# SCADA Talks

By Ian Wiese

**The flow of information aids the flow of water down under**

When Western Australia officials established the government-owned Water Corp. of Western Australia (WCWA) as a commercial enterprise in January 1996, they encouraged the large water utility to act in a commercial manner.

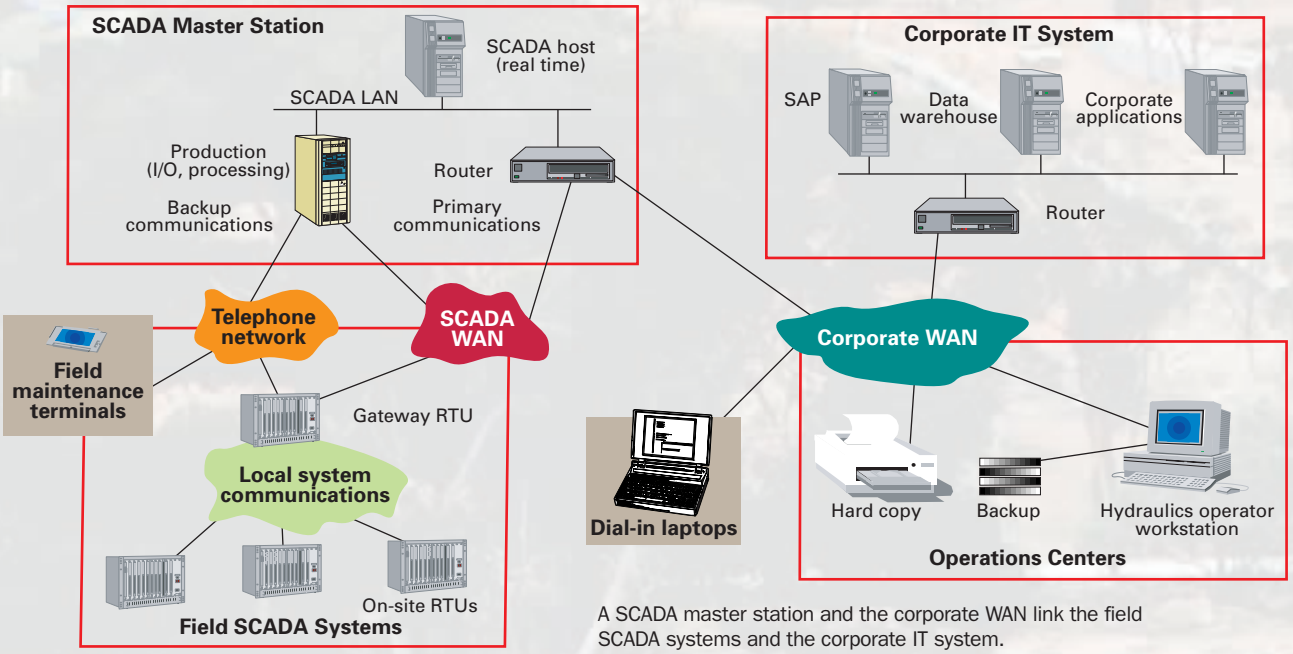
To that end, WCWA uses information technology (IT) systems extensively. It recently installed SAP R/3, implemented a sophisticated customer billing system, uses geographic information systems technology, and operates a corporate data network of PCs connected via a wide-area network (WAN) extending across the state to all manned locations.

Meanwhile, treatment plants throughout the state are becoming more sophisticated, with modern distributed control systems (DCSs) being used in many cases to control the processes. Increasing demands, growing consumer sophistication, a changing regulatory environment, and commercial pressures are forcing the upgrade of the supervisory control and data acquisition (SCADA) systems. The latest challenge to their commercial success is to link the SCADA systems with the corporate IT systems.

## Integration on a Grand Scale

The challenge is exacerbated by the sheer scope of the enterprise. As one of the largest water utilities in the world, WCWA provides water-related services across a state that makes up nearly a third of the Australian continent, serving 639,000 homes and 48,000 businesses in 230 cities and towns.

In an area greater than that of Alaska, Texas, and California combined, WCWA operates 243 water treatment plants, 73 dams and reservoirs, 779 water wells in 106 well fields, 107 service reservoirs, 91 wastewater treatment plants, and 635 water tanks and towers. It has more than 17,000 miles of water mains and nearly 7,000 miles of sewers. During the past year, it supplied 86 billion gallons of water.




A SCADA master station and the corporate WAN link the field SCADA systems and the corporate IT system.

The sophistication of the SCADA systems varies with the locale of the water system. The Perth metropolitan water and wastewater systems, for example, use modern SCADA and DCS systems to operate the metropolitan water distribution network, the major water and wastewater treatment plants, and the wastewater collection systems.

Outside of Perth, the corporation uses a variety of technologies to control and operate its facilities. Due to the small size of the usually unmanned rural systems, it can't justify the more expensive solutions such as those applied in Perth. Communicating with these often remote locations is difficult and expensive. Maintenance is a particular problem because of the remoteness and problems with skilled staff availability. The legacy of a strong regional organizational structure means differing standards and technologies have been applied around the state.

## Stand-Alone SCADA Won't Do

WCWA—and the Water Authority before it—introduced SCADA at a number of locations around the state in the past 10 or more years. These systems almost always concentrated on providing control functionality and alarms, but data from the SCADA systems has not been made available to corporate IT systems for many reasons. The principal issues have been technical communications problems, the differing standards both among different SCADA systems and between those systems and the IT systems, and the fact that these SCADA systems were designed and managed only as a tool for day-to-day operations.

Early SCADA applications introduced at specific sites often solved single problems such as reducing power cost or improving control of a particularly complex operation. As time passed and experience installing SCADA systems broadened, the scope widened into implementing regional SCADA systems. This regional concept developed further into a plan to integrate all SCADA systems and DCSs across the state into a single, centrally managed and operated SCADA system.

The new SCADA system will be connected statewide via the WAN, allowing access to the SCADA system from any PC on the corporate data network. This access will allow flexibility in choosing the location from which to operate the individual systems.

A number of obstacles had to be overcome before an integrated system became feasible. The WCWA staff set out to identify and resolve those issues, determining that the adoption of open programming and communications standards was a prerequisite to this project's success.

## Building on Open Standards

After looking at the market, the corporation chose distributed network protocol (DNP) 3.0 for both local and wide-area SCADA communications, with the latter carried over user datagram protocol/Internet protocol (UDP/IP). It also chose IEC 1131-3 for remote terminal unit (RTU) programming. Other Australian water utilities also saw the need for the water industry to reduce its dependence on proprietary systems and have subsequently adopted the DNP 3.0 and IEC 1131-3 standards.

Ci Technologies' Citect software was chosen as the SCADA master software because there were no real master software standards, and a large number of competing suppliers widely use and supply it in Australia. WCWA is watching the American Water Works Association's adoption of the utilities communications architecture standard because the underlying object modeling approach will assist integration of SCADA data into corporate IT systems.

There were many other pieces in this large, complicated integration jigsaw puzzle, including the development of a communications architecture that separates the SCADA local-area network (LAN) and the SCADA master communications WAN. The local communication is generally provided by a radio at each site in a setup using a talk-through radio repeater. A variety of radio systems are normally used for the LAN. Modern digital radio systems allow communication speeds up to 9,600 bits per second in this part of the network.

The SCADA WAN provides the communications link between the central SCADA server in Perth and a LAN, which can be thousands of miles away, via a variety of communications media. All but the most remote areas are finding frame relay attractive. In the most remote areas, VSAT satellite technology is being tested. The development of a "gateway" to bridge the two networks is important. DNP 3.0 carries out protocol encapsulation and routing. UDP/IP is part of the suite of protocols used by the Internet and allows general-purpose communications networks and equipment to be used and shared.

Another important initiative was to identify and adopt standard configurations for different devices and develop standard techniques for the automatic control of these systems. The control philosophy adopted allows the local SCADA RTUs to operate autonomously and communicate directly with one another to control the system.

For example, a tank RTU can directly command a transfer pump station RTU to start a pump. The SCADA master server sets performance targets and receives data and alarms. This philosophy of autonomous local control allows the control system to continue working in the event of lost WAN communications and prevents remote towns from running out of water. The local control is quite complex and involves rules-based expert systems. The standard technique used for this automatic control is to break down the system into independent zones, each of which can be controlled by a rules-based expert system (see the figure on p. 34).

## Around-the-Clock Reliability

Increasingly using the corporate IT communications infrastructure to carry both SCADA operator terminal traffic and data has changed the architectural landscape. The joint use of the communications WAN and PC network removes the need for SCADA to establish a parallel network. However, it also means that the corporate WAN must be upgraded to provide reliable 24 by 7 operations, and this represents some fundamental changes in philosophy and design of the corporate WAN. The entire SCADA system is being designed to achieve 99.9% availability through the use of extensive redundant hardware.

During design, the concept has evolved from simply providing PC access across the corporate WAN with a separate data collection network for SCADA data toward a fully shared system. This substantially reduces costs and provides a better, faster, more reliable service for all parties. Recent advances in telecommunications services available in rural areas have introduced frame-relay communications links to communicate with all but the most remote towns. These remote sites will probably use VSAT satellite technology that allows installation of a satellite dish at the remote gateway's site; the VSAT service provider delivers the data via a satellite hub in Perth.

Developing standards for I/O configurations, control strategies, screen design, database, tag naming, and so on, as well as

enforcing these standards, is essential to ensure large-scale rollout of the integrated SCADA system. With potentially 3,000 sites to cover, custom engineering would not result in a scalable solution or one that could be implemented in any useful time frame. Adopting standards also dramatically reduces costs. Increasing pressures such as environmental performance, regulatory reporting, and the commercial demands for more efficiency are causing the corporation to accelerate the program. Current plans are for full deployment in four to seven years.

## A Wide Range of Benefits

The desire to integrate data into the corporate IT systems motivates this approach. Centralizing data at a single point will ease its capture into software applications such as those used when planning capacity upgrades. Information about the performance of existing assets and customer demand patterns is vital to the correct staging and sizing of facilities and equipment upgrades. The corporation has sophisticated hydraulic models of each water supply system throughout the state, and data from the SCADA systems will be invaluable in calibrating these models.

Accurate reporting to regulators such as the licensing, environmental, and water resource allocation regulators is vital for the corporation's continued operation. Automated reporting of operating performance is an essential tool for managing operations better. Condition monitoring and assessment and reporting of this data is important to improve the corporation's performance in these areas.

To anticipate yet-to-be-determined needs, the SCADA data will be transferred to a data historian for archiving. The data historian facility will be available online, providing tools such as spreadsheet links enabling use of the data in day-to-day activities.

Beyond the myriad benefits to the corporation at large, the move to SCADA system standardization was proved at the local level when Cyclone Vance struck the city of Exmouth in March. The storm's 165 mile-per-hour winds, the highest ever recorded in Australia, wiped out the year-old system that ran the well field for the town's only water supply. Within two weeks, a replacement system was up and running.

According to Allan O' Neill, business support services operations planning manager, the corporation "had a vision of getting to the stage where telemetry and SCADA systems could be set up using modules." The vision became a reality when a system developed for another site was brought to Exmouth and "assembled like an [Erector] set." **IC**

**ABOUT THE AUTHOR**

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