FROST & SULLIVAN

BEST PRACTICES AWARDS

Innovium®

2020 NORTH AMERICAN NETWORK SWITCH SILICON SOLUTIONS FOR NEXT GENERATION DATA CENTERS TECHNOLOGY INNOVATION LEADERSHIP AWARD

Contents

Background and Company Performance

Industry Challenges

The global data center industry represents one of the key pillars supporting the global economy, as it forges the development of cutting-edge networking switch devices. Frost & Sullivan expects the rapid use of next-generation applications, such as connected and autonomous cars, 5G, artificial intelligence (AI), and the number of connected and Internet of Things (IoT)-based devices, to drive the growth of the cloud and edge data centers market; the amount of data generated by these technologies is quite vast and estimated to grow from 50 zettabytes in 2020 to 175 zettabytes by 2025.

Moreover, the demand for high network bandwidth, data transfer, and storage has significantly increased in the last few years and is expected to increase further during COVID-19. The pandemic is forcing more remote working and online education through video streaming, gaming, eCommerce, and telemedicine. This demand for data transfer and storage has led to a more dynamic and sophisticated design of storage and computing solutions, causing a significant transition toward modularity. Even with the increasing number of modular data centers, Frost & Sullivan's own research shows that multiple market-related needs are limiting the ability to provide comprehensive solutions for the next generation of IT/cloud services.

Frost & Sullivan analysts have identified the following limitations and needs in incumbent data center network switch solutions:

- *Increased network traffic*: Network traffic is increasing in large data centers, with massive growth in traffic flow within a data center that is driven by AI, non-volatile memory express (NVMe)-based IP storage and microservices-based applications. Customers need high-performance, high-radix, and high-bandwidth networking solutions to properly overcome these challenges.
- *Real-time analytics and telemetry*: As the size of the data center increases, real-time telemetry, event-driven analytics, and automation support for network operators are needed to troubleshoot problems and optimize operations.
- *Programmable network infrastructure solutions*: Data center customers are looking for other ways to use device programmability to implement new network technologies and protocols to future-proof network hardware infrastructure.
- *Low latency*: The growing use of distributed applications and networked storage renders latency vital in any network hop. Customers are searching for the lowest latencies for efficiency enhancement in network infrastructure.

Frost & Sullivan concludes that the abovementioned limitations have led to the need for an innovative solution with zero latency in high-quality compute, storage, and network infrastructure with analytics and automation for superior remote monitoring and for future-proofing the infrastructure for next-generation and power-efficient IT/cloud data center services.

Technology Leverage and Business Impact

Commitment to Innovation

Founded in December 2014, California-based Innovium has developed a patented ultra-efficient Ethernet switch silicon architecture called TERALYNX™, optimized for next-generation data centers. The company developed the TERALYNX architecture with a ground-up design that delivers a fast and highly power-efficient Ethernet switch silicon architecture with low latency, industry-leading analytics, and programmability - in addition to large on-chip buffers that deliver better network and application performance that are not encumbered by legacy architectures.

Unlike traditional high-cost silicon solutions that fail to deliver consistent architecture,

features, and functionalities for products with different performance requirements, Frost & Sullivan recognizes how Innovium's TERALYNX architecture overcomes these challenges by providing cost-efficient and consistent features for data center customers. In addition, the TERALYNX architecture is highly scalable from 2 Terabits per second (Tbps) to 51.2 Tbps and beyond with the same consistent features, functionalities, and software while addressing customers' needs, such as providing high network bandwidth for future applications, including 5G and autonomous vehicles. Innovium's TERALYNX architecture comprises the following three novel components: INNOFLEX™, TERASCALE™, and FLASHLIGHT™.

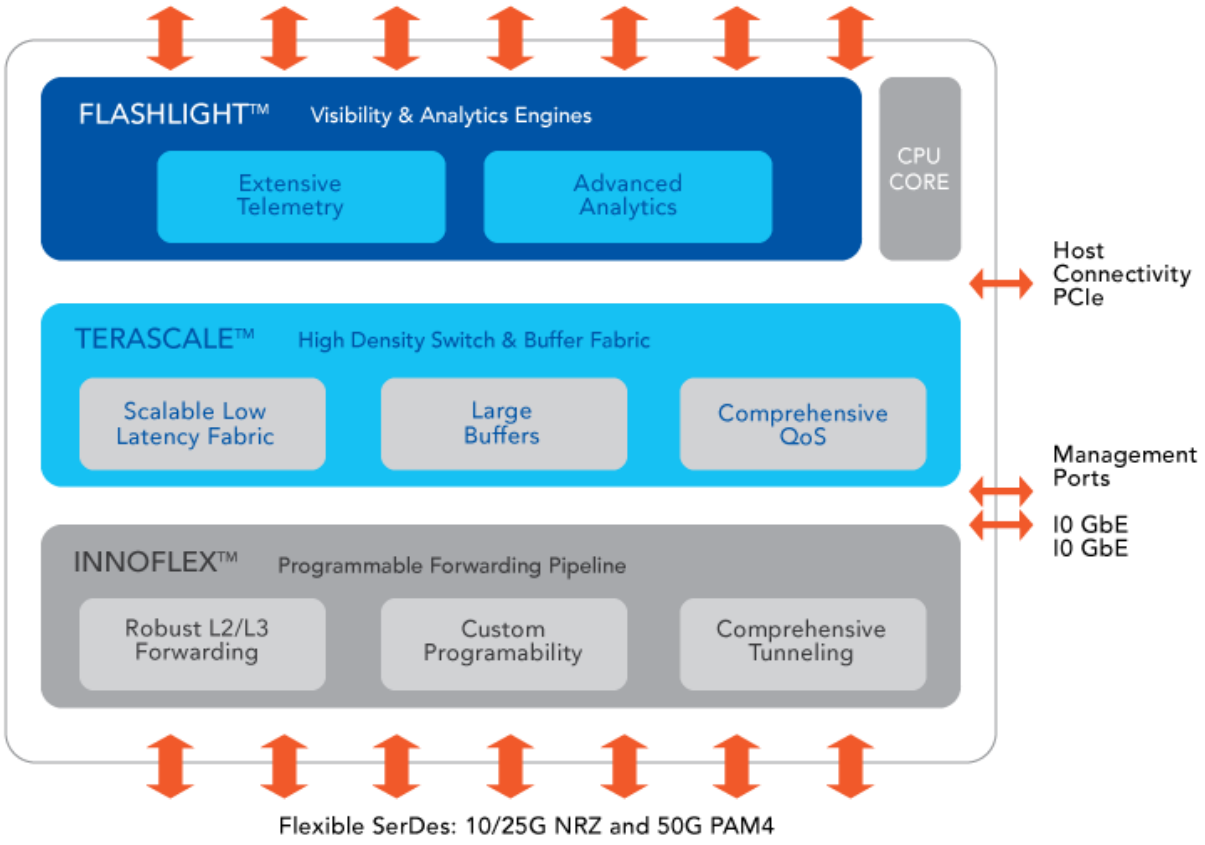


Figure 1: TERALYNX Architecture

These three components support the TERALYNX family of products by providing low latency and flexibility to enhance the data center with new protocols through standard-based programming, advanced data traffic management, large smart packet buffers, comprehensive real-time transparency, and measurable grid analytics for troubleshooting and addressing network congestion issues in real time. Moreover, unlike alternate Ethernet switch silicon architectures that require complex circuitry designs to work across multi-chip system designs, the TERALYNX architecture is flexible enough to work in both single chip and multi-chip system designs - without requiring any additional complex circuitry design.

Innovium's TERALYNX architecture has been commercialized and is expected to disrupt the global data center market in the next three to five years through its programmable switch family of products that future-proof the data center infrastructure to support technology demands. In addition to offering low latency and programmability features, Innovium's TERALYNX features high radix SerDes that supports 10/25G NRZ and 50/100G PAM4 network standards, thereby enabling customers to leverage a variety of connectivity selections that range from 10/25/40/50/100G Ethernet to the upcoming 200/400G Ethernet connectivity.

Frost & Sullivan commends Innovium's exemplary strategy of enabling its technology to impact the global data centers industry, including engaging in strategic collaborations with data center original equipment manufacturers (OEMs), original design manufacturers (ODMs), and multiple Tier I hyperscale cloud providers to develop solutions to match specific key requirements.

Commitment to Creativity

Edge and cloud data center customers currently face high network traffic because of increasing data loads from cloud computing, AI/machine learning, data analytics, high-resolution video streaming, micro-service-based applications, and distributed storage. Customers need an ideal network architecture that will provide the typical application efficiency while reducing operating costs through low power consumption, flexibility, and automation.

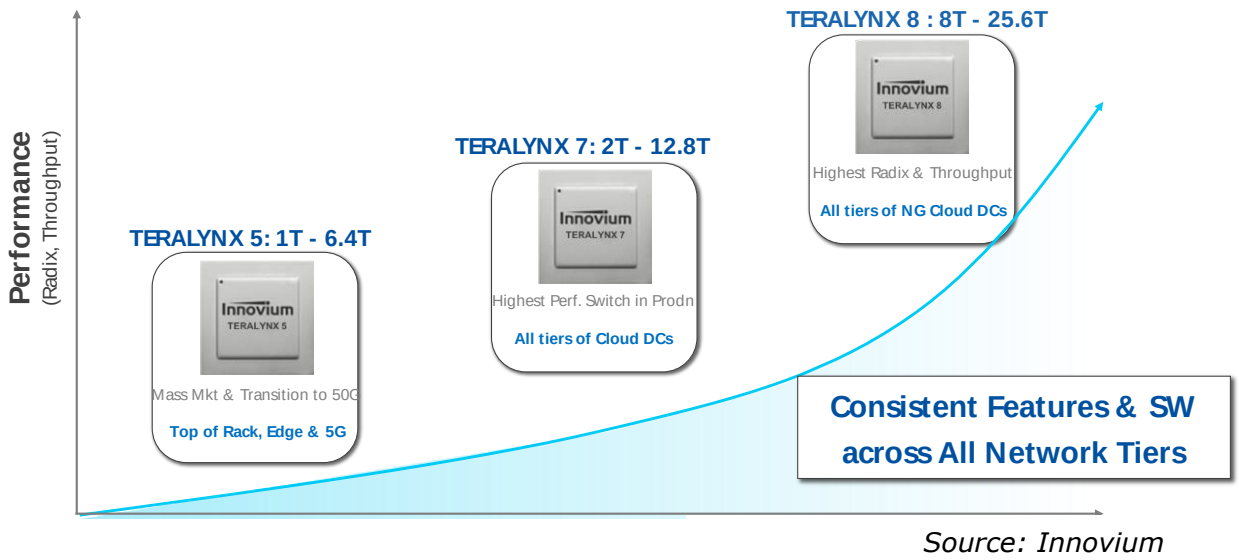
To address this customer need, Innovium has developed Ethernet switch silicon products based on its ultra-efficient TERALYNX architecture. Innovium has considered large data center customer pain points and trends and has thus focused its entire research efforts on solving the issues, leading to the filing of more than 80 patents.

Based on the TERALYNX architecture, Innovium has developed the following data center Ethernet switch products:

- **TERALYNX 5**: The TERALYNX 5 family of products offers up to 6.4-Tbps single-chip performance and is ideal for top of rack (ToR), enterprise, edge, and 5G switching solutions. This family of products is currently ramping shipments for customer designs.
- **TERALYNX 7:** The TERALYNX 7 family of products includes a high-performance silicon switch that offers up to 12.8 Tbps for private and public cloud data centers. TERALYNX 7 is ramping up volume production; offers more than 15 different OEM

and ODM designs; and was selected by leading data center OEMs, ODMs, and cloud providers for several system configurations that encourage superior infrastructure and profitability. For instance, Cisco Nexus 3400-S switches leverage Innovium's TERALYNX 7 switch for data center networking applications.

- **TERALYNX 8:** Innovium launched the TERALYNX 8 family of products in May 2020 to enable next-generation private and public cloud data center customers to design a compact, high-performance programmable switch with 25.6 Tbps in a 1 rack unit (RU) form factor. TERALYNX 8 will be commercialized in the second half of 2020 with three variants and will have an on-chip memory buffer capacity of 170 MB, which is 30% higher than competing chips. The competing Ethernet switch requires a 512 SerDes connection operating at 50G and requires more chipsets to deliver bandwidth of 25.6 Tbps. In contrast, Innovium's TERALYNX 8 uses only one chip with a 256 SerDes connection to accomplish the same 25.6 Tbps switching bandwidth.



Source: Innovium

Figure 2: TERALYNX Product Family

In addition to developing Ethernet switches, Innovium has established Software for Open Networking in the Cloud (SONiC) that features rich telemetry and analytics that simplify operations with deep insights on network traffic and automation. Moreover, the TERALYNX products are compatible with any edge and cloud data center networking switch operating system and are used by hyperscale cloud providers to run their own/proprietary network operating systems.

Frost & Sullivan analysis indicates that the market potential is quite high for Innovium's innovative technology, becoming an industry standard for cloud and edge data center applications. In addition, the simplicity, high integration potential, and cost advantage will make Innovium's solution a preferred choice across global sectors in the near future.

Commercialization Success and Customer Acquisition

Innovium builds its customer base by partnering with customers to obtain valuable feedback, which is then used to determine and implement the correct and desired specifications for both current and future products. Frost & Sullivan finds that Innovium has constructed an effective means of gaining an increasing number of customers by fully understanding their pain points, including low latency and high manufacturing cost, and by understanding their challenges in the conventional network switch to scale and deliver better network quality and performance.

Despite the recent global economic setbacks because of COVID-19, Innovium continues to achieve a robust financial performance. With recent funding of $170 million raised in July 2020, Innovium is valued at more than $1 billion. In fact, in the most recent financial report, Innovium captured a 23% market share in 2019 for 50G SerDes switch silicon global shipments and has emerged as the only credible silicon diversity option after industry leader Broadcom (76% market share) and other competitors (combined 1% market share). Innovium's net revenue grew five times in 1H 2020 compared to 1H 2019, and the company has expanded its operations, sales, and support in North America, Europe, and Asia-Pacific (APAC), indicating a fairly healthy business worldwide. While some COVID-19-related setbacks are expected, the company remains optimistic that it can meet the industry need for mission-critical network solutions.

Innovium's technology has received positive feedback from the top 25 cloud and edge data center OEMs and white box ODMs after testing and evaluating the novel solution. Since its establishment, Innovium has raised more than $350 million in series funding rounds from investors and venture capitalists, including PremjiInvest, BlackRock, DFJ Growth, Greylock Partners, Redline Capital, Qualcomm Ventures, WRVI Capital, Capricorn Investment Group, S-Cubed Capital, and DAG Ventures. The company intends to utilize this funding for further technology and product enhancements and to expand its customer engagements as a trusted long-term partner.

Frost & Sullivan finds that Innovium's focused technology development with a reduced cost in terms of mass production is a major factor in attracting more customers. The combined strength of the technology's attributes and its wide applicability in 5G radio access network (RAN), IoT, retail and factory automation, smart cities, and autonomous vehicles enables Innovium to impact the data centers market significantly and capture an impressive market share.

Growth Potential

Even though Innovium is a young company, it has shown strong growth, largely attributed to its entry into the cloud and edge data centers market at a relatively emerging and opportunistic stage of the technology. Interest in the field of network switches has increased based on the company's ability to provide superior telemetry and a highly power-efficient and scalable family of Ethernet switches. This technology allows Innovium to sustain its revenue growth and drive customer acquisition. Frost & Sullivan expects that the global market for modular data centers will approach about $14 billion over the next few years,

positioning Innovium, with the recent release of its high-performance TERALYNX 8 network switch chip, to achieve optimum growth in the near future.

Customers in emerging markets are primarily focused on delivering high network bandwidth product solutions in cloud and edge data centers; therefore, Innovium is well positioned for growth since it focuses on high-volume production and the manufacturing and marketing of scalable, cost-effective, and high-quality products. In addition, Innovium's strong brand name, creative business model, and successful delivery of high-quality network switching technologies ensure its reputation for investors, developers, and end users, indicating the company's promising future growth potential.

Frost & Sullivan's research shows that Innovium is in the ideal spot to meet current market needs as well as cater to future market trends, boding well for the company's solid growth potential.

Human Capital

Innovium effectively maintains successful relationships with its investors, customers, and experts by providing dedicated support engineers. The company's employees have extensive professional and technical expertise in data center switches and cloud and mobile infrastructure solutions, where top management executives, including veterans from Broadcom, Cisco, Dell EMC, Juniper Networks, Marvell, and Intel, bring more than 30 years of combined experience in commercializing network switch products. This leadership expertise positions Innovium to develop new technology innovation for next-generation network silicon solutions. The company's skilled technologists have enabled key patents to be filed related to high-density switches, buffer fabric, visibility and analytics engines, and systems and packages with high-speed 50G SerDes.

Frost & Sullivan notes that Innovium's commitment to creating value for customers parallels its culture regarding management and technology, including transparency and authenticity. With its patent-protected technology, in addition to its well-established contacts with OEMs, the company has a vast growth opportunity to build a global footprint over the long term. Furthermore, Innovium is a pioneering market participant, and its positioning and marketing strategy for its production-scalable technology will allow it to capture significant market share in the coming years.

Conclusion

Because the cloud and edge data centers industry is loaded with a significant amount of data generated at the edge of networks for realizing 5G, IoT, retail and factory automation, smart cities, and autonomous vehicle applications, it must identify innovative, high-performance, and economical network switch solutions to properly handle these next-generation applications.

With its ultra-efficient TERALYNX architecture, Frost & Sullivan applauds how Innovium addresses this industry need and offers the world's most scalable Ethernet switch family with consistent architecture and features, such as low latency, superior telemetry and analytics, and the ability to scale from 1 Tbps to over 51.2 Tbps to meet customers' modern data center network bandwidth requirements. Innovium's TERALYNX products have already garnered significant interest among customers, such as Cisco. The company constantly enhances its product capabilities and strives to make its Ethernet switch chipsets even more scalable and intuitive going forward.

With its strong overall performance, Innovium has earned the 2020 Frost & Sullivan Technology Innovation Leadership Award.

Significance of Technology Innovation Leadership

Technology-rich companies with strong commercialization strategies benefit from the demand for high-quality, technologically innovative products that help shape the brand, resulting in a strong, differentiated market position.

Understanding Technology Innovation Leadership

Technology innovation leadership recognizes companies that lead the development and successful introduction of high-tech solutions to customers' most pressing needs, altering the industry or business landscape in the process. These companies shape the future of technology and its uses. Ultimately, success is measured by the degree to which a technology is leveraged and the impact it has on growing the business.

Key Benchmarking Criteria

For the Technology Innovation Leadership Award, Frost & Sullivan analysts independently evaluated 2 key factors (Technology Leverage and Business Impact) according to the criteria identified below.

Technology Leverage

Criterion 1: Commitment to Innovation
Criterion 2: Commitment to Creativity
Criterion 3: Technology Incubation
Criterion 4: Commercialization Success
Criterion 5: Application Diversity

Business Impact

Criterion 1: Financial Performance
Criterion 2: Customer Acquisition
Criterion 3: Operational Efficiency
Criterion 4: Growth Potential
Criterion 5: Human Capital

Technology Leverage

Criterion 1: Commitment to Innovation

Requirement: Conscious, ongoing development of an organization's culture that supports the pursuit of groundbreaking ideas through the leverage of technology.

Criterion 2: Commitment to Creativity

Requirement: Employees rewarded for pushing the limits of form and function by integrating the latest technologies to enhance products.

Criterion 3: Technology Incubation

Requirement: A structured process with adequate investment to incubate new technologies developed internally or through strategic partnerships.

Criterion 4: Commercialization Success

Requirement: A proven track record of commercializing new technologies by enabling new products and/or through licensing strategies.

Criterion 5: Application Diversity

Requirement: The development of technologies that serve multiple products, multiple applications, and multiple user environments.

Business Impact

Criterion 1: Financial Performance

Requirement: Overall financial performance is strong in terms of revenue, revenue growth, operating margin, and other key financial metrics.

Criterion 2: Customer Acquisition

Requirement: Overall technology strength enables acquisition of new customers, even as it enhances retention of current customers.

Criterion 3: Operational Efficiency

Requirement: Staff is able to perform assigned tasks productively, quickly, and to a high quality standard.

Criterion 4: Growth Potential

Requirements: Technology focus strengthens brand, reinforces customer loyalty, and enhances growth potential.

Criterion 5: Human Capital

Requirement: Company culture is characterized by a strong commitment to customer impact through technology leverage, which enhances employee morale and retention.

Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan analysts follow a 10-step process to evaluate Award candidates and assess their fit with select best practices criteria. The reputation and integrity of the Awards are based on close adherence to this process.

STEP		OBJECTIVE	KEY ACTIVITIES	OUTPUT
1	**Monitor, target, and screen**	Identify Award recipient candidates from around the world	• Conduct in-depth industry research • Identify emerging industries • Scan multiple regions	Pipeline of candidates that potentially meet all best practices criteria
2	**Perform 360-degree research**	Perform comprehensive, 360-degree research on all candidates in the pipeline	• Interview thought leaders and industry practitioners • Assess candidates' fit with best practices criteria • Rank all candidates	Matrix positioning of all candidates' performance relative to one another
3	**Invite thought leadership in best practices**	Perform in-depth examination of all candidates	• Confirm best practices criteria • Examine eligibility of all candidates • Identify any information gaps	Detailed profiles of all ranked candidates
4	**Initiate research director review**	Conduct an unbiased evaluation of all candidate profiles	• Brainstorm ranking options • Invite multiple perspectives on candidates' performance • Update candidate profiles	Final prioritization of all eligible candidates and companion best practices positioning paper
5	**Assemble panel of industry experts**	Present findings to an expert panel of industry thought leaders	• Share findings • Strengthen cases for candidate eligibility • Prioritize candidates	Refined list of prioritized Award candidates
6	**Conduct global industry review**	Build consensus on Award candidates' eligibility	• Hold global team meeting to review all candidates • Pressure-test fit with criteria • Confirm inclusion of all eligible candidates	Final list of eligible Award candidates, representing success stories worldwide
7	**Perform quality check**	Develop official Award consideration materials	• Perform final performance benchmarking activities • Write nominations • Perform quality review	High-quality, accurate, and creative presentation of nominees' successes
8	**Reconnect with panel of industry experts**	Finalize the selection of the best practices Award recipient	• Review analysis with panel • Build consensus • Select recipient	Decision on which company performs best against all best practices criteria
9	**Communicate recognition**	Inform Award recipient of recognition	• Announce Award to the CEO • Inspire the organization for continued success • Celebrate the recipient's performance	Announcement of Award and plan for how recipient can use the Award to enhance the brand
10	**Take strategic action**	Upon licensing, company is able to share Award news with stakeholders and customers	• Coordinate media outreach • Design a marketing plan • Assess Award's role in strategic planning	Widespread awareness of recipient's Award status among investors, media personnel, and employees

The Intersection between 360-Degree Research and Best Practices Awards

Research Methodology

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of the research process. It offers a 360-degree view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan's research methodologies. Too often companies make important growth decisions based on a narrow understanding of their environment, resulting in errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry players and for identifying those performing at best-in-class levels.

360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS

About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, helps clients accelerate growth and achieve best-in-class positions in growth, innovation, and leadership. The company's Growth Partnership Service provides the CEO and the CEO's growth team with disciplined research and best practice models to drive the generation, evaluation and implementation of powerful growth strategies. Frost & Sullivan leverages nearly 60 years of experience in partnering with Global 1000 companies, emerging businesses, and the investment community from 45 offices on 6 continents. To join Frost & Sullivan's Growth Partnership, visit http://www.frost.com.