Managing road traffic in a city of millions is always a demanding job. But what happens when Sydney decides to host the 2000 Olympic Games? How does the city ensure the smooth running of its transport systems when they are suddenly flooded not only with daily commuters, but also with hundreds of thousands of visitors?

Although Sydney employs several state-of-the-art, real time monitoring systems, how does the city guarantee a clear, overall picture of its many highways and side streets? Traditional transport management methods simply don't work in an environment where a finite road network is pushed to capacity. Sydney's Roads and Traffic Authority (RTA) in alliance with Earth Resource Mapping and Digital Earth Pty. Ltd., have created a solution that finally solves this small but vital problem - not only for the Sydney Olympics, but for transportation authorities worldwide.

Consider the case of Chris Ruwoldt, Transport Operations Planning Manager for RTA, who went to work and encountered a pressing problem at the worst possible time. The week before Sydney's opening ceremony, two Senior Traffic Operations Controllers were hotly disputing an application for Road Occupancy. In Chris' words: “A factory was upgrading its lane. Bear in mind the RTA receives..."
over 1000 applications every month for road occupancies and preparations for the Olympics Games are in full swing. The lane was a State Road; therefore approval was required from the RTA prior to the work being done. Before they can give approval, Controllers must assess the traffic impact of the closure. The impact of closing one lane of two is much more significant than closing one lane of three. The applicant didn't put on their application what lane configuration was at that location. The Controllers got into a debate because one thought it was a two-lane road and the other thought three. I walked over to my computer and called up Earth Resource Mapping's software Image Web Server. I panned and zoomed into the particular area. We found it was three lanes. End of discussion. Application approved.*

Before the Games, surveyors in the RTA Spatial Information Section were asked to provide a mapping interface to help plan and manage ‘Road Occupancies’. (Road Occupancy is an event that purposely interrupts the free and normal flow of traffic. For example, a Road Occupancy may be required to repair a kerb, trim trees, supply concrete to a building site, or for an event such as a march, New Year’s Eve celebrations, etc. Such ‘Road Occupancies’ are planned events, as opposed to un-planned events which include motor vehicle accidents and breakdowns.

Despite having extensive vector databases and real-time camera networks, the RTA’s system lacked the ability to fill in the gaps between this data. RTA conceived that high-resolution digital aerial photography and raster street maps, integrated with the system, would solve this problem. Further, the system had to display the imagery in a web browser, ArcView ® and Microsoft Word®, and be simultaneously accessed by users across a network. Digital Earth and Earth Resource Mapping approached RTA with a solution that meets all of these requirements - Image Web Server. Digital Earth knew that coverage of such a wide area would take hundreds of files and add up to over 600 gigabytes of data. Their approach was to mosaic the data using ER Mapper and then compress it to a manageable size using Earth Resource Mapping’s Enhanced Compressed Wavelet (ECW) technology. The compressed data was then to be built into an Image Web Server so that RTA could access it across a network. RTA requested a trial system using sample imagery. Andrew Hallam, Technical Manager for Digital Earth, created several sample pages, one of which displayed aerial photography and raster street maps in the browser using “geolink” mode. (That is, if you roamed or zoomed in one image the other would display the same area). Another web page simulated a suburb search function. RTA decided to integrate Image Web Server technology with their system based on Digital Earth’s trial.

Andrew Hallam, Digital Earth and Robert Leake, Development Photogrammetrist for RTA collaborated to process all imagery and develop the website. The project was broken into two stages. In the first stage, three different types of imagery were purchased: 1. 20cm, colour aerial photography of the Sydney metropolitan area. 2. 1m aerial photography covering all major roads in the Greater Sydney area, including Newcastle in the north, Katoomba (Blue Mountains) in the west, and Wollongong in the South. 3. 2m raster street maps of the Greater Sydney Area.

Andrew and Robert mosaiced the imagery using ER Mapper 6.1. In order to use the Image Web Server as the delivery mechanism they needed to then compress the imagery into ECW format. As a
further challenge, RTA required the imagery to be displayed in two different projections based on the GDA94 datum: Map Grid of Australia (Zone 56) and RTA's custom Lambert projection of New South Wales. In Andrew's words: "All the imagery was provided in TIFF format with TIFF World files providing georeferencing information. These files had to be converted into mosaics no larger than 100 gigabytes each, in order to be served on the RTA's Corporate Edition of Image Web Server (the Corporate Edition has a limit of 100-gigabytes per image served). That meant we had to create a total of ten mosaics (five mosaics for each projection), four of which contained 96 gigabytes of raw data."

"We processed approximately 600 gigabytes of data using two computers equipped with 160 gigabytes of useable hard disk space and a DLT tape drive. We were also able to save several mosaic algorithms in one directory and compress them using a batch process. The 96 gigabyte mosaics took about 17 hours each to compress so we took advantage of weekends to create several ECW files."

Due to ER Mapper's algorithm functionality, which allows for real-time image processing with very low hardware requirements, the project was successfully completed on available equipment. Andrew and Robert could mosaic and compress very large images without having to import them or save intermediate datasets. This greatly reduced the amount of time and labour needed. Another benefit ER Mapper brought to this project is the ability to mosaic imagery of varying resolution (or cell size). The Sydney mosaics contain both 20cm and 1m resolution data, but can be viewed as one complete image. Using ER Mapper's Image Display and Mosaic Wizard, RTA could easily fuse the two data sets with a few mouse clicks, and then watch the software process the real-time results. By overlaying wide-area coverage 1m data with the 20cm small-area coverage, RTA could easily fill in any gaps in the higher resolution dataset.

The second stage of the project was the development of the website that is used as first point of access to the imagery. During the Olympics, the main requirement was to be able to search for a suburb and display both the aerial photography and raster street map of the area in a web browser. The user then roams and zooms to their area of interest. The user enters part or all of a suburb name, selects the projection they wish to view, and clicks on the "Search" button. A database on the server is queried and a list of matching suburbs and images is returned. Clicking on the image "Quality" hyperlink...
displays the selected suburb using the selected image, and also displays the associated raster street map. “The fact that Image Web Server makes all this possible is transparent to most people. They now have fast and efficient access to the imagery from their desktop, and they don’t have to understand the technology that makes it happen.

Although Image Web Server is relatively new, the RTA already gets significant benefit from it. It provides access for many people to a large quantity of valuable imagery. As the access to Image Web Server is rolled out to other groups within the RTA the benefit will increase as more people think up new ways to use the imagery”, continues Andrew Hallam. Chris Ruwaldt leaves us with three final thoughts: “Prior to the Image Web Server, aerial photography was only available to a select few and the coverage was extremely limited. Generally, aerial photographs were taken during the design phase of a major road construction project. They were generally not digitized and orthorectified. The Image Web Server has changed all that”. “We demonstrated it to a large number of people who were either involved in the Olympic transport effort or in the ongoing RTA business of managing the NSW road network. Without exception, it changed peoples’ view of the world. Their expectations suddenly changed to fit the new paradigm. There is no going back”. “As you can imagine, there are a number of traffic and transport studies underway during the Games on the (performance of the road network). Because of the variety of ways people can get to the Olympic venues (train, regional bus services, park & ride) it is important to monitor the busloads to ensure capacity is in line with demand. A number of transport planners are based in the Transport Management Centre (TMC), during these studies and are using the Image Web Server. So for the first time they have the ability to get a bird’s eye view of the roads they are using. They love it!”
The Internet has opened up a whole new avenue of learning possibilities. The amount of educational research being carried out over the net, as opposed to through more traditional methods is ever increasing. With web access that is often easier to understand than the reference system of the local library it is no wonder that students are increasingly turning from textbooks to the Internet. Add these trends to growing domestic PC ownership and the introduction of TV Internet access and it becomes apparent that the net is encroaching into ever more areas of everyday life and the sphere of education is no exception.

The world of spatial imagery is another arena that is reliant upon high-end technology, capable of handling terabytes of information. GIS illustrations in turn provide educational opportunities of the highest order. This is something which Plymouth city council have realised and are already acting upon, showing an understanding of both the imaging technology available and the need to utilise the Internet as a teaching tool. The Plymouth grid for learning has been created by the Plymouth LEA and stands as an illustration of the value of the Internet to the educational fraternity.

Ambitiously the Plymouth LEA also wanted to provide the areas students with access to some of the most advanced GIS technologies available. To make subjects such as geography come alive without leaving the classroom was the specific aim of including a GIS Mapping element within the learning grid. The applications that the GIS Mapping area of the site will house include the ability to take students on a virtual field trip; bringing locations to students as opposed to the more costly and time-consuming alternative. Students will be able to follow the journey of a river such as the Tamar, from source to mouth, examining areas of geographical and historical interest along the way. How to bring this vision to life was a major hurdle to the success of the project.

To put such a project together requires GIS map data and overlays, current and historical photographic data, 360-degree stills and Video clips, along with digitized historical documents. Environment Agency river & sea-mouth data and supporting text also form part of such an experience. Having collated all of the necessary information there is then the problem of providing access to it. In order to allow an unlimited number of students and teachers to simultaneously view the virtual field trip, a solution had to be found that would allow fast, high-resolution access to large numbers of users. To solve this problem the LEA have turned to the Image Web Server, as provided by Earth Resource Mapping. Using the ECW file format Plymouth found this technology to allow multiple access to files of gigabyte size, without affecting either speed or resolution. In this way a vehicle had been found to deliver the package of the virtual field trip.

The on-line trip will provide the areas teaching staff with the ability...
to compare one location with a similar or dissimilar one and use maps and photography to distinguish between land use patterns. It will also become possible to analyse the features and characteristics of a pupil's own school situation and environment; looking at geography, topography, human geography, geology, history and communications.

The project will directly link graphical, textual and statistical resources that will allow classroom access to remote environments. Making these data available from a single source and on demand will render the delivery of the National Curriculum easier. The learning that results from the grid will be experiential rather than abstract and as such will give students a greater comprehension of the environments involved than could ever be provided by textbooks alone.

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The project will primarily be targeted at Key Stages one to four (ages 6-13), with later expansion planned into adult education. The site will also lend itself to the independent investigative work of more able children and will provide support for those who find abstract conceptualisation difficult.

The virtual field trip and indeed the learning grid itself will stand not only as a valuable teaching aid, but also as an example to other education authorities. In exploring newly available GIS technologies, Plymouth will be able to identify learning opportunities and investigate all of the implementation difficulties, in order to provide other authorities with a guide to how to set up similar sites most effectively.

To assess the success of the initiative, enhancements in pupil achievement will be monitored as an integral part of the scheme. This will provide a clear indication of the worth of the financial investment needed to set up and then extend the site. A major element of whole initiative is to produce a summative report, based upon implementation at LEA level and use at school level. In this way it will become possible to chart improvements in student’s levels of development with the development of the learning grid. Such progress reports and indeed the virtual trip application itself are due to be in operation by the end of the year.

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The Plymouth site will also give the LEA the ability to serve information regarding transport systems and statistics, to graphically illustrate how transport has influenced the development of locations and provide students with an understanding of the nature and notion of routes and provide examples of mapping symbols. In this way Plymouth City Council will be able to provide its students with an average school day that is more involving than ever before.