E1 AND E2 ARCHITECTURE AND MIGRATION OVERVIEW

INTRODUCTION

E1 and E2 brain boards provide processing power and communications for I/O just like their predecessors, the B1 and B2 brain boards. Designed as drop-in replacement boards for the B1 or B2, the E1 and E2 have the same Optomux and serial network capabilities, but also add significant new features: Ethernet support, additional protocol support, and migration and expansion opportunities.

Since E1s and E2s were designed to be interchangeable with existing B1s and B2s, you can simply remove an older brain board from the rack and replace it with an E1 or E2. Your Optomux application will run on the E1 or E2 without any software changes required.

Because the E1 and E2 add Ethernet capability, however, you can also use them for monitoring and control over Ethernet networks, using OPC, Modbus/TCP, and software applications built with Opto 22's PAC Project™ software suite or with the memory-mapped protocol, OptoMMP™.

E1s and E2s are ideal for migrating your system to newer networks, controllers, I/O, and software applications over time, as they have the flexibility to work with both older and newer networks, I/O, and protocols.

Questions?

If you have questions about migration paths or using the new brain boards, please contact your local distributor or system integrator, or contact an Opto 22 Pre-Sales Engineer at 800-321-6786 (or sales@opto22.com).

PROTOCOL AND NETWORK OPTIONS

An E1 or E2 can communicate with a host through its serial port, its Ethernet port, or both, using a variety of protocols. The advantages of moving from B1s and B2s to E1s and E2s are the flexibility and new opportunities you gain in moving from a single-protocol, single-network system to a multiple-protocol, multiple-network system.

The Optomux protocol can be used on both serial and Ethernet networks simultaneously; the other protocols are available on Ethernet and can also be used simultaneously. Protocols and networks have specific advantages and disadvantages, summarized below.

Protocol & Network	Advantages	Disadvantages
Optomux over Ethernet	All Optomux brain board features are available. Ethernet network allows multiple hosts and more than 255 I/O units. No changes needed to host software if first E1 or E2 is used as a serial-to-Ethernet router (see page 6).	If serial-to-Ethernet routing is not used, will require changes to host software (may be minor if using Optomwd.dll).
OPC over Ethernet	OPC clients communicate to E1 and E2 Optomux brains and I/O via OptoOPCServer™. Can be used simultaneously with Optomux control software running over Ethernet or serial.	Brain board features are somewhat limited.*
Modbus/TCP over Ethernet	E1 and E2 Optomux brains and I/O become part of a Modbus/TCP system. Can be used simultaneously with Optomux control software running over Ethernet or serial.	Brain board features are somewhat limited.*
OptoMMP over Ethernet	Provides migration and expansion path to more versatile SNAP hardware and PAC Project software. Can be used simultaneously with other protocols. Ethernet network allows multiple hosts and more than 255 I/O units.	New software development needed. Brain board features are somewhat limited.*
Optomux over serial	Maintain existing system while developing new software. All possible brain board features are available.	Limited to one host and 255 I/O units. Host must be on the serial network.

* No pulsing or time delay on E1; no input averaging or waveform generation on E2.

MIGRATION OPTIONS

If you are using the E1 or E2 to migrate from an existing Optomux system using B1 or B2 brain boards, the protocol and network you choose are determined by your goals for the system. The following table shows how to accomplish specific migration goals with the E1 or E2 and refers you to sources for more information.

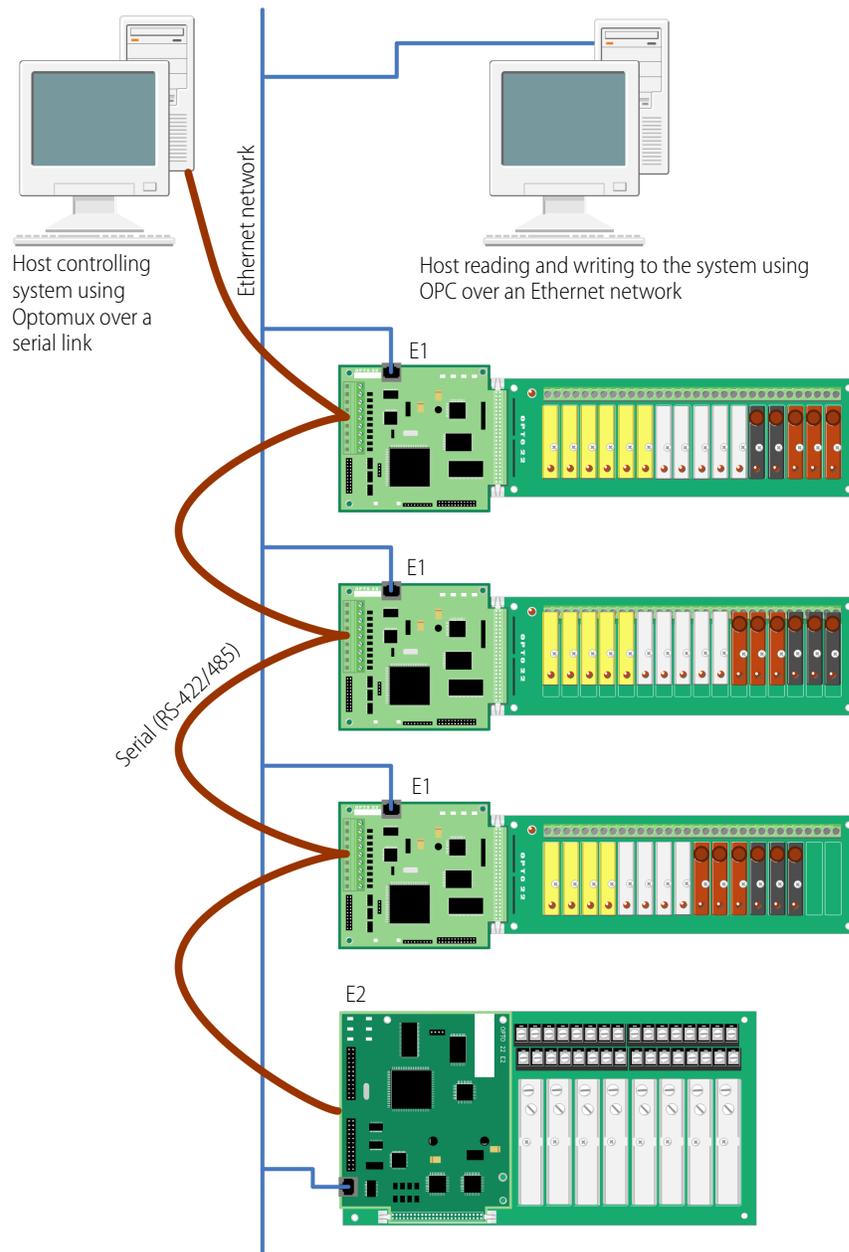| Your goal	Hardware and network changes	Software changes	See
Keep existing software running over serial. Add Ethernet capability so you can communicate with the system using an OPC client.	Replace B1s and B2s with E1s and E2s, keeping same racks and I/O. Keep serial network; add Ethernet network and OPC host.	Existing software continues to run over serial. Use OptoOPC-Server to communicate with E1s and E2s over Ethernet.	Architecture: page 4 Programming: Opto 22 form 1439, the *OptoOPCServer User's Guide*.
Keep existing software running over serial. Add Ethernet capability so that Modbus/TCP clients can communicate with the system.	Replace B1s and B2s with E1s and E2s, keeping same racks and I/O. Keep serial network; add Ethernet network and Modbus/TCP host.	Existing software continues to run over serial. Use Modbus/TCP to communicate with E1s and E2s over Ethernet.	Architecture: page 5 Programming: Modbus/TCP chapter in Opto 22 form 1563, the *E1 and E2 User's Guide*.
Keep existing software running over serial. Add Ethernet capability so you can extend the system beyond serial network physical limitations.	Replace B1s and B2s with E1s and E2s, keeping same racks and I/O. Retire serial network except for PC link to first brain board; add Ethernet network.	Existing software continues to run over serial. Configure first E1 or E2 as a serial-to-Ethernet router.	Architecture: page 6 Programming: See "More About Optomux Serial-to-Ethernet Routing" on page 7.
Replace serial network with Ethernet network, but continue using Optomux protocol.	Replace B1s and B2s with E1s and E2s, keeping same racks and I/O. Replace network.	Modify or replace current software using the Optomux Protocol Driver.	Architecture: page 8 Programming: Opto 22 form 1572, the *Optomux Protocol Guide* (combines previous forms 92 and 203 into new form number).
Replace serial network with Ethernet network. Use an Opto 22 SNAP PAC industrial controller to control the system.	Replace B1s and B2s with E1s and E2s, keeping same racks and I/O. Replace network. Add SNAP PAC controller. (Optional) Expand system to include SNAP hardware.	Replace current control software with software built using PAC Control™. (Optional) Add an HMI or OPC support using other PAC Project software applications.	Architecture: page 8 Programming: Opto 22 form 1700, the *PAC Control User's Guide*, and Opto 22 form 1701, the *Command Reference*.

Communicating Using OPC

You can use OPC to communicate with E1 and E2 brain boards without disturbing your existing software. OptoOPCServer can serve data from E1s and E2s over Ethernet, independently of the software running over serial.

As shown below, simply replace the existing B1s and B2s with E1s and E2s, keeping the same racks and I/O, and link the E1s and E2s to the Ethernet network. Because the new brain boards have a serial port, they work exactly like the old ones over serial, and your existing Optomux software application needs no changes.

Use OptoOPCServer (sold separately) to read and write to E1s and E2s using OPC over the Ethernet link.

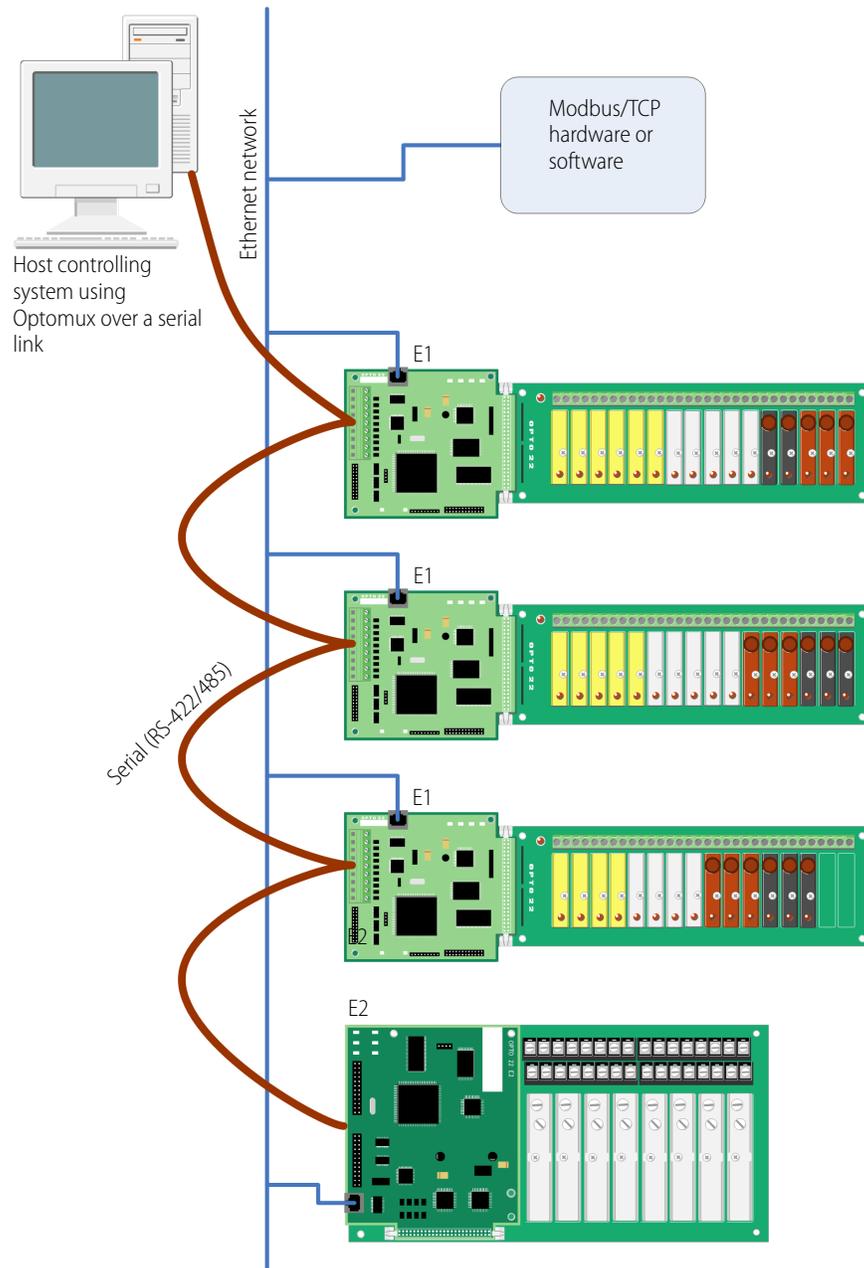See the *OptoOPCServer User's Guide* (form #1439) for more information.

Host controlling system using Optomux over a serial link

Ethernet network

Host reading and writing to the system using OPC over an Ethernet network

Serial (RS-422/485)

E1

E1

E1

E2

Communicating via Modbus/TCP

You can communicate with the E1 or E2 using Modbus/TCP over Ethernet without disturbing the existing software running over serial.

Replace the existing B1s and B2s with E1s and E2s as shown below, keeping the same racks and I/O, and attach the new brain boards to the Ethernet network. Because the E1s and E2s have a serial port with the same capabilities as the B1 and B2, your existing Optomux software application does not need to be changed.

Modbus/TCP can be used to read and write to E1s and E2s over the Ethernet network.

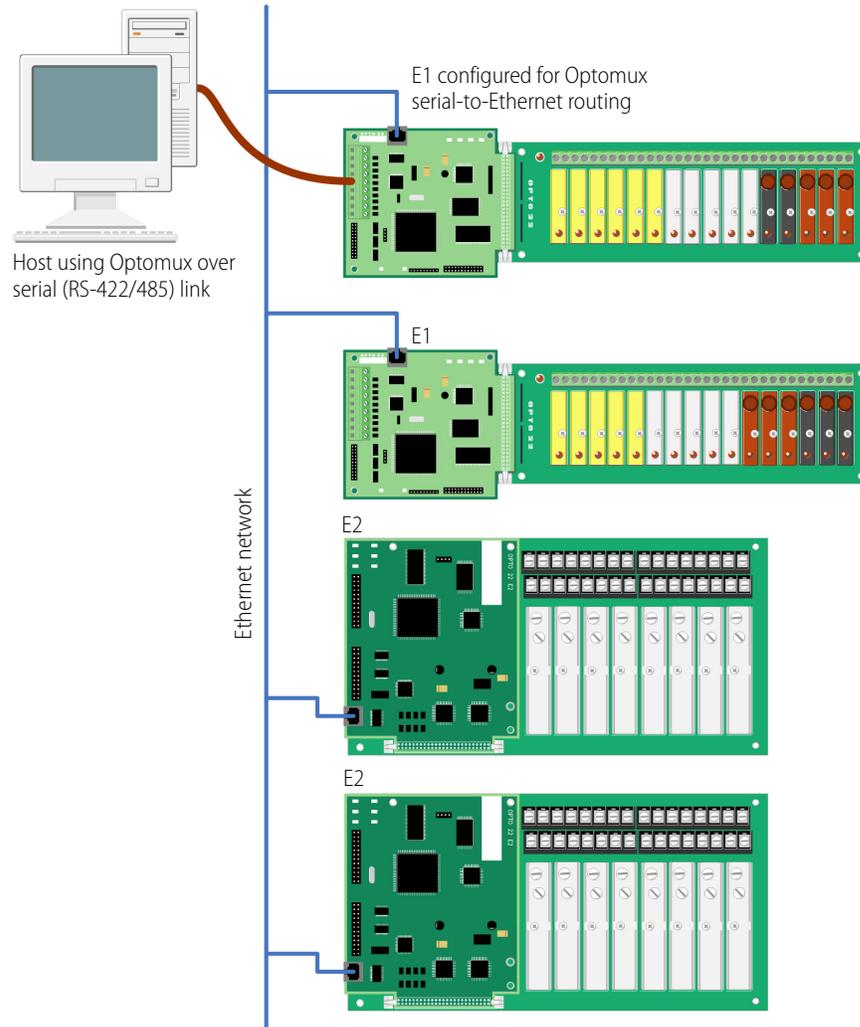For more information, see the Modbus chapter in the *E1 and E2 User's Guide*, form #1563.

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Extending an Existing System Using Ethernet

If you don't want to or cannot change existing host Optomux software, you can extend your system beyond the physical limitations of an RS-422/485 link by adding Ethernet capability.

To do so, replace existing B1s and B2s with E1s and E2s, keeping the same racks and I/O. Keep the serial link from the host to the first E1's or E2's serial port, and configure the first E1 or E2 for serial-to-Ethernet routing. (See "More About Optomux Serial-to-Ethernet Routing" below.) Put all the E1s and E2s on an Ethernet network. With an Ethernet network, the I/O units can be literally anywhere in the world.

As shown below, your existing Optomux application continues to run over serial without needing any changes; the first E1 or E2 translates communications between the host and all other I/O units. You can acquire data over Ethernet via OPC or Modbus/TCP at the same time.

E1 configured for Optomux
serial-to-Ethernet routing

Host using Optomux over
serial (RS-422/485) link

E1

Ethernet network

E2

E2

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More About Optomux Serial–to–Ethernet Routing

As shown in the diagram on the previous page, an E1 or E2 brain board can be used to route commands coming through a serial network to other Optomux brains on the Ethernet network.
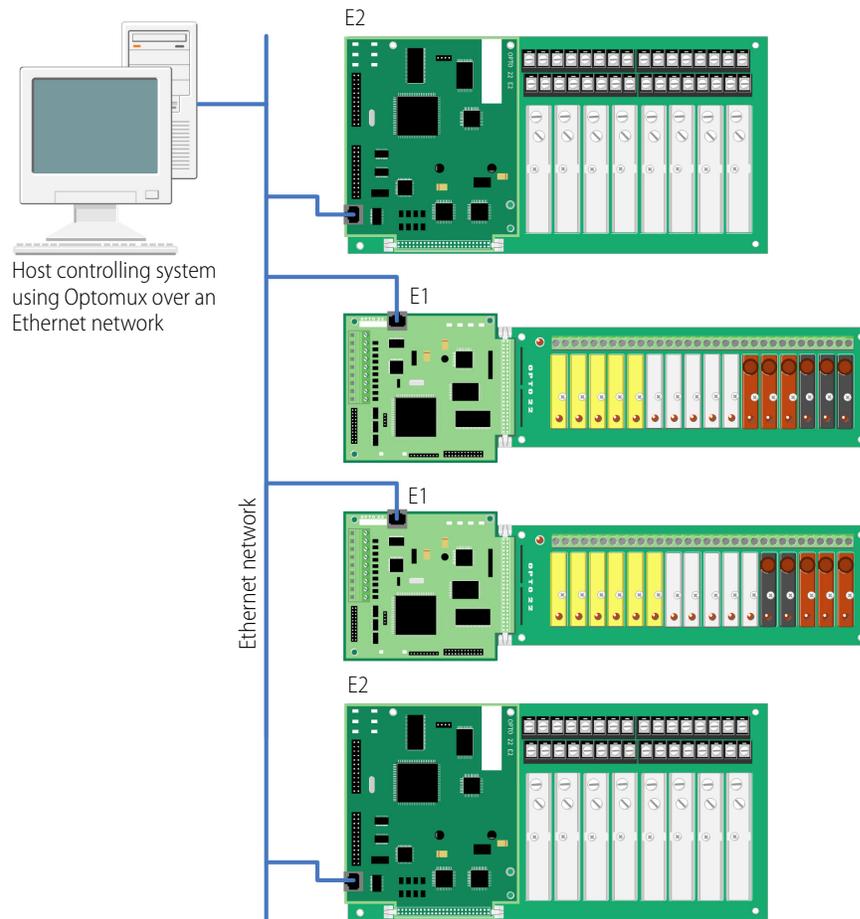
When the brain board used as the router receives an Optomux packet from its serial port, it compares the Optomux address in the packet to a list of Optomux addresses in a routing table stored in its memory. If there's a match, the brain board forwards the packet to the appropriate device over Ethernet. When the response is received from the Ethernet port, it is forwarded to the serial network.

The maximum number of Optomux devices that can be accessed through serial-to-Ethernet routing is 255, because an Optomux serial host can communicate with only 255 devices. The E1 or E2 doing serial-to-Ethernet routing behaves as an Optomux device on the RS-422/485 link.

Using an Ethernet Network with the Optomux Protocol

If you must replace an existing host computer with one that does not have serial capability, or if you need to move it to an Ethernet network, you can continue using the Optomux protocol.

Replace your existing B1s and B2s with E1s and E2s, keeping the same racks and I/O, and replace the serial network with an Ethernet network. Your current Optomux software application can be modified to run over Ethernet using the Optomux Protocol Driver. (If your current application uses Opto 22's optomwd.dll, the modifications are fairly simple. Other implementations will require more extensive programming changes.) See Opto 22 form #1572, the *Optomux Protocol Guide*, for help. This guide combines all the information that used to be in forms 203 (Optomux) and 92 (Optoware), plus adds new driver data, how to modify applications, and Visual Basic examples.
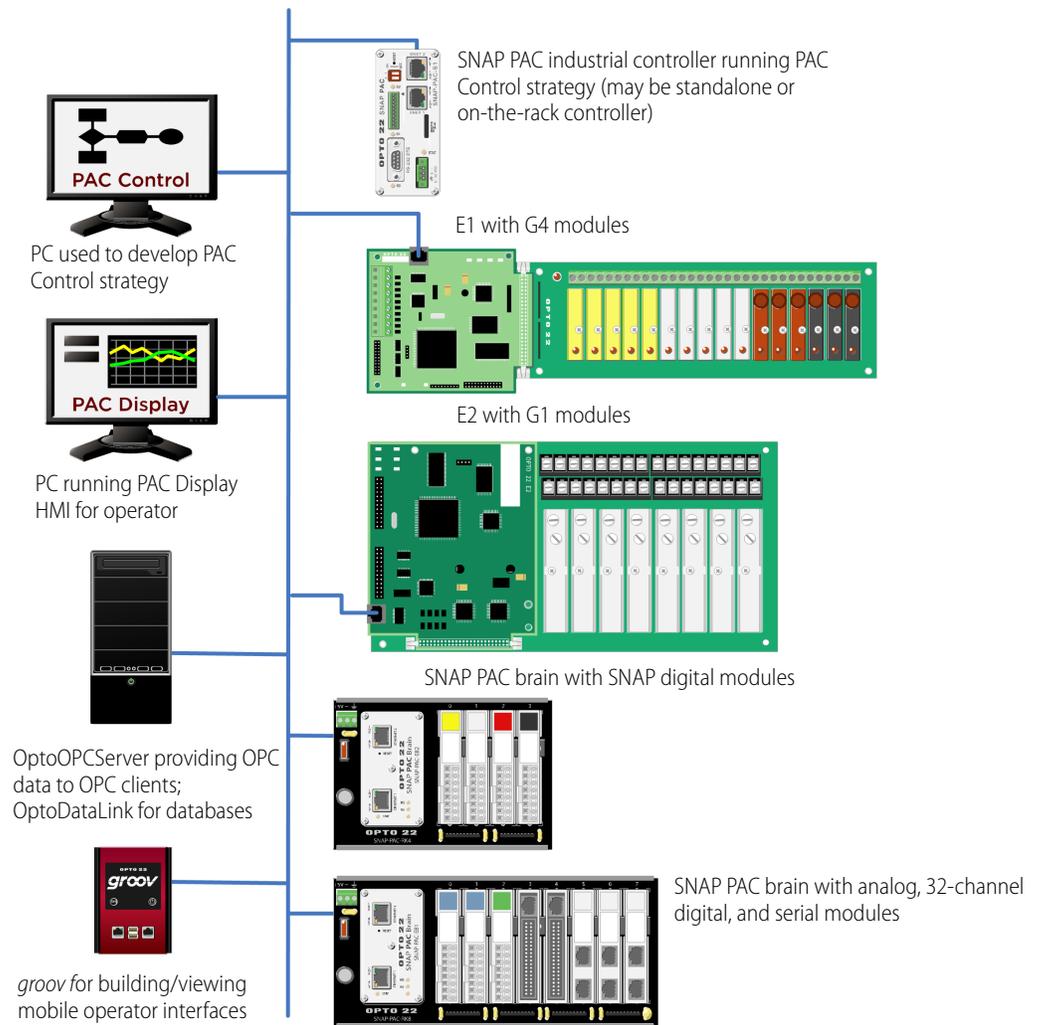

Host controlling system using Optomux over an Ethernet network

E2

E1

E1

E2

Ethernet network

Using an Ethernet Network with an Opto 22 Controller

To gain independence from a host PC, you can move from serial to Ethernet, add an Opto 22 SNAP PAC programmable automation controller, and use PAC Project, our flowchart-based control and HMI software. The system can then be merged with newer Opto 22 hardware such as SNAP I/O® and SNAP PAC Ethernet-based brains, which can handle digital, analog, and serial signals on the same rack. These moves can be done all at once or in stages, using E1s and E2s as the first step.

To start, replace existing B1s and B2s with E1s and E2s, keeping the same racks and I/O. Add a SNAP PAC controller and replace your current control software with software built using PAC Control Basic, which is included with the purchase of the controller.

About E1 and E2 brain boards: You can configure E1s and E2s like any other I/O unit if you have E1/E2 firmware R1.2a (and higher) and PAC Project 9.5000 (and higher). Also, if a SNAP PAC controller communicates with the E1 or E2, the controller must have PAC firmware R9.5a (or higher) to use this simplified configuration method. If you are not using these firmware and software versions (or if you prefer to use the previous method to reconfigure existing E1s or E2s), see I/O Configuration for E1 an E2 Brain Boards*I/O Configuration for E1 an E2 Brain Boards (form 1576).*

As shown below, you can integrate the system with SNAP PAC hardware or replace older racks, I/O, and brains as needed. You can also add an HMI built with PAC Display, a *groov* mobile operator interface, OPC capability through OptoOPCServer, and data exchange with SQL databases through OptoDataLink. PAC Display is included in PAC Project Basic; OptoOPCServer and OptoDataLink are available separately or as part of PAC Project Professional. For more about *groov,* visit groov.com.

PAC Control

PC used to develop PAC Control strategy

PAC Display

PC running PAC Display HMI for operator

OptoOPCServer providing OPC data to OPC clients; OptoDataLink for databases

groov for building/viewing mobile operator interfaces

SNAP PAC industrial controller running PAC Control strategy (may be standalone or on-the-rack controller)

E1 with G4 modules

E2 with G1 modules

SNAP PAC brain with SNAP digital modules

SNAP PAC brain with analog, 32-channel digital, and serial modules

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OTHER COMMUNICATION OPTIONS

Building Custom Applications with the OptoMMP Protocol

For custom applications, you can also communicate with the E1 and E2 brain boards over Ethernet using OptoMMP, Opto 22's memory-mapped protocol.

This is the same protocol used with all current Opto 22 Ethernet brains and related software. Therefore, custom applications you build using OptoMMP can consolidate E1s and E2s with SNAP Ethernet-based systems, and applications you may have already built for SNAP Ethernet-based systems can be easily expanded to include E1s and E2s.

OptoMMP is open and documented, and a communication toolkit is available. You can download the toolkit from our website using this link: C++ OptoMMP Communication Toolkit or go to www.opto22.com and search for PAC-DEV-OPTOMMP-CPLUS. Opto 22 form #1465, the *OptoMMP Protocol Guide*, provides complete documentation of the memory map.

Accessing E1 and E2 Brain Boards Over the Internet

Since E1 and E2 brain boards are just like any other hardware on the Ethernet network, you can access them over the Internet in exactly the same way you would access a computer. Remote monitoring, data acquisition, and control applications can communicate with the brain boards over the Internet. The details of doing so depend on your network and Internet connection. Consult your system or network administrator or your Internet Service Provider (ISP) for more information. Also see form 1796, *Guide to Networking Opto 22 Products*.