FROST & SULLIVAN

INTEL

2022
TECHNOLOGY INNOVATION LEADER

GLOBAL EDGE COMPUTING INDUSTRY

Best Practices Criteria for World-Class Performance

Frost & Sullivan applies a rigorous analytical process to evaluate multiple nominees for each award category before determining the final award recipient. The process involves a detailed evaluation of best practices criteria across two dimensions for each nominated company. Intel excels in many of the criteria in the edge computing space.

AWARD CRITERIA

Technology Leverage	Business Impact
Commitment to Innovation	Financial Performance
Commitment to Creativity	Customer Acquisition
Stage Gate Efficiency	Operational Efficiency
Commercialization Success	Growth Potential
Application Diversity	Human Capital

Intel´s ability to launch incremental innovations with a higher frequency is remarkable in a nascent and constantly changing market

The Edge Computing commercial offering from operators in wireless networks is called Multi-access Edge Computing (MEC). The MEC market is still at nascent stage, with telecom operators and cloud providers reaching agreements to launch the offering commercially, in certain cases, or conducting trials in certain metropolitan areas in other cases. The implementation of the MEC infrastructure presents challenges for other Information and Communication Technologies (ICT) industry participants. The first challenge related to developing and implementing enabling technologies that allow low-latency (<10 milliseconds) in wireless networks. The second challenge relates to allowing an intelligent edge in the telecommunications networks with computing power to process data in the edge and improve performance of applications and user experience. In addition, there are challenges related to underdeveloped ecosystems in different verticals, lack of standardization and interoperability of MEC across telecom operators worldwide and lack of specialized work force.

> *"In 2020, the company also completed 6 acquisitions to expand product offerings, what demonstrates the commitment of Intel to Innovation, in its effort to drive a "data-centric future", moving away from its past Personal Computer (PC) centric strategy."*
>
> *- Carina Gonçalves,*
> *Senior Consultant*

Intel, a semiconductor design and manufacturing company, which also has solutions in a broad range of industries and is increasingly playing an important role in digital transformation, is currently focused on artificial intelligence (AI), advanced 5G networking technologies, and intelligent, autonomous edge computing to enhance its integrated digital technology platform. The company has been present in implementations throughout the years with its semiconductors embedded in original equipment manufacturers (OEMs) servers and other hardware such as processors, memories, Field Programmable Gate Array (FPGA), artificial intelligence (AI) accelerators and software. Moreover, Intel develops edge reference architectures for solutions, and provides a MEC platform and software for different use cases.

One of Intel's competitive differentiators and a key strength compared to competitors is its ability to launch incremental innovations with a higher frequency, including technologies for edge computing. The company recently renewed its commitment to Moore's law, which stated in 1965 that "The numbers of transistors incorporated in a chip will approximately double every 24 months." Gordon Moore, author of this famous observation and projection, is an Intel co-founder. Moore's law still serves as a guideline for research & development (R&D) investment and progress in the semiconductor business, driving significant advancements in computing and to the society productivity overall. This R&D investment level positions the company in 10th place worldwide in R&D spending in 2020, among all companies globally, according to FDI Intelligence. Intel's investment volume in R&D has been increasing in a trend line for the past 15 years, growing from $4.78 billion in 2004 to $13.6 billion in 2020. In 2020, the company also completed six acquisitions to expand its product offerings. This demonstrates Intel's commitment to innovation, in its effort to drive a "software defined future" on flexible hardware and open software, moving away from its past personal computer (PC) centric strategy.

The company is also investing in processors with features made specifically for edge workloads. Most recently, the company launched the new Intel® Xeon® D processor, a System-on-Chip (SoC) with built-in AI acceleration, SD-WAN, power management and other optimizations for network and IoT deployments at the edge; in addition to the announcement of the 12th Gen Intel® Core™ processors with enhancements for IoT applications. They have a full stack of processors for IoT applications from Intel® Xeon® Scalable processors and Intel® Core™ processors to Intel Atom® processors, bringing new AI, security, functional safety, sustainability, and real-time capabilities to edge customers.   Intel is well aware of key market challenges in the buildout of the edge—particularity with the transition to cloud native infrastructure—and has designed these features to reduce complexity, lower the cost of ownership, and support a variety of applications in edge environments.

Intel positions itself as a trusted advisor and architecture partner for telecom operators, enabling commercialization success

The commercial success of Intel in 5G MEC has to do with its strategic partnerships with telecom operators, to which it serves as a trusted advisor and architecture partner. To name a few Telecom operators, Intel has public implementation cases with South Korea Telecom (SKT), China Unicom, Rakuten and AT&T for 5G MEC. In addition, Intel has been a key player promoting the ecosystem development in different verticals, catering to diverse consumption models within the ecosystem, working in different forums and industry groups on standardization and interoperability of MEC, such as the Industry Specification Group (ISG) within ETSI, and helping supply skilled people for

implementations. Recently, Intel announced a partnership with Google to boost Open RAN and edge 5G architectures. In that sense, Intel has been helping the industry mitigate challenges related to the implementation and evolution of 5G MEC.

> *"Intel´s is one of the few companies with the technical and financial resources to compete in both markets: edge nodes and edge foundry. The company is committed to building a state-of-the-art foundry in the United States and Europe that can deliver technologies for different countries globally."*
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Intel´s MEC platform, called Intel® Smart Edge, is designed for applications that require low latency, supporting Telecom Operators and enterprises for on-premises as well as network edge (base stations and regional data centers) deployments. The Smart Edge portfolio consists of a commercial turn-key software from Intel as well as a royalty-free toolkit, Intel® Smart Edge Open that offers pre-validated SDKs and advanced capabilities to build an edge platform. The platform can host any cloud-native application using MEC servers as well as private wireless deployments in retail marketing and operations, heavy enterprise applications involving machine learning, IoT, connected vehicles, augmented reality (AR) as well as advanced 5G network functions. Furthermore, Intel® Smart Edge's MEC platform can analyze network and application performance data and act on the insights, without sending data to a remote cloud data center for processing. The platform is embedded with capabilities including performing real-time analytics, security, media and enables applications to be deployed across the network, thereby reducing the cost of data transport and processing, which normally would occur in a centralized data center.

In addition, Intel´s aggressive pace of releasing innovative new features annually displays a proven track record of taking new technologies to market with a high success rate. The new IoT capabilities reach higher core counts, larger cache sizes, and higher processor frequency, along with significant expansion of its 5G networking infrastructure. Intel is one of the few companies with the technical and financial resources to compete in both markets: edge nodes and edge foundry, manufacturing semiconductors to other companies. The company is committed to building a state-of-the-art foundry in the United States and Europe that can deliver technologies for different countries globally.

Intel´s integrated digital technology platform serves multiple applications and multiple environments

Intel® has been working with different telecom operators globally to establish architectures and implement platforms to enable MEC for different applications. Intel® Smart Edge's MEC platform improves application performance significantly, reduces latency (and thus response times) and improves customer experience. It can be applied to a variety of applications that require low latency, such as immersive experiences with virtual and augmented reality (e.g., games, stadiums), ultra high definition video streaming, computer vision, autonomous cars, industry 4.0 and 5G gaming, to name a few. The experience with relevant operators in the Asia-Pacific region, such as SKT, China Unicom and Rakuten, should help Intel expand the 5G MEC architectures in other continents, following the expansion of 5G in different economies. The company has already engaged with more than 100 potential customers who are working with the leading-edge Intel 18A.

Intel® Smart Edge offers flexible consumption models for rapid turn-key deployments as well as accelerated build paths for ecosystem scale

With a complex ecosystem at the edge, Intel caters to diverse consumption and business models to be able to serve the needs of everyone. While the commercial Smart Edge software delivers turn-key MEC with advanced service level support for the enterprise buyer, the Intel® Smart Edge Open royalty-free toolkit offers pre-validated Experience Kits or SDKs that an edge builder can easily adopt. Experience Kits are opinionated edge software stacks composed of a set of Intel technology building blocks carefully selected, optimized on IA and integrated with modern tools to host a specific set of edge services, including those of priority at the edge such as private wireless and vRAN. These location and workload-specific stacks are packaged in an easily consumable manner drastically reducing development time for partners and resulting in accelerated time to market. Some of these experience kits are also offered part of the commercial offering.

Intel® Smart Edge offers breakthrough performance in bringing computing power to the edge, enhancing customer acquisition

Intel® Smart Edge MEC Controller is a collection of micro services for centralized provisioning and management which are built on high-performing Intel scalable processors. The Controller has an extremely small footprint, and can be deployed in a public or private cloud.It is configurable for a classic rack mount or as a standalone unit to fit any use across vertical markets and working environments. Moreover, the solution has embedded security by design with fast encryption powered by Intel QuickAssist Technology, accelerating security and data compression tasks by offloading data to hardware that can optimize the functions. Intel® Smart Edge MEC software run in Intel architecture based servers and hosts the various workloads that have an affinity for running on the edge. Workloads include private mobility (4G/5G), 3rd party applications hosted in VMs or Containers, and 3rd party uCPE functions such as SD-WAN and firewalls.   In addition, the solution can collect and display service-quality analytics. Frost & Sullivan firmly believes that Intel® Smart Edge offers breakthrough capabilities with respect to bringing computing power to the edge in a highly secure and cost effective manner.

Intel® Smart Edge solution can scale down for smaller companies and scale up to meet the needs of large enterprises, reinforcing customer loyalty

Intel´s strong customer focus strengthens the brand and reinforces customer loyalty. In order to easily support telecom operators, OEMs, enterprises and other industry participants, Intel developed a MEC software platform that is accessible and easy to deploy and manage post deployment. Intel Smart Edge offers simple to select bundles with add on options available in an on-demand dynamic basis.   With this packaging, the Intel® Smart Edge solution can scale down for smaller deployments and scale up to meet the needs of large enterprises. Customers may elect to customize their implementations according to the vertical industries they operate, such as retail, telecommunications, manufacturing, or other, through a rich set of APIs exposed by the Smart Edge platform, while taking advantage of Intel's broad ecosystem. In parallel, Intel developed a skilled team to support customer needs. Frost & Sullivan expects that the customer service experience, along with leading technology, will enable a high market share participation of Intel in the edge computing business.

Commitment to quality is the foundation of Intel's culture

The "Intel Inside" market campaign during the 90s for personal computers (PCs) made its processors relevant purchase criteria for the end-customer choosing a PC. The commitment to quality and to customers characterized the company culture, which in turn enhanced customer retention. Intel is now present in every semiconductor area, such as mobile, servers and gateways, in addition to having industry solutions, software and services. Its solid reputation and ability to provide consulting and end-to-end solutions provides a significant driver for ecosystem participants to engage with Intel for 5G MEC deployments. As Michelle Johnston Holthaus, executive vice president and general manager of the Intel sales, marketing and communications group, said in its 2020 annual report: "Our customers' success is our obsession. We are committed to delivering a portfolio of the best quality products, performance, and experiences to enable our customers to solve the world's most challenging problems."

Intel employees follow the Intel Code of Conduct, and Intel's Global Human Rights Principles, which form the foundation of its policies and practices and an ethical business culture. The company seeks employees with diverse perspectives, experiences and backgrounds. The company has a culture that empowers and inspires employees to collaborate and create while promoting inclusion. Frost & Sullivan believes this culture is critical to Intel's strategy to lead innovation in the edge computing market.

Conclusion

Intel's comprehensive portfolio for edge computing, with hardware, platform/software and consulting/services, is unparalleled. Intel became a key strategic partner to telecom operators, OEMs, cloud providers and other ecosystem participants to enable edge local zones and allow for the evolution of 5G and a variety of applications that will disrupt industries. Frost & Sullivan analysis concludes that Intel´s recently introduced features specifically for edge workloads will have a significant impact on providing real-time insights to enterprises, while minimizing latency issues and controlling network bandwidth. With its strong overall performance, Intel earns Frost & Sullivan's 2022 Global Technology Innovation Leadership Award in the Edge Computing industry.

What You Need to Know about the Technology Innovation Leadership Recognition

Frost & Sullivan's Technology Innovation Leadership Award recognizes the company that has introduced the best underlying technology for achieving remarkable product and customer success while driving future business value.

Best Practices Award Analysis

For the Technology Innovation Leadership Award, Frost & Sullivan analysts independently evaluated the criteria listed below.

Technology Leverage

Commitment to Innovation: Continuous emerging technology adoption and creation enables new product development and enhances product performance

Commitment to Creativity: Company leverages technology advancements to push the limits of form and function in the pursuit of white space innovation

Stage Gate Efficiency: Technology adoption enhances the stage gate process for launching new products and solutions

Commercialization Success: Company displays a proven track record of taking new technologies to market with a high success rate

Application Diversity: Company develops and/or integrates technology that serves multiple applications and multiple environments

Business Impact

Financial Performance: Strong overall financial performance is achieved in terms of revenues, revenue growth, operating margin, and other key financial metrics

Customer Acquisition: Customer-facing processes support efficient and consistent new customer acquisition while enhancing customer retention

Operational Efficiency: Company staff performs assigned tasks productively, quickly, and to a high-quality standard

Growth Potential: Growth is fostered by a strong customer focus that strengthens the brand and reinforces customer loyalty

Human Capital: Commitment to quality and to customers characterize the company culture, which in turn enhances employee morale and retention

About Frost & Sullivan

Frost & Sullivan is the Growth Pipeline Company™. We power our clients to a future shaped by growth. Our Growth Pipeline as a Service™ provides the CEO and the CEO's growth team with a continuous and rigorous platform of growth opportunities, ensuring long-term success. To achieve positive outcomes, our team leverages over 60 years of experience, coaching organizations of all types and sizes across 6 continents with our proven best practices. To power your Growth Pipeline future, visit Frost & Sullivan at http://www.frost.com.

The Growth Pipeline Engine™

Frost & Sullivan's proprietary model to systematically create ongoing growth opportunities and strategies for our clients is fuelled by the Innovation Generator™.
Learn more.

Key Impacts:

■ **Growth Pipeline:** *Continuous Flow of Growth Opportunities*

■ **Growth Strategies:** *Proven Best Practices*

■ **Innovation Culture:** *Optimized Customer Experience*

■ **ROI & Margin:** *Implementation Excellence*

■ **Transformational Growth:** *Industry Leadership*

The Innovation Generator™

Our 6 analytical perspectives are crucial in capturing the broadest range of innovative growth opportunities, most of which occur at the points of these perspectives.

Analytical Perspectives:

■ Mega Trend (MT)

■ Business Model (BM)

■ Technology (TE)

■ Industries (IN)

■ Customer (CU)

■ Geographies (GE)