

Enhancing Network Resilience through Real-Time Activity Monitoring for High Lightning Density Network

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Abstract (*approximately 200–400 words in one page*)

Lightning is a major contributor to faults and outages on overhead transmission and distribution networks, especially in regions with high lightning activity. Utilities typically rely on protection relay records, fault indicators, and post-event field inspections to determine whether lightning is the root cause of an outage. These methods are often reactive and time-consuming, resulting in extended restoration times and inefficient deployment of maintenance resources. This work presents utility experience with the application of a real-time lightning activity location and detection system to support the mitigation of lightning-related fault incidences on overhead power lines.

The implemented system uses a network of lightning detection sensors combined with time-of-arrival and direction-finding techniques to detect and locate lightning events in real time. Key lightning parameters, including strike location, time, polarity, and estimated peak current, are captured and displayed through a centralized monitoring platform. Lightning data are overlaid with transmission and overhead distribution line routes, enabling operators to quickly correlate lightning activity with network disturbances.

From an operational perspective, real-time lightning visibility provides significant benefits for fault analysis and response. During storm conditions, operators can assess whether line trips or protection operations are likely lightning induced, allowing faster fault classification and decision-making. Following fault events, maintenance crews can be directed to specific line sections exposed to nearby lightning strikes, reducing unnecessary patrols and shortening outage restoration time. The system has also been used to support safety briefings and operational alerts during periods of intense thunderstorm activity.

Field experience and event analysis indicate that the system reliably detects lightning events near power line assets and provides valuable situational awareness for network operations. Case studies demonstrate improved fault investigation efficiency and better prioritization of inspection activities. Challenges related to data interpretation, system integration, and operator training are discussed, along with lessons learned during deployment.

This research contributes to ongoing technical discussions within the IERE community by highlighting how real-time lightning detection technologies can be practically applied to enhance network resilience. The findings support the adoption of such systems as a complementary tool for lightning performance assessment, fault mitigation strategies, and asset management of overhead transmission and distribution networks.
