# **Underlying Technologies and Software Components of Edge Zero's EdgeConnected™ Platform for Real-Time Monitoring of Electricity Distribution Networks**

1. **Introduction:**  
   The increasing integration of Distributed Energy Resources (DERs), such as rooftop solar photovoltaic systems, battery storage, and electric vehicles, is fundamentally changing the landscape of electricity distribution networks. This shift from traditional, centralized power generation to a more decentralized model presents significant challenges and opportunities for grid operators. Ensuring the stability, reliability, and efficiency of these evolving networks necessitates advanced monitoring solutions that can provide real-time visibility and control over a multitude of distributed assets. Edge Zero has emerged as a key player in this domain, offering its EdgeConnected™ platform as a comprehensive solution for the real-time monitoring of electricity distribution networks 1. This report aims to provide a detailed analysis of the underlying technologies and software components that constitute the EdgeConnected™ platform, elucidating its architecture, functionalities, and its role in modern grid management. The platform's significance is underscored by its adoption by major utilities like Endeavour Energy, indicating its crucial role in facilitating grid modernization and the integration of diverse DERs 2. The focus of the EdgeConnected™ platform directly addresses the challenges associated with incorporating a growing number of renewable energy sources into the existing grid infrastructure, aiming to enable a more sustainable energy future 2.
2. **Edge Zero's Hardware Infrastructure for Data Acquisition:**  
   The foundation of the EdgeConnected™ platform's real-time monitoring capabilities lies in its robust hardware infrastructure, primarily composed of the EdgeSensor Series and the Energy Monitor. These devices are strategically deployed across the distribution network to capture critical data.  
   2.1. **EdgeSensor Series:**  
   The EdgeSensor stands as the primary hardware component enabling the real-time monitoring of electricity distribution networks 2. Deployed across existing and new distribution transformers, these sensors are designed to provide comprehensive visibility into the network's operational parameters 2. The EdgeSensor meticulously measures a range of critical parameters, including voltage, current, active and reactive power, and energy consumption. Furthermore, it tracks harmonics and power factor, offering a detailed understanding of the power quality within the network 3. This granular level of data acquisition allows for the immediate detection of anomalies and the assessment of overall network health. Beyond basic measurements, the EdgeSensor is equipped to alert grid operators to critical events such as voltage fluctuations that could impact equipment performance, power outages that disrupt supply, and frequency changes that indicate potential instability 3. By continuously monitoring transformer health, the EdgeSensor provides valuable insights into the condition of these critical assets, enabling proactive maintenance strategies 4. The scale of the EdgeSensor deployment highlights its proven capabilities and reliability. Endeavour Energy, a major Australian utility, has entered into a long-term supply contract with Edge Zero, leading to the deployment of over 10,000 EdgeSensor transformer monitors across its distribution network over a three-year period 2. This extensive rollout signifies the utility's confidence in the technology's ability to provide the necessary data for effective grid management in the face of increasing DER penetration. The EdgeSensor, therefore, offers a detailed, asset-level perspective of the distribution network's performance, crucial for identifying and addressing localized issues that could otherwise escalate 3. The significant investment and large-scale deployment by a major utility like Endeavour Energy strongly suggest that the EdgeSensor technology is mature, dependable, and capable of handling the demands of modern grid monitoring 2.  
   2.2. **Energy Monitor:**  
   Complementing the network-wide monitoring provided by the EdgeSensor series, the Energy Monitor offers a focused approach to gaining deep insights into energy consumption patterns 3. This hardware component provides real-time tracking of energy usage, allowing for a detailed understanding of how and when energy is being consumed 3. A key feature of the Energy Monitor is its ability to track the performance of Distributed Energy Resources at a localized level 3. This enables users to assess the efficiency and output of their solar panels, battery storage systems, or other DER assets. Furthermore, the Energy Monitor facilitates the generation of customized reports, providing valuable data for identifying opportunities to improve energy efficiency and reduce overall energy costs 3. Unlike the EdgeSensor, which focuses on monitoring the distribution network at the transformer level, the Energy Monitor is typically deployed at the switchboard or even at the level of a single electrical load within a facility 3. This distinction allows for a more granular analysis of energy consumption and DER performance at specific points within the electrical system. The Energy Monitor, therefore, addresses a different but equally important monitoring requirement, focusing on the consumption side of the energy equation and the performance of localized generation resources 3. This localized monitoring capability provides valuable data for energy management within commercial and industrial facilities, as well as for individual consumers looking to optimize their energy usage and the performance of their DER assets.
3. **EdgeConnected™ Software Platform Architecture:**  
   The data collected by Edge Zero's hardware infrastructure is then processed, analyzed, and visualized through the EdgeConnected™ software platform. This platform is built upon a robust cloud-based architecture, leveraging the capabilities of Amazon Web Services (AWS).  
   3.1. **Cloud-Based Infrastructure:**  
   The EdgeConnected™ platform is hosted on the Amazon Web Services (AWS) cloud infrastructure 1. This strategic choice provides numerous benefits, including the inherent scalability required to manage the vast amounts of data streaming from potentially thousands of monitoring devices deployed across a utility's network 4. The elasticity of the AWS cloud allows the platform to dynamically adjust its resources based on the volume of data being processed and analyzed, ensuring consistent performance even during peak demand periods. Furthermore, the cloud-based nature of the platform ensures high availability and facilitates accessibility from any location with a secure internet connection 4. Utility operators can access the platform's dashboards and data from their control rooms, offices, or even remotely, enabling timely decision-making and response to grid events. Given the critical nature of electricity distribution networks, security is paramount. The EdgeConnected™ platform is designed with secure, encrypted data transmission protocols and adheres to stringent industry cybersecurity standards 4. By leveraging the security features and compliance certifications of AWS, Edge Zero ensures that sensitive grid data is protected against unauthorized access and cyber threats. The decision to build the EdgeConnected™ platform on AWS provides a strong and reliable foundation, allowing Edge Zero to focus on its core expertise in grid monitoring and analytics while benefiting from the robust and secure infrastructure offered by a leading cloud provider 1. This cloud-centric approach ensures that the platform can meet the evolving demands of modern grid management without the need for utilities to invest in and maintain extensive on-premises infrastructure.  
   3.2. **Key Software Modules and Functionalities:**  
   The EdgeConnected™ software platform encompasses a suite of key software modules and functionalities designed to provide comprehensive real-time monitoring, advanced analytics, and reporting capabilities for electricity distribution networks.  
   3.2.1. **Real-Time Data Processing and Visualization:**  
   At its core, the EdgeConnected™ platform is engineered to continuously process the live data streams emanating from the deployed Edge Zero monitors 4. This constant ingestion and processing of data ensures that utility operators have an up-to-the-minute view of their network's status. A critical aspect of this functionality is the live tracking of key parameters, with a particular emphasis on transformer health 4. By monitoring metrics related to transformer performance, the platform can provide early warnings of potential issues, allowing for proactive intervention before failures occur. The platform also incorporates an intelligent instant alert system 4. This system is configured to automatically detect anomalies, such as power outages or significant voltage fluctuations, and immediately notify the relevant personnel. This rapid notification capability is crucial for enabling a swift response, thereby minimizing the duration and impact of grid disruptions. To facilitate comprehensive oversight, EdgeConnected™ offers grid-wide visualization through a secure, cloud-based dashboard 4. This intuitive dashboard presents a consolidated view of the entire distribution network's performance, utilizing visual aids to make complex data easily understandable. Utility operators can quickly assess the overall health of the grid, identify areas of concern, and drill down into specific assets for more detailed information. The platform's emphasis on immediate data availability and user-friendly visualization underscores its design philosophy: to empower utility operators with the information they need, in a format they can readily interpret, to make timely and effective decisions regarding the operation and maintenance of the electricity network 4.  
   3.2.2. **Advanced Analytics Engine:**  
   Beyond its real-time monitoring capabilities, the EdgeConnected™ platform features a sophisticated advanced analytics engine 4. This powerful component analyzes both historical and real-time data collected from the network to discern underlying trends and patterns that might not be immediately apparent through simple monitoring. A key application of this analytics engine is predictive maintenance 4. By identifying subtle indicators of potential equipment degradation or impending failure, the platform can alert utilities to proactively schedule maintenance, thereby preventing unexpected outages and extending the lifespan of critical assets. The advanced analytics also provide valuable insights into various aspects of grid performance, including power quality, overall system efficiency, loading levels on different network segments, and load management effectiveness 4. This data-driven understanding enables utilities to optimize their operations, improve energy delivery, and make informed decisions about future network planning and upgrades. Furthermore, the platform offers customizable reporting and dashboard functionalities 4. This flexibility allows utilities to tailor the presentation of data and analytical insights to their specific operational needs and priorities. They can configure dashboards to display the key performance indicators (KPIs) that are most relevant to their roles and generate reports on specific aspects of network performance as required. The integration of this advanced analytics engine transforms the EdgeConnected™ platform from a mere monitoring tool into a powerful system for proactive grid management and optimization, providing utilities with the intelligence needed to operate their networks more efficiently and reliably 4.  
   3.2.3. **Real-Time Reporting and Control Features:**  
   The EdgeConnected™ platform extends beyond passive monitoring to offer a suite of real-time reporting and control features, enabling active management of the electricity distribution network 4. The platform provides authenticated administrative user access control, ensuring that only authorized personnel can manage devices and configure the system 4. This is crucial for maintaining the security and integrity of the monitoring infrastructure. Live grid state monitoring is another key feature, providing operators with real-time information for actively tracking fault locations, assessing outage visibility across the network, and facilitating efficient disaster recovery efforts 4. The platform also offers specific reporting capabilities, including phase imbalance analysis, which helps identify potential issues related to uneven load distribution across the three phases of the power system, and asset transformer health analysis, providing detailed insights into the condition and performance of these vital components 4. Additionally, EdgeConnected™ is capable of detecting power theft and loss of neutral conditions, which are critical for maintaining power quality, ensuring voltage management within acceptable limits, and enhancing overall safety compliance 4. Notably, the platform supports demand response control of solar photovoltaic systems, electric vehicles, and other Distributed Energy Resources (DERs) 4. This capability enables the implementation of advanced tariff structures, such as nodal pricing and Time-of-Use (TOU) rates, which can incentivize consumers to adjust their energy consumption patterns in response to grid conditions or price signals. Ensuring the integrity of the collected data is paramount, and the EdgeConnected™ platform employs encrypted end-to-end data transmission protocols 4. Furthermore, the platform is designed with the capacity to support future system planning needs, allowing utilities to leverage the historical and real-time data for forecasting and long-term infrastructure development 4. These comprehensive real-time reporting and control functionalities position the EdgeConnected™ platform as a powerful tool for actively managing the complexities of modern electricity distribution networks.  
   3.3. **Data Flow:**  
   The operation of the EdgeConnected™ platform involves a seamless flow of data from the field to the cloud and back. Initially, the EdgeSensors and Energy Monitors, deployed at strategic locations across the electricity distribution network, diligently collect a wide array of data related to power quality, energy consumption, and asset health 2. This raw data, captured in real time, forms the foundation for the platform's monitoring and analytical capabilities. Subsequently, this collected data needs to be efficiently transmitted to the EdgeConnected™ platform, which resides in the AWS Cloud 1. This transmission is facilitated by various communication technologies, including 4G internal modems embedded within the monitoring devices and LoRaWAN mesh networks, ensuring reliable connectivity even in diverse geographical and infrastructural conditions 5. Once the data reaches the cloud-based platform, it undergoes a series of crucial processes. The platform's sophisticated software algorithms process and cleanse the incoming data, preparing it for analysis. The advanced analytics engine then scrutinizes this processed data, identifying trends, anomalies, and potential issues, thereby generating valuable insights into the network's performance and the health of its assets 4. Finally, the platform visualizes this analyzed data through intuitive dashboards and generates comprehensive reports, making it readily accessible to utility operators and other authorized users via secure web interfaces and APIs 4. This well-orchestrated data flow, from the initial capture in the field to the final presentation to the users, is engineered for efficiency and low latency. This ensures that critical information about the electricity grid's status is available in a timely manner, empowering operators to make informed decisions and take swift actions when necessary to maintain network stability and reliability.
4. **Integration with Utility Ecosystems:**  
   A critical aspect of the EdgeConnected™ platform's value proposition is its ability to seamlessly integrate with the existing technological ecosystems within utility companies. This interoperability ensures that the platform can augment and enhance, rather than replace, established systems and workflows.  
   4.1. **API Integration:**  
   The EdgeConnected™ platform is designed with robust API compatibility, enabling seamless integration with a variety of existing utility systems 4. This Application Programming Interface allows for the exchange of data and commands between the EdgeConnected™ platform and other critical utility software, such as Advanced Distribution Management Systems (ADMS), Supervisory Control and Data Acquisition (SCADA) systems, and Geographic Information Systems (GIS) 4. For instance, real-time data on power flows and asset conditions captured by Edge Zero's hardware can be fed directly into an ADMS, providing a more accurate and up-to-date view of the network for operational decision-making. Similarly, GIS can leverage the location-specific data from the platform to enhance their spatial analysis capabilities. The flexibility afforded by API integration allows utilities to tailor the EdgeConnected™ platform to their specific infrastructural needs and operational processes 4. Whether a utility has a highly customized suite of legacy systems or a more modern, off-the-shelf software environment, the platform's open architecture facilitates the smooth flow of information, maximizing the value derived from both the new monitoring capabilities and the existing investments in utility software. This ability to integrate seamlessly minimizes disruption during the implementation phase and ensures that the EdgeConnected™ platform becomes a valuable and well-integrated component of the utility's overall operational framework.  
   4.2. **SCADA Integration via DNP3:**  
   Recognizing the widespread use of SCADA systems in utility control rooms, Edge Zero has incorporated a mechanism for seamless integration with these established platforms through the implementation of a DNP3 virtual Remote Terminal Unit (RTU) service 5. DNP3 (Distributed Network Protocol version 3) is a widely adopted communication protocol in the utility industry for communication between control centers and remote devices. The EdgeConnected™ platform's DNP3 virtual RTU service acts as a translator, effectively converting the comprehensive data set available through the platform's API into the DNP3 protocol 5. This allows traditional SCADA systems to access the rich, real-time data on power quality, asset status, and other critical parameters collected by Edge Zero's hardware and processed by its cloud platform. By supporting DNP3, Edge Zero demonstrates a clear commitment to ensuring compatibility with the existing infrastructure that many utilities rely upon for their core operations 5. This integration pathway simplifies the adoption of the EdgeConnected™ platform for utilities that may not be ready to fully migrate to newer, API-centric integration methods. Instead, they can leverage their existing SCADA systems to visualize and utilize the valuable data provided by Edge Zero, facilitating a smoother transition towards more advanced grid monitoring and management capabilities. This interoperability with SCADA via DNP3 significantly enhances the platform's accessibility and broadens its potential user base within the utility sector.
5. **Communication Technologies for Reliable Data Transmission:**  
   The reliable transmission of data from the field-deployed monitoring devices to the cloud-based EdgeConnected™ platform is paramount for its effective operation. Edge Zero employs a combination of communication technologies to ensure this reliability across diverse environments.  
   5.1. **4G Internal Modems:**  
   A primary communication pathway utilized by the Edge Zero LV Monitors is through integrated 4G internal modems 5. These modems provide wide-area cellular connectivity, enabling the monitoring devices to directly connect to cellular networks and transmit the collected data to the EdgeConnected™ platform in the cloud 5. The use of 4G technology offers several advantages, including relatively high bandwidth capabilities suitable for transmitting continuous streams of monitoring data and broad coverage in many geographical areas. This makes 4G a reliable option for a significant portion of the deployed devices, particularly in urban and suburban regions with established cellular infrastructure. The internal nature of the modems simplifies the deployment process, as the devices can connect to the network without requiring additional external communication hardware in many cases. This direct cellular connectivity ensures a consistent and readily available communication channel for the real-time flow of critical grid data from the monitoring points to the central platform for processing and analysis.  
   5.2. **LoRaWAN Mesh:**  
   In addition to cellular connectivity, Edge Zero leverages LoRaWAN mesh technology to facilitate resilient data transmission, particularly in scenarios where cellular coverage might be limited or unreliable 5. LoRaWAN (Long Range Wide Area Network) is a low-power, wide-area network protocol designed for wireless battery-operated IoT devices. Its long-range communication capabilities make it well-suited for reaching devices deployed across geographically dispersed areas, such as rural or remote parts of an electricity distribution network 6. The mesh networking aspect of the LoRaWAN implementation enhances the resilience of the communication infrastructure. In a mesh network, devices can communicate with each other, and data can hop across multiple devices to reach the gateway connected to the internet. This means that even if a direct connection to a gateway is not available for a particular device, it might still be able to transmit its data by routing it through neighboring devices in the mesh. This redundancy improves the overall reliability of data transmission, ensuring that critical monitoring information can still reach the EdgeConnected™ platform even in challenging communication environments. The low power consumption of LoRaWAN also contributes to the longevity of battery-powered monitoring devices, reducing the need for frequent maintenance in remote deployments. The integration of both 4G cellular and LoRaWAN mesh technologies provides Edge Zero with a flexible and robust communication strategy for its monitoring solutions, ensuring reliable data transmission across a wide range of deployment scenarios.
6. **Security and Reliability of the EdgeConnected™ Platform:**  
   Given the critical nature of monitoring electricity distribution networks, the security and reliability of the EdgeConnected™ platform are of paramount importance. Edge Zero has implemented several measures to address these crucial aspects.  
   6.1. **Secure Data Transmission:**  
   The EdgeConnected™ platform is engineered with a strong emphasis on security, employing secure, encrypted data transmission protocols throughout its architecture 4. This end-to-end encryption ensures that all data transmitted between the field-deployed monitoring devices and the cloud-based platform is protected from unauthorized interception or tampering. By utilizing robust encryption algorithms and secure communication channels, Edge Zero safeguards the confidentiality and integrity of the sensitive grid information being collected and analyzed. Furthermore, the platform is designed to comply with relevant industry cybersecurity standards 4. This commitment to adhering to established security best practices and regulatory requirements demonstrates Edge Zero's proactive approach to mitigating cyber threats and ensuring the security of its platform and the data it handles. The robust security measures implemented within the EdgeConnected™ platform are essential for maintaining the trust of utility operators and ensuring the integrity of the critical infrastructure being monitored.  
   6.2. **Scalability:**  
   The EdgeConnected™ platform is designed to be highly scalable, capable of accommodating the monitoring needs of electricity distribution networks of any size or complexity 4. Whether it is a small-scale pilot deployment or a large-scale, nationwide network, the platform's architecture, particularly its foundation on the AWS cloud infrastructure, allows it to seamlessly handle increasing volumes of data from a growing number of connected devices. The open architecture of the platform provides the flexibility to adapt to the evolving demands of electricity distribution networks 4. As networks expand, incorporate more DERs, and require more sophisticated monitoring capabilities, the EdgeConnected™ platform can scale its resources accordingly, ensuring sustained performance and reliability. This scalability is a key advantage, allowing utilities to deploy the platform initially for targeted monitoring and then expand its coverage as their needs evolve, without requiring significant re-architecting or disruption to existing operations. The platform's ability to scale effectively ensures that it can continue to provide valuable monitoring and analytics even as the electricity grid undergoes further transformation.  
   6.3. **Reliability and Uptime:**  
   Reliability and continuous uptime are critical requirements for any system monitoring essential infrastructure like electricity distribution networks. The EdgeConnected™ platform addresses these requirements through its cloud-based architecture on AWS, which offers inherent redundancy and high availability 4. The distributed nature of cloud infrastructure minimizes the risk of single points of failure, ensuring that the platform remains operational even in the event of localized issues. Furthermore, Edge Zero emphasizes the "zero downtime" aspect of its platform 1. This suggests that the platform is designed for continuous operation, with mechanisms in place for seamless updates, maintenance, and failover, minimizing any potential interruptions to the monitoring service. This focus on high reliability and continuous uptime is essential for providing utilities with uninterrupted visibility into their networks, enabling them to respond promptly to any issues and maintain the stability and security of the electricity supply. The robust infrastructure and design principles of the EdgeConnected™ platform aim to provide a dependable and always-available monitoring solution for critical grid operations.
7. **Real-World Applications and Impact:**  
   The EdgeConnected™ platform has demonstrated its practical value and impact through various real-world deployments and partnerships, showcasing its ability to address the evolving needs of electricity distribution networks.  
   7.1. **Endeavour Energy Partnership:**  
   A significant application of the EdgeConnected™ platform is its partnership with Endeavour Energy, a major electricity network operator. This collaboration involves a large-scale deployment of EdgeSensor devices across Endeavour Energy's network 2. The integration of Edge Zero's technology is aimed at enhancing the safety and reliability of the grid, particularly as it incorporates more customer-sited Distributed Energy Resources (DERs) 2. By providing real-time data on power flows, power quality, and potential faults, the EdgeConnected™ platform enables Endeavour Energy to more efficiently connect DERs, such as solar PV and batteries, to the grid 2. This enhanced monitoring also contributes to the reduction of carbon emissions by facilitating the integration of cleaner energy sources and improving overall grid efficiency 2. Furthermore, the partnership is expected to lead to improved customer satisfaction by ensuring a more stable and reliable electricity supply. Executives at Endeavour Energy have expressed positive feedback regarding the adoption of Edge Zero's technology, highlighting its role in enabling them to confidently integrate renewable energy solutions while maintaining a stable and reliable grid 1. The scale and strategic importance of this partnership underscore the tangible benefits and proven capabilities of the EdgeConnected™ platform in a large-scale utility environment.  
   7.2. **Vermont Electric Cooperative Deployment:**  
   The EdgeConnected™ platform has also been deployed in North America, with Vermont Electric Cooperative (VEC) becoming Edge Zero's first U.S. customer 10. This deployment demonstrates the platform's applicability and value proposition beyond the Australian market. VEC is utilizing Edge Zero's real-time grid monitoring, which is part of the EdgeConnected™ software, to enhance its network visibility and operational efficiency. Notably, VEC reported immediate value from the deployment, with the sensors identifying a high voltage issue on a transformer that could have potentially led to an outage 1. This early detection capability highlights the platform's effectiveness in providing timely and actionable insights for preventing grid disruptions. The successful deployment with VEC showcases the EdgeConnected™ platform's ability to deliver tangible benefits to different types of utilities in diverse geographical locations, suggesting its broader market potential in addressing the challenges of modern grid management.  
   7.3. **Other Potential Applications:**  
   Beyond these specific deployments, Edge Zero's solutions, powered by the EdgeConnected™ platform, have the potential to address a wide range of other critical needs within the energy sector 1. The platform's real-time monitoring and analytics capabilities can be leveraged for proactive asset management, allowing utilities to optimize maintenance schedules and extend the lifespan of their infrastructure 7. Its ability to integrate and manage Distributed Energy Resources makes it a valuable tool for facilitating the transition to a cleaner energy mix 1. As the adoption of electric vehicles continues to grow, the platform can play a role in managing EV charging loads and their impact on the grid 1. Furthermore, the granular visibility provided by the platform can contribute to wildfire prevention efforts by detecting anomalies that might indicate potential hazards 1. The comprehensive situational awareness offered by EdgeConnected™ enhances overall grid resilience and facilitates more effective response to various operational challenges 1. Finally, the platform's capabilities can be applied in microgrid environments, enabling the seamless integration and management of distributed generation and storage resources within localized energy systems 1. The versatility of the EdgeConnected™ platform underscores its potential to be a comprehensive solution for a multitude of challenges and opportunities in the evolving energy landscape.
8. **Conclusion:**  
   Edge Zero's EdgeConnected™ platform for real-time monitoring of electricity distribution networks is built upon a foundation of sophisticated hardware and a robust cloud-based software architecture. The platform leverages the EdgeSensor series for granular, asset-level data acquisition in the field, capturing critical parameters related to power quality and asset health. This data is then transmitted via reliable communication technologies, including 4G internal modems and LoRaWAN mesh networks, to the EdgeConnected™ platform hosted on the AWS cloud. The software platform provides real-time data processing and visualization, an advanced analytics engine for predictive maintenance and grid optimization, and comprehensive real-time reporting and control features. Seamless integration with existing utility ecosystems is facilitated through API compatibility and SCADA integration via DNP3. The platform's design prioritizes security, scalability, and reliability, ensuring a dependable solution for monitoring critical infrastructure. Real-world deployments and partnerships, such as those with Endeavour Energy and Vermont Electric Cooperative, demonstrate the practical value and tangible benefits of the EdgeConnected™ platform in enhancing grid safety, reliability, and the integration of distributed energy resources. In conclusion, the underlying technologies and software components of Edge Zero's EdgeConnected™ platform provide a powerful and comprehensive solution for the evolving needs of modern electricity distribution networks, playing a significant role in enabling a more resilient, efficient, and sustainable energy future.

| **Feature** | **Description** | **Snippet(s)** |
| --- | --- | --- |
| **Real-Time Network Data** | Live voltage, current, power quality reporting | 4 |
| **Live Tracking** | Continuous monitoring of transformer health | 4 |
| **Instant Alerts** | Automated notifications for outages, voltage fluctuations | 4 |
| **Grid-Wide Visualization** | Secure, cloud-based dashboard for network performance overview | 4 |
| **Advanced Analytics** | Predictive maintenance, power quality insights, load management | 4 |
| **Customizable Reporting** | Tailored dashboards and reports | 4 |
| **API Integration** | Seamless connection with ADMS, SCADA, GIS | 4 |
| **Scalability** | Adaptable to any grid size | 4 |
| **Secure Transmission** | Encrypted data transfer, cybersecurity compliance | 4 |
| **Real-Time Reporting** | Fault location, outage visibility, asset health analysis | 4 |
| **Demand Response Control** | Management of solar, EV, DER assets | 4 |
| **DNP3 Integration** | SCADA interoperability via virtual RTU | 5 |
| **Communication (Hardware)** | 4G internal modems, LoRaWAN mesh | 5 |
| **Cloud Platform** | Hosted on AWS | 1 |

**Table 1: EdgeConnected™ Platform - Key Software Modules and Functionalities**

| **Module** | **Key Functionalities** | **Snippet(s)** |
| --- | --- | --- |
| **Real-Time Data Processing & Visualization** | Live tracking of transformer health, instant alerts, grid-wide dashboard, continuous data reporting | 4 |
| **Advanced Analytics Engine** | Predictive maintenance, power quality analysis, system efficiency insights, load management optimization, customizable reporting | 4 |
| **Real-Time Reporting & Control Features** | Authenticated access control, live grid state monitoring, phase imbalance analysis, asset transformer health analysis, power theft detection, loss of neutral detection, demand response control for DERs, encrypted data integrity | 4 |

#### Works cited

1. Edge Zero: Home | Smart Grid System, accessed March 19, 2025, <https://edgezero.co/>
2. Edge Zero Expands Partnership with Endeavour Energy to Enhance Grid Reliability and Support Distributed Energy Resources | Utility Dive, accessed March 19, 2025, <https://www.utilitydive.com/press-release/20250123-edge-zero-expands-partnership-with-endeavour-energy-to-enhance-grid-reliabi-2/>
3. Products | Smart Grid System | Edge Zero, accessed March 19, 2025, <https://edgezero.co/products/>
4. EdgeConnected Software | Smart Grid System - Edge Zero, accessed March 19, 2025, <https://edgezero.co/products/edgeconnected-software/>
5. edgezero.co, accessed March 19, 2025, <https://edgezero.co/wp-content/uploads/2025/01/Edge-Zero_AMI-Solution-Brief_2024Q4.pdf>
6. Projects | Smart Grid System | Edge Zero, accessed March 19, 2025, <https://edgezero.co/resources/projects/>
7. Asset Management Solutions | Smart Grid System | Edge Zero, accessed March 19, 2025, <https://edgezero.co/solutions/asset-management-solutions/>
8. FAQs | Smart Grid System | Edge Zero, accessed March 19, 2025, <https://edgezero.co/resources/faqs/>
9. Edge Zero expands partnership with Endeavour Energy to enhance grid reliability and support Distributed Energy Resources, accessed March 19, 2025, <https://www.endeavourenergy.com.au/news/media-releases/edge-zero-expands-partnership-with-endeavour-energy-to-enhance-grid-reliability-and-support-distributed-energy-resources>
10. Newsroom | Smart Grid System - Edge Zero, accessed March 19, 2025, <https://edgezero.co/resources/newsroom/>
11. Resources | Smart Grid System - Edge Zero, accessed March 19, 2025, <https://edgezero.co/resources/>