AN INSIGHT INTO

EDGE

AND

FOG COMPUTING

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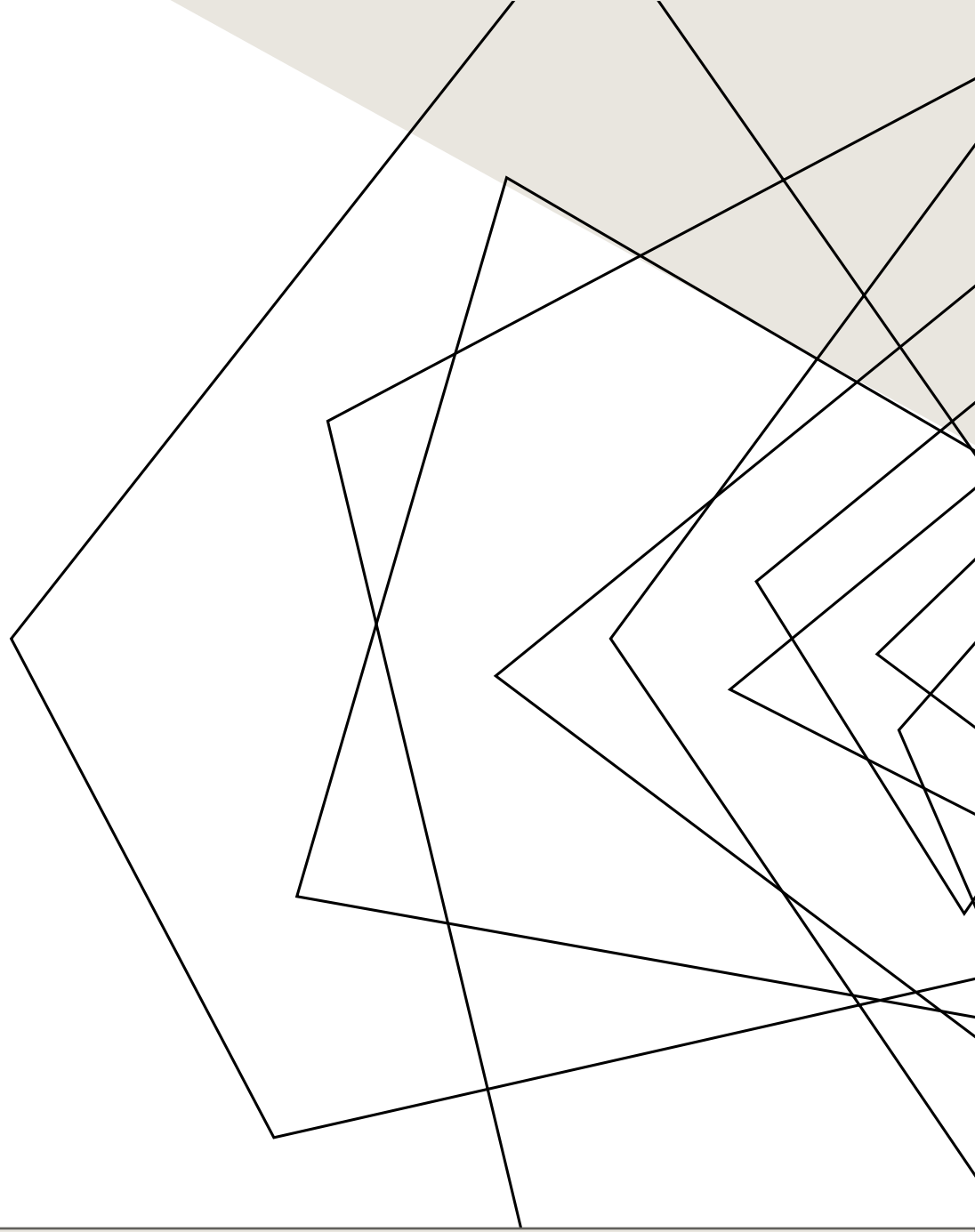
OVERVIEW

- Introduction – Traditional Data Processing
- Definitions
  - Edge Computing
  - Fog Computing
- Challenges
- Applications
- Future



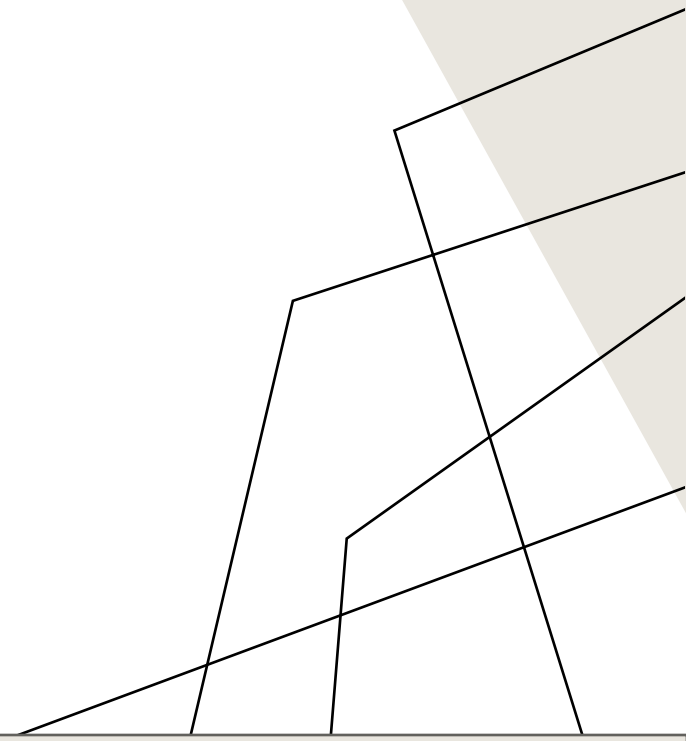
TRADITIONAL DATA PROCESSING STEPS

- **Data Collection:** Data collecting devices (sensors, cameras, IoT devices)
- **Data Transmission:** Data ➡ Central Server or Cloud Data Center
- **Data Processing**
- **Response Transmission:** Processing Result ➡ Original Device
- **Action Execution**

EDGE COMPUTING

EDGE COMPUTING

- **Nearby Processing – at the "Edge" of the Network**
  - Local Systems
  - IoT devices themselves (sensors, cameras, gateways etc.)



EDGE COMPUTING...

- reduces time and effort. (low latency)
- saves bandwith, saves cost.
- can work with limited or no internet connectivity.
- eliminates delay and congestion.

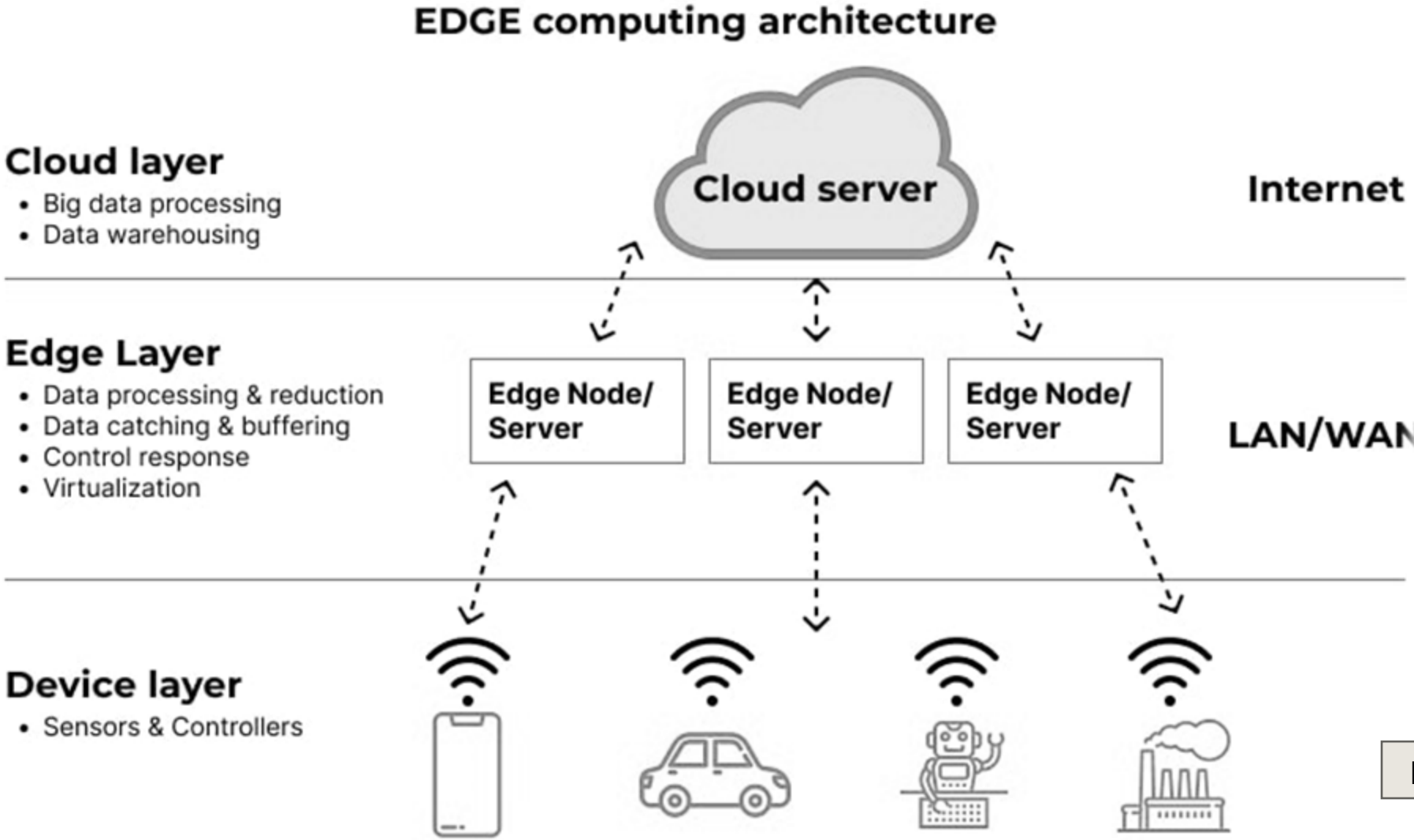

EDGE computing architecture
Cloud layer
• Big data processing
• Data warehousing
Cloud server
Internet
Edge Layer
• Data processing & reduction
• Data catching & buffering
• Control response
• Virtualization
Edge Node/ Server
Edge Node/ Server
Edge Node/ Server
LAN/WAN
Device layer
• Sensors & Controllers

Fig. 1

EXAMPLE — SELF-DRIVING CAR

Fig. 2

DATA PROCESSING

Feature	Without Edge Computing	With Edge Computing
Data Processing	Distant Cloud	Local
Latency	High	Low
Bandwidth Use	High	Low
Internet Dependence	High	Low

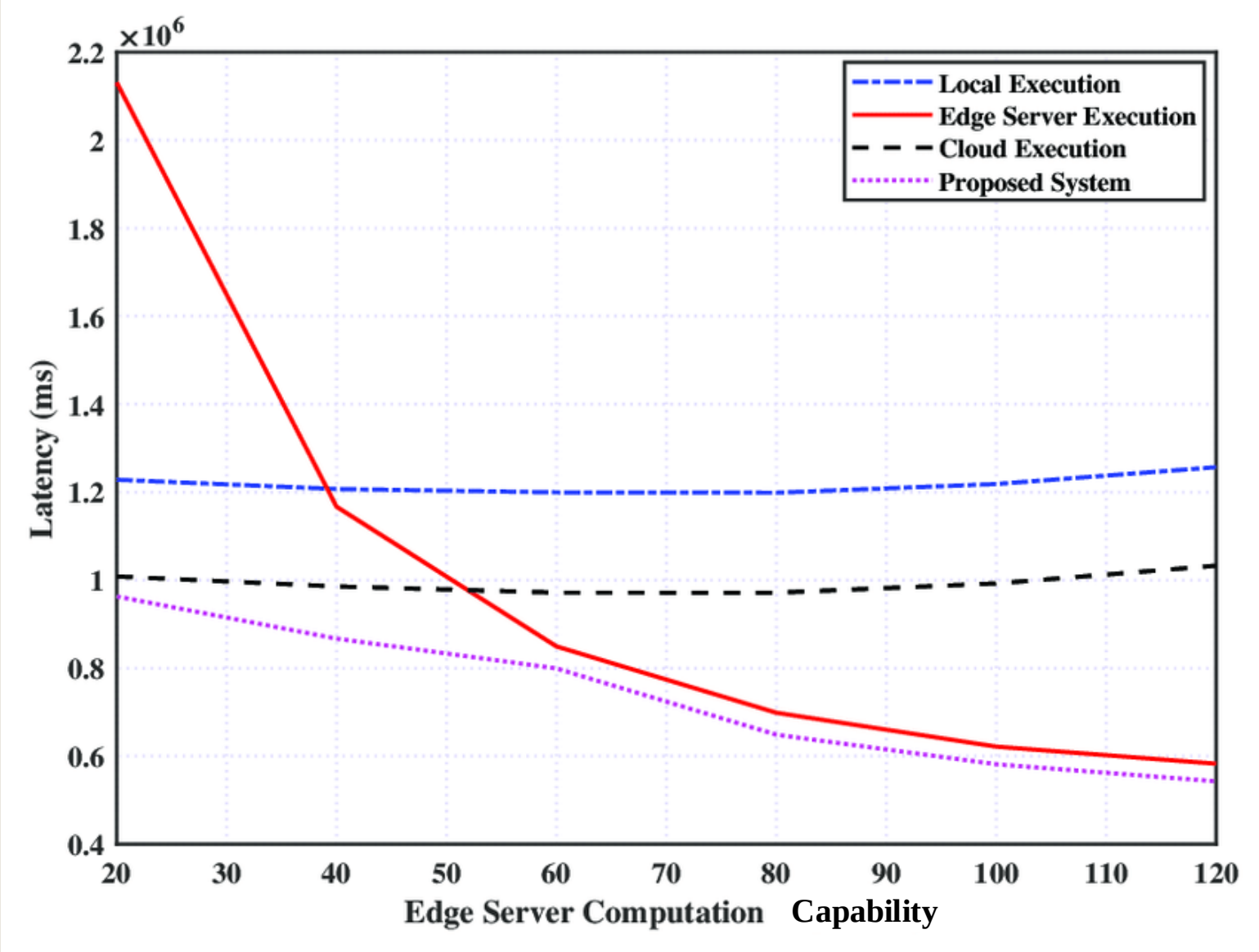

×10^6
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
Latency (ms)
Local Execution
Edge Server Execution
Cloud Execution
Proposed System
20
30
40
50
60
70
80
90
100
110
120
Edge Server Computation Capability

Fig. 3

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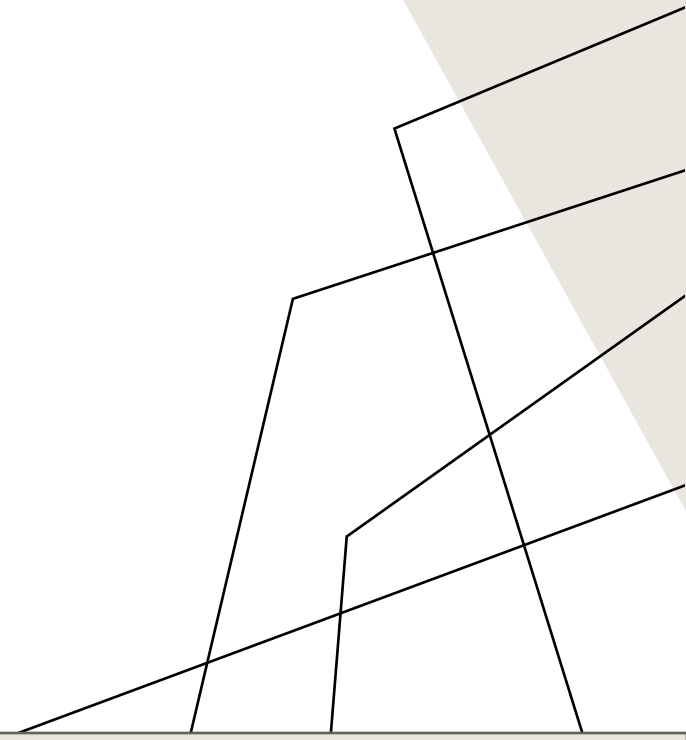
FOG COMPUTING

FOG COMPUTING

- **Fog Nodes – Processing in the Middle**
  - Local Systems
  - Local Devices (routers, local servers)



FOG COMPUTING...

- reduces load on edge devices.
- provides a nearby helper to edge devices.
- makes large-scale systems more efficient.
- manages data better in congested environs.
- reduces latency and bandwidth use.
- de-centers load.

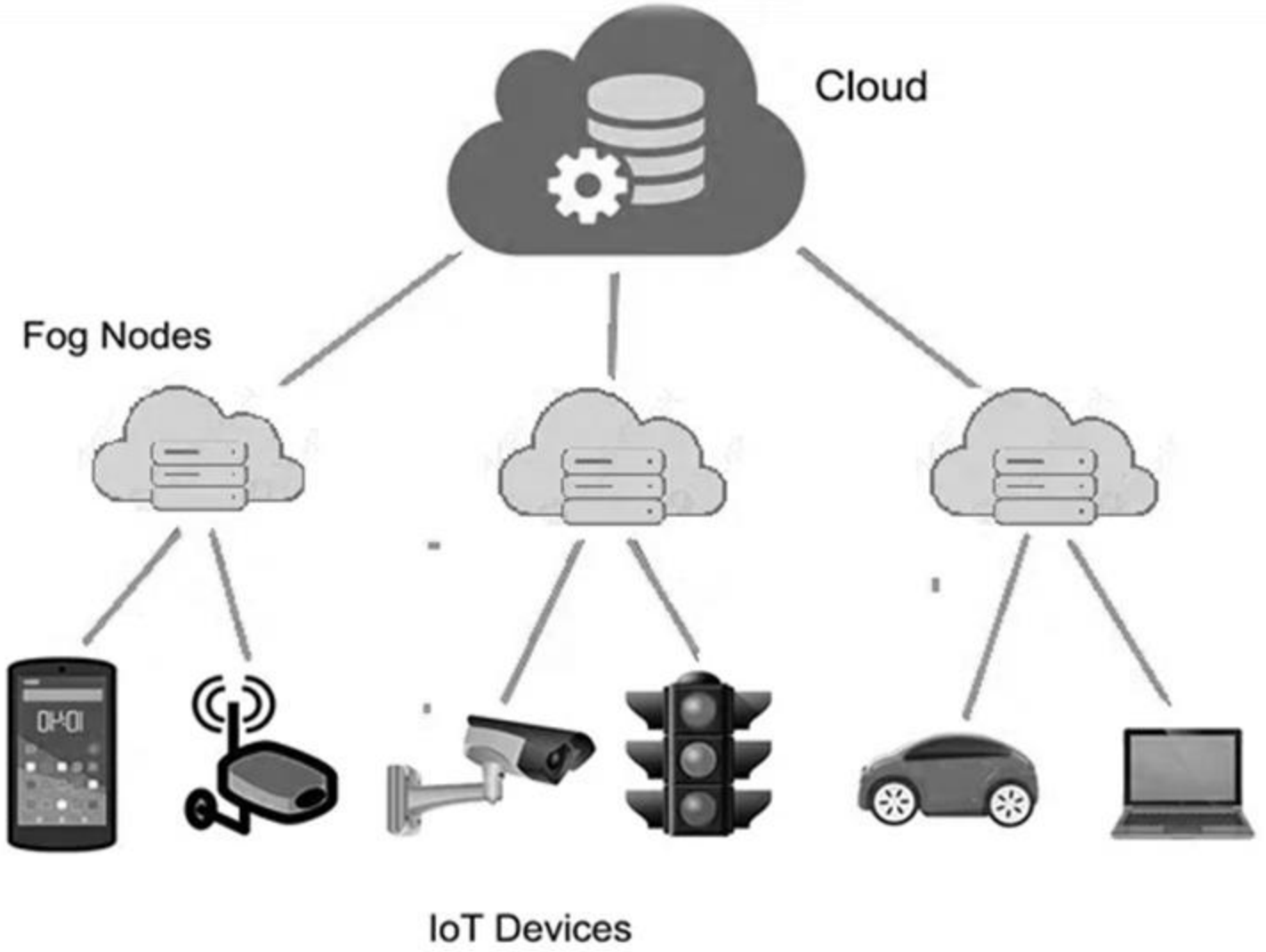


Fig. 4

DATA PROCESSING

Feature	Without Fog Computing	With Fog Computing
Data Processing	Distant Cloud	Distributed locally
Latency	High	Low
Bandwidth Use	High	Low
Scalability	Limited	Improved

FOG AND EDGE COMPUTING COMPARISON

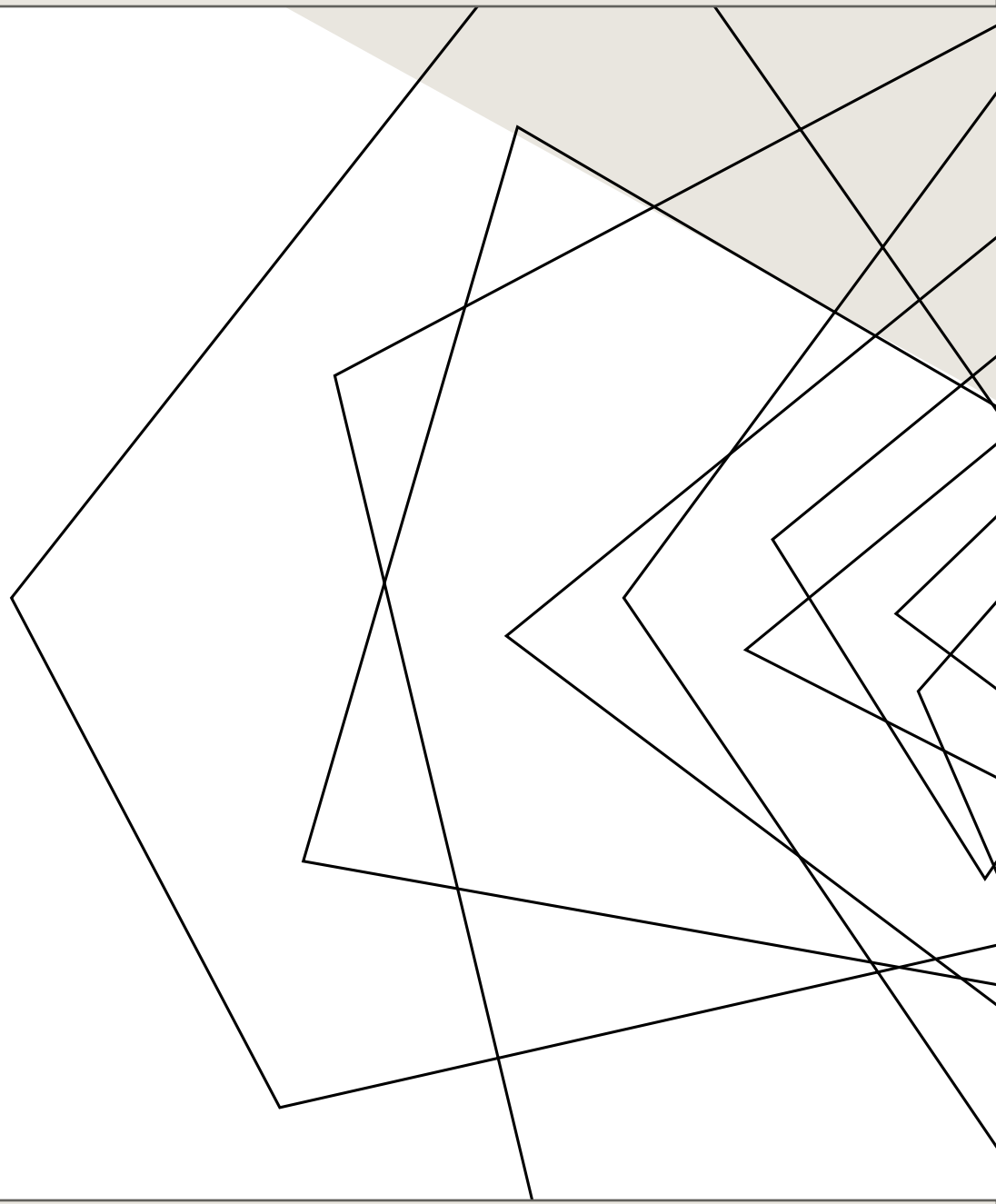
Feature	Edge Computing	Fog Computing
Data Processing	At the device, or close	Local nodes near the edge
Use case example	Real-time actions	Larger-scale systems
Latency	Extremely Low	Low
Power	Device Dependent	Helper nearby systems

CHALLENGES

of Edge and Fog Computing

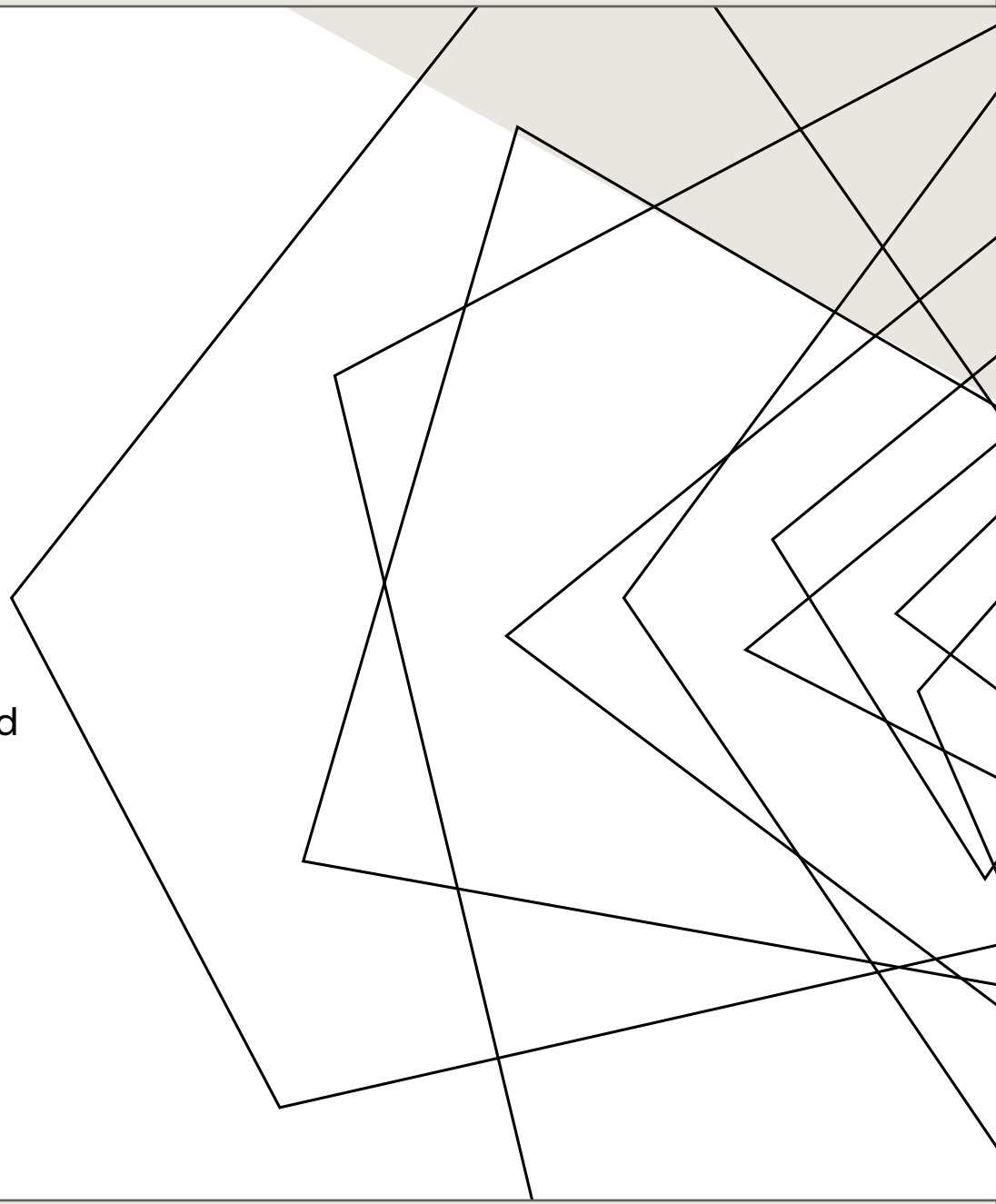
EDGE COMPUTING

- Limited Processing Power and Storage
  - Problems with Data Analysis, AI algorithms, etc.
  - Example: Limited drone device analyzing real-time video footage
- High Costs
  - Expensive to include sufficient computing power and robustness
  - Entry barrier for small industries



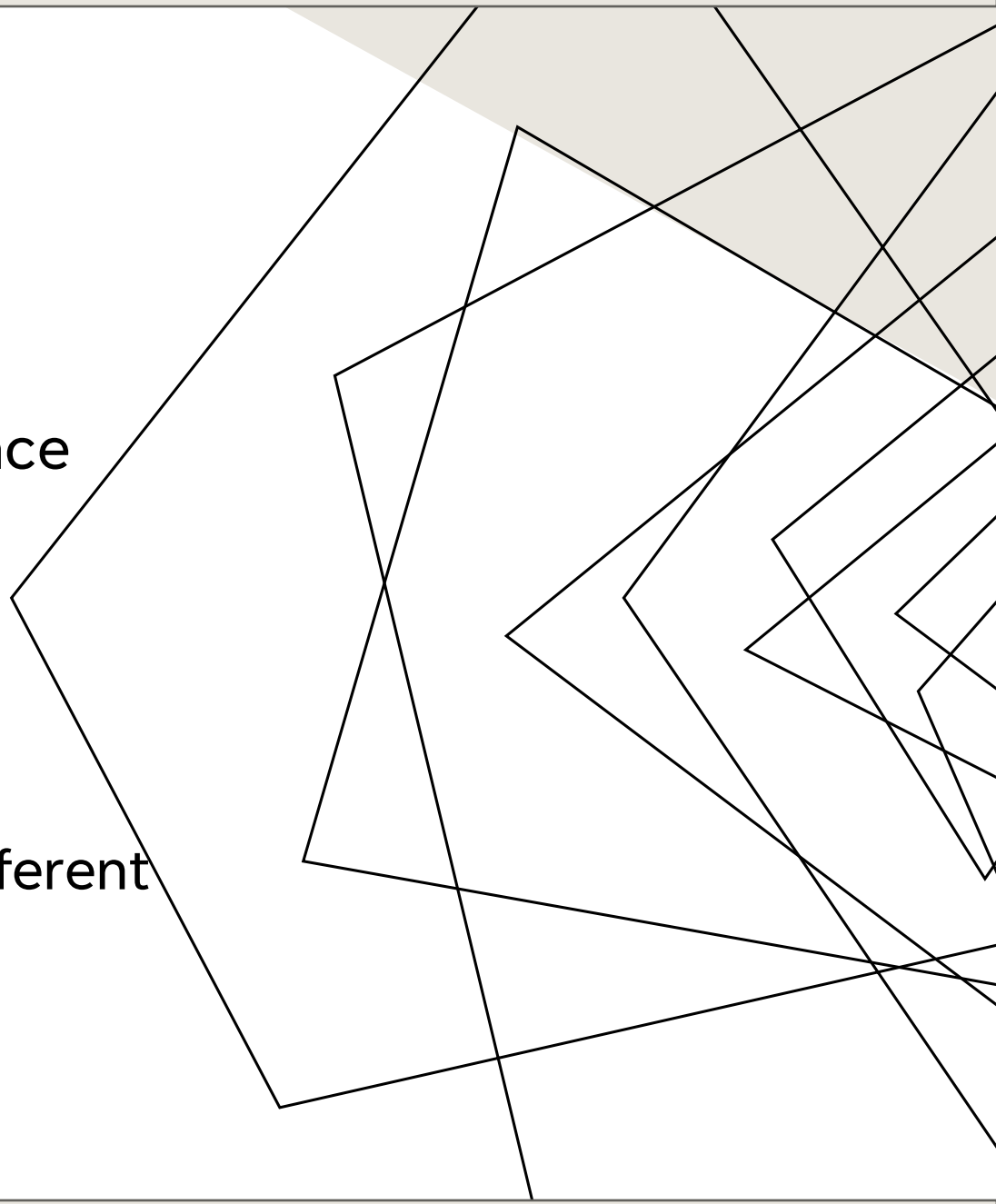
EDGE COMPUTING

- Scalability Issues
  - Overwhelming to manage large-scale projects (high device quantity)
- Data Security and Privacy
  - Can be vulnerable to hacking/data tampering and intercepting
- Device Management and Maintenance
- Interoperability



EDGE COMPUTING

- Device Management and Maintenance
  - Updating and maintenance is challenging
- Interoperability
  - Compatibility issues in case of different device manufacturers

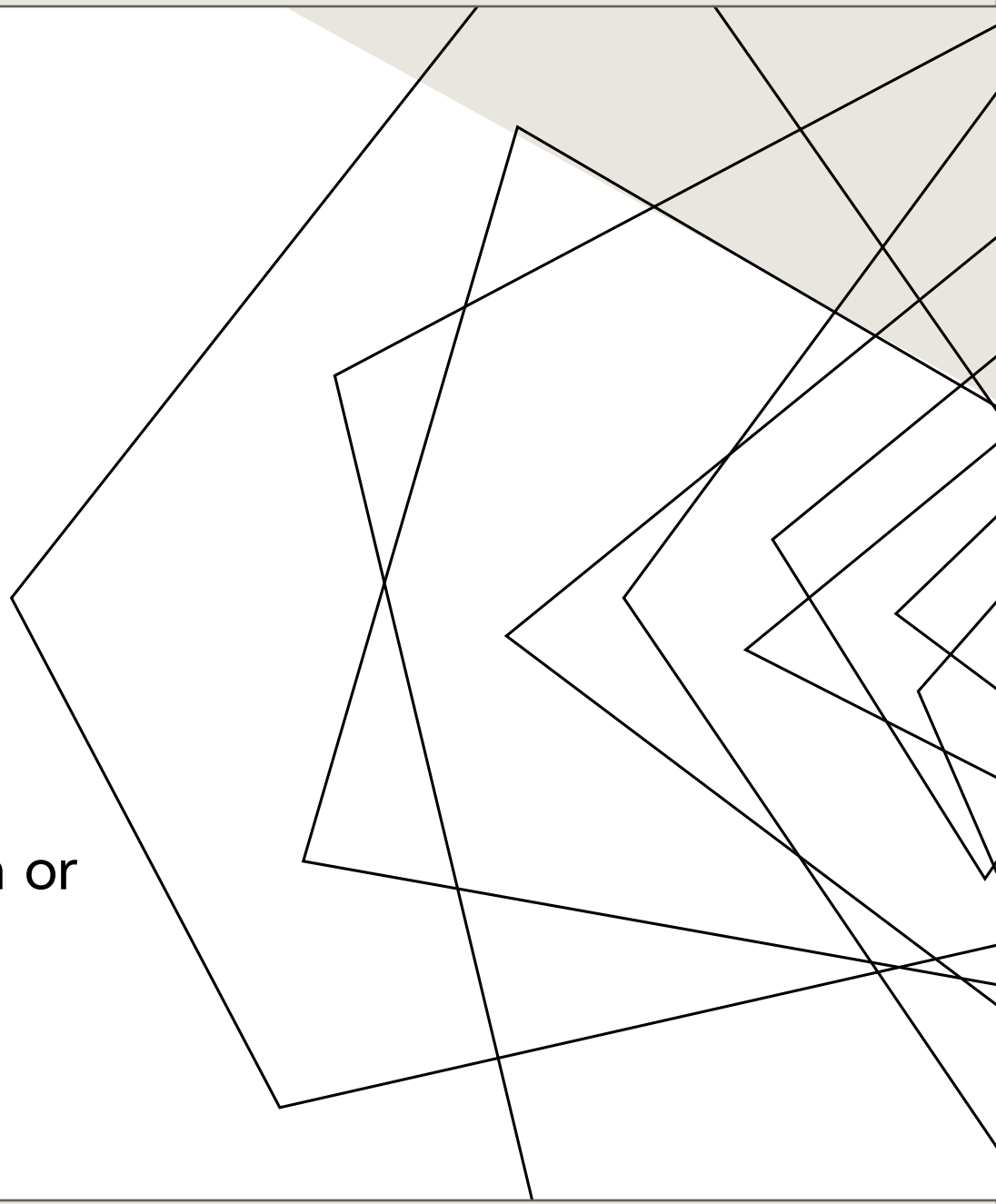


FOG COMPUTING

- Complex Architecture
  - Designing multi-layer systems requires expertise
- High Costs
  - Possibly high distribution, hardware, software, maintenance costs

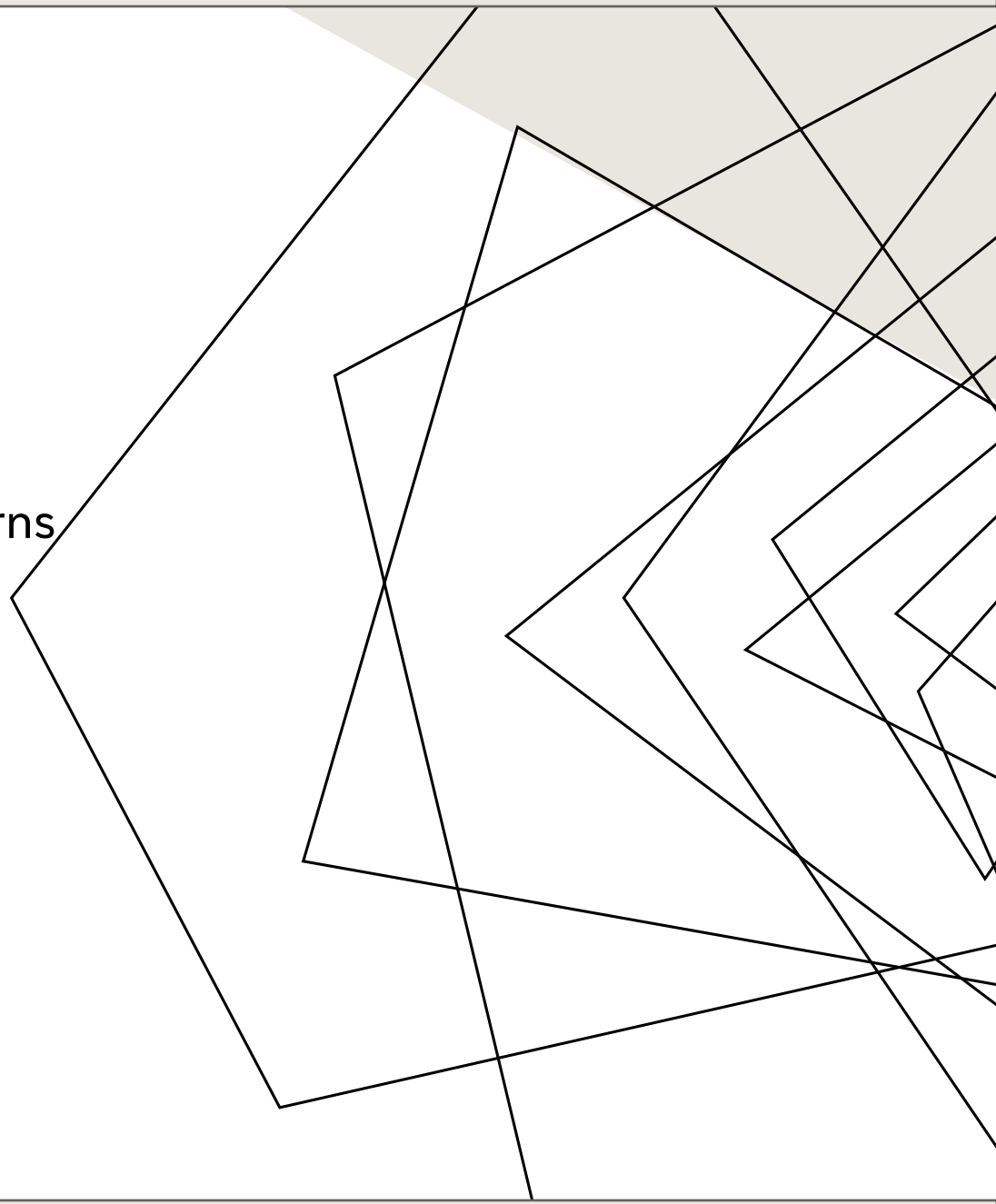
FOG COMPUTING

- Latency and Connectivity Issues
  - Relies on network connectivity between fog nodes and devices
- Data Security and Privacy
  - Data is at risk during transmission or in local storage



FOG COMPUTING

- Energy Consumption
  - High energy costs, environmental concerns
- Standardization Issues
  - No universal standards
- Latency Variability
  - Fog nodes in different proximities can produce different latencies

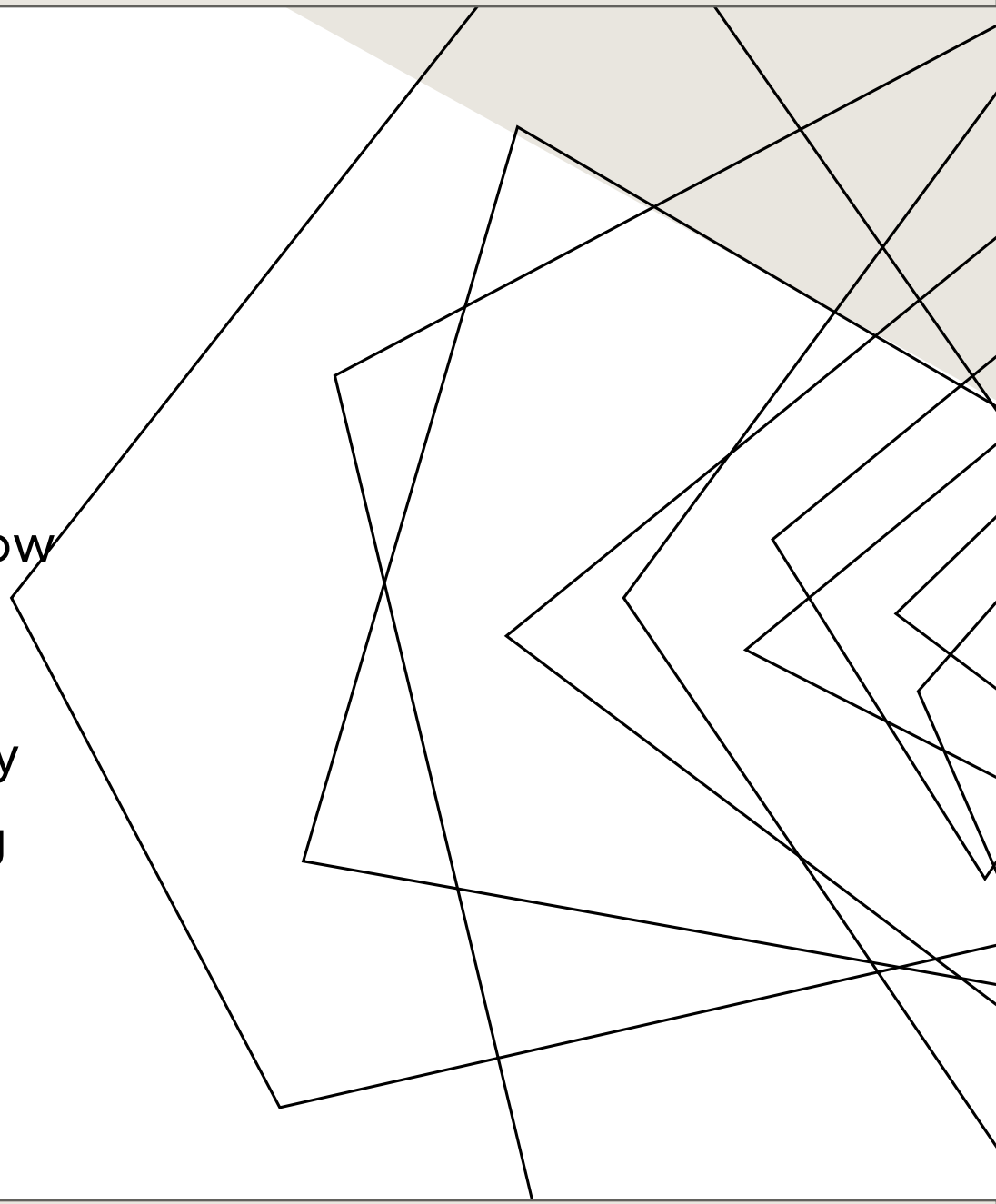


COMMON CHALLENGES

- Limited Expertise
  - Relatively new technologies
- Data Synchronization
  - Decentralized processing increases difficulty

COMMON CHALLENGES

- Hardware Reliability
  - Failure of devices can disrupt workflow
- Legal and Regulatory Compliance
  - Sensitive data processing locally may differ from region to region, requiring adaptations



CURRENT APPLICATION EXAMPLES

of Edge and Fog Computing

EDGE COMPUTING

- **Self-Driving Cars**
- **Smart Home Devices**
- **Healthcare**

10 YEARS AGO THE BASE STATION IS SMALL.

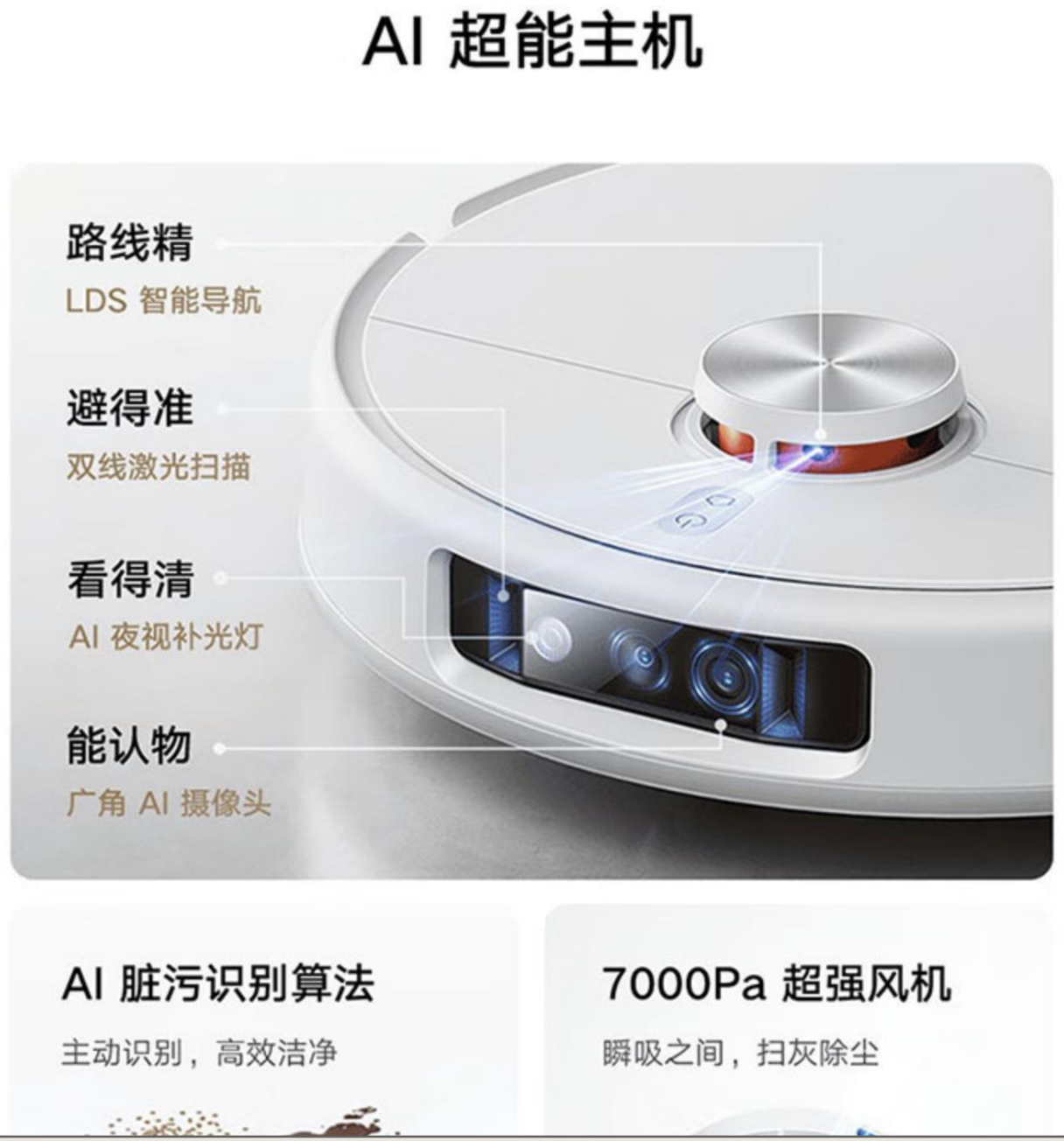
1. Single function
2. No intelligence
3. Infrared detection
4. No data analysis

NEW GENERATION

- 1. Base stations are like computer cases
- 2.Add AI function
- 3.Data analysis

UPGRADE

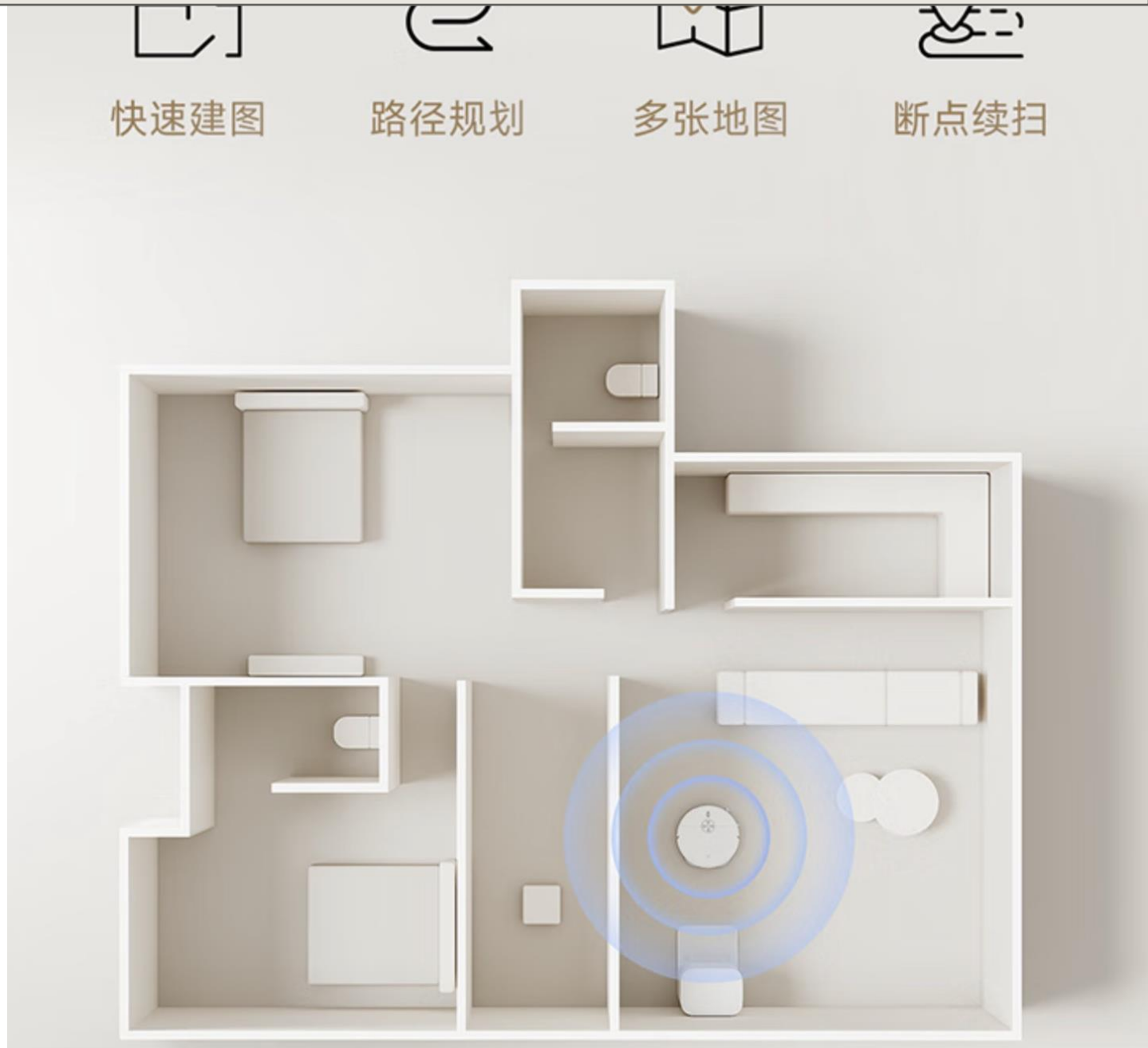
- 1. Route planning
- 2.Dual laser sensing
- 3.AI night vision
- 4.Visual Recognition



PRACTICAL EXPERIENCE

- Advantages:
- 1. The collected data is handed over to the host computer for analysis
- 2.Real-time analysis and update

- Disadvantages:
- 1.Leakage of private information
- 2.Advertisement harassment



FOG COMPUTING

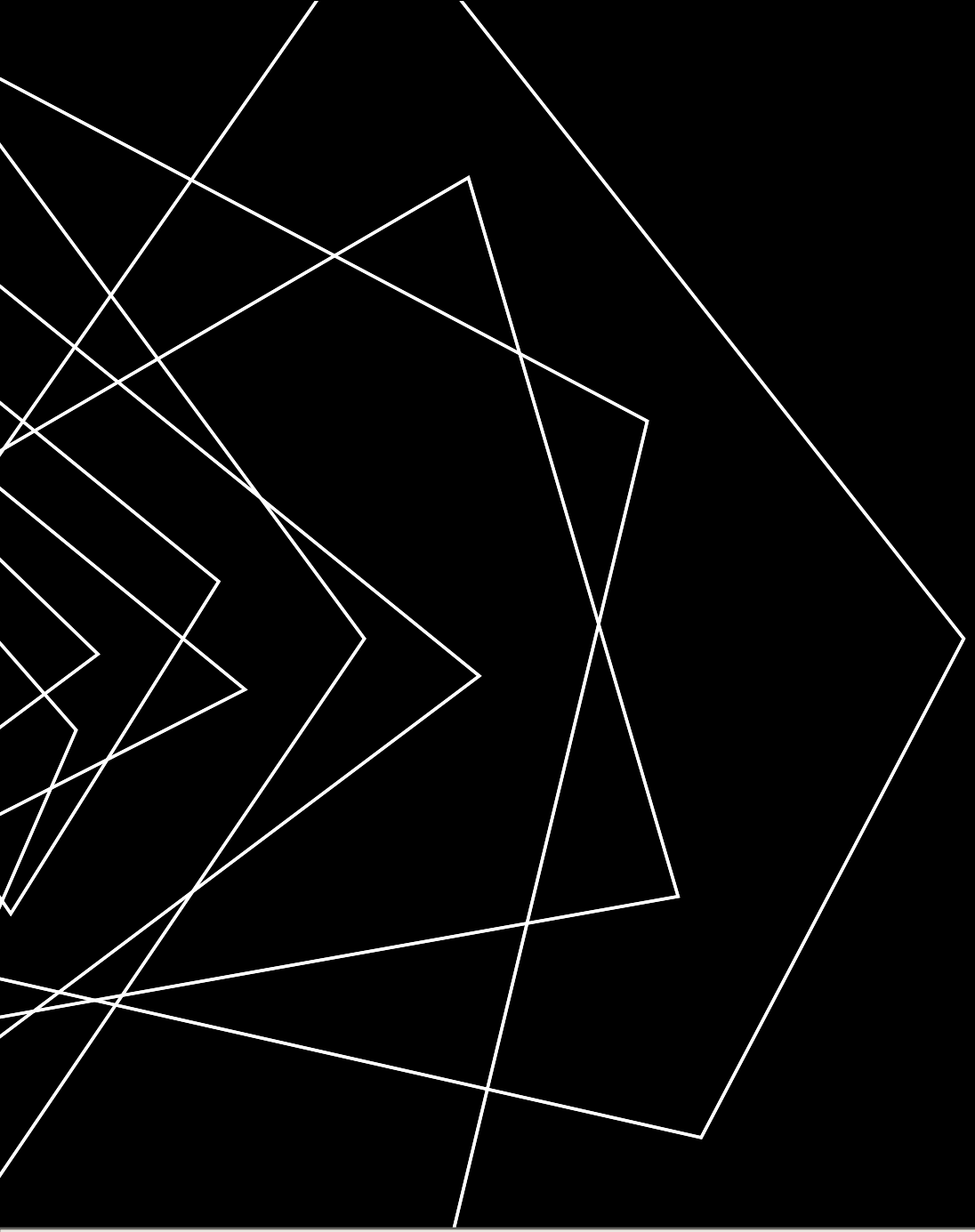
- **Smart Cities**
- **Telecommunications(5G)**
- **Smart Agriculture**

FUTURE APPLICATION EXAMPLES

of Edge and Fog Computing

COLLABORATIVE FUTURE APPLICATIONS

- **Autonomous Supply Chains**
- **Next-Gen Entertainment Experiences**
- **Green Energy Management for Smart Cities**



THANK YOU

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- [Fig. 1]: Website Files. (n.d.). *Edge computing architecture*
- [Fig. 2]: TechAhead Corp. (2023). *Fog computing architecture illustrating data flow and processing layers*
- [Fig. 3]: Medium. (n.d.). *Fog Computing vs Edge Computing comparison*
- [Fig. 4]:ResearchGate. (2020). *Latency comparison under different values of edge server capability*