A New Geo-Information Framework for Great Britain

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ABSTRACT

For almost a decade the idea of a national spatial data infrastructure has been at the forefront of national geo-information aspirations. The concept has been driven by people whose goal is to bring a semblance of order to the often varied and confusing assembly of geographic information datasets offered by local and central government, the private sector and others, in each nation.

In Great Britain, the use of digital geodata is already widespread across many user sectors (eg central government, local authorities, land & property professionals, utilities etc) and supports many hundreds of private sector applications. A study in 1999 showed that £100 billion of the GB GDP per annum is underpinned by Ordnance Survey information. However little of the information that is collected, managed and used today can be easily cross referenced or interchanged, often time and labour is required which does not directly contribute to the users project goals.

To meet this challenge Ordnance Survey has embarked on several parallel developments to ensure that customers can start to concentrate on gaining greater direct benefits from GI. This will be achieved by making major investments in the data and service delivery infrastructure the organisation provides. Key initiatives already underway aim to establish new levels of customer care, supported by establishing a new customer friendly on-line service delivery channels. The largest of the projects however is the development of OS MasterMap™ – a truly seamless database of over 433 million features. The first release of OS MasterMap was took place in November 2001 and offers several themes of detailed topographic information. OS MasterMap can be ordered on-line and delivered on-line or via media.

OS MasterMap Version 1, Release 1 was just the first step in establishing an integrated and comprehensive national geodata infrastructure. Additional future layers are expected to include: colour aerial imagery; height; address/postcode information linked to land & property information, administrative & electoral boundaries, transport networks, Points of Interest and others. Several of these layers demand close collaboration with customers/users and/or joint ventures with third parties in government, for example HM Land Registry, the Local Authorities, and commercial companies. OS MasterMap will be maintained by a variety of highly integrated data processes including, increasingly, electronic design plans.
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OS MasterMap will be consistent with a new geospatial data standard, known as the Digital National Framework, developed in conjunction with several other National Mapping

Agencies. The topographic features (eg buildings, land parcels, roads etc) will *each* hold a unique identifier known as a TOID (Topographic Identifier) to support data linking & data sharing - based on location.

The paper describes the evolution of this new initiative, which is being driven by Ordnance Survey's customers and partners. Since 1999 Ordnance Survey has been independently financed through revenues from the sale of goods, it is this freedom which has allowed the organisation to invest surplus revenues into the development of the new infrastructure

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1. INTRODUCTION

The world we live in is a multi-dimensional place, we occupy three-dimensional space, and events happen concurrently everywhere and anywhere. These in turn often initiate reactive events over time, we can move freely from land to water etc. Within our respective working and leisure environments we are increasingly trying to model this multi-faceted environment within modern IT applications, whether that is for taxation purposes, delivering emergency services or deciding where to go and what to see on vacation.

In reality, what we are able to achieve today is very limited and I'm sure that we will look backing 50 years with the same amusement that we view early developments in road transportation, telecommunications or computing resources. If one contrasts the real world we live in and the way we model it today; it's not too difficult to see why there is such a gap between our aspirations and our current level of achievement. Geographers have long seen that there is a better way, they have articulated a world of joined up reference data, a world where information can be shared easily by using a common base and standards and a world where conclusions and predictions can then be made with some level of quality assurance.

More recently, ie over the past 10-15 years such visions have been articulated through some form of Spatial Data Infrastructure (SDI) either at a local, national or international level. The idea of modelling the real world through a combination of layered national datasets. In this way each layer forms "part of the whole" and when added together they amount to "greater than the sum of the parts". This idea has been established for many years and such a concept was being pursued in Switzerland, for example, over 10 years ago.

This paper will argue that it is not sufficient to have a vision of this nature and expect governments to invest in developing such an initiative. Justification and user needs are not satisfied in terms of the "logical way forward", nor is it sufficient any longer to simply identify disparate datasets through a metadata service and expect to use that data to develop and solve complex solutions. We have to become smarter and address/drive these big issues from the user and applications perspective.

The development of an infrastructure to meet such needs will be incur high costs, so large that the development must be approached one step at a time, financed, ideally self financing and prioritised in steps to meet the critical needs of the emerging knowledge economy and its applications. The world is too dynamic to design a database for five years hence and expect it to meet the user needs at that time. While many concentrate on the creation costs of establishing the infrastructure, it is often overlooked that the maintenance of data and market servicing/customer support of the data, year on year, will be a recurring and substantial percentage of the initial creation costs.

2. WHAT IS THE CURRENT SITUATION?

Of all the different nations in the world, there are as many different solutions. This is a matter of history and something that is unlikely to change significantly in our lifetime. The differences vary in political, economic and cultural ways; for example, in some nations the mapping agency is combined with the land registration body (as in Sweden), in others this is not the case (as in Great Britain). Just within Great Britain there are two different land law legislation: 1) England and Wales & 2) Scotland.

At lower levels, nationally the diversity can become further fragmented where different national or sub-national bodies execute different “resolutions of survey”. For example in Denmark “technical” mapping – ie large-scale mapping – is undertaken by the local authority. In such cases local priorities inevitably vary, and this can influence the willingness or simply the resources required to “join-up datasets”. The development of a common national specification in such circumstances is a very challenging prospect indeed.

Much of today’s data has been digitised from paper maps and may or may not have been updated. In many cases, this material was developed to support applications often established 50 year or more ago, examples might be:

- Land maps for registration of property ownership
- Address lists for delivering mail
- “Cartography” and mapping for leisure & tourism
- Plans for town planning
- Asset location maps for utility plant etc.

It’s not hard to see that **technically** data integration is a challenge at the national level (putting aside global or regional-global levels). When the **political** and **commercial** issues are also considered one can only conclude that real step changes towards spatial data harmonisation are all but impossible given the priorities that governments have to address concurrently (feeding the hungry, ensuring employment, terrorism & conflicts, addressing social issues etc). Therefore we need to be pragmatic and ensure that GI plays an effective role in servicing the new economies of the future both at the government level and in new emerging commercial applications such as location based services.

3. WHAT IS CHANGING?

Much has already changed in the last 2-3 years, mostly enabled through major advances in **Technology**, coupled with smarter **Users** and in turn increased **Competition**. These issues are considered below:

3.1 Technology

Computing power and processing capabilities have improved significantly year on year. In Summer 2000 a standard desktop home PC was in the order of 700-800Mhz, 18 months later the same PC is now measured in terms of 1-2GHz and increasing. This is still opening up capability in new technologies, such as the mobile telecoms market and imminent widespread introduction of services based on the third generation licences, PDA's, greater software possibilities on the desktop and the integration of technologies into everyday applications such as GPS into personal navigation.

Equally major improvements in network bandwidth, not just within business, but in terms standard telephone lines and greater cable connectivity. The impact of the internet on NMA's has already proving very significant (Gower, 2001). As a result the expensive technology that only the major IT companies could afford to trial, or even start to think about 10 years ago, is now largely a commodity … off the shelf.

PDA (Personal Digital Assistant) technology
- mobile geography, mobile information

Kiosk technology
- print on demand small scale mapping

This provides evidence that the days of the "digital map" are set for decline, the "mapping" links with the past are fast changing and we now need a framework that will enable us to manage the growing number of geographically related data types. A framework is needed upon which all kinds of data can be easily integrated, cross-referenced and exchanged between users in as seamless and reliable way.

– Raster maps/drawings
– Topographic vector objects (buildings, land parcels, rivers etc)
– Digital aerial imagery
– DEMs (land surface & heights of topographic features)
– Land Use/Land Cover classifications
– Property information (ownership & occupancy extents)
– Network data (transport, utilities)
– Address information
– Satellite imagery
– SAR data (DEM & Images)
– Boundaries (administrative, electoral etc), TV area, Health area
– LIDAR data
– Video
– CAD plans, internal & external
– Photographs (buildings)
– Postcode/Zipcode Extents

… (above) the variety of geographic information data types - this data in turn needs to link with several other "text based" databases, if geography is going to "make it" in mainstream applications, for example:

- Land registration records
- Taxation records based on property
- Crime records
- Fire records
- Road traffic accident records
- Cinema programmes & booking
- Hotel profiles and booking systems
- Banking information
- Insurance policies
- Social security records
- Car parking availability and fees
- Cable/sewer capacities and materials
- Railway timetables
- Births, deaths

3.2 Users

The customers and users of GI have become more smarter over this time. A new generation of young IT literate people are now starting to occupying posts that were previously held by those who found themselves in a "technology job". This may have been because they were in the "right place at the right/wrong time" – depending on their comfort in encountering the new technology they found themselves immersed in.

Users are becoming more demanding, they want better value, they want quality (currency, consistency, completeness, and accuracy), they want information – not necessarily maps, and they want better reliability, service and support. They don't want to spend 2 weeks loading and testing data – they just want to plug it in, seamlessly, use it and exploit it. They want to get on with the job they are paid to do. Look at any organisation that uses GI data today and compare how much time they can spend sourcing, loading and configuring their data – compare this with how much it is directly exploited and by how many people.

The smart ones have worked out that getting on top of data management is a very important and early step along with the introduction of greater the levels of automation – here the more effective their organisation will be, whether that is measured in profit, customer service or job satisfaction.

3.3 Competition

The traditional geodata suppliers have had a relatively protected life until recently and some remain necessarily protected by government decree, for example the land registration authorities. Even here new ways of operating are evident, as the status and the development of the Kadaster in the Netherlands towards privatisation has demonstrated (www.kadaster.nl/engels/index.html).

Enabled by the new, easy-to-use technologies it is possible to collect imagery and height information either from space, by aircraft or terrestrial platforms and use this to derive "fit for purpose" products. Such derivatives will rarely match the traditional specifications, but are tuned to meet clients immediate/minimum project needs. Indeed today it remains sometimes easier, faster and more economic to commission a new survey rather than source & integrate several disparate datasets, which don't always meet the project need.

In the global economy both government and many private companies need to seamlessly supply services or information across national boundaries through applications such as statistical regional reporting, navigation, personal security asset/transport management etc. The frequent absence of suitable national datasets offers opportunities for third parties to service that need. There are many potential opportunities for government/commercial sector collaboration here – but also some that will never work.

4. IMPLICATIONS FOR THE FUTURE

- There is a critical need **within nations** (or federal states) to provide a modern, effective framework to meet the needs of new government and the commercial sector. A realistic estimate suggest that this will make progress, but it is likely to be years, or decades before true internal harmony is evident and is unlikely to be achieved in some countries.

- However the failure to harmonise datasets within a nation inevitably leads to massive duplication of effort of which the cost of failure is doubled when the one attempts to cross reference disparate datasets and great effort is required to "clean the data". The cost of failing to address the problem is high – *but this is not the way to approach the solution.*

- Beyond this there is a need to be able to aggregate state or national data (eg for continental size nations) up to **regional** level - for example the NSDI in the US (http://www.nsdi.org). More recently we have seen the emergence of the European Spatial Data Infrastructure (ESDI) (www.ec-gis.org/e-esdi) which is taking a direct approach by prioritising by theme, ie initially to support the European Commission's environmental directives such as the "Water Directive" by establishing an "E"-ESDI (E=Environmental). This is recognised as both challenging and ambitious but has momentum.

- Finally a **global** perspective has been established through the Global Spatial Data Infrastructure (GSDI), though this is more in terms of providing guidance and a source of information eg the so-called GSDI "Cookbook". A repository of the national positions, where they are updated, demonstrates the wide variation we all operate within today (www.gsdi.org).

The necessary key components to support a modern data infrastructure:

- Key National Datasets
- Metadata
- Data accessibility
- Public Sector Partnerships
- Private Sector Partnerships
- Data Standards
- Data Maintenance policy
- Funding, + Pricing & Licensing
- Service Delivery (e-delivery, mobile comms, media) infrastructure
- Customer support

5. THE SITUATION IN GREAT BRITAIN

In some respects in Britain we enjoy some natural and historical benefits. As an island there is little problem in "joining up" along national boundaries and the wisdom to move to a metric and homogeneous coordinate system in the 1930s was inspired. As part of the Davidson report (Ordnance Survey, 1938) all national mapping was re-established in a consistent framework which not only set the standard in terms of reference system, (the National Grid) but this also set the standard in **topographic mapping** for what became known as the National Topographic Database. In the digital era new customer requirements led to the creation of several related databases for example **georeferenced postal addresses, administrative boundaries, road-centrelines, digital terrain models** etc. These have been successfully supplied as revenue earning products to satisfy particular needs.

More recently other government agencies have embarked on their own digitising programmes, using the Ordnance Survey large-scale data as a key. This includes the land registries: Registers of Scotland (www.ros.gov.uk) and HM Land Registry (www.landreg.gov.uk) who use the Ordnance Survey map as the base for legal title. A national metadata service was established in 2000 (www.askGIraffe.com).

6. ORDNANCE SURVEY

Ordnance Survey today is a Government Agency with a staff of 1,850 and an annual turnover in 2000-01 of £100 million ($144 million or €162 million - at January 2002 exchange rates). Since April 1999 Ordnance Survey has operated under a Trading Fund remit, which provides a further degree of freedom based on financial independence of government. Any profits can be retained for investment, equally any revenue shortfalls that do not recover costs and pay a dividend to government, have to be found within the organisation. A study by an independent research group in 1999 determined that £100 billion of the GB GDP per annum is underpinned by Ordnance Survey information (OXERA, 1999).

The issues discussed already in this paper led Ordnance Survey to consider the future of it's own information and how this might be developed. This was undertaken within two major strategic steps during the year 2000:

6.1 The Database

It had increasingly been recognised during the 1990's that the various datasets managed by Ordnance Survey needed to be better integrated and managed in a seamless nature to meet the changing user needs. The concept of a layered database was announced in a consultation document in early 2000 (Ordnance Survey, 2000) and a series of evolving industry consultation events held with customers/partners, applications engineers, and systems suppliers.

6.2 The e-Business Strategy

The entire business strategy was reviewed in the light of the major changes in the industry such as the emerging new "e"-technologies in mobile and navigation fields. The e-business strategy was approved, incorporating major developments in "putting the customer first", the database developments, and an entire new "e" way of managing the business of Ordnance Survey. The strategy is now in advanced stages of implementation.

The new e-business strategy, was one of a very small number to receive a "green light" from the UK's E-Envoy's Office (www.ukonline.gov.uk) in October 2000 and re-endorsed more recently, the strategy was based on the organisation's vision:

Ordnance Survey and its partners will be the content provider of choice for location based information in the new knowledge economy.

This reflects that Ordnance Survey needs partners (of all kinds) to succeed, that the organisation will have competition, and will operate in a world that requires integrated information based on location and it is a new world where "knowledge is king".

In November 2001 the first part of the new national database development was released. This is known as OS MasterMap (www.ordnancesurvey.co.uk/osmastermap) and currently consists of a national coverage of:

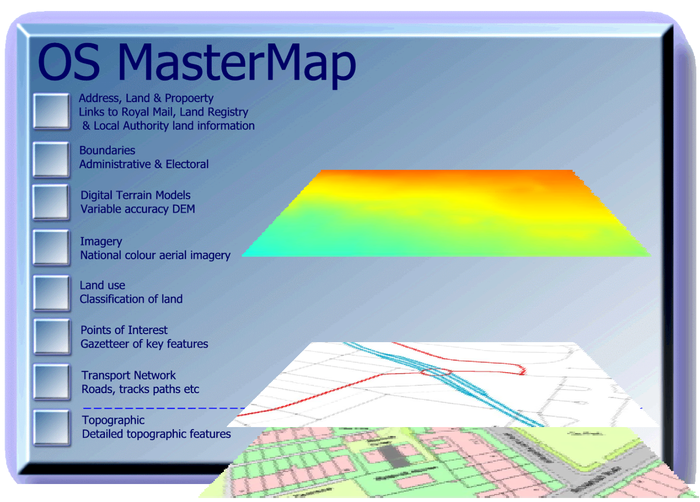
- Detailed topographic vector objects (houses, land parcels, pavements etc)
- A seamless database of 433 million objects (classified features).
- Each of these features has a unique identifier, known as a TOID (TOpographic IDentifier)
- Features are versioned as changes occur
- Update will be delivered at the feature level
- The data is available to users by theme, (or combinations of themes) eg a customer may just require building footprints.
- OS MasterMap is ordered on-line
- And delivered on-line or off-line

The data is intended to provide the **definitive** georeferencing base for Great Britain where users can "hook" their information onto the topographic features via the TOID. This will enable a stronger **intelligent** database approach to geospatial information and crucially support integrated applications. This is supported by improved **accessibility**, and in time greater exchange and sharing of information, of all kinds, more often by third parties who use the reference base in common. A new electronic delivery portal as part of a revised web site has accompanied the introduction of the database.

The OS MasterMap user interface for data selection and purchase.

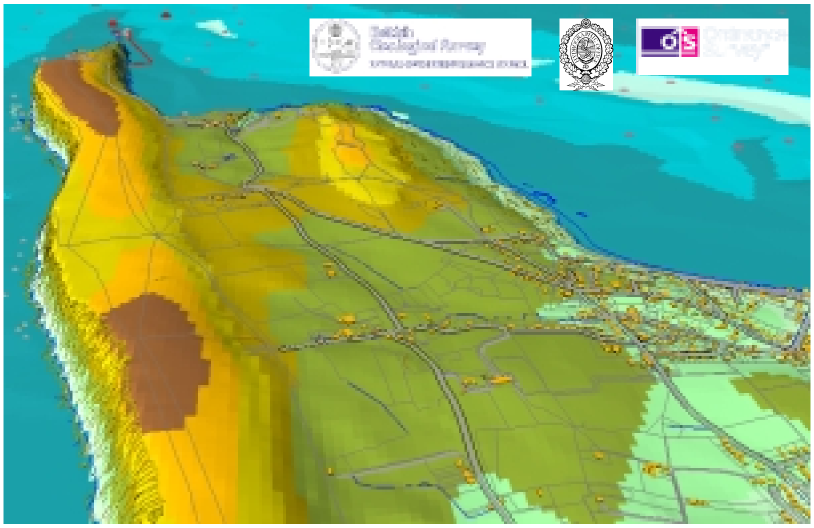
7. DEVELOPING THE INFRASTRUCTURE

During 2002, and beyond, further layers will be introduced, driven by the needs of our customers and partners as part of a major internally funded investment programme. These layers will be consistent with this base and will form key elements of the national geospatial data infrastructure.



An overview of OS MasterMap with and example of three of the proposed information layers. All layers will be consistent with each other and provide the customer with an opportunity to select, mix and match the data they need.

In 2001 a joint project was commenced to integrate Ordnance Survey data with that of the UK Hydrographic Office and the British Geological Survey. This should provide a much more consistent and reliable reference base for all those who operate in the coastal zone (www.iczmap.org.uk). This work is currently progressing at research stage.



Integrating Land, Geology and Hydrographic data from Ordnance Survey, the British Geological Survey and the UK Hydrographic Office

8. STANDARDS

Standards have been recognised as a key part of this initiative in two distinct ways, through the **Adoption of standards** and in **Setting standards** or extending existing standards.

8.1 Adoption of Standards

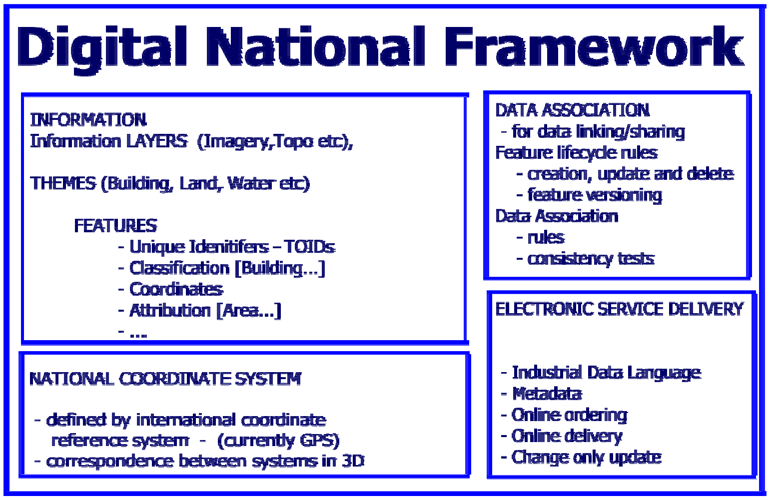
As technological change accelerates standards are increasingly set by industry; some in turn are incorporated in formal standards by bodies such as ISO. Ordnance Survey has adopted a pragmatic approach which, recognises that some standards will affect us, but we are not in a position to influence them greatly eg internet standards via W3C. Ordnance Survey is an active Technical Member of OpenGIS (www.opengis.org) and has been engaged in the development of GML (Geography Markup Language) to support a new way of enabling computer to computer dialogue in geographic information. OS MasterMap is supplied in GML only. We also track developments elsewhere and play a role in national and international standards.

8.2 Setting Standards

Ordnance Survey has set the standard grid and mapping system for Great Britain for over 200 years, indeed some national mapping agencies currently refer to their data as "ordnance survey" data. The aim is to continue and strengthen the role of providing definitive data by:

a) defining the overall set of elements that make up the framework
b) working with other mapping agencies to establish a such common set of elements

The standard is known as the “Digital National Framework” and was first described in the Consultation paper 2000/1 (Ordnance Survey 2000). This will be more formally described and developed as required. OS MasterMap is consistent with the DNF standard.



An overview of DNF components at December 2001
- an important element of the standard will be the consistent referencing of third party data and information to OS MasterMap – via the TOID.

In support of the standardisation objective we have been working closely with Ordnance Survey of Northern Ireland and Ordnance Survey Ireland in agreeing common terminology, technical classifications, data structures and the TOID identifier system. This has largely been driven by our common need to better serve customers shared by the three organisations, who increasingly operate across Britain and all of Ireland. Their need is simple: they need to be able to obtain like data from two or more of the agencies and use it immediately.

This reflects similar cooperation between the telecoms giants in Europe who got together to develop a common standard (GSM), which accelerated the adoption of mobile technology across Europe - at a rate we have never seen before.

9. CONCLUSIONS

In summary, the establishment of OS MasterMap in Great Britain is based on a proven track record, and has the potential to fulfil a large part of the national spatial data infrastructure for Great Britain.

– This will require further cooperation with government bodies and the private sector. It will demand working with our customers and partners much more closely in future. This will take time, a lot of negotiation and therefore patience, but the short, medium and longer-term benefits of an integrated spatial data infrastructure are clear.

– The funding and investment in the new infrastructure is sourced from revenues on the sale of goods, this is affordable now because of the greater freedoms Ordnance

Survey enjoys as a Trading Fund within Government where profits can be reinvested. Prior to 1999 the absence of such this kind of flexibility was a major limiting factor.

– The release of OS MasterMap in November 2001 moved us beyond the discussion and concept stage, we now have established the foundations of a modern national spatial data infrastructure for Great Britain.

– The longer-term scope of this initiative is difficult to foresee, since it will be influenced not only by technologies we have yet to embrace but also by the customers of tomorrow who can be expected to become more discerning and exercise greater choice in future**.**

– ***It is only through their direction and income they provide, we can ensure that the spatial data infrastructure not only becomes a long-lasting reality but moves on to thrive and develop beyond our present day expectations***.

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BIOGRAPHICAL NOTES

Keith Murray is currently Head of Geographic Information Strategy at the Ordnance Survey based in Southampton. He has worked as a surveyor and has extensive experience in the use of imagery both in production and in research. More recently he has been centrally involved in developing the concept of DNF and developing the overall geographic information strategy for the Ordnance Survey. He has published numerous articles on the use of imagery, new developments in GI strategy and research. He is a member of the Royal Institution of Chartered Surveyors (RICS), the Remote Sensing and Photogrammetric Society (RSPSoc) and the American Society for Photogrammetry and Remote Sensing (ASPRS).