Building on BACnet®

Supervisors • Routers • Gateways

Controllers • Thermostats • I/O Modules
Building on BACnet®

BACnet (Building Automation and Control Network), developed by the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), is the most popular open protocol found in building automation and energy management systems. The intent of this open standard is to allow building owners and systems integrators the opportunity to pick and choose BACnet-compliant equipment from various vendors. Contemporary Controls endorses the “open control” concept and its BASautomation line of BACnet products offers open solutions when implementing networked controls in buildings.

BACnet client devices initiate commands while BACnet server devices respond to commands. BACnet devices communicate to one another over a network. The more popular networks include the Internet Protocol (BACnet/IP) and the Master-Slave Token-Passing network (BACnet MS/TP). Interconnecting BACnet networks requires BACnet routers while connecting non-compliant BACnet devices, such as Modbus®, to a BACnet network requires a gateway. Supervisors typically reside at the IP level functioning as clients while I/O modules and communicating thermostats reside at the MS/TP level functioning as servers. Controllers can be found at either level functioning as servers or in some cases as client/servers.

Whatever the product need, the BASautomation line has a solution.
Supervisors

Supervisors provide both BACnet/IP client functionality and control in one package. Besides BACnet MS/TP and Modbus to BACnet integration, supervisors provide head-end capabilities such as alarming, trending, scheduling and graphics.

Routers

The BASrouters are multi-network routers used to route messages between BACnet/IP, BACnet Ethernet and BACnet MS/TP networks. Three versions are available – DIN-rail or panel mounted units for fixed installations and a USB powered portable unit for commissioning and troubleshooting.

Gateways

To achieve BACnet compliance, BASgateways make Modbus devices appear as individual BACnet devices. Using the concept of virtual routing, each connected Modbus device is treated as a separate BACnet device with object points representing Modbus registers selected from the addressed device.

Controllers

The BAScontrol and BASpi Open Control Series utilize BACnet/IP as an open communications protocol, Sedona function block diagram (FBD) programming, and the free BAScontrol Toolset for unrestricted use in program development and archiving. Ideal for unitary control of air-handlers (AHUs), fan coils (FCUs), and rooftop units (RTUs), these controllers are freely-programmable and customizable. The BASpi series offers additional features such as graphical dashboards and cloud connectivity.

Communicating Thermostats

The BASstat line of BACnet Communicating Thermostats feature BACnet functionality over MS/TP or Wi-Fi. Models exist for multi-staged heating/cooling of rooftop units (RTUs) and for 2-pipe or 4-pipe fan coils (FCUs). These devices can easily be supervised by BACnet clients.

I/O Modules

For those installations that support a fieldbus solution such as Modbus RTU or BACnet MS/TP, Contemporary Controls provides solutions for expanding the number of I/O points in the field. Cost-effective Cube I/O modules are available with analog and digital inputs and outputs in varying combinations.

Original Design Manufacturing

Contemporary Controls designs and manufacturers networking and control products used in various automation industries where performance and reliability are essential. These products, along with our comprehensive design experience, allow us to offer original design manufacturing (ODM) services where we provide the product you require under your brand.
BASview3 – Web-based Graphical Interface for Buildings

BASview3 is a stand-alone, embedded, web-based graphical interface for building automation and process automation systems. It can be accessed from any web browser providing client functionality to any BACnet/IP or Modbus TCP system. By using BASrouter or BASgateway products, additional protocols such as BACnet MS/TP and Modbus RTU can be integrated. Supervisory features include animated graphic screens, scheduling, historical trending, runtime accumulation and email alarms/notifications. The BASview3 is totally self-contained, requiring no external PC or application for its use. Multiple web browser users can access the device simultaneously. It is ideal for medium-sized buildings or processes that require an easy and intuitive to use graphical interface with no licensing requirements.

Features

- BACnet/IP and Modbus TCP network supervisor
- Animated graphics & dashboards
- Schedules with sunrise/sunset offsets
- Trend collection, display and export
- Runtime accumulation with email notification
- Alarm condition monitoring with email notification
- Calculated point values (average, min, max, etc.)
- Simple scripting language for light control logic
- Database of up to 100 users and 100 user groups
- Multiple user permission levels
- Activity log for tracking important user actions
- Template system for quickly cloning points and graphics
- Support for up to 1,000 points
- No licensing requirements
- Convenient Installation – 24VAC/VDC powered and DIN-rail mountable
- Real time clock for time retention during power loss

Dashboard Graphics
The BASview3 is housed in a compact metal enclosure that is DIN-rail mounted. Powered by a 24VAC/VDC power source for convenience, and it can retain time in the event of power loss thanks to capacitor-backed RTC. Internally powered by a 1.2GHz quad-core CPU, it has 1GB RAM and 8GB of Flash memory for data storage. Simply connect the device to a BACnet/IP or Modbus TCP 10/100 Mbps Ethernet network to access both BACnet and Modbus compliant equipment.

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
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<tbody>
<tr>
<td>BASV-3</td>
<td>BACnet/IP Supervisor HTML5 Graphical Interface</td>
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</table>
Mango Embedded Supervisor – Supports Multiple Protocols

The Mango Embedded Supervisor is an advanced stand-alone web-based supervisor that uses built-in protocols such as BACnet and Modbus for managing downstream automation devices found in building automation, energy monitoring and data center monitoring. Intended for medium-sized systems, it supports up to 1,000 points for which there is no license required. The Mango Embedded Supervisor runs on a 1.2GHz quad-core CPU with 1GB of RAM and 4GB of user space eMMC Flash for data storage. Supervisory features include point trending historian, custom reports writer, alarming, scheduling, and data visualization.

Features

- 2x 10/100Mbps non-switched Ethernet ports
- 2x opto-isolated EIA-485 ports - one BACnet MS/TP and one Modbus RTU
- BACnet/IP, BACnet MS/TP, Modbus TCP, Modbus RTU, SNMP
- HTML5 web interface
- Up to 1,000 points - no point licensing required
- High performance historian, data logging and export of trends
- 4GB eMMC user space Flash data storage
- Advanced scheduling, graphically configured with exception calendar
- Alarms with notifications
- Dashboard designer, drag-and-drop dynamic web page and graphics editor
- Reporting and billing, with fully customized reports
- Multiple user permission levels
- Event log for tracking user actions
- Customizable user menu
- Convenient installation – 24VAC/VDC power and DIN-rail mounting in a metal enclosure
The Mango Embedded Supervisor has two 10/100 Mbps Ethernet ports and two isolated EIA-485 serial ports. It utilizes a 1.2GHz quad-core processor, 1GB of SRAM and 4GB of eMMC Flash for data storage. Housed in a metal enclosure, it is DIN-rail mounted and powered from a 24 VAC/VDC source. Resident protocol support includes BACnet/IP and MS/TP, Modbus TCP and RTU, SNMP and MQTT. Up to 1,000 points can be supervised with no point licensing.

<table>
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<tr>
<th>Model</th>
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<tr>
<td>BMES-2E2S</td>
<td>Mango Embedded Supervisor Dual Ethernet Dual EIA-485</td>
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</table>
BACnet Multi-Network Routing

Our compact BASrouter series of BACnet multi-network routers provides stand-alone routing between BACnet/IP, BACnet Ethernet, and BACnet MS/TP, thereby allowing the system integrator to mix BACnet network technologies within a single BACnet internetwork. New features include built-in BACnet diagnostic capabilities with visual analytics MS/TP status table, routing status table, network errors count, and traffic statistics. This allows the integrator to easily install robust BACnet networks and drastically speed up troubleshooting. Our compact BACnet routers come in two distinct models – the BASrouter is DIN-rail mounted and powered from a 24 VAC/VDC source while the Portable BASrouter is USB powered for portable use.

Flexible Communications
- 10/100 Mbps Ethernet with auto-negotiation and Auto-MDIX
- Optically isolated MS/TP port
- MS/TP baud rates range from 9.6-76.8 kbps

IP Network Support
- Web server for commissioning and troubleshooting
- Communication diagnostic web page
- BACnet/IP Broadcast Management Device (BBMD)
- Foreign Device Registration (FDR)

BASrouter – BACnet Multi-Network Router

The BASrouter routes messages between BACnet/IP and BACnet MS/TP and BACnet Ethernet networks. There are two physical communication ports. One is a 10/100 Mbps Ethernet port and the other an isolated MS/TP port. DIN-rail mounted and 24 VAC/VDC powered.

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
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<tbody>
<tr>
<td>BASRT-B</td>
<td>BASrouter BACnet/IP to MS/TP to Ethernet DIN-Rail Mount</td>
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</tbody>
</table>

Portable BASrouter – Portable BACnet Multi-Network Router

The Portable BASrouter routes messages between BACnet/IP and BACnet MS/TP networks. There are two physical communication ports. One is a 10/100 Mbps Ethernet port and the other an isolated MS/TP port. For power, the BASRTP-B attaches to the USB port of a laptop computer.

<table>
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<tr>
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<tbody>
<tr>
<td>BASRTP-B</td>
<td>BASrouter Portable BACnet/IP to MS/TP to Ethernet</td>
</tr>
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</table>
BACnet Multi-Network Routing and Wireshark® Capture

The BASrouterLX is a high-performance BACnet router providing stand-alone routing between BACnet networks such as BACnet/IP, BACnet Ethernet (ISO 8802-3), and BACnet MS/TP. Besides its high-speed processor, it has advanced features such as MS/TP Backbone, Backward Routing, Whitelist option for enhanced security, MS/TP slave proxy support (allowing auto-discovery of MS/TP slaves) and MS/TP frame capture and storage for use with Wireshark®. As a BBMD, up to 50 BDT and 147 FDR entries can be supported. The BASrouterLX has two physical communication ports – a 10/100 Mbps BACnet/IP Ethernet port and an optically-isolated EIA-485 port for MS/TP. Router configuration is accomplished via web pages.

Versatile Routing Between …
- BACnet/IP and BACnet MS/TP
- BACnet Ethernet and BACnet MS/TP
- BACnet/IP and BACnet Ethernet
- BACnet/IP and BACnet Ethernet and BACnet MS/TP
- Two BACnet/IP networks (between two UDP ports)

Convenient Installation
- 24 VAC/VDC (± 10%), 47–63 Hz input voltage
- Din-rail mount (BASRTLX-B) or panel mount (BASRTLX-B/P)

IP Network Support
- Web server for commissioning and troubleshooting
- MS/TP capture using Wireshark
- BACnet/IP Broadcast Management Device (BBMD)
- Foreign Device Registration (FDR)

Flexible Communications
- 10/100 Mbps Ethernet with auto-negotiation and Auto-MDIX
- Supports MS/TP slave auto-discovery and proxy
- MS/TP Backbone
- Backward Routing
- Whitelist
- Optically-isolated MS/TP port
- MS/TP baud rates range from 9.6–115.2 kbps

BASrouterLX – High Performance BACnet Router

The BASrouterLX high-performance router routes messages between BACnet/IP and BACnet MS/TP and BACnet Ethernet networks. There are two physical communication ports. One is a 10/100 Mbps Ethernet port and the other an isolated MS/TP port. The product features Wireshark capture. DIN-rail mounted and 24 VAC/VDC powered.

<table>
<thead>
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<th>Model</th>
<th>Description</th>
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<tbody>
<tr>
<td>BASRTLX-B</td>
<td>BASrouterLX High Performance BACnet Router DIN-Rail Mount</td>
</tr>
<tr>
<td>BASRTLX-B/P</td>
<td>BASrouterLX High Performance BACnet Router Panel Mount</td>
</tr>
</tbody>
</table>
High-Performance BACnet Cellular Router

The BASrouterCX is a high-performance BACnet cellular router providing the combined functionality of a BACnet router with stand-alone routing between BACnet/IP, BACnet Ethernet, and BACnet MS/TP networks, as well as a cellular VPN remote access router. Thanks to its built-in cellular modem, it can communicate over cellular networks and provide a remote VPN client connection, creating a secure tunnel for remote access communication to BACnet networks. This combined functionality allows for local BACnet routing as well as secure remote access to sites where a wired Internet connection is not an option. The BASrouterCX can be used with Contemporary Controls’ RemoteVPN service, as well as Self-HostedVPN which requires no monthly subscriptions. Powered by a high-performance processor, the BASrouterCX has advanced features such as BACnet MS/TP slave proxy support (allowing auto-discovery of MS/TP slaves), MS/TP backbone, enhanced security features such as a stateful firewall, whitelist, broadcast I-Am blocking, and encrypted VPN tunnel. As a BACnet Broadcast Management Device (BBMD), up to 50 BDT and 147 FDR entries are supported. The BASrouterCX has a 10/100 Mbps Ethernet port, a cellular port, and an opto-isolated EIA-485 port for BACnet MS/TP. Wide temperature operation makes the BASrouterCX suitable for indoor and outdoor installations.

Versatile Routing Between...
- BACnet/IP and BACnet MS/TP
- BACnet Ethernet and BACnet MS/TP
- BACnet/IP and BACnet Ethernet
- BACnet/IP and BACnet Ethernet and BACnet MS/TP
- Two BACnet/IP UDP ports
- Two BACnet/IP networks – local and cellular

Flexible Communications
- 10/100 Mbps Ethernet with auto-negotiation and Auto-MDIX
- LTE cellular communication
- Supports BACnet MS/TP slave auto-discovery and proxy
- Opto-isolated EIA-485 port
- MS/TP baud rates range from 9.6–115.2 kbps

IP Network Support
- Web page for commissioning, troubleshooting and firmware updates
- BACnet/IP Broadcast Management Device (BBMD)
- Foreign Device Registration (FDR)
- Stateful firewall
- Broadcast I-Am blocking
- Whitelist
- VPN client

Convenient Installation
- 24 VAC/VDC (± 10%), 47–63 Hz input voltage
- Din-rail mounted
- Wide temperature operation -40 to +75 °C

BASrouterCX - High-Performance BACnet Cellular Router

<table>
<thead>
<tr>
<th>Model</th>
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<tbody>
<tr>
<td>BASRTCX-C1</td>
<td>BACnet Cellular Router AT&amp;T/Verizon 4G LTE CAT4</td>
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<tr>
<td>BASRTCX-C2</td>
<td>BACnet Cellular Router Europe CAT4</td>
</tr>
<tr>
<td>BASRTCX-C3</td>
<td>BACnet Cellular Router Verizon 4G LTE CAT1</td>
</tr>
</tbody>
</table>
Modbus to BACnet Gateway

Modbus remains a popular network interface and is commonly found on jobs such as boiler control, variable speed drives, and metering applications, but these devices lack BACnet compliance. To make Modbus devices appear as individual BACnet devices, a BASgatewayLX is used. This device has one 10/100 Mbps Modbus TCP and BACnet/IP Ethernet port and an opto-isolated Modbus EIA-485 serial port for Modbus RTU or Modbus ASCII devices. Up to 100 Modbus serial devices represented by up to 1,000 polled points can share the single Modbus EIA-485 port on the BASgatewayLX. BACnet COV notification is supported on 200 points (100 Analog and 100 Binary points). The virtual routing feature in the BASgatewayLX allows each connected Modbus device to appear as an individual BACnet compliant device. A device profile is needed for each Modbus type device. Contemporary Controls maintains a library of freely-available device profiles available for download. If the device profile is not available, Contemporary Controls will provide it upon request. Custom Modbus device profiles can also be uploaded to the BASgatewayLX using a web page. Modbus data points from Modbus Serial or Modbus TCP/IP devices can be mapped to BACnet objects.

Using web pages and a resident database of common Modbus device profiles, Modbus data points from Modbus Serial or Modbus TCP devices can be mapped to BACnet objects.

Over 100 pre-built devices are available from the Contemporary Controls device profiles library.

BASgatewayLX – Modbus to BACnet Gateway

The BASgatewayLX is housed in a metal case that mounts on 35-mm DIN-rail and it is powered from a 24 VAC/VDC (± 10%) source. Its half-wave rectified power supply allows sharing of power with other half-wave devices. The optically-isolated serial port allows for connection to either 2-wire or 3-wire EIA-485 networks using a removable 5-pin terminal block. Up to 100 EIA-485 Modbus devices can share the serial bus at data rates between 2.4 and 115.2 kbps. Internal jumpers allow flexible bias and termination options. They can be removed for mid-span installations. A resident web server allows for commissioning and troubleshooting via a standard web browser.

<table>
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<th>Model</th>
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<tr>
<td>BASGLX-M1</td>
<td>BASgatewayLX Modbus to BACnet Gateway DIN-Rail Mount</td>
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<tr>
<td>BASGLX-M1/P</td>
<td>BASgatewayLX Modbus to BACnet Gateway Panel Mount</td>
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</tbody>
</table>
IoT Cellular Gateways – BACnet and Modbus

The EIOT series of high-performance IoT gateways provide easy BACnet or Modbus device VPN remote access as well as cloud connectivity to the Azure IoT Central (SaaS) cloud solution. A cellular connection makes them ideal for sites where a wired Internet connection is not an option. A web page configurable cloud connector makes cloud configuration quick and easy. By leveraging open IoT protocols such as MQTT and proven security mechanisms such as Transport Layer Security (TLS), the EIOT gateways provide the secure connection point between the cloud and local devices to push raw or scaled/calculated/transformed BACnet or Modbus point data to the cloud. Azure IoT Central cloud provides features such as email alarming, scheduling, web-based dashboard with gauges, charts, sliders, and other data visualization widgets as well as trending of data in the cloud and passing control/configuration commands from the cloud to local devices.

Two EIOT models exist. The EIOT-M provides cloud connectivity to Modbus RTU and Modbus TCP devices. The EIOT-B supports BACnet/IP and BACnet/MSTP devices. An OpenVPN client provides a secure VPN remote access option. The EIOT series of IoT gateways has a built-in cellular port, a 10/100 Mbps Ethernet port and an opto-isolated EIA-485 port with DIP switch configuration for bias and termination.

The built-in cellular LTE modem and wide temperature range of operation make the EIOT series of IoT gateways convenient for indoor or outdoor installation at remote locations, providing connectivity and visibility for equipment with limited connection capabilities. Sedona function block diagram (FBD) programmable control and data processing at the Edge is standard in the EIOT gateways. Connected end devices can be controlled with user defined logic and their point data can be processed prior to pushing it to the cloud. The EIOT gateways can send supervisory commands such as setpoints, control configuration parameters, and event triggers from the cloud making them ideal for remote asset management and supervision. The EIOT gateways make any BACnet or Modbus device a cloud connected asset.

Versatile IoT gateway
- BACnet/IP and BACnet MS/TP to cloud gateway (EIOT-B)
- Modbus TCP and Modbus RTU to cloud gateway (EIOT-M)
- Azure IoT Central (SaaS) cloud connected
- Resident Sedona Virtual Machine (SVM)
- Function block diagram (FBD) programmable control and data processing at the Edge using Sedona
- Email/SMS alarms/notifications
- Free programming toolset

Flexible Communications
- 10/100 Mbps Ethernet with auto-negotiation and Auto-MDIX
- LTE cellular communication
- Opto-isolated EIA-485 port
- EIA-485 port baud rates range from 9.6–115.2 kbps

Convenient Installation
- 24 VAC/VDC (± 10%), 47–63 Hz input voltage
- Din-rail mounted
- Diagnostic LED – cellular signal strength
- Wide temperature operation -40 to +75 °C

IP Network Support
- Web page for commissioning, troubleshooting and firmware updates
- Stateful firewall
- VPN client for remote access
IoT Cellular Gateways – BACnet and Modbus

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<tbody>
<tr>
<td>EIOT-M</td>
<td>Modbus Network IoT Cellular Gateway</td>
</tr>
<tr>
<td>EIOT-B</td>
<td>BACnet Network IoT Cellular Gateway</td>
</tr>
</tbody>
</table>
The Advantages of a BAScontrol Open Controller

Contemporary Controls has always supported open protocols like BACnet, but BACnet does not provide control, only a standardized method for communications. Having BACnet is not sufficient when you are locked out of a job due to a proprietary programming language, licensing restrictions, or a proprietary programming tool only available to “partners.” The BAScontrol Series is Contemporary Controls’ way of providing a truly open controller by having:

- An open communications network in IP Ethernet
- An open industry supported building automation protocol in BACnet
- An open control language that is license-free in Sedona
- A free programming tool that is available to all without restriction in the Sedona Application Editor

The BAScontrol series utilizes a powerful 32-bit ARM7 processor with 512 KB of flash memory plus a 16 Mbit serial flash file system for storing configuration data and an application program. By operating at the BACnet/IP level, the BAScontrol20/22 can share the same Ethernet network with supervisory controllers and operator workstations. Each unit can be configured for a fixed IP address or can operate as a DHCP client receiving its IP address from a DHCP server. A real-time clock with a super-cap backup allows for creating local schedules. A 10/100 Mbps Ethernet port supports protocols such as BACnet/IP, Sedona SOX, HTTP and FTP. Configuration of universal inputs and virtual points can be accomplished using web pages. Type II and type III 10 kΩ thermistor curves and a 20 kΩ thermistor curve are resident in the unit. Current inputs can be measured using external resistors. Contact closures require a voltage-free source. Binary inputs and outputs as well as analog outputs require no configuration. The unit is powered from a 24 VAC/VDC source.

BAScontrol20 – 20-Point BACnet/IP Sedona Unitary Controller

The BAScontrol20 is a 20-point BACnet/IP, Sedona-programmable unitary controller with direct connection to an Ethernet network. The unit complies with the B-ASC device profile having a convenient mix of 8 universal inputs, 4 binary inputs, 4 analog outputs and 4 relay (20R) or triac (20T) outputs. The controller is fully web page configurable using a common web browser, and freely-programmable using Contemporary Controls’ free Sedona Application Editor (SAE). Rugged metal design, low profile, and wide temperature operation make it suitable for indoor or outdoor use.

<table>
<thead>
<tr>
<th>Model</th>
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<tbody>
<tr>
<td>BASC-20R</td>
<td>BAScontrol20 BACnet Server 20-Point 4 Relays</td>
</tr>
<tr>
<td>BASC-20T</td>
<td>BAScontrol20 BACnet Server 20-Point 4 Triacs</td>
</tr>
<tr>
<td>BASC-20CR</td>
<td>BAScontrol20 BACnet Client/Server 20-Point 6 Relays</td>
</tr>
</tbody>
</table>
Controllers

Client/Server Operation

All BAScontrol series models have B-ASC device profiles meaning they are BACnet server devices that respond to commands initiated by BACnet clients. However, there is one model in the BAScontrol22 series that also provides BACnet client functionality at a slight cost in wire sheet memory usage. The BASC-22CR uses a NetV Sedona component that can initiate a read or write operation to a point on another BACnet device within the BACnet inter-network. There is a configuration page on the BASC-22CR to identify the BACnet server devices to be accessed. Once device configuration is completed, a NetV component can be placed on the wire sheet and configured for each object point and type to be accessed on the server devices. With client capability, a BAScontrol can supervise points on other BACnet/IP controllers or BACnet MS/TP controllers using a BACnet router without the need of a BACnet head-end.

BAScontrol22 – 22-Point BACnet/IP Sedona Unitary Controller

The BAScontrol22 is a 22-point BACnet/IP, Sedona-programmable unitary controller with a 2-port Ethernet switch for connection to an Ethernet network. The unit complies with the B-ASC device profile having a convenient mix of 8 universal inputs, 4 binary inputs, 4 analog outputs and 6 relay outputs. The controller is fully web page configurable using a common web browser, and freely-programmable using Contemporary Controls’ free Sedona Application Editor (SAE). Rugged metal design, low profile, and wide temperature operation make it suitable for indoor or outdoor use.

<table>
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<tbody>
<tr>
<td>BASC-22CR</td>
<td>BAScontrol22 BACnet Client/Server 22-Point 6 Relays</td>
</tr>
<tr>
<td>BASC-22R</td>
<td>BAScontrol22 BACnet Server 22-Point 6 Relays 2xRJ45 Switch</td>
</tr>
</tbody>
</table>

Pre-Built Constant Volume RTU Sedona Applications make it easy to utilize a Contemporary Controls’ BAScontrol22 BACnet/IP Sedona Unitary controller in constant volume air-handling (AHU) or constant volume rooftop unit (RTU) applications. Although the BAScontrol22 is a freely-programmable controller using Sedona as the control language, it can be made into a configurable controller by installing one of five versions (CvRTUv1-CvRTUv5) of constant volume AHU/RTU applications into the controller from the CvRTU Application Series.
Creating the Next Generation Controller

The mass popularity of powerful micro PCs such as the Raspberry Pi brings low-cost computing power to technical professionals and hobbyists alike. Suitable for most field installations, they also provide an excellent training and experimental platform for individuals interested in controls and automation. Contemporary Controls, committed to open controls, is contributing to this effort by offering controller products under the BASpi name which are powered by the Raspberry Pi. The BASpi-I/O series offers the option of purchasing just I/O daughterboards, also called “hats” which can be mounted on Raspberry Pi and combined with our firmware image to create a powerful DDC controller. BASpi free downloads include the firmware image providing web server for monitoring and configuration, BACnet communication, function block diagram (FBD) programmable sequence of operation using Sedona, as well as free programming tools – the BAScontrol Toolset. Individuals can develop applications for their unique needs and are encouraged to share them with Contemporary Controls’ community.

BASpi-I/O – Board-Level Controllers

The BASpi I/O daughterboards are 12-point expansion boards for the Raspberry Pi with models that differ only in the makeup of their outputs. An I/O board, plus the downloaded firmware image provided by Contemporary Controls turn your Raspberry Pi into a BACnet connected, Sedona programmable controller with 6 universal inputs and 6 relay outputs or 4 relay outputs and 2 analog outputs (model dependent). The universal inputs can be configured for binary input, analog input, thermistor, resistance or pulse. In addition to 12 physical I/O points there are 24 virtual points – all configurable as BACnet points. A total of 48 web components are usable for configuration points accessible through a common web browser. The BASpi communicates over 10/100 Mbps Ethernet or Wi-Fi.

To create a BASpi controller, download the free firmware image from Contemporary Controls’ website, burn a micro SD card with the image, mount it into your Raspberry Pi micro SD slot, place one of the BASpi I/O daughterboards on the Raspberry Pi, and boot your new DDC controller. This simple process makes a powerful 12-point BACnet/IP Sedona programmable controller.

Versatile Control Device
- BACnet/IP server over 10/100 Mbps Ethernet or Wi-Fi
- Resident Sedona Virtual Machine (SVM)
- Web page configurable over Ethernet or Wi-Fi
- Email alarms/notifications
- NTP server or manually settable clock
- Free BAScontrol Toolset
  - Sedona Applications Editor (SAE)
  - BASemulator – BASpi controller emulation on PC
  - BASbackup – BASpi project utility

Flexible Input/Output – 12-points of physical I/O
- Six configurable universal inputs: analog input (0-10V), binary input, resistance, thermistor (10kT2, 10kT3, 20k), pulse input (40Hz max)
- Four or six relay outputs (30 V @ 2A max current)
- Two or zero analog outputs (0-10V)
- 24 Virtual Points (VT) communicate with BACnet clients and supervisory workstations
- 48 Web Components (WC) communicate with web browser for monitoring and configuration

BASpi-I/O Series – Board-Level Controllers

The BASpi I/O daughterboards do not include a Raspberry Pi or a micro SD card. Free firmware must be downloaded from the Contemporary Controls’ website to create a BASpi controller.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>BASPI-I06U6R</td>
<td>Raspberry Pi Daughterboard 6UI/6 Relay</td>
</tr>
<tr>
<td>BASPI-I06U4R2A</td>
<td>Raspberry Pi Daughterboard 6UI/4 Relay/2 Analog Out</td>
</tr>
</tbody>
</table>
BASpi-Edge – Cloud Connected BACnet Controllers

The BASpi-Edge series are hardened controllers with enhanced features and data processing at the Edge functionality, powered by Raspberry Pi. Housed in a compact 4U (70mm wide) DIN rail mounted enclosure with 24 VAC/VDC power input and a resilient pSLC 8GB micro SD card gives them performance and convenience advantages, making them suitable for a wide array of applications. BACnet client/server communication over Ethernet or Wi-Fi, function block diagram (FBD) programmable control, and data processing at the Edge using Sedona come standard.

The BASpi-Edge are fully web page configurable with quick and easy cloud connectivity to Azure IoT Central (SaaS) cloud solution. Additional features such as email alarms/notifications, schedules with holidays/exceptions, weather web service, as well as graphical dashboards served over Ethernet, Wi-Fi, or directly out of the resident HDMI port, make the BASpi-Edge ideal for standalone or BACnet supervised automation applications. These Edge controllers can communicate with the local operational network and supervisory stations or other Edge controllers using the industry standard protocol – BACnet.

By leveraging open IoT protocols such as MQTT, proven security mechanisms such as Transport Layer Security (TLS), and robust and easy to use software as a service cloud solutions (SaaS) such as Azure IoT Central, BASpi-Edge controllers can easily and securely connect to the cloud, effectively making any attached equipment a cloud connected asset. Cloud connectivity is optional, but it provides excellent global asset management and supervision capabilities in multi-site building applications, or multi-branch store or retail chains.

Versatile Control Device
- BACnet/IP client/server over 10/100 Mbps Ethernet or Wi-Fi
- Resident Sedona Virtual Machine (SVM)
- Web page configurable over Ethernet or Wi-Fi
- Schedules with holidays/exceptions
- Email alarms/notifications
- Weather web service
- Azure IoT Central (SaaS) cloud connected
- Graphical dashboard served over Ethernet, Wi-Fi, or direct HDMI output
- NTP server or manually settable clock
- Free BAScontrol Toolset
  - Sedona Applications Editor (SAE)
  - BASemulator – BASpi controller emulation on PC
  - BASbackup – BASpi project utility

Flexible Input/Output – 12-points of physical I/O
- Six configurable universal inputs: analog input (0-10V), binary input, resistance, thermistor (10kT2, 10kT3, 20k), pulse input (40Hz max with retention to FRAM memory)
- Four or six relay outputs (30 V @ 2A max current)
- Two or zero analog outputs (0-10V)
- 48 Virtual Points (VT) communicate with BACnet clients and supervisory workstations
- 48 Web Components (WC) communicate with web browser for monitoring and configuration
- 24 VAC/VDC power and DIN rail mounted
BASpi-Edge Series – Cloud Connected BACnet Controllers

The BASpi-Edge series are hardened controllers with enhanced features and data processing at the Edge functionality, powered by Raspberry Pi. Housed in a compact 4U (70mm wide) DIN rail mounted enclosure with 24 VAC/VDC power input and a resilient pSLC 8 GB micro SD card.

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<tr>
<th>Model</th>
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<tbody>
<tr>
<td>BASPI-E6U6R</td>
<td>BACnet Edge Controller with 6UI/6 Relay</td>
</tr>
<tr>
<td>BASPI-E6U4R2A</td>
<td>BACnet Edge Controller with 6UI/4 Relay/2 Analog Out</td>
</tr>
</tbody>
</table>
BASpi-BCC – Small Building Supervisor

The BASpi-BCC (BACnet Client Controller) is a BACnet supervisory device powered by Raspberry Pi. Housed in a compact 4U (70mm wide) DIN rail mounted enclosure with 24 VAC/VDC power input and a resilient pSLC 8GB micro SD card makes for convenient installation. It is an ideal BACnet/IP and BACnet MS/TP small to medium building supervisor with function block diagram (FBD) programmable control and data processing at the Edge using Sedona. It serves as a supervisor to BACnet/IP devices over Ethernet or Wi-Fi and BACnet MS/TP devices over an opto-isolated EIA-485 port.

Using custom Sedona network variable components (NETV), the BASpi-BCC can command, schedule, alarm, and visualize BACnet/IP or BACnet MS/TP points on connected devices. Server points need not be Sedona compliant – just BACnet compliant. Any BACnet remote I/O such as Contemporary Controls' Cube I/O or BASstat MS/TP and Wi-Fi thermostats can be supervised by using the BASpi-BCC.

The small supervisor is fully web page configurable with quick and easy cloud connectivity to Azure IoT Central (SaaS) cloud solution. Features such as email alarms/notifications, schedules with holidays/exceptions, weather web service, as well as graphical dashboards served over Ethernet, Wi-Fi, or directly out of the resident HDMI port make it the ideal small supervisory device.

By leveraging open IoT protocols such as MQTT, proven security mechanisms such as Transport Layer Security (TLS), and robust and easy to use software as a service cloud solutions (SaaS) such as Azure IoT Central, the BASpi-BCC supervisor can easily and securely connect to the cloud, effectively making any BACnet/IP or MS/TP device a cloud connected asset. Cloud connectivity is optional, but it provides excellent global asset management and supervision capabilities in multi-site building applications, or multi-branch store or retail chains.

The BCC incorporates a communication daughterboard with a 3-wire opto-isolated EIA-485 port for driving isolated or non-isolated BACnet MS/TP devices with a bias/termination DIP switch and power, status, and transmit/receive LEDs. The unit has a 24 VAC/VDC power input and a real-time clock with super-cap retention of date and time in the case of power loss.

**Versatile Client Device**
- BACnet/IP client/server over 10/100 Mbps Ethernet or Wi-Fi
- BACnet MS/TP client/server over 3-wire opto-isolated EIA-485 serial port
- BACnet utility and MS/TP communication statistics for troubleshooting
- Resident Sedona Virtual Machine (SVM)
- Web page configurable over Ethernet or Wi-Fi
- Schedules with holidays/exceptions
- Email alarms/notifications
- Weather web service
- Sunrise/sunset by geolocation
- Azure IoT Central (SaaS) cloud connected
- Graphical dashboard served over Ethernet, Wi-Fi, or direct HDMI output
- NTP server or manually settable real-time clock with supercap retention
- Free BAScontrol Toolset
  - Sedona Applications Editor (SAE)
  - BASemulator – BASpi controller emulation on PC
  - BASbackup – BASpi project utility

**Flexible Input/Output — Supervises Remote BACnet I/O**
- Supervise BACnet/IP and MS/TP connected device
- Make any BACnet/IP or MS/TP device a cloud connected asset
- DIP switch selectable termination and bias
- Power, status, transmit and receive LEDs
- 192 Virtual Points (VT) communicate with BACnet clients and supervisory workstations
- 48 Web Components (WC) communicate with web browser for monitoring and configuration
- 24 VAC/VDC power and DIN rail mounted
The BASpi-BCC (BACnet Client Controller) is a BACnet supervisory device powered by Raspberry Pi. Features such as email alarms/notifications, schedules with holidays/exceptions, weather web service, as well as graphical dashboards make it an ideal small supervisory device.

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<tr>
<td>BASPI-EBCC</td>
<td>Small Building BACnet Supervisor with Cloud Connection</td>
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</table>
BAScontrol Toolset

Contemporary Controls has developed the BAScontrol Toolset, which simplifies controller programming and project archiving for the BAScontrol Series and the BASpi. The following tools are included in the free BAScontrol Programming Toolset.

**Sedona Application Editor** (SAE) is used to connect to Sedona devices (SVM), write/edit function block diagram (FBD) Sedona wire sheet control applications and to make local wire sheet application (SAX file) backups to a Windows PC or laptop.

- Powerful drag-and-drop function block diagram (FBD) programming methodology
- Fast and easy to learn
- Pre-assembled components for quick and easy program development
- Continuously growing library of components
- Program changes execute immediately
- Programs run stand-alone and can interact with BACnet clients and supervisory controllers

**BASemulator** is the next best thing to a real controller. It is a full controller emulator for the BAScontrol and BASpi series which runs on Windows computers and works in conjunction with Sedona Application Editor and BASbackup Project Utility. This controller emulator allows you to write your Sedona wiresheet application and fully configure all parameters such as Network Settings, I/O Channel Configuration, and BACnet Settings before deploying onto real controllers. The emulator can also be used for training and education purposes because it runs on any standard Windows PC.

**BASbackup** allows you to quickly and easily backup and restore both a Sedona wiresheet application, as well as complete device configuration to a single project file – making a comprehensive copy of your BAScontrol or BASpi project. This file is transferable between real controllers or emulated controllers (using BASemulator). In addition, BASbackup allows you to clone controllers or reproduce controllers with the ability to alter device configuration settings such as IP address and BACnet device instance during the process which is useful for quick and easy device commissioning in the field.

The BAScontrol Toolset is available as a free download and supports the BAScontrol, BASpi, and EIOT series.
Communicating Thermostats

BACnet-Compliant Thermostats

The BASstat line of BTL-listed BACnet Communicating Thermostats feature BACnet server functionality over MS/TP or Wi-Fi. Models exist for multi-staged heating/cooling of rooftop units (RTUs) and for 2-pipe or 4-pipe fan coils (FCUs). These devices can easily be supervised by BACnet clients. All models feature an attractive wall-mounted enclosure with large LCD display indicating setpoint, space temperature and modes of operation using icons. Each BASstat has a built-in space temperature sensor or can be programmed to use a remote 3 kΩ thermistor. Units are configurable using its display or via a network connection to a BACnet client. Controller parameters such as deadband, proportional gain, integral rate, stage trip points, stage widths, as well as occupied and unoccupied setpoints are all configurable. Operator control is accomplished with six buttons – mode, fan, raise, lower, set and power. The operator can override occupancy selection.

Intended for controlling RTUs, the 5-relay staged-heating/cooling models can control one or two stages of heating and one or two stages of DX cooling with short-cycle protection. One relay is reserved for controlling the fan. There are two models with the only difference in the way the thermostat communicates with a BACnet client – one over MS/TP and the other over Wi-Fi.

For fan coils there is an analog model with two analog outputs that allow for either 2-pipe or 4-pipe operation with one relay output for fan. This model is only available with MS/TP.

Common Features
- Large back-lit LCD display in °C or °F with informative icons
- Local or network configurable from a BACnet client
- Ventilation, heating, cooling modes with manual or automatic changeover
- Automatic single-speed or continuous fan control
- Occupied and unoccupied setpoints with temporary override
- Remote sensor option
- 24 VAC powered

Staged Heating/Cooling Models
- Single- or dual-stage heating/cooling

Analog Heating/Cooling Models
- 2-pipe or 4-pipe operation
- Two 0/2-10V analog outputs
- Direct or reverse action configuration

Wired Model Features
- BACnet MS/TP
- Baud rates from 9.6–76.8 kbps

Wireless Model Features
- BACnet/IP
- Wi-Fi (IEEE 802.11 b/g/n)

BASstat – BACnet Communicating Thermostat

The BASstat series of BACnet-compliant communicating thermostats are BTL listed and capable of controlling single- and dual-stage rooftop units or 2-pipe or 4-pipe fan coils. These units can be configured locally or over the network. The wired models are BACnet MS/TP compliant while the wireless model is BACnet/IP compliant over Wi-Fi.

<table>
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<tr>
<td>BAST-221C-B2</td>
<td>BACnet MS/TP Thermostat 2-Heat/2-Cool/1-Fan Wired</td>
</tr>
<tr>
<td>BAST-221C-BW2</td>
<td>BACnet/IP Thermostat 2-Heat/2-Cool/1-Fan Wi-Fi</td>
</tr>
<tr>
<td>BAST-421A-B2</td>
<td>BACnet MS/TP Thermostat 4-Pipe/2-AO/1-Fan Wired</td>
</tr>
</tbody>
</table>
For those installations that require that field input/output devices must be distributed away from the central controller or simply that more points are needed in Class 2 field installations, Contemporary Controls has a solution for both BACnet MS/TP and Modbus RTU systems. These compact cost-effective Cube I/O modules are available with varying configurations of analog and digital inputs and outputs. Digital input modules can be configured to support either “wet or dry” contacts up to 10 points. There are also analog input modules to measure voltage and resistance, analog output modules that output voltage, relay output modules and mixed digital input/output modules. All modules operate from a 24 VAC/VDC supply.

### Cube I/O BACnet MS/TP

#### Input Modules

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<tr>
<td>BMT-DI4</td>
<td>BACnet MS/TP 4 Digital Inputs</td>
</tr>
<tr>
<td>BMT-DI10</td>
<td>BACnet MS/TP 10 Digital Inputs</td>
</tr>
<tr>
<td>BMT-SI4</td>
<td>BACnet MS/TP 4 Retentive Pulse Counting Inputs</td>
</tr>
<tr>
<td>BMT-AI8</td>
<td>BACnet MS/TP 8 Resistance or Voltage Inputs</td>
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#### Output Modules

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<tr>
<td>BMT-DO4</td>
<td>BACnet MS/TP 4 Digital Relay Outputs w/ HOA</td>
</tr>
<tr>
<td>BMT-AO4</td>
<td>BACnet MS/TP 4 Analog Outputs 0 to 10 VDC</td>
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#### Mixed Input and Output Modules

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<tr>
<td>BMT-DIO4/2</td>
<td>BACnet MS/TP 4 Digital Inputs &amp; 2 Relay Outputs w/ HOA</td>
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### Cube I/O Modbus RTU

#### Input Modules

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<td>Modbus RTU 4 Digital Inputs</td>
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<td>MR-DI10</td>
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<td>MR-SI4</td>
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High Value Solutions for Unique Projects

Contemporary Controls designs and manufacturers networking and control products used in various automation industries where performance and reliability are essential. These products, along with our comprehensive design experience, allow us to offer original design manufacturing (ODM) services where we provide the product you require under your brand.

With more than 40 years of experience in electronics design, development and manufacturing, we have a rich inventory of intellectual property that can be tapped for your next project. Two design and manufacturing locations provide private-label and ODM services. Leverage our design and manufacturing resources to reduce your costs and time-to-market.

Case Study: Application Ready Platform

Automation Platform

The Automation Platform is a robust and powerful hardware platform ready to run any application software compliant with the Raspberry Pi. Intended for non-stop automation projects, the Automation Platform builds upon the high-speed Raspberry Pi Compute Module by including two isolated EIA-485 serial ports suitable for BACnet MS/TP, Modbus RTU or other serial protocols, and two Ethernet ports.

If your application software can run on a Raspberry Pi, it will most likely run on our Automation Platform. Use our hardware expertise to bring your software application to market faster under your brand with the Automation Platform.

What We Design, We Make

Contemporary Controls has two manufacturing locations, one in Downers Grove, Illinois and the other in Suzhou, PRC. Both operations are ISO9001:2015 registered and are under Underwriters Laboratories (UL) surveillance. In addition to self-manufacturing, Contemporary Controls sources complementary networking and control products for the convenience of our customers. The US operation has modern Panasonic multi-function, surface-mount technology (SMT) process lines that produce sophisticated, lead-free, high-density printed circuit board assemblies (PCBAs) that incorporate ball-grid-array (BGA) components. These PCBAs are then installed into their enclosures, tested and stored in their final packaging in an environmentally-controlled warehouse ready for worldwide shipment.

While the US operation is ideal for prototyping, and producing high-mix, low-volume and Made in USA products, the China operation with its sourcing partners are better suited for high-volume, low-mix production. In either location, intellectual property is protected.

Both plants adhere to ISO9001 quality procedures and follow IPC workmanship standards recognized in the electronics industry. Both plants are under Underwriters Laboratories (UL) surveillance.

Quality Policy

Contemporary Controls develops, manufactures and markets innovative networking and control products to the benefit of our automation customers worldwide. We are committed to delivering products and services that meet customer requirements and strive to exceed their expectations through our continuous improvement efforts.
Ethernet Built for Buildings

Whatever the Ethernet infrastructure need, a solution is available from CTRLink. For simple systems, plug-and-play unmanaged switches can be put into service without adjustments and provide a simple, cost-effective method for expanding Ethernet networks. Most models include features such as auto-MDIX and auto-negotiation.

For more demanding applications, the ultimate in performance and flexibility can be found in a SNMP compliant managed switch. By configuring the switch through either a web page or console screen, features such as virtual LANs, Quality of Service, cable redundancy and port mirroring can be invoked.

For troubleshooting, the diagnostic switch retains all the virtues of a switch with one exception – no address learning. All messages – directed, multicast, broadcast – are flooded to all ports on the switch allowing a protocol analyzer tool such as Wireshark the ability to observe all traffic on the network.

If no fiber optic ports are available on equipment to be connected, a media converter will do the trick. Media converters offer the lowest latency because they are pure media converters and not 2-port switches. Conversion from copper to fiber optic cabling is possible without the loss of auto-negotiation features.

While Ethernet switches can expand a single Ethernet network, IP routers connect two Internet Protocol (IP) networks together, passing appropriate traffic while blocking all other traffic. One of the networks is designated the local-area-network and the other the wide-area-network. IP routers are used to isolate traffic and for gaining access to remote equipment. CTRLink provides several secure wired and wireless network solutions.

Power over Ethernet (PoE) provides data and power over one cable, thereby eliminating the need for additional power supplies for Ethernet-enabled devices placed in challenging locations, such as wireless access points or IP cameras on a ceiling or outdoors.

Smoke and Fire UL 864

The CTRLink product line includes products that comply with the requirements of Underwriters Laboratories (UL) 864 Control Units and Accessories for Fire Alarm Systems 10th Edition. A UL recognized component has already been evaluated and tested in accordance with UL’s component safety standards, streamlining the qualification process for the system supplier.
Simplified Remote Access Minimizes Site Visits

Utilizing the Internet for remote commissioning provides convenience while saving time and money, but accessing machines at job sites can be difficult because firewalls block messages that originate from the Internet. Although it is possible to open ports in firewalls using port forwarding, IT professionals are often reluctant to compromise the security of their network and usually decline this type of request. Without support from the IT department, the systems integrator is usually left with very few options. However, one solution is to incorporate a virtual private network (VPN). By hosting a VPN server in the cloud, our RemoteVPN server simplifies communication over the Internet while maintaining security.

Contemporary Controls’ RemoteVPN subscription service incorporates a cloud-based OpenVPN® server, OpenVPN clients for workstations and mobile devices, and OpenVPN routers installed at job sites. OpenVPN is open-source and incorporates SSL/TLS security with encryption.

How it works

The RemoteVPN server, hosted on the Internet and maintained by Contemporary Controls, allows OpenVPN client devices to communicate together. Communication initiated by OpenVPN clients pass through firewalls up to the RemoteVPN server which completes the client connections. All that is needed is an account on the server to utilize the RemoteVPN service.

OpenVPN clients are easy to obtain and can be downloaded from OpenVPN.net, or via Google Play for Android devices, or via the Apple App Store for iOS devices.

CTRLLink Gigabit VPN routers such as the EIGR-V and EIGR-C provide OpenVPN client communication at the job sites. These routers have four 10/100/1000 Mbps Ethernet LAN ports and a single WAN port for connection to the Internet. The EIGR-V WAN port is 10/100/1000 Mbps Ethernet while the EIGR-C uses a built-in LTE cellular modem. If wired Internet access is not yet available at the job site then choose cellular.

RemoteVPN is an easy, cost-effective remote access solution that allows you to proactively review and communicate with your customers’ automation systems – resulting in valuable time and money savings.
Host Your Own OpenVPN Server and Eliminate Subscription Fees

The RemoteVPN subscription service provides security and convenience. However, for network-savvy customers wishing to avoid subscription fees, the newly released EIGR routers can be configured to operate in OpenVPN server mode, thereby eliminating the cloud service and related fees. Setting up an OpenVPN server on your own is not trivial. It involves setting up a root certificate authority and generating certificates and keys for the OpenVPN server and for each client device that intends to connect to this server. However, the EIGR-V's built-in webpages facilitate the tasks without requiring downloaded software to generate certificates or keys. One EIGR-V set to OpenVPN server mode and assigned a fixed public IP address resides at the client site or any other convenient site and uses the Internet for communicating to OpenVPN clients without any cloud service involved.

One EIGR-V in OpenVPN server mode can support up to 15 EIGR-V routers in OpenVPN client mode. These are devices connected to equipment at various locations. In addition, up to 15 PC clients (or any device with OpenVPN functionality like tablets/phones) can be connected to the same OpenVPN server. These PC clients can be located anywhere that has Internet connectivity. With this arrangement, PC clients and client routers in remote locations can communicate securely using the services of this one EIGR-V OpenVPN server. There is no additional requirement to setup NAT or Port Forwarding on the client routers as they initiate outbound connections to the OpenVPN server. Furthermore, the OpenVPN client devices only require internet access – there is no requirement for a static public IP address. The only requirement for a public IP is for the OpenVPN server router. The OpenVPN server router itself can be connected behind an existing firewall/router with a public IP and have the OpenVPN port forwarded to it.

An additional benefit is that each PC client can be configured to communicate with one or more router clients independent of each other. The EIGR-V provides the ideal solution for secure remote access across multiple locations without subscription fees or cloud service dependencies.
About **BASautomation Building on BACnet**

Contemporary Controls is unique in the industry by supplying products that maximize the benefits of both BACnet and Ethernet. BACnet, an internationally recognized building automation standard, can take you from the field level to the Internet. With buildings pre-wired for Ethernet, BACnet/IP is the ideal choice for building automation systems. Ethernet is everywhere and understood by many. With BASautomation – Building on BACnet and CTRlink – Ethernet Built for Buildings, Contemporary Controls provides the system building blocks for networking, integrating and controlling your building.

**BASautomation products have provided solutions worldwide**