colt
Data Centre Services

From Complexity to Consistency: Unlocking Value with a **Global Reference Design**

Matt Wilkins IEng MIET AISEP
Global Director of Design & Engineering

Foreword

The explosive growth of cloud computing, artificial intelligence (AI), and digital services has created unprecedented demand for hyperscale data centres worldwide. Yet with this rapid expansion comes increasing complexity. Each region introduces unique regulatory, climatic, and supply chain challenges. Relying on bespoke, one-off designs often results in delays, cost overruns, and operational inconsistencies that hinder global scalability.

A **Global Reference Design (GRD)** offers a solution for hyperscale data centre providers like Colt Data Centre Services (Colt DCS). By establishing a standardised, repeatable blueprint, flexible enough to adapt to local requirements yet consistent in its core principles, hyperscale data centre developers such as Colt DCS can accelerate deployment, optimise costs, and ensure uniform quality across their portfolio.

The benefits of adopting a GRD are significant. Standardisation shortens design and construction timeframes, delivering faster time-to-market. Global procurement strategies reduce capital expenditure whilst securing reliable supply chains. Consistent design and operational practices improve reliability, maintainability, and sustainability performance, while also simplifying compliance reporting. Crucially, a GRD balances uniformity with flexibility, enabling local adaptation without compromising global consistency and quality.

This whitepaper outlines how a GRD can transform hyperscale data centre development. It highlights the strategic advantages of speed, scalability, cost efficiency, resilience, and sustainability, while addressing implementation considerations and potential challenges. By adopting a GRD, hyperscale data centre developers can not only meet today's end-user demand with greater certainty, but also position themselves for long-term competitive advantage in a rapidly evolving digital landscape.

Introduction

The hyperscale era has redefined the data centre industry. Rapid adoption of cloud services, streaming platforms, and AI workloads continue to drive unprecedented demand for capacity. At the same time, hyperscale data centre developers must contend with a number of challenges:

1. **Global reach** - developers are pursuing simultaneous expansion across multiple continents. For example, Colt DCS has active developments across both EMEA and APAC to meet global demand.
2. **Changing customer demands** - customers now expect facilities to be delivered faster, at lower cost, and with built-in flexibility for higher power densities, liquid cooling, and rapid scalability. According to McKinsey, average rack densities have more than doubled in just two years, rising from 8kW to 17kW per rack, driven by AI workloads. Sustainability has also become a critical differentiator, with carbon footprint reduction and clean energy sourcing now key decision criteria.
3. **Utility power constraints** - in many markets, grid capacity is either limited or subject to long lead times for new connections due to transmission and substation constraints, as well as permitting delays. This has become a critical bottleneck, forcing developers to explore new geographies, on-site generation, renewable integration, and alternative energy strategies. For instance, in several FLAPD markets, power-ready land is now scarce, commanding a premium alongside high energy costs.
4. **Escalating construction costs** - labour and skills shortages, supply chain disruptions, and material inflation have significantly increased build costs. Demand far outweighs supply, meaning there is a greater risk of delay, threatening financial performance and return on investment through penalties and missed deadlines.
5. **Regulatory variation** - differing building codes, permitting processes, and compliance regimes complicate global expansion. Fire safety regulations and seismic standards, for instance, drive specific requirements that must be embedded into designs at the outset.
6. **Operational consistency** - maintaining uniform standards across multiple geographies is increasingly difficult with bespoke designs. Handing over complex systems to operational teams requires extensive training and new procedures. Managing facilities with varied designs also makes lifecycle decision-making more complex.

Traditional approaches, where each project is engineered from scratch, can no longer keep pace. The market requires hyperscale data centres to adopt a model that delivers speed, scale, and consistency while retaining the flexibility to adapt to local challenges. This is where the **GRD** becomes transformative.

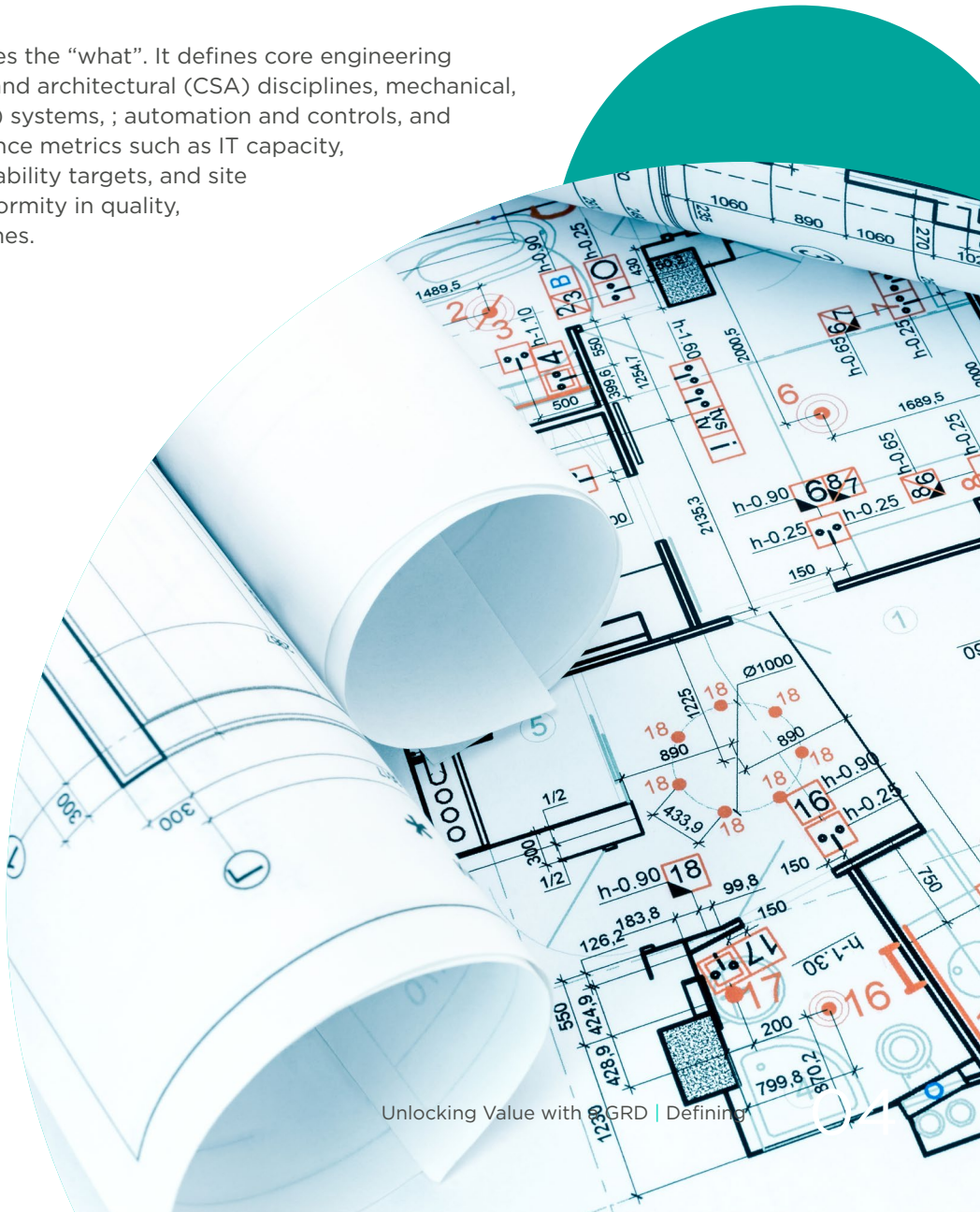
Defining a Global Reference Design (GRD)

A **GRD** is a centralised framework that establishes a consistent design baseline for all data centre projects within a global portfolio. It is neither a rigid “one-size-fits-all” template nor a purely localised blueprint. Instead, it provides a structured system that balances **standardisation and flexibility**, allowing hyperscale data centre developers to deliver at scale without continually “reinventing the wheel”.

Data centres are highly complex facilities. Beyond the IT load in the white space, they depend on extensive mechanical, electrical, control, and service systems housed in the grey space and firm robust, structural and architectural elements throughout. Careful design coordination is required to ensure resilience and maintainability without compromising uptime.

Both hyperscale data centre developers and end users have core requirements that designs must meet. The challenge lies in defining **what** must be delivered consistently across all facilities, versus **how** it should be achieved in different markets where conditions vary.

A robust **Basis of Design** addresses the “what”. It defines core engineering principles across civil, structural, and architectural (CSA) disciplines, mechanical, electrical, and public health (MEP) systems, ; automation and controls, and security. It also sets out performance metrics such as IT capacity, density, energy efficiency, sustainability targets, and site footprint. This ensures global uniformity in quality, resilience, and operational outcomes.



colt
Data Centre Services

At the same time, scalability is essential. Whereas data centres in the early 2000s often delivered only a few megawatts, today's facilities commonly exceed 40MW of IT capacity, with campuses reaching hundreds of megawatts. Such developments require significant investment and long build cycles. Delivering them in a single phase would demand large capital expenditure before any revenue is realised, an unattractive proposition for both hyperscale data centre developers and customers. To overcome this, GRDs enable a **modular**, **phased approach**, using standardised building blocks such as electrical rooms, cooling modules, and repeatable floor layouts. These can be deployed incrementally in line with customer demand or site constraints.

This is where the "how" becomes critical. By adopting **standardised**, repeatable systems, hyperscale data centre providers not only reduce design timeframes, but also gain control of supply chains, ensure quality, incorporate lessons learned, and enable operational teams to maintain facilities with greater ease. To achieve this, technical specifications for key materials, plant, and systems must be defined and enforced globally.

Flexibility remains vital. In today's fast-moving environment, customer requirements are constantly evolving. AI workloads, for example, are driving higher rack densities and necessitating advanced cooling solutions such as direct liquid cooling. A GRD must be **customer-centric**, allowing for customisation, higher densities, enhanced security features, or emerging technologies without requiring a complete redesign.

Equally, **local adaptability** is essential. The GRD must allow controlled variations to meet regional regulatory codes, climate conditions, local planning restrictions and supply chain realities. If each new geography demands a ground-up redesign, the purpose of a GRD is lost. The art lies in defining the right level of global consistency while accommodating targeted local adjustments.

Finally, a GRD must be built upon a **culture of continuous improvement**. Lessons learned from projects should be systematically captured and fed back into the reference design, ensuring that each new facility benefits from accumulated experience and that past errors are not repeated.

Colt DCS established and have operated a GRD since 2022 and have carried out several updates & developments to mature the framework.

Benefits of a Global Reference Design (GRD)

A GRD accelerates **speed to market** by reducing design cycles through pre-approved templates, streamlining internal and external approvals, and enabling modular, phased construction that brings capacity online sooner. Standardisation creates a supply chain that is familiar with repeatable specifications, securing long-lead items faster and reducing procurement delays, while proven configurations minimise commissioning risks. Together, these factors shorten delivery timelines, improve capital efficiency, and give hyperscale data centre developers a competitive advantage by consistently bringing reliable capacity to market ahead of demand.

A GRD improves **cost efficiency** by reducing duplicated engineering effort from professional teams, enabling bulk procurement of standardised components, and driving economies of scale across multiple projects. **Standardisation** lowers design and construction overheads, while well-developed specifications allow developers to negotiate long-term vendor agreements and optimise supply chain management. These efficiencies not only reduce capital expenditure but also improve predictability of project budgets and strengthen financial performance over time.

By applying a repeatable design framework, a GRD ensures uniform **quality** and **reliability** across global facilities. Standardised systems simplify commissioning, operations, training, and maintenance, reducing the risk of errors and unplanned downtime. Proven configurations and consistent operational practices improve uptime performance, while giving customers confidence that facilities across different regions deliver the same levels of resilience and service.

A GRD enables **scalable** development through modular building blocks that can be deployed in phases, allowing capacity to grow in line with customer demand. This approach reduces upfront capital requirements while ensuring facilities can expand predictably to support future workloads. At the same time, the GRD provides flexibility to accommodate varying customer requirements such as higher rack densities, liquid cooling solutions, or enhanced security, without needing a complete redesign, thereby supporting **customer-centric** growth.

Although globally standardised, a GRD allows controlled variation to meet local requirements such as regulatory codes, climate conditions, and supply chain availability. This balance ensures global **consistency** while still adapting to the nuances of individual markets. By defining clear boundaries between global standards and local customisation, developers can achieve faster, more reliable deployments without compromising compliance or operational performance.

A GRD embeds **sustainability** principles into the core of the design, ensuring that energy efficiency, carbon reduction, and renewable integration are prioritised from the outset. Standardised performance metrics simplify ESG reporting across regions and create a framework for meeting global sustainability targets. This not only reduces environmental impact but also aligns with customer expectations and regulatory requirements, strengthening the developer's long-term market position. Many developers including Colt DCS have ESG strategies & targets.

By standardising proven designs and operational frameworks, a GRD reduces risks associated with cost overruns, commissioning delays, and performance inconsistencies. It provides greater certainty in project delivery, supports compliance with diverse regulations, and ensures lessons learned are systematically applied across the portfolio. This approach minimises exposure to operational, financial, and reputational risks, offering developers and customers alike a higher degree of confidence in the resilience of their facilities.

Implementing a Global Reference Design (GRD)

Implementing a GRD is not only a technical exercise, it requires disciplined governance, stakeholder alignment and a structured approach to execution to ensure successful adoption into projects.

Firstly, it must be centrally governed by a dedicated **Global Standards** team consisting of engineers, who are responsible for authoring the GRD as well as updates and consistent application across all projects. Clear lines of accountability must be established with decision making authorised defined to avoid design drift at project levels across regions and the goal is missed.

It must be treated as a "living framework", evolving as technologies, regulations, and customer requirements change. A formal change-control process is essential to evaluate proposed modifications, prevent unnecessary fragmentation, and ensure lessons learned from past projects are incorporated systematically. Updates should be version-controlled, with robust documentation so that all stakeholders understand which iteration applies to their projects.

While global consistency is the objective, local adaptation is always required. The GRD should define a structured process for regional engineering teams to request deviations where required by local codes, climate conditions, or supply chain constraints. These adaptations must be documented, justified, and approved centrally to ensure that they do not undermine overall design consistency.

There is opportunity to integrate supply chain into the GRD framework. Standardised technical specifications allow vendors to pre-engineer, **pre-fabricate**, and stock components, reducing procurement risk and lead times. Strategic partnerships with preferred suppliers can deliver cost savings, ensure product availability, and reinforce design consistency across multiple geographies and maintain quality.

Successful implementation requires alignment not only within design and construction teams but also with commercial, sales & operations teams. Standardised systems and practices mean training programmes can be streamlined, ensuring staff are equipped to operate and maintain facilities globally. Knowledge transfer should extend across functions and geographies to build confidence in applying the GRD.

Digital platforms such as **Building Information Modelling (BIM)**, digital twins, and cloud-based collaboration tools are essential to coordinating multiple stakeholders around a unified design. These technologies provide visibility of changes, reduce errors, and allow performance data from live facilities to feed back into the GRD for ongoing optimisation.

Implementation requires buy-in from multiple stakeholders: investors, regulators, design consultants, contractors, and customers. Proactive communication of the GRD's benefits including speed, cost efficiency, and operational certainty, helps overcome resistance and secures alignment around the framework. A structured implementation approach reduces risk but does not eliminate it. Regular compliance audits, both during construction and operation, ensure adherence to the GRD. Risk registers must track potential deviations or failures to apply standards, with clear escalation pathways for resolution.

Implementation is about more than just technical standards. It is about embedding a repeatable, governed, and continuously improving framework across global teams and supply chains. Done correctly, the GRD becomes not only a design tool, but a strategic enabler of global expansion.

Challenges

While the benefits of a GRD are clear, implementation is not without challenges. These risks must be anticipated and addressed through robust mitigation strategies to protect the long-term success of the framework.

Local Adoption

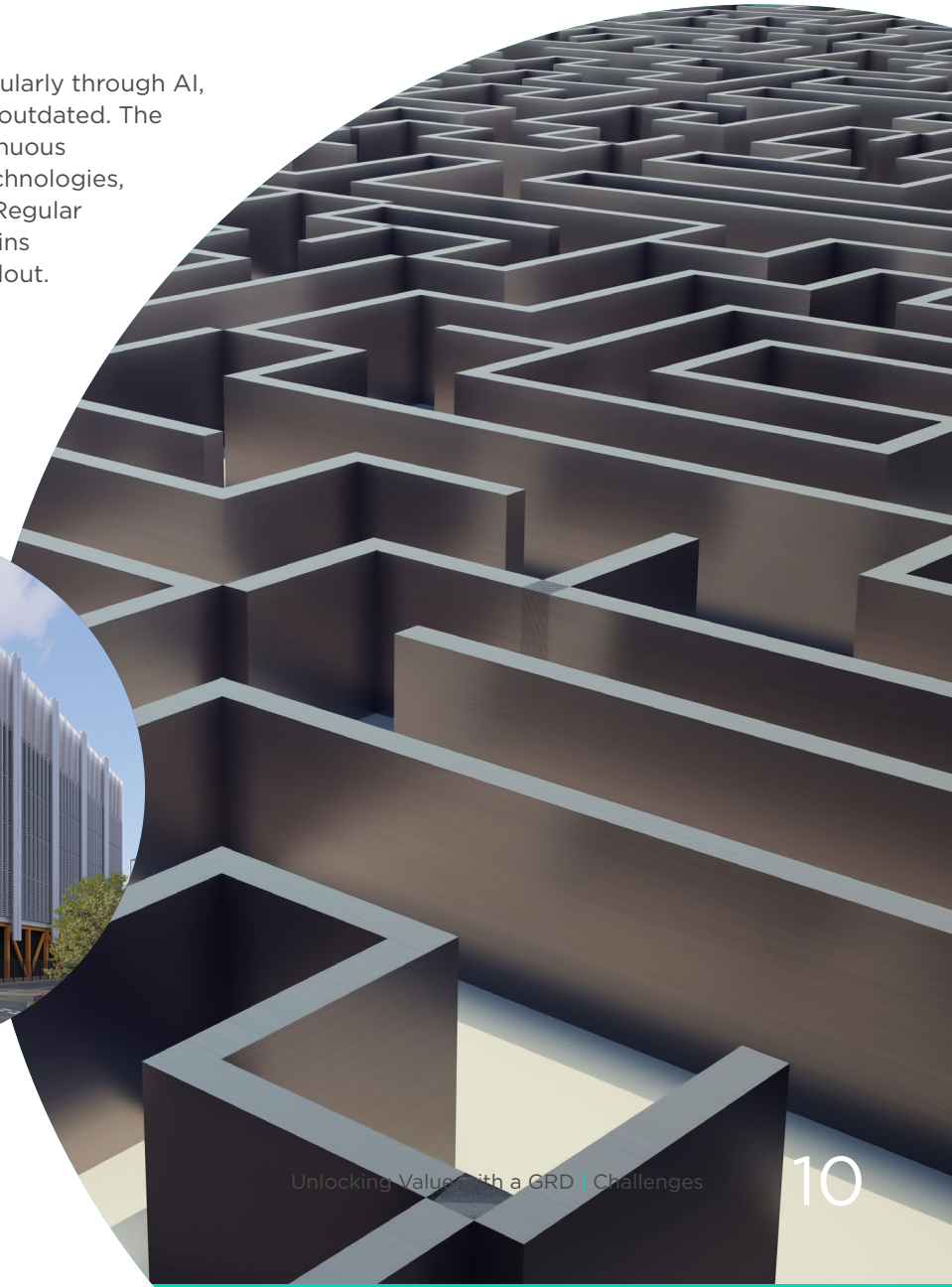
Teams may resist moving away from established practices they believe better suit their markets. This resistance can arise from lack of familiarity or concerns about added complexity. Early stakeholder engagement is therefore critical, supported by clear governance, training, and transparent communication. Involving regional teams in decision-making fosters ownership and builds confidence in the GRD.

Over-Standardisation

A GRD can be perceived as too rigid if it ignores local conditions such as climate or building codes. To avoid this, global standards should clearly define “must-have” elements while allowing controlled flexibility for “may-adapt” features. A structured governance process for reviewing and approving variations ensures compliance without compromising design integrity.

Innovation

With IT workloads evolving rapidly, particularly through AI, there is a risk that a static GRD becomes outdated. The framework must therefore embrace continuous improvement, incorporating emerging technologies, lessons learned and customer feedback. Regular review cycles and tools such as digital twins can validate innovations before global rollout.



Delivery Phasing

Utility power constraints and escalating construction costs often necessitate phased delivery of capacity. This makes it essential to embed scalability and modularity into the GRD, ensuring IT capacity can be brought online in stages to meet customer Ready-for-Service (RFS) dates. Standardised equipment, bulk procurement, and pre-fabrication strategies help control costs and improve delivery certainty.

Compliance

Operating across regions such as EMEA and APAC introduces diverse regulatory requirements, from seismic codes to sustainability reporting. Failure to adapt designs risks delays, penalties, or reputational damage. Embedding a structured local adaptation process, supported by local specialists feeding into a central regulatory knowledge base, ensures compliance and consistent integration of updates.

Operations

Handover to operations teams across different geographies can be challenging if staff are unfamiliar with new systems. Without proper training, the risk of downtime increases. To mitigate this, operations must be engaged early in the design process, with global playbooks, commissioning procedures, and standardised training aligned to the GRD.

Communication

Global frameworks can expose cultural, linguistic, and communication barriers, leading to misinterpretation of requirements or inconsistent adoption. Investing in cross-regional project management platforms, consistent documentation formats, and global knowledge-sharing sessions maintains clarity and reinforces alignment across all teams.

Conclusion

The hyperscale data centre industry is evolving rapidly, driven by the relentless demands of cloud, AI, and digital services. End users increasingly expect not only more capacity, but also faster delivery, higher reliability, flexibility for new technologies, and a clear commitment to sustainability. Meeting these expectations with traditional one-off, bespoke designs is no longer viable.

Colt DCS have bridged this gap by implementing a **GRD** creating a consistent yet adaptable framework that directly benefits customers. For end users, this means facilities delivered on time and ready for use sooner, with predictable quality across geographies. It ensures capacity can scale in line with their business growth, while allowing for tailored features such as higher rack densities, liquid cooling, or enhanced security without the delays of starting from scratch. The GRD also embeds sustainability and ESG commitments into every facility, aligning with the growing importance customers place on carbon reduction and responsible sourcing.

From the developer's perspective, the GRD is a strategic enabler. It reduces cost and schedule risk, strengthens supply chains, and drives operational consistency. But its real value lies in the customer outcome: faster speed to market, greater flexibility, reliable service continuity, and confidence that their digital infrastructure partner can deliver globally at scale.

In a competitive and fast-changing digital landscape, adopting a GRD is not just about efficiency, it is about **meeting and exceeding customer expectations**. Developers who embrace this approach will not only achieve operational excellence, but will also secure long-term trust, loyalty, and strategic advantage with the hyperscale customers that are shaping the future of the digital economy.

Find out more about Colt DCS' solutions, by visiting **www.coltdatacentres.net**

Our Carrier Neutral Data Centre Locations

France
Colt Paris South West Data Centre
Colt Paris 2 Data Centre*
Colt Paris 3 Data Centre*
Colt Paris 4 Data Centre*
Colt Paris 5 Data Centre*
Colt Paris 6 Data Centre*

Germany
Colt Berlin 1 Data Centre*
Colt Berlin 2 Data Centre*
Colt Frankfurt City Data Centre
Colt Frankfurt West Data Centre
Colt Frankfurt 3 Data Centre*
Colt Frankfurt 4 Data Centre*
Colt Frankfurt 5 Data Centre*

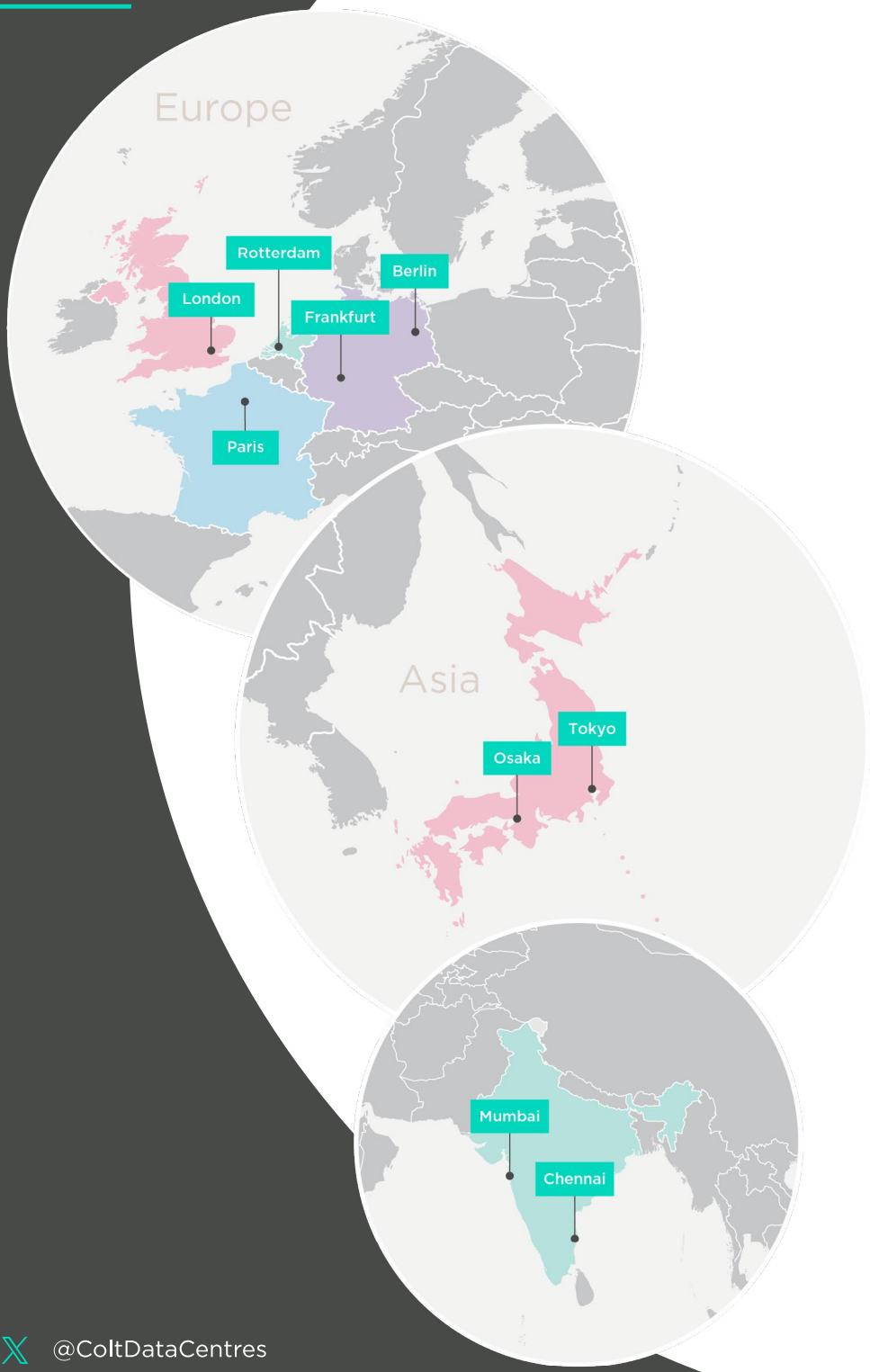
India
Colt Mumbai 1 Data Centre
Colt Mumbai 2 Data Centre*
Colt Chennai Data Centre*

Japan
Colt Osaka Keihanna Data Centre
Colt Tokyo Shiohama Data Centre
Colt Tokyo Inzai 1 Data Centre
Colt Tokyo Inzai 2 Data Centre
Colt Tokyo Inzai 3 Data Centre
Colt Tokyo Inzai 4 Data Centre
Colt Tokyo Inzai 5 Data Centre*
Colt Tokyo Yoshikawa 1 Data Centre*
Colt Tokyo Yoshikawa 2 Data Centre*

Netherlands
Colt Rotterdam Data Centre

United Kingdom
Colt London West Data Centre
Colt London North Data Centre
Colt London 4 Data Centre*
Colt London 5 Data Centre*
Colt London 6 Data Centre*
Colt London 7 Data Centre*
Colt London 8 Data Centre*

* In development



0800 358 3598
+44 20 3003 4584
www.coltdcs.com
dcsinfo@colt.net

@ColtDataCentres
Colt Data Centre Services
Colt Data Centre Services
Colt Data Centre Services

colt
Data Centre Services

Accreditations:
ISO 27001
ISO 14001