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(Mun ID: 202415994)

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## Introduction

- Rapid growth of connected devices and real-time applications
- Traditional cloud computing reaches its limits
- **Edge computing** brings computation closer to the data source

2025-03-30

# Edge Computing: A Decentralized Evolution of the Cloud

- └ Introduction

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  - Traditional cloud computing reaches its limits
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# Why Edge Computing?

- **Latency:** Reduces delay for real-time responses
- **Bandwidth:** Minimizes data transfer volume
- **Privacy:** Keeps sensitive data local
- **Resilience:** Operates even with cloud disconnections

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## Edge Computing: A Decentralized Evolution of the Cloud

### └ Why Edge Computing?

Edge computing helps reduce latency by processing data locally. It decreases bandwidth use, enhances privacy, and ensures services continue running even if the cloud is unavailable.

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# Architecture Overview

- **Edge devices:** Sensors, wearables, cameras
- **Edge nodes:** Gateways, micro-servers, local processors
- **Cloud layer:** For large-scale analytics and storage

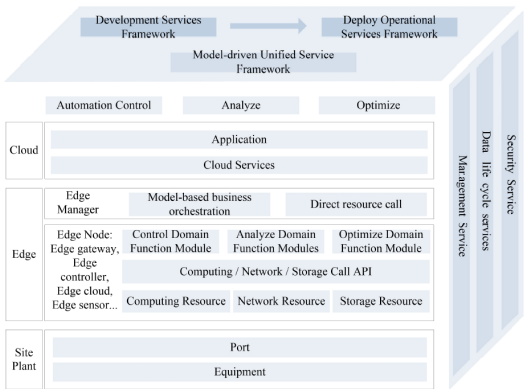


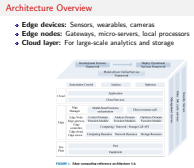
FIGURE 1. Edge computing reference architecture 3.0.

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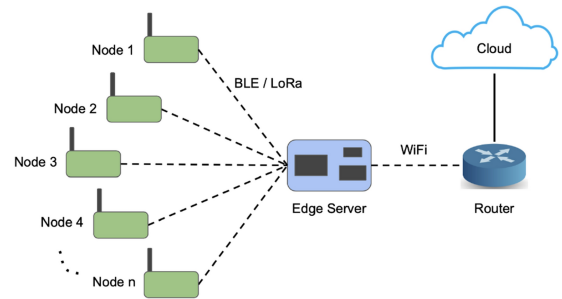
### Architecture Overview

The edge architecture consists of three layers: edge devices, edge nodes, and the cloud. The goal is to shift part of the processing to the edge, while still leveraging cloud capabilities.



# Use Case: Internet of Things (IoT)

- Smart homes: temperature, lighting, security
- Environmental monitoring: air quality, agriculture
- Local processing improves responsiveness and privacy



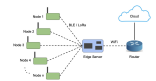
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IoT applications benefit from edge computing through fast reactions and privacy. In smart homes, sensors react immediately. In agriculture, edge devices adapt irrigation in real time.

# Use Case: Autonomous Vehicles

- Onboard sensors generate huge data streams
- Requires instant decision-making (e.g. braking)
- Edge computing enables safety-critical operations

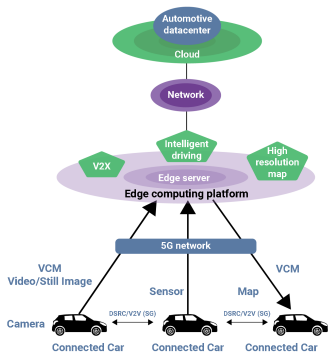


Figure 5 - Collaborative edge-cloud computing

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└ Use Case: Autonomous Vehicles

Autonomous vehicles need to process data within milliseconds. Edge computing allows cars to detect obstacles and make driving decisions instantly, which is essential for safety.

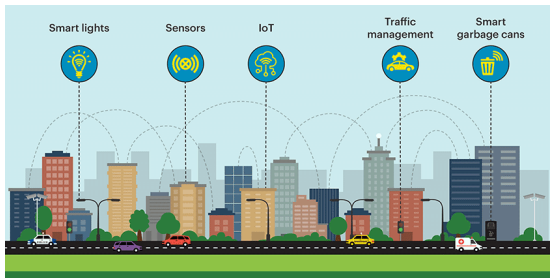
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Figure 1 - Illustration of edge computing

## Use Case: Smart Cities

- Real-time traffic management
- Public safety and surveillance
- Energy optimization and environmental monitoring



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## Edge Computing: A Decentralized Evolution of the Cloud

└ Use Case: Smart Cities

Edge computing enables cities to be smarter and more efficient. Local processing in traffic lights and surveillance systems improves responsiveness and reduces network dependency.

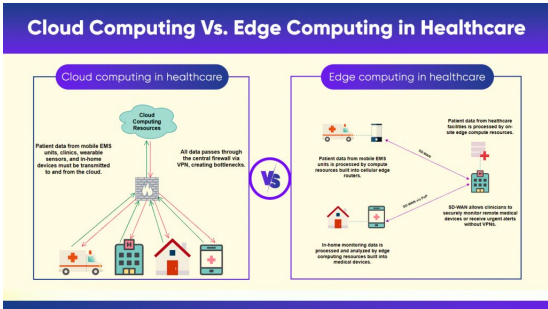
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# Use Case: Healthcare and Telemedicine

- Real-time patient monitoring
- On-site diagnostics in emergencies
- Strong data privacy and compliance (e.g. GDPR)



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└ Use Case: Healthcare and Telemedicine

Healthcare systems use edge computing for real-time monitoring and diagnostics. Patient data stays local, enhancing privacy and compliance with health data regulations.

Use Case: Healthcare and Telemedicine

- Real-time patient monitoring
- On-site diagnostics in emergencies
- Strong data privacy and compliance (e.g. GDPR)





# Advantages and Challenges

## Advantages:

- Lower latency and bandwidth usage
- Better data privacy and security
- Improved resilience and scalability

## Challenges:

- Complex management of distributed nodes
- Interoperability with cloud platforms
- Security at the edge

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## Edge Computing: A Decentralized Evolution of the Cloud

### Advantages and Challenges

While edge computing has many strengths, it introduces new challenges. Managing and securing distributed nodes is complex, and integration with existing cloud systems remains tricky.

#### Advantages and Challenges

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## Trends and Future Perspectives

- Integration with AI and 5G for smarter edge decisions
- Lightweight containers and orchestration (e.g. K3s)
- Research in privacy-preserving analytics, federated learning

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## Edge Computing: A Decentralized Evolution of the Cloud

### └ Trends and Future Perspectives

Edge computing is evolving. With AI, devices make smarter decisions. 5G supports high-speed communication. New tools like K3s make edge deployment easier, and research continues on privacy.

Trends and Future Perspectives

- Integration with AI and 5G for smarter edge decisions
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# Conclusion

- Edge computing addresses key limitations of centralized cloud
- Use cases show strong benefits in latency, privacy, and efficiency
- Future: a hybrid cloud-edge ecosystem

Thank you!

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## Edge Computing: A Decentralized Evolution of the Cloud

### Conclusion

In conclusion, edge computing complements the cloud. It improves response times, protects data, and enables smarter systems. The future lies in combining both models for flexibility and power.

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- Future: a hybrid cloud-edge ecosystem

Thank you!

## Open Discussion

## Discussion Point

Edge computing reduces data exchanges by processing locally. But: **With network demands constantly rising, will edge computing be enough?**  
Or is it just a temporary relief before a new saturation point?

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# Edge Computing: A Decentralized Evolution of the Cloud

## Open Discussion

Let's open the floor: Do you think edge computing is a long-term solution, or just a short-term patch? Can it keep up with the exploding demand for connectivity and data?

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# References

- source 1
- source 2
- ...

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