

EXCHANGE OF DIGITAL RECORDS BETWEEN PUBLIC
UTILITY DIGITAL MAPPING SYSTEMS

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ABSTRACT

There is a need for Public Utilities to exchange information concerning their mains and plant records. The introduction of digital records systems in the utilities offers the opportunity for exchanging these records in digital form. This paper describes the work being done in this area, particularly that at Taunton where records are being exchanged between individual utility digital records systems. The Taunton trial has highlighted a number of key issues relating to commonality of digital base maps and their updates, and also relating to the data exchange formats.

BACKGROUND

The Requirement to Exchange Records

There is an existing practice for Public Utilities to exchange records in connection with major operations covered by the Public Utilities Street Works Act, 1950 (PUSWA).

PUSWA governs the relations between the undertakers (Public Utilities) on the one hand and the persons or bodies who own or control the highways on the other. It also provides a code to regulate the relations of undertakers amongst themselves when the operations of one undertaker interferes with or affects apparatus belonging to another. Before the commencement of any major works there must be an exchange of a notice and records indicating the proposed works. There are, however, two exceptions. Emergency works may be carried out immediately with the details being provided subsequently and for minor works, particularly services, there is only a requirement to serve a notice with no provision of records.

The present procedures covering the implementation of PUSWA impose a considerable clerical and drawing office task for the organisations involved. The introduction of digital records will not directly affect the statutory obligations to provide a notice but it does offer the opportunity to make improvements in the exchange of records.

The requirement to exchange records is not simply to fulfil a legal obligation, but it is necessary for the protection of operatives involved in street works and to limit the damage to underground mains and plant. A survey conducted by the National Joint Utilities Group (NJUG) in 1981 indicated that the national cost of mains and plant damage was of the order of £14 million per annum. Prior knowledge of the location of other utilities mains and plant will also lead to benefits in the planning of street works.

A review of street works activities has recently been completed for the Department of Transport, reference HORNE (1985). Whilst not actively promoting the exchange of digital map based records, it has identified the need for more computerised information on street works.

NJUG Trial at Dudley

Recognising the opportunity which digital records offers for exchanging information, NJUG set up a five year trial in 1982. This was located at Dudley and covered an area of 50 square km, some 250 map sheets. The principal objectives of the trial are:-

- (i) to establish standards for the interchange and display of digital mains records
- (ii) to gain experience in the methods and techniques involved in the joint use of digital records and map backgrounds
- (iii) to reduce the level of utility damage and to investigate the implications for PUSWA

All four utilities (electricity, gas, water and telecom) and the local authority are participating in the trial. Each has digitised its own records over a common map base, which was provided in digital form by Ordnance Survey. The system is based on a shared central processor to which the individual utility workstations are connected.

Whilst the trial has not yet been completed, some interim conclusions have been identified. The use of a shared processor system implies that the operational units of the individual utilities need to have coincident boundaries. In practice, this is not the case and even at Dudley compromises have had to be made. Consequently, further developments in exchanging digital records between utilities need to be based on a different technique; exchange between individual utility digital mapping systems is seen as a suitable alternative.

The Dudley trial has a major advantage in using a shared map base thus automatically ensuring registration between the individual utility records. In exchanging records between systems, this question of registration is very significant.

The NJUG trial has been important in creating co-operation between utilities on the question of exchanging digital records to assist in street works.

TAUNTON JOINT UTILITIES TRIAL

Introduction

In 1983, the utilities in the South West agreed to investigate areas for co-operation through the exchange of records. It was necessary for initial work to involve a very limited scheme in order to minimise costs, resources and the timescale to implement the pilot project.

Initial Taunton Trial

The Taunton Joint Utilities Group (TJUG) was established and a trial was set up at the end of 1983. The initial participants were South Western Electricity Board (SWEB), British Gas South Western, Wessex Water and British Telecom; subsequently the local authority (Taunton Deane Borough Council) was also included.

The initial trial was based on a 1 sq.km. area in the centre of Taunton. Taunton was chosen as this was the location of the initial SWEB digital records system. The Ordnance Survey agreed to support the trial by including the urban area of Taunton in their digital map program.

The utility records for the initial trial area were digitised by SWEB and a hard copy of all the records was provided to all utilities. At this stage, only SWEB had a digital records system available in the Taunton area.

For the trial area, utilities had prior knowledge of the location of all underground mains and plant to assist their operations. For major works, it was only necessary to confirm that these records represented the most up-to-date situation. SWEB, besides undertaking the initial digitising also maintained all utility digitised records in the trial area.

Whilst the initial trial was set up and was operating satisfactorily, it was evident that the trial area was too small. It was agreed to expand the trial area and to introduce the exchange of digital records to overcome the overheads in managing hard copy maps inherent in the initial trial.

TJUG Phase 2

In July 1985, the trial was expanded to cover a third of the Taunton urban area, 6 square km. The objectives set for phase 2 of the trial included:-

- (i) to expand the procedures set up in the initial trial for monitoring damage to underground mains and plant in the trial area with the longer term objective of assessing the reduction in damage arising from improved, more timely records information.
- (ii) to examine the alternatives available and the implications for the exchange of digital records.

Two utilities, electricity and gas, had digital records systems operating in the trial, whilst systems in the other utilities had not been incorporated at that stage.

At the time of setting up the second phase of the trial, Ordnance Survey had not digitised a large enough continuous area adjoining the initial trial area. Consequently, 12 Ordnance Survey digital maps were used together with 7 map sheets of vectorised scanned maps, all at 1/1250 scale. No problems were encountered in integrating these two forms of digital map, however, the scanned maps required some updating as they had been produced from published map sheets.

Identical versions of the digital base maps were installed on the electricity and gas systems and all utility records were digitised. Hard copy plans were again produced for all utility records as an interim measure prior to digital records systems being available for all utilities in the trial area. In order to reduce the paper burden, some rationalisation of the hard copy output was achieved so that four A1 sheets were prepared for each 1/2 x 1/2 km quadrant :-

- (i) Telecom and Gas at 1/1250 scale
- (ii) Water and Sewer at 1/1250 scale
- (iii) & (iv) Electricity at 1/500 scale

The format of the joint sheets is illustrated - fig. 1.

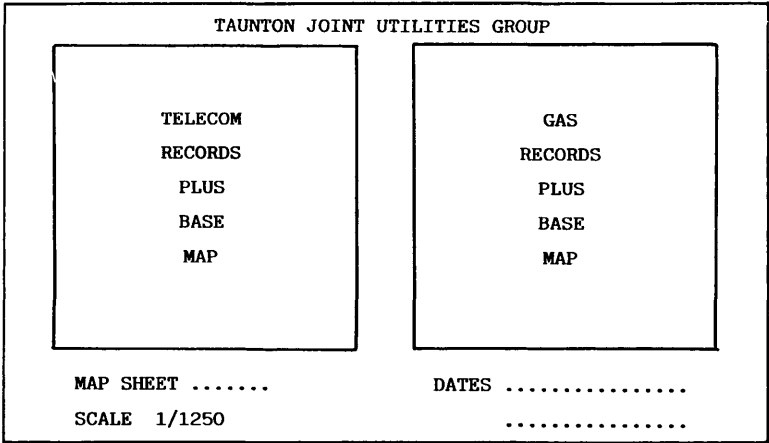


Fig.1 TJUG joint hard copy format for Telecom and Gas

For electricity and gas, digital records for all utilities were exchanged between the systems using magnetic tape transfer. This exchange excluded the base map.

Progress at Taunton has been necessarily slow since a second operational system was required to reduce the workload on SWEB before the second phase commenced. Also work at Taunton is being undertaken as an adjunct to the existing operational priorities for digital records in the utilities, as opposed to Dudley where the exchange trial is the only priority for the system. This point is demonstrated by the two preceding papers by Wessex Water and SWEB, references Bolland (1986) and Hoyland (1986). This should not be construed as a criticism but as a comment on the realities of the way digital records are being introduced by the utilities.

The hybrid operations involving both digital and hard copy records at Taunton again reflect the situation where utilities will move into digital records with differing timescales and priorities.

TJUG Future

The Taunton trial will expand to incorporate the whole of the Taunton urban area and also to include the other utilities digital records systems.

Not all the utility systems involved in the Taunton trial are located at Taunton, indeed the method of operation does not require that they are closely located. This enables the trial to accommodate the differing needs of utilities for digital records and also their different operational boundaries. The location of the systems is shown diagrammatically in fig. 2.

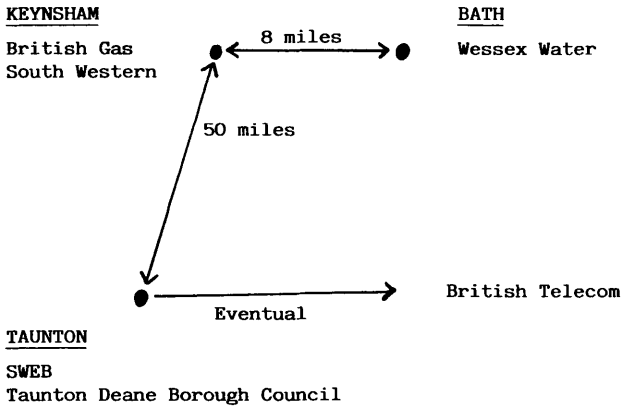


Fig. 2 - Diagrammatic location of systems in TJUG

Operations at Taunton have identified a number of major issues which are considered in the next section.

MAJOR ISSUES FOR THE EXCHANGE OF DIGITAL RECORDS

Digital Base Maps

In order to be able to exchange digital records between systems and for these records to be correctly registered in each system, it is essential that identical copies of the base map are used by all utilities.

This has major implications for the future outside the area of the Taunton trial, since utilities will work in areas according to their operational priorities and it is unlikely that these will be coincident. The Taunton trial, where all utilities are working together, is aiming to produce standards for the exchange of records which utilities can work to in the knowledge that they will ultimately be able to successfully exchange records when other utilities have digitised their records in a specific area.

This vital question of the provision of a common base map goes beyond the question of the supply of base maps. The issue of the incompatibility between the needs of utilities for digital maps and the Ordnance Survey digital program has already been discussed, reference IVES (1985). The question which has yet to be addressed is the provision of updates to digital maps and the form of these updates.

At present, Ordnance Survey has digitised some 25,000 large scale maps in Great Britain, unfortunately only 250 of these in the Dudley trial area are being kept up to date. Consequently, utilities are having to maintain their digital base maps themselves. When this situation is considered with the need for identical base maps in utilities digital records systems, a substantial problem is revealed.

Under the controlled conditions at Taunton, updates of the digital map base can be satisfactorily achieved, however, in other areas this may cause substantial problems. Should utilities not be able to achieve commonality in base maps, and their update, then records are unlikely to be able to be registered correctly in other systems and a major area of benefit of digital records will be lost.

At Taunton, areas of base map change are identified on a copy of the latest version of the geography, namely the supply of hitherto unpublished survey information (SUSI) from the Ordnance Survey. The area of change is digitised and the merged with the digital base map. In this way, only the records in the area of change need to be adjusted, in the remaining part of the map the records are untouched as they remain correctly registered.

Records Updating

The present operations are based on the principle of each utility holding a copy of each others records. These records need to be kept up to date and checks are required to ensure that the data is not 'lost' or corrupted.

At Taunton, utilities issue a new copy for their records in a 1 km square where there is an amendment to the mains and plant details. This is felt to be the best way to control the data. An amendment process based on passing details relating to a particular piece of main is likely to be difficult to control and would lead to errors, which would be unacceptable.

Data Exchange Format

The format of the data being exchanged between systems must comply with the following:-

- (i) The format must be transportable across a range of manufacturers systems and must be independent of the way in which a particular utility system is set up, i.e. in terms of resolution and units.
- (ii) The large volumes of data associated with utility records, particularly electricity, require the data transfer to be efficient and not rely on processes that are onerous.

The first requirement effectively rules out transfers in the internal format of a particular system, which would only be able to take place in a few instances.

A universal exchange format is available since all systems in the utilities must be able to read digital map data in Ordnance Survey format. Working on this, NJUG and Ordnance Survey agreed, in early 1985, an expanded feature code structure for the proposed new Ordnance Survey transfer format (OSTF) for digital map data, which would allow codes for utilities mains and plant data.

This would appear to be a most suitable format, unfortunately it has two major drawbacks :-

- (i) The Ordnance Survey has been unable to implement the host format (OSTF) for its own map products in the intervening period, since the proposals for the exchange format were published in February 1985. This failure has compromised the major advantage for utilities of using OSTF format which would have meant both base maps and other utilities records formats would have been common.
- (ii) Being a universal 'high' level format does lead OSTF to be inefficient in terms of the processing power required to transform it into systems internal data formats, and vice versa.

Consequently an intermediate format would seem desirable in order to reduce the processing for data translation. A suitable format already exists, namely Standard Interchange Format (SIF) developed by Intergraph and widely used in USA.

SIF is used as the data transfer format in the Taunton trial.

Data Exchange Mechanisms

At present, data exchanges between systems in the Taunton trial use magnetic tape media.

There is nothing inherent in the present operations which would inhibit direct connection of the host processors. The question of controlled transfers over a data link or of interactive linking into other systems will be a matter for individual utilities to resolve in the future. Interactive linking would have the advantage of not requiring utilities to hold copies of each others data, but such an operation would require acceptable response times for data requests and would also need to determine the availability of the service, for example out of normal working hours.

CONCLUSIONS

The main conclusion deriving from both the Dudley and Taunton joint utility trials is that utilities can co-operate to exchange digital mains and plant records. Exchange using digital records greatly improves access times to data and reduces the clerical overheads inherent in the process of exchanging hard copy records. More timely availability of data will lead to better information being available for short lead-time operations, including emergency work.

In addition a number of conclusions have been drawn from the operations at Taunton involving exchanges between individual utility digital records systems even though the trial has yet to be completed.

1. An identical digital map base must be installed in each utility system to ensure the correct registration of records. This is seen as a major problem with the current lack of availability of a single source of digital maps in the required timescales.
2. It is also essential that each utility holds the same updates for the digital map. Unlike conventional maps, there are no digital map updates available, except on a limited basis at Dudley.
3. A universal, efficient data transfer format is required. The intermediate format SIF is seen to be the most suitable, although transfers using Ordnance Survey data formats could be used if SIF was not available on a particular system.

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