AI AT THE EDGE: UNLOCKING THE THREE CORNERSTONES OF EDGE DATA CENTRE DESIGN

eBook by

ONNEC

In partnership with:

VERTIV.

INTRODUCTION

Edge data centres can play a key role in accelerating AI, but success hinges on overcoming power, cooling, and cabling challenges. Poor infrastructure can lead to higher costs and performance issues. With the right power solutions, cooling, and cabling, AI deployments stay scalable, reliable, and efficient, reducing latency and driving innovation.

Onnec and Vertiv have co-authored this eBook to combine their expertise in infrastructure and critical systems, and help organisations overcome the power, cooling, and cabling challenges that stand in the way of scalable, high-performance Edge data centre deployments.

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UNLOCKING AI'S POTENTIAL: MEETING THE CHALLENGES HEAD ON

The data centre industry is in a critical phase of development. With organisations working to adopt AI – first driven by GenAI, and now the emergence of Agentic AI – there needs to be rapid innovation in data centre design and technology to meet growing demand while managing rising power needs.

The race is on to build data centre capacity, but the industry faces supply/demand pressures that threaten to stifle innovation. Analysis from McKinsey shows global demand for data centre capacity could rise at an annual rate of 19-22% from 2023 to 2030 to reach a yearly demand of 171 to 219 gigawatts (GW). But there are fears supply won't match demand, creating a bottleneck that can't be overcome quickly.

Analysis from JLL also shows that enterprises will continue to use a combination of on-premise, colocation and cloud when deploying IT infrastructure. However, the need to have networking capabilities closer to endpoints will create an AI niche for the Edge that could help ease supply fears and enable AI use cases. This will see Edge IT infrastructure and data centres become a $317 billion market globally by 2026, representing 107% growth from the 2020 market valued at $153 billion.

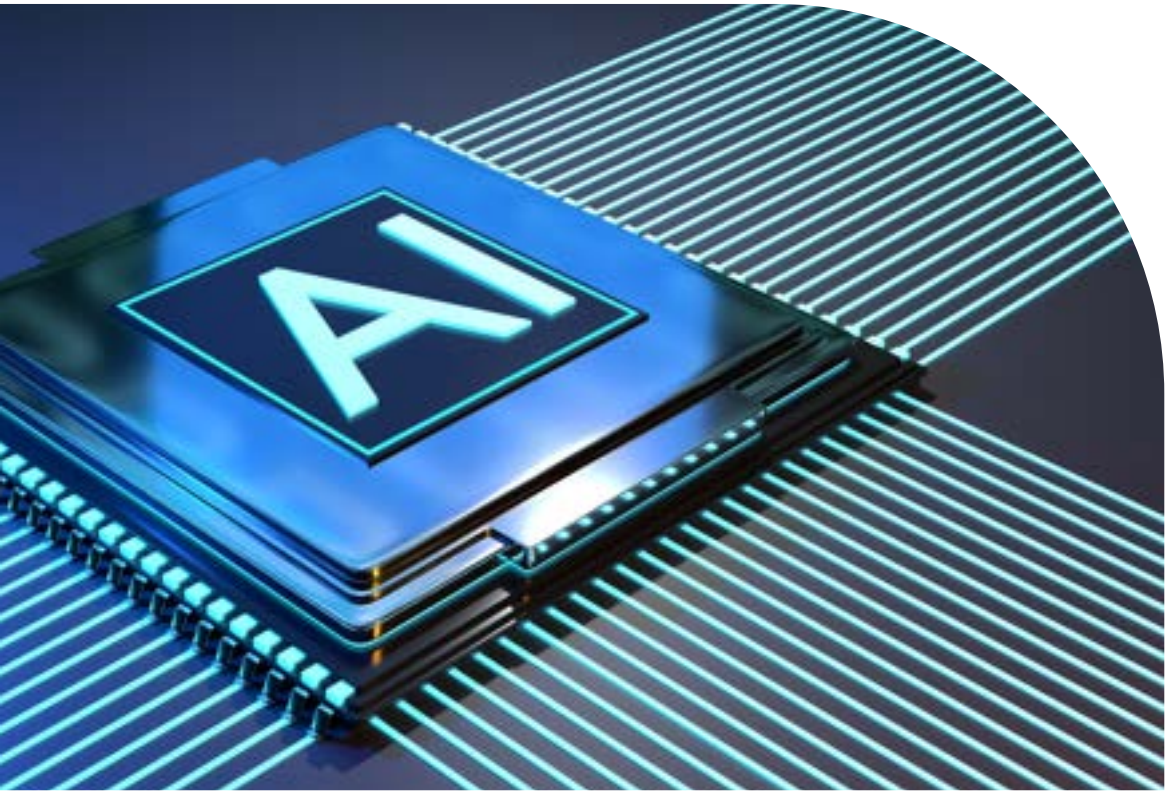
Edge data centres could hold the key to helping organisations and operators accelerate AI deployments. Edge data centres are smaller, decentralised facilities located near users and devices, helping organisations overcome supply challenges and accelerate AI deployments by enabling low-latency, high-bandwidth data processing.

But to do so, holistic design principles must be followed to overcome challenges and problems in three key areas: power, cooling and cabling. These are the three cornerstones of data centre design and failing to take a holistic approach will result in failed Edge deployments and stifled innovation, limiting AI's transformative impact.

> "LOWERING LATENCY BY BRINGING THE COMPUTING INFRASTRUCTURE CLOSER TO THE DATA SOURCE AND USER, EDGE IT INFRASTRUCTURE WILL BECOME AN ESSENTIAL COMPONENT IN THE INTERNATIONAL ECONOMY."
>
> - Jonathan Kinsey, EMEA Lead and Global Chair, Data Centre Solutions at JLL

THE SUPPLY VS DEMAND GAP
THAT THREATENS TO THROTTLE AI

The strain on data centre infrastructure has never been greater. With the rapid advancements in artificial intelligence (AI), global demand for data is increasing. But, while demand booms, the ability of operators to deliver sufficient data centre capacity has started to fall short:



$453bn

Market booming – Global data centre market revenue set to reach $453 bn by 2025, $624.1 bn by 2029.

33%

AI supercharging growth - AI ready capacity will grow 33% annually, accounting for 70% of total demand by 2030.

60 GW

Supply falling short – Current capacity is 60 GW, requiring rapid expansion to meet soaring demand.

The gap between data centre demand and available capacity will continue to widen. To avoid a shortfall, the industry must build twice the capacity added since 2000 in less than a quarter of the time.

Some significant hurdles need to be overcome to build all these new data centres. Limited availability of suitable land, persistent supply chain disruptions, and the steep costs of scaling infrastructure are hindering efforts to keep pace with growth.

> DEMAND IN EUROPE WILL ONLY ACCELERATE, GIVEN THAT ARTIFICIAL INTELLIGENCE WORKLOADS ARE EXPECTED TO GENERATE HIGHER DEMAND FOR CAPACITY, AS ORGANISATIONS LOOK TO ENHANCE THEIR OPERATIONS BY LEVERAGING MACHINE LEARNING ALGORITHMS. FOR THE MEANTIME, THE CHALLENGE REMAINS THE LACK OF AVAILABLE POWER AND AI-APPROPRIATE FACILITIES ACROSS EUROPE."
>
> – Andrew Jay, CBRE's Head of Data Centre Solutions for Europe

These constraints are not just logistical; they pose a real threat to technological innovation. Without sufficient data centre capacity, AI deployment and other data-intensive technologies could be significantly delayed, slowing progress across key industries.

EDGE DATA CENTRES – A DECENTRALISED SOLUTION

Edge data centres can help organisations address supply challenges and accelerate AI deployments. Unlike traditional centralised data centres, Edge facilities are smaller, decentralised units positioned close to users and devices. They process data locally, enabling low-latency, high-bandwidth operations that are essential for AI and IoT applications.

Around 80% of organisations expect to repatriate some compute and storage resources within the next year, due to challenges in maintaining consistent security policies – and the increasing need for localised compute power. Edge computing brings computation closer to the source of data, reducing the distance information needs to travel. This architecture minimises latency, enhances efficiency, and complies with data sovereignty laws.

These advantages are particularly appealing to industries looking to integrate AI into operations. For instance, Edge data centres can serve as "AI factories," where machine learning models are trained and deployed on-premises, improving response times and bolstering security by keeping critical data within controlled environments.

Edge data centre benefits across key industries:

HEALTHCARE

Real-time diagnostic tools powered by Edge computing enhance patient care by enabling immediate data analysis. For example, AI-enabled imaging systems can process X-rays locally to flag urgent cases for radiologists, which helps expedite critical diagnoses.

MANUFACTURING

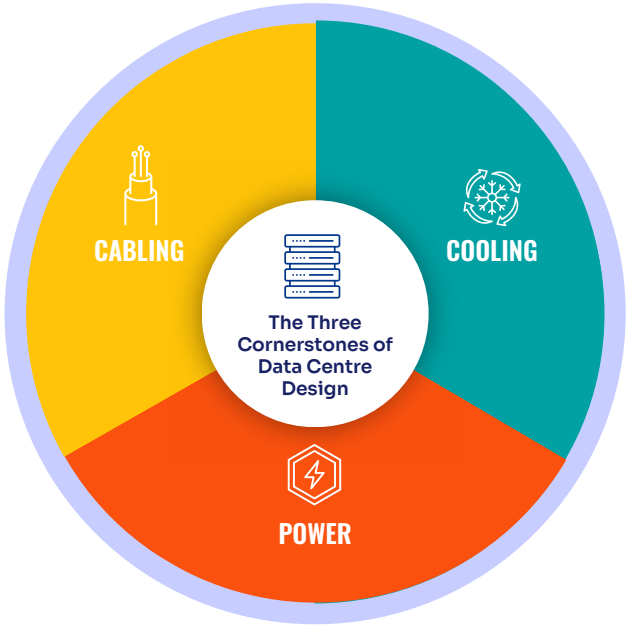
Predictive maintenance systems use Edge processing to analyse data from IoT sensors in real-time, reducing equipment downtime. This can monitor machinery conditions and trigger preventative measures before failures occur.

FINANCIAL SERVICES

Edge computing supports fraud detection by processing transaction data at the source. For example, localised analytics can identify suspicious activity in real-time, enabling financial institutions to take immediate action and protect customer accounts.

THE THREE CORNERSTONES FOR EDGE DATA CENTRES

Successfully deploying Edge data centres requires operators to take a holistic approach to three key challenges: power, cooling and cabling. The three cornerstones of data centre design, these elements are deeply interconnected – inefficiencies in one area will inevitably affect the others, compromising performance.



CABLING

Cable congestion is a major challenge in Edge data centres, where limited space required meticulous planning to keep installations accessible and efficient. High-power cabling for AI workloads generates significant heat, quickly exposing poor-quality materials that lead to connectivity issues and data corruption. Cluttered, obstructive layouts not only worsen these risks but also make deployment and maintenance more difficult, slowing down installation teams – and increasing troubleshooting time.

COOLING

As next-generation hardware continues to push power consumption higher, effective thermal management is key. Facility teams deploying high-density solutions must address the heat challenge. While air cooling is the more traditional and cost-effective, liquid cooling offers greater efficiency for managing high-density workloads and the intense thermal output typical of AI applications.

POWER

Edge facilities face a dual challenge – maintaining efficient power delivery and advancing decarbonisation efforts. Although smaller than traditional centralised data centres, Edge facilities are often located near populated areas to support low-latency services. This proximity can place additional strain on local power grids. Separately, meeting sustainability goals requires operators to pursue decarbonisation through efficient power systems – including energy integration, advanced power management, and UPS solutions tailored for Edge deployments.

To help overcome these challenges it's vital to look at cabling, cooling and power together, rather than as isolated components. This will boost reliable connectivity, effective heat management, and optimised energy use, making Edge data centres suitable for the growing demands of AI, IoT, and real-time applications.

SIX KEY EDGE DATA CENTRE DESIGN CONSIDERATIONS

Holistic design principles contribute to making Edge data centres fit for purpose. Each data centre project must be treated as a living giant, otherwise changes or problems in one area could impact the entire site. Here are six key considerations:

1 DEFINE AND UNDERSTAND THE IT LOAD – WHAT IS THE PURPOSE AND USE CASE?

- IT load is the processing power a data centre requires. This will vary depending on the application and purpose being designed for.
- Record-breaking absorption of IT load across markets has seen vacancies fall to extreme lows across major global markets.
- This is why it is essential to define IT load based on what the AI application is trying to achieve and the specific use cases, which can vary across industries and applications.
- To determine IT load, operators will need to understand the type of AI model they are implementing, the data requirements and the speed at which the system must respond. From here, it's important to build in buffer to help accommodate growth and evolving demands.
- This will help operators carefully match the available power supply, define cooling requirements, and set cabling standards that deliver the required speed, with room for growth.

2 LOCATION, LOCATION, LOCATION – CAN YOUR SITE SUPPORT YOUR IT LOAD REQUIREMENTS?

- Once the IT load, purpose, and use cases are defined, operators can plan the ideal location for Edge data centres.
- The US and FLAP-D economies consider data centres to be a foundational piece of the growth puzzle. As such, they make favourable locations.
- However, many FLAP-D economies are facing power pressures. For example, Amsterdam has a national moratorium on data centres with a maximum IT load of over 70MW.
- Spain is attracting major investment, with access to renewable energy sources a key component. Likewise, Denmark, Norway, and Sweden are making major data centre plays, bolstered by an abundance of hydro, geothermal, and wind power. Emerging economies may also make for attractive options.

3 UNDERSTANDING THE RULES – WHAT REGULATIONS NEED TO BE CONSIDERED?

- With IT load and location defined, operators can build a picture of the regulations the data centre must comply with.
- The most important regulations concern sustainability, including requirements to meet certain Power Usage Effectiveness (PUE) standards.
- The average data centre PUE has remained flat for five years at 1.56, but the regulatory environment is putting pressure on operators to reduce this.
- Germany has stringent PUE targets for data centres. Those commissioned before 1st July 2026 must achieve a PUE of 1.3 by 2030. This means no more than 30% of the data centre's total energy consumption may be used for building technology. Those built after 1st July 2027 must achieve a PUE of 1.3 from the outset.
- Regulations also exist around water usage effectiveness, energy reuse and energy consumption from renewable energy sources.
- These will all influence the design decisions for power, cooling and cabling to support data centres efficiency while meeting the required IT load.
- Further innovation will be required for sites to adhere to sustainability legislation, such as the adoption of AI to optimise cooling.

4 CONSISTENCY IS KEY – WHAT DESIGN ELEMENTS CAN BE STANDARDISED?

- With the IT load defined and knowledge of regulations, designers can develop reference designs for power, cooling and cabling solutions.
- The standardisation of certain aspects of design can speed up builds through pre-integration, prefabrication, and flexible designs.
- AI inferencing and model training are driving rack densities and power/cooling loads to new extremes – designs now need to be more adaptable and trusted, so that they can be repeated across projects.
- One area that is crying out for standardisation is cabling. To avoid the need for refits, cabling should be standardised to optimise performance, minimise clutter and streamline installation and troubleshooting.
- Adopting standardised frameworks, such as those from Open Compute Project (OCP), can also help to promote uniformity and efficiency across designs.

5 POWER IN, HEAT OUT – HOW CAN YOUR SITE BEST REUSE RESOURCES?

- The use of alternate energy sources and waste heat reuse should be a cornerstone of every Edge data centre development.
- Circularity is rising up the agenda – many operators are seeking to move away from the make-break-dispose model to one that reuses waste heat, recycles water, or uses low-carbon building materials and processes to reduce emissions.
- Heat reuse is a compelling example of circularity – some data centres are now channelling waste heat to warm homes, offices, greenhouses or even for aquaculture.
- There is also a growing trend of water-positive data centres that return more water than consumed. Data centres draw from drinkable water sources and recirculate it through cooling systems. To reduce the amount of potable water being taken, operators are turning to purified wastewater to become water-positive.
- A commitment to efficiency and circularity minimises waste while maximising resource efficiency, allowing Edge data centres to use power and resources multiple times.

AI IS DRIVING THE NEED FOR A RETHINK ON COOLING

AI demand is creating a completely new data centre architecture. Operators need energy densities that are previously unheard of. A conventional data centre running CPUs for storage would have had a typical power requirement of 10-15kw per rack. The energy density was much lower and could be cooled with air ventilation.

But AI applications require hardware that will drive power requirements to well beyond 50kw per rack. With 5x the energy density, air will no longer be able to cool effectively. The fans can't keep up with the heat, leading to temperature spikes that damage hardware. In the AI era, operators will be obliged to use liquid cooling, because only a liquid can absorb and recirculate this energy. If done properly, liquid cooling can be more efficient and produce less waste than an air equivalent.

6 CABLING AS A BUFFER – WHAT BEST PRACTICE CAN YOU IMPLEMENT AND FOLLOW?

- The importance of high-quality cabling is often overlooked despite connectivity being a vital element for any data centre. AI applications require a lot of power and heat, which strains cables and exposes poor-quality materials, leading to performance issues.
- Common pitfalls include budget constraints that limit an operator's ability to invest in best-of-breed cabling, improper installation, and inadequate planning. This leads to poor labelling, loose connections, and unsuitable cabling, increasing the risk of costly future upgrades and performance failures.
- Mistakes or cut corners greatly impact performance and how often refreshes will be required. This is why best practice must be followed.
    - Firstly, operators should have detailed, granular cabling standards for each data centre build, covering everything from containment to testing.
    - Then, prioritise early engagement on cabling. Coordinate early with third parties to align cabling infrastructure with power, cooling, and security requirements, reducing bottlenecks and upholding high standards.
    - Finally, invest in high-quality cabling and think of it as a buffer that designs for tomorrow, leaving space to grow and enabling higher performance capabilities as technological enhancements push the bandwidth and latency capacity up.

RETROFITTING EXISTING EDGE DATA CENTRES FOR AI WORKLOADS

Retrofitting existing data centres for AI workloads can serve as an interim solution, and maintaining a comprehensive database of OEM guides, 3D models, rack layouts, and cut sheets is crucial for seamless upgrades and ongoing operations.

However, AI workloads demand high-performance processors like GPUs and DPUs, which consume significantly more power than traditional CPUs, creating hot spots and power fluctuations. Designers must carefully assess power density per rack and cooling strategies to avoid inefficiencies.

Long-term AI success requires purpose-built facilities. Retrofitting provides a stepping stone for testing and pilot projects. Scalable AI infrastructure should ideally be designed from scratch to fully support evolving performance and energy demands.

SUMMARY: HOLISTIC DESIGN AND THE ROLE OF PARTNERS

A holistic approach to Edge data centre design will help create the required infrastructure to run complex AI applications. Paying close attention to the three cornerstones of power, cooling and cabling will allow operators to unleash innovation and AI's full potential.

But operators and organisations cannot do this alone. They need strong partners that act as an extension of the team to consider every aspect of Edge data centre design. These partners can help at every stage of the project, setting out the key considerations and providing the vital expertise required to understand local markets and their requirements.

This knowledge will be critical in supporting operators to navigate all the potential challenges and pitfalls, creating Edge data centres that are fit for purpose.

If you'd like to learn more about the benefits of strong partners and how they can help manage growing workloads and expand to new markets, speak with Onnec today.

CHECK OUT OUR EBOOK: THE SUPPLY CHAIN CHALLENGE: HOW VALUED PARTNERSHIPS CAN DE-RISK DISRUPTION.

GET IN TOUCH

Discover how Onnec can help operators lay the cornerstones for years to come.

Connect with us to learn how we can help deliver business growth and certainty in your data centre.

FIND OUT MORE

ABOUT ONNEC

Onnec is a leading Infrastructure Solutions and Services company for tech and enterprise, specialising in structured cabling, managed services, and network solutions. Our team of experienced designers, project managers, and engineers, supported by world-class vendor partnerships, delivers top-tier services and solutions.

Onnec's expertise spans all data centre environments, and can support customers with:

- Structured cabling design and installation
- Installation of cabling, ODFs, PDUs and containment solutions
- Network hardware installations, changes and support
- Connectivity and equipment upgrades and changes
- Smart Hands Support Services

www.onnecgroup.com

ABOUT VERTIV

Vertiv brings together hardware, software, analytics and ongoing services to enable its customers' vital applications to run continuously, perform optimally and grow with their business needs. Vertiv solves the most important challenges facing today's data centers, communication networks and commercial and industrial facilities with a portfolio of power, cooling and IT infrastructure solutions and services that extends from the cloud to the edge of the network. Headquartered in Westerville, Ohio, USA, Vertiv does business in more than 130 countries.

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Learn more about the unique capabilities we've built over 30 years, delivering IT Network and Structured Cabling at scale, in multiple locations across the globe.

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