

System integration oriented data center planning

In terms of ATEN's eco Sensors DCIM solution



1. Introduction

The reliability of an enterprise data center servicing either external or internal clients is central to service quality. A comprehensive data center contains scores of subsystems that rely on Environmental Management System (EMS) for efficient operation. Differing from the monitoring orientation of earlier EMS, a natural result of limited technology and concepts, current ones are more control focused. A complete system requires necessary monitoring (observe and control) capability to effectively manage every subsystem's operation for a stable and safe environment mandated by any information system operation. By addressing the full range of data center requirements, Aten's Global Infrastructure Service (GIS) provides overall planning services including electricity, air conditioning, fire fighting, security access, lighting and information equipment management, for the enhanced efficiency of electricity, air conditioning and space utilization. This in turn improves the competitiveness of IDC collocation and controls management costs at enterprise internal data centers. Aten's eco Sensors green data center solution integrates individual systems and improves efficiency on the basis of DCIM and open structure.

2. A brief review of structure in data center system integration

The EMS is centered on automatic control systems which, in turn, were derived from military and industrial automation as well as led to the introduction of intelligent buildings in facility management. Centralized monitoring systems have long been a standard feature of contemporary buildings which, has fostered EMS and data center technology. Restricted by technical barriers and installation costs, in the past small and medium data centers did not have EMS, which is not now the case. Instead of existing as an independent operating system the EMS is now integrated into information structure well known to most information personnel, thanks to a fall in installation costs, advances in technology and standards availability, as well as the emergence of network based EMS and the support of equipment that enables easy system setup by information personnel and data center maintenance technicians. Evolution of data center EMS is summarized below:

2.1 Equipment connection mechanism

Early EMS employed dry contacts to connect devices. That soon gave way to serial ports including RS232, RS485 and RS422, because devices that can be monitored through dry contacts are limited. Serial ports, still suffered from limited quantity and the performance of equipment integration and gave way to network connection and network protocols such as Modbus TCP, BACNet and SNMP. Modbus TCP enables conventional Modbus signals to run on TCP networks which is the de facto network in current networking environment. Simple Network Management Protocol (SNMP) is a standard network management protocol designed for information equipment management. Most network based EMS exist in contemporary data centers which support this protocol and are replacing conventional connection and communication measures. Even so, a lot of mechanic and electrical equipment still lacks SNMP support. It is most likely that dry contact and serial port connection will remain active for the foreseeable future.

Aten's energy saving EC2004 Energy Box and Energy PDU support dry contact input, serial port and SNMP protocol for easy systems integration.

2.2 Control mechanism

In the beginning control functions were made available with relays. That then changed to Direct Digital Controller, DDC and Programmable Logic Controller (PLC). The introduction of PLC brought sharp changes to automatic control with more diversified logical judgment, simplified systems structure, reduced costs and flexibility.

2.3 Management interface

Management information was first presented with a light indicator panel and switch based control interface. Along with improved information technologies, this has been replaced by the so called graphic control interface, e.g. Supervisory Control and Data Acquisition/Human Machine Interface (SCADA/HMI). The digital dashboard, an extension of graphic control interface, integrates messages into individual information systems for presentation and the easy access of system administrators.

2.4 System structure

Most systems formerly employed the centralized star structure. However, with the adoption of DDC and PLC, hierarchical system structure is being replaced by the client server one. To adapt to flexible and complex structures and different auto-control equipment provided by individual suppliers, OPC (OLE for Process Control) standards face the challenge of integrating heterogeneous devices and even platforms. A unified OPC server not only simplifies the system integration process with communication and data exchange platforms for individual equipment and systems, but also unifies the presentation of messages and status with interfaced SCADA systems and OPC clients. Aten's eco Sensors system supports OPC standards to integrate even more subsystems.

3. Site system integration

3.1 Power system

- Building centralized monitoring system (BCMS): This monitors the status of grid power, emergency power generator, ATS, oil levels and emergency power auto switches.
- Site environment monitoring system (SEMS): This monitors the status of distribution panels, grid power, UPS, power circuits, Rack PDU and power On/Off group automation controls.
- Integration of BCMS and SEMS: The SEMS graphic control interface may monitor site power configuration contained in BCMS.

Every rack within the site features two independent power circuits with respective PDU switches. Users can power on or off individual sockets, monitor PDU load, circuit and socket, and schedule the on/off latency of each switch. The latter is important because information systems are required to turn on and off in proper sequence or information service failure can follow. Users can set up different latencies

for individual types of devices to fine tune automatic equipment control and precisely monitor the load of individual racks with the help of Switch PDU.

3.2 Air conditioning system

- BCMS: This monitors the status of chillers, pumps, plate heat exchanger, cooling towers, ice water, ambient environment, automatic chiller switches and the energy saving auto control of the cooling water.
- SEMS: This monitors the status of blowers, ice water, leakages, environment, ambient environment, fans, air doors, external air energy saving auto control and heat channel close control.
- Integration of BCMS and SEMS: The SEMS graphic control interface may monitor site air conditioning configuration in BCMS and vice versa.

The energy saving air conditioning is designed with two features: (1) external air energy saving and (2) cooling water energy saving. Both systems cool down the computer room with external air in winter when it is cooler than what is required inside. The external air energy saving system leads outside air of proper temperature and humidity directly into computer room. The cooling water energy saving system cools the computer room and reduces the use of chillers by exchanging cooling water and ice water the with plate heat exchanger at given temperature conditions. Conventional chillers may employ either water or air chilling mechanisms. Air conditioning in the computer room is achieved by using conventional air conditioning systems with these two energy saving systems. It is more complex in system logic judgments and automation when compared with other types of computer room, with operational parameters requiring much fine tuning along with weather conditions.

Each rack within the computer room features independent temperature and humidity monitoring. Every row of racks and rack air conditioner features inbound and outbound air temperature and speed monitoring. Flow speed and the temperature of ice water are controlled. Ice water pipes within the computer room feature a leak detection band. All these along with eco Sensors can simulate and evaluate the impact of a single air conditioning equipment failure to fine tune the air conditioning system for more efficient application and operation. For the best energy saving effect, heat and cool channels in computer room are separated. Key areas in computer room are heat channel closed for optimal energy saving effects. In case of air conditioning system failure, heat concentration can increase fast as a result of closed heat channels, which may lead to rapid information equipments heat crashing. This is prevented by proactive and passive design. When the ambient temperature rises above a given threshold, the fire and smoke exhaust fans in the computer room start to force the

inflow of external air for cooling, normal operation and reduced risks in the computer room.

3.3 Fire system

- BCMS: This monitors the status of smoke sensors, fire alarms and the broadcasting system.
 - SEMS: This monitors the status of smoke sensors, gas fire monitoring, gas and smoke exhaust controls and air door controls.
 - Integration of BCMS and SEMS: The BCMS may monitor fire control configuration through its graphic control interface in the computer room.
- The computer room fire system is inert gas based. It is composed of modularized equipment with independent self-operation logic. The computer room's SEMS monitors the fire system's operation configuration rather than interferes with its independence. However, the computer room's external energy saving system may enable fans and air doors in specific conditions. This can lead to system conflicts and fail the fire system's designed functions. The environment control system is required to take this interlocking logic into account to avoid operation conflicts. Despite being equipped with an independent fire system, a fire is a critical and specific event that must be closely-connected with its counterparts in the whole building. This requires special integration design with the BCMS.
- The system is designed to start in gas and smoke exhaustion mode in the morning, to test gas the reliability of the smoke exhaust fans every other 10 days and recycle computer room air for better air quality.

3.4 Access control and video monitoring system

- SEMS: This monitors the status of smoke sensors, gas fire fighting, gas and smoke exhaust systems, and air door control. The access security and video monitoring systems for the computer room and the building are totally independent of each other. In contrast to other systems, the BCMS has no access to relevant configurations of its counterpart as the latter is the most critical core area and the data contained in access security and video monitoring systems is too sensitive to leave to building security officers.
- The BCMS and SEMS employ the same access card with independent systems. The computer room's key entrance/exit doors are equipped with biometric access controllers for personnel identification. They are accompanied with video and event monitoring systems where optional events may be integrated into the EMS. The access control and video recording systems are independent from each other for enhanced system security.

3.5 Overall environment control and graphic control systems

The computer room employs the SNMP protocol based eco Sensors management system which resembles the structure, easy setup and installation of general package software. Information personnel can set up the graphic interface and connect the SNMP environment control devices with the help of the user manual. This is a big improvement over conventional EMS's installation and implementation as the latter still mandates PLC bridging and integration. The eco Sensors system not only integrates the monitoring of conventional systems, but also manages computer room status including asset status, equipment location and space allocation and utilization. Aten's KVM product helps to manage servers in computer rooms. It logs every piece of equipment in the computer room including equipment dimensions, power consumption, brand, model number and serial number, as well as the MAC address of each network equipment. This helps the system monitor the load of each rack, space requirements and even weigh distribution as well as manage individual equipment more conveniently. Its graphic interface enables more intuitive relationships and easy management.

The eco Sensors system enables users to set up different policies against abnormalities of individual grades and types. On the basis of the severity of an event, the system can be configured to inform personnel of different authorities or define different handling processes and methods for more effective management with refined measures.

3.6 eco Sensors and building central control system integration

The eco Sensors system integrates with BCMS by exchanging information with BMS through SCADA open protocol.

The computer room eco Sensors system integrates with BCMS by connecting to monitoring workstations, by obtaining its IP address from Ethernet networking switches, to retrieve PLC data on each floor contained in their real-time database.

The computer room eco Sensors system and BCMS are designed with independent permissions. The EMS retrieves essential BCMS data for monitoring rather than controlling. The EMS opens selected interfaces and monitoring equipment for BCMS. Its standard operating procedures contain joint process and emergency response solutions with the control center for secured computer room operations.

4. Conclusion

With open structure, easy connection to individual subsystems and its PDU, Energy Box and KVM products, Aten's eco Sensors DCIM management system helps to manage computer room information equipments and infrastructures effectively. DCIM has been accepted as one of the most important issues in data center management. However, some myths remain, for example that DCIM costs heavily in hardware and software. In reality, users may manage computer room power, air conditioning, cool/hot points and space and resources effectively with proper planning and relatively small outlay on Aten's eco Sensors data center management software along with its eco PDU and Energy Box hardware. To further improve infrastructure management efficiency, this system improves computer room security and reliability as well as instant information and simulation and decision making proposals against future requirements. Aten's DCIM solution suits data centers with both IDC and SME. It is the ideal choice for any data center with DCIM needs.