SNAP PAC REST API and the Internet of Things

For IT Professionals

OPTO 22
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Opto 22

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INTRODUCTION

We've all heard about the Internet of Things (IoT) and its promises: bringing useful data directly to people who make business decisions, and enabling machines to communicate with each other and make decisions for human benefit.

But how does the IoT actually work? What's the pathway, from the ground up, that all these machines use to connect to each other through cloud technologies?

Millions of sensors, machines, devices, and actuators exist now in the physical world, and very few of them have any built-in capability to communicate with computer systems.

Things like backup diesel generators, data center air conditioning equipment, and power distribution units don't talk the protocols used in computers, and they have no physical ports for communication on computer networks. Even when used in industrial automation systems, data from these things must travel through a chain of hardware and software intermediary systems to be usable in the IoT.

What can connect them more directly—and as a result can help you realize your IoT goals now—is an Opto 22 SNAP PAC programmable automation controller.

PACS, PLCS, AND I/O

Opto 22 SNAP PAC programmable automation controllers (PACs) are industrially hardened, small-footprint, computer-like devices that run programs to monitor, control, and get data from things in the physical world. From monitoring remote sites to controlling entire factories and buildings, PACs and their cousins, PLCs (programmable logic controllers) are familiar in the automation industry.
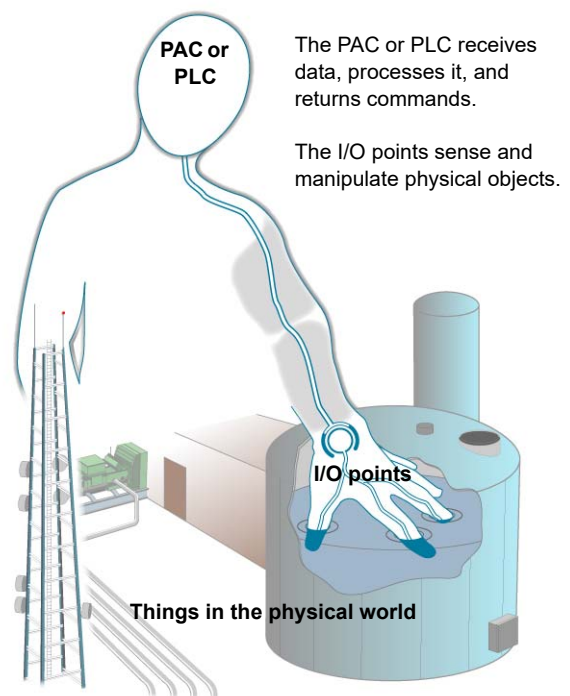
PACs and PLCs connect to things through input and output (I/O) points. I/O points are wired directly to physical sensors, machines, devices, and actuators. If you think of the PAC or PLC as being like a human brain—receiving data, processing it, and returning commands to act—then the I/O points are the fingers on human hands, sensing and manipulating physical objects.

The key function of I/O is to translate between the physical world and the digital world, which inherently do not understand each other. Sensors and machines typically understand electrical signals like voltage and current, which computers do not understand. This translation can go both ways:

- I/O takes the electrical signals from physical things and translates them into the ones and zeros understood by the digital world.
- For action on the physical world, I/O translates digital ones and zeros into electrical signals and sends them to physical things to change their state.

Without this translation, the Internet of Things would be impossible.

PAC or PLC

The PAC or PLC receives data, processes it, and returns commands.

The I/O points sense and manipulate physical objects.

I/O points

Things in the physical world

SNAP PAC REST API and the Internet of Things

VALUABLE DATA IN A SNAP PAC

Opto 22 SNAP PACs contain and control a lot of data—data from the I/O points connected to the PAC, and data in variables within the controller's logic. For example, you might want to see or use data like this:

- **Status**—Is the pump (or chiller, or light, or production line) on or off?
- **Value**—What's the pressure in the pipe? What's the temperature of the refrigeration unit? How many amps is the motor drawing right now? How full is the diesel generator fuel tank?
- **Variables**—How many widgets were produced in the last hour? How does that compare to yesterday at the same time? Who just accessed the security door? What are the setpoints for all the HVAC units in building A? Where is Car 54? What's the status of the controller itself?

You might also want to control I/O points or change variables in the PAC, for example:

- Respond to an alarm by turning off a pump or opening a valve.
- Change the setpoint on a heating and air conditioning unit or revise a maintenance schedule.

Difficulties of accessing controller data

Industrial controllers—both PACs and PLCs—are often used to monitor and control processes and equipment that **cannot be interrupted,** because an interruption would cause product or business losses, damage machinery, or endanger human safety.

Because their function is so crucial, industrial control networks are typically protected from unauthorized access and network outage by being physically isolated from other company networks.

In addition to physical isolation, many industrial control networks use proprietary or application-specific protocols, such as Profinet, EtherNet/IP, or Modbus, rather than the standard TCP/IP used in the IT world.

Both of these factors can make it difficult to obtain data from control networks, even when that data would be useful elsewhere in the company.

To make sure interruptions do not occur, Operational Technology (OT) engineers and technicians are understandably reluctant to open up control networks to company IT networks.

The solution: To realize the promise of the Internet of Things, the two groups—OT and IT—must work together to achieve two goals: first, keep critical control networks safe, and second, provide useful data where and when it is needed.

Two ways SNAP PACs can help

Opto 22 SNAP PACs were designed by engineers with one foot in automation hardware tradition and the other in standards-based Internet technology. These tough, small-footprint controllers run on standard Ethernet networks and communicate over open standards like IP, SNMP, SMTP, and FTP on the IT side and Modbus/TCP, OPC, and EtherNet/IP on the OT side.

If you need an automation system, the SNAP PAC System can monitor your physical assets at remote sites, run the processes in your machine or your factory, manage your data center HVAC systems, provide interfaces to your equipment on anything from a smartphone to a web-enabled HDTV, acquire the data you need, and serve it up to clients over a secure HTTPS connection through an open, free, documented RESTful API.

But if you already have an automation system, you don't need to replace it to get the IoT data you want. You can use SNAP PACs and I/O in another way: attach them separately to the sensors and devices you want to monitor, without disturbing the existing control system. Sometimes this is the best way to keep control networks safe: not to tap into their data directly, but instead to add separate hardware—SNAP PACs and I/O—for IoT purposes.

ACCESSING SNAP PAC DATA

The reason SNAP PACs and I/O can provide either or both automation and secure access to data is that they are built on open standards. Opto 22's S-series and R-series SNAP PAC industrial controllers run on **standard Ethernet networks** and communicate over the standard Internet Protocol (IP). And as of firmware version R9.5a, SNAP PACs also include:

- a built-in **HTTP/HTTPS server** for communication
- a **RESTful API**

RESTful clients can use a standard HTTP GET to request data from the PAC and a standard HTTP POST to send data to the PAC. Data is returned as JSON.

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SNAP PAC REST API

The complete SNAP PAC REST API is documented on developer.opto22.com. It includes all possible calls you can make to read data from or write data to the PAC, using your programming language of choice (for example, PHP, Python, .NET, JavaScript). In the API you'll see how to access I/O point data as well as numeric and string data from variables in the PAC's logic.

What do you need to access data in a SNAP PAC via the REST API?

- Understand HTTP/HTTPS APIs and a programming language like PHP, Python, Node.js, Ruby, .NET, Perl, or JavaScript. Or use Node-RED (see below).
- Understand JSON formatting
- Make sure the client can access the PAC over a TCP/IP network on port 443
- Decide whether access to data should be read-only or read-write

Due to the often critical nature of data on a SNAP PAC, read-write access should be carefully controlled. Consider all possible consequences before granting read-write access to any client—person or system.

Networking considerations

We never recommend putting a SNAP PAC controller directly on the Internet. The PAC should be located behind a firewall, and in most cases the control network should be segmented from the company computer network to facilitate security. You can use the two built-in independent Ethernet network interfaces on the SNAP PAC to segment networks (see the controller's user guide for setup steps).

Because the SNAP PAC acts as an HTTPS server for data, the PAC must be accessible by the client over a TCP/IP network. A client might be:

- A computer that displays the PAC's data
- A database or other system
- A smartphone on your wireless network that incorporates data into an app
- Other web services or applications

What if you want to access the PAC's data from somewhere else, like on your phone outside the building or from a remote location? You can set up a VPN, or have a client that accesses data from the PAC send data beyond the firewall.
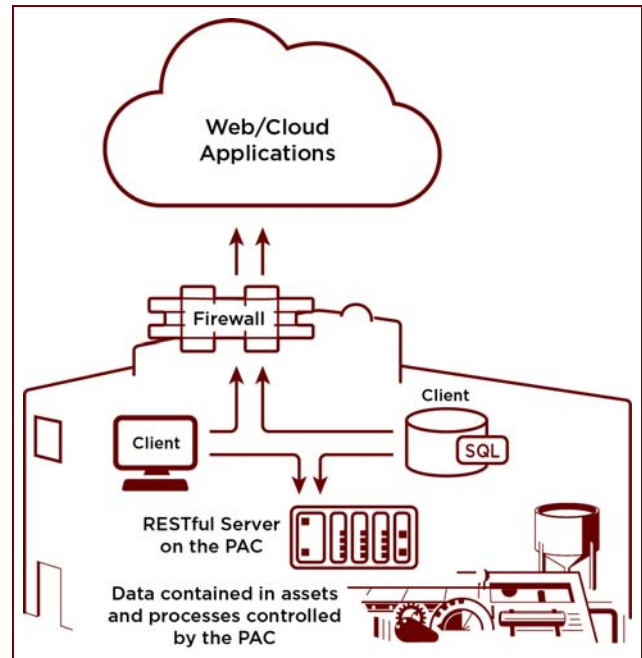
Node-RED

If you're not ready to write your own program for the client using a language compatible with the REST API, an easy way to access data on the PAC is by using Node-RED.

For example, you might use Node-RED to provide a facilities manager with a map showing local temperatures, chiller on/off times, and electrical usage for building sites. This mashup could use data from your PAC, a weather website such as Weather Underground, and Google maps.

Two nodes are available for SNAP PACs, one for reading and one for writing. Complete information and instructions are on developer.opto22.com.

WHY OPTO 22?

Three reasons: experience, reliable products, and personal attention.

Opto 22 began in 1974, when our engineer founder, Bob Engman, designed a better solid-state relay (SSR). With more than 40 years of automation experience, today we manufacture controllers, SSRs, and I/O known worldwide for reliability, plus easy-to-use software for developing control programs, visualizing data on any device, and integrating automation systems with computer networks.

SNAP PAC REST API and the Internet of Things

All Opto 22 products are built on open standards. All products are designed, manufactured, and supported at company headquarters in Temecula, California, U.S.A.

Most SSRs and I/O modules carry a lifetime warranty. Product Support is free. Pre-sales Engineering is also free, so you can call us with any questions about your application before you buy.

GETTING STARTED

See developer.opto22.com for the REST API and Node-RED nodes for SNAP PAC controllers.

If you already have an Opto 22 SNAP PAC S-series or R-series controller and I/O, make sure you have firmware version R9.5a or higher in the PAC.

If you don't have a PAC and I/O, see them on our website, www.opto22.com:

- SNAP PAC S-series standalone controllers
- SNAP PAC R-series rack-mounted controllers
- SNAP I/O

All Opto 22 products are available through distributors worldwide:

- Regional distributors in the U.S. and Canada
- National distributors (U.S. and Canada)
- International distributors

Questions?

Contact your local distributor or Opto 22 Pre-sales Engineering with any questions about products, system architecture, or the IoT.

Phone: **1-800-321-6786** (toll-free in the U.S. and Canada) or **1+951-695-3000**

Or send a question to an engineer.

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