Contextual Mobility for Monitoring and Control

By Edward Nugent

Deriving Context from Location and Role

Today mobility is associated with smart devices, most notably phones and tablets. They are increasingly the preferred communications method for people on the move. Interaction with mobile devices differs from the way in which people interact with laptop and desktop computers. Historical approaches to mobility solutions used to monitor, diagnose, maintain and control Buildings and Energy Management Systems (EMS) are being revolutionized by advances in contextual mobility.

In the distributed environment of monitoring and control, there are typically independent servers for each physical area or zone of control. A zone may refer to all the equipment in an area, such as a floor in a facility, or it may refer to a specific automation system.

The people responsible for these systems are increasing required to be on the move. They typically use their smart devices to access equipment and other assets located in each zone. They must know how to connect to the control server responsible for that zone in order to get relevant information and controls. Given the many different publishers of control server software it is unlikely that the zones will have information organized in a consistent way or have a common user interface. This greatly complicates access and increases the time required for a mobile worker to carry out their responsibilities.

The responsibilities of the mobile worker are defined by their organizational role and they may vary by zone of control. For example, a person responsible for operating equipment in one zone and may only monitor equipment in another. Likewise, within any given zone, there is a difference between the information needed by maintenance personnel than that required by operators. The information and controls required are therefore in the context of the person’s role and their location. What is needed is a system that is proactively and securely presenting the right contextual information, to the right person, at the right location and at the right time.

A new infrastructure to serve contextual mobility is needed. The Mobility Infrastructure (MI) presented here embraces the smart mobile device to increase the value and capability of the entire system. It consists of indoor positioning systems (IPS) deployed in zones of control, a Proximity Services application on the mobile devices and a Mobility Server responsible for evaluating the appropriate contextual requirements and handling the communications needed to monitor and control equipment and other assets.

Figure 1 Contextual Mobility

Proximity Services for Contextual Mobility

IPS and the long-standing Global Positioning System (GPS) are standard features of today's mobile devices. Using IPS or GPS, the mobile device is able to determine its own current location. When an app on the device validates and maintains the user's credentials, the device is now able to determine both the role of the user and their real-time location. In addition, using the same IPS technology, the app is able to sense mobile assets that are in the proximity and along with the location and profile of the user synchronize this information with the Mobility Server.

The mobile device is connected using standard wireless network connections. Geo-tags including Bluetooth Low Energy (BLE) beacons, Near Field Communication (NFC) tags and QR-Codes are used along with WiFi Access Point triangulation and other emerging technologies to determine the micro geolocation of the mobile device. In similar fashion, these Geo-tags may be applied to mobile assets for enhanced Proximity Services. Since this picture is changing as the user is on the move, the user creates a movement history that may be recorded by the Mobility Server as allowed by privacy considerations.

Figure 2 Proximity Services

Mobility Server and the Contextual Logic Engine

The cornerstone of the infrastructure is the Mobility Server and its Contextual Logic Engine (CLE). The Mobility Server determines the appropriate actions and distributes information and control elements to the mobile worker in the context of the where they are and their responsibilities at that location. The information may include real-time status or control of equipment. It may suggest additional resources (drawings, schematics, etc.) needed by the worker in the performance of their duties.

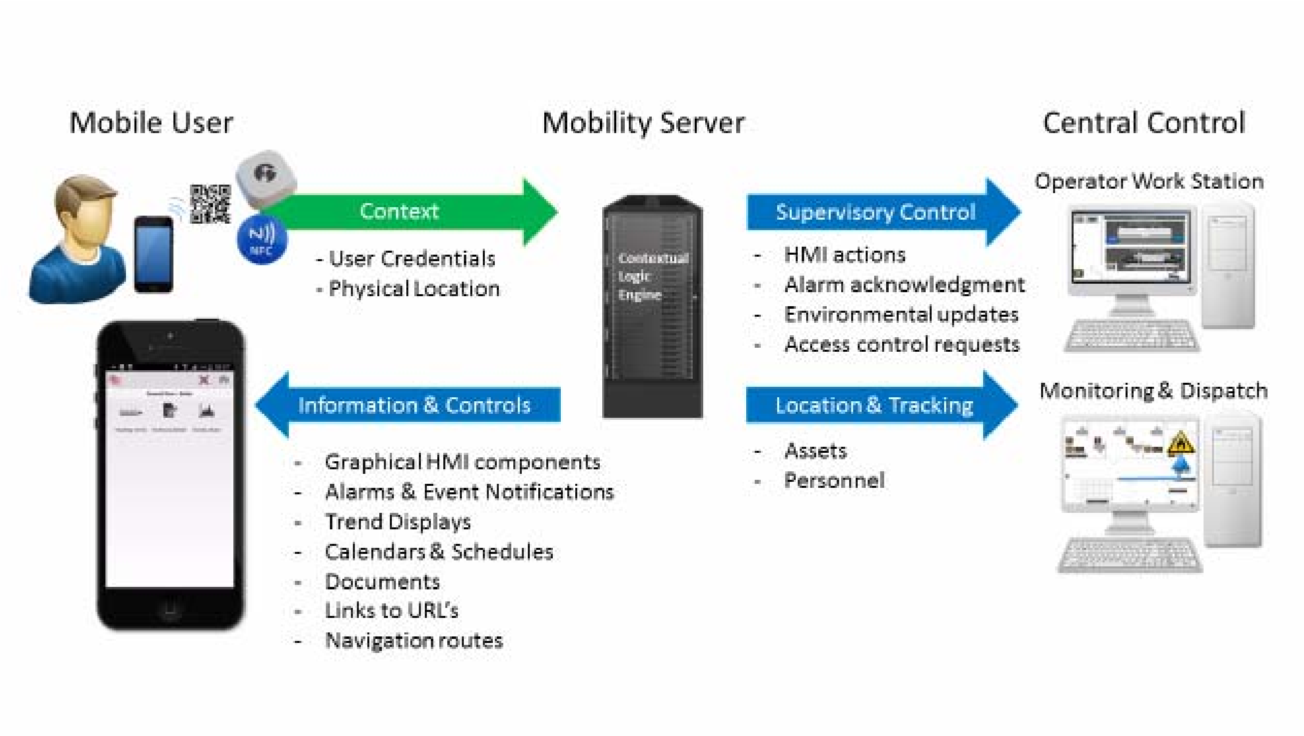

Figure 3 Mobility Infrastructure

When the CLE determines that conditions require new information and actions to be provided to the mobile user, they are automatically sent to the smart device. Some examples are:

- Graphical Human Machine Interface (HMI) with status and ability to command.
- List of measurement values.
- Trend chart of key values.
- Display and/or modify a schedule of events.
- Manage alarms.
- Launch a web page, display a document or invoke other operating system resources.
- The CLE may also make environmental comfort adjustments or provide access control.

Securing the Mobile Device

Cyber Security concerns are paramount in any information system and as in any network it is important to provide the full range security measures such as firewalls and active user rights management. Additional considerations must be thought through when deploying a mobility solution. Specific features within the framework of the Mobility Infrastructure include:

- User sign-on required to use the smart app.
- Re-authenticate before control actions are performed.

- Validation before critical actions are performed.
    - Validate proximity of the user to the device with wearable sensor such as a BLE beacon.
    - Confirm validity via Geo-tag attached to equipment such as a QR-Code.

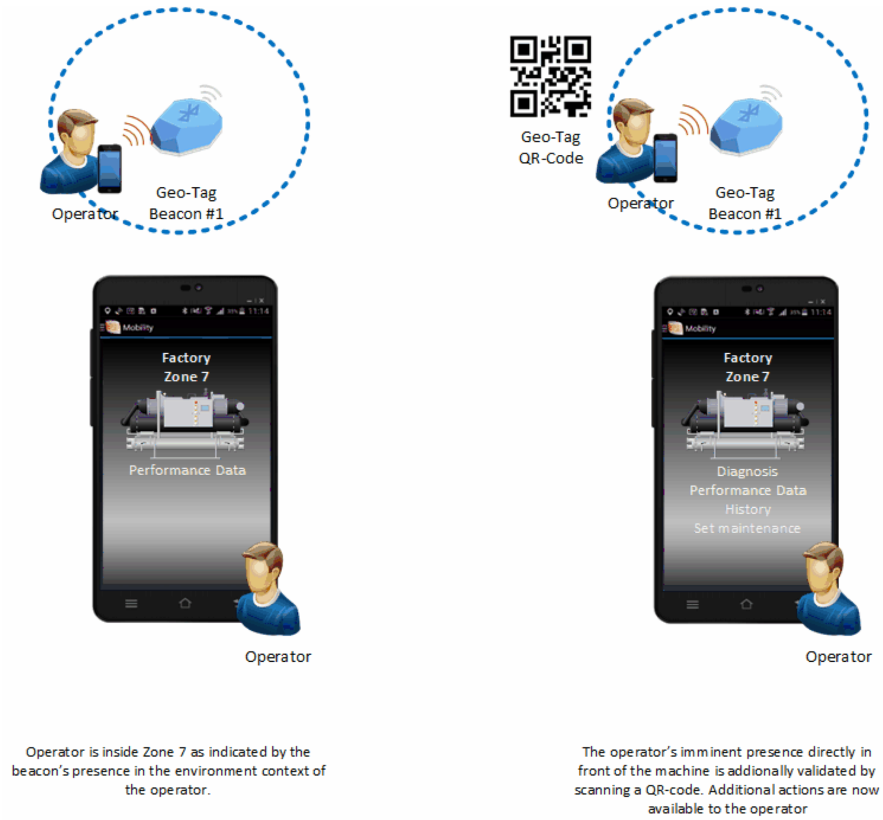

Figure 4 Validator Tags Determine User Rights within Zones

Benefits to Mobile Users

Many benefits are realized with the deployment of a Mobility Infrastructure. These include benefits to all users and benefits specific to certain worker responsibilities. There is also benefit to the entire organization in safety, security, comfort and efficiency which are discussed below.

Equipment Management

Operators are able to move out of the control room and work closer with the systems they manage. This is possible with the ability to view key characteristics, which are refreshed as they move. This is possible while at the same time continuing to maintain awareness and receive alarms across all zones. Trends may be viewed, set points changed and any other operator actions performed. When out of the zone of operational responsibility, the operator's rights may allow viewing operations without access to control of those particular assets.

Maintenance

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The Mobility Server is aware of the location of remote maintenance personnel and is able to intelligently dispatch alarms to the person who is best positioned to respond. The proximity rules enable innovative thinking about organizing a maintenance strategy. New ways to combine proactive and reactive aspects of maintenance based on a real-time assessment of resources and proximity are possible.

In a recent study by Fraunhofer, USA the benefits of mobility were explored with industry experts who specify and design BMS and EMS systems. What emerged was that supervisory systems could be a double-edged sword for maintenance workers. The information needed for maintenance is in the system, but it can be difficult to access and it can be difficult to understand, given the format of the information. The promise of mobility to proactively deliver the needed information in an understandable format and to guide the maintenance worker to solve the problem was identified as a major benefit.

As the maintenance worker moves, they are provided updated contextual tools. These tools are in the context of both the physical orientation (nearby, lift equipment zone, full facility, etc.) but also factored to provide the most useful tools for that user based on training and certifications.

For example, a maintenance engineer may be monitoring an asset that is suspected or known to have malfunctioned. The component has uniquely identified its location determined by one or more Geo-tags. When approaching the Geo-tags the Proximity Services app synchronizes with the Mobility Server, which responds with contextual information and control actions. The information and control actions related to nearby assets include:

- Access to real-time and historical information.
- Display of the trend for any variable of interest.
- Access to the asset’s alarm list.
- Ability to put the asset into maintenance mode.
- Access to technical documentation for the asset.

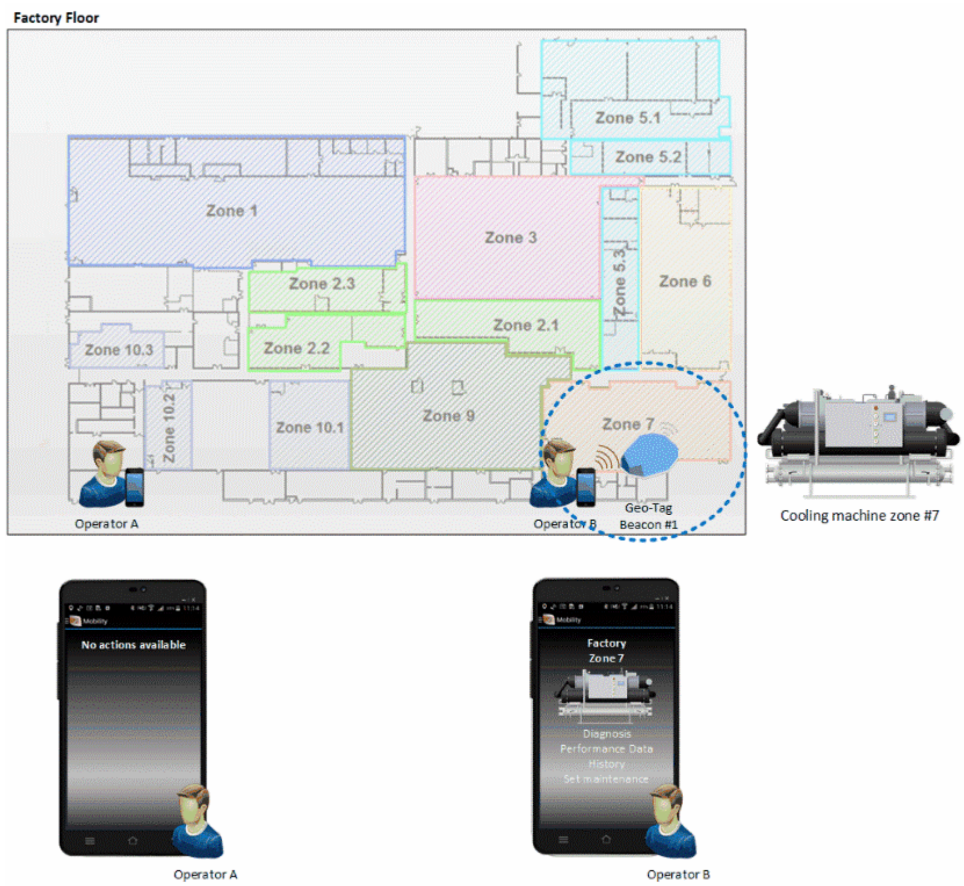

Figure 5 Contextual Mobility from Zone and User

<u>Commissioning</u>

Commissioning can be labor intensive and time consuming. Typically one worker located at the control room uses a radio to communicate with a field worker to relay the status of the equipment. A participant in the Fraunhofer report noted, “I don’t need two people to do something one can now do.” The mobile worker is provided with a HMI for operating the equipment and access to resources such as commissioning checklists, electrical diagrams and startup procedures automatically delivered to the mobile device as the worker approaches the equipment.

<u>Access Control</u>

The Mobility Server knowledge of workers’ credentials and current location provides the baseline for access control. When a facility visitor requires access to a zone, the request is known to the Mobility Server based on the person’s proximity to a Geo-tag associated to the access point. The Mobility Server may grant access and verify that the user has in fact entered the zone.

Geo-fencing refers to the management of user rights as they move through different zones. The Mobility Server enforces the Geo-fences. The rights of a worker are allowed to change depending on the current zone. An alarm may be raised when persons are entering or leaving a zone (crossing the virtual fence) without prior authorization.

Safe Movement

The Mobility Infrastructure also supports life safety. It is able to coordinate and monitor the progress of any required evacuations including providing information about the best route given the real-time situation. The Mobility Server is able to monitor workers remaining in danger zones and alert workers moving in an unsafe direction. Safety related warnings can be directed to the mobility user and that person will now be accounted for in the case of an emergency.

Benefits to Operations

The aggregate view of mobile personnel and movable assets is extremely valuable for managing resources.

User Movement History

Tracking changes of location over time is an extension of the proximity services. By monitoring the real-time location of the worker, traffic analysis such as the density of workers in an area, can be visualized in real-time and displayed on 2D or 3D maps. According to the designers who participated in the Fraunhofer study, this is the future of the industry. This is particularly true in high-value facilities such as multi-use buildings, hospitals, labs, vivarium, and facilities and campuses with large central plants or chillers. Actions of the Mobility Server as a result of tracking asset location include:

- Raising a security alarm
- Adjust environmental controls for temperature, lighting, etc.
- Perform energy balancing

Asset Tracking

Geo-tags associated with assets are registered in the Mobility Server. The relationship with the position of the asset Geo-tag compared to stationary Geo-tags associated with zones makes it possible to track mobile assets inside a facility. As in previously described cases, the Mobility Server may react to the repositioning of a moving asset via alarming, visualization or recording (archiving).

Conclusion

The rise of smart mobile devices that are now familiar to almost all workers has created an opportunity to improve mobility for monitoring and control. This trend is away from managing from a central control room to a distributed model of personnel on the move. The way in which users interact with their mobile device in comparison to the way in which an operator works in a control room requires a Mobility Infrastructure to optimize efficiency, safety and security.

With the standardization of geo-location and micro geo-location capability on mobile devices it is possible to monitor mobile personnel location and drive contextual information and controls to their smart device based on their credentials and location without requiring specialized equipment.

The Mobility Infrastructure was born of the desire to make use of the rapid growth and availability of Smartphones and Tablets. Incorporating proximity services with a mobile app and Mobile Server enables world-class mobility solutions for SCADA and building management system projects.

About

Edward Nugent is the Chief Operating Officer of PcVue Inc. of Woburn, Massachusetts. The company is the North American affiliate of ARC Informatique, which is headquartered in the southwest of Paris in Sèvres, France. ARC Informatique is the publisher of the innovative PcVue Solutions for SCADA/HMI; a platform used extensively in Building Management Systems, Energy Management Systems and many other vertical markets worldwide.

The Fraunhofer Center for Sustainable Energy Systems (CSE) is an applied research and development laboratory that assists industry and government clients with a focus in building energy technologies, solar photovoltaics, distributed electrical energy systems, start-up assistance, and technical validation. Fraunhofer is partnered with PcVue in evaluation of Contextual Mobility at the intersection of Technology and Behavior.