DE-CENTRALIZED WORKING FOR OUTAGE MANAGEMENT, INCLUDING AUTO-DISPATCH

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ABSTRACT

The traditional model of fault management across electricity distribution networks operators relies on a large team of centralized incident controllers, who can be overloaded during busy periods, and under-utilized during quiet times. Based on analysis undertaken at SP Energy Networks (SPEN), as well as the availability of cutting-edge technology, a new model of de-centralized dispatch management is being implemented which is based on enabling technologies for:

- *Automatic reporting of current field crew positions to the central dispatch centre*
- *Intelligent grouping of calls by the Outage Management System (OMS)*
- *Automatic dispatch of outages to field crews by the OMS system*
- *Equipping of field crews with mobile devices allowing for autonomous status reporting*

INTRODUCTION

SPEN is the operator for two electricity distribution regions in the UK:

- SP Distribution covering 2 million customers across central and Southern Scotland
- SP Manweb covering 1.5 million customers across North Wales and West England

As a regulated business, SPEN is subject to targets agreed with the UK regulator, Office of Gas and Electricity Markets (OFGEM). An area of focus for the business is driving customer service. Two specific measurements are a focus for SPEN driving improvement:

- Customer Minutes Lost (CML) defines the average number of minutes that a customer has their supply interrupted. Specifically, by end of RIIO ED-1 Price Control (ED-1) SPEN has committed to reducing the average time their customers are off supply by 25%.
- The customer service score is based on a telephone survey of customer satisfaction. Currently SPEN is rated as 8.4 out of 10 in SP Manweb and 8.8 in SP Distribution areas. SPEN is looking to improve on the current customer satisfaction score and have committed to a 20% improvement in its overall scores.

As an additional challenge these targets must be achieved in an environment where SPEN will undergo a significant change of experienced personnel in their workforce, with 60% of staff due to retire in the next 10 years.

This paper will describe in detail the new work processes being implemented at SPEN to move from a centralized to a de-centralized approach. The intent is to improve customer service, and use technology as an enabler to standardise process in the context of a changing workforce, with particular focus on:

- Technology drivers to ensure timeliness of information
- Staff re-skilling and training on the new processes
- Quality of governance and auditing in the new processes
- Empowerment of field crews to make operational decisions
- Cyber security considerations in a de-centralized architecture.

TECHNOLOGY UTILISATION

In the move to de-centralized operation, SPEN have identified 4 key technologies, implemented in a phased approach. These are: Intelligent Grouping of Calls; Enabling of Mobile Working for Field Crews; Field crew Positions in Real-time; Automatic Dispatch of Work. Each of these is described in detail in the following sections.

Intelligent Grouping of Calls

In 1998, SPEN were one of the first UK network operators to implement an Outage Management System which was fully integrated with their SCADA and Distribution Management System (DMS). This type of solution is now referred to as an Advanced Distribution Management System (ADMS). SPEN currently use the PowerOn ADMS product from GE to record and mange outage events based on customer calls, switching actions and telemetered devices.

The PowerOn OMS module provides SPEN with capabilities to record customer calls using the Call Taker application. When the system receives a customer call, it

is evaluated to determine if it is in the scope of a known outage or not. If it is not, the call is displayed on the screen of an incident controller responsible for the operating zone the call was recorded from, and from there the controller can either manage it as a single-premise event, or merge it with other calls in the same area to create a larger outage.

The existing process of manually analysing and grouping calls is resource intensive and can be subject to error. To address this, the Automatic Incidents feature of the ADMS automatically create incidents based on calls or SCADA events. In the case of calls, the system can intelligently analyse each incoming call and predict the most likely protection device to have operated. This technique means the system automatically uses its model of the real-time network configuration to escalate a single premise incident to a larger scope (e.g. LV, HV, etc.) based on calls received. At each stage, the algorithm re-analyses all available information, including SCADA, to determine the optimal prediction, allowing field crews to be dispatched to the most likely source of fault as quickly as possible.

Enabling of Mobile Working for Field Crews

Traditionally, SPEN managed interaction between incident controllers and field crews using voice instructions over radio and telephone. This meant that the telephony systems would be a major point of congestion in the process during busy periods and during storm conditions. To address this, SPEN have issued their field crews with mobile devices, and deployed infrastructure allowing work to be electronically dispatched to them.

At the start of a shift, the field crew personnel will log on to their mobile device, and automatically receives any work which has been dispatched to them. Any updates or new work dispatched results in an audible alarm on the mobile device.

The field crew reads the details of the work to be undertaken, and then accept or reject the work. Subsequently, they provide updates, such as ‘on the way’, ‘estimated time of arrival’, ‘arrived on-site’, etc. Each update made on the mobile device is automatically displayed as an update on the ADMS console of the incident controller, greatly eliminating the need for voice communications.

The mobile solution is closely integrated with the ADMS, which realises additional efficiency of operation. Specifically, the field crew personnel can request information on the customer calls which have been associated with the work. As the field crew makes updates to the Estimated Restoration Time, this information is automatically updated in the ADMS system, which subsequently provides updates to customers via the web site and Interactive Voice Response (IVR) system. Due to a single integrated system, this workflow from field updates to customer updates happens immediately, improving the timeliness and accuracy of information to customers.

In the case of a fault when a field crew start to restore supply, they can provide precise numbers of customers restored at each stage. This information which is automatically recorded in the post-outage report compiled by the ADMS. After fault restoration is finalised, the post-outage fault form can be completed directly by the field crew using their mobile device. This last feature is a significant productivity gain as prior to implementation of the mobile solution, the post-fault information had to be manually relayed by the field crew to the incident controller who manually completed the form.

Field Crew Positions in Real-Time

To enable more efficient allocation of field crews to unplanned work, knowing the geographical location of field crew allows SPEN to determine which crews are in the vicinity of a particular work order. SPEN has implemented a mechanism whereby the current position of field crews is determined via GPS on their hand-held devices. The current location, of each field crew are then periodically relayed to the central dispatch system.

Automatic Dispatch of Work

The end goal for SPEN in implementing the previously mentioned technologies is to allow for an efficient process for automatically dispatching unplanned work to field crews. To achieve this, an auto-dispatch module was added to the operational ADMS system. This module takes work orders which have been automatically created as an input, then searches for field crews which have the required skills / authorizations, availability and are near-by to the location of the fault. The work order is sent to the mobile devices of field crews which have been determined as suitable candidates. The high-level architecture is outlined in Figure 1.

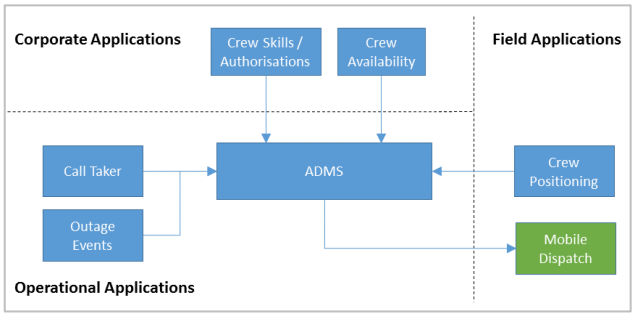

Figure 1 - High-level blocks of auto-dispatch mechanism

The required information for Crew Skills / Authorizations and Crew Availability are stored in external corporate applications:

Crew Authorizations are stored in an external database which monitors the qualifications of specific field crews. This includes tracking of when specific authorizations have expired. This information is periodically transferred to the ADMS system, where a local record is maintained.

Crew Availability is maintained by an external work force management system. The basis for this information is shift patterns, which record when field engineers are on-shift, on standby or are not working. Additionally, this system records exceptions to these patterns such as holidays and absence due to illness. In a similar fashion to the authorizations database, the ADMS stores a local copy of the information which can be synchronized.

All interfaces with corporate systems are enabled by a secure messaging gateway to the operational system, and are subject to SPEN's cybersecurity requirements. An important aspect of the interfaces is that they synchronize the database of the ADMS and the corporate systems, meaning that the auto-dispatch function is highly available, and does not rely on the availability of the corporate systems.

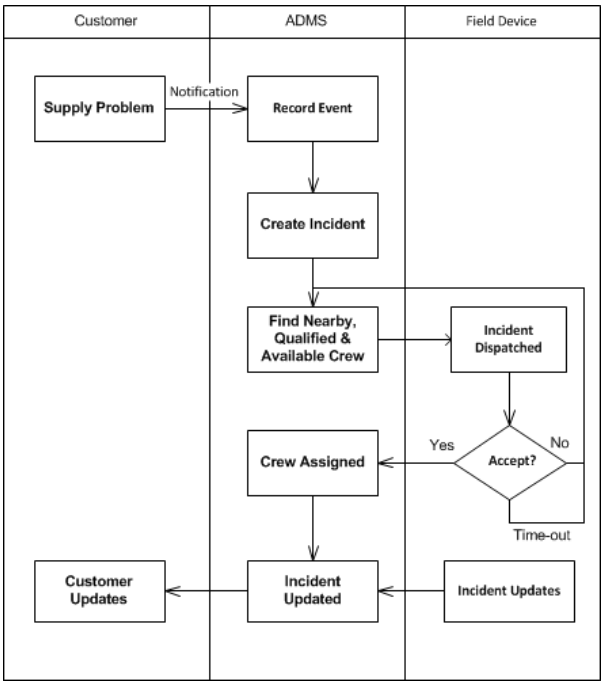

Figure 2 - Workflow for Auto-Dispatch of Fault Work

Once the system has selected a candidate field crew for an incident, the work is sent to the mobile device of the crew, causing an audible alarm to be generated on the device. SPEN has empowered field crews to make their own work decisions and so field crews personnel can choose to either accept or decline the work order, and update their mobile device accordingly. These actions are relayed to the central system. If the field crew personnel have accepted the work, it is allocated to their device. If the work is rejected, the system sends the incident to the next candidate field crew. An incident can be rejected by a maximum number of field crews before an alert is raised in the dispatch centre, alerting an incident controller that no crews are currently available. The full process is depicted in Figure 2.

TECHNOLOGY CONSIDERATIONS

When deploying any de-centralized solution, some essential technology considerations need to be made at the outset of the project. Some aspects are discussed in the following sections.

Mobile Devices for Field Crews

SPEN already utilises mobile technology to perform a range of field tasks and so there is an existing estate of mobile devices already deployed to field crews. Due to this, deployment of the auto-dispatch module is to existing devices and is aligned with existing business device replacement policy. The existing estate is a combination of both ToughBook and ToughPad devices, using both Microsoft Windows 7 and 8 operating systems (Figure 3).

Figure 3 - ToughBook and ToughPad Devices

During the initial phase of deployment of the mobile application on existing devices, it was observed that operators frequently closed the laptop lids, or logged off the devices. Though this was in line with current SPEN business practices for security, it meant that dispatch alarms could be missed by field crews. To accommodate this challenge, the deployed solution was enhanced to deliver messages via SMS to the mobile telephone of the field crew personnel so they would be aware that an incident was waiting for their attention.

Communications Infrastructure

The deployment of auto-dispatch has required a review of reliable communications across the geographic footprint of SPEN. Areas of weak or no signal have been identified and flexible solutions deployed. This included installing new masts and antennas on field vehicles to enhance signal quality.

Figure 4 – Field use of Mobile device

Cyber Security

To ensure that the auto-dispatch solution was compliant with both SPEN's cyber security policy, and with the guidelines of UK Centre for Protection of National Infrastructure (CPNI) guidelines, the designed architecture includes encrypted communications, as well as a series of controlled security zones, enforced using firewalls and proxy servers.

TRAINING/RE-SKILLING

Operator Training

When designing the project, SPEN identified that quality training of staff would be the major defining factor in success of the implementation. Significant changes to the processes, of both field incident management and auto-dispatch, affecting both incident controllers and field operators, result from the project and these need to be effectively managed.

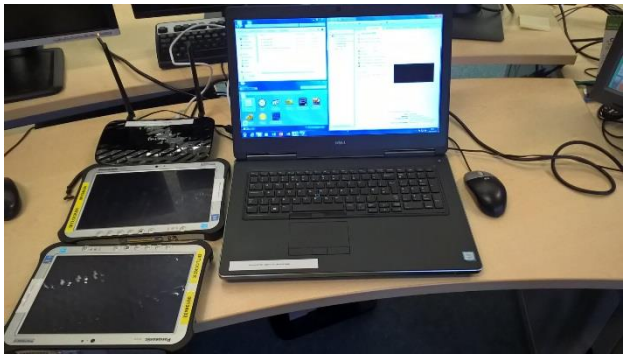

Figure 5 - Portable Training Environment

The concept of a pop-up control system was introduced, with training laptops complete with SPEN's ADMS systems installed and configured for hand held device operation (Figure 5). This meant that training could be taken to each of the 11 Districts. This was determined to be more cost effective than large numbers of staff travelling to a central training location.

With the availability of portable training environments, it was assessed that an initial "pilot" district (one in each license area) would be targeted first to fully test the "live" business deployment and process implementation. A period of two weeks was allocated for initial feedback before the subsequent training plan was rolled out, over a further ten-week period.

Process Review/Revisions

To introduce mobile working, all incident management processes were reviewed and revised to reflect such a deployment. Auto-dispatch was the principle change that removed the centralized intervention of incident management. This change in process to de-centralize activity required several additional areas of activity to be assessed for long-term placement:

- Management of additional field crew to support colleagues
- Enhancement of incident updating
- Management of "paused" incidents
- Dynamic interaction with field crew to actively manage information flows to support customer service needs
- Validation/sign-off/compliance of incident reporting.

For Auto-dispatch, coming along quickly after the pilot roll-out, the transition period into "Business as Usual" was determined as at least six months. This included establishing the process change, and implementing robust assessment of each of these activities to determine the final responsibilities.

Ultimately this change moved the real-time incident management to a de-centralized function, and from an on-duty to on-standby resource out of hours.

IT / OT Support Changes

Within SPEN the hand-held device fleet is managed by another business unit, so expanded and overlapping responsibilities now exist. This required the development and implementation of enhanced support arrangements. Specifically, the IT team managing mobile devices need to be aware that an operational technology (OT) application is being managed on the mobile devices, with additional availability and security features required.

Prior to the deployment of the mobile system, the OT support team were responsible for supporting the 90 or so control room operators using the ADMS system. After the deployment, this increased to supporting over 900 field users having access to the mobile application, resulting in an increase in support requests and new processes for raising support requests for mobile users.

FUTURE WORK

The current implementation of mobile working is focussed on driving efficiency and customer service improvement primarily for faults on the Low Voltage network. In the future, SPEN anticipates extending the concepts of mobile working to:

- Enable mobile dispatch of High Voltage (11kV and above) switching schedules for fault work
- Enable mobile for use on planned HV switching schedules
- Enable viewing of schematic network diagrams on the mobile devices of field crews