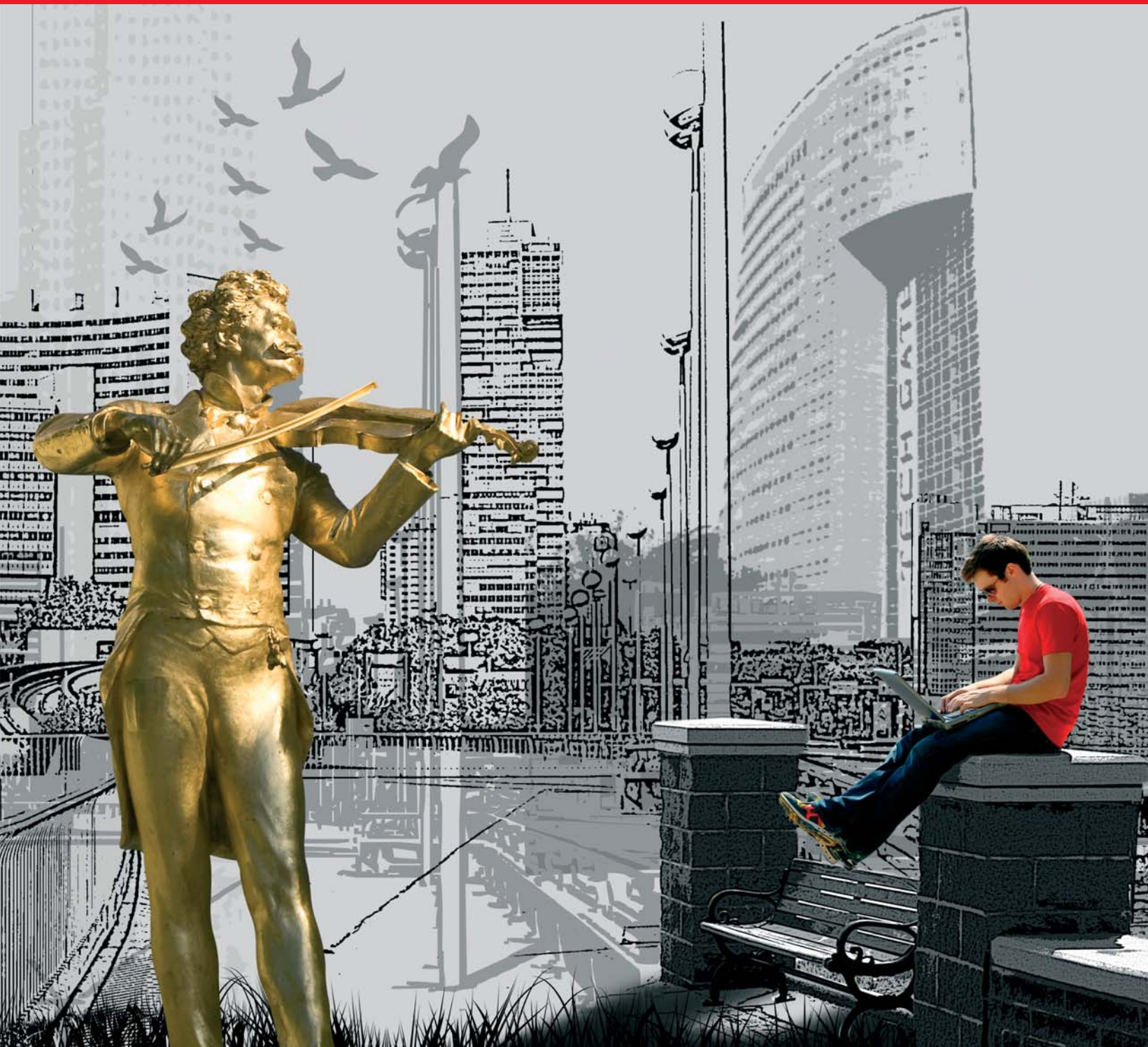# VIENNA.
THE DIGITAL CITY.

ICT Business and Research in Vienna

Municipal Department
für EU-Strategy and
Economic Development

City of ✠ Vienna
Vienna is special.

Imprint

VIENNA.
THE DIGITAL CITY.

ICT BUSINESS AND RESEARCH IN VIENNA

Renate Brauner
Vice Mayor and Deputy Governor
Executive City Councillor of Finances, Economic Affairs and Vienna Public Enterprises of the City of Vienna

Dear Readers,

You have probably heard of Vienna, and you may have already been there. Vienna: famed city of music and cultural metropolis at the heart of Europe. Vienna is among the top-ranked cities worldwide in terms of quality of life. But Vienna has even more to offer.

Vienna is a vibrant business location, a hub between East and West, host to one of the three international UN headquarters, and one of Europe's hottest spots in terms of creative industries and digital technologies.

This brochure should give you an overview of Vienna's assets in the world of information and communication technologies. The city is proud of its excellent broadband infrastructure and its highly ranked e-government services. It enjoys global renown in the area of electronic music. It boasts numerous enterprises, both large and small, developing high-tech products and services and exporting them to markets all over the world. It also has excellent schools and universities whose achievements play a role in the current and future place of Vienna among the most prosperous cities in Europe.

Vienna's municipal administration has introduced a wide range of support measures to foster the city's transition into the information age, including the groundbreaking digitalization of the administration itself; the implementation of fiber to the home (FTTH); financial support of the industry; and the establishment of networks to aid research and business in collaboration and internationalization.

The business and research agencies of the City of Vienna – the Vienna Business Agency or VBA (www.vba.at), Vienna IT Enterprises or VITE (www.vite.at) and the Center for Innovation and Technology (www.zit.co.at) - will be at your service if you are interested in moving your business to Vienna or in cooperating with a Viennese company or university.

I wish you much success in all your business ventures and look forward to seeing you in Vienna soon.

Yours

Renate Brauner

Dear Readers,

The ICT industry is booming all over the world – and in Vienna, too. This brochure describes the findings of a study on Vienna as an ICT location. It was carried out in 2007 and commissioned by the Municipal Department for EU-Strategy and Economic Development (https://www.wien.gv.at/wirtschaft/eu-strategie/wirtschaft/pdf/ikt.pdf).
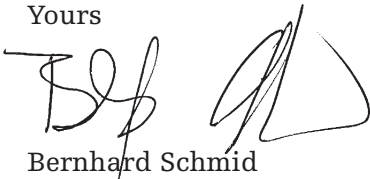
The study shows that the added value of Vienna's ICT industry is six times higher than that of Vienna's traditional mainstay, the tourism industry. In 2006, the combined gross revenue of approximately 5,500 companies, from small enterprises to multinational corporations, amounted to approximately € 20 billion. Thus the ICT industry is one of the pillars of the city's wealth.

Thanks to its location at the heart of Europe, Vienna is a very international city and functions as a hub for the Central and Eastern European countries. It excels in terms of quality of life. It has extremely high standards in education and vocational training.

Austria is a pioneer in investing and working in new markets. Austria is the biggest investor in Bulgaria, Croatia and Slovenia, and ranks among the top three in several other countries of the region such as the Czech Republic, Hungary and Slovakia. Most of these activities originate in Vienna, where the majority of the big industry players are found. This setting is also an incubator for young and innovative start ups and it sets standards for the city's future as an important ICT location.

As a business, it is worth your while to enter into cooperation with IT companies located in Vienna. And the benefits of founding or relocating a business in this attractive city are also worth considering. We would be happy to provide assistance in all matters related to doing business in Vienna.

Yours

Bernhard Schmid
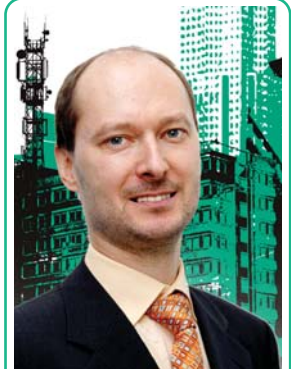
Bernhard Schmid
Project Manager
Vienna IT Enterprises (VITE) /
Vienna Business Agency (VBA)

Vienna: The Sound of High-Tech

Vienna is already world famous for its cultural heritage and classical music. In the past decades it has also become one of Europe's leading convention cities. But an even more recent development involves the city's booming digital industry. Its added value for the municipality is six times greater than that of the tourism industry. Vienna is the biggest ICT hub for Central and Eastern Europe and is one of the region's main ICT-related research locations.

This standing has been achieved in part due to the City of Vienna's forward-looking, headline strategy for research and technological development: "Wien denkt Zukunft," or "Vienna Looks to the Future" (www.wiendenktzukunft.at/downloads/strategie_english.pdf).

>>> **The following pages will provide an overview of Vienna and its ICT industry.**

Gross turnover of the Vienna ICT industry grew to more than € 24 billion in 2007, 30% of which was in export. Nearly 60% of all export revenues came from the new EU member states and Eastern European countries. Numerous ICT multinationals and Austrian companies manage their CEE operations from Vienna. The city hosts important subsidiaries of Siemens, Philips, Alcatel, SAP and more.

Vienna's highlights include digital image processing and computer vision, embedded systems, e-government, quantum computing, speech processing, traffic telematics and the vast area of creative industries.

Vienna houses all institutions of Austria's federal government. And Austria consistently scores among the top countries in European e-government rankings, an accomplishment which has a lot to do with the efforts undertaken by the city of Vienna itself.

For example, there are the numerous activities of the city's public funding bodies, the **Vienna Business Agency (VBA)** and its **Center for Technology and Innovation (ZIT)**; its platforms for ICT and the creative industries, **VITE** and **departure**, respectively; and also the **Vienna Science and Technology Fund (WWTF)**.

Vienna is also the setting for Europe's most competitive mobile communications market. As one spokesperson for Alcatel Lucent Austria, the Austrian subsidiary of the French ICT giant, claims, "if you can make it in Vienna, you can make it anywhere."

CONTENT

VIENNA: THE BASICS
A Traditional Face with a High-Tech Heart

A Traditional Face with a High-Tech Heart

Vienna (www.wien.at/english) is the capital of Austria and a federal republic at the heart of Europe. Historically, geographically and economically, the city has long been Europe's leading hub for doing business in Central and Eastern Europe and beyond. The international information and communication industries in particular have selected Vienna as their Central European center.

With around 1.8 million inhabitants, Vienna is the third-largest university location in the German-speaking realm and ranks among the top three cities worldwide in terms of quality of life and public safety.

Vienna's municipal administration is one of Europe's most efficient. It is also ranked among the cities with the highest density of broadband access. Thanks to the Vienna International Airport (www.viennaairport.com) it boasts the highest number of flights to Central and Eastern Europe as well as Central Asia. To top it off, it also has an excellent public transportation network (www.vor.at).

As the capital of Austria, Vienna profits from the country's high productivity, low unemployment rate, low inflation rate, and extremely low strike rate (www.wien.gv.at/english/politics/statistics). Among international cities, Vienna has one of the very lowest levels of corruption.

Vienna has an excellent educational infrastructure on all levels. It is home to around 20 international schools where students are taught in as many languages, from Arabic, Czech, English, French, German, Japanese, Russian to Swedish.

Innovative companies based in Vienna profit from an extensive public funding system for start ups, research and development and a wide range of other support measures.

Although Vienna is a historic city with imperial grandeur, it has an exceedingly modern infrastructure which accommodates a constantly growing industry. The Vienna property market continued its positive development in 2007, when new letting reached a record high of 385,000 m^2 and the property investment market saw a record volume of € 2.8 billion. The high level of occupancy is mainly due to relocations, with many companies moving into modern, more efficient office space, such as the projects Donau City (www.donaucity.at), Business Park Vienna (www.businessparkvienna.com) and TownTown (www.towntown.at). At the same time, Vienna's office space rental rates are among the most affordable in Europe.

Brigitte Ederer,
CEO Siemens Austria

Brigitte Ederer studied economics and worked for Austria's Chamber of Labour, was Member of Parliament, chaired several parliamentary committees, was Minister of State for European Integration and Development Cooperation and later Minister of State for European Affairs, Secretary General of Austria's Social Democratic Party, then Executive City Councillor for Finance, Economic Affairs and the Public Enterprises of the City of Vienna and, in 2005, became Chief Executive Officer of Siemens AG Austria. Today, Brigitte Ederer is CEO of Siemens Austria and of the company's CEE cluster consisting of 17 countries in Central and Eastern Europe. Siemens Austria is also the headquarters of Siemens' program and software development division PSE.

The high-tech district Donau City, one of many tech hot spots in Vienna.
In the foreground, the city's more traditional silhouette.

Education & Vocational Training:
Excellent Skills for a Sound Economy

A survey by Austria's major economic research institute WIFO reveals that multinationals located in Vienna name two main criteria for their decision to come to and remain in Vienna: the availability of a qualified workforce and the high level of school education. These two factors are obviously inter-related.

Austria's school system – and particularly Vienna's, where the density and variety of schools is the highest – has two main advantages for high-tech industries:

- The dual vocational training system (www.bmukk.gv.at/enfr/school/secon/app.xml) re-quires vocational students (usually at the age of fifteen, when mandatory schooling ends) to apply for an appropriate job at a certified company. Employing vocational students obliges companies to fulfill demanding cri-teria; altogether, this results in a high educational level. Austria's appren-tices are ranked at the very top in annual international vocational contests, such as the WorldSkills international 2007 (www.worldskills.org) in Japan, where Austria won two gold, one silver and one bronze medal and 19 awards for excellence. Overall, Austria is ranked number two in Europe, just after Switzerland.

- The Höhere Technische Lehranstalt HTL (www.berufsbildendeschulen.at) is a secon-dary technical high school system that has earned the respect of the indu-stry. Students graduate at the age of 19 and are frequently rated equal to university graduates on the basis of their practical skills. One of the most esteemed schools for informatics and management is Vienna's HTL Spengergasse (www.spengergasse.at) with its approximately 1,300 students.

Companies like Siemens, Philips, Telekom Austria, Kapsch, but also small and medium-sized ICT companies literally line up on graduation day to employ apprentices and HTL graduates.

Vienna's leading schools for academic education in informatics and ICT are the Vienna University of Technology (www.tuwien.ac.at) and Vienna University (www.univie.ac.at). Vienna's University of Economics and Business Administration (www.wu-wien.ac.at) offers studies in business informatics; a number of universi-ties of applied sciences, called "Fachhochschulen" in German (www.fhr.ac.at), offer a wide variety of special ICT-related subjects.

The 2007 World Competitiveness Yearbook ranks Austrian skilled labor, pro-ductivity and management competence as top in the area of employee moti-vation and corporate training and second place worldwide overall (www.imd.ch/research/publications/wcy/index.cfm).

Networks & Platforms

The ICT industry is one of the best networked sectors, and Vienna offers a rich variety of initiatives and associations to foster and support ICT businesses, in particular for the more than 70,000 small and medium-sized businesses.

VITE, or Vienna IT Enterprises (www.vite.at) is a network for ICT companies, entrepreneurs and research organizations supporting its members in marketing, export, internationalization, EU projects, legal matters and a range of other issues. Several times each year VITE organizes presentations abroad and has so far visited Belgrade, Brussels, Bucharest, Kiev and Moscow. The platform was founded in 2004 by the VBA, or Vienna Business Agency (www.vba.at) which is Vienna's major funding and investment institution and a joint venture of the City of Vienna and the Austrian Federal Economic Chamber (www.wko.at).

Via its Center for Innovation and Technology, or ZIT (www.zit.co.at) the VBA also organizes regular ICT-related calls for tenders in which companies and organizations compete for funding opportunities. This healthy competition has helped a growing number of companies to develop innovative and potentially lucrative products and services (www.zit.co.at).

In Austria, membership in the Federal Economic Chamber is mandatory for every registered company. The Chamber offers service platforms for each industry. UBIT (www.ubit.at) is the Chamber's ICT association, and the Vienna chapter is the biggest in Austria. UBIT is involved in issues such as salary negotiations and employment regulations and acts as a lobby for its members.

Vienna is also the home of the Austrian Computer Society, or OCG (www.ocg.at) with just over 1,000 members. The OCG is a more scientifically-oriented platform, organizing national and international ICT conferences such as the annual E-Gov Days (e-government.adv.at) and its sister event in the Czech Republic (www.epma.cz/7th_eeegovdays.html).

The electronics industry networks via its platform FEEI (www.feei.at). Internet providers lobby and share know-how within the ISPA (www.ispa.at). As well, there are a number of smaller specialized associations for multimedia, broadband, mobile communications, gaming and others, so that each particular interest enjoys representation.

A VITE delegation at the European Parliament in Brussels after a presentation of Vienna's ICT research agenda in April 2008.

Small is Beautiful, Smart – and Highly International

Austria is a small but smart market. And Vienna's high-tech industry is clearly oriented to the global market. Most of the major ICT multinationals located in and around the city also oversee the neighboring countries, primarily in Central and Eastern Europe, but in some cases Germany, Switzerland or even all of Europe, the Middle East and Africa.

Siemens (www.siemens.at) runs its biggest foreign subsidiary in Vienna, which is simultaneously the regional headquarters for 17 countries in Central and Eastern Europe. It is also the company's central hub for its program and software development division PSE. Siemens Austria CEO Brigitte Ederer has been quoted as saying, "I have daily contact with colleagues all around the world, which is essential because we pass on know-how to manage complex projects. This expertise enables them to represent Siemens in a very positive manner. This is also the way we find solutions for our customers."
(Leaders' Magazine, July 2008, www.leadersmag.com/issues/2008.3_July/women/ederer.html.)

Leading global ERP software producer **SAP** (www.sap.at) runs its entire CEE business from Vienna. The Vienna headquarters also manage the company's service helpdesk and several other European divisions.

Nearly 98% of its production is destined for export: **Philips Austria** (www.philips.at), based in Vienna, has a long tradition of introducing new technologies which then spread across the globe, from VHS VCR, to audio cassette, the CD and beyond. More recently, Philips Austria has been responsible for the company's speech processing and RFID semiconductor development units, which have been meanwhile sold to the Vienna subsidiaries of **NXP semiconductors** (www.nxp.com) and **Nuance Communications** (www.nuance.de). NXP Vienna has also located its international headquarters for mobile sound solutions in Vienna and manages the NXP China unit from here.

In 2007, NXP and Sony founded **Moversa** (www.moversa.net), a joint venture that will drive global adoption of contactless smart card applications in mobile phones using Near Field Communication (NFC). Moversa is headquartered in Vienna.

Alcatel Lucent (www.alcatel-lucent.at) in Vienna is home to the company's top technology scouts. Their long term partner **Thales** (www.thalesgroup.com) supplies rail signaling solutions to many European countries.

Since 2002, **Samsung Electronics Austria** (www.samsung.at) has been handling the markets in Austria, Albania, Bosnia, Bulgaria, Croatia, Macedonia, Montenegro, Romania, Serbia, Slovenia and Switzerland.

T-Systems Austria (www.t-systems.at) is the international competence center for SAP-based hospital solutions of T-Systems International. The division called Service Line Health has developed a fully-integrated clinical information system, i.s.h.med, together with GSD Berlin, which has been implemented in more than 240 locations worldwide.

Scientific Games International (www.scientificgames.com) develop lottery software, e-business solutions and financial transaction applications for banks, credit card companies and clearing houses in Vienna for Europe, the Middle East and Africa.

Boris Nemsic,
CEO Telekom Austria Group

Boris Nemsic earned his degree as an electrical engineer at the Sarajevo Technical University in 1980. In 1990 he was awarded a doctorate from the Vienna University of Technology, where he was also employed from 1988 to 1990 as a scientific assistant at the Institute for Communications and Radio-Frequency Engineering. In 1997 Boris Nemsic was hired by Mobilkom Austria as department head for network planning. Today he is Chief Executive Officer (CEO) of the Telekom Austria Group and of mobilkom austria AG.

Vienna's culture district Museumsquartier, home of numerous museums as well as of Quartier 21, a home base for digital culture and art between reality and virtuality. www.mqw.at

After buying IBM's PC business, Chinese hardware giant **Lenovo** (www.lenovo.at) established its headquarters for Europe, the Middle East and Africa in Vienna.

Maxbill (www.maxbill.com) opened its first office abroad in Vienna after winning the race for real-time online billing for mobile providers. This competition was observed very closely as Austria is said to be the toughest market for the cell phone business. Maxbill Vienna also supports customers in Western and South Eastern Europe.

Back in 1976, **Hewlett Packard** (www.hewlett-packard.at) was among the first ICT multinationals to acquaint itself with Vienna's very special advantages. HP currently has a vice president and several divisions responsible for Eastern Europe, the Middle East and Africa located here.

There are countless other success stories given that more than a hundred ICT companies run their CEE business from Vienna.

Activities and Investments Worldwide

Although Vienna's focus is on Central and Eastern Europe, its activities and influence range far beyond Europe. More than 300 multinational and local companies export to or invest in foreign markets worldwide. Vienna's biggest ICT exporter is the local **Siemens** subsidiary (www.siemens.at) and the biggest investor in the South Eastern European region is the **Telekom Austria Group** (www.telekomaustria.com) with its mobile communications segment. The company has developed into a mid-sized European player, having acquired or built up a range of mobile phone companies in Slovenia, Croatia, Serbia, Macedonia, Bulgaria, Belarus and Liechtenstein. The Telekom Austria Group has around 17,000 employees. More than 2.3 million fixed line customers and 17 million mobile customers place their trust in its products and services. The company also runs a fibre-optic high-speed network called JetStream which reaches from London to Sofia.

One of Vienna's oldest telecom companies, **Kapsch AG** (www.kapsch.net), specializes in road pricing solutions and has equipped more than 140 road networks in 30 countries in Europe, Latin America, Oceania, the Pacific Rim and Africa. It is currently testing systems in the USA. The company runs subsidiaries in 18 countries.

Smart card and banking automation specialist **BGS Smartcard Systems** (www.bgssmartcard.com) is mainly active in Central and Southeast Asia and India and has delivered smart card systems for entire cities in Russia. A wide range of other companies run subsidiaries in or export to numerous destinations worldwide, like control center solutions expert **Frequentis** (www.frequentis.at), which is particularly active in Southeast Asian countries. **TTTech** (www.tttech.com) is one of the world's most renowned producers of time-triggered systems for the automotive and aviation industries. **Altova** (www.altova.at) is ranked among the world's top developers of XML applications; the USA is the source of most of its turnover.

S&T AG (www.snt.at) is one of Austria's biggest system integrators; its principal market extends from Russia to Romania, where the company is the market leader. **AT&S AG** (www.ats.net), which has commenced production on its two new premises in China, is Europe's number one in printed circuit boards, supplying, among others, Nokia and Canada's smart phone manufacturer Research in Motion, best known for the BlackBerry. **KeyMile AG** (www.keymile.at) is currently developing access solutions for the telecommunications industry and boasts customers in more than 100 countries. Telecoms infrastructure is also the main business of the Austrian branch of Hungarian HTCC, formerly MTC AG, which brought a 12,500 kilometer optical network across Central and Eastern Europe to the merger, making HTCC one of the most important players in the region.
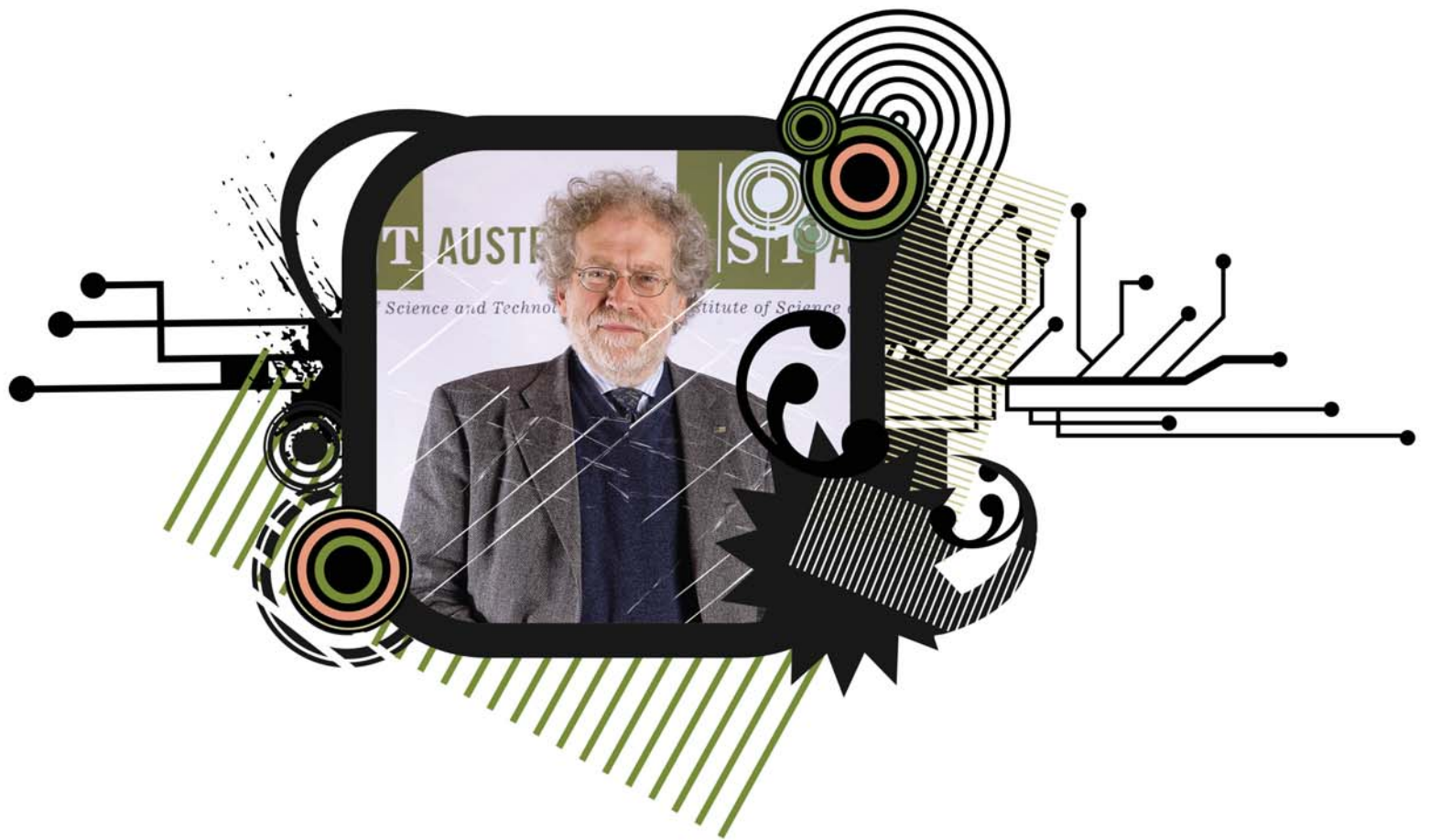
QUANTUM COMPUTING
Worldwide Leadership

Quantum Computing: Worldwide Leadership

Quantum Physics is pretty heavy stuff – even for insiders. In Vienna, Quantum Physics has been popularized thanks to the activities of the Institute for Quantum Optics and Quantum Information, IQOQI (www.iqoqi.at and www.quantum.at). The head of its Vienna division, Anton Zeilinger, is one of the world's leading researchers in the field. IQOQI was co-founded by the Austrian Academy of Sciences (www.oeaw.ac.at) and the University of Vienna. In tandem with other institutes and enterprises, IQOQI collaborates with the smart systems division of Austria's largest research organization, Austrian Research Centers ARCS, on quantum cryptography and related issues (for more, go to www.smartsystems.at).

The renowned Seed Magazine writes:

The theory (of Quantum Mechanics) implies that when we measure particles and atoms, at least one of two long-held physical principles is untenable: Distant events do not affect one other, and properties we wish to observe exist before our measurements. One of these, locality or realism, must be fundamentally incorrect.

For more than 70 years, innumerable physicists have tried to disentangle the meaning of quantum mechanics through debate. Now Zeilinger and his collaborators have performed a series of experiments that, while neatly agreeing with the theory's predictions, are reinvigorating these historical dialogues. In Vienna experiments are testing whether quantum mechanics permits a fundamental physical reality. A new way of understanding an already powerful theory is beginning to take shape, one that could change the way we understand the world around us.

This past January (2008), Zeilinger became the first ever recipient of the Isaac Newton Medal for his pioneering contributions to physics as the head of one of the most successful quantum optics groups in the world. *

In October 2008, Siemens IT Solutions and Services (SIS PSE) in Vienna (www.pse.siemens.at) and Austrian Research Centers ARCS presented the world's first tap-proof communication network using quantum physics within the European SECOQC project (www.secoqc.net). It is the first commercial application and the result of many years of outstanding research by Zeilinger's institute and many other groups in Europe.

The vision of SECOQC is to provide European citizens, companies and institutions with a tool that allows them to confront the threats of future interception technologies, thus creating significant competitive advantages for the European economy.

SECOQC will provide the basis for long-range high-security communication in a network regime that combines the entirely novel technology of quantum key distribution with solutions from traditional computer science, network design and cryptography.

The project SECOQC aims at evolving quantum cryptography into an instrument that can be operated in a commercial environment. Seven of the 40 project partners are from Austria, and five of these are from Vienna.

Anton Zeilinger, head of the Vienna division of the Institute for Quantum Optics and Quantum Information (IQOQI) of the Austrian Academy of Sciences.

In the 1970s, Anton Zeilinger started his work on the foundations of quantum mechanics. Since then, Zeilinger has performed many experiments with entangled photons, including quantum teleportation, quantum cryptography, all-optical one-way quantum computation and a number of quantum gates.

Thus far, the most important stages in the career of Anton Zeilinger include the Vienna University of Technology, M.I.T., the Technical University of Munich, the University of Innsbruck, the Collége de France, the University of Vienna and the Austrian Academy of Sciences.

Semiconductors: Nanostructures and Atom Chips

Austria has a very interesting semiconductor "landscape" and Vienna itself can boast several highlights in both R&D and commerce. In addition to the above-mentioned **NXP Semiconductors** (www.nxp.com), OnDemand **Micro-electronics** (www.ondemand.co.at) is another successful young enterprise based in Vienna's high-tech district Donau City. Founded in 2003 as a spin-off from Analog Devices, OnDemand Microelectronics is a venture capital-backed fab-less semiconductor company with offices in Palo Alto, Austin, and Bangalore. The mission of the company from its inception has been to provide program-mable high-performance video and imaging solutions based on a novel and scalable processor architecture.

IMS Nanofabrication AG (www.ims.co.at) is a technology innovator and provider for nanotechnology industries. Thanks to their extensive know-how in charged particle systems, they can offer solutions for the direct transfer of custom design patterns to resist or to generate "resist-less" two- and three-dimensional surface modifications with features below 10 nanometers. IMS has started a joint project with the Vienna University of Technology to devel-op a new type of semiconductor production by creating nano-stamps as tra-ditional production patterns which cannot be further miniaturized.

The Vienna University of Technology plays an important role in semiconduc-tor research. One example: the Atom Chip Group (www.atomchip.org) of semicon-ductor "guru" Jörg Schmiedmayer, which is working on revolutionary new developments in microstructures which will eventually lead to completely new computer architectures.
Atom chips are microfabricated, integrated devices in which electric, magnet-ic and optical fields can confine, control and manipulate cold atoms. Through miniaturization, atom chips offer a versatile new technology for implement-ing modern ideas in quantum optics, quantum measurement and quantum information processing. Over the last five years, there has been spectacular progress in preparing and manipulating the quantum states of atom clouds on chips. The next major challenge is manipulating single atoms, allowing them to have controlled collisions and coupling them to single photons in optical microcavities. This emerging technology will lead to new quantum devices and ultimately to quantum information processing on a chip.

Jörg Schmiedmayer is working on revolutionary new developments in microstruct-ures which will eventually lead to completely new computer architectures.

Near Field Communication: A Technology Developed in Vienna

Austria has a remarkable history of pioneering developments but also of rapidly adopting new technologies. Austria was the first country in Europe to have an independent, interbank automatic teller machine system available around the clock; one of the first countries to introduce the electronic wallet, mobile payment, and commercial UMTS; it tested the first Voice over IP applications; and has introduced ENUM. Most of these break-through developments happened first in Vienna, normally within the framework of joint projects between universities and companies such as Alcatel, Siemens, Ericsson or Kapsch. Vienna was where the music cassette and the VHS system, the CD and more recently, Near Field Communication got their start.

>>> Near Field Communication for Mobile Applications

In September 2007 Mobilkom Austria, Telekom Austria Group's mobile subsidiary, launched the world's largest and most comprehensive commercial package of Near Field Communication (NFC) services in Austria in cooperation with its partners NXP Semiconductors, Nokia, Austrian Federal Railways (ÖBB) and Wiener Linien, Vienna's main public transportation operator. NFC, developed in Austria by NXP (formerly Philips Semiconductors) and Sony, facilitates short-range communication between electronic devices via a fast and easy wireless connection.

Meanwhile ÖBB and Wiener Linien have introduced NFC ticketing in daily operations. Mobile phone tickets and SMS tickets were already extremely popular with public transportation passengers before NFC. Now, NFC offers customers another new and safe opportunity to purchase public transport tickets. Passengers hold their mobile phones to an NFC touchpoint located directly on the platform, then enter the desired destination and send off the text; seconds later, the ticket arrives on the mobile phone.

NFC solutions have now been implemented all around Vienna for public transport tickets, food and beverage vending machines, lottery games, ringtones and railway vouchers (http://www.nfc.at).

Break-through NFC developments have also originated in the e-health division of Austrian Research Centers ARCS: a cell phone based on touch-free applications for the telemonitoring of health data for patients who are not able to type in data on a cell phone keyboard. Data is transmitted to the cell phone by moving the phone close to another device, for example a blood pressure gauge. This product was awarded the Frost & Sullivan Excellence in Research Award in 2007 and was presented at the 2008 eHealth conference (www.arcsmed.at).

NFC ticketing at a Viennese public transport stop.
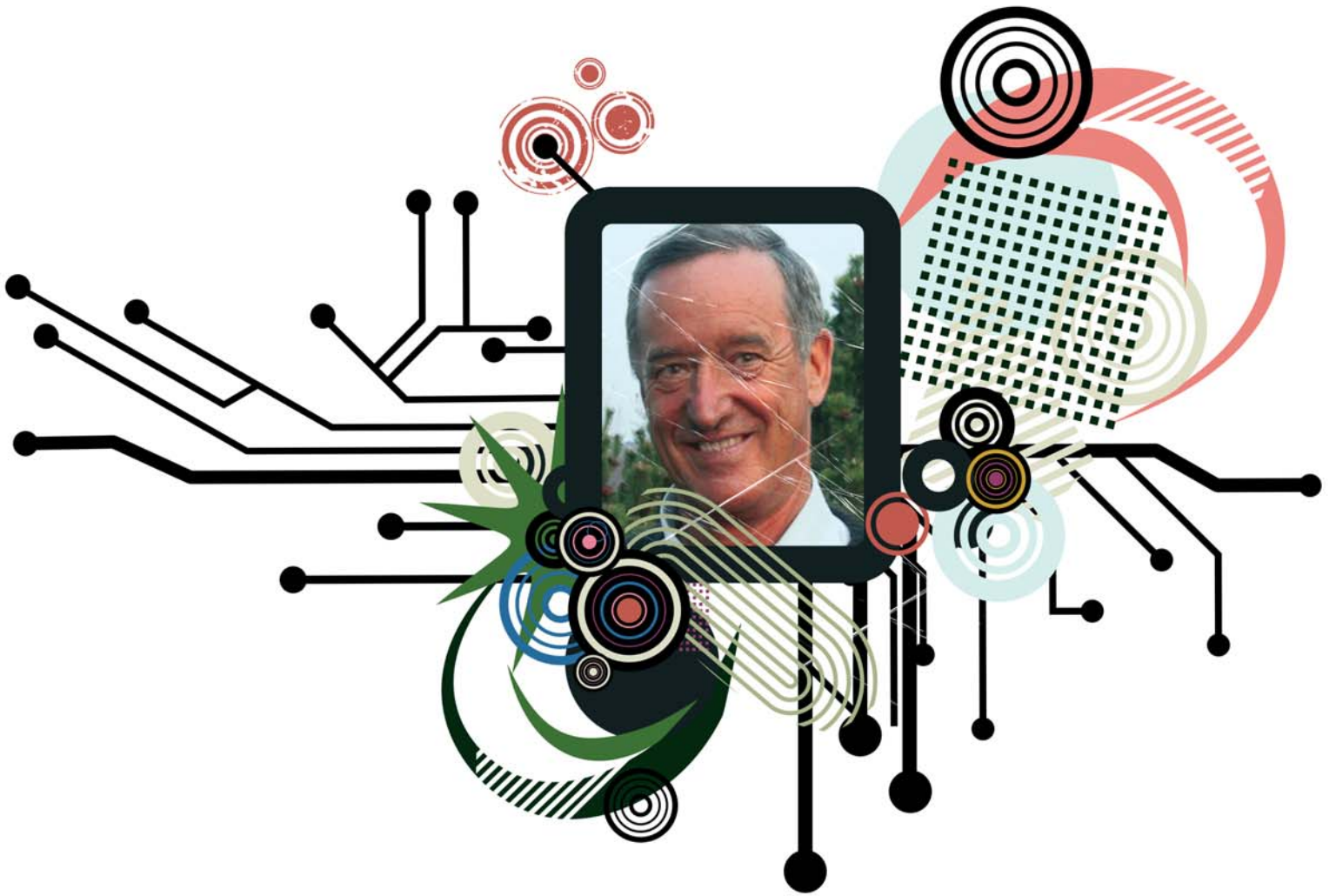
Embedded Systems: Electronic Hearts for Cars, Trains and Planes

Embedded systems are computing units for all kinds of devices. In Vienna, companies have developed cutting-edge expertise in areas such as applications for the automotive and aviation industries and in particular in the area of Time-Triggered Protocols, for smart card technologies, RFID tags, wireless home networks and much more.

Embedded systems have not only become a vital segment in Vienna's R&D landscape but have also been turned into viable commercial products. For this reason, several public organizations have created Embase, an online database monitoring Austrian and international companies and research organizations developing embedded systems (www.embase.at).

A pioneering company in the field of embedded systems is Vienna-based TTTech, a spin-off of the Vienna University of Technology. TTTech (www.tttech.com) produces embedded applications for the aviation and car manufacturing industries based on so-called Time-Triggered Protocols, i.e. systems that must work immediately and reliably, no matter what the circumstances.

Embedded systems are among the wide range of publicly-funded technology developments supported by Austria's Federal Ministry for Traffic, Innovation, and Technology (BMVIT) within the framework of the "FIT IT" program (www.fit.it.at). From 2002 to 2006, the program financed 35 projects related to embedded systems development; more projects are in the pipeline.

One of the projects is the Wireless Cargo Monitoring System or WCMS (www.ict.tuwien.ac.at/wcms), involving, among others, the Vienna University of Technology and RailCargo Austria, the federal railway's cargo division. It has been dedicated to developing an Internet-based monitoring system that would generate its own energy supply, measure precisely all kinds of movements and vibrations, withstand harsh environmental conditions and remain reliably online.

One of the project partners is Bluetechnix (www.bluetechnix.at), typical of the large number of highly innovative ICT SMBs based in Vienna. This company offers a set of tiny core modules for certain special microprocessor families and outstanding development boards for rapid prototyping; these help developers and system engineers to quickly design their products. Intended for prototypes as well as small and medium volume products, Bluetechnix Tinyboards save on development costs, reduce risk significantly, and enable incredible performance in a tiny space.

In addition to OEM modules, Bluetechnix offers custom design services and development assistance. Bluetechnix has more than 400 customers in over 50 countries on five continents.
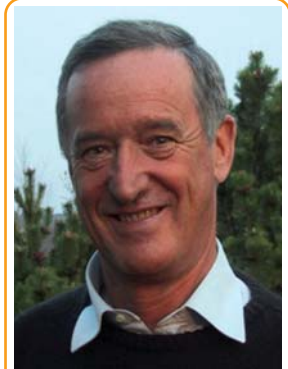
Hermann Kopetz, founder of TTTech AG and professor at the Vienna University of Technology.

Hermann Kopetz was a manager of a computer process control department at Voest Alpine in Linz, Austria, before joining the Technical University of Berlin as a professor for Computer Process Control in 1978. Since 1982 he has been professor for Real-Time Systems at the Vienna University of Technology. In 1993 he was offered a position as Director of the Max Planck Institute in Saarbrücken, Germany. During the last few years, Dr. Kopetz has been a visiting professor at the University of California in Irvine and Santa Barbara. Dr. Kopetz' research interests focus on the intersection of real-time systems, fault-tolerant systems, and distributed systems. He is the chief architect of the Time-Triggered Protocol (TTP) for distributed fault-tolerant real-time systems. He is the founder of TTTech AG, which produces embedded systems for the car and aviation industries; it numbers Audi and Boeing among its customers.

Vienna's main public library has equipped its approx. 1,500,000 books, magazines and CDs with RFID tags which enable users to handle lending and returning the media themselves.

RFID: Identification and Logistics, from Convention to Hospital

Radio Frequency Identification plays a major role in several fields of application, including identification and access, communications and logistics. The technology is particularly useful when it comes to large numbers of persons or objects to be identified. Vienna's main public library has equipped its approx. 1,500,000 books, magazines and CDs with RFID tags which enable users to handle lending and returning the media themselves. The system prevents theft and loss and allows library staff to dedicate themselves to assisting visitors instead of inventory control. Every day, approximately 12,000 objects are either lent or returned (www.buechereien.wien.at/en).

Vienna's General Hospital, the AKH, has upgraded its materials logistics system to RFID control. Each day, around 800 containers equipped with weather and chemical-proof RFID chips automatically distribute food, clothing and medication to various departments. The tags assist in inventory control – also during surgery – and enable the monitoring of the highly-sensitive supply chain of blood bags. The system originated with **Siemens** and was developed by the Vienna-based **SIS PSE** division, which is responsible for new Siemens developments worldwide (www.pse.siemens.at).

Vienna is one of the world's leading convention locations and hosts a range of large gatherings such as the European Radiologists' Congress with about 15,000 participants. Handling identification, access and other types of information – such as which visitors visited which workshops – is quite a challenge, but one mastered by the two companies installing the Auto ID solution: **Webges** (www.webges.at), a highly-experienced, internationally-recognized conference solutions provider, and **Datatronic** (www.datatronic-id.com), a producer of innovative RFID solutions.

Research on Auto ID systems is carried out by institutes of higher learning such as the Institute of Communications and Radio-Frequency Engineering (INTHFT) at the **Vienna University of Technology**, one of the largest departments of the Faculty of Electrical Engineering and Information (www.nt.tuwien.ac.at). Researchers at the institute's Christian Doppler Pilot Laboratory for Design Methodology of Signal Processing Algorithms came in at second place at the 2008 EEEfCOM (Electrical and Electronic Engineering for Communication) Innovation Award in Berlin for their new universal RFID test system. For the first time ever, this system enables testers to compare all RFID standards independent of their technological background (www.gerotron.com/html/innovation/inno_2008.htm).

Mobile Telephony & Computing: Europe's Champion in Wireless 3rd Generation Internet

Mobile computing is a consumer-driven industry, and the Viennese have already integrated a wide range of mobile offerings into their daily lives. A SIM card penetration rate of 120% offers providers ideal opportunities to expand their services. While fixed line telephony is stagnating and wired broadband access is growing at a slower rate than in Denmark or Switzerland, Austria, and in particular Vienna, is Europe's leader in wireless third-generation Internet. Thirty percent of all broadband Internet connections are wireless, versus 6% in Switzerland and 2% in Germany. The boom has been caused by Europe's fiercest competition on tariffs, which has resulted in one of the lowest price levels in Europe – but also in the rapid introduction of new services. Some global telecoms such as **Nokia** and **Alcatel** consider Vienna to be the ideal test market and/or battleground, as do other specialists, such as those active in real-time online billing. Thus both mobile telephony and mobile broadband Internet have become part of Vienna's attractive infrastructure for consumers as well as for businesses.

Today, the Viennese use cell phones for booking tram and train tickets, paying parking meters, buying drinks, paying taxi fares and finding their way around thanks to navigation systems. They also use their cell phones for online games and digital home control features for heating or surveillance. Companies are trading in their fixed line switchboards for mobile alternatives and are using mobile Voice over IP solutions for communication with their offices abroad. Near Field Communication has introduced additional options, including a growing range of industrial logistics applications as well as mobile e-health diagnostics. Most of Vienna's home care organizations have switched from handwritten documentation to smart phone solutions which combine field service applications with mobile e-healthcare. And ever since the European Soccer Championships took place in Austria and Switzerland in June 2008, mobile TV has been available.

Mobile communication has also become crucial for public safety: starting in 2004, **Alcatel Lucent Austria** (www.alcatel-lucent.at) and **Motorola** (www.motorola.at) have been successively implementing a unified national trunked radio network for all public safety and emergency organizations called Digitalfunk BOS-Austria. The system is managed by a joint venture of the two companies called **Tetron** (www.tetron.at). It is based on the TETRA standard and is the most advanced digital emergency network in Europe. Its most challenging task so far involved the European Soccer Championships in June 2008.

Most of the products and services in use were developed in Austria. Telekom Austria and other providers have their own in-house research divisions and cooperate closely with major global telecoms such as **Nokia** (www.nokia.at), **Alcatel Lucent** or **Kapsch** (www.kapsch.net), but also with new start ups such as **Symena** (www.symena.at), a company producing software for intelligent antennas which track the increasing density of mobile communication. The **Vienna University of Technology** (www.tuwien.ac.at), the telecom research center **FTW** (www.ftw.at) and **Austrian Research Centers ARCS** (www.arcs.ac.at) have played and continue to play a major role in Austria's mobile communications boom and have been the mainspring of several developments that have had their premiere in Vienna, such as UMTS, NFC and Voice over IP.
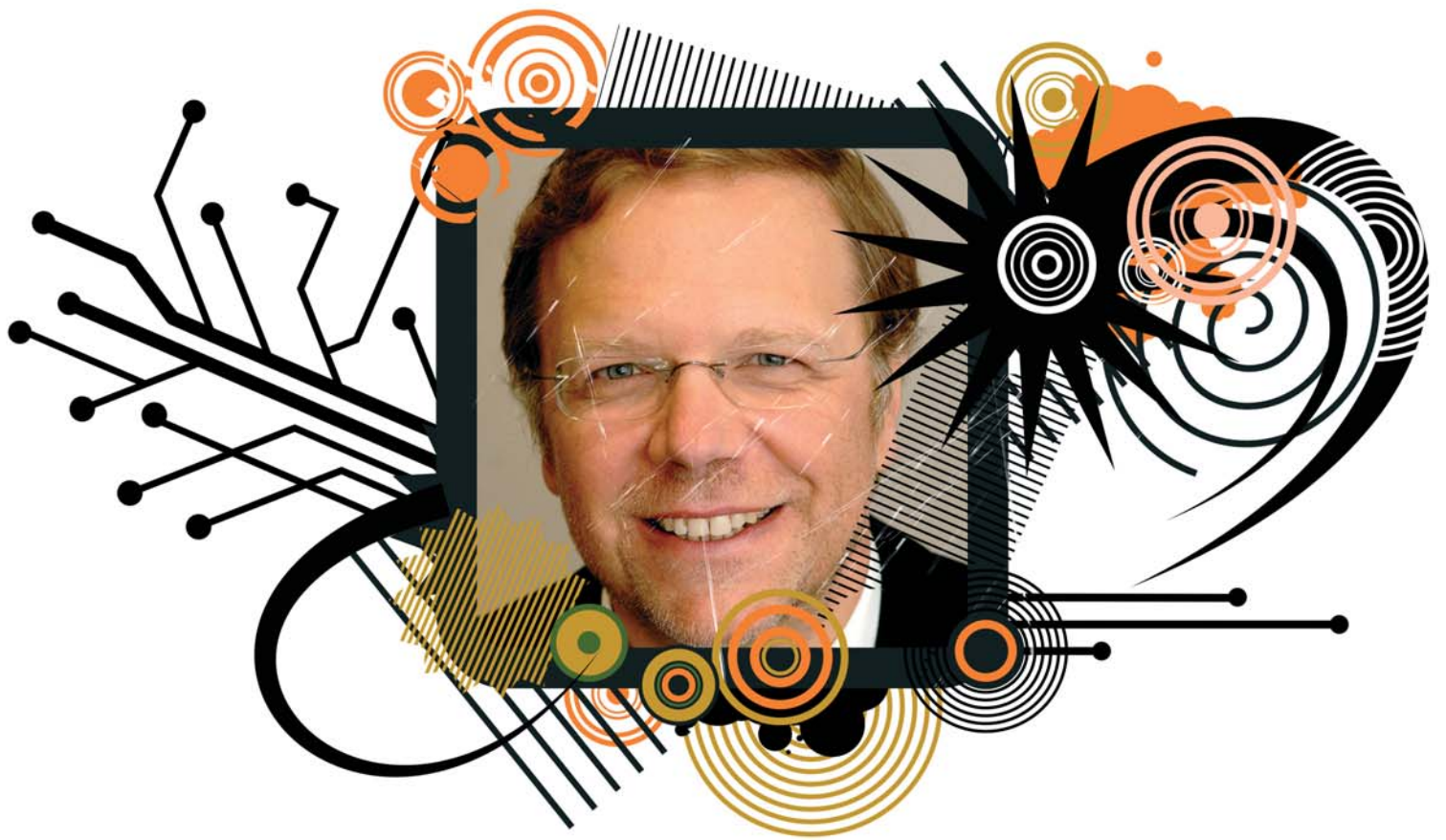
Semantic Systems: When Letters Become Words

Semantic technologies have gained in importance in tandem with the growing relevance of search machines as well as all other applications dealing with the understanding of contexts ("online market intelligence"). Vienna is the center for numerous activities in Austria and beyond: Vienna hosts the **STI International** (www.sti2.org), a semantic technologies network closely cooperating with the **University of Innsbruck** (www.sti-innsbruck.at), a leading institute in the wider field, and around 30 universities, research institutes and companies worldwide. STI International's area coordinator Dr. Rudi Studer (AIFB, University of Karlsruhe), explains STI International as follows:

The main objective of STI International is to advance the definition, development and outreach of scientific foundations as well as methods and tools required for the take-up of semantic technologies at corporate and public level.
As an organization which brings together a critical mass of leading institutions in the Semantic Technology field, STI International provides the ideal environment for exploiting the synergies between individual research initiatives across the world, thus ensuring further achievements and their transfer to industry. Overall, STI International will shape the landscape for research in semantic technologies.

One of the main projects of STI International is the Standardization & Reference Architecture Service, which coordinates the joint standardization strategy for STI International's research efforts and the development of reference architectures for semantic technologies. The aim is to strengthen the impact of STI International research by fostering the admission by acknowledged standardization bodies, and to support the software development in associated research projects by providing open and generic reference architectures for semantic technologies.

Commercial exploitation of semantic technologies is already taking place in companies such as **Lixto** a spin-off company of Vienna University of Technology (www.lixto.com); **Prolytic** (www.prolytic.com), a spin-off of Vienna's University of Economics; **Matrixware** (www.matrixware.com), working on enabling semantic search for patent literature; **UMA** (www.uma.at), which is developing special search solutions for individual clients; and the **Semantic Web Company** (www.semantic-web.at) which is also running the Semantic Web School, a recently-founded institute that has already made a name for itself. One of their partners is **punkt.net Services** (www.punkt.at), a developer of a content management system based on semantic technologies.

Projects developing semantic systems are also supported by the "FIT IT" funding program (www.fit-it.at) initiated by Austria's Federal Ministry for Traffic, Innovation, and Technology (BMVIT).

Georg Gottlob is Chairman of the Scientific Advisory Board of Lixto GmbH.

Georg Gottlob, currently Adjunct Professor of Computer Science at Vienna University of Technology and Professor of Computer Science at Oxford University, has been a guest speaker at many international conferences. He received the Wittgenstein Award from the Austrian National Science Fund, was elected Member of the Austrian Academy of Sciences, is holder of a Royal Society Research Merit Award and Fellow of the ACM. He chaired the Program Committees of ACM PODS 2000 (ACM Conference on Principles of Database Systems) and of IJCAI 2003 (International Joint Conference on Artificial Intelligence). He is a co-founder of Lixto.

Visiting Vienna and taking a horse-drawn carriage ride ("Fiaker") allows you to experience first hand the charm of Vienna's local dialect.
Vienna's renowned research center FTW has developed recognition algorithms for dialectal varieties to make them available for speech processing.

Speech Processing: How Vienna Makes Machines Smarter

Language is essential to the character of Vienna. The city's natives speak a rich and distinctive local dialect, yet the metropolis is home to some of the most renowned theaters and stages in the German-speaking realm where "Hochdeutsch," or High German, is spoken. This ambiguous bilingualism is an endless source of creativity in the city. Thus it is fitting that speech recognition and processing have become keywords in **Philips** Vienna's long tradition of application development, as well as at Alcatel; both divisions have now been outsourced to subsidiaries of **Nuance** and **Sonorys** (www.speechmagic.com and www.sonorys.at).

One of Europe's most outstanding SMEs in this field is the Vienna-based **Sail Labs** (www.sail-technology.com), a member of Vienna's speech processing cluster **COAST** (www.coast.at). Sail Labs produce high-end speech recognition products that can among other things automate the process of indexing live news feeds and multimedia archives in real time.

COAST has nine members, including audio content processor and analyzer **NOA Audio Solutions** (www.noa-audio.com) and Vienna's renowned **Austrian Research Institute for Artificial Intelligence**, or OFAI (www.ofai.at). Along with its Language Technology Group, the OFAI is a member of the European Network of Excellence in Human Language Technologies (ELSNET) ; see page 27 for more on OFAI.

The COAST cluster is currently working on eight projects, most of which attempt to eliminate some current deficiencies of speech recognition and processing programs (such as in the written transcription of verbal language aspects including shortened sentences, individual attributes etc.), improve handling of background noise, management of structured data input from verbal sources, and more.

Voice Business (www.voicebusiness.net) develops speech-controlled dialogue systems for telephone communication.

Research on speech processing is also one of the main subjects of Vienna's telecommunications research institute **FTW** (www.ftw.at). One of the most remarkable recent projects has been the automated recognition of dialectal aspects of Austrian German.

Computer Vision: From Earth Observation to Doping Tests

During recent years the processing of visual content has become one of the city's strongest research subjects. The Vienna University of Technology, Austrian Research Centers ARCS, the Austrian Academy of Sciences, the Center for Virtual Reality and Visualization (VRVis) and other research organizations – in collaboration with a large number of companies – have developed an impressive portfolio of research projects and products. An overview would include the following:

Collaborating with the **Institute for Computer Graphics and Algorithms** at the Vienna University of Technology (www.cg.tuwien.ac.at) and the **Academy of Sciences** (www.viskom.oeaw.ac.at), the **Center for Virtual Reality and Visualization**, or VRVis, (www.vrvis.at) has earned international acclaim as the so-called "Vienna Group." Today, they are Europe's second largest research group for computer graphics. They have collaborated with, among others, the Vienna division of **Philips Medical Systems** (www.philips.at/medical); **Tiani Spirit** (www.tiani-spirit.com), a company specializing in digital radiography; and with **Microsoft** and its Virtual Earth program together with Austrian photogrammetry specialist **Vexcel** (www.microsoft.com/ultracam).

Gepard (www.gepard.at) was founded in 1988 in Vienna as a team of experts united to carry out research on and develop sophisticated methods and computer systems for earth observation and meteorology, industrial vision systems and simulation. They produce the award-winning CineSat MSG visualization solution for the new generation of Meteosat weather satellites.

ArtiBrain, recently acquired by Kapsch, is a specialist for intelligent tunnel surveillance applications (www.kapsch.net/trafficcom).

The ICT division of the **Austrian Research Centers ARCS** ("smart systems" www.smart-systems.at) are internationally known in the domain of high performance image processing, in particular in the area of optical quality control for security printing, e.g. for banknotes. In order to process the resulting data rates within the range of gigabytes per second, proprietary camera systems, new image processing algorithms and optimally coordinated computer hardware systems have been developed. ARCS have also developed an internationally recognized method for the optical analysis of doping tests in sports (www.antidoping.at).

Gepard: Polar-stereographic projection of the European region; IR (infra-red) cloud image together with a land/sea background, geographical net and the major European cities drawn as overlay.
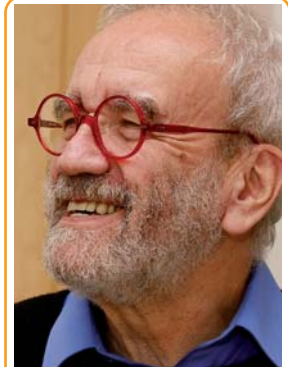
Artificial Intelligence: A Viennese Landmark

Artifical Intelligence has a long tradition in Vienna. The **Austrian Research Institute for Artificial Intelligence** or **OFAI** (www.ofai.at), is one of Europe's leading non-profit contract research institutions. It collaborates with more than 100 partners, international and national organizations, companies, universities and research institutes from 28 countries. In solving the problems of its partners, OFAI uses methods such as machine learning and data mining, language and speech technology, neural networks, intelligent software agents and other software technologies, with many of the underlying methods developed in-house.

Language technology has constituted a major research area at the OFAI since its inception in 1984. The institute conducts research in the modeling and processing of human languages, particularly German. This includes constructing linguistic resources (such as lexica, grammars, discourse models), processing algorithms (morphological components, parsers, generators, speech synthesizers, discourse processing components), and application prototypes (such as natural language interfaces, advisory systems and concept-to-speech systems).

Artificial Intelligence also plays a role in the arts. The rapidly growing amount of music available in digital form via the Internet or digital libraries calls for entirely new computer-based methods for analyzing, describing, distributing, and presenting music. The currently-emerging research and application field known as Music Information Retrieval (MIR) is a direct response to this need.

OFAI has thus initiated a project – this is Vienna, after all – on this subject and has developed software which finds songs based on specific criteria, for example according to genre (jazz, blues, hip-hop etc.). Audio files are analyzed by rhythm, sounds or pitch in around 1.5 seconds and filed accordingly. Radio stations use the agent for recommendations or for the compilation of genre-specific programs. Radio listeners also benefit from this technology: **FM4 Soundpark** (http://fm4.orf.at/soundpark) is an Internet platform run by the Austrian public radio station FM4. Artists can upload and present their music free of charge, and visitors to the website can listen to and download all the tracks at no cost. FM4 Soundpark attracts a large community interested in up-and-coming music.

Robert Trappl is head of the Austrian Research Institute for Artificial Intelligence (OFAI) in Vienna, which was founded in 1984.

He is professor of Medical Cybernetics and Artificial Intelligence at the Institute of Medical Cybernetics and Artificial Intelligence, Center for Brain Research, Medical University of Vienna, Austria. He holds a PhD in psychology (minor: astronomy), a diploma in sociology (Institute for Advanced Studies, Vienna), and a degree in electrical engineering. He has published more than 180 articles. His main research focus at present is the investigation of the potential contributions of Artificial Intelligence methods to the avoidance of outbreaks of wars or in ending them, and the development of intelligent and emotional personality agents for synthetic actors in films, television and interactive media (especially games), with a view to their consequences for theories on cognition and emotion. In recent years he has given lectures in many countries and has worked as a consultant for national and international companies and organizations, including the OECD, UNIDO and WHO.

Metrology/Sensorics, Simulation, Optimization and Forecasting

These are highly complex, abstract and scientific subjects, yet they are essential for many industries and offer a wide range of applications. Simulation helps save both time and money and, in some cases, lives. Optimization helps to improve development and production. The four disciplines are closely connected and have a strong mathematical and engineering foundation. Vienna has an excellent reputation in mathematics research.

Thanks to the growing complexity of algorithms, electronic forecasting systems now boast high levels of precision. Companies such as **pro:kons** (www.prokons.com), with customers in Germany, Austria and Switzerland, offer solutions for elections, financial markets, sports betting and other applications. Energy markets are the focus of Vienna-based **IRM** (www.irm.at), a company specialized in solutions specifically tailored to the requirements of deregulated markets. The solutions range from structured procurement management (forecast, energy disposition, from simple registration and handling of an increasing number of procurement flows including scheduling and balancing group management); to energy trading with portfolio/risk management (including complex risk and optimization functionalities) in the multicommodity environment as well as in investment analysis and planning. IRM is a leading solution provider in Europe with more than 40 reference clients in 16 countries and a staff of over 70.

Another highlight in the field of complex applications is **Hakom** (www.hakom.at). A market leader in certain segments of energy data management in Austria, Hakom's share of the market is growing steadily in Germany and the emerging markets. Their solutions support the management of sensor data, forecasting systems, portfolio management, risk management and public transport scheduling portals.

Adcon Telemetry (www.smartwirelesssolutions.com) is specialized in telemetric solutions for agriculture and the environment. Its telemetric solutions are based on a proprietary ultra-low power radio technology and GSM/GPRS modems, both integrated into their own range of loggers. What makes the Adcon solution unique is a range of unrivalled product features. These have made Adcon the market leader, in particular for agricultural applications.

There are several platforms that support collaborative research and networking: **ARGE Sensorik** (www.arge-sensorik.at), a platform for sensor research in Austria whose lead partner is the Institute of Sensor and Actuator Systems at Vienna University of Technology (www.isas.tuwien.ac.at); and **ARGESIM**, a nonprofit working group providing the infrastructure and administration for dissemination of information on modeling and simulation in Europe. ARGESIM is located at the Vienna University of Technology, Department of Simulation (www.argesim.org).

Geographic Information Systems: Showing the Way in Europe

Many of Vienna's modern success stories actually have a long and rich history, albeit in different form; witness the boom of electronic music, digital arts and e-tourism. Another case in point is cartography. Vienna has long been fertile ground for this discipline, and the new field of geographic information systems continues the tradition.

The Vienna city administration offers GIS services for its own purposes as well as for businesses and the general public. The digitalization of maps commenced in the 1970s in order to facilitate regional analyses. **Vienna's GIS®** activities really took off in the mid-1990s with the introduction of the World Wide Web. Today, ViennaGIS (www.wien.gv.at/english/viennagis) offers a multitude of services: interactive maps for the PC or PDA (including a photo version with details down to 15 cm); land registry information for communal and private building projects, canalization projects, energy networks; the mapping of construction sites, car park pools, medical services networks, bike routes; traffic information; emergency services-related information for the city; and even the graphic display of cultural and historic highlights. As of 2009, the service will also incorporate environmental data. The system has around 35,000 users within the City administration and approximately 200,000 visits per day at its website. Municipal data can be purchased via the **ViennaGIS®-GeoShop** which is run by City administration.

Vienna's pre-eminence in the field of cartography has made the city a focal point for international projects, particularly in conjunction with the Central and Eastern European countries; 1989 saw a resurgence of demand for new maps, catastral information and spatial planning. **The Vienna University of Technology** (www.geoinfo.tuwien.ac.at), the **University of Vienna** (http://carto.univie.ac.at) and federal organizations based in Vienna such as the Austrian Institute for Spatial Planning, or **OIR** (www.oir.at) responded with numerous projects. **ÖROK Atlas** (www.oerok-atlas.at) is a joint project of the Institute for Cartography of the University of Vienna and **ÖROK** (www.oerok.at), the Austrian Conference on Spatial Planning. The project promises a wide variety of special interactive mapping services for agriculture, hydrology, ecology, urban development, migration and tourism as well as many other applications.

Many projects are run in public private partnerships (PPP) with companies such as **Synergis** (www.synergis.at), which is active across Europe; and **Geologic** (www.geologic.at), which combines geographic data with fuzzy logic; and around 20 other companies in Vienna.

The extremely high quality of life enjoyed in Austria and Vienna can be attributed in part to the stringent regulation of drinking water, air quality, food and the environment in general. These standards are set by the **Umweltbundesamt** (www.umweltbundesamt.at), the expert authority of the federal government for environmental protection and control. Its activities are supported by a multitude of GIS applications (http://gis.umweltbundesamt.at). The ministry acted as coordinator for the EU Water Framework Directive project. As an expert body, it is frequently consulted by European and international institutions such as the European Environment Agency. The source of most of Austria's geographic and photogrammetric data is the **BEV** (www.bev.gv.at), a state office for surveying and mapping and one of the oldest institutions of its kind in the world. Among many other services it coordinates the Austrian Positioning Service (APOS) by processing GPS data for various applications.

One of the numerous offerings of ViennaGIS®:
A map on art in public spaces, i.e. monuments etc.

Traffic Telematics & Road Pricing: Market Leaders

Austria has made quite a name for itself in the fields of traffic telematics and road pricing, especially after Vienna-based **Kapsch TrafficCom AG** (www.kapsch.net) won several national and international tenders for road pricing projects – from Ireland to Australia. Kapsch also develops innovative tunnel surveillance systems, invests in vehicle detection and classification, highway control and digital railway communication.

Siemens Austria (www.siemens.at) has gained extensive experience in advanced traffic telematics and equips cities with traffic control systems, as it did for example in Prague in 2008. Siemens IT Solutions and Services and **Mobilkom Austria** (www.mobilkom.at) have developed one of Europe's first m-parking systems for Vienna. Drivers book and pay their parking slots via mobile phone. The system has now been implemented in eight cities across Austria (www.handyparken.at).

The scientific background for intelligent surveillance also comes from Vienna. **Austrian Research Centers ARCS** is a leader in international research in the field of computer vision (www.smart-systems.at). Their smart eye division is dedicated to developing and improving embedded multilane traffic data acquisition and algorithms for vehicle speed estimation with a near-zero failure rate. After a call for tenders issued by the Vienna Science and Technology Fund, or **WWTF** (www.wwtf.at), Vienna's telecom research organization **FTW** (www.ftw.at) has won the contract for developing efficient real-time mobile information systems. They will be working jointly with the Institute for Analysis and Scientific Computing at the Vienna University of Technology (https://portal.ftw.at/projects/all/cocomint).

Thanks to such pioneering developments, Austria's highway monitoring and control center is one of the most advanced in Europe. The center is run by **ASFINAG** (www.asfinag.at), the state-owned road administration department headquartered in Vienna. **ATTC**, the Austrian Traffic Telematics Cluster (www.attc.at), is a project platform for larger enterprises including **Frequentis** (www.frequentis.com), world market leader in air traffic control but also the maker of communication and information systems for public transport and maritime communication.

To improve cooperation, networks for smaller companies have been established, such as **ANTTS** (www.antts.at). One network member is **Smartspector** (www.smartspector.com), specialists in artificial perception engineering, and **Prisma Solutions** (www.prisma-solutions.at), who focus on traffic data pools. Currently Prisma is collaborating with numerous important partners from the industry on a project called "**ITS Vienna Region**," or "Intelligent Transport System" (http://its-viennaregion.at). The aim of this traffic data collection project is to integrate data from a variety of sources to form an intermodal data pool: public transportation, passenger vehicles, bicycles and pedestrians, but also road construction sites, car floating management and other features. There is also a joint platform for Vienna and neighboring "twin city" Bratislava. As of 2009 the data pool and all its related services will be accessible online.

The City of Vienna publishes its traffic management information on www.wien.gv.at/verkehr/verkehrsmanagement including the real-time public transport information system **RBL**, which displays arrival times for Vienna's five underground lines, 31 tram lines and 80 bus lines. Vienna has been hosting the illustrious annual conference "Urban Planning and Regional Development in the Information Society," or **CORP** (www.corp.at). In 2009, the conference moves to Sitges, Spain, for the first time.

Georg Kapsch is CEO of Kapsch AG, a telecommunications and traffic telematics company, and board member of several ICT-related associations.

The Kapsch Group is a pioneer in telecommunications applications and traffic telematics. Like many Austrian companies, the Kapsch Group does a significant portion of its business abroad – in Central and Eastern Europe and in 46 countries around the world.

E-Government & E-Health: Number One in Europe

Austria is Europe's leader in e-government solutions, with applications being implemented by communities and cities, by provincial administrations and by federal authorities. E-government involves the digitalization of data and files within the administration as well as all forms of communication and transactions among citizens, businesses and the authorities. The portal **help.gv.at** (www.help.gv.at) run by the Austrian Federal Chancellery collects and classifies data. Help.gv.at features more than 120 categories; the City of Vienna's service catalogue contains 46 categories such as emergency services, tax information, environmental monitoring, and healthcare. For more, go to www.wien.gv.at/egov/e-government/interaktiv.html or consult the comprehensive online help desk at www.wien.gv.at/amtshelfer. To view the responsible persons or offices for projects currently in the pipeline, go to http://reference.e-government.gv.at.

The Austrian Federal Computing Center, called **BRZ** in German (www.brz.gv.at) is the leading source for intra-administrational e-government solutions. Headquartered in Vienna and employing a staff of around 1,200, it supports over 30,000 civil servants in the federal administration and other governmental offices and hosts an overall data volume of around 500 terabyte.

The City of Vienna's **Municipal Department 14** – Automated Electronic Data Processing, Information and Communications Technologies (www.wien.gv.at/english/edp) runs one of Europe's largest networks, providing the ICT infrastructure for over 35,000 employees and all electronic services for the Viennese population.

The list of companies in Vienna supplying technology for federal and municipal applications is long and includes international corporations such as **IBM** (www.ibm.at), **Microsoft** (www.microsoft.at), **Hewlett Packard** (www.hewlett-packard.at), **Cisco** (www.cisco.at) and **Unisys** (www.unisys.at) as well as many innovative local developers such as **Fabasoft** (www.fabasoft.at), Austria's most successful solution provider for e-government, and **IT solution** (www.itsolution.at), the company which licenses their e-signature software to the Austrian government.

Awards and award ceremonies are not only good for publicity, but are also a means of promoting strategies on a broader scale. Thus they play an important part in Austria's lively e-government scene. For example, in 2006 the Vienna subsidiary of **Unisys** was awarded the "Amtsmanager" or "Public Office Manager" of the year for public management by the Austrian Federal Economic Chamber (www.wko.at). Unisys was ranked first in the category of traffic management for offering a solution for handling the over 12,000 applications submitted annually for construction sites on or close to Vienna streets. Such applications must normally be screened in a time-intensive manner by numerous departments- from utilities to waste treatment, traffic control and others – prior to approval. Unisys' solution encompasses all required information for rapid municipal approval of projects as well as consideration of other parameters such as handling of transaction fees.

In 2008, the national e-government prize (www.multimedia-staatspreis.at) was awarded to Vienna's **Raiffeisen Informatik** (www.raiffeiseninformatik.at), a data center and service provider for banks, large corporations and public authorities. Raiffeisen Informatik won for their "dual delivery" project involving official letters from public authorities to citizens and businesses. Until recently, receipt of such letters had to be acknowledged in writing by the recipient.

Now, however, the government is evaluating the award-winning system with the aim of implementing it in order to eliminate the necessity of actual physical delivery of correspondence in the future.

In a country where health services are basically public services, e-health is a public issue as well. Like the closely affiliated e-government sector, e-health was taken up early in Vienna. The city is home to around a fifth of Austria's total population and thus has a large number of clinics and hospitals and the highest density of medical practitioners and specialists in the country. Although all imaginable kinds of health services are offered here, Vienna is at the fore in the treatment of cancer and heart disease but also provides cutting-edge technologies in the areas of digital radiology and brain-computer interface solutions.

Aside from the technology and treatment aspects of medicine, e-health also has a less glamorous administrative side involving extensive paperwork for hospitals, doctors and patients. Austria was the first country in Europe to introduce a personalized digital ID card for all citizens: the so-called **e-Card** (www.chipkarte.at) can be equipped with vaccination records and upgraded to full e-signature card functionalities. It replaces the traditional paper-based exchange of information between patients, practitioners and hospitals. The card and its implemental infrastructure (networks, physician's IT equipment etc.) was developed by Vienna-based **SVC** (www.svc.co.at) and supported by **IBM**, **Siemens**, **Telekom Austria** and other companies. A related project is **ELGA** (www.arge-elga.at), an electronic health filing system that will combine all paper-based records of a patient that have previously circulated among general practitioners, clinics and authorities such as health insurance organizations. It will even reclaim records which were thought to have been lost. ELGA is a joint venture among several organizations and companies working on the technical and political ramifications of this project.

E-health related technologies developed in Vienna include comprehensive digital hospital projects: for example **AME International**, with offices in the UK, South Africa, China, the United Arab Emirates and Malaysia (www.ame-international.com) boasts an impressive list of reference projects. Hardware solutions are offered by **Philips Medical** (www.philips.at/medical) and **Siemens Medical Solutions** (www.siemens.at); digital x-ray storage by **Agfa Healthcare's** Vienna development labs, which have contributed to Agfa's worldwide leadership in PACS (Picture Archiving and Communication Systems) applications (www.agfa.com).

In 2007, **Otto Bock Healthcare Vienna** (www.ottobock.at) presented as a world premiere the first "mind-controlled" arm prosthesis. The project was carried out in close collaboration with Vienna's **General Hospital** (AKH), a facility which is internationally-renowned in the areas of neuromuscular reconstruction, among others; and with the **Medical University of Vienna**. Otto Bock's Vienna subsidiary (the parent company is based in Germany) is the corporate competence center for complex applications in medical technologies. The AKH and the Medical University of Vienna operate dedicated departments for medical ICT research comprising institutes for clinical biometrics, medical statistics, biomedical computer simulation and bio informatics, medical picture processing and pattern recognition, as well as two departments for knowledge management and expert systems (www.meduniwien.ac.at/msi). In addition, the Medical University runs two special research groups called Molecular Technology Network and Molecular Imaging Network.

The world's first fully thought-controlled prosthesis by Otto Bock Vienna, Vienna's General Hospital and the Medical University of Vienna.

Digital Culture: From Heritage to Future

Vienna is one of Europe's leading cultural capitals with a rich, nearly unparalleled cultural heritage and enormous creative potential. These assets have fostered the development of a vibrant and booming artistic digerati scene which has garnered artistic acclaim but also experienced commercial success.

Some movements have been inspired by the traditional arts, such as the award-winning **Vienna Symphonic Library** (http://vsl.co.at), the most comprehensive and technically advanced sample library of orchestral sounds worldwide.

A rich multimedia scene is the cradle for many related activities and creations that are not necessarily part of ICT's core enterprise; electronic music is one of these important outgrowths of the industry, and Vienna is one of the world's hot spots for electronica.

An anonymous author posted this account at http://vienna.metblogs.com:

> *One day back in 1991, music programmer Klaus Filip introduced his new music production tool Iloop to his friend Christoph Kurzmann, who installed it on his laptop to use it as a completely new voice in improvisational music. While the rest of the world succumbed to grunge rock, Vienna celebrated the birth of a new music genre: electronic music, or to be more precise: a special kind of electro-acoustic improvisation. And because Kurzmann was the first to do this, I declare this Vienna's gift to the world.*

The most famous representatives of Vienna's electronic music scene are certainly **Kruder&Dorfmeister** (www.kruderdorfmeister.com) who have contributed immeasurably to the popularity of this genre across the globe. Today, Vienna is home to a large number of producers and labels.

A perfect example of the merge between Vienna's historic creative tradition and its modern form of expression and the way this fusion is embedded in the city's daily life is the Essl family, owners of the well-known do-it-yourself retail chain BauMax. While the father and one of the sons run a celebrated modern art museum located just outside of Vienna, another son, **Karlheinz Essl Jr.** (http://de.wikipedia.org/wiki/Karlheinz_Essl), is one of Vienna's busiest composers and performers of e-music. He teaches electro-acoustic and experimental music at Vienna's acclaimed **University of Music and Performing Arts Vienna** (www.mdw.ac.at), which boasts alumni legends such as Herbert von Karajan and Zubin Mehta.

Streetforward (www.streetforward.com), a young start up, recognized the trend early on and focused on electronic music from the beginning. They produce customized CDs whose content users can preview and select online; corporate identity elements may be integrated in the cover and other parts. Many platforms such as **technoboard** (www.technoboard.at) are dedicated to electronic music, which forms the background for many events and festivals. The **net culture lab** (http://lab.netculture.at) is a platform and weblog sponsored by **Telekom Austria** (www.telekomaustria.at) offering information on electronic music, creative workshops, IT support for artists, intellectual property rights and more.

Metalab (http://metalab.at), sponsored in part by the City of Vienna, is a creative space open to anyone involved in organizing events directed to computer "gurus" but is also active in the planning and carrying out of a large number of innovative projects located between the realms of ICT and culture.

Johanna Rachinger has been Director General of the Austrian National Library in Vienna since 2001 and is, among other positions, deputy chairwoman of the Austrian Science Council.

Under her leadership the digitalization of the library's catalogue was completed; the catalogue presently contains more than six million entries, all of which can be located via online search. In 2006, the library commenced the digitalization of analogue audio documents. The Austrian National Library is one of the few major libraries worldwide with a fully-digitalized online catalogue.

Many of these platforms and organizations are coordinated by the Quartier für Digitale Kultur (http://qdk.blogsome.com), an umbrella institution which organizes regular events and conferences. It is located in Vienna's new cultural district, the MQ or Museumsquartier (www.mqw.at).

FM4 (http://fm4.orf.at), the national alternative radio station based in Vienna, offers creative people an interesting link between the arts and hardcore informatics on their **Soundpark** website (www.soundpark.at) Listeners can upload their own music or any music of their choice. Artificial Intelligence created by Vienna's **OFAI** (www.ofai.at) sorts and categorizes the songs according to musical features recognized by a software (see also "Artificial Intelligence" on page 27).

>>> The Vienna Symphonic Library

The Vienna Symphonic Library (VSL) is a producer of samples of orchestral instruments renowned for their verisimilitude and high quality. They are recorded by members of the Vienna Philharmonic (www.wienerphilharmoniker.at). For recording the samples, VSL uses the Silent Stage, a recording studio especially constructed for this purpose. The number of recorded samples is currently around 1.75 million. The outstanding features of VSL's products are true legato and repetition articulations, which were previously impossible to realize in computer-based compositions. The library is a source for composers and producers creating orchestral arrangements on the computer. New offerings such as the Horizon Series combine the musical traditions of Vienna with intelligent high-end technology that surpasses the limitations of conventional orchestral sample libraries by far. The mixing and host software, Vienna Ensemble 3, is the first MIDI and audio LAN solution that sports a network option that can connect PCs and Macs by a simple Ethernet cable. MIDI and audio data can be sent back and forth without any additional audio hardware, in sync and without any latency issues – a flawless software solution that has turned the industry's collective head.

Multimedia applications offer a wide range of solutions. **Audite** (www.audite.at), specialized in interactive audio and visual installations, has recently begun a collaboration with Stanford University. Audite's offspring **Interactive Media Solutions** (www.im-solutions.com) has successfully developed award-winning interactive projections and counts UEFA, The Coca-Cola Company, T-Mobile, Swiss Post and more among their customers.

As they do in the world of music, digital applications play a vital role in the preservation of knowledge and wisdom. The digitalization of our cultural heritage is an important task in a city that hosts innumerable archives, libraries, galleries and music collections. **Austria's Digital Heritage** (www.digital-heritage.at), a website sponsored by the Federal Ministry for Education, Culture and Arts, offers an excellent overview on digitalization projects in Austria, such as at the **Austrian National Library** (www.onb.ac.at) with its eight million books, magazines, digital media, etc.; and the **Vienna University Library** (http://bibliothek.univie.ac.at) with 6.6 million books. Both collections date back to the 14th century. On a separate website, the Austrian National Library has compiled its enormous collection of pictures, graphics and photos in the **Bildarchiv** (www.bildarchiv.at). Other major projects include **The Austrian National Archive** (www.oesta.gv.at) and the Documentation Centre of Austrian Resistance or **DÖW** (www.doew.at), an institution investigating among other topics the Austrian resistance movement, Nazi crimes and right-wing extremism.

The **Medien Archive Austria**, or MAA (http://medienarchive.at), is a shared venture bringing together various audiovisual media archives in Austria; all participating institutions are located in Vienna.

Like citizens of other cities around the globe, Vienna's creative minds started to use digital media a few years ago to re-discover and assess their city by way of interactive maps, 3D views and navigational applications based on GIS (Geographic Information Systems). One of the most exciting projects has been "The Josefsplatz Experience" by the Vienna Institute for Virtual Reality and Visualization, or **VRVis** (www.vrvis.at/research/projects/josefsplatz). The Josefsplatz is one of the most impressive squares in Vienna's historic center, dominated by the huge baroque State Hall of the Austrian National Library. The goal of the project was to reconstruct a complex 3D model of an urban environment from historical pictures and paintings and present this 4D information space (3D geometry over time) on mobile devices to a broad audience. It includes a user-adaptive meta-information system that enables the visualization of complex, interlinked historic events. A special focus was set on the different qualities of historical information. "The Josefsplatz Experience" is one of the projects co-funded by Vienna's Science & Technology Fund, WWTF (www.wwtf.at).

Wien Kulturgut (www.wien.gv.at/kultur/kulturgut) is the new and very comprehensive web-based archive and multimedia library of Vienna's cultural heritage. The application, called "ViennaGIS Web Framework," is a brand new and internationally competitive development initiated by the City of Vienna's Municipal Department 14 – Automated Electronic Data Processing, Information und Communications Technologies. It has a strong emphasis on usability.

One of the most compelling and complex fields of digital creation is the rapidly expanding sector of digital games. Originally, this domain appeared to be firmly under the control of American and Far East producers. But in the meantime, Vienna has produced a remarkable number of internationally successful game studios, evidenced by the sale of the former NEO software to Rockstar, a division of US game producer Electronic Arts (EA), and employing around a hundred designers. When EA closed their European operations, the Vienna Rockstar staff founded Deep Silver Vienna (http://deepsilver.com), now a division of the Koch Media Group.

A particularly interesting company is **Avaloop** (http://avaloop.com), a firm focusing entirely on 3D online scenarios. The project which has received the most international attention is **Papermint** (http://papermint.com) in which gaming is combined with social networking. Other important companies include **Sproing** (www.sproing.at), **Greentube** (www.greentube.com), **Edelweiss** (www.e-medien.at) and **JoWood** (www.jowood.com). JoWood is Austria's biggest game developer and responsible for the award-winning releases "Agatha Christie: Murder on the Orient Express" and "Agatha Christie: Evil Under the Sun," among others. Its distribution center is in Vienna. JoWood owns the Canadian company DreamCatcher and also has a subsidiary in Romania.

Vienna is also home to one of the most sophisticated suppliers of the gaming industry, **Rabcat** (www.rabcat.com), developing high-end, real-time 3D content for publishers and developers from around the world.
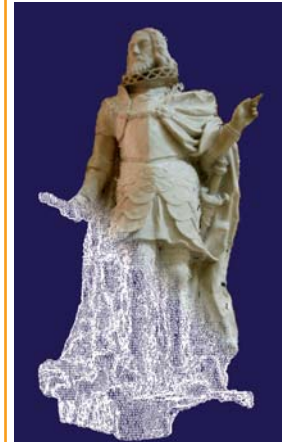
The goal of the VRVis project "Creative Histories" is to reconstruct a complex 3D model of an urban environment (Josefsplatz in Vienna) from historical pictures and paintings and present it on mobile devices to address a wide audience. Included will be a user adaptive meta-information system that enables the visualization of complex, interlinked historic events.

Media Quarter Marx, a brand new center for the creative industries.

Many of the most creative minds attended the School for Game Engineering und Simulation at **Technikum Wien** (www.technikum-wien.at), a university of applied science; the Institute of Computer Graphics and Algorithms (www.cg.tuwien.ac.at) at the **Vienna University of Technology**; or the **Games College** (www.games-college.at).

To encourage exchange among practitioners, the gaming industry in Vienna has created various platforms, including the Game Tank (www.game-tank.at), Gamers (www.gamers.at); and the entertainment software association OVUS (www.ovus.at) as well as support blogs such as Game Studies (www.gamestudies.at) and CG Forum (http://cgforum.at).

Industry players get competitive once at year at the annual Austrian Gamers Choice Award. In 2008, both JoWood and Greentube received awards, the latter for its wildly successful "ORF Ski Challenge" (http://skichallenge.orf.at).

There are other exciting developments in Vienna in digital TV, virtual reality and various Web 2.0 applications. The City of Vienna has embraced these developments in its support for the **Media Quarter Marx** (www.mediaquarter.at), a brand new center for the creative industries. Located in the St. Marx quarter of Vienna, the grounds were once home to a slaughterhouse. Just around the corner is T-Mobile's spectacular "T-Center" building. By 2010, over 30,000 m^2 office space and studio facilities will be available for use by film, TV, multimedia and other high-tech operations. The aim is to establish the center as a hub for creative East-West collaboration. In total, there are over 170,000 m^2 available on site for further development.

In 2004 the Vienna Business Agency created a platform for the support and funding of companies in the field of creative industries: **departure** (www.departure.at) has since helped more than 166 projects to establish themselves on the market.

ICT ADDRESSES AND CONTACTS

Information & Communication Technologies in Vienna

Information & Support:

- **Vienna Business Agency, VBA** www.vba.at
  Investment and business promotion agency of the City of Vienna
- **Zentrum für Innovation & Technologie, ZIT** www.zit.co.at
  Center for Innovation and Technology; technology agency of the City of
  Vienna and VBA subsidiary
- **departure** www.departure.at
  The funding and support platform for the creative industries
  and a VBA subsidiary
- **Vienna Science and Technology Fund, WWTF** www.wwtf.at
  Promotion and funding of science and research in Vienna
- **Austrian Business Agency, ABA** www.investinaustria.at
  Investment agency of the Republic of Austria
- **Austrian Trade** http://advantageaustria.org
  Austrian Trade is the official Austrian foreign trade promotion
  organization

Associations & Platforms:

- **Vienna IT Enterprises, VITE** www.vite.at
  ICT association; platform of the VBA
- **Professional Association of Management Consulting and Information
  Technology, UBIT** www.ubit.at
  Official ICT association of the Austrian Federal Economic Chamber
- **Professional Telecommunication Association** http://wko.at/telekom
  Official telecom association of the Austrian Federal Economic Chamber
- **Internet Service Providers Austria, ISPA** www.ispa.at
  Austrian ISP association
- **Association of Alternative Telecom Providers** www.vat.at
  Association of alternative telecommunications companies
- **Austrian Computer Society, OCG** www.ocg.at
  ICT association with a clear emphasis on research-related issues
- **Arbeitsgemeinschaft für Datenverarbeitung, ADV** www.adv.at
  ICT association with a strong focus on ICT seminars and conferences
- **Austrian International Consultants, AIC** www.a-i-c.at
  Export-oriented consultants' association with ICT as one
  of several priorities

Business Parks with ICT focus:

- **Donau City** www.donaucity.at
- **Business Park Vienna** www.businessparkvienna.com
- **Euro Plaza** www.europlaza.at

Technology & Research Clusters:

- **TechGate** www.techgate.at
- **Business & Research Center** www.brc.co.at
- **Bena Business Bases** www.bena.at
- **PRISMA Centers** www.prisma-zentrum.com

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www.wien.gv.at/english/

This group is responsible for strategy development regarding information and communication technology in the administration of the City of Vienna.

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The department Information Technology supports employees of the Vienna Hospital Association in all IT-related issues in their workplace.

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www.wien.gv.at/wirtschaft/eu-strategie

The Vienna Business Agency (VBA)
The Vienna Business Agency or VBA is the City of Vienna's primary business promotion vehicle. Its mission is to boost the competitiveness of the Vienna business community, driving innovation and continually upgrading the city's status as a state-of-the-art business destination.
The VBA offers professional consulting services for entrepreneurs, start ups and investors including support in obtaining financial assistance and help in the selection, development and acquisition of appropriate sites. The VBA assists and invests in the construction and operation of advanced technology and start-up centers. It supports networking and the organization of cooperative ventures throughout Austria and the EU. Finally, the VBA oversees the marketing of Vienna as a world-class business location on an international level.
The Vienna Business Agency is publicly financed in large part by the City of Vienna. At the same time, with around 3.5 million square meters in holdings, the VBA ranks among the City's largest property owners.

www.vba.at

The Center for Innovation and Technology (ZIT)
The ZIT (from the German "Zentrum für Innovation und Technologie") is a subsidiary of the Vienna Business Agency (VBA) and serves as the technology agency of the City of Vienna. ZIT activities include providing direct financial assistance (i.e. grants) to companies, making technology-specific infrastructure available, and implementing a broad range of accompanying measures in all phases of the innovation process.
Center employees evaluate the technology sector with respect to trends, developments and functionality. On this basis, they design measures to support technology-oriented companies.

www.zit.co.at

Vienna IT Enterprises (VITE)

Vienna IT Enterprises is a network for IT companies, R&D and educational institutions. It is a Vienna Business Agency (VBA) project.

VITE's medium and long-term objectives are to strengthen the innovative power and the competitiveness of its partners on both national and international levels.

VITE's main targets are raising and enhancing awareness of the value of cooperation and connecting already existing skills of experts. To reach these goals VITE offers a platform for the implementation of ideas and initiatives.

VITE offers numerous services such as organizing events and workshops on current issues and advising on PR and marketing activities in Austria and abroad. Furthermore VITE provides funding opportunities and consulting services on location; it supports matchmaking, connects potential partners, and offers general project assistance.

www.vite.at

Vienna Science and Technology Fund (WWTF)

The Vienna Science and Technology Fund (or WWTF for "Wiener Wissenschafts-, Forschungs- und Technologiefonds") is a non-profit organization established to promote science and research in Vienna. The organization's funding tools and methods are designed to boost elite research in Vienna. Some of its calls for bids are explicitly directed to promising young scientists.

The WWTF obtains its funds from the "Privatstiftung zur Verwaltung von Anteilsrechten," a private foundation in the financial sector.

www.wwtf.at

departure wirtschaft, kunst und kultur gmbh

departure, a funding organization and point of contact for those active in the creative industries, was established in 2003.

departure addresses creative professionals who are used to thinking and acting commercially, who accept the basic rules and mechanisms of the economy and consider themselves part of business life. departure supports entrepreneurs and company founders active in the creative industries who want to get things moving in the city and who contribute meaningfully to the prosperity of the metropolis of Vienna – people for whom it is a concern to bring more international cultural and economic flair to the city and thus to strengthen the innovative power of an entire region.

The objectives of departure are manifold: the development of an economically sustainable basis for Vienna's creative professionals which shall promote economic growth, create new jobs, and encourage the founding of new companies. This requires promoting entrepreneurial know-how and the cooperation between creative professionals and commerce.

www.departure.at

www.wiendenktzukunft.at