Data center reliability

Downtime is the enemy of every data center. Aberdeen Research reports downtime in "average" performing facilities at 60 minutes in an average of 2.3 incidents per year. Best-in-class organizations see 0.3 incidents for a total of just 6 minutes of downtime per year.

Cost estimates for data center downtime vary widely from one source to another. An Aberdeen Research study in 2012 reported average cost per incident at $161,000, up nearly two thirds from $97,850 in 2010. However, a report released by the Ponemon Institute in December of 2013 showed a much higher average figure of $626,418. The results of that study also ranged from a minimum of $74,223 to a whopping $1.7 million at the high end.

Failures can come in many forms and can be attributed to any of a number of causes such as component quality issues, power supply disturbances or human intervention. Even turning systems off for routine maintenance can precipitate a potentially costly incident.

The takeaway for data center owners and operators is that downtime is expensive and is getting more so. That puts an ever-higher premium on the reliability of every piece of equipment in the facility from the UPS to the cooling system to the servers themselves. Even the most innocuous cable could cost the data center tens or even hundreds of thousands of dollars if it fails.

As technology has advanced, especially with regard to monitoring and control capabilities, data center operators have had an opportunity to reduce the risk of failures and significantly improve reliability of their facilities. This is particularly true with regard to data center infrastructure management (DCIM) systems as they replace the patchwork of power, energy storage and environmental controls that historically operated independently.

But just how much of a difference can such systems make? ABB recently undertook an in-depth study to answer that question using its Decathlon DCIM in a comparison with industry standard systems. The results were compelling, but it's important to first understand what we mean when we talk about reliability in the context of a data center.

A few distinctions

Perhaps the most important distinction to make is between reliability and availability. The latter refers to the ability of a component or system to perform its function at a specific moment in time whereas the former adds the provision of performing that function over a given period of time.

The time factor is crucial because availability makes no distinction between systems that fail relatively often but are quickly repaired and those that fail rarely but remain down for longer periods of time. In fact, there are infinite combinations of Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR) that would produce the same level of availability for a given component or system, but there may be substantial value in having one that failed less often, for example, even if it meant taking longer to restore normal operations.

Another distinction we should make has to do with defining "failure." For the purpose of this study, ABB focused on a failure of the supervisory system, which may or may not precipitate immediate repercussions such as data loss, cooling failure or damage to specific pieces of equipment. The study was not intended to simulate real-world performance, and it should not be viewed as a predictor of actual performance in the field. Rather, like similar studies, it is intended simply to provide a common yardstick to evaluate the relative impact of one system or practice versus another.

Focus of the study

Historically, data centers have used separate systems to monitor and control UPS and energy storage, power distribution within the facility and environmental equipment such as HVAC systems. DCIM offers an alternative that puts all of these behind a single user interface. The ABB study, then, compared the Decathlon DCIM with the conventional alternative of separate controls for the energy management system (EMS), supervisory control and data acquisition (SCADA) system—also referred to as the power management system (PMS)—and the building management system (BMS). The study did not include functions for server-specific operations like virtualization and provisioning.

ABB also considered three hypothetical maintenance strategies:

- **Minimal** – maintenance only performed when the system as whole fails (i.e., an inability to detect component failures)
- **Moderate** – annual inspections with repair of any components deemed to be near failure
- **Aggressive** – repair of components at the time of failure (i.e., component-level monitoring assumed)

While it may seem obvious that the approach a data center operator takes to maintenance would have a strong influence over reliability, the reality is less intuitive. This is because the simple act of performing maintenance creates the potential for new problems to be introduced via human error. For the purpose of this study, ABB assumed that maintenance activities would precipitate a failure at the component or system level 1 percent of the time.

Finally, the study considered redundancy, comparing fully redundant and non-redundant versions of both Decathlon and the state-of-the-art system. Redundancy, like maintenance, is not a straightforward consideration precisely because of the interplay between these two elements. A fully redundant system creates the possibility to perform maintenance without interrupting data center operations, but as just noted, this also creates more opportunities for mistakes that could cause a failure. The figures in the appendix provide reliability block diagrams for each of three system configurations of increasing redundancy.

Study methodology

ABB used Monte Carlo analysis, a common time-based modeling technique, to simulate 1,000 scenarios in order to arrive at an estimate of what is most likely to occur under a given combination of system (Decathlon vs. state-of-the-art), redundancy (non- or fully redundant) and maintenance (minimal, moderate or aggressive).

The time-based aspect is critical for this analysis because it takes into consideration things like the availability of standby equipment, lead time for replacement components and required repair time.

Results

ABB's analysis showed that the Decathlon system was three times as reliable as the state-of-the-art system. Projected downtime was approximately one third less with the Decathlon system, which is to be expected given that we are moving from three systems to one. However, much larger gains were realized when redundancy was taken into consideration. This is largely attributable to the fact that most "redundant" systems currently in use actually duplicate functions only at a few critical points. The system overall, therefore, is not truly redundant end-to-end.

In the current paradigm (see Figure 1), the BMS, PMS, and EMS contain a total of 19 essential components (workplaces, servers, power supplies, I/O boards, etc.). Even the non-redundant Decathlon, however, only requires 6 essential components to provide the same functionality. The cost difference can be applied to make the system more redundant, for example by adding an extra workplace, server, controller, and power supply as shown in Figure 3. This vastly improves reliability using half the components of a conventional system.

Perhaps not surprisingly, the fully redundant Decathlon option produced a 74 percent improvement in reliability even under the minimal maintenance scenario as compared to the partially redundant industry standard system.

Under the aggressive maintenance condition, reliability was 88,000 percent higher with Decathlon than the alternative. Granted, such large improvements would be nearly impossible to achieve in the field due to a range of confounding factors, but even the moderate maintenance case produced a 210 percent improvement over the non-redundant Decathlon system and a 600 percent improvement over the most reliable alternative.

These results are compelling, but they should be seen as a starting point rather than an end in themselves. What is clear, though, is that fully redundant DCIM systems such as Decathlon offer a viable path to greater data center reliability.

For more information, please visit:
www.abb.com/decathlon-datacenters to contact your local ABB Decathlon for Data Center representative.

Appendix

The following diagrams illustrate increasing levels of redundancy in data center operations beginning with a traditional non-redundant configuration and moving to the partially redundant current state of the art and the more fully redundant Decathlon.

Figures in order:

1. “Controller Configuration Drawings”
2. “Red SotA TriSystem Drawing and RBD”
3. “Fully redundant Decathlon”

Figure 1: Traditional, non-redundant

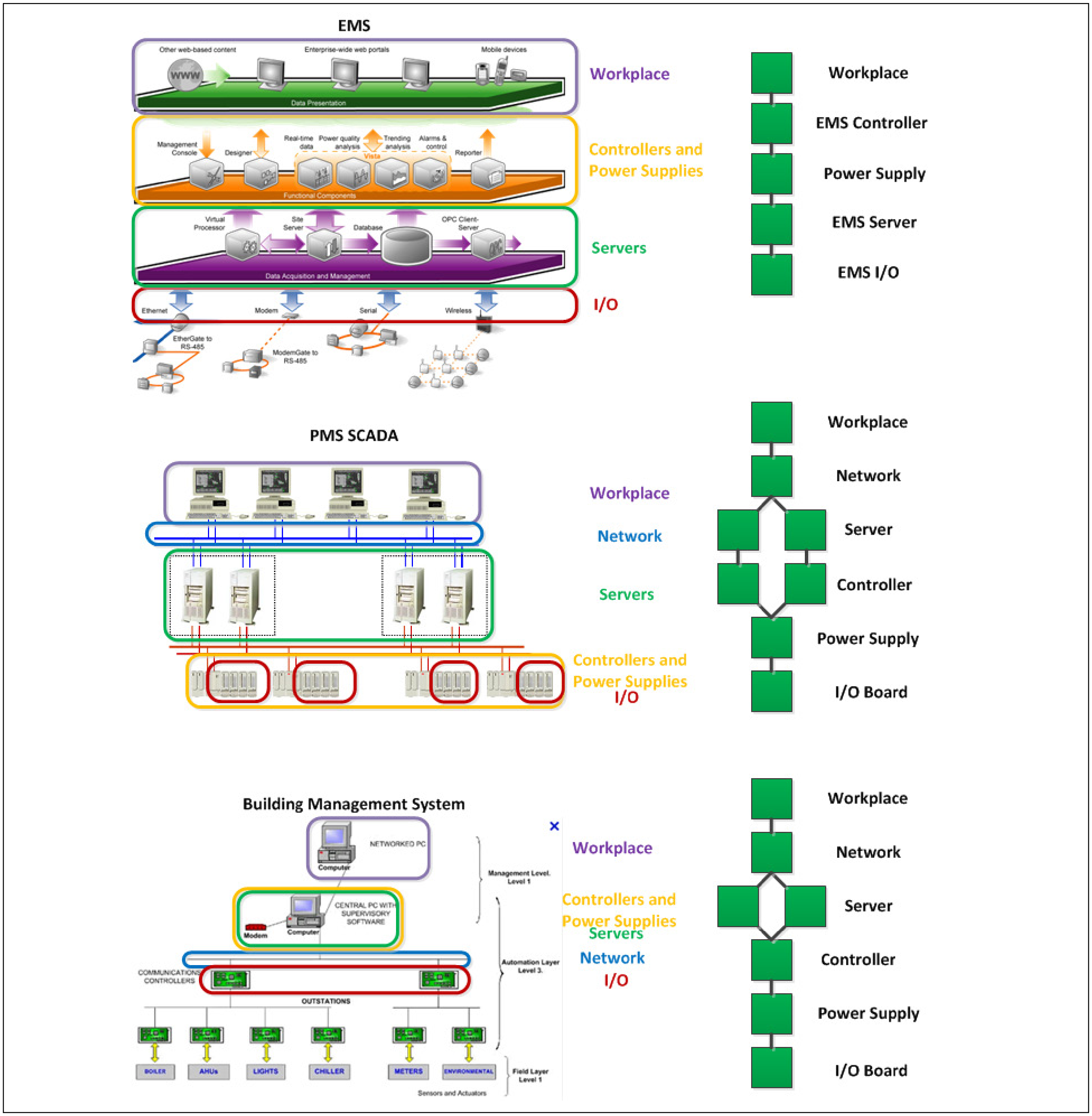

Figure 2: State of the art, partially redundant

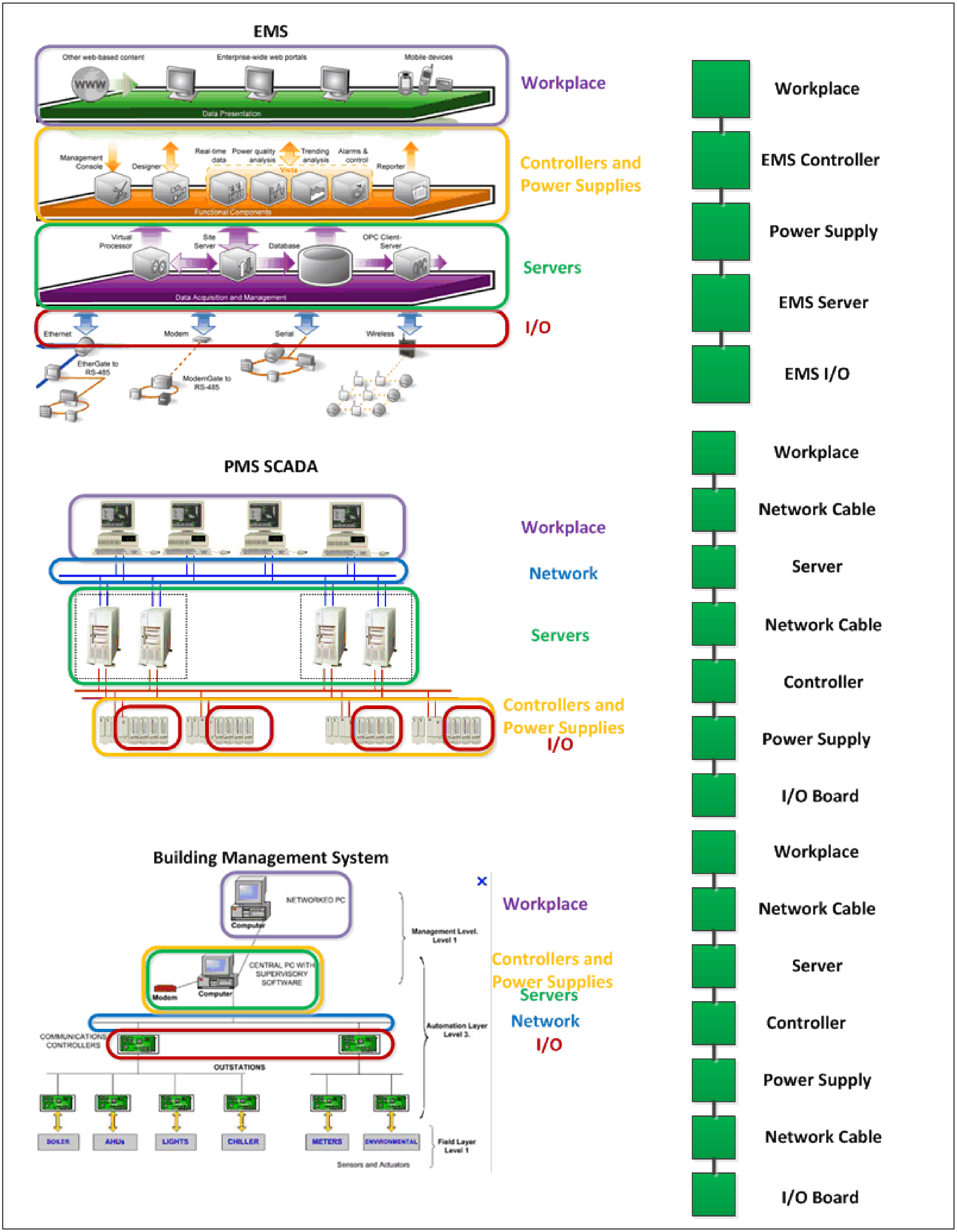

Figure 3: Fully redundant Decathlon