Apax
PARTNERS

The impact of innovation

Technology Pioneers 2003

Technology Pioneers are a
constituency of the
World Economic Forum.

Apax Partners and Deloitte Touche
Tohmatsu are strategic partners of
the Technology Pioneers programme.

Contents

Acknowledgements
Page 2

Preface
Page 3

The impact of innovation
Page 4

Technology Pioneer profiles
Page 10

Acknowledgements

This report was prepared by Apax Partners with the help of the Economist Intelligence Unit. We would like to thank Tom Standage, Daniel Franklin, Andrew Palmer, Mike Johnson and Mike Kenny. Thanks also go to Sohini Chowdhury at the World Economic Forum.

Apax Partners' international telecoms, information technology and healthcare investment teams contributed significantly to the report. Special contributions were made by Adrian Beecroft, Amos Goren, Peter Englander, Gal Hayut, Regina Hodits, John McMonigall, Anat Naschitz, Cathrin Petty, Jeremy Reffin, Michael Risman, Evangelos Simoudis, Stephen Thompson, Paul Vais and Alexander Wong.

© 2003 Apax Partners Ltd/
Economist Intelligence Unit.
All rights reserved.

Neither this publication nor any part of it may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of Apax Partners Ltd ("Apax") and the Economist Intelligence Unit.

Nothing in this publication is intended to constitute an offer or solicitation to buy or sell investments of any description in any jurisdiction. Apax makes no representation that the information or materials in this publication are appropriate for use in all locations, or that any investments or services that are referred to in this publication are available in all jurisdictions, to everyone, or at all. You are responsible for compliance with local laws or regulations and for obtaining your own legal, tax and financial advice before entering into any transaction.

All the information in this publication is verified to the best of the authors' and publisher's ability, but we make no representation that it is accurate, reliable or complete. All such information and opinions are subject to change without notice. You must in any event conduct your own due diligence and investigations rather than relying on any of the information in this publication. We cannot accept responsibility for loss arising from decisions based on this publication. The investments or services referred to in this publication may not be suitable for everyone. If you have any doubts as to suitability, you should seek advice from an investment adviser.

Apax Partners Ltd is regulated in the UK by the FSA.

Preface

Computing once conjured up images of the mainframe and now makes us think of the PC and the Internet. What image will best represent computing in the future? Take your pick. As we argue in the essay at the front of this report, computing is fast becoming an enabling technology that powers advances in many other areas. From mobile phones to industrial production, drug discovery to supply chain management, the impact of computing is increasingly pervasive.

The rippling of computing into other fields is exemplified by many of today's most innovative technology companies. A majority of the 40 companies that have been selected as World Economic Forum Technology Pioneers in 2003 sit at the intersection of computing and other industries. Brief profiles of all the Technology Pioneers can be found at the back of this report—they are derived from material submitted by the companies themselves.

It is in the nature of pioneers that not all of them succeed. But as a group, the Technology Pioneers illuminate the breakthroughs that will eventually affect us all. For that they deserve warmest congratulations.

About the Technology Pioneers programme

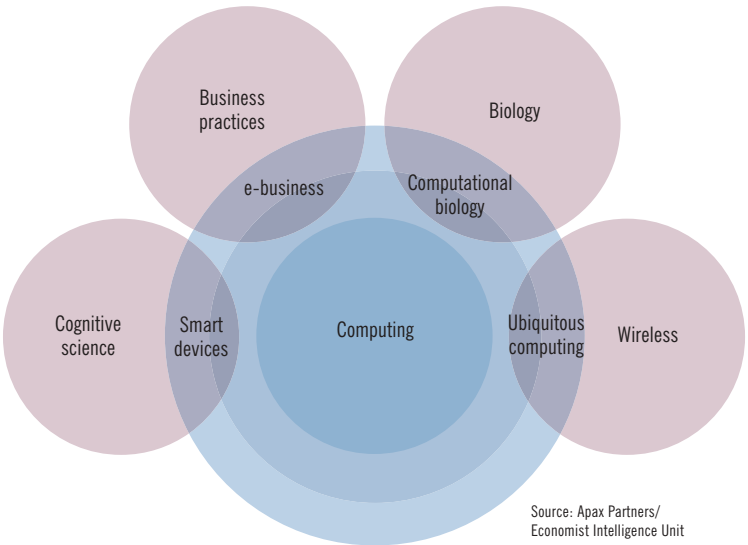
The Technology Pioneers programme honours the leaders of companies that develop and apply the most innovative and transformational technologies. The programme was co-founded by the World Economic Forum and Deloitte Touche Tohmatsu in 2000. The programme is currently run by the World Economic Forum with guidance from Apax Partners and Deloitte Touche Tohmatsu.

For further information on the programme and on how companies become Technology Pioneers, please visit the World Economic Forum's website at http://www.weforum.org.

The impact of innovation

Progress in computing is providing the foundation for innovation in other fields

The ripple effect
Innovation occurs in overlap areas as computing ripples outwards. The examples below are not exhaustive.



Source: Apax Partners/ Economist Intelligence Unit

Innovation in one field often has an unexpected impact elsewhere. The Technology Pioneers profiled later in this report might appear to be working in separate, well-defined industries such as biotechnology, information technology, energy and manufacturing. But look closely, and it is apparent that they can be grouped in another, more informative way. Most of these firms are operating where computing has started to overlap with other previously separate fields, such as biology, wireless communications, cognitive science and business practices. Each new area of overlap provides fertile ground for innovation. And each one is a different manifestation of the same technological trend, as the impact of computing ripples outwards and is felt in other fields.

Computing's circle of influence continues to grow as technological progress drives down costs and makes its application possible in new areas. This progress is most visible in the exponential growth of processing power, storage capacity and networking bandwidth. The best known of these is the first, encapsulated in Moore's law, a rule of thumb that says the number of transistors that can be squeezed on to a chip, and hence the processing power available at a given price, doubles every 18 months or so. But this is actually the least impressive of the three. Storage capacity per unit area is doubling every year; and the amount of data that can be squeezed down a fibre-optic cable is doubling every nine months (see charts on following pages).

The impact of this technological progress has only just begun to be felt, but it will be extremely far-reaching. A helpful historical analogy is with electricity. The world's first power station, which came to life on Pearl Street in Lower Manhattan on September 4th 1882, was called an "electric light-power station", because the electricity it generated was ini-

tially used solely for lighting the offices of nearby Wall Street firms. But the notion of an electrical grid soon took hold and the provision of electricity as a utility—cheap, reliable, always on—caused a surge of innovation. Once it could be relied upon, electricity was soon being put to use not just for lighting, but in other ways: to power industrial machinery, labour-saving devices, elevators and household appliances from fans to toasters. The ripple effect of these developments, in turn, enabled further unanticipated innovations: electrical elevators made skyscrapers possible, for example. The whole process took decades, but electricity is now so much a part of the fabric of everyday life that, in the developed world at least, our dependence on it is only apparent when the supply fails.

More than a century later, computing is now going through the same transformation. Systems are becoming increasingly interconnected and computing power is slowly becoming a utility: a pervasive, reliable, always-on service that can be applied in new fields, new devices and new ways. This is a long-term, multi-decade process, just as the spread of electricity was. But already a surge of innovation is under way, as the fruits of decades of progress in the computer industry are applied in other areas. Like electricity over a century ago, computing is now transforming entire industries and spawning new ones, by providing the foundations for further innovation.

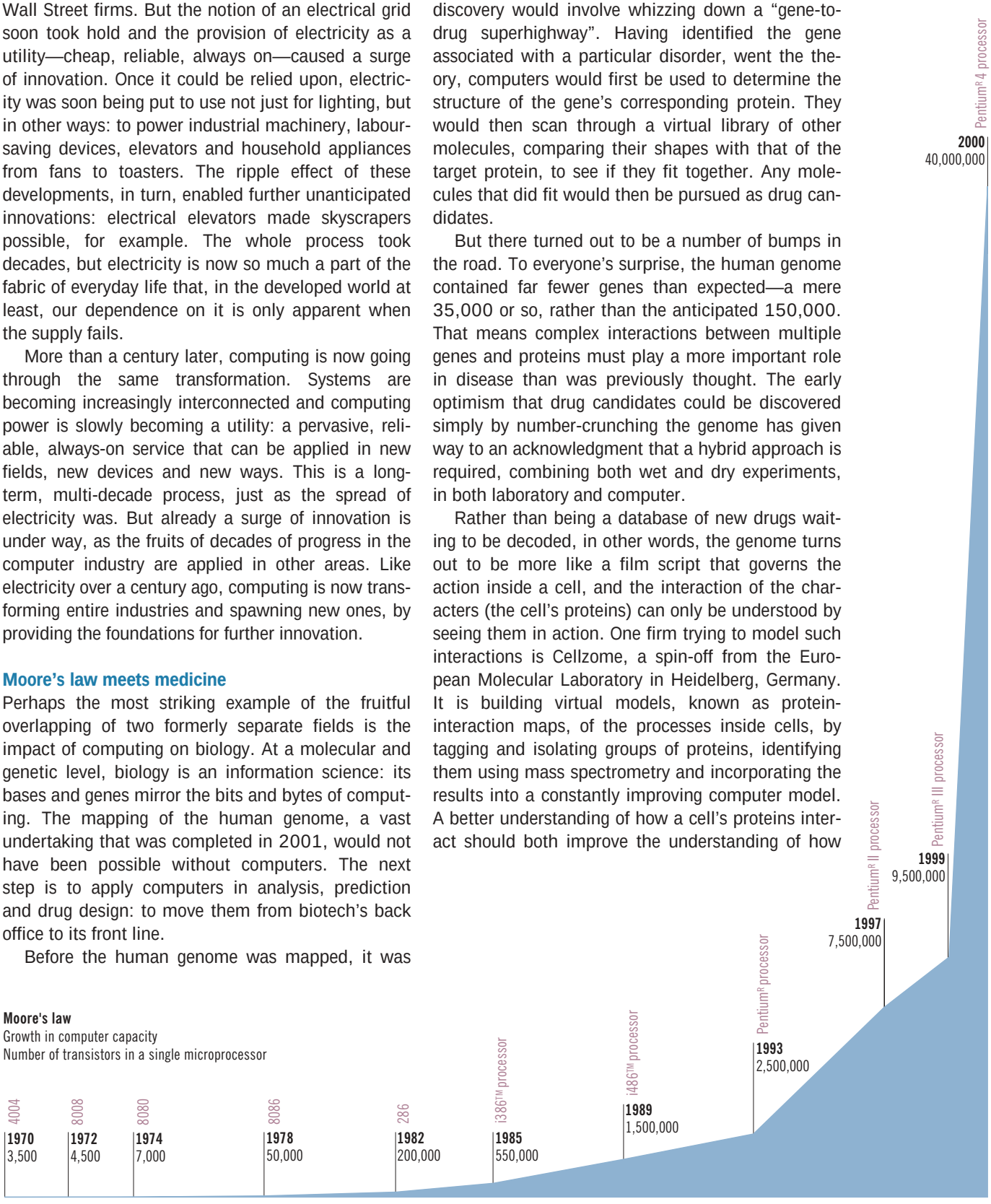
Moore's law meets medicine

Perhaps the most striking example of the fruitful overlapping of two formerly separate fields is the impact of computing on biology. At a molecular and genetic level, biology is an information science: its bases and genes mirror the bits and bytes of computing. The mapping of the human genome, a vast undertaking that was completed in 2001, would not have been possible without computers. The next step is to apply computers in analysis, prediction and drug design: to move them from biotech's back office to its front line.

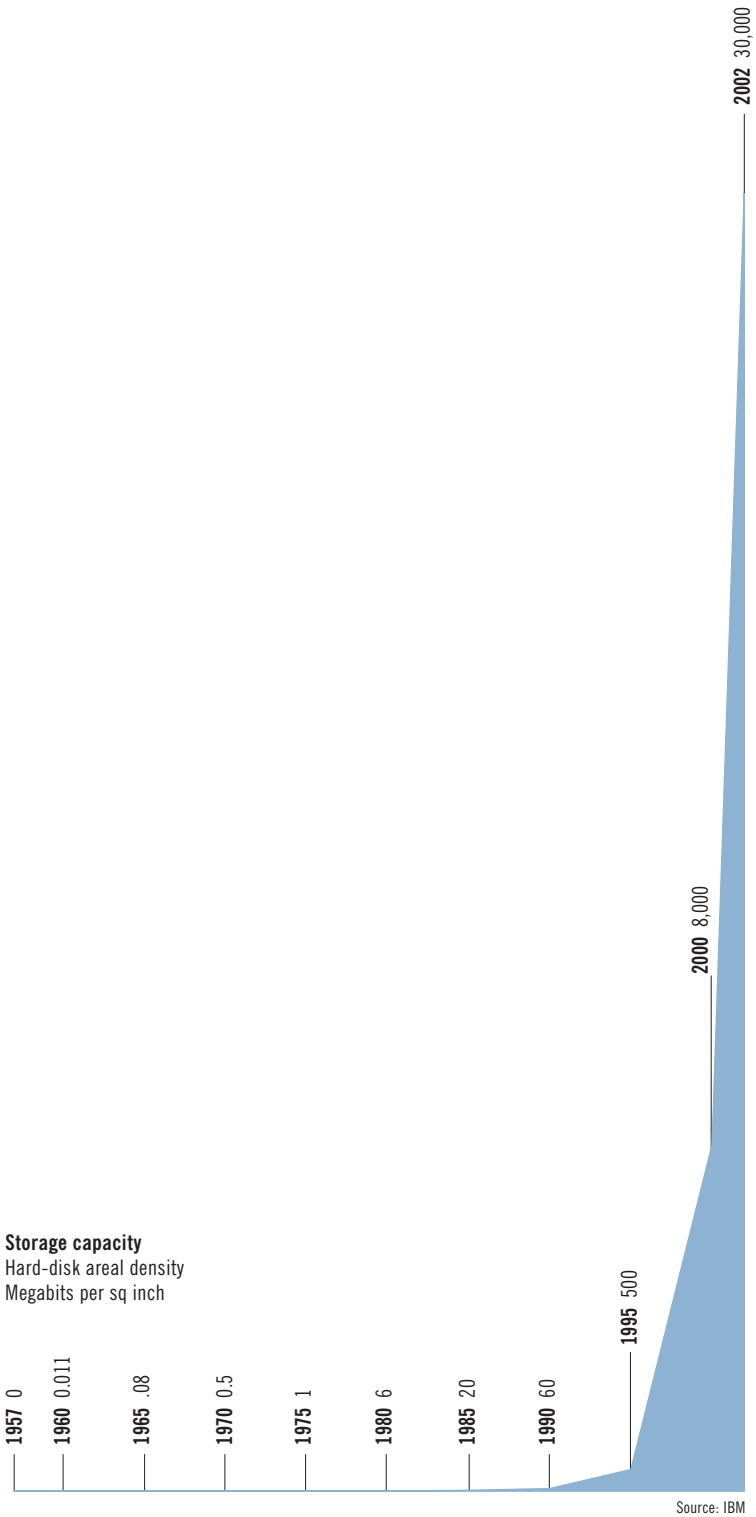
Before the human genome was mapped, it was assumed that using computers for "in silico" drug discovery would involve whizzing down a "gene-to-drug superhighway". Having identified the gene associated with a particular disorder, went the theory, computers would first be used to determine the structure of the gene's corresponding protein. They would then scan through a virtual library of other molecules, comparing their shapes with that of the target protein, to see if they fit together. Any molecules that did fit would then be pursued as drug candidates.

But there turned out to be a number of bumps in the road. To everyone's surprise, the human genome contained far fewer genes than expected—a mere 35,000 or so, rather than the anticipated 150,000. That means complex interactions between multiple genes and proteins must play a more important role in disease than was previously thought. The early optimism that drug candidates could be discovered simply by number-crunching the genome has given way to an acknowledgment that a hybrid approach is required, combining both wet and dry experiments, in both laboratory and computer.

Rather than being a database of new drugs waiting to be decoded, in other words, the genome turns out to be more like a film script that governs the action inside a cell, and the interaction of the characters (the cell's proteins) can only be understood by seeing them in action. One firm trying to model such interactions is Cellzome, a spin-off from the European Molecular Laboratory in Heidelberg, Germany. It is building virtual models, known as protein-interaction maps, of the processes inside cells, by tagging and isolating groups of proteins, identifying them using mass spectrometry and incorporating the results into a constantly improving computer model. A better understanding of how a cell's proteins interact should both improve the understanding of how



Source: Intel



Source: IBM

existing drugs work and facilitate the discovery of new ones.

Other firms are trying to find gene-to-drug shortcuts by focusing on specific areas of particular promise. Arena Pharmaceuticals of San Diego is concentrating on identifying cellular receptors known as G-Protein Coupled Receptors, which are akin to buttons on the outside of cells that trigger particular responses when pressed. Many modern drugs rely on interaction with GPCRs, of which 40 or so are known. But analysis of the human genome suggests that there could be as many as 800 GPCRs in total, providing much potential for new treatments. Arena's approach combines computer analysis of the genome with automated chemistry to identify GPCRs and determine their responses to various compounds. These results are collated in a database and can be used as the basis for drug discovery.

Another form of shortcut is being pursued by RiboTargets, based in Cambridge in the United Kingdom, and Vertex Pharmaceuticals of Cambridge, Massachusetts. Both firms are using computers to screen drug candidates to see how likely they are to interact with a target whose structure is already known in detail. The target's shape is determined experimentally, using crystallography, mass-spectroscopy or nuclear-magnetic resonance; it is then modelled in the computer and compared against a virtual library of small molecules to see which ones show a good fit. Only the compounds that make it through this computational sieve are screened in the laboratory, dramatically reducing the amount of testing required when searching for new drugs.

Even though computational biology is still a young science, many of these firms have established partnerships with large pharmaceutical companies and some already have drugs under trial or on the market. The accuracy with which molecular and cellular structures can be modelled, compared and fit together by computers will only increase as the cost of computing power continues to fall. And as the use of computational models starts to gain traction, biology will be able to hitch a ride on computing's coattails, as performance improves and prices fall.

Computing everywhere

Another new and productive area of overlap is between computing and wireless telecommunications, two industries that have arrived at the same point from opposite sides. The computer industry has developed pocket-sized computers that can be taken everywhere; the latest models have built-in wireless connectivity and some double as mobile

telephones. Meanwhile, the mobile-phone industry is delivering handsets of growing complexity and power, so that they increasingly resemble computers. Both camps are trying to take computing to its next stage: to make devices small enough to be taken everywhere or built into everything and connected up using wireless network links. From mainframes to PCs to pocket-sized devices, the move towards ubiquitous computing is already apparent. But there are still many problems to be solved along the way.

A fundamental problem is combining the expertise from the computer industry, which understands data networking, with that of the mobile-phone industry, which has a much firmer grasp of consumer psychology and the importance of design and branding. There is much catching up to do on both sides of the divide; meanwhile, the door is open for a new breed of start-ups, including Danger, a firm based in Palo Alto. It has devised an innovative new device, the Hiptop™, that is a true computer/phone hybrid, supporting voice calls, messaging and web browsing, with two neat twists. First, offloading as much computational work as possible on to servers built into the wireless operator's network improves the device's performance and extends its battery life. Second, Danger does not build the devices itself, but relies on contract manufacturers to make the devices to order for particular wireless operators, customising the hardware and software as appropriate to allow operators to differentiate themselves from their rivals.

The wide range of different wireless standards also presents an opportunity for innovation. No single standard can be used for everything and each has its own niche: Bluetooth for short-range use between nearby devices, Wi-Fi for high-speed Internet connections within buildings and cellular networks for wide-area connectivity the rest of the time, but at lower speeds. Stitching this patchwork of different types of network together in a seamless manner is the focus of much activity. One company working in this area is Red-M, a British firm that makes software to automate the switching between different types of wireless network while taking care of authentication, security and data synchronisation.

An additional challenge as portable devices become more powerful is keeping them running: colour screens, powerful processing chips and always-on wireless links can drain batteries in a matter of hours. TIAX, a company based in Cambridge, Massachusetts, is working to make the lithium-ion batteries used in most portable devices smaller, lighter and longer-lasting. One potential alternative to batteries is to use fuel cells, which combine oxygen from the air with stored hydrogen to produce electricity. Working in conjunction with an Israeli subsidiary, Medis, a company based in New York, has developed a tiny fuel cell suitable for powering portable devices that uses liquid methanol as the hydrogen source. When the fuel cell runs out of juice, it is not recharged, but refilled with a pocket-sized canister of methanol.

Computing will become pervasive and ubiquitous once it becomes possible to add wireless connectivity for very little additional cost in components, volume and energy consumption. CSR (Cambridge Silicon Radio), based in Cambridge in the United Kingdom, is working in this area by combining everything needed to provide a Bluetooth wireless connection into a single chip, thus minimising the cost and difficulty of integrating Bluetooth into new devices. An even more radical approach to reducing the cost of adding wireless to everything is being taken by Alien Technologies of Morgan Hill, California. Its "fluidic self assembly" process is a novel, high-volume way of placing millions of tiny components on a surface and wiring them up. Initially, the firm hopes to use this technology to produce radio-ID tags at far lower cost than is currently possible, enabling radio tags to be added to mass-produced items. The same technology could also be used to manufacture flat-screen displays that are cheaper, lighter and more resilient than existing displays made using glass. Flat, flexible, low-cost displays would be ideal for portable

Source: Lucent

devices and could be incorporated into all sorts of other things, such as credit cards or packaging.

Smart stuff

More speculative than ubiquitous computing, but potentially just as significant, is the notion of applying computer power to make devices smarter. Admittedly, the omens do not look good: after decades of over-optimism and numerous broken promises, research into "artificial intelligence" (AI) would seem to have achieved very little. Intelligent computers of the kind epitomised by HAL, the fictional supercomputer in "2001: A Space Odyssey" are nowhere to be seen, even in 2003.

Appearances are deceptive, however. Much of the research initiated in the 1950s under the umbrella of AI has produced technologies that are surprisingly useful and widespread and have crept into many corners of everyday life. Even though there has been little progress towards a general theory of machine intelligence, smart devices are all around us: mobile phones that recognise spoken names, handheld computers that recognise handwriting, mail-sorting machines that read handwritten zip codes, and fuzzy-logic control systems in washing machines, coffee makers and auto-focus cameras. A little intelligence can go a long way, so a number of firms are now working to reduce the cost of making devices smarter.

In particular, while there has been a great deal of effort expended in improving the visual and audio output of computers (in the form of dedicated graphics-accelerator chips and surround-sound systems), there has been far less work done on the input side. One company trying to redress this imbalance is Canesta of San Jose, which aims to "sight-enable" a range of devices with its tiny 3-D sensor chip and embedded perception software. Giving devices the ability to see and perceive depth could have a range of applications: in-car sensors could take passengers' sizes and positions into account when triggering airbags, for example. Another possibility is a handheld device that is pointed at a box and accurately calculates its volume, just by looking at it. Shipping companies could, it is thought, improve efficiency by up to 15% through improved estimates of package sizes.

Also working in this area is Seeing Machines, a spin-off from the Australian National University. It has developed technology to analyse stereo images of people, detect and track faces, and then determine their blink rate and direction of gaze. The technology was originally developed to detect fatigue or lack of concentration in truck drivers, and to determine whether new cabin layouts were likely to distract the driver, but it could also be applied in consumer products. Imagen, a spin-off from the MIT Artificial Intelligence Laboratory, has developed image-analysis technology that is used to inspect items on a production line, detect faults and diagnose the cause. The underlying challenge in this area is to move from enabling a computer to "see"—a relatively simple matter of plugging in a cheap sensor of the kind found in digital cameras—to getting it to perceive and comprehend features and ultimately to learn about them.

Similar work is being done with speech input. SpeechWorks, a Boston-based firm that makes systems to provide speech-activated services over the telephone, is now expanding into new areas. Its speech-recognition, speaker-verification and text-to-speech technology software could also find its way into in-car navigation systems, handheld computers and mobile phones. Akustica, a firm based in Pittsburgh, is taking a novel approach to incorporating sound input and output into microchips. It can place microphones or speakers made with micro-electro-mechanical systems (MEMS) technology on a single chip alongside the processing circuitry required for voice recognition and noise cancellation. This makes possible smaller, cheaper, smarter audio devices, from mobile phones to hearing aids. It also points the way towards another long-awaited but oft-delayed revolution, as fabrication techniques from the computer industry are applied to make new materials and devices at the nanometre level.

Strengthening the foundations

All of these innovations build on the foundations of progress in computing. Less glamorous, but just as important, is the work being done to strengthen those foundations. For whenever computing is applied in new areas, new bottlenecks emerge. The use of computers in biotechnology, for example, generates enormous amounts of data: some biotech firms produce a terabyte of data (roughly 1m megabytes) a week. Similarly, the powerful back-end systems required to support tens of millions of wireless devices must be reliable and "scalable"—in other words, it must be possible to add more processing, storage and network capacity smoothly to enhance performance. Security and privacy are also growing concerns as computing permeates ever further into the fabric of everyday life. But each new bottleneck is also an opportunity for further innovation: improvements in storage, scalability and secu-

rity are necessary steps in transforming computing into a utility.

Much of the work in this area is being done under the banner of "utility computing", also known as "grid computing", in a conscious acknowledgement of the parallel with the construction of the electricity grid a century ago. Indeed, hardware and services firms refer to warehouses full of computing power, providing number-crunching to distant users via high-speed network links, as "computing power plants". Grid computing involves connecting up computing resources scattered over a wide area—even around the world—to create the illusion of a single system that combines the processing power, storage and network connectivity of its component parts. This allows companies or universities to pool computing resources when working on large calculations (such as mining customer data or simulating the folding of a protein); in the long run, it could allow computer power to be supplied on demand, just as electricity is today.

In the meantime, systems administrators face a smaller version of the same challenge within their organisations as they attempt to simplify the management of multiple incompatible platforms. Corporate budgets for information technology are being squeezed, so the emphasis has switched to wringing more out of existing systems and reducing costs, through consolidation of hardware and greater use of clever software for management.

Many firms are working to improve the performance of computer systems and to make them more reliable and secure. BlueArc, based in San Jose, produces high-performance storage systems, accelerated using dedicated hardware that can deliver data as fast as an optical network can transport them. Digital Envoy of Atlanta specialises in mapping Internet addresses to locations in the real world. Websites can then customise their content in response to each visitor's location; the company has also developed intelligent routing technology that takes geography into account when delivering content across the Internet. Special-purpose hardware developed by Digital Fountain of Fremont, California, can send multi-terabyte files over long distances (between two regional offices of a large firm, for example) more quickly and securely than other file-transfer systems; it is the Internet equivalent of long-haul freight.

On the security front, Cryptomathic, a Danish company, has devised an innovative scheme to facilitate electronic transactions over the Internet. Users store their keys in a central database, rather than on their own machines, which makes secure transactions possible from any Internet-connected device. And Network 365, based near Dublin, has created a secure digital wallet to facilitate transactions from mobile devices.

Computers and development

So far, the benefits of advances in computing have chiefly been felt in the developed world. The "digital divide" between rich and poor countries is, however, an effect, not a cause. It is largely a reflection of deeper, more fundamental divides: the literacy divide, the healthcare divide and the sanitation divide, all of which are of far more pressing concern. But as computing overlaps with other fields, it has the potential to help parts of the world that have so far missed out on its benefits. The application of computers to biotechnology could, for example, help with the development of vaccines and treatments for diseases that particularly afflict people in the developing world, such as malaria, tuberculosis, hepatitis and HIV/AIDS.

Similarly, mobile telephony is already taking off in parts of the world that fixed-line telephones have previously failed to reach. Almost all new network construction in sub-Saharan Africa is of wireless, rather than fixed, telephone networks. During 2001, the world's least-developed countries reached the significant milestone of one telephone per 100 people, largely because of the rapid growth of mobile telephony; mobile networks are growing faster in these countries than anywhere else. Mobile has two advantages over fixed-line access: it allows large areas to be blanketed with coverage far more quickly than running wires all over the place, and the use of pre-paid cards makes phones available to anybody, whatever their financial circumstances. As computers and mobile devices converge, it seems likely that in many parts of the developing world, people's first glimpse of the Internet will be on the screen of a mobile phone rather than a PC.

Computing comes of age

One definition of a mature technology is that it becomes invisible and is only apparent when it stops working. Electricity has clearly reached that stage in the developed world; computing is now moving along the same trajectory. Like electricity before it, computing has matured to become an enabling technology. New innovations are now emerging as it provides the foundation for progress in other areas. The initial impact of computing, as exciting as it was unexpected, has now passed. But the ripples of innovation will continue to spread for decades to come.

Technology Pioneer profiles

Forty companies have been chosen as pioneers in 2003. They come from four categories—biotechnology, energy, information technology and new business models. Candidates are nominated by members, constituents and collaborators of the World Economic Forum. Candidates are reviewed by an external Selection Advisory Committee comprising technology experts in a variety of fields; the World Economic Forum takes the final decision.

The pioneers are chosen on the basis of six selection criteria:

- Innovation. The company must be truly innovative. A new version or repackaging of an already well-accepted technological solution does not qualify as an innovation. The innovation and commercialisation should be recent. The company should invest significantly in R&D.
- Potential impact. The company must have the potential to have a substantial long-term impact on business and society.
- Growth and sustainability. The company should have all the signs of a long-term market leader and should have well-formulated plans for future development and growth.
- Proof of concept. The company must have a product on the market or have proven practical applications of the technology. Companies in "stealth" mode and those with untested ideas or models do not qualify.
- Leadership. The company must have visionary leadership that plays a critical role in driving it towards its goals.
- Status. The company must not currently be a Member of the World Economic Forum.

1

Akustica Inc

Dr Kaigham J Gabriel, *co-founder, chairman and chief technology officer*

CATEGORY: Information technology
LOCATION: Pennsylvania, US
NUMBER OF EMPLOYEES: 10
YEAR FOUNDED: 2001
ORIGINS: Technology developed at Carnegie Mellon

Akustica is changing the way sound is captured, processed and reproduced by combining microelectronic chips with acoustic components.

The company has developed a new class of acoustic solutions that provides such advanced capabilities as directionality, noise cancellation, voice-recognition input and direct digital sound capture and reproduction.

Akustica uses patented micro-electro-mechanical systems (MEMS), computer chips that contain both mechanical and electrical components. This eliminates the need for costly and bulky discrete acoustic components. The MEMS structures and devices are designed either with a single integrated membrane or multiple membrane arrays to be used as sensing elements (microphones to measure sound) or as actuating elements (microspeakers to produce sound).

Akustica leverages standard semiconductor fabrication processes to ensure that its products are produced with the best available technologies, consistent quality and scalable capacity. The company is focused particularly on acoustic MEMS for next-generation audio and acoustic products.

Why is the company a pioneer?

Akustica's AkuSound™ platform represents a new paradigm in acoustic technology and product development by employing application-specific integrated MEMS design.

Applications have the potential to revolutionise any device with a speaker or a microphone, including mobile phones, hearing aids, earphones and other consumer devices. MEMS uses the proven materials and processes of microelectronics fabrication to offer the advantages of miniaturisation of multiple components—reduced component space, simplified manufacturing processes, lower system costs and increased reliability.

http://www.akustica.com

2

Alien Technology

Dr Stavro E Prodromou, *chief executive*

CATEGORY: Information technology
LOCATION: California, US
YEAR FOUNDED: 1998
ORIGINS: Entrepreneurial founder

Alien Technology has developed a manufacturing technology called fluidic self assembly (FSA) that allows the placement of large numbers of small components across a surface in a single operation. The company plans to launch the technology in the manufacture of low-cost radio frequency identification (RFID) tags—tiny radio-powered microchips that broadcast a unique serial number, like a talking bar code.

The Alien chips are a few times the width of a human hair and shaped like minuscule tablets. They fit precisely into holes stamped into sheets of plastic in any pattern. The plastic is fed on rolls through a bath containing the chips and the chips fall into place. The plastic rolls pass through further processes that seal the chips and connect them to tiny wire leads. The sheet can then be cut into whatever is being made—large, flexible computer screens, or tiny displays on ATM cards to indicate account balances.

Alien is working with partners Rafsec and Avery Dennison to manufacture inlays and finished tags. The first product is a 64-bit read-only tag, expected in 2003. RFID products with greater capability will follow shortly thereafter.

Why is the company a pioneer?

Alien's fluidic self assembly technology is a departure from current methods of embedding products with semiconductor chips. The process allows the packaging of tiny integrated circuits for assembly into electronic product code tags at rates upwards of 2m per hour versus the approximately 10,000 per hour possible with conventional methods. This is essential both for reducing the cost of tags, whose incorporation into products promises a leap in the efficiency of supply chains, and for producing tags in quantities of billions or even trillions.

http://www.alientechnology.com

3

Anoto AB

Christer Fahraeus, *chief executive officer*

CATEGORY: Information technology
LOCATION: Lund, Sweden
NUMBER OF EMPLOYEES: 300
YEAR FOUNDED: 1999
ORIGINS: Entrepreneurial founder

Anoto AB brings together digital communications and handwriting, enabling users to send whatever they write and draw to their own PC or as an e-mail, a text message or a fax.

The Bluetooth™-equipped Anoto pen writes and draws on "communications-friendly" digital paper. As the pen moves, it creates a digital trace that is stored in the pen and can be forwarded to a personal computer, or via any device with a Bluetooth connection to any computer, mobile phone or data recipient in the world.

The Anoto digital paper is covered with a proprietary pattern of microscopic dots. The pattern of dots, which are spaced only 0.3mm apart, is perceived by the eye as slightly off-white in colour. The dots pinpoint the pen's exact location relative to the full pattern. Unique patterns within boxes on the paper can be assigned different functions such as e-mail, text message and fax.

The pen and paper are already marketed by Logitech as "Logitech® io" and by Sony Ericsson as the Chatpen CH-30.

Why is the company a pioneer?

Anoto bases its technology platform on human intelligence and advanced image processing, with the aim of uniting paper and pen with the digital world and creating a bridge between traditional and digital communications. The technology has become the global *de facto* standard for paper-based digital communications. Anoto believes that the market will favour input tools based on the oldest and most widely used medium—paper and pen—adapted to suit natural human behaviour.

http://www.anoto.com

4

AppStream Inc

Uri Raz, *chairman and chief executive*

CATEGORY: Information technology
LOCATION: California, US
NUMBER OF EMPLOYEES: 55
YEAR FOUNDED: 1999
ORIGINS: Entrepreneurial founder

AppStream is a leading provider of infrastructure software that allows enterprises to web-enable and distribute their applications to millions of users more efficiently, with strong benefits in scalability and manageability.

AppStream's objective is to allow users to leverage their current IT equipment to distribute any application over any network to any device, making the extended enterprise a reality. Maintenance tasks of licensing, upgrading, version control and support are simplified while costs are dramatically reduced.

The company's technology combines the performance benefits of locally installed applications with the management benefits of centralised control. An application can be deployed as is, without re-coding or re-engineering. The costly and resource-intensive process of distributing and configuring each application is eliminated, and manual installation begins to look prehistoric.

Gartner Group predicts that up to 40% of all applications will be delivered over the Internet within the next two to three years. AppStream clients such as Credit Suisse First Boston and Sabre Corporation already use the application for efficient software deployment.

Why is the company a pioneer?

By making its applications easily available to the extended enterprise regardless of desktop operating system or network connection, AppStream has achieved a delivery breakthrough. A leader in "software as a service" (SaaS), the company has also created a viable new business model, allowing independent software vendors (ISVs) and enterprises to enjoy the benefits associated with renting applications. AppStream is the only solution that enables ISVs and enterprises to integrate SaaS into their business model today.

http://www.appstream.com

5

Arena Pharmaceuticals Inc

Jack Lief, *president and chief executive*

CATEGORY: Biotechnology
LOCATION: California, US
NUMBER OF EMPLOYEES: 160
YEAR FOUNDED: 1997
ORIGINS: Entrepreneurial founders

Arena Pharmaceuticals is widely acknowledged to be the leader in the effort to identify novel G protein-coupled receptors (GPCRs) as drug targets and to discover and develop new drugs that address them.

Scientists estimate that there are approximately 40,000 genes within the human genome, and of these, approximately 800 are GPCRs with potential therapeutic applications. At present, the functions of fewer than 40 of these are known and addressed by established drugs, leaving open opportunities to analyse and understand the functions of the remaining 760, many of which could provide solutions for poorly treated or untreatable diseases.

The company's technology can discover drugs without first having to identify native ligands—molecules that naturally bind to a receptor and activate or inhibit a biological response. The technology mimics the behaviour of ligands to identify chemical compounds that alter biological responses, facilitating faster drug discovery.

Arena Pharmaceuticals has discovered drug candidates that have demonstrated pharmacological activity in pre-clinical and animal studies. Arena has partnerships with such companies as Eli Lilly, Merck & Co and Fujisawa Pharmaceuticals. Subsidiary Aressa Pharmaceuticals is developing a possible treatment for Alzheimer's disease.

Why is the company a pioneer?

Arena has a unique and proprietary platform called Constitutively Activated Receptor Technology, or CART, that can be applied to GPCRs and other classes of receptors to identify drug leads. Traditional drug discovery techniques to find new drug candidates cannot be applied to GPCRs until their native ligands are identified, a process that typically requires four to five years and costs millions of dollars per GPCR. CART Technology avoids this major bottleneck in drug discovery efforts, an approach that has been proven to cut years off traditional methods.

http://www.arenapharm.com

6

BlueArc Corp

Gianluca Rattazzi, *chairman and chief executive*

CATEGORY: Information technology
LOCATION: California, US
NUMBER OF EMPLOYEES: 165
YEAR FOUNDED: 1998
ORIGINS: Entrepreneurial founders

BlueArc Corp has developed a high-performance data network storage system based on new architecture that greatly eases traditional server bottlenecks.

Increased Internet traffic has meant a significant cost in both equipment and management. Because of the limitations of traditional computational architecture, today's file transport protocol (FTP) systems must deploy an ever-increasing number of servers to support demand. BlueArc saw that problem coming.

The BlueArc breakthrough offers the world's first architecture capable of scaling beyond today's gigabit optical networks and towards tomorrow's 10-gigabit networks, providing a solution that will keep pace with customer needs while also significantly lowering costs.

A single BlueArc SiliconServer can replace between 10 and 15 traditional file servers. It accommodates up to 250 terabytes of storage capacity, up to 38,000 simultaneously connected users, provides up to a fivefold improvement in price/performance ratio and has a record of 99.999% solid state reliability. This extreme performance is now being leveraged for a wide range of applications following the completion of a beta programme at more than 20 sites in the United States and the United Kingdom.

Why is the company a pioneer?

With the first totally new server architecture in 50 years, the SiliconServer family is expressly designed to remove the blockages of traditional architecture. Network equipment providers have solved a similar problem for routing by designing all data movement in silicon, yielding high performance at reasonable cost. Adopting a related approach, BlueArc's architecture has for the first time integrated protocols, file and network services into programmable hardware.

http://www.bluearc.com

7

Canesta Inc

Nazim Kareemi, *president and chief executive*

CATEGORY: Information technology
LOCATION: California, US
NUMBER OF EMPLOYEES: 35
YEAR FOUNDED: 1999
ORIGINS: Entrepreneurial founders

Canesta is the inventor of a revolutionary, low-cost electronic perception technology that enables ordinary electronic devices to perceive and react to nearby objects or individuals in real time.

Canesta's electronic perception chips and software enable consumer, automotive, industrial, military and medical products to attain levels of functionality and ease of use that are impossible with "blind" electronics equipment.

For example, Canesta opens the way for the next generation of wireless devices to be further miniaturised while delivering large screen and input interfaces. The company's technology can provide the convenience of a full-sized keyboard and mouse "out of thin air" by projecting beams of light on any flat service and detecting finger movements.

Canesta's goal is to further exploit the technology and make it possible for devices or applications of any complexity to perceive objects and features in the nearby environment for identification and action. NEC Corp is evaluating Canesta's technology and will initially focus on the Canesta Keyboard Perception Chipset™, which applies the technology to mobile and wireless devices.

Why is the company a pioneer?

Canesta makes it possible for actionable information to be processed in real time by observation of the nearby environment through an ultra-low-cost sensor technology. Electronic perception technology is the first inexpensive, practical solution to enable everyday machines and computer devices to "see" in three dimensions in real time. Canesta has taken a leadership role in defining and implementing practical electronic perception technology with the development of low-cost, semiconductor-based image sensor chip technology and powerful embedded image-processing software.

http://www.canesta.com

8

Cellzome

Dr Charles Cohen, *co-founder and chairman*

CATEGORY: Biotechnology
LOCATION: Heidelberg, Germany
NUMBER OF EMPLOYEES: 120
YEAR FOUNDED: 2000
ORIGINS: Spin-off from EMBL

Cellular physiology depends on the function of proteins. Proteins rarely act alone in the cell; rather, they interact to form multi-protein complexes. Cellzome, a leader in the field of functional proteomics, uses its proprietary technology to characterise cellular protein complexes, which are the actual molecular targets of drugs. The company—the first-ever spin-off from the European Molecular Biology Laboratory (EMBL) in Heidelberg—also develops action-based drugs.

Cellzome is developing protein interaction and pathway maps to describe the molecular context for identified targets and to provide the basis for target and lead validation. Cellzome maps are expected to enable researchers to understand the roles of individual proteins in biology more fully and provide for a more comprehensive approach in choosing targets for drug discovery.

Cellzome believes this approach will enable a better understanding of the mode of action of existing and potential drugs, creating the opportunity to develop a second generation of drugs with a higher efficacy, specificity and safety profile.

Cellzome has acquired the GlaxoSmithKline (GSK) UK-based Cell Map unit to support the company's efforts to move towards product development and commercialisation.

Why is the company a pioneer?

Cellzome is going beyond conventional drug target discovery, applying its technology to determine the precise physiological context of drug targets so as to better direct experimental efforts and decrease the risks associated with drug development. Cellzome is currently using this approach with human cells to establish the molecular context involved in the onset and progression of various chronic degenerative diseases.

http://www.cellzome.com

9

CommercialWare Inc

Amish Mehta, *chairman*

CATEGORY: Information technology
LOCATION: Massachusetts, US
NUMBER OF EMPLOYEES: 170
YEAR FOUNDED: 1999
ORIGINS: Relaunch of existing company

CommercialWare is the world's leading provider of software solutions for multi-channel retailers, enabling them to interact with their customers across all channels in real time.

The evolution of e-commerce has acted as a catalyst for retail organisations to integrate channels, processes and systems into a single cohesive business. Customers dealing with these organisations expect seamless service regardless of the point of contact with the retailer—be it a mobile device, catalogue, website or store. A successful "click-and-mortar" presence increasingly obliges retailers to unify customer interaction channels and to integrate their front-office and back-office processes.

CommercialWare's products provide a robust, scalable architecture that streamlines order management, fulfilment and customer service for organisations processing millions of transactions a year. The application creates a unified view of the customer through the transaction lifecycle and across all points of contact.

CommercialWare products already lie behind retail commerce at more than 90 leading retail brands, including Abercrombie & Fitch, Staples, Target, Casual Corner, Brooks Brothers, Starbucks, EBWorld.com, J.Jill, Ritz Camera and Patagonia.

Why is the company a pioneer?

CommercialWare is at the forefront of efforts to address the challenges of the Internet economy. The company's products enable retailers to build a customer-orientated infrastructure that streamlines interaction with customers, suppliers and distribution partners across all the channels that exist in a complex commercial environment. Retailers can leverage this convergence to build customer loyalty, manage inventory and run targeted marketing campaigns.

http://www.commercialware.com

10

Cryptomathic A/S

Claus Bo Mikkelsen, *chief executive*

CATEGORY: Information technology
LOCATION: Aarhus, Denmark
NUMBER OF EMPLOYEES: 80
YEAR FOUNDED: 1986
ORIGINS: University spin-off

Cryptomathic, an established Danish company with 15 years' experience in data security and encryption, has created a unique network application that allows users to carry out mobile transactions from any terminal connected to the Internet with unparalleled security.

Traditionally, private keys for encryption and digital signatures are stored on the individual's PC or on a smart card protected by a password. These two methods prevent the user from conducting banking business or other mobile transactions from devices other than their own, or alternatively require smart cards as well as smart card readers. Such mobility restrictions are lifted with Cryptomathic's Secure Signer solution.

Cryptomathic Secure Signer is a central server that stores the user's private signature key in a secure database while allowing the individual to access it at all times via a web browser, a mail client or a mobile device. The key used for conducting electronic transactions and creating digital signatures is no longer the user's responsibility, as it is not physically stored on the user's PC or on a smart card.

Why is the company a pioneer?

Cryptomathic's Secure Signer represents a major step forward in user-friendly security. It combines both mobility and security by providing a single, secure log-on. Secure Signer was developed for and holds a strong position in the European financial sector, in particular for home banking. However, the potential of the product covers all areas of e-business. It is the company's most important vehicle for providing end-users with easy, mobile and secure digital-signature capabilities.

http://www.cryptomathic.com

11

CSR

John Hodgson, *chief executive*

CATEGORY: Information technology
LOCATION: Cambridge, United Kingdom
YEAR FOUNDED: 1998
ORIGINS: Entrepreneurial founders

CSR (Cambridge Silicon Radio) designs single-chip radio devices for short-range and wireless LAN communications. Its first output, the BlueCore™ family of communications products, provides cost-effective solutions for Bluetooth™ applications. Its single-chip architecture has attracted Bluetooth product developers worldwide.

The BlueCore product family saves product designers costs and time through a unique technology combining radio, baseband digital signal processor and microcontroller functions with full Bluetooth protocol software. These solutions cut the costs and risks of adding Bluetooth to products, and offer accelerated time-to-market potential.

BlueCore is suitable for a wide range of Bluetooth-enabled products, including PCs, mobile phones, headsets, personal digital assistants (PDAs) and palmtops, and industrial applications.

CSR recently won a contract to supply Samsung Electro-Mechanics (Semco) with 1m BlueCore2 Bluetooth chips during 2003. The Korean group will use the devices in modules to provide Bluetooth capability to a wide range of products, including Samsung laptops, PDAs and other consumer electronic devices.

In addition to CSR's long-term focus on Bluetooth, the company has designed leading-edge application-specific integrated circuits to meet GSM, UMTS, DECT, ERMES and FLEX wireless communications standards.

Why is the company a pioneer?

CSR has built the first truly integrated single-chip Bluetooth system, based on commodity complementary metal-oxide semiconductor (CMOS) technology with all its inherent cost and security-of-supply advantages. CSR's expertise in CMOS radio solutions led to this breakthrough in integration, eliminating virtually all additional radio frequency (RF) components conventionally required to implement radio capability. This level of integration removes the significant barrier that otherwise faces original equipment manufacturers (OEMs) seeking specialist RF design skills.

http://www.cambridgesiliconradio.com

12

Cyclacel Ltd

Dr Spiro Rombotis, *chief executive*

CATEGORY: Biotechnology
LOCATION: Dundee, United Kingdom
ORIGINS: Research findings of Professor David Lane

Cyclacel is a biotechnology company specialising in therapeutics for treating cancer and other diseases by exploiting insights into the biology of cell cycle control. The company was founded by a leading authority on the gene regulating cell division, Professor David Lane of the University of Dundee in the United Kingdom.

Cyclacel focuses on small-molecule drugs to stop uncontrolled cell division in cancer and other diseases involving abnormal cell proliferation. The company is building a drug pipeline based on four discovery engines with new product potential. Three of them involve key aspects of cell cycle control and the fourth uses Cyclacel's proprietary drug delivery technology.

Cyclacel's most advanced programme is CYC202, a Cyclin Dependent Kinase (CDK) inhibitor, currently in Phase Ib trials for cancer. CYC202 has also completed a Phase I trial in healthy volunteers and is being explored for use in glomerulonephritis, a disease of renal cell proliferation.

Cyclacel has raised £50m ($80m) to date and has made progress towards commercialisation, with drugs in Phase II clinical trials and collaborations with global leaders in oncology, including Astra-Zeneca for the development of a specific cyclin groove inhibitor (CGI) for cancer treatment.

Why is the company a pioneer?

Cyclacel designs novel drugs to re-establish normal cell cycle control in pre-cancerous or cancerous cells and/or to exploit the P53 gene to design and deliver novel, highly specific cytotoxic or cytostatic agents. The company's discovery engines integrate core cell cycle expertise with a large library of proprietary gene-based targets, state-of-the-art molecular biology and computational chemistry rapidly to deliver new drug candidates.

http://www.cyclacel.com

13

Cytokinetics

Dr James H Sabry, *president and chief executive*

CATEGORY: Biotechnology
LOCATION: California, US
NUMBER OF EMPLOYEES: 150
YEAR FOUNDED: 1998
ORIGINS: Founded by four cell biologists

Cytokinetics is a biotechnology company that links the life sciences and information technology sectors to pursue complementary missions of drug discovery and the commercialisation of novel cellular bioinformatics technologies.

The company's technologies, branded Cytometrix™, help speed target identification and compound characterisation. Cytometrix employ fluidics automation and high-resolution microscopy, as well as image analysis and bioinformatics to quantify the biological response of a diverse array of human cell lines to chemical entities or to genetic alteration.

Cytokinetics maintains multiple small-molecule drug discovery programmes targeting oncology, cardiovascular disease and fungal infections. These forward-looking programmes capitalise on recent advances that underscore the essential roles of cytoskeletal proteins, and molecular motors in particular, in critical cellular processes.

The company's first drug discovery collaboration, with GlaxoSmithKline, was announced in June 2001 and focuses on small-molecule therapeutics targeting mitotic kinesins. Phase I studies have already begun in the United States.

Why is the company a pioneer?

Cytokinetics scientists and engineers bring considerable cross-functional expertise in cytoskeletal biology, enzymology, biophysics and biochemistry, combined with drug discovery genomics, molecular biology, medicinal and analytical chemistry, informatics, software and database development, and laboratory automation. The resultant cellular bioinformatics technologies increase productivity and accelerate pharmaceutical discovery and development. This has allowed Cytokinetics to move rapidly towards the characterisation of novel small-molecule therapeutics.

http://www.cytokinetics.com

14

Danger Inc

Andy Rubin, *president*

CATEGORY: Information technology
LOCATION: California, US
YEAR FOUNDED: 2000
ORIGINS: Entrepreneurial startup

Danger Inc has developed an end-to-end mobile Internet solution offering wireless service operators three key integrated components: a back-end infrastructure; a development platform that uses standard application development tools; and the hiptop™ Device Design, a hardware design for a wireless all-in-one device.

Danger technology is a standards-based platform that is configured to evolve with advancements in hardware, software and network standards, providing a low-risk, future-proof platform for content and service delivery.

Danger differentiates itself from personal digital assistant (PDA)/handset competitors by focusing on affordability. The design allows for the back-end infrastructure to do the data processing instead of the device. This results in a lower-cost device with improved performance and battery life.

The device also provides a seamless, integrated data capability. With a single log-on, the user can multi-task, receiving voice calls while also sending and receiving e-mail, communicating via instant messaging or accessing the Internet. No additional Internet ISPs or data services are required.

The hiptop platform is customisable to the carrier's needs, allowing carriers to target specific audiences. Danger's launch partner is T-Mobile USA, which is targeting the young adult market.

Why is the company a pioneer?

Danger bridges two distinct categories of competitor—the handset/PDA manufacturer and the data infrastructure provider. By providing a genuinely end-to-end service, Danger is able to offer operators an affordable and integrated wireless solution. No other solution provides such a broad range of applications and features on a single device. The over-the-air software updates allow for continual improvements and delivery of premium services without the support burden and cost of manual software updates. Danger also provides carriers with access to an existing developer base.

http://www.danger.com

15

Digital Envoy

Sanjay Parekh, *co-founder and chief strategy officer*

CATEGORY: Information technology
LOCATION: Georgia, US
NUMBER OF EMPLOYEES: 35
YEAR FOUNDED: 1999
ORIGINS: Entrepreneurial founder

Digital Envoy coined the term "geo-intelligence" to describe its product—technology that helps e-companies control information distribution by identifying the location and modem connection speed of users worldwide, down to the level of a specific city.

The technology allows e-commerce, streaming media, online advertising and information sites, among others, to customise, restrict and target content based on the location of an individual user. By parsing existing data based on user location, companies have a new way to reach out to online users. The technology also provides a way to measure the effectiveness of marketing and advertising campaigns by tracking web traffic increases in real time.

Digital Envoy's geo-intelligence analysis is enabling companies such as AOL Time Warner, Cable & Wireless and Google to determine user locations. The company's next-generation Emissary product will allow enterprises to optimise network performance by routing users to globally dispersed content servers, using real-time, quickest-path analysis.

In what way is the company a pioneer?

Digital Envoy is the leader in geo-intelligent solutions and intelligent routing for the Internet. The system uses autonomous search agents (ASAs) that function in much the same way as search-engine spiders. ASAs use more than 20 different proprietary methods and rules to analyse the interconnection of IP-enabled devices on the Internet. By using Digital Envoy's data to overlay a geographical map of the Internet, the Internet's topography can be analysed. Further proprietary methods are then applied to tie an IP address to a geographic location.

http://www.digitalenvoy.com

16

Digital Fountain

Cliff Meltzer, *chief executive*

CATEGORY: Information technology
LOCATION: California, US
NUMBER OF EMPLOYEES: 70
YEAR FOUNDED: 1998
ORIGINS: Technology first developed in a university

Digital Fountain products allow both enterprise customers and content providers a cost-effective way to deliver broadband media on demand to a virtually limitless audience.

Digital Fountain's products are based on the company's patented Meta-Content™ technology, a networking innovation that dramatically simplifies the processes required to deliver data over any network, regardless of impairments like packet loss and delay. The technology allows the receiving computer to reconstruct the original file from a string of data packets that may arrive out of order and even with certain parts missing.

Developed for companies that regularly need to move large volumes of data among global locations, Transporter Fountain, the company's flagship product, delivers data from 3 to 30 times faster than traditional data transport systems like file transport protocol (FTP). PeopleSoft already uses the technology to distribute daily builds of its software, each measuring as large as 1 gigabyte, to 14 regional centres around the world. Potential consumer applications include the delivery of digital entertainment content to homes.

Why is the company a pioneer?

Digital Fountain offers an innovative approach to content delivery that materially improves upon previous solutions. This new technology enables unlimited user concurrency, maximises existing network resources and guarantees system predictability. A 500 megabyte file that would normally take up to four hours across a standard wide area network can be delivered in only 47 minutes through the Transporter Fountain.

Benefits to customers include enhanced productivity through significant time savings, better communication between partners, customers and employees irrespective of location, and more efficient use of existing bandwidth. As firms move larger amounts of data around their networks, these advantages become ever more compelling.

http://www.digitalfountain.com

17

FreeMarkets Inc

Glen T Meakem, *co-founder, chairman and chief executive*

CATEGORY: New business models
LOCATION: Pennsylvania, US
NUMBER OF EMPLOYEES: 968
YEAR FOUNDED: 1995
ORIGINS: Entrepreneurial founders

FreeMarkets operates online "reverse auctions" to help buyers purchase or source industrial parts, raw materials, commodities and services. Suppliers compete by anonymously bidding down the price of the buyer's order.

FreeMarkets combines web-based e-sourcing software, market information, commodity knowledge, market operations and online market-making expertise. The company aims to improve clients' sourcing process by generating fast, measurable results and a higher return on investment.

Since its inception, FreeMarkets has sourced more than $35bn in goods and services in more than 130 supply categories. Savings to buyers have been estimated at $7bn.

FreeMarkets provides coverage of any geographic location, offering its services in 30 languages and currencies. The company maintains an extensive directory of buyers and sellers available to clients, and can create specially designed trading portals to support each company's unique needs. Companies interested in exploring e-auction technology can turn to FreeMarkets to create, host and manage the entire operation.

Why is the company a pioneer?

To increase buyer and supplier options, FreeMarkets has created the first global marketplace in which multiple suppliers can submit bids for a buyer's purchase order in a real-time interactive competition. Before the advent of the Internet, buyers had limited ways of establishing relationships with new suppliers. With restricted competition between suppliers, buyers may have paid higher prices or obtained lower quality than they would have in a more efficient market with better information and more readily available alternative sources of supply. FreeMarkets creates just such a market.

http://www.freemarkets.com

18

Imagen Inc

Dr Pamela Lipson, *president and chief executive*

CATEGORY: Information technology
LOCATION: Massachusetts, US
YEAR FOUNDED: 1997
ORIGINS: MIT Labs spin-off

Imagen specialises in automated visual recognition and pictorial/multimedia search technology. Its groundbreaking approach to image and video analysis was developed by the founders, who spun off the company from the Massachusettts Institute of Technology (MIT) Artificial Intelligence Laboratory.

Imagen's technology has been applied for the first time in a product family manufactured and marketed by Teradyne. Optima 7200 systems incorporate image management and analysis technology licensed from Imagen for the optical inspection of PC boards during the production process. The systems identify process variation while detecting problems and noting quality trends in boards and are capable of diagnosing problems in the upstream production line.

Optima 7200 is an automated system technology for defect detection as well as process monitoring of the surface mount technology (SMT) component placement process. The technology calls for a state-of-the-art megapixel colour camera, telecentric optics and a multi-axis broad-spectrum lighting system. The image acquisition system is attached to an overhead gantry that scans the entire printed circuit board.

Why is the company a pioneer?

The Optima 7200's patented combination of three image analysis methods provides the best perspective on component placement and the assembly process. Imagen's technology brings a new level of inspection benefits—including image matching, structural analysis and geometry measurement—to every component inspected. The technology helps eliminate human set-up errors and reduces time-to-volume, the volume of defects produced and the cost to repair them.

http://www.imagen-inc.com

19

Impella Cardiotechnik AG

Dr Rolf Kaese, *chief executive*

CATEGORY: Biotechnology
LOCATION: Aachen, Germany
NUMBER OF EMPLOYEES: 55
YEAR FOUNDED: 1997
ORIGINS: Research project

Impella Cardiotechnik develops, manufactures and markets advanced intracorporeal circulatory-assist systems for use in cardiology and cardiac surgery. All its products are based on the technology platform of its intracardiac pump system, which was developed initially through a research project conducted by the Helmholtz Institute for Biomedical Technology in Aachen.

The company's flagship product, the impella®elect, is the world's first biventricular intracardiac pump system, and provides a minimally invasive alternative to the heart-lung machine for use during cardiac surgery. Impella®recover, a pump system designed for use over a period of several days, represents a promising second product for use in the post-operative period.

All the company's products use tiny high-performance motors as well as miniature pressure sensors, only a few tenths of a millimetre in size, that can reliably transmit data from within the bloodstream for a period of days.

Impella intends to develop and manufacture additional new products in Europe as well, in close co-operation with leading domestic and foreign heart centres and research institutes such as the Helmholtz Institute and the Aachen Centre of Excellence for Medical Technology (AKM).

Why is the company a pioneer?

The intracardiac pump system is the first heart support system to enable intracorporeal, as opposed to extracorporeal, circulation. The technology platform represents a realistic chance for the emergence of an alternative method for minimally invasive coronary bypass surgery. Minimally invasive surgical techniques reduce overall stress as well as risk for the patient both during and after surgery. They also contribute to cost reductions in the area of public health services.

http://www.impella.com

20

MDS Proteomics

Frank Gleeson, *president and chief executive*

CATEGORY: Biotechnology
LOCATION: Toronto, Canada
NUMBER OF EMPLOYEES: 200
YEAR FOUNDED: 1999
ORIGINS: Launched by parent company

MDS Proteomics (MDSP) is a drug discovery company that aims to increase clinical success rates and drug development productivity through the direct study of the human proteins primarily involved in health and disease.

Proteomics is the systematic analysis of protein functions and expression patterns in tissues. It involves the isolation, separation, identification and functional characterisation of the proteins in an organism. The functioning of drug targets using proteomics is key to the understanding of the causes of disease and to the development of new drugs and diagnostic products. MDSP has delivered drug targets to collaborators and presently has a number of candidate drug targets in pre-clinical discovery.

MDSP specialises in therapeutic product development, using proprietary methods and know-how for the functional analysis of proteins. The technology enables the discovery of protein drug targets that are difficult or impossible to determine using conventional methods.

MDSP is majority-owned by MDS Inc, a leading health and life sciences company. This structure allows access to clinical development resources that are usually not available to small companies at this stage of development.

Why is the company a pioneer?

MDSP's automated, large-scale proteomics technology fuses pathway biology, computational design, ultra-sensitive mass spectrometry systems and high-performance supercomputing. The MDSP technologies are designed to revolutionise drug discovery productivity, enabling faster, better-informed selection of drug targets and profiling of cellular response to drugs in development.

http://www.mdsp.com

21

Medis Technologies

Robert K Lifton, *chairman and chief executive*

CATEGORY: Energy/environmental technology
LOCATION: New York, US
YEAR FOUNDED: 1992
ORIGINS: Émigré Russian scientists in Israel

Medis Technologies is developing advanced power sources to help satisfy the worldwide demand for cleaner and more efficient energy.

The advent of third-generation (3G) mobile phones able to offer Internet access and personal digital assistant (PDA) connections will require more power than previous phones. Medis's strategy is to be the primary supplier of fuel cell batteries, installed as original equipment, for 3G phone companies. Medis currently offers the highest power density per square centimetre, over ten times more than conventional technology.

The company's product pipeline, based on the accumulated knowledge of leading Russian-Israeli scientists and cutting-edge military technology, also includes an AA-sized battery with twice the life of today's batteries, and a new proprietary-shaped engine offering great fuel efficiency.

To satisfy growing demand for the technology, Medis intends to grant licences, establish joint ventures or merge with a company capable of worldwide production. It also plans to manufacture the proprietary elements that are at the heart of its technology—the highly electric conductive polymers, the catalyst and the electrolyte.

Why is the company a pioneer?

Medis has developed the world's most advanced direct liquid methanol (DLM) fuel cell to date. Designed without the standard proton exchange membrane (PEM), the DLM fuel cell does not require a complex external hydrogen source. And whereas PEM fuel cells generally consist of a fuel electrode and an oxidant electrode separated by an ion-conducting membrane, DLM fuel cells do not need a membrane, enabling a higher fuel concentration.

http://www.medisel.com

22

Monster.com

Jeff Taylor, *chief executive*

CATEGORY: New business models
LOCATION: Massachusetts, US
NUMBER OF EMPLOYEES: 1,500
YEAR FOUNDED: 1994
ORIGINS: Created by TMP Worldwide Inc

Monster.com is the world's leading online career network, connecting companies with qualified, career-minded individuals and offering innovative technology and services that give consumers and businesses more control over the recruitment process.

Monster.com has 16m registered visitors worldwide, 10m of whom have put their CVs online. The company is now taking its innovations into the human resources departments of firms and is working with HR managers to redefine the way they manage their employees.

Monster.com has opened up a world of new employment possibilities for skilled workers from less developed nations in Asia, Eastern Europe and Africa.

Why is the company a pioneer?

Monster.com has pioneered online recruiting and career management, changing the way individuals and firms manage their recruitment and career development. Monster.com has introduced a stream of innovations over the past few years that have helped ensure its success. For job-seekers, Monster.com is a lifelong career network, providing continuous access to employers as well as interactive, personalised tools to make the process effective and convenient. Features include My Monster, a personal career management office; CV management; a personal job search agent; a careers network; chats and message boards; privacy options; expert advice on job-seeking; and free career management newsletters.

For employers, Monster.com offers cost-effective and efficient recruiting solutions, including real-time job postings, company profiles and CV screening, routing and searching. Features for members include CV skills screening, real-time recruiting, a comprehensive CV database, CV routing and white-label functionality.

http://about.monster.com

23

Myriad Genetics Inc

Peter D Meldrum, *president and chief executive*

CATEGORY: Biotechnology
LOCATION: Utah, US
NUMBER OF EMPLOYEES: 520
YEAR FOUNDED: 1991
ORIGINS: Entrepreneurial founders

Myriad Genetics uses bioinformatic gene mapping, family history analysis and protein interaction identification to locate inherited gene mutations that increase the risk of disease. Research and development is focused on the discovery of therapeutic targets related to society's predominant killers: cancer and viral diseases.

The company also has significant development programmes in the areas of depression, dementia, obesity, diabetes and rheumatoid arthritis.

Myriad has expertise both in identifying genes and in proteomics. This has allowed it to develop businesses in two complementary areas: creation of early-warning diagnostics for gene mutations and identification of compounds with high potential for acting as drugs to combat genetically induced diseases.

Research alliances have linked Myriad with Bayer, Eli Lilly and Schering-Plough. The firm has also teamed with Hitachi and Oracle to map the human proteome, cataloguing all human protein interactions and biochemical pathways.

Why is the company a pioneer?

Myriad's database of important disease pathways, ProNet®, provides a significant advantage in drug discovery, enabling scientists to generate a large number of potential drug targets. ProTrap™ technology is used to screen many targets against a library of small-molecule compounds. This integrated platform enables the company to pursue a rapid and cost-effective approach to identifying drug candidates. In contrast to much of the biotechnology industry, Myriad is able to screen large numbers of drug targets against a relatively small but diverse library of compounds and rigorously to select the most promising candidates.

http://www.myriad.com

24

Nanogen Inc

Howard C Birndorf, *co-founder and executive chairman*

CATEGORY: Biotechnology
LOCATION: California, US
NUMBER OF EMPLOYEES: 194
YEAR FOUNDED: 1993
ORIGINS: Entrepreneurial founders

Nanogen develops and commercialises molecular diagnostic tools and systems for the gene-based testing market.

The company's approach combines advanced microelectronics and molecular biology into a platform technology with potential commercial applications in the fields of medical diagnostics, biomedical research, genomics, genetic testing and drug discovery. Nanogen's fully automated system, which incorporates a proprietary semiconductor microchip, provides a flexible tool for the rapid identification and analysis of biomolecules.

Nanogen's mission is to become a leading supplier of molecular diagnostic tests by developing commercial applications for its technology and by working towards recognition as the standard for molecular identification and analysis.

To date, Nanogen has developed two analyte specific reagents (ASRs), one for the detection of Factor V Leiden, a common hereditary blood coagulation disorder, and the other for cystic fibrosis. The company has also internally validated four research protocols, three associated with cardiovascular disease and one with hereditary hemochromatosis, the most common form of iron overload disease.

Why is the company a pioneer?

Molecules, including DNA and RNA, have natural positive and negative charges. Through the use of microelectronics, Nanogen enables the active movement and concentration of charged molecules to and from designated microlocations, or test sites, on the semiconductor microchip.

Its semiconductor-based platform technology provides a low-cost, highly efficient and accurate system that will shift the paradigm for molecular diagnostics from current manual and mechanical methods to microelectronic systems, thereby significantly improving the quality of healthcare.

http://www.nanogen.com

25

Narad Networks

Dev Gupta, *founder, president and chief executive*

CATEGORY: Information technology
LOCATION: Massachusetts, US
NUMBER OF EMPLOYEES: 100
YEAR FOUNDED: 2000
ORIGINS: Entrepreneurial founders

Narad Networks is a business services software and broadband access company that creates new business models for cable operators through its True Broadband™ infrastructure solution. The solution comprises both network hardware and service delivery software for the creation, provisioning and management of broadband services.

Narad's access network leverages the vast unused portion of cable networks on the "last mile" of coaxial cable without affecting existing services. High-speed Ethernet switching and breakthrough modem technology enable Narad to provide fibre-like performance characteristics over hybrid fibre coaxial (HFC) networks at a fraction of the cost of alternative, pure fibre-based solutions.

The upshot is in effect a tripling of the cable frequency range available to cable operators. This results in cable networks that are faster, more cost effective and better equipped to deliver broadband IP services.

Narad's True Broadband software is the first fully automated back-office software solution for broadband provision. Based on industry-standard technologies and Narad innovations, the software suite ensures quality of service levels across the network.

Why is the company a pioneer?

The "last mile" bottleneck is a significant barrier to the pervasive deployment of broadband services. Narad is the only company capable of delivering switched gigabit Ethernet over the existing HFC network. As a result, Narad's solution allows cable operators to offer premium IT services such as data back-up, disaster recovery, and outsourced storage and IT services to an entirely new customer base—small and medium-sized business customers.

http://www.naradnetworks.com

26

Network 365

Raomal Perera, *chief executive*

CATEGORY: Information technology
LOCATION: Ireland
NUMBER OF EMPLOYEES: 70
YEAR FOUNDED: 1999
ORIGINS: Entrepreneurial founders

Network 365's mission is to enable wireless operators, banks and enterprises to deliver the mobile lifestyle to their customers with its m**zone**™ technology, a secure personalised payments, identification and service delivery platform.

The company has four main products. m**zone** avatar is a secure digital wallet that enables consumers to pay quickly and easily for e-commerce goods and services from any location via a mobile phone or other communications device.

m**zone** kiosk is an integrated m-commerce platform that enables service providers to launch and operate m-commerce communities. m**zone** kiosk provides the infrastructure to create and manage virtual shopping malls and other value-added services, including games, betting and stock tracking.

m**zone** maestro identifies the type of mobile device and network in use and transforms content into an optimised form for that network and device so that the subscriber enjoys an exciting mobile experience that is tailored to his environment.

m**zone** agora is a messaging product designed to allow access to applications over a variety of messaging protocols. It acts as both a hub and server, providing messaging services to a series of client applications.

One of the advantages of the firm's m**zone** product suite is that it is operable across GPRS, EDGE, UMTS (3G) and i-mode. The company's m**zone** technology is being used by telecoms operators worldwide, among them Hong Kong CSL, Cesky Oskar Mobil in the Czech Republic, Meteor Mobile Communications and mmO2.

Why is the company a pioneer?

Network 365 is one of the few companies in the world deploying applications that enable secure payment, personalisation, and identity and content delivery. Its proven track record is illustrated by a succession of industry firsts, including deployment of the first WAP-based payment system, the first business-to-business application on all three Japanese networks, the first fully functioning mobile wallet and participation in Europe's first 3G trial.

http://www.network365.com

27

Nvidia Corp

Jen-Hsun Huang, *co-founder, president and chief executive*

CATEGORY: Information technology
LOCATION: California, US
NUMBER OF EMPLOYEES: 1,300
YEAR FOUNDED: 1993
ORIGINS: Entrepreneurial founders

As one of the world's leading makers of graphics chips and boards, Nvidia designs and manufactures high-definition 2D and 3D graphics processors for gaming and industrial-design applications.

3D graphics are a powerful digital medium that enables the communication and visualisation of the simplest information to the most complex, whether in professional applications such as CAD/CAM, commercial applications such as financial analysis tools or consumer products such as computer games. The visually engaging and interactive nature of 3D graphics meets customers' demands for a convincing simulation of reality.

Nvidia is the recognised global leader in advanced graphics processing technology for mainstream platforms. The breadth of Nvidia's product line provides 3D, 2D and high-definition digital video and television for various audiences, from workstations to Internet-enabled appliances. Nvidia chips are used in Compaq, Dell, Gateway and IBM computers, and on add-in boards and motherboards produced by companies such as Creative Technology and Intel.

Why is the company a pioneer?

Nvidia is the first semiconductor company to deliver a complete top-to-bottom series of 3D graphics solutions with full support across multiple operating systems. PC original equipment manufacturers (OEMs), add-in card manufacturers, system builders and consumer-electronics companies worldwide choose Nvidia graphics processing units (GPUs) as the core elements of their graphics processing solutions. Nvidia's award-winning graphics processors deliver crisp visual quality for PC-based applications in areas such as manufacturing, science, e-business, entertainment and education.

http://www.nvidia.com

28

OmniSonics Medical Technologies Inc

Robert A Rabiner, *president and chief executive*

CATEGORY: Biotechnology
LOCATION: Massachusetts, US
NUMBER OF EMPLOYEES: 30
YEAR FOUNDED: 1998
ORIGINS: Entrepreneurial founders

OmniSonics Medical Technologies is an early-stage medical equipment company dedicated to developing innovative, minimally invasive medical devices. Based on proprietary ultrasonic platforms, its products are intended to improve patient surgical outcomes while advancing standards and methodologies for the removal of soft tissue.

OmniSonics has developed a technology called Resolution™ System, designed to remove large volumes of tissue in a non-thermal, non-traumatic fashion. The technology uses a handheld transducer to convert electrical signals into specific motion on a probe. This ultrasonic energy device uses a very small, thin wire at the tip of, for example, a catheter to treat cardiovascular diseases by breaking up and removing blood clots and other blockages from the human circulatory system.

The company has made significant progress towards developing its core applications for this innovative technology in the treatment of arterial thrombosis and peripheral vascular disease, among other disorders. Clinical trials are under way in the United States and Europe. Commercialisation in Europe is imminent and OmniSonics plans to initiate additional trials in 2003.

Why is the company a pioneer?

The company continues to develop proprietary products for a broad range of minimally invasive surgical procedures where rapid, precise tissue removal is required. Currently there are limited tools for removing body tissue in a safe, non-thermal manner. OmniSonics' innovative Resolution System enables surgeons to carry out a more controlled dissection and removal of soft tissue. This system will help minimise potential damage to surrounding tissue and improve operative precision and efficiency—key benefits for the patient.

http://www.omnisonics.com

29

OTB-Group BV

Ron Kok, *founder*

CATEGORY: Information technology
LOCATION: Eindhoven, The Netherlands
YEAR FOUNDED: 1994
ORIGINS: Entrepreneurial founder

OTB-Group designs, develops and realises breakthrough high-precision inline production equipment. The company's inventive use of injection moulding, deposition/vacuum technology and inline production automation is changing the manufacturing economics of everything from contact lenses to solar energy cells and DVDs.

For example, engineers working with founder Ron Kok developed an inline machine that radically reduced the cost of producing disposable contact lenses for Johnson & Johnson. At the time Johnson & Johnson was manufacturing contact lenses using an automated batch system that required 26 operators. OTB-Group's invention did the same job with five operators. Similar technology was then applied to the production of photovoltaic solar cells for Royal Dutch Shell, radically reducing costs with a fully automated process.

In the optical media sector, OTB-Group has designed inline machines for the mass production of DVDs, recordable DVDs and the next wave of DVDs, called blue laser. To do this, the company invented a new type of compression moulding technology called the E-Clamp.

OTB-Group sells its processes and services worldwide, and has built up annual revenues to about $100m.

Why is the company a pioneer?

OTB-Group is known for its ability to produce tailor-made manufacturing breakthroughs. Now the company is working on ways to apply its core technology to silicon wafers and flat panel displays, with the aim of reducing production costs by as much as a factor of ten. OTB-Group also sees the possibility of extending its expertise to biomedical systems, since replicating nanostructures is within the company's grasp.

http://www.otb-group.nl

30

Red-M

Mike McTighe, *chairman*

CATEGORY: Information technology
LOCATION: London, United Kingdom
YEAR FOUNDED: 1999
ORIGINS: Entrepreneurial founders

Red-M develops and markets hardware and software for mobile data, voice and video communication to a range of devices, including computers, personal digital assistants (PDAs), wireless application protocol (WAP) smart phones and other emerging information appliances, using Bluetooth™ technology.

Red-M's mission is to allow users to be as effective on the move as they are at their desks while minimising mobile communication costs. The company's True Mobility™ technology is designed to solve the problems (such as security, roaming, device diversity and location awareness) associated with moving within and between wireless networks.

Red-M configuration comprises a mobility server, a software suite optimised for voice and data communications, and wireless access points and access servers for wireless local area networks (LAN) and Bluetooth connectivity. The aim is to enable multiple wireless technologies to be integrated with existing corporate wired networks.

The company is a market leader in short-range radio networking solutions, including Bluetooth/802.11. These standards facilitate wireless broadband networking. Alliances are in place with Computer Associates, Motorola, BT and Flextronics, among others.

Why is the company a pioneer?

The company is breaking new ground in advanced mobile commerce solutions, focusing on next-generation mobile data, voice and video services in the workplace, home and public concourses. Red-M's Mobility Services Infrastructure unites general packet radio service (GPRS), wireless LAN and Bluetooth for the first time, enabling secure management of all mobile voice and data services quickly and cost-effectively. Red-M is also developing wireless Internet server products that allow mobile access to the Internet and intranets from a wide range of devices.

http://www.red-m.com

31

RiboTargets Ltd

Simon J Sturge, *chief executive*

CATEGORY: Biotechnology
LOCATION: Cambridge, United Kingdom
NUMBER OF EMPLOYEES: 93
YEAR FOUNDED: 1997
ORIGINS: Spin-off from UK Medical Research Council

RiboTargets is applying its drug discovery platform to a wide range of anti-infective drug targets, concentrating on two therapeutic areas: anti-bacterials and anti-cancers. The company expects its first compounds to enter clinical development in 2003.

Research draws on a unique computational screening platform technology, RiboDock®, which supports the rapid generation of lead compounds from target structures. It is the only computational screening platform capable of screening against both proteins and nucleic acids.

To unleash the full power of RiboDock®, the company accesses a library of over 4m compounds that are screened against 3D structures of new drug targets. RiboTargets has particular interests in the bacterial ribosome, which contains many known and novel sites for antibiotic action, including that of two of the four top-selling antibiotics, with combined sales of over $3bn. The company maintains an exclusive consultancy agreement with Venki Ramakrishnan, who defined the crystal structure of the 30S ribosomal subunit in bacteria. It also has an exclusive option to negotiate patent rights to the structure of the 30S ribosome.

Why is the company a pioneer?

RiboTargets has built a world-class capability that can rapidly and accurately elucidate the 3D structure of protein and nucleic acid targets using X-ray crystallography or NMR spectroscopic methods. RiboTargets has established an innovative drug design and development engine focused on the use of structure-based design to improve the drug discovery process. RiboTargets was the first company in the world able to apply such structure-based drug design to the bacterial ribosome, one of the richest pools of targets for existing antibiotics.

http://www.ribotargets.co.uk

32

Savi Technology

Vic Verma, *president and chief executive*

CATEGORY: Information technology
LOCATION: California, US
NUMBER OF EMPLOYEES: 275
YEAR FOUNDED: 1989
ORIGINS: Entrepreneurial founder

Savi Technology provides supply chain asset management, security and collaboration software that is uniquely integrated with automatic data collection and identification systems to provide timely logistics solutions.

Ideal supply chain security and asset management solutions must include real-time data, structured data aggregation, and secure, automated asset management of all containers and their contents. Savi delivers on all these elements with its complete product offering.

Savi's radio frequency identification infrastructure, including the innovative EchoPoint technology and Savi SmartSeal electronic security seals, provides status monitoring and plugs directly into the Savi SmartChain Platform. The SmartChain Platform aggregates and integrates logistical data from multiple sources and translates them into actionable information. Asset owners, carriers, terminal operators, international ports and logistics service providers thus have the ability to monitor, manage and secure supply chain assets more efficiently.

The company's customer base includes the US Department of Defense, for which it built and operates the world's largest real-time tracking network, the US Postal Service and Singapore Airlines, as well as major automotive, electronics, grocery and retail companies.

Why is the company a pioneer?

Savi Technology is a leader in dynamic supply chain execution solutions, providing visibility into global supply chains in order to improve, control and optimise operational performance. Savi's software platform and applications enable multinational shippers, logistics service providers, conveyance owners and infrastructure owners to monitor, manage and improve the progress of goods through all segments of a global supply chain.

http://www.savi.com

33

Seeing Machines

Dr Alex Zelinsky, *chief executive*

CATEGORY: Information technology
LOCATION: Canberra, Australia
NUMBER OF EMPLOYEES: 21
YEAR FOUNDED: 2000
ORIGINS: University spin-off

Seeing Machines has developed new technology to read facial expressions for the purpose of detecting a subject's fatigue or inattention, to measure human performance and to provide input for interactive multimedia products.

Seeing Machines faceLAB™ technology performs precise and reliable human facial measurement to fix the direction of a subject's gaze. The technology uses two cameras and operates through passive analysis of stereo-video information. The software is able to locate and identify a human face, then track it by locating the 3D positions of facial features.

The research was sponsored by Volvo Technology and Development and is based on work done at the Research School of Information Sciences and Engineering at the Australian National University. Volvo's interest was to test the safety of new lorry cabin designs by determining whether cabin layouts were likely to confuse or distract the driver.

Further work evolving from the ground-breaking Volvo project holds promise for the company. The development of camera technology is likely to force down video capture and processing power costs, shifting the balance towards systems with more than one camera. Seeing Machines is also developing products based on a low-cost, single-camera system, aimed at the consumer market.

Why is the company a pioneer?

After studying and testing the state of existing eye-gaze-tracking technology, Volvo concluded that its requirements for reliability and robustness simply weren't met by any other available system. Other systems require slow head motion, cannot track in three dimensions and are prone to failure or false measurement under certain conditions. The Seeing Machines system overcomes all these limitations.

http://www.seeingmachines.com

34

Solid Technologies Inc

Dr Joon Chung, *chief executive*

CATEGORY: Information technology
LOCATION: South Korea
NUMBER OF EMPLOYEES: 102
YEAR FOUNDED: 1998
ORIGINS: Entrepreneurial start-up

Solid Technologies has developed innovative solutions for wireless operators based on its digital signal processing, fibre optics and radio technologies expertise. The company's product line includes wireless repeaters for in-building coverage, high power hybrid fibre coaxial (HFC) systems and digital fibre-optic repeater systems. Solid Technologies is currently developing broadband (1xEV-DO) wireless communication systems and plans to develop mobile IP-based data access systems.

The company has launched a series of innovations for the code division multiple access (CDMA) networking equipment market, including the introduction to South Korea of in-building CDMA repeaters and the launch of digital repeaters.

The company has grown very quickly to become a leading CDMA equipment manufacturer in Korea. Customers are the two dominant Korean CDMA operators, SKT and KTF. Solid Technologies' products have allowed the operators to reduce their network development costs and enhance their in-building service quality.

Now the company is developing a new type of 3G wireless data base station combining 1xEV-DO technology with its repeater technology and know-how accumulated during the past three years. This base station will be particularly useful in serving hot spots where a high capacity for wireless data is required.

Why is the company a pioneer?

Using its software-defined radio technology and digital signal processing technology, Solid Technologies was the first company in the world to introduce digital repeaters. The digital repeater offers a lot more flexibility in usage, better reliability and higher performance, leading to a significant cost reduction for wireless network deployment. KT iCom, one of the wireless operators with a 3G licence in Korea, has adopted the digital repeater as its outdoor repeater. SK IMT, another 3G operator, also opted for the product as one of its repeater solutions.

http://www.st.co.kr

35

Soluz Inc

Richard D Hansen, *president*

CATEGORY: Energy/environmental technology
LOCATION: Massachusetts, US
NUMBER OF EMPLOYEES: 40
YEAR FOUNDED: 1993
ORIGINS: Entrepreneurial founder

Soluz develops and operates rural energy companies offering distributed micropower in off-grid areas of developing countries. Customers are rural households and dispersed small businesses, mainly served through a fee-for-service approach that offers solar-powered photovoltaic (PV) systems and service.

Soluz was established expressly to develop the commercial potential of PV technology. The company's core expertise is in the development and support of rural energy delivery companies (REDCOs) to meet the vast need for electrical service in rural areas, where an estimated 2bn people, or 400m households, lack access to electrical distribution infrastructure.

Soluz customers can pay set monthly fees to rent PV systems, including wiring and fluorescent lighting, for illumination and power for radios and television sets. Majority-owned Soluz subsidiaries in the Dominican Republic, launched in 1995, and Honduras, begun in 1998, are serving thousands of rural households and small businesses with the fee-for-service offering. The operations are models for large-scale PV electrification.

Why is the company a pioneer?

Soluz has built an innovative business and technology model for the delivery and financing of solar power for rural electrification in developing countries. Soluz has developed the first REDCOs to combine distributed PV technology with an unsubsidised fee-for-service, or rental, offering. The rental option offers customers an easy payment method and total service commitment, significantly broadening the reach of PV beyond cash and credit sales.

http://www.soluz.net

36

SpeechWorks International

Stuart Patterson, *chief executive*

CATEGORY: Information technology
LOCATION: Massachusetts, US
NUMBER OF EMPLOYEES: 409
YEAR FOUNDED: 1994
ORIGINS: Spin-off from MIT Labs

SpeechWorks is a leading provider of software products and professional services, enabling enterprises and carriers to offer automated speech-activated services by telephone. SpeechWorks delivers natural language speech recognition, speaker verification and text-to-speech solutions to leading corporations, telecommunications providers and government organisations worldwide. Through the power of SpeechWorks' products and technologies, the human voice is all a caller needs to access instant information and conduct transactions from any landline or wireless phone.

SpeechWorks' research has led to a suite of products providing open, standards-compliant speech technologies engineered for fast platform integration and superior performance on voice-processing platforms. SpeechWorks' products have been built to optimise the performance of VoiceXML-based speech services.

The company's products are now embraced by more than 80% of leading interactive voice response (IVR) and automated speech recognition (ASR) platform providers worldwide, including Avaya, Comverse Network Systems, Convergys, Edify, Intervoice, Nortel Networks, VoiceGenie and West. SpeechWorks' customers include AOL, Continental Airlines, E*TRADE, FedEx, Crédit Lyonnais, Amtrak and United Airlines.

Why is the company a pioneer?

To reduce the intricacy of building speech-recognition applications, SpeechWorks pioneered the concept of building blocks called DialogModules, which pre-package common tasks such as capturing an account number, date, or "yes/no" response—the lower-level tasks of application development.

SpeechWorks also takes a leadership role in establishing standards for creating speech-enabled applications. SpeechWorks was the first to provide an open source VoiceXML interpreter to facilitate the development of browser-based speech-recognition solutions.

http://www.speechworks.com

37

TIAX LLC

Dr Kenan Sahin, *president*

CATEGORY: Energy/environmental technology
LOCATION: Massachusetts, US
NUMBER OF EMPLOYEES: 280
YEAR FOUNDED: 2002
ORIGINS: Successor to Arthur D Little unit

TIAX, a leading technology research consulting firm, is involved in a wide range of research and development activities, prime among them research into next-generation power sources.

TIAX has developed key technologies for lithium polymer ion batteries, which provide three to four times the energy density (120-200 watt hours per kilogram) of a standard nickel-cadmium battery. TIAX's solutions extend battery life, reduce volume and add the capability to shape the battery in any form, stretching the design horizons for next-generation devices.

TIAX researchers have also worked for more than a decade to develop and assess fuel cell technologies and their commercial prospects. The company contributes the technical, commercial and infrastructural understanding that is essential for bringing these and other emerging energy technologies to the marketplace.

Formerly Arthur D Little's Technology and Innovation unit, the company has also worked on residential and commercial power generation and portable power projects to develop proprietary technology or improve existing technology.

Why is the company a pioneer?

Among other achievements, TIAX was central to the formation of Nuvera Fuel Cells. Nuvera has become one of the leading integrated fuel cell system suppliers in the world for stationary and transportation applications. TIAX has also developed new technologies to burn coal more cleanly and efficiently, a possible avenue towards reduced US dependence on oil. More recently, TIAX has been selected by the California Energy Commission to pioneer electricity generation from landfills using hydrogen-enriched biogas.

http://www.tiax.biz

38

Vertex Pharmaceuticals Inc

Dr Joshua Boger, *chairman and chief executive*

CATEGORY: Biotechnology
LOCATION: Massachusetts, US
NUMBER OF EMPLOYEES: 1,000
YEAR FOUNDED: 1989
ORIGINS: Entrepreneurial start-up

Vertex Pharmaceuticals brings together a range of drug discovery technologies into a single approach. The firm's multi-disciplinary tools—using biophysics, chemistry and computer-based modelling—eliminate the traditional trial-and-error approach to drug development.

Vertex is dedicated to the discovery of the structure of malfunctioning molecules associated with disease and to the design of compounds that alter those molecules' functions. Vertex seeks to develop and commercialise major pharmaceutical products independently or with partners.

Vertex's first approved product is Agenerase®, an HIV protease inhibitor, which Vertex co-promotes with GlaxoSmithKline. It is approved for use in the United States. The company has 12 drug candidates in development to treat viral diseases, inflammation, cancer, autoimmune diseases and neurological disorders.

Vertex has developed a variety of advanced and proprietary technologies, including compound screening using nuclear magnetic resonance (NMR) spectroscopy, virtual screening using computer modelling and combinatorial chemistry, and early incorporation of pharmacological testing.

Collaborative agreements are in place with Novartis, Eli Lilly, Aventis and Schering AG, among others.

Why is the company a pioneer?

Within the past few years, Vertex has pioneered the new field of chemogenomics to accelerate drug discovery directed at gene families. Chemogenomics drives parallel drug design directed at targets within the same gene family. In contrast to approaches that group genomic targets according to therapeutic area, Vertex has the potential to allow highly efficient discovery of lead compounds, since chemical information based on one target can be rapidly applied towards structurally similar targets whose biological function may be very different.

http://www.vrtx.com

39

VivoMetrics Inc

Paul L Kennedy, *president and chief executive*

CATEGORY: Biotechnology
LOCATION: California, US
NUMBER OF EMPLOYEES: 35
YEAR FOUNDED: 1999
ORIGINS: Entrepreneurial founders

VivoMetrics provides continuous, ambulatory health monitoring products and services for the collection, analysis and reporting of physiological data gathered during a subject's everyday activities.

The company's core offering is the LifeShirt™, a lightweight shirt with embedded sensors that collect data without interrupting daily life. Proprietary PC-based software decrypts and processes recorded data using patented algorithms. The processed data help clinicians make more informed healthcare decisions.

LifeShirt's core technology is based on the in-patient respiratory monitoring system Respitrace®, which VivoMetrics has miniaturised and adapted for everyday use. Respitrace is currently used in more than 1,000 hospitals worldwide.

The technology is based on inductive plethysmography, a non-invasive respiratory monitoring system uniquely capable of differentiating between varieties of sleep apnea, among other disorders. A three-lead, single channel ECG measures heart rate and a two-axis accelerometer records patient posture and activity level. Optional peripheral devices measure blood pressure and blood oxygen saturation.

The US Food and Drug Administration as well as Canadian and European regulators have approved the LifeShirt for consumer use.

Why is the company a pioneer?

Clinicians and researchers examining a patient have so far been limited to viewing a "snapshot" of that patient's health—a moment of data frozen in time. The LifeShirt's embedded sensors and patient diary capture continuous data, affording an unprecedented, real-world view of the patient. For the first time, researchers and clinicians can review trends and interactions among multiple physiological responses to real events in patients' daily lives.

http://www.vivometrics.com

40

Z-KAT Inc

Tom Alexandris, *president and chief executive*

CATEGORY: Information technology
LOCATION: Florida, US
YEAR FOUNDED: 1997
ORIGINS: Technology licensed from a university

As surgical procedures become less invasive, clinicians need access to more and better data to gauge where instruments, implants or other therapies need to be placed in the patient's body. Z-KAT is helping to enable this revolution by making surgery and intervention procedures digital.

The company has launched a number of imaging tools in orthopaedic surgery and is now moving into brain surgery. For other applications, a robot assistant is in clinical trials. With its acquisition of Marconi Medical System's image-guided surgery business, Z-KAT's portfolio of patents and technologies is one of the broadest in the industry.

Z-KAT's technologies are applied today both for invasive and non-invasive procedures, since open procedures often provide only limited vision and access for the surgeon. Z-KAT products are in use today in a growing number of hospitals around the United States and have been used in thousands of surgical cases.

Z-KAT believes in a variation of Moore's law (the exponential growth of computing power with minimal cost increases), predicting that high technology products will be delivered to the medical community with expanded functionality year after year. By applying the growth of computing power directly to the surgical process, tremendous strides in the standards of treatment and significant reductions in the costs of healthcare beckon.

Why is the company a pioneer?

Z-KAT's focus is on providing leading-edge, image-guided technology solutions to clinicians. The technology allows the clinician fully to explore the target anatomy pre-operatively as well as acting upon the data during an operation. Z-KAT's products enable clinicians to develop techniques and procedures that are less invasive yet faster, more accurate and easier to perform than standard procedures.

http://www.z-kat.com

Apax Partners' international offices

FRANCE
Apax Partners S.A.
45 Avenue Kléber
Cedex 16
75784
Paris
France
Telephone: +33 (0)1 53 65 01 00

GERMANY
Apax Partners
Beteiligungsberatung GmbH
Possartstrasse 11
D-81679
Munich
Germany
Telephone: +49 (0)89 998 9090

ISRAEL
Apax Partners Israel Ltd
2 Maskit Street
6th Floor
PO Box 2034
Herzliya
46120
Israel
Telephone: +972 (0)9 960 8100

ITALY
Apax Partners S.r.l.
Via Boschetti 1
20121
Milan
Italy
Telephone: +39 02 762 1191

JAPAN
Apax Globis Partners & Co
Sumitomofudosan Nibancho Bldg. 4F
11-7 Nibancho
Chiyoda-ku
Tokyo
102-0084
Japan
Telephone: +81 3 5275 3939

SPAIN
Apax Partners España, S.A.
Velázquez 10-5º
(E) 28001
Madrid
Spain
Telephone: +34 914 231 000

UK
Apax Partners Ltd
15 Portland Place
London
W1B 1PT
United Kingdom
Telephone: +44 (0)20 7872 6300

Apax Partners Ltd
1 City Square
Leeds
LS1 2AL
United Kingdom
Telephone: +44 (0)113 388 9200

USA
Apax Partners, Inc
445 Park Avenue
11th Floor
New York
NY 10022
USA
Telephone: +1 212 753 6300

Apax Partners, Inc
2100 Geng Road
Suite 150
Palo Alto
CA 94303
USA
Telephone: +1 650 494 9944

Apax Partners, one of the world's leading private equity firms, advises and manages private equity funds of over €12bn. We are currently investing over €6bn in high-growth companies around the world.