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What did OpenGIS ever do for us?

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Abstract

The work of the OpenGIS Consortium and the term 'interoperability' are often cited in Geographic Information (GI) industry literature. In the UK, many GI and Geographic Information System (GIS) users have been exposed to the realisation of OGC technologies through the Geography Markup Language based, OS MasterMap product. Awareness is also occurring through the UK Government's electronic-Government Interoperability Framework (e-GIF), in which GML is now the adopted standard for spatial data exchange. This paper presents an overview of the OGC for the uninitiated - outlining its membership, aims and objectives. The paper then defines how OGC initiatives are impacting on the UK Geographic Information community, with the aim of demystifying what is meant by 'interoperability'.

Relevant technologies and standards will be discussed in order to place OGC technology in context. The business benefits which OGC can provide to spatial data users, and the challenges which need to be addressed to do realise these benefits, will be used to conclude the paper as we ponder - 'What did the OpenGIS Consortium ever do for us?' (with apologies to John Cleese et al 1979). The paper will cover the following topics;

- An Overview of the constituency and aims of OpenGIS
- Significance and impact of OpenGIS standards to UK GI and GIS users
- Technological advances and business benefits
- Challenges and opportunities presented in pursuit of interoperable systems

Introduction

The term 'OpenGIS' is now commonplace in GIS journals, trade magazines, product literature, tender documents and so on. For many though, 'OpenGIS' is still something of an unknown quantity, the next few paragraphs should, however, begin to shed a little light onto the work of the OpenGIS Consortium (OGC) and illustrate where OGC's work is impacting in the GI industry.

An Overview of the OpenGIS Consortium

The OpenGIS Consortium (OGC) appeared as such in November 1994, following various initiatives concerned with spatial data sharing between systems. These initiatives were very much 'US centric' with funding coming from the US Federal Government, military and other research agencies. Although the term 'OpenGIS' has only really reached the mainstream in the last five years or so, the head of steam has been building since the 1980's, with GRASS (GIS) being a tangible offshoot. From its North American, 'governmental' origins OGC is now a much more complex entity. As of July 2003, 28 countries are represented in a membership of 255 agencies. Whilst the US contains the largest contingent of members (109), it is by no means a majority, EU countries account for 69 members with Germany's (22 members) and

the UK's (14) commitment being sizable. Countries such as Canada (19), Australia (13) and Japan (12) are also thriving centres of activity with relation to OGC's work.

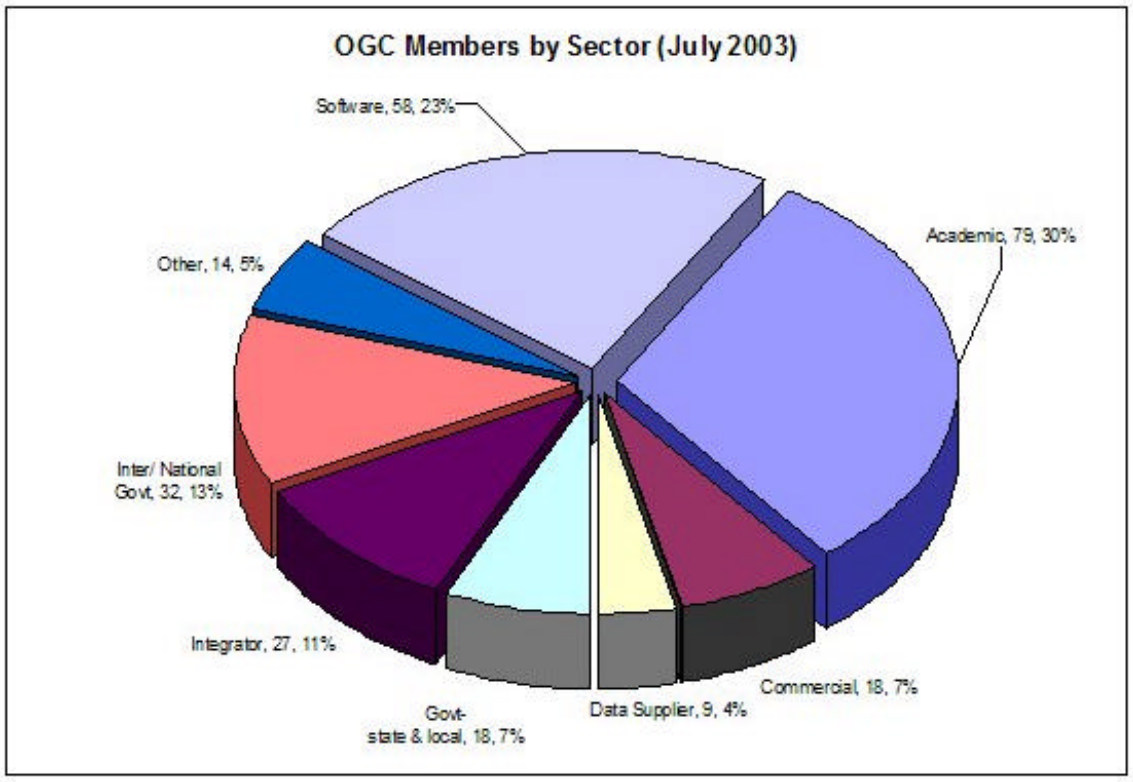

Figure 1. OGC Members by Sector (July 2003). Data sourced from OGC.

The geographical diversity is complemented by the depth of membership in terms of industry sector with software vendors accounting for the largest, discrete non-academic group. See Figure 1.

Membership levels have different fee levels, this, coupled with a company's size and expertise determines how it can channel its efforts into the OGC body. Principal and Strategic membership is dominated by large military (Lockheed Martin, Northrop Grumman), multinational GIS software houses (Intergraph, ESRI) US agencies such as the FGDC, USGS and NASA and others private sector companies such as Oracle Corp. and Shell. This level of membership is open to any GIS interested body willing to commit to a US$50,000 fee per annum. This entitles the member to input into the OGC's Planning Committee and the OGC Technical Committee. There are currently 19 members of Principal status or higher. The impact of recent growth in OGC membership is reported by Carl Reed, OGC's Specification Director; "In 1996, OGC had fewer than 60 members. Now it has more than 250. The value of networking and collaborating has grown far more than the 400-percent increase in membership." Source: http://www.geoplace.com/gw/2003/0304/0304opng.asp

The main thrust of activity which actually impacts on GIS users, via resultant data and systems, is formulated in the Technical Committee (TC). This body has an elected representative which sits on the management board and essentially develops technical specifications and ideas during the ten or so meetings hosted each year. Most, but not all of the software houses and data providers hold a Technical level membership within OGC. Technical specifications follow strict protocols and undergo rigorous vetting, scrutiny and endorsement. These specifications are drawn up by consensus from the expert pool who attend OGC meetings – all parties have the opportunity to become involved. This is entirely in line with the OGC Mission Statement;

"Our core mission is to deliver spatial interface specifications that are openly available for global use." With the benefit of ;"enabl[ing] content providers, application developers and integrators to focus on delivering more capable products and services to consumers in less time, at less cost, and with more flexibility." Source: http://www.opengis.org/info/vm.htm

The input an organisation has into OGC specifications can vary according to their expertise and subject knowledge. In terms of impact on the data and systems used in the industry, a useful metric is to view which organisations have actually implemented OGC specifications in their software or services. Implementation is a pre-cursor to conformance which means that OGC have ratified an implementation via a conformance test. The specifications and conformance tests are accredited by OGC staff. Conformant and implementing products are listed on the OGC web site. See Figure 2.

Figure 2. OpenGIS Website displaying conformant products. Source: http://www.opengis.org/testing/product/index.php?conf=2

GI and GIS users should be very wary of any claims of 'OpenGIS compliance' this is an erroneous claim, as no such thing actually exists in OGC parlance. It is sometimes used by parties who may have some association with, but no technical accreditation from, OGC. Caveat emptor!

But what has the OpenGIS Consortium ever done for us?

Having established that the OGC is a large and growing consortium of industry bodies, dedicated to the advancement of "spatial interface specifications", the average GIS 'man on the street' may not realise that this work is starting to filter into mainstream GIS and spatial data provision. In an often mimicked scene in Monty Python's Life of Brian (1979), John Cleese et al ask "What did the Romans ever do for us?", whilst the OGC has not (yet) brought us sanitation, medicine, education, wine, public order, irrigation, roads, a fresh water system, public health or peace – it is starting to appear on many people's agendas because of some of its recent outputs.

In the UK, the most publicised OGC 'product' has been the adoption of Geography Markup Language (GML 2.0) by Ordnance Survey (GB) as a means to supply OS MasterMap data. This has been a bold departure as GML is a vendor neutral format, it is voluminous in comparison to National Transfer Format (NTF) and it is the first dataset of national coverage to adopt the specification. This will impact on nearly every use of GI in Great Britain due to the precedent OS(GB) set and due to the consequences it will have for large-scale data users. By adopting GML, OS(GB) have given themselves the opportunity to 'clean' and reconstitute the much berated NTF OS Land-Line, giving users much better base data. This is of course at a cost, to them

and to their users and software partners. It has however, forced the GI industry a step further towards mainstream Information Technology by the use of XML (eXtensible Markup Language) based document types and definitions i.e. GML. GML has also been adopted and approved as the standard for geospatial data exchange within the UK Government's electronic-Government Interoperability Framework (e-GIF). See: http://www.govtalk.gov.uk/documents/e-gif_v5_part2_2003-04-25.pdf

Other specifications which are borne by OGC are also receiving increased recognition and use within the UK. The OGC Simple Features specification (vector geometry) is at the core of GML, furthermore OGC's Grid Coverages specification is also growing in stature as more vendors adopt interfaces to raster data providers who are adopting the tenets of OGC. The widespread adoption of database technology to store geometric data is also being accelerated and coupled through OGC SQL92 specifications.

But what do these standards mean in practical terms? Essentially by adopting these de jure i.e. ratified, standards vendors and data providers are taking GIS to the next stage of their evolution and further towards mainstream I.T.. They are also challenging the previous adoption of less stable, vendor specific formats. By adopting the 'Lingua Franca' of GML, GIS is maturing, and maturing with a common metric which allows users to actually share and access data rather than simply transfer it to other parties and reprocess it, ad infinitum. OGC member involvement within ISO TC/211(and vice versa) is ensuring that standards are being harmonised to reduce any future conflict - avoiding the maxim that the beauty of standards is that there are so many to choose from.

Technological advances and business benefits "and what did they ever do for us?"

The specification programme at OGC has obvious advantages for GIS users in that all the hard work is done by the vendors, government bodies, data providers and so on. Serious funding is also directed into these programs. This is evident in the Web Map Testbeds and other OGC Pilot Projects. It also yields clear and stable building blocks for GIS which are unlikely to change, or disappear, without notice. The formalisation of Spatial Testing e.g. union, intersect, overlap etc, under the DE9IM specification is a good example where common semantics can be used in GIS. This is important, for example, two agencies may be using different GIS to analyse a geographical problem. If they are generating different sets of answers because their systems are not harmonised this could have serious consequences. The difference between 'within' and 'overlaps' may be the difference between a house being at risk of falling into a disused mine shaft or not.

Other explanations of the benefits OGC specifications tend to focus on 'interoperability'. Interoperability is a key element in GIS, partly because of the slide of GIS to mainstream computing, and partly because people are now actually deploying OGC interfaces in systems and data provision mechanisms. Amongst others, Canadian company PCI had a handle on this very quickly; "To understand the value of interoperability, imagine a world where my phone could not call your phone, simply because they were made by different vendors!" Source: Arnold M. Hougham, PCI Geomatics http://www.pcigeomatics.com/corpinfo/opengis.html. At Cadcorp, we often cite the example of being able to drive a car. Because you can drive a Ford, you can also drive a Volkswagen because the pedals, steering wheel and set up are basically the same. Applying this philosophy to GIS, is at the heart of what industry experts would suggest 'open' systems are all about.

This helps emphasise the differences between OGC and previous attempts to standardise GIS. OGC is not concerned with data format specification but with interface specifications. Common interfaces reduce the need for data conversion (usually a 'lossy' process), they also allow data to be viewed 'live' as systems are interacting directly with data. These interfaces can also be published discretely, allowing for systems and users to catch up or 'cherry pick' those which are relevant to them. Changing one side of a data transfer mechanism, or an entire format change can cause untold problems between (and within) systems and user should be aware of the functionality their systems should be aspiring to.

"There's the Interoperability Reg…"

In practice, interoperable systems should allow any number of clients to connect to any number of datasets which themselves can cascade to other servers. This is basically 'Distributed GIS' (Doyle & Daly 2002). This may be the biggest initial 'tool' OGC will offer to the GI data users as a whole. There are now numerous GIS which have OGC Web Map, Web Feature and Web Terrain Server interfaces which can connect directly into

data provider (and other) services. Natural Resources Canada provide the Atlas of Canada OGC Web Map Server, which any OGC WMS client can access directly. This allows any number of clients, be they desktop GIS, browser based HTML or JAVA tools to link to the Canadian data and display and query it dynamically. It also has the potential for portals to be established, which link to multiple WMS sites, therefore acting as gateways to spatial data. This is possible because the fundamental building blocks, OGC interface specifications, are in place. This allows GIS, and spatial data users, to harness some of the benefits offered by mainstream applications using XML based services. See Figure 3.

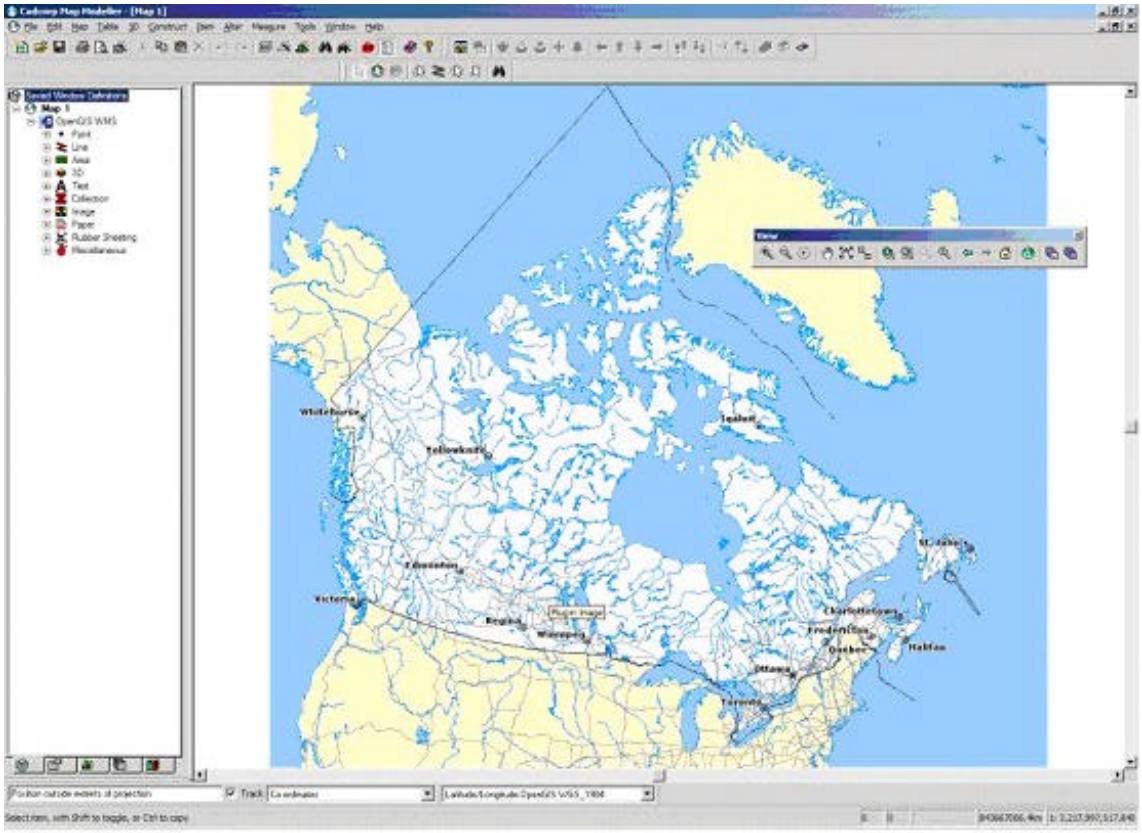

Figure 3. Atlas of Canada OGC Web Map Server viewed directly from a desktop GIS (Cadcorp SIS™).

To illustrate the benefits of interoperable systems further take Figure 4a which illustrates how organisations have traditionally 'inter-operated'. This is the model deployed in many, if not most, GIS which are implemented in large organisations. Because there can be no guarantee that Organisations A and B will have the same software, software version, operating system, locale settings and so on, some contingency is usually needed for data conversion – so that data can be shared.

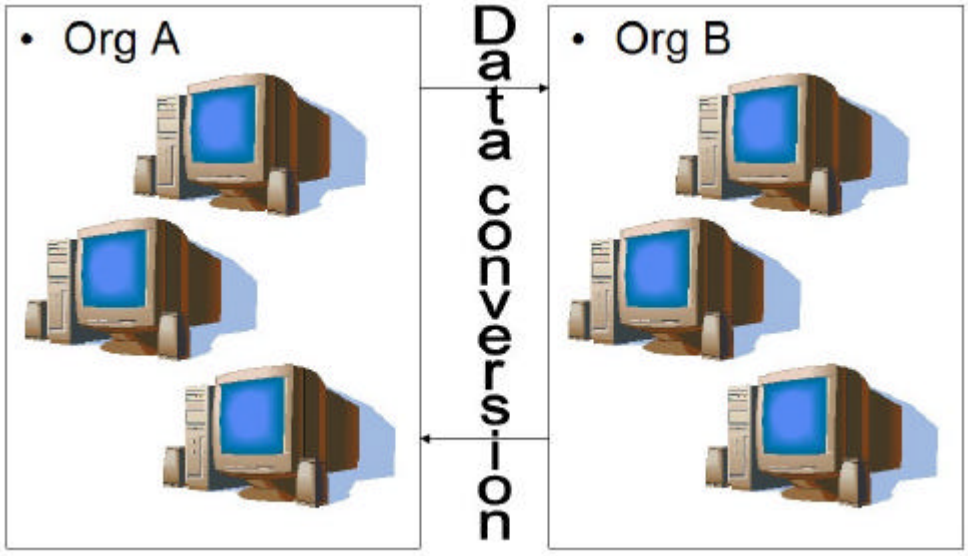

Figure 4a. Traditional 'non-interoperable' GIS.

This may be satisfactory for some purposes but not for those which are being deployed in today's I.T. environments. OGC specifications such as the OGC WMS specifications allow the data conversion hurdle to be removed, so that users can access and share live data both within and beyond the constraints of their 'vendor' software. OpenGIS specifications are essential if we are to see a global network of distinct GI servers and services interacting effectively for use by the GI community as a whole. They are also the mechanisms which will allow greater inter-agency collaboration e.g. Police, Fire, Ambulance, Local Authority etc.

Figure 4b illustrates this point. Atlas of Canada may be seen to be one of the nodes in this simple network. This network can have as many organisations as you may imagine and the connectivity between nodes can be as complex as any to be found on the World Wide Web.

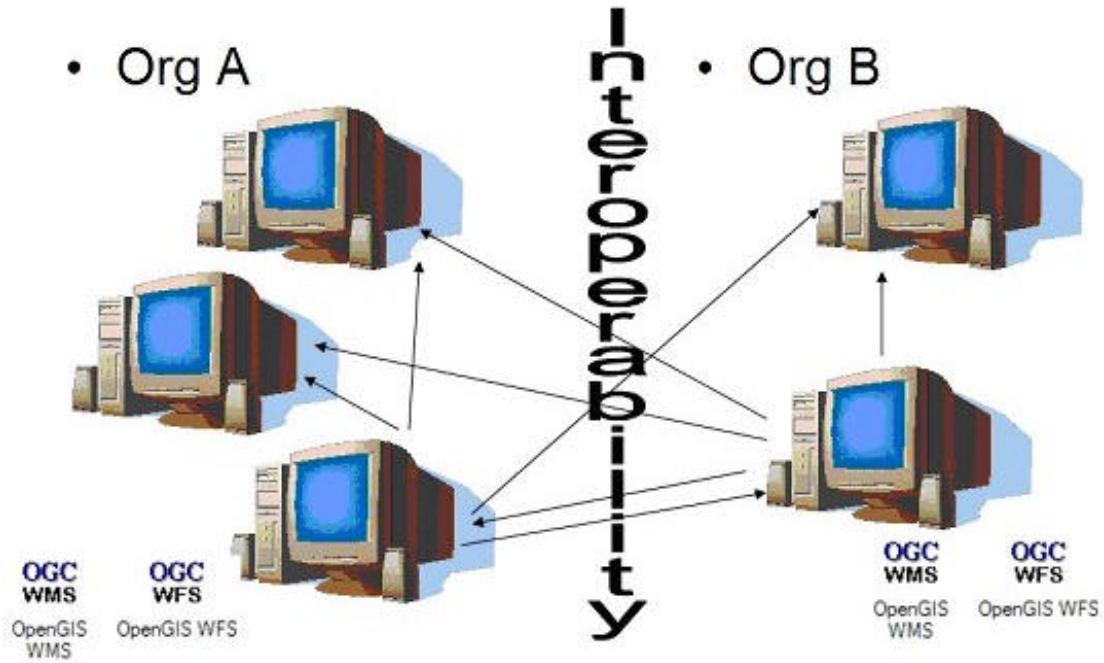

Figure 4b. Interoperable GIS allowing users to truly access and share data.

Interoperability: The Challenges

For developers

There are many software houses adopting the tenets of OpenGIS i.e. adopting and implementing OGC specifications, of which, GML2 is probably the most visible sign of this adoption; allowing data to be passed between organisations, systems and processes. GML3 will eventually extend to multi-dimension and complex geometries, further strengthening the case for its use – broadening the scope for data storage and transfer. Whilst not all vendors will adopt OGC specifications or commit to re-engineer their GIS, those who do will be able to serve organisations who wish, and need to share geospatial data, far better. Cadcorp SIS™, for example, is conformant in several OGC specification areas and, whilst it is a desktop GIS, it allows users to use it as a client to any OGC Web Map or Web Feature Server. Thereby the user can access raster and vector data, regardless of its original matter – providing that the host server implements the appropriate OGC interface specifications. The restriction here is merely in the number of available OGC servers and the speed at which it can be transferred across a network. Those developers who ignore the importance of GML and interoperable systems do so at their peril.

Implications for data suppliers

There is an obvious requirement for spatial data to be delivered effectively and quickly – the temporal currency of data is an increasingly important aspect of its value. If users can access such data without recourse to explicit data transfer i.e. directly into their GIS – regardless of what that system may be – then the data will penetrate more markets, or the same markets, deeper than any 'restrictive' de facto standard. That is not to say that once delivered, GML cannot be converted to another format to satisfy legacy or other systems. With GML for instance, data suppliers can provide data as files or they can provide direct, web based, data leasing. GML also potentially offers a neutral alternative to Binary Large Objects (BLOB) database storage.

Ordnance Survey's adoption of GML (as mentioned above) has changed the face of geospatial data provision in Great Britain and set a template for other major data providers i.e. using GML for data supply and maintenance. By doing so it has increased the pressures on GIS vendors to 'cope'. It has also allowed OGC specifications to be realised on a very large scale, in an important and operational context. US Census Bureau's TIGER/GML may be the next whole scale conduit for the realisation of current OGC specifications. In these cases, data providers are forcing the market, although there is a circular process in action; the more GML data provided, the more interoperable GIS will become, the more interoperable GIS there are, the greater the amount of GML data there will be. Web users who may be familiar with 'show me the nearest' type applications will be taken on a journey where functionality will increase to a point where they will be 'doing' quite complex GIS without realising.

Implications for users

Users will no doubt be as receptive to the benefits of interoperability once these benefits have been fully exposed. In certain areas this is just reaching a critical mass. Initiatives such as the OGC USL and the Ordnance Survey Digital National Framework are at the fore and are lighting the path for increased user uptake of interoperable practices. It is unlikely that rigid homogeneous (single vendor) systems and processes will be able to fully exploit these benefits per se but there will be 'some' need for them to interface with the new generation of GIS which have interoperability in their blueprint. The concept of remote data storage, which is accessible through common tools, is one which underpins the World Wide Web. This analogy is being applied to the GIS sector but it will be further advanced through increased user uptake.

Conclusions " Show us the Messiah! The Messiah! The Messiah! Show us the Messiah!"

Interoperable systems have obvious advantages for GI users and system architects. Along with initiatives and specification programs outlined above, OGC are implicitly forging GIS systems convergence. A by-product of this process is to making GIS less of a 'black art' and more of a transparent science. It also provides opportunity to build software from discrete components, which will, in turn, allow easier

comparisons of cost versus performance. The rise in OGC's membership and a growing awareness of its work and benefits beyond the Consortium, is also driving commercial decision makers so as to make software more open, consistent and reliable.

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References

Doyle, S & Daly, M.P. (2002) Enabling Distributed GIS, Proceedings GISRUK 2002 pp.229-235, Univ. of Sheffield.

Links

OpenGIS Consortium http://www.ogc.org

Atlas of Canada http://atlas.gc.org

Cadcorp http://www.cadcorp.com

Ordnance Survey http://www.ordnancesurvey.co.uk

UK GovTalk http://www.govtalk.co.uk

Multi-media

Monty Python's Life of Brian (TriStar 1979) is available from all good Video/ DVD retailers;

http://www.amazon.co.uk/exec/obidos/ASIN/B00008RWS7/ref=sr_aps_dvd_1_1/202-0567780-7296618