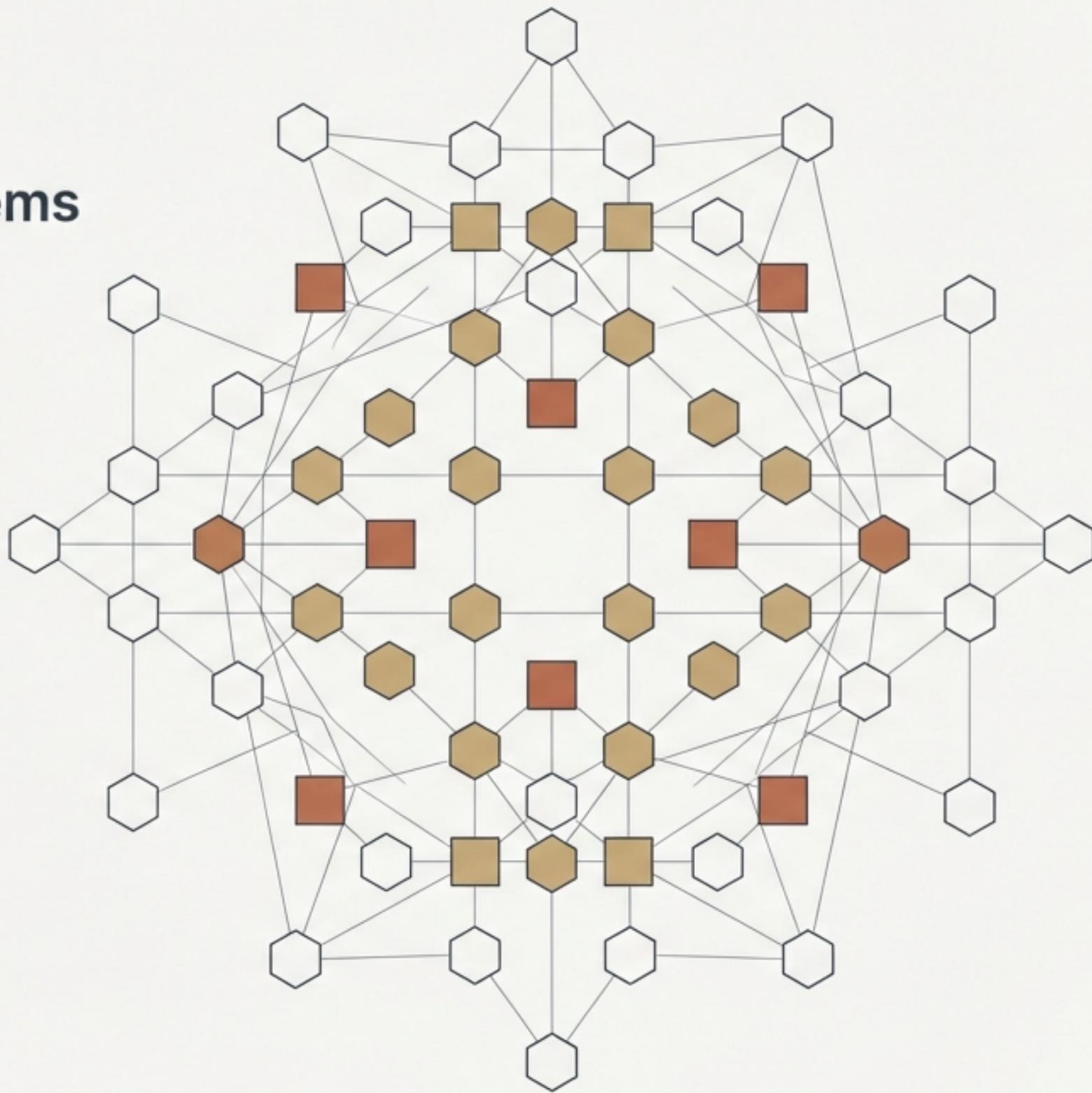


# ATOMIC Lab

Auto-Trajectory Oriented Micro-systems  
for Intelligent Coordination



ATOMIC Lab

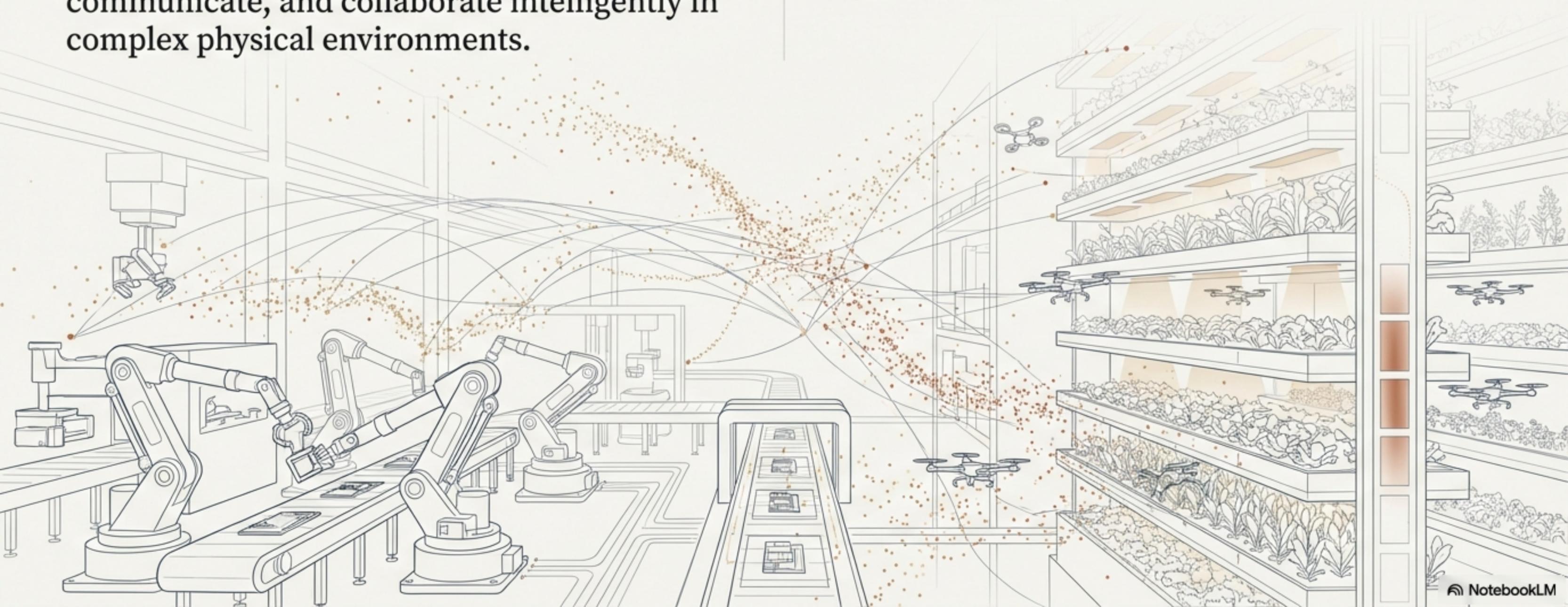


HONG KONG  
UNIVERSITY OF SCIENCE  
AND TECHNOLOGY  
(GUANGZHOU)

# Our Vision: The AI-enabled Internet of Micro-Things

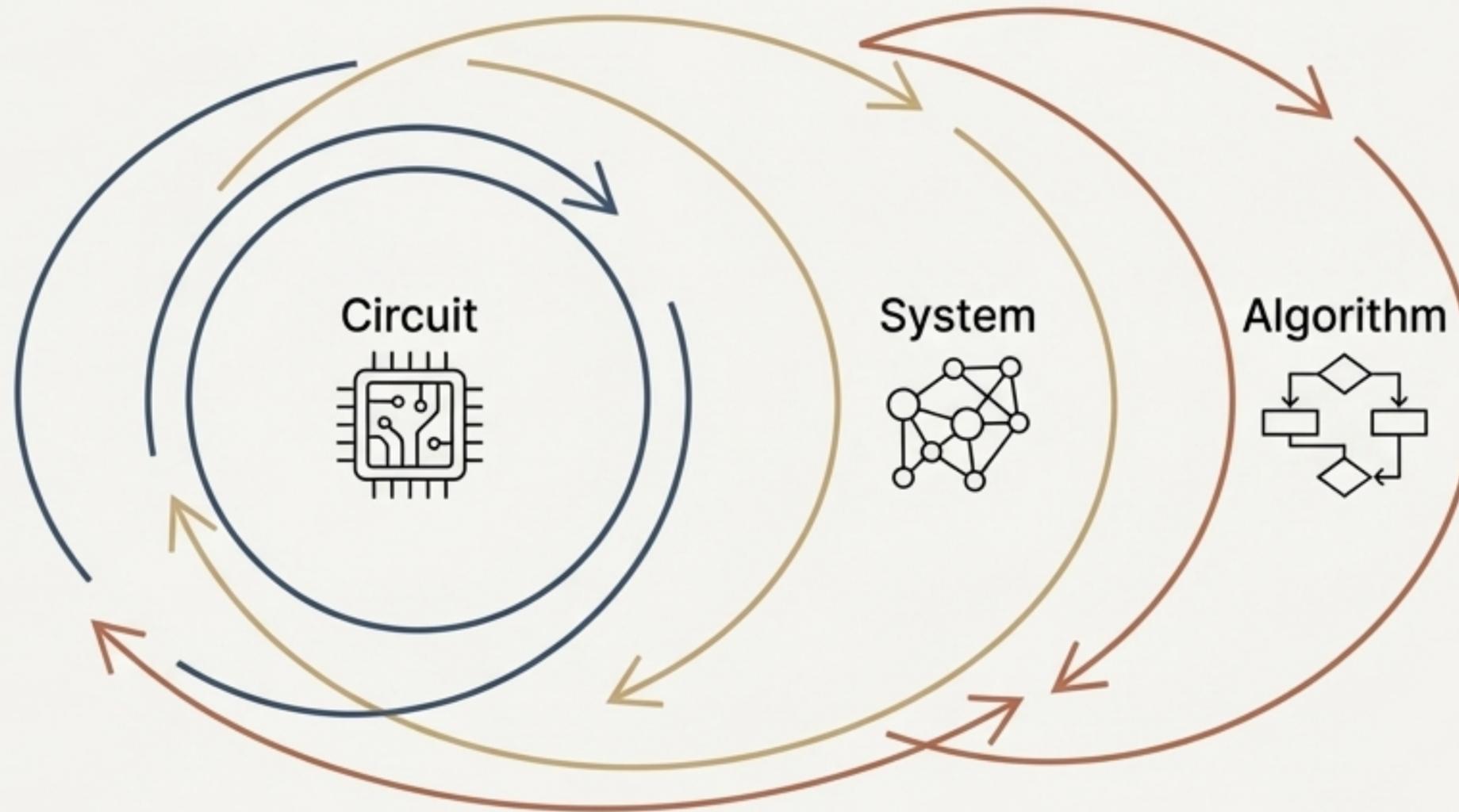
Our long-term vision is to enable large numbers of constrained devices and robots with varied footprints to sense, communicate, communicate, and collaborate intelligently in complex physical environments.

This represents a new paradigm where distributed intelligent systems are deeply integrated with micro-electronics, wireless networking, sensing, and autonomous robotics.



# Our Blueprint: A Unified Circuit–System–Algorithm Co-Design

ATOMIC Lab emphasizes a tightly coupled **circuit–system–algorithm** co-design approach.

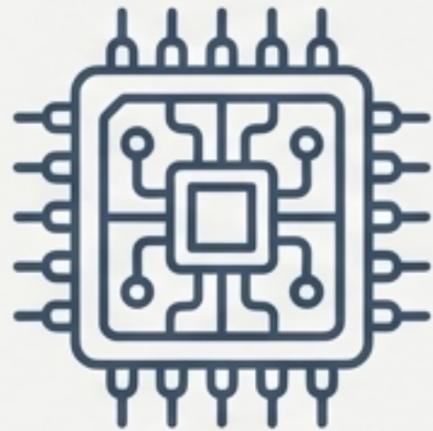


We validate our ideas through real hardware prototypes, system-level integration, and experimental deployments rather than simulation alone.

# Bringing the Vision to Life: Our Core Research Pillars

Our system-oriented research focuses on ultra-low-power intelligent platforms that are scalable, infrastructure-less, and capable of cooperative intelligence under real-world constraints. Our work spans from micro-chip design to robotic coordination.

## The Foundation



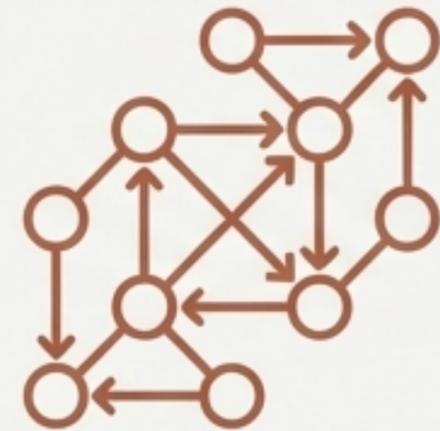
The physical hardware and communication fabric that form the bedrock of our systems.

## The Senses



How our distributed systems perceive, orient, and navigate the physical world.

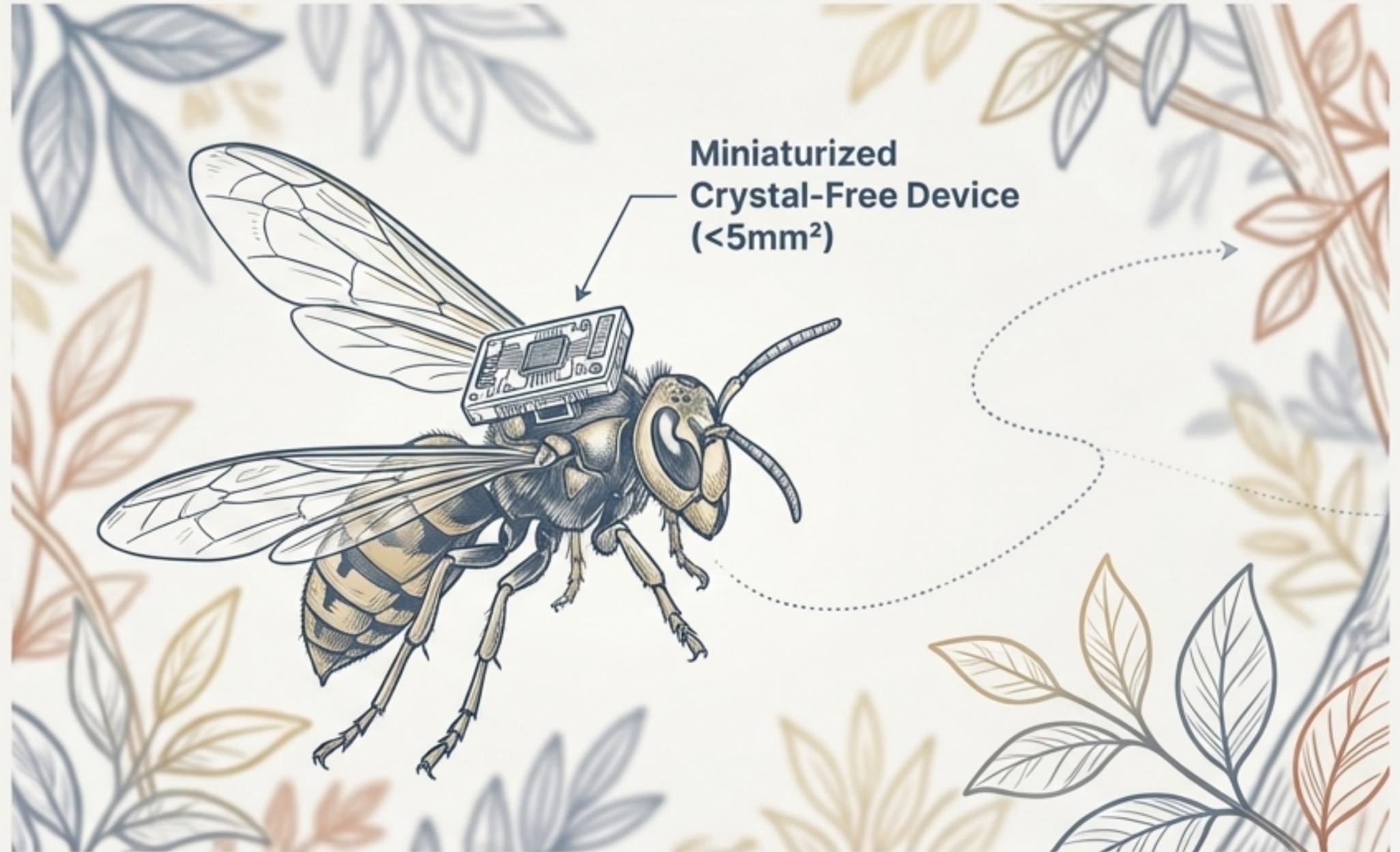
## The Intelligence



The high-level decision-making and coordination that enable autonomous collaboration.

# The Foundation: Micro-Integrated and Crystal-Free Systems

We explore micro-integrated circuit platforms that minimize size, cost, and power consumption. A key focus is understanding and compensating for clock instability in crystal-free systems through system-level co-design.



Application Example: Tracking a hornet to demonstrate extreme miniaturization and real-world viability.

# The Connection: Low-Power, Time-Synchronized Wireless Networking

We investigate time-synchronized and energy-efficient wireless networking technologies for dense, large-scale, and mobile systems. Our work focuses on reliability, synchronization, and cross-layer optimization under strict power constraints.

TSCH

BLE

LoRa

SLE

HaLow

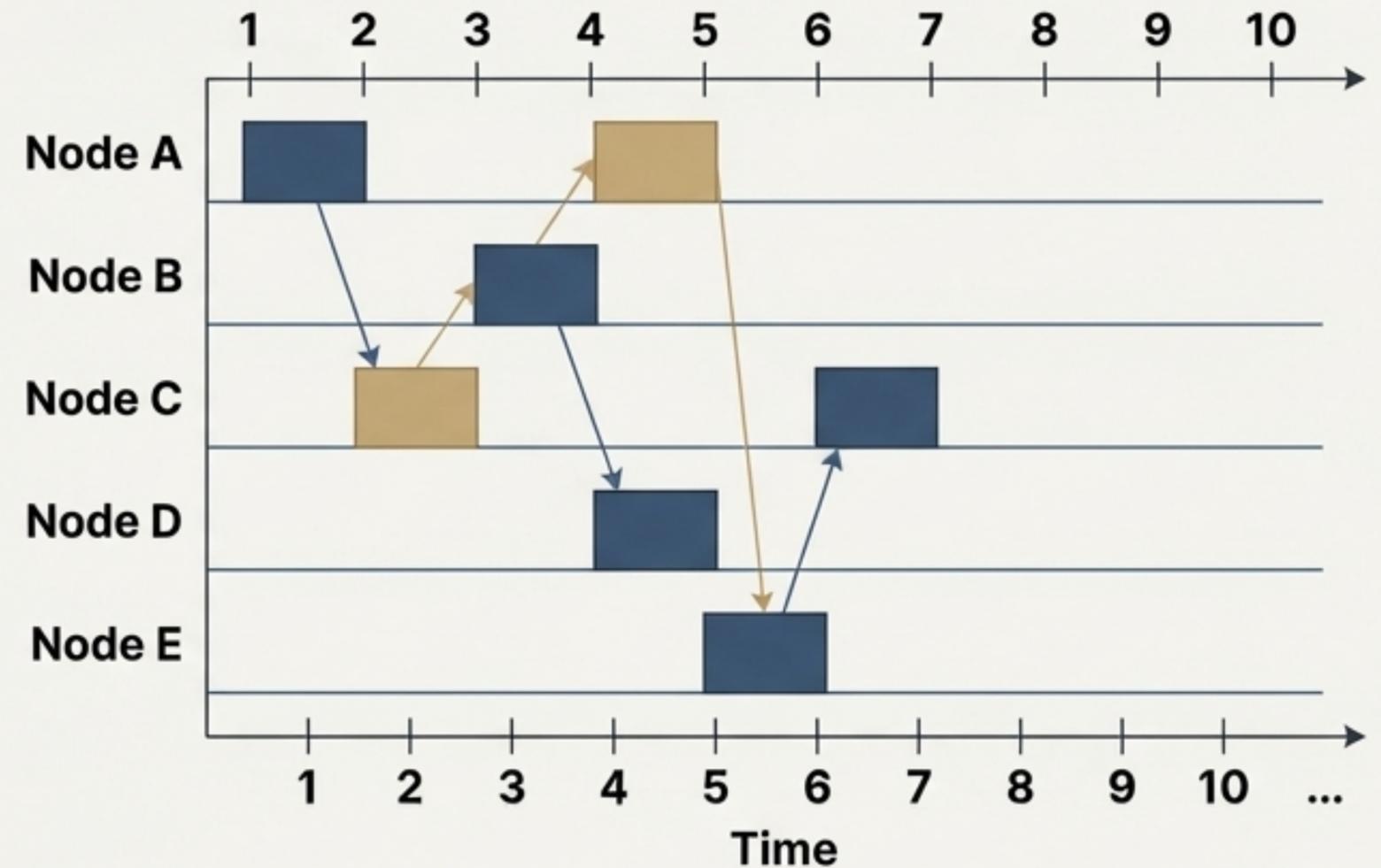
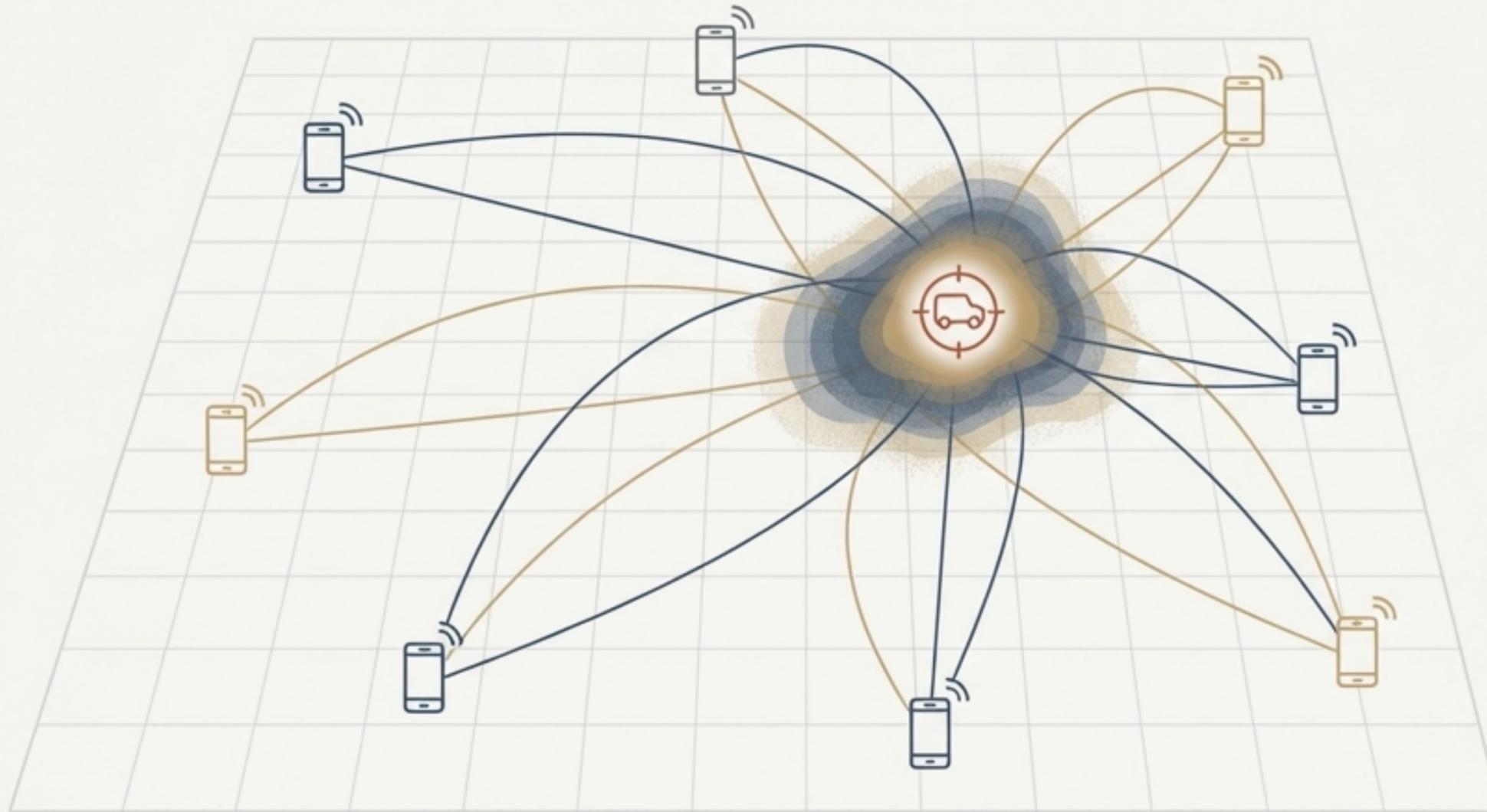


Diagram of a Time-Synchronized Channel Hopping (TSCH) protocol, ensuring collision-free and energy-efficient communication.

# The Senses: Large-Scale, Infrastructure-Less Tracking

We develop tracking and localization systems that operate without fixed infrastructure such as cameras or anchors.

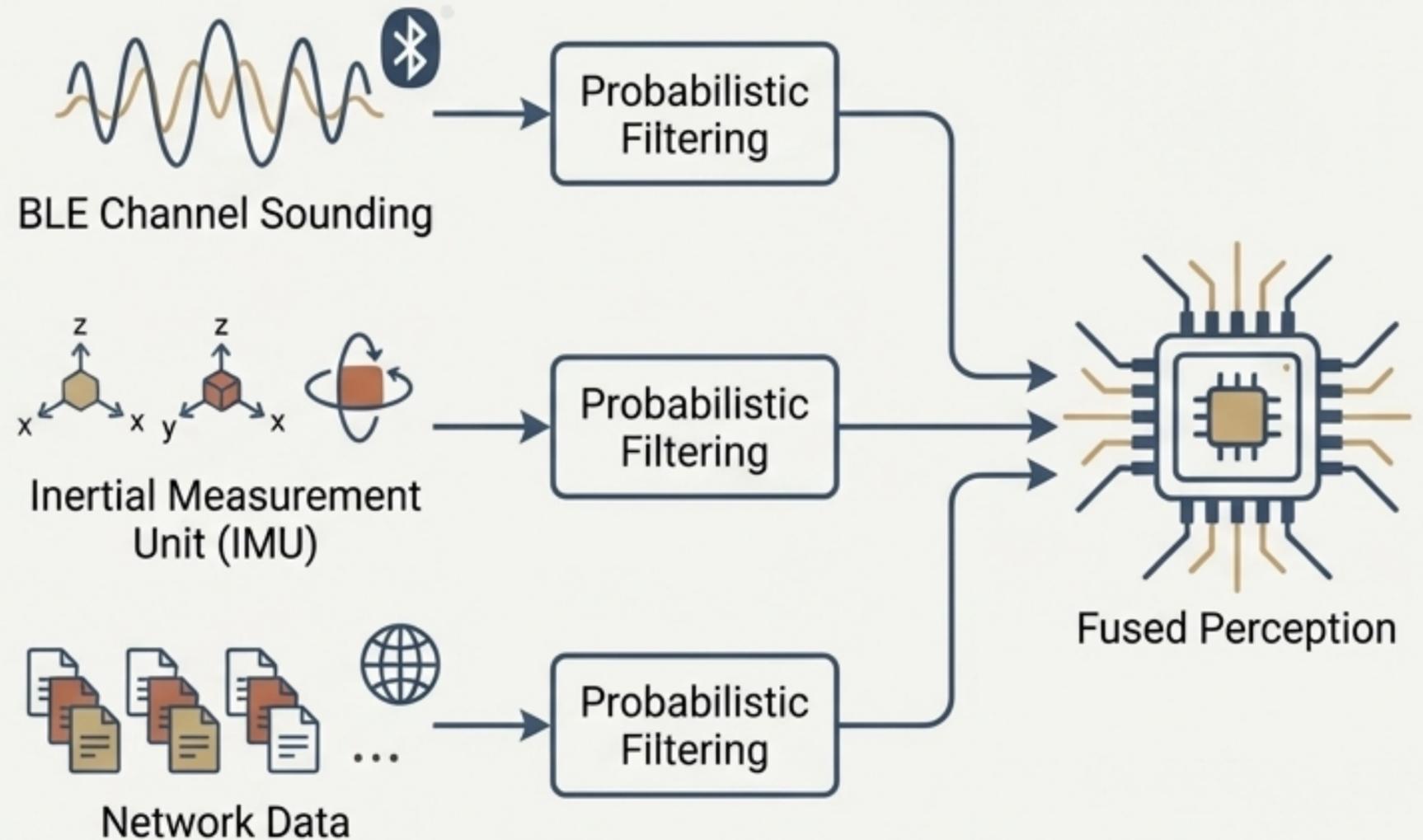
Our research targets large-scale environments where deployment cost and accessibility prohibit traditional solutions.



Conceptual illustration of network-assisted Angle of Departure (AoD) tracking, enabling localization without fixed infrastructure.

# The Senses: Distributed Sensing and Multi-Sensor Fusion” Inter Bold

We study how multiple sensing modalities and distributed nodes can be fused to achieve robust perception. Our work emphasizes probabilistic modeling, adaptive filtering, and resource-aware sensor fusion.

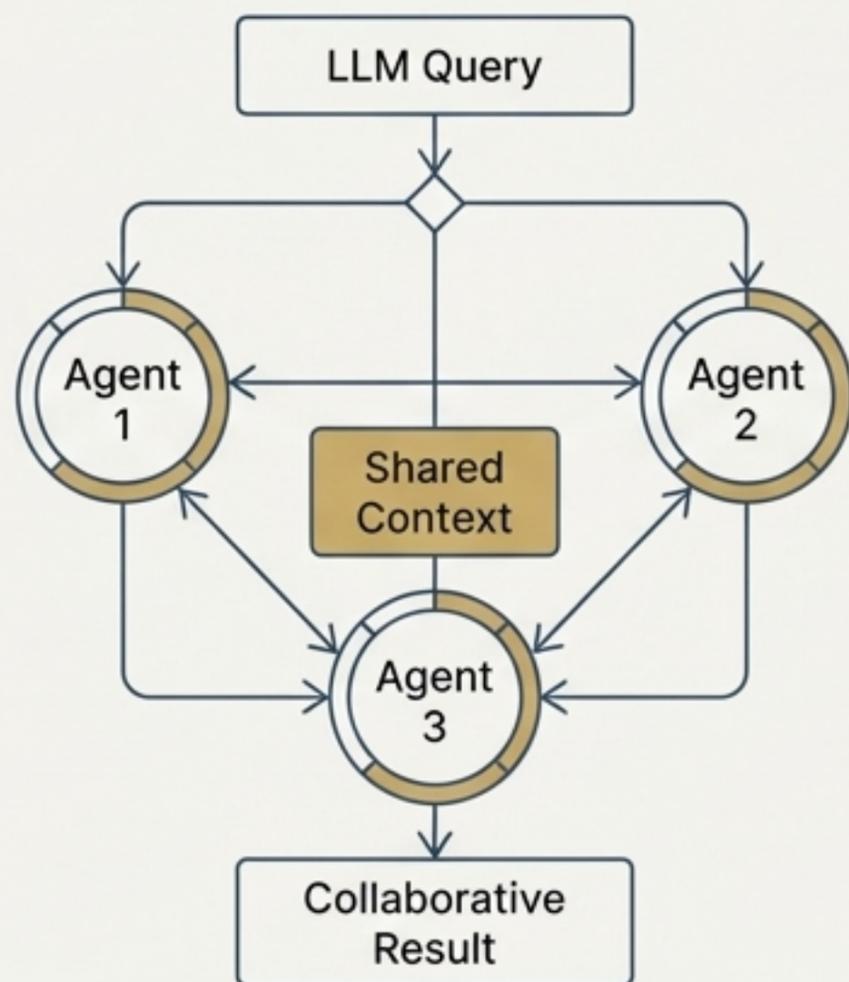


Conceptual model of multi-sensor fusion, integrating modalities like BLE 6.0 Channel Sounding for robust environmental perception.

# The Intelligence: Edge AI and Cooperative Swarms

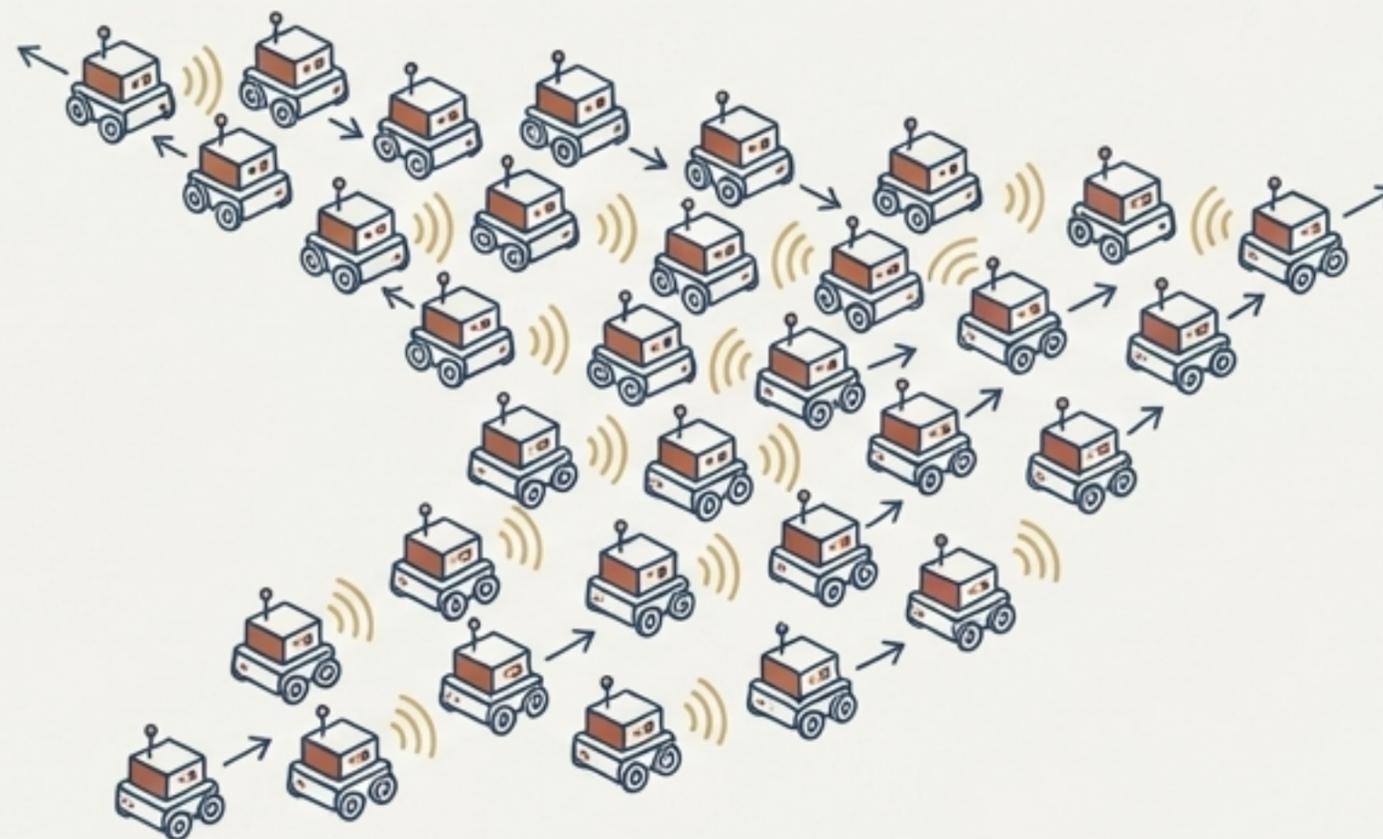
## Edge AI & Cooperative LLM Inference

We investigate edge AI systems that enable intelligent services under strict resource constraints, with a key focus on optimizing LLM inference through multi-agent collaboration and shared context.

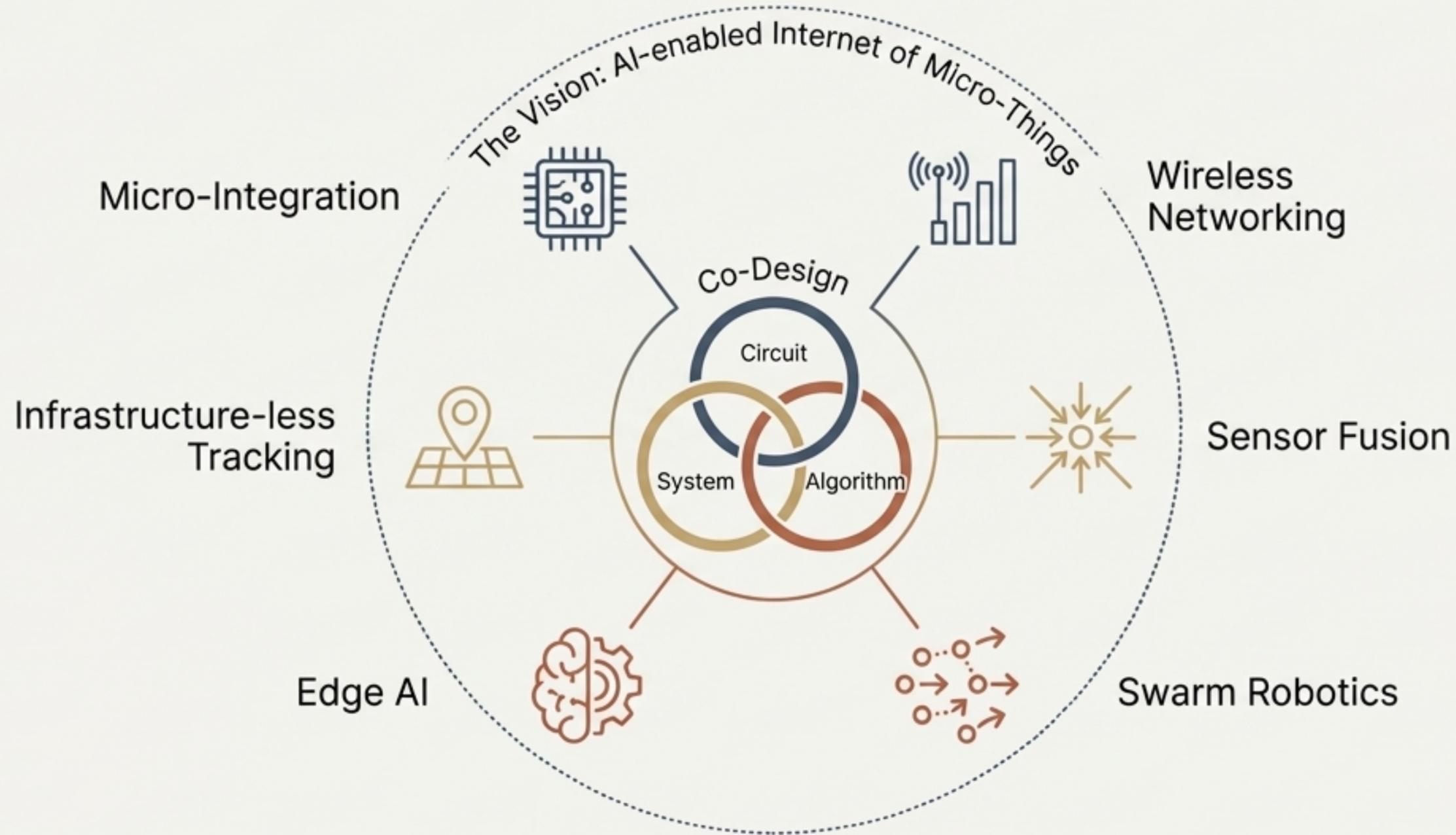


## Swarm Robotics & Cooperative Intelligence

We investigate how large numbers of simple robots can coordinate through wireless communication and local sensing, focusing on scalability, robustness, and minimal assumptions about global coordination.



# An Integrated System: From Silicon to Swarm Intelligence



Our research pillars are not isolated efforts; they are deeply integrated components of a unified platform for distributed intelligence.

# Our Foundation: The Team and Institution

## Leadership

ATOMIC Lab is led by *Tengfei Chang*.

## Affiliation

The lab is part of the research activities at the Hong Kong University of Science and Technology (Guangzhou), a world-class institution dedicated to cross-disciplinary research and innovation.



# Collaborate With Us

We welcome inquiries from prospective students, collaborators, and industrial partners partners interested in low-power wireless systems, micro-integrated circuits, sensing, and autonomous robotic systems.

## Email

For general inquiries, please contact:

Tengfei Chang - [tengfeichang@hkust-gz.edu.cn](mailto:tengfeichang@hkust-gz.edu.cn)

## Address

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