

Aluminium Smelter Benefits from New Approach to Networking



One of world's largest aluminium smelters uses Ethernet-to-the-Factory to improve manufacturing efficiency.

EXECUTIVE SUMMARY

Customer Name: Emirates Aluminium Company Limited

Industry: Manufacturing

Location: United Arab Emirates

Number of Employees: 1600

Challenge

- Improve plant efficiency
- Achieve lower cost of ownership
- Meet demanding greenfield project timescales

Solution

- Cisco and Rockwell Automation Ethernet-to-the-Factory
- Cisco Advanced Services
- Cisco unified communications

Results

- Optimized plant production
- Reduced capital and operational costs
- Increased business agility

Challenge

The Emirates Aluminium Company Ltd. (EMAL) was formed in 2007 to construct an aluminium smelting plant at Taweelah, in the Emirate of Abu Dhabi. It is a \$US5.7 billion joint venture between Dubai Aluminium Company and the Mubadala investment company.

The initiative is part of a regional trend to diversify away from oil and gas production and is the largest industrial project in the United Arab Emirates outside those traditional industries. At full capacity, the plant will produce 1.4 million tonnes of aluminium annually, making it the world's most productive single-site aluminium production facility.

Aluminium smelting companies face a changing, competitive business environment. Customers are more demanding, and globalization means that customers can choose from suppliers worldwide. Commercial success increasingly rests on efficient manufacturing.

Smelting is a complex process, comprising production areas that, while operating as separate units (power, material handling, carbon, reduction, and cast house), are interdependent. A combination of batch, semibatch, and continuous processes creates a dynamic environment, where changes in one part of the process can have a significant effect on others. Problems in one area can even bring the entire operation to a halt, resulting in high costs and materials loss.

Energy needed for the smelting process accounts for 70 percent of operating costs. From the beginning, EMAL designed the smelter to maximize production while minimizing power consumption and achieving low total cost of ownership.

Achieving these goals demanded a control network for smelting operations, as well as the ability to share control data with manufacturing execution systems (MESs) and the company's enterprise resource planning (ERP) system. Although each production area needed its own discrete network to isolate it from problems in any other area, overall efficiencies could only be maximized by sharing information. The challenge was how to converge these disparate networks without compromising resilience and security.



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Steven Mulherron
Industrial Plant Networking Specialist
KEOPS Technologies Inc

Solution

EMAL knew that the traditional approach to manufacturing plant networking would not deliver the truly integrated, but discrete, model that the company needed. In building the plant, EMAL brought together experts from around the world, including IT industrial solution provider KEOPS Technologies Inc, a company specializing in MES, supervisory control and data acquisition (SCADA), and industrial networks, and BBA, an engineering consultancy with particular expertise in automation and control networks. In meeting EMAL’s needs, the companies looked to take advantage of the strategic alliance between Cisco and Rockwell Automation.

Formed in 2007, the alliance has created joint reference architectures for global manufacturers based on best practices and a common technology view. The proven and validated architectures help ensure maximum operational efficiency and production uptime, while also improving security and visibility between the office and factory environments.

“Being able to combine Cisco and Rockwell’s best practices and expertise in IP networking products and services was of a great advantage to our project team,” says Steven Mulherron, industrial plant networking specialist at KEOPS Technologies. “This, complemented by KEOPS Technologies’ aluminium industry know-how and BBA’s industrial automation expertise, contributed to the successful development of the final solution and went a long way in de-risking the project for EMAL.”

The Cisco Advanced Services Team were commissioned to create a high-level network architecture. An intensive series of meetings and workshops enabled Cisco network architects to understand the plant’s special requirements and develop an innovative solution using the network edge, commonly called demilitarized zones (DMZs).

“DMZs are normally used to protect corporate networks from Internet threats,” says Sylvain Boily, automation manager for BBA. “Cisco Advanced Services were able to take this enterprise best practice and show us how we could use it internally. This application of DMZs within a manufacturing environment is ground breaking.”

The design effectively offered EMAL the best of both worlds: on the manufacturing side, a distributed design focused on high availability, the security of edge devices, and investment protection of factory automation and plant systems; and on the corporate side, a centralized design delivering controlled end-to-end information flow, simplified management, and lower total cost of ownership.

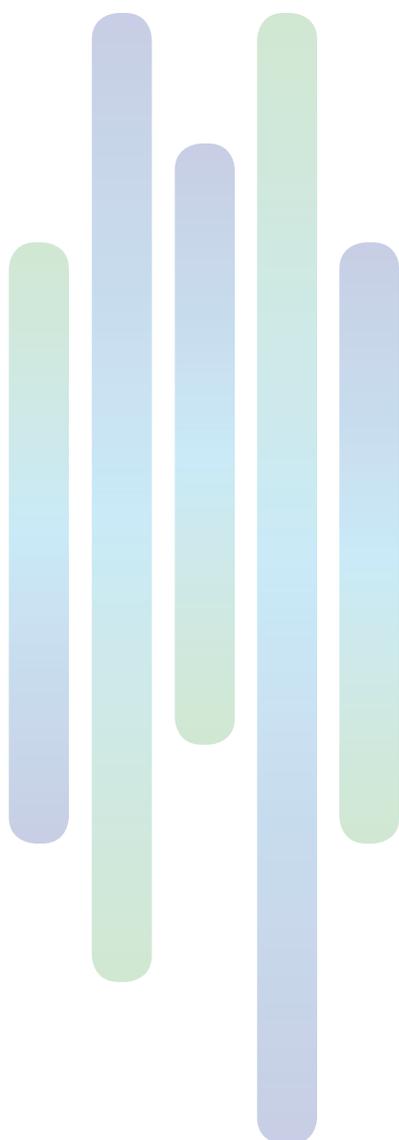
The Cisco® and Rockwell Ethernet-to-the-Factory architecture implemented by EMAL includes Cisco Catalyst® 3750 and 6500 Series Switches, which form a 10 Gbps fiber network, connecting the administration building and each of the four production areas. These switches connect to dual-facing Allen-Bradley Stratix 8000 industrial Ethernet switches (running Cisco IOS) in each production area, which link to Rockwell Automation controllers, drives, Programmable Logic Controllers (PLC), Human Machine Interfaces (HMI), and engineering manufacturing and SCADA systems. Each area has a DMZ, with twin firewalls, which acts as a “neutral zone” where suspicious traffic can be identified and isolated before it can penetrate networks, servers, and systems.

The networks were installed by a Cisco partner according to a very detailed, “low-level” design devised and documented by Cisco Advanced Services. The plan included everything needed to install the infrastructure, from device configurations to testing checklists.

Post installation, EMAL also took out Cisco’s SMARTnet technical support service, providing proactive network monitoring and direct, anytime access to Cisco engineers and technical resources.

“We have created a network for now and the future. It has everything we need to move information to where we want it. There is no limitation on what we can do. Redundancy, security, traffic control; everything is there.”

Sylvain Boily
Automation Manager
BBA



Results

Taking an architectural approach is enabling EMAL to significantly improve plant efficiency. Information that previously was not available, either because it was isolated or because it relied on manual collection, can now pass between the plant and the office, enabling schedules to be adapted and potential barriers removed.

“This type of Ethernet-based network is the future, and everything is heading that way,” says Mulherron. “The new generation of systems being developed to improve plant efficiency means that it is important that those plants have a robust, flexible, and scalable network architecture in place to make best use of them.”

The use of Commercial Off-The-Shelf (COTS), Ethernet-based technology not only helps avoid any cost premium associated with proprietary systems, it also provides investment protection in terms of future developments.

The proven Cisco and Rockwell Automation Ethernet-to-the-Factory architecture has enabled EMAL to take advantage of a standardized approach while meeting the particular needs of the plant in terms of discrete, yet integrated operations.

EMAL’s confidence in moving to an innovative architecture was strengthened by the support given by Cisco Advanced Services. “It gave us the opportunity to work with some very skilled and senior people in the region,” says Mulherron. “We faced aggressive timelines and we definitely saw that experience come through to help us meet our deadlines. This was the risk management and commitment we were looking for when we first invested in Cisco.”

The more widespread use of IP networking is also reducing ongoing maintenance and support costs, with field personnel able to carry out simple tasks supported by a more skilled, central IT team. Secure wide area connections also make it possible for automation systems vendors to provide direct, expert third-level support to better avoid or minimize downtime.

EMAL has a highly-available platform for all the plant’s operations, both now and in the future. In addition to establishing new levels of connectivity between devices and controllers, the scalability of the network provides a robust and flexible foundation on which to build.

“We have created a network for now and the future,” says Boily. “It has everything we need to move information to where we want it. There is no limitation on what we can do. Redundancy, security, traffic control; everything is there.”

Next Steps

EMAL has already started to build on its new foundation, introducing new services and facilities as it needs them, while optimizing its investment in the network and increasing business agility.

Cisco IP telephony runs over the network, and a Cisco wireless network has been installed in the cast house. This means that staff with hand-held scanners can better track and manage the logistics and transportation of aluminum in the yard to help ensure timely delivery of product to customers.

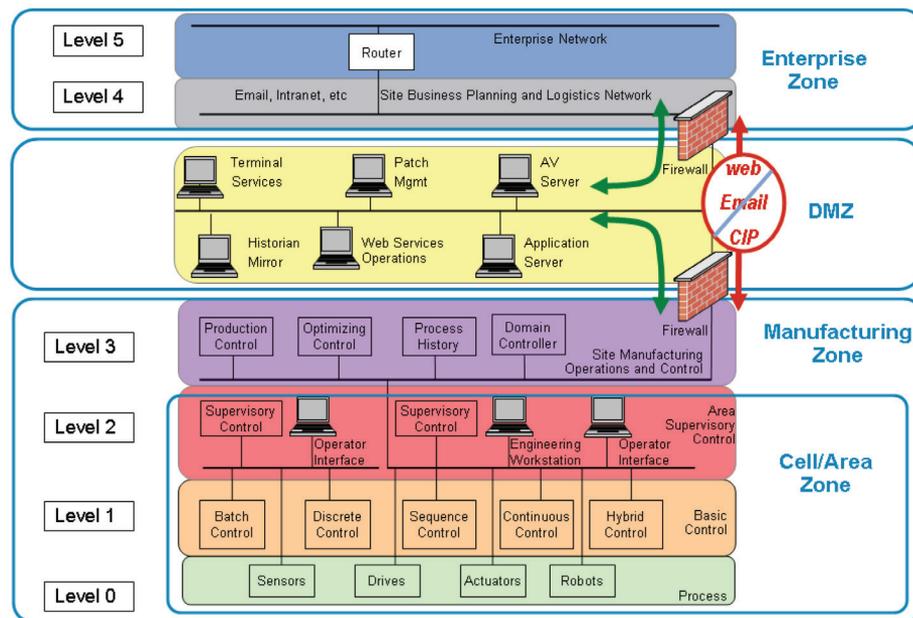
Other solutions being evaluated include an IP-based surveillance system that could integrate video monitoring with other techniques, such as analytics and access control, to provide a plantwide security solution. Also under consideration are Cisco Digital Signage and Cisco TelePresence™, which are seen as a potentially effective means of enabling better collaboration between stakeholders in the EMAL project, including senior executives in Canada and Australia.



Technical Implementation

Figure 1 shows how EMAL has used the Cisco and Rockwell Automation Ethernet-to-the-Factory open-standards architecture to bridge traditionally separated manufacturing and enterprise domains. The company has effectively merged the enterprise and manufacturing networks together using a DMZ as a bridge, thus enabling data sharing between both networks and overcoming proprietary interfaces.

Figure 1. EMAL network topology



There are four industrial areas: power, energy and material handling; reduction; carbon and cast house. Each has its own manufacturing network (levels 0-3) and enterprise network (levels 4-5), with a DMZ bridging the two. Each network utilizes dual-ring optical fiber, delivering high bandwidth and resiliency.

In the enterprise zone, traffic travels across Cisco Catalyst 3750 Series Switches (at the edge) and Cisco Catalyst 6500 Series Switches (in the core) before arriving at the DMZ. Cisco ASA 5500 Series Adaptive Security Appliances provide advanced intrusion protection services and determine which data, voice, video, and multimedia traffic should be allowed to pass through the firewall to the manufacturing zone (via the manufacturing network’s core Cisco Catalyst 6500 Series Switches, through to the Catalyst 3750 Series distribution switches, and then on to Allen-Bradley Stratix 8000 industrial Ethernet switches).

Resilience is built into every part of the architecture. Redundant power supplies enable any switch to be powered from two different sources. In the unlikely event that EMAL should experience further problems, it can quickly restore service on the core Catalyst 6500 Series Switches using Cisco Virtual Switching System (VSS) technology. For the distribution switches, stacking technology is used to overcome switch unavailability in the same way. This capability allows two physical Cisco switches located in different cabinets to be “merged” together into a single, easily managed entity. So, if one switch were to fail, EMAL would still have the other switch live and operational.



VSS also helps EMAL to benefit from fewer points of management and not having to negotiate service windows, making it easier and faster to implement security and software updates. IT training costs are also significantly lower.

Security is enhanced by the DMZs, which not only allow efficient exchange of data and services between the zones (subject to strict traffic control policies), but also allow new features to be introduced in an area without disrupting operations elsewhere.

EMAL's architecture also protects it from a problem that affects many manufacturing networks. Industrial networks often rely on broadcast or multicast communication, and "broadcast storms" can happen when a device produces a large quantity of messages that flood the network. The Ethernet-to-the-Factory architecture counters this by enabling fine-grain traffic control. For instance, by specifying which devices can talk to each other and then putting in place "storm controls" by limiting MAC addresses per port.

"Build once, use many times" is another key feature of the architecture. For example, EMAL has already made use of the Power over Ethernet (PoE) features on the Cisco Catalyst Switches to power IP telephony and wireless access points. PoE could also be used for a plantwide IP surveillance system in the future.

For More Information

For further information on the Cisco and Rockwell Automation partnership go to: www.cisco.com/web/strategy/manufacturing/cisco-rockwell_automation.html

To learn more about Cisco Smart+Connected Manufacturing solutions go to: www.cisco.com/go/manufacturing

PRODUCT AND SERVICES LIST

Routing and Switching

- Cisco Catalyst 3750 and 6500 Series Switches

Security and VPN

- Cisco ASA 5500 Series Adaptive Security Appliances
- Cisco 1120 Secure ACS Appliance
- Cisco IPS 4270 Intrusion Prevention System
- Voice and IP Communications
- Cisco Unified Communications Manager 6.1

Wireless

- Cisco Aironet® 1520 Series outdoor mesh access points
- Cisco 5500 Series Wireless Controller

Network Management

- CiscoWorks LAN Management Solution 3.2

Services

- Cisco Advanced Services
- Cisco SMARTnet



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