PeerComm

CONTINUOUS PEER-TO-PEER COMMUNICATION

COOPER Power Systems
Whether implementing sophisticated protection and control schemes, looking for a way to reduce automation costs, or implementing economical remote station monitoring, PeerComm™ provides the answer. PeerComm is an advanced peer-to-peer communication protocol for use with Cooper Power Systems’ line of Idea™ relays and controls, and Form 6 recloser controls. Designed with flexibility and ease of use in mind, PeerComm allows sharing of status points, counters and measurement values over networks of up to 32 devices. Recognizing that power system applications can be overhead, underground, in substations, or a mix of these locations, PeerComm is equally at home using a variety of communications media. Whether being used with radios or a fiber/copper, hardwire network, PeerComm’s communications can be tailored to meet your needs. Plus, PeerComm’s unique graphical user interface allows the system to be set up quickly and efficiently. PeerComm can be used to: • Implement advanced protection and control schemes, • Eliminate RTUs and data concentrators, • Provide substation-wide graphical interfaces.
Enhancing Protection and Control: Eliminate the Island of Ignorance

When it comes to enhancing protection and control, PeerComm provides endless possibilities. Protection applications traditionally depend upon primary and secondary devices to clear a fault. The requisite time coordination slows the overall response. Multiple layers of relays are sometimes employed to see special situations that other relays, already present, must ignore because they only see partial information. Each relay becomes an island unto itself, responding to only what it sees, largely ignorant of what else is happening around it.

PeerComm gives the protection and control engineer the ability to allow every relay or control connected in a PeerComm network to see what every other device on the network is seeing. Devices on a PeerComm network share status indications (binary values), counters and duty registers (integers), and metered values (floating point numbers). The amount of information they share is scalable for the application. More devices can be added at any time. Data sets can be changed or added to meet shifting needs.

PeerComm™ and ProView™ – the Perfect Match

ProView™ is the operating software for Cooper’s Idea™ and Form 6 lines of relays and controls. A Windows® application and an operating system for the IED itself, ProView is easily the most flexible and powerful protection and control configuration software available. Key to this power is the Idea Workbench™, a feature of ProView that goes well beyond the simple equation or command based logic programming tools found in other IEDs. In addition to creating custom logic, the Idea Workbench allows the user to create or add new protection and control functions and features. These modules can then be saved, re-used and shared at will. Most importantly, this is accomplished using an intuitive, drag-and-drop graphical user interface.

The Communications section of the Idea Workbench permits the user to select what protocol to use, as well as to customize the data set. Add, delete or rearrange points, or create entirely new points to pass back to your SCADA system. Choose from DNP 3.0, Modbus, 2179, or IEC 870-5 protocols.

PeerComm’s Workbench tool palette integrates seamlessly into ProView and provides all the drag-and-drop tools necessary to easily incorporate PeerComm into your protection and control schemes.
The Mechanics of PeerComm

Using ProView, the user drags-and-drops a PeerComm object into the Idea Workbench. This object, or block, allocates an array in the device's memory that will be populated with the data from all of the devices on the network (see below). The devices in a PeerComm network take turns sharing their data by broadcasting it on the network. All non-broadcasting devices are in listening mode during this broadcast and update their images of the shared data accordingly. Once Device One finishes broadcasting its data, Device Two broadcasts its data, and so forth.

Along with every data update, each device also notes whether the data from every other device is valid. The user may use these Data Valid signals to implement logic that can adapt to incomplete data from one or more devices.

When the common memory array has been populated, the values of any of the array members may be accessed in the relay or control and used to implement custom protection and control schemes.

Sample Memory Array

<table>
<thead>
<tr>
<th>Device 1</th>
<th>Device 2</th>
<th>Device 3</th>
<th>Device N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binary 1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Binary 2</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Binary 3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Floating Point #n

<table>
<thead>
<tr>
<th>12.456</th>
<th>16.222</th>
<th>0.000</th>
<th>14.441</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (yes)</td>
<td>1 (yes)</td>
<td>1 (yes)</td>
<td>1 (yes)</td>
</tr>
</tbody>
</table>

PeerComm works equally well with radios for overhead applications, or fiber or copper based serial connections for use in substations or underground. The speed of the media used, as well as the size of the network and the amount of data being shared, determines the ultimate throughput of a PeerComm network. For example, passing large amounts of data among many devices over a slow radio-based network may introduce enough time delay to preclude using PeerComm to deploy a high-speed protection application. Yet this same application may be perfectly acceptable if the communication media is moved to fiber.

PeerComm Is Robust

Exceptional reliability and security are mandatory in the power industry. PeerComm uses a continuous communication method, rather than communication by exception. CRC 16 data correction validates all data, and data timeouts are monitored. PeerComm also employs a collision avoidance scheme, enabling every device on the network to confirm the validity and timeliness of the shared information. This provides the ability for the protection or control scheme to react differently depending on what information may be missing or unreliable.

Distributed Intelligence

Protection and control algorithms in a PeerComm network are typically deployed separately in each device on the network1. Compare this to networks that concentrate the protection and control algorithms in a single device, allowing that device to direct the actions of the other network members. This would be common of PLC, data concentrator, RTU, or similar device-based control schemes.

PeerComm's distributed intelligence allows each device to operate together as a group, a sub-group, or autonomously depending on the situation and status of data on the network. This also eliminates the single point of failure that comes from concentrating the logic in a single RTU or communication processor unit.

To expand control logic across substations, data can be passed from one PeerComm network to another by establishing a bridge network between one device on each network.

Error Correction

The CRC-16 Error correction used in PeerComm provides superb results:

**CRC-16 Error Checking Accuracy**

<table>
<thead>
<tr>
<th>Error Type</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Bit Errors</td>
<td>100%</td>
</tr>
<tr>
<td>Double Bit Errors</td>
<td>100%</td>
</tr>
<tr>
<td>Odd-numbered Errors</td>
<td>100%</td>
</tr>
<tr>
<td>Burst Errors Shorter than 16 bits</td>
<td>100%</td>
</tr>
<tr>
<td>Burst Errors of Exactly 17 bits</td>
<td>99.9969%</td>
</tr>
<tr>
<td>All Other Burst Errors</td>
<td>99.9984%</td>
</tr>
</tbody>
</table>

1 Note that PeerComm's flexibility does allow the logic to be concentrated in one device if desired.
Say Goodbye to RTUs and Data Concentrators

The function of an RTU or data concentrator is to collect measurement data and binary points from various IEDs in a substation, organize it, and act as a single point of communication of that information back to the utility's SCADA system. In the opposite direction, the RTU parses out commands received from the SCADA system to the appropriate IED. Cooper IEDs and PeerComm can provide the same functionality.

PeerComm can be used to pass critical metering points and binary status values back to a single relay or control. The Communications section of the Idea Workbench can then be populated with the other IED’s data, in the same way as an RTU. This device can then be connected to the SCADA master to serve this information.

Using a PeerComm network, Cooper IEDs offer a number of advantages when acting as RTUs:

- **Cost savings**: The RTU functionality is built in to every PeerComm compatible relay or control. There is no need to purchase a separate RTU.

- **Backup RTU**: Every relay and control on the PeerComm network can have their Workbenches configured to supply the same information back to the SCADA master. It’s like having multiple backup RTUs on-line at all times.

- **Common configuration software**: Since the protocol configuration is done using ProView, there is no need to learn or master the configuration software for a separate RTU.

- **Simple system verification**: ProView offers the ability to go “on-line” with a relay and view its status and other data in real-time. Using this tool it is possible for the communications engineer setting up the relay to:
  - Verify what data is being received from the other relays over PeerComm.
  - Verify the communication protocol point list is being updated properly.
  - Verify that commands received by SCADA are properly recognized and sent out over PeerComm.

Any IED can act as an RTU, collecting and distributing data over the PeerComm network.
Remote Substation Monitoring

Many utilities desire a convenient method to monitor and/or control all of the devices in the substation, yet do not do so for any number of reasons:

- No SCADA system is installed, or the SCADA system is off limits to protection engineers.
- The cost of purchasing an expensive graphical user interface software package to run on a dedicated substation PC is prohibitive.
- The use of port-switchers to talk to each individual relay or control separately is cumbersome and the lack of visual feedback makes it difficult to quickly ascertain the state of all devices.

PeerComm can easily provide a local or remote monitoring system at very low cost. It works the same way that PeerComm can be used to eliminate the need for an RTU.

All of the critical device data in the substation can be collected by PeerComm. Cooper Power Systems can provide a custom Idea Workbench module that acts as a graphical representation of the substation. PeerComm data is then used to populate and update this one-line with metering values, position indication, close/open controls and so forth. Up to 250 binary or analog values may be kept “live” on the one-line. (See screen capture.)

Optionally operate breakers from within ProView.

Breaker OPEN/CLOSE status is clearly indicated.
Advantages of a PeerComm Monitoring System

- For remote monitoring, an engineer can dial up one IED, or connect to the IED via the internet, and see all of the important substation information including breaker status. No more need to connect to each device to check the status of the substation. Know immediately which devices have tripped, or reclose the breaker remotely to avoid a costly service call to a remote substation.

- Eliminate the cost of traditional GUI interface software and the consulting fees needed for its configuration.

- Eliminate the need for a dedicated PC in the substation to run the graphical interface. Simply connect a laptop to the IED whose Workbench includes the system one-line. And since the data sent over PeerComm is available to all the devices on the PeerComm network, it is perfectly reasonable to load the Idea Workbench one-line module into each and every relay. This will allow a technician or engineer to connect their laptop to any IED in the substation and see what is happening everywhere in the station.

- The monitoring capability can coexist with utility SCADA systems. PeerComm provides a virtually cost-free method for the engineering department to have access to station and IED status without affecting SCADA system operation.
PeerComm – as Easy as Drag-and-Drop

A powerful peer-to-peer network is useless if the setup procedure is prohibitively cumbersome. When defining a PeerComm network, all devices and data are given text names. This allows working with variable names that mean something, like “Feeder1:52a Status,” rather than names like “R1P4” which are difficult and confusing to both program with and to troubleshoot. And the graphical nature of ProView programming is a dramatic improvement in programming clarity.

The Idea Workbench – Visual Programming at its Best

The Idea Workbench offers the user the ability to rapidly and accurately create customizations by working the way the engineer thinks - by using logic diagrams and flowchart construction.

File management is simplified as you can save and reuse individual logic groups or entire Idea Workbench structures. Load Custom Plug-In modules to add new features or functions without the need to update the IED’s firmware.

Virtual front and rear panels provide easy programming access to contact inputs and outputs, front panel targets and pushbuttons.

Toolboxes provide drag-and-drop access to a variety of math functions, settings, latches, logic gates, timers, etc.

This is an example of how PeerComm looks when it’s programmed - drawn just the way you want it to operate. Operation of the logic is intuitive. When connected to the relay in Online-View mode, the logic diagrams become “live,” showing their status and operation in real-time.

The Workbench Outputs menu provides the ability to control virtually every aspect of the device’s operation.

The Workbench Inputs menu provides access to hundreds of signals regarding the status of practically every protective element, operating mode and status point in the device.

Click here to see...

...the available signals from this IED
methods. No equation-based or command-based logic programming is required.

Debugging and testing is further simplified using the Online-View mode of ProView. When connected to an IED in Online-View mode, the graphical programming screens become live, populated with real-time data both from the local IED as well as with all the other IED’s data as passed via PeerComm. This invaluable tool makes verification of system operation an intuitive process, where cause and effect across the system can be easily observed.
The diagram above shows a typical substation bus. This PeerComm network provides the following functionality without any other equipment or single point of failure:

- Fast bus trip for radial applications: If the low side transformer relay sees a fault but no feeders do, then a bus fault is simply declared and breaker 2 operates.

- Pseudo bus differential for network applications: If the low side transformer relay and all the feeder relays see faults flowing into the bus, then a bus fault is declared and all breakers are tripped.

- Breaker Fail: If any feeder relay fails to operate, breaker 2 will be commanded to open without waiting for time graded coordination. If breaker 2 fails to open, breaker 1 will be tripped.

- RTU Elimination: Pass along all desired SCADA analog and binary points to one of the relays which will gather and publish these values in its DNP map. That one relay may then interface to the SCADA system, eliminating the need for a separate RTU. Note that this same data mapping can be done in all relays so that they may act as RTU backups.

This entire installation can be configured using simple twisted pair, or an optional fiber optic media interface may be used.
The above diagram shows an underground loop system fed by two separate sources. The breakers at 1 and 2, as well as all of the pad-mounted switchgear, are controlled by Idea relays connected by a PeerComm network. Depending upon topology, the PeerComm physical link can be either radio or fiber.

By sharing information regarding fault location and load levels, the system performs the following functions:

- For a fault in any section 1-3, 3-4, 2-5 or 5-6, all devices immediately know where the fault is located. The system will open the fault interrupters on either side of the fault.

- If the system load level will allow the loop to be closed to pick up any isolated load, then the tie interrupter at 7 will be closed. This prevents closing the tie and causing it or other interrupters to start tripping due to overload conditions. Conversely, load may be selectively shed before the tie is closed. These abilities are made possible by PeerComm’s capacity to pass numeric information.

- Both of the above actions take place immediately. This reduces the amount of time power is lost to non-faulted sections of the system. SCADA is able to immediately determine the faulted section of the circuit.
To find out how PeerComm can address your protection, control, data concentration, GUI, or other needs, contact your Cooper Power Systems sales representative. Or visit us on the web at www.cooperpower.com/peercomm.