Welcome @ Swisscom Innovations : this is BLUES Zone. Bluetooth : towards ubiquitous wireless communication

Autor(en): **El-Ata, Monira Abu / Schädler, Michael / Winker, Simnon**

Objekttyp: **Article**

Zeitschrift: **Comtec : Informations- und Telekommunikationstechnologie = information and telecommunication technology**

Band (Jahr): **80 (2002)**

Heft 9

PDF erstellt am: **28.06.2024**

Persistenter Link: https://doi.org/10.5169/seals-877227

Welcome @ Swisscom Innovations – This is BLUES Zone

Bluetooth: Towards Ubiquitous Wireless Communication

For you as a visitor at Swisscom Innovations, our Bluetooth infrastructure will soon be able to open security doors, guide you to your meeting room, point out the nearest printer or fax, allow you to access your email, enable you to make voice calls and more … All we ask is to allow us to talk to your Bluetooth mobile phone or PDA.

The programme "Future Network Services" explores future network technologies enabling wired and wireless, fix and mobile broadband services. It covers the core, metropolitan and access networks and includes a multitude of access technologies such as DSL, GSM, GPRS, UMTS, WLAN or Bluetooth, and the new services that they can provide.
With its Innovation Programmes, Swisscom Innovations follows the objective of recognising early on the impact of technological developments, finding new business opportunities, promoting technical synergies, and developing concrete innovation proposals. Further, the expertise built up enables active engineering support of business innovation projects.

MONIRA ABU EL-ATA, MICHAEL SCHÄDLER, SIMON WINIKER, MARC DANZEISEN, AND JESÚS ROY SOLANAS

Global mobility and the quest for advanced data services create demand for service delivery in many different locations. Connecting useful online services adapted to the new ubiquitous computing environment while at home, at the office, or in public places is subject to research activities at Swisscom Innovations.
Bluetooth is a standard for wireless, device independent connection between all kinds of customer devices, e. g. mobile phones, PDAs, cameras, and computers. Bluetooth implementation is moving from being a high-end feature of mobile devices towards mass market applications. It is anticipated that by 2003, more than 200 million Bluetooth devices will be in use, reaching 1.4 milliards by 2005 [1]. Currently, there are more mobile phones than PCs, and soon (2004) they will exceed the number of TV sets [2]. Bluetooth smart mobile phones are likely to become the main interface to access the Internet via either wireless or fixed networks [3].
Bluetooth devices offer a number of important features: devices and services discovery, object exchange, synchronisation, hands-free telephony, location detection, ad hoc networking and Personal Area Networking (PAN), etc. Together, these features drive the creation of new services that can generate different revenue streams.
Bluetooth is particularly tuned for
– *Data services:* Bluetooth mobile phones will enable other Bluetooth devices to access the GSM/GPRS networks. This capability opens, additionally, the door for new business in transaction-oriented applications that require authentication and billing by a trusted mobile operator, e. g. m-payment, access control, monitoring and tracking. A Bluetooth PDA linked to a phone can extend the visual form factor to display objects such as pictures, maps, etc.
– *Voice services:* Solutions involving voice over Bluetooth offer attractive and cheap mobile telephony for the enterprise and home networks. Voice over Bluetooth will have to address issues such as access devices (one or multiple), telephone numbering (universal or multiple) and networks (multiple). It is believed that the mobile phone will become the user's favourable access device, preferably with one universal number for accessing any network [3].

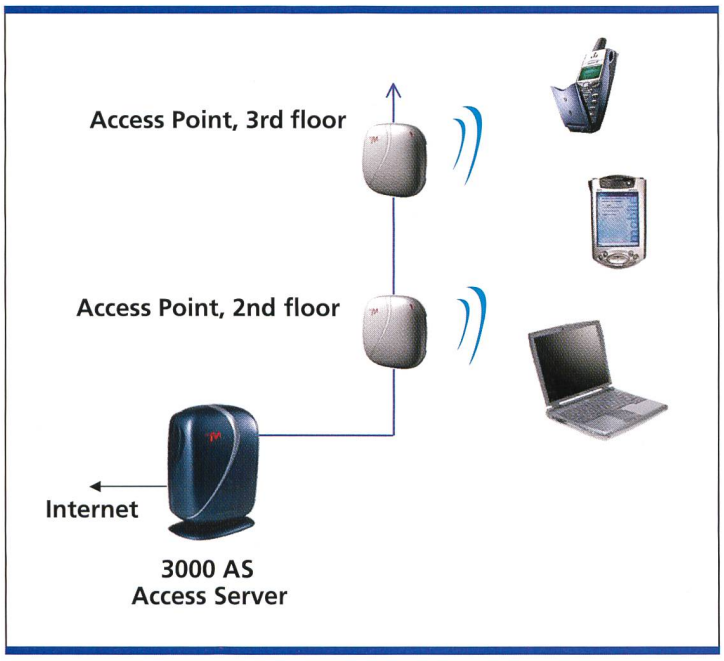


Fig. 1. Demo Platform architecture.

The BLUES project implements a Bluetooth demo platform to realise a number of use cases helpful for enterprises, public hotspots, and homes. The types of applications and suitable access devices are investigated from a user perspective. Two Bluetooth access devices are used in this project: mobile phones and PDAs.

The growth in the number of wireless users, applications, and network access technologies leads to a vision where users have network access anytime anywhere to applications that are location-sensitive and context-aware. For an operator to realise this vision, the wireless and fixed networks must be able to extend connectivity beyond private networks (corporate, university campus, etc.) into other spaces such as homes, airports, malls, hotels, parks, sport arenas, i. e. places where individuals spend a considerable amount of their time away from traditional private networks.

Bluetooth Activities at Swisscom Innovations

A Bluetooth demo platform based on commercial equipment has been implemented in our laboratories. The platform is currently able to provide Internet access on an iPAQ through an access point infrastructure. Software is currently being developed to demonstrate features of Bluetooth such as location awareness and device detection. In addition, a prac-

tical experiment is being set up to develop both a Bluetooth Personal Area Network (PAN) and a public hotspot, using the Bluetooth PAN profile. This experiment enables to further study practically important issues such as security, mobility, PAN access to services, peer-to-peer communication/relay, etc.
Moreover, a study of the business aspects was carried out to monitor market trends and continue to refine the business case exploiting the Bluetooth technology.

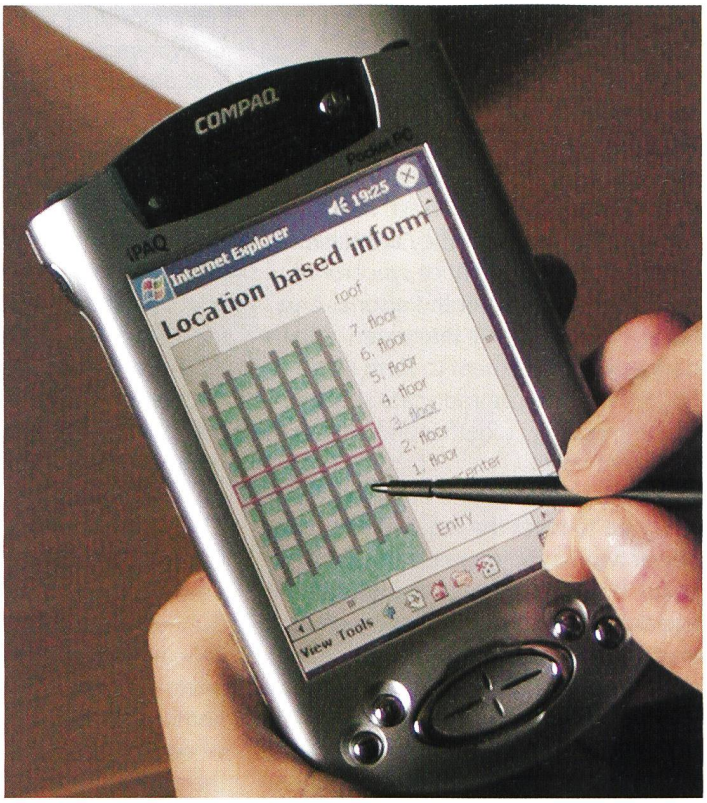


Fig. 3. Response to a user current location query.

Bluetooth Demo Platform

The RedM Bluetooth equipment has been used to implement a platform for enterprise use cases. The platform consists of Bluetooth access points (1000AP) and an access server (3000AS) that includes an access point, an integrated Linux-based server, and an Internet gateway. The 3000AS provides core support and management for the other daisy-chained 1000APs, extending the total service coverage of the network. This infrastructure enables communication with a wide range of devices, including PDAs, laptops and PCs. Figure 1 depicts a schematic diagram of the demo platform architecture.
The access server 3000AS is capable of automatic discovery of any Bluetooth device within its range, authentication and assignment of service levels (DB for registered users and user groups), and automatic routing of all communication to and from the devices whenever they connect to the Bluetooth network.
The built-in radio provides wireless coverage for Bluetooth user devices up to 100 meters. With additional access points, the number of Bluetooth users and the coverage can be extended.
The platform offers several levels of security: user device authentication, link encryption, device authorisation and finally individual user authentication.

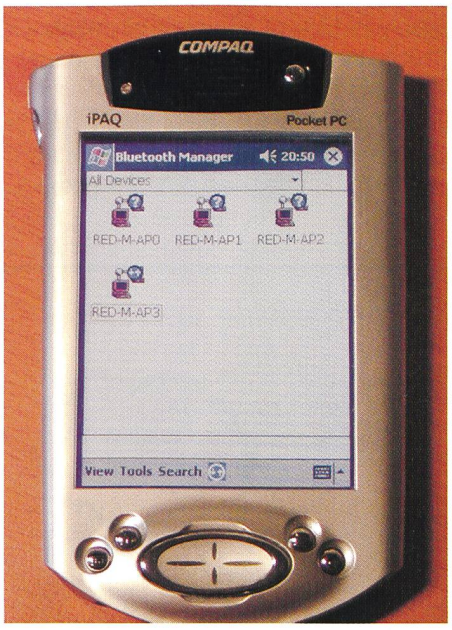


Fig. 2. iPAQ connected to an access point of the demonstrator.

Applications

The following applications were configured to demonstrate how an authenticated user is able to access services on the platform. iPAQ is used as a typical Bluetooth access device in these applications.

- *Internet Access:* The access server provides the Dial-Up Networking (DUN) and LAN access profiles. Depending on the user hardware, either the LAN access profile or the DUN profile can be used to connect to the AS/AP. According to the configuration on the 3000AS, a pre-registered user needs to provide a pin code for the link level authorisation/encryption and username/password for the PPP authentication. Access rights (pins, username/passwords) can be given on a per-user basis. The usernames and passwords are given to users prior to service use and a user group is set up on the AS accordingly. Unauthenticated or untrusted users may only access information stored locally and Internet access is blocked, while other users may profit from Internet access. Figure 2 shows a typical screen display appearing on a user iPAQ.
- *Location Based Information:* Wherever a user connects to the platform, location information is readily available since the geographical co-ordinates of the specific access point communicating with the user are known. This allows the provision of location based information such as maps, background information (exhibitions for example), advertising, etc. Figure 3 illustrates the response to a location information query, showing the user what floor she/he is currently on. The possibility to retrieve further information such as the floor office plan, or phone numbers and locations of employees working on that floor, can also be offered.
- *User Detection:* The 3000AS continuously searches for new devices within its range. Whenever a new discoverable device is detected, a trap is generated. This allows, together with third party applications, the implementation of services like door opening systems, welcome messages or location detection of devices or persons.

Bluetooth Ad Hoc Networks (Personal and Public)

Rationale

Generally, laptops are very slow to boot and synchronise with a remote server (normally offline). In contrast, PDAs are faster in this regard as they are capable of being online and hence synchronise immediately. A Bluetooth Personal Area Network (PAN) profile integrated in these devices will allow them to form an ad hoc PAN and to communicate seamlessly and immediately together and with external networks.

Bluetooth hardware and protocols are designed to meet the requirements of ad hoc networking of devices. Bluetooth enabled devices are able to explore their environment and act in an autonomous way to establish communication channels to other devices within their reach. In Bluetooth, the Service Detection Protocol module SDP and its service detection algorithms and service definitions enable service detection without the need for user intervention. This behaviour of an autonomous environment exploration can be exploited to create location based services such as: information distribution for sightseeing, timetable broadcasting in train stations, newspaper download at kiosks, etc. The provision of these ad hoc services allows electronic information to be transferred to a mobile device such as a PDA where and when required.

Development Environment

The Bluetooth protocol stack was designed as a general communication tool able to easily accommodate future applications/profiles. Currently, however, only few profiles are commercially available including the PAN profile itself. Due to the importance of both personal area networking and ad hoc networking, it was decided to develop an experimental PAN profile platform to examine closely its functionality, but most importantly to define viable use cases. The platform can be used in the future to further study the technical issues of ad hoc networking.

The PAN profile describes two access scenarios. One scenario defines the establishment of an ad hoc PAN (also known as a piconet) and is known as Group ad hoc Network (GN). The master of a GN provides the GN services and is itself therefore often referred to as GN. Figure 4 shows that up to 7 slaves can exist in such a piconet, each known as PAN User (PANU). The other scenario, shown in figure 5, uses a Network Access Point (NAP) as a master to set up an ad hoc PAN that provides access to external networks via bridging or routing mechanisms. A PAN provides an IP ad hoc networking with attached devices. However, the profile so far (as expected in phase 2 of the standard) does not allow for multihop between networks.

For evaluation and testing purposes, a free open source for Bluetooth layers stack was sought. The BlueZ Bluetooth stack, being part of the Linux Kernel since version 2.4.6, is used as the base for this experimental platform. The stack implements all the lower layers of Bluetooth, namely: radio layer, baseband layer, Host Controller Interface HCI, the Link Manager Protocol LMP, and the Link Layer and Adaptation Protocol L2CAP. The implementation also provides the standard Unix socket interface to each layer. Additional implementations are available such as the RFCOMM (serial interface over Bluetooth link), Service Discovery Protocol (SDP), and various command line tools. With the implementation of the Bluetooth Network Encapsulation Protocol (BNEP), the PAN profile functionality is complete.

The platform is used to test

a) WEB surfing on the PANU device using the Bluetooth link to a NAP that in turn provides access to external networks,
b) ad hoc networking using SDP to check the needed services. A device needs to be authorised prior to connection establishment for accessing any services. Authorisation is granted (and a connection is set up) only if the PIN provided by the user is the same as a previously registered PIN in the NAP/GN. Consequently, for the development of ad hoc services, a user must obtain a PIN before connection setup can take place. A trusted operator is in a very good position to provide this PIN and thus secure ad hoc networking using the PAN profile.

The Market For Bluetooth

In Switzerland, by the year 2005, over 3 million customers with one or more Bluetooth devices each and at an active usage rate of 70% can be expected. Figure 6 presents the anticipated number of Bluetooth and WLAN devices.

In Europe (applicable also to Switzerland), by the end of 2003, the most significant scenario for the mobile payment market is expected to be mobile assisted Internet payments. By 2005, it is anticipated that the customer payment at the Point Of Sale (POS) would have expanded considerably to 13% of all mobile payments. This is due to a predicted change in user habits and merchant adoption [4].

Future implementations of Bluetooth profiles such as the Cordless Telephony Profile (CTP) offer new business poten-

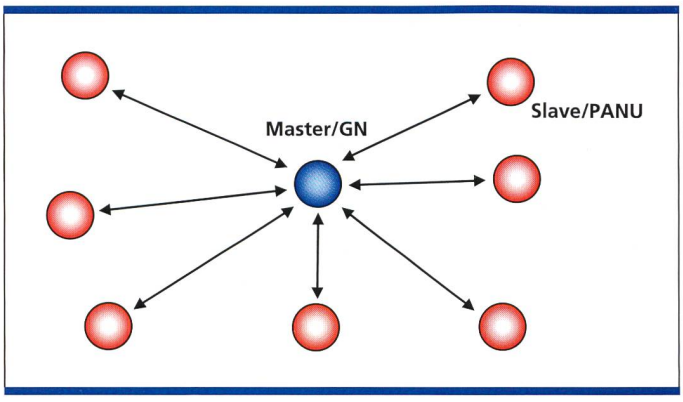


Fig. 4. Personal Area Network (PAN) structure.

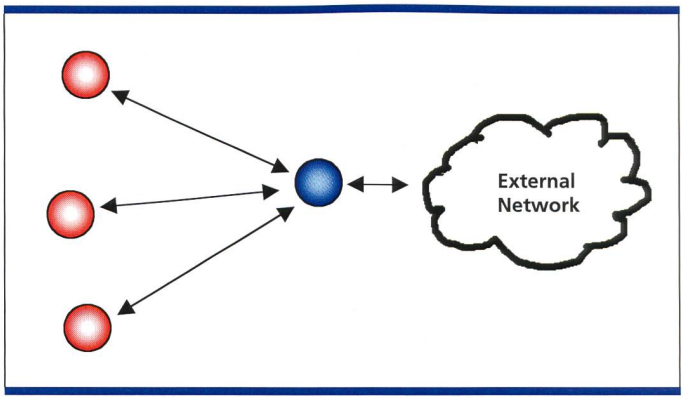


Fig. 5. Network Access Point (NAP) structure.

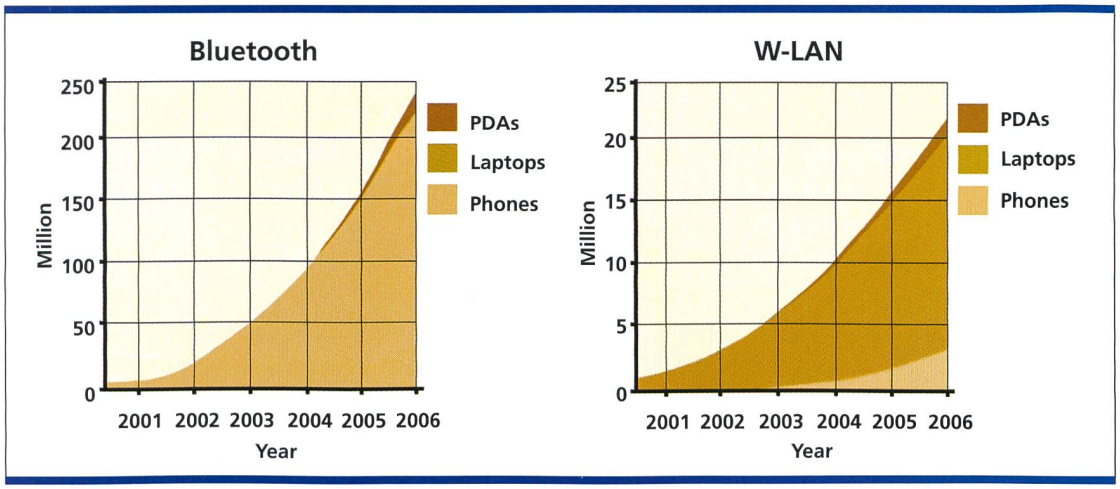


Fig. 6. Expected development of Bluetooth and WLAN devices.

tial. Public phones will be able to overcome the one-user-at-a-time limitation. Mobile users of other operators could access the PSTN with their own mobile device. Most important, however, is the potential of making cheaper voice calls using the mobile phone within the enterprise, hotspots, and homes.

Bluetooth ad hoc features will allow communication with local servers in a secure and fast way. With Bluetooth PDAs, this secure ad hoc channel will extend the usability of public infrastructure by other entities, e. g. ticket machines at a train station, where a user-friendly interface is realisable on the screen of the PDA.

Key for the utilisation of paid services in ad hoc or peer-to-peer environments is a secure authentication of the mobile device/user. Centralised authentication services such as Certificate Authorities (CA) or Home Locator Register (HLR) are needed to authenticate a registered user.

Bluetooth Business Opportunities

M-payment is currently a targeted business application for operators [4]. Bluetooth may be one of the most effective access channels using the free spectrum for interaction between user devices and machines, e. g. vending or ticket machines. These systems rely on a supporting infrastructure for authentication and billing, services that can be typically offered by an operator.

Extending the eminent deployment of public WLAN hotspots by adding facilities for Bluetooth access provides another opportunity: Allowing PDAs and mobile phone users access to local services and the Internet should increase the traffic on the network(s) and therefore generate new revenues.

Co-branding, i. e. deploying public Bluetooth hotspot in partnership with retailers and enterprises, for payment, voice calls, local advertisement, services access, etc., can be an additional source of revenue for an operator.

Finally, a new market can be entered by offering a global and trusted service to authenticate users initiating small financial transactions (daily buys to be charged to their mobile phone bill). In addition, such a service would also increase customer binding/loyalty.

Conclusions

Bluetooth is gradually being integrated in a wide range of mobile devices thus increasing their versatility. In particular, the mobile phone is now ready for new roles in both the wireless and fixed networks. The data and voice profiles of Bluetooth combined with the SIM card are essential ingredients for providing new services to subscribers in public hotspots, offices and homes. Users may find the new universal role of the mobile phone supported by trusted operator

Abbreviations

AP	Access Point
AS	Access Server
BNEP	Bluetooth Network Encapsulation Protocol
CTP	Cordless Telephony Profile
DUN	Dial-Up Networking
GN	Group Network
GPRS	General Packet Radio Service
NAP	Network Access Point
PAN	Personal Area Network
PANU	PAN User
PDA	Personal Digital Assistant
POS	Point Of Sale
SDP	Service Detection Protocol
SIG	Special Interest Group (Bluetooth standards body)
SIM	Subscriber Identity Module
UMTS	Universal Mobile Telecommunications System

References

[1] Emerging Technology Conference, 30 November 2000, Merrill Lynch
[2] Dataquest, EMC 2000
[3] Eliseo Sandeo Trasobares, Telefonica, The future of mobile Networks, m2000, Stockholm, 5–6 December 2000
[4] Lars Torholm Christensen, Ericsson, Bluetooth in Transaction, Bluetooth congress 2002, RAI, Amsterdam 11–14 June 2002
[5] Bluetooth Access: A promising Access Technology to Ubiquitous Computing Services, http://www.eurescom.de/public/projects/P1100-series/P1118/
[6] ARC Group, June 2002
[7] Bluetooth and W-LAN, Will Coexist, Forrester, 19 October 2001
[8] Bluetooth as a 3G enabler, Intercai Mondiale Ltd, 2002

services assuring, convenient and time saving.
Bluetooth throughput makes the devices most suited for the exchange of short messages for transactional services such as financial, location based services, maps, advertisement, etc. The ownership of a Bluetooth device allows the user to access a collection of ad hoc services at any time of the day, in the office, on the road, at home, within the airport, etc. Bluetooth mobile phones and PDAs are key favourable devices for ad hoc services access.
Bluetooth devices should be able to offer voice calls at lower costs everywhere. A cordless home base station or public telephone boxes upgraded with Bluetooth access points will connect the mobile phone to the ISDN/PSTN network. This solution can replace dedicated home wireless terminals as DECT phones with a more versatile access point [5].
The demo platform use cases and the market studies point out a number of business opportunities for the enterprise, the hotspots, and for homes. Business potential of the use cases includes access control, location information and detection, voice services, m-payment, etc. These services make use of the ad hoc networking feature of Bluetooth.
There are a number of possible extensions for the demo platform that require further consideration. These may include the development of design concepts for voice over Bluetooth CTP (Cordless Telephony Profile) and m-payment services.
The practical development of, and experimentation with, a number of use cases will provide the basis for convincing business cases in the enterprise, in hotspots, and at home [6].

Outlook

Users seeking a universal device that enables them to carry out most of their daily activities will find a candidate in a smart mobile phone with Bluetooth. The mobile phone is already ubiquitous, highly mobile, enjoys in-and-outdoor coverage and has a proven billing and authentication record. Consequently, exploring the new roles and services of mobile phones in the enterprise, in public hotspots, and at home is necessary.
For proposed services and devices, associated technical challenges and user acceptance need to be defined and resolved. In addition, the new proposed profiles by Bluetooth SIG standards, e. g. audio and video profiles, will provide new capabilities and hence potential for more services. Also, Bluetooth SIG continues to seek better algorithms and solutions for security concerns and WLAN co-existence interference [7].
Finally, Bluetooth is considered a 3G enabler as it can extend the reach and scope of cellular networks [8]. 6

Pointers

Bluetooth SIG:
http://www.bluetooth.com
Eurescom Projects:
http://www.eurescom.de

Zusammenfassung

Wenn verschiedene Geräte – angefangen beim Handy, über PDA, Computer und Videokamera bis hin zum Drucker – miteinander kommunizieren sollen, ist Bluetooth der geeignete Standard dafür. Die Heterogenität der Endgeräte und ihre Allgegenwart stellen eine grosse Herausforderung für die Entwicklung neuer Dienste dar. Zusammen mit der zunehmenden Mobilität und dem Wunsch nach überall verfügbaren Daten- und Sprachdiensten ergibt sich eine vielversprechende Chance für einen Dienstanbieter.
Ziel des Projekts BLUES war es, die gegenwärtigen Spezifikationen und bestehenden Implementationen von Bluetooth aus dem Blickwinkel der Entwicklung von Anwendungsfällen zu untersuchen. Die daraus gewonnenen Erkenntnisse und umgesetzten Beispielszenarien können als Wegbereiter zur Entwicklung sinnvoller Anwendungen angesehen werden und ermöglichen damit eine Erweiterung des Dienstleistungsangebots.

Monira Abu El-ata *studied electrical and electronic engineering at Menofia University in Egypt and received a doctoral degree in 1980 from the University of Greenwich in London. She has worked in industry and academia as a development engineer, lecturer and researcher in the field of electronic engineering. She joined Swisscom Innovations at the end of 1999 and is currently involved in GPRS, UMTS and Bluetooth projects.*

Michael Schädler *studied electrical engineering at the Swiss Federal Institute of Technology (EPFL, Lausanne) and obtained his masters degree in 2001. Since then he has been working at Swisscom Innovations in the area of wireless access technologies (WLAN, Bluetooth) and future networks (IPv6).*

Simon Winiker *is a student of computer science at the University of Bern. During 2001, he was engaged in a project with Swisscom Innovations in the field of wireless LAN and Bluetooth technologies as part of his degree course. Currently, he is working on his thesis at Swisscom Innovations and will graduate at the end of 2003.*

Marc Danzeisen *studied computer science at the University of Bern, majored in mobile networking and graduated in 2001. He is now a PhD candidate and works for Swisscom Innovations. His main research interests are mobile ad hoc networking and 4G wireless networks.*

Jesús Roy Solanas *holds a MSc in telecommunication engineering, and a MS degree in economics and new technologies from the European University in Madrid. He joined Swisscom in 1997 and has been involved in a number of projects related to techno-economic assessment and business planning of broadband services provision, both in fixed and mobile networks. Currently, he holds the position of a senior business analyst at Swisscom Innovations.*

SAP und Kaba Benzing

Bedanet –
perfekte Integration
in die SAP-Welt.

Für perfekt integrierte Lösungen.

Seit vielen Jahren pflegen SAP und Kaba Benzing eine erfolgreiche Partnerschaft. Mehr als 700 internationale SAP R/3-Anwender setzen auf die Zuverlässigkeit der Produkte. Und das zu Recht. Wir bieten in Zeitwirtschaft und Betriebsdatenerfassung als erster SAP-Partner HR-PDC/XML zertifizierte Lösungen.

KABA® BENZING

KABA

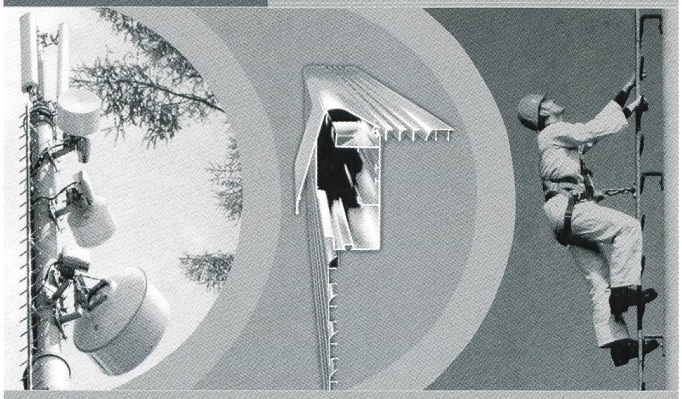
Kaba Benzing (Schweiz) AG
Lerzenstrasse 12
CH-8953 Dietikon
Telefon 01/745 15 15
Telefax 01/741 43 35
www.kaba-benzing.ch

Sidler/Basel

Orbit 02 24.–27. Sept.
Halle 2.2 Stand B78

letrona

Erfolgreich in die Zukunft



Kompetent in:

- KOMMUNIKATIONSTECHNIK
- ELEKTROTECHNIK
- SICHERHEITSTECHNIK

Letrona AG
Schulstrasse 22
CH-9504 Friltschen
Tel.: +41(0)71 654 64 64
Fax: +41(0)71 654 64 65

Riedackerstrasse 17
CH-8153 Rümlang
Tel.: +41(0)1 818 74 50
Fax: +41(0)1 818 74 51

E-Mail:
marketing@letrona.ch
www.letrona.ch