

System Redundancy in Power Substation Retrofits

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Abstract

In order to reduce power outage occurrences and duration, power grids around the world are increasingly retrofitting legacy power substations to be intelligent and automation. Due to the mission-critical nature of power substation applications, system redundancy is of the utmost importance to retrofit legacy substations.

System redundancy in power substation retrofitting applications can be deployed using either decentralized or centralized system architectures. In a decentralized architecture, network redundancy is ensured by multiple physical computers where each computer only runs a single operating system or application. In a centralized architecture, on the other hand, network redundancy is achieved by running multiple operating systems and multiple applications on the same physical server (i.e., server virtualization).

Although both decentralized and centralized architectures can be used effectively to provide retrofitted power substations with system redundancy, system integrators still need to be mindful of protecting against a number of control and management issues.

The Importance of Management-System Redundancy

Since replacing existing legacy power substations with newly-built automated facilities is generally impractical and cost-prohibitive, most substation automation applications rely on retrofitting or upgrading legacy equipment and integrating the relevant subsystems.

Substation automation retrofitting generally focuses on deploying intelligent electronic devices (IED) to make primary equipment intelligent, or serve as secondary equipment in substation bus networking, by converting formerly analog condition monitoring data into digitalized data or protocols for transmission, storage, or further computations by a computer management system. Therefore, the trend of substation automation is to collect and integrate the data from all of these supervisory subsystems into a powerful and secure control system.

Due to the mission-critical nature of power substation applications, even light data loss may severely disable the substation if the management system were to malfunction, resulting in disaster. Therefore, focusing on management system redundancy is of the utmost importance when retrofitting legacy substations equipment and subsystems especially in remote and unmanned control, data acquisition and supervision. Moreover, paying special attention to management-system redundancy when retrofitting for power substation automation can help

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you to minimize system downtime and allocate more resources to troubleshooting.

Control and Management Issues in Substation Redundancy

When retrofitting a power substation, system integrators need to overcome a number of control and management pain points.

1. First, when an unstable application crashes on a system, system errors will not only affect the application crashed, but may also hang the entire system and affect other applications running on the same computer.
2. Second, control and management issues can also arise when migrating legacy operating systems and applications. For example, many legacy substation applications were originally designed for older OS versions by a third-party vendor who may no longer be providing support for the original application to the end-user. Alternatively, the operating system itself may be too old (i.e., running on an outdated kernel). In both cases, simply upgrading the firmware may not be enough, or even feasible, to migrate these legacy software applications for use with the latest operating systems and hardware. Oftentimes, end-users may even need to commission a new application to be developed for the new OS.
3. Finally, system integrators also require a number of advanced features to maintain business continuity and increase uptime. In particular, distributed resource scheduling, high availability, fault tolerance, and storage migration.

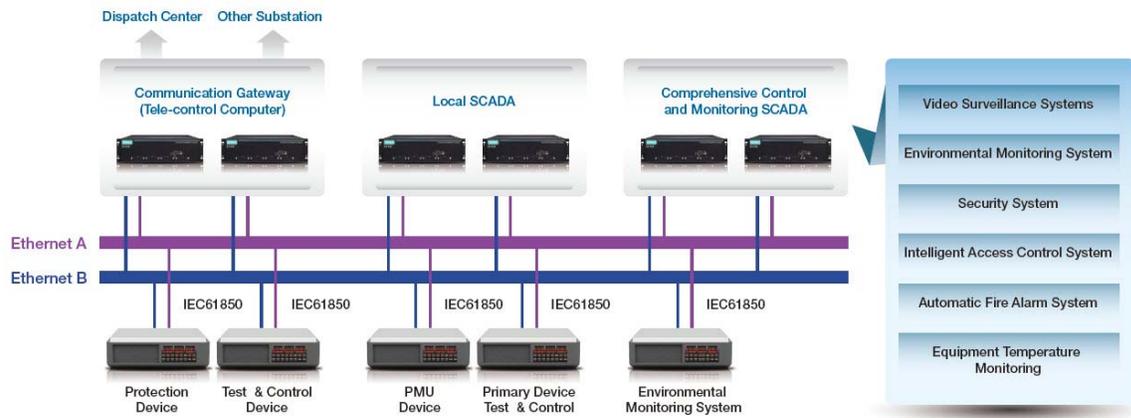
How System Redundancy Resolves Management Issues

Focusing on system redundancy in power substation retrofitting applications can resolve these system management issues by using either decentralized or centralized system management architectures.

Decentralization

In a decentralized management architecture, system redundancy is ensured by multiple physical computers where each computer only runs a single operating system and application. Since each computer on a decentralized system is only running a single application, an unstable application on any node represents a single point of failure in this multi-node network. These are clear benefits to running a single operating system or a single application on the same physical server.

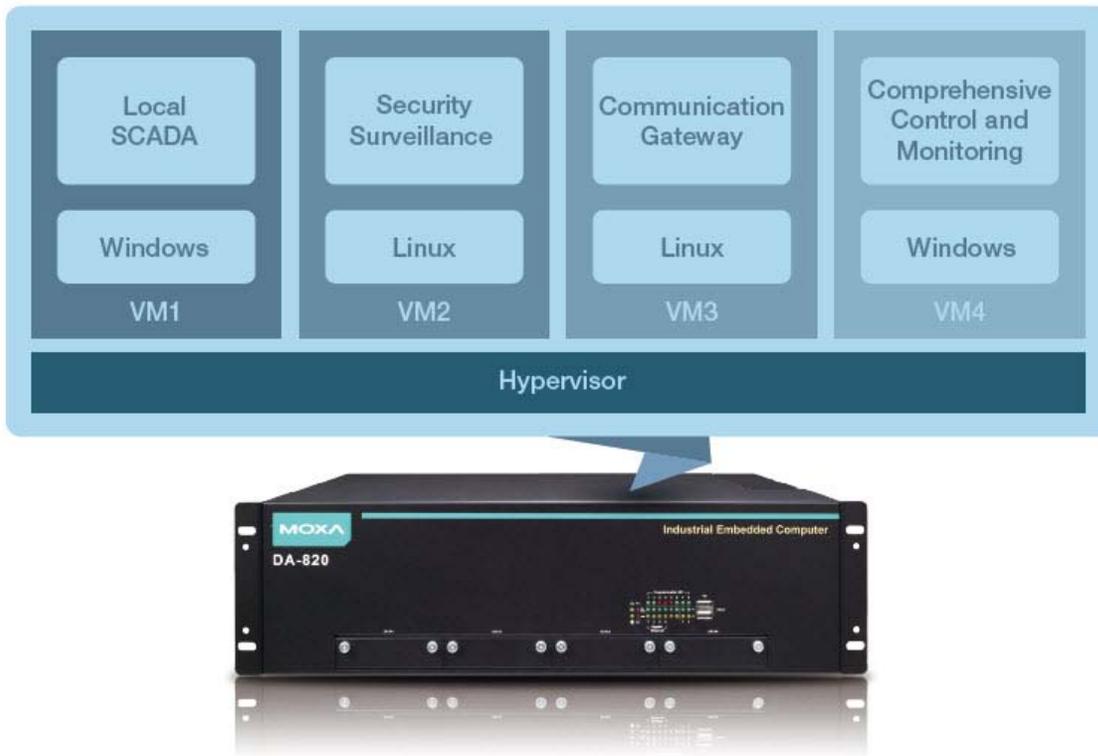
But to deploy one physical machine for each application, this hardware-based approach will clearly incur additional equipment and maintenance overhead. Moreover, a decentralized management architecture may not overcome the issues associated with migrating legacy operating systems and applications, due to the fact that new computer platforms usually do not support drivers for legacy operating systems.



Centralization

In a centralized management architecture, on the other hand, system management redundancy is achieved by running multiple operating systems and applications on the same physical server via virtualization technology (i.e., VMware). By running multiple operating systems and multiple applications on the same physical server, virtualization lets you reduce costs while increasing the efficiency and utilization of your existing x86 hardware.

1. First, instead of physically isolating applications on separate computers, server virtualization provides application isolation and removes application compatibility issues by consolidating many of these virtual machines across far fewer physical servers.
2. Second, integrated availability and fault tolerance protects all your virtualized applications. If a server or node ever fails, all the virtual machines (i.e., VMware) will automatically restart or continue on another machine, with no downtime or data loss. However, this virtual machine software feature is available only on the PC platform.
3. Finally, by virtualizing and encapsulating legacy applications, you can effectively extend the life of the legacy application, maintain system uptime, and finally replace ageing and out-dated equipment on your network with the latest hardware.



Conclusion

Upgrading legacy power substation equipment with IEDs and integrating the relevant subsystems is not a light-hearted task. Focusing on management-system redundancy in retrofitting power substations is the key to overcoming control and management issues. Effective management-system redundancy can be achieved by employing either a decentralized approach or a centralized approach to system redundancy. Although the choice between these two approaches to system redundancy are yours to make, note that running multiple operating systems and multiple applications on the same physical server will also allow you to reduce costs while increasing the efficiency and utilization of your existing x86 hardware.

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