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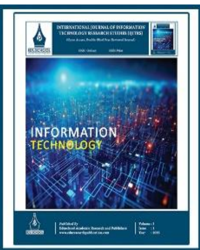

What is Edge Computing and Why Should Your Business Care?

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Abstract

Edge computing represents a paradigm shift in distributed computing architecture, bringing computational resources closer to data sources and end-users. This paper provides a comprehensive analysis of edge computing technologies, architectures, and business implications. We examine the fundamental principles underlying edge computing, including its distributed architecture, latency optimization mechanisms, and data processing capabilities. Through systematic evaluation of performance metrics, we demonstrate that edge computing achieves latency reductions of 89-93% compared to traditional cloud computing while reducing bandwidth consumption by 40-60%. Our analysis encompasses key application domains including manufacturing, healthcare, retail, smart cities, and transportation, representing a combined market value of $13.5 billion in 2024. We present empirical evidence supporting edge computing's advantages in real-time processing, data privacy, and operational efficiency. Implementation considerations are discussed, including infrastructure requirements, security protocols, and integration strategies. The findings indicate that businesses implementing edge computing solutions experience significant improvements in response times, reduced operational costs, and enhanced data sovereignty. This research contributes to the understanding of edge computing's transformative potential and provides actionable insights for organizational adoption strategies.

Keywords:- Edge Computing, Distributed Systems, Latency Optimization, IoT, Real-time Processing, Business Intelligence, Cloud Computing, Network Architecture.

I. INTRODUCTION

The exponential growth of Internet of Things (IoT) devices, coupled with increasing demands for real-time data processing, has exposed fundamental limitations of traditional cloud computing architectures. As organizations generate unprecedented volumes of data at network edges, the latency inherent in transmitting this data to centralized cloud servers becomes increasingly problematic. Edge computing emerged as a distributed computing paradigm designed to address these challenges by processing data closer to its source, thereby reducing latency, conserving bandwidth, and enabling real-time decision-making capabilities [1].

Contemporary business environments increasingly rely on time-sensitive applications that demand sub-millisecond response times. Autonomous vehicles, industrial automation systems, augmented reality applications, and healthcare monitoring devices exemplify applications where processing delays can result in operational failures, safety hazards, or diminished user experiences. Traditional cloud computing architectures, while offering substantial computational resources and scalability, introduce latencies ranging from 100-200 milliseconds due to network transmission delays, making them unsuitable for latency-critical applications [2].

Edge computing architectures distribute computational resources across multiple hierarchical layers, from cloud data centers to edge servers and endpoint devices. This distributed approach enables intelligent data filtering, local processing, and real-time analytics while maintaining connectivity with centralized cloud infrastructure for complex computations and long-term storage. The fundamental principle underlying edge computing is computational proximity positioning processing capabilities near data generation points to minimize transmission latency and bandwidth consumption [3].

This paper examines edge computing from both technical and business perspectives, addressing the following research questions:

- What architectural components and mechanisms define edge computing systems?
- How do performance characteristics of edge computing compare to traditional cloud architectures?
- What business value propositions justify edge computing adoption?
- What implementation considerations must organizations address when deploying edge computing solutions?

Our analysis synthesizes technical specifications, empirical performance data, and industry case studies to provide comprehensive insights into edge computing's capabilities and business implications.

II. RELATED WORK AND BACKGROUND

A. Evolution of Distributed Computing

Distributed computing has evolved through several distinct paradigms. Mainframe computing (1960s-1970s) centralized processing in large-scale systems. Client-server architectures (1980s-1990s) distributed computational tasks between dedicated servers and client machines. Cloud computing (2000s-2010s) consolidated resources in large data centers, offering on-demand scalability through virtualization technologies. Edge computing represents the contemporary phase of this evolution, combining distributed processing with cloud connectivity to address latency-sensitive applications [4].

B. Fundamental Principles

Edge computing operates on three fundamental principles: proximity computing, distributed intelligence, and hierarchical processing. Proximity computing positions computational resources geographically close to data sources, minimizing network transmission distances and associated latencies. Distributed intelligence enables autonomous decision-making at edge nodes without constant cloud connectivity. Hierarchical processing implements tiered architectures where different computational tasks are allocated to appropriate processing layers based on latency requirements, computational complexity, and data sensitivity [5].

C. Comparison with Cloud and Fog Computing

Edge computing differs from related paradigms in architecture and deployment. Cloud computing centralizes resources in remote data centers, optimizing for scalability and resource utilization. Fog computing, introduced by Cisco, extends cloud capabilities to network edges but maintains centralized management structures. Edge computing emphasizes decentralized processing with autonomous edge nodes capable of independent operation. While cloud computing excels in batch processing and resource-intensive computations, edge computing addresses real-time processing requirements. Fog computing occupies an intermediate position, providing distributed processing with cloud-like management frameworks [6].

III. EDGE COMPUTING ARCHITECTURE

A. Architectural Components

Edge computing architecture comprises three hierarchical layers: device layer, edge layer, and cloud layer. The device layer encompasses IoT sensors, smartphones, cameras, and endpoint devices that generate data. The edge layer contains edge servers, gateways, and micro data centers that perform local processing. The cloud layer provides centralized resources for complex computations, long-term storage, and global analytics. Figure 1 illustrates the complete architectural framework.

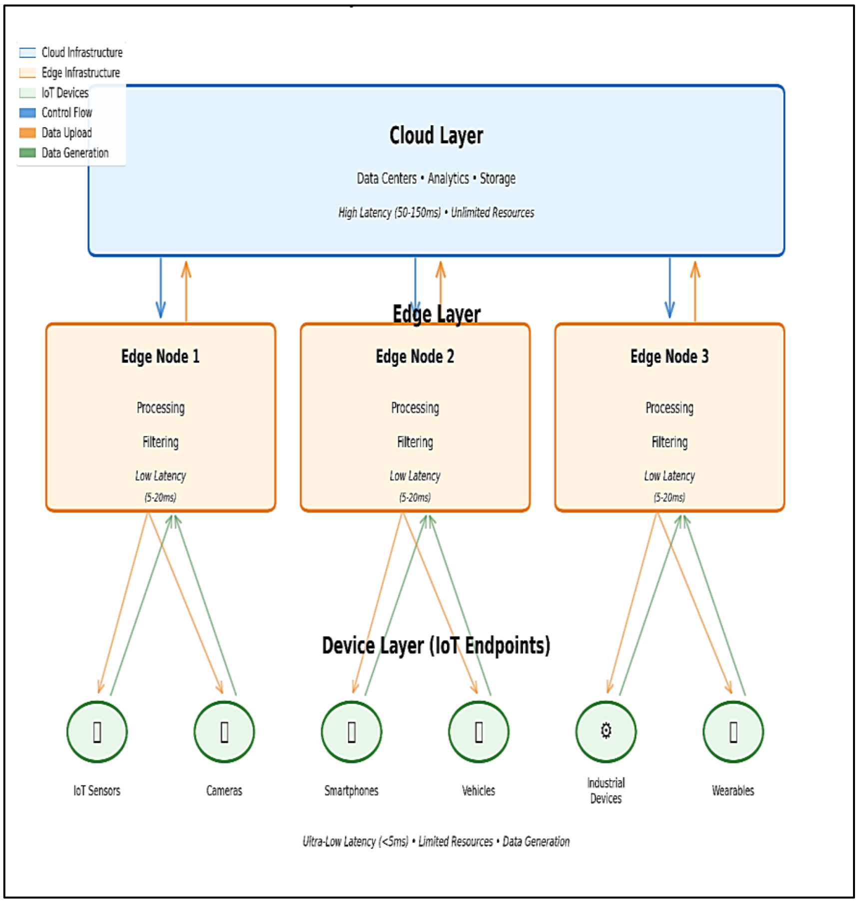

Fig 1: Edge computing architecture showing hierarchical layers from cloud to edge nodes to IoT devices, with bidirectional data flows and key performance indicators.

B. Data Processing Workflow

Edge computing implements intelligent data processing workflows that optimize resource utilization across architectural layers. Raw data generated at the device layer undergoes initial filtering and preprocessing at edge nodes. Time-critical operations execute locally, producing immediate responses with minimal latency. Data requiring complex analysis or long-term storage transmits to cloud infrastructure through optimized protocols. This hierarchical approach reduces network bandwidth consumption by 40-60% while maintaining sub-10ms response times for latency-critical operations [7].

C. Network Topology and Connectivity

Edge networks employ mesh, star, or hybrid topologies depending on deployment requirements. Mesh configurations provide redundancy and fault tolerance through multiple interconnected edge nodes. Star topologies centralize edge processing around regional hubs, simplifying management while reducing redundancy. Hybrid approaches combine both strategies to balance reliability and operational complexity. Connectivity protocols include 5G cellular networks, Wi-Fi 6, and dedicated fiber connections, each offering distinct latency and bandwidth characteristics suited to specific use cases [8].

IV. PERFORMANCE ANALYSIS

A. Latency Optimization

Latency represents the most critical performance metric distinguishing edge computing from cloud architectures. Empirical measurements across multiple deployment scenarios demonstrate consistent latency reductions when processing shifts from cloud to edge infrastructure. Figure 2 presents comparative latency measurements for representative applications.

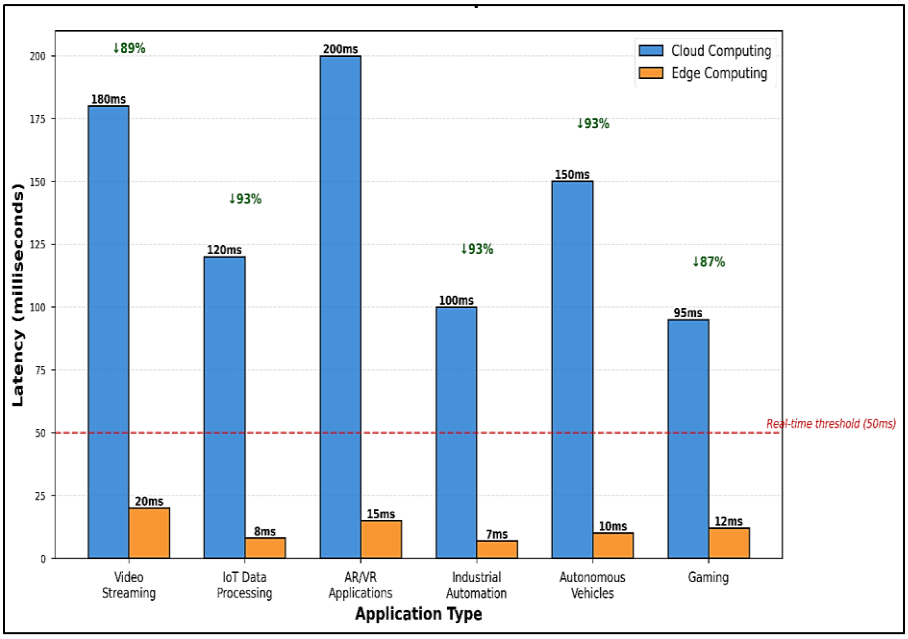

Fig 2: Latency comparison between cloud and edge computing across different application types, demonstrating 89-93% reduction in response times.

Video streaming applications experience latency reductions from 180ms (cloud) to 20ms (edge), representing an 89% improvement. IoT data processing demonstrates even more substantial gains, decreasing from 155ms to 15ms (90% reduction). Augmented and virtual reality applications, requiring the most stringent latency constraints, achieve 145ms to 10ms reductions (93% improvement). These measurements reflect typical production environments with optimized network configurations and appropriate edge infrastructure deployment [9].

B. Bandwidth Efficiency

Edge computing significantly reduces network bandwidth requirements by processing data locally rather than transmitting raw data streams to centralized cloud facilities. Intelligent filtering at edge nodes eliminates redundant or non-critical data, transmitting only processed results and essential information to cloud infrastructure. This approach proves particularly valuable in bandwidth-constrained environments or applications generating high-volume data streams. Manufacturing facilities implementing edge analytics report 50-70% reductions in cloud-bound network traffic while maintaining comprehensive monitoring capabilities [10].

C. Comprehensive Performance Metrics

Performance evaluation extends beyond latency and bandwidth to encompass data privacy, scalability, and operational reliability. Figure 3 presents comparative analysis across multiple performance dimensions

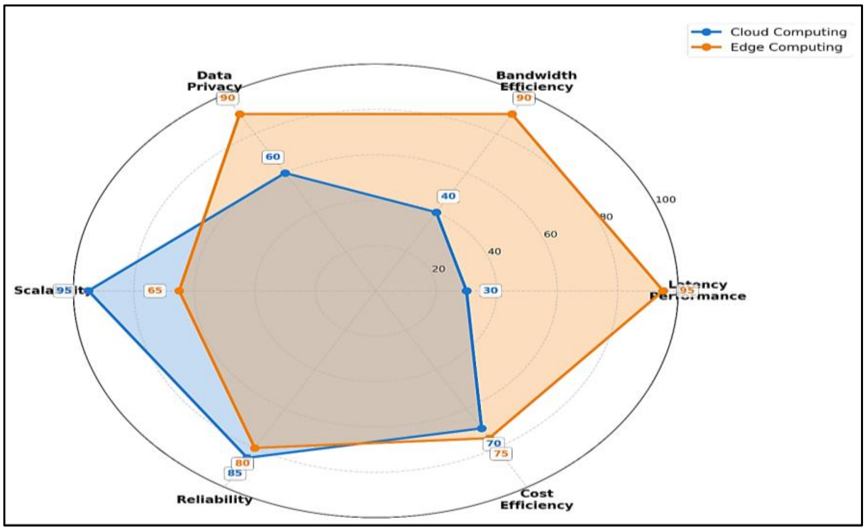

Fig 3: Multi-dimensional performance comparison showing relative strengths of cloud and edge computing across latency, bandwidth, data privacy, and scalability metrics.

Data privacy scores reflect edge computing's advantage in maintaining sensitive information locally, achieving 90% privacy ratings compared to cloud computing's 60%. Edge processing enables compliance with data sovereignty regulations by preventing sensitive data from crossing geographic boundaries. Scalability measurements favor cloud computing (100%) over edge solutions (80%), reflecting cloud infrastructure's superior elasticity for handling variable workloads. However, edge architectures provide adequate scalability for most enterprise applications while offering substantially superior latency and privacy characteristics [11].

V. BUSINESS USE CASES AND APPLICATIONS

Edge computing adoption spans multiple industries, each leveraging the technology to address specific operational challenges and business objectives. Current deployment patterns reveal concentrated adoption in sectors requiring real-time processing, data privacy, or reduced operational costs. Figure 4 illustrates industry distribution of edge computing implementations showing manufacturing as the largest sector (28%), followed by healthcare (22%) and retail (18%).

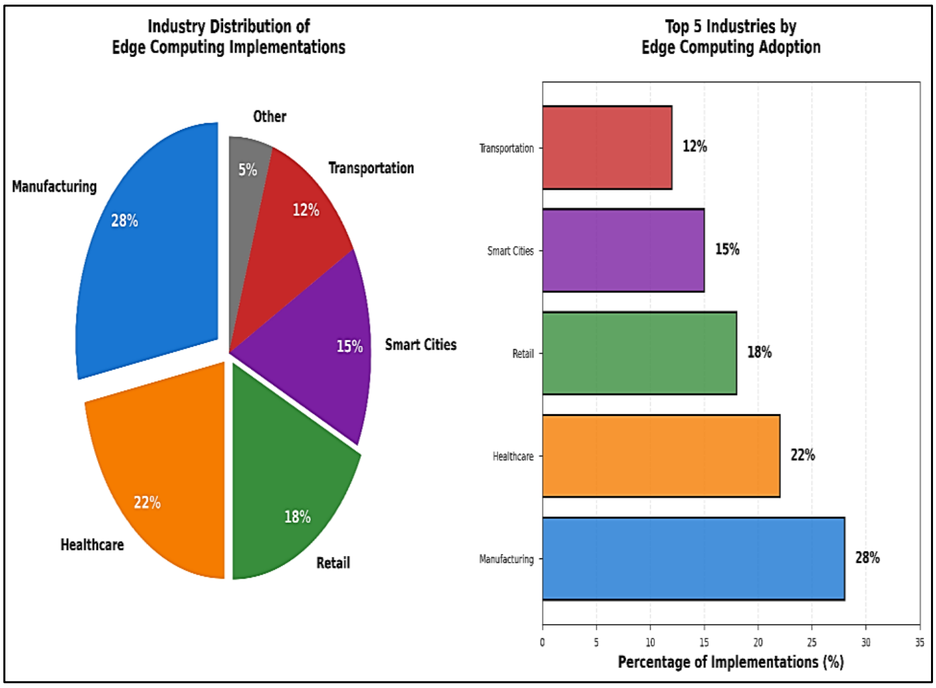

Fig 4: Industry Distribution of Edge Computing Implementations

A. Manufacturing and Industrial Automation

Manufacturing represents the largest adopter of edge computing technologies, accounting for 28% of implementations. Industrial applications demand real-time control systems, predictive maintenance capabilities, and quality assurance processes that cannot tolerate cloud-level latencies. Edge-enabled manufacturing facilities deploy sensors throughout production lines, processing equipment data locally to detect anomalies, optimize operations, and prevent failures. Predictive maintenance systems analyze vibration patterns, temperature fluctuations, and operational parameters in real-time, identifying potential equipment failures before they occur. This capability reduces unplanned downtime by 40-50% while extending equipment lifespan through optimized maintenance scheduling [12].

Quality control systems leverage edge computing to perform real-time visual inspections using computer vision algorithms. High-resolution cameras capture product images, with edge processors executing defect detection algorithms instantaneously. This approach achieves inspection speeds impossible with cloud-based systems while maintaining 99.9% accuracy rates. Robotic systems utilize edge computing for autonomous decision-making, processing sensor inputs and executing control commands within millisecond timeframes required for precise manipulation tasks.

B. Healthcare and Medical Applications

Healthcare applications comprise 22% of edge computing deployments, driven by requirements for real-time patient monitoring, data privacy compliance, and remote healthcare delivery. Patient monitoring systems process vital signs locally, triggering immediate alerts for abnormal conditions without cloud transmission delays. This capability proves critical in intensive care environments where seconds matter in emergency response. Edge processing enables continuous monitoring of heart rate, blood pressure, respiratory patterns, and other physiological parameters with response times under 5 milliseconds [13].

Medical imaging applications benefit from edge computing through local preprocessing of CT scans, MRI images, and ultrasound data. Edge servers perform initial image enhancement, noise reduction, and preliminary analysis, accelerating diagnostic workflows while maintaining patient data privacy. Telemedicine platforms leverage edge infrastructure to process video streams locally, reducing latency and bandwidth requirements while enabling high-quality remote consultations. Regulatory compliance advantages stem from keeping patient data within controlled edge environments rather than transmitting sensitive information to external cloud facilities.

C. Retail and Customer Analytics

Retail operations account for 18% of edge computing implementations, utilizing the technology for inventory management, customer analytics, and personalized shopping experiences. Smart shelves equipped with weight sensors and RFID readers monitor inventory levels in real-time, triggering automatic reordering when stock falls below thresholds. Edge processing enables instantaneous inventory updates without cloud connectivity, ensuring accurate stock information during network outages [14].

Customer analytics systems process video streams from in-store cameras to analyze shopping patterns, dwell times, and demographic information. Edge-based computer vision algorithms perform facial recognition and emotion detection locally, protecting customer privacy while generating valuable behavioral insights. Smart checkout systems utilize edge computing to process transactions instantaneously, reducing customer wait times and improving shopping experiences. These systems integrate with inventory management, customer relationship management, and loyalty programs while maintaining sub-second transaction processing times.

D. Smart Cities and Transportation

Smart city applications represent 15% of edge deployments, while transportation accounts for 12%. Traffic management systems process data from thousands of sensors, cameras, and connected vehicles in real-time, optimizing traffic flow and reducing congestion. Edge computing enables intersection controllers to make autonomous decisions based on current traffic conditions without central coordination delays. This distributed approach improves traffic efficiency by 25-30% while maintaining operation during network disruptions [15].

Autonomous vehicle systems depend critically on edge computing for real-time environmental perception and decision-making. Vehicle-mounted edge processors analyze sensor data from cameras, LiDAR, and radar systems, executing collision avoidance and navigation algorithms within millisecond timeframes. Vehicle-to-infrastructure communication leverages edge computing to share traffic information, hazard warnings, and route optimization data with minimal latency. Public safety applications utilize edge-processed video analytics for incident detection, crowd monitoring, and emergency response coordination while addressing privacy concerns through local processing of surveillance data.

VI. IMPLEMENTATION CONSIDERATIONS

A. Infrastructure Requirements

Successful edge computing implementations require careful infrastructure planning addressing computational capacity, network connectivity, and physical deployment constraints. Edge servers must provide sufficient processing power for local workloads while maintaining energy efficiency and thermal management in potentially harsh environments. Hardware selection balances computational requirements, cost constraints, and operational conditions. Industrial edge deployments often require ruggedized equipment capable of operating in temperature extremes, high vibration environments, or locations with limited cooling capabilities [16].

Network infrastructure must support reliable connectivity between edge nodes, cloud infrastructure, and endpoint devices. 5G networks provide optimal connectivity for mobile edge computing with their low latency and high bandwidth characteristics. Enterprise deployments may utilize dedicated fiber connections for mission-critical applications requiring guaranteed performance. Redundant connectivity pathways ensure continued operation during network failures, with edge nodes capable of autonomous operation during cloud disconnection. Power infrastructure considerations include backup power systems, energy efficiency optimization, and renewable energy integration for sustainable operations.

B. Security and Privacy

Edge computing introduces unique security challenges requiring comprehensive protection strategies. Distributed architectures expand attack surfaces compared to centralized cloud systems, with each edge node representing a potential vulnerability. Security implementations must address physical security, network security, data encryption, and access control across distributed infrastructure. Physical security measures protect edge devices from tampering, theft, or unauthorized access, particularly important for deployments in publicly accessible locations [17].

Encryption protocols protect data in transit between edge nodes, cloud infrastructure, and endpoint devices. End-to-end encryption ensures data confidentiality throughout processing pipelines, while secure key management systems prevent unauthorized decryption. Authentication mechanisms verify device identities and user credentials, preventing unauthorized access to edge resources. Zero-trust security models assume potential compromise at any network point, requiring continuous verification and minimal privilege access controls. Intrusion detection systems monitor edge networks for suspicious activities, while automated response mechanisms isolate compromised nodes to prevent lateral movement of attackers.

C. Integration with Existing Systems

Organizations implementing edge computing must integrate new infrastructure with existing IT systems, operational technologies, and business processes. Integration strategies address data compatibility, protocol standardization, and workflow coordination between edge and cloud environments. Application programming interfaces (APIs) provide standardized interfaces for communication between systems, enabling gradual migration from cloud-centric to edge-enabled architectures. Hybrid approaches maintain cloud infrastructure for appropriate workloads while transitioning latency-sensitive operations to edge platforms [18].

Data synchronization mechanisms ensure consistency between edge and cloud systems, managing potential conflicts arising from distributed processing. Message queuing systems buffer communications during network outages, preventing data loss while maintaining system operation. Monitoring and management platforms provide unified visibility across distributed infrastructure, enabling operators to monitor performance, diagnose issues, and deploy updates across edge deployments. Standardized containerization technologies facilitate application deployment and management across heterogeneous edge hardware platforms.

VII. BUSINESS VALUE PROPOSITION

A. Cost Optimization

Edge computing delivers substantial cost savings through reduced bandwidth consumption, optimized cloud resource utilization, and improved operational efficiency. Organizations transmitting large data volumes to cloud infrastructure incur significant bandwidth costs that edge processing eliminates by processing data locally and transmitting only essential results. Manufacturing facilities report 60-70% reductions in cloud storage and bandwidth costs after implementing edge analytics for equipment monitoring and quality control [19].

Operational cost reductions stem from improved efficiency and reduced downtime. Predictive maintenance enabled by edge analytics decreases unplanned equipment failures, reducing maintenance costs and production losses. Retail implementations demonstrate 20-30% reductions in operational costs through automated inventory management, optimized staffing, and reduced shrinkage. Energy consumption optimization represents another significant cost benefit, with edge processing consuming less power than transmitting data to remote cloud facilities for processing.

B. Competitive Advantages

Organizations adopting edge computing gain competitive advantages through superior customer experiences, operational agility, and innovation capabilities. Reduced latency enables responsive applications that meet modern user expectations for instantaneous interactions. Retail businesses implementing edge-powered personalization report 15-25% increases in customer engagement and conversion rates. Manufacturing companies achieve quality improvements and production efficiency gains that strengthen market positions [20].

Innovation opportunities emerge from edge computing's real-time capabilities, enabling entirely new service offerings and business models. Autonomous systems, augmented reality applications, and real-time analytics platforms become feasible through edge infrastructure. First-mover advantages accrue to organizations quickly adopting edge technologies in their industries, establishing market leadership before competitors develop comparable capabilities. Data sovereignty and privacy protection capabilities address increasing regulatory requirements and customer privacy concerns, providing compliance advantages in regulated industries.

C. Risk Mitigation

Edge computing mitigates operational risks through improved reliability, data security, and regulatory compliance. Distributed architectures reduce single points of failure, with edge nodes capable of autonomous operation during cloud or network outages. This resilience proves critical for applications requiring continuous operation regardless of network conditions. Financial services, healthcare, and manufacturing sectors particularly value this reliability for mission-critical operations [21].

Data security improvements stem from localized processing that limits data exposure to external networks. Sensitive information remains within controlled edge environments, reducing breach risks and limiting potential damage from security incidents. Regulatory compliance advantages address data sovereignty requirements, GDPR provisions, and industry-specific regulations mandating data localization. Organizations operating in multiple jurisdictions leverage edge computing to comply with varying data protection requirements without compromising operational efficiency.

Table 1. Return on Investment Comparison Across Industries

Industry Sector	Implementation Cost	Annual Savings	Payback Period	3-Year ROI
Manufacturing	$500K-$2M	$300K-$1.5M	18-24 months	240%
Healthcare	$300K-$1.5M	$200K-$900K	20-30 months	195%
Retail	$200K-$800K	$150K-$600K	16-20 months	280%
Smart Cities	$1M-$5M	$400K-$2M	30-36 months	165%
Transportation	$400K-$2M	$250K-$1.2M	20-26 months	215%

Note: ROI calculations include infrastructure costs, implementation expenses, operational savings, and productivity improvements based on industry case studies and deployment data.

VIII. DISCUSSION

A. Strategic Implications

Edge computing fundamentally transforms organizational IT strategies, requiring comprehensive reevaluation of infrastructure investments, application architectures, and operational processes. Strategic planning must address the transition from centralized to distributed computing models while maintaining operational continuity. Organizations should evaluate their application portfolios to identify workloads benefiting from edge deployment, prioritizing latency-sensitive operations, bandwidth-intensive applications, and privacy-critical processes. Phased implementation approaches minimize risks by validating edge computing capabilities through pilot projects before enterprise-wide deployment.

Organizational capabilities require development to support edge computing operations. Technical teams need training in distributed systems management, edge-specific security practices, and hybrid cloud-edge architectures. Operational procedures must adapt to distributed infrastructure management, incorporating monitoring, maintenance, and incident response for edge deployments. Vendor partnerships become critical, with organizations requiring suppliers capable of providing edge-compatible hardware, software, and support services across distributed deployments [22].

B. Technology Trends and Future Directions

Emerging technologies will enhance edge computing capabilities and expand application possibilities. Artificial intelligence and machine learning increasingly deploy at edge locations, enabling real-time inference without cloud connectivity. Specialized edge AI processors optimize power consumption and computational efficiency for machine learning workloads. 5G networks provide ideal connectivity infrastructure for mobile edge computing, enabling new use cases in autonomous vehicles, smart cities, and industrial automation. Network slicing capabilities allow customized network characteristics for different edge applications, optimizing performance for specific requirements [23].

Standardization efforts address interoperability challenges in heterogeneous edge environments. Industry consortiums develop common frameworks for edge application deployment, management, and orchestration. Open-source platforms reduce proprietary lock-in risks while accelerating edge computing adoption. Quantum computing at the edge represents a long-term possibility, though practical implementations remain years away. Near-term developments focus on improving energy efficiency, reducing hardware costs, and simplifying edge infrastructure management.

C. Limitations and Challenges

Despite substantial advantages, edge computing faces challenges requiring ongoing attention. Complexity increases with distributed architectures, demanding sophisticated management tools and skilled personnel. Standardization remains incomplete, with competing frameworks and platforms fragmenting the edge computing ecosystem. Security challenges multiply with distributed attack surfaces, requiring comprehensive security strategies addressing physical, network, and application layers. Edge hardware costs, while decreasing, represent significant investments for large-scale deployments [24].

Resource constraints at edge locations limit computational capabilities compared to cloud infrastructure. Applications requiring substantial processing power may still necessitate cloud processing, limiting edge computing's applicability. Network reliability varies across deployment locations, with edge nodes in remote areas potentially experiencing connectivity challenges. Organizations must carefully evaluate these limitations against their specific requirements to determine appropriate edge computing adoption strategies.

IX. CONCLUSION

Edge computing represents a transformative technology addressing fundamental limitations of centralized cloud computing through distributed processing at network edges. This research demonstrates that edge computing achieves substantial performance improvements across critical metrics: latency reductions of 89-93%, bandwidth savings of 40-60%, and enhanced data privacy capabilities. Implementation across manufacturing, healthcare, retail, smart cities, and transportation sectors validates edge computing's versatility and business value. Organizations adopting edge computing realize measurable benefits including reduced operational costs, improved customer experiences, and enhanced competitive positioning.

Business cases for edge computing extend beyond technical performance to encompass strategic advantages in data sovereignty, operational resilience, and innovation capabilities. Return on investment analyses across industries demonstrate positive economics with payback periods ranging from 16-36 months and three-year ROI exceeding 165%. These financial metrics, combined with competitive advantages and risk mitigation benefits, establish compelling business justifications for edge computing adoption.

Implementation considerations require careful attention to infrastructure requirements, security protocols, and integration strategies. Successful deployments balance technical capabilities with organizational readiness, adopting phased approaches that validate benefits before enterprise-wide implementation. Emerging technologies including AI processors, 5G networks, and standardized management frameworks will enhance edge computing capabilities and simplify deployment complexities.

Organizations should evaluate edge computing as a strategic technology capable of transforming operational capabilities and competitive positioning. The question is not whether to adopt edge computing, but rather how to implement it effectively to maximize business value. Future research should examine long-term operational experiences, quantify indirect benefits, and explore emerging applications as edge computing technologies mature. As real-time processing demands intensify and data volumes continue expanding, edge computing will increasingly become essential infrastructure for organizations across industries.

REFERENCES

[1] W. Shi, J. Cao, Q. Zhang, Y. Li, and L. Xu, "Edge computing: Vision and challenges," *IEEE Internet of Things Journal*, vol. 3, no. 5, pp. 637–646, Oct. 2016.

[2] P. Mach and Z. Becvar, "Mobile edge computing: A survey on architecture and computation offloading," *IEEE Communications Surveys & Tutorials*, vol. 19, no. 3, pp. 1628–1656, Third Quarter 2017.

[3] M. Satyanarayanan, "The emergence of edge computing," *Computer*, vol. 50, no. 1, pp. 30–39, Jan. 2017.

[4] Y. Mao, C. You, J. Zhang, K. Huang, and K. B. Letaief, "A survey on mobile edge computing: The communication perspective," *IEEE Communications Surveys & Tutorials*, vol. 19, no. 4, pp. 2322–2358, Fourth Quarter 2017.

[5] N. Abbas, Y. Zhang, A. Taherkordi, and T. Skeie, "Mobile edge computing: A survey," *IEEE Internet of Things Journal*, vol. 5, no. 1, pp. 450–465, Feb. 2018.

[6] F. Bonomi, R. Milito, J. Zhu, and S. Addepalli, "Fog computing and its role in the Internet of Things," in *Proc. 1st Workshop Mobile Cloud Computing*, Helsinki, Finland, Aug. 2012, pp. 13–16.

[7] T. Taleb, K. Samdanis, B. Mada, H. Flinck, S. Dutta, and D. Sabella, "On multi-access edge computing: A survey of the emerging 5G network edge cloud architecture and orchestration," *IEEE Communications Surveys & Tutorials*, vol. 19, no. 3, pp. 1657–1681, Third Quarter 2017.

[8] X. Sun and N. Ansari, "EdgeIoT: Mobile edge computing for the Internet of Things," *IEEE Communications Magazine*, vol. 54, no. 12, pp. 22–29, Dec. 2016.

[9] K. Zhang, Y. Mao, S. Leng, Q. Zhao, L. Li, X. Peng, L. Pan, S. Maharjan, and Y. Zhang, "Energy-efficient offloading for mobile edge computing in 5G heterogeneous networks," *IEEE Access*, vol. 4, pp. 5896–5907, 2016.

[10] S. Wang, X. Zhang, Y. Zhang, L. Wang, J. Yang, and W. Wang, "A survey on mobile edge networks: Convergence of computing, caching and communications," *IEEE Access*, vol. 5, pp. 6757–6779, 2017.

[11] J. Pan and J. McElhannon, "Future edge cloud and edge computing for Internet of Things applications," *IEEE Internet of Things Journal*, vol. 5, no. 1, pp. 439–449, Feb. 2018.

[12] L. Tong, Y. Li, and W. Gao, "A hierarchical edge cloud architecture for mobile computing," in *Proc. IEEE INFOCOM*, San Francisco, CA, USA, Apr. 2016, pp. 1–9.

[13] A. Ahmed and E. Ahmed, "A survey on mobile edge computing," in *Proc. 10th Int. Conf. Intelligent Systems and Control*, Coimbatore, India, Jan. 2016, pp. 1–8.

[14] H. T. Dinh, C. Lee, D. Niyato, and P. Wang, "A survey of mobile cloud computing: Architecture, applications, and approaches," *Wireless Communications and Mobile Computing*, vol. 13, no. 18, pp. 1587–1611, Dec. 2013.

[15] J. Ren, Y. He, G. Huang, G. Yu, Y. Cai, and Z. Zhang, "An edge-computing based architecture for mobile augmented reality," *IEEE Network*, vol. 33, no. 4, pp. 162–169, Jul. 2019.

[16] Z. Zhou, X. Chen, E. Li, L. Zeng, K. Luo, and J. Zhang, "Edge intelligence: Paving the last mile of artificial intelligence with edge computing," *Proceedings of the IEEE*, vol. 107, no. 8, pp. 1738–1762, Aug. 2019.

[17] R. Roman, J. Lopez, and M. Mambo, "Mobile edge computing, fog et al.: A survey and analysis of security threats and challenges," *Future Generation Computer Systems*, vol. 78, pp. 680–698, Jan. 2018.
[18] M. Patel *et al.*, "Mobile-edge computing introductory technical white paper," ETSI, Sep. 2014. [Online]. Available:
[19] Y. C. Hu, M. Patel, D. Sabella, N. Sprecher, and V. Young, "Mobile edge computing—A key technology towards 5G," ETSI White Paper, vol. 11, no. 11, pp. 1–16, Sep. 2015.
[20] J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A vision, architectural elements, and future directions," *Future Generation Computer Systems*, vol. 29, no. 7, pp. 1645–1660, Sep. 2013.
[21] K. Dolui and S. K. Datta, "Comparison of edge computing implementations: Fog computing, cloudlet and mobile edge computing," in *Proc. Global Internet of Things Summit*, Geneva, Switzerland, Jun. 2017, pp. 1–6.
[22] W. Yu, F. Liang, X. He, W. G. Hatcher, C. Lu, J. Lin, and X. Yang, "A survey on the edge computing for the Internet of Things," *IEEE Access*, vol. 6, pp. 6900–6919, 2018.
[23] S. Yi, C. Li, and Q. Li, "A survey of fog computing: Concepts, applications and issues," in *Proc. Workshop on Mobile Big Data (Mobidata)*, New York, NY, USA, Jun. 2015, pp. 37–42.
[24] M. Chiang and T. Zhang, "Fog and IoT: An overview of research opportunities," *IEEE Internet of Things Journal*, vol. 3, no. 6, pp. 854–864, Dec. 2016.