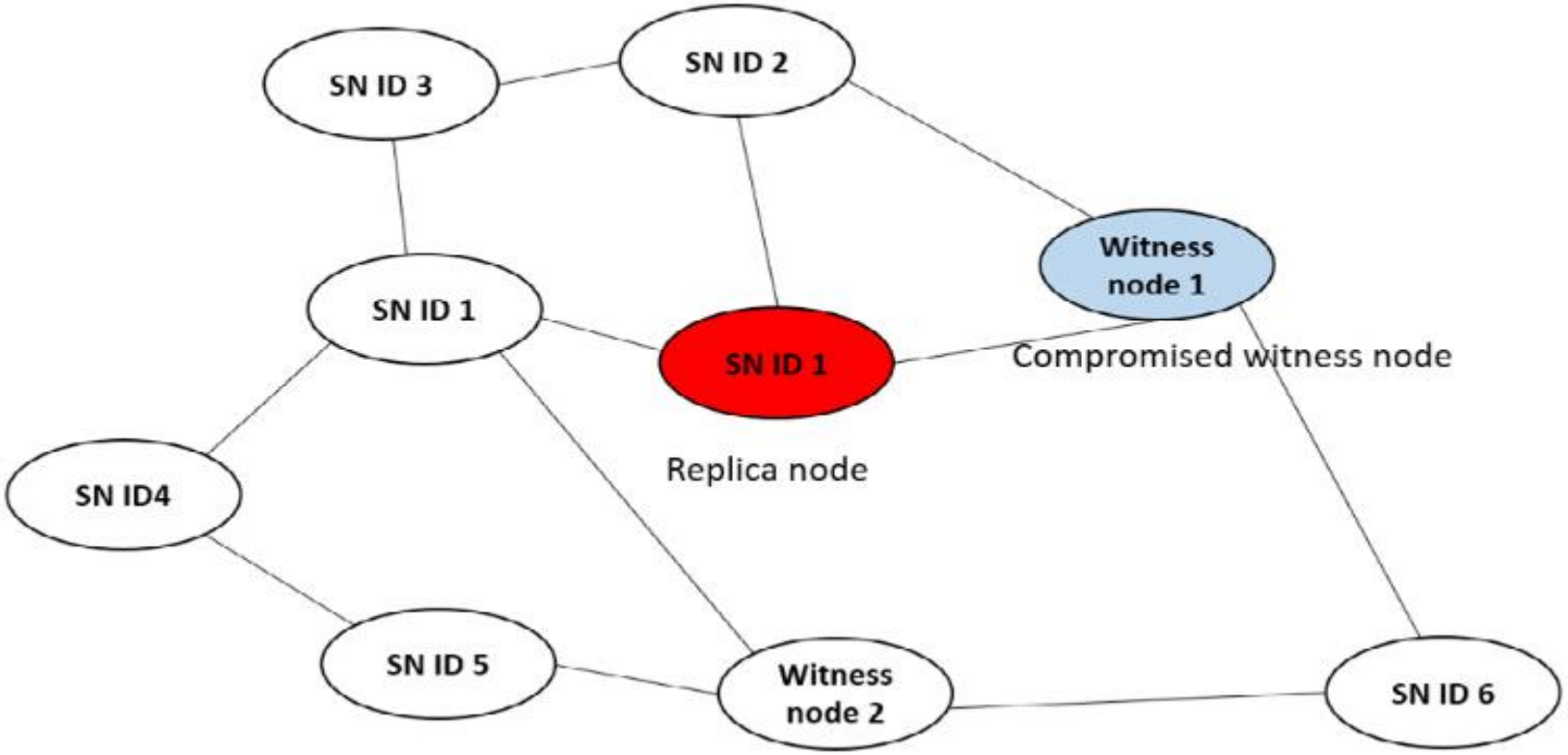
Bacem Mbarek, Mouzhi Ge, Tomás Pitner: Trust-Based Authentication for Smart Home Systems. Wirel. Pers. Commun. 117(3): 2157-2172 (2021)

**A Real time Healthcare Tracking System based on Blockchain Application**



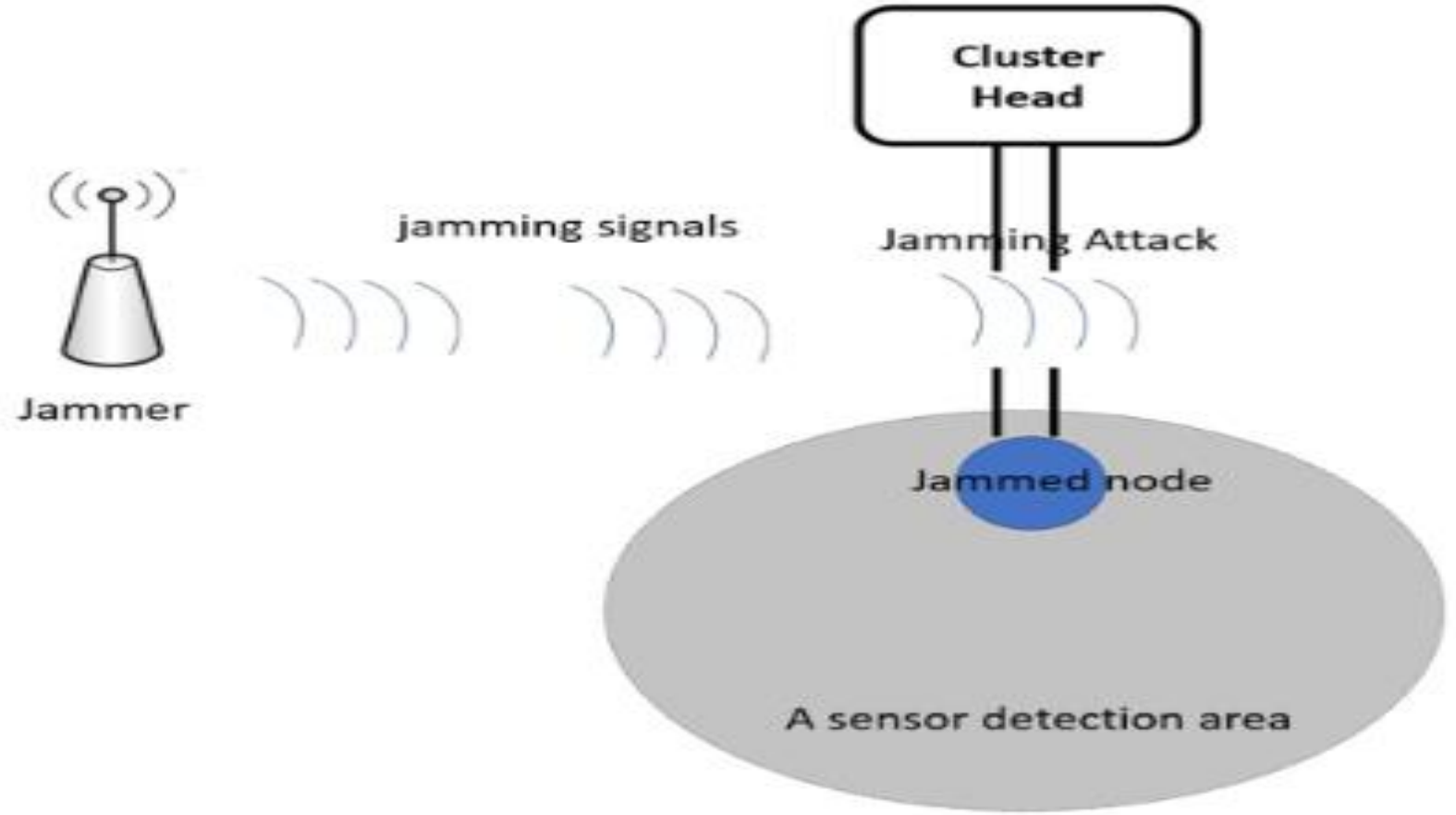

Thomas Lavigne, Bacem Mbarek, Tomás Pitner: A Real time Healthcare Tracking System based on Blockchain Application. AICCSA 2021: 1-8

# Proactive trust classification for detection of replication attacks in 6LoWPAN-based IoT.



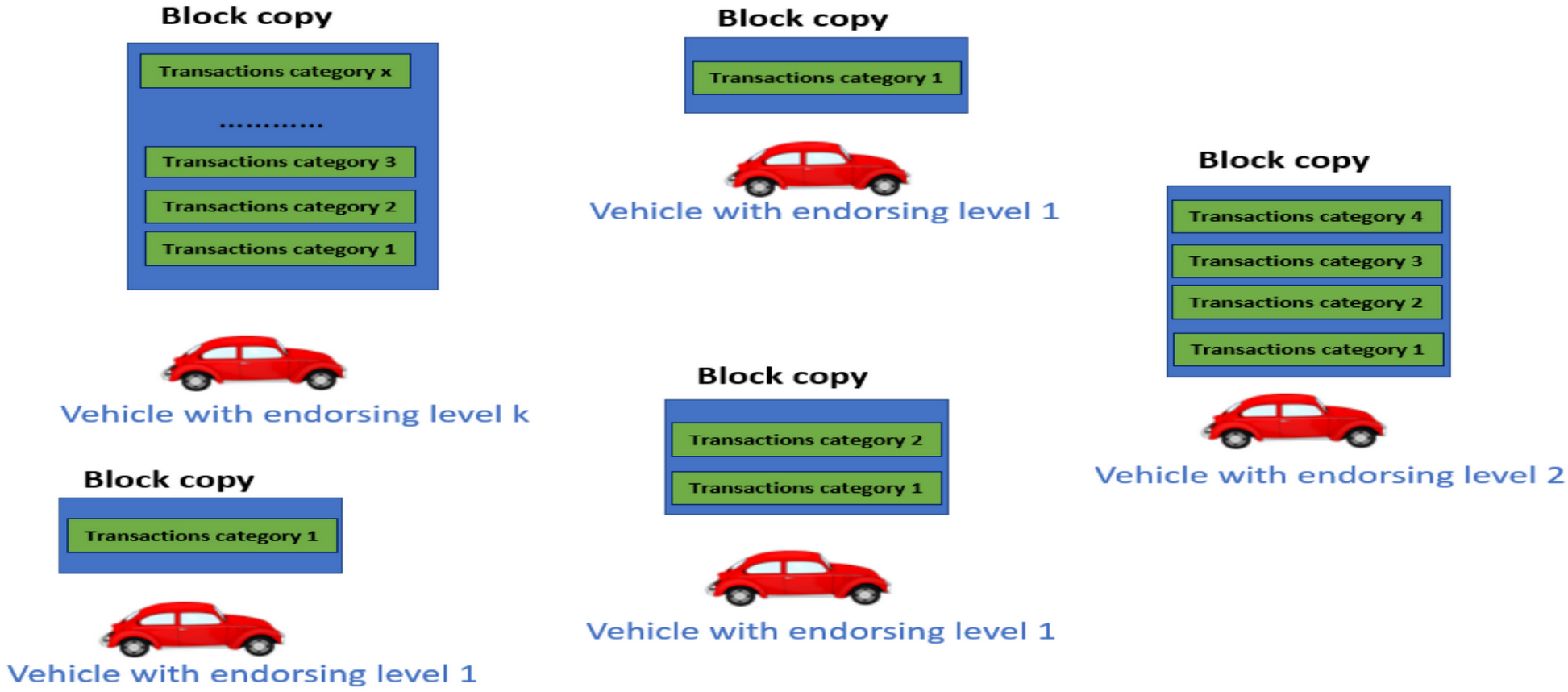

Bacem Mbarek, Mouzhi Ge, Tomás Pitner: Proactive trust classification for detection of replication attacks in 6LoWPAN-based IoT. Internet Things 16: 100442 (2021)

# An adaptive anti-jamming system in HyperLedger-based wireless sensor networks




*Bacem Mbarek*, *Mouzhi Ge*, *Tomás Pitner*, **Wireless Networks 2022**

# Empowering Communications in Vehicular Networks with an Intelligent Blockchain-Based Solution




Mbarek, B.; Jabeur, N.; Pitner, T.; Yasar, A.-U.-H. Empowering Communications in Vehicular Networks with an Intelligent Blockchain-Based Solution. *Sustainability* **2020**, *12*, 7917. https://doi.org/10.3390/su12197917

# Questions and Discussion

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