WHITE PAPER

Enhanced Operating and Cost Benefits Achieved with Motorola ACE3600-Based Water SCADA Systems

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Abstract

Efficient monitoring of water distribution networks have long been a challenge for management, even in countries with a well-developed infrastructure and good operating practices. Improperly managed water networks might result in an increased cost of supply, insufficient supply of potable water, inconvenience, unsatisfied customers, and more.

Supervisory Control And Data Acquisition (SCADA) solutions may significantly improve the situation. These measures have to be complemented with water conservation programs adapted at minimizing excessive water usage. These initiatives should be combined to form a "water strategy" for conserving this valuable resource and making it available at an affordable price.

Use of advanced Remote Terminal Units (RTUs) and suitable types of communication will further enhance the system performance compared to using Programmable Logic Controllers (PLCs) or simple RTUs. The integrated features in the advanced RTUs will not only enhance the financial benefits but also lead to more efficient system maintenance, faster handling of field problems, more satisfied employees, and enhanced public image of the utility.

The Motorola ACE3600 RTUs perform unique system maintenance functions remotely that allow instant detection of application programs and communication related problems, remote uploading and downloading of application programs, configurations, and more. These capabilities help reduce the number of trips to remote sites since most maintenance functions can be performed remotely and thus help minimize the Total Cost of Ownership (TCO).

Investment Considerations and Calculations

While considering the TCO and Return on Investment (ROI) calculations for a system, the first step involves determining the real cost components resulting from owning and operating a SCADA system. The annual costs are typically composed of three main components:

- ***Capital cost:*** This calculation is based on the interest rate of the initially invested capital, but also includes future investments in improvements and upgrades. Capital cost is just one among many parameters to be considered but not necessarily the most important one.
- ***Annual depreciation:*** This is related to the purchase cost of the equipment, the calculation is based on the expected lifetime of the equipment (e.g. 15 years), as well as tax write-off regulations. It is important to keep in mind that higher quality products last longer and therefore depreciate over a longer time period.
- ***Operating costs:*** This includes the salaries allocated for the dedicated manpower, training of operators, field transportation, maintenance costs, field repairs, etc., which can be attributed to the system operation. A SCADA system is expected to reduce this cost.
- ***Unaccounted for Water (UFW):*** This financial factor refers to loss of income due to lack of supply during outages, loss of billing revenue due to incorrect billing, water losses during pipe breaks, loss of income due to fraud, and other billing related issues.

Nowadays utilities want to enhance the level of service and operate the water network in a more efficient, convenient, advanced, and modern way. A request to improve the grade of service may, for example, be dictated by local country legislation which is overseen by the “utility watchdogs” and/or the city mayor. They may also be interested in boosting the public confidence and customer satisfaction, as well as demonstrating to the public that actual savings are being pursued, especially prior to privatization of the public sector.

Utilities often make decisions to purchase their system in a step-by-step process. This approach makes sense, since modular SCADA systems can be built with a lower initial budget and allows for adjusting definitions of the current and future needs prior to starting a significant expansion program.

SCADA Cost Contributors

Integrating and operating a SCADA system involves the use of computer hardware, instrumentation and sensors, electrical control panels, software programming, data communication, equipment and infrastructure, consulting fees, and system installation and commissioning. Careful selection of these components may help to make the system expandable, upgradeable and also affordable.

- ***Hardware instrumentation:*** Although investment in computer hardware is neither the most critical nor the most expensive part, it is considered the "heart & soul" of the system. The reason is that people consider the computer hardware as the “main thing” that makes the system ”tick”.
- ***Computer operating system and application program:*** Maintenance of the Master Control Center (MCC) software program is required, since vendors may release enhanced versions, which could be incompatible with utilized application programs.
- ***Communication infrastructure:*** The data communication data network used for the SCADA can be viewed as the "nervous system" of the system conveying information to the “brain”. Therefore, selecting a suitable and reliable type of communication medium and data protocol is mandatory.
- ***Field instrumentation:*** These devices are often built into the equipment needing to be monitored or controlled. Sensors and controls linked to RTUs must be reliable and accurate in order to make the SCADA system function properly.
- ***System installation and commissioning:*** Professional installation of the system components with “ease of maintenance” in mind is as important as any other step when integrating the system. This work can be performed by the utility or by an outside system integration firm.
- ***System maintenance costs:*** These include the costs of all repairs and preventive maintenance. The overall figure can be broken down into several segments of the installed system. Maintenance of the communication equipment should be considered as well.
- ***Trained operators and technicians:*** In order to operate these systems, utilities must employ well trained operators who typically work in 3 shifts. This cost is associated with periodic travel to remote sites for reviewing the condition of remote sites. If the equipment is more reliable, the amount of travel and related costs can be reduced.
- ***Other cost factors:*** Field installations as well as sensors must be tested and calibrated periodically. One major advantage of smart RTUs is that they allow you to perform these functions remotely using software managed calibration methods.

Reduced Cost of Ownership with ACE3600

This can be achieved by selecting the most suitable hardware and software. The ACE3600 RTU may interface with a wide range of sensors, PLCs and other RTUs:

- ***Communications infrastructure:*** Implementing the most optimal, reliable, secure and cost-effective data communication for each segment of the system allows for minimizing the number of repeaters and minimizing the cost of maintaining these remote sites.
- ***Operators and technicians:*** Trained personnel will be able to perform complete remote programming and diagnostics as well as reliably detect even the most rare, or unexpected problem. This helps minimize field trips and allows performing the repair by trained technicians.
- ***System maintenance costs:*** Use of high quality RTU hardware, power supplies, batteries, and communication modems that can withstand the harsh outdoor environment helps to reduce the cost of RTUs and communications repairs.

Summary and Conclusions

Use of SCADA for management of water networks results in many intangible benefits, which are as important as the direct financial improvements. If only the quantifiable benefits are taken into consideration, investment in such systems might not justify the expenditure. However, if non-quantifiable benefits are also included, SCADA systems more than justify the investment.

Use of high quality RTUs and communication solutions, such as the Motorola ACE3600 system, allows for selecting the most optimal communication network for each section of the network, implementing communication network redundancy, completing remote diagnostics and maintenance of the RTU application programs, helping to reduce the Total Cost of Ownership, enhancing operating and cost benefits, and improving public satisfaction.

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Motorola ACE3600 RTUs Enhance System Performance

(Appendix to White paper)

- ACE3600 RTUs support a wide range of data communication media such as Analog and Digital Conventional and Trunking communications in the VHF, UHF and 800 MHz ranges. Further more these RTUs are certified to operate over Motorola Canopy and ASTRO IV&D wireless IP networks, microwave, satellite, fiber-optic and telephone line modems, etc.
- ACE3600 RTUs operate with a range of 3rd party radios and data modems operating over wireless and physical media, microwave, satellite, spread spectrum, power line carrier cellular networks. These units may interface via one of the five ports integrated with the ACE3600 CPU.
- ACE3600 RTUs run the application program separately from the data communication process. This, process supported by the Motorola Data Link Communication (MDLC) protocol allows “on-the-fly” modification of applications and parameters, without interrupting the RTU operation.
- ACE3600 RTUs feature transparent communication, while data routing, error detection and correction, remote program uploading and downloading, remote diagnostics are supported with the MDLC seven layer (based on OSI/ISO based stack) protocol.
- ACE3600 RTUs perform reliable Peer-to-Peer (RTU-to-RTU) and RTU-to-Master control center communication. This capability is supported by the MDLC Network layer and allows extending the geographical coverage for those RTUs which do not have direct link with the control center.
- ACE3600 RTUs perform Store and Forward (S&F) operation using a pair or single radio frequency. Prior to retransmitting the data, the repeater verifies it for data integrity. If an error is detected, it is corrected prior to retransmission using a packet based retry mechanism.
- ACE3600 RTUs are truly optimal for reliable and secure SCADA communication (hardware, software, protocol) and are ready to be upgraded with encryption (using preprogrammed keys), which helps to assure system wide operating reliability and data security.
- ACE3600 RTUs have built in capability to perform data encapsulation or emulation of other vendors' data protocols, allowing the MCC to communicate with a wide range of RTUs, PLCs and Intelligent Electronic Devices (IED) over the network using their native protocol.
- ACE3600 RTUs have built-in capability to send time-stamped messages. They also allow performing over-the-network RTU clock synchronization simultaneously with normal operation. This feature allow implementation of event analysis utilizing time-stamped data.
- ACE3600 RTUs have the capability to link between two or more different physical wireless media. This allows extending the geographical coverage via multiple nodes, while selecting the media which is the most optimal for SCADA-Data communication for each specific segment.
- ACE3600 RTUs have the capability of operating over the wireless network in interrogation, report-by-exception and report–by-event modes. When simultaneous events/reports occur, these RTUs have a built-in capability to quickly and reliable clear that condition.
- ACE3600 based data communication reliability is assured by checking the data integrity for each segment. Upon detecting an error, these RTUs resend only the missing/incorrect packets. Upon receipt of a complete/correct message, it is reconfirmed to the sending site.
- ACE3600 RTUs seamlessly interface with a wide range of MCC units supplied by leading vendors worldwide. This can be done via RS-232 serial ports, Ethernet using MDLC, MODBUS, DNP 3.0 and OPC over TCP/IP, and a range of other SCADA protocols.

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