This white paper evaluates the business and financial value of adopting Whitebox switching solutions compared to traditional proprietary solutions when viewed over a five-year time horizon.

TCO Analysis

Whitebox versus Proprietary

Mark Harris, July 2025

White Paper

The Business Value of Adopting A Whitebox Switching Strategy: A 5-Year Total Cost of Ownership (TCO) Study

---

Executive Summary

This white paper evaluates the business and financial value of adopting Whitebox data center switching devices compared to traditional proprietary solutions over a five-year horizon. It provides a comprehensive Total Cost of Ownership (TCO) analysis that includes capital expenditures, operating costs, licensing, support, and staffing considerations.

Our findings demonstrate that Whitebox switching when coupled with open network operating systems (NOS) delivers a compelling cost advantage, with an estimated 54% reduction in TCO over five years for a typical enterprise-scale deployment. This significant saving is driven by lower hardware costs, reduced licensing fees through the operating system, and operational efficiencies gained via automation and vendor flexibility.

Beyond cost savings, Whitebox switching offers strategic benefits such as vendor independence, faster innovation cycles enabled by community-driven software development, enhanced scalability for emerging workloads like artificial intelligence (AI), and improved operational agility through programmable, API-driven networks.

While adoption requires addressing challenges like staff training and evolving support models, a phased approach involving pilot projects, tailored skill development, and strategic partnerships can mitigate risks effectively.

While simple TCO for Whitebox will be shown to be **HALF** of that compared to proprietary solutions, there are many other additional benefits of decoupling hardware and software.

Enterprises that embrace Whitebox switching today position themselves to have the highest level of performance while dramatically reducing costs, while at the same time gaining the flexibility and innovation necessary to support today's AI and future data center demands. This white paper urges organizations to lead their own transformation toward open, programmable, and vendor-neutral networking infrastructures, unlocking both immediate financial benefits and long-term competitive advantages.

---

1. Introduction

As businesses increasingly migrate from traditional infrastructures that support applications built upon x86 platforms, to those that are GPU-centric and a magnitude denser, the need for scalable, flexible, and cost-effective networking becomes paramount. Traditionally, enterprises relied on proprietary network devices from established vendors. These traditional devices often lock users into vertically integrated ecosystems, limiting flexibility and increasing costs… which subsequently inhibits business innovation and reduces competitive positioning in the era of AI.

Whitebox switches, combined with open network operating systems (NOS) such as SONiC, DENT or Open Network Linux, offer a new approach which is made for today's AI-centric workloads. This open model promises operational agility, vendor independence, and significant cost savings.

Data centers today are responsible for servicing a wide array of business-critical applications, including enterprise resource planning (ERP), customer relationship management (CRM), and data analytics platforms. Additionally, the rise of artificial intelligence (AI) workloads has now dramatically increased the demand for high-throughput, low-latency networking infrastructures to support AI computing. According to IDC, spending on AI-centric infrastructure is expected to reach $300 billion by 2026, underscoring the need for flexible, cost-effective networking solutions to support these resource-intensive applications.

2. Market Definition and Scope

The **Whitebox switching market** refers to the sector of the networking industry that provides data center and enterprise network switches built on standardized, commodity hardware platforms paired with disaggregated open-source Network Operating Systems (NOS). Unlike proprietary switching solutions, which combine vendor-specific hardware and tightly integrated proprietary software, Whitebox switches separate these two elements, enabling greater flexibility, cost savings, and innovation.

2.1 Hardware: Whitebox switches use broadly available, industry-standard silicon chips (from vendors like Broadcom, Nvidia, MediaTek, Xsight, Intel, or Marvell) and in many cases open-source chassis designs to support a range of requirements. These Whitebox devices are manufactured by various original design manufacturers (ODMs) rather than traditional proprietary networking vendors and can provide the same levels of performance as their proprietary counterparts, but at a fraction of the cost of those solutions. These Whitebox devices come in a wide variety of port configurations with backplane throughputs exceeding 100Tbps. Common Whitebox designs are available to support 1Gbps through 1.6Tbps line-speeds today. The most popular Whitebox designs support the OCP-inspired ONIE bootable environment standard which assures that ONIE compliant operating systems (such as SONiC and DENT) can be deployed on these devices to operate flawlessly.

2.2 Software: Breaking from the traditional OEM solutions which supply their own proprietary NOS with a specific proprietary hardware platform, Whitebox switches can be sourced independently and support disaggregated software operating systems such as the popular SONiC (Software for Open Networking in the Cloud), or Cumulus Linux, DENT or any other open-source alternative. This approach enables enterprises who have the technical prowess to do so to choose, customize, or develop their own network software stack. For other Enterprises, off-the-shelf distributions of SONiC are commonly used and reduce the DevOps & NetDevOps requirements internally.

> "We currently predict that by 2026, nearly 10% of ALL switches deployed in enterprise networks will be running SONIC"
>
> - Sameh Boujelbene (Dell'Oro Group)

It's important to keep in mind that open networking operating systems provide all the core capabilities needed by modern business but are created by thousands of developers which hail from hundreds of companies, including Hyperscalers and Large Enterprises alike. Open operating systems can be supplied off the shelf as binaries ready to run or can be modified and compiled for customized infrastructure requirements to add or remove specific features and capabilities as needed.

Feature	Open Source	Proprietary
Vendor Lock-in	Avoids lock-in; runs on whitebox switches from multiple vendors	Tightly coupled with vendor hardware
Cost	No licensing fees; lower TCO with whitebox hardware	High upfront and ongoing software/hardware support costs
Flexibility	Modular, container-based architecture allows custom feature development	Limited customization; features controlled by the vendor
Ecosystem	Backed by a growing open-source community and major cloud providers like Microsoft	Mature, with extensive support, documentation, and certified professionals
Support & Stability	Requires in-house expertise or third-party integrators; community-driven support	Enterprise-grade support and SLAs from vendor
Use Cases	Ideal for hyperscale data centers, cloud providers, and programmable environments	Strong fit for traditional enterprises and regulated industries needing turnkey solutions

2.3 Deployment Environment: The Whitebox market primarily serves hyperscalers, large-scale data centers, cloud service providers, and other large enterprises with significant networking needs, and increasingly, edge computing environments. It caters to environments demanding high scalability, programmability, and cost efficiency. And due to today's macro-economics and the rise of AI adoption across the Enterprise, Whitebox has become a strong candidate for migrations and new infrastructure deployments.

2.1 Market Drivers

- **Cost Efficiency:** Significant reductions in both capital and operational expenditures, by leveraging commoditized hardware and eliminating vendor lock-in.
- **Vendor Neutrality:** Enterprises gain freedom to mix and match hardware and software vendors, fostering competition and innovation.
- **Open Networking and Automation:** Growing demand for programmable networks to support DevOps/NetOps workflows, infrastructure as code, and automated provisioning.
- **AI and Cloud Workloads:** The surge in AI, machine learning, and cloud-native applications require flexible, high-performance, and low-latency networking solutions, which Whitebox switching can more readily accommodate.
- **Ecosystem Maturation:** Increasing maturity of open-source NOS platforms and growing support from ODMs and ecosystem partners enhance reliability and feature sets.

2.2 Market Trends

- Increasing adoption by hyperscale cloud providers initially paved the way, now expanding into mainstream enterprises.
- Growing offerings of commercial support services around open NOS platforms.
- Expansion beyond data centers into edge computing and telco environments.
- Enhanced focus on security hardening and compliance in Whitebox software.

3. Cost Components of Whitebox Switching

To comprehensively evaluate the total cost of ownership over a five-year period, it's essential to break down the primary cost components involved in deploying and maintaining a data center switching infrastructure. These components apply to both proprietary and Whitebox approaches, but with notable differences in magnitude and flexibility:

- **Capital Expenditure (CapEx):** This includes the upfront purchase cost of switching hardware and bundled software (for proprietary solutions) or disaggregated NOS (in Whitebox deployments). Whitebox hardware, built using industry-standard components, typically offers significantly lower initial CapEx.
- **Operating Expenditure (OpEx):** Ongoing costs that accumulate over the switch lifecycle, including electricity for powering and cooling devices, as well as routine maintenance and hardware replacements. Power efficiency and cooling overhead are increasingly important as data centers expand to support AI and high-density workloads.
- **Licensing and Support Costs:** Proprietary vendors often charge recurring licensing fees for NOS software, firmware updates, and advanced features. These can also include support contracts with varying SLA tiers. In contrast, Whitebox environments may leverage open-source NOS (e.g., SONiC, DENT, ONL) with optional enterprise support contracts, allowing for more flexible cost structures.
- **Staff Training and Enablement:** Transitioning to Whitebox solutions requires investing in training programs for IT staff unfamiliar with Linux-based NOS environments and automation tool chains. While upfront training may be higher for Whitebox, ongoing operational efficiencies and reusable automation reduce long-term labor costs.
- **Upgrade and Refresh Cycles:** The ability to upgrade software independently of hardware in Whitebox environments can extend equipment life and reduce the frequency and cost of full refreshes. Proprietary systems may require coordinated upgrades of both software and hardware, leading to higher refresh cycle costs and forced obsolescence.

Understanding and quantifying each of these cost dimensions enables organizations to make informed investment decisions and supports a more accurate TCO comparison between proprietary and Whitebox networking models.

4. The 5-Year TCO Comparison: Detailed Analysis (by example)

When it comes to making strategic decisions about IT infrastructure, the initial cost of every component is undeniably a significant factor. However, focusing solely on the immediate price tag can lead to a myopic view of an organization's financial planning. To gain genuine fiscal insight from an enterprise perspective, critical discussion must revolve around cost over time, more commonly known as Total Cost of Ownership (TCO). This analysis specifically emphasizes a 5-year TCO timeframe. This duration choice isn't arbitrary; it directly aligns with prevailing industry standards for technology refresh cycles. While these cycles have historically been longer, the current pace of innovation dictates that most organizations now refresh their core technology infrastructure approximately every five years. Therefore, evaluating TCO over this FIVE-YEAR period provides the most accurate and relevant financial picture for long-term infrastructure planning.

4.1 Example Scenario and Assumptions

We have built a model which compares a data center environment built upon 100 Whitebox switches to the same scenario using proprietary equipment from mainstream suppliers. The goal is to illustrate the components and costs associated with this example over a period of 5 years, which is the typical technical refresh cycle today (as presented in a recent Uptime Institute survey.)

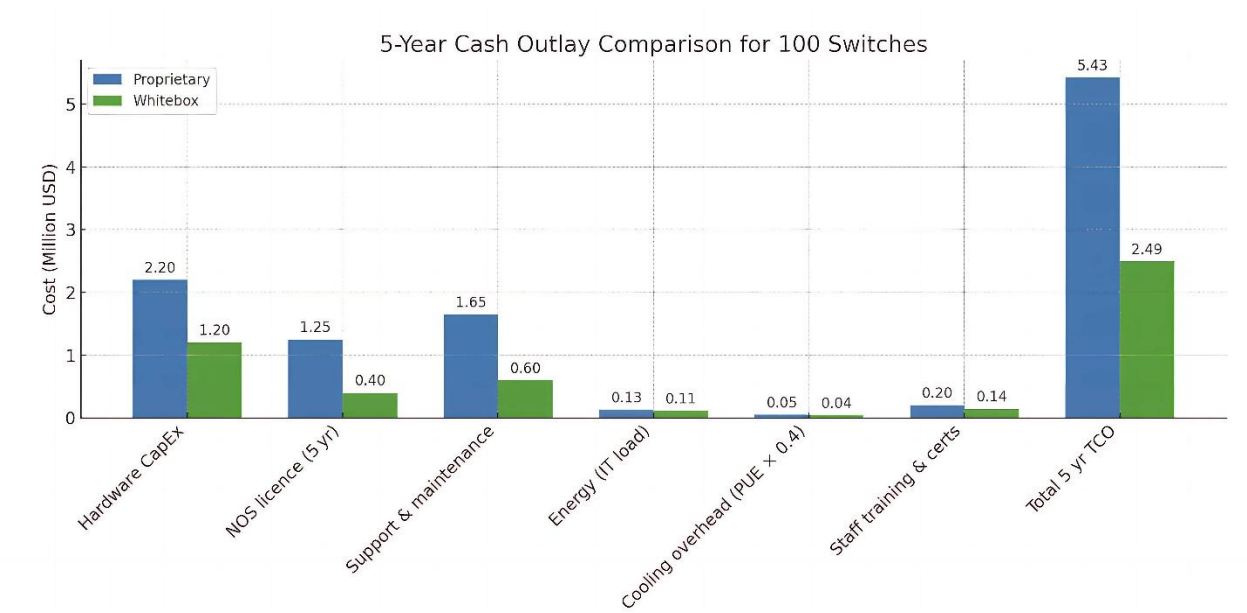
The Model Description and Component Pricing:

- 100 top-of-rack (ToR) 32 × 100 GbE switches
- Electricity cost: **$0.10/kWh**, Data-center PUE = **1.4**
- Evaluation horizon: **5 years**, nominal dollars
- Street pricing used as base discount level
- No discounted cash-flow applied, inflation held constant

Component	Proprietary	Whitebox
Street price per switch	$22,000	$12,000
Annual NOS license	$2,500	$0 (SONiC) / $800 with enterprise support
Annual HW support (Next-Day)	15% of HW list (typ)	10 % of HW list (typ)
Typical power draw	300 W (est)	260 W (est)
Initial staff enablement	$150,000	$90,000
Annual skill refresh	$10,000	$10,000

4.2 Five-Year Cash Outlay (100 switches)

The key components for this constructed model of the total costs of ownership over a period of five years versus its proprietary equivalent can be illustrated as follows:



For this 100 switch example, the chart above illustrates combined TCO savings of: **$2.94 M** ($5.43M versus $2.49M) or an incredible ≈ **54 %** over the five year period being studied!

4.3 Payback and Cumulative Cash-flow

The savings available with a true Whitebox and open-source NOS approach continues year after year. The incremental CapEx premium for proprietary gear is recovered by Whitebox deployments in about ≈ **18 months** and thereafter, Whitebox switching continues to compound savings year over year.

4.4 Analysis Sensitivity

Analysis Sensitivity checks in the context of this Total Cost of Ownership (TCO) analysis refers to evaluating how changes in key variables (such as hardware price, electricity cost, or support fees) impact the overall financial outcome. It tests the robustness of the model by simulating different plausible scenarios to see how sensitive the savings are to fluctuations in inputs.

In simpler terms, “Analysis Sensitivity” is a way to ask:
“If one or more assumptions shown above actually change, do the conclusions still hold?”

Specific examples of possible changes used in this analysis (and the resulting TCO effect of these changes):

- Reducing proprietary hardware price by an additional percentage
- Increasing electricity costs
- Increasing Whitebox support fees

Some examples of these common variable factors and their impact on Whitebox savings:

Variable	Base (Delta)	Variation	TCO Saving Impact
Proprietary Add'l discount	0 %	–10 %	Savings drop to 46 %
Electricity price	$0.10/kWh	$0.18/kWh	Savings rise to 57 %
Whitebox support tier	$800 → $1,200	+50 %	Savings fall to 51 %

This shows that even under less favorable assumptions, the Whitebox model maintains a significant advantage, demonstrating a resilient and credible financial case. The Whitebox approach is fiscally important to consider. Even with additional and aggressive proprietary vendor hardware discounts or higher third-party support fees, the Whitebox solution preserves a **≥ 45 %** TCO advantage.

5. Whitebox Business Benefits Beyond Cost Savings

While the financial savings associated with Whitebox switching are substantial, the broader strategic advantages provide even greater long-term value for enterprises. These benefits align closely with modern IT goals such as agility, innovation, and support for emerging workloads.

- **Vendor Independence:** Disaggregated networking architectures allow organizations to select best-of-breed components without being locked into vertically integrated ecosystems. This fosters competitive pricing and reduces risk by avoiding over-reliance on any single vendor for hardware, software, and support.
- **Faster Innovation Cycles:** Open-source NOS platforms like SONiC benefit from active community and hyperscaler contributions. This leads to more frequent feature updates, faster bug fixes, and earlier access to emerging technologies such as network telemetry, streaming analytics, and advanced routing protocols.
- **Scalability and Flexibility:** Whitebox infrastructure scales linearly using commodity hardware, making it easier to respond to increasing demand from data-intensive applications. This is particularly important for organizations building out support for cloud-native services or AI/ML workloads, where east-west traffic can grow unpredictably.

While the **TCO** shown above is more than compelling by itself, there are numerous attributes of open networking that form the basis for a forward-looking and lower risk digital infrastructure.

- **Operational Agility and Automation:** Open networking supports modern DevOps and NetOps practices by enabling network programmability through standard APIs and automation frameworks such as Ansible, Terraform, CHEF, Puppet and gNMI. This streamlines provisioning, troubleshooting, and change management.
- **Application Readiness and Futureproofing for AI:** The demands of AI model training, inference, and high-performance analytics place new requirements on the network in terms of throughput, low latency, and fault tolerance. Whitebox switching provides flexibility to fine-tune infrastructure to meet these needs, including support for ROCEv2/RDMA, VXLAN, and high-availability configurations.
- **A Standard Based Approach:** Research firm Dell'Oro (who has been the recognized leader in data center switching trends for decades,) states that while both InfiniBand and Ethernet can be used successfully for AI infrastructure, they are seeing the rapid adoption of Ethernet in lieu of InfiniBand for AI and they project that Ethernet will become the dominant technology standard for data center switching by 2026. This is largely due to the higher costs associated with InfiniBand (and fewer suppliers), the availability of a wide range of merchant silicon-based Ethernet suppliers, and due to strong technical advancements in Ethernet solutions which deliver low latency through the support of ROCEv2 and Ultra-Ethernet Next.
- **Transparent Lifecycle Management:** By decoupling hardware and software, enterprises can extend the life of switching platforms through in-place NOS upgrades or mix-and-match refresh cycles, optimizing performance without full-scale hardware replacements.

Switching vendors that include a comprehensive layer of Day-0 , Day-1 and Day-2 lifecycle management should be particularly interesting to Enterprise buyers.

These strategic benefits, combined with a compelling TCO profile, make Whitebox switching a transformative element in modern data center strategy.

6. Additional Considerations and Risks

While the benefits of Whitebox switching are significant, successful adoption requires thoughtful planning and mitigation of potential challenges. Key considerations include:

- **Internal Expertise and Skills Gap:** Deploying and operating typical Whitebox infrastructure requires in-house expertise in Linux, scripting, and network automation. Unlike proprietary solutions that offer tightly coupled vendor support and GUI-based management, Whitebox systems rely heavily on command-line interfaces and open-source knowledge. Enterprises must invest in upskilling or hiring staff with experience in disaggregated networking or these organizations *may* choose Whitebox solution providers that include a lifecycle operating envelope in their offering itself (Production-Ready). This packaged Whitebox approach provides the OEM user experience.
- **Support Structure and SLAs:** Support models differ from traditional vendors. Instead of a single point of contact, enterprises may need to coordinate among multiple providers—hardware vendors, NOS developers, and third-party support organizations. Choosing the right support ecosystem and defining clear service-level agreements (SLAs) are critical to ensuring uptime and issue resolution.
- **Integration Complexity and Tooling:** Initial deployment and integration can be complex, especially in mixed environments with legacy infrastructure. Compatibility testing, firmware management, and interface normalization may require additional effort during the early phases of deployment. Automation pipelines and monitoring tools should be evaluated for compatibility with disaggregated environments.
- **Vendor Ecosystem Maturity:** While platforms like SONiC are maturing rapidly, the ecosystem for enterprise-grade add-ons (e.g., GUI interfaces, advanced telemetry, security hardening) may not be as rich or standardized as those of proprietary vendors. Enterprises should carefully assess feature parity and roadmap alignment. That said, there are a number of mature offerings that augment the OEM experience including gNMI/gNOI with OpenConfig, Prometheus + Grafana, and Thanos or Victoria Metrics. These solutions are purpose built to support open network operating systems and are comparable to their proprietary counterparts.
- **Change Management and Organizational Readiness:** Transitioning to a Whitebox model affects procurement, operations, and security workflows. Organizations should evaluate their readiness to embrace DevOps-like processes for the network infrastructure. To this end, these organizations should strongly consider Whitebox suppliers that include a comprehensive layer of lifecycle management, typically with a purpose-built and scalable controller that handles the management of Whiteboxes and their NOS platforms, configurations, firmware, status and health checks.

By addressing these challenges proactively—through training, vendor evaluation, process alignment, and pilot programs—enterprises can position themselves to fully capitalize on the transformative potential of Whitebox switching.

7. Recommendations for Enterprises

To successfully adopt a Whitebox strategy, enterprises should follow a structured and phased approach. The following maturity model and phasing assures that Whitebox can become a cornerstone of a cost-effective and strategic buildout of AI-compatible digital infrastructure:

- **Validation, Justification & Piloting**

  This phase encompasses the current recommendations of pilot deployments and TCO modeling. The goal is to validate the technology in a lab or non-critical environment, build foundational skills, and solidify the internal business case.

  - **Conduct TCO and ROI Modeling:** Customize the cost model outlined in this paper using internal data to validate savings. Include CapEx and OpEx; expected training costs, support options, and energy prices. Use this analysis to build the business case for executives and financial stakeholders.
  - **Pilot Deployments:** Begin with small-scale, non-critical workloads or lab environments to validate performance, management workflows, and integration with existing systems. This helps identify configuration issues and streamline provisioning processes before broader rollout.

- **Strategic Deployment**

  This phase focuses on deploying Whitebox solutions for new "greenfield" projects (like a new AI cluster) or as part of a scheduled tech refresh for a specific data center pod. The organization develops automation playbooks and solidifies support partnerships.

  - **Assess Operational Readiness:** Evaluate how Whitebox switching will affect procurement, security, configuration management, and compliance. Update internal processes to align with the DevOps-style workflows enabled by open networking. Update approved/recommended vendor list and related reference designs across the organization.
  - **Skill Development and Training:** Build internal competency in Linux, network automation, and open NOS platforms. Invest in certifications, workshops, or partnerships with training providers to enable staff to confidently manage and troubleshoot disaggregated environments.

- **Enterprise Standardization**

  In this final phase, open networking becomes the default, architecturally preferred standard for all new data center network deployments. An internal "Center of Excellence"

for NetOps is established, and automation is deeply integrated into all operational workflows.

- **Select Strategic Partners:** Choose hardware vendors and NOS providers with proven success in enterprise deployments. Look for partners that offer long-term roadmap alignment, robust support models (e.g., Business SLAs), and integration with popular automation and monitoring tools that support open standards. Look for Whitebox suppliers that have integrated the NOS and hardware platform together in a production-ready "OEM-like" offering, eliminating much of the DevOps and software engineering typically experienced with open systems.
- **Create Governance and Change Control Policies:** Develop consistent policies for NOS versioning, patch management, configuration backups, and rollback procedures. Model these after existing policies associated with OEM solutions to reduce operational friction across existing teams.
- **Establish Support Escalation Paths:** Define a clear plan for technical support, with contractual commitments on response times. Consider hybrid models that combine open-source NOS with enterprise-grade support options.

- **Planning for Growth and Scale**

  Once your Enterprise has begun the process of migrating traditional approaches to building infrastructure to an open approach based upon Whitebox and open-source technologies, it will become apparent that AI as a catalyst for transformation is very real. It is expected that nearly every business-critical application will be updated or replaced with one that leverages AI. As such, the infrastructure built today must be part of a bigger and explicitly scalable plan.

  - **Plan for Scale:** Once initial deployments are validated, design a phased scale-out plan to expand Whitebox switching across more of the data center. Each functional layer in the network architecture (e.g. Spine or Leaf) should be templatized to allow the design elements to be easily replicated at scale.
  - **Application Growth:** Today, it is safe to assume that most new core business applications (e.g. AI Inference) and greenfield designs will need to be served with high performance and cost-effective infrastructures that are vastly different than those designs and technologies put in place 3 or more years ago. As such, this will also include transition plans and technology refreshes for legacy devices and applications, along with support for hybrid network environments.

By taking these proactive steps, enterprises can mitigate risks, accelerate adoption, and unlock the full business and operational benefits of Whitebox switching.

---

8. Conclusions

Whitebox switching presents not just a tactical cost-saving measure but a strategic opportunity to support the business an all of its strategic applications in a much more aligned fashion, transforming enterprise networking to be business driven rather than the reverse. The data is clear: the use of Whitebox offers a **54%** TCO reduction over five years, improved operational agility, and its greater scalability creates a strong platform for change. But beyond numbers, Whitebox networking empowers IT organizations to break free from vendor lock-in, accelerate innovation cycles, and build resilient, programmable infrastructures tailored for today's data-driven workload, especially AI and real-time analytics.

Whitebox offers a **54%** TCO savings in comparison to proprietary solutions over a period of five years, along with improved operational agility and the raw performance needed to power today's campus, service provider and GPU-centric & HPC computing styles

To remain competitive in their own markets, Enterprises should pay close attention to the rapid and widespread adoption which is already occurring and simply begin to validate this open approach and determine a roadmap within their own organizations. Open systems are no longer a question of "IF", but simply "WHEN". The most successful IT leaders are beginning to articulate the roadmaps to get there within their own organizations, starting with well-scoped pilots, developing cross-functional expertise, and forging new support partnerships. Those who act decisively will position themselves to outpace competitors in both performance and cost-efficiency.

The future of data center networking is open, programmable, and vendor neutral. The time to begin that transformation is now. As open networking matures, enterprises ready to embrace this model will gain a substantial competitive edge.

About Edgecore

Edgecore Networks is the market leader in providing open standards-based and disaggregated network and computing solutions to the hyperscale, large enterprise, service provider and campus communities. Edgecore is the leading provider of industry-standard Whitebox switches which enable architectural flexibility, unlimited scalability and a total cost of ownership which is half of competitive approaches. With more than 35 years of experience and millions of devices shipped, our business model is centered on building long-term partnerships that foster trust and innovation. Edgecore Networks enables its customers to accelerate transformation across data center, telecom, and enterprise environments.

About the Author

This white paper was developed by Edgecore Networks, using the published research (referenced below) related to the technology and positioning of open networking, open computing, the requirements of modern AI-centric applications and required data center architectures to support those.

External References

1. IDC, "Worldwide Spending on Artificial Intelligence Forecast to Reach Nearly $300 Billion in 2026," March 2023.
2. Gartner, "2023 Strategic Roadmap for Networking," Gartner Research, January 2023.
3. Open Compute Project, "Disaggregated Networking: White Box Switching Use Cases," OCP Summit, 2022.
4. Linux Foundation, "State of the Edge 2023 Report." January 2023.
5. Broadcom, "Open Networking: The Future of Data Center Infrastructure," March 2023.
6. Linux Foundation “SONiC FAQ, ” July 2024
7. Linux Foundation “Sonic Roadmap Planning,” May 31, 2025
8. Horizon Editorial, “Navigating Hardware Refresh Cycles in the Data Center,” Nov 2024
9. Uptime Institute 2023 “Annual Data Center Survey”, June 2023
10. “InfiniBand Leads in the Near Term, Ethernet Set to Dominate Soon”, Dell’Oro July 16, 2024

