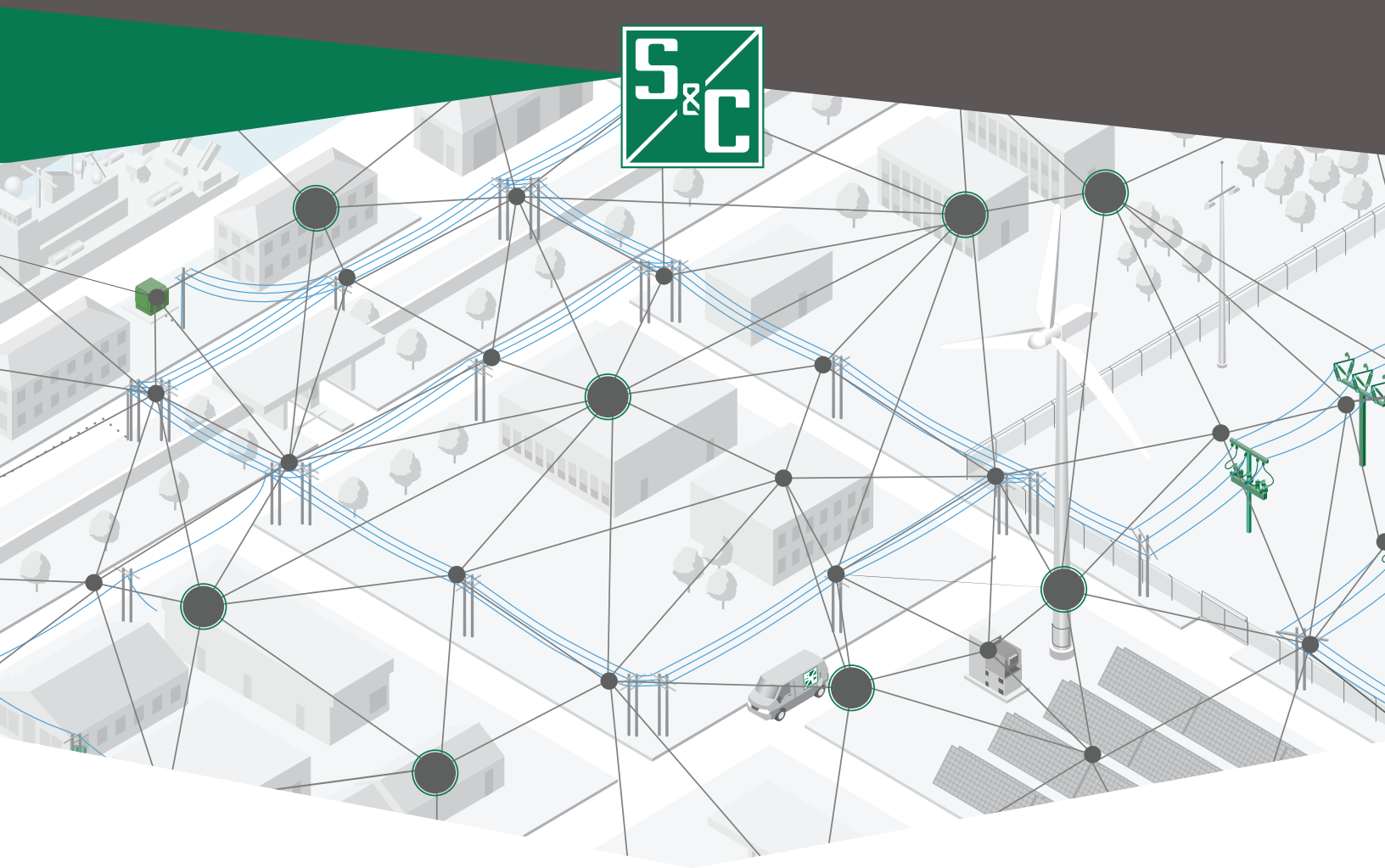
IntelliTeam® SG

Automatic Restoration System



Making Self-Healing Grids a Reality

Outages Remain an Issue

Even with continued equipment improvements to the grid, outages remain a big issue. Recurring outages such as trees falling on power lines or vehicles knocking down poles are an ongoing problem. Extreme weather events are occurring more frequently and are having a greater impact on the grid. Aging infrastructure leads to more outages and higher operational costs for utilities. Further complicating matters is the continued growth of distributed energy resources, making the grid more complex and dealing with outages more difficult.

What can utilities do to further address the issue of outages? The answer is to deploy a self-healing grid. A self-healing grid uses distribution automation to quickly restore power to troubled areas and maintain power service throughout. In fact, a self-healing grid can cut a utility's remaining outages by half!

The Benefits of a Self-Healing Grid

A deployment of automation equipment, such as S&C's IntelliRupter® fault interrupters, improves feeder segmentation, resulting in much fewer outages for customers upstream of main-line distribution faults. See Figure 1. The homes ahead of the fault keep their lights on, but homes behind the fault unnecessarily experience a sustained outage every time there's a permanent fault until the fault is removed or the power is manually rerouted.

WITHOUT SELF-HEALING:

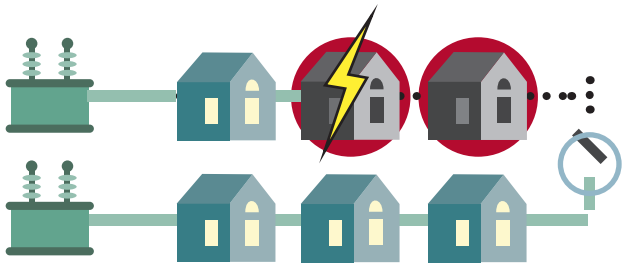


Figure 1. A feeder without a self-healing grid.

Rolling a truck to repair a fault or to perform manual switching takes hours or sometimes days depending on the conditions. With a self-healing grid, these faults are immediately identified, isolated, and restored to all customers behind the fault without any human interaction. See Figure 2. By the time a truck is rolled to repair the fault, most of the customers are back online and dispatchers know exactly where to send the crews to repair the fault.

WITH SELF-HEALING:

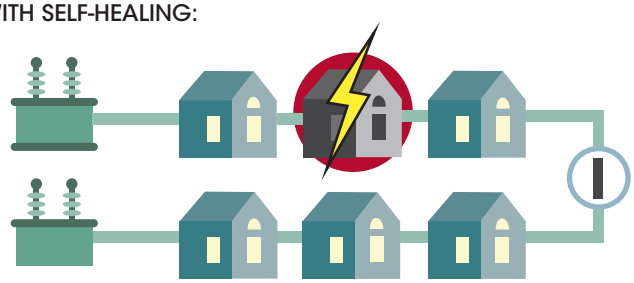


Figure 2. A feeder with a self-healing grid.

When a self-healing grid is applied to feeders, reliability improves. Figure 3 shows the type of improvements utilities may see on their feeders based on their level of feeder segmentation. With a deployment of three automated switches per feeder—two mid-line switches and one tie-switch—the utility may see up to a 50% improvement in reliability on those feeders!

Additional reliability improvements with self-healing	
2 feeder segments	33%
3 feeder segments	50%
4 feeder segments	60%
5 feeder segments	67%
6 feeder segments	71%

Figure 3. Reliability improvements with a self-healing grid.

Three Options, but Only One True Solution

When utilities build their self-healing grid, there are three system options: centralized, regional, and distributed:

- Centralized systems, such as a Distribution Management System (DMS), take a long time to deploy and are inherently slow. One utility shared that its DMS could not meet the 5-minute restoration-time target and would disable itself when a storm rolled through because there was insufficient communications bandwidth to handle all the data.

- Regional systems, such as a substation controller-based solution, are successful for simple circuits but are difficult to scale for complex ones. One utility spent an entire year scripting all the possible scenarios because the standard logic was inadequate. Once deployed, they realized the solution wasn't scalable and repeatable.

- Utilities need a distributed solution where ALL the restoration logic is predefined and resides in the field devices themselves, which makes it fast, reliable, and easily scalable. **That solution is the IntelliTeam SG Automatic Restoration System.**

Fast, Reliable, and Scalable

The IntelliTeam SG system uses advanced controls, network communication, and distributed intelligence to quickly isolate a fault and then restore service to the maximum possible amount of load. **This distributed approach places logic inside devices, improving scalability and enabling decisions to be made at the edge of the grid.**

Because communications are between local devices, decisions are made faster and more reliably, allowing for restoration times of less than a minute.

Here's an example: In January 2013, a storm knocked power out to more than 11,000 homes and businesses. Some 43 seconds later, a great majority of these customers, about 95%, were brought back into service. See Figure 4. This was a result of S&C's IntelliTeam SG Automatic Restoration System. With the IntelliTeam SG system, dispatchers knew exactly where to send crews to repair the faults and restore power to the remaining customers. After deploying this system, the utility experienced performance improvements exceeding 60%, and its customers began saving $35 million annually.

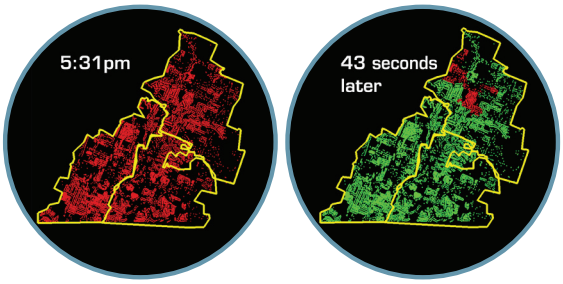


Figure 4: IntelliTeam SG system results following a storm.

Features

Rapid Self-Healing isolates the faulted grid section and restores service to non-faulted sections in seconds by closing in a single switch, significantly decreasing response time by minimizing switch operations.

Real-Time Loading, not often-outdated historical loading data, prevents overloading during restoration.

IntelliNode™ Interface Module allows interoperability with a wide array of new and existing DNP 3.0-compatible intelligent electronic devices from other manufacturers.

Distributed Generation can be added to the IntelliTeam SG system in anti-islanding applications. In addition to supporting bi-directional load and fault current, the system sends and receives transfer trip commands to remove the distributed generation from the circuit when necessary.

Phase-Loss Isolation detects and isolates a potentially broken conductor or other conditions that cause loss of one or two phases using voltage sensing and peer-to-peer communications.

Post-Restoration Load Management protects a reconfigured system from exceeding its capabilities. It accomplishes this by monitoring the feeder-loading after restoration occurs. If an overload is detected, it sheds the load or transfers it to another feeder.

Closed-Loop Operation eliminates the need for a normally open switching point in applications where the loop is served from two substations. Such an operation is ideal for sub-transmission applications.

IntelliTeam Designer® software simplifies system configuration. It allows the user to draw a single line diagram of the distribution system using drag-and-drop tools. No custom programming is required. When drawn and configured, the software then propagates the new system settings to all devices on the system. See Figure 5.

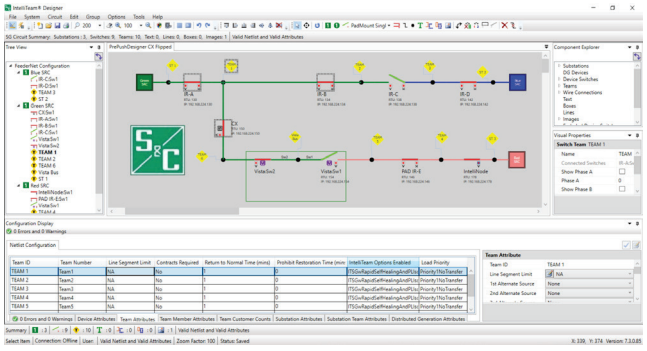


Figure 5. The IntelliTeam Designer software workspace.

Instant Replay aides in the analysis of events. IntelliTeam Designer collects event logs from affected devices and compiles them in a single record. A user may play back results on the single-line diagram used to configure the IntelliTeam SG system.