

t2.6

Creating reality from a virtual company

Alan Wild, Projects Director, Getmapping.com plc

Abstract

In this time of new Government initiatives such as the National Land and Property Gazetteer (NLPG), the National Land Information System (NLIS) and the National Land Use Database (NLUD) there is an ever increasing demand on already scarce resources in Local Authorities, Central Government Agencies and even the private sector to provide more information more accurately and faster than ever before. The creation of these online services from Government to Business and to the Consumer (G2B2C) requires that publicly held information needs to be created digitally, maintained more regularly and made available 24 hours per day 7 days per week.

This paper describes how one man's vision became a public flotation into a .com plc and then changed shape to become a national dataset available to Government under low cost service level agreements. It will describe the technical problems of flying and maintaining aerial photography over the whole of UK and the conversion into a seamless orthophoto database, 4 terabytes in size. It will go on to describe the complexities of making so much data available online and the approach to Government to get the data used in its delivery of its own services.

Today the Digital National Imagery Initiative is assisting in preserving our cultural heritage and monitoring our urban and rural environments by delivering up to date digital imagery of the whole of UK both on and off line to a wide range of Public and Private Sector organisations as well as satisfying a consumer demand for aerial photographs.

Introduction

Aerial photography has been flown in the UK since the 1920's but with the exception of the monochromatic photography flown by the RAF just after the last World War there has never been comprehensive and seamless coverage of the UK. The vast majority of aerial photography has been either for specific projects such as the Wash Barrage Scheme, the motorway-building programme in the 1970's or that commissioned by Local Authorities and Central Government Agencies to individual specifications and scales. Much of this photography has been flown to coincide with the ten-year cycle of the Census and until recently, was almost invariably monochromatic.

Whilst technology has allowed raster display of imagery for well over 15 years now, the hardware required has, until recently, been prohibitively expensive to buy and has required the use of sophisticated specialist GIS software. Image storage has also been an expensive business, necessitating the use of off-line or near-line storage devices such as optical platters or tapes handled by large jukebox devices. Because of the specialist nature of the systems, an expert user has generally been required to operate the system and this in itself has led to islands of information of digital imagery.

In the last two years we have seen a technological revolution in terms of the power of the PC, networking speeds, mass storage, and standard software, whilst the cost of the whole has dropped incrementally year on year. It is hard to imagine that, only seven years ago the 486 processor was launched by Intel and at the time, Microsoft was only just introducing Windows to the world. Since then, the power of the processor has

doubled every nine months to the point where computing power is now awesome and continues its exponential increase in performance unabated. Only five years ago anyone holding anything more than 1 Gigabyte of data in a database was into serious computing but today, databases of Terabytes of data are not uncommon.

The Vision

It was in this burgeoning world of IT that Tristram Cary, a former Royal Navy officer, first came up with the concept of national pictorial coverage of the UK from the air. The inspiration for the idea came from seeing at first hand the tremendous inefficiency inherent in the old market model. The majority of photography was acquired by different public sector organisations for their own use, giving rise to a patchwork of data at a variety of scales, dates and formats. Since the data was also often owned and stored by the procuring organisations, it was generally impossible for anyone else to access the data, especially if they required an area that crossed the boundaries of individual datasets.

In an ideal world, aerial photography needs to be in digital form, in colour and to a consistent scale. It should also be maintained and updated regularly and made easily available to the thousands of potential users who cannot currently do so because of the problems I've just mentioned. Finally, to ensure maximum usage the entire dataset set should be corrected to fit Ordnance Survey Land-Line® mapping.

Taking on a project of this size is not to be underestimated. In terms of uncompressed data the whole of UK forms a 40 Terabyte database. When originally conceived, the cost of the technology required to handle this size of datastore efficiently was very high, so with this in mind, it was obvious that a new company in this field was going to need some serious funding to get it off the ground – literally in this case!

Tristram Cary and Joe Studholme founded The Millennium Mapping Company Limited (MMC) in November 1998 with the mission of creating a sustainable business based on the Millennium Map™, a Digital Image of Britain which would be kept up to date and sold at affordable prices. As well as the Millennium Map™, the company acquired the rights to the only true facsimile of William the Conqueror's Domesday Book. Apart from being another source of revenue, The Domesday Book underlined the importance of the Millennium Map™ as a modern-day Domesday Book and as a base-line for measuring change through the 21st century and beyond.

The usual round of City institutions and venture capitalists took place resulting in MMC being successful in raising £2m from both private investors and Oxford Technology Venture Capital Trust (OTVCT). With initial funding in place, work could begin almost straightaway, enabling MMC to begin flying the Millennium Map™ in April 1999.

In November of the same year, the Millennium Map™ was launched at the Royal Geographical Society to enormous public and media interest. This interest also coincided with the dot-com boom, and it was decided to capitalise upon this and float the Company on the Alternative Investment Market (AIM) of the London Stock Exchange.

In April 2000 the Company was successfully floated on AIM as Getmapping.com plc, raising a total of £13M in the process. The money raised enabled the company to start geocorrecting the Millennium Map™ straightaway instead of waiting for customer orders and to create a web-based business B2B (Business to Business) and B2C (Business to Consumer) as well as develop in overseas markets.

In November 2000 Getmapping.com acquired Wildgoose Publications, bringing the control of film-processing, scanning and geocorrection in-house and creating the UK's largest aerial photography company. Wildgoose was already well established selling products in the education sector as well as offering film processing, printing, scanning and geocorrection services. As Wildgoose was undertaking much of the geocorrection work for MMC it seemed a natural partnership.

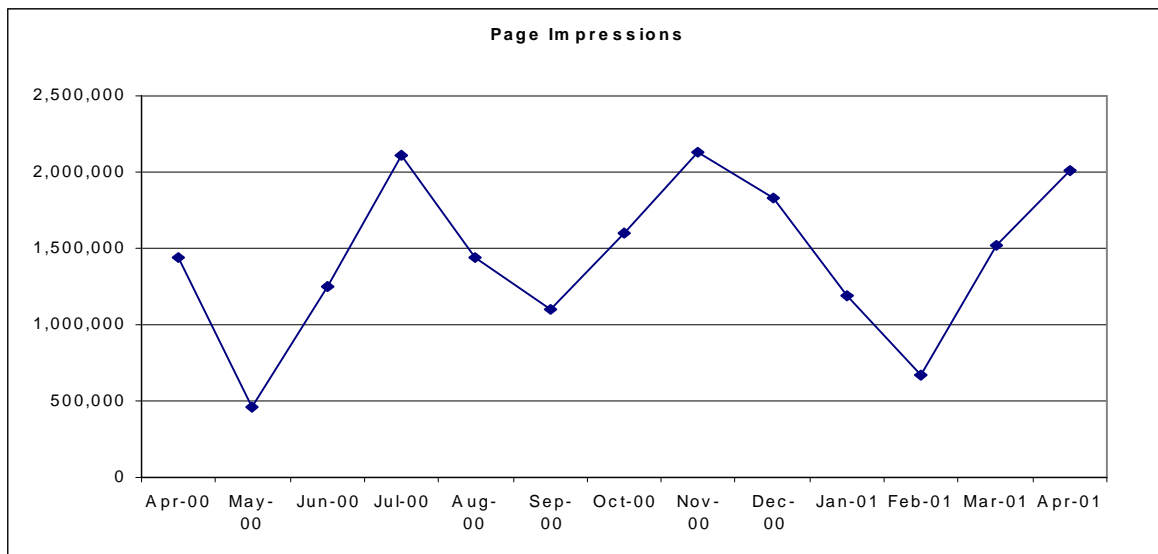
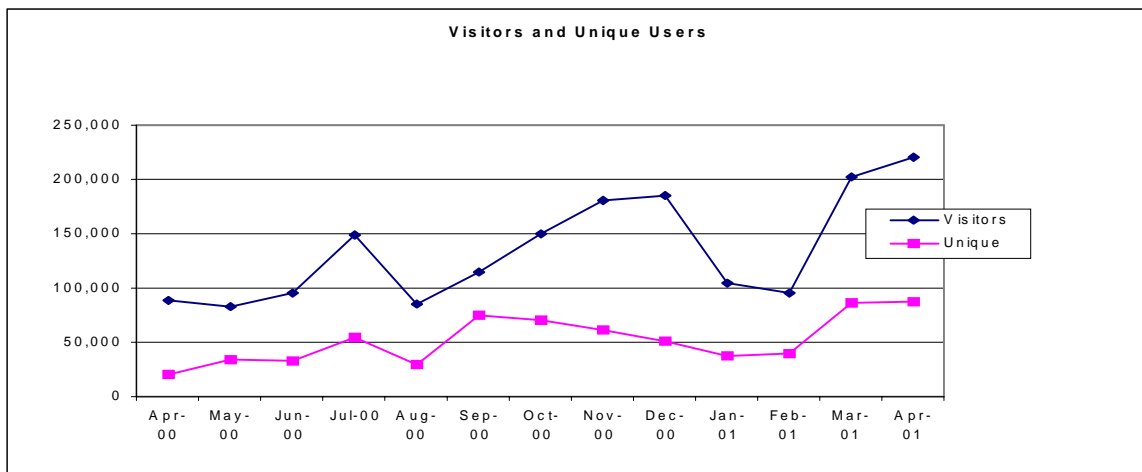
The company still has extensive relationships with a number of outside contractors for various specialist tasks but more of these later.

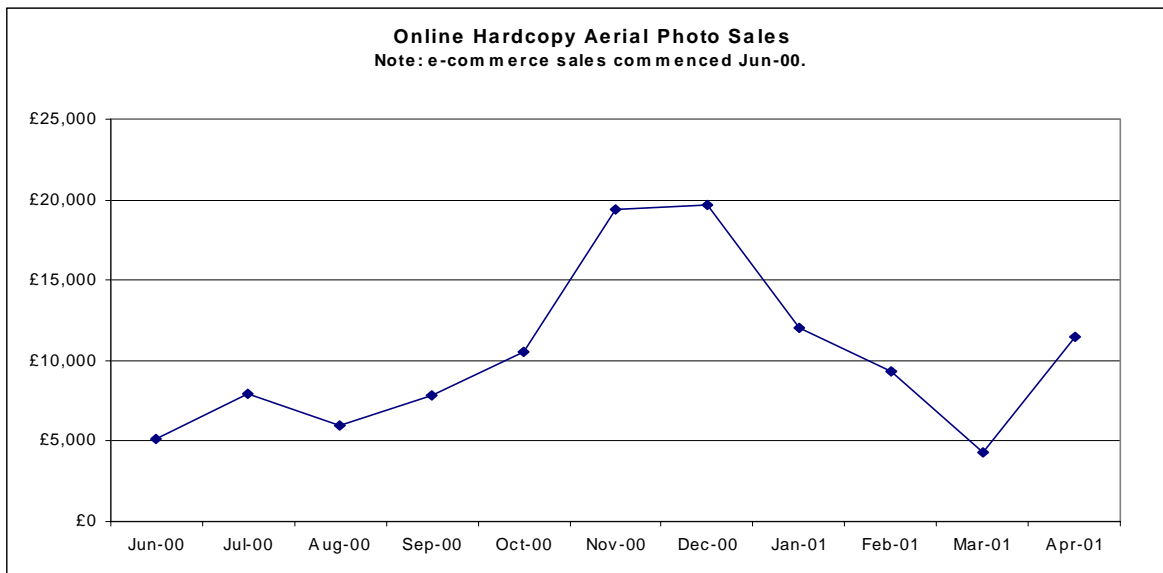
Of course, the main stockmarket float occurred at the height of the dot com era. Since then the dot com suffix has become synonymous with poor performance, not least with investors and a decision was taken in April of this year to drop the suffix from our name and become simply Getmapping plc.

I am pleased to report that unlike many of its dot com peers, Getmapping has grown to be a cash rich operation and its turnover is increasing exponentially. Having the ability to complete our operations as quickly as the weather and seasons allow is the real key and means that the task of capturing complete coverage becomes easier.

The interest in the company gained as a result of the launch was enormous. Two factors were that the Queen decided to invest in the company and the press got hold of the 'spy in the sky' angle when they realised that we had imagery covering all the sensitive establishments in the country. To give you an idea of how high profile the launch was, some two months after the event a market survey showed that 60% of the general public had heard of Getmapping.

The original concept for generating sales was entirely based around an e-commerce on-line ordering service with a hard copy aerial certificate being printed on demand and posted, framed or unframed, to the customer. This service has been successful but is dependant on marketing to the general public, the cost of which is prohibitively expensive. It is also seasonal as people tend to purchase a certificate as a Christmas present. The following charts show the activity on Getmapping's website:



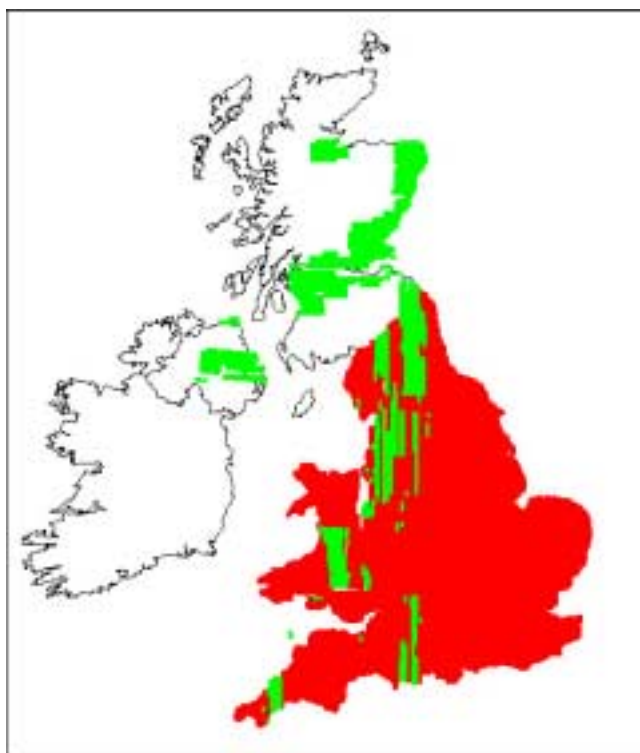


As can be seen, whilst this is an interesting hitherto untapped market, it is not going to support the future funding of a large national dataset.

Therefore we needed to review our game plan and as a result, two new strategies were conceived:

- To concentrate on marketing large subsets of data to the traditional market of Local Authorities and Central Government Agencies and,
- To offer an on-line service to deliver small extracts of the data in digital form over the Internet to professional users such as Estate Agents and Property Developers.

As a result of these two new potential revenue streams, I joined the company in November last year with the intention of setting up the project for the Government market place. At that time much of the photography of England and Wales had already been collected and there was a dawning realisation that we were on the verge of attaining the goal of true national coverage. Getmapping thus created Digital National Imagery (DNI) as a brand aimed at these markets and was duly launched in March of this year to an audience of some 300+ National and Local Government officials. Since then, at the time of writing of this paper the coverage has grown to the following levels.



The green areas in the above diagram show where photography exists and the red shows the geo-corrected areas as at 25-6-01.

I am delighted to report that this initiative has already been incredibly successful. The bottom line is that DNI aims to sell complete coverage on the UK to a multiplicity of departments and authorities at very low annual prices together with an update of the data, which is included in the annual price, of not longer than a five-year cycle. The price varies according to a complex formula of area covered, population density, how many other customers are already using that area and length of contract - the intention being to make the price as equitable as possible whether a customer wants complete coverage of Wales or just a London Borough. With this novel approach we have found that even Local Authority Finance Departments can find any reason not to approve the purchase!

With all geo-correction work on England now completed Getmapping was in a position to offer imagexpress™ and imagexpress plus™ plus to customers over the Internet. Imagexpress™ allows a customer to enter a postcode or address into the website and be returned an uncorrected 0.5x0.5 Km square of image which is then delivered as an e-mail attachment within 4 hours of order. Imagexpress plus™, due to be launched in the autumn, allows a customer to interactively receive the same size image but in geo-corrected form and in real time. This service is aimed at the regular user of small areas of data such as Estate Agents.

Both these services together with the certificate printing operation require large technical resource, which is where the usually unsung heroes of the backroom come in. Let me introduce you to the backroom boys and girls.

Firstly, the Flying. Getmapping contracts four modified Aero Commander twin engined planes, which are dedicated solely to our operations during the flying season of between April and October. They are fitted with survey cameras, which have Forward Motion Compensation (FMC) and interfaced with Differential GPS Flight Management Systems to record position to an accuracy of less than 1m. The planes fly nominally at 5000 feet at a speed of 180 knots with the cameras taking an exposure every 5 seconds. All photography exceeds the latest RICS Specifications.

The film used is 9"x9" AGFA Aviophot H100 colour aerial film. Each roll is 135m in length, providing some 500 exposures and costs about £1000 a time – and you can't get it at Boots. All our film processing together with the creation of contact prints and diapositives is done in-house at Getmapping's Coalville site using Colenta processors with C41 chemistry. Each film takes about four hours to process, which is considerably longer than the time taken to expose it in the first place.

Every exposure is scanned at 1200dpi resolution (21 microns taking in the full extent of each photograph with all scans taken directly from the original negatives.). This results in an image of 10,800 pixels Δ , with an uncompressed size of 330Mbs. All images are stored on DLT tapes in JPEG format using a fairly light compression ration of approximately 12:1. At this ratio there are no signs of any loss of quality. To date over 100,000 scans have been stored.

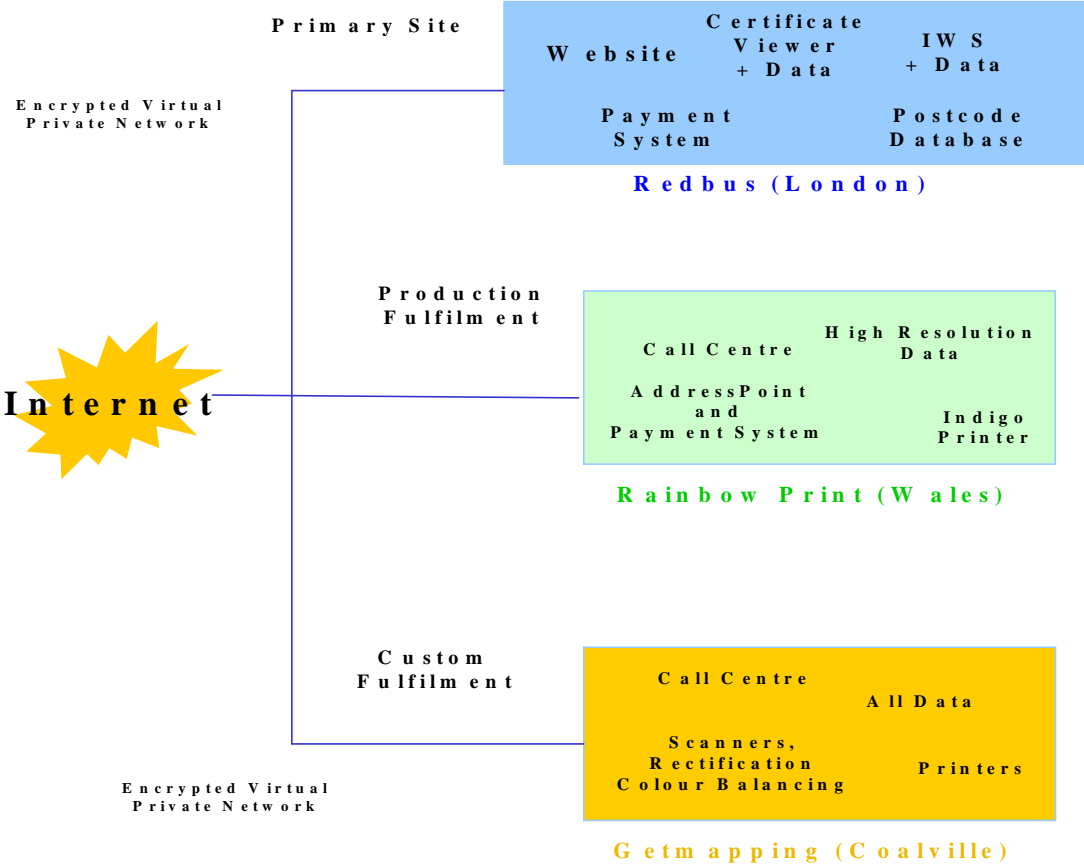
Once scanning is complete, the rectification work can begin and three sub-contractors as well as Getmapping staff are used for the work. One sub-contractor operates in India, a second is based in UK and South Africa whilst the third is purely UK based. Wildgoose also undertake some of this work. The data is controlled using the largest scale of OS Land-Line® data available in any area and in Northern Ireland OSNI data is used. In flat areas the image is warped to the mapping data in two dimensions only, whereas in hilly areas full ortho-rectification using a Digital Terrain Model is undertaken. Extensive research has shown that there is no appreciable difference in the two techniques when used in flat areas. All the data is guaranteed to be within +/-2m RMSE of the Land-Line® with at least 20 control points per image being used in the geo-correction work. The images are then mosaiced together using great care to choose the cutline path that gives minimum building lean. To finish off, an automated ERMapper colour balancing procedure is used to get even tonal balance. Approximately 20,000 Km Δ of data is created in this way each month.

All scanned images are held in Coalville with a back-up kept off-site. The Primary Internet Site is based at Redbus Interhouse Ltd in London. Redbus provides 24/7 support, including UPS and operators to monitor all the equipment and has all its own quality assurance procedures.

Our Certificate Production facility is at Rainbow Print (Wales) Ltd in Merthyr Tydfil where the Indigo printer is maintained on a day to day basis by Rainbow staff in accordance with the manufacturer’s instructions and the data stored on mass storage devices called Snap servers.

Softwright Ltd in Slough developed the Certificate database system. Softwright still maintains the system under a long term maintenance agreement. The system is fully documented in accordance with Softwright’s own development procedures

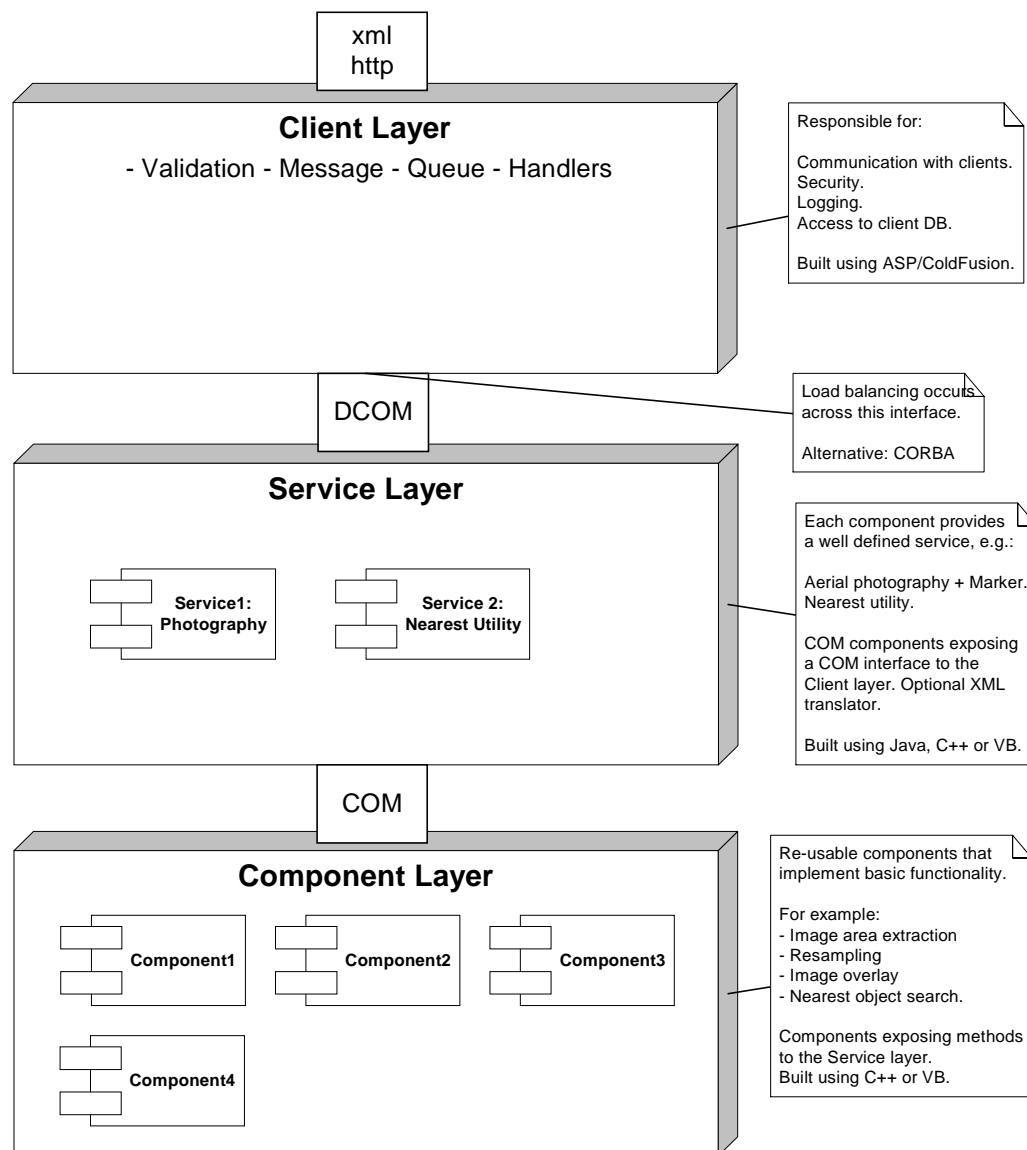
The Internet Site also uses ER Mapper’s Image Web Server (IWS) system, which was developed in Australia to ER Mapper’s software standards. The following is a schematic of the complete system.



As a part of this, Getmapping has invested in the development of GM Server, a high performance raster engine designed to:

- Supply custom-imagery across the Internet in a variety of formats and at variable resolution and scale (under customer control).
- Provide AddressPoint accuracy in identifying locations, and exact centring of imagery on the point of interest.
- Support multiple charging models.
- Provide secure Logging, Billing and Administration functionality.
- Provide IPR-protection after sale by embedding a unique customer watermark within the data.
- Provide on-line security by suppressing screen-dump, export and printing functions within a user’s computer.

Designed, built and tested in-house using industry best practice and latest technologies the software has a multi-layered, component architecture that provides versatility and extensibility. The main software layers of the architecture are shown below



Some of the benefits of this component layered architecture are:

- Increased ease of maintenance.
- Faster development times due to re-use of components.
- Increased reliability due to use of existing, tested components.
- Low cost of increasing the capacity.

What happens next?

Already the data is being used in many different ways by a variety of third party organisations that have entered into licensing agreements with Getmapping. Harper Collins has published a coffee table edition of the London Atlas, providing complete coverage on the whole of Greater London. Priced at £50 it has already sold more than 40,000 copies. Their next project is the England Atlas, which will be available before Christmas and provide aerial photography for the whole of England at a price of £99. The Overview Mapping

Company is using our imagery as a background to tourist maps of towns such as Windsor, Cheltenham and York which include street mapping and tourist information overlaid on the top of the image.

Digital National Imagery is also allowing new applications to be developed across the board. Because most people now have the necessary hardware power on their desktop and because of software like ER Mapper Image Web Server, which can be easily used by anyone and offers high compression of the data to typically 50:1, most organisations can now serve up imagery to all their staff.

Of course, when Getmapping data is used within a GIS either in JPEG or ECW format the combination of OS Land-Line ® and DNI provides users with an extremely visual source of extra data.

If one believes the old adage that all maps are a generalisation of reality and therefore all maps lie, the imagery layer brings a welcome taste of honesty back into mapping. Imagery is WYSIWYG (what you see is what you get) and therefore can be extremely valuable. For example, does a house extension exist on the image at time of flying? Ask the same question of a map and the answer might be that the extension did exist at the time of the last update but the surveyor either missed it or was not allowed to survey it.

Getmapping imagery is already being used for many very basic roles where traditionally an inspector had to visit the site in question to establish the truth. All the legwork can now be undertaken on the desktop, thereby saving large amounts of time, money and shoe leather. A good example would be tree preservation orders that require each tree listed to be located on a map. As Land-Line® does not show individual trees, our imagery can prove to be a huge asset in identifying and plotting TPO sites onto the line map.

Likewise in the National initiatives of NLUD, NLPG and NLIS. Images can provide more information about a particular area than the traditional map ever could. In the context of NLIS every property sale should have an aerial image attached. In NLUD the condition of any area identified in the database can be assessed before any expensive time consuming site visit takes place.

As technology progresses there will be an opportunity to fully develop three dimensional models for the whole country (bearing in mind that the original photography has been taken with the necessary overlaps for this purpose). Already our data is being used in such applications and new advances appear seemingly daily. As we intend to update the imagery on a regular basis there is also the opportunity to fly larger and larger scale photography. Already we are flying 12.5cm resolution imagery of London, which shows people in the streets.

Rarely has there been a more exciting time for airborne imagery in the UK.