Mobile Data and Location Developments within RAC Motoring Services

Peter Skilton and Max Murdoch

(*RAC Motoring Services*)

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This paper describes the rationale used by the Royal Automobile Club (RAC) Motoring Services to update and improve the location and communication systems used by their breakdown service. It discusses the needs and problems of locating customers, and of locating, controlling, and communicating with patrols; the new systems adopted to meet these needs are described. Future requirements are also discussed together with new technologies that are expected to become available.

KEY WORDS

1. Land. 2. Vehicle tracking. 3. Communications. 4. Telematics.

1. INTRODUCTION. RAC Motoring Services was founded in 1897. There are currently (April 2001) 6·2 million members, and 1250 patrols attend approximately 2·5 million breakdowns per year across UK and Ireland. RAC Motoring Services operates from 5 major UK centres: including some high profile buildings alongside the motorway network. Communication with patrol vehicles is predominantly through a Private Mobile Radio network. The present command and control system has a distributed processor architecture running a bespoke application with in-house hardware and software support. Accurate and timely location of customers and of patrol vehicles is critical to the successful operation of the RAC breakdown business.

2. LOCATING THE CUSTOMER. The first requirement of the customers of any breakdown service is speed of response. RAC's objective is to meet that requirement, while making the most efficient use of the patrols, which, with their vehicles and equipment, represent a very high fixed cost. This deployment task is not markedly different from that faced by thousands of other organisations, such as utilities and delivery companies. What makes RAC's problem more unusual is that a very large proportion of the customers do not know where they are when they call for assistance.

The difficulties faced by someone breaking down in an unfamiliar area are obvious but, even on a regular journey, few people can describe their location with any accuracy. The problem is compounded when away from familiar routes, perhaps deep in the countryside, in a hostile urban wasteland, or in total darkness. On the motorways, some customers are unable to identify the last junction, their direction of travel, or even the motorway itself. To compound the problem, breaking down is often a traumatic experience and is at best a major inconvenience. As a result, many customers are not in the best frame of mind to collect and convey information.

Therefore, when the RAC specified its first fully computed-based control system in the mid-eighties, deriving the breakdown location accurately was a high priority. Electronic mapping systems were considered but, at that time, the technology was immature and the necessary graphic terminals were expensive. It was believed (and subsequently proven) that with a good text-based gazetteer a very high proportion (our target was 90%) of breakdowns could be located without recourse to a map. On that basis, costly electronic mapping could not be justified.

Again, at that time, no 'off-the-shelf' gazetteer could be sourced, and the RAC proceeded to construct its own. This uses as its base the Royal Mail Postal Address File (PAF), which was one of the few UK-wide digital geographic databases available at the time. Another was the RAC's own road database, originally developed to provide routing information, which was also incorporated in the gazetteer. These two sources cover every habitation (strictly, every address to which mail can be delivered) and every motorway and A and B road in the UK. To this gazetteer has been added data from a variety of sources, not least local information from RAC patrols on the ground. Much of the data has had to be collated manually; for example, information on motorway SOS boxes came from 40-odd police forces (in almost as many different formats). The gazetteer has now grown to include over 100 000 'landmarks', such as public houses, filling stations, supermarkets, hotels, and of course garages. Data on the Irish Republic, Isle of Man and the Channel Islands has also been added. With the help of this gazetteer trained operators were generally able, in dialogue with the customer, to locate the breakdown sufficiently accurately for a patrol or contractor (both of whom invariably benefit from local knowledge) to find it first time.

Since 1998, with reducing costs for graphics platforms and map data, a new PC-based 'front-end' has augmented the gazetteer with digital mapping. Developed in house, the system uses the Ordnance Survey OSCAR dataset. Paradoxically, other advances in technology have made the original problem worse. Without a mobile phone, the customer has to find a landline to call for help. The area code is used as an initial means of locating the calling line, and frequently assistance from a local person at a shop, pub or filling station, or at least a street sign or recognisable landmark can help. Now, however, almost 50% of calls come from cellphones and from customers who are reluctant to leave the comfort and perceived safety of their vehicles.

3. LOCATING THE PATROL. When the operator is confident that a breakdown has been located as accurately as possible, the next step is to identify the most appropriate patrol. To do this, the despatcher has a graphic display with the patrol and breakdown locations indicated on a map. This again is derived from OSCAR data. In normal operation, the patrols are displayed at their last known location. The patrolman's working day starts at a known point – his home. On signing on, he will either be given a job immediately, or sent to another known location, perhaps a nearby motorway junction. On completing a breakdown task, he will normally remain nearby unless it is either unsafe to do so (e.g. on a motorway) or he is out in the countryside where another breakdown is unlikely. In these cases,

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he will relocate to a more appropriate spot, in consultation with the despatcher. In some cases, he may need to tow the broken-down vehicle, and again should advise the despatcher of his new location on completion.

Inevitably, these methods of locating both customers and patrols are flawed. In the case of the customers, almost 99% are found at the first attempt. In the other cases, if a contact number is available, the customer is normally called by the attending patrolman, who is able to use local knowledge to resolve the problem. For the remainder, a second call from the customer and a second patrol callout, means inconvenience, delay and (for the RAC) added cost.

In the patrol's case, the current procedure is heavily dependent upon voice communications between patrol and despatcher; if this proves difficult, the patrol's location does not get updated. Further, it is only as good as the motivation of the patrolman to make it work.

4. MOBILE DATA. The final element of the command and control system is mobile data. As soon as a despatch decision is made, breakdown details are sent automatically to the patrol's mobile data terminal (MDT), which he then uses to update his status as he sets out, arrives at the job, and completes it. The RAC has used its current Private Mobile Radio (PMR) network since 1988 for voice and data communications with patrols. The system is a national system, operating at low-band VHF (77 MHz to 87 MHz) from over 140 sites across mainland UK. Whilst it has provided excellent service to the company since its inception, the mobile radio equipment and trunk switches, along with the in-vehicle radios and MDTs, are showing evidence of their long life with difficulty in obtaining spares and maintenance costs both increasing.

5. THE INFLUENCE OF AUTOMATIC VEHICLE LOCATION (AVL). Being an organisation whose core business revolves around an understanding of the location of customers, the location of patrol vehicles and bringing the two together in the most efficient manner, it is hardly surprising that developments in location technology have proved very relevant to the RAC. Over the last 6 years of technical proving, piloting and business case demonstration, the RAC has used AVL with various groups of patrol vehicles in the UK Midlands. Contrasting the AVL group with representative control groups, every controlled measurement of performance has shown a business benefit for the AVL group. Consistently, journey times for the AVL group were 4% to 10% lower than those for the control group. This was a consequence of presenting the despatcher with accurate, timely location data enabling a faster and better despatch decision to be made. Not only is such a reduction in journey time to the benefit of customers, it also reduces fuel consumption and hence potentially harmful vehicle emissions.

Studies and supporting field trials in 1994 contrasted the performance of terrestrial, hyperbolic navigation options and GPS. Even at that time, motor manufacturer customers were starting to investigate vehicle telematics services as a means of differentiating themselves from their competition. Since all potential telematics products were targeting a global or at least a European market, GPS and GSM were virtually exclusively selected to support the location and communication roles of the telematics units. Employing a differential GPS solution for patrol vehicles, loosely integrated with the despatch process, could provide a credible technical advantage for

RAC in all telematics initiatives. Thus the GPS system was chosen for location of patrol vehicles for both business and technical reasons.

For the AVL project, effective personal communication with those patrols involved with the various pilot projects proved essential. There is no doubt that when the first AVL trial plans were being formed in 1993, AVL was universally perceived as a 'big brother' feature. Only through preliminary discussion with the Trade Unions, and one-to-one briefing with each of the first 50 patrols involved in the pilot project, was it possible to communicate the motives for introducing AVL. These were associated with better despatch decisions, minimising patrol mileage, improving customer satisfaction, keeping a competitive advantage and embracing technology that was being adopted by our motor manufacturer customers. The fact that a patrol's personal safety would also benefit from the technology was important in overcoming any initial opposition to the introduction. Now, the initial group of patrols are some of the best ambassadors for promoting the technology amongst their colleagues. Although the GPS antennas were not covertly installed, the presence of AVL also helped with vehicle security. Over a trial period of several years we had 3 vehicles stolen; all were recovered. In no case had any attempt been made to interfere with the AVL system and a record of the vehicle movements, including locations when the vehicle was stationary was used to 'assist with enquiries'.

Many of the recent changes to the RAC's business processes within the control centres are based on an analysis of activity flow and of historic data derived from 2·5 million annual callouts. However, demonstrating a sound business case for full-scale implementation of a new process or system, such as AVL, cannot always be readily achieved through such an analysis. Prior to the first AVL trials, there was a logical school of thought, arguing against the need for AVL. The essence of the argument could be summarised as '…. when we are busy we know where all patrols are; they are with the customer: when we aren't busy, it doesn't matter … '. An argument in favour of AVL invoked the logic that accurate and timely knowledge of patrol location at a time when despatch decisions were being made would result in faster, higher quality decisions that would improve travel time to the job and reduce fuel consumption. At that time (1994), there was relatively little information from either the breakdown services sector or other relevant industry sectors that assisted in resolving the argument. The only way in which the value of AVL could be confidently assessed was to invest in a statistically significant group trial of AVL, define the qualitative and quantitative measures that would be assessed and view the results in the context of the RAC's particular business operation. As with other pilot activities, aimed at providing the data to support a business case, it has been found that this 'toe in water' approach not only achieves a high level of confidence in the following implementation, it also frequently demonstrates other unexpected benefits.

6. A STRATEGIC APPROACH.

For the pilot trial of AVL, the hardware added to the patrol vehicle was very loosely integrated with other vehicle and MDT functionality. The vehicle location was transmitted in response to a poll from the control centre, in accordance with a simple time or distance dependent algorithm or at a change of ignition status. This worked well for the pilot but was not appropriate for an operational system.

In addition to AVL, solutions for retrieval of technical information, expert systems for customer vehicle diagnostics, electronic cash transactions, computer-based training and provision of telematics information for the patrol have been the focus of some of the RAC's other development projects. By the middle of 1998, it was clear that a more strategic communication and information management framework for the patrol vehicle was required. This framework was to include all aspects of mobile data and information management, at both a functional and hardware platform level, and was to form the reference against which each new concept would be technically and financially assessed.

In summary, the strategy proposes a two-platform solution. A basic, touchscreen, monochrome MDT fulfils the functions performed by our current MDT and includes AVL, and some simple additional functionality, whilst a more sophisticated platform supports those functions requiring a PC-level of processing. The two are linked and both can access the radio communications network. Acceptance of a strategy that allows for new functionality to meet evolving business needs in an affordable manner has proved one key to shifting several areas of development, including AVL, from 'proof of concept' to operational status.

Figure 1. The touchscreen MDT installed on an RAC patrol vehicle.

7. THE WAY AHEAD. As the core control system migrates over the next year to a new, widely used and less bespoke commercial system, many of the lessons gained in the techniques of customer location from the first generation system will be carried forward to the new system. In future, customer locations derived from their in-vehicle telematics units will be more widely available. The units, which typically derive location from a GPS receiver and transmit that location to the telematics service provider via a GSM short message, are now starting to appear on the European market with Breakdown Call (B-Call) functions.

For those who have closely followed vehicle telematics services over the last 5 years, it appears that the in-vehicle telematics hardware and associated telematics services that offer the end customer services they want at prices they can afford, have been very slow to make a significant impression on the European market. All the market research that the RAC has seen, or initiated, shows a strong customer liking for the 'peace of mind' services such as B-Call and links to the national emergency services (E-Call). Such research also shows a clear customer expectation that a B-Call service will become part of the standard customer offering from their breakdown service provider at little or no price premium. After all, it is *our* responsibility to locate the customer!

The RAC are currently replacing all patrol vehicle MDTs with units fulfilling the functionality outlined in the above summary. The new MDT includes a GPS receiver at a negligible incremental cost. With total control over the software application running on the new MDT and the ability to download configuration files over air, the use of AVL can be fine-tuned to maximise the benefit of the location data whilst minimising the communications overhead. On-going changes to the command and control system will also result in integration of AVL data with other command and control functions at a lower cost and risk than before. The arguments for AVL, based on the benefit to the business process, are unaltered from the first 'proof of concept' in 1995. However, the significantly lower cost of implementation is now showing a clear financial benefit for AVL.

Faced with an inevitable change to the PMR network within the next two years, RAC clearly recognise that the options available today are very different from those that existed when the PMR was last re-built twelve years ago. The relative costs of network ownership, in comparison with use of third party networks, has been investigated in depth over the last two years and extensive confirmation of coverage, capacity and network latency undertaken. Use of a third party radio data network has to be a serious consideration in any evaluation of data communications strategy.

The RAC has experience of and continues to keep abreast of developments in cellular location. Cell ID is employed as the location element in the traffic information service (Short dial code 1740 from a cellphone on any UK network). Once cellular location services become available at improved levels of precision to those achievable with just cell ID, customers, will, correctly, expect RAC to support such services.

Location technology and developments in mobile data are closely related for a business such as the RAC. With continuing development to business processes and the supporting control system, location and mobile data developments will have a major influence on the core RAC business over the next two years. The second-generation system has a hard act to follow!