COMPACT I/O SOLUTIONS

L3 MAPPS has been using compact input/output (I/O) solutions on recent full scope simulators and simulator I/O system replacements. This paper looks at Orchid® Input Output (Orchid® IO) and describes the wide variety of applications where this technology can be utilized.

The input/output (I/O) system is a critical part of any power plant simulator. This system is responsible for relaying operator actions to the simulation and provides the operators with the visual cues (indications and alarms) required to operate the plant. It is essentially the data link between the simulation server running the plant models and the simulator's main control room panels.

In recent years, L3 MAPPS has deployed several compact I/O systems on various projects. Several years ago, when L3 MAPPS was made aware by its original I/O equipment supplier that several electronic components for the legacy Datapath SC I/O system were becoming difficult to procure, L3 MAPPS decided to evaluate and select an up-to-date, cost-effective I/O solution for its customers. So L3 MAPPS conducted a thorough technical evaluation of twenty-three (23) I/O solutions from various worldwide vendors located in countries such as the USA, Canada, China, Germany and Spain. The evaluation criteria included such factors as high reliability, being non-proprietary, high availability (worldwide), large user base, expandability, flexibility (centralized and distributed architecture) and cost.

While L3 MAPPS sources several different I/O systems as required to best fit the needs of its customers, one of the more widely used solutions is discussed here.

Compact I/O Solutions

An approach that has been adopted by L3 MAPPS is to take advantage of compact I/O systems for both full scope simulators and simulator I/O replacement projects. The selected compact I/O solution is actually the smallest modular, fieldbus independent, low power consumption and distributed I/O system available on the market. Two manufacturers offer this innovative technology commonly used in the industrial automation, building automation, marine automation, and onshore/offshore applications: WAGO and Beckhoff Automation. Each manufacturer has dozens of distributors worldwide. L3 MAPPS has worked with both manufacturers' technologies on different projects. The small dimensions (approximate) of the I/O modules are impressive: 12mm (W) X 65mm (H) X 100mm (L).
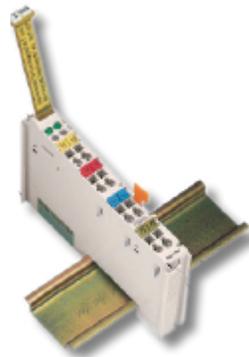
All I/O modules are mounted on a standard 35mm DIN rail without the need for a dedicated chassis or backplane. The first I/O module in a group of modules (I/O node) is always the Ethernet controller which reads/writes to/from the local bus (communication with adjacent I/O modules) and communicates with the simulation server. The Ethernet controller is approximately four times as wide as standard modules and can support up to 255 I/O modules with
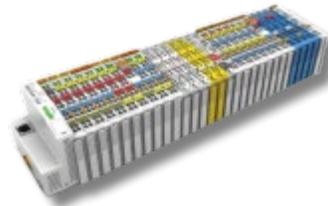
I/O Node on left-hand side

the use of repeater modules (64 without repeater modules). A bus extender can be added if more than 64 modules are desired on a specific node. The Ethernet controller also has also the capability of running user-programmable control logic that can be utilized to drive special devices that may require faster update rates (e.g. synchroscopes). A wide variety of I/O modules are available for specialized applications to supplement the high density standard color-coded modules such as analog input (up to 8 channels), analog output (up to 8 channels), digital input (up to 16 channels) and digital output (up to 16 channels). For ease of maintenance, the I/O modules have a built-in terminal block such that modules can be replaced easily. All I/O modules use passive ventilation resulting in less cabinet noise than conventional I/O systems
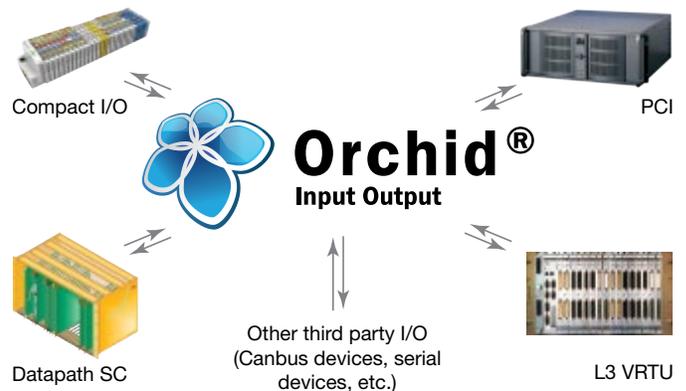
Orchid® IO can handle different I/O equipment simultaneously

Orchid® Input Output

The Orchid® IO solution revolves around the powerful Orchid® IO software. The software can run on the simulation server or on a dedicated I/O computer. Orchid® IO handles the engineering to electrical unit conversions and communicates with the simulation and the various I/O nodes. Orchid® IO includes the necessary features to configure, maintain and troubleshoot the entire I/O system. It allows the hardware engineer and technician to monitor the health and status of all the I/O nodes and to force and monitor individual I/O points. The software also includes detailed historical logs for troubleshooting purposes. Orchid® IO is able to seamlessly integrate I/O nodes from different types of I/O systems. Orchid® IO is delivered with detailed off-the-shelf documentation.

Orchid® IO software provides all the features necessary to configure, monitor and troubleshoot the I/O system from any computer on the I/O network

L3 MAPPS compact I/O solution can be used for full scope simulators, simulator I/O system replacements or for actual plant DCS validations.

Compact I/O system in Embalse Full Scope Simulator

Compact I/O solutions have now been proven on full scope simulators with Orchid® IO acting as the nervous system. I/O

system upgrades are a reality for aging simulators when legacy I/O systems become obsolete and the number of available spare parts is insufficient to ensure continued, reliable simulator operation. L3 MAPPS' Orchid® IO provides a credible answer to the issue of legacy I/O systems reaching end of life. The solutions offered by L3 MAPPS are cost effective, reliable, easy to use, flexible, expandable, and take advantage of modern I/O equipment widely used in numerous industries.

Our Compact I/O Customers

Customer	I/O Count
ARGENTINA	
Embalse	~6,800
BELGIUM	
Tihange 1	~6,800
CANADA	
Point Lepreau (Expansion)	~500
CHINA	
Daya Bay	~12,000
GREAT BRITAIN	
Astute Class Submarine Trainer	~2,100
Dungeness B	~6,000
Hinkley Point B (Expansion)	~250
Heysham 1 (Expansion)	~1,600
KOREA	
Wolsong 1	~18,600
SLOVENIA	
Krško	~11,700
SOUTH AFRICA	
Koeberg	~9,000
Koeberg (Second FSS)	~9,000
USA	
Callaway (Plant DCS Validation)	~250
Diablo Canyon	~10,500
McGuire	~10,500
Pilgrim (Test System)	~100
St. Lucie Unit 2	~20,000
Turkey Point 3	~11,800

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