# Ubiquitous Computing and Beyond

More and more consumer devices – phones, PDAs (personal digital assistant), cameras, TVs, household appliances – have some sort of electronic processors embedded. Computing power everywhere – «Ubiquitous Computing". In addition, it becomes cheap and standard to have such devices connectable to the Internet by wire or wireless.

Taking Ubiquitous Computing and the Internet for granted opens up new possibilities. It unlocks a world where not only technology freaks but everyday people profit from a host of communication services – voice, still picture and video, instant messaging, presence information, and many more – unburdened of restrictions of technical feasibility and supported by a technology that brings usability, privacy and security.

The CTO Office supports the Swisscom CTO (Chief Technology Officer) by tracking technological and market developments and their disruptive potential and delivers aggregated, focused and well-adapted technology forecasting for the entire Swisscom Group. The CTO Office also runs an outpost in Silicon Valley to closely monitor new developments in the Internet industry and to establish business relationships with attractive Internet start-ups. The acquired know-how further serves as input for Exploration Programme planning.

With its Exploration Programmes, Corporate Technology is exploring telecommunication technologies and new service possibilities with a long-term view of 2–5 years. Further, the expertise built up in the course of this activity enables active support of business innovation projects.

Ubiquitous Computing names the third wave in computing beginning just now. First there were the mainframes (each mainframe was shared by many people). Then there was

CYRILL MEIER

the personal computing era whose end we are in right now (one person stares uneasily at one personal computer). Next comes Ubiquitous Computing where technology recedes into the background of our lives.

From our daily business life experience we get the certain feeling that there is no computer like no computer. Just because the needs one has are normally quite different from working for the computer's sake. For example, writing this report I would have liked to use an adapted word-processing-publishing-styling tool and not a personal computer running Windows 2000 professional and having MS Office 2000 installed.

Ubiquitous Computing replaces the PC era. Right now, the market shows powerful, multifunctional devices created by merging functionalities into new, very powerful devices. Examples for this trend are Smartphone, PocketPC or Webpad. These devices are connected seamless and wireless with the Internet, that in fact makes them wireless interconnected.

There are two big trends in the market of Ubiquitous Computing. First there is the convergence of end user devices paired with the evolution of their capability. They will have touch colour displays (varying in size), human oriented input and output (voice, writing etc), usable multimedia, network interfaces etc. Table 1 presents the currently most interesting end user device classes driven by this convergence. The second trend is to go wireless. This includes connecting the devices always-on to the Internet and interconnecting them among each other. In this area the

emerging WLAN (wireless LAN), UMTS (Universal Mobile Telecommunications System) and Bluetooth technologies are paving the way:

– WLAN technologies will promote wireless broadband access to the Internet (gaming, sending pictures etc) for mobile devices. Furthermore, WLAN technologies are always-on data networks that allow communication applications to be active for outgoing and incoming calls.
– UMTS is the future wireless public network and offers best quality voice and always-on data communication.
– Bluetooth will enable the usage of functionalities across devices (e.g. the MSN Messenger on the Pocket PC might use the mobile phone to place phone calls).

**Evolution of Ubiquitous Computing**
Ubiquitous Computing is growing and at the same time fading away as a term in the computing and Telco industry (fig. 1). In about 5 years from now the Ubiquitous Internet will be formed by a lot of different user devices being tightly linked via different networks to the Internet. The Evernet will follow this phase and put focus on availability of data and services, while hiding Internet and technologies. The next needed step from this point will be to strongly focus on user needs such as security, privacy and usability (Usernet).

*Ubiquitous Computing*
As written in the introduction the market for end user devices is still very turbulent and evolving. The diversity of devices, their functionalities and use cases will still rise. All devices will have computing, storage and multimedia input/output capabilities not limited by the technology, but by power consumption. This will form two extremes of devices. One extreme is the "techie" device trying to integrate all the newest technology. The other extreme is the simple user device offering only basic functionalities but focusing on ease of use.

What is tying them together are standards. Standards about how to describe content (XML), how to transport data (IP) and how to be interconnected (Internet) that are accepted and implemented by device manufacturers, service creators and service providers.

The era of Ubiquitous Computing is characterised by (fig. 2)
– new wireless devices like Pocket PCs and Webpads suited for multimedia
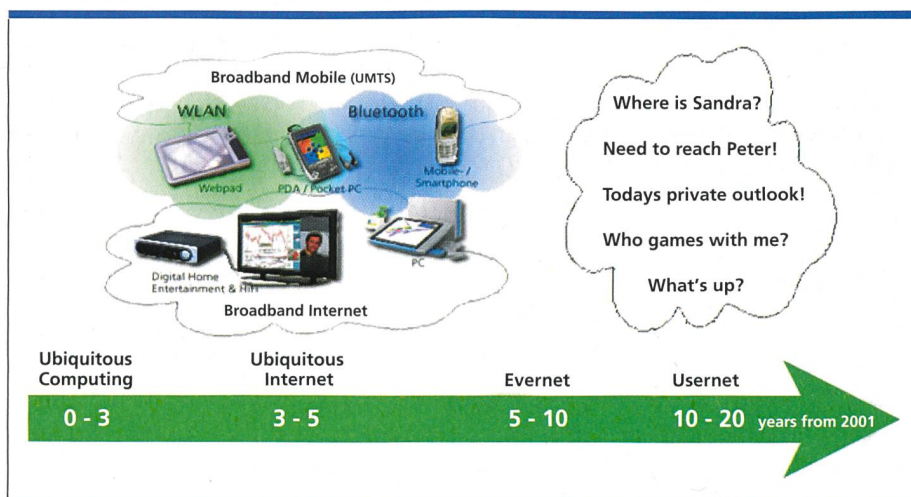


*Fig. 1. The extrapolated evolution of Ubiquitous Computing.*

| Device class | | Combines | Example products |
|---|---|---|---|
| PocketPC | | PDA<br>PC | iPAQ Pocket PC<br>Cassiopeia EM500 |
| Smartphone | | Mobile phone<br>PDA | Sagem WA 3050<br>Siemens MultiMobile |
| Webpad | | Notebook<br>PDA | Swisscom ScreenPad<br>Monec Voyager |
| Home<br>Entertainment | | HiFi<br>PC | Compaq iPAQ Music Center<br>Fujitsu-Siemens Activy 300 |

*Tab. 1. Emerging device classes and their origin.*

entertainment and communication entering the market,
– the evolution of existing devices which allows to hid technology realising the paradigm of invisible computing,
– new wireless networks which open the Internet for any device rendering the Internet access a commodity,
– the digital home, HiFi and entertainment profiting from the invisibility of computing power and Internet access.

### Ubiquitous Internet

The Internet will expand into literally any device and interconnect any network. Therefore the Internet will be ubiquitous [1]. The starting point for this evolution is broadband and always-on fixed access networks (xDSL, cable modem, WLL etc). But widely available wireless networks (Wireless-LAN, HiperLAN and UMTS) and wireless connected devices (Bluetooth, Personal Area Network) will prove to have even more impact.
All this will make the connection to the Internet a commodity. So the Internet connectivity diminishes as main focus, whereas the importance of availability and usability becomes more apparent. This shifts the focus of services from being device-bound to device-independent.

### Evernet

There will be more and more different device classes (PC, mobile phone, PDA, Pocket PC, Webpad) to develop services for. They will be connected to the Internet and offer standard ways of accessing data and displaying content. As this is a big part of the total effort needed today to create new services, it will significantly reduce production time or free up resources. This situation will enable the creation of user-needs-oriented services. The constraint of being forced to have one specific device (e.g. a phone) at hand

to fulfil a task (to call someone) will fade away.
The goal in the area of service design will be to make applications adaptable to the current environment of the users (devices, services etc). Not the adoption of services to devices, but how services make use of devices to the benefit of the user is the main focus.

### Usernet

What are the user needs in an environment, where
– different devices offer similar functionalities,
– services offer the same functionality as devices,
– personal data is stored somewhere in the network?
The answer is usability, privacy and security and therefore the same needs as today. But those needs will have more market impact and be strongly demanded by customers, because

– the more services are available offering the same functionality, the more important intuitive and instant use is;
– the evolution of the Internet depicts how important security and trust are (personal data must stay private, services must be hacker-proof etc).
The difference between this phase and today's Ubiquitous Computing era is: the establishing of Evernet that solves a lot of problems; the technology being mature enough and residing in the background; the possibility to focus on basic customer needs and create services that do not force the customer to understand the technology behind them.

### Conclusions

In about 5 years from now the effects of Ubiquitous Computing and the interlinked Ubiquitous Internet will hit the mass market. By then, technology will no longer be a factor for real differentiation from competitors. The technological evolution will open many different ways how to build a specific service fulfilling user needs. In such a situation it is very important to know more about those needs.
One approach is to carefully investigate the personal environment of potential users which can be described as follows:
– Physical context (@home, @work, fix, mobile): Where am I?
– Role (working, private, spare time etc.): How am I acting at this moment?
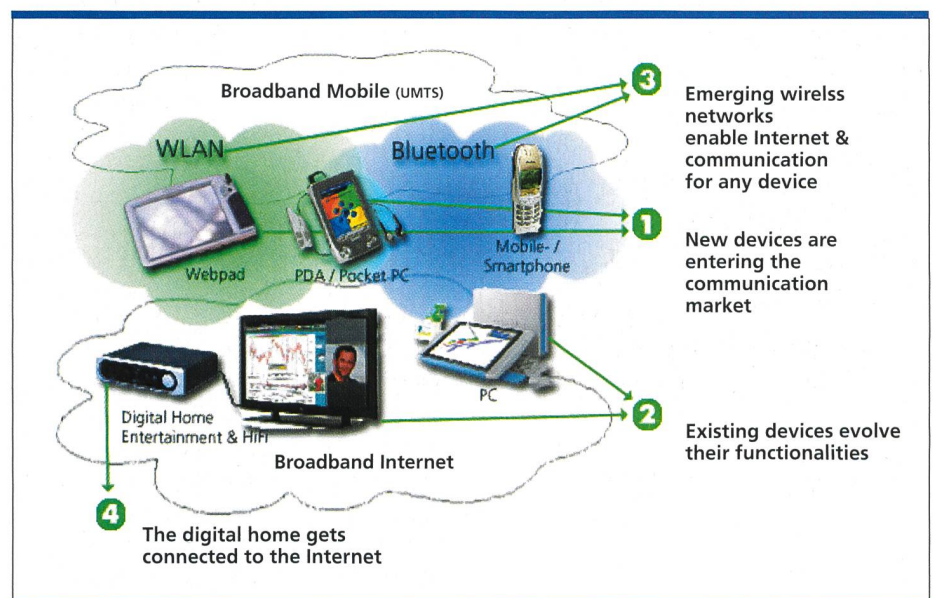– Circumstance (single, married, parent, grandparent): What are my life circumstances?



*Fig. 2. Devices, wireless data networks and the Internet melt together.*

– Involvement (consumer, producer, watching, interacting): What do I want to do with the content or service?
– Means (devices, services, functionalities): What means can I use to do something? Mapping services and functionalities to this personal environment leads to functional requirements describing how, when and where a specific need can be met. No longer is the technology or one specific service important, but the capability of supporting the user. For example, offering the right communication channel if someone needs to be reached, or supporting to choose the TV transmission I am really interested in etc.

## Outlook

Swisscom as a provider of high quality communication services today may evolve as tomorrow's provider of services and functionalities that precisely meet the users with their current needs. I.e. knowing the personal environment (see above) of our customers and using the currently available devices and services as tools.

Coming back to Ubiquitous Computing, the challenge for Swisscom is to support and stimulate the evolution of Ubiquitous Computing into Ubiquitous Internet (e.g. by combining access, services and devices into user-need oriented solutions) and use this transition phase to position the company as the provider of personal communication services of any kind. [11]

## References

[1] The Forester Report, The Ubiquitous Internet, February 2001

### Abbreviations

| | |
|---|---|
| DSL | Digital Subscriber Line |
| IP | Internet Protocol |
| MSN | MicroSoft Network |
| PDA | Personal Digital Assistant |
| UMTS | Universal Mobile Telecommunications System |
| WLAN | Wireless Local Area Network |
| WLL | Wireless Local Loop |
| XML | eXtensible Markup Language |

**iPAQ Pocket PC:**
http://www.compaq.com/products/handhelds/pocketpc/index.html

**Sagem WA 3050:**
http://www.sagem.com/en/

**Monec Voyager:**
http://www.monec.ch/start.cfm?PID=voyager.cfm

**Compaq iPAQ Music Center:**
http://athome.compaq.com/showroom/static/iPAQ/music_center.asp

**Fujitsu-Siemens Activy 300:**
http://www.fujitsu-siemens.com/activy/activy_300.html

**Further pointers:**
http://www.ubiq.com/hypertext/weiser/UbiHome.html

http://www.uwifi.com/

http://www.hermans.org/agents2/ch4.htm

http://www.m-lab.ch/

*Cyrill Meier* worked as a Software Engineer since 1986 before studying electric engineering for 3 years at ETHZ and taking a dipl. Ing. HTL degree at ISB in 1994. He was then an assistant at ISB and worked for Ascom Tech before joining Swisscom. His technical experience ranges from Basic, Pascal, Modula, C, SmallTalk, C++, Objects, Components, and RDBs to xDSL, NT, IP, IPmc, Live-TV streaming over IP, PC & Server, and Games. Cyrill Meier is currently working as a Senior Engineer at Swisscom AG, Corporate Technology, in the field of Multimedia Services.

## Zusammenfassung

Die technische Weiterentwicklung und massenhafte Verbreitung von Benutzerendgeräten wie Mobilephones, PDAs, PCs, digitale Kameras, TVs oder HiFi-Anlagen verwirklichen die Vision von überall verfügbarer Rechenleistung (Ubiquitous Computing). Gleichzeitig ist es normal und trivial diese Geräte mit dem Internet zu verbinden (Ubiquitous Internet).

Diese Selbstverständlichkeit, immer und überall Endgeräte und Internet zur Verfügung zu haben, öffnet die Möglichkeit nicht nur "early adaptors" durch neueste Technologien, sondern auch normale Kunden durch bedarfsorientierte und persönliche Kommunikationsdienste (voice, instant messaging, presence information, unified message box etc.) zu gewinnen.

Das Erstellen von bedarfsorientierten, einfach zu nutzenden Diensten muss sich am persönlichen Umfeld potentieller Kunden orientieren und lässt sich wie folgt beschreiben:
– Physischer Kontext (@home, @work, fix, mobil): *Wo bin ich?*
– Rolle (arbeitend, privat, Freizeit usw): *Was mache ich jetzt im Moment gerade?*
– Lebenssituation (single, verheiratet, Eltern): *Welches sind meine Lebensumstände?*
– Beteiligung (Kosument, Produzent, beobachten, interagieren): *Wie will ich den Inhalt / die Dienstleistung nutzen?*
– Hilfsmittel (Endgeräte, Dienste, Funktionalitäten): *Was für Hilfsmittel stehen mir momentan zur Verfügung?*

Swisscom als umfassender Anbieter von Kommunikationsdiensten hat eine gute Ausgangslage um von der Weiterentwicklung der Endgeräte (Ubiquitous Computing) und dem Internet (Ubiquitous Internet) zu profitieren. Dieser Trend sollte durch gebündelte Angebote von Geräten, Internet Access und Dienstleistungen unterstützt werden. Gleichzeitig müssen sich diese Produkte vermehrt am oben beschriebenen Umfeld der Benutzer orientieren, damit Swisscom in Zukunft zum Anbieter von persönlichen Kommunikationsdiensten jeglicher Art werden kann.