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## ...and we're off!

**W**elcome to the first edition of *eBritain* Science & Innovation a journal of innovation, a magazine for consumers and a critical tool for industry. The focus is on pioneering technology and re-engineering science creating a fusion between consumer and business products.

We aim to play a pivotal role in publishing the latest research and act as a forum for debate on its practical application. *eBritain* will contribute towards a convergence of research with the precise requirements of business and consumers, facilitating and disseminating this debate on a global scale.

Through the diversity of its articles, the magazine will also seek to bridge the gap between academia and industry encouraging a cross-fertilisation of ideas. For instance, in this first issue, on the business side we look at colocation centres, taking in consumer markets we consider how standards can help create 'a world of internet appliances,' research papers include e-banking and an online inductive programming tool, while country reports consider e-business in China and technology forums between the UK and Asia.

With technological development taking place at such a pace, the magazine depends on those on the front line of innovation to keep us informed. So if you would like to write on any area of your experience or specialisation that includes traces of science and evolution we will be interested to hear from you.

I look forward to working with government, businesses, academics and the human chain in order to make a difference in science and innovation. Please contact [ebritain@bite.ac.uk](mailto:ebritain@bite.ac.uk).

**Dr M Farmer**  
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# UK means e-business

**MP, Alun Michael, welcomes BITE's initiative in launching e-Britain and discusses the UK Government's plans to develop e-business.**



I have a particular interest in the work that organisations such as BITE are undertaking to ensure that we are all working together with the one aim of making the UK the best place in the world for e-business.

E-Business, the operational use of Information and Communication Technology affects all of us, in the public and private sector alike. ICT is key to a successful economy in all its aspects, be they business, citizen or government focused.

One of the Government's key challenges is to help more businesses understand the benefits of exploiting ICT is to deliver sustained business improvement. Successful e-business is central to increasing productivity, enhancing competitiveness and stimulating innovation. This is not just a matter of opinion. A growing body of evidence now backs this up. Recent reports from the Economist Intelligence Unit and OECD have shown that effective use of ICT accounts for a significant part of the productivity gap between the best performing economies and those doing less well.

### **Pervasive ICT**

The good news is that in the UK we are deploying ICT more pervasively and innovatively than ever before. It is now commonplace to see employees quite at ease accessing company systems on their laptops through wireless connections while on the move. More broadly, businesses are increasingly

integrating and exchanging a wide range of information with their customers and suppliers.

The DTI's International Benchmarking Study, which looks at business adoption and use of ICT, this year placed the UK third, of the eleven major countries surveyed, in its ranking of sophisticated use of ICT. The study confirms that more businesses are now connected to the Internet through broadband with the level of xDSL usage almost doubling over the last twelve months. It also confirms that UK businesses are amongst the leaders in the adoption of new technologies such as Voice over IP and desktop video conferencing.

The public is also connecting in ever-greater numbers to the Internet for information, entertainment, education and commerce - and using broadband to do so. Our latest research shows that in September last year, "The UK became the most extensive broadband market in the G7." Up from 3rd position only six months earlier to overtake Canada and Japan. At the beginning of 2002, availability of broadband stood at 64% and there were 350,000 broadband subscribers. Today broadband is available to more than 96% of households with more than 6 million subscribers.

By this summer that figure will rise to over 99.4%, with the figure getting closer to 100% by December

*'Successful e-business is central to increasing productivity, enhancing competitiveness and stimulating innovation'*

2005, with every prospect of there being 9 million subscribers by the end of this year. New subscribers are growing by 50,000-60,000 each week. The UK is on the road to becoming a truly e-enabled economy.

### **Broadband enabler**

The world of ICT/ broadband/Internet is now one that has become entwined with all aspects of society. From cutting edge business use, to social provision of government services online. From educational aspects of project work and online homework, to online entertainment, music and games. Broadband is a huge enabler of all these activities and the Government is proud of the affect that our policies have had in increasing broadband

availability and uptake.

However, as Government we can do more to highlight the benefits of broadband and increase take-up. In my role as Minister for the Regions I recently wrote with my predecessor Mike O'Brien to 8,000 Parish Councils and other local authorities and interested bodies with a copy of a CD Rom that delivers nearly 500 case studies from private and public sector sources.

The successful exploitation of broadband by business and communities provides the most persuasive case for others to follow. And this Government attaches a great deal of importance to the impact of free market competition to drive improved broadband competitiveness.

### **Promoting awareness**

Government has a clear role in helping to promote and increase public awareness about the Internet and harness the economic and social returns in a way that benefits all society. In April, Patricia Hewitt on behalf of the Prime Minister launched 'Connecting the UK: the Digital Strategy. The Prime Minister's Strategy Unit and the DTI, in partnership with industry, aim to make the UK a world leader in digital excellence and the first nation to close the digital divide.

The Government is committed to ensuring that all of society can benefit from the new services that ICT can provide. The document, outlines the steps the Government are taking so that ICT can improve the cohesion of our society, the wealth of its economy and the quality of life of its people. There are seven key Actions outlined in the digital strategy which are outlined at the bottom of these pages.

### **Modernising Government**

The Government is also taking steps to modernise its own services for the 21st Century. The e-Government Unit, headed by Ian Watmore, is focused on delivering our target of 100% capability of joined-up online government services. The Government's focus is to ensure that these services are achieving high levels of use. Good progress is being made and over 70% of Government services are now online.

## **UK DIGITAL STRATEGY ACTION PLAN**

### **Action 1: Transform learning with ICT**

Includes the commitment to provide all learners with their own virtual learning space where they can store and access their work, and to provide students with the opportunity to access ICT in the home through the national laptop and home PC leasing scheme.

### **Action 2: Set up a digital strategy for local authorities**

A joint industry and government initiative that would see the winning local authority establish by 2008 universal local access to advanced public services delivered by ICT.

### **Action 3: Make the UK the safest place to use the internet**

Includes the announcement that the Home Office will establish a multi-agency national internet safety centre to deter criminals targeting the UK for internet crime.



A key approach for the Government here will be to work with intermediaries from the private and voluntary sectors. We recognise that we cannot work alone and that intermediaries provide a trusted way for people to do business. Importantly, too, the Government has launched its new online service Directgov, [www.direct.gov.uk](http://www.direct.gov.uk), to bring together information from across many Whitehall departments into one place.

This should make it significantly easier for people to find what they want from Government. This will allow for example, drivers to renew car tax while buying car insurance online. Or to fill in a VAT return direct from an online bank account. Ensuring that people have appropriate online access is critical to the Government's vision for ICT. To this end, we have taken steps to encourage the widest possible participation in the digital age.

Through the Home Computing Initiative (HCI), employees can take advantage of tax exemptions on loaned computer equipment provided by their employer for use at home. HCI schemes help businesses and organisations increase their performance by raising the potential of the workforce through improved ICT skills. Like Numeracy and Literacy, ICT skills, are now recognised by the Government as a third skill for life. ICT skills also help people take advantage of online learning and other computer-based training, contributing to a broader skills set.

**Educational potential**

Families that understand the educational potential of broadband for their children can choose from a range of products. Healthy competition to deliver the price and product they require will allow the majority of households to make their own provision for broadband. The challenge remains to ensure that those families who want broadband but are, for whatever reason, unable to get broadband are not excluded from taking advantages of the obvious opportunities. Government will work with industry to develop solutions to ensure that this becomes a reality. Already, the furthest anyone in the UK has to travel to get online is to their local library. But we will seek to improve upon this. So, while we have made some real achievements along the way, it is clear that there are still many challenges that face us if we are to become a world leader in e-business.

At European level we intend to access how we can use our Presidency of the European Union to promote the importance of improved exploitation of ICTs to meet the Lisbon goals and help set the Lisbon Agenda for 2010.

New technology has produced great achievement in communication and business opportunities but it

*‘Already, the furthest anyone in the UK has to travel to get online is to their local library’*

has also raised some concerns. It is essential for the Government to work to ensure that Cyberspace is a safe and secure place for all. Management of spam, security, viruses and protection of intellectual property rights are issues for everyone - businesses and consumers alike.

**Working with industry**

The Government will continue to work with industry and the regulators to take strong and effective action to deal with these issues. It is key that confidence in ICT is maintained so that we can all reap the economic and social benefits, and opportunities. However this should not blind us to the significant benefits that ICTs bring to businesses, government and consumers and it is important that government and industry recognise these challenges. Government can help, but there is also a vital role for industry, to collaborate effectively and make the necessary investments.

These investments need to be made not only in terms of technology; people and processes, which are every bit as important. Strong leadership and commitment from top-level management is also vital for success, as too is the need to bring e-business into mainstream activity.



**Action 4: Promote the creation of innovative broadband content**

Encourage the UK to become a world leader in allowing people to use or reach any content, with any device, anywhere, any time.

**Action 5: Set out a strategy for the transformation of the delivery of public services**

There is a commitment to transform public service delivery through the effective use of modern technology, to give citizens more choice, greater personalization, convenience and flexibility.

**Action 6: Ask Ofcom to consider how the regulatory framework can be used to improve competition and take-up in the broadband market.**

**Action 7: Improve accessibility for the digitally excluded and ease of use for the disabled.**

Specific initiatives under this action include building on the network of UK online centres, review options for making the Home Computer Initiative more attractive and accessible to low-income earners, and ensure that people with disabilities can access all government websites and online services.





# Fast Tracking UK Broadband Infrastructure

**Stephen Timms, Minister for Competitiveness, looks at why the UK's broadband infrastructure needs to be fast tracked.**



**M**y department is committed to ensuring that UK businesses can exploit the immense potential of the information age. And as Minister for Competitiveness, one of my highest priorities is to ensure we have a high performance telecommunications infrastructure in every part of the country.

That's why I welcome the contribution of organisations like BITE and its work to address skill needs in technology and e-commerce. I see initiatives such as *e-Britain* as important, because it's only by championing innovation and encouraging research that the economic success of the UK can continue to be assured in such a globally competitive market.

There is no doubt that new technologies and fast access to information have transformed - and continue to transform - the business landscape.

In 2002 when I was appointed e-commerce minister at the DTI, it was reported that the UK's broadband capability was neck and neck with Croatia. Since then the UK has developed one of the most competitive and extensive broadband markets in the G8 and, on broadband take up and use, we're now ahead of the US, Japan, France and Germany.

Today as I champion UK competitiveness at the Department for Business, Enterprise and Regulatory Reform, I'm extremely pleased to see broadband's rapid rate of growth and the excellent progress we have made.

My department is working closely with industry. We set up the Information Age Partnership (IAP), which I now chair, with the aim to accelerate UK adoption of information technologies, and so to improve the UK's overall competitive position.

The main government and industry forum for the ITEC sector, the Partnership supports high-level dialogue and debate between the chief executives

of the UK's leading IT, electronics, communications and content companies, as well as key representative organisations such as the CBI, major trade bodies, such as Intellect and the Digital Content Forum (DCF), and government ministers and senior officials.

The Partnership recently published evidence from the UK to highlight how effective use of information and communication technology enables productivity growth. As the technology evolves, it creates new market opportunities and challenges existing business models.

Today other countries are starting to invest in new, fibre based communications infrastructure, delivering considerably higher bandwidth than is available in the UK.

In April, a report from the Broadband Stakeholder Group - the government's advisory group on broadband - highlights the need for the UK to develop high speed broadband if we are to maintain our competitive edge.

Whilst the UK's satellite and terrestrial multi-channel TV delivery networks are well developed, high speed broadband technology is not. The growing numbers of people working from home don't currently have access to the high speed connections enjoyed elsewhere in the world.

*'The UK's satellite and terrestrial multi-channel TV delivery networks are well developed'*

For example the OECD records the number of fibre to the home connections in the UK as zero, compared to 46,000 in the Slovak republic, 900,000 in the US and almost 8 million in Japan. Their networks are capable of delivering broadband speeds of 50 to 100 megabits a second (Mbps).

In the UK although broadband speeds of 24 Mbps are available, they are only accessible to homes within a short distance of the BT exchange. This is because the technology uses the existing copper wires leading from the exchange to the premises and connection speeds decrease with distance.

We are beginning to see signs of progress. For instance Virgin Media has successfully trialed speeds up to 50 Mbps among 100 customers in Kent. The technology is believed to be capable of delivering 100 Mbps and the trial is being extended to other areas in Kent. Meanwhile BT is deploying fibre access to greenfield housing sites from next year and will provide fibre access on a wholesale basis to other service providers.

We are also seeing the first announcements of the technology that can overcome such limitations - next generation access networks.

However, whilst these advances are welcome, I am concerned that growth is too slow. In April this year, the Stakeholder Group warned that the UK has a window of just two years to make decisions about next generation access and to encourage investment in high speed broadband. If we don't there's a high risk that UK competitiveness will suffer.

This is the reason why I intend to convene an industry summit later this year to consider how we can progress from our current position to where we need to be in the future, including any possible role for government intervention to spur investment in high-speed broadband. I intend it to be a frank and open exchange bringing together key people from government, Ofcom and from industry. I want the full range of issues to be explored and I want the results to help us develop a telecoms infrastructure capable of meeting the needs of future generations.

The services and applications coming on to the UK market will only be properly exploited and enjoyed if the bandwidth exists to deliver them to the end user. We are committed to working with our partners in industry to create the right conditions for global success and I look forward to the challenges ahead.





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
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Avicenna House  
259-260 Brompton Road London W1 2LL  
Tel: 020 8552 3071 Fax: 020 8552 3048  
Email: [info@bite.ac.uk](mailto:info@bite.ac.uk) Web: [www.bite.ac.uk](http://www.bite.ac.uk)



# Planning for e-Commerce

**Setting up an e-commerce business requires a systematic approach. The Department of Trade and Industry outlines the key stages.**

## Identifying e-Commerce Opportunities

There are several different ways you might use e-commerce in your business.

### Direct Sales

Many businesses use e-commerce for the direct selling of goods or services online. For some businesses such as those selling software or music, the actual sale and delivery of goods can be made online. However, for most the supply of goods will continue to require a physical delivery.

If you plan to sell online, you may need to rethink many of your business activities. This is because you will fundamentally change the way in which you interact with your customers - for example, if customers place orders online instead of talking to a salesperson. You will also need to work out how every aspect of a transaction is handled - including order confirmation, invoicing and payment, and deliveries and returns.

### Pre-Sales

You can use your website for pre-sales activities - exploiting the widespread use of the Internet to generate sales leads. At its most basic this can be through the use of "brochureware" - having an online version of your promotional materials on your site. Other options include email campaigns or online advertising to attract visitors to your own website where you can promote your products.

### Post-Sales Support

You can also use the Internet to automate aspects of your customer support to reduce the number of routine customer service calls. This can be achieved by using your site to answer the most frequently asked questions, or by putting technical information online.

However you decide to use e-commerce, it is important to define your expectations from the outset. What level of sales are you hoping to make? How many sales leads are you looking to generate? What percentage reduction in customer telephone calls are you expecting to achieve? Ensure that targets are put in place so that you can measure the success, or otherwise, of your e-commerce facility.

## Making an e-Commerce Site Easy to Use

The ease with which a customer is able to use an e-commerce site is an important part of its success. It's also an important part of your online brand image.

There are three elements of the shopping process that influence how easy and enjoyable the customer finds it to shop on an e-commerce site - the shop front, shopping cart and payment software.

### Shop front

The shop front is the interface presented to the customer. This often incorporates an online catalogue that enables them to browse for products and identify those they wish to purchase.

Customers should be able to find the product they are looking for quickly. An eight-second guideline is frequently cited; if customers are unable to find the product within that time, they are likely to go to an alternative site.

The design of the shop front should make shopping intuitive, with the customer knowing at all times what stage of the buying process they are at.

### Shopping Cart

This is the software that facilitates easy selection and payment for products purchased by a customer from an e-commerce website. Once the goods have been selected, the customer should find the checkout clearly signposted, so that they can proceed to pay for the goods.

The system should process the order speedily and provide you with a summary, including any packing and shipping requirements. It should also generate a printable receipt and allow you to send a confirmation email to the customer.

### Payment software

Most customers will wish to pay for their purchases with credit or debit cards. There are three options for accepting such payments - you can:

- open a merchant account
- use a payment processing company
- set up an online shop within a virtual shopping mall

## Trading Partner relationships

As well as offering new ways of doing business with customers, e-commerce also provides new ways of building closer links and improving business relationships with key trading partners.

These Internet-based technologies and processes also allow you to improve your own business efficiency. Some of the key technologies are listed below.

These are private internal company networks that use the same browser-based technology and network protocols as the Internet.

### Intranets

- are protected from unauthorised use by a firewall
- improve efficiency by enabling employees to search the business' knowledge and information store from their own desktop, regardless of location

### Extranets

This is a shared intranet that allows users to share key trading data such as inventory levels and sales trends. Extranets can:

- be made available to selected external partners, such as vendors, contractors, suppliers and key customers
- be used for exchanging data and applications, and sharing specific business information
- improve supply chain management

### Supply Chain Management

The concept of supply chain management revolves around having the right product in the right place, at the right time, and in the right condition.

The key aspects of supply chain management include the ability of businesses to:

- exchange information on stock levels
- fulfil orders more quickly
- minimise excess inventory
- improve customer service
- use a networking infrastructure to ensure good response times and speed

### e-Marketplaces

There are many online exchanges that enable suppliers, buyers and intermediaries to come together and offer products or services to each other, according to set criteria. Buyers and sellers work interactively with bids and offers. When a deal is made, it is a match between the buyer and seller on variables such as price, volume and delivery costs.







Reverse auctions are buyer-controlled events and are used to attract bids, with the lowest bid winning. Buyers post details of the goods they want to buy and suppliers compete to provide them.

The key tool for delivering e-commerce services is the business website. This must be specified, designed, hosted and maintained.

## Implementing e-Commerce

### Specification

The website specification should clearly identify what the site is trying to achieve and how its various components will contribute to this. An understanding of the intended user audience is required for both technical and marketing purposes.

### Domain Name

Domain names are an enormous help in the branding of a business. Your domain name should be easy to remember and spell, and should show what your business is all about. If not, then potential customers will surf elsewhere and possibly find your competition.

Check if the domain name you are planning to use has already been taken at the Nominet website.

### Website Hosting

If you purchase your own domain name you can either host your own website or have an Internet service provider (ISP) host it on your behalf. If you choose to host the website yourself, you will require a fast Internet connection and a suitable PC.

However, ISP hosting is relatively cheap and straightforward.

The type of Internet connectivity and the available bandwidth will be an important consideration, irrespective of which hosting solution is selected. Most businesses choose some form of broadband connection.

### Software Options

An important early decision to consider is whether to use a "shop" package or build the software from scratch.

Shop packages allow you to configure product information and the look and feel of the shop. However, they can provide limited opportunities for tailoring them to your back office processes.

Alternatively you can get a third party to build the software for you, or develop it yourself.





# STYLE COUNCIL: GADGETS

## WORLDS FASTEST-SHOOTING DIGITAL CAMERA

Casio Computer Co., Ltd., has announced that it is developing an entirely new digital camera with high speed performance and image capture functions that make the most of its cutting-edge digital technologies. This camera will be able to take still images at an astonishing shooting speed, to catch fast-moving subjects at the crucial moment. It will also take movies that capture movement so fast that it cannot even be seen by the human eye.

Casio's digital cameras have been setting the pace since 1995, when the company introduced the QV-10, a digital camera for personal use with an LCD display that played a major role in creating the digital camera market. In 2002, Casio commenced sales of the card-sized EXILIM® series of LCD digital cameras, which feature portability and response speeds. Casio is constantly seeking to expand the market by delivering greater ease of use and the kind of innovative functions that only digital cameras can offer.

The prototype of Casio's latest revolutionary camera features a new high speed CMOS sensor and a high speed LSI image processing chip. This 6.0 megapixel, 12x optical zoom, high performance digital camera prototype with CMOS-shift image stabilization function offers not only ultra high speed burst shooting for still images, but also high speed movie recording.

For still images, the camera achieves ultra high speed burst shooting of 60 images per second at maximum resolution -the fastest in the world. Moreover, using Pre-shot Burst Mode, (a ultra-high speed continuous shooting mode that captures images from the scene prior to the moment when you actually press the shutter button), users can be confident they will never miss the most crucial photographic moment.

The camera can also capture movies at VGA resolution at an incredible 300 frames per second, which means it can record movies for replay in ultra-slow motion, a function that has only been possible so far with a limited range of professional movie equipment.



**Ultra-high speed burst shooting captures 60 still images per second and High speed movie recording, at 300 fps**



## MAIN SPECIFICATIONS

- Effective pixels: 6.0 million
- Imaging element:: 1/1.8 inch high speed CMOS sensor (Total pixels: 6.6 million)
- High speed burst shooting: 60 images per second at 6.0 million pixels, JPEG
- High speed movie: 300fps, Motion JPEG, AVI format, VGA
- Lens/focal distance: 12 lenses in 9 groups
- F2.7 to 4.6, equivalent to approx 35 to 420 mm on a 35 mm film camera
- Zoom: 12x optical zoom
- Image stabilization mechanism: CMOS-shift image stabilization
- Monitor screen: 2.8 inch widescreen TFT colour LCD, approx. 230,000 pixels
- Viewfinder: Colour LCD, approx. 200,000 pixels
- Dimension Weight: 127.5mm (W) x 79.5mm (H) x 130.0mm (D)
- Weight : Approx. 650 g (excluding battery and accessories)





## H3 Powerful 10x Zoom in Compact

### New Sony Cyber-shot - Easy-to-Carry Design

The H3 is the smallest ever Cyber-shot featuring a Carl Zeiss 10x zoom lens (38-380mm equivalent; F3.5-4.4). The powerful optical zoom pulls distant subjects closer with superb clarity. Its wide range also broadens the scope of framing options for greater creative possibilities - from expansive landscapes and intimate portraits to dynamic nature shots and sporting scenes. Magnification is boosted further still by the 17x HD Smart Zoom (in 16:9 shooting mode) for powerful telephoto images that can be enjoyed with stunning quality on a large HD-Ready television. Weighing only 246 grams\* and measuring 106.0mm (w) x 68.5mm (h) x 47.5mm (d), you'll find the H3 is compact and light enough to carry with you on all occasions.

### Sports Mode with High Speed Shooting

The Cyber-shot H3 keeps pace with the action in challenging situations like live sports where anything can happen. A new Advanced Sports Shooting Mode teams a high 1/2000 sec shutter speed with predictive autofocus for crisp, clear capture of fast-moving subjects that can pose problems for other compact digital cameras.

### Photo TV HD Full HD image display

It's easy to enjoy the finest quality High Definition images captured with the H3 on a BRAVIA or HD Ready display (HD output adapter cable required) so you can share your

settings, Sony Clear RAW NR noise reduction suppresses colour and luminance noise for natural results.

### Easy picture retouching - with no PC needed

A range of in-camera retouching functions expands the palette of creative options without the need for a PC and image editing software. Red eye reduction and trim functions are complemented by four new filter effects to add an extra sparkle to your favourite shots.

The H3 is easy to use with on-screen function guides and a handy 'home' button for quick, fuss-free navigation.



### Face Detection and Dynamic Range Optimiser

With a resolution of 8.1 effective megapixels, the H3 delivers all the picture quality you'd expect from the Cyber-shot brand.

The compact, easy-to-use Face Detection capability helps photographers of all abilities capture great-looking 'people pictures' without the risk of spoiled shots.

Powered by the camera's super-responsive BIONZ image processor, Face Detection automatically adjusts exposure, flash and other settings. Enhanced autofocus performance and advanced eye detection ensure beautifully sharp portraits with natural skin tones - even at high zoom settings, in low light or with moving subjects.

The H3 also adjusts exposure and contrast using the Dynamic Range Optimiser (DRO), analysing each image for balanced, natural-looking results.

images with friends and family. Music can accompany the slideshows for an extra dimension of enjoyment to your photos. Just pick from four visual effects (Simple, Nostalgic, Active and Stylish) and four preset musical accompaniments - then watch the show onscreen with HDTV image quality. Slideshows can be personalised further with MP3 background music tracks imported from a PC.

Photo TV HD optimises the images for subtler, more natural colour and textures on the latest generation of Full HD BRAVIA. This offers a significant improvement over viewing still images on conventional TV sets that are optimised for moving video.

### Double Anti-blur technology

Double Anti-Blur technology reduces camera shake for clear, bright images when shooting conditions are less than perfect. Super SteadyShot image stabilisation is coupled with high sensitivity (ISO 3200) for blur-free, atmospheric results without flash. When you're shooting indoors or in low light at high ISO





## Smart flexible audio conferencing

Now you can Bluetooth your mobile phone to a conferencing unit and chat to your business colleagues without setting foot in the boardroom. The Konftel 60W is a mobile conference unit for the modern office that includes Bluetooth technology for greater versatility.

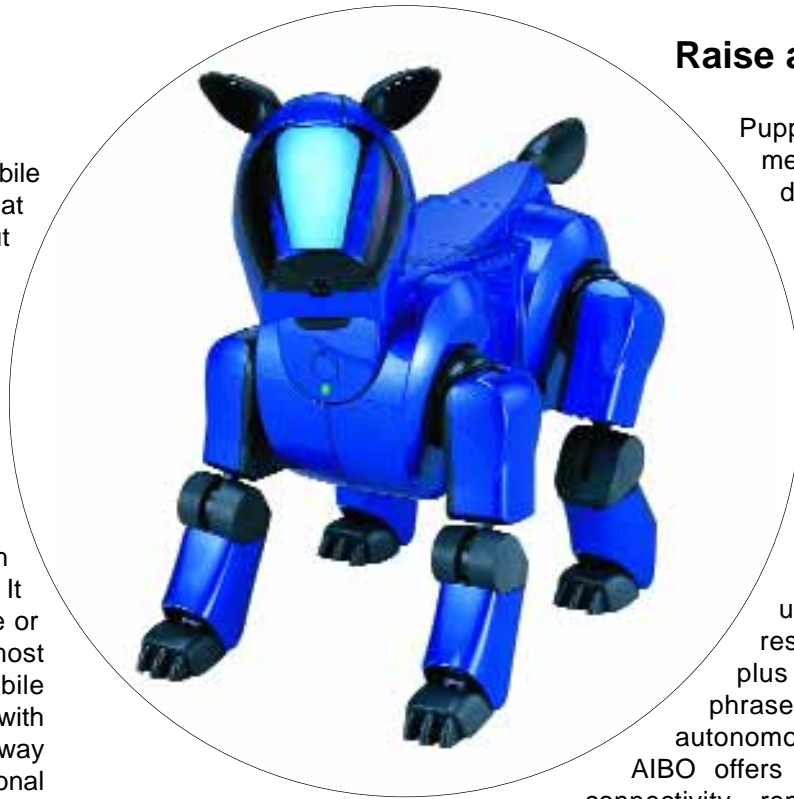
Offering sound quality and easy-to-use functions, it connects to computers and system telephones and operates cordlessly with Bluetooth enabled mobile phones. It requires no dedicated telephone line or subscription and connects to most system phones, DECT and mobile phones. The system is compatible with telephone features such as three-way calling and is expandable with additional microphones.



## Raise a dog bot

Puppies can be messy so raising a doggy robot is a much cleaner option than the animal variety. You can house train Sony's Entertainment version of its AIBO robot and see it mature from a puppy to an adult. It understands and responds to 100 plus words and phrases with autonomous behaviour.

AIBO offers built-in wireless connectivity, remote control, a music player, and scheduler, video and photo recording. The package includes AIBO, software and an energy station. The picture shows a cobalt blue AIBO.



## Sharp focus at Casio

The Casio's EX-Z120 features anti-shake DSP, which reduces blurring caused by shaking hands or moving subjects. For sharp focussing it offers auto macro and quick shutter functions. A High Sensitivity Mode produces clear shots with a bright background without flash when lighting is dim. The EX-Z120 features a 32 scene Bestshot function located on a mode dial with a 7.2 megapixel CCD and a slim 3x optical zoom. It can take 170 still shots on one battery charge according to CIPA standards. Movies can be recorded in VGA (640x480 pixels) at 30 frames per second and 28 frames per second (Motion JPEG).





and set them as a ring tone or an alarm. The D720 has a dual stereo speaker system. Both models provide Bluetooth-based multiple games function enabling two people to play each other via Bluetooth. They offer an internal storage capacity of 18MB and support an external memory storage capacity up to 512MB.

### DVD quality on a stick

The Panasonic SV-AV100 records DVD-quality (MPEG2) onto a compatible SD Memory Card, creating picture quality rivalling DVDs. In both fine and normal modes, images are

recorded at the same rate used in TV broadcasts. You can also record MPEG4 video, which produces natural-looking action footage without a choppy "frame-by-frame" effect. MPEG4 is ideal for sharing over the Internet by e-mail, posting on Web pages or viewing on a compatible PC or television.

It can also take 340,000 pixel digital still pictures for casual, "memo-style" snapshots. With the A/V terminal on the included cradle, you can connect to an external device, like a TV or VCR, and then transfer the content directly onto the SD Memory Card inside the SV-AV100. Once the transfer is complete, movies can be watched in the palm of the hand.

### Multimedia on the go

The Samsung YH-999, Windows Mobile based, Portable Media Device can store and play recorded TV, movies, home videos, music and photos. Multimedia material can simply be downloaded from a PC with Windows XP. On the go, you can use the 3.5 inch TFT screen in the palm of your hand or playback through a TV or stereo. With a 20GB Hard Disk Drive the device can store and play up to 80 hours of video, up to 5000 songs or tens of thousands of pictures. It supports MP3, WMA, Secure WMA(DRM) playback WMV and MPG.

### Tuneful Samsung smartphones

Samsung's first smartphones in the European market are equipped with a 1.3 megapixel camera as well as MP3 player with lyrics support. The Symbian OS-based smartphones, D720 and D730 allow the user to compose tunes easily with the Music Maker feature





# NEWS ROUNDUP

## INTELLIGENT SUPERMARKET TROLLEY AIDS CONSUMER CHOICE

Nearly one-third of supermarket shoppers would like to access information via a barcode reader on their trolley which can provide product information on nutrition, the environment and ethical sourcing.

This is one of the main findings of a research study carried out by international food and grocery expert IGD, on behalf of EDS, the global technology services company. The project was undertaken to understand how supermarket shoppers interact with information and how they want to access this data.

Shopping Choices: Attraction or Distraction? reveals that today's shoppers are demanding more information than ever before:

- 95% of people want nutritional information
- 93% want ethical information
- 92% look for environmental information

Price, use-by and best-before dates, and promotions are the main information criteria on which people base their grocery purchasing decisions for fresh and processed foods. In addition:

- Almost a quarter (22%) of people want information on country of origin of fresh products (fruit, vegetables and meat). A similar number (21%) want information about locally and regionally sourced produce
- 19% of people requested information on whether their products were free range
- 15% of people wanted to see a Fairtrade logo on the fruit and vegetables that they buy

Most (78%) people say they prefer to get information from on-pack labelling. However, 46% of shoppers want retailers to cut back on unnecessary packaging. Barcodes, which have been used by retailers successfully since the 1980s, are well placed to address this packaging paradox.

Retailers and technology providers often dismiss barcodes as the 'Cinderella' of retail technology, with RFID chips more often lauded as the technology of the future.

The research shows that 30% of the shoppers surveyed would welcome an on-trolley barcode reader. EDS believes that barcodes can be further exploited in supermarkets. Barcodes, which contain information on a product, could enable

shoppers to make more informed decisions about their product choices based on a range of factors, such as how it is sourced and where it is from, and would empower shoppers to purchase products they are actually comfortable buying.

Sion Roberts, EMEA Industry Leader for Consumer Industries & Retail, EDS said:

"It's high-time that the humble barcode is recognised as a practical and cost-effective solution to consumers' thirst for information. While RFID chips are an important and valuable addition to the retail technology stable, we already have the technology to provide the information that consumers want now. RFID chips will have an important role to play in the future as information about individual items becomes more important. But retailers don't need to wait for RFID chips to come down in price before responding to consumer information demands. We want to work with retailers to give shoppers the information they need to make informed choices sooner rather than later."

### Taste for Technology

The report also showed that shoppers were open to adopting other in-store technology that will change the supermarket shopping landscape.

- 23% want information terminals in the aisle where you can check for additional product information (e.g., touch screen for product and select information needed)
- 22% want buttons on the shelf by each product that allow you to choose the information you want (e.g., buttons for information on nutrition, production values and ingredients)

### Fear for Food Safety

Consumers are more aware than ever before about food safety. Amidst stories of product recalls and food tampering, use-by dates or best before dates are second only to price when consumers choose which products to purchase.

- 30% of shoppers would

welcome the use of technology to warn them when food is past its sell-by date

- 28% want technology to play a greater role in food safety at supermarkets, with packaging which tells you if the product has been stored correctly on-shelf

The research showed that fear over food safety appears to come as a result of media coverage of food scares:

- 35% of people have stopped purchasing a product as a result of watching a TV documentary
- 35% have done so because they have read news stories about food scares (e.g., bird flu, foot and mouth, etc.)

Gerardine Padbury, senior researcher at IGD, said:

"Our research shows a clear demand for an increased use of technology to solve the packaging and information paradox. In a world where we are becoming more concerned about the environment and reducing packaging on products, we face the challenge of providing more information, but with less packaging. Retailers need to embrace technology to give shoppers what they want."







# MOBILE PHONES TAKE TO THE SKIES



Ofcom has set out proposals to enable airlines to offer mobile communication services on UK-registered aircraft, if they wish to do so.

Ofcom is the independent regulator and competition authority for the UK communications industries and is responsible for issuing Wireless Telegraphy Act licences to enable use of the UK's radio spectrum.

One of Ofcom's objectives is to create opportunities for companies to develop innovative technologies, in particular to make the most efficient use of the radio spectrum for the benefit of citizens and consumers.

The proposals have been developed jointly with other EU countries and are intended to cover all European airspace.

It will be a matter for individual airlines to judge whether there is consumer demand for these services, and the installation of mobile systems on aircraft will only be allowed when approved by the relevant UK and European aviation authorities.

## Using mobiles on aircraft

The proposed system includes an on-board base station which connects to the passengers' own mobile phone handsets. Both of these must be switched off during take-off and landing to eliminate interference with other terrestrial mobile networks.

Once the aircraft reaches a minimum height of 3000 metres, the system may be switched on by the cabin crew. Mobile handsets will then be able to use the aircraft's network service to make and receive calls which will be routed via a satellite link to the network on the ground.

Calls will be billed through passengers' normal service providers.

2G (GSM) phones will be able to use the system for data, voice and text services. If the service is successful it could be extended to 3G and other standards in the future. Ofcom proposes to allow the use of these systems by amending the aircraft operators' existing Wireless Telegraphy Act 2006 licences.

Australia has already issued a licence to operate in-flight mobile services. The earliest that services could be available from UK registered airlines is 2008, subject to approval by the aviation authorities.

For a number of years some airlines have offered customers in-flight outbound telephone services via the airline's own network. The new proposals will allow airlines to enable passengers to use their own mobile handsets.

# HISTORIC INDO-BRITISH AGREEMENT

## Between the University of Madras and the British Institute of Technology & E-commerce

One of the top ranking and oldest universities in India has signed an historic agreement with the British Institute of Technology & E-commerce. The focus of the agreement is collaborative research, consulting and assisting students who wish to get a global exposure and experience from UK higher education. BITE's distinctive business-oriented education provides a continuous programme in management, research and consultancy.

Students from the University of Madras will come to London to study at BITE for a one year fast-track Masters programme. BITE director, Dr Muhammad Farmer signed the agreement in Chennai with the University of Madras vice chancellor, Professor S. Ramachandran. Courses offered will include cutting edge technology programmes such as e-bio, e-nano, IT security, e-forensic, data mining, communications, biometrics, energy, strategic management, supply chain management, customer relationship management, marketing, finance and human resource management.

Dr Farmer said, "This tie-up will help knowledge-hungry students from India enrich their learning and gain an international insight in their chosen field." Professor Ramachandran added, "We are restructuring and reorienting the University to offer value-added services to students and this agreement with BITE will enable us to provide Master's degree equivalents to those courses in other countries."



Mr M Ghani, Dr M Farmer, Prof S Ramachandran, Dr G Mohanram



## O2 TRIALS UK TV TO MOBILE

The race is on to add multimedia value to mobile services in the UK and O2 has trialed a TV to mobile system with NTL Broadcast TV. Channels involved include the Cartoon Network, CNN, Discovery Channel, Sky Sports News and Sky Travel.

BSkyB, Chart Show TV, Discovery Networks Europe, Shorts International and Turner Broadcasting were among the organisations providing 16 television channels to O2 customers in the Oxford area using the Nokia 7710 handset.

### One-to-many

The trial used the DVB-H broadcast transmission standard which is specially designed for handheld reception. With its low battery power consumption and robust reception, DVB-H allows an efficient 'one-to-many' method of delivering TV content in a way that complements the one-to-one video streaming which is already possible via GPRS and 3G networks.

Dave Williams, O2's chief technology officer, explained, "We believe that mobile broadcast TV has the potential to sit alongside our existing customer services based on GPRS (2.5G) and 3G mobile data networks. Mobile broadcast TV aims to be a cost effective method for transmitting high quality content from one source to multiple customers whereas 3G is ideal for providing bespoke content to users."

### Useful insight

Head of media business development at NTL Broadcast, Terry Howard added "This trial will give a useful insight into how the new technology performs, and we intend to use that information to inform the broadcasters, mobile operators and Ofcom about the consumer appeal of the service."

## BENDY TRANSISTORS FOR CLOTHES AND SCREENS

Plastic transistor technology with bendable applications in areas such as clothing and displays is set to take off at Plastic Logic's multi-million dollar prototyping facility in Cambridge in the UK.

Stuart Evans, CEO of Plastic Logic, said "the plastic electronics industry is making an important transition from research and invention to customers and products." Plastic Logic will use its prototype line to work with customers to demonstrate advanced product prototypes, and to work with licensees on process qualification and technology transfer.

The company is a leading developer of plastic electronics technology and has secured \$30m from financial and industrial investors, including Siemens, Dow Chemical, Mitsubishi, CDT and Seiko Epson.

### Low cost fabrication

Plastic Logic has a growing portfolio of expertise and intellectual property in plastic electronics - a new technology for manufacturing or printing electronics. The Plastic Logic approach solves the critical issues with fabricating low cost, large area, high resolution transistor arrays on plastic substrates by using a low temperature process without vacuum deposition or mask alignment. This enables radically new product concepts in a wide range of applications including displays and sensors.

The prototype line is initially targeted at producing active matrix backplanes for flexible e-reader displays. When combined with an electronic paper imaging film, Plastic Logic's backplanes enable highly portable, readable and power efficient displays. To enable the rapid growth of the plastic electronics industry, Plastic Logic's process technology is available for licensing to display and printing companies and comes with a package of technology transfer and support.

## ZAPPING THE SPAM ZOMBIES

Law enforcement agencies around the world have joined forces to zap hackers who tap into home computers to send spam e-mails.

The agencies have launched operation 'Spam Zombies' to urge ISPs to address the increasing problem of spammers hijacking other computers - known as 'zombies.' A total of 34 agencies from around the world are mounting cross-border initiative contacting ISPs and requesting that they implement security measures to protect their customers' computers.

### Operation Spam Zombies

The Operation involves:

- identifying computers that are sending unusual amounts of e-mail and taking steps to determine if the computer is acting as a spam zombie and, if necessary, quarantining the affected computer until the source of the problem is removed
- providing plain-language information for customers on how to keep their home computers secure
- providing or pointing customers to easy-to-use tools to remove zombie code if their computers become infected.

The next phase will be to identify likely spam zombies around the world and the providers that operate the networks that are hosting them. The partners will then notify these providers of the problem and urge them to implement corrective measures.

Agencies involved in the Spam Zombies operation include the Office of Fair Trading in the UK, Federal Trade Commission, Department of Commerce, Department of Homeland Security in the USA, and agencies from Albania, Argentina, Australia, Belgium, Bulgaria, Canada, Colombia, Cyprus, Denmark, Greece, Ireland, Japan, Korea, Lithuania, Malaysia, Netherlands, Norway, Panama, Peru, Poland, Spain, Switzerland and Taiwan.







# Watching the Detectives

**M. Ettisch-Enchelmaier is a private investigator and CEO of Ettisch-Enchelmaier GmbH in Germany. Here she considers some of the problems involved in gaining access to data that can inhibit the spread of e-commerce.**

**E**-commerce is enabling international business to grow at an unprecedented rate but restrictions to access and the use of data are impeding this growth. As the supporting infrastructure for e-commerce develops there are several key issues revolving around legal barriers, security, education, access and cultural factors that need to be addressed. I will begin by considering some of the legal barriers to accessing data.

## Data protection

In the US the data protection regulation in question is the Federal Credit Reporting Act (FCR) and in the EU, the Data Protection Act (DPA). While the Americans initiated many of the legal controls, they are less strictly adhered to compared to Europe - although this is changing. To business people these laws may sometimes seem draconian, however in many Arab countries and parts of Africa it can even be illegal to undertake data investigations.

Business people rightly expect that their personal, professional and confidential information submitted orally or otherwise in a non-public place is kept confidential. So in order not to hinder business transactions, especially within Europe, leading American organisations usually voluntarily seek a 'Safe Haven'. This means that in doing business with European companies, they subject themselves to the stricter European privacy laws.

Business people need the help of official, institutional and commercial sources, be it for assets searches on potential customers or monies owed on account of bankruptcy or damage done, but many sources are reluctant to cooperate. Banks for instance have their own rules and regulations for keeping their clients' data confidential. These rules and regulations were already in existence before privacy laws became so prominent, but banks can "hide" behind the DPA to avoid divulging any information and increasing their workload.

This author's decades of experience have shown that while Americans place a high value on their privacy, when interviewed in the framework of a potential business transaction, they are much more willing to supply information compared with their European counterparts. If Americans are willing to answer 80-100% of questions, Europeans may answer only 40-60%. Subsequently with much persuasion by the interviewers, showing that answering the

questions is for the interviewees' own benefit, the Europeans may answer a further 20% of questions.

In the US, e-commerce, not only the trading of goods but also the supplying of services, is far more developed compared to other parts of the world because there are fewer impeding factors. One reason of course is that computerisation is far more developed in the US, but additionally Americans more readily supply private data, including social security and credit card numbers. However, a counter trend is now emerging with greater fears of "identity theft", a fast growing fraudulent trend and a strong threat to e-commerce.

## Security Fears

A key issue in e-commerce and information availability is security. Companies offering goods and services by means of a website have to take security very seriously. E-businesses must impose or set acceptance notice rules and Internet standards on web sites that make hacking and theft of confidential data more difficult.

There are quite a number of on-line sources for searching for potential business partners and checking them out. In order to get the information required, a business person first has to supply his name, address, contact data, and, in the USA, often also their social security number to register. Then to search for the information needed or buy the goods of interest, sometimes prepayment must be effected through online banking or more often via a credit card thus supplying sensitive information often via an unsecured medium. Greater efforts are now being applied towards security with recognition through awards bestowed by the European Electronic Messaging Association (EEMA) which grants these for outstanding European projects in the area e-business security. However, many countries still lack a good telecommunication infrastructure and secure facilities to pay by credit card or online banking.

## Education

Business people must endeavour to gain a good legal knowledge not only of data legislation pertaining to their native country but also of the countries they do business with. Otherwise they may jeopardize themselves and customers and face fines or even imprisonment. As in other professions, knowledge of major languages is a good start for global trading, particularly since international business bears the main potential for business growth. Even the best translators employed may overlook or omit nuances in texts. They can make fundamental mistakes, eg. taking the British digit '7' for the German digit '1'. An interpreter may overlook hints supplied by a speaker involuntarily through body language. The seasoned businessman can often tell when a counterpart is lying or does not tell the full story.

## Cultural barriers

It is easy for business people to fail to appreciate the nuances of a foreign communication. Even

when two business people speak the same language they may not fully understand each other. There are many subtle linguistic and cultural differences between the US and UK even though the same language is spoken. For example, in the UK one pays the bill (invoice) with a cheque,

while in the US one pays the check (invoice) with a bill. Thus a different cultural background and upbringing may lead the business person in a foreign country to accept assignments, but understand the requirements in a different way than intended.

## Culture clash

The clash of cultures is often apparent in e-communication. Americans are much more easygoing, taking etiquette less seriously. They use first name terms immediately, even in instances where they have had no contact with their counterparts before. In Germany this is a *faux pas*. One is addressed by Mr. or Mrs./Miss and family name, often adding the businessman's title, such as Dr. Miller. In Austria they go further addressing a person by their (professional) title (Herr Geheimrat Müller) or a higher grade such as Herr Baron to express respect.

*'when interviewed in the framework of a potential business transaction, Americans are more willing to supply information compared with their European counterparts'*

Letters are also more formally composed. In the US a writer may close with only a first name. In France a business letter may close with "Nous vous prions, Monsieur, d'agréer nos salutations les plus distinguées" (We ask you, dear Sir, to accept our most respectful greetings) or similar formal phrases. However, generally style is becoming more informal under the influence of the US and in the wake of e-mails and globalisation. Business people need to relate requests in terms understandable and acceptable to the local supplier but also taking into account the cultural customs prevailing in the latter's country.

## Lack of availability of data

Availability of information online to the public took off in the mid nineties and has rapidly expanded so that today there must be more than a billion sites. But there are growing factors inhibiting development, for instance hosts that restrict their facilities to paying surfers and information that is restricted to specialists. The presence of so much unchecked and sometimes out of date information can also lead to inaccuracies. Perhaps over-reliance on the Internet to the exclusion of other sources is becoming a new danger for businesses.



# British Edu-Culture Fusion

## BITE Annual Awards - 2007

The BITE Annual Event recognises Lifetime Support of Technology, Outstanding Contribution to e-Commerce and Excellence in research dissertation from a BITE student. These awards reflect the aims of BITE, the British Institute for Technology and E-Commerce, to foster the increased application of technology and e-commerce in the global community.

### Championing Technology Award (Rolls-Royce)

This award is intended to recognise individuals who have shown continued and effective commitment to the creation, development and dissemination of technological advances for the benefit of the wider community and economy. It is aimed at the 'Champions' of technology rather than the inventors of an individual discovery or development.

### Championing e-Commerce Award

E-Commerce is becoming ever more prevalent in business and in the general community. This award is intended to recognise major and continued contributions to the spread and acceptance of e-commerce.

## Academic Awards : The annual awards recognise the best of the graduates from BITE in the MSc and MBA.

### Award for the Best BITE MBA Dissertation (KPMG)

The BITE MBA courses are intended to equip graduates to face the challenges that they will meet in future employment. They address the rapid changes in business environment and technology management expected in the future. This award, again given on the basis of the best BITE dissertation, is sponsored by KPMG.

### Award for the Best BITE MSc Dissertation

This award, given on the basis of the dissertation produced, recognises and encourages excellence in the technology and science aspects of BITE courses.

## Guest List

Dr David Clarke  
Head of Technology Strategy  
Rolls Royce

Mrs. Nina Amin  
KPMG

Mr. Jonathan Costa  
KPMG

Dr. Hieki Hirakawa  
Senior Technology Officer  
Toshiba

Mr Stephen Timms  
Minister of State  
for Business Competitiveness

Ms. Yingtong Xi  
First Secretary, Embassy of China

Mr. Emil Pietras  
Consellor for Education, Poland

Mr. Reynaldo Gatapang  
Deputy Chief of Mission, Philippines

Mr. Zainal Arif Mantaha  
Deputy High Commissioner  
Singapore

Dr. Iftikhar Ayaz OBE  
H.E Ambassador, Tuvalu

Mrs. Maria Beatris Souviron  
H.E. Ambassador, Bolivia

Mr. Joseph S. Charter  
H.E. Ambassador, Grenada

Dr. Tanja Milasinovic  
H.E. Ambassador,  
Bosnia and Herzegovina

Mr. Gehad Madi  
H.E. Ambassador, Egypt

Mr. Garba A. Zakari  
Minister/head, Trade & Economic  
Nigeria

Mr. Farid M. Saadi  
Director

Mr. Mohammed Halili  
H.E. Ambassador, Macedonia

Mr. Felipe Salz  
First Secretary Embassy of Chile

Mr. Ali Sher  
OMEC Secretariat, Malaysia

Mrs. Maria Angelica Ikeda  
Embassy of Brazil

Dr. Brigitte Andersen  
Director of Innovation  
University of London

Prof. Andrei Doncescu  
Laas Labs, France

Mrs. Teresa Sayers  
Chief Executive Financial Services  
Skill Council

Mr. Anvir Patel  
Prestons Chartered Accountants

Prof. Des Mapps  
University of Plymouth

Prof. Mark Slevin  
BBVA Chair Clinical Biomedicine  
Manchester Metropolitan University

Mr. Tony McGrath  
Embassy Republic of Ireland

Mr. Sardor Rustambaev  
The Embassy of Uzbekistan

Prof Martin Everett,  
Vice Chancellor  
University of East London

Mr Solomon Alexis  
Collaboration Manager  
University of East London

Prof Dr. D. Viswanathan  
Vice Chancellor  
ANNA University, India

Mr. Adel Rouz  
Deputy Managing Director

Prof. S. Ramachandran  
Vice Chancellor  
University of Madras, India

Dr. G. Mohanram  
Director International Sales  
UKTI

Mr. Mike Carr  
Chief Science Officer, BT

Dr. Hussein Hassan  
Chairman Sharia Board  
Dubai Islamic Bank Group

Ahmed Hussein Hassan  
Manager  
Dubai Islamic Bank Group

Mrs. Elane Cameron  
International Trade Adviser  
UKTI

Ms Susan Haird  
Deputy Chief Executive  
UKTI

Mr. Paul Whiteway  
Director International Sales  
UKTI

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Chief Executive  
Gateway to London

Dr. Ann Wright  
OBE

Prof. Gilles Richard  
Deputy Principle for Research, BITE

Prof. Don Harper  
Deputy Principle for Education, BITE

Prof. Terry Knibb  
Deputy Principle for Consulting, BITE

Prof Abdul Waheed Khan  
Deputy Principle of Operation, BITE

Prof. Peter Abell  
Former director  
London School of Economics

Mr. Ehsan Chugtai  
Nasim & Co. Solicitors

Prof. Abby Ghobadian  
Dean of MBA  
Henley Management School

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University of Hertfordshire

Prof. Silvano Barros  
Queen Mary, University of London

Mrs Barbara Genevaz  
Senior Counsellor, World Bank UK

Shiekh Ahmed Amir  
President of European Academy

Dr. Mohan Chana  
Director LSCLE

Dr. Jatin Pancholi  
Middlesex University

Mr. Darko Hajdukovic  
London Stock Exchange, UK

Ms. Jemma Pedley  
Next Retail Ltd

Mr Stuart Packham  
Director  
Michael Page Technology

Mr. Marnie Lewis  
Senior Business Development  
Manager Technology  
Australia

Mrs. Suzana Mohd Ali  
Malaysian Student Department,  
London

Mr. Bill Edwards  
Managing Partner gov3 Ltd.

Ms. Alison Bowen  
Director of Corporate & External  
Affairs, University of Manchester





# Experienced Graduates and Postgraduates from BITE



**Mohammad Farooq Abbasi**  
6 Years experience in Financial Services and Banking  
**MBA Innovative Management**  
Email : [mfabbasi@gmail.com](mailto:mfabbasi@gmail.com)  
Winner of Best MBA Dissertation Award sponsored by KPMG



**Abdul Hassan Riyas Hassan**  
5 Years experience as Business Analyst & Operational Manager  
**MBA Innovative Management**  
Email : [ahriyas@gmail.com](mailto:ahriyas@gmail.com)



**Asadullah Khan**  
2 Years experience in Business Management  
**MBA Innovative Management**  
Email : [asad.khan.2@gmail.com](mailto:asad.khan.2@gmail.com)



**Mudassar Siddique Awan**  
3 Years experience Manager Computer Systems Engineer  
**MBA Innovative Management**  
Email : [msawan100@yahoo.com](mailto:msawan100@yahoo.com)



**Ahmed Ali Sufyan**  
2 Years experience as a Branch Manager  
**MBA Innovative Management**  
Email : [alisufyan@msn.com](mailto:alisufyan@msn.com)



**Martin Stanislaus**  
3 Years experience as a Quality Controller  
**MBA Innovative Management**  
Email : [martin\\_mark003@yahoo.co.in](mailto:martin_mark003@yahoo.co.in)



**Muhammad Rizwan Shams**  
3 Years experience in Business Administration  
**MBA Innovative Management**  
Email : [rizig6@hotmail.com](mailto:rizig6@hotmail.com)



**Ali Raza**  
1 Year experience in Business Management  
**MBA Innovative Management**  
Email : [aly\\_raza83@hotmail.com](mailto:aly_raza83@hotmail.com)



**Imran Irshad**  
2 Years experience in Business Management  
**MBA Innovative Management**  
Email : [immyled@yahoo.com](mailto:immyled@yahoo.com)



**Paul Mazai**  
10 years experience as a Systems Analyst and Developer  
**MSc Innovative Technology, CIISP**  
Email : [pmazai@yahoo.com](mailto:pmazai@yahoo.com)  
Winner of Best MSc Dissertation Award



**Shehzad Rafique**  
2 Years experience as Senior Sales Supervisor  
**MBA Innovative Management**  
Email : [shehzadrafique319@hotmail.com](mailto:shehzadrafique319@hotmail.com)



**Usama Shahzad**  
1 Year experience in Administration  
**MBA Innovative Management**  
Email : [osamashahzad105@hotmail.com](mailto:osamashahzad105@hotmail.com)



**Maqsood Ahmad**  
2 Years experience as Manager, Computer Operations  
**MBA Innovative Management**  
Email : [mahmad261023@yahoo.com](mailto:mahmad261023@yahoo.com)



**Siddharth Pattnaik**  
2 Years experience as Asst. Administrative Manager  
**MBA Innovative Management**  
Email : [siddharthpattnaik@gmail.com](mailto:siddharthpattnaik@gmail.com)



**Masroor Hasan Khan**  
2 Years experience in Business Management  
**MBA Innovative Management**  
Email : [masroorhasankhan@yahoo.com](mailto:masroorhasankhan@yahoo.com)



**Samir Pravin Kumar Patel**  
3 Years experience as a Business Development Manager  
**MBA Innovative Management**  
Email : [sam\\_5874@yahoo.com](mailto:sam_5874@yahoo.com)



**Naser Chuck Farooqi Mohammed**  
2 Years experience in Business Management  
**MBA Innovative Management**  
Email : [naserleo09@googlemail.com](mailto:naserleo09@googlemail.com)



**Emmanuel Sefa Owusu**  
10 Years experience as a Research Officer  
**MBA Innovative Management**  
Email : [emmlsefa50@yahoo.com](mailto:emmlsefa50@yahoo.com)


**Mohammed Asmat Ali Khan**

2 Years experience in IT Business Management

**MBA Innovative Management**

Email : [asmatkhan\\_be@yahoo.com](mailto:asmatkhan_be@yahoo.com)


**Ameer Mohammed**

2 Years experience as Marketing Executive

**MBA Innovative Management**

Email : [amer\\_in@hotmail.com](mailto:amer_in@hotmail.com)


**Paul Amey Sebuava**

2 Years experience in Business Administration

**MBA Innovative Management**

**Bismark Tawiah Akoi**

4 Years experience in Tech Manager

**MBA Innovative Management**

Email : [akobii@yahoo.com](mailto:akobii@yahoo.com)


**Mohammad Fayyaz Alam**

5 Years experience as Shift Manager

**MBA Innovative Management**

Email : [mfayyaz@hotmail.com](mailto:mfayyaz@hotmail.com)


**Vinupriya Mohan**

2 Years experience as Telesales Agent

**MBA Innovative Management**

Email : [vinupriya\\_mohan@yahoo.com](mailto:vinupriya_mohan@yahoo.com)


**M Fayyaz Ali Siddiqui**

4 Years experience as Senior Sales Executive and MIS

**MBA Innovative Management**

Email : [fas626@yahoo.com](mailto:fas626@yahoo.com)


**Muhammad Usman**

2 Years experience as Purchase Manager

**MBA Innovative Management**

Email : [mianusman121@yahoo.com](mailto:mianusman121@yahoo.com)


**Shaik Qhadeer Ahmed**

4 Years experience as Supervisor Sales and Marketing

**MBA Innovative Management**

Email : [shaik\\_qhadeer@yahoo.com](mailto:shaik_qhadeer@yahoo.com)


**Ricardo Fortune**

4 Years experience as Service Desk Analyst and IT Logistics

**MSc Innovative Technology**

Email : [Ricardo@Fortune.name](mailto:Ricardo@Fortune.name)


**Mohsin Rafiq**

2 Years experience in Business Administration

**MBA Innovative Management**

Email : [mohsinrafiq.khan@gmail.com](mailto:mohsinrafiq.khan@gmail.com)


**Mohammad Munaaf Shaikh**

4 Years experience as Senior Supervisor

**MBA Innovative Management**

Email : [mstmohammaduk@yahoo.com](mailto:mstmohammaduk@yahoo.com)


**N Nicolene Mhlongo**

2 Years experience in Business Management

**MBA Innovative Management**

Email : [mnlongonn@hotmail.com](mailto:mnlongonn@hotmail.com)


**Sadir Najib Hussain**

6 Years experience in Manager in Garments

**MBA Innovative Management**

Email : [sadir.homewise@gmail.com](mailto:sadir.homewise@gmail.com)


**Stacia F. Levy**

4 Years experience as Manager in Wintec

**MBA Innovative Management**

Email : [staciaflevy@yahoo.com](mailto:staciaflevy@yahoo.com)


**Baboucarr Gaye**

4 Years experience as Shift Manager

**MBA Innovative Management**

Email : [baboucarr.gaye@gmail.com](mailto:baboucarr.gaye@gmail.com)


**Javed Iqbal**

2 Years experience as Accountant

**MBA Innovative Management**

Email : [abc433@hotmail.com](mailto:abc433@hotmail.com)


**Muhammad Ovais Rizvi**

3 Years experience in Hotel Management (Holiday Inn)

**MBA Innovative Management**

Email : [ovais79@hotmail.com](mailto:ovais79@hotmail.com)


**Syed Asif Ali**

3 Years experience in IT / Accounting

**MBA Innovative Management**

Email : [syed\\_asifali\\_us@yahoo.com](mailto:syed_asifali_us@yahoo.com)


**Vinothkumar Raman**

1 Year experience in Information Technology

**MSc Innovative Technology**

Email : [vinothkumar\\_raman@yahoo.co.in](mailto:vinothkumar_raman@yahoo.co.in)





**Shahzad Amir Khan**  
2 Years experience as Java Developer and Desktop Engineer  
**MSc Innovative Technology**  
Email : shahzadamirkhan@yahoo.com



**Ghanshyam Vadadoriya**  
1 Year experience as Software Developer  
**MSc Innovative Technology**  
Email : shyam\_vadadoriya@yahoo.com



**Kashif Rao**  
1 Year experience in IT Administration  
**MSc Innovative Technology**  
Email : kashifrao78@yahoo.com



**Shahzaman Rind Baloch**  
1 Year experience in Networking  
**BSc Technology & E-commerce**  
Email : shahzamanrind@hotmail.com



**M Ismail M Israth**  
2 Years experience in Computer Networks, Internet, E-commerce and E-marketing  
**BSc Technology & E-commerce**  
Email : israth@gmail.com



**Mubasher Mehdi**  
3 Years experience as Business Development Manager  
**BSc Technology & E-commerce**  
Email : zabikhan22@yahoo.com



**Zeeshan Chanda**  
1 Year experience in IT Management  
**BSc Technology & E-commerce**  
Email : zchanda@hotmail.com



**Kumar Milantha Suppaiya**  
2 Years experience as IT Consultant  
**BSc Technology & E-commerce**  
Email : milantha80@hotmail.co.uk



**Mohammad Samsuzzaman**  
5 Year experience as Manager Retail  
**BSc Technology & E-commerce**  
Email : szbipu@yahoo.com



**Mohamed Althaf Mohamed Osman**  
2 Years experience as Supervisor Retail  
**BSc Technology & E-commerce**  
Email : althafosman@hotmail.com



**Faraz Ali**  
3 Years experience in Software Development & PC and Network Installation  
**MSc Innovative Technology**  
Email : farazalich@yahoo.com



**Mir Abrar Ali Khan**  
2 Years experience in Network Security  
**MSc Innovative Technology**  
Email : khanabrar18@hotmail.com



**Asif Shafiq**  
1 Year experience in e-Security  
**MSc Innovative Technology**  
Email : masifshafiq@hotmail.com



**Fared Seeni Mohamed**  
2 Years experience as Asst. Retail Manager  
**BSc Technology & E-commerce**  
Email : fseenimohamed@yahoo.co.uk



**Ali Raza Rind Baloch**  
2 Years experience as Network Admin & Software Developer  
**BSc Technology & E-commerce**  
Email : alirazarindbaloch@hotmail.com



**Irfan Ali**  
2 Years experience as Financial Consultant  
**BSc Technology & E-commerce**  
Email : irfanalimalik@hotmail.com



**Vijayta Bhuria**  
1 Year experience in Sales and IT  
**BSc Technology & E-commerce**  
Email :



**Shamial Ahmed**  
2 Years experience in Estate Agent  
**BSc Technology & E-commerce**  
Email : k\_shamial@hotmail.com



**Syed Shan Abbas Abidi**  
2 Years experience as Store Supervisor  
**BSc Technology & E-commerce**  
Email : shanabedi@yahoo.com



**Athambawa Najimudeen**  
2 Years experience as a Production Associate in Innodata lanka  
**BSc Technology & E-commerce**  
Email : najimu99@yahoo.com

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# A World of Internet Appliances

**Dave Nelson, Sun Technology Academic Resources Director, explains how standards are key to creating a world of plug and play internet appliances**

The computing world is changing very rapidly. Not long ago, mainframe computers ruled the world. If you wanted to partake in computing, you had to be connected to the mainframe in one form or another. Currently, we are experiencing the personal computer generation. In this era, users have become "independent" from the mainframe, but have taken on the burden of managing programs, files, administration and maintenance themselves.

We are about to see another revolutionary change. The Internet has brought about not only a world of information at the fingertips of users; it has also created the potential for a freedom and utility in computing that has not been seen before.

## New standards

Content on the Internet began as an art form. To a great degree, it still is. What has changed are the standards that have been put into place to govern the creation of content. With the advent of XML and Java, not only is content easier to create, it is also becoming much more inter-operable.

In the future, the power of computing will be used as a utility in a similar way that we use the power of electricity - without concern about how it is generated. In this paradigm, users will have computing appliances that gives them access to information and computational ability.

Soon, users will have the power of computing at their fingertips, but won't have the burden of managing programs and being their own systems administrators. The key to this world of Internet appliances is standards. These appliances must become like electrical appliances, whose voltage, amperage, cycles, plugs and receptacles are common and agreed upon so that all the consumer needs to do is plug in and operate the appliance.

## Centralised storage

The other key to the future of Internet appliances is the way in which data is stored. Data needs to be secure and protected. Storing data in a consistent, centralised way would provide users with far better protection than they could provide for themselves.

The need for individual virus protection and attacks could be also managed centrally. If professionals used a centralised method of virus protection, data would be far more secure than it would be if virus protection were left up to individuals. Internet appliances would also be inexpensive. Without having the processor locally and without rotating storage reduces the points of failure and power requirements. If a component does fail the cost of replacing it would be much less than the more

complex systems of today.

In the near future, Grid computing and "thin" clients will become the appliances that give users access to the Internet as well as to their data. When computing becomes a utility, it is much easier to use because there is far less to worry about. This new paradigm would also make information and computing more ubiquitous helping to bridge the digital divide.

We have seen several generations of computing. The new generation of utility computing and Internet appliances will be the best one yet.







# Powering e-commerce: Colocation data centres

**Mike Tobin, CEO of Redbus Interhouse, looks at how colocation data centres can help companies cope with the surge in e-commerce.**

**R**emember the dot com boom? Was it all hype? The digital bubble expanded at hyper speed towards the end of the nineties only to disappear faster than our memories of the millennium. But are we now seeing genuine e-growth for the first time?

It looks as though the Internet is coming of age. A recent study, conducted by PricewaterhouseCoopers, showed that in 2004 companies paid out £653 million for advertising on the Internet - and over the Christmas period last year, Internet shopping in the UK soared to over £2.5 billion (US\$4.6 billion), representing a rise of nearly 70 percent on the year before. And it's not just individuals that are buying online, over 54 percent of British businesses now place orders online. Online purchasing patterns indicate that broadband users spend twice as much time online than people who have dial-up internet access, so with more than six million broadband connections in the UK, we're spending fast! And, it's not just when the High Street is closed that we use the Internet - online shops are proving to be busiest during weekdays between noon and 5:30 p.m.

## Online malls

The European Union offers online shops a potential marketplace of 450 million people, and more than 200 million are current Internet users. This has grown by over 115 percent since 2000, and this growth figure is broadly reflected globally with nearly 800 million Internet users in total. In the UK we have around 36 million regular users of the Internet and growth is an impressive 132 percent since 2000. This is dwarfed by the growth rates (albeit from very low starting points) of Albania and Bosnia of over 1,100 percent each!

## Colocation data centres

As a direct result of this surge in e-commerce, colocation data centres are becoming increasingly busier. With so many businesses across the globe now so reliant on the Internet, server downtime means loss of transactions, loss of revenue, potential legal implications, data corruption, and, ultimately, loss of customers. If customers go to your Website and find it down, they'll quickly move on to the next one that is working.

The other problem is that even if the power drops for a second, it could take your server hours to reboot and successfully restore the data to the point at which the interruption occurred. The ramifications of this can be catastrophic to every online company's bottom line. For every one of these companies, their golden egg is their IT infrastructure and rather than it becoming an unwieldy and unmanageable beast, they recognize that the critical database of customers residing on the server beneath the IT manager's desk is just not safe enough.



*'The critical database of customers residing on the server beneath the IT manager's desk is just not safe enough'*

The cost of creating a secure environment that a data centre can offer becomes prohibitive compared to outsourcing the task. Fire and vandalism are other major issues that need to be taken into account - data centres have bomb-proof and shatter-proof glass and highly sensitive fire suppression systems, which are designed to protect your business.

And, it's not just physical threats; all these companies are also at risk from DDOS (distributed denial of service) attacks. Such attacks occur when a system is flooded with incoming messages, saturating the network with traffic. If you and thousands of other customers have your computers connected into a network provider who experiences a DDOS attack, then the whole network is ground to a halt. The only means of avoiding such attacks is to create a safe environment, with sufficient capacity and level of security, and only the likes of a data centre can do this.

## The Outsourcing Catch 22

The upsurge in outsourcing brings new challenges. But it is a Catch 22 situation - how does a data centre expect to have its floor space full when there are increasing demands for power for the multiplying numbers of computers which subsequently drives up the cost of power, the cost per square metre of floor space? And it doesn't just stop there. The number of IT systems you house drives the demand for cooling which, as you would expect, puts further pressures on power requirements.

So how does a data centre support these companies? Do you build another data centre with vastly higher specifications to withstand the new demands for power or do you upgrade your existing data centre? It is not that simple, where will you build your new data centre when there is no suitable available space? If it is outside your preferred area then you have multiple problems - there may be no fibre links, you are likely to have electricity difficulties, it probably will not be on an Internet Exchange, the telcos won't come and naturally, without the telcos you won't attract any customers. The other option is to upgrade to a live site, which also, is very difficult.

Based on any data centre's current pricing, there would be no ROI in building a new data centre. To do so, prices would have to increase by 300 - 400%, and this is not a viable option. A hardening in pricing needs to occur before any new data centres can be built. The downside of this is that the UK has reached saturation point. Space is at a premium in London, whereas space is in abundance in Frankfurt. So is a pan-European data centre strategy the route to go?

The net result is that Redbus Interhouse supports all its e-commerce customers by offering versatile, cost-effective, business resilient services within its own independent colocation facilities in Europe's key business centres. We manage IT infrastructures to enable our clients to focus on their core business so they can sleep soundly at night in the knowledge that their systems are in safe hands.

The critical mass of carriers and connectivity options within our sites acts as a magnet for content providers of all descriptions looking to be based at the very hub of the internet, thus reducing latency, risk of failure and cost. More importantly, we provide services to our customers in a highly flexible way. Many of our customers, who were impacted by the bursting of the dot.com bubble years ago but willing to try to be entrepreneurial again, appreciate the fact that we offer all our services on contracts as short as one month duration, so they can experiment and try their ideas with little long-term risk or commitment. This encourages true entrepreneurial spirit not only amongst the SME community, but within corporate customers who have projects. At the end of the day, if the idea works they stay. If not, well, let's try again!



# Enter the Dragon: China's emerging e-business industry

Dr Jiang Yu is a PhD Research Fellow at the Institute of Policy and Management at the Chinese Academy of Sciences in Beijing. Here he considers the opportunities and challenges facing e-commerce in China.

China was officially connected to the Internet in 1994. At that time, only 1.2 million computers were used and only a small portion was connected to the Internet. These users were mainly government employees and researchers at that time. However, China's Internet population has seen a remarkable increase over the past several years in absolute terms (see Fig.1). The number of Internet users reached 79.5 million, the second largest Internet population after the US, although its size relative to its 1.3 billion people is still quite low.

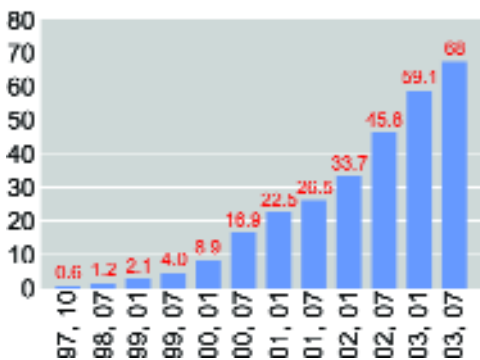
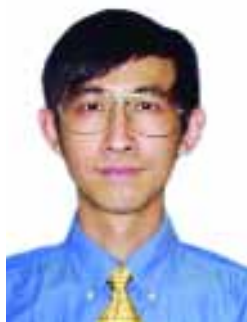


Fig.1 The development of Internet users in China (million)

E-commerce has grown steadily and of surveyed Internet users in big cities, some 40.7% now report having purchased online in the previous year. This is up by seven percentage points over January 2003. There are 122,099 web sites registered under the .cn domain, including 96,221 sites (78.8% of all registered domain names) that belong to commercial and financial organisations. The sharp increase in the number of web sites in the year 2000 indicates that many companies are becoming Internet conscious and are registering their own web sites with the strong intention of engaging in e-commerce.

## Continued Expansion

China continues to see the expansion of its e-commerce industry in both B2C (business to consumer) and B2B (business to business) sectors. Early B2C websites were started by entrepreneurs with domestic and foreign venture capital, small firms and large enterprises which were involved in a sudden 'gold rush.' Since 2001, dramatic developments have been seen in the Chinese e-business industry. The impressive annual growth rates of B2B and B2C transactions in recent years, as well as the positive forecasts, are pointing to the fact that China is making fast progress in the sector. By 2002, the total transaction volume reached 13.2 billion dollars (CCID, 2002). Entrepreneurs have come up with various business innovations that enable e-business to gain early adapters in China, even in the absence of some critical infrastructure components such as a credit card system or an efficient delivery system. One of the forces driving e-commerce in China will be foreign investment, especially from the US, and China's accession to the World Trade Organisation will accelerate that process.



China has taken the first step to participating in the e-commerce arena and the market potential is undoubtedly great. However, Chinese firms are still far behind their global counterparts in terms of real online sales volume. When sales for consumers and businesses are combined, only 3.4% of Chinese firms' total sales are conducted online. In addition, only 8.8% of Chinese firms' websites support online payment.

## Business to Consumer

There were 2,056 B2C websites at the beginning of 2002, based on CCID's statistics (CCID 2002). The B2C sector has seen a low transaction volume in spite of its large number of websites. The online payment system was improved by the major innovation of payment by cell phone tariff in the absence of a credit card system.

Take Sohu.com, one of the leading Internet companies, as an example. E-commerce revenues are earned from direct sales of consumer products through Sohu's web site. Products includes books, health care, cosmetics, videos, CDs and computer

*'Of surveyed Internet users in big cities, some 40.7% report having purchased online in the previous year'*

equipment. Services such as hotel and airline bookings and digital entertainment can be easier to provide since physical delivery may not be involved.

## Business to Business

There were 1,345 B2B websites at the beginning of 2002. B2B still dominates the sector in China, accounting for 82.6% of total e-commerce spending in China. Entrepreneurs with the support of domestic and foreign venture capital have started most of China's B2B websites since 1999. However, the uncertainty of the return-of-investment has gradually drained out domestic and foreign venture capital. Many start-ups have disappeared from the playing ground. Meanwhile, large enterprises and government affiliated organizations have started to dominate the B2B sector by buying out existing websites or creating their own sites. This is mostly because large enterprises and government-affiliated organisations have a large pool of IT experts and close ties with the industry. The main reasons for refusing e-commerce given by small and medium sized businesses are immature social environments and insufficient techniques (see Figure 2).

When sales for consumers and businesses are combined, only 3.4% of Chinese firms' total sales are conducted online. In addition, only 8.8% of Chinese firms' websites support online payment, while 33.6% of global firms' websites have the online payment function. Chinese firms remain at the early stage of e-commerce.

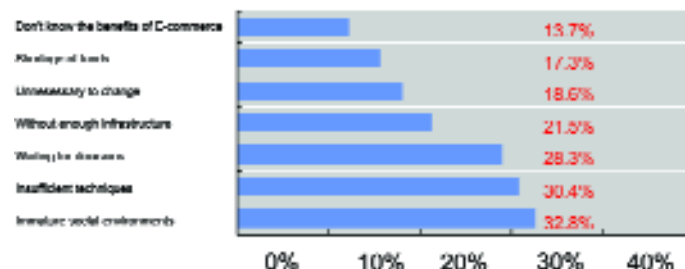
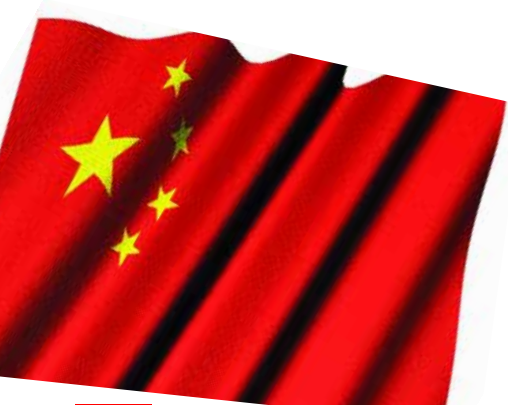


Fig.2 Main reasons for refusing e-commerce by the corporations







### Online procurement

China's wholesale/retail sector is the most active online purchasing participant and spends a higher mean percentage of money on online procurement. The banking/insurance sector is a less active participant and spends a lower mean percentage of money for online procurement. SMEs have the higher participating percentage and spend more money for online purchasing compared to large firms.

*'slow network connections coupled with legal and regulatory uncertainty and competition from the telephone monopoly are among the most damaging obstacles'*

On the other hand, the impressive annual growth rates of B2B and B2C transactions in recent years, as well as the positive forecasts, are pointing to the fact that China is making progress and gradually working on its business, legal and cultural barriers while upgrading its technology infrastructure. It remains to be seen how fast these barriers can be alleviated or even removed. There are also some differences between large firms and SMEs regarding e-commerce diffusion strategies and impacts.

### Legal and cultural environment

Because it operates in a very different political, cultural and physical environment, the growth of e-commerce in China will be very different from what has happened elsewhere. China's rapidly growing Internet businesses have attracted foreign companies that have the technological and financial resources to enter the market. The current slow network connections coupled with legal and regulatory uncertainty and competition from the telephone monopoly are among the most damaging obstacles.

As to e-commerce taxation, the customers of a potential foreign e-commerce company making sales to China may be liable for a value added tax, customs duty and consumption tax depending on the nature of

the goods they are importing into China (Rayburn, J. M. and Conrad).

### Business environment

Due to domestic constraints such as regional economic disparities, a low level of disposable personal income and administrative restrictions on the operation of Internet companies, it appears that e-commerce is likely to meet many challenges in the near future. A survey by Horizon Research indicated that more than half of China's Internet users did not trust online trading and Internet security was their biggest concern.

As China currently does not have a reliable nationwide product distribution network, the fulfilment of goods purchased over the Internet will continue to be a factor constraining the growth of e-commerce. An additional barrier to the development of e-commerce in China is the lack of reliable payment systems and credit cards are not widely used. To solve the delivery problem, most B2C websites provide a standard 2-3 days' postal service, EMS. Some B2C websites hire full-time deliverymen. This way, customers get their orders delivered within a day or two. They do not have to pay in advance, but make the payment to deliverymen when their orders arrive.

### Some implications

Since 2001, dramatic developments have been seen in the Chinese e-business industry with several business innovations that enable e-business to attract early adapters in China. China has been aggressively upgrading its technology infrastructure for e-commerce diffusion in recent years. However, barriers in business, legal and cultural areas fail to accommodate the technology progress. These factors in combination lead to a very limited amount of actual B2B and B2C online transactions. This is why most Chinese websites do not offer or support online business although there is a large percentage of web presence among Chinese firms. In some special cases such as wireless SMS services where business, legal and cultural barriers are resolved, technology upgrade allows China to experience diffusion on a par with or even beyond other countries.

This has further confirmed that a more friendly business, legal and cultural environment is needed to nurture China's e-commerce. The government is considering help, possibly through its state-owned enterprises, to build up financial, certifying, security, and even delivery systems to serve e-commerce transactions. As to the potential SMEs intending to enter China's on line market, they must pay more attention to localising content and services to build up a critical mass of customers/business partners for these ventures.







# Angiogenesis and Vascular Biology



**Professor Mark Slevin**

BBVA Chair in Clinical Biomedicine, ICCG, St Paul Hospital, Barcelona.

Reader in Cellular Pathology School of Biology Manchester Metropolitan University

The main focus on of our research work is to identify the components of and mechanisms through which tissue remodelling occurs in important angiogenic diseases such as solid tumour growth, atherosclerosis, stroke/heart disease and proliferative diabetic retinopathy. Understanding the molecular processes involved in modulating new blood vessel formation could lead to production of more efficient therapies for their treatment.

Promotion of patent neovessels is essential for efficient wound healing and significantly improves reperfusion, neuronal survival and patient recovery following ischaemic stroke. However, formation of intimal 'leaky' blood vessels is thought to be associated with development of complicated, unstable atherosclerotic plaques, prone development of blood vessels to supply the rapidly growing cells; and expansion of microvessels from the retina into the vitreous of diabetic patients can eventually result in blindness.

Our present studies are concentrated on the following aspects of vascular biology:

1. Identifying the genetic profile of neovessels from different disease/injury sites to understand the mechanisms of their activation.

2. Investigation expression of novel pro- and anti-angiogenic proteins to establish their role and potential in modulating the angiogenic process.

3. Characterization of the intra-cellular signalling pathways responsible for mediating re-vascularization and tissue remodelling in disease.

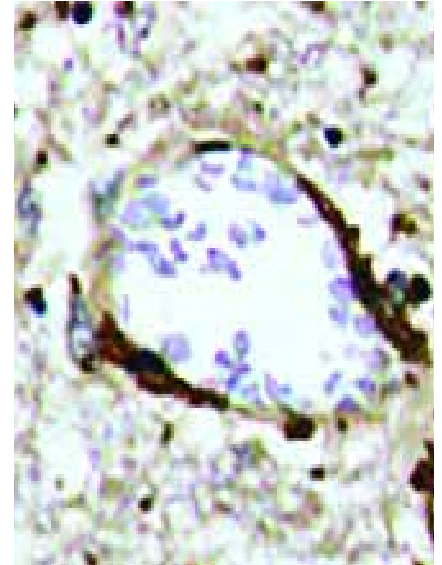
State-of-the-art equipment and technology are being employed to ensure continued success in this work.

For example, basic cell and molecular biology techniques and in vitro studies are combined with high throughput screening, cDNA and protein microarray technology, TaqMan real-time PCR, LC-MS-MS and laser-capture tissue micro-dissection.

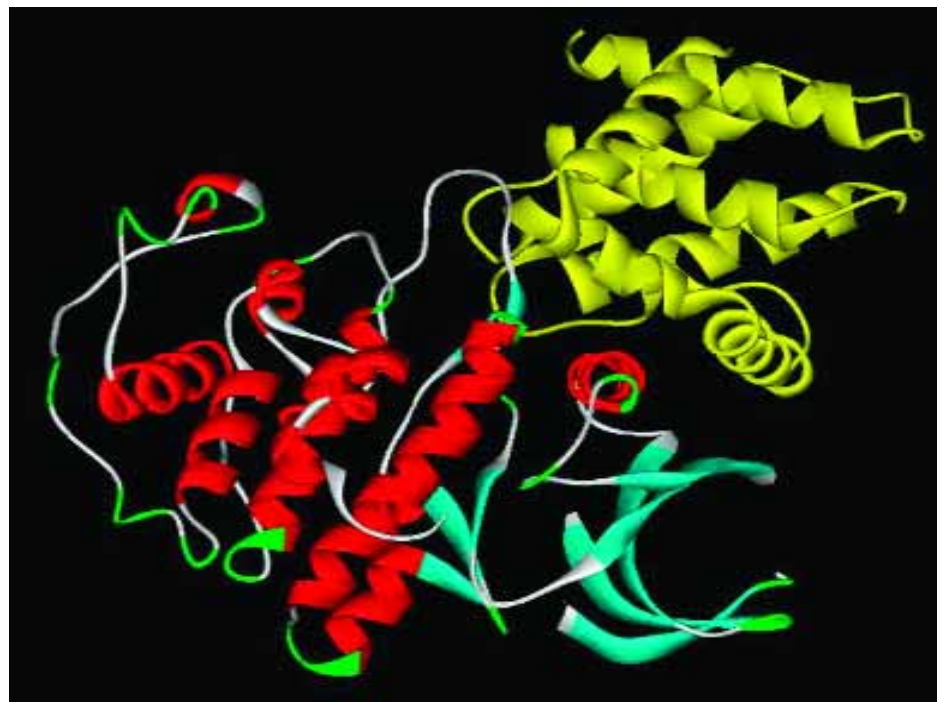
In vivo models are used to test the resulting hypothesis with a view to translation into future patient therapies.

## FOCUS on cyclin dependent kinase-5 expression in blood vessels of patients following acute ischaemic stroke'

*(supported by the Wellcome Trust, UK).*



**Immuno-histochemistry  
Cdk5 expression in  
brain infarcted blood vessels**



**Molecular Modelling  
CDK5 Activation by P25 (Yellow)**

References: Mitsios N, Pennucci R, Sanfeliu C, Krupinski J, Gaffney J, Kumar P, Kumar S and Slevin M (2007) Over-expression and activation of cyclin-dependent kinase-5 following acute ischaemic stroke in man. *Brain. Pathol.* 17; 11-23

More details can be found on <http://www.mmu.ac.uk/research/>





# Biometric - Face Recognition a challenging task

**Dr Ognjen Arandjelovic**  
University of Cambridge

Writing about face recognition is always a challenging but interesting task. In the last few decades, the field of face recognition has been on an all too familiar rollercoaster of overenthusiastic research expectations and disappointing practical experiences; dozens (if not more) algorithms have been proposed and then, many of them, forgotten. Being somebody who has for a number of years worked on and with face recognition technology, may be it would be too ambitious of me to promise a complete lack of bias. While I won't make that promise, a balanced overview of the topic shall certainly be my aim.

Our research group, a part of the Machine Intelligence Laboratory at the University of Cambridge, is interested in a variety of problems that fall under the broad umbrella of Human-Computer Interaction or HCI for short. Specifically, we are working on making computers understand images and

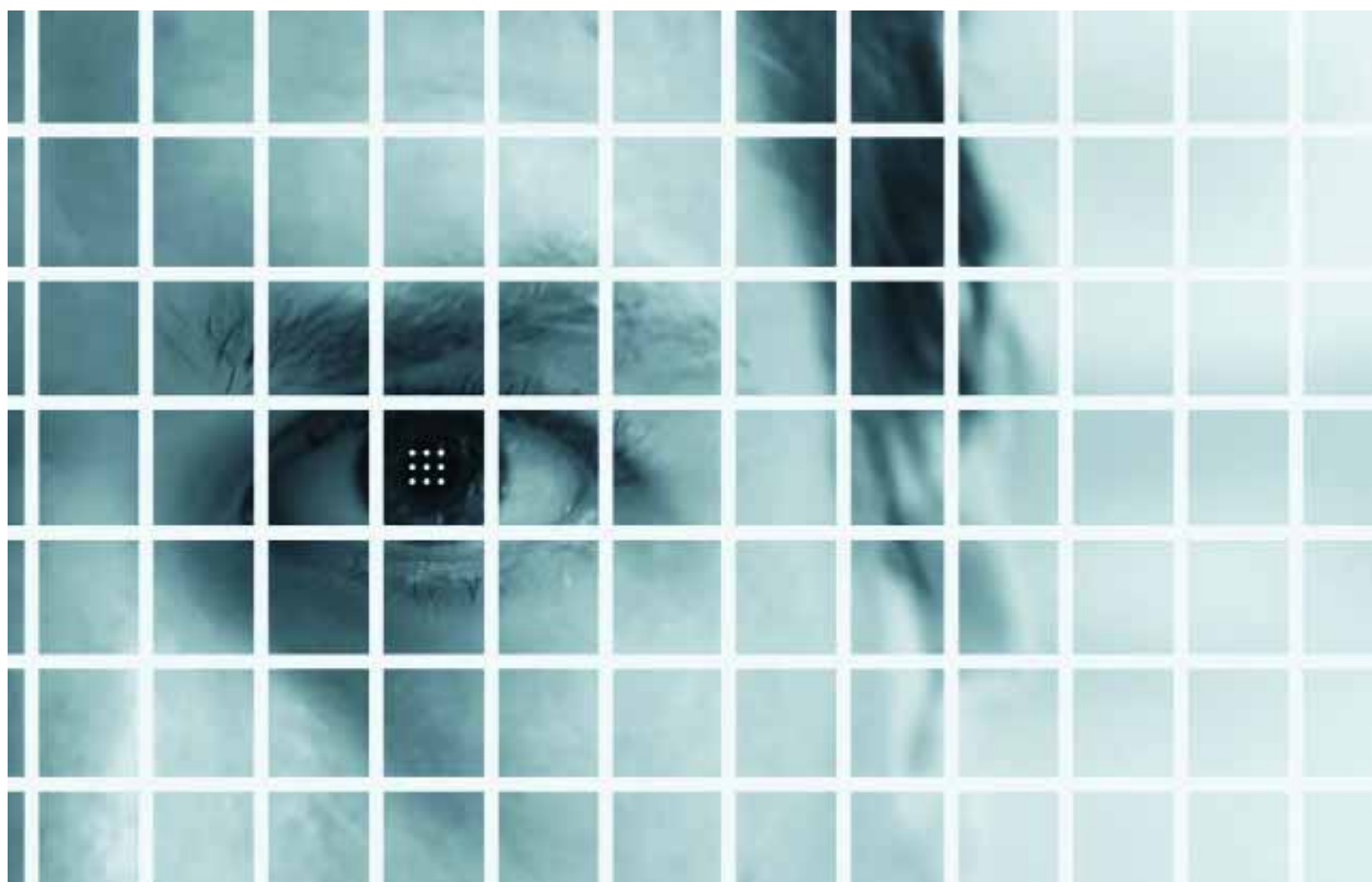
videos, much like humans do. Our goal is to develop algorithms that will enable computers to find people in images and then recognize them, see if they are behaving suspiciously (in CCTV footage recorded in shopping malls, for example), understand what they are gesturing, make sense of the sign language. These are all problems of excruciating difficulty but also of enormous practical importance - without doubt an irresistibly challenging combination for any scientist.

*'Face Recognition is a  
challenging task  
in biometrics'*

In the following issues of e-Britain, I shall run a series of articles on face recognition or, more accurately, automatic or computer-based face recognition, which is aimed at you - the consumer. The aim is neither to encourage nor to discourage you from using this technology. Rather, I would like

to help you broaden your appreciation and understanding of the underlying difficulties, as well as the extent to which the currently available state-of-the-art can cope with them. My hope is that this will ultimately help you decide for yourself if automatic face recognition offers something that can benefit you or your organization. I shall start by looking at the dawn of face recognition research in the 1970s and discuss why certain well-known algorithms have now been abandoned.

I will then outline how research trends have changed as our understanding of relevant challenges evolved, describe the latest research focus and advances, and finally summarize the success rates achieved in the most recent vendor evaluation tests.





# An Intellectual Property Right regime in support of 'Open Innovation'

## *The emergence of 'Open Innovation' in an old-fashioned IPR regime*

**Dr Birgitte Andersen**

Reader in the Economics and Management of Innovation at University of London, Birkbeck College & Visiting Professor at BITE

*...many firms participate in the same knowledge and creative spheres which tend to be collaborative, multi-disciplinary and global...*

When firms innovate, they increasingly engage or interact in the same complementary knowledge spheres. This is because they have become inter-dependent in their knowledge bases, creative spheres and the development of such. This increasing tendency of many firms participating in the same knowledge and creative spheres which tend to be collaborative, multi-disciplinary and global, and thereby look at an 'external path' (rather than 'internal') to the market when they advance and commercialize their new technology, is also termed 'Open Innovation'. It shall be seen in sharp contrast to 'Closed Innovation' where companies generate their own ideas when they then commercialize using only internal resources, which therefore need high protection.

It should be noted that especially knowledge intensive business services have experienced an emergence of 'Open Innovation' into their innovative spheres. This is because these service sectors are already heavy adopters of information and communication technology and micro electronics in their efforts to increase the quality and productivity of their services. These are the very same technologies which makes possible the worldwide availability and distribution of scientific data, information and creative expressions.

However, to reap the benefits of this 'Open Innovation' evolution, innovation policy and innovation practices in firms and industries must adapt. It therefore, seems paradoxical that while micro-electronics and the new information and communication technology support the dynamics of sharing information, knowledge, ideas and (cultural) expressions in new 'Open Innovation' spheres, this is made more difficult, and sometimes impossible, by the IPR legislation in its current form of providing very exclusive and stronger protection (e.g. via broader patents, increased period of protection of patents and

copyrights, lower requirement of 'inventive step', new areas of protection, increased enforcement worldwide, etc.).

*...while government has made IPRs more exclusive and stronger the way in which IPRs have been managed by firms and industry in 'Open Innovation' systems has made them less exclusive and less strong*

It is also a paradox that, while government has made IPRs more exclusive and stronger the way in which IPRs have been managed by firms and industry in 'Open Innovation' systems has made them less exclusive and less strong.

**IPR protection in the spirit of 'Open Innovation'**

*The evolution towards 'Open Innovation' has been supported and even underpinned by the IPR system in many different ways...*

IPR protection (which is conventionally associated with knowledge protection and monopolistic market structures) and 'Open Innovation' can seem like two innovation strategies which are contradictory in terms. However, it is not necessarily so. The evolution towards 'Open Innovation' has been supported and even underpinned by the IPR system in many different ways, applying both proprietary and non-proprietary models for innovation protection.

For example proprietary protected inventions (which include restrictions on using, copying and modifying any invention) by using all the legal restrictions which patent or copyright law provide or by using some technical means (e.g. by withholding the invention source) does not necessarily mean that value from innovation and innovation appropriation is generated internally in the firm. In the spirit of 'Open Innovation', the financial and non-financial value from such proprietary protected inventions is realised via external interaction in which rights to own or

control IPRs are exchanged. Such proprietary relationships range from simple buying and selling IPRs, licensing out or in, and sharing the IPR, to more complex



arrangements such as cross licensing and pooling of IPRs.

These 'Open Innovation' proprietary methods contract sharply with the previous Closed Innovation paradigm in which firms hold on to their IPRs for market protection. The financial or non-financial value which can be established for firms and individuals in such 'Open Innovation' methods using proprietary models are manifold.

They include (a) access to ownership of productive knowledge via various licensing agreements, (b) setting territories (i.e. market power) via strategic (often exclusive) licensing, cross-licensing or patent-pooling agreements, (c) income from licensing or buying and selling IPRs, (d) cost cutting from royalty free cross-licensing or patent pooling agreements, (e) raising venture capital from listing IP assets on the stock market, (f) establishing favourable joint ventures, (g) or other measures such as enabling the strategic evolution of common standards. Thus, the strategic use of IPRs in proprietary protected inventions within 'Open Innovation' processes consider IPRs as a 'value driven intellectual capital'. Especially larger firms use such appropriation models.

*Dr Birgitte Andersen is director of Specific Target Research Project funded by the European Union: "An IPR Regime in Support of a Knowledge Based Economy", which form part of U-KNOW (Understanding the relationship between knowledge and competitiveness in the enlarging European Union); and she is sub-director of EU funded Network of Excellence (NoE), DIME (Dynamics of Markets and Institutions in Europe), where she is coordinating the research area 'The Influence of Rules, Norms and Standards on Knowledge Exchange' which has a special focus on Intellectual Property Rights (IPRs).*

E-mail: [b.andersen@bbk.ac.uk](mailto:b.andersen@bbk.ac.uk) Web : <http://www.bbk.ac.uk/manop/management/staff/andersen.shtml>





However, it is increasingly common for service firms to use IPRs in non-proprietary innovation models. Here IPRs are used as a tool to easily mark the scientific and creative work with the freedoms the inventors want it to carry. It is about changing the terms of IPR protection from all rights reserved to some rights reserved. That is, whereas IPR law is designed to automatically restricts the right to use, imitate, modify and redistribute copies of an inventor's or author's work as well as provide permission to withhold the source of the invention; a modification of an IP license (e.g. General Public License (GPL) or copyleft license) uses the very same IPR law to ensure that every person who receives a copy of an invention or work has the same rights to study, use, modify, and also redistribute it, as well derived versions of it. Thus, such non-proprietary licenses require that the same license terms apply to all redistributed versions of the invention or work. Thus, it is about freedom of expression and access and/or contribution to the commons, and it is about believing that maximising such interaction in development spheres create better knowledge and inventions, which can then be applied in commercial business context. The reason for not putting the invention or work into the public domain, unprotected from any use of IPRs, is essentially to secure that uncooperative agents do not convert the invention or the work into proprietary material, based upon changes from the non-proprietary material, and then subsequently distribute the result as a proprietary product.

*IPR law provides the opportunity to exercise rights that are so exclusive, that it may be impossible avoiding any abuse of those.*

Examples where non-proprietary 'Open Innovation' models are used include especially the software industry (open source software, free software, freeware and shareware) but there are also other industries including for example: 'Creative Commons' licensing in the creative industries; 'Wiki' in publishing and the 'Wikipedia' encyclopedia project; Open source in media (such as Weblogs, Messageboards, and Open Document); Open Source Movie Production, Open Source Documentary or Open Source Filmmaking, as well as Open Source in education and scientific research (Science

Commons; Open-source pharmaceutical development for the creation of new medicine to enhance healthcare, such as the Tropical Disease Initiative, and the One World Health and the Drugs for Neglected Diseases Initiative); and open source innovation processes in markets for drinks where OpenCola is the first open source cola with its development phase, and Vores Øl (Danish for Our Beer) is the first Open Source beer, today also known as 'Free Beer'. Small and medium sized enterprises, as well as some large firms, are increasingly using non-proprietary 'Open Innovation' models. However, in reality, many firms use a mix of proprietary and non-proprietary innovation models.

**Minimizing the problem of rent-seeking rather than welfare enhancing behaviour**

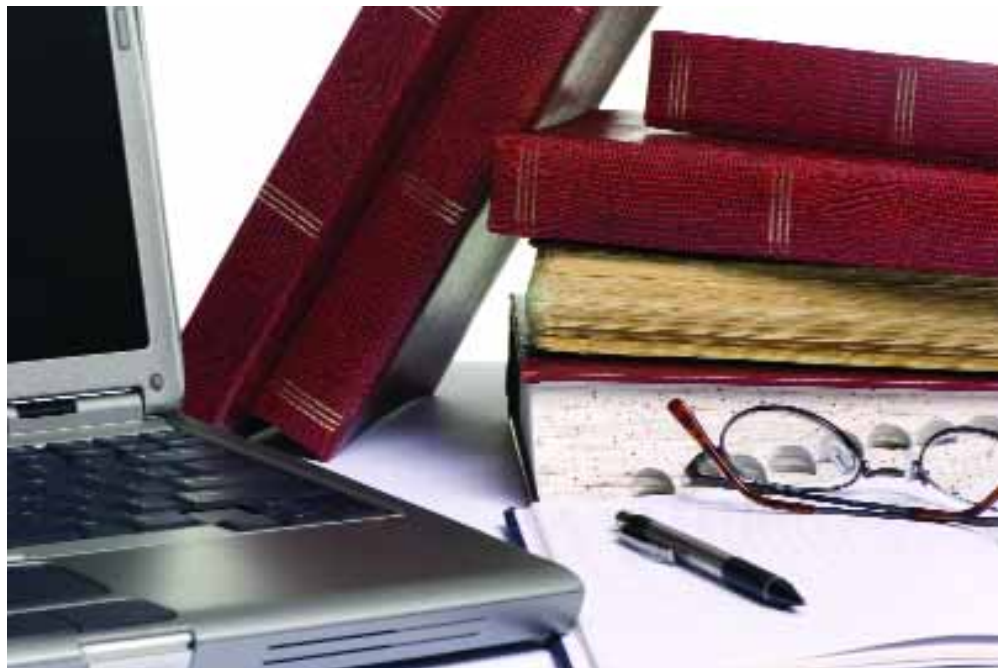
IPR law is not currently geared towards encouraging 'Open Innovation' in non-proprietary models, as the current system is (more or less) based upon providing as exclusive IP rights as possible. It can even be questioned whether IPR law in its current form is able to stimulate any proprietary 'Open innovation' model, as IPR law provides the opportunity to exercise rights that are so exclusive, that it may be impossible avoiding any abuse of those. This in turn diminishes the potential productive dynamics of the 'Open innovation' processes. It is a general problem in the nature of the strategic interaction of firms that many IPR stakeholders are more interested in the size of their individual share of the pie (or value created from IPRs) rather than the collaboration in creating a larger pie in which they may be given a smaller share. In this way, IPR law encourages

rent-seeking rather than welfare enhancing behaviour.

***...the 'rules of the game' should be changed to become less exclusive...***

In order for IPR legislation to minimize such problems of abuse, the 'rules of the game' should be changed to become less exclusive, e.g. by introducing compulsory licensing, less broad patents, higher requirement of inventive step, required disclosure of the source codes, shorter terms (period) of protection.

This will not only help Open Innovation dynamics, but it will also work more efficiently in terms of reaching its originally intended objectives for the individuals and firms participating in the system, as well as reaching the economic or societal objectives in terms of creating markets for knowledge and creative expressions; facilitating, through trade, spill-over and expansion of knowledge based ideas and the creative expressions of ideas; stimulating incentives to invest in invention and innovation, which in turn stimulate innovation-based competition; protecting entrepreneurial talent which facilitate sustainable development of firms and industry; and rewarding inventiveness and creativity throughout the economic system. This would also reduce the costs of the system as a result of anti-competitive behaviour and inefficiency.



**References (research material underpinning the arguments in this article):**

- Andersen, B (2007) Intellectual Property Rights and Open Innovation in Services. A Think Piece prepared for the DTI (former Department of Trade and Industry of the UK), March
- Andersen, B. (2004) If 'Intellectual Property Rights' is the Answer, What is the Question?' Economics of Innovation and New Technology, vol 13(5), 417-442
- Andersen, B and Konzelmann, S. (forthcoming 2008) 'In Search of a Useful Theory of The Productive Potential of Intellectual Property Rights'. Research Policy.



# Firewalls and the end-to-end principle

William R Cheswick is a US-based co-author of the classic text, *Firewalls and Internet Security*.

I heard a speech from Vint Cerf, one of the inventors of the Internet a number of months ago. In his talk, he was bemoaning several violations of "the end-to-end principle," an early design goal of the Internet that is not well-known to most Internet users and which I would like to discuss here. (He was also complaining that he had to actually pay for extra IP addresses - something he helped invent!)

First a bit of background. The Internet grew out of the heresy of packet switching networks. The "Bell heads" thought they had networking about right. To paraphrase one comment, "We've installed a copper mine on poles around the world. Why do we need another network?" The phone network was engineered for the delivery of "isochronous data", the low delay, low loss needs of voice traffic.

The phone system has the smarts in the middle of the network. The users own dumb terminals (telephones) and connect to carefully engineered and provisioned computers owned by the phone company. If you want to install a new phone, you have to call the phone company. If you want something other than voice-grade isochronous network service, you have to either pay the phone company a lot of money for some other offerings, or go somewhere else.

## Dumb networks

The packet folks wanted the centre of the network to be as dumb as possible. Just get the data to the other guy, and the everyday computers connected to the network, the "edge" machines, will have the smarts. This makes the network relatively cheap to deploy. The centre has computers that simply hot-potato packets around, and the innovation occurs at the edges. The end-to-end principle means that each edge computer can connect to every other edge computer. Wherever two or more agree on a new protocol, they can use it without the knowledge or approval of the owners of the network.

This principle put innovation in the hands of the little guy. Telephone companies make innovations slowly and only in accord with their business models. New marketing ideas, like the cellphone family plans would take months to deploy, limited by the speed new billing algorithms can be created, tested, and installed.

## Unleashing creativity

The end-to-end principle means that you and I can design a simple protocol, implement it, and deploy it in a few minutes. No bureaucrats, no permission, just a working prototype. This unleashed the creativity of millions of programmers and businessmen. Many services were obvious, and can be found in the low-numbered ports of Internet



TCP and UDP services - file transfer, remote login, time-of-day, etc. Others came as a surprise.

In the first edition of our firewalls book written in 1993 I wrote "most people connect to the Internet to read email." This was true at the time, but certainly wasn't a couple of years later. Some physicists at CERN had extended hypercards, a somewhat interesting text publishing approach found on Macintoshes, with networking. They picked TCP port 80, and the web was born. I had no idea it was coming. You can bet the phone company would never have thought of it.

*'The end-to-end principle means that you and I can design a simple protocol, implement it, and deploy it in a few minutes'*

## New Services

Today we have a lot of new services: IP-telephony, massive Internet gaming, video conferencing, instant messaging, etc. Almost a half of backbone traffic is peer-to-peer networking, the sharing of files, mostly music and movies. And some of the traffic is evil: communities of botnets are corralled to send us spam, collect our credit card numbers, and fool us into revealing banking information.

It is the presence of evil that has led to limitations on the end-to-end principle. The first packets on the ARPAnet were sent in October 1969, but the TCP/IP Internet we know first started in the early 1980s. The early network services were a wonderful improvement, but they had simplistic security. Passwords were sent in the clear over the

network, authentication was often based on one's network address, and the software was brittle and had many security holes.

By the end of the 1980s, firewalls were deployed to protect network enclaves from attacks on its own frangible network service software. The early firewalls we built worked at the application level: we broke the end-to-end principle thoroughly by inserting our own ends. We thought there might be dangerous games you could play with raw IP packets, games with fragmentation, oversized packets, and many other pathologies that might test and exploit weaknesses in the TCP/IP stack. History has shown that we were right to fear such exploits.

Application gateways strip-search your network traffic. If you are sending email, you send it to the firewall, not through it. The firewall unpacks the mail, reads it, checks for viruses, malformed addresses, etc and then forwards it. We were implementing fascist border guards, one for each network service you wanted to use.

I spent a fair amount of time in those years dealing with innovative new network protocols. Were they dangerous?

Could existing services be used instead?

Was there a way to make the service reasonably safe? Since I was running the gateway at Bell Labs, my users were especially innovative and cutting edge, and sometimes I stood in the way of their research.





I did deploy a circuit-level gateway as well, for outgoing TCP connections. This gateway blocked the end-to-end principle at the IP level, but basically preserved the principle for outgoing TCP connections, including FTP, which is always a problem. I coined the name "proxy" for the service, several years before Socks was released and became popular.

**Open end-to-end policy**

In my slides and books, I tend to use the symbol of a diode for a firewall, because most firewalls implement an open end-to-end policy from the "good" side to the "bad" side, but not vice versa. The circuit-level gateway was a diode, and most stateful firewalls (firewalls that keeps track of the state of network connections) deployed today are diodes. Homeowners are allowed to connect to the Internet freely, but the marauding Internet evil background radiation packets are blocked from access to the home computer.

We've eased off on the deployment of application-level gateways. Many sites, and even ISPs, still use them for email, now for spam and virus filtering. Many ISPs block outgoing TCP port 25 from all of their clients, unless asked not to. This stops my Dad's computer, and many others like it, from spewing spam onto the Internet. But the "stateful inspection" packet filters allow the actual IP packets through, if only in one direction. This does block innovation, much of it in evil services.

But it also frustrates a number of business models and new Internet services. Companies like Realaudio have had to deal with firewalls since the start. They want to transmit UDP packets, which are the best choice for audio streams, but most firewalls obstinately block arbitrary UDP packets, which can be abused in a number of ways. TCP connections are allowed, but its error-correcting protocol is inappropriate for multimedia streams. Protocols can be poorly specified, or proprietary, or designed assuming end-to-end connectivity. H.323, an early IP telephony protocol, was uniquely misdesigned for transiting firewalls.

The classic paper on the end-to-end argument is in [1], and I agree with most of it. For example, the end-to-end encryption of ssh sessions completely trumps problems with WEP encryption, crooked ISPs, spies, etc. The paper also advocates flexibility based on engineering concerns, and I believe our exceptions fall nicely in within that dictum.



*'Communities of botnets are corralled to send us spam, collect our credit card numbers, and fool us into revealing banking information'*

- We had to break the end-to-end principle because weak software or insecure protocols threaten our hosts.

- [1] J.H. Saltzer, D.P. Reed and D.D. Clark, End-to-end Arguments in System Design. ACM Transactions on Computer Systems, 1984.





# E-commerce and sustainable development

**Dr Gilles Richard, a lecturer at the British Institute of Technology and E-commerce, considers how e-commerce can contribute towards a sustainable environment.**

Is it good for business? Traditionally that has often been the simple measure of whether a proposed strategy should be introduced. But that is no longer sufficient, especially in the global economy of e-commerce. Nowadays we have a greater awareness of how business and particularly e-business must contribute towards the sustainability of the global economy.

In the field of energy for example, at a strictly business level, nuclear power may be a cost-effective solution for many needs but not for sustainable development. Similarly petroleum may offer a quick fix for business needs but in terms of depleting finite resources and pollution it is a definite no.

## E-commerce improvements

So what about e-commerce? We must examine this technology not only from a business perspective, but also in relation to sustainability and the future. E-business offers two principal improvements in the way we interact. Firstly virtual (electronic) documents can replace physical paper ones. Remote communication is a consequence of this first point. There is no need to be physically present in order to exchange work. We can remotely communicate to achieve transactions. By increasing the number of virtual documents we automatically reduce the number of paper documents. There are still many paper documents that we use in our everyday lives that could be replaced with electronic documents. Our ultimate aim could be set at "zero paper" (a concept similar to "zero default" in the industrial

quality process). The paper industry is one of the most polluting in the world: it is the fifth largest consumer of energy, accounting for four per cent of all the world's energy use. This industry has two main primary materials: wood and water and the pulp and paper industry uses more water to produce a ton of product than any other industry.

## Global warming

Evidence indicates that global warming is occurring as a result of the additional accumulation of carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) in the earth's atmosphere (source: www.livingtreepaper.com). Forests constitute one of our most precious resources for fighting global warming as they absorb carbon dioxide. While the use of recycled paper will greatly reduce the need for non-sustainable forests a global reduction of paper use would be more efficient.

Virtual documents, remote communication and e-technology also enhance the possibility of working from home. Such a work scheme, when used on a large scale, will greatly reduce transport activity and the pollution this generates. While "zero work transportation" may be a far-fetched goal the influence a reduction in transportation could have on quality of life, especially in terms of family life, is immeasurable.

## Facts and the City

It could also reduce costs and contribute to a decrease in pollutants and their effect on global warming. Take as an example the City of London, the financial heart of the capital, which has a surface of less than 3km<sup>2</sup>. A few facts, there are around 300,000 people working there but less than 8,000 people live there (Source: www.statistics.gov.uk and www.encyclopedia.laborlawtalk.com). So over 290,000 people travel five days a week, 45 weeks a year into and out of the City. In a year there are



*'the influence a reduction in transportation could have on quality of life, especially in terms of family life, is immeasurable'*



290,000 people making 130,500,000 journeys.

There are only three parameters that could bring this level down - the number of working people, the number of working days or reducing the number of trips. E-commerce can help with the latter. Let us suppose that we can achieve a reduction in attending the city office to three days a week, the two other days could also be spent on work but from home, still in communication with colleagues and clients. Even if only two out of three people - 200,000 - did this, we could avoid 86,000,000 trips per year.

If we take just £5 as an average price for a trip, the cost saving per year is £180m. This is 180 times the funds that was pledged by the City of London for London's bid to host the 2012 Olympic and Paralympic Games.

In London the electronic ticketing system for public transport, Oyster, has taken away the need for paper tickets and has made a valuable contribution towards paper reduction. If the average weight of a ticket is 10g we could save 360 tons of paper a year. The UK papermaking industry produces 6.2m of tons of paper a year using 4.5m of tons of recovered paper with 1.7m of tons of new paper generated per year (source: Confederation of Paper Industries). By reducing the number of tickets for public transport we can eliminate a significant amount of the production of new paper.





### Home working

Changes in the designs of apartments and houses is assisting home working with the creation of what have been called "live/work" flats. These flats are designed to integrate a specific space where there are all the broadband facilities needed for e-working and e-commerce. A new style of life could be possible where people work yet spend more time with family and friends.

Unfortunately to date the productivity gains resulting from e-commerce have often only resulted in fewer people being employed and having to work longer hours. Working from home on a large scale could bring a real change in our way of life, thinking and in our society. It will call for real structural change in society and work. Some jobs may disappear but new ones will be created.

Increasing the level of work from home and decreasing transport also reduces pollution and global warming. One of the main problems in trying to reduce global warming, is the fact that we often ask people in developed countries to reduce their perceived standard of life by, for example, using less heating and not using cars. This is a very sensitive issue and few politicians are able to back such a solution. However, increasing work from home using e-commerce is a much more appealing solution which could be much more positively explained and backed by the whole population.

I hope that these examples have shown that E-commerce not only makes doing global business easier, it can also play a pivotal role in reducing global warming, improving the quality of life and enhancing sustainable development. In the interim, there may be economic drawbacks, but it is a price worth paying for a cleaner planet for future generations.





# E-BUSINESS PROFILES

From retailing to engineering, we take a look at how companies can be transformed by e-business

## Mountaineering equipment retailing:

### Rock+Run scales new peaks

Rock+Run caters for mountain equipment enthusiasts at its shop in Cumbria and is expanding its specialist market through a snazzy web site highlighting innovative new products.

Customers buying from the website can be e-mailed updates, prices in a choice of currencies, offered trackable orders and next-day delivery at a time of their choice. Products are displayed next to links to climbing discussion sites so browsers can seek unbiased advice from other climbers. This attention to detail has helped create a loyal customer base and dramatically reduced the number of customer service enquiries.

Supporting the online sales side of the business is an integrated ordering and stock system. Shared between the retail outlet and website, the system has created an efficient set of processes from what had effectively been two separate businesses. This back-end systems integration has produced a more streamlined sales process and increased efficiency. The online operation has far lower overheads than a bricks and mortar shop and can be promoted more cheaply creating a higher profit margin.

Web sales are now valued at £350,000, which represents a 50 per cent increase on the previous year and a larger volume of sales than from the retail outlet. In fact, a third of Rock+Run's business now comes in via the website. Director of Rock+Run, Andy Hyslop says, "We are adapting and changing the business to stay competitive and can now compete with much larger competition."

## Co-operative farming:

### Virtual farming at Norfolk Essential Oils

Technology has allowed Norfolk Essential Oils (NEO) to trade as a virtual business, eliminating many of the administrative costs that can burden small firms.

NEO was set up in 1997 by a co-operative of essential oil farmers who wanted to diversify their businesses. The co-operative members are linked to each other by PC and e-mail, and to many overseas customers and suppliers by a secure e-commerce website. The company's use of communication technology provides enormous flexibility and eliminates the need to employ administrative staff, allowing the business to compete against much larger companies. This has helped give the co-operative a much higher industry profile than companies of a similar size.

To maximise productivity, incoming calls are diverted to the growers' mobile phones while they are in the field. Paperwork is also kept to a minimum - all of the growers access the same accounting package and customer database. This innovative business model has proved a great success: year-on-year sales growth is 20 per cent.

Key to NEO's marketing strategy is its website which allows customers to find out the background of products, and to join the co-operative's mailing list to receive newsletters. It is also a low-cost way of selling profitable value-added products like floral waters and soaps. Following a revamp, the website experienced a ten-fold increase in sales. With orders from as far afield as Honolulu and Alaska, NEO estimates that around 40 per cent of business now comes in through e-mail and the web.

## Engineering consultancy:

### Delap & Waller integrates suppliers and clients

Delap & Waller has used e-business to reshape its entire business model from internal processes to relationships with clients.

The engineering consultancy has used technology to improve information sharing between staff in various offices and with architects - streamlining business processes and providing a speedier and more efficient service for clients. The engineering business has traditionally revolved around partnership between customers, suppliers and trading partners. With investment in a Wide Area Network (WAN) to link offices and a secure client extranet, the company has strengthened these bonds by embracing the concept of an integrated supply chain based around collaborative working.

Virtual teams of clients, suppliers and staff now co-operate on projects, streamlining processes and reducing completion times. Administration of all offices is carried out at one site, whilst a company intranet ensures that all members of staff have access to vital business information. This reduction in duplication of effort has translated into impressive cost savings.

A collaborative approach has unlocked knowledge and expertise within the company, and allowed Delap & Waller to take on a wider variety of projects and win new business from a range of clients. One of the key turning points for the business was winning a contract with Marks & Spencer. "We wouldn't have secured that work if we hadn't been proactive in technology development," says managing director Liam O'Hagan. The combination of cost savings and new business has had a positive effect on the company's bottom line. Profits have increased over the last three years, a fact Liam attributes in part to technology. "Technology has certainly given us the edge with many blue-chip clients and has brought in contracts that we wouldn't have been able to handle without investing in technology."







## **Business software and technical book retailing:**

### **Grey Matter opens up international markets**

Grey Matter has developed a full e-commerce website that allows it to trade in eight currencies. Corporate customers can use an online trading facility that allows them to buy on credit, access tiered discounts based on volume and set individual spending limits for their staff.

As well as easing customers' cashflow and administration burdens, the site provides monitoring and management reporting facilities. The bespoke database of product information feeds into the website, the printed catalogue and an electronic procurement system, giving customers access to the most up-to-date information.

Over the last two years, Grey Matter has invested heavily in scalable systems to help build the sales capability and improve the account management side of the business. The company has an electronic procurement system that has dramatically improved communications with suppliers and customers. Suppliers are able to update product information more quickly and offer live availability details.

In turn, this has meant that customers get more accurate product information and quicker turnaround times on delivery. The integrated infrastructure that now runs through the business has had a big impact on costs. "We couldn't get the level of productivity out of our staff that we do if we didn't have these systems on board," says Phil Butcher, Grey Matter's managing director.

## **Marketing automotive parts:**

### **Mansfield Motors drives exports market**

Mansfield Motors has used e-business to open up an export market for Land Rover parts, creating a sophisticated website that focuses on brand building and community marketing.

The company has used the web as a powerful marketing tool and cultivated a strong customer community feel, using discussion boards and newsletters to encourage repeat visits to its site and ask users for ideas on improvements. As well as keeping customers returning to the pages, this has given the site a human touch and helps to build customer trust in the brand.

"The website has to look professional and be functional, but it also has to have a human touch," says director Mike Hands. "We wanted to make the online buying process as much like buying face to face as possible."

This enviable closeness with customers has opened new distribution channels - Mansfield Motors now markets to vehicle owner clubs worldwide, incentivising buyers with group discounts and using customer profiling to target relevant offers to individuals.

Having successfully implemented its internal system, Mansfield Motors has allowed major suppliers secure access to the stock database so they can check availability and place orders. With goods arriving the next day, this makes the ordering process much more efficient and timely, and strengthens the relationships between Mansfield Motors and its suppliers.

"Technology has definitely had a big impact on the business," Mike acknowledges. "Since we set up the website in 1997, we've done £100,000 worth of mail order business - it has been a significant growth contributor."

Mike is adamant that businesses have to put technology at the heart of their decision-making. "No business can afford to ignore any form of marketing that has the benefits that the internet brings."

## **Radio controlled model cars:**

### **Schumacher builds customer loyalty**

Technology has allowed Schumacher to turn its customer base into an online community, building loyalty and generating sales.

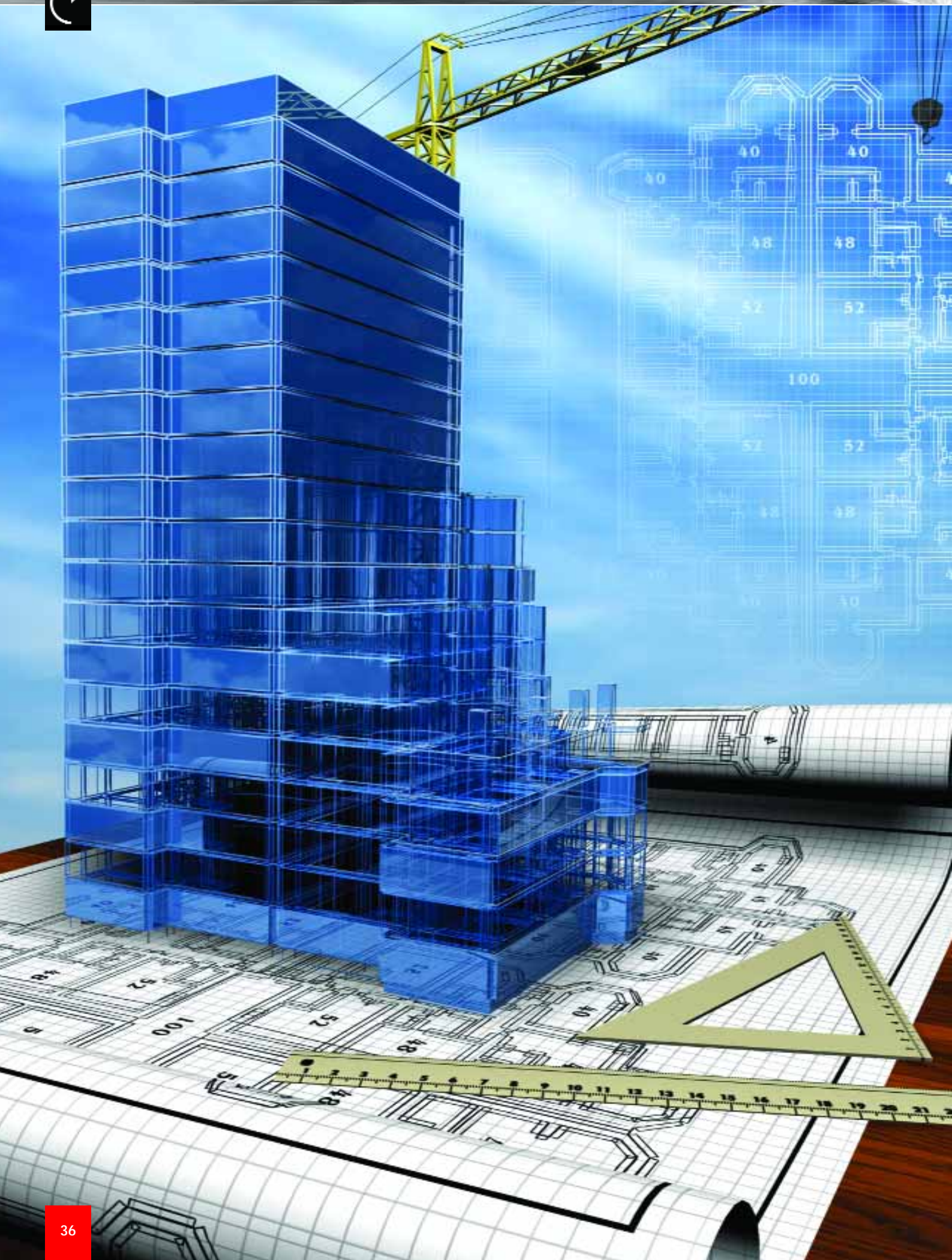
As one of the most famous and best-established names in the world of radio-controlled model cars, the company has always had a loyal customer base. With recent technology developments, Schumacher saw opportunities to strengthen these relationships still further. Central to its strategy was the use of the internet and e-mail to position the company not just as a supplier of cars, but as a member of the model car community of enthusiasts.

The Schumacher website has full e-commerce facilities and a strong community feel to encourage repeat visits. The front page is regularly updated with the latest news from the model car industry and the site hosts popular message boards and discussion groups. A forum on the site also enables customers to submit technical queries, and it is testament to the community nature of the site that visitors as well as staff regularly respond to the queries.

The company's large database of e-mail addresses gives scope for highly targeted, personalised e-marketing. On a monthly basis, customers receive an e-mailed company newsletter containing all the latest product information, advice, hints and tips on getting the best performance from their car. Digital images, created in CAD at the product development stage, are also used to market the products before they are even rolling off the production line.

"If you don't invest in technology, you get left behind," cautions managing director, Robin Schumacher. "Technology is a vital part of business planning and we're convinced that the investment we've made is for the long-term benefit of the business."









## Gaskets, materials and mouldings:

### Getting machinery moving with British Gaskets

British Gaskets has brought e-business to all aspects of its operations, integrating processes with the aim of e-enabling the entire customer journey and reducing costs.

Central to this has been a significant investment in CAD/CAM, which allows clients to e-mail drawings to be fed directly into the system. Formerly, material utilisation ran at between 50-60 per cent and has now reached up to 90% with CAM.

"Our business is heavily dependent on materials usage so if we can save money there, it makes a big difference," says Greg Mazurkewicz, operations manager for British Gaskets in Sudbury.

Job analysis tools have also been introduced to help analyse the profitability of each job and pinpoint any problem areas, something the company felt would provide a significant competitive edge. Analysis revealed that the computer-aided machinery produced 6,000 gaskets in the time it would have taken to produce 1,000 manually.

Another area of success has been the company's advance towards online tendering. British Gaskets has been successfully involved in online bidding and this way of gaining new business is becoming more frequent.

The company believes that it is vital that senior managers educate themselves about technology and continuously monitor developments to secure maximum return on investment. One unanticipated benefit of the company's investment in technology has been an improvement in clients' perceptions of the business and its capabilities. Greg explains: "Customers see our business as being innovative because of our use of IT, and that has brought us in diverse new contracts. Our website cost under £5,000 to set up and it's been money well spent."

## Home delivery service:

### SimplyOrganic delivers online success

Organic home deliveries specialist, SimplyOrganic Food Company has created an online ordering system that offers security, as well as helping the company manage stocks and target marketing at specific customers. "We've only been trading since 1999 but have seen huge growth," says Matt Giles, Head of Trading.

Orders, which can come in by web, fax or phone are automatically entered into the computer trading system. Customers' details are held on a database separated from the web system for security reasons and tied to their orders by the customer's unique ID number. Stock is automatically allocated and an order for the supplier is then generated according to the quantities needed and how quickly they're required.

The company's major fruit and vegetable supplier also uses a web site and SimplyOrganic Food Company has a password protected area where it can check on product information, including details of harvesting levels and organic certification. Orders are made by email to most of SimplyOrganic Food Company's other suppliers.

In addition, its suppliers can email digital photos of produce that SimplyOrganic Food Company can check before buying. If a product comes in with problems, the company takes its own digital photograph and emails this visual proof to the supplier. The digital camera also enables the company to create product photographs for promoting virtually instant special offers on its web site.

SimplyOrganic Food Company can also track all its customer orders online via its couriers' web sites - a distinct improvement from when it had to phone the courier companies and wait in a queuing system before being dealt with.

"There's a huge saving on all aspects of the business," explains Matt. "Everything is automated so it works 24 hours a day and human error is cut out. It also gives us 100% information on what's been ordered, what stock levels we have and where orders are going."

The flexibility of its ordering system allows SimplyOrganic Food Company to provide its customers with an added value service. If the company has a problem getting stocks of a particular product, it can type in the product name and get the details of all the customers who've ordered it. These customers can then be contacted and asked if they would like to choose something else, for example, or cancel the order.

By looking at customers' order histories, special offers can be targeted, avoiding irritating their customers and wasting time. "We'd never send promotions for baby foods to people who've never ordered anything for babies, for example," said Matt. "On the promotional side, sending a one-to-many email costs virtually nothing whereas sending the same by post would be very expensive. Customers can get information about products - something they couldn't get in a supermarket. And our system even remembers a customer's shopping list so they only need to make minor adjustments each time."

The SimplyOrganic Food Company has taken the lead in an industry that was under-developed in electronic trading. Until recently, one of its major suppliers was still sending hand-written invoices but now it's computerised and is emailing invoices. Technology is having an impact on the way SimplyOrganic Food Company does business with its suppliers leading to improved communication, reduced time lags and cost savings as goods are not sitting around in stock resulting in wastage.

The security of ordering online via credit cards is still an issue with some customers. And while SimplyOrganic Food Company encourages ordering via the web - and most of its customers do - customers can also give their card details over the telephone.



# Research Papers

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# Blue Gene/L compute chip: Synthesis, timing, and physical design

A. A. Bright  
R. A. Haring  
M. B. Dombrowa  
M. Ohmacht  
D. Hoenicke  
S. Singh  
J. A. Marcella  
R. F. Lembach  
S. M. Douskey  
M. R. Ellavsky  
C. G. Zoellin  
A. Gara

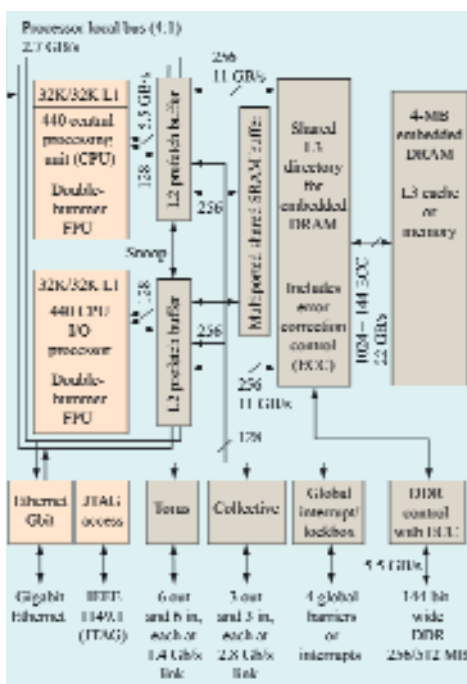
As one of the most highly integrated system-on-a-chip application-specific integrated circuits (ASICs) to date, the Blue Gene/L compute chip presented unique challenges that required extensions of the standard ASIC synthesis, timing, and physical design methodologies. We describe the design flow from floor planning through synthesis and timing closure to physical design, with emphasis on the novel features of this ASIC. Among these are a process to easily inject data path placements for speed critical circuits or to relieve wire congestion, and a timing closure methodology that resulted in timing closure for both nominal and worst-case timing specifications. The physical design methodology featured removal of the pre-physical-design buffering to improve routability and visualization of buses, and it featured strategic seeding of buffers to close wiring and timing and end up at 90% utilization of total chip area. Robustness was enhanced by using additional input/output (I/O) and internal decoupling capacitors and by increasing I/O-to-C4 wire widths.

## Introduction

With the steady advance of integrated circuit chip technology to ever-smaller features, more devices per chip, and ever-higher operating frequencies, application specific integrated circuit (ASIC) design faces many new challenges. The Blue Gene/L (BG/L) compute chip is among the most highly integrated chips produced to date, incorporating a full complement of system-on-a-chip (SoC) features, including hard cores (PowerPC\* processor cores [1], floating-point units [2]), soft cores (Ethernet interface, test access macro [3]), custom logic, synchronous random access memory chips (SRAMs), and embedded dynamic random access memory chips (DRAMs) [4, 5]. Architecturally, it holds two microprocessors, each with an attached floating point coprocessor, a full L1/L2/L3 memory hierarchy, an interface to external double-data-rate (DDR) DRAM, and five different communications interfaces (Figure 1). The chip operates at up to 700 MHz, with some critical circuits running at 1.4 GHz.

A system this complex necessarily puts significant demands on the ASIC technology and the design methodology used to create it. IBM 0.13- $\mu$ m technology, CMOS 8SF, is used as the basis for the Cu-11 ASIC library [6]. The BG/L chip (BLC) takes full advantage of the technology and the features of the Cu-11 library to achieve its high level of integration. This paper describes the overall design approach used. Working within the framework of the standard IBM ASIC methodology and design tools, new techniques were devised to deal with the special challenges posed by this chip. Emphasis is placed on the features that represent extensions, enhancements, or significant new variations of existing ASIC methodologies.

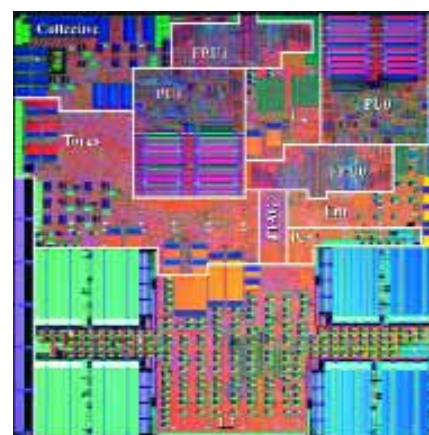
excessive wiring congestion was avoided, while also placing these large objects near the edges of the chip to maximize the amount of uninterrupted space in the middle for random logic placement. Similarly, the SRAM arrays were preplaced near the edges of their respective functional units and, where possible, near the edges of the chip to allow a maximum of open space for the unit logic. Within this general guideline, the floor plan for the chip was driven by three primary considerations. First, the input/output (I/O) for the primary communications networks—the collective<sup>1</sup> and the torus [7] (see Figure 1)—are 1.5-V differential drivers and receivers, while the remaining I/O, primarily the DDR DRAM interface, are 2.5 V. Cu-11 allows multiple I/O voltages, but standard



**Figure 1:** Blue Gene/L computer (BLC) chip architecture. Yellow shading indicates off-the-shelf cores. (c) 2002 IEEE. Reprinted with permission from G. Almasi et al., "Cellular Supercomputing with System-on-a-chip," *Digest of Technical Papers*, 2002 IEEE International Solid-State Circuits conference.

## Floor plan

Figure 2 is a photograph of the chip taken prior to the application of the wiring to enhance the visibility of the circuitry. The major regions of the chip are indicated. As discussed below, physical design of a chip with a combination of objects of mixed sizes is challenging, so it was important to carefully plan the overall chip layout to minimize placement and wiring problems later on. In general, this meant placing the largest objects (embedded DRAMs and processor cores) with the logical structure of the chip in mind so that



**Figure 2:** The Blue Gene/L computer chip, showing the twin PowerPC 440 processors (PU0 and PU1) and their associated floating-point units (FPU0 and FPU1), network interface controllers (collective, torus, JTAG, eth), and the memory hierarchy (L1 caches internal to the processor units, L2 and L3). The four large arrays in the L3 region are the 4 MB of embedded DRAM. The small rectangles distributed throughout the L3 region and elsewhere are I/O cells and decoupling capacitors. (c) 2005 IEEE. Reprinted with permission from A.A. Bright et al., "Creating Blue Gene/L Supercomputer from Low Power System-on-a-Chip ASICs," *Digest of Technical Papers*, 2005 IEEE International Solid-State Circuits Conference.

image configurations require that there be only one voltage in each quadrant of the die. This condition can be relaxed for custom images, but for simplicity, it was decided to use the predefined quadrant definitions. Therefore, the collective and torus and their off-chip interfaces were placed in one quadrant, and the remaining units with off-chip interfaces were placed in the other three quadrants. The specific assignment of the C4 contacts for each of these networks was driven by packaging



considerations, allowing for the easiest wiring path considering the desired design of the first level package and circuit card.

Second, the two PowerPC processor hard cores with their associated double-wide floating-point units (FPUs) operate at 700 MHz and must communicate with the L2 cache units at that speed and with low latency; the two L2 units must likewise have low latency between them. These requirements were met by arranging the processor cores face-to-face, with the L2 cache units and a shared SRAM between them. Because of the shape and position of the FPUs with respect to the processors to which they are attached, the resulting processor cluster surrounds the L2 cache units. Figure 3 is a sketch of the final floor plan with the major buses indicated. Although the L2 cache units communicate at high bandwidth with several other units, which requires a large number of wire

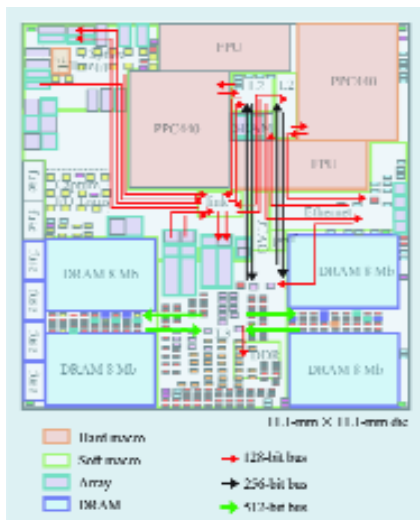


Figure 3: Locations of the major buses where wiring congestion was a concern

crossings over the FPU below them, the wiring capability of the technology is high enough to accommodate these buses. The third important floor planning consideration concerns the placement of the embedded DRAMs. Because of the large number of wide buses and the need to keep the controller logic compact for low latency, the four embedded DRAM macros were arranged with two on each side of the controller logic, even though this split placement would make it necessary to duplicate certain parts of the controller logic in order to meet timing requirements. The high I/O count for the external DDR DRAM interface required the use of most of the available C4 locations in the lower half of the chip, including many superimposed on the embedded DRAM macros. Detailed I/O placement was also driven by the requirement that prescribed locations for the 64 alternating current (ac) test pins be included among the C4 locations used.

The I/O ports were placed as close as possible to their respective C4 contacts to minimize wire resistance. The specific assignments of the I/O cells and C4 contacts for the external memory clock, data, data strobe, address, and control signals were selected to ensure balanced timing between signals and to facilitate the package design. Die size is a major determinant of

manufacturing cost. The initial high-level design for the BG/L set ambitious goals with respect to network bandwidths (I/O count) and buffer sizes. Die size estimates from floor planning indicated the need for a 12.0-mm 312.0-mm chip, which was deemed too expensive. By revising the bandwidth and buffering requirements to be in better balance with processor performance and system hardware limitations, it was possible to reduce the die size to 11.1 mm 3 11.1 mm, which carried an acceptable cost commensurate with the cost of other node components. The utilization of chip area is illustrated in Figure 4. More than half of the chip is consumed by the hard cores and embedded DRAMs. Other fixed components, such as I/O cells, decoupling capacitors, fuse macros, and SRAMs, occupy another quarter. Only about 10% of the area is used for custom logic. This high degree of utilization of predesigned entities is the essence of SoC design and makes it possible for a modest-sized team to complete such a highly complex design.

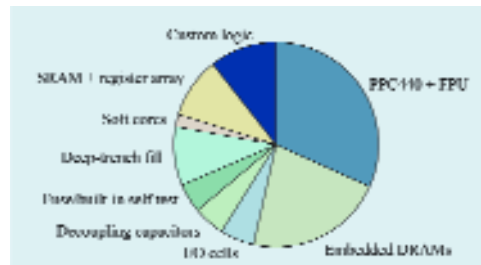


Figure 4: Relative utilization of the Blue Gene/L chip area by different types of components. Only about 10% of the area is consumed by custom logic

### Synthesis methodology

Starting from the Very high-speed integrated circuit Hardware Description Language (VHDL) logic design, the synthesis process consists of four basic steps: high level synthesis, technology mapping, timing correction, and physical design. These operations are carried out using the IBM electronic design automation (EDA) toolset [8]: Hiasynth, BooleDozer\*, EinsTimer\*, and ChipBench\*, respectively. The IBM Engineering and Technology Services Design Center has developed an enhanced environment for the synthesis and timing tools [9]. This environment consists of a set of standard scripts for performing tasks such as unit-level synthesis, "stitching" or wiring together synthesized units, and timing correction. The scripts are highly parameterized to provide flexibility within a framework, which frees designers from many of the subtle details of operation of the synthesis tools. This allows them to focus simply on what they want the tools to accomplish and specify parameter values accordingly. By maintaining a standard set of parameters at the project level, tool support is simplified as well. The designer typically needs to customize only a relatively few parameters for the specific requirements of a particular unit. It is worth noting that the presence of embedded DRAM arrays in the design did not require significant changes in the methodology. A strength of the IBM embedded DRAM technology [4, 5] is that it is seamlessly integrated into the ASIC libraries. Embedded DRAM arrays are handled very much the same way as SRAMs. The only exception is that the deep-trench process that

creates the embedded DRAM cell capacitors requires, for process uniformity, a certain minimum density of deep trench shapes on the die. If, as often happens, that minimum is not met by the deep trenches within the embedded DRAMs, additional "deep-trench fill" cells must be added to make up the difference. This requirement can have an impact on the die size and, to a lesser extent, on the floor plan, but is otherwise transparent.

At all stages of the design process, it is important to verify that the design remains functionally identical to the original VHDL logic design. This is accomplished using the IBM Verity tool [10], which verifies logical equivalence between the different views of the design which are produced by the synthesis tools at various stages of the process.

### Timing closure

In the usual ASIC approach to timing correction, the timing specification and synthesis parameters are based on worst-case conditions for technology process parameters, voltage, and temperature. This approach is designed to ensure that all parts free of manufacturing defects will meet the timing specifications and be usable by the customer. The BG/L design uses a different approach. The guaranteed worst-case performance of the Cu-11 PowerPC core design is less than the BG/L target of 700 MHz. Therefore, sorting parts by frequency is required. A timing strategy is needed that maximizes the yield of parts meeting the target frequency. For a high-performance design such as BG/L, the standard ASCI

worst case strategy has a significant shortcoming. In advanced technologies such as CMOS 8SF, the reduced dimensions of the wire interconnects and insulation between wires result in higher wire resistance and capacitance. As a consequence, wire delay has become a significant contributor to overall circuit delay. However, the variability of wire delay resulting from process variations, from worst case to nominal to best case, is much less than the variability of device performance, so timing correction done at worst-case conditions sees the effects of device degradation more than wire degradation. Thus, the paths that are found to be critical for timing closure are typically paths with many stages of logic and not much wiring. The effect of this on the performance distribution of manufactured chips designed with worst-case assumptions is that device performance improves as the process moves away from worst-case conditions, but wire delay remains relatively unchanged. For wire-intensive paths, the low-frequency tail of the distribution is inhibited from improving as much as it would if wire delay were less severe, so a larger fraction of manufactured chips may be expected to fall below the sort criterion. An alternative approach was used for the BLC. The design was synthesized and timed using nominal conditions, at a





frequency target high enough to account for various factors that are not taken into account by the timing models. These factors include the variance between the cycle time of functional circuits and the cycle time measured by the on-chip ring oscillators used as performance monitors, degradation of performance over time due to aging, and variability of the voltage across the chip. Under nominal timing conditions, device delay is not exaggerated, so the balance between wire and logic delays are less biased. The timing-critical paths include proportionally more wire delay, so the low-frequency tail of the performance distribution is less broadened than in worst-case synthesis. A different technique was reported [11] for helping the timing analysis to better account for wire-delay-limited paths by timing under worst-case conditions and artificially increasing the wire resistance by 30%. In that work, the concern was the improvement in worst-case device performance as the process matures, allowing the operating frequency to be increased. In effect, the early process worst-case devices on wire-dominated paths are oversized, so that later in the process lifetime, the faster worst-case devices on these paths will compensate for the relatively unchanging wiring delays, making these paths more likely to meet the higher target frequency timing. In comparison, the method used on the BLC avoids the arbitrariness of the 30% boost and uses the real nominal timing rules to size devices for real wire loads. This results in better accuracy, more efficient use of power, and greater certainty that the timing goals are successfully met.

BG/L synthesis and timing were done under nominal conditions at a frequency sufficient to provide a guard band above the 700-MHz target. Subsequent timing analysis using worst-case timing models at the lower frequency guaranteed for the PowerPC cores revealed relatively few timing misses (paths that exceed the specified cycle time). It was possible to correct these paths during the physical design phase, resulting in the achievement of timing closure under both nominal and worst-case conditions. As a result, the probability of low performing parts was minimized, and confidence that the design would work properly, whether manufactured with nominal or worst-case process conditions, was maximized.

### Clock tree

The clock tree provides several functions. In addition to creating, distributing, and buffering the functional and scan clocks, the clock tree minimizes clock skew both within a clock domain and between domains. It also provides the structure and control signals to support on-chip test and debug capabilities, such as array built-in self test (ABIST), logic built-in self test (LBIST), and debug access through the JTAG (IEEE 1149.1 standard developed by the Joint Test Action Group) port. The BG/L clock tree is described in detail in [3]. The functional

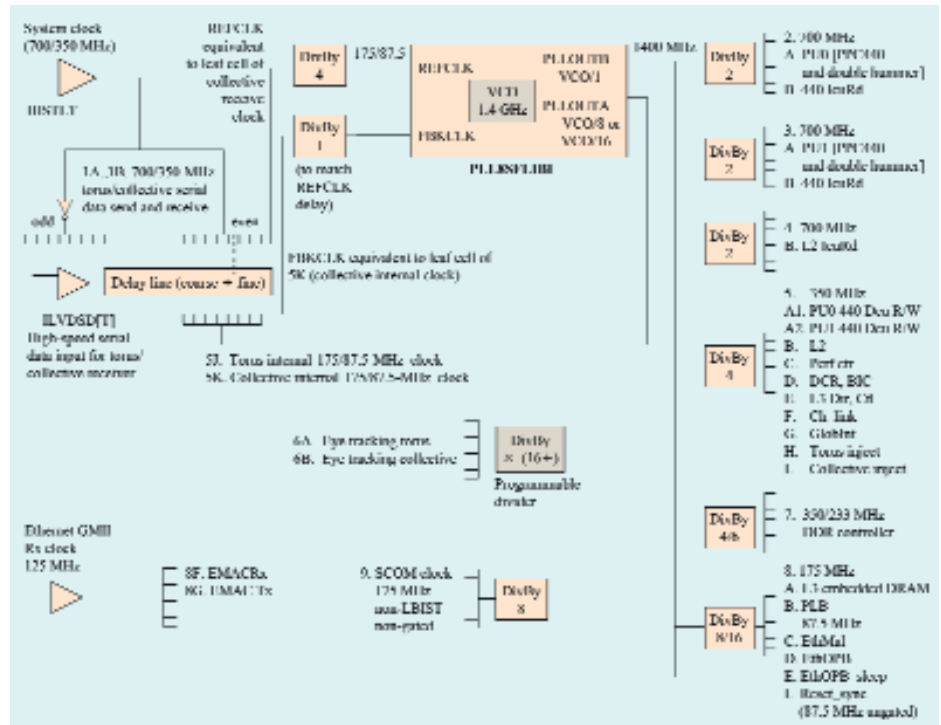


Figure 5: Blue Gene/L compute chip clock tree structure. (c) 2005 IEEE. Reprinted with permission. Adapted from A.A. Bright, "Creating the Blue Gene/L Supercomputer from Low Power System-on-a-Chip ASICs," *Digest of Technical Papers*, 2005 IEEE International Solid-State Circuits Conference.

clock tree is shown schematically in Figure 5. The oscillator signal is received at either 700 MHz or 350 MHz and is used in its raw form to clock the logic in the high-speed data-recovery circuits [12] for the collective and the torus. This was required after detailed timing analysis of the bit serial links revealed insufficient margin to allow a phase-locked loop (PLL), with its associated long- and short-term jitter, to be used to clock these DDR I/Os. After being divided down, the oscillator is used as the reference signal for an on-chip PLL with an output frequency of 1,400 MHz. The PLL output is divided down to several frequencies, which therefore maintain a well-defined frequency and phase relationship to one another. The divided clock signals are distributed to the various units on the chip.

Unlike the specialized clock distribution methodologies used in custom processor design [13], the methodology for BG/L was based on an ASIC clock distribution methodology that efficiently routes low-skew trees to latches as needed. The clock tree is designed and maintained separately from the rest of the logic on the chip. The clock gating signals, test control signals, and frequency dividers are kept within the clock tree and drive idealized clock splitters, which are considered to have enough drive

strength to power all of the latches and registers to which they are attached, with ideal timing. The details of the clock control logic are thus not entangled with the functional logic, and the logic designers see the clocks as simply B-clock and C-clock pairs, without having to deal with the multitude of test control and clock gating signals. It is not until the chip reaches the physical design stages that the idealized clock splitters are converted to real clock splitters and propagated to the ends of the clock tree branches. Balancing, resizing, and skew minimization are performed

within the physical design environment as described below.

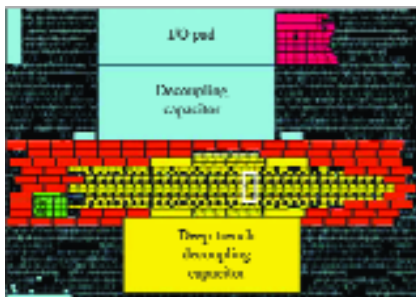
### Datapath placement

The ASIC approach to physical design relies on automated placement and wiring tools to achieve reasonable performance and area with as little manual intervention as possible. Some parts of the BLC design demanded exceptional performance and timing uniformity, and others required careful bus layout to achieve high area utilization and efficient timing. These requirements were met by assembling selected components into "datapaths," that is, clusters of custom placed components with carefully optimized placement relationships to minimize wire loads and delays, ensure uniform delays through multiple identical paths, or guide the wiring and placement of other components. Techniques and tools were developed that are used within ChipBench to specify the datapath component placements relationally so that structures can be described in an easily visualized way and modifications can be made with minimal effort. For example, rows or columns are formed by simply listing the components and any needed spaces between them in order. The rows or columns are then easily stacked together into blocks in the same way. To build up larger structures, it is beneficial to take advantage of any hierarchy in the design. The unit is synthesized without fattening the hierarchy. Placement of individual cells or blocks is done within the lowest hierarchical units, after which these units are placed within their parent cells by the same technique, and so on. The structure is then fattened and is henceforth handled as a single object.

Examples of three datapath assemblies on the BLC are shown in Figure 6. The largest of these designs is part of the high-speed data recovery circuits, which receive off-chip signals and serialize



them for the collective and torus interfaces. The design is described in detail in [12]. Here it is sufficient to note that the received signal has arbitrary phase and is phase-aligned to the on-chip clock by means of a delay line (chain of inverters). The signals at each stage of the chain are sampled and analyzed to determine the stage with optimum phase for error-free reception. This circuit demands both high-speed operation and a high degree of uniformity from stage to stage, including not only the inverter chain itself but also the surrounding logic. Both requirements were met by careful layout of the components into a regular structure that could be replicated to form the chain. The basic unit, consisting of an inverter and the latches and logic around it, is indicated in Figure 6. This unit is replicated 32 times and stacked horizontally. Additional logic, such as multiplexer trees, show somewhat less regularity while still using multiple instances of similar cells. This logic is also custom placed above and below the delay chain using the hierarchical approach described above. Before creating the datapath and using the IBM PowerSpice circuit simulator, simple simulations assuming reasonable wire loads were constructed to choose logic cell strength, clock fan-out strategies, and decoupling. After placement and wiring, timing-critical and duty-cycle-critical areas of the clock and clocking were analyzed by running PowerSpice simulations on the extracted net lines. Correspondence between static timing and PowerSpice results was close enough that no post wiring changes were required. The assemblage was treated as a single unit to be embedded into the physical design and placed as required on the chip. Several instances are visible in Figure 2 in both the collective and torus regions on the left side of the chip. The standard wiring tools in ChipBench were used to wire the datapaths along with the surrounding logic. Experience has shown that a well-designed datapath placement is easy to wire without resorting to circuitous paths that could adversely affect performance or uniformity, so there is no need to use a custom wiring methodology. The ability to use routine wiring allows full placement flexibility, which could be impeded if custom wiring were used.



**Figure 6:** Data path for the high speed data reception macro (yellow). The delay chain repeating unit is outlined in white. Two smaller data paths are also visible (green and cerise). The red rectangles are regular decoupling capacitors. (c) 2005 IEEE. Reprinted with permission. Adapted from A.A. Bright, "Creating the Blue Gene/L Supercomputer from Low Power System-on-a-Chip ASICs," *Digest of Technical Papers*, 2005 IEEE International Solid-State Circuits Conference.

The control logic in the L3 cache [14] has many wide buses (512 bits plus ECC) that communicate with the embedded DRAMs. Efficient, orderly placement was essential to keep the wires from becoming entangled, which could degrade both performance and area utilization. Entanglement can result in excessive wire lengths on paths that encounter wiring congestion. The extra buffering and wire delay along these paths makes timing closure challenging. Wiring congestion can also make it necessary to spread the logic apart simply to make room for the wires, which wastes chip area. Custom placement of the entire L3 cache would be clearly impractical, but with well-planned placement of critical components, the wiring was guided into a manageable configuration. Two 512-bit 3 5-way multiplexers were assembled as datapaths on either side of the generating logic, with the bits stacked in the same order as the embedded DRAM ports. They are visible in Figure 2 as the thin vertical shapes that extend nearly to the bottom edge of the chip between the lower pair of embedded DRAMs. These preplaced datapaths provided a constraint on the wiring that eliminated much of the randomness that would otherwise be unavoidable in an unguided placement of this large unit. The area utilization and timing of the L3 cache were significantly improved, and the effort required to wire it was greatly reduced.

#### Physical design

With 95 million transistors, the Blue Gene/L chip used the IBM Blue Logic\* Cu-11 ASIC technology and design system [6] as the framework for physical design. To manage the classical conflicting metrics of die size, timing, routability, and schedule, several novel measures were employed. These measures resulted in a relatively high (90%) silicon area utilization at the top level of the chip hierarchy. Any available space within hard cores was protected against encroachment by top-level cells to allow hard-core enhancements to continue concurrently with physical design at the top level. Even with higher than typical utilization, the residual area proved sufficient for last-minute engineering changes. As an SoC, the BG/L chip contains large objects, including the PowerPC cores, custom FPUs, embedded DRAMs, and various memory elements. In addition, it includes more than one million Cu-11 library elements. With area array I/O, the I/O circuits and their decoupling circuits are positioned near their C4 pads among these large and small objects (see Figure 2). This mixture of object sizes is a floor planning challenge, as discussed earlier. To manage this challenge and to keep resources low, the physical design was done in a simple flat manner. Area constraints for each logical unit, use of datapaths, and preplacement of critical circuitry maintained the spirit of the logical hierarchy. After the large objects and other critical circuitry were positioned, the remaining top-level logic cells were placed. Before executing this task, the netlist was modified in two ways. First, all buffer cells present in the netlist were removed. This buffering is created when synthesis is run before physical design to get a rough idea of performance and area. This removal resulted in a smaller number of cells to be placed, and it eliminated arbitrary connectivity that can frustrate placement algorithms. Second, if both inverted and noninverted versions of a logic signal were needed, the netlist was altered to propagate

only one version of the signal with any inversion accomplished by adding a small inverter at sink pins. This eliminated the possibility that both inverted and noninverted signals might have to span long distances to potentially nearby sinks. These measures served to rid the netlist of arbitrary connectivity and create interconnect topologies conducive to good cell placement. Because BG/L is an SoC, the routing space is fragmented by large objects (see Figure 3), each of which has unique routing blockage characteristics. After cell placement, routing congestion was found to be acceptable as defined by completion of all connections and minimal meandering of the routes. After the addition of nearly 500,000 buffers to aid in timing closure, routing congestion was severe. The results from physical synthesis, which involved running placement and timing optimization concurrently, were even worse. The timing optimizers continue to mature but, at the time, they were blind to the routing congestion they created. To circumvent this and guide the automatic buffer insertion tools, a thousand buffers were strategically positioned and not allowed to move. As seen in Figure 3, there is a confluence of major buses traveling around the edge of the PowerPC 440 (PPC440) from the collective to the link regions and over the FPU from the L2 to the L3 regions. By guiding arbitrary buffering away from these two routing hot spots, acceptable routing congestion was achieved. In addition, some low-speed paths were elongated to further reduce routing congestion and placement, and connections. This cloning resulted in splitters with matching loads. The low-skew domains had targets set locally at 250 fF to allow for extra wire capacitance when balance-routing these nets. The global distribution finished with an average of 32 latches per splitter cell, where all on-chip latches were driven directly from a splitter.

Skew was accounted for in timing using standard ASIC EinsTimer mechanisms. Physical design skew is accounted for by looking for the absolute arrival times at splitter outputs, which vary slightly on the basis of mismatching loading and wiring within the tree. Process variation skew is calculated from the late-mode and early mode arrival times on the basis of the technology timing rules, taking account of both best-case and worst-case timing. Common path credit is then checked on all paths that have negative slacks, and credit is given where data and clock have common clock paths. Oscillator jitter was minimized as well. The input oscillator, which drives the high-speed data-recovery circuits, has a low period jitter of 40 ps worst case. Additionally, the PLL was set up to minimize its period jitter by using the fastest voltage-controlled oscillator frequency along with no division. This caused only 50 ps of worst-case period jitter for the majority of the on-chip clocks. These minimization techniques allowed for





more available cycle time on latch-to-latch paths.

Adding robustness in targeted areas can help protect physical design schedules. On BG/L, our targeted areas included enhanced power bus robustness, which avoided rework as new substrate parasitics became available or new analysis tools were added to the methodology. Shielding and isolating of critical routes was performed. Decoupling capacitors were added to reduce power supply noise near noise-generating and noise-sensitive circuits, particularly around the hard cores and the datapaths (see Figure 6), and were also added ubiquitously into the chip.

### Engineering changes

After a chip design is frozen and released to physical design, timing closure becomes the responsibility of the physical design team. Timing fixes are inserted into the physical design netlist by means of engineering change orders, or ECOs. Logic bug fixes, including fixes to solve self-test problems, may also be identified and are handled by an extension of the same mechanism. Figure 7 shows the process flow. At the time the design is frozen, a "snapshot" is taken that constitutes a definitive "golden" copy of the VHDL and associated timing assertions and parameters. This version of the design is the basis for simulation to verify that it is functionally correct. The netlist provided to physical design is synthesized from this snapshot. IBM Verity is used to verify logical equivalence between the VHDL and the pre-physical-design netlist, and between the pre-physical-design and post-physical-design netlists. When a logic bug is identified, the fix is applied to a new working copy of the VHDL, which is simulated to verify correctness. The new VHDL is then promoted into a new snapshot, which becomes the new "golden" version. Concurrently, the physical design netlist is updated manually as follows. The smallest portion of the netlist that contains all of the logic requiring changes is identified and pruned from the full netlist. The designer makes the changes by editing the pruned section.

A command is run that compares the original and edited versions of the pruned section and extracts the differences into a file in a format that can be used to apply the changes to the full physical design netlist. Verity is used in two steps, as before, to verify that the new physical design netlist is logically equivalent to the new "golden" VHDL. This process provides a very manageable framework for generating, tracking, and verifying ECOs.

### Conclusions

The Blue Gene/L chip is an advanced system-on-a-chip design that placed new demands on the normal ASIC methodology.

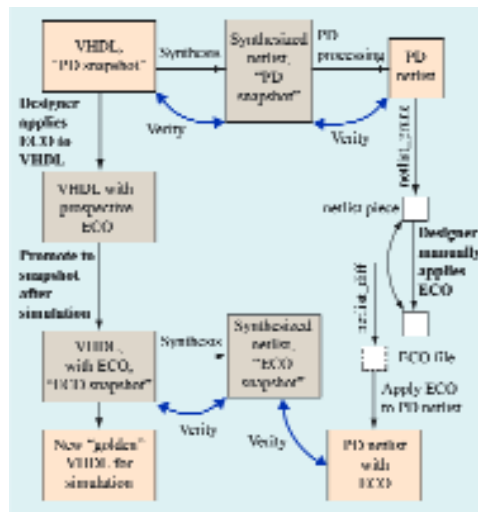


Figure 7: Process flow for engineering change orders.

Through careful floor planning, an innovative approach to timing closure, the use of custom placed datapath assemblies, and other novel physical design techniques, the design challenges were successfully met. The physical design integration was completed, and chips were manufactured in a first-time-right manner within the constraints of die size, routing, timing, and schedule.

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# A web-based architecture for inductive logic programming in biology

Andrei Doncescu  
LAAS Toulouse, France  
Avenue du Colonel Roche  
31077 Toulouse -  
France  
adoncescu@laas.fr

Muhammad Farmer  
BITE Avicenna House  
258-262 Romford Road London E7 9HZ  
United Kingdom  
farmer@bite.ac.uk

Katsumi Inoue  
NII, 2-1-2 Hitotsubashi, Chiyoda-ku,  
Tokyo 101-8430, Japan  
ki@nii.ac.jp

Gilles Richard  
IRIT, 118 route de Narbonne  
Toulouse, France

## Abstract

In this paper, we present a current cooperative work involving different institutes around the world. Our aim is to provide an online Inductive Logic Programming tool. This is the first step in a more complete structure for enabling e-technology for machine learning and bio-informatics. We describe the main architecture of the project and how the data will be formatted for being sent to the ILP machinery. We focus on a biological application (yeast fermentation process) due to its importance for high added value end products.

## 1 Introduction

Our main aim is to provide a web-based machine learning application. On one hand, we have at our disposal a powerful inductive machinery (Inoue2004), enjoying interesting theoretical properties (soundness, completeness) and whose current version is implemented in JAVA. On the other hand, there is a considerable effort made by the biologists to understand and then to control a well known bioprocess, namely yeast fermentation.

None of the available mathematical models (mainly based on dynamic differential equations) allows a precise understanding. But the possibility to understand the biological processes leading to high added value end-products like vitamins, antibiotics,... is highly challenging. For instance, it has recently been shown that the human yeast carry out synthetically the different tasks of producing the human biosynthesis protein. The recent results show that a "humanised yeast" could

simplify drug manufacture by introducing a human gene inside yeast chromosome.

Since yeast grow faster and need less tending

than mammalian cells, it could be a solution to produce proteins cheaper and easier. More than that, there is today a huge effort to imagine alternative to classical petrol-based fuel. Ethanol is one of the possible solution. Several governments encourage biologists to focus on bio-processes leading to ethanol as side product of a whole process. The more the final percentage of ethanol, the more the fermentation process is successful. It makes no doubt that, in a sustainable development perspective, this research topics has to be more deeply investigated. But, as previously explained, it is difficult to produce these proteins to a commercial scale due to the incapacity of the biologist to keep the cell on a specific pathway. Due to the lack of relevant models, micro-biologists are not able to dynamically tune the relevant parameters insuring a high percentage of ethanol output.

In this project, our aim is to apply techniques issued from the field of Inductive Logic Programming to complement the standard mathematical tools. We hope that our inductive machinery will be able to highlight the relevant parameters, and more than that, to provide simple explanations in a logical form. Not only, we want to send the output of the yeast fermentation observation to an inductive machine, but we also focus on the possibility to send online the data to the ILP machine. In this paper, we investigate the structure of our web-based application.

The next section is devoted to a general presentation of the advantages e-technology can bring in the context of machine learning and especially in bio-informatics. Section 3 briefly recall the main philosophy of inductive logic programming, as a sub-topic of machine learning. In section 4, we describe how we process the data, using XML as a backbone format, and we present the general architecture of our system. We conclude in section 5.

## 2 E-technology

E- Technology has made it possible to carry out lot of activities, previously locally achieved and are remotely performed. All these activities constitute what is usually called E-business. Government and organisation have come to realise the value of e-technology hence such projects i.e. e-learning, e-government, e-commerce, e-health are being implemented globally. In some sense, bio-informatics aims to solve biological problems using computing methods. That is why we think it is essential to make bio-informatics benefit of these techniques because the bio-informatics definitions are changing in accordance with the development

of new areas in science. BITE (UK), IRIT (France), LAAS (France) and NII (Japan) focus together on maturing technology to globalise development and

research of bio-informatics.

A global platform [1], integrating grid computing, programming tools and data visualization technologies would enable scientists to gain greater insight into their research through direct comparisons of simulations, experiments and observations. Knowledge repositories maintaining relationships, concepts, and inference rules would be accessible through such a global platform.

Starting from these ideas, we develop a web-based architecture around a machine learning application: the target machinery is an Inductive Logic Programming (ILP) system and the target application is a bio-process leading to ethanol. The next sections are devoted to a more precise investigation of these two fields. But it should be clear that our scheme is open and that there is no conceptual obstacle to integrate other inductive engines as well as there is no obstacle to focus on other fields than bio-informatics.

## 3 Inductive logic programming : a brief review







Inductive Logic Programming (ILP) is the part of machine learning where the underlying model is described in term of first-order logic. We briefly outline here the standard definitions and notations. Given a first-order language  $L$  with a set of variables  $Var$ , we build the set of terms  $Term$ , atoms  $Atom$  and formulas as usual. The set of ground terms is the Herbrand universe  $H$  and the set of ground atoms or facts is the Herbrand base  $B$ . A literal  $l$  is just an atom  $a$  (positive literal) or its negation  $\sim a$  (negative literal). A substitution  $s$  is an application from  $Var$  to  $Term$  with inductive extension to  $Atom$ . We denote  $Subst$  the set of ground substitutions.

A clause is a finite disjunction of literals and a Horn clause is a clause with at most one positive literal. A Herbrand interpretation  $I$  is just a subset of  $B$ :  $I$  is the set of true ground atomic formulas and its complementary denotes the set of false ground atomic formulas. We can now proceed with the notion of logical consequence. Given  $A$  an atomic formula,  $I, s \models A$  means that  $s(A)$  belongs to  $I$ . As usual, the extension to general formulas Fuses compositionality.  $I \models F$  means : forall  $s, I, s \models F$  (we say  $I$  is a model of  $F$ ).

$I \models F$  means : forall  $I, I \models F$ .  
 $F \models G$  means that all models of  $F$  are models of  $G$ .

Stated in the general context of first-order logic, the task of induction is to find a set of formulas  $H$  such that:

$B \cup H \models E$  given a background theory  $B$  and a set of observations  $E$  (training set), where  $E, B$  and  $H$  here denote sets of clauses. In this paper,  $E$  is always given as positive examples, but negative examples can also be introduced as well. A set of formulas is here, as usual, considered as the conjunction of its elements. Of course, one may add two natural restrictions:-:

- $\sim (B \models E)$  since, in such a case,  $H$  would not be necessary to explain  $E$ .
- $\sim (B \cup H \models -)$  : this means  $B \cup H$  is a consistent theory.

In the setting of relational databases, inductive logic programming (ILP) is often restricted to Horn clauses and function-free formulas,  $E$  is just a set of ground facts. The main reason of this restriction is due to easiness for handling such formulas. An extension to non-Horn clauses in  $B, E$ , and  $H$  is, however, useful in many applications. For example, indefinite statements can be represented by disjunctions with more than

one positive literals, and integrity constraints are usually represented as clauses with only negative literals. A clause-form example is also useful to represent causality. The inductive machinery developed by [2] can handle all such extended classes.

There are two other remarks on the logic for induction.

The distinction between  $B$  and  $E$  is a matter of taste. In fact, some induction problems which often be seen in data mining do not distinguish between  $B$  and  $E$ , and extracts rules merely from the whole knowledge base. However, the distinction is important from practical viewpoints (Inoue and Saito 2004). When we already have our current knowledge  $B$  and then a new observation  $E$  is obtained to update  $B$ , this  $E$  should be assimilated into our knowledge in a way that  $E$  should change the current theory  $B$  into the augmented theory  $B \cup H$  such that  $B \cup H \models E$  holds. In this case, background knowledge is intrinsic to knowledge evolution. We cannot realize continuous and incremental learning if we merely treat examples without any prior knowledge.

When we investigate induction deeper, some subtleties appear according to the properties of induction (e.g., whether the closed-world assumption is applied or not). These issues are out of the scope of this paper. See [3].

The scheme below describes with a functional flowchart the ILP machinery: We give an example for an induction problem for the inductive machinery by [2]. Suppose  $B$  contains only two rules  $B1$  and  $B2$  such that every cat is a pet ( $B1$ ) and that if a pet is small and fluffy then it is cuddly

( $B2$ ): `input(b1,bg,[-cat(X), +pet(X)]).`  
`input(b2,bg,[-small(X), -fluffy(X), -pet(X), +cuddly(X)]).`

Suppose we observe  $E$  that any fluffy cat is cuddly:

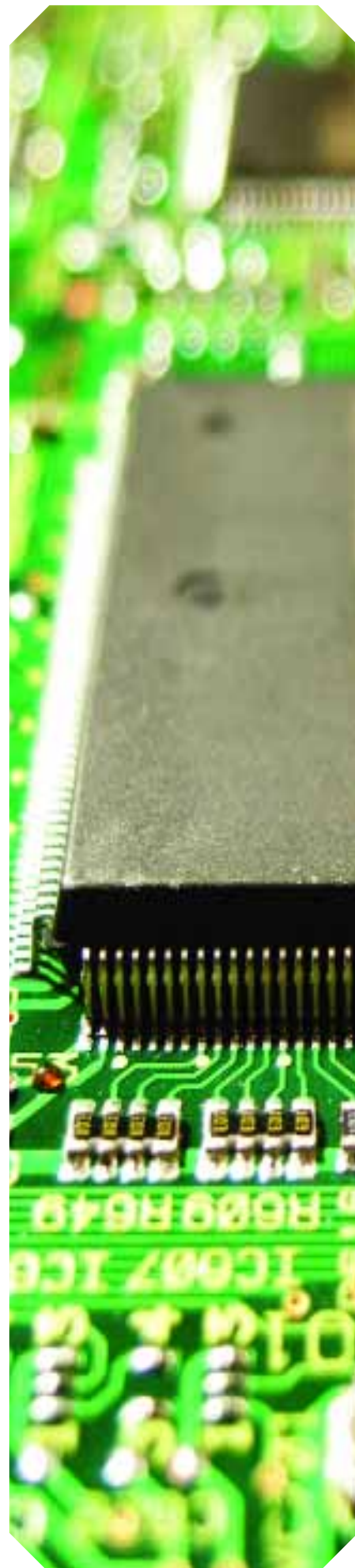
`input(e1,obs,[-fluffy(X), -cat(X), +cuddly(X)]).`

We also put some control information for the inductive machinery such that the maximum allowed length of clauses and the maximal term depth:

`production_field([length <= 3, term_depth < 3]).`  
`strategy(depth_first_iterative_deepening([depth <= 4, iterative_depth_step = 1])).`

`inductive_bias([include_carc = 0, lgg = 0, dropping = 1]).`

Then we get the following result as  $H$ , namely, a fluffy cat is small: `% java CF problem/example2.ax`  
 Observations  $E$ : `[-fluffy(_X), -cat(_X), cuddly(_X)]`  
 Background  $B$ : `[-cat(_X), pet(_X)]`





[-small(\_X), -fluffy(\_X), -pet(\_X), cuddly(\_X)]

Hypotheses:

[[!-pet(\_X), -fluffy(\_X), -cat(\_X), small(\_X),

cuddly(\_X)]]

selecting dropping literals in the clause:

1,5.

Hypotheses:

[[!-fluffy(\_X), -cat(\_X), small(\_X)]]

That is the simple implication :

cat(X) and fluffy(X) -> small(X)

This is easily readable as a natural language sentence :

A fluffy cat is small.

This is one of the great feature of first order logic

: the translation of the output into a human-readable format is rather straightforward.

#### 4 The general architecture

The expected architecture is rather simple and in accordance with the n-tier e-application model. We begin with the data i.e. the set E we have to provide to the machine.

##### 4.1 The data

We distinguish 2 kinds of parameters which are

```
<!ELEMENT dataset (data*)>
```

```
<!ELEMENT data (name, type, value)>
```

And a set of data looks like :

```
<dataset>
```

```
<data>
```

```
<name>pH</name>
```

```
<type>discrete</type>
```

```
<value>6.5</value>
```

```
</data>
```

```
<data>
```

```
<name>form</name>
```

```
<type>discrete</type>
```

```
<value>spheric</value>
```

```
</data>
```

```
</dataset>
```

meaningful in the whole process and for which we have data :

Macroscopic parameters : temperature, pressure, increasing rates for these parameters (kinetics of the process), etc.. These parameters are evaluated online with the relevant sensors. Each measure has a very low cost, so we can potentially

dispose of a huge database. These parameters have numerical values.

Microscopic parameters : we need to distinguish here two kinds :

- Cellular level : by image analysis, we can get the form of a cell (spheric, elliptic, etc...). These parameters are symbolic in nature and belong to a finite set of values.

- Molecular level : these parameters describe the DNA structure of the target molecule. This kind of analysis is not only very long to be achieved but very expensive. That is why we cannot get a lot of data from this side. These parameters have symbolic values.

Some other parameters are available but it is not clear today if they make sense for the whole process. The inductive machinery supplied by ILP usually takes inputs with symbolic representation. For this reason, numerical values are often put into Boolean values like +1 (positive/increasing), 0 (neutral/no change), -1 (negative/decreasing), by using thresholds and the multinomial distribution. These Boolean values are suited for modelling qualitative behaviors between parameters.

```
<!ELEMENT cnf (disjunction*)>
```

```
<!ELEMENT disjunction (literal*)>
```

```
<!ELEMENT literal (predicate, argument*)>
```

Of course, some intermediate values can be associated as representation of fuzziness. For more complex domains, we need a regression method to detect linear and nonlinear relationships. A more practical method would employ a profile data for an important parameter.

We understand that we have a lot of parameters to deal with. The data are abstractly described in an XML format. Typical DTD definition of our data s :

Since the real data are mainly provided as a xls format, there is no difficulty to compile into the XML format (basically, Excel includes a conversion facility to HTML). This XML file is sent to the server. A simple compiler converts the XML files into convenient data input format for the target ILP machine.

The output of the ILP machinery is just a finite set of logical rules which are translated into a human readable format, as previously explained. There is few things to do since the rules are put in an implicative form and this is generally understandable as soon as the predicate names support intuition.

##### 4.2 The background knowledge

There is a huge amount of literature about the subject and we have to extract, with the help of biologists, the rules which could be useful as a way to guide the research (see [5]). The experimental evolution for state variable of the system : biomass, substrate and product could be figure up by the curves below :

We understand that the consumption of the

substrate increases the number of interesting cells (parameters X and P (ethanol partial pressure)). This is translated into a very simple logical rule : not increase(S,t) OR [(increase(P,t) AND i n c r e a s e ( X , t ) ) ] which is equivalent into [not increase(S,t) OR increase(P,t)] AND [not increase(t) OR increase,(t)] We get a set of 2 clauses (conjunctive normal forms). The parameter t, representing the time, appears in every predicate in order to capture the dynamic of the process. The time is considered as a discrete attribute corresponding to the discrete sample steps.

Such rules are translated in an XML format, in order to be easily adaptable to the input format of the remote ILP machine. It is remarkable to see that XML format is very close to a logical format. For instance, some DTD rules for a logic program (not reduced to Horn clauses) are

In this case, the translation is straightforward and there is no need to spend a lot of time for that. This is mainly a recursive walk inside a text file. 4.3 A functional view of the whole system We have below two functional diagrams explaining the flow of data and the expected output.

The output of the ILP machinery is a finite set of logical rules that are translated into a human readable format. The rules are output in an implicative form and this is understandable as soon as the predicate names support intuition.

#### 5 Conclusion

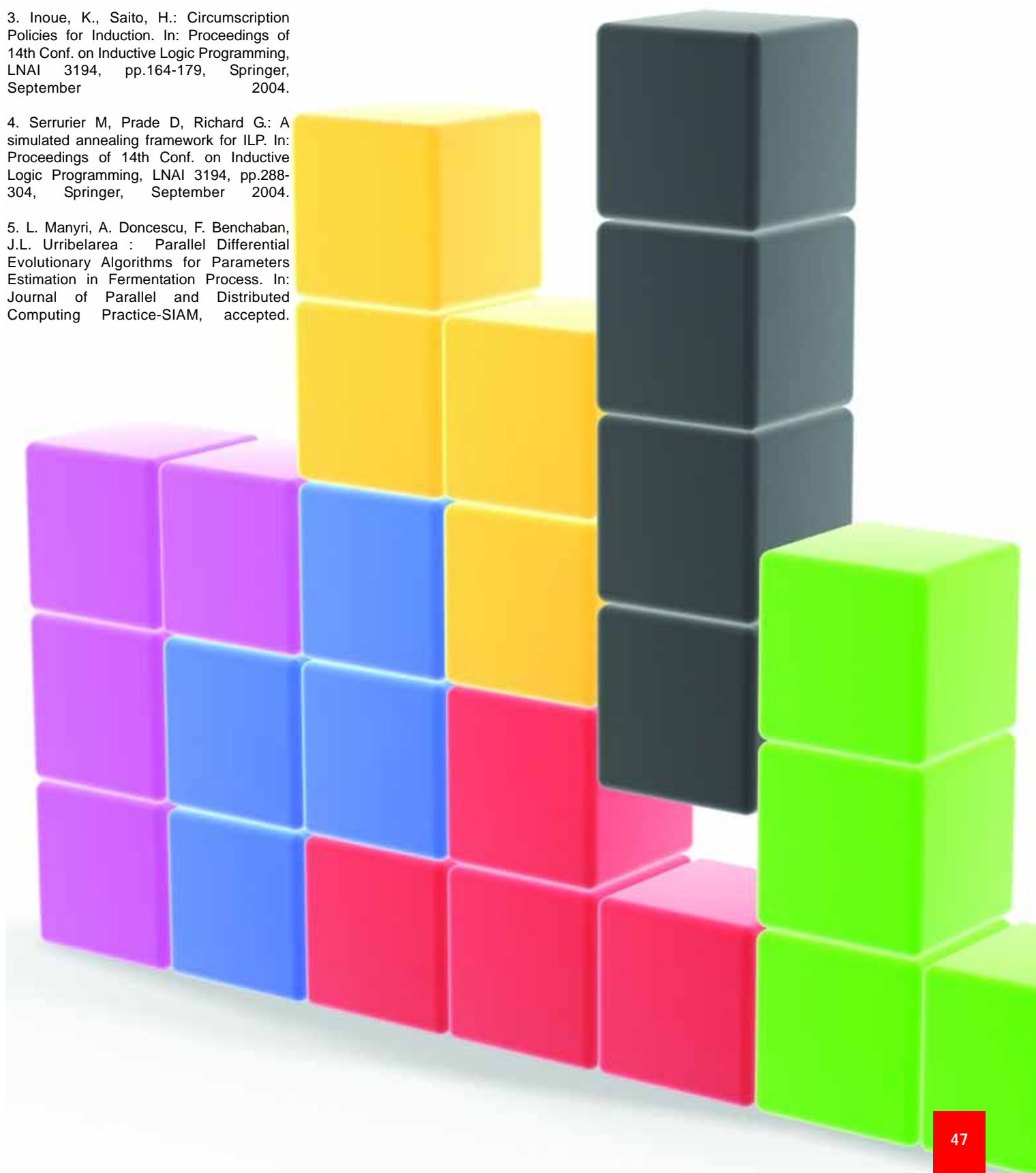
Today, it is a common technique to enable a lot of applications with e-technology. We investigate here the field of Inductive Logic Programming targeting to a biological application. Due to the similarity between the first-order logic syntax and XML, there is no difficulty to use XML as a standard format for our files exchange. One of the main interest of our approach is that we only manipulate data and files which are almost human readable and the output product (a set of rules) is easily understandable for non-expert people. We expect to have a continuous flow of data, and so to continuously improve the target ILP machinery. As a mid-term objective, we want to provide a public access to the machinery and to make several ILP engines (see [4] for instance) to compete for extracting rules. Since the underlying language is the same (first order logic), it is very easy to compare and why not, to mix different extracted rules to get a better understanding of the process on hands. As a long term objective, our platform could create a vacuum of knowledge under one roof and open the doors to a worldwide consortium of Bio Informatics experts to access data, research, forums, resources and application through the Internet.





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# E-banking Evolution in the Third Millennium

Prof. Dr. Ali Sanayei

Associate Professor of Faculty of Administrative Sciences & Economics, University of Isfahan.

Email Sanayei110@yahoo.com

www.DrSanayei.com

Hamed Rabbani

IT Staff and Researcher of Middle East Export & Marketing Research Institution

Email Rabbani.Hamed@gmail.com

## Abstract

Banking has evolved over the past few years from a face to face (customer to teller) service to that of "anytime/anywhere/anyhow" banking services, using various delivery channels. E-banking is the way forward for the banking industry. It brings new opportunities and possible additional risks for banks and presents fresh challenges for regulators. Furthermore, there is no doubt that technology is now the single biggest strategic issue in banking. In particular, bankers like other businessmen are, or should be, urgently reviewing the opportunities provided by the internet. Although it is tempting to dismiss much of what is said about the internet as media hype, we do believe that it is true to say that we are living in the "Age of the Internet", and businesses that do not adapt to the opportunities and challenges which this presents, will have a limited future.

The advantages of e-banking, and internet banking in particular, are quite clear - the ability, for example, to disseminate information widely and instantaneously at low cost and to cross-sell products in a much more effective way. But there are also strategic threats. The cheapness and global reach of the internet opens up the threat of increased competition from new entrants who will no longer need a branch network to operate effectively in any given market. This competition can be launched across national frontiers. In this article we will discuss e-banking evolution and explain the emerging of e-banking services, e-payment systems as well as legal, risk management challenges, and present suggestions for managing e-banking.

## 1. Introduction

Today technology can have an impact on the growth of business, particularly e-business, in a number of ways. It allows countries to obtain comparative advantages in the production of commodities, and based on these cost advantages (e.g. virtual markets) previously unprofitable markets now become worth considering.

On the other hand, the emergence of global networks has already begun to influence the way individuals interact with each other, businesses conduct their affairs, and governments provide services to their citizens. As with traditional



commerce, electronic commerce requires trust across the whole spectrum of users and providers of services and goods.

The radical changes brought about by the emergence of open networks will, in some instances require modifications to the existing framework of rules to assure this trust. Today's commercial transactions are governed by a mix of laws enacted by government and business self-regulatory mechanisms, and most of suppliers' on-line B2B strategies entail courting the few buyers already using the Internet.

The Internet greatly facilitates a bank's ability to distribute products and services over virtually unlimited geographic territory, including across national borders. Such cross-border e-banking activity, particularly if conducted without any existing licensed physical presence in the "host country," potentially subjects banks to increased legal, regulatory and country risk due to the substantial differences that may exist between jurisdictions with respect to bank licensing, supervision and customer protection requirements. Because of the need to avoid inadvertent non-compliance with a foreign country's laws or regulations, as well as to manage relevant country risk factors, banks contemplating cross-border e-banking operations need to fully explore these risks before undertaking such operations and effectively manage them.

## 2. Discussion

The 1999 Annual Survey on Asian CEOs by the World Economic Forum revealed that 50% believe that the financial industry would be most significantly affected by the Internet over the next two years, 42% do not rule out government regulations of the Internet of some kind and 65% believe that Internet access, transactions and uses should not be taxed.

On the other hand, exponential growth of Internet users since the middle of the 1990s is an unequalled business phenomenon. USA has the highest user ratio of 32%, followed by 28% for Singapore, 23% for Australia and 19% for Hong Kong. The fastest growth of internet users is found in East Asia: with China at 51%, Hong Kong at 44% and Malaysia at 41%. (Giap, Tan khee, 2002). Moreover E-Banking has filtered fast into commercial banks such as Wells Fargo Bank in 1995, First Union Bank and Bank of America in 1996 and Citicorp and Banc One in 1997. Not until 1998 did major houses such as JP Morgan, Bankers Trust, Chase and First Chicago move into this new medium of financial services.

## 3. Observations on Alternate Delivery Channels for e-Banking Automated Teller Machines (ATMs)

As can be seen from Figure-1. ATMs continue to grow although no longer at the rate of other delivery channels.

The primary use for ATMs is to withdraw funds from accounts (70%) and to make deposits (20%).

### 3.1 Debit Card Purchases:

According to information published by the Interact Association there were almost 2 billion debit card transactions (1.96 billion) processed in 2000 in the financial services industry.

### 3.2 Telephone Banking:

All major deposit-taking institutions now provide some form of telephone banking service. These services provide both an automated component for basic transactional processing, as well as call centre operators who will handle more complex transactions such as taking loan applications, requests for credit line increases and investment fund counselling/sales.





### 3.3 PC/Internet Banking:

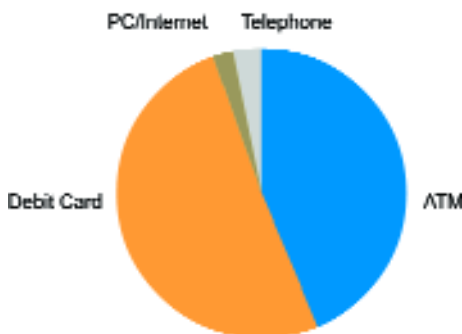
Similar to other delivery channels, all major deposit-taking institutions now provide PC/Internet banking. Initially, consumers were provided with a set of diskettes or a CD-ROM that would allow them to register and do basic financial transactions through a dialup connection to the banks' data centers. This process proved to be cumbersome and required that banks maintain a support staff to deal with issues such as set-up and compatibility of the software with consumers' personal computers. In order to alleviate the issues surrounding PC banking, financial institutions developed Internet banking where the customer could, using a simple registration process, access their accounts and perform financial transactions through the Internet. This eliminated many of the issues related to supporting the PC banking products and was a great incentive for customers to adopt the new service.



**Figure -1: Alternate Delivery Channels for e-Banking**

### 4. Emerging e-Banking Services:

Electronic commerce technology, using the Internet as the distribution network, can enable a multitude of connections for business and consumers. This can take the form of Business to Business (B2B), Business to Consumer (B2C) and Consumer to Consumer (C2C) transactions.



Government is also heavily involved in the movement of activities to an electronic basis. Mobile commerce ("m-Commerce") is another version of electronic commerce using Wireless devices such as cell phones or Personal Digital Assistants as the access device to establish Internet type connections for the exchange of information and transactions. M-Commerce is in the early development stages and will be moving more aggressively into the market over the next 2-3 years.

Financial Account Aggregation uses the Internet to gather information from various

Websites to allow a consumer to view their complete "financial picture" at one location, thus allowing them to make more informed decisions as to how they will direct their investment and debt portfolios. In addition to financial institutions, other third party Financial Account Aggregation Service Providers will be offering similar competitive services to bank customers. Initially these services are being offered to collect all of a customer's information at one central site; however, in the future, Financial Account Aggregation Service Providers may also supply transaction-based service.

Moreover, financial institutions and retailers have also worked to ensure that customers are aware of the physical security issues related to these cards. For example, customers are advised to select a PIN that is not obvious, and to shield their PIN from view of others as it is entered. This type of information is provided to customers in their account agreements with their financial institution. In addition, a broad stakeholder group, including government, retailers, financial institutions and consumer groups, has developed the Canadian Code of Practice for Consumer Debit Card Services [Debit Card Code]. This Code sets out the responsibilities of card issuers, users and customers in an effort to increase the security of debit card services.

Furthermore continuing technological innovation and competition among existing banking organizations and new entrants have allowed for a much wider array of banking products and services to become accessible and delivered to retail and wholesale customers through an electronic distribution channel collectively referred to as e-banking. However, the rapid development of e-banking capabilities carries risks as well as benefits.

### 5. Legal and Reputation Risk management:

To protect banks against business, legal and reputation risk, e-banking services must be delivered on a consistent and timely basis in accordance with high customer expectations for constant and rapid availability and potentially high transaction demand. The bank must have the ability to deliver e-banking services to all end-users and be able to maintain such availability in all circumstances. Effective incident response

mechanisms are also critical to minimize operational, legal and reputational risks arising from unexpected events, including internal and external attacks, which may affect the provision of e-banking systems and services. To meet customers' expectations, banks should therefore have effective capacity, business continuity and

contingency planning. Banks should also develop appropriate incident response plans, including communication strategies that ensure business continuity, control reputation risk and limit liability associated with disruptions in their e-banking services ([www.bis.org](http://www.bis.org)).

Banking organizations have been delivering electronic services to consumers and businesses remotely for years. Electronic funds transfer, including small payments and corporate cash management systems, as well as publicly accessible automated machines for currency withdrawal and retail account management, are global fixtures. However, the increased world-wide acceptance of the Internet as a delivery channel for banking products and services provides new business opportunities for banks as well as service benefits for their customers.

### 6. Risk management challenges

The speed of change relating to technological and customer service innovation in e-banking is unprecedented. Historically, new banking applications were implemented over relatively long periods of time and only after in-depth testing. Today, however, banks are experiencing competitive pressure to roll out new business applications in very compressed time frames - often only a few months from concept to production. This competition intensifies the management challenge to ensure that adequate strategic assessment, risk analysis and security reviews are conducted prior to implementing new e-banking applications. Transactional e-banking web sites and associated retail and wholesale business applications are typically integrated as much as possible with legacy computer systems to allow more straight-through processing of electronic transactions. Such straight-through automated processing reduces opportunities for human error and fraud inherent in manual processes, but it also increases dependence on sound systems design and architecture as well as system interoperability and operational scalability.

Furthermore the worldwide proliferation of the Internet led to the birth of electronic commerce, a business environment that allows the electronic transfer of transactional information. Electronic commerce flourished because of the openness, speed, anonymity, digitization, and global accessibility characteristics of the Internet, which facilitated real-time business activities, including advertising, querying, sourcing, negotiation, auction, ordering, and paying for merchandise.

On the other hand, the main concern regarding electronic payment is the level of security in each step of the transaction, because money and merchandise are transferred while there is no direct contact between the two sides involved in the transaction. If there is even the slightest possibility that the payment system may not be secure, trust and confidence in this system will



begin to erode, destroying the infrastructure needed for electronic commerce.

There are currently four major categories of electronic payment systems: (1) online credit card payment, (2) electronic cash, (3) electronic cheques and (4) small payments [21]. Each of these systems has its advantages and disadvantages. (Wayner P.1997).

This paper compares the four types of electronic payment systems in terms of the requirements of merchants and consumers, the appropriate business environments, and the future potential of expandability (Table 1).

On the other hand, economic needs can be divided into two categories: one is associated with the real currency value aspect; the other is related to the degree of widespread use of the Internet. The preceding two factors can be used to analyze the economic needs that include:

**1. The cost of transactions:**

This refers to the cost paid by the seller and buyer involved in the transaction. This can be divided into direct cost and indirect cost. In choosing the electronic payment system for small payments, the cost of the transaction will be a deciding factor.

**2. Atomic exchange:**

This means that, during a transaction, the consumer will pay money or something equivalent in value.

**3. User range:**

This refers to the range of users to which an electronic payment system is accessible. This includes whether the system is accessible in all countries of the world, to all ages.

**4. Value mobility:**

This means that the payment method is not restricted to the company that created the value. The value can be used in different places, given

away, or exchanged for currency in equal value.

**5. Financial risk:**

Consumers are very concerned about the degree of security involved in online transactions. So, in addition to added security measures, to prevent information from being stolen or made public, the question of what will happen if private information is made public should be considered when designing the electronic payment system. After analyzing and comparing the different types of payment systems, and according to the development of electronic payment systems, one can reach the following conclusions.

Although using a credit card requires the payment of a high fee and even though credit cards have a limit on how much money you can charge to the card, it is popular because of its acceptability in many foreign countries and also because it is a relatively safe method of payment. For this reason, this method of payment is suitable for most consumers and retail markets. Among the different online credit cards, VCC is secure and protects the privacy of the user when the user makes online transactions. VCC also has the advantage of being used everywhere; its use is not limited to one location, and is suitable for wireless setups and web TV. Therefore, in the future, the use of virtual credit cards will escalate.

**7. Electronic cash:**

Smart cards lack the disadvantages of traditional electronic cash; for example, the maintenance of large databanks and also the inability to give change. But they have most of the advantages of electronic cash, including anonymity, payment between parties, and low transaction fee. Therefore, in the future, smart cards will replace traditional electronic cash in the market. But because electronic cash is not replaceable when it is lost, consumers will bear the risk of electronic cash being lost or stolen. To solve the described problem, the amount of electronic cash used

should always be a relatively small amount, making this the perfect payment system for small payments. Currently, the two large smart card systems have different kinds of policies, and are not compatible with the magnetic strip reader. Before it is ascertained which smart card system will become the main one used in markets, banks are unwilling to adopt either system. Therefore, when establishing a smart card system, its compatibility with other systems is a key success factor in popularizing the system and for its development. In addition, there are other organizations that wish to enter the smart card market. Therefore, different brands of smart cards and different organizations must establish a global smart card standard interface, and need to establish a trustworthy and certified organization in charge of overseeing the making of all smart card systems compatible; otherwise the smart card products will not develop.

**8. Electronic cheques:**

Because the direct cost of electronic cheques is high, they can only be used in a virtual world; they do not protect users' privacy. Therefore this method is not suitable for most consumers. But for governments and private corporations, most transactions and deals made between corporations and corporations or between corporations and the government are publicized, and the need for user privacy is not a concern. Also, since the amount of money transferred is usually a large sum, online credit card payments or electronic cash systems are both unable to make such a large transfer. So electronic checks are suitable for corporations and the government. Currently, FTSC's participants consist mostly of American financial organizations, research organizations and government agencies. FTSC lacks participants from other countries and organizations. In the global trend, FSTC should plan to cooperate with other countries' companies or agencies (for example, W3C) to become widely used all over the world; otherwise, if it is only used in America, it will not become popularized worldwide.

**9. Small payments:**

Consumers are gradually beginning to accept the fact that information has value, and are willing to pay a reasonable price to browse through information. According to the value of the information, not only will small payments be more reasonable than a "member" set price, they will also be more convenient for those consumers who are not frequent users. Therefore pay-per-click and per-fee-links will definitely become an online trend for transactions. But since small payment structures are not brought forth by international financial organizations, and it does not use traditional financial systems or methods as its structure, to increase consumer acceptability there needs to be cooperation with banks, Internet service

Characteristics	Online credit card payment	Electronic cash	Electronic cheques	Smart cards
Small payments	Transaction costs are high. Not suitable for small payments	Transaction costs are low, suitable for small payments	Allows stores to accumulate debts until it reaches a limit before paying for it. Suitable for small payments	Transaction costs are low. Allows stores to accumulate debts until it reaches a limit before paying for it. Therefore, it is suitable for small payments
Database safeguarding	Safeguards regular creditcard account information	Needs to safeguard a large database, and maintain records of the serial numbers of used electronic cash	Safeguards regular account information	Safeguards regular account information
Transaction information face value	Can be signed and issued freely in compliance with the limit	Face value is often set, and cannot give change	Can be signed and issued freely in compliance with the limit	Can be deducted freely in compliance with the limit
Real/virtual world	Can be partially used in real world	Can only be used in the virtual world	Limited to virtual world, but can share a chequing account in the real world. No limit	Can be used in real and virtual worlds
Limit on transfer Amounts Mobility	Dependent on the limit of the credit card. Yes	Dependent on how much is prepaid. No	No	Dependent on how much money is saved. Yes

Table 1. Categories of electronic payment systems





providers, the telecommunications industry, and websites and customer services. The described industries provide servers or become suppliers, therefore compiling bills, to promote system compatibility, and to gain the customers of these industries.

#### 10. Conclusion:

When companies enter the B2C electronic commerce market, choosing an electronic payment system that will work well with the way they run their business that is both popular and safe is a major concern. Therefore, this research paper aims to analyze different kinds of electronic payment systems based on electronic payment system needs, and target electronic payment systems that have already entered the market or received support from W3C or other conglomerates. Some of these include: VCC, SSL, Cyber Cash, SET, Ecash, Mondex, Visa Cash, FSTC, Millicent, MPTP, and IBM small payment.

Moreover, Wireless and wideband Internet is a trend in future telecommunications. WAP and televisions that are able to access the Internet are increasingly becoming a trend. Consumers are no longer limited to using their personal computers to access the Internet and buy merchandise. Therefore, personal computers, digital televisions, personal digital assistants, and other wireless installations must have the electronic payment function. This is a trend for future electronic payment systems. Secondly, there are more types of electronic payment systems and the same electronic payment system may have different distributors. Therefore, to increase the frequency of use of electronic payment systems and to increase the loyalty of distributors, it is necessary for the other industries to share the same policies and to provide deals. For example, they can form alliances with the telecommunications, traffic, water, electricity, insurance, financial and other industries, to undergo online bill payment and search, or to provide consumer points and discounts on products.

In addition, distance is not a factor on the Internet; online consumers come from different countries. Therefore, electronic payment systems must have the function of exchanging currencies. The system must track all applicable fluctuating exchange rates and perhaps also take into consideration any applicable sales taxes, which will vary by locality and over time. No matter where the website is based, or where

the consumer is, everyone should be able to use the same electronic payment system, and not have to reapply for an electronic payment system that uses the desired currency. This step is necessary to make the electronic payment system multi-functional and to enable it to compete in the international market for managing

outsourced e-banking systems and services. Suggestions for developing countries are as follows:

1. Banks should adopt appropriate processes for evaluating decisions to outsource e-banking systems or services.
2. Banks should conduct appropriate risk analysis and due diligence prior to selecting an e-banking service provider and at appropriate intervals thereafter.
3. Banks should adopt appropriate procedures for ensuring the adequacy of contracts governing e-banking.
4. Banks should ensure that periodic independent internal and/or external audits are conducted of outsourced operations to at least the same scope required if such operations were conducted in-house.
5. Banks should develop appropriate contingency plans for outsourced e-banking activities.
6. Banks that provide e-banking services to third parties should ensure that their operations, responsibilities, and liabilities are sufficiently clear so that serviced institutions can adequately carry out their own effective due diligence reviews and ongoing oversight of the relationship.

On the other hand, in maintaining the privacy of customer e-banking information we should do the following:

1. Banks should employ appropriate cryptographic techniques, specific protocols or other security controls to ensure the confidentiality of customer e-banking data.
2. Banks should develop appropriate procedures and controls to periodically assess customer security infrastructure and protocols for e-banking.
3. Banks should ensure that third-party service providers have confidentiality and privacy policies that are consistent with their own.
4. Banks should take appropriate steps to inform e-banking customers about the confidentiality and privacy of their information.

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# Similarity Search over Multidimensional Data with the SH-Tree

Dang Tran Khanh  
School of Computing Science  
Middlesex University  
London, United Kingdom  
k.dang@mdx.ac.uk

## Abstract:

Nowadays feature vector based similarity search is emerging in modern data management systems. Such feature vectors extracted from real world objects are usually presented in the form of multidimensional data. As a result, a large number of multidimensional access methods (MAMs) have been introduced to the research community. These MAMs are categorized into two main classes: space partitioning/KD-tree-based and data partitioning/R-tree-based. Although there are a variety of "mixed" access methods, which try to inherit positive aspects from more than one access method, the number of "mixed" access methods that are derived from these two main classes is just a few. In this article, we introduce such a "mixed" MAM, the SH-tree: a novel and flexible super hybrid index structure for multidimensional data. Theoretical analyses will indicate that the SH-tree is a good combination of the two access method classes with respect to both the presentation and search algorithms. It overcomes shortcomings and makes use of their positive aspects to facilitate efficient similarity searches in multidimensional data spaces. Empirical experiment results with both synthetic and real datasets will confirm our theoretical analyses.

## 1. Introduction

The de facto standard technique widely applied to dealing with the searching problem in many modern database applications is the so-called feature transformation, where important properties of (complex) objects are extracted and mapped into points of a multidimensional vector space, which are simply called feature vectors. Feature based similarity search has a long development process which is still in progress now. Its broad application range includes multimedia databases [24], time-series databases [9], flexible query answering systems (FQASs) [10], etc. In these large databases, feature spaces have been usually indexed by means of multidimensional access methods (MAMs) in order to speed up the search process and minimize related costs. Similarity queries are naturally become neighborhood queries in the feature space.

Since Morton introduced the space-filling curves in 1966 up to now, many index structures have been developed. A survey schema that summarizes MAMs history from 1966 to 1996 is presented in [11]. In [10], we also introduced an evolution schema for most prominent MAMs published recently as well as many discussions of great worth. These surveys consistently show that MAMs can be divided into two main classes: (1) Access methods based on space partitioning (SP)

or KD-tree [3] such as KDB-tree [23], hB-tree [20], LSDh-tree [16], GNAT tree [7], etc., and (2) access methods based on data partitioning (DP) or R-tree [13] such as R-tree and its variants [25, 5], SS-tree [26], SR-tree [19], etc. The remains, which can not be categorized into the above schema, may be hybrid MAMs of both access method classes just mentioned above or special MAMs, which are called dimensionality reduction index techniques like Pyramid technique [2], UB-tree [1] or space-filling curves based MAMs (see [11] for a survey). Recently, the Hybrid tree [8], a hybrid MAM, has been proposed. It is formed by combining some positive aspects of both SP- and DP-based access methods. Although the Hybrid tree has been proven to be efficient in managing and querying multidimensional datasets, it still has deficiencies, which is one of reasons that lead us to introduce a new efficient and flexible MAM. We elaborate on these impulsive reasons in the next section. The rest of this paper is organized as follows: Section 2 discusses motivations that lead us to introduce the SH-tree. In section 3, we provide insights into the SH-tree structure and introduce a new concept of balance to SH-trees. Section 4 presents basic operations on the SH-tree. Adapted k-nearest neighbor algorithms and performance evaluation results for the tree is shown in section 5. In section 6, we introduce issues relevant to the integration of the SH-tree into DBMSs and discuss advanced query types that the tree can support. Finally, section 7 gives conclusions and presents open research directions.

## 2. Motivations

The SR-tree has shown superiorities over the R\*-tree and the SS-tree by dividing feature space into both small volume regions (using bounding rectangles-BRs) and short diameter regions (using bounding spheres-BSSs). Nevertheless, the SR-tree must incur the fan-out problem: only one third of the SS-tree and two thirds of the R\*-tree [19]. The low fan-out causes the SR-tree based searches to read more nodes (i.e. IO-cost increases) and to reduce the query performance. This problem does not occur in the KD-tree based index techniques: the fan-out is constant for arbitrary dimension number.

The Hybrid tree has been introduced recently in [8] and it makes use of positive characteristics of both SP-based and DP-based access methods. It

depends on the KD-tree based layout for internal nodes and employs bounding regions (BRs) as hints to prune while traversing the tree. To overcome the access problem of unnecessary data pages, the Hybrid tree applies a dead space eliminating technique by coding actual data regions (CADR) [16]. Although the CADR technique partly softens the unnecessary disk access problem, it is still not a high efficient solution to solve the problem entirely. It strongly depends on the number of bits used to code the actual data region and, in some cases, this technique does not benefit regardless of how many bits are used to code the space. Figures 1a and 1b show such examples in a 2-dimensional example space. Therein, the whole region is coded irrespective of how many bits are used. Figure 1c shows another example where the benefit from coding the actual data region is not much interesting, especially for range and nearest neighbor (NN) queries. This is due to the high remaining dead space ratio in the coded data region. Besides, as new objects locate outside the bounds of feature space already indexed by the Hybrid tree, the encoded live space (ELS) must be recomputed from scratch.

Furthermore, the SP/KD-tree based MAMs as the LSDh-tree, the Hybrid tree, etc. in common recursively partition space into two subspaces using a single dimension until the data object number in each subspace can be stored in a single data page. This partitioning way may lead cluster of data to be quickly destroyed because objects stored in the same page may be "far away" from each other in the real space. This problem could significantly influence the search performance and, especially, it could cause the number of disk accesses per range queries to be increased [11]. It is contrary to the DP/R-tree based MAMs as the SS-tree, the SR-tree, etc., in which they try to keep near objects in the feature space into each data page.

To alleviate these problems and take inherent advantages of the SR-tree (R-tree

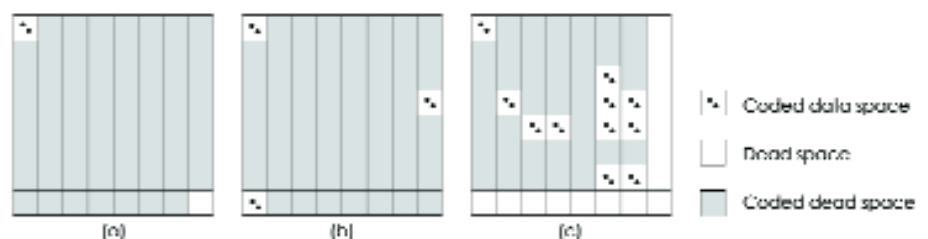


Figure 1: Some problems with coding actual data region





based MAMs as a whole), together with introducing novel noteworthy concepts we will present the SH-tree in later sections. As with the SH-tree, the fan-out problem will be overcome by employing the KD-tree-like presentation for partitions of its internal nodes. The data cluster problem as mentioned above, however, is softened by still keeping the SR-tree-like structure for presentation of balanced nodes of the SH-tree (cf. section 3.1). In addition, to manage not only spatial data points, but also extended spatial data objects like lines, polygons, etc. the SH-tree also allows overlaps between partitions. The next section will detail these ideas.

### 3. The SH-Tree Structure

This section presents insights into the SH-tree structure. We will introduce a very special hybrid multidimensional index structure of the SH-tree and discuss how to split multidimensional space into subspaces during the dynamic tree building process, together with a new concept of the SH-tree balance, which is termed "extended balance".

#### 3.1 Multidimensional Space Partitioning and Basic Structure of the SH-Tree

The SH-tree is planned to apply for both point and extended data objects so we choose a no overlap-free space partitioning strategy for directory nodes. The idea of this approach is to easily manage objects that cross a selected split position and to solve the storage utilization problem. The former is described in the SKD-tree [21] and the latter has happened to the KDB-tree, which shows uninterestingly slow performance even in 4-dimensional feature vector spaces [12].

There are three node kinds in the SH-tree: internal, balanced and leaf nodes. Each internal node  $i$  has the structure like  $\langle d, lo, up, other\_info \rangle$ , where  $d$  is the split dimension,  $lo$  represents the left (lower) boundary of the right (higher) partition,  $up$  represents the right (higher) boundary of the left (lower) partition, and  $other\_info$  consists of additional information as node type, pointers to its left, right child and its parent node as well as meta-data like the data object number of its left, right child. While  $up \leq lo$  means no overlap between partitions of its two child nodes,  $up > lo$  indicates that the partitions are overlapping. This structure is similar to ones introduced in the SKD-tree and Hybrid tree. The supplemental information like the meta-data as mentioned above also gives hints to develop a cost model for NN queries in high-dimensional space, or to estimate the selectivity of range queries, etc. Moreover, let  $BR_i$  denote bounding rectangle of internal node  $i$ . The bounding

rectangle of its left child is defined as  $BR_i \cap (d \text{ up})$ . Note that  $\cap$  denotes geometric intersection. Similarly, the bounding rectangle of its right child is defined as

$BR_i \cap (d \ lo)$ . This allows us to apply algorithms used in the DP/R-tree based MAMs to the SH-tree. Balanced nodes are just above leaf nodes and they are not hierarchical (cf. Figure 2). Each of them has a similar structure to that of an internal node of the SR-tree. This is a specific characteristic of the SH-trees. It conserves the data cluster, in part, and makes the tree height smaller as well as employing the SR-tree's superior aspects during the querying phase. Moreover, it also shows that the SH-trees are not simple in binary shape as in typical KD-tree based MAMs. They are also multi-way trees as R-tree based

MAMs:  $BN: \langle B1, B2, \dots, Bn \rangle$   
 $(\min BN\_E \ n \ \max BN\_E)$   
 $Bi: \langle BS, MBR, num, child\_pointer \rangle$

In general, a balanced node consists of  $n$  entries  $B1, B2, \dots, Bn$  with  $\min BN\_E \ n \ \max BN\_E$ , where  $\min BN\_E$  and  $\max BN\_E$  are the minimum and maximum number of entries in the node, respectively. Each entry  $Bi$  keeps information of a leaf node including four components: a bounding sphere  $BS$ , a minimum bounding rectangle  $MBR$ , the object number of leaf node  $num$  and a pointer to the leaf pointer. Note that, due to the computational complexity of the problem of computing minimum bounding spheres (MBSs) in high-dimensional spaces, the SH-tree only employs MBRs and BSs. Details of the calculation formulas can be found in [10, 19].

Furthermore, each leaf node of the SH-tree has the same structure as that of the SS-tree (because the SR-tree is just designed for point objects but the SH-tree is planned for both points and extended objects):

$LN: \langle L1, L2, \dots, Lm \rangle \quad (\min O\_E \ m \ \max O\_E)$   
 $Li: \langle obj, info \rangle$

As we see above, each leaf node of the SH-tree consists of  $m$  entries  $L1, L2, \dots, Lm$ , with  $\min O\_E \ m \ \max O\_E$ , where  $\min O\_E$  and  $\max O\_E$  are the minimum and maximum number of entries in a leaf, respectively. Each entry  $Li$  consists of a data object  $obj$  and information in the structure  $info$  as coordinate values of the data object's feature vector, a radius that bounds the data object's extent in the feature space, the data object's MBR, etc. If data objects in the database are complex,  $obj$  is only an identifier instead of a real data object. In addition, in case the SH-tree

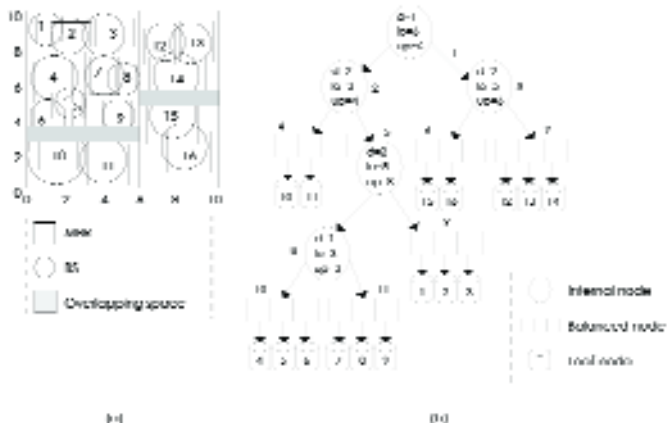


Figure 2: A possible partition of an example data space and the corresponding mapping of the SH-tree

is only applied to point data objects, each  $Li$  is similar to that of the SR-tree:  $Li: \langle obj, feature\_info \rangle$ . In this case, the other information of the objects is no longer needed. For example, the parameter radius is always equal to zero and MBR is the point itself.

Figures 2a, 2b show a possible partition of an example feature space and its corresponding mapping to the SH-tree, individually. Assume we have a two-dimensional feature space  $D$  with the size of  $(0, 0, 10, 10)$ . With the split information  $(d, lo, up) = (1, 6, 6)$ , the BRs of left and right children of the internal node 1 are  $BR2 = D \cap (d \ lo) = (0, 0, 6, 10)$  and  $BR3 = D \cap (d \ up) = (6, 0, 10, 10)$ , individually. For the internal node 2, assume that  $(d, lo, up) = (2, 3, 4)$ , we have  $BR4 = BR2 \cap (d \ lo) = (0, 0, 6, 4)$ ,  $BR5 = BR2 \cap (d \ up) = (0, 3, 6, 10)$ . Similarly, for the internal node 3, with  $(d, lo, up) = (2, 5, 6)$  we obtain  $BR6 = BR3 \cap (d \ lo) = (6, 0, 10, 6)$ ,  $BR7 = BR3 \cap (d \ up) = (6, 5, 10, 10)$ , and so on. Note that, the BRs coordinate information is not stored in the SH-tree explicitly, but it is dynamically computed when necessary.

In addition, the storage utilization constraints of the SH-tree must ensure that each balanced node is always filled with at least  $\min BN\_E$  entries and each data page must contain at least  $\min O\_E$  data objects. Therefore, each subspace according to a balanced node will hold DON (data object number) data objects and DON satisfies the following condition:

$$\min O\_E \times \min BN\_E \leq DON \leq \max O\_E \times \max BN\_E \quad (1)$$

#### 3.2 Splitting Nodes in the SH-Tree

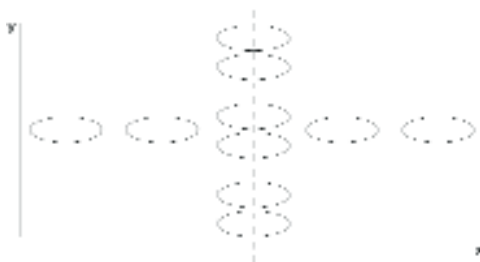
The SH-tree, like other MAMs, can be created from static or dynamic inputs. As the SH-tree is built on some given static data set, operations related to both the tree and data set such as insertion, deletion, etc. are not allowed during the building process. The problem of building MAMs over such static inputs is related to the bulk-loading problem [10] and in the context of the SH-tree we have to consider the internal node splitting. Due to the space limitation, we will not detail this problem. In this section, we assume the SH-tree is incrementally created from a dynamic database, and thus we just consider the split problem of leaf and balanced nodes. Leaf node splitting: The boundary of a leaf node in the SH-tree is the geometric intersection between its MBR and BS (this information is maintained in its parent node, i.e. a certain balanced node), but BS is isotropic thus it is not suitable for choosing the split dimension. Therefore, the choice of the split dimension depends on its MBR. This problem in the SH-tree is solved in the same way as that of the Hybrid tree. The selected split dimension minimize the expected disk access number per query. Without loss of generality, assume that the space is  $d$ -dimensional and the extent of MBR along the  $i$ th dimension is  $e_i$ . Let a range query  $Q$  be



a bounding box with each dimension of length  $r$ . Proving as done in [8], we get the following result: the split dimension is  $k$  if  $r/(ek+r)$  is the minimum. Hence, the split dimension  $k$  is chosen such that its extent in MBR is the maximum, i.e.,  $ek = \max(e_i)$ ,  $i=1, \dots, n$ .

The next step is to select the split position. First of all, we check if it is possible to split the MBR in the middle of the selected split dimension without violating the utilization constraint. If it is impossible, we distribute data items equally into two nodes after sorting data items according to their feature values in the selected split dimension. This way also solves a special case as shown in the hB-tree [20]. Figure 3 shows this case as an illustrative example in two-dimensional space: Assume the split dimension  $x$  is chosen and the minimum data object number of each partition must be three (the storage utilization constraint). There is no suitable split position if we apply the proposed method of the Hybrid tree as described in [8]. In this case and other similar cases, the SH-tree will distribute data items equally into two nodes.

**Balanced node splitting:** Because the balanced node has the similar structure to internal nodes of the SR-tree and R\*-tree, the internal node splitting algorithm of the R\*-tree [5] can be applied to splitting overfull balanced nodes of the SH-tree. With the SH-tree, however, if the sibling of an overfull balanced node is also a balanced node and still not full, an entry of the overfull balanced node can be shifted to the sibling to avoid a split. This method also increases the storage utilization [15, 16]. Note that, the best entry of the overfull balanced node to be shifted is one that the sibling needs least enlargement to enclose. Thus, the modified splitting algorithm for overfull balanced nodes can be concisely described as follows: First, try to avoid a node splitting as just discussed. If it



**Figure 3:** Leaf node splitting in the Hybrid tree: no suitable split position satisfies the storage utilization constraint

fails, the split algorithm similar to that of the R\*-tree is employed. Moreover, note that, in the SH-tree, the balanced node split does not cause propagated splits upwards or downwards, which is called cascading splits [20] and happened to the KDB-tree [23]. The storage utilization constraint of the SH-tree therefore is also not affected by the splits at all.

### 3.3 The Extended Balanced SH-Tree

For almost MAMs based on the KD-tree, the tree structure is not balanced (e.g., LSDh-tree, SKD-tree). It means that, in such index trees, there are leaf nodes that are farther away from the root than all others are. The experiments as presented in [7],

however, have shown that a good balance is not crucial for the performance of an index structure. In this section, we introduce a new concept for the balance problem in the SH-tree: extended balance. The motivation is to retain acceptable performance of the index structure and reduce maintenance cost for its exact balance in the presentation structure.

Suppose that  $p$ ,  $b$ ,  $b_{min}$ , and  $b_{max}$  denote leaf and balanced node number, minimum and maximum number of balanced nodes in the SH-tree, respectively. The following inequality holds:

$$b_{min} \leq b \leq b_{max} \quad (2)$$

We desire that the SH-tree's height  $h$  satisfies the following inequality:

$$1 + \frac{b_{min}}{h} \leq b \leq 1 + \frac{b_{max}}{h} \quad (3)$$

Inequality 3 is used to evaluate if the SH-tree is "balanced". The meaning of the balance here is loose: it does not mean that the path length of every leaf node from the root is equal to each other. If the height  $h$  at each leaf node in the SH-tree satisfies inequality 3, then the SH-tree is called an extended balanced tree (EBT), and otherwise it is not a balanced tree. The extended balance concept generalizes the conventional one: if inequality 3 becomes  $1 + \frac{b_{min}}{h} \leq b \leq 1 + \frac{b_{max}}{h}$ , then an EBT becomes a conventional balanced tree (CBT). Let's see an example as follows: If  $minBN_E=2$  and  $maxBN_E=3$ , the SH-tree as illustrated in Figure 2 is neither a CBT nor an EBT, and in general it is not a balanced tree. However, inequality 3 can also be extended and rewritten as follows:

$$1 + \frac{x \cdot b_{min}}{h} \leq b \leq 1 + \frac{y \cdot b_{max}}{h} \quad (4)$$

or a more general form:

$$1 + \frac{x \cdot b_{min}}{h} \leq b \leq 1 + \frac{y \cdot b_{max}}{h} \quad (5)$$

In inequalities 4 and 5, parameters  $x$  and  $y$  are acceptable "errors" (or tolerant errors). These parameters give more flexibility to the SH-tree but they must be selected carefully to prevent from creating a too much unbalanced tree. The SH-tree does not satisfy inequality 3 but satisfies an inequality 4 or 5 is called a loosely extended balanced tree (LEBT). For example, concerning the SH-tree as illustrated in Figure 2 and assume that  $minBN_E=2$  and  $maxBN_E=3$  then inequality 3 becomes  $4 \leq h \leq 4$  (here  $b_{min}=6$  and  $b_{max}=8$ ). If the SH-tree satisfies this condition, it really becomes a CBT (also EBT). We can readjust this condition with  $x=1$  and get a new condition with respect to inequality 4:  $3 \leq h \leq 5$ . As with this new condition, the above SH-tree can be considered as a LEBT. Selecting parameters  $x$  and  $y$  in equations 4 and 5 depends on many other attributes, say  $p$ ,  $minBN_E$ ,  $maxBN_E$ , etc. If these parameters are chosen suitably, the maintenance cost for the balance of the SH-tree is substantially decreased but it does not affect the querying performance. In general, if the SH-tree fails to satisfy inequalities 4 or 5 (with certain values of  $x$  and  $y$ ), it needs to be reformed. The reformation can reorganize the SH-tree entirely (also called dynamic bulk-loading [10]) or suitably change the splitting algorithm as introduced in [14]. There, Henrich presented a hybrid split strategy for KD-tree based MAMs. It depends on the weighted average of the split positions calculated using two split strategies, data dependence and distribution dependence. Note

that the dynamic reformation operation usually incurs substantial costs including both I/O accesses and CPU time. An efficient algorithm for such a reformation for the whole SH-tree is still an open problem. In [10], we preliminarily introduced a local dynamic bulk-loading algorithm for the SH-tree, which just dynamically reforms a certain part of the tree, but not the whole SH-tree, as necessary.

## 4. The SH-tree Basic Operations

### 4.1 Insertion

Let NDO be a new data object to be inserted into the SH-tree. First, we must traverse the SH-tree from the root downwards to locate a suitable leaf node  $w$ , which NDO will belong to. To accomplish this, we must differentiate the tree traversal between two node types: internal and balanced nodes. For internal nodes, we must select one among two branches to continue going down the tree. This task is easy inasmuch as we can treat the SH-tree's internal nodes like those of the well-know KD-tree. For a balanced node, the best candidate to hold NDO is a leaf node having the closest distance to NDO. To compute the distance  $dist(NDO, Leaf)$  from NDO to a leaf node, whose real covering region is the intersection between a MBR and a BS, we use a similar method to that of the SR-tree:

$$dist(NDO, Leaf) = \max(d_r, d_s) \cdot d_r = MINDIST(NDO, Leaf.MBR) \cdot d_s = \max(0, ||NDO - Leaf.BS.Center|| - Leaf.BS.Radius) \quad (6)$$

Here, notation  $||z||$  denotes the norm of expression  $z$  and the MINDIST distance metric is originally introduced in [22]: The distance of a point  $P(p_1, p_2, \dots, p_n)$  in Euclidean space of  $n$  dimensions from a hyper-rectangle  $R(lb_1, lb_2, \dots, lb_n, ub_1, ub_2, \dots, ub_n)$  in the same space, denoted  $MINDIST(P, R)$ , is computed as follows:

$$MINDIST_2(P, R) = \max_i \{0, p_i - ub_i, lb_i - p_i\} \quad (7)$$

After determining such a leaf node, if there is an empty entry in this leaf, NDO is inserted. Conversely, the leaf is overfull and we propose two strategies that can be conducted together in the SH-tree to endeavor avoiding a node split:

- Reinsertion: If the REINSERTION flag of this leaf node is still FALSE, a portion of its entries will be reinserted after setting that flag to TRUE. Here, we use a flag to control the reinsertion strategy, the leaf node can be performed this strategy again when the flag is changed from TRUE to FALSE. This is also different from the ways the SS-tree and R\*-tree employ to control the reinsertion (see [26, 5]).

- Redistribution: One entry of this leaf can be redistributed to one of its siblings, which is still not full, to make space for NDO. This idea is the same as that of [15] but does not





recursively go upwards like that: the siblings here are locally located in the balanced node. In fact, the predefined constant  $l$  of the algorithm proposed in [15] is similar to the current entry number (CEN) of the balanced node ( $\min BN\_E \leq CEN \leq \max BN\_E$ ). Note that the parameter CEN for the SH-tree's redistribution algorithm may be different from each balanced node. In the case if a split is still compulsory, it can only propagate upwards at most one level. Figure 4 illustrates the split propagation in the SH-tree. Assume a leaf P1 is selected to insert a NDO and P1's current entry number

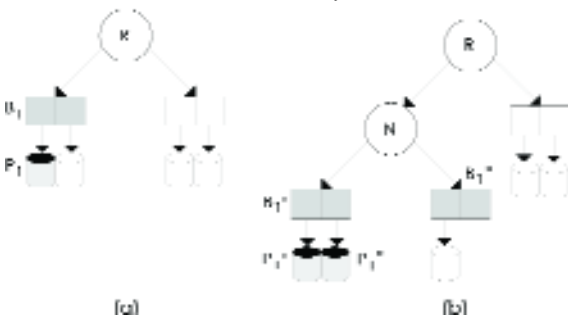


Figure 4: Split propagation in the SH-tree

is  $\max O\_E$  already. Moreover, suppose the redistribution also failed and the REINSERTION flag of the node is TRUE. Consequently, P1 is split into P1' and P1". Nevertheless, because  $\max BN\_E=2$  ( $\min BN\_E=1$ ) in this example, the balanced node B1 is later split into B1' and B1" and a new internal node N is created (Figure 4b sketches a possible resulting index structure after this split). The split process is stopped and has no more propagation to upper level (the root R in this example). This special characteristic of the SH-tree is far removed from that of the R-tree family, where a leaf node split can propagate upwards to the root.

#### 4.2 Deletion

After determining which leaf node contains the object and removing the object, the leaf may become under-full (it means that the object number in this leaf is less than  $\min O\_E$ ). There are some solutions to solve this problem as discussed in [13]. An under-full leaf node can be merged with whichever sibling that needs to have the least enlargement or its objects can be scattered among sibling nodes. Both of them can cause the node splits, especially the latter can lead into a propagated splitting, say the balanced nodes splitting. The R/R\*-tree and many modern MAMs as the SR-tree, SS-tree, Hybrid-tree, etc. employed re-insertion policy instead of the two ones above. For the special structure of the SH-tree, we propose a new algorithm to solve the under-full leaf problem called eliminate-pull-reinsert algorithm. The algorithm is similar to the eliminate-and-reinsert policy as well. However, because reinsertion can also cause the splits of leaf and balanced nodes,

thus after deleting the object, if the leaf node is under-full, we apply a "pull" strategy to get one object from one among the closest siblings so that this sibling still satisfies the storage utilization constraints. This also depends on the idea in section 4.1 but in a contrary direction. While the under-full leaf here "pulls" one object from some sibling, the overfull leaf "shifts" one object to the closest sibling that is still not full. Moreover, in case the pull policy as discussed still does not solve the problem, all objects in the under-full leaf will be reinserted. Note that, the pull policy can only propagate to the siblings located in the same balanced node, which is the parent node of this leaf.

#### 4.3 Search

As with the SH-tree, internal nodes can be treated as ones of either the KD-tree or R-tree based MAMs, but the balanced nodes and leaves are only considered as nodes of the R-tree based MAMs (or more concretely, the SR-tree). The SH-tree can support basic query types such as exact match queries, range queries, NN and k-nearest neighbor (k-NN) queries. Because of the space limitation, we will not go into details of all query types except for the k-NN query, which we will elaborate on and use to evaluate the search performance of the SH-tree. We refer interested readers to [10] for other details. Given a query object Q in a d-dimensional space E. Find all data objects O in the database DB having a minimum distance from Q, i.e.  $D(Q,O)=D(Q,O')$ ,  $O' \in DB$  where D is a metric distance function. This is the definition of NN queries. The k-NN query type is a generalization of NN queries: given a query object Q in a d-dimensional space E and a natural number k, find at least k objects closest to Q in the database. We introduce adapted algorithms to solve k-NN queries for the SH-tree in the next section.

#### 5. Evaluating Performance of the SH-Tree

In this section, we first introduce two adaptations of the state-of-the-art algorithms for k-NN queries to the SH-tree, and then present experimental results with both synthetic and real data sets to show the efficiency of the tree.

##### 5.1 k-NN Algorithms for the SH-Tree

The state-of-the-art algorithms for processing k-NN queries in spatial databases are shown in [22] and [17]. First of all, we introduce an adapted k-NN

```

Adapted algorithm 1:
1: ANN_Query(Node, Obj, ANN_Index, k, MB)
2: MINIMUM_OBJECT //current node
3: MAXIMUM_OBJECT //query object
4: CURRENT_OBJECT //current object of result objects
5: MIN //current of ANN_Index
6: BOUNDING_BOX //Node's bounding region
7: Case (Obj_Type) of
8: INTERNAL_NODE:
9: //compare MB for left and right child
10: MINIMUM_OBJECT:=MIN (Obj_Type, Obj)
11: MAXIMUM_OBJECT:=MAX (Obj_Type, Obj)
12: //transfer from Obj to left and right
13: POINT:=MIN (Obj_Type, Obj, MB_Type)
14: POINT:=MIN (Obj_Type, MB_Type)
15: if (Obj_Type:=INTERNAL) then
16: if (Obj_Type:=INTERNAL) then
17: ANN_Query(Node.Left, Obj, ANN_Index, k, Distance)
18: else return
19: if (Obj_Type:=INTERNAL) then
20: ANN_Query(Node.Right, Obj, ANN_Index, k, Distance)
21: else return
22: if (Obj_Type:=INTERNAL) then
23: ANN_Query(Node, Obj, ANN_Index, k, Distance)
24: else return
25: if (Obj_Type:=INTERNAL) then
26: ANN_Query(Node, Obj, ANN_Index, k, Distance)
27: RETURN MB
28:
29: For each entry leaf do
30: if (Obj_Type:=INTERNAL) or (low buffer[Obj].Distance(Obj, Leaf) <= MB) then
31: ANN_Query(Leaf, Obj, ANN_Index, k, MB)
32: END FOR
33:
34: For each object object do
35: ANN_Index:=ObjectDistance(Obj, Object)
36: if (Obj_Type:=INTERNAL) then
37: ANN_Index:=MIN (Obj_Type, Obj)
38: END FOR

```

algorithm based on the one proposed in [22]. Figure 5 below shows pseudo-code of this adapted algorithm.

This algorithm implements a depth-first search similar to the one introduced in [22]. However, depending on the special structure of the SH-tree, this adapted algorithm does not use the so-called ABL-Active Branch List. At an internal node, the algorithm recursively calls itself according to MINDIST from the query object Obj to its left and right child nodes. At a balanced node, a leaf is loaded if the distance from Obj to Leaf (line 29) is less than the current kth NN or there are less than k NNs found. Note that, the distance Distance(Obj, Leaf) is defined as the longer one between the minimum distances to the leaf's MBR and BS (cf. Formula 6). The function ObjectDistance(Obj,

```

Adapted algorithm 2:
1: ANN_Query(Obj, MB, MB)
2: MAXIMUM_OBJECT //query object
3: MINIMUM_OBJECT //current object of result objects
4: CURRENT_OBJECT //current object of result objects
5: MIN //current of ANN_Index
6: BOUNDING_BOX //Node's bounding region
7: Case (Obj_Type) of
8: INTERNAL_NODE:
9: //compare MB for left and right child
10: MINIMUM_OBJECT:=MIN (Obj_Type, Obj)
11: MAXIMUM_OBJECT:=MAX (Obj_Type, Obj)
12: //transfer from Obj to left and right
13: POINT:=MIN (Obj_Type, Obj, MB_Type)
14: POINT:=MIN (Obj_Type, MB_Type)
15: if (Obj_Type:=INTERNAL) then
16: if (Obj_Type:=INTERNAL) then
17: ANN_Query(Node.Left, Obj, ANN_Index, k, Distance)
18: else return
19: if (Obj_Type:=INTERNAL) then
20: ANN_Query(Node.Right, Obj, ANN_Index, k, Distance)
21: else return
22: if (Obj_Type:=INTERNAL) then
23: ANN_Query(Node, Obj, ANN_Index, k, Distance)
24: else return
25: if (Obj_Type:=INTERNAL) then
26: ANN_Query(Node, Obj, ANN_Index, k, Distance)
27: RETURN MB
28:
29: For each entry leaf do
30: if (Obj_Type:=INTERNAL) or (low buffer[Obj].Distance(Obj, Leaf) <= MB) then
31: ANN_Query(Leaf, Obj, ANN_Index, k, MB)
32: END FOR
33:
34: For each object object do
35: ANN_Index:=ObjectDistance(Obj, Object)
36: if (Obj_Type:=INTERNAL) then
37: ANN_Index:=MIN (Obj_Type, Obj)
38: END FOR

```

Object) (line 33) is used to compute the distance between two objects, which is the Euclidean metric (L2 metric) in our implementation. Because the ABL is not used here, its maintenance costs including all costs for generating and sorting the ABL are omitted. This is also a reason that improves the CPU-cost of this algorithm (cf.



section 5.2). Importantly, this algorithm only works as we know the value  $k$  in advance. Next, we introduce an adapted  $k$ -NN algorithm based on the one introduced in [17]. Figure 6 below sketches pseudo-code of the algorithm.

Algorithm described in Figure 6 is easy to follow and has a notable aspect: The priority queue PQ does not keep BRs of internal nodes, but they are calculated approximately using the BR of the whole effective data space. In fact, in this case, internal nodes of the SH-tree are being treated as ones of the KD-tree based MAMs. Specially, when a query object is chosen among data objects indexed, this traversal way is very fast to determine the leaf node that it should belong to. Therefore, its NNs are hopefully to be found efficiently. Moreover, even in the case we cannot immediately find the correct NNs of such a query, this method is still powerful to search for its approximate NNs. We had also developed a similar adapted algorithm where internal nodes of the SH-tree were treated as ones of the R-tree based MAMs. However, our intensive experiments with this adapted algorithm to compare the SH-tree with the SR-tree showed that the IO-cost during the query processing over the SH-tree was much less than that of the SR-tree but the CPU-cost was approximately equal. This is not expected, especially as the main memory can keep the whole SH-tree. The main reason for this is due to maintenance costs of the priority queue PQ. Our adapted algorithm in Figure 6 above needs a smaller memory space for the priority queue.

5.2 Experimental Results

Our performance tests concentrate on comparing performance of the SH-tree to that of the SR-tree with respect to  $k$ -NN queries. We choose the SR-tree because one of the main purposes of the SH-tree is to alleviate the SR-tree fan-out problem (cf. section 2) and the SR-tree is also one of the most prominent MAMs at the moment. As the SH-tree, similarity search on the SR-tree is also implemented based on the two original algorithms published in [22] and [17]. In the below charts, legends "SH-tree with algorithm 1" and "SH-tree with algorithm 2" (resp., "SR-tree with algorithm 1" and "SR-tree with algorithm 2") are correspondent with each of these algorithms, individually. For the tests, we use both synthetic and real datasets. The dimension number  $d$  of synthetic datasets varies from 2 to 64 and each of them has 100000 tuples of such multidimensional data points. The real dataset consists of 60000 9-dimensional image feature vectors (downloaded from <http://kdd.ics.uci.edu/>), which are extracted from images and based on their color moments. All the tests are tackled on a Sun Ultra Sparc-II 300MHz with 256 Mbytes of main memory and some Gigabytes of hard disk capacity. All programs are implemented in C++ and the page size is 8Kb for all datasets to meet with the disk block size of the operating system. There are some special test conditions we have done with the SH-tree: For synthetic datasets, the minimum storage utilization factor is set to 40% for leaf nodes and the reinsertion factor is set to 60%. For the real dataset, these parameters are 30% and 50%, individually. For all experiments, we found that if the dimension number  $d \leq 12$ , we should not use the redistribution policy for

insertions (cf. section 4.1). In our experiments, this policy is employed for synthetic datasets, whose dimension number is greater 12 and, in these cases, the reinsertion factor is set to 30% as proposed in [5]. Moreover, we carry out queries to find 15 nearest neighbors in all experiments. For each test, 100 query points are randomly selected among the corresponding datasets. Figure 7 shows experiment results to evaluate the performance according to various dimension numbers of the synthetic datasets. The SH-tree

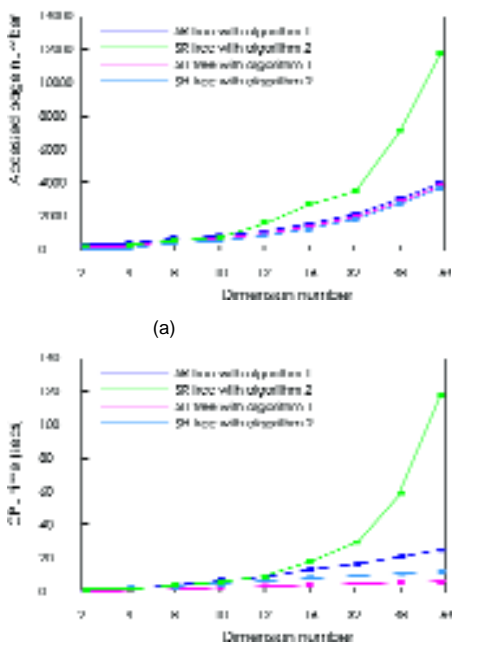
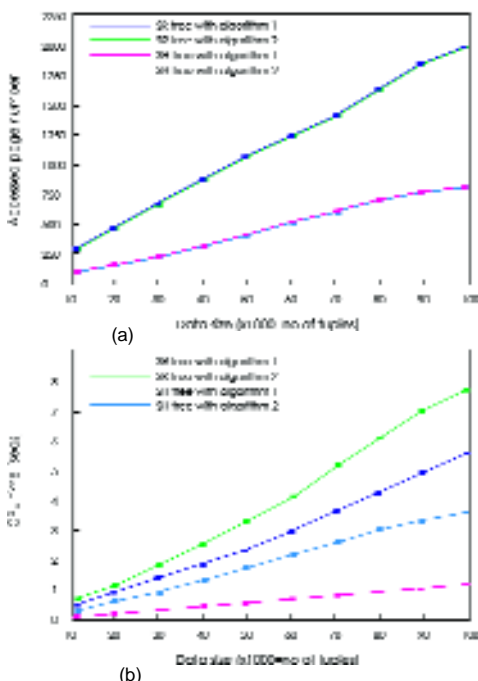


Figure 7: Variety in dimension number of synthetic datasets

adapted algorithms for both CPU-time and IO-cost. Besides, the first adapted algorithm shows better CPU-time over the second one for all the tests with the SH-tree. Nevertheless, the accessed page number of the second algorithm is less. Although research results introduced in [4] have pointed out that experiments with high-dimensional synthesis data sets are not meaningful, we still want to show here that the fan-out problem of the SR-tree really



causes more disk accesses.

Figure 8 shows performance of the SH-tree with a variety in data size of the 16-dimensional synthetic dataset. The results as shown in both Figures 7 and 8 partly confirm the conclusion, as declared in [18], that the second adapted algorithm outperforms the first one, but only in terms of the IO-cost in the case of the SH-tree. It also indicates well-scaled possibility of the

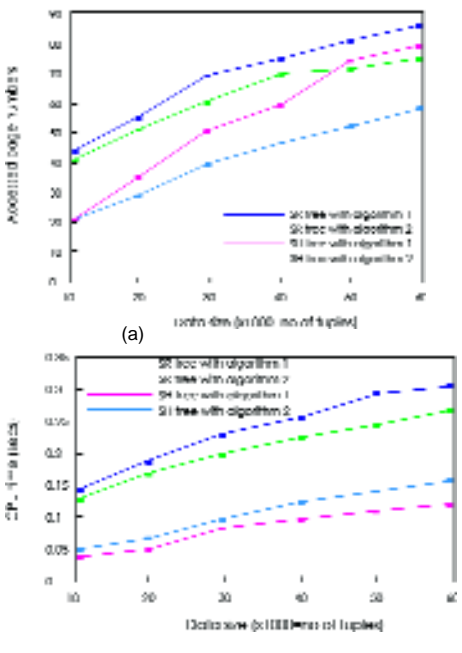


Figure 9: Variety in data size of 9-d real dataset

SH-tree concerning a variety of data size. Figure 9 presents the performance evaluation of the SH-tree and SR-tree with a variety in data size of the 9-dimensional real dataset. The experimental results also prove superiority of the SH-tree to the SR-tree. Specially, the second adapted algorithm shows a better result over the first one. This result again confirms the conclusion that has been presented in [6] that the second algorithm is optimal in terms of the accessed page number.

Figures 10 and 11 depict the SH-tree performance concerning various numbers of  $k$  nearest neighbors for both real dataset and 16-dimensional synthetic dataset. The SH-tree also outperforms the SR-tree in all cases.

To conclude this section, we give some explanations for the above experimental results as follows. With all the tests, the SH-tree's CPU-cost is less than that of the SR-tree because the algorithms do not have to compute the distance from the given query object to BSs of the SH-tree's internal nodes. As with the adapted algorithm 2, one more reason is as we discussed: its maintenance costs for the priority queue are reduced because we proposed an adapted algorithm using a smaller priority queue in

Figure 8: Variety in data size of 16-d synthetic dataset





size. Also, searching on the SH-tree accesses less data pages because of its special structure as discussed in section 3. Our experiments confirmed this theoretical analysis. Nevertheless, the SH-tree just employs BRs at the internal nodes, so pruning when traversing may be unsuitable for very skewed data. In such cases, the SH-tree's IO-cost may be higher than that of the SR-tree. Moreover, "push" operations of the priority queue at lines 16, 17, 20 and 23 of the second adapted algorithm as described in Figure 6 are expensive, and thus it accounts for the higher CPU-time of this algorithm. These operations must ensure the priority queue PQ in ascending order. The same operation in Figure 5 only

occurs at line 36. Overall, choosing an efficient algorithm also depends on the size and distribution of data indexed. The first adapted algorithm is very suitable for SH-trees that fit in the memory because its CPU-cost is lower, while the second one is optimal in terms of IO-cost. In addition, the second adapted algorithm is also suitable for k-NN queries without knowing values k in advance. In such circumstances, the second algorithm shows much better cumulative costs than the first one [18].

## 6. Discussions

Despite MAMs advantages, to support similarity search capabilities efficiently and flexibly in FQASs, we should give facilities for supporting MAMs as powerful data access methods in DBMSs. But, to integrate MAMs into standard DBMSs smoothly, we must first address several non-trivial issues to make MAMs functionate properly and efficiently in those DBMSs. These issues are well-known, but still not well-addressed yet, such as a new MAM should be in concord with available facilities in a DBMS as query optimizer, efficient transaction processing, and so on. As demonstrated in previous sections, the SH-tree is a very promising MAM. However, before the SH-tree can be integrated as an access method to a

commercial strength DBMS and become useful for a wide range of application domains, we need to develop efficient techniques to provide facilities for the query optimizer, transactional access to data via the SH-tree, and quick building of the tree. In [10], we disclosed and discussed these problems theoretically, together with introducing a simple but efficient approach to estimating IO-cost and accessed object number approximately for k-NN and range queries over the SH-tree, an algorithm for local dynamic bulk-loading of the tree, and an approach to preserving the tree consistency in presence of concurrent operations as insertions, deletions, and modifications. More work should be carried out towards bringing the SH-tree out to the commercial world.

Another interesting problem that we have been intensively investigating and got some initial encouraging results is to facilitate advanced query types using the SH-tree. A vast number of advanced query types were introduced in [10], including approximate similarity queries, multi-feature k-NN queries, spatial joins, etc., and we also presented efficient approaches to some of them. Interested readers can refer to [10] for more information about the SH-tree as well as valuable discussions about similarity search in modern database applications.

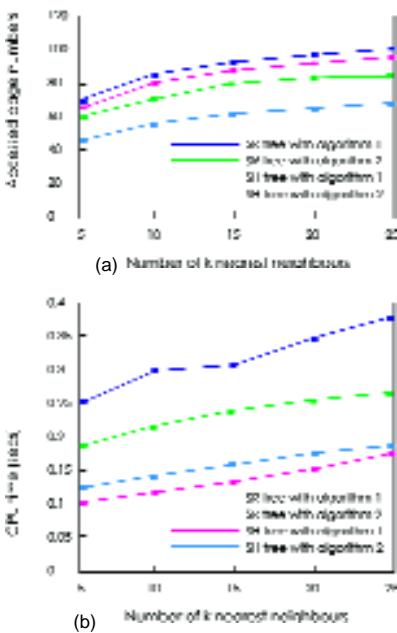


Figure 10: Variety in number of NN (9-d real dataset)

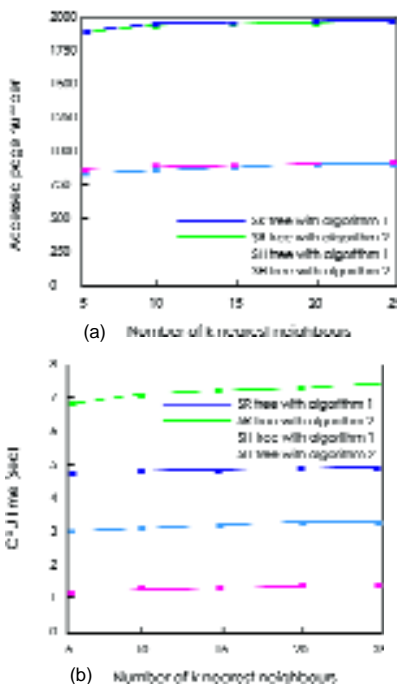
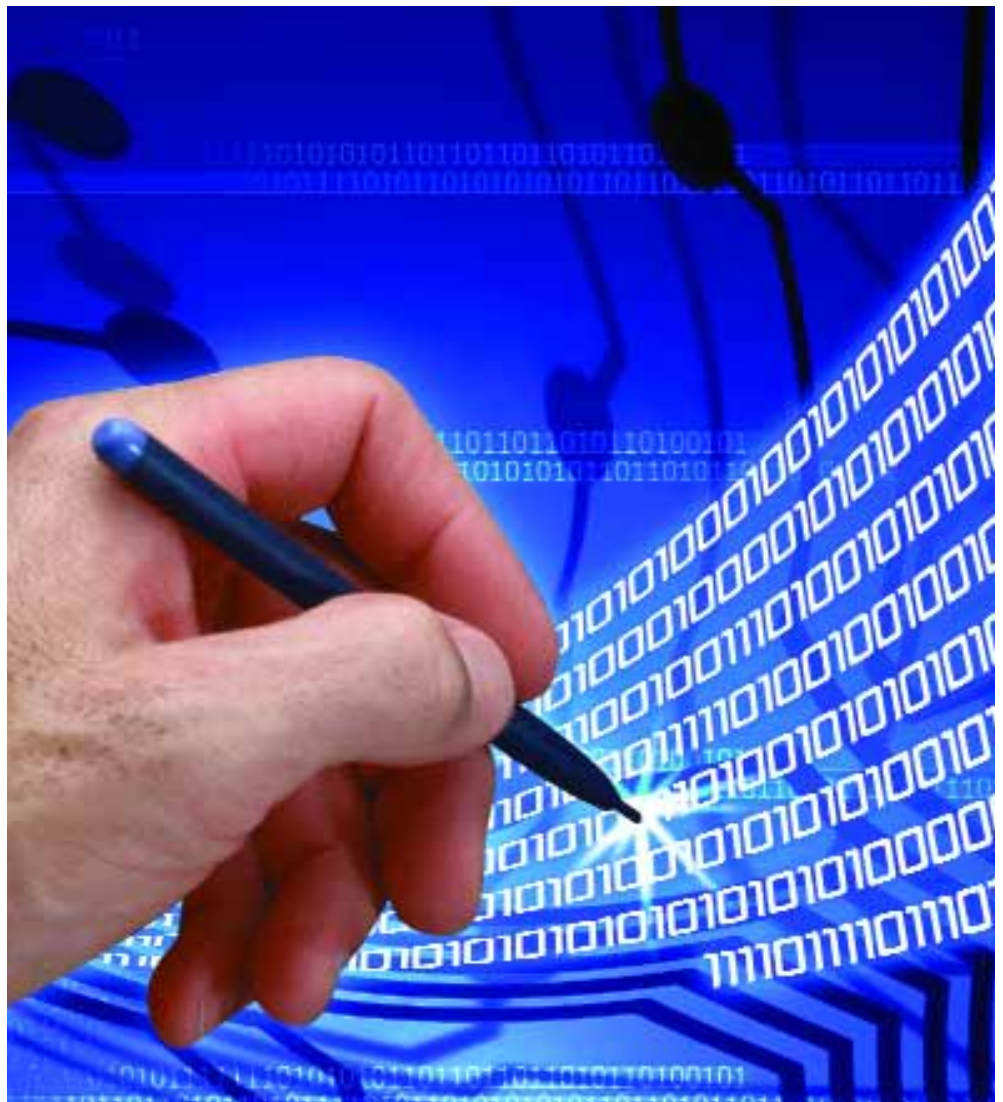


Figure 11: Variety in number of NN (16-d synthetic dataset)





## 7. Conclusions and Future Work

In this article, we introduced the SH-tree for indexing and searching multidimensional data. It is a well-combined structure of both the SR-tree and KD-tree based MAMs. While the fan-out problem of the SR-tree is overcome by employing the KD-tree like representation for partitions of internal nodes, the SH-tree still takes the SR-tree's advantages by using balanced nodes, which are the same as internal nodes of the SR-tree. In addition, the SH-tree has been designed to manage both point data and extended spatial objects. Importantly, we also introduced a new concept for the SH-tree, called the extended balanced tree (EBT). It implies that the SH-trees are not necessary to be exactly balanced, but the querying performance is still not deteriorated and maintenance costs for the tree balance are reduced dramatically.

Again, we also presented algorithms with the SH-tree for an important similarity query type, k-NN queries. Two adapted k-NN algorithms, which are originated from the state-of-the-art research results, were introduced for the SH-tree. The experiment results with both synthetic and real datasets have shown that the SH-tree processes k-NN queries very efficiently and outperforms the SR-tree by an order of magnitude. Our results also confirmed the conclusion of previous researches regarding the optimality in terms of the IO-cost of the algorithm presented in [17]. Besides, our results also show that the SH-tree can efficiently scale to high-dimensional spatial databases. As a part of the future work, we intend to compare the SH-tree to other prominent MAMs and deploy it for real world applications. Besides, extending the concepts of the SH-tree to form other new MAMs is also worth considering. For example,

motivating from experimental results and comments in section 5.2, we are thinking about multi-level balanced nodes in the SH-tree instead of one-level balanced nodes as discussed in previous sections. The real effectiveness and efficiency of this SH-tree are still an open question. Also, dealing with related issues towards integrating the SH-tree into existing commercial DBMSs will be a subject of great interest for our future research activities.

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# E-POLICY: INTERNET ORGANISATIONS

**We begin a series highlighting the work of internet bodies involved in global e-policy**

## **The Internet SOCIety (ISOC)**

The Internet SOCIety (ISOC) is a professional membership society with more than 100 organizations and about 20,000 individual members in over 180 countries. The Society provides leadership in addressing issues that confront the future of the Internet, and is the organization home for the groups responsible for Internet infrastructure standards, including the Internet Engineering Task Force (IETF) and the Internet Architecture Board (IAB).

Since 1992, the Internet Society has served as the international organisation for global coordination and cooperation on the Internet, promoting and maintaining activities focused on the Internet's development, availability, and associated technologies. The Society acts not only as a global clearing house for Internet information and education but also as a facilitator and coordinator of Internet-related initiatives around the world.

The Society serves the needs of the growing global Internet community through its annual International Networking (INET) conference and other sponsored events. It is involved in developing country training workshops, tutorials, market research, publications, public policy and trade activities, regional and local chapters and standardization activities. From commerce to education to social issues, the goal is to enhance the availability and utility of the Internet on the widest possible scale.

The Society's individual and organisation members are bound by a common stake in maintaining the viability and global scaling of the Internet. They comprise the companies, government agencies, and foundations that have created the Internet and its technologies as well as innovative new entrepreneurial organizations contributing to maintain that dynamic.

## **The World Wide Web Consortium**

The World Wide Web Consortium (W3C) develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential. W3C is a forum for information, commerce, communication, and collective understanding.

one of W3C's important projects is the Mobile Web Initiative. While World Wide Web technologies have become the key enablers for access to the Internet through desktop and notebook computing platforms, web technologies have the potential to play the same role for Internet access from mobile devices. However, mobile Web access suffers from interoperability and usability problems that make the Web difficult to use for most mobile phone subscribers. W3C's "Mobile Web Initiative" (W3C MWI) proposes to address these issues through a concerted effort of key players in the mobile production chain, including authoring tool vendors, content providers, handset manufacturers, browser vendors and mobile operators.

The W3C MWI is focussing on developing "best



practices" and a trustmark for Web sites (working name: "mobileOK"), work on device information needed for content adaptation, and marketing and outreach activities.

## **Internet Assigned Numbers Authority (IANA)**

IANA is dedicated to preserving the central coordinating functions of the global Internet for the public good. It is responsible for various administrative functions associated with

management of the Internet's domain-name system root zone, including reviewing the appropriateness of various changes to the content of the root zone as the Internet evolves and preparing reports on requested changes.

The Internet domain-name system (DNS) was deployed under the guidance of Jon Postel in 1984 and 1985 as a distributed database for information about resources on the Internet, replacing the prior "hosts.txt" system. The DNS contains resource records that map easy-to-remember domain names to the unique numeric addresses assigned to every computer on the Internet.

Internet Research Task Force (IRTF) IRTF's research groups work on topics related to Internet protocols, applications, architecture and technology. They have the stable long term membership needed to promote the development of research collaboration and teamwork in exploring research issues. Participation is by individual contributors, rather than by representatives of organizations.

The IRTF is managed by the IRTF Chair in consultation with the Internet Research Steering Group (IRSG). The IRSG membership includes the IRTF Chair, the chairs of the various Research Group and other individuals from the research community.

In addition to managing the research groups, the IRSG holds topical workshops focusing on research areas of importance to the evolution of the Internet, or more general workshops to, for example, discuss research priorities from an Internet perspective.

## **Nominet UK**

Most countries have their own Top Level Domain. In the UK .uk TLD was first used during the 1980s, and at that time a voluntary group called the Naming Committee managed the registration of .uk domain names.

Nominet UK manages a central database of domain names ending in .uk. The company was established in 1996 and is recognised by the UK internet community as the official manager of the .uk Top Level Domain (TLD). Just as Companies House in the UK holds authoritative records for company names Nominet maintains the database of .uk registered internet names.

Every organisation or individual connected to the internet is uniquely identified by a numerical address that is mapped onto a more memorable name. As a result, most countries have a central Registry - such as Nominet UK - to store these unique domain names. Nominet is not a governing or regulatory body, but provides a public service for the .uk namespace on behalf of the UK internet community.



## ASIAN TIGERS CHALLENGE

# JAPAN

**Louis Turner is Chief Executive of the Asia-Pacific Technology Network and has run the UK-Japan High Technology Industry Forum for the last 20 years. Here he offers a unique perspective on technological development in the UK and the Asian economies' growing challenge to Japan**

## Asia on the move

The progression of the UK-Asia Forums over the last 20 years, starting with Japan and then incorporating Korea and China, has matched the development of these Asian countries as international competitors. Back in 1986 when the UK-Japan High Technology Industry Forum started, I doubt if either Korea or China were mentioned as potential competitors yet twenty years later, there is universal acceptance that Asia as a whole is on the move.

Perhaps the biggest lesson from running these Forums is that the psychology of the three countries varies markedly. Certainly, these Forums demonstrate that there is no such thing as a universal Asian business culture.

Our Japanese partners have always been dedicated to detail and have remained quietly unassuming, while their delegations have been happy to talk about long-term technological trends and potential technological collaborations. What they have been reluctant to do is debate contentious issues.

### Japanese slowdown

By the early 1990s, the Japanese economy was running into trouble. At the Forums, the

British, having come through the worst of Mrs Thatcher's reforms, were starting to offer papers on corporate restructuring. Despite the fact that there were probably some lessons which the Japanese side could take away from the British experience, there was positive resistance to having such a debate put into Forum programmes. There were pressures on the British not to use inflammatory terms such as "restructuring" in the titles of their talks.

By the mid-1990s, Japan's tendency to sweep contentious issues under the carpet was becoming very clear. During the 10th Forum, held in 1995, one of the Japanese participants went on record to say that he noted that the official British delegates were all talking about the need to improve British competitiveness. He commented that it was very noticeable that the Japanese counterparts studiously avoided the use of such a term. They continued to stress the need for forecasting and collaboration. Words like "competition", "competitiveness" and "restructuring" remained taboo.

### Entrepreneurs lacking

What also became abundantly clear by the mid-1990s was Japan's bad record of producing new entrepreneurs. I remember visiting Japan's first Science City (Tsukuba) in 1997 to find that, although it was full of national research laboratories, there did not seem to have been a single spin-out

company from it. (I later learned that Mrs Thatcher had made the same discovery when she visited Tsukuba on an earlier occasion).

This led to my organising a conference the following year in Tsukuba with GlaxoWellcome as a partner. The topic was academic entrepreneurship, and what sticks in my mind was that, during the first 90 minutes of presentations by Japanese speakers, the only examples of Japanese entrepreneurs who were mentioned were Mr Honda (who was dead), Sony's Mr Morita (then at the end of his career, incapacitated by a stroke) and the executives of Asahi Beer who had produced a new brand, Asahi Lite (which no Westerner would rate as an example of entrepreneurship).

The Koreans have some similarities with the Japanese. Their big companies (the Chaebol) such as Samsung Electronics produced speakers who were on a par with the best of the Japanese executives. However, right from the start, there were a significant number of small Korean companies involved.

### Chinese entrepreneurs

However, it is the Chinese who seem the furthest away from the Japanese mind-set. From the very first Forum in Shanghai (2002), they insisted on having sessions on Venture Capital and Science Parks. After the conference, a group of us visited the Zhangjiang Hi-Tech Park in Pudong. In the initial presentation, it was clear that the Chinese were



Lord Sainsbury speaking at the UK-Korea High Technology Industry Forum





copying all the elements which had gone into making Silicon Valley what it had become. In particular, they pointed to two or three sections of the Park which were dedicated to incubator units - facilities designed to allow small companies to do their initial growing. In 2005, when we visited Zhongguancun Life Science Park in Beijing, the planners had gone further by creating incubator units aimed specifically at Chinese entrepreneurs who were coming back to China from overseas spells in countries like the United States. The contrast with Tsukuba City was immense.

Whatever the underlying challenges facing China (need for political evolution, a creaking financial system, some serious environmental challenges which are building up), the mind-set displayed by the average Chinese delegate is far more international in its thinking than the equivalent Japanese delegate's mindset back in the 1980s. One of the big differences is education where, like the Koreans, the Chinese positively encourage people to go overseas for their graduate education.

In all Forums, we are dealing with high quality delegates and speakers. It is now very difficult to tell apart the best Korean corporate speakers from their Japanese competitors. The Chinese do not yet have many excellent speakers from their corporate

sector, but the presentations from their research institutes and the better universities are generally high-quality.

### The Japanese Enigma

Twenty years of running these Forums leaves me, though, with one major puzzle - why can Japan not turn its scientific and technological prowess into much faster growth?

The Japanese economy is still the second largest in the world. On a per-capita basis, the Chinese economy is still far behind where Japan was in the 1950s at the start of Japan's post-1945 burst of growth. Japanese companies rest on a massive technological base. Their laboratories are lavishly funded. Government funding has been stepped up so that their public laboratories are similarly well-funded. In the digital economy, they seem to be well placed to take the leading role.

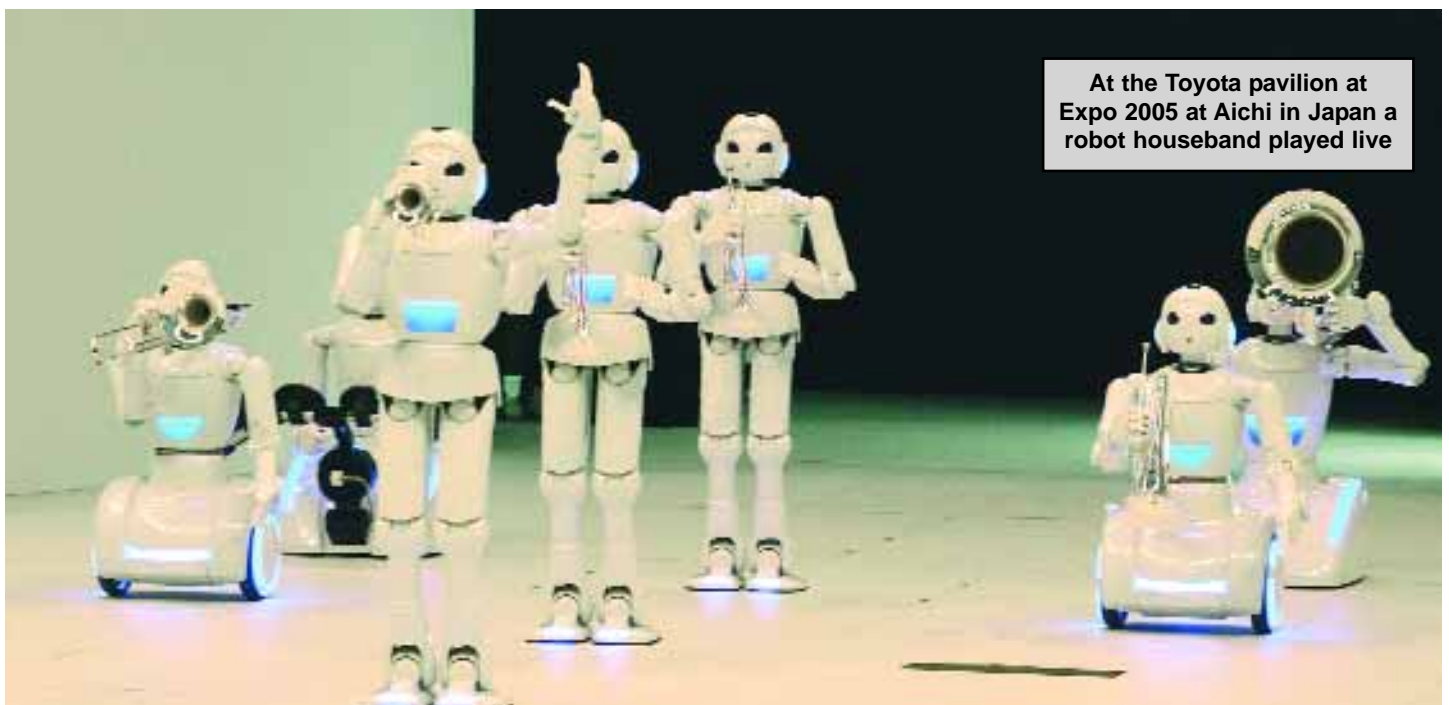
Yet when putting together the 2005 UK-China Forum, we had 120 Brits attending, while we barely got 40 out to the equivalent UK-Japan one. This may well tell us something about the fickleness of international investors. However, it may also reflect that, however good one's science base, one has to have a culture which encourages entrepreneurship and stresses the importance of competitiveness. The Chinese science base is far poorer (though genuinely world-class in selected areas such as parts of genomics), but the culture seems more naturally entrepreneurial. The question for Japan is,

can it rebuild the dynamism it had up to 1990?

### THE CHANGING FACE OF THE UK

Running 28 forums over the course of 20 years it has been instructive to observe changing moods on the British side. When we started the Forums in 1986, British self-confidence was at its lowest ebb. The 1970s had been traumatic, culminating in the 1979 election of Mrs Thatcher and her subsequent programme of radical economic restructuring which had pushed up unemployment to nearly 15% and the apparent decimation of the British manufacturing sector. The collapse of the British-owned consumer electronic, computer and auto industries meant that famous corporate names were going out of business - many apparently into the arms of upcoming Japanese competitors. There was a genuine feeling that the Japanese had permanently overtaken the UK as an economic power.

Gradually, though, one could see British self-confidence re-emerging. This first showed in the debate which recognised the relative strengths of the British innovation system. This showed up in the argument that British "serendipity" was a different, but powerful, kind of innovation compared with Japan's continuous improvement. This self-belief was reinforced when Japanese companies started putting research operations down around the Universities of Cambridge, Oxford and London (amongst others).



At the Toyota pavilion at Expo 2005 at Aichi in Japan a robot houseband played live



### **SMEs emerge**

There was an emergence during the 1980s of a growing number of self-confident British high-tech SMEs (Small and Medium Sized Enterprises) which played an increasingly important role in British delegations. Many of these had actually spun out of the University system.

It became clear that, although the British had lost their way in consumer electronics, automobiles and computing, they were actually seeing off the Japanese competition in industries such as Oil and Gas, Pharmaceuticals, Aerospace and Financial Services. The Japanese were never very interested in the latter sector but the Chinese insisted right from the start of the Forums with them that there should always be a major session on Venture Capital and the financing of innovation. This led directly to the creation of a UK Chinese working party focusing on the development of Chinese venture capital markets.

### **Creative Technologies**

There were even subtle developments in the electronic sector, where Britain seemed to have done so badly during the 1980s. By the end of the 1990s, Britain had taken a world lead in Digital Broadcasting to the extent that, in 1999, APTN actually organised a standalone conference for the Department of Trade to demonstrate Britain's Digital Broadcasting experience to the Japanese electronics industry. If anything, Britain's lead in this sector has grown in subsequent years to counteract the strides the Asian countries have made in mobile communications.

### **Digital Broadcasting**

In recent Forums, we have put Digital Broadcasting into the wider context of "Creative Technologies," a concept which includes broadcasting, but also games, animation and educational content. At the moment, the jury is still out as to whether the British have sustainable strengths in this general area. They will almost certainly continue to be a major force in digital broadcasting technology, but the broadcasting sector faces competition from new delivery techniques made possible by the spread of broadband.

In this general area, Korea is clearly gaining competitive strengths from its position as world leader in broadband penetration to the home. The last Korean Forum had a presentation on the development of MMOG (Massive Multiplayer Online Games), while a session on Creative Technologies in the last China Forum showed that the games sector

was starting to boom in China as well, along with a very active animation industry.

### **UK-Japan Forums: a quick history**

The first UK-Japan High Technology Forum took place in 1986 and celebrated its 20th anniversary with a Forum in Osaka in May this year. The concept was created along with Tomihiro Taniguchi, a visiting researcher from Japan's Ministry of International Trade and Industry (MITI) when we were working in the Royal Institute of International Affairs (now Chatham House). We won a competition within MITI for initiatives to encourage Euro-Japanese collaboration with a concept for an annual event which would be built round next-generation young executives. The Japanese delegation would be funded from semi-public sources. The British side would be self-funding. The first Forum was held in London and came at an interesting time in UK-Japanese economic relations. On the British side, Mrs Thatcher's reforms were wreaking havoc in British industry, with very few signs that they were going to work. In consumer electronics, British industry had been almost totally eclipsed by Japanese competition. Major British companies like ICL (computers) and Rover (autos) were being forced into collaborations with Japanese companies such as Fujitsu and Honda.

### **Moral low**

The morale of British executives was low. On the other hand, leading Japanese companies were some 15 years into the wave of international investment which started in the early 1970s. It seemed they could do no wrong - and their confidence was boosted by the wave of books with titles such as Japan As Number One, which implied that Japan had found the secret to eternal growth.

The first Forum, therefore, focussed on UK-Japanese collaboration, with the implicit assumption that in most collaborations the weaker British partner would gain most from their links with a technologically-stronger Japanese one.

Almost immediately, however, there were signs of some self-doubt on the Japanese side. In the second Forum in Tokyo (1987), Don Braben of BP Ventures drew a distinction between "Japanity" - the Japanese tradition of continuous improvement - and the British art of innovation through "serendipity", the ability to make breakthroughs by seeing non-obvious connections. To the surprise of the British,

the Japanese side seemed to accept there was such a psychological distinction, and in subsequent years, this debate deepened.

### **Japan in the UK**

The Forum was soon giving Japanese companies such as Canon, Toshiba, Sharp, Hitachi and Kobe Steel the chance to discuss their new research operations in the United Kingdom. These seemed to be coming to the UK at least in part because the Japanese companies appreciated the quality of British universities and researchers.

Subsequently, triggered by a Forum held in Oxford (1996), the Japanese side realised that British Universities were also starting to spin companies off in a way which seemed inconceivable within Japanese culture. This awareness fed into Japanese policy initiatives, such as the creation of TLOs (Technology Licensing Organisations) which were designed to commercialise the intellectual property coming out of Japanese universities. One of the Japanese delegates in Oxford, Yoshiaki Tsukamoto, went on to become a Professor at Tokyo Institute of Technology where he actually managed the first TLO to be created.

### **Institutional Background**

Up to 1993, these Forums were managed by the Japan Economic Forum and the Royal Institute of International Affairs. However, in that year, the RIIA allowed me to spin the Forum concept out through a semi-charitable company (a Company Limited by Guarantee) which, after a couple of name changes, is now known as the Asia-Pacific Technology Network.

This meant that the British side remained strictly non-governmental and, during the 1990s, as Japan slid into recession and became unfashionable, it was difficult to keep the British side of this operation going. However, by the end of the 1990s, the Department of Trade started to give limited financial support, and Lord Sainsbury, the Science Minister attended his first UK-Japan Forum in Sendai (2000), and subsequently met Japanese delegations which came to the UK in 2001 and 2003.





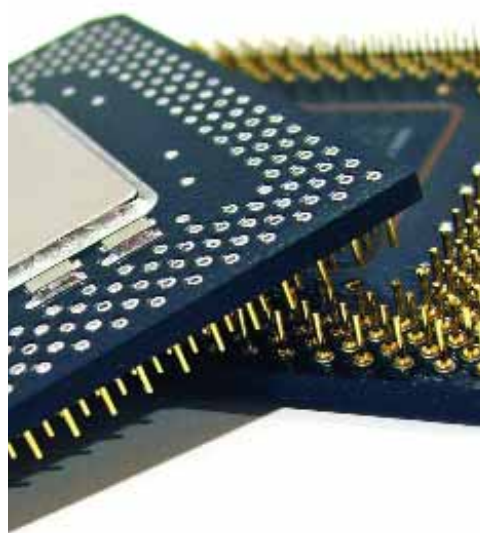
## UK-Korea and UK-China

The renewed vitality of these UK-Japan Forums then caught the attention of the British Embassy in Seoul. Mike Cherrett, the Science Attache there, visited Japan for the Sendai Forum and asked APTN to put a British delegation together for a first UK-Korea Forum, which was duly held in Seoul that November, taking advantage of a mission of British Research Councils, again led by Lord Sainsbury.

The Korean Forum was different from the original Japanese one, in that there was much greater official British support, involving both the Department of Trade's International Technology Service and TradePartners UK (now known as UK Trade and Investment). On the Korean side, the Ministry of Commerce, Industry and Energy was the main partner, working through an organisation known as KOTEF.

The basic structure of the conferences and the visits programme was much as had been developed in the UK-Japan

Forums. These Korean Forums were immediately put onto an annual cycle of conferences alternating between Seoul and the UK. The major innovation in this series



has been a much greater emphasis on Business-to-Business than was put into the Japanese ones.

This UK-Korean initiative then led directly on to the UK-Chinese Forum, with the Department of Trade's International Technology Service taking the financial lead. They asked APTN to organise the first UK-China High Tech Forum in Shanghai in October 2002 as part of a British week of excellence ("Leading Edge").

Lord Sainsbury led the delegation, which included Nobel Prize winner, Professor Sir Harry Kroto. China's Ministry of Science and Technology was the local partner, though most of the Chinese speakers came from Shanghai and its environs. This initial Forum was followed by a second Forum in London in November 2003, and, then, the 3rd one in Beijing in January 2005.

## UK-China High Technology Forum, Beijing

The third UK-China High Technology Forum was held in Beijing to launch a Year of British Science in China. The British Science Minister, Lord Sainsbury, led a 120-strong delegation. On the Chinese side, Dr Liu Yanhua, Vice Minister, for Science and Technology led a Chinese delegation of 220.

The delegates discussed topics ranging over Sino-British collaboration, Venture Capital, Cancer Research, Environmental Technology, Semiconductors for Mobile Communications, Marine Sciences, Universities and Innovation, Advanced Manufacturing, Creative Technologies and Wireless Broadband

This programme is a prime example of the High Technology Forums which Britain has been running with Asian countries over the last 20 years. Even when Ministers are involved, these Forums are executive-driven, with the topics being chosen to reflect corporate interests, with some 60% of the British speakers being business people. The Forums alternate between the UK and Asia roughly on an annual basis. The conferences normally last for two days and typically combine a half day of high-level plenary sessions, with a day and a half of specialist parallel ones. There is usually a programme around the conference, in which delegates visit research labs, science parks and factories.

## Digital Convergence

What has been particularly noticeable during the 20 years of Forums has been the increased emphasis on Digital Convergence, with particular emphasis on the importance of mobile communications.

From the very earliest UK-Japan Forums, Japanese companies such as NEC, NTT and Sumitomo Electric talked about the coming together of Communications and Computing. By the mid-1990s, Japanese presentations fairly routinely were looking at a world in which communication would be "Anytime, Anywhere and Whomever" (to quote Sharp's Dr Kataoka).

### Mobile communications

Today, whichever country we are dealing with, it is impossible to run a Forum without dealing with the mobile communications revolution. Although Europe took a lead in Second Generation mobile communications, through the development of the GSM standard, it was the Japanese, through NTT DoCoMo's iMode, who first showed how the internet could be routinely accessed through the mobile phone.

Europeans have been scrambling to stay in touch with Asian developments since then. As I write, there is a sense that the centre of gravity of mobile communications is moving inexorably eastwards as the technologically sophisticated Japanese mobile consumer, is joined by the Koreans and the Chinese who are now the world's largest market for mobile handsets.

However, British companies are not yet out of the race. ARM Holdings regularly provides speakers to our Forums who point out that chips, designed around their energy-efficient architecture, are in over half the mobile handsets sold globally. Similarly, Symbian has produced an operating system for mobile operations which Microsoft has had trouble competing with. Then, in the 2005 UK-China Forum, a small British company, picoChip, announced a deal to create a partnership with the Institute of Computing Technology, China Academy of Sciences, to accelerate WiMAX development and deployment in China.

Finally, there is Vodafone, which may not be a significant generator of technology (and is currently having troubles competing in Japan) but has developed a global presence and now runs the world's biggest mobile phone network.



# East v West



**Crispin O'Brien, Head of Technology at KPMG**

Over a third of the world now lives in China and India. With a population of 2.4 billion people between them, the growth of these two markets cannot be ignored, but how is competition between technology companies in the East versus West shaping up? And how can Western companies balance the opportunities and threats posed by these emerging markets?

Maturity in the Western technology sector is limiting domestic growth - penetration rates are close to 100% in some instances, such as mobile phones - and there is a growing feeling among consumers that the technology they already own is 'good enough'. Western consumer demand is changing to focus on converged technologies and simplicity of usage.

In contrast, countries such as China and India have a seemingly endless supply of new customers, many of whom are becoming consumers for the first time in their lives. For example, an average 7 million new mobile phones are registered in India each month and 6 million in China. Given such a potential market, technology companies would seem to have the world at their feet. However, both countries have their own challenges to overcome before they truly become forces on a global scale.

India's giant IT service providers enjoy success by offering cost-efficient back office and infrastructure solutions for established Western corporations. This service-orientated strategy, if left unchanged, will come at the expense of India's own domestic innovation. India's national infrastructure still leaves much to be desired, and continues to pose great challenges in the areas of transport, logistics, and telecommunications.

China needs to focus on ensuring global confidence in their efforts to effectively address IP recognition. The sheer scale of the growing Chinese economy poses unique challenges in terms of ensuring regulatory compliance. There is also a growing perception that the Chinese Yuan is an undervalued currency which gives

**ANNA University**  
**Visited BITE**

The Vice Chancellor of one of the leading Engineering Universities in India visited BITE recently to identify areas of research and development. ANNA University is due to sign a Memorandum of Understanding with BITE. This initiative will enable both institutions to exchange knowledge and create a platform for diversifying learning at a global level.

Chinese companies an unfair competitive advantage.

While these Eastern countries will undoubtedly overcome these issues eventually, for now, Western IT companies can capitalise on their head start and continue expanding into these markets. However, to retain future competitive advantage, it will be imperative for Western IT to focus on innovation and stay at the top of the value chain. Perhaps in the new digital world the answer lies in 'coopetition'.





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Avicenna House  
258-262 Romford Road London E7 9HZ  
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