EBOOK

cadence

Why Does a Data Center Need a Digital Twin?

Everything You Need to Know About the Purpose and Value of a Digital Twin in a Data Center Context

Who Should Read This eBook?

- Data Center Operations Managers
- IT Directors
- CFOs
- Data Center Facilities Managers
- Head of Sustainability

The Future of Computing: Data Center Digital Twins

The global digital twin market is on a rapid ascent, projected to skyrocket from $11.51 billion in 2023 to $137.67 billion by 2030. Spanning industries from aerospace to healthcare, digital twins are becoming an essential tool for efficient management. But what is a digital twin?

Essentially, it's a digital replica of any real-world entity—a product, system, or process—used for simulation, testing, and maintenance. For instance, a data center digital twin is just that, but for data centers, and can be powered by cutting-edge computational fluid dynamics (CFD) for unparalleled accuracy in airflow and temperature predictions.

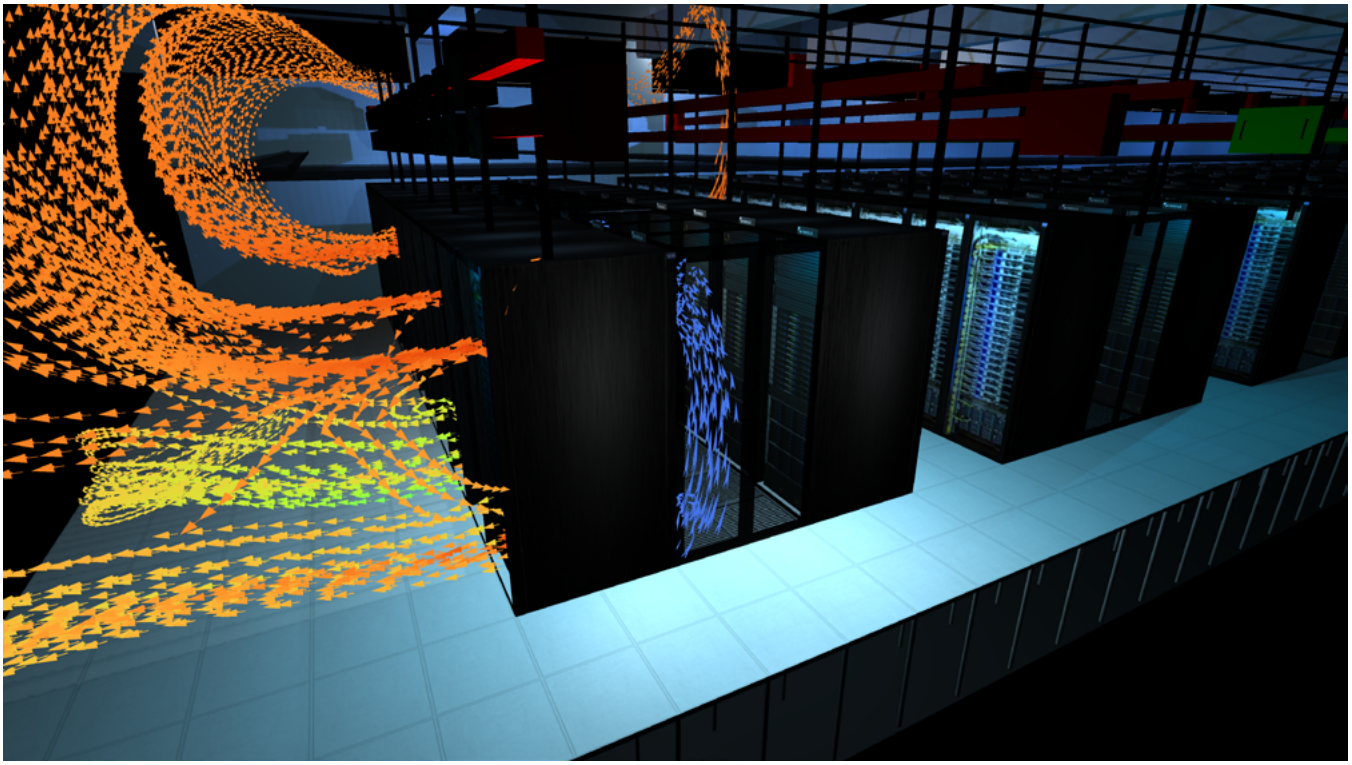
Despite the buzz, a Cadence study of 500 technology professionals in the data center field revealed only 42% are up to speed with leveraging digital twin technology. Recognizing this gap, Cadence developed this eBook to demystify the purpose of digital twins in the context of data centers and showcase how to maximize their value.

Why Physics-Based Simulation Powered by CFD?

When we introduce CFD-powered data center digital twins to data center professionals, we're often met with the question, "I'm already using environmental monitoring and thermal mapping to manage the temperature in my data center; isn't that enough?"

Environmental monitoring is absolutely essential for data center operations. It uses sensors to measure the environment and ensure optimal conditions for both employees and equipment. Thermal mapping, a technique that builds on data from these sensors, aims to provide a temperature overview of the facility but has limitations in pinpointing specific overheating issues due to its inability to capture conditions between sensors.

Integrating a data center digital twin, especially one powered by CFD, into your workflow can significantly enhance the effectiveness of environmental monitoring by catching what environmental monitoring might miss. It refines temperature distribution analysis and identifies inefficiencies, paving the way for optimizing cooling systems to meet high-performance computing demands in an energy-efficient manner for today's plans and tomorrow's unimagined requirements.



Digital Twins for Data Center Design Versus Data Center Operations

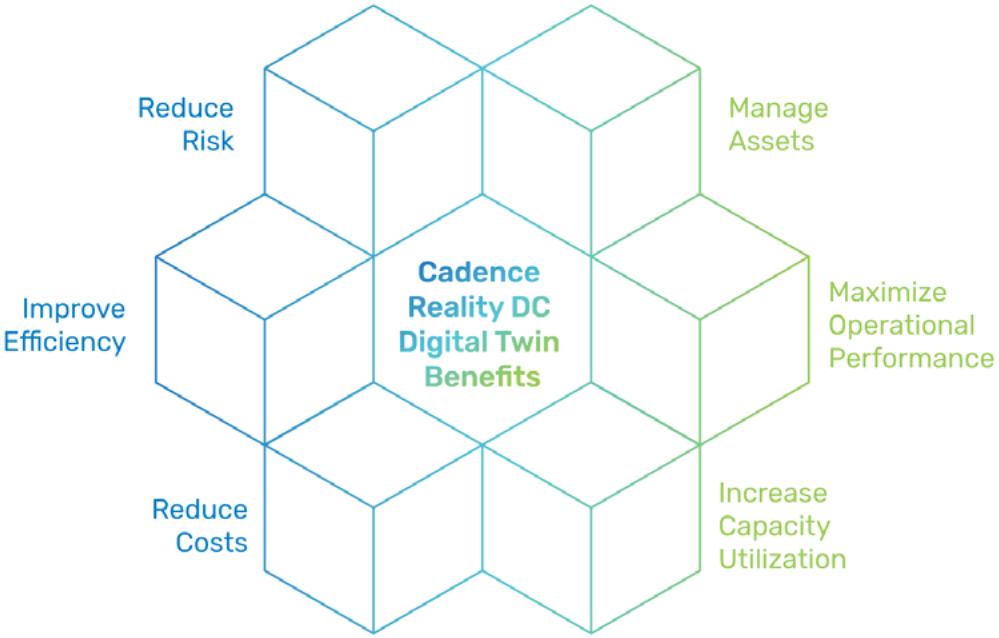
Let's take a quick look at how CFD-powered digital twins support both design and operations.

CFD-powered data center digital twins enable the analysis of design configurations and failure scenarios for advanced, resilient, and efficient (re)designs. Using CFD-powered data center digital twins, designers can

- Optimize cooling designs, including liquid cooling, (non-) raised floors, fan walls, in-row, and (in)direct adiabatic evaporative cooling
- Model and analyze the external environment
- Evaluate design resilience with transient simulations and what-if scenarios
- Prioritize sustainable design with carbon usage analytics and energy efficiency reports
- Model control systems and power networks
- Export photorealistic images and movies to demonstrate design performance intuitively for others

CFD-powered data center digital twins can also do all the above during the operations stage, plus aid operators in balancing capacity use, energy efficiency, and downtime risk. Using CFD-powered data center digital twins, operators can also

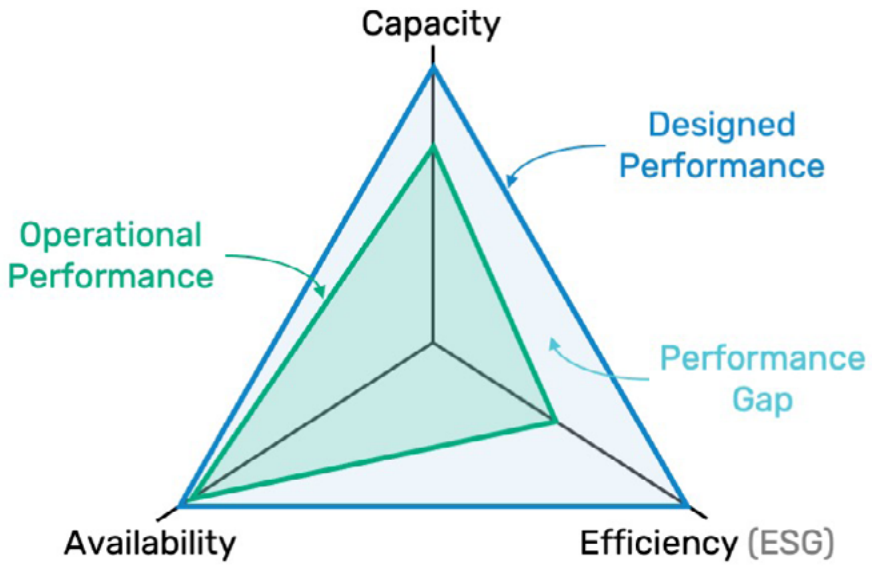
- Coordinate across teams with a centralized platform
- Test deployment options and failure scenarios
- Study the implications of different power, loading, and cooling scenarios
- Simulate airflow and cooling to optimize performance



Maintaining as Near to Designed-Performance as Possible

In the real world, no data center can reach its original design capacity due to the inevitable changes in space, power, and cooling. Operational data centers continuously evolve, moving away from their initial design plans. Deploying IT without understanding its impact leads to inefficiencies and limits further expansion. Using CFD-powered digital twins is crucial for closely aligning with the original design and preventing fragmentation issues.

By leveraging CFD-powered digital twins, data center operators can validate operational decisions virtually before implementation, optimizing resource allocation and enhancing performance. This technology offers a way to avoid the potential for unintended consequences and understand how the changes impact the interconnected performance metrics of availability, capacity, and efficiency. Adopting this proactive approach allows operators to minimize inefficiencies, reduce operational costs, and support sustainable expansion while ensuring the data center evolves effectively and is more able to meet growing demands.



How to Build a Data Center Digital Twin

At Cadence, we've developed a straightforward four-step implementation process for building and incorporating a data center digital twin into your workflow.

Step 1: Create the Data Center Digital Twin Model

The process begins by inputting IT assets, CAD floorplans, and circuit data into our software. The Cadence engineering team (or your selected qualified M&E engineering team) guides this process, aiming for off-site completion with possible brief on-site validations if necessary.

Step 2: Calibrate the Model

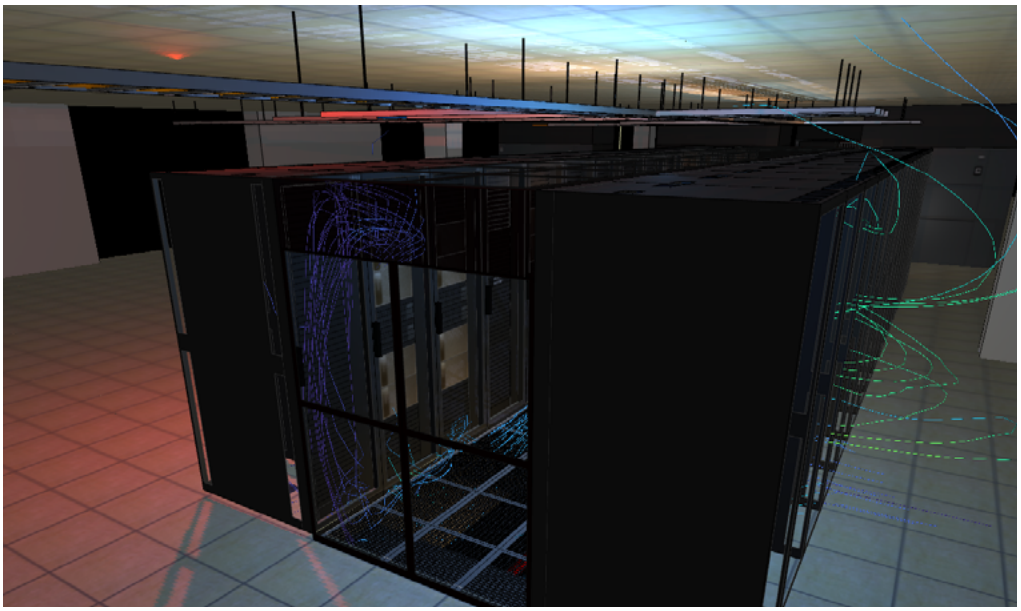
Once the digital twin model of the data center is calibrated with real-world data, adjustments ensure it accurately reflects the facility. The engineers then produce a detailed assessment report on airflow and cooling management in PowerPoint format. This report includes recommendations for remediating any identified issues.

Step 3: Train, Integrate, and Implement

The engineering team provides software training and helps integrate the software with tools your organization likely already uses, such as DCIM and CMDB. The model can be tested in a trial environment before official deployment. This deployment involves setting up the software, security certificates, and necessary accounts.

Step 4: Ongoing Support

Our expert data center engineers offer global, 24/7 support and tailored training sessions to maximize your data center's capabilities with our software.

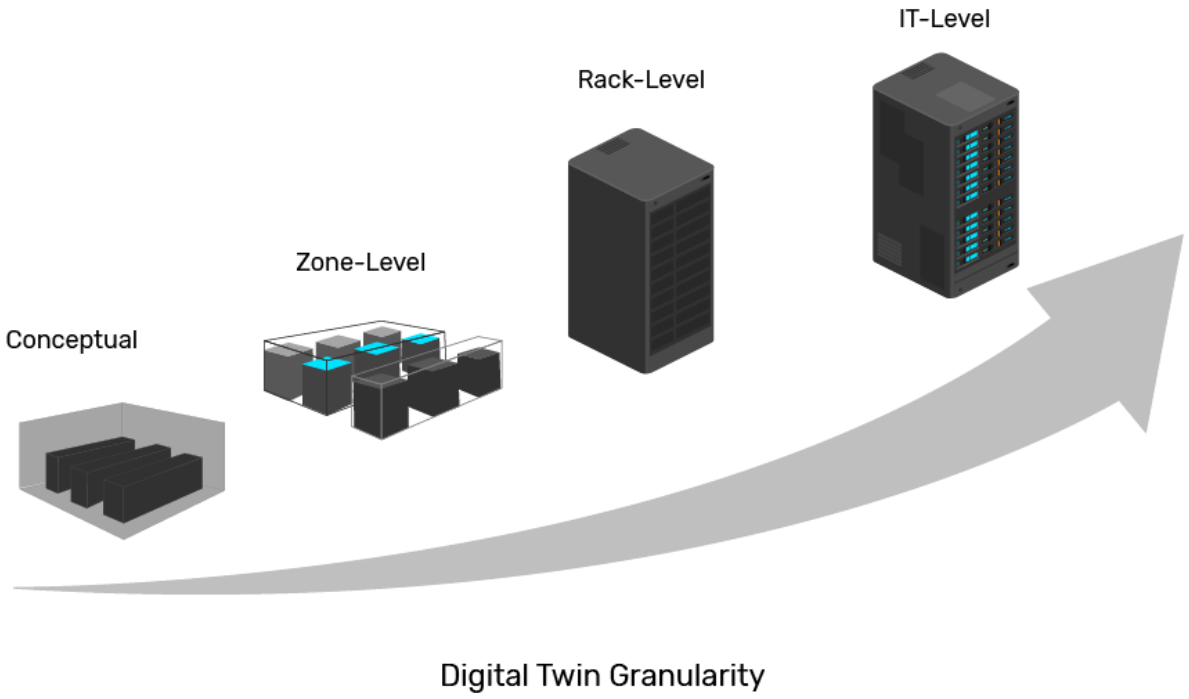


Getting Value from Your Data Center Digital Twin

Calibration and integration ensure a data center digital twin accurately aids decision-making, even as data centers evolve. Our solution keeps the model updated in real time by integrating data from operational tools, such as environmental monitoring systems, DCIM, and CSV spreadsheets. These integrations enable operators to focus on capacity, energy efficiency, and compliance rather than model upkeep.

Operators can evaluate deployment locations and future scenarios based on thermal limits and space, power, and cooling effects, using Cadence's analytics features, such as reports and dashboards, to optimize capacity and ensure IT uptime.

These reports and dashboards can include simulation results, live monitoring data, PUE, carbon usage, and more. Having these insights accessible whenever a change is made to the data center enables operators to quantify decisions based on energy efficiency metrics and, in turn, cost avoidance.



Case Studies: Data Center Digital Twins in Action

The best way to understand what a CFD-powered data center digital twin can do for you is to see what it has done for others. Below are very short synopses of a few key data center digital twin case studies that you can read in full in this eBook. These enterprises adopted Cadence® Reality™ DC Digital Twin to maximize their data center performance and prioritize energy efficiency.

Aerospace

A leading aerospace company used Cadence Reality DC Digital Twin to optimize asset management, cutting power consumption and boosting performance by 30 – 40% while improving cooling efficiency and lowering facility PUE from 4 to 1.6.

Automotive

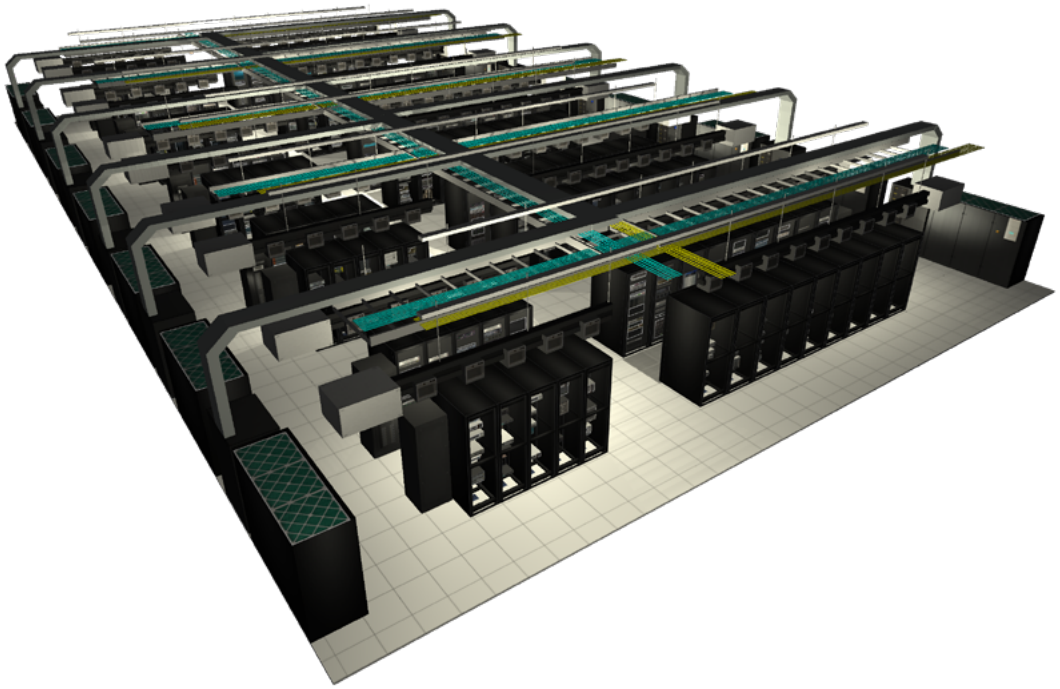
A major European car maker used Cadence Reality DC Digital Twin to enhance cooling and energy efficiency in its data centers, boosting IT and Facilities collaboration, and ensuring timely, on-budget data center transformation with optimized space use.

Healthcare

A large healthcare enterprise modernized legacy systems and assesses IT deployments by using Cadence Reality DC Digital Twin for CFD simulations, enabling risk-free accommodation of large IT units without migrating to the cloud.

Finance

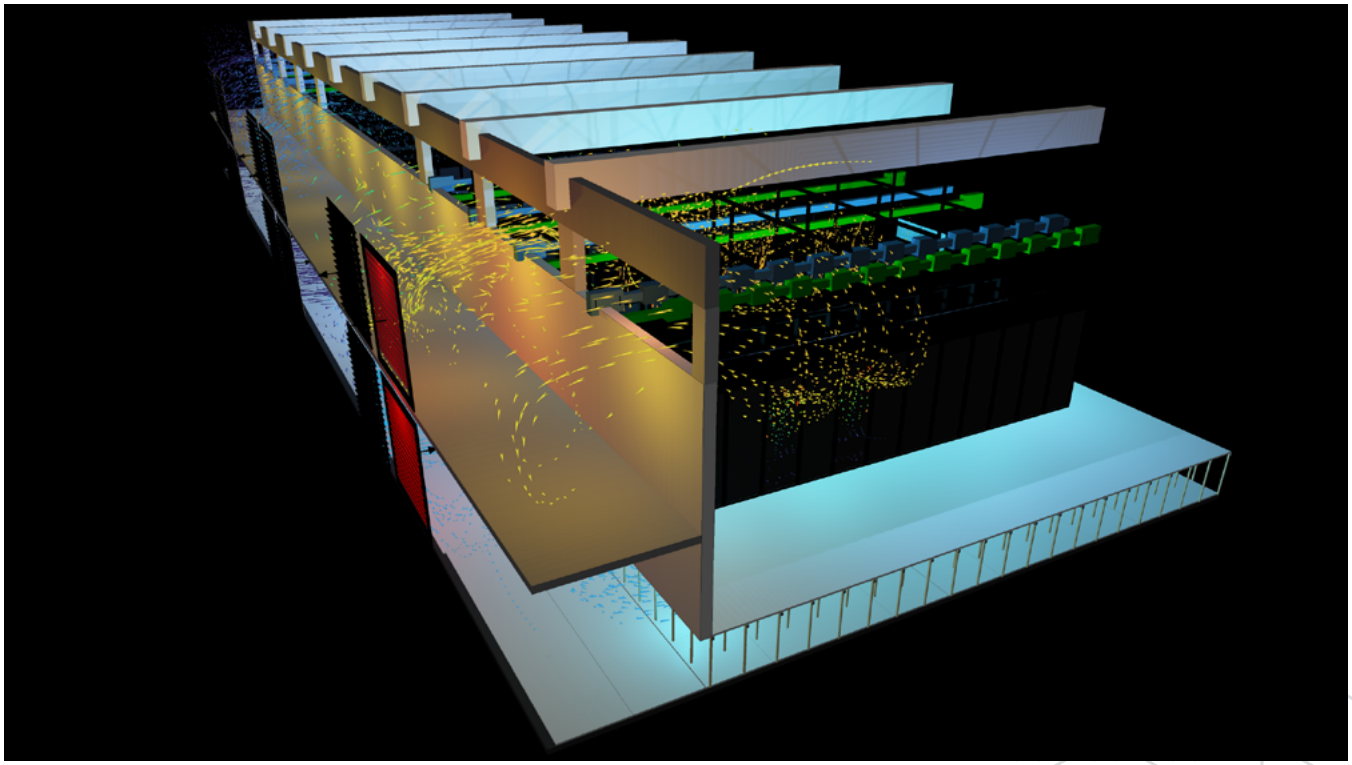
Using Cadence Reality DC Digital Twin, this global financial service organization with over 200,000 employees streamlines capacity decisions, conducts failure analysis, and enhances risk mitigation, leading to reduced OPEX costs and improved staff understanding of data center impacts.



Maximize Performance with CFD-Powered Data Center Digital Twins

Proactively meeting the expectations surrounding uptime, capacity utilization, and energy efficiency starts with having the right information. Cadence Reality DC Digital Twin provides a framework to gather that data by visualizing a data center's layout, airflow, cooling, power, and the impact of changes on operations in a digital twin model.

Watch this webinar to see a data center digital twin in action, or contact us to learn what a digital twin can do for your project.



cadence®

Cadence is a pivotal leader in electronic systems design and computational expertise, using its Intelligent System Design strategy to turn design concepts into reality. Cadence customers are the world's most creative and innovative companies, delivering extraordinary electronic products from chips to boards to complete systems for the most dynamic applications. **www.cadence.com**

© 2024 Cadence Design Systems, Inc. All rights reserved worldwide. Cadence, the Cadence logo, and the other Cadence marks found at www.cadence.com/go/trademarks are trademarks or registered trademarks of Cadence Design Systems, Inc. All other trademarks are the property of their respective owners. J32168 06/24 SA/VY/PDF