CREATING A MOBILE-CENTRIC OPERATIONAL MODEL IN UTILITIES

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ABSTRACT

The consumer market is progressing towards a post-PC era with the wide-scale adoption of mobile and tablet technology. Computer technology in the enterprise is heading in the same direction. As mobile devices have gained dominance, so too has the need to remodel organizations from a mobile-centric viewpoint. Mobile solutions now have over 10 years of operational use in electricity distribution, applied as an adjunct to major centralised IT systems and used for asset operations and asset management. This paper offers a vision of how electrical utilities will redesign their asset operations by placing mobile technology at the centre of their model.

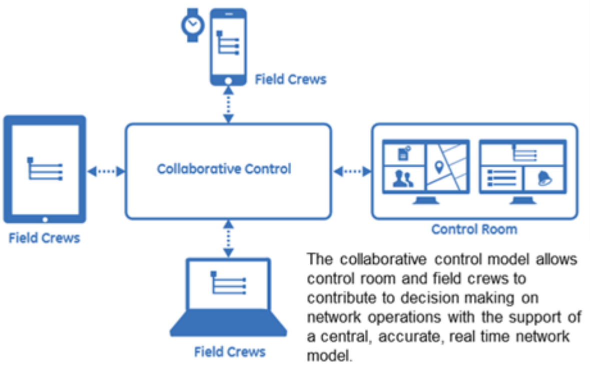

Figure 1. Collaborative Control Concept

UTILITIES CANNOT SOLVE TODAY'S PROBLEMS WITH YESTERDAY'S TOOLS

Electricity distribution management is changing, driven by several, sometimes contradictory, challenges:

- Customers are becoming more dependent on electricity, while demanding greater value for money.
- Shareholders are requiring improved returns, challenging costs and investment, while in parallel, the removal of fossil fuel generation is driving a rapid expansion in the use of embedded renewable generation necessitating additional network investment.
- Regulators, and consumers, are demanding more reliability, at the same time as emerging technologies such as electric cars are driving up electricity demand and disrupting networks that were originally designed for unidirectional load flows.
- A greater frequency of severe weather events is increasing the number of unplanned outages experienced at many utilities, while at the same time distribution network control is becoming more complex as elements of active control are introduced to manage embedded generation.

Together, these changes are exposing the centralised command and control model which grew in response to the "more from less" challenges of the 1990s.

The traditional response

Historically, the utility approach to meeting similar challenges has been to drive large-scale headcount reductions in conjunction with investments in network automation and software systems. This approach has delivered significant benefits, but the resulting "command-and-control" operation model is proving less effective in tackling new opportunities and challenges.

Major Storms

Storms and major incidents increase activity on the network, and in particular the number of faults, which typically require more frequent and focused contact between Field and Control. This exacerbates the general problem of communications contention between a control engineer and the (up to 20) field engineers typically working under their supervision.

This natural bottle-neck slows the flow of information to and from the field, impacting the rate with which updates are applied to the Advanced Distribution Management System (ADMS) model. This, in turn, reduces the effectiveness of processes dependant on the ADMS model. The utility must also invest resources post-event to ensure the ADMS network model is updated to correctly reflect the final state of the physical network.

Increasingly Complex Networks

Embedded generation can cause multi-directional load flows, increasing the complexity of contingency planning and planned outage approvals, both of which place an additional burden on control room operations.

LV Networks

Increases in domestic generation, and the uptake of electric vehicles and other high-load consumer technologies put pressure on the LV network, and are causing many utilities to look at modelling and operating their LV network in real-time. This presents major scalability challenges for software systems and control room operations.

Under the traditional command-and-control model, the utility would have two responses to these challenges:

1. Increase staff levels across both field and control - undermining the mantra to do more with less.
2. Devolve a measure of control to the districts - increasing local responsiveness, but reducing overall visibility of real-time network state across the wider enterprise.

THE IMPACT OF MOBILE TECHNOLOGY

Over the last 10 years, mobile technology has been introduced by several utilities to begin breaking down the communications bottle neck.

These technologies have generally been used to transmit instructions and updates from control to field, removing the need to verbally confirm each update. However, the field engineer has remained under the direction of control, with limited ability to create and execute their own switching. Field engineers have also not been provided with a real-time view of the wider network context beyond the specific fault or planned order currently present of their mobile device.

However, despite the above limitations, these applications have generally been successful in reducing the volume of voice communications, and have helped lay the foundations for the next phase of mobile developments.

The transformational path to "collaborative control"

Consumer usage of smartphones and tablets surpassed the use of traditional personal computers in 2013. This growth was made possible by the creation of devices and software that support complex information consumption and creation, and has spawned major applications such as Google® Maps, Facebook® and YouTube®.

The opportunity now exists to leverage the advances in technology originally developed for the consumer space. Sophisticated, secure messaging, collaboration, location tracking and augmented reality have been combined in the consumer market to form a closer union of the real-world environment with computer generated sensory input informing computer modelling of that real-time environment. These technologies offer are a true real-time understanding of what the crews are doing, the real world demands on them, and on computer maintained network models.

Changes in the workforce also favour the adoption of mobile technologies. New technology-aware employees are coming on board, and existing personnel are increasingly experienced in using mobile systems both at work and with their personal smartphones and tablets.

Furthermore, emerging wearable technologies – notable examples being Google Glass® and Apple® Watch – as well as voice control also show great promise. These newer technologies solve specific issues for field crews who are often required to wear gloves and work in situations in which hands-free access to notifications and data would be of significant benefit.

Our vision sees the provision of a range of mobile apps connected in real-time that offer critical data to field crews in a format that suits their role. Some apps, for example, provide data and tools needed for complex decision-making, planning and crew management while other apps allow non-specialist staff to capture information to be fed back into the control system. We foresee electrical utilities using mobile technologies to transform the system, moving from the command-and-control model to an operational model in which controllers, dispatchers and field personnel all contribute to decision-making with the support of a central, real-time network model. We call this new operational model "collaborative control."

This new model empowers field crews to be responsible for end-to-end processes. Switching operators, for example, would create and execute network switching while the current standard model splits these activities between program writers, controllers and switching operators. The new approach eliminates the central control bottleneck and increases flexibility by enabling the network to be broken down into separately managed sections within which the new aspects of planned outage approval involving considerations of embedded generation, connection contracts, constraint management and contingency planning can be evenly spread across the managed sections close to the network and customers involved.

Collaborative control has the potential to transform workflows that are routinely delegated to field crews, such as storm response and low-voltage fault restoration. In these situations, field personnel are traditionally reliant on local knowledge and experience to make decisions due to a lack of real-time network data. Central control often has limited visibility into work completed in the field. Under the collaborative control model, field crews can become significantly more effective. For example, they would be able to:

- Select and execute the highest priority work order without calling the control room or dispatcher for instructions
- Combine access to the real-time network model with observable local conditions, such as equipment damage, weather events and embedded generation
- Collaborate with controllers, dispatchers and other field personnel around the operational context (e.g.,

job or portion of network), with all parties able to share text, voice, photos and videos and enable takeover of delegated control of portions of network

- The LV network is a major candidate for collaborative control with every authorised mobile crew interacting directly with the LV network model to update it on actions taken during normal work and fault investigations.
- Access real-time decision-support tools in the field to help drive best practice in operations and fault detection and repair.
- Assign additional tasks to current and future shifts, emergency services or contractors.

MOBILE-CENTRIC COLLABORATIVE CONTROL MODEL DELIVERS BENEFITS

The transition to a mobile-enabled collaborative control operational model offers the potential for electrical utilities to unlock significant safety, service, compliance and cost improvements:

Reduce number of safety incidents

Real-time collaboration between controllers, dispatchers and field crews around a shared network model – coupled with end-to-end process ownership by field crews – offers significant safety benefits. These benefits come from reducing inaccurate or outdated information on the status of the network and crews, as well as decreasing human errors resulting from a lack of ownership of business processes.

Mobile-enabled situation awareness technologies also promise to improve field personnel safety. Basic examples of this include standardised safety workflows recorded on the mobile device, including integrated safety checklists to be completed prior to undertaking high –risk actions under potentially stressful conditions. These workflows can be enhanced such that a field crew’s presence at a site might, for example, be detected via short-range proximity tools and geo-positioning tools – with the control room dispatcher then updated on the location of the field crew who, in turn, are guided through the applicable workflow. Other such technologies include combining the real-world environment with computer-generated sensory input to provide additional information to field crews to support safe work practices. A field crew could, for example see that a cable is energised or view operating instructions over the top of the network equipment to be operated.

Figure 2. Augmented Reality

Improve service and compliance.

Moving from a fault diagnosis based on experience to a diagnosis based on the use of decision support tools that combine historical and real-time information has significant potential. This transition improves the effectiveness of repairs which, in turn, can reduce repeat asset failures that frustrate consumers and negatively impact SAIDI/CML performance.

Empowering field crews to be responsible for end-to-end processes around specific parts of network can accelerate fault restoration. Benefits of this model include removing central control as a bottleneck – eliminating the need for field crews to sit idle while waiting on the phone for instructions – as well as enabling field personnel to define and address priorities based on local knowledge and conditions.

Reduce operational and capital cost

The operational improvements gained from a collaborative control model can result in operational and capital cost reductions across the board. Labour, material and compliance costs will decrease as a result of the reduced number and duration of fault outages. Collaborative control enables improved employee productivity through lower error rates, reduced handoffs and better communication. Field staff are empowered to make local decisions with reduced reliance, (and associated delays) on central control. Meanwhile, major capital investments associated with having to scale centralized operations are also avoided, as are the risks associated with adapting the network to new generation and demand patterns.

CONSIDERATIONS FOR CREATING A MOBILE CENTRIC OPERATIONAL PLAN

Key considerations have been identified for those seeking to create a plan for the transition to a mobile-focused operational model. This starts with a mind-set in which mobile is at the centre of all strategy and planning of business systems and processes. Without this mind-set, software will continue to be built with mobile as an afterthought, leaving businesses unable to truly transform their processes and realise additional operational improvements.

Consider these best practices when building a mobile centric organization

1. Address organizational barriers that impede mobile adoption

Recognise and address the organizational barriers that impede coordinated adoption of mobile technologies. Such barriers are common as responsibilities are frequently split between corporate IT, real-time systems and customer service organizations – with misaligned incentives and poor coordination that stifles progress.

2. Build a tech-savvy, problem-solving field organization

Establish a business-wide vision of field operations in which field staff are both tech-savvy as well as capable of complex problem-solving and decision-making. This vision must ultimately permeate all activities related to recruitment and training, as well as change and performance management.

3. Redefine operational roles and responsibilities around a mobile-centric operation

Redefine roles and responsibilities in a manner consistent with the new mobile enabled operational model. Traditional structures built on “control vs. field”, and “operate vs. maintain” models should be replaced with end-to-end ownership of processes.

Address major technology challenges

4. Navigate towards a multi-device future rather than one size fits all

Navigate the business towards a future with proactive support for a range of mobile devices and form factors – allowing devices to be matched to the unique needs of each group of field staff. This may require new skills and infrastructure to support device and application management on platforms such as iOS® and Android®.

5. Take a multi-pronged approach to securing mobile devices and apps and to managing the complexity and increasing scale of these IT systems

Develop a multi-dimensional plan when it comes to security. Establish field processes to ensure physical security of devices, conduct regular penetration testing and adopt a mobile device management platform that provides best-practice security features (including user/device access, secure communications and operating system patch updates). This substantial increase in the amount of data, number of devices, users and general complexity causes significant challenges for the IT management function of utilities of all sizes. Cloud computing and the Industrial Internet provide a route to addressing these problems with solutions which include high-availability and cyber-security built in to the base architecture.

6. Auto-build network model based on field capture of network data

Improve the network model data – in particular that of the low voltage network – with real-time aggregation of data from field crews, third parties and social media, as well as network automation. This dynamic network model should support photo and video data inputs as well as traditional data on asset attributes and conditions. The efficient gathering of detailed measurements of asset routes and locations, and the arrangement of devices within a congested substation location can be driven as a mobile measurement point and click app when there is a need for more accuracy than that provided by GPS.

Target critical operations processes

7. Take a business process – not a system – view of mobile initiatives

Shift thinking away from apps for individual systems and instead focus on apps that mobilise complete business processes with integration across multiple systems. This design represents a major departure for most utilities and could provide, for example, a solution for fault response involving integration with outage, asset and customer management systems.

8. Rebuild processes around control delegated to field operations

Start with a clear vision for storm response and low voltage network operations that is built on field crews managing selected portions of the network. Field personnel should, for example, be able to propose and execute actions on the network as well as manage the distribution of work to other field crews.

9. Think beyond the business and help mobilise third parties

Set a program of mobile-based collaboration with external stakeholders. This would, for example, embed mobile-centric thinking into contracts with field service partners as well as empowering emergency services with apps so that their staff are able to assist with major event scenarios.

CONCLUSION

Doing more with less is a common challenge utilities face on a daily basis. The need to reduce costs across distribution operations while ensuring operational safety is growing. This, combined with the need to manage the increasing number of devices across the network and multiple IT systems, calls for a new approach to interactions between man and machine. The time is right for electrical utilities to leverage consumer mobile and adopt a mobile-centric vision of operations. This vision sees mobilization of advanced distribution management functions in a manner that enables a new collaborative control operational model which, in turn, unlocks significant safety, service, compliance and cost improvements. Leaders looking to place mobile at the centre of their operations need to build a mobile-focused organization, address major technology challenges and target critical business processes.

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