Communication Protocols for Opto 22 Products

Introduction

Opto 22 products—both current and legacy—provide a variety of protocols for communication and options for exchanging data. This technical note describes these protocols and data exchange options and lists the products that support them. It also describes the Opto 22 integration kits available for PAC Project and legacy products.

For more information online and links to integration kits, go to www.opto22.com/lp/system_integration.aspx.

If you have questions on supported protocols or the use of Opto 22 products, contact **Pre-Sales Engineering** by phone or email.

Phone: 800-321-6786 (toll-free in the U.S.) or 951-695-3000
Email: systemseng@opto22.com

NOTE: Additional methods of communication developed by our user community may be found in the OptoForums at www.opto22.com.

Protocol Descriptions

The following table lists all communication protocols and data exchange options that may be supported in Opto 22 products. To see which products support which protocols, see .

Industrial Ethernet Protocols	Internet Protocols	Serial Protocols	Parallel Protocol	Data Exchange Options
OptoMMP Modbus/TCP EtherNet/IP	TCP/IP UDP/IP SNMP SMTP PPP[1] FTP HTTP	Modbus RTU Modbus ASCII PROFIBUS DP DF1[2] DNP3 BACnet MS/TP[3] CAN Optomux mistic SSI TL1	Pamux	OPC 2.0—OptoOPCServer OPC 1.0—OptoServer SQL database—OptoDataLink Mass storage—microSD card Peer-to-peer—Scratch Pad

[1]PPP is technically an Internet Protocol but requires a dial-up modem to connect.
[2]DF1 is an Allen-Bradley® protocol.
[3]BACnet MS/TP is RS-485 only.

Protocols and options are described below.

Industrial Ethernet Protocols

Industrial Ethernet protocols run over an Ethernet physical layer (wired or wireless) and are used in industrial automation applications.

OptoMMP—An open protocol developed by Opto 22 for its Ethernet-based controllers and brains. Documented in Opto 22 form 1465, *OptoMMP Protocol Guide*.

Modbus/TCP—Open protocol developed by Modicon, Inc., Industrial Automation Systems. See Opto 22 form 1678, the *Modbus/TCP Protocol Guide*, for details on setting up communication.

EtherNet/IP—Open protocol originally developed by Rockwell Automation and now managed by ODVA (Open Device Vendors' Association). To set up communication, see Opto 22 form 1770, *EtherNet/IP for SNAP PAC Protocol Guide*.

Internet Protocols

Internet Protocols are open protocols originally designed for use on the Internet and in information technology (IT). All run over an Ethernet network (wired or wireless). Detailed information about Internet Protocols is available on (curiously enough) the Internet.

TCP/IP—Transmission Control Protocol/Internet Protocol, the first two networking protocols defined in the Internet Protocol Suite. IP is just above the link layer and provides for the delivery of data packets. TCP runs at the transport layer, above IP, and delivers data reliably by setting up initial data channels and verifying receipt of data. TCP also resends data if no response is received within a given time.

UDP/IP—User Datagram Protocol, also running at the transport layer over IP. UDP, in contrast to TCP, delivers data quickly by sending it without having to set up data channels in advance and without waiting for a response. UDP is useful for time-sensitive data because it is faster, but data may be lost. The application verifies data delivery.

SNMP—Simple Network Management Protocol. Runs at the application layer, over TCP or UDP. SNMP is primarily used by IT departments for managing devices on an Ethernet network.

SMTP—Simple Mail Transfer Protocol. Also an application layer protocol, SMTP is used to send email.

PPP—Point-to-Point Protocol is at the link layer, just above the physical layer. While technically an Internet Protocol, PPP requires a dial-up modem (a serial connection) for communication.

FTP—File Transfer Protocol. An application layer protocol used to manage files on the Internet, for example to move files from one device to another or add data to them.

HTTP—Hypertext Transfer Protocol. Another application layer protocol, HTTP is fundamental for the World Wide Web and used for communication between servers and clients.

Serial Protocols

Serial protocols run over a standard serial physical network, either RS-485/422 or RS-232.

Modbus RTU—Modbus is an open protocol originally developed by Modicon for its serial-based PLCs. Modbus RTU is the binary version of the protocol and often used for remote telemetry units (RTUs) in a supervisory control and data acquisition (SCADA) application.

Modbus ASCII—Also the Modbus protocol, but this version presents numerical data in ASCII for easier reading. One major difference between the binary and ASCII versions of Modbus is the checksum calculation method.

PROFIBUS DP—An open field bus protocol originally developed by an industry group in Germany and widely used in Europe today.

DF1—An Allen-Bradley protocol used to communicate with A-B devices and PLCs over an RS-232 serial link.

DNP3—Distributed Network Protocol, primarily used in the electrical and water utility industries. DNP3 is often used for communication between a SCADA master station and RTUs or intelligent electronic devices (IEDs).

BACnet—BACnet is a communications protocol for building automation and control networks.

CAN—Controller Area Network, originally developed for use in the automotive industry but now used more widely in automation

Optomux—An open protocol developed by Opto 22, which became an industry standard. Optomux runs on RS-485/422 and is documented in form 1572, the *Optomux Protocol Guide*.

mistic—An open protocol developed by Opto 22 and documented in form 270, the *mistic Protocol Manual*. Runs on RS-485/422.

SSI—Serial Synchronous Interface. Often used for communication between an absolute position sensor and a controller for motion control. Runs on RS-422.

TL1—Transaction Language 1 (TL1) is an element management protocol widely used in telecommunications in North America.

Parallel Protocol

Pamux—An open protocol developed by Opto 22 for fast digital control over a parallel cable. Also supports analog I/O. See individual product documentation and form 726, the *Pamux Manual*.

Data Exchange Options

OPC—OLE (Object Linking and Embedding) for Process Control. Not a protocol, but a series of standards for exchanging data among devices in industrial automation. These standards can be used over an Ethernet or serial physical layer. Managed by the OPC Foundation. Use the following Opto 22 software for the OPC versions shown:

- **OPC 2.0—OptoOPCServer**—An Opto 22 OPC server for exchanging data between OPC clients and the SNAP PAC System or legacy SNAP Ethernet-based I/O units. OptoOPCServer is OPC 2.0 compliant.

- **OPC 1.0—OptoServer**—An older Opto 22 OPC server used with legacy FactoryFloor systems. For OPC 1.0-compliant or DDE clients.

Database—OptoDataLink—OptoDataLink is an Opto 22 software application that lets you move data easily between the SNAP PAC System and popular databases such as Microsoft SQL Server, Microsoft Access, and MySQL.

Mass storage—microSD card—A microSD card is a tiny flash memory card used to store data. The card can be physically moved between devices that have microSD card slots in order to exchange data between devices. SNAP PAC controllers manufactured after November 2008 contain a microSD card slot. For more information, see the PAC's user guide.

Peer-to-peer—Scratch Pad—The Scratch Pad is an area in the memory map of SNAP PAC controllers and brains (and older Ethernet-based I/O units) that can be used to store data for peer-to-peer communication. For details on types of data and how to use the Scratch Pad, see the *PAC Manager User's Guide* (form 1704 for SNAP PAC controllers and brains, or form 1714 for legacy hardware).

SNAP PAC .NET OptoMMP Messaging Toolkit—This 100% managed OptoMMP toolkit is provided in our Samples & Freeware downloads section. It offers an easy-to-use interface for a .NET developer to quickly create an application for Opto 22 products that use the OptoMMP protocol. This toolkit is built using Microsoft's .NET 3.5 Framework, and may be used for Visual Studio 2005, 2008, and 2010 versions. This toolkit is recommended for new applications.

OptoMMP Communication Toolkit—The OptoMMP Communication Toolkit (IOP-DEV-OPTOMMP) includes ActiveX components and C++ classes for communicating with Opto 22 Ethernet-based brains and controllers, which are memory-mapped devices using the OptoMMP protocol. You can use programming

tools such as Visual Basic or Visual C++ to easily communicate with these Ethernet devices. (Note that this toolkit is older than the SNAP PAC .NET Messaging Toolkit and does not support analog I/O with more than four channels.)

Supported Protocols and Toolkits by Product Group

NOTE: Products marked "Legacy" are not recommended for new development.

SNAP PAC System (R-series and S-series Controllers)

Industrial Ethernet Protocols	Internet Protocols	Serial Protocols	Data Exchange Options	Integration/Developer Toolkits (Free Downloads)
OptoMMP Modbus/TCP[1] EtherNet/IP	TCP/IP UDP/IP SNMP SMTP PPP FTP HTTP	Modbus RTU[2] Modbus ASCII[2] PROFIBUS DP[2] DF1[2] DNP3[2] CAN[4] mistic (I/O only)[3] BACnet MS/TP[2] TL1[2]	Database—OptoDataLink OPC 2.0—OptoOPCServer Mass storage—microSD card Peer-to-peer—Scratch Pad	Modbus Integration Kit for PAC Control[1] PROFIBUS-DP Master Software[3] Allen-Bradley DF1 Integration Kit for PAC Control DNP3 Integration Kit for PAC Control CAN (Controller Area Network) Integration Kit for PAC Control[4] BACnet Protocol Integration Kit for SNAP-PAC-S[5] TL1 Integration Kit for PAC Control Basler DGC-2020 Digital Genset Controller Integration Kit for PAC Control SNAP PAC .NET OptoMMP Messaging Toolkit OptoMMP Communication Toolkit[6]

[1]The built-in Modbus/TCP protocol is slave only. The integration kit includes both master and slave for both serial and Ethernet networks.
[2]Via Integration Kits (PAC Control software routines)
[3]Requires a SNAP-SCM-PROFI serial communication module
[4]Requires a SNAP-SCM-CAN2B serial communication module
[5]Requires a SNAP PAC S-series controller
[6]This version does not support analog I/O with more than 4 channels. The .NET toolkit is recommended for new development.

SNAP PAC EB Brains (Processors for SNAP I/O)

Industrial Ethernet Protocols	Internet Protocols	Data Exchange Options
OptoMMP Modbus/TCP* EtherNet/IP	TCP/IP UDP/IP SNMP SMTP PPP FTP	Database—OptoDataLink OPC 2.0—OptoOPCServer Peer-to-peer—Scratch Pad

*Slave only

FactoryFloor System (LCM4 and M4 Controllers—Legacy)

Industrial Ethernet Protocols	Internet Protocols[1]	Serial Protocols	Data Exchange Options	Integration/Developer Kits (Free Downloads)
mistic (controllers)	TCP/IP UDP/IP	Modbus RTU[2] Modbus ASCII[2] DF1[2] Optomux[2] mistic (I/O and controllers)	OPC 1.0—OptoServer OPC 2.0—OptoOPCServer[1]	Allen-Bradley DF1 Integration Kit for Opto-Control Modbus Integration Kit for OptoControl (Serial) OptoControl SDK

[1]Requires an M4SENET-100 Ethernet card
[2]Via integration kits (OptoControl software routines)

SNAP Ultimate/Ethernet Brains (Legacy)

For details by part number, see *Current and Legacy Product Comparison Charts*, form 1693.

Industrial Ethernet Protocols	Internet Protocols	Data Exchange Options	Integration/Developer Kits (Free Downloads)
OptoMMP Modbus/TCP*	TCP/IP UDP/IP SNMP SMTP PPP FTP	Database—OptoDataLink OPC 2.0—OptoOPCServer Peer-to-peer—Scratch Pad	Modbus/TCP Integration Kit for ioControl Modbus Serial Integration Kit for ioControl

*Slave only

Optomux (E1 and E2 Brain Boards)

Industrial Ethernet Protocols	Internet Protocols	Serial Protocols	Data Exchange Options (Ethernet only)	Integration/Developer Kits (Free Downloads)
OptoMMP Modbus/TCP[1] Optomux	TCP/IP	Optomux OPC[2]	Database—OptoDataLink OPC 2.0—OptoOPCServer	Optomux Protocol Drivers & Utilities Toolkit

[1]Slave only
[2]Via third-party server only

Optomux (B1 and B2 Brain Boards—Legacy)

Serial Protocols	Data Exchange Options	Integration/Developer Kits (Free Downloads)
Optomux	OPC*	Optomux Protocol Drivers & Utilities Toolkit

 *Via third-party server only

Pamux Systems (PC Adapter Cards and Pamux Brains)

Parallel Protocol	Integration/Developer Kits (Free Downloads)
Pamux	PCI-AC5/PCI-AC51 Pamux Toolkit

Integration Kits for PAC Project

Modbus Integration Kit for PAC Control

(Part # PAC-INT-MB) The Modbus Integration Kit for PAC Control allows Opto 22 SNAP PAC controllers using PAC Control to connect via serial or Ethernet to Modbus devices. The Integration Kit contains a set of PAC Control master subroutines, an example Modbus Master chart, a PAC Control slave subroutine, an example Modbus Slave, a demo data chart, and example initialization files.

Allen-Bradley DF1 Integration Kit for PAC Control

(Part # PAC-INT-ABDF1) The Allen-Bradley DF1 Integration Kit provides users of Opto 22's PAC Control software an easy method of communicating with Allen-Bradley devices or PLCs that support the DF1 protocol.

The Allen-Bradley DF1 Integration Kit consists of a set of PAC Control subroutines, which can be called from any flowchart in the PAC Control strategy.

DNP3 Integration Kit for PAC Control

(Part # PAC-INT-DNP3) The DNP3 Integration Kit for PAC Control allows Opto 22 SNAP PAC controllers, using PAC Control, to connect via an Ethernet network or serial port and communicate using DNP3, the Distributed Network Protocol. The integration kit contains a set of PAC Control subroutines that are added to a strategy to add DNP events, an example DNP3 strategy containing the DNP3_protocol and

DNP3_CROB charts that are imported into a strategy to enable an Opto 22 controller to communicate as a DNP3 Level 2 Master or Outstation.

BACnet MS/TP Integration Kit for SNAP-PAC-S

(Part # PAC-INT-BAC) The BACnet MS/TP Integration Kit for SNAP-PAC-S enables your Opto 22 PAC system equipped with a SNAP-PAC-S2 controller to communicate with a BACnet MS/TP network via RS-485. BACnet is a communications protocol for building automation and control networks. MS/TP is a Master-Slave / Token-Passing specification of BACnet. The integration kit contains the BACnet_Protocol and Master_Sub charts, which contain everything you need to use the BACnet MS/TP protocol in your own PAC Control strategy.

TL1 Integration Kit for PAC Control

(Part # PAC-INT-TL1) The TL1 Integration Kit for PAC Control allows Opto 22 SNAP PAC controllers using PAC Control to manage telecommunication network elements (NEs) using the Transaction Language 1 (TL1) protocol, an element management protocol widely used in North America. The integration kit contains an example strategy, which contains everything you need to use the TL1 protocol in your own PAC Control strategy.

Basler DGC-2020 Digital Genset Controller Integration Kit for PAC Control

(Part # PAC-INT-MBBAS) The Basler Integration Kit provides an interface to use a SNAP PAC controller to read and write Modbus parameters to a DGC-2020 Digital Genset Controller by Basler Electric. The PAC Control and PAC Display files take advantage of an optional feature of the DGC-2020 that performs Modbus communications by emulating a subset of the Modicon 984 Programmable Controller.

Legacy Integration Kits

Modbus Serial Integration Kit for ioControl

(Part # IOP-INT-MBSER) The Modbus Serial Integration Kit for ioControl allows Opto 22 Ultimate I/O controllers, using ioControl, to connect via a serial network to any Modbus device and communicate using the Modbus RTU or ASCII protocols. The Integration Kit contains a set of ioControl master subroutines, an example

Modbus slave strategy, and ioDisplay master and slave projects to show communication between the example strategies and a Modbus device.

Modbus/TCP Integration Kit for ioControl

(Part # IOP-INT-MBTCP) The Modbus/TCP Integration Kit for ioControl allows Opto 22 Ultimate controllers using ioControl to connect via Ethernet to Modbus/TCP devices. This free Integration Kit contains a set of ioControl master subroutines, an example Modbus/TCP slave strategy, and ioDisplay master and slave projects to show communication between the example strategies and a Modbus/TCP device.

Allen-Bradley DF1 Integration Kit for OptoControl

(Part # OPTOINTAB) Allen-Bradley DF1 Integration Kit for OptoControl allows communication between OptoControl controllers and Allen-Bradley DF1 protocol devices. The integration kit includes subroutines, example strategies, and documentation.

Modbus Serial Integration Kit for OptoControl

(Part # OPTOINTMB) The OPTOINTMB integration kit allows communication between OptoControl controllers and third-party serial Modbus RTU or ASCII protocol devices. The integration kit includes subroutines, example strategies, and documentation.

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