Weathering the Storm with a Smart Utility Network

The FlexNet® communication network is purposely-engineered to effectively and efficiently manage outages

A reliable, resilient and secure grid is dependent upon having a network that is capable of evolving, adapting and scaling to a changing world. The insight provided by endpoints across your grid is a key component to effectively manage the world's most complex machine. Especially when you need it the most – during and after severe storm events.

The FlexNet communication network is purposely engineered to effectively and efficiently manage outages. There are three key drivers that enable FlexNet's superior outage and restoration service:

- Built-in Redundancy
- Hardened Base Station Installations
- Reliable Message Transmission

Built-in Redundancy

FlexNet's point-to-multipoint architecture was designed to withstand interruptions and failures. There are multiple levels of redundancy – mitigating the impact of storms to utility operations.

Overlapping Coverage

The network doesn't need to reconfigure or reroute endpoint communications during events. Alternative networks rely on meters to communicate to each other which often results in reconfiguration challenges. Instead, FlexNet is designed with overlapping RF coverage (Figure 1) where endpoint messages are received automatically by multiple base stations. This overlapping coverage creates a robust network where re-routing is not needed and nested outages are a challenge that can be overcome.

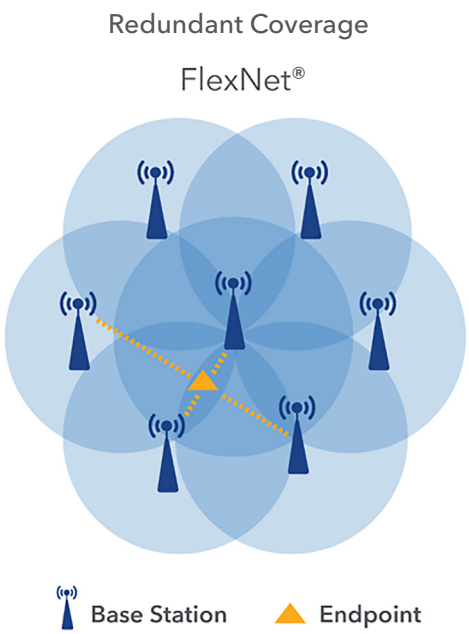

Figure 1: Overlapping coverage

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Outages and power restorations are detected quickly and efficiently—allowing repair crews to address problems with pinpoint accuracy.

FlexNet systems are designed so each base station collector intentionally overlaps adjacent cells, creating signal redundancy over an entire service area. Base stations relay every message received to the head end system where duplicates are then resolved. This overlapping coverage ensures that neighboring base stations process all endpoint messages normally. In the event that one base station goes offline or its backhaul goes down, its endpoints will continue to have their messages received by neighboring base stations–without any loss of functionality.

Each base station continuously listens for meter transmissions using the APA technology (All Paths Always) standard. In parallel, all paths are used simultaneously. This is extremely important during weather events where system visibility is critical.

Lightning-fast Backhaul Connections
Endpoint data received by the base station is transmitted immediately to the head end system via the base station's backhaul connection. This design gets the incoming information from the field to the utility's systems quickly. By using a direct communication approach, utilities receive grid information in near real-time.

In the event that a base station's backhaul connection goes down, it will continue to receive all incoming endpoint messages and store them in on-board, non-volatile memory for 30 days. Upon restoration of the backhaul connection, the stored messages are sent to the head end system along with the real-time readings being received. During the time that the backhaul is down, messages can be retrieved locally by utility personnel if desired.

Remote Data Centers
For increased insurance against failures, Sensus provides our FlexNet head end as a Software as a Service (SaaS) with SSAE 16 Tier IV restricted-access data centers. Sensus operates three world-class data centers in North America:

- Boise, Idaho;
- Raleigh, North Carolina;
- Toronto, Ontario, Canada.

Every component at our data centers is backed up with a full onsite backup. This includes WAN connections, electric utility substation connections, onsite generators, and server backups. In addition, the SaaS service comes standard with disaster recovery capability.

Hardened Infrastructure

FlexNet, with its ability to communicate over long distances, gives utilities many options to build redundant coverage across a service area. Base stations can be installed on any hardened vertical asset including communication towers, water tanks, poles, and buildings. This rock-solid communication foundation ensures that utilities have complete grid visibility during and after the storm event.

The FlexNet M400B2 base station is packaged in a NEMA-4 cabinet enclosure for convenient mounting on a wide variety of structures, poles, or walls. It's typically mounted at ground level with a coax cable leading to an antenna fastened at the height specified in the propagation design. It can be installed indoors or outdoors, giving utilities extreme flexibility when choosing installation locations.

Examples of FlexNet® Base Station Installations

Figure 2: M400B2 base station mounted outside of substation

Figure 3: M400B2 mounted on steel pole

Figure 4: M400B2 base station mounted to structure in substation

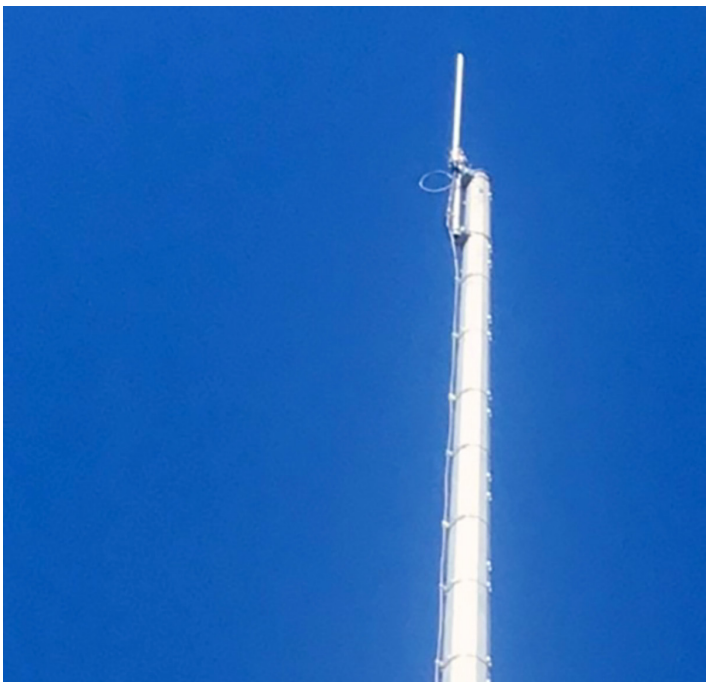

Figure 5: Base station antenna mounted at top of steel pole

Figure 6: Coax going up steel transmission pole at M400B2 base station site

Figure 7: M400B2 base station installation on steel pole at substation

Figure 8: Antenna mounted at top of steel pole at M400B2 base station site

Figure 9: M400B2 mounted in building with building side mount antenna

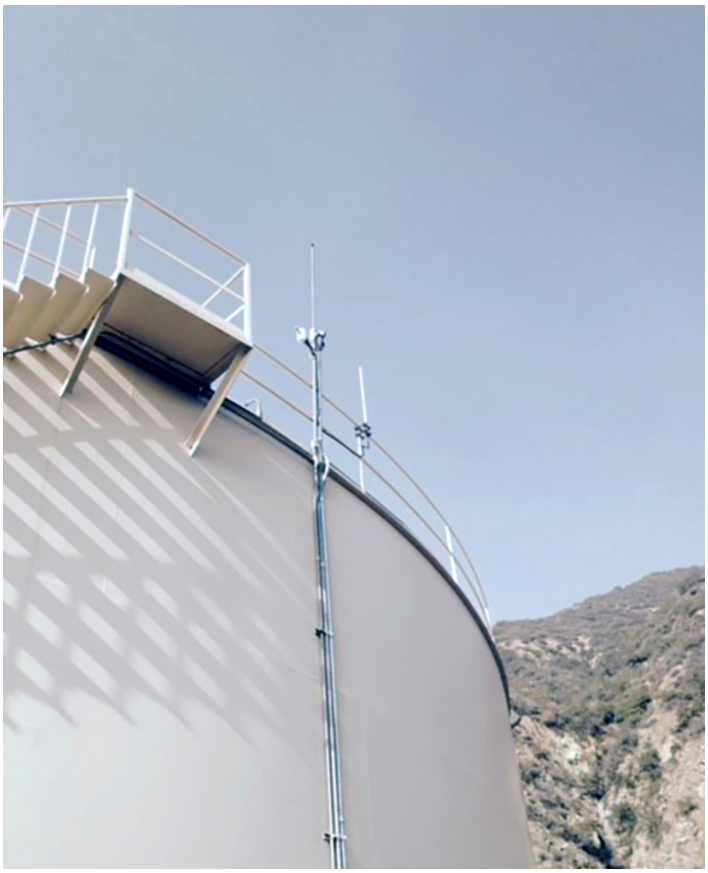

Figure 10: Base station antenna mounted on water tank rail

Figure 11: Base station mounted on concrete pad with antenna at top of pole

Figure 12: Base station antenna mounted on water tank rail

Figure 13: B400B2 base station on lattice tower with solar panels

Reliable Message Transmission

The reliable transmission of alarm messages during extreme events is critical for utilities when pinpointing grid problems.

In the absence of line power, FlexNet®-enabled meters detect, log, and report outages to the head end system for utility consumption. Meters come standard with a super capacitor allowing them to issue alarm messages for ten minutes post-outage.

In the event of an outage, each meter transmits four last gasp outage messages at random times. These alarms are transmitted over a dedicated RF alarm channel which eliminates inadvertent collisions with non-critical messages. This real-world tested message architecture ensures that alarms are received by the utility regardless of the size of the outage.

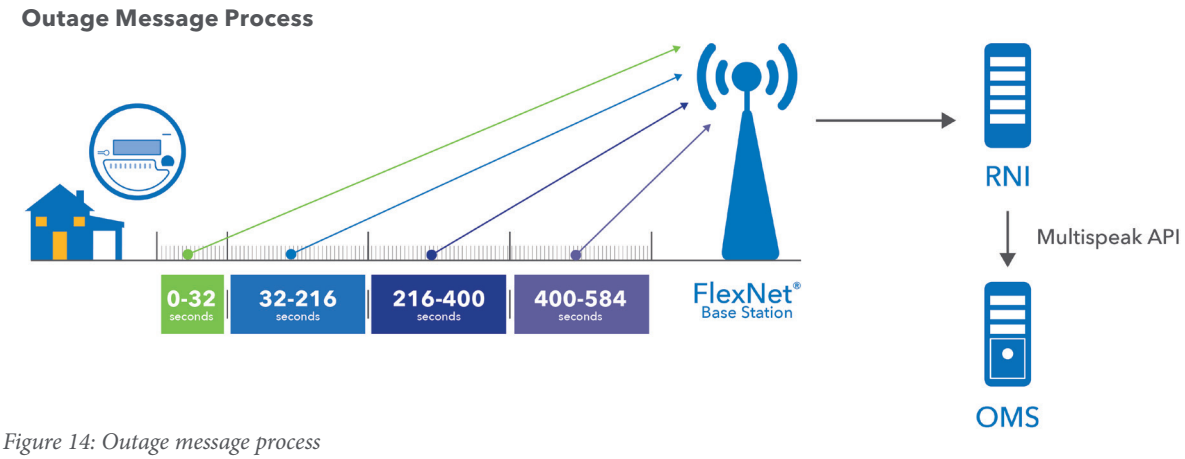

Figure 14: Outage message process

Integrations

Our outage solution easily integrates with an Outage Management System (OMS) using both real-time notifications and batch interfaces. Utilities are provided outage notifications through a MultiSpeak API, which allows for easy integration with OMS applications. For non-real time interfaces, the utility can use flat file CMEP exports. The head end system user interface provides outage alarm data, including history and other alarms, for endpoint diagnostic purposes.

Power restoral uses the same solution architecture. There is a configurable uptime threshold to abort false positives with a semi-random algorithm for reporting restored power. This process removes network collisions with adjacent meters experiencing power restoral at the same time.

Summary

FlexNet is a foundational element for utilities to successfully manage severe weather events. Utilities can improve their operations using the real time alarms, data, and capabilities of the network facilitated by advanced, industry-leading status dashboards. With its built-in redundancy, hardened infrastructure, and reliable message transmissions FlexNet alleviates many of the challenges utilities face with outages and restorations.

Key components of the FlexNet communication network include:

- Simple and straightforward architecture. Endpoints to base station to head end software without complicated configurations to get communications up and running. The system powers up and is available immediately following outage events.
- Point-to-multipoint architecture where endpoints automatically communicate with multiple base stations ensuring redundancy across your service area
- The network is independent from endpoints, which often are powered down during weather events
- Base stations are installed on hardened assets and are equipped with battery backup
- Dedicated RF alarm channel for processing outage and restoral messages

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