

SCADA System Alarm Notification Options for a Mobile Workforce

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Abstract

For those businesses that use it, SCADA systems are a critical piece of their infrastructure. To maximize the system's benefits, it is essential to have reliable handling of, and proper response to, alarms. This paper presents a solution for improving the effectiveness of SCADA system alarm notifications. The solution covers how to most effectively send out or manage alarm notification to a distributed, mobile workforce; and how to save time, reduce resource allocation, improve safety, and increase data security.

SCADA systems are implemented all over the world ranging from industrial control systems, industrial processes, infrastructure, as well as facilities. Common SCADA characteristics include a centralized system that monitors and controls multiple systems through the acquisition and interpretation of data from multiple devices or systems in a geographically distributed environment. A single input or output value monitored or controlled in a SCADA system is commonly referred to as a tag. Tags are defined with event characteristics resulting in alarms being raised when a criteria is in range, out of range, thresholds are met or exceeded or when multiple criteria is met. The focus of this paper is how to deal with alarm notification to a distributed, mobile workforce and how new technologies are allowing innovative solutions to be developed that save time, reduce resource allocation, improve safety for the people involved and increase the security of the data being shared.

Many on-call systems are in place to deal with SCADA alarms. Often notification is sent to a designated person or group via an email, SMS (short message service), pager or some combination of these options. These methods are usually fire and forget. Send a notification and hope it arrives at the intended destination in a timely manner. Field personnel in remote locations are burdened with unreliable or reduced network connectivity. Carrier coverage differs significantly in performance and reliability. Emails, SMS messages, and pagers can experience significant delays in delivery. Given the severity of some of the alarms, critical events are escalating yet intended personnel are not aware there is an issue to be addressed.

Assuming the message is received, additional steps are required by the designated person to acknowledge the alarm, review related information, and take some form of additional action. In the event that the notification is sent to a group, a separate action needs to occur to notify the other members of the group that an acknowledgement has occurred and their participation is not required. Participants may have to carry numerous devices to handle and respond to alarms. These devices range from cell phones, pagers, and laptops. In a typical scenario, an on-call person receives notification of an alarm via email, SMS, or pager and finds an available access point to login to the SCADA system to acknowledge the alarm and determine if additional steps need to be taken. Without proper historical data or the ability to review related events, one or more personnel representing different areas of expertise are often required to go to the location of the device generating the alarm to determine what corrective steps need to occur.

Such onsite visits could be eliminated or at least reduced for some personnel if greater visibility to the related events at the problem location is provided.

A new approach is available to address the shortcomings mentioned above. Using Recursion Software's **SCADA-Aware Mobile** application, notifying, responding, and analyzing alarms can occur on smartphones. Today, most SCADA systems interact with smartphones via SMS. Usually an alarm is pushed to the field service engineer and interaction with the SCADA system occurs through a different device. SMS delivery in a timely manner (if at all) has proven to be problematic depending on the location of the mobile device as well as the carrier. Utilizing another device (e.g. a laptop) to login and respond to an alarm raises a different set of technical issues further decreasing the overall reliability that SCADA alarms are being properly addressed in accordance to contracted Service Level Agreements.

SCADA-Aware Mobile allows smartphones to act as both a client and a server. Besides just sending an alarm notification, our application can verify the message was received on the intended device. If the notification is not verified as delivered, automatic steps can be taken to close the gap. The mobile device being offline can itself be a tag with defined alarm triggering events. Note that the verification of alarm delivery is a separate event from acknowledging/taking ownership of an alarm. Alarm acknowledgement will be discussed later. Another feature that **SCADA-Aware Mobile** brings to alarm notification is the ability to query the device's location information and determine if the device is within the designated proximity to the problem device to even receive an alarm notification. If not, alternative escalation and notifications can occur.

SCADA-Aware Mobile can use the carrier's TCP/IP network or the Wi-Fi interface on smartphones. Carrier coverage varies significantly in different parts of the country. This becomes more significant in many remote field operations when the issue is not whether 3G or 4G networks are available, but whether any signal is obtainable. Our **SCADA-Aware Mobile** application can be tuned for unreliable networks. 3G or higher speeds are not required depending on the amount of data shared with the device. The application needs to handle the disruptive network as it moves from no coverage, minimal connectivity, to full 3G or 4G, and provide the field service engineers as well as the SCADA system a level of confidence that the alarm has been received and acknowledged.

While the field service engineer does not need to worry about the changes between network speeds, the application developer needs to handle the connection reestablishments and the new IP number assignments that occur with each change. In some locations, the carrier network bounces between EDGE, 2G, 3G, and 4G connectivity. As the smart device switches between the different cellular networks, the TCP/IP connection is dropped and reestablished. The application framework needs to handle the unreliable environment and maintain or reinitiate connectivity to the network and application. **SCADA-Aware Mobile** handles this changing environment below the user's UI experience.

SCADA-Aware Mobile can interact with the operating system on the smartphone to detect network changes and respond accordingly. Users may experience a dropped connection, but the application will recover automatically.

Besides improving the validation of an alarm delivery, **SCADA-Aware Mobile** aids in the acknowledgement of alarms. Often an alarm notification is sent to several individuals. Due to **SCADA-Aware Mobile** collaboration capabilities, a field service engineer can acknowledge an alarm that initiates an update to the SCADA system assigning ownership of the alarm as well as providing the other individuals who received the notification an update of who has taken ownership of the event. All of this interaction can occur directly from the smartphone

device without anyone using another device (e.g. laptop) to take further action. With validation of an alarm's delivery to the device as well as allowing alarm acknowledgement, accountability of alarm handling improves.

Prior to acknowledging the alarm, a field service engineer can query related tag values as well as historical information to help determine next steps. Related tags may suggest a different skillset is required to address the alarm. Historical data will provide a level of urgency depending on how quickly the threshold values are changing. With this additional information, the alarm can be acknowledged and informed next steps can be determined. Sending a field service engineer on site is costly to an organization. Often this trip is outside of normal business hours. Besides the cost associated with additional hours, there are costs related to the risks of travel and exposure to hazardous materials. Minimizing the number of trips as well as improving on the accuracy of the skillsets needed to resolve the issue is of significant value to the overall SCADA system. Reducing these risks also improves the safety for the impacted employees.

This increased functionality comes with additional considerations. Valuable corporate data is exposed through the smartphone application. Steps must be taken to secure that data. **SCADA-Aware Mobile** provides several mechanisms to help. Using **SCADA-Aware Mobile**, users can be authenticated against the corporate Open LDAP servers or Microsoft's Active Directory servers. Other authentication methods can be incorporated. Using a challenge response interaction, the user is verified and the application is provided a list of access rights and roles allowed for this user or device. **SCADA-Aware Mobile** will use this information to determine what information is available to the user and what actions the user can take with an alarm. This initial authentication also establishes the communities of interest for the user to aid in the collaboration with team members.

After a user has been properly verified over the carrier's network, the next critical security mechanism is the encryption of data between devices.

SCADA-Aware Mobile supports SSL between all devices. **SCADA-Aware Mobile** can be extended to handle additional encryption protocols. As active alarms are communicated and requests for historical data is fulfilled, corporations need to guarantee visibility to the information is properly managed. The features described above provide the necessary tools for application developers to implement a secure environment.

SCADA systems are a critical piece of a business' infrastructure. To maximize the benefits provided by the system, reliable handling of an alarm and the proper response to address the alarm is needed. This paper has identified several areas for improvement in the current alarm notification components of SCADA systems. Without a guarantee that the alarm notification has reached the intended device in the required timeframe, assumptions are made that increase the risk of the elevated event not being properly handled. The system needs a way to determine that the device is available and in range, that the notification was received by the device and that the user of the device has taken ownership of the alarm or has taken the necessary steps of notifying other members that additional steps are not necessary. Recursion Software's **SCADA-Aware Mobile** provides many of the features required to improve this part of a SCADA system. Users on smartphones can interact with the SCADA system and pull historical and related information to better determine the appropriate next steps. These capabilities help companies maximize their SCADA investment and reduce the exposure to employees of the risks inherent in some of these environments.

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