GE
Intelligent Platforms

Five Essential Components for Highly Reliable Data Centers

Ensuring continuous operations with an integrated, holistic technology strategy that provides high availability, increased visibility, and insight through information

Introduction

According to the Electrical Power Research Institute (EPRI), power disturbances cost the U.S. industry as much as $188 billion per year in lost data, materials, and productivity. In today's information-driven economy, where system availability is imperative to operations, data centers and other facilities with mission-critical applications must ensure the highest level of reliability at all times.

The negative business consequences of power interruptions can include lost data, lost profitability, lost credibility, and worst yet, lost customers—making any instance of downtime unacceptable. It is estimated that companies worldwide annually spend more than $5 billion on backup power systems, according to industry analysts at the Darnell Group.

While these backup systems alone may have delivered what was considered an acceptable level of reliability in the past, today's data centers need holistic technology infrastructures that go beyond increasing reliability to virtually eliminating downtime—an opportunity that many facilities have yet to capitalize on. With the right combination of advanced technologies, data centers can maximize system reliability for continuous operations.

This paper highlights an integrated, holistic strategy for highly reliable data centers that encompasses five essential components. Readers will understand how the integration of advanced hardware and software technologies can deliver insight through information for the highest level of efficiency, reliability, and uptime—enabling a sustainable competitive advantage.

Key challenges

Data centers typically have "baseline" infrastructure technologies for reliability such as paralleling switchgear, standby power generation, alternative energy sources, automatic transfer switches, UPS systems and chillers. However, these disparate technologies often do not easily integrate with each other or other systems, increasing the complexity of data center operations.

- **Standalone subsystems**
  Many data centers do not have visibility into the baseline infrastructures due to disparate systems, whereby failures are managed locally. It is difficult to collect, correlate, and analyze data from these various systems, which is critical to identify trends, uncover root causes and implement strategies for improvement. Without the ability to connect information and compare this information to established baseline data and statistics such as resource consumption, operational efficiency and availability, there can be no true understanding into the reliability and associated operating costs of the data center as a whole.

- **Inability to scale solution**
  Scalability is a challenge with standalone subsystems because while adding redundancy may eliminate single points of failure and increase reliability, it also increases complexity and systematic risk, threatening reliability altogether. If a data center needs to scale its technology infrastructure, extensive reprogramming and reconfiguration is often required, which also increases costs and time to solution.

- **Proprietary technologies**
  Systems that leverage proprietary technologies generally face a higher likelihood of failure when these systems are interfaced with components from other manufacturers or software from third-party suppliers. Testing and maintenance are also more involved if there are compatibility issues between the components and subsystems, whereby risk can reside at system interfaces.

Five key components of a holistic data center strategy

As downtime costs continue to rise, forward-looking strategies must address various infrastructure challenges and encompass both hardware and software solutions that are scalable, open, and tightly integrated—working together as a comprehensive system.

Integrating existing infrastructures with high availability control and advanced software capabilities such as monitoring or alarming can significantly increase operational performance by reducing human error, improving system availability and performance, and reducing energy consumption.

There are five key components that are critical to helping data centers shift toward long-term maintainability, efficiency, and reliability for facility optimization.

1. High availability control

At the core of data center performance is high availability control, which helps data centers ensure data protection, continuous operations, and recovery, in the event of an outage. Traditional high availability control solutions are designed to maximize uptime through the doubling of individual system components and the passing over of control from the active to the backup systems at the moment of failure.

However, it is important to note that some architectures provide a higher level of advanced capability to drive maximum system availability for all critical applications. For example, a data center that leverages a paralleling switchgear high availability solution with true dual control and dual redundancy data synchronization can provide transparent process switchover and protect from loss in the event of failure, delivering continuous operation and availability to the end user.

Deterministic high-speed communications is another key capability for paralleling switchgear reliability that enables high-speed, low latency, data delivery and deterministic data transfers. A high availability solution that synchronizes systems at the beginning and end of each logic scan execution can keep all variable data the same—providing fast, full system synchronization and bumpless switchover for maximized reliability.

Other critical high availability features include:

- Redundant Synchronization Links
- Redundant Input/Output LANs
- Redundant Ethernet LANs for integration to facility management systems
- Full process mirror image
- Sequence of Event (SOE) Recording

For tier IV data centers that require an even higher level of availability, there is a quad redundancy solution available from GE that virtually eliminates downtime with four redundant controllers, instead of two controllers. It features a patented algorithm that continually calculates the relative system availability in real time and delivers predictive analysis to maintain maximum system availability—helping data centers with more demanding applications.

> Architectures with true dual redundancy have controllers with dedicated, redundant links to one another and operate synchronously with virtually no overhead added to the control application. They provide the ability to transfer all application variables, status, and I/O on every scan—increasing survivability and reducing single points of failure.

2. Advanced data collection

The next essential component of a data center support strategy is advanced data collection. Continuous operation and performance improvements of all data center systems are only as good as the runtime data collected for analysis and action from all the infrastructure systems. A key challenge for many data centers today is the difficulty of integrating many disparate hardware and software systems and standalone products into a common data collection and management strategy.

An advanced historian software solution is the foundation for increased insight, providing built-in data collection capabilities and the ability to capture large volumes of real-time data from multiple sensors and systems at high speeds; some historians offer up to a 1 msec resolution. It maximizes the power of time series data and excels at helping data centers answer questions that impact real-time decisions such as root cause analysis of component problems or “out-of-spec” conditions; optimization of the cooling infrastructure to deliver the correct temperature, humidity, and pressure; and power and heat reductions to increase efficiency and reduce costs.

In addition, some advanced historians can address network and server disruptions through a "store and forward" capability, which buffers data at the collector should a disruption occur. The buffers are eventually uploaded when the server comes back online with automatic reconnection—ensuring no data loss—an advantage that enables continuous availability of data.

An additional asset to any data historian is the integration with sequence of event recording at the control layer, which provides for the high-speed data collection and forwarding of critical system events to the historian.

3. Advanced analytics
With the data collected, advanced analytics can then help extract knowledge from the data, which is critical to driving corrective action for maximized performance and reliability. With advanced analytics software, data centers can gain insight into the likely causes of events or issues, perform "what if" scenario analysis, and identify opportunities for continuous improvements and the prevention of future problems.

Advanced analytics can provide data centers with critical context to otherwise static historical and real-time data, increasing data integrity and enabling better decision making for improved facility management and performance. For example, analytics can provide insight into metrics such as power usage effectiveness (PUE) so data centers can better understand the relationships between the factors that impact the metric, providing a means to take action on the extracted knowledge.

With the added insight that analysis provides, data centers can troubleshoot problems faster and optimize their processes for increased operational efficiency. Software solutions can provide non-linear and linear regression analysis, multivariate analysis, and offline modeling and simulation to address questions such as "why did it happen?" The knowledge can then help set the course for data centers to take action for optimized performance and reliability.

4. Critical alarm response
The fourth critical capability is the use of alarms to improve responsiveness and consistency. Leveraging next-generation alarm response management software can help data centers reduce costs and risk by ensuring the correct response to the small subset of critical alarms—increasing system availability and reducing liability exposure and costs.

Alarm response management software can help operators make better decisions by providing information and guidance with the exact responses needed to address critical alarms. It also helps track performance and allows managers to review results and improve response instructions.

For example, using proven workflow technology, GE's Alarm Response Management software allows HMI/SCADA users to provide operators with specific instructions and the precise information they need to make the correct decisions in critical situations. Decreasing the time for corrective action improves alarm response statistics such as Mean Time To Repair (MTTR), increasing availability.

By filtering MTTR by location within the facility or by operator responding, a data center can quickly identify trends. Why is one operator so much faster than the rest? Are they aware of a corrective action that should be incorporated into the standard response instructions?

Another metric, Mean Time Between Failure (MTBF), allows data centers to look at how often an alarm is occurring. For example, if an alarm occurs too often, this probably signals another deficiency in the system that should be addressed to keep the alarm from occurring at all. By enabling operators to take actions on alarms with specific alarm response instructions, data centers can reduce response time and filter alarms; ensure the right response to issues; decrease errors, rework, and waste; and automatically generate reports to measure response results.

5. Integration of all systems
Lastly, as improving efficiency of power supply systems is a key goal, it is only through an integrated, holistic approach that data centers can gain real-time views across systems and global comparative analytics for complete facility risk assessment. The ability to focus on all systems—as opposed to a select one or two—within a data center enables the critical "big picture" view of the operation's reliability and efficiency.

The selected technology for managing power supply systems and infrastructure should be open and flexible for seamless integration with a data center's current systems as well as its future technologies because integration enables critical understanding into the overall state of the facility. It also allows stakeholders to drill down into functional requirements and root causes, leverage real-time and historical data to drive continuous improvements, and make better decisions.

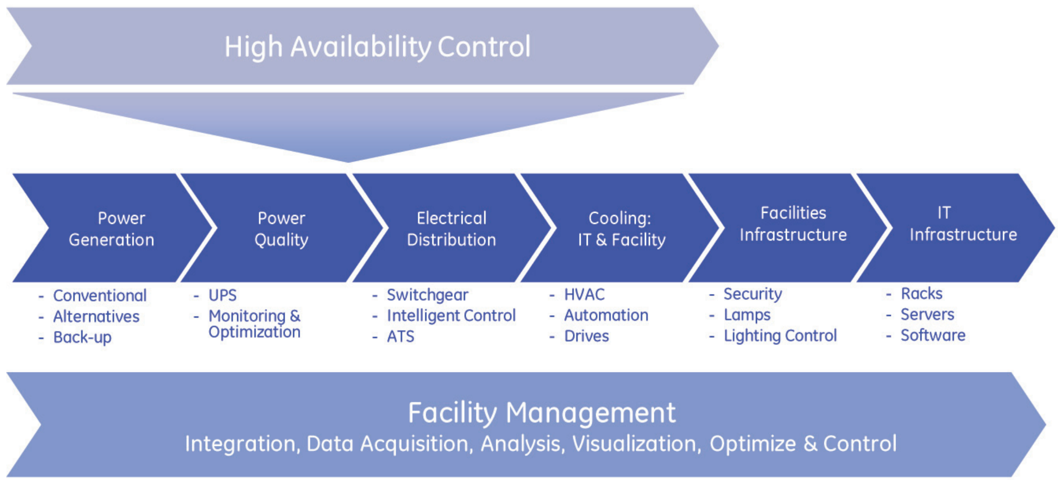

Figure 1 Selection of a proven set of integrated hardware, software and service solutions can provide a complete, tightly integrated facility solution — bringing together standalone building management, power management, and control into a simpler, yet comprehensive system.

Data centers can leverage an industrial Service Oriented Architecture (SOA) such as GE's Proficy* SOA to improve interoperability and enable composite applications that leverage a cross-system, real-time data and services bus, and repository. Used in combination with appropriate industry standards, SOA allows for a "plug and play" architecture for IT systems, whereby functionality can quickly be added, changed, or removed to meet evolving needs and market demands.

Delivering a solid backbone for leveraging "real-time" and historical information and providing an infrastructure to distribute the information between different locations, an SOA also provides developers with common architectural services like security, event management, and user services. They can design the information structure based on specific industry requirements, adding relevant intelligence to the system for greater reliability.

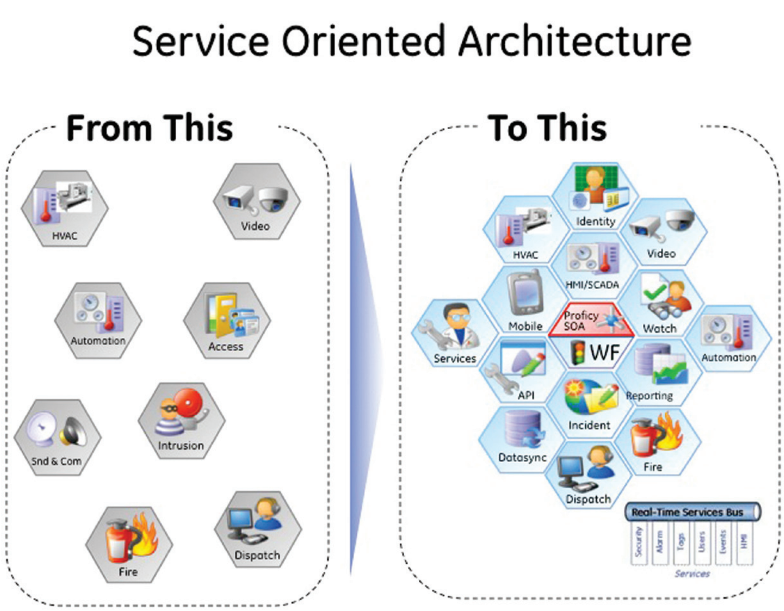

Figure 2 SOA can help data centers consolidate, simplify and scale their systems, lower operating costs, and respond to changing needs more quickly.

Conclusion

Data centers need to capitalize on the real opportunity available to maximize their system reliability for continuous operations by moving toward an integrated and holistic technology approach. The foundation is a centralized, scalable, and open platform built on SOA that enables integration and interoperability—providing a single, yet comprehensive view of the facility.

High availability redundant control, combined with a set of critical software capabilities, allows data center users to precisely monitor and control all critical systems; understand cross-functional synergies, constraints, and performance and cost metrics; and immediately respond to critical events with corrective action.

By implementing the right mix of enabling technologies that provide critical capabilities, data centers can position themselves to attain the highest level of reliability, availability, and operational efficiency—optimizing the management of their facility for a sustainable competitive advantage.

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