Sustainability and ESG Data Analytics

Artificial Intelligence of Things (AIoT) in ESG and Sustainability Applications
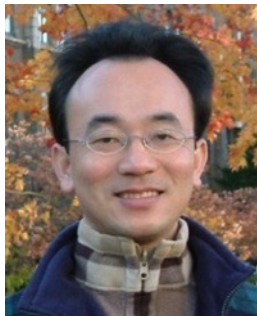
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Professor

Institute of Information Management, **National Taipei University**

https://web.ntpu.edu.tw/~myday

https://meet.google.com/
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2024-12-04

Syllabus

Week   Date   Subject/Topics

1 2024/09/11 Introduction Sustainability and ESG Data Analytics

2 2024/09/18 Environmental, Social, and Governance (ESG) in
                     Net-Zero Digital Transformation

3 2024/09/25 Data Science for Sustainability and ESG

4 2024/10/02 (Class Canceled due to Typhoon)

5 2024/10/09 (Self-Learning) Web 3.0 and Big Data Analysis in Fintech, Green and Sustainable Finance

6 2024/10/16 Case Study on Sustainability and ESG Data Analytics I

Syllabus

Week   Date   Subject/Topics

7 2024/10/23 (Self-Learning) Task Force on Climate-Related Financial
              Disclosures (TCFD) and En-Roads Interactive;
              ESG Data Gathering, Analysis, and Visualization

8 2024/10/30 (Self-Learning)

9 2024/11/06 Self-Learning

10 2024/11/13 Midterm Project Report

11 2024/11/20 ESG Data Reporting; Corporate Sustainability Reports;
               ESG Data Verification

12 2024/11/27 Case Study on Sustainability and ESG Data Analytics II

Syllabus

Week   Date   Subject/Topics

13 2024/12/04 Artificial Intelligence of things (AIoT) in ESG and Sustainability Applications

14 2024/12/11 Generative AI for ESG Rating and Reporting Generation

15 2024/12/18 Final Project Report I

16 2024/12/25 Final Project Report II

Artificial Intelligence of Things (AIoT)
in
ESG and Sustainability Applications

Outline

- **Artificial Intelligence of Things (AIoT)**
- **AIoT for ESG and Sustainability Applications**

Sherry Madera (2024),
Navigating Sustainability Data: How Organizations can use ESG Data to Secure Their Future, Kogan Page
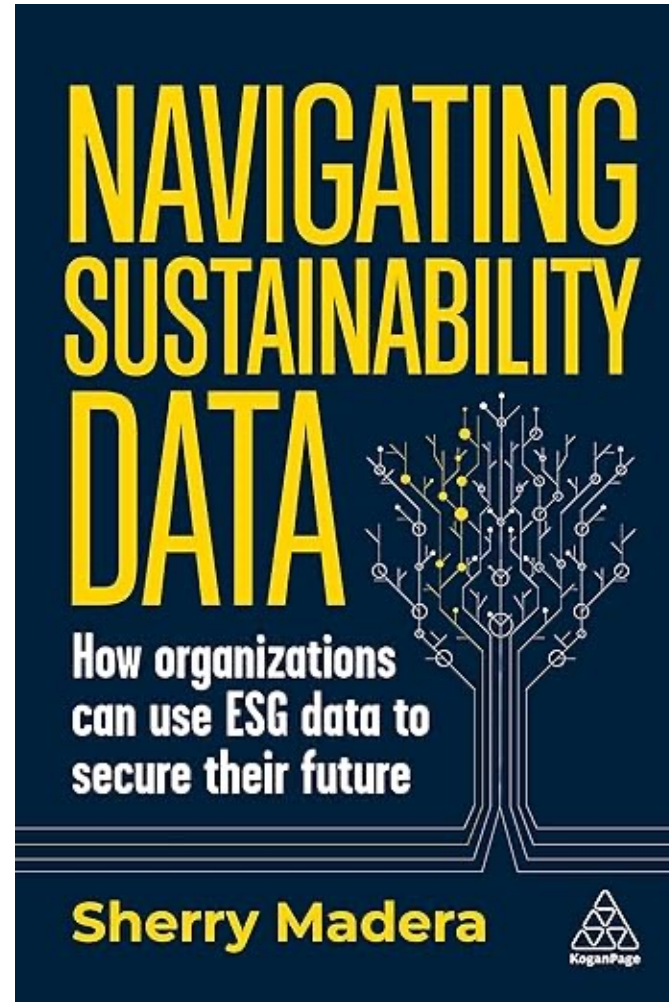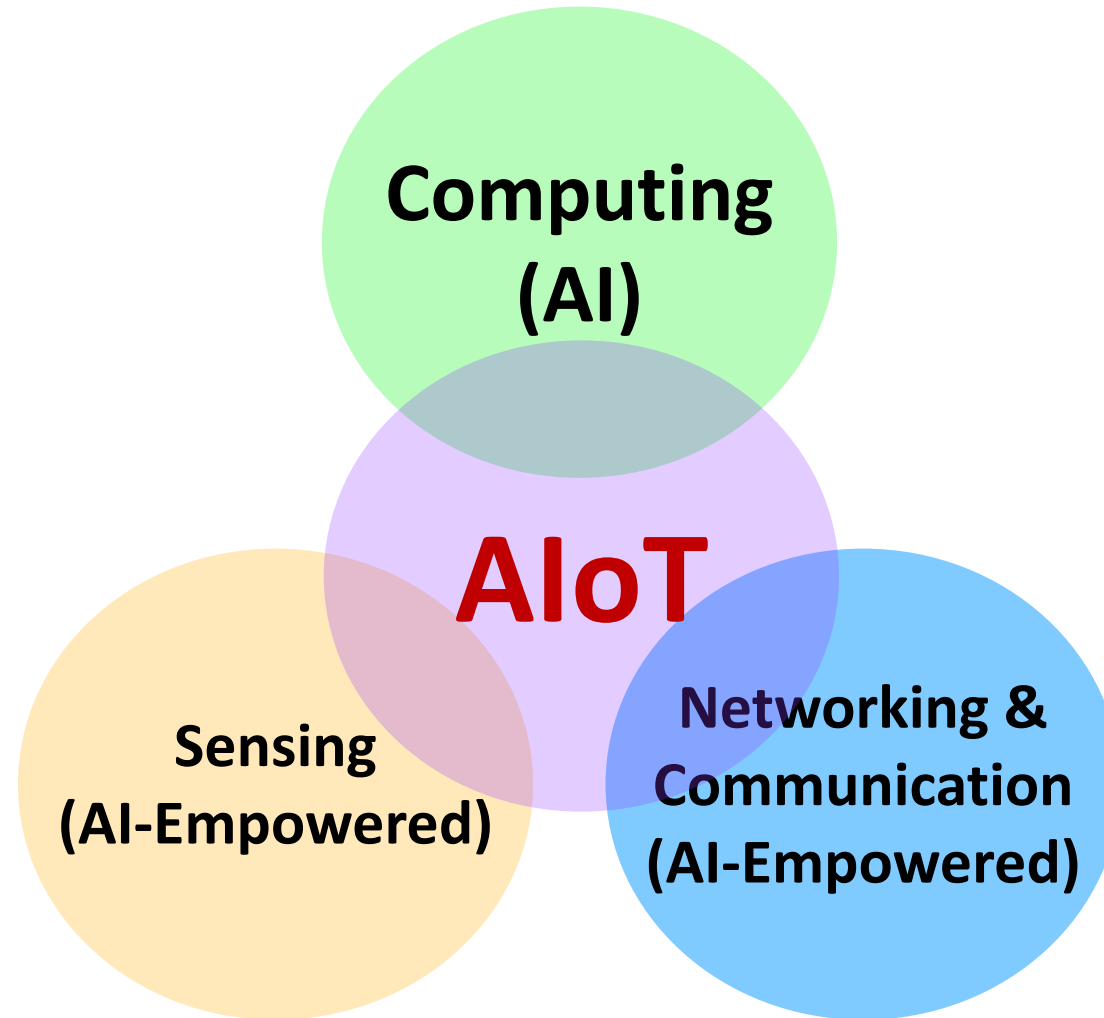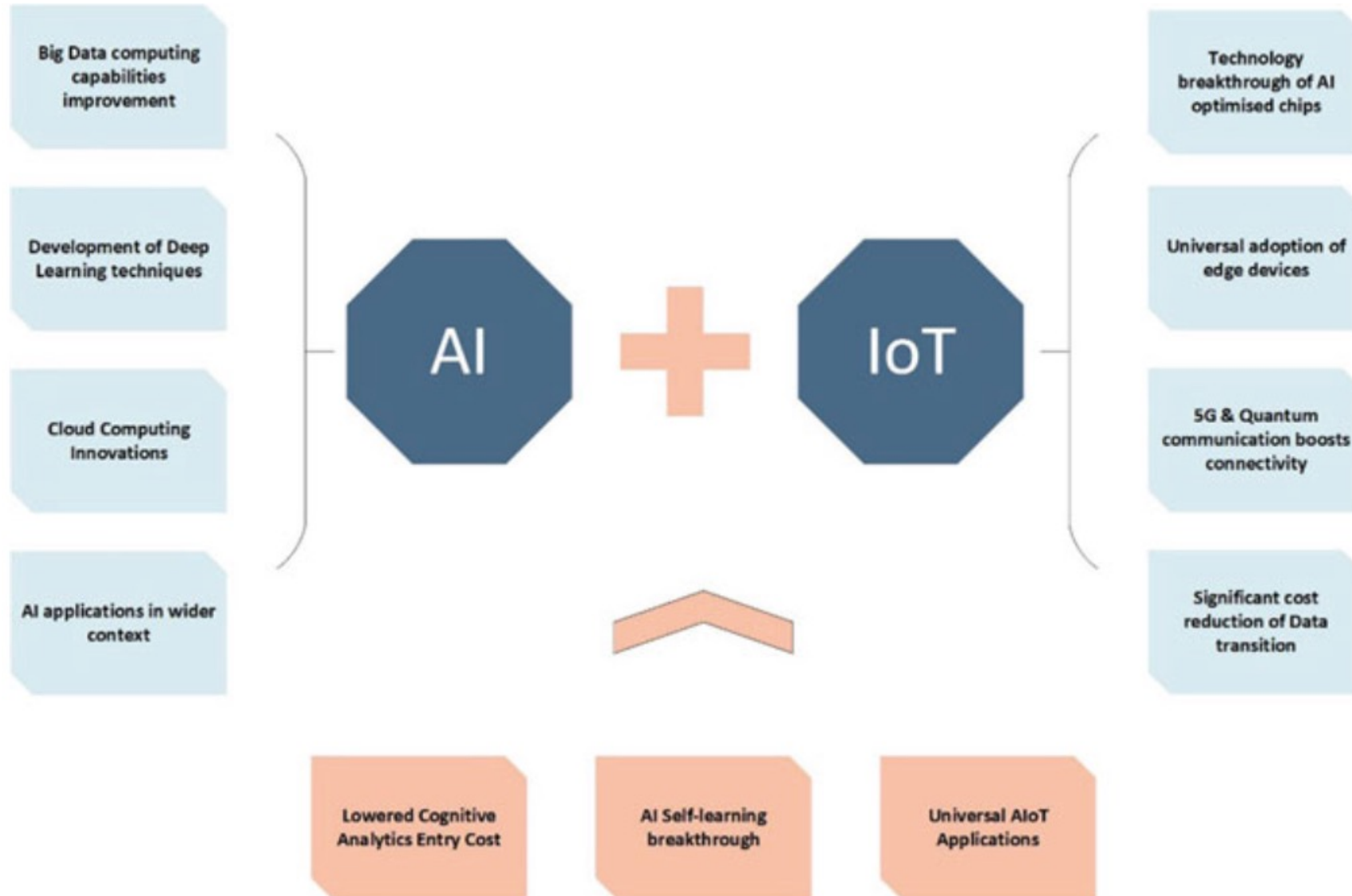
Sustainability and ESG Data Analytics

Definition of AIoT

- **Artificial Intelligence (AI)**
  - **Predictive analytics, machine learning, and decision-making**
- **Internet of Things (IoT)**
  - **Sensors, devices, and real-time data collection**
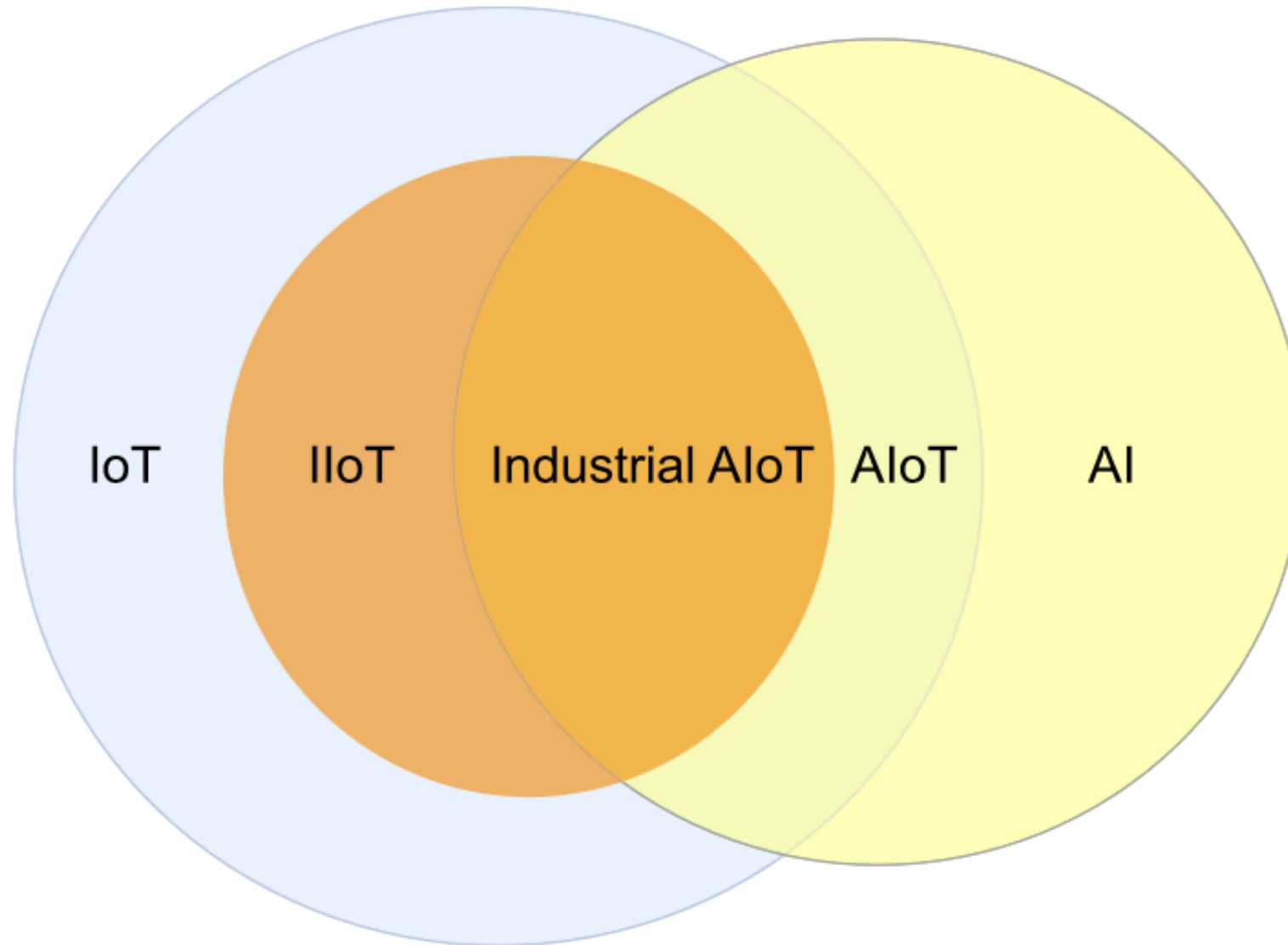- **Synergy between AI and IoT in ESG domains**
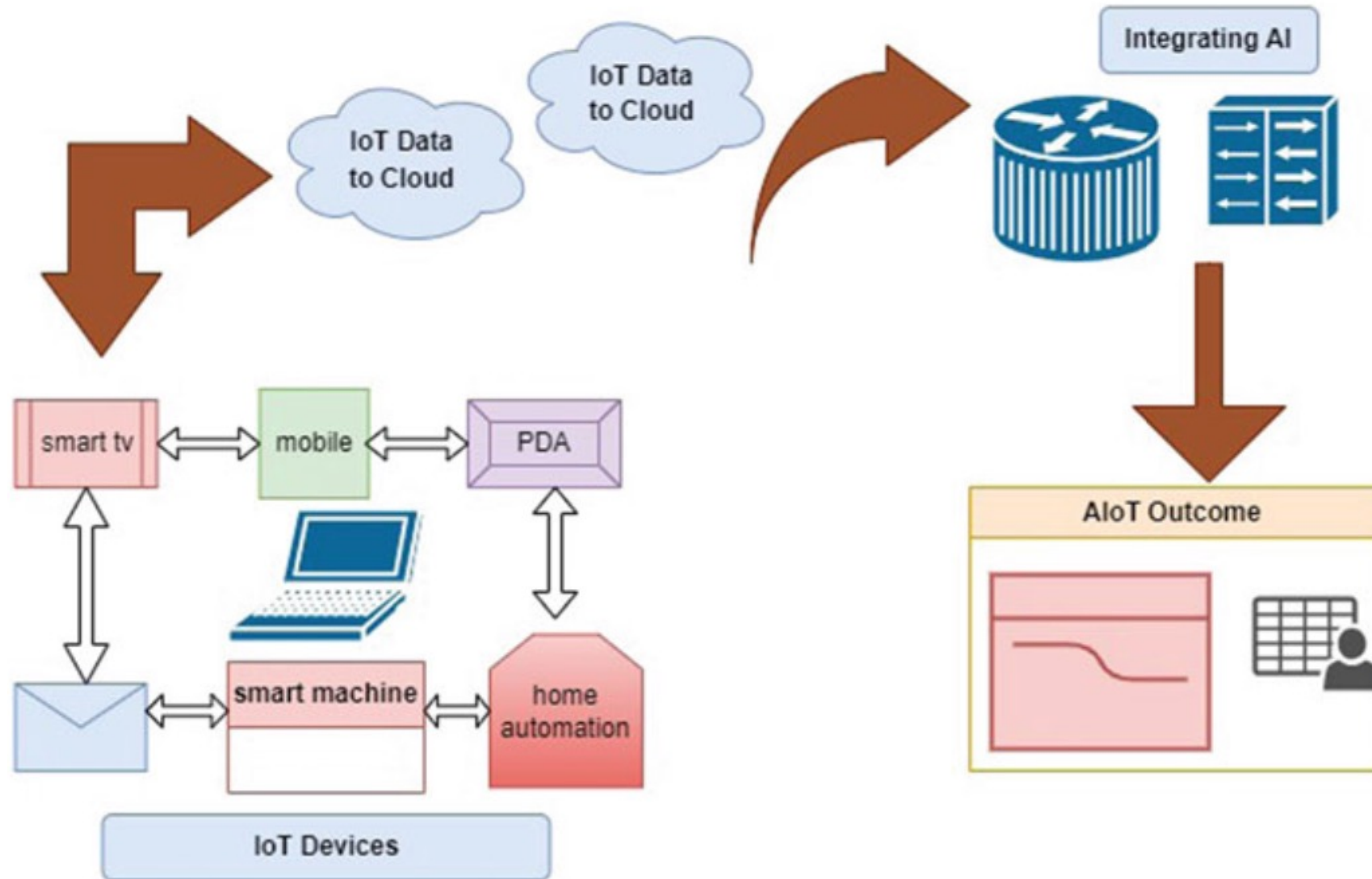
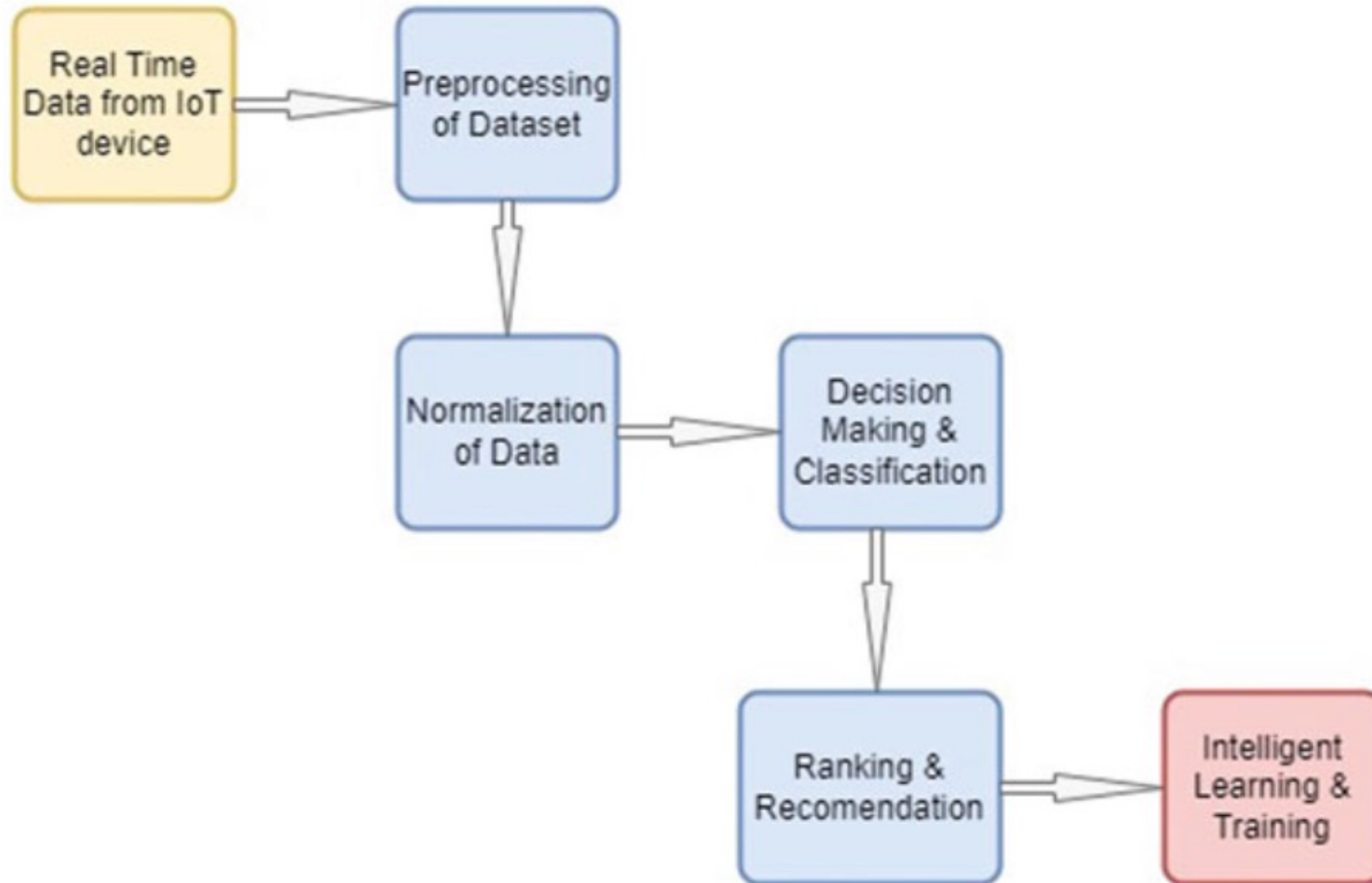# Artificial Intelligence of Things (AIoT)

AIoT = AI + IoT
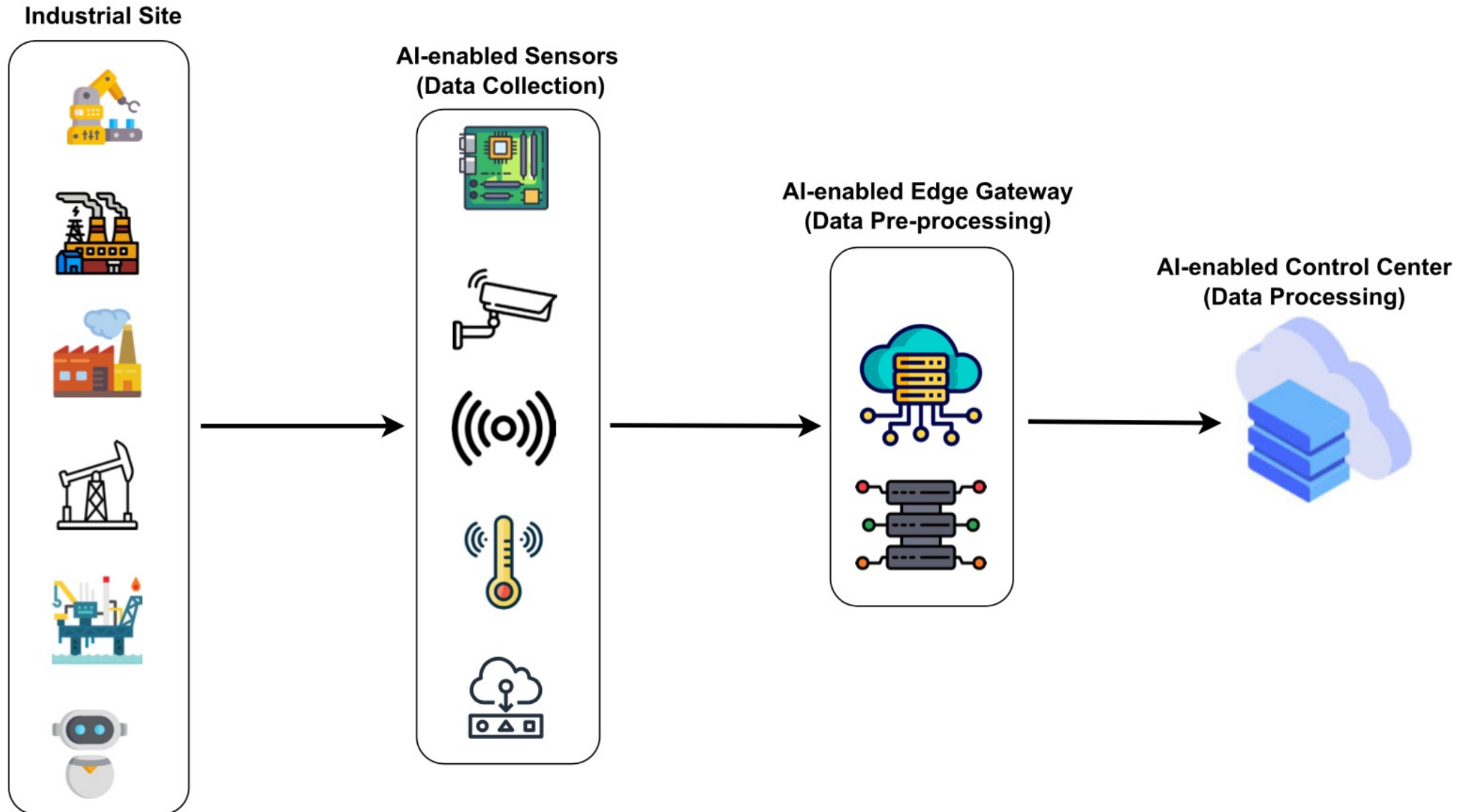
IoT, IIoT, AIoT, and industrial AIoT
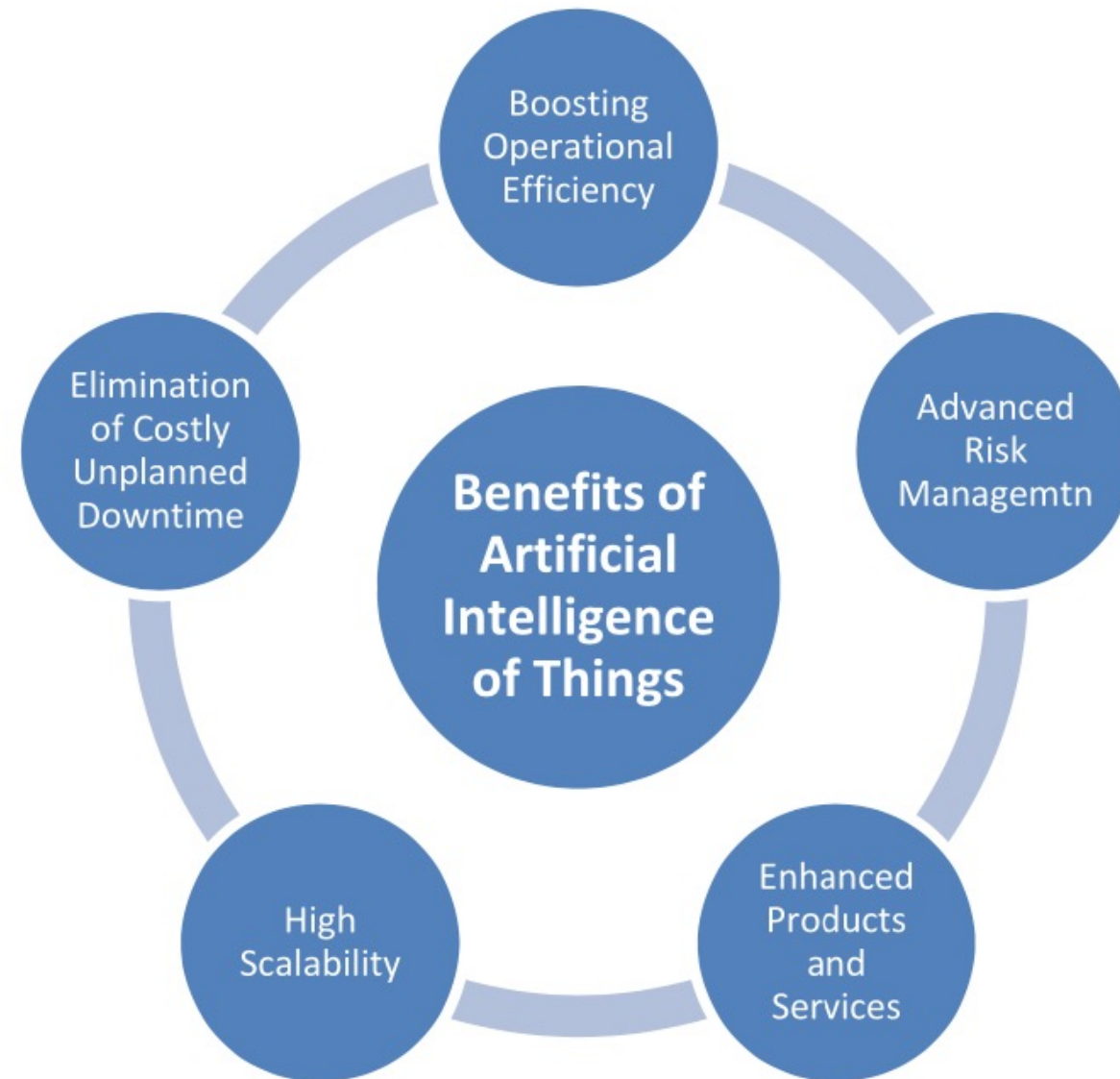
Integration of AI with IoT
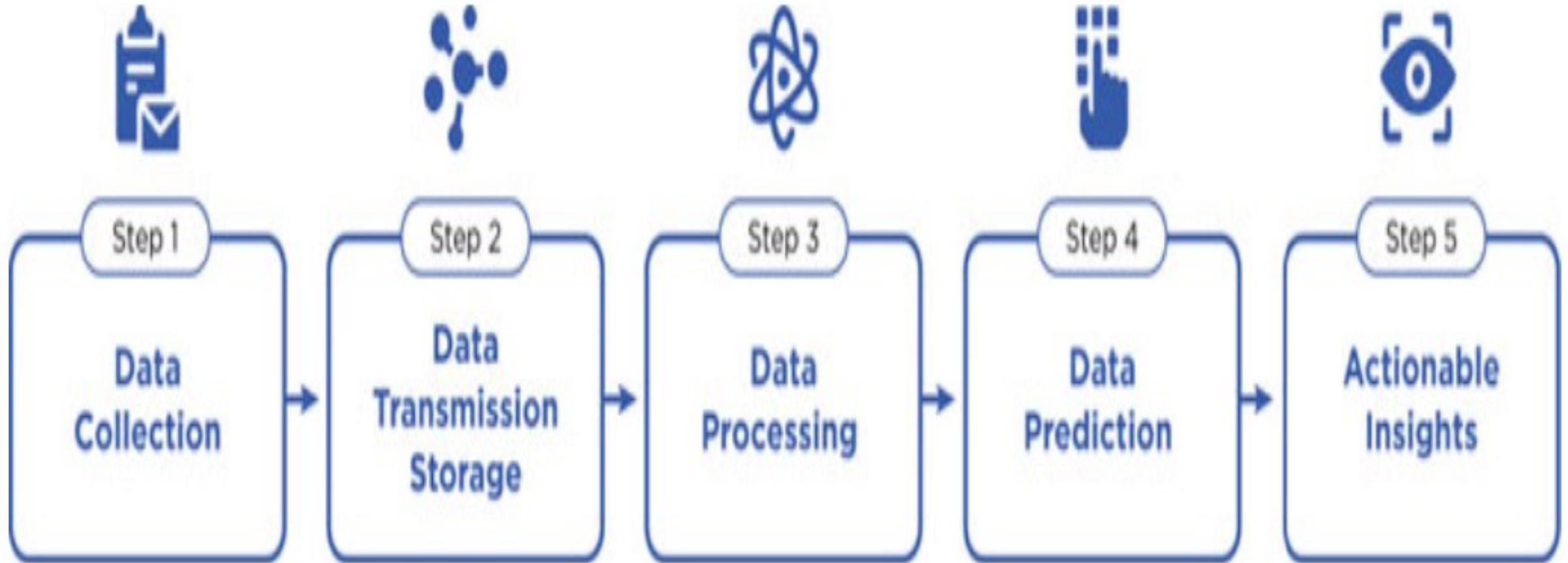
Combining AI and ML with IoT data
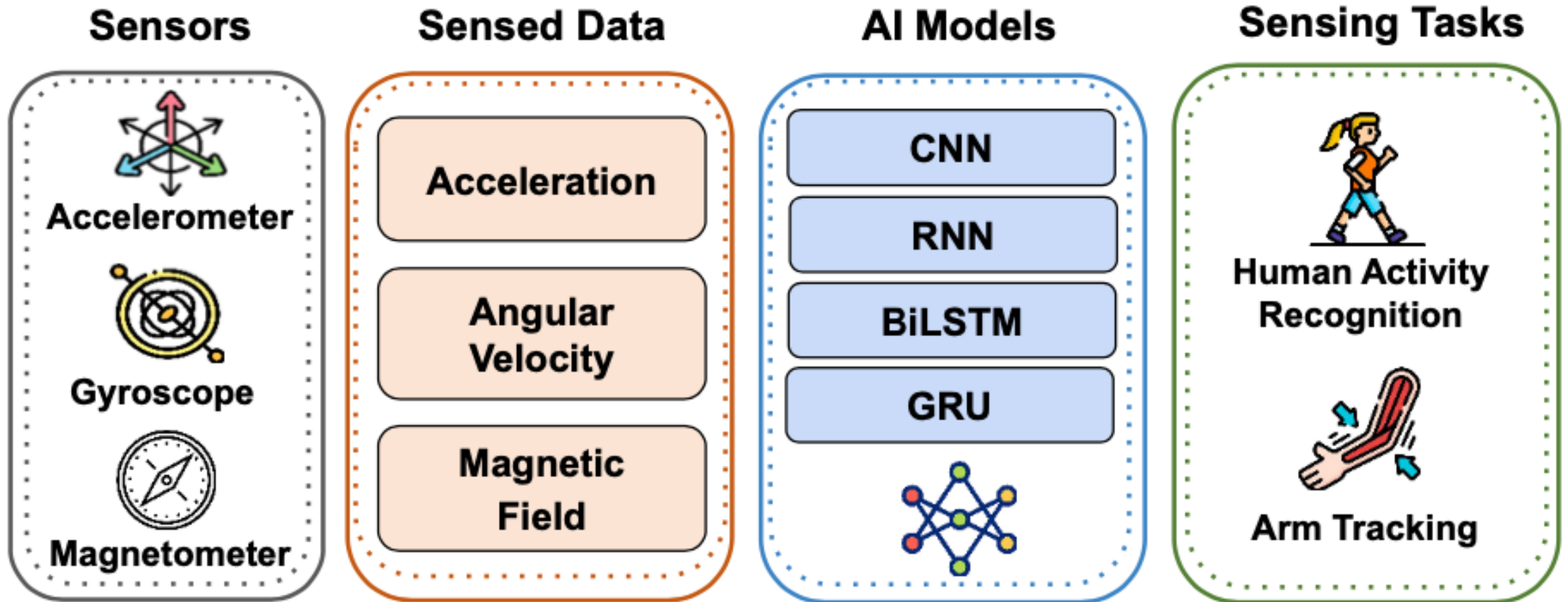
Architecture of industrial AIoT
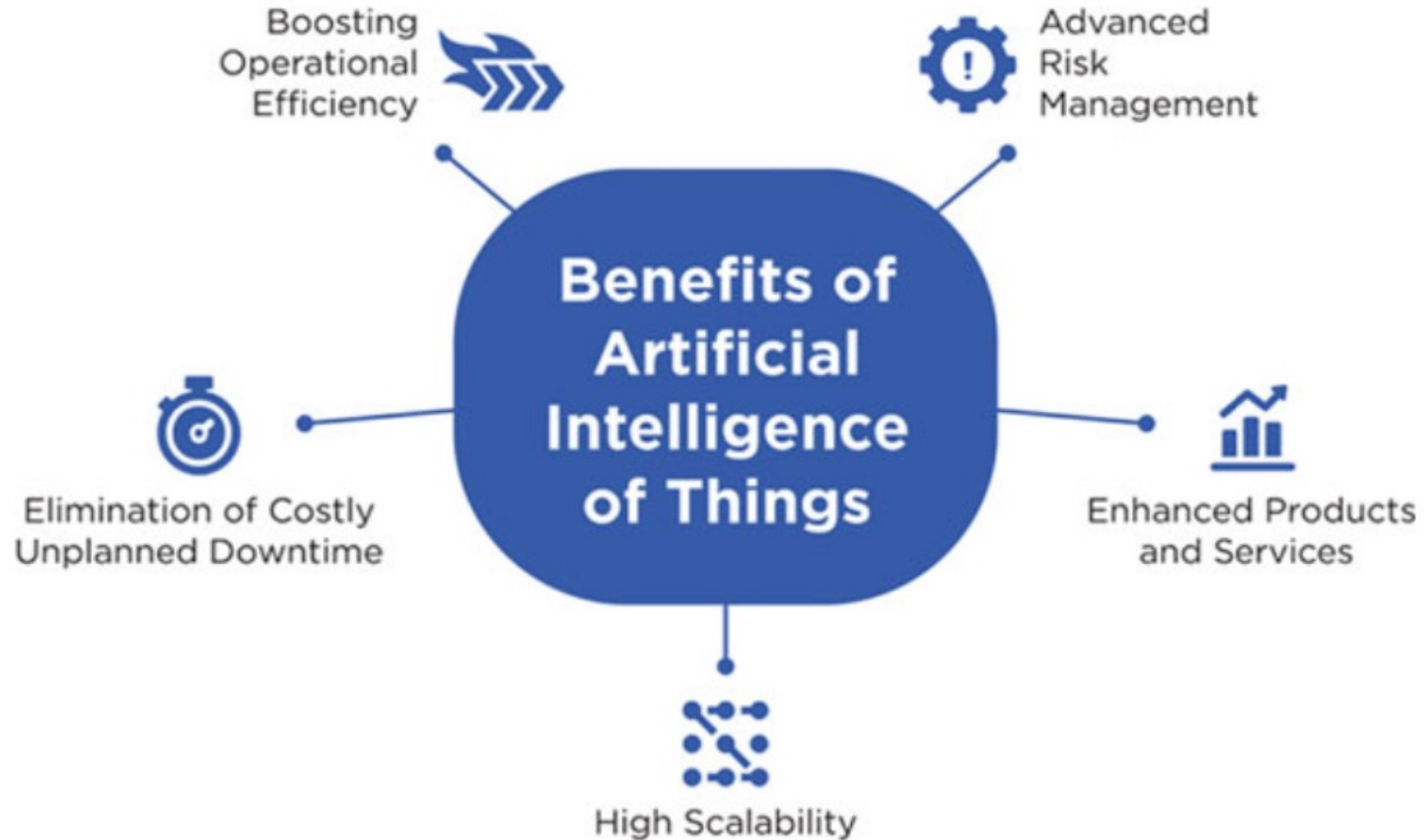
Advantages of Artificial Intelligence of Things

Workflow diagram of AIoT-enabled device

AI-empowered Motion Sensing Pipeline

Source: Shakhrul Iman Siam, Hyunho Ahn, Li Liu, Samiul Alam, Hui Shen, Zhichao Cao, Ness Shroff, Bhaskar Krishnamachari, Mani Srivastava, and Mi Zhang (2024), "Artificial Intelligence of Things: A Survey", ACM Transactions on Sensor Networks, https://doi.org/10.1145/3690639

Benefits of Artificial Intelligence of Things

Boosting Operational Efficiency

Advanced Risk Management

Benefits of Artificial Intelligence of Things

Elimination of Costly Unplanned Downtime

Enhanced Products and Services

High Scalability

Role of AIoT in Enabling Sustainability and ESG Compliance

- **Enabling Sustainability:**
  - **Energy Efficiency**
  - **Resource Optimization**
  - **Climate Resilience**
- **Enhancing ESG Compliance:**
  - **Real-time Monitoring**
  - **Automated Reporting**
  - **Supply Chain Transparency**

AIoT in Enabling Sustainability and ESG Compliance

- **Business Benefits:**
  - **Cost Savings**
  - **Regulatory Adherence**
  - **Reputation Enhancement**

AIoT in Environmental Applications

- **Energy management and optimization in smart grids**

- **Monitoring and mitigating air and water pollution**

- **Climate change adaptation: Predictive analytics for weather and disaster management**

AIoT in Environmental Applications

- **Case studies:**
  - **Smart buildings reducing carbon footprints**
  - **AI-driven agricultural practices**

AIoT in Social and Governance Applications

- **Enhancing workplace safety with IoT sensors and AI-driven alerts**

- **Supply chain transparency using blockchain-integrated IoT**
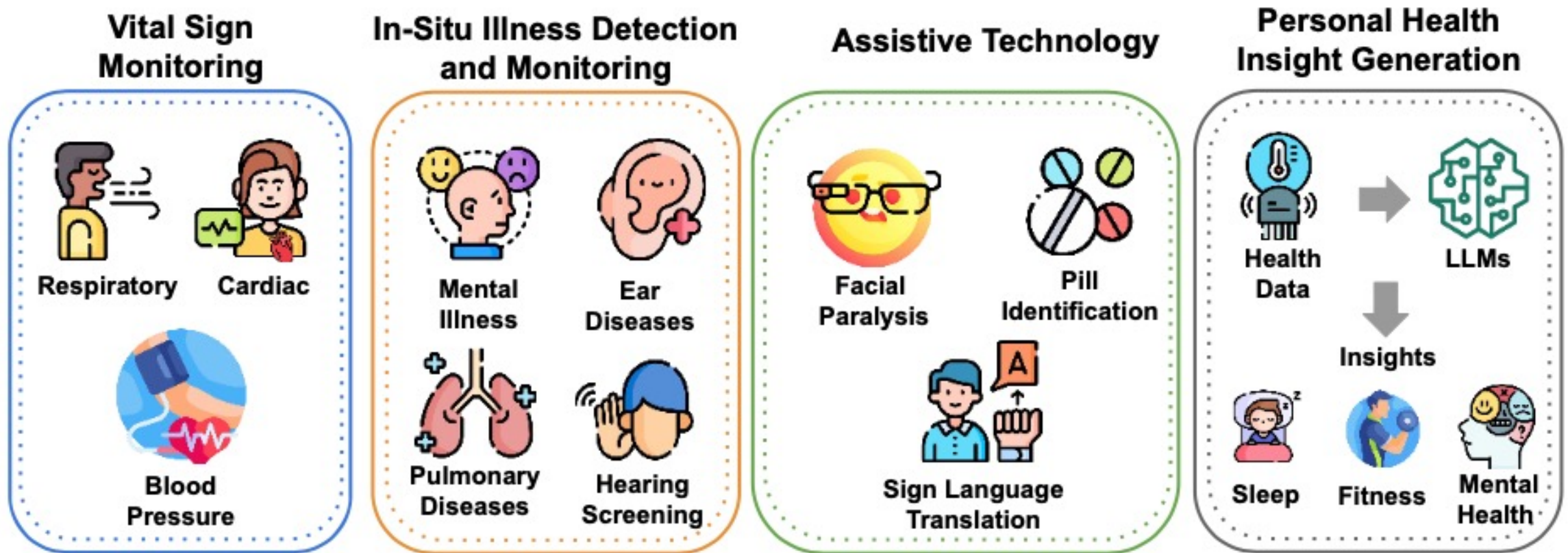
- **Ethical AI considerations in ESG**

AIoT in Social and Governance Applications

- **Case studies:**
  - **Smart cities improving quality of life.**
  - **IoT-enabled healthcare for underserved populations.**

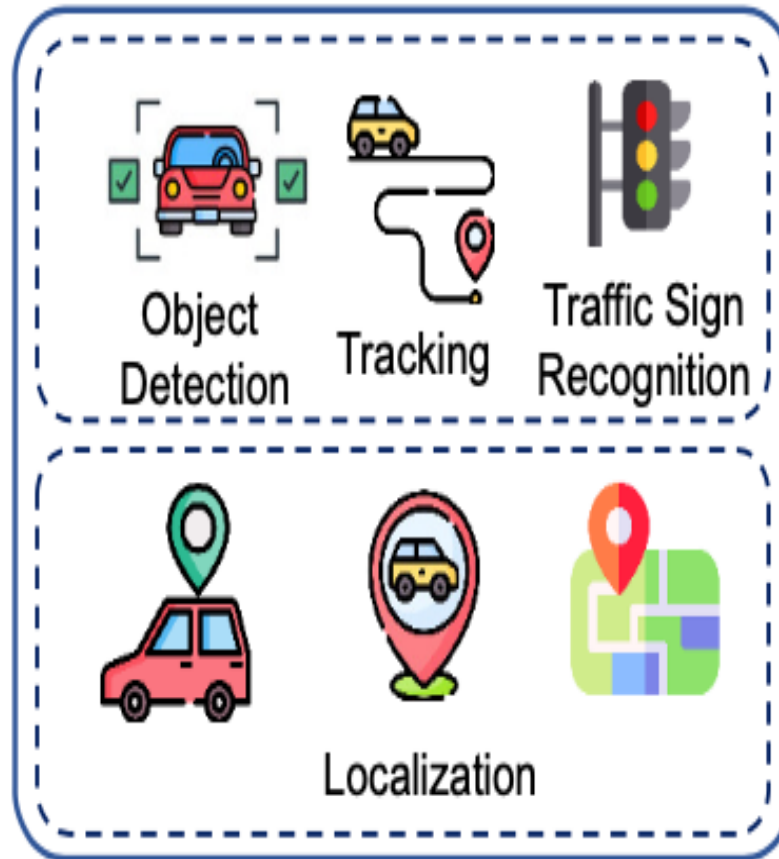# AI-empowered Multi-modal Sensing Pipeline

26
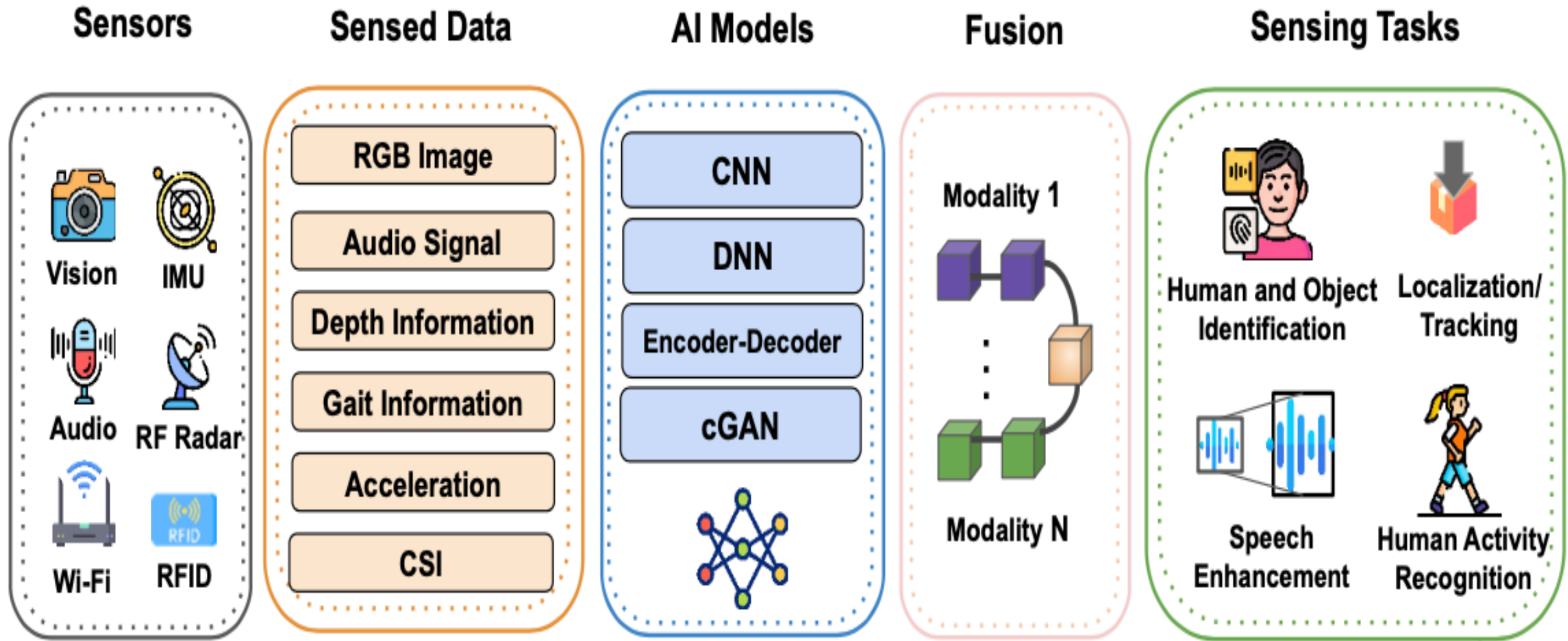
AIoT Systems for Healthcare and Well-being
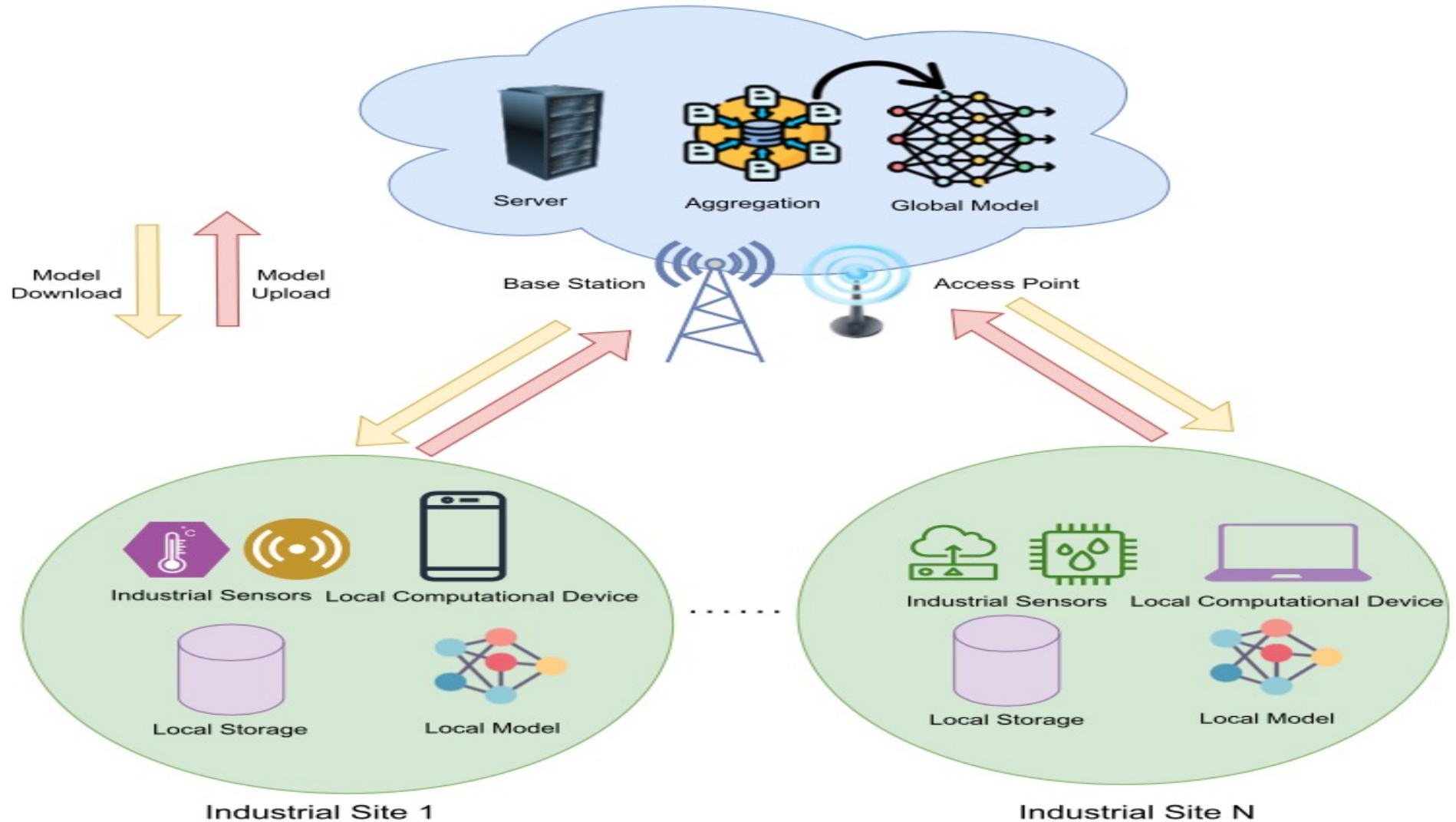
27

AIoT Systems for Autonomous Driving

28
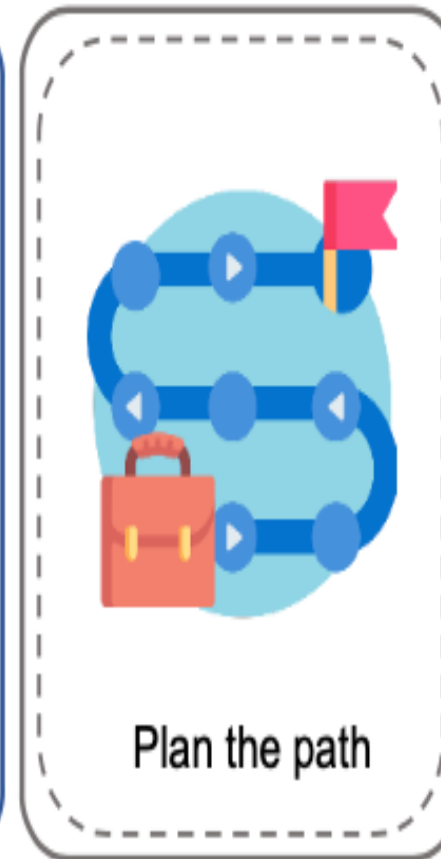
Federated Learning (FL) in Industrial AIoT enabled systems

Source: Kamran Sattar Awaisi, Qiang Ye, and Srinivas Sampalli (2024), "A Survey of Industrial AIoT: Opportunities, Challenges, and Directions", IEEE Access.

Key Applications of Industrial AIoT
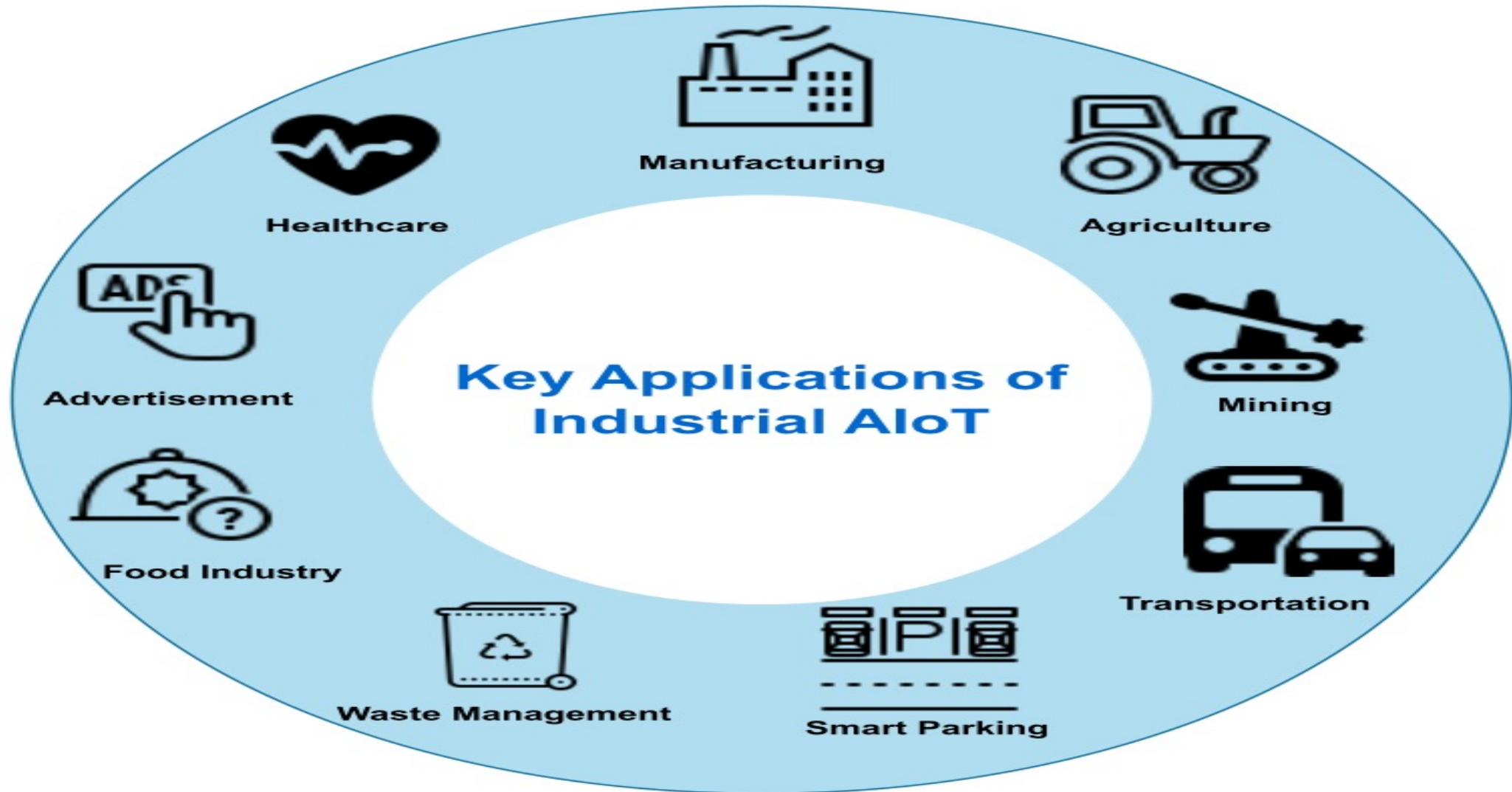
Industrial AIoT Enabled Real-time Manufacturing Industry

Production Lines → Real-time Equipment Monitoring → Data Analysis → Predictive Maintenance

Industrial AIoT Enabled Agriculture Industry
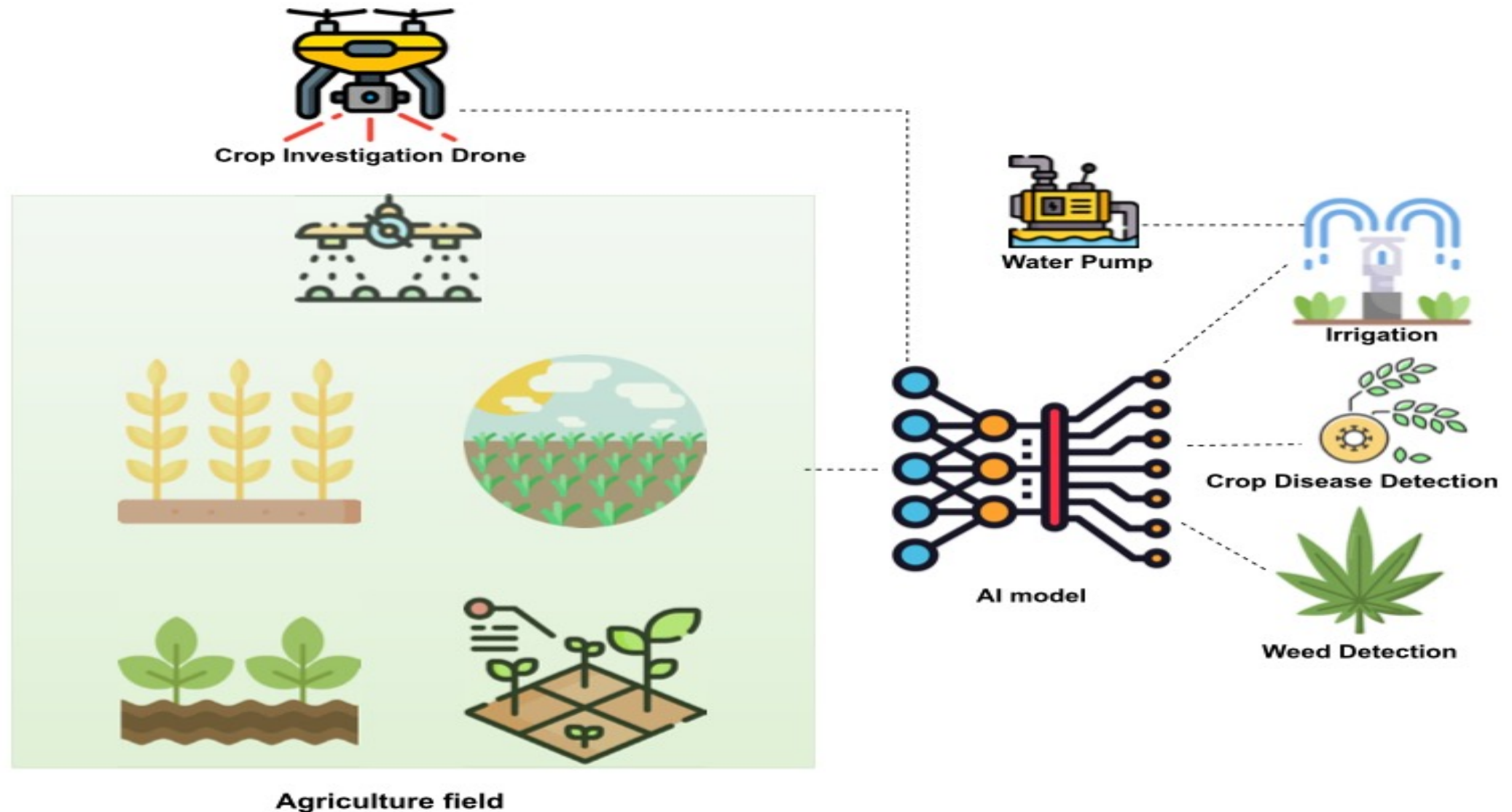
Industrial AIoT Enabled Transportation

Vehicle-to-Infrastructure (V2I)

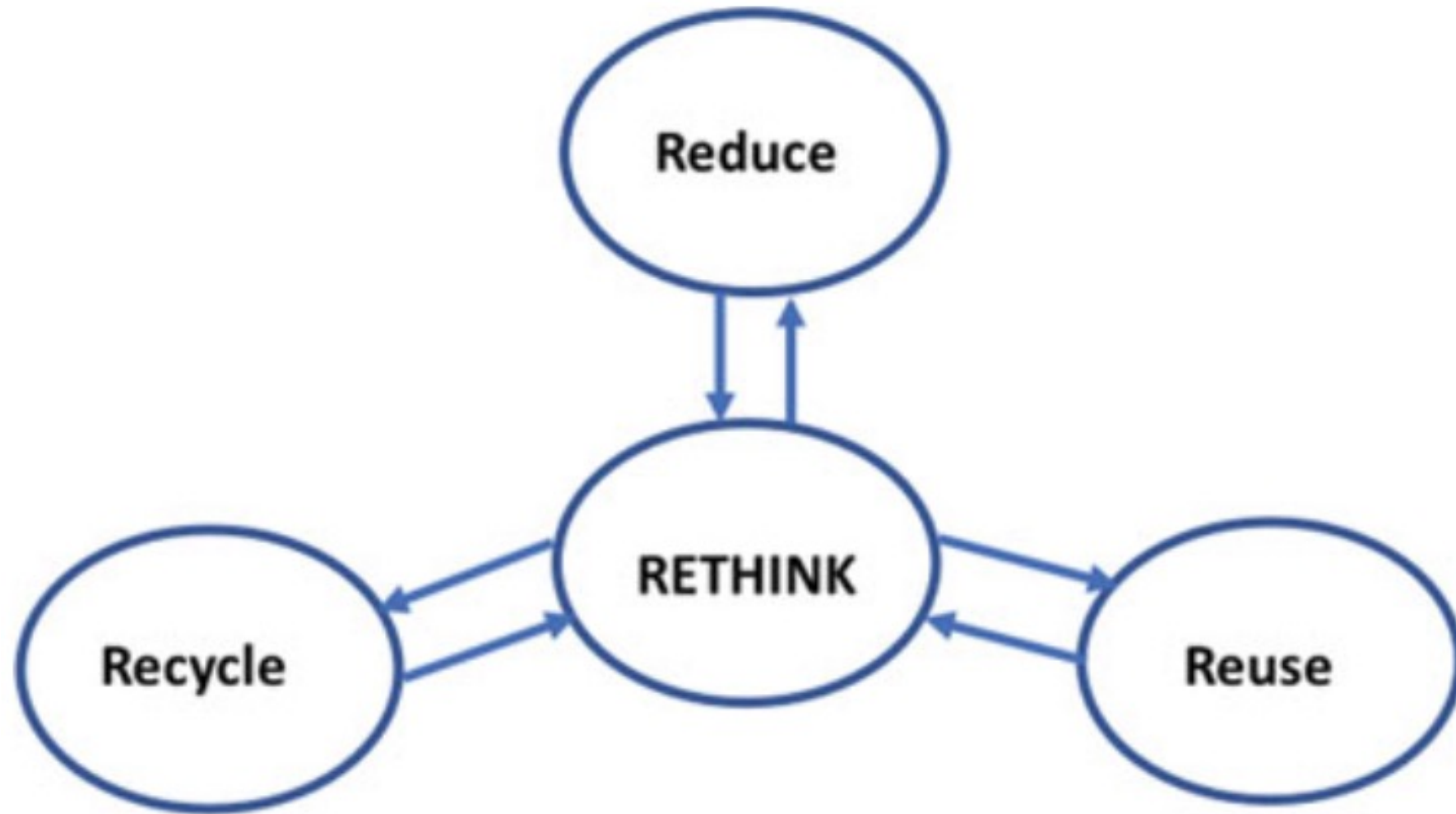Vehicle-to-vehicle (V2V)

Road Side Unit
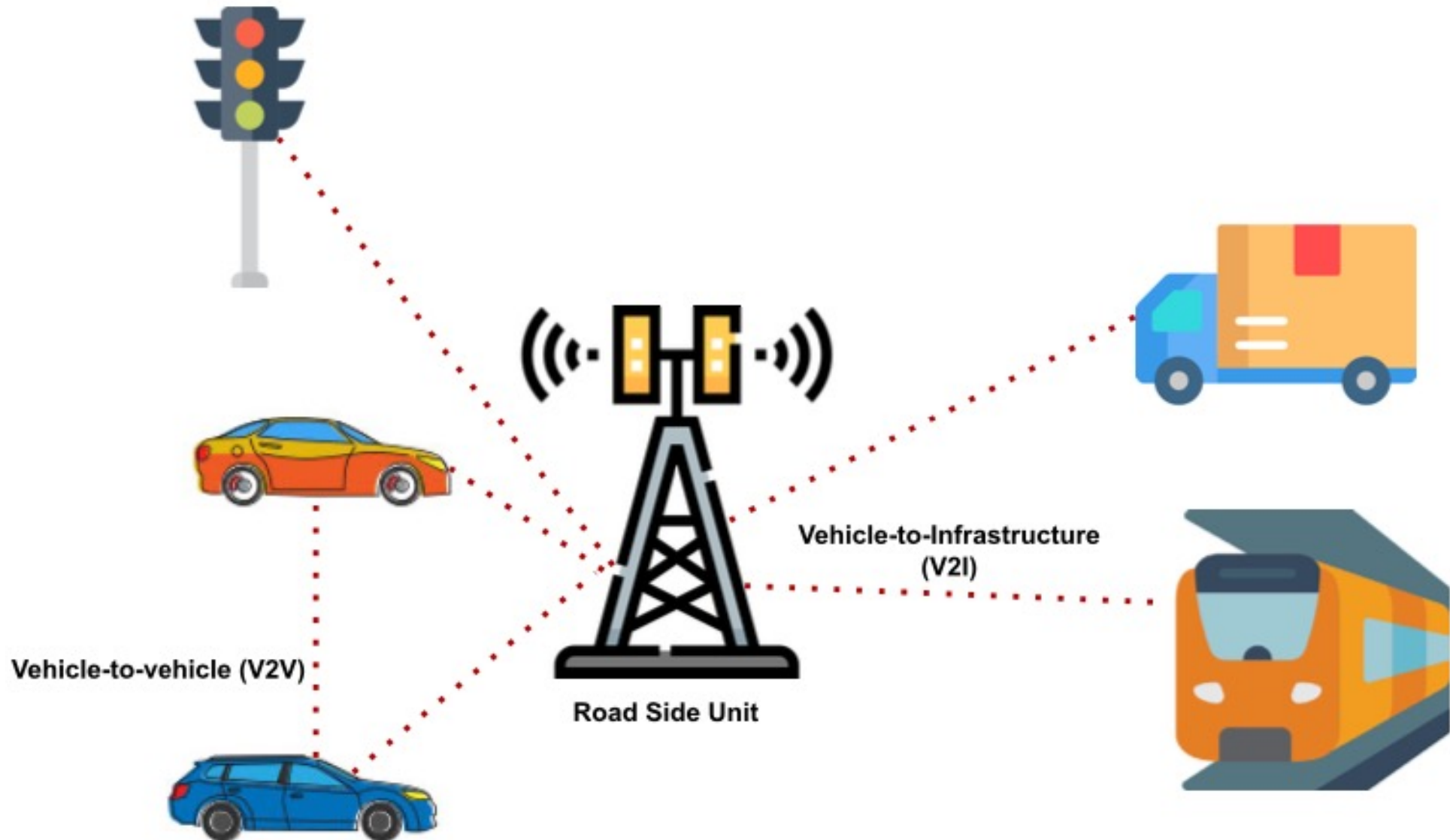
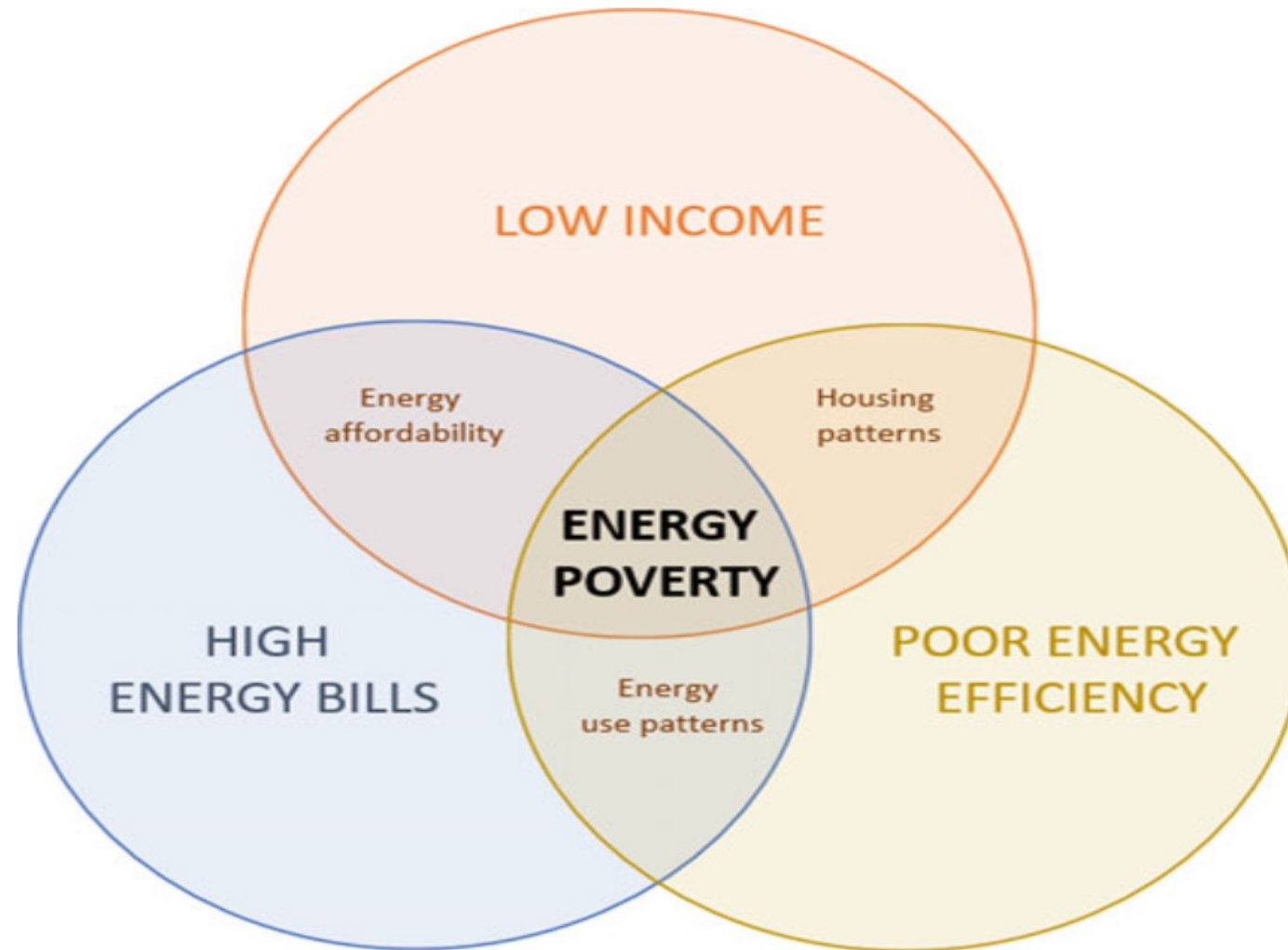# Industrial AIoT Enabled Healthcare
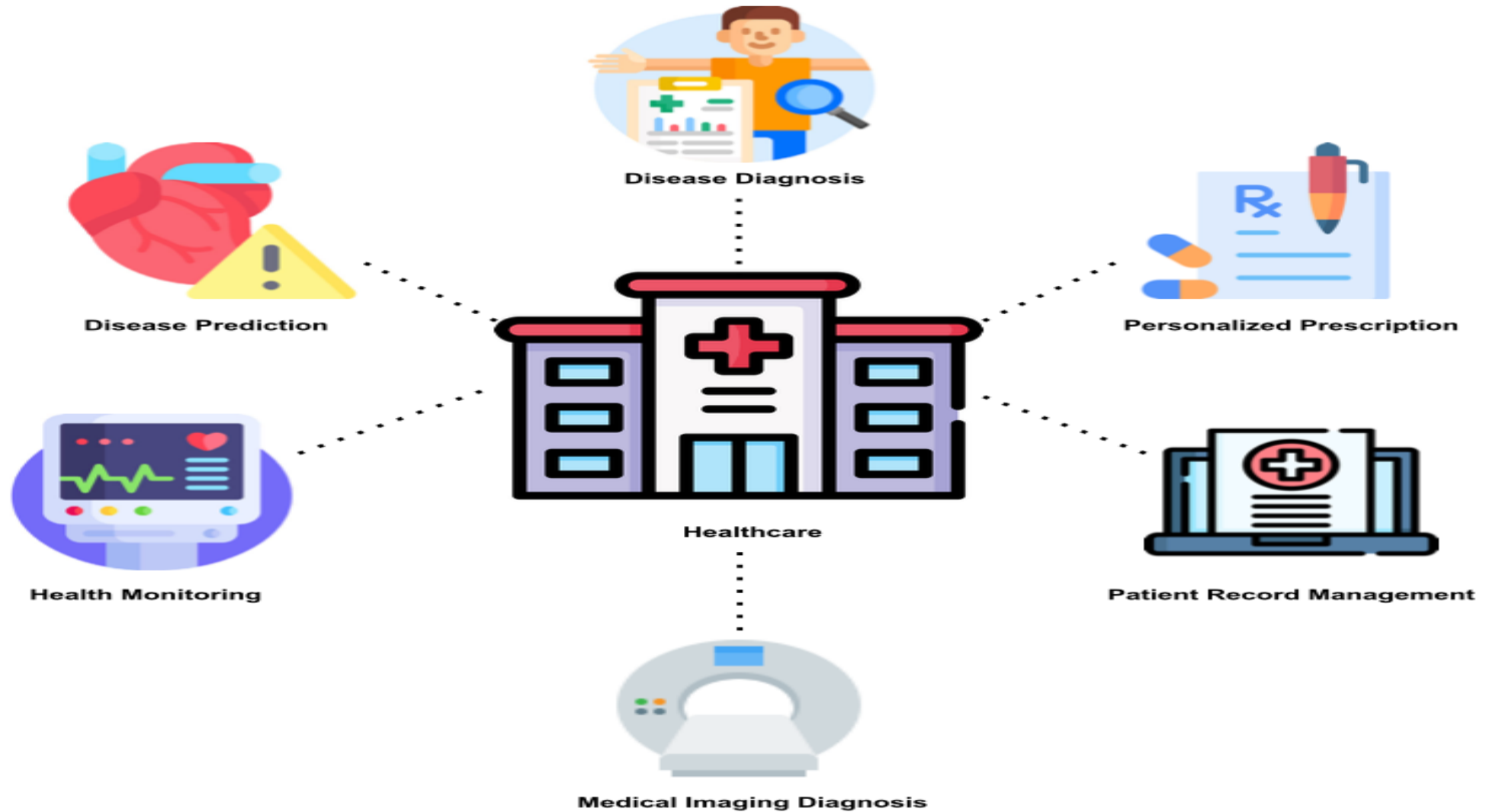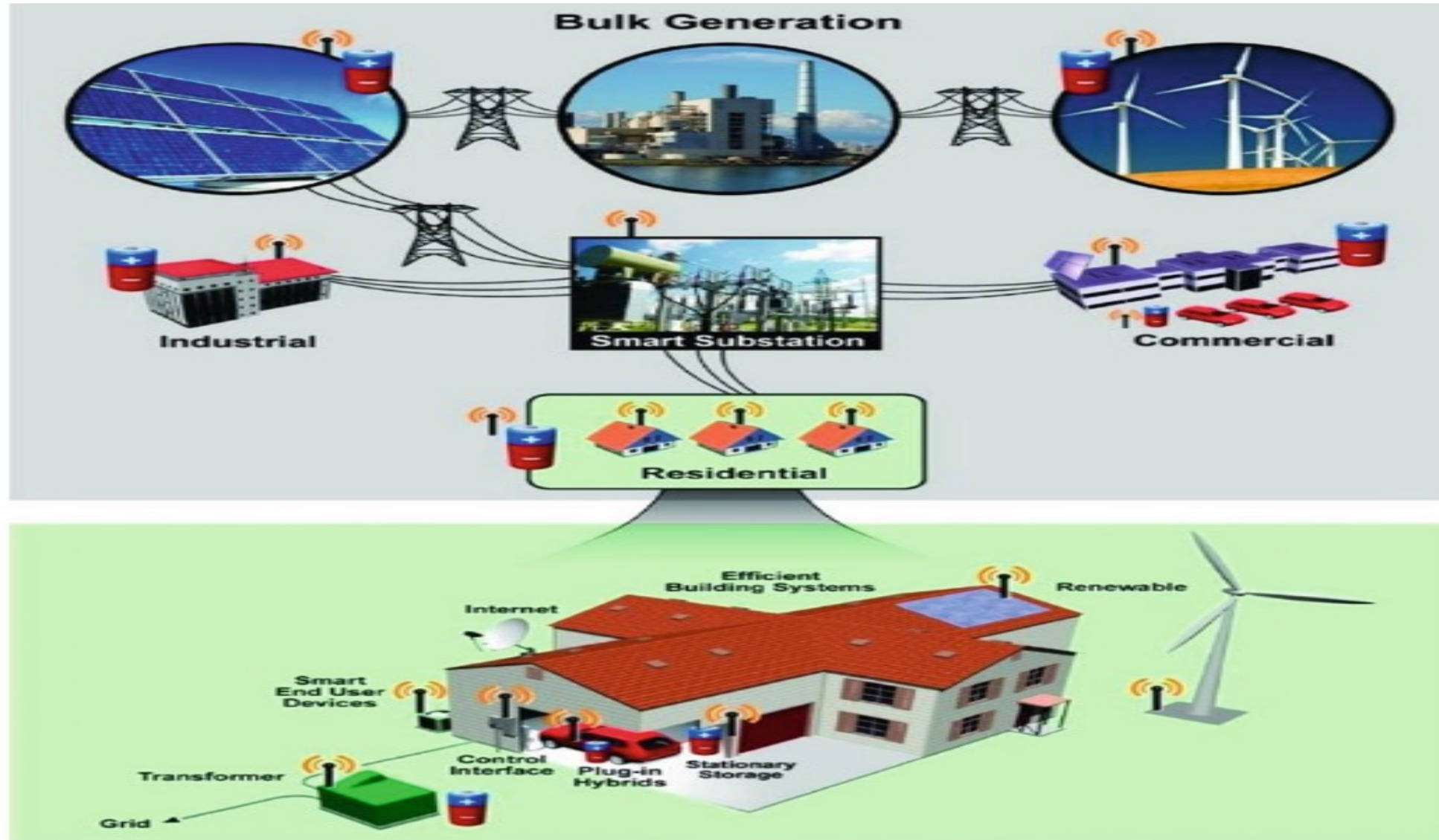
Industrial AIoT Challenges
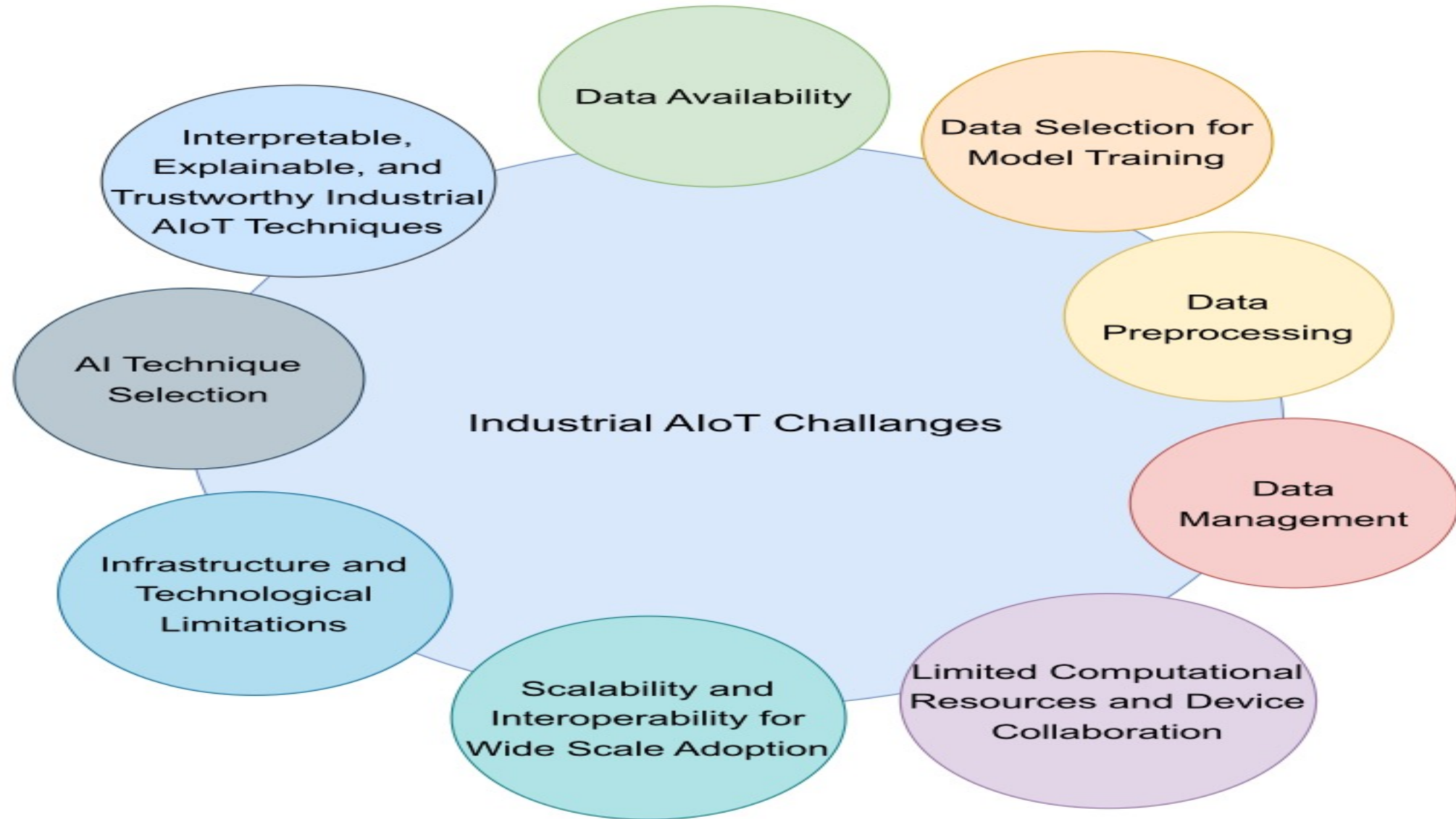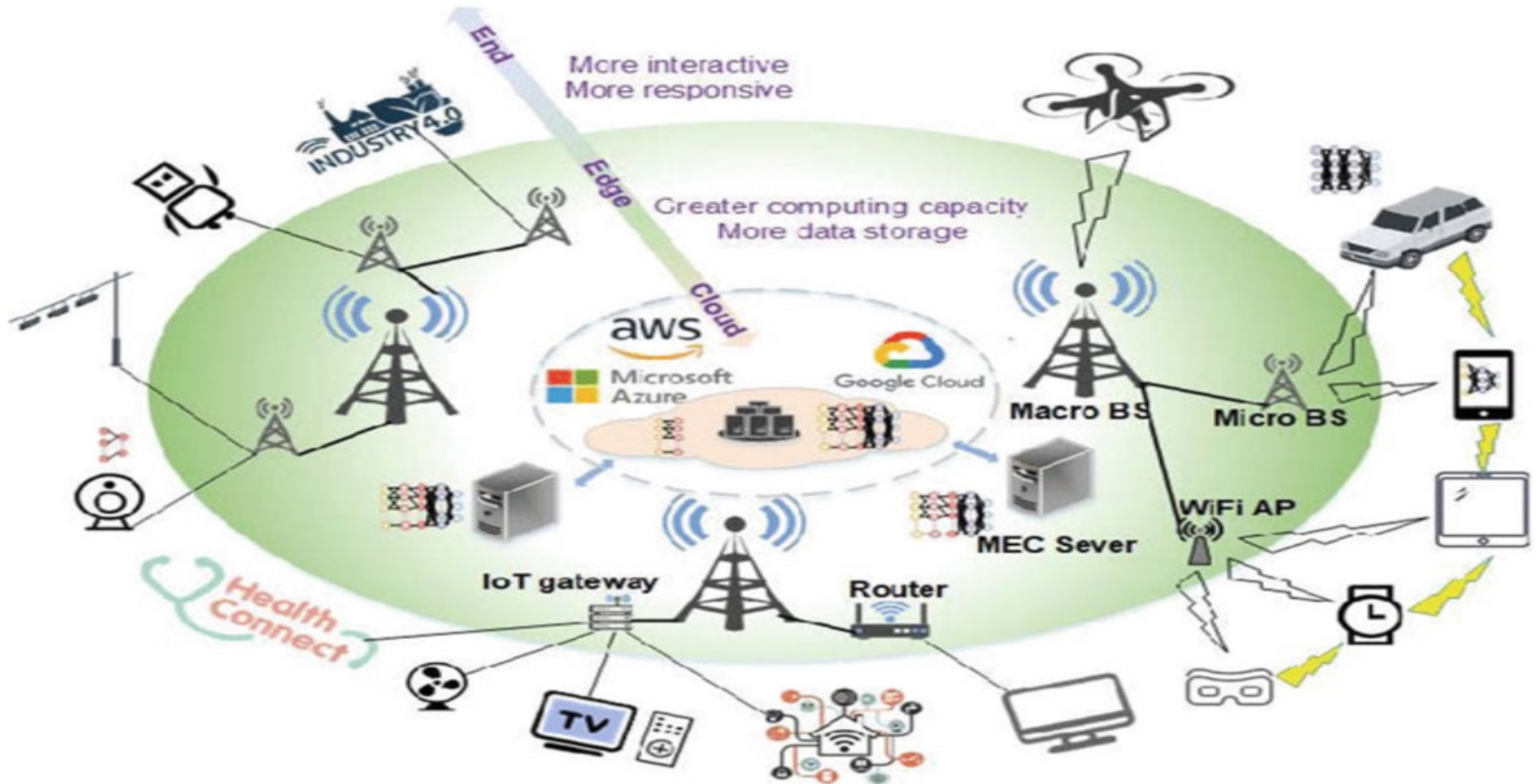
The 4R Sustainability Framework

Energy Poverty:
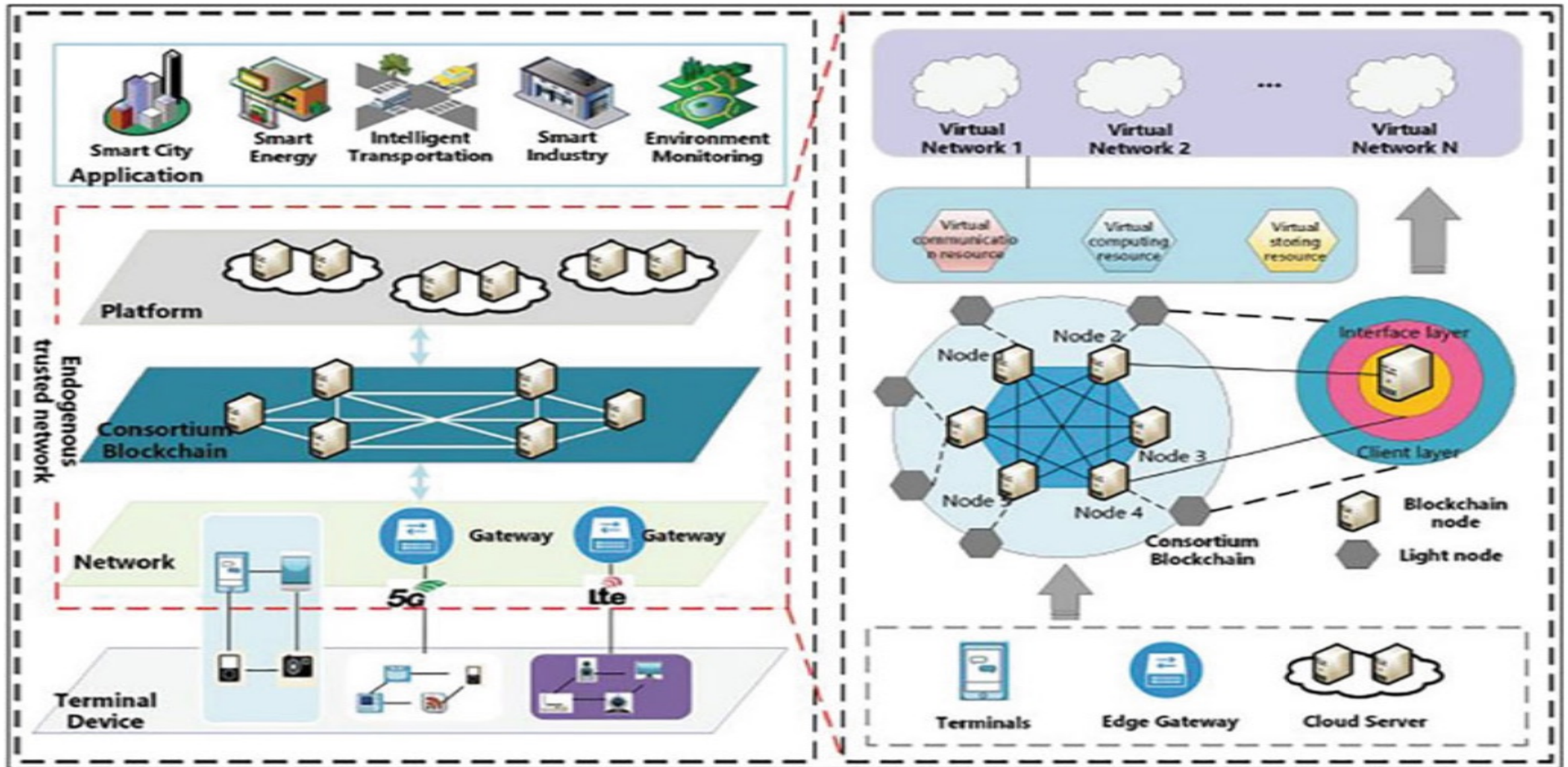# important drivers and key indications

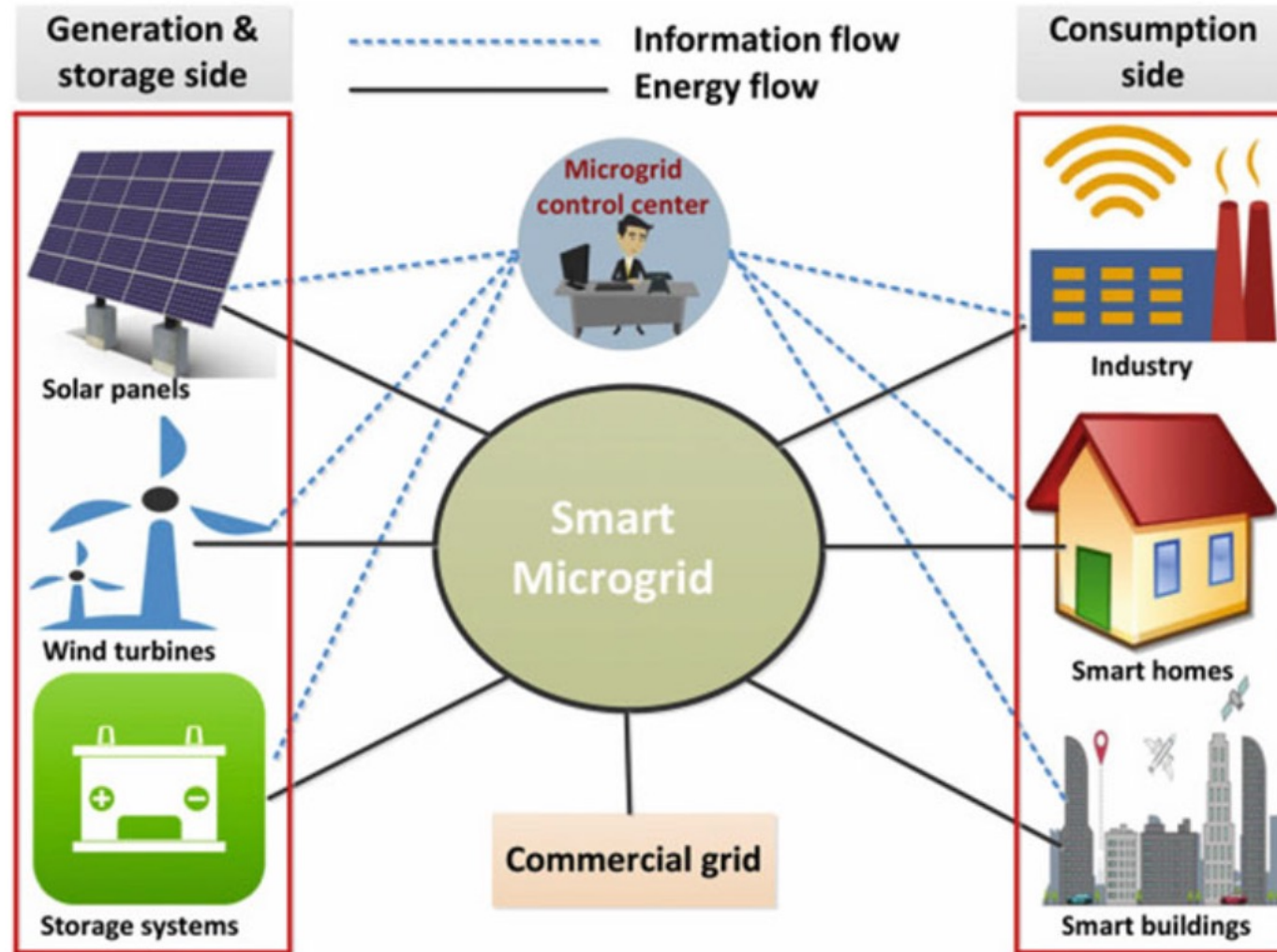# Overview of AIoT-enabled smart grids

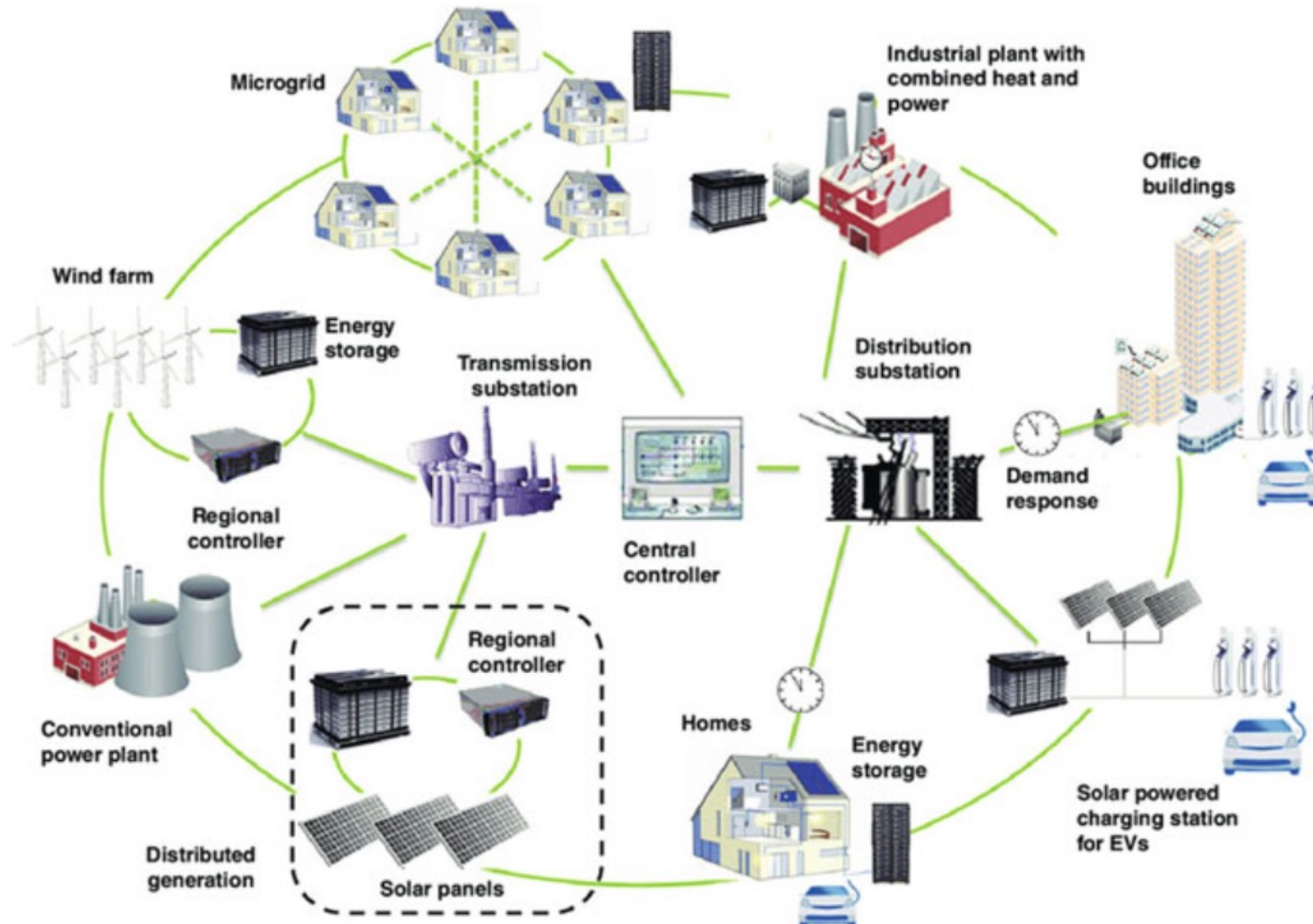# AIoT and its Application in Energy Systems

39

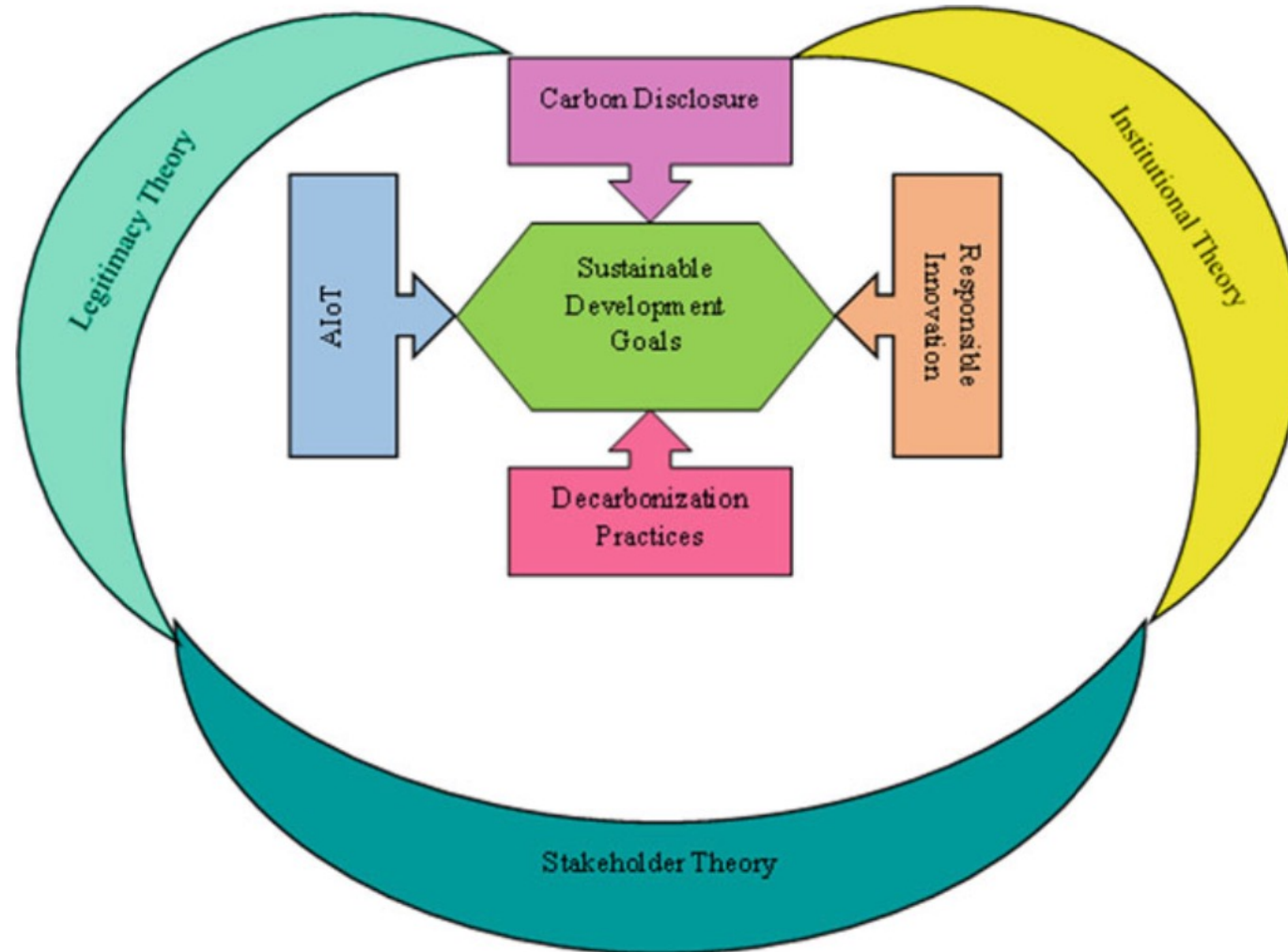# The AIoT-enabled Smart Grids Framework

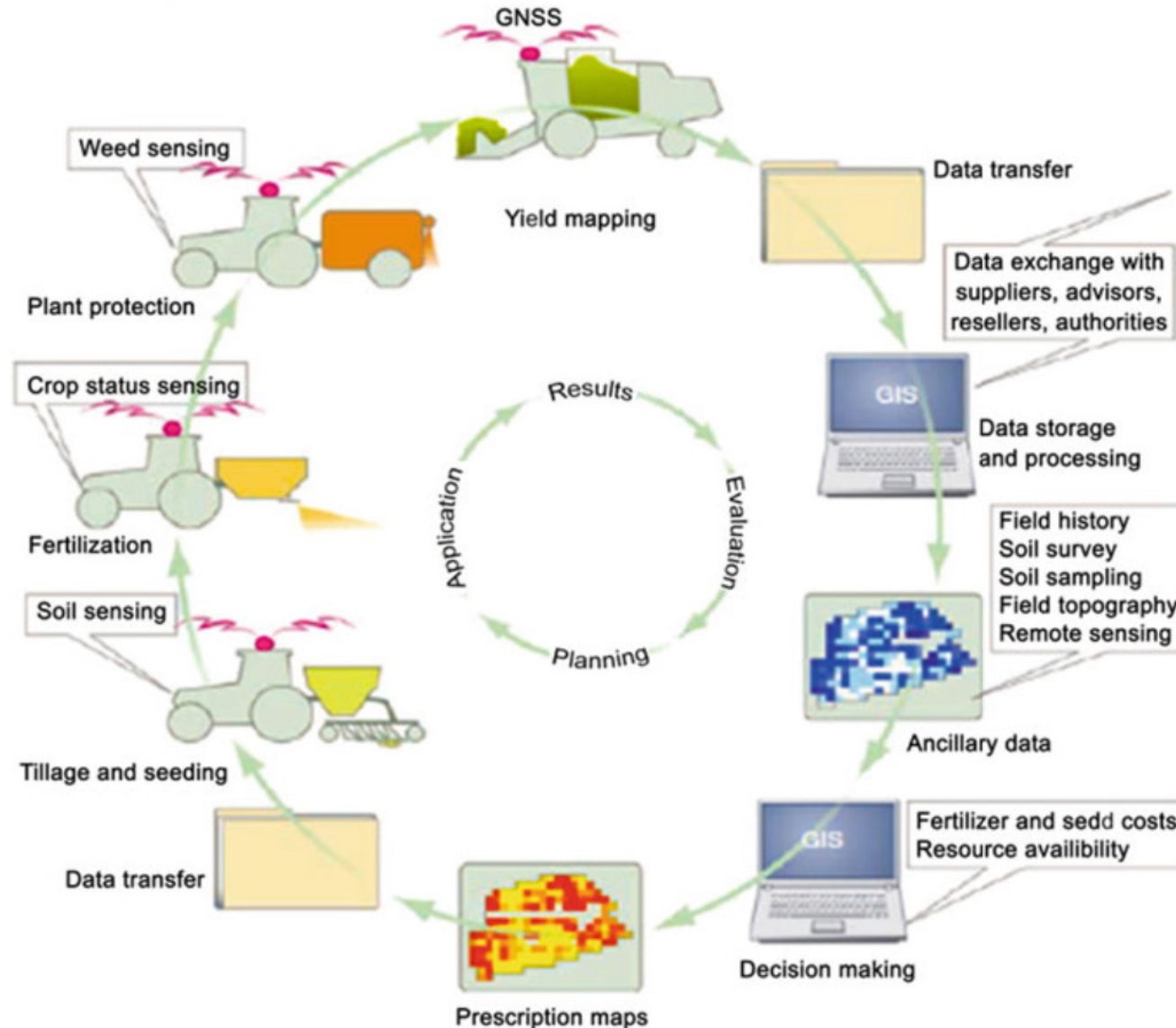# AIoT for forecasting and optimizing renewable energy generation

Smart grid control for grid stability with high renewables

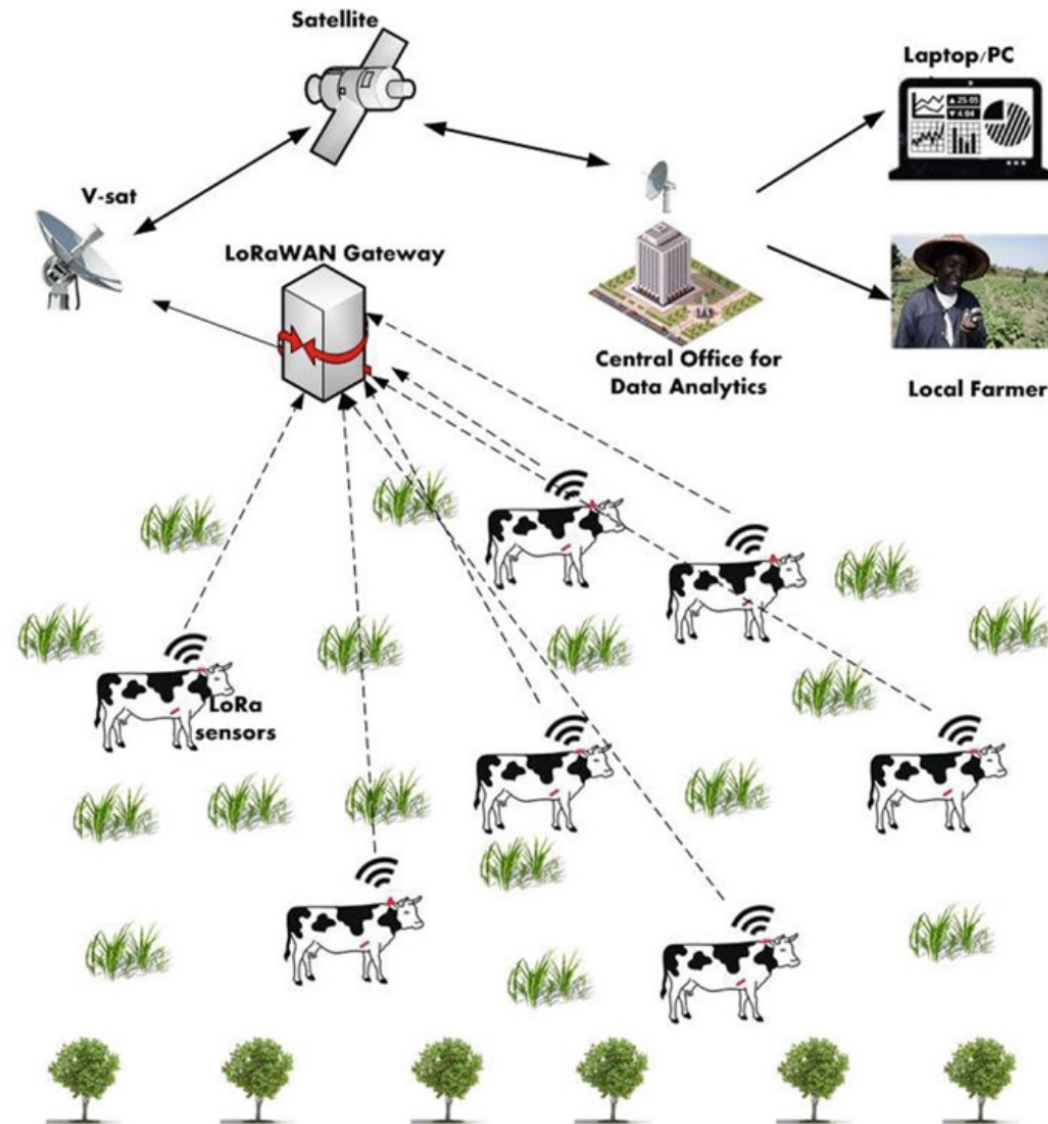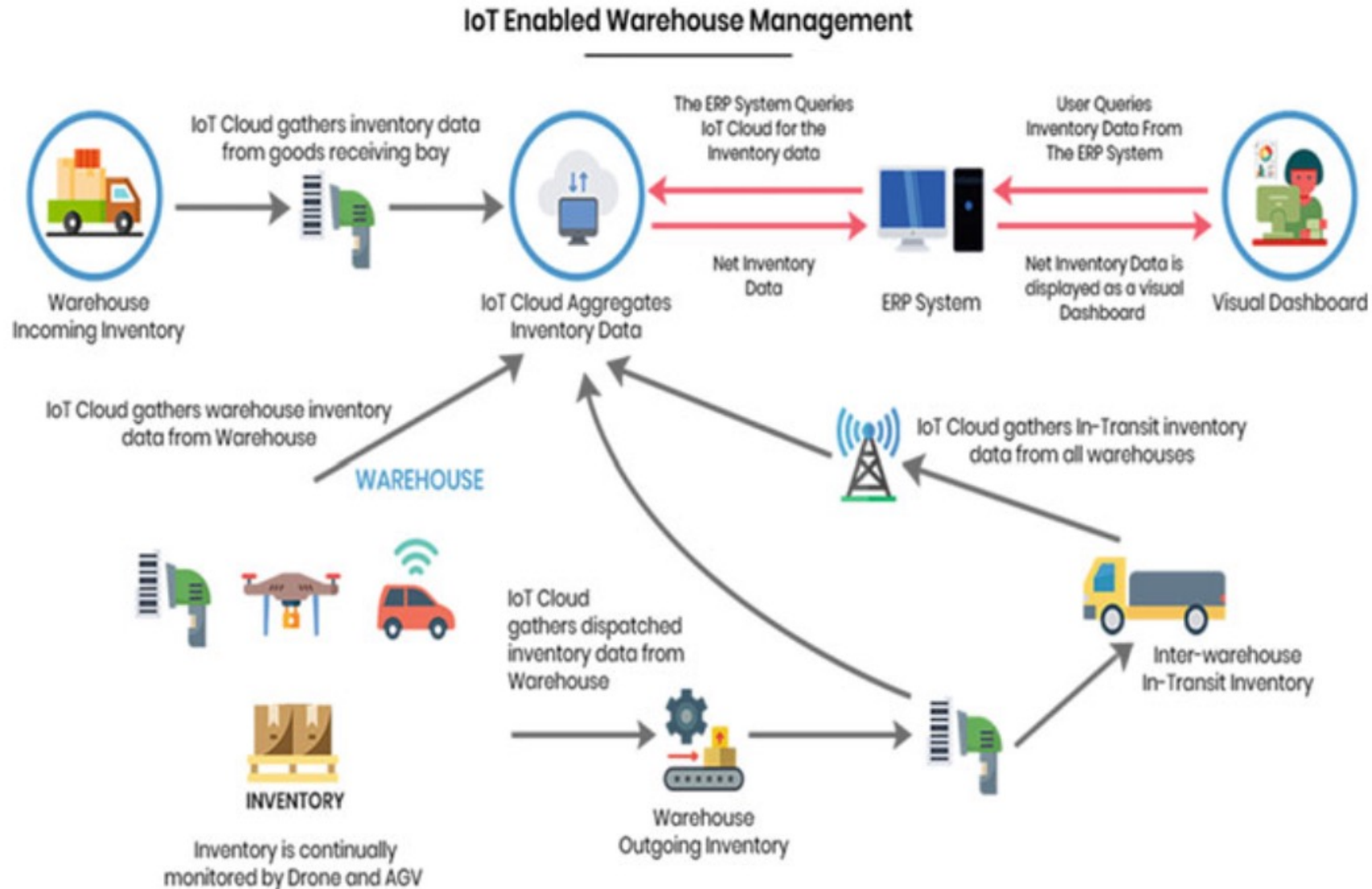# Conceptual framework of carbon disclosure and decarbonization practices with perspective of SDGs

The components of precision agriculture

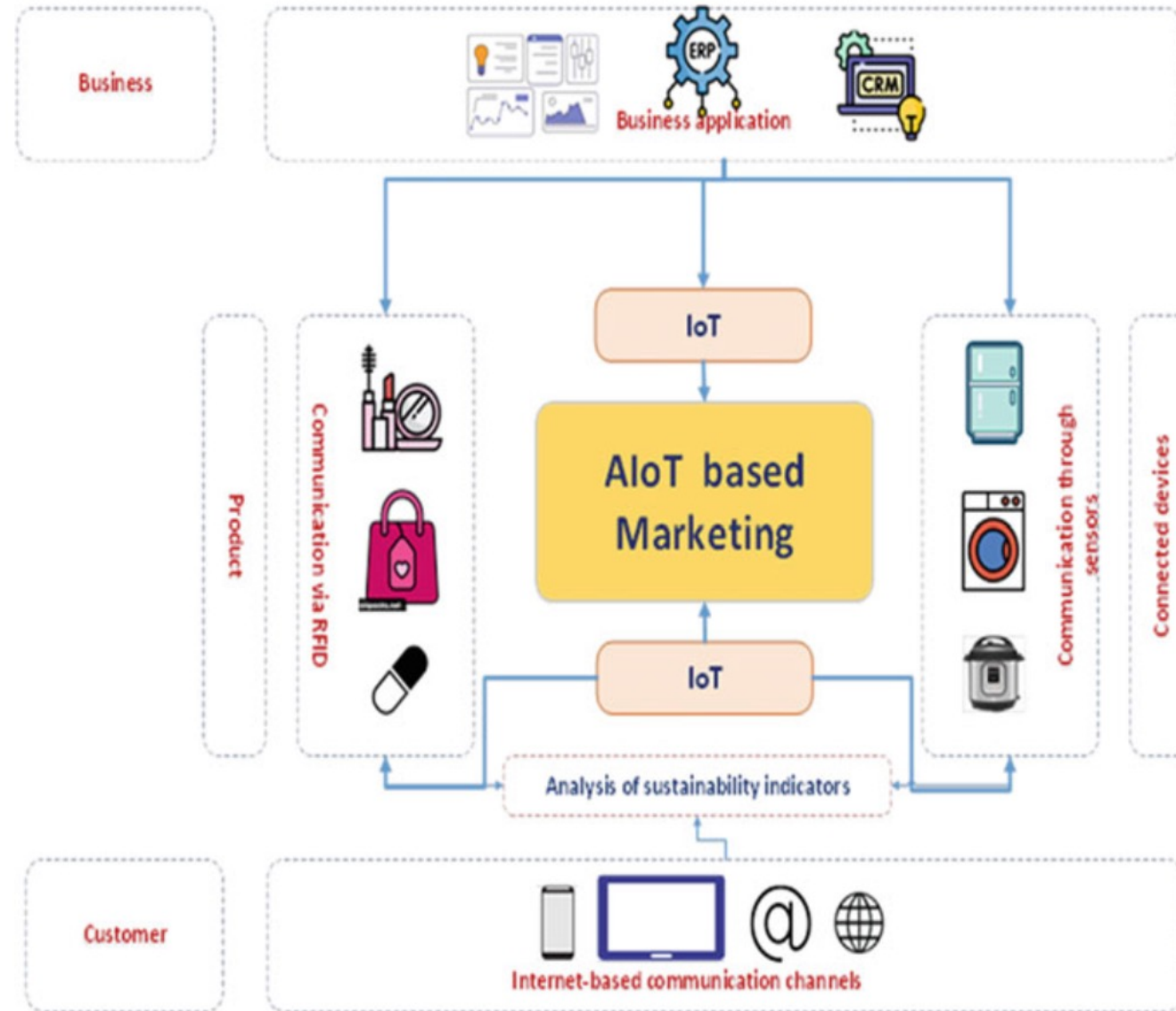# Livestock management and health monitoring

AIoT in food supply chain management

IoT Enabled Warehouse Management

AIoT-based Sustainable Marketing

IoT and AIoT for Sustainable Transportation
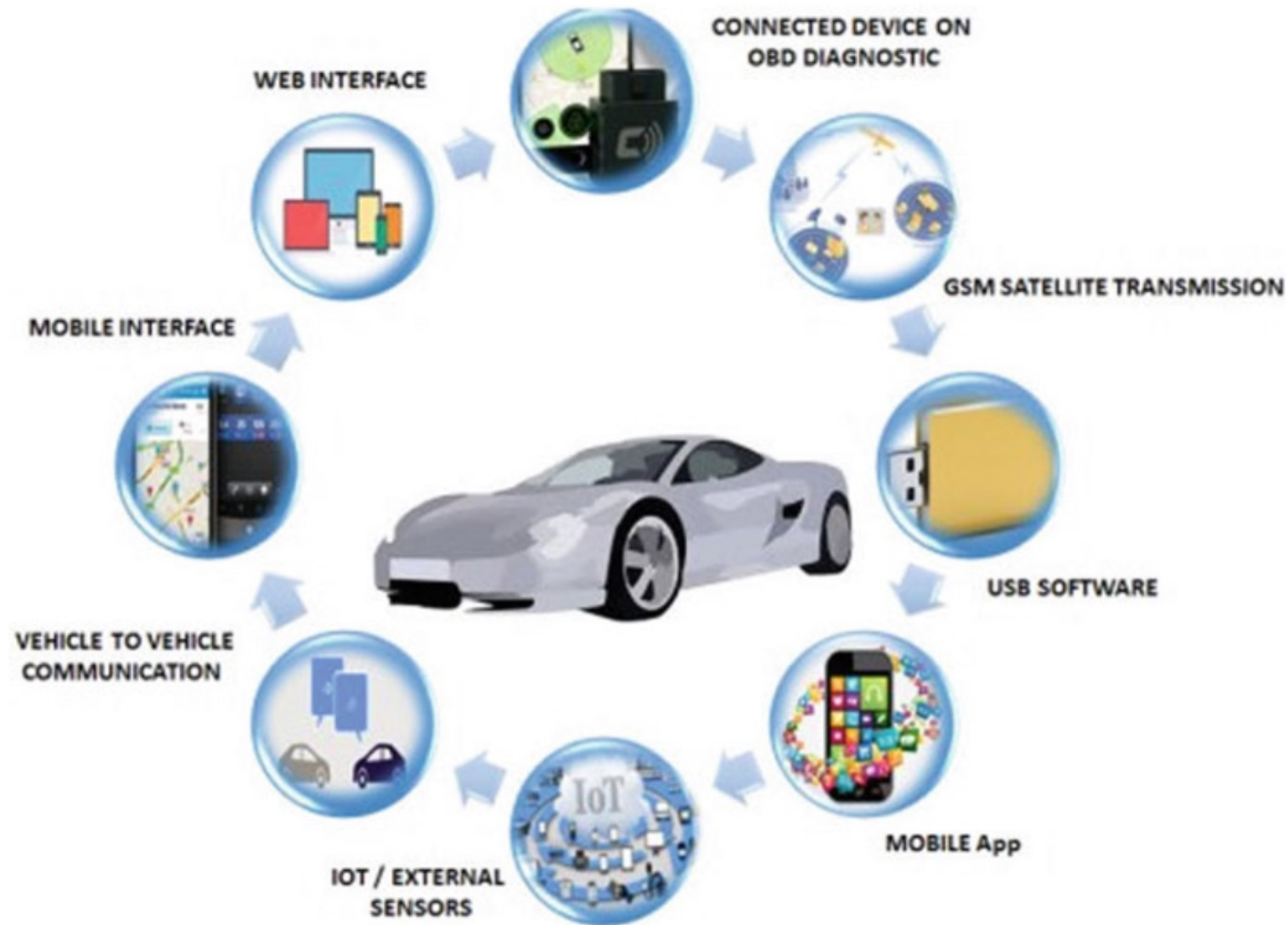
IoT-based traffic monitoring and congestion control

IoT-based Supply Chain

Producer → Physical distribution

Warehouse

Retail store

(2) (3)

(5)

(4)

Product ID —(1)→ IoT Data Base

Customer

1- Product Information
2- Information about Producer
3- Logistics Information
4- Selling Information
5- Information from final customer
6- Product status/Final decision

(6)

Supply chain Manager ← IoT System
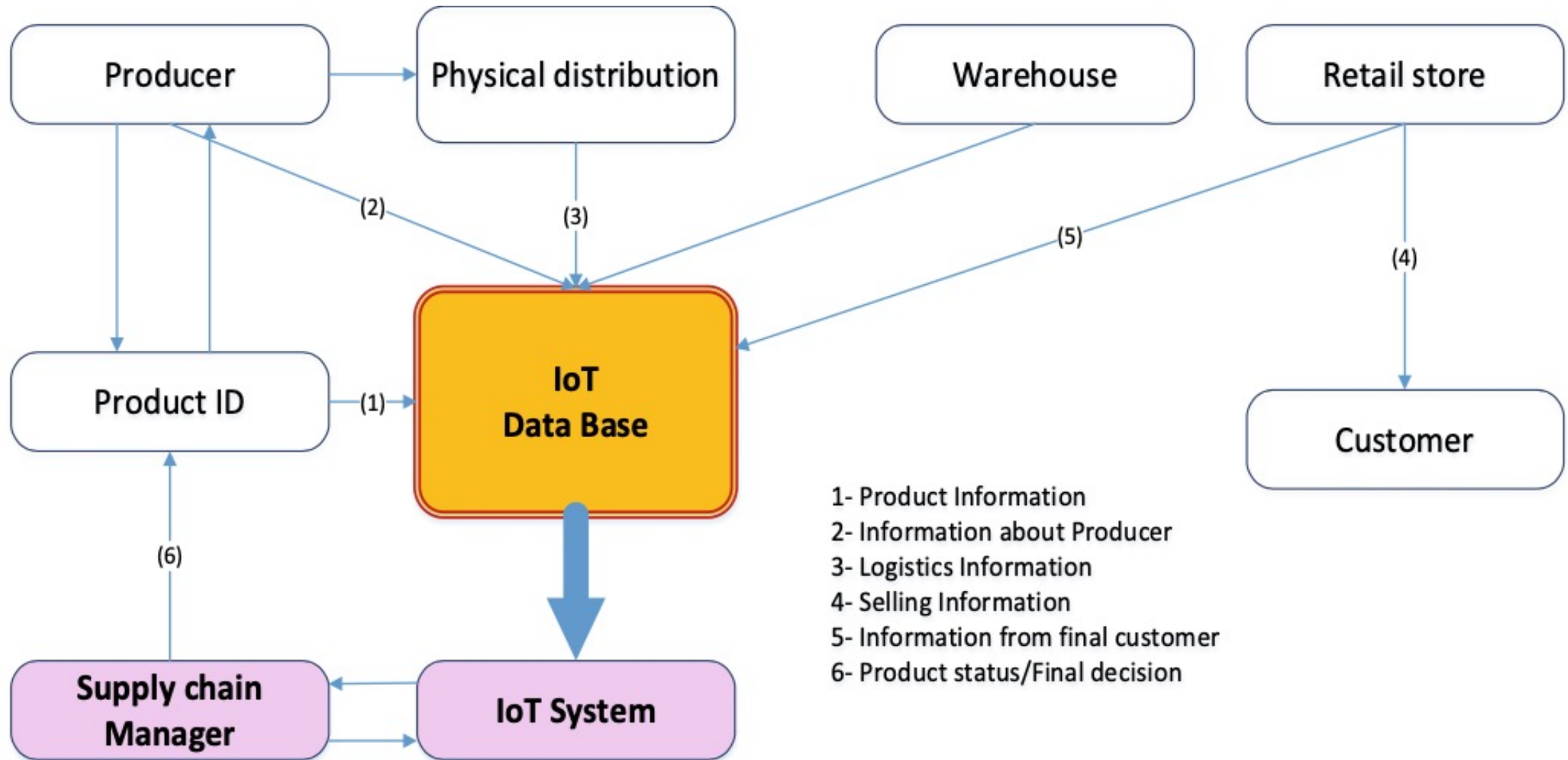
AIoT for Smart Logistics and Warehousing
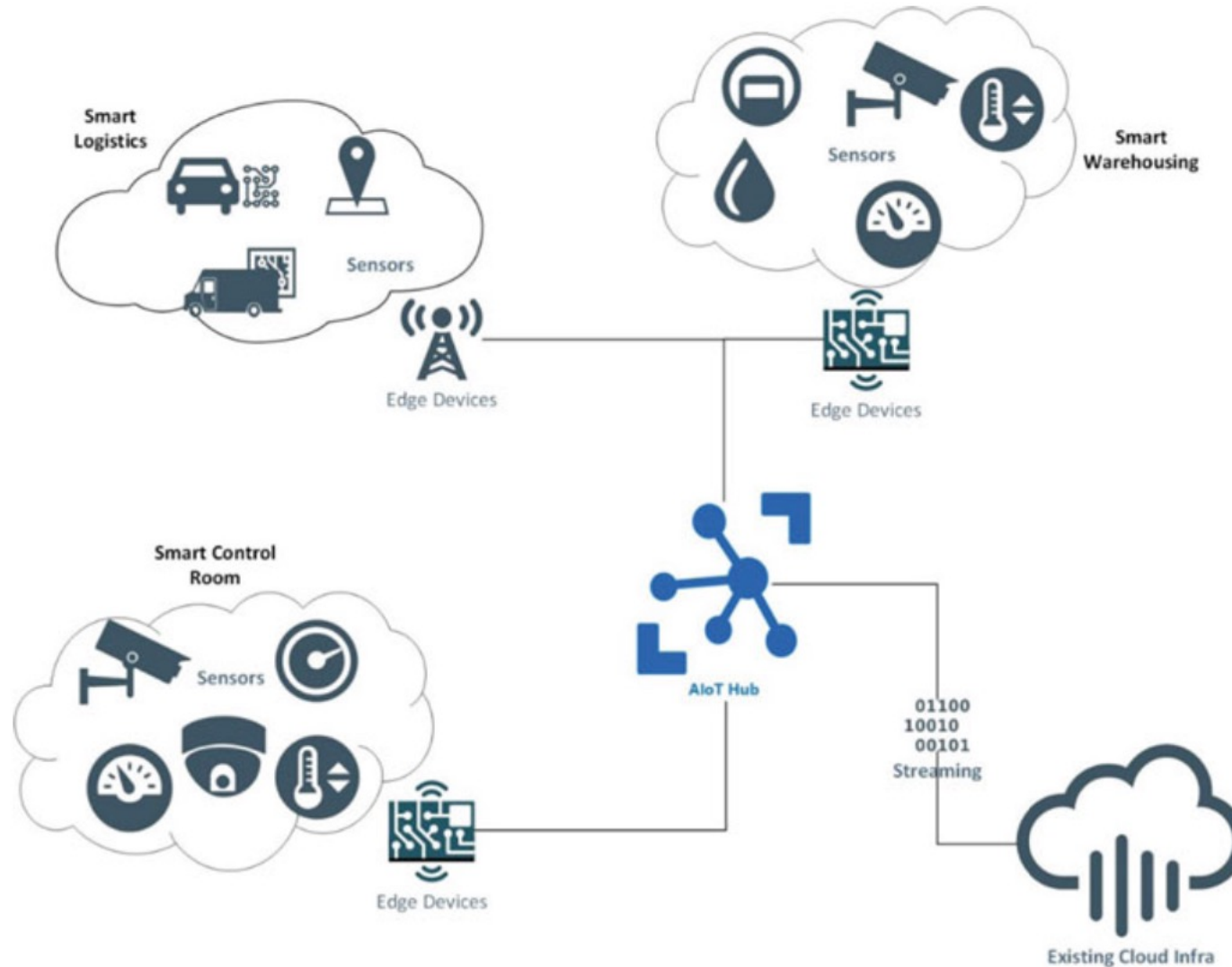
IoT-based Smart and Sustainable Supply Chain

Source: Sanjay Misra, Kerstin Siakas, Georgios Lampropoulos (2024), Artificial Intelligence of Things for Achieving Sustainable Development Goals, Springer
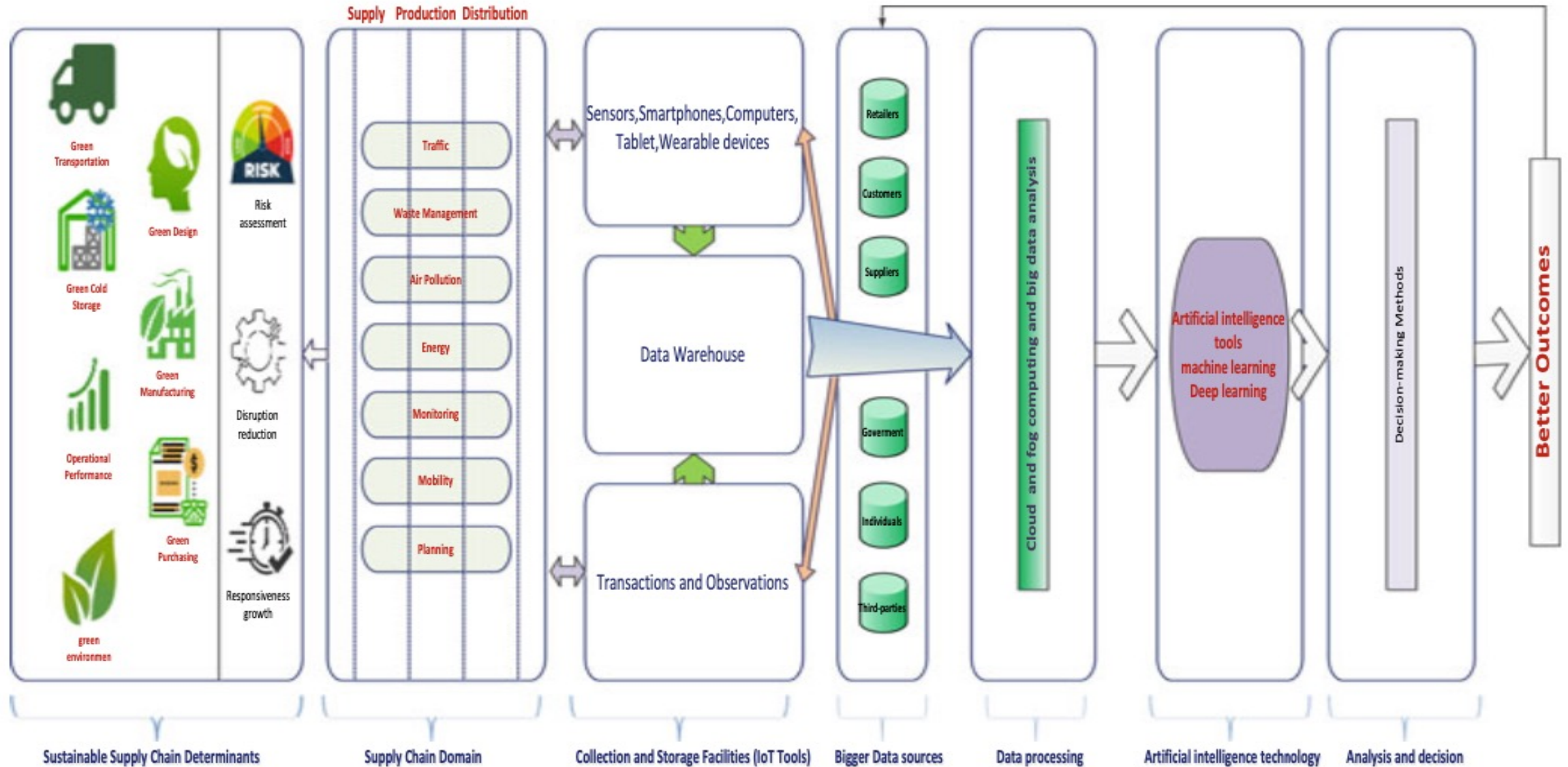
Environmental Impacts of Digitalization
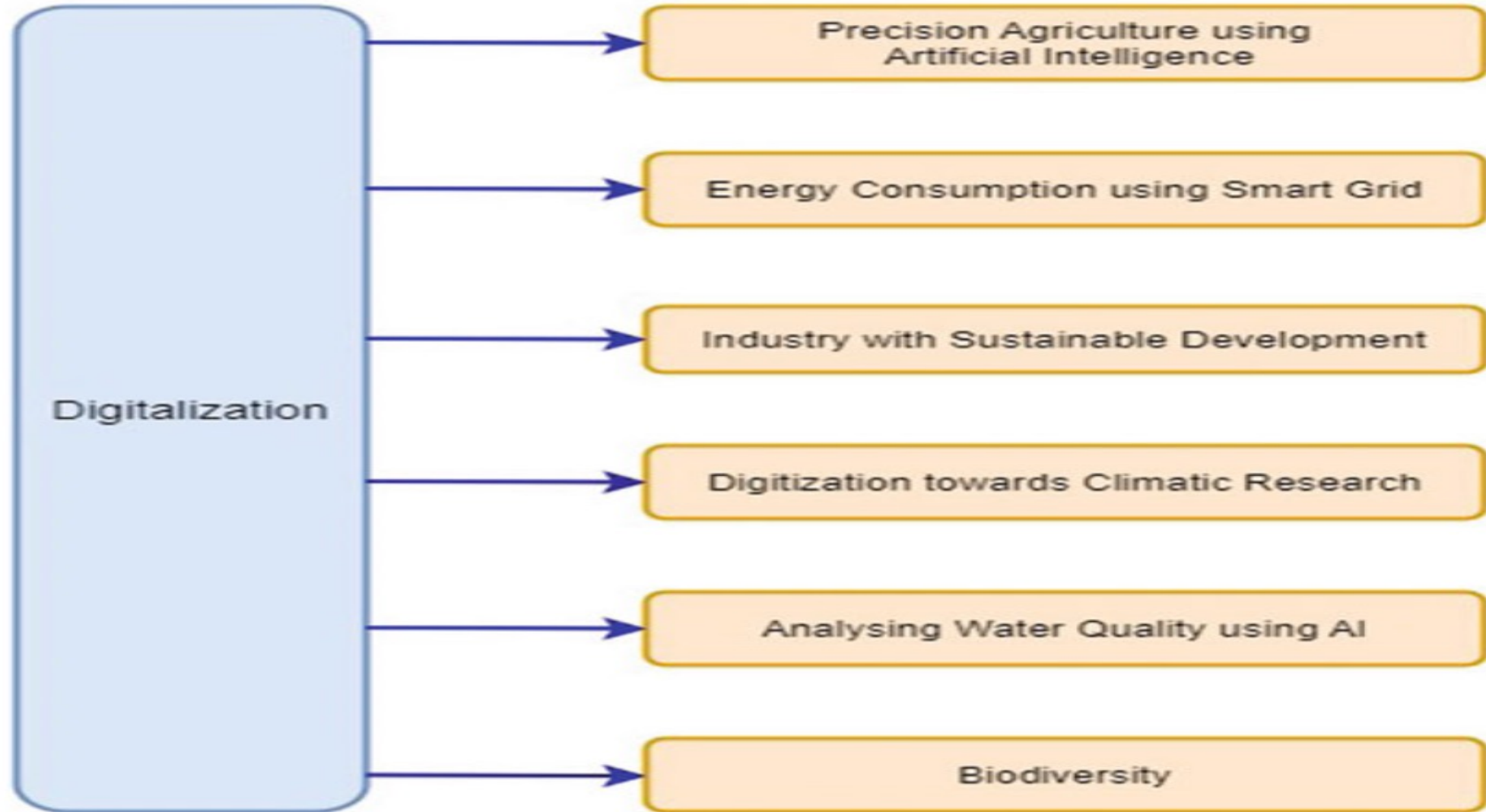
Common IoT Security Architecture
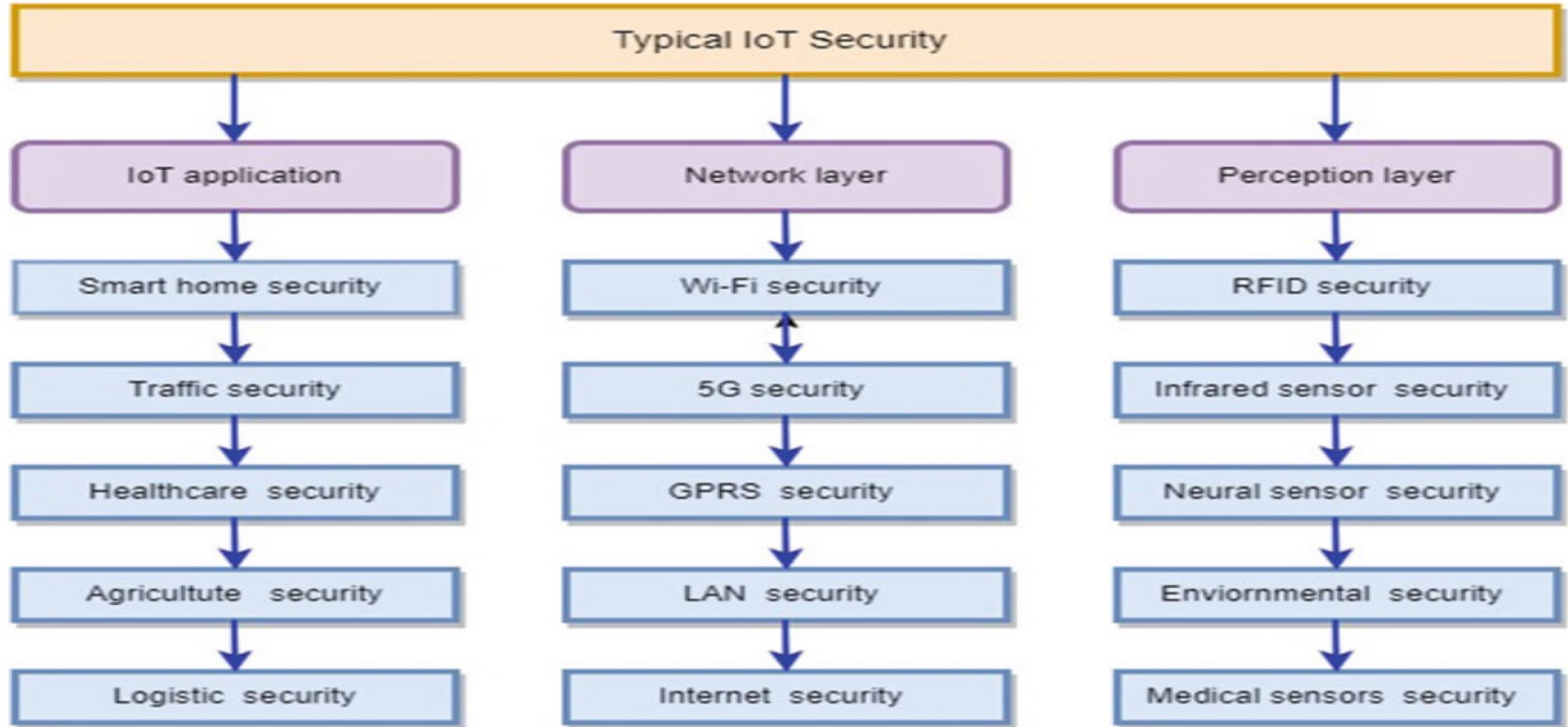
Security Measure for AIoT

The SDG drivers for AIOT

Summary

- **Artificial Intelligence of Things (AIoT)**

- **AIoT for ESG and Sustainability Applications**

References

- Sherry Madera (2024), Navigating Sustainability Data: How Organizations can use ESG Data to Secure Their Future, Kogan Page
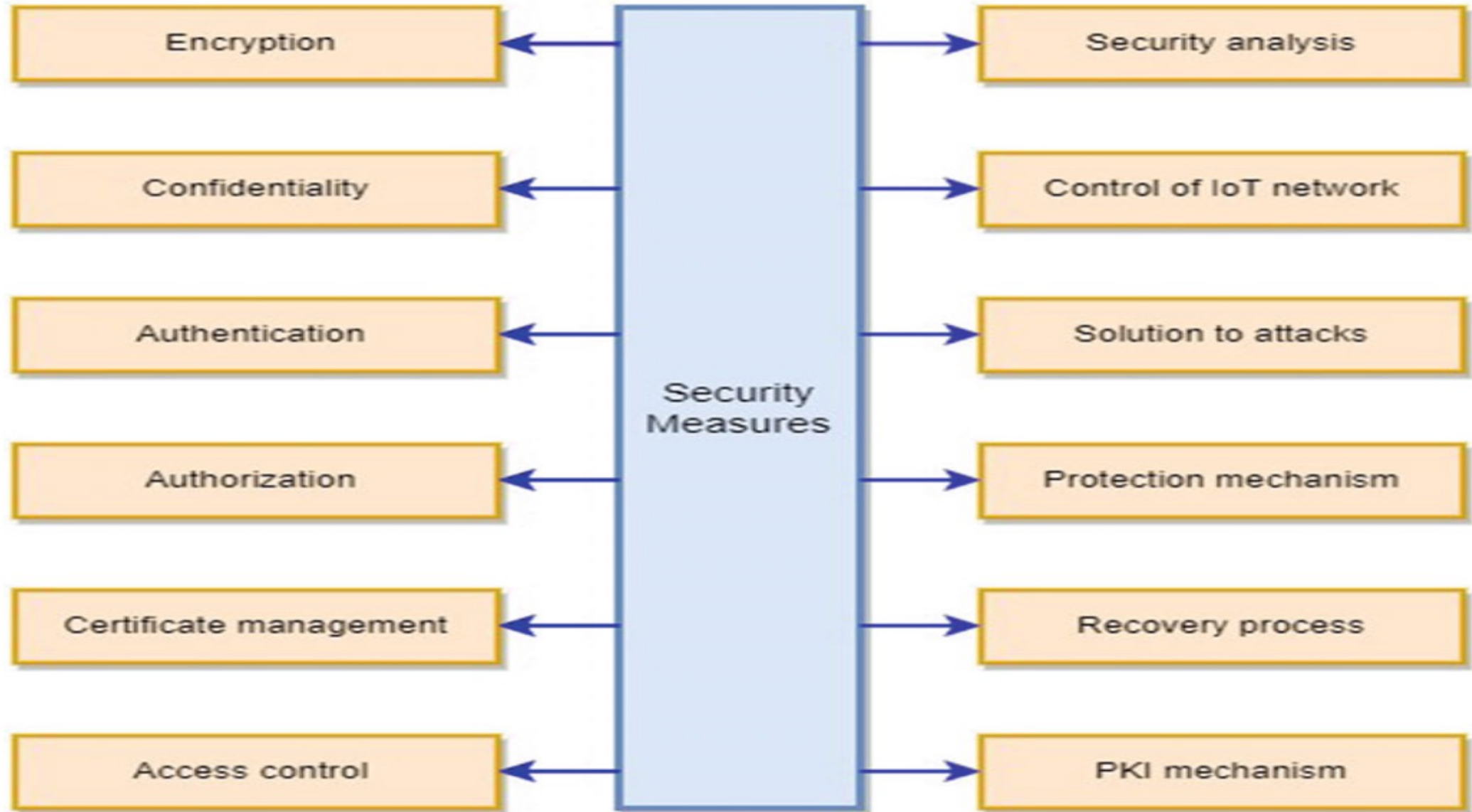- Simon Thompson (2023), Green and Sustainable Finance: Principles and Practice in Banking, Investment and Insurance, 2nd Edition, Kogan Page.
- Chrissa Pagitsas (2023), Chief Sustainability Officers At Work: How CSOs Build Successful Sustainability and ESG Strategies, Apress.
- Wes McKinney (2022), "Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter", 3rd Edition, O'Reilly Media.
- Cino Robin Castelli, Cyril Shmatov (2022), Quantitative Methods for ESG Finance, Wiley
- Simon Thompson (2023), Green and Sustainable Finance: Principles and Practice in Banking, Investment and Insurance, 2nd Edition, Kogan Page.
- Chrissa Pagitsas (2023), Chief Sustainability Officers At Work: How CSOs Build Successful Sustainability and ESG Strategies, Apress.
- Shakhrul Iman Siam, Hyunho Ahn, Li Liu, Samiul Alam, Hui Shen, Zhichao Cao, Ness Shroff, Bhaskar Krishnamachari, Mani Srivastava, and Mi Zhang (2024), "Artificial Intelligence of Things: A Survey", ACM Transactions on Sensor Networks, https://doi.org/10.1145/3690639
- Kamran Sattar Awaisi, Qiang Ye, and Srinivas Sampalli (2024), "A Survey of Industrial AIoT: Opportunities, Challenges, and Directions", IEEE Access.
- Sanjay Misra, Kerstin Siakas, and Georgios Lampropoulos (2024), Artificial Intelligence of Things for Achieving Sustainable Development Goals, Springer
- Min-Yuh Day (2024), Python 101, https://tinyurl.com/aintpupython101