Issue 2/2003

EURESCOM mess@ge

XML WEB SERVICES – BETWEEN HYPE AND HOPE

Project reports
Location Awareness

European issues
The CELTIC Initiative

A bit beyond
Submarines in your body

EURESCOM Summit 2003
29 September to 1 October 2003
Marriott Hotel, Heidelberg, Germany

Evolution of Broadband Services
Satisfying user and market needs

SCOPE OF THE CONFERENCE

The continuing evolution of telecommunications services and technologies, including broadband, mobility and pervasiveness has reached levels where users and customers are often confronted with technology instead of service aspects. They often feel overwhelmed by confusing functionality, different handling modes, and user interfaces and device layouts that are difficult to understand and to use. There is an increasing risk that the potential of new communication services and technologies cannot be fully exploited and users may not enjoy the full benefits of the new technologies. As a result, expected market shares and business success may not be achieved.

This third Eurescom Summit 2003 on the 'Evolution of Broadband Services' aims at capturing a snapshot of ongoing activities in these areas, providing value to executives, business professionals and technical experts of network operators, service providers, equipment manufacturers, content providers as well as to the research community. It aims at looking into technical issues of advanced services and technologies, showing how the advances in service creation technologies can support the creation of user- friendly services. It will consider usability and user acceptance of advanced services and devices, as well as looking at their business relevance.

An objective of the conference is to explore business challenges, threats and opportunities for the next generation of applications, services and communication technologies, by covering the whole value chain. Furthermore it aims to identify new ways to bridge the gap between a purely technology-driven and a more user-focused service evolution.

The conference will provide a platform for the discussion of innovative and marketable solutions, strategies for the promotion of new communication technologies and applications, as well as open issues for further research. It will cover the following list of issues both from a user perspective, as well as from a technology and a business point of view:

- Applications & services including mobility
- Business aspects, opportunities and threats
- User aspects and customer relations
- User requirements
- Personalisation
- Identifying the market pull
- Technology trends including:
- Service platforms
- Service platform related systems & architectures
- Device evolution
- Content related aspects

The programme is complemented by keynote presentations, panel discussions, tutorials, exhibitions, and demonstrations.

TARGET AUDIENCE

Experts, researchers, executives, business and product planners, strategists, service developers from telecom operators and IT vendors, content providers, manufacturers of IT/telecom software/hardware, application service providers, telecom service providers and consultant companies.

EXHIBITION – EXPERTS MEET EXPERTS

The conference will also host an exhibition presenting available and emerging products, devices and tools demonstrating recent advances in communication services and enabling technologies, Please send requests for exhibition space to summit2003@eurescom.de.

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The next technology hype

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Do you remember UMTS? This question may sound provocative, but today, UMTS has practically vanished from the public agenda. Nonetheless, the UMTS technology has never been closer to maturity than today. How can the UMTS hype and its sudden end be explained? UMTS is just the most recent case of technology hype. Previous centuries are full of examples for technology hypes. Just think of the hypes over steam power, electricity, and steel production. Today, we take these technologies for granted, then, they were the cause of technological fascination and controversial discussion.

The hype cycle

Already in 1995, long before UMTS was visible on the public horizon, Gartner Group analyst Jackie Fenn analysed the phenomenon and called it 'hype cycle'. He derived his five-part hype cycle from the analysis of an over-hyped product called Windows 95, but his conclusions apply also to UMTS and any other hyped technology, product, or service.

The first phase, according to Fenn and the Gartner Group, is the 'technology trigger': an announced breakthrough, public demonstration, or product launch that generates significant press and industry interest.

The second phase is the 'peak of inflated expectations'. This is a phase of exaggerated enthusiasm and unrealistic projections during which hectic marketing activities and high media exposure accompany few successes and more failures. While the technology is pushed to its limits, only conference organisers, magazine publishers, and – though Gartner does not mention this – analysts are making money at this stage. Currently, the Wireless LAN technology is going through this phase.

The third phase is called 'trough of disillusionment'. This is the point at which the technology becomes unfashionable, because the technology did not live up to its over-inflated expectations.

This is followed by the 'slope of enlightenment'. In this fourth phase, solid development efforts lead to a true understanding of the technology's applicability, and commercial tools, which facilitate the development process, become available.

Finally, in the fifth phase of the cycle, the 'plateau of productivity' is reached. The real-world benefits of the technology are demonstrated and accepted. Tools and methodologies are increasingly stable as they enter their second and third generation.

Applied to UMTS, we are now in the fourth phase, in which all major players have come to a realistic assessment of the technology's benefits and push it through solid development of marketable products and services. However, it should be clear that this will take some time. Even for a less complex technology like GSM it took years to debug and stabilise the technology, particularly the software, in order to make it as reliable and user-friendly as it is today.

Lessons for the next hype

Why is it so important for everyone in the telecoms business to understand the hype cycle? The answer is obvious: to avoid the mistakes and damages made in previous hypes. It might sound a bit anachronistic to talk about technology hypes during a phase of economic downturn, in which many companies try to recover from the burst of the Internet bubble.

However, under the surface a number of new technologies are popping up, which have the potential for the next big hype. One of the prospects is XML Web Services. In this issue of *Eurescom mess@ge* and at a Eurescom workshop in June, the promising opportunities of XML Web Services in the telecoms domain are presented. It may look as if Eurescom participates in creating a new hype, but the opposite is true.

With our projects and public activities in this area, we want to get as fast possible to phase four, the 'slope of enlightenment', leaping the detrimental hype phases two and three. Some people might argue why a hype should be detrimental. A hype accelerates demand, and, at least for a short period, leads to rising share prices.

The point, why a hype is detrimental for new technologies is that in the end, customer trust in these technologies and the companies that offer them is undermined, compromising the long-term business prospects of the whole industry.

Fighting the negative effects of hypes does not mean to restrict the enthusiasm of researchers, developers, marketing people, analysts, shareholders and others. It means to put new technologies, products and services into perspective and try to evaluate them in a realistic and accurate way, which will win more customer trust than a short-lived hype. We have to acknowledge the simple fact that only a limited number of new technologies and products will succeed in the marketplace, and nobody definitely knows in advance, which ones this will be.

Respecting the borderline

As a research organisation and centre of innovation, Eurescom is trying hard to explore, develop and evaluate technologies and services in an unbiased way to give its community of members an accurate and solid basis for their investment decisions in the area of innovative technologies and services. The borderline between healthy enthusiasm and unwholesome hype is narrow. It is essential to respect this borderline, if we want to achieve enduring customer and shareholder satisfaction.

Dear readers,

In this issue of *Eurescom mess@ge* you will find again a broad range of interesting R&D topics. Our cover theme is XML Web Services, which reflects the importance of software for telecommunications. The exclusive articles in our cover theme will show you what the opportunities of XML Web Services are. There are several reasons why we thought this topic to be timely. First, there are a number of products, services, and prototypes maturing rapidly. Second, there is a Eurescom workshop taking place in Heidelberg from 24 to 25 June. This is the first major event which gives an overview on the opportunities of XML Web Services for the telecoms market and specifically for telcos. Some of the speakers at the workshop are also authors of articles in our cover theme. We think that the aspects selected for this cover theme are highly relevant to the telecoms sector.

Besides the cover theme, there are plenty of topics covered in this issue, which are of equal importance. 'Project reports' features two articles about Eurescom projects on 'location awareness' and 'Ethernet-based access networks'. Under 'European issues' you will find a report about CELTIC, an industry-driven European initiative for maintaining European leadership in telecoms. If you think small is beautiful, you will certainly like this issue's 'A bit beyond' article. It covers the stunning symbiosis of nano-technology and telecommunications in medicine.

We hope you will find the contents of this issue interesting. Please tell us what you think. Your feedback is important for us, the editors, but also for the authors, who spent a lot of time giving you exclusive insights into their work.

Finally, we would like to thank our readers regarding an organisational issue: the fax and online form we started to offer with issue 1/2003 for updating your address details has been well accepted. It is quite important for us to be informed about your address changes. This will help us deliver the printed issue correctly with the least amount of misdirected mail.

The Web form can be used both for address updates and for subscriptions at www.eurescom.de/message/subscribe.asp.

If you are interested in contributing as an author to one of the next issues, please contact us, and we discuss if and how it would fit. Please do not send unsolicited articles but rather an abstract and a biographical note about yourself.

Enjoy the magazine!

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Brussels, here I come!

Eurescom's FP6 messenger, ready for a fast ride to Europe's capital.

The speedy rider is no other than *Eurescom mess@ge* editor Peter Stollenmayer. On 23 April he delivered Eurescom's project proposal for the EU 6th Framework Programme to the European Commission in Brussels – just in time to meet the deadline.

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Imprint
EURESCOM mess@ge, issue 2/2003 (June 2003)
ISSN 1618-5196 (print edition)
ISSN 1618-520X (Internet edition)

Editors: Milon Gupta (editor-in-chief), Peter Stollenmayer, Anastasius Gavras, Uwe Herzog

Submissions are welcome, including proposals for articles and complete articles, but we reserve the right to edit.
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Distribution: Eurescom mess@ge is distributed quarterly.

Eurescom mess@ge on the Web:
http://www.eurescom.de/message

Novel wrist-phone from NTT DoCoMo

In May, NTT DoCoMo started the market launch of its novel wrist-phone in Japan. Wristomo is the world's first commercial wristwatch-style Personal Handyphone System (PHS) mobile phone, NTT DoCoMo claims. The device combines a waterproof wristwatch with a mobile phone. Wristomo opens up into a handset when buttons on either side of the watch face are pressed.

Users can send and receive e-mails up to 6,000 alphanumeric characters via the Internet without having to sign up for a provider. The wrist phone transfers data at up to 64 kbps. Wristomo is able to access DoCoMo's location based services, which provide information about restaurants, weather, transportation and other content based on the user's current location. Another feature is the automated information synchronisation with PCs. The 113 grams light device has a continuous talk time of around 120 minutes and a continuous stand-by time of about 200 hours according to NTT DoCoMo.

www.wristomo.com

Dispute over mobile-phone technology for Iraq

Darrell Issa

In the midst of the war against Iraq, U.S. congressman Darrell Issa kicked off a transatlantic dispute over mobile phone technology standards for Iraq. At the end of March, the Republican congressman from California introduced a legislation, in which he demanded the use of CDMA instead of GSM for the U.S.-financed building of a mobile phone network in Iraq. He sent a letter to U.S. Secretary of Defence, Donald Rumsfeld, objecting to a proposal by the Department of Defence and USAID to use federal funds to build a communications system in post-war Iraq based on the European GSM standard.

This provoked a retort by the GSM Association. In a written statement, the CEO of the GSM Association, Rob Conway, rejected Mr Issa's initiative as "ill-timed as it is misinformed". Mr Conway pointed out that GSM is not a French or European standard, as Mr Issa had suggested, but a global standard used by almost 1 billion consumers world-wide including 60 million customers in the Middle-East region.

The row over the mobile phone standard for Iraq was for the time being defused by the U.S. government's preliminary decision in May not to award a major contract for rebuilding Iraq's telecommunications networks under its $2.5 billion reconstruction programme. U.S. officials said they would leave it to the next Iraqi government to decide how to reconstruct the telecommunications system that has suffered under years of neglect and two U.S.-led wars. Less than 3 percent of Iraq's population has access to a wired telephone line. On 16 May, Reuters reported that MCI won a contract to build a wireless phone network in Baghdad – based on GSM. Comment by Rob Conway: "We are very pleased by this."

Rob Conway

The advance of XML Web Services

Techno hype or business hope for telcos?

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Web Services is currently one of the hottest issues in the software industry. Regardless of the typical hype that inevitably seems to accompany the emergence of new technologies, there are good reasons for predicting a success of Web Services. In the world of Web Services, one software application can dynamically discover a number of others over the Internet, and by using their compound functionality new services can be created. This functionality gives Web Services the potential to repeat the success of the Internet. An important question is: will there be a role for telcos?

Web Services for IT

If you trust the analysts' opinions, then the great future of Web Services has already begun in the IT domain. Consulting companies like Cap Gemini, Ernst & Young, or the Meta Group have published studies on Web Services, in which they forecast that the breakthrough of Web Services will soon happen. This forecast is based on industry surveys by consulting companies. The survey results showed that Web Services are high on the agenda, being pushed from CEO level in more than 50 percent of the cases. Marketing, sales and CRM are considered as the most promising application areas.

Can telcos benefit from Web Services?

Web Services have also a big potential for telcos. Two areas shall exemplify this. Across the world, network operators and service providers are looking for new content-based and application-based multimedia services as a way to boost revenues. Telcos will need to partner with content providers and application providers in order to deliver new services to users. These partnerships will lead to extended value chains, with a number of players involved. Web Services is an exciting technology that can be used to realise and automatise these interactions. The resulting reduction of costs of the service provision is one of the advantages that can be gained. This will enable service offerings that would have been impossible to make without Web Services, due to an otherwise unsellable high service price for the end-user.

A second application area for Web Services is the integration of company internal systems. Due to the historical process of introducing components or systems in a company, they often adhere to different standards for their operating systems, communication protocols and other system components. At a telecoms network operator, these could be the switches, the network or service management systems, or billing components. A technology which has already been widely applied to achieve interoperability is the Common Object Request Broker Architecture (CORBA). CORBA can arbitrate between applications on a number of operating systems and of several programming languages. CORBA, however, often fails when it is used between physically remote applications and in particular when firewalls have to be passed. This is where one of the strengths of Web Services comes in, for which large distances or firewalls are no problem.

For clarification it should be noted that the term Web Services does not include services like Web server provisioning, Internet access, or services like Napster. XML Web Services is an umbrella term. It defines methods which enable applications, pieces of software, to access the functionality of other remote software components over the Internet. This can be compared to the advent of Web browsing, which enabled people to view content, or in general, to use services that could be located anywhere on the Web. The concept of Web Services now extends the opportunity to access a remote service 'of its own choice' to software applications.

Conclusions

There are surely more aspects in Web Services than mentioned above, which make them an exciting technology deserving a close interest from telcos. A number of Eurescom projects have already been working on the technical issues and business opportunities of XML Web Services: P1209 'XML Web Services', P1242 'Web Services Orchestration', and, just started, P1306 'BIZCOOL – Business to business interaction with Web Services and ebXML'. This cover theme includes two articles from the project leaders of P1209 and P1242 and an exclusive article on security mechanisms for Web Services. These contributions will shed some more light on the emerging field of XML Web Services and might help telcos in evaluating the business opportunities for them.

XML Web Services and telcos

The new business opportunities

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Recently, the concept of XML Web Services has attracted significant attention both from a technology and a business point of view. XML Web Services provide a standardised way for machines to access and use encapsulated services and functions on other machines over the Internet. Due to the service-oriented architecture model behind XML Web Services, a whole range of potential business opportunities is arising, particularly for telcos. In this article a brief introduction to the concept of XML Web Services will be provided along with a description of the current status of XML Web Services standardisation. Selected business opportunities for telcos will be discussed, and finally some conclusions will be drawn.

Overview of XML Web Services technology

In a very basic form, the term XML Web Service is often associated with a simple and robust mechanism for Remote Procedure Call-type service invocation based on the Simple Object Access Protocol (SOAP), a communication protocol running e.g. over HTTP and XML, a data description language. By adding registry services, a means for dynamic search and match of service consumer and provider at run-time is introduced. This service model, with its three main entities provider, consumer, and registrar, is an example of a Service-Oriented Architecture (SOA) suitable for an open and dynamic service environment.

Here are some definitions of Web Services. They also indicate the areas in which Web Services can be applied.

- **Interoperable Internet middleware.** Although currently available middleware, e.g. the Common Object Request Broker Architecture (CORBA) or Java's Remote Method Invocation (RMI), have been successfully deployed in Intranets, the application of these technologies over the Internet between partners operating different infrastructures poses a great challenge. Web Services can be considered as middleware, which establishes interoperability between different infrastructure platforms over the Internet.
- **Extensions of applications onto the Internet.** This vision refers to Web Services as the means for applications to access remote functionality located somewhere on the Internet.
- **Means for the commercial exploitation of data and services on a 'pay-per-use' basis.** This vision refers to Web Services as a means to sell data or services via the Internet.
- **Enabler for an open service market on the Internet.** In this vision XML Web Services are regarded as the means for advertising, brokering and accessing data and services on a dynamic basis. Providers publish their service interfaces in an appropriate registry, and requesters query the registry to discover and contact available services relevant to their needs.
- **Means for automatic, dynamic e-business.** As an extension of the previous vision this may be viewed as the ultimate goal for many proponents of the XML Web Services concept. Here, e-business is realised by means of highly dynamic, peer-to-peer business transactions based on contracts with Web Service providers which are negotiated on-the-fly.

Standardisation

Though the XML Web Services core specifications are a good starting point, they are not sufficient to effectively support complex transactions in a uniform and standardised manner. This is due to constraints and requirements ranging from reliability and security up to business transaction support, which are not addressed by the core standards and specifications mentioned above.

For a better overview, the various protocols and specifications relevant to a future standardised Web Services protocol stack may be grouped within a simple protocol stack framework, outlined by IBM and Microsoft during a W3C workshop on Web Services in Spring 2001 called the Web Services Framework (see figure 1). Interoperability between the various protocol stack levels of the Web Services Framework is not necessarily given, but an important goal of the ongoing standardisation process.

The main players in the field of Web Services standardisation are the World Wide Web Consortium (W3C), the OASIS group, which, together with the UN, backed the ebXML consortium, and software vendors, like IBM, Microsoft and Sun Microsystems, who push their own technologies. Important industry-specific groups include RosettaNet, BizTalk, commercialXML (cXML), the Open Travel Alliance (OTA), the XML/EDI group and the Business Process Management Initiative (BPMI). The W3C attempts to create robust standards for Web Services in a bottom-up style, e.g. SOAP and XML, while the ebXML mission was to provide an open SOAP-/XML-based infrastructure comprehensively enabling the global use of electronic business information.

It is apparent that additional protocols and specifications are required which together form a commonly accepted and openly available XML Web Services protocol stack. Currently, however, many complementary as well as rivalling approaches to various protocol needs are available. Some of them have been endorsed by established standardisation bodies, others by industry groups or even individual companies only. As yet, no consolidated and standardised Web Services protocol stack or Web Services architecture exists. It remains to be seen which standardisation body or industry group will prevail or in which way their efforts might be merged. This applies particularly to the higher-level business-oriented protocols, e.g. business process orchestration. These protocols currently are being pushed into OASIS, which is seen as the more appropriate body due to its history in ebXML.

Business opportunities for telcos

In order to analyse potential business opportunities for telcos in the XML Web Services arena, figure 2 illustrates the expected value chain and where a telco might find suitable business opportunities. Eurescom project P1209 has conducted an initial analysis of business models relevant to telcos. Two of them are briefly introduced below.

Web Services broker

A telco operating a vertical Web Services broker will run, for example, a Universal Description, Discovery and Integration (UDDI) registry, in which suppliers are able to register Web Services. A taxonomy/categorisation will be provided to facilitate searching.

To leverage its knowledge of the supplier network, the broker will provide ratings of the participating suppliers, and it can further provide ratings for individual Web Services based on either a testing programme or customer feedback or popularity. Other value-added services such as payment brokerage, availability and QoS could be offered if the broker is part of a Web Services network solution.

The broker may use its established brand to attract customers to search for providers through its registry. To support this, the broker might be providing value-added consulting and integration services.

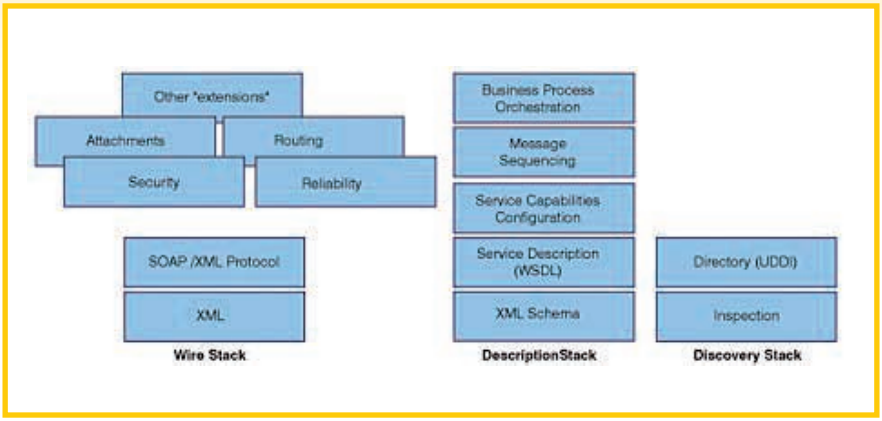

Figure 1: Web Services Framework

The Web Service brokering scenario offers new market opportunities. As the registry grows, brokers may decide to differentiate and specialise in specific geographical areas or industries. The opportunities for such specialised value added Web Service providers are even larger as it is expected that horizontal value added services, for example secure communications, logging, monitoring, will be commoditised and included in the Web Service standards and vendor platforms. In addition, brokers specialised on specific industries will have the advantages of niche markets and loyal customers.

Web Services infrastructure provisioning

This business model sees the telco as a provider of basic infrastructure services, which are offered to Web Service providers, for instance:

- secure messaging – the ability to communicate reliably and securely over an insecure medium (the Internet);
- authentication – being able to identify who is communicating;
- authorisation – allowing authenticated users access to certain parts of a system;
- billing and payment – standard methods for payment to occur,

The rationale behind this is that providers cannot always implement the whole infrastructure needed for Web Service business collaboration on their own, due to the lack of resources.

Telcos are in a good position to establish themselves as infrastructure providers, mainly because they already have experience in providing infrastructure services. The associated costs are too high for small and medium-sized enterprises (SMEs), but can be covered by a telco. This business model is, however, inhibited by the currently still immature Web Services market.

Conclusions

At present, telcos are mainly experimenting with Web Services internally. Isolated examples indicate though that the usage of Web Services as an additional access path to information and services for external partners has already begun. This evolution will continue, allowing business partners in the near future to integrate their business processes via Web Services more closely.

Additionally, through the maturing of Web Service technology new business models will become possible, which are closely related to B2B eBusiness. Web Services extend the available technology for B2B eBusiness in order to get a step closer to the ultimate vision of eBusiness, meaning to perform business on an ad hoc basis 'on the fly'. However, a number of open issues still need to be solved for achieving this ultimate goal, for instance methods for contracting and standards for business-specific documents.

Whether this vision can be achieved depends on a market for Web Services, which still needs to emerge. At the moment it is not yet clear whether this market will come into existence. Telcos are advised to carefully observe the further evolution of XML Web Services and to exploit the emerging business opportunities.

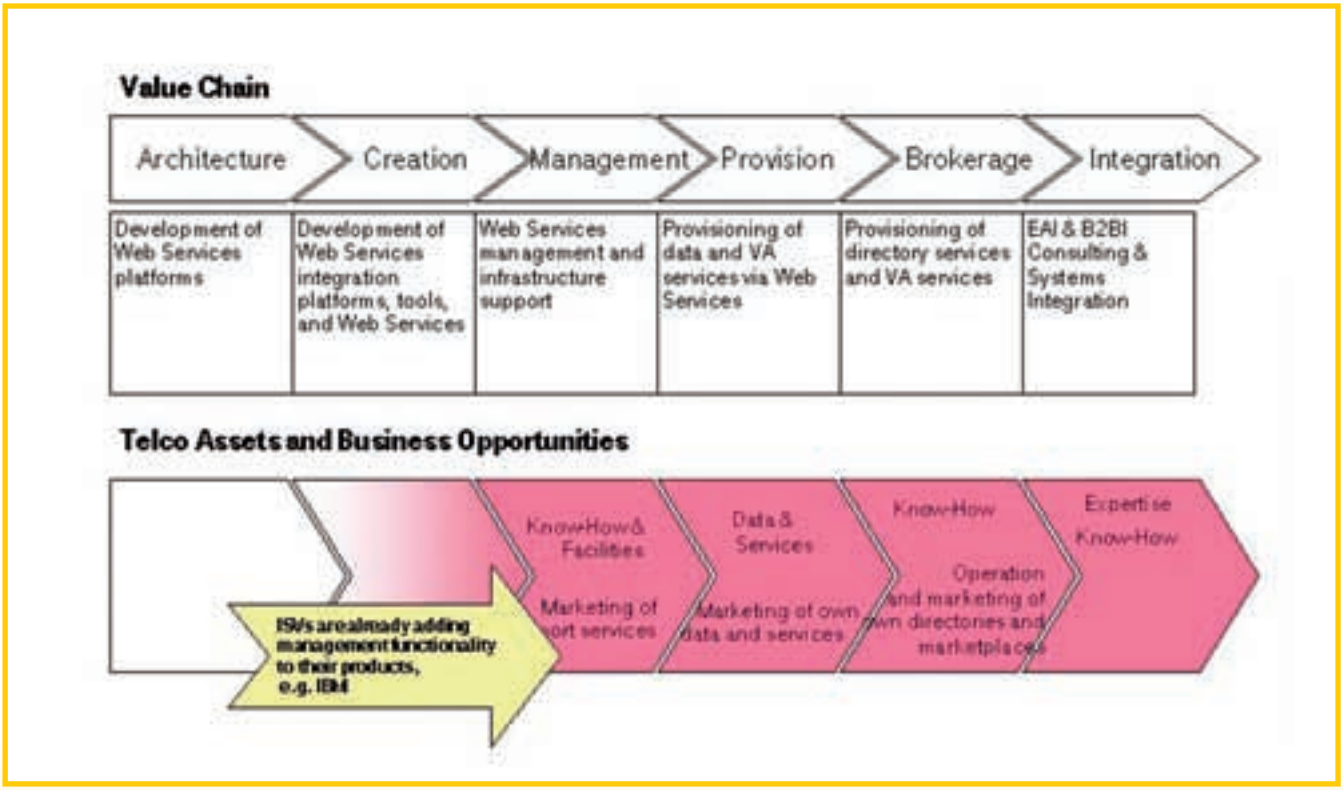

Figure 2: XML Web Services – value chain and business opportunities

Web Service Orchestration

An open and standardised approach for creating advanced services

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"The right music played by the right instruments at the right time in the right combination: that's good orchestration," said Leonard Bernstein, the great conductor and composer. Orchestration is a big part of composing music. Think of all the choices a composer has to make when writing his music. Should he use a flute or a violin or a drum or a tuba? Should he use one instrument or many? What combinations would sound the best with his music? As in music, orchestration plays a crucial role in the composition and deployment of sophisticated and complex Web Services.

Like a music composer, the Web Service composer has to select the necessary Web Services, to decide how they are going to interact with each other at the message level and at the execution level, i.e. sequential, parallel, transactional, long-lived, etc. Bad orchestration will result in bad and unprofitable services.

What is Web Service Orchestration?

The standard set of Web Service technologies (XML, SOAP, WSDL) provides the means to describe, locate and invoke a Web Service as an entity in its own right. Although a Web Service may expose many methods, each Web Service Description Language (WSDL) file describes fairly atomic, low-level functions. What the basic technologies do not give us is the rich behavioural detail that describes the role the service plays as part of a larger, more complex collaboration. When these collaborations are collections of activities designed to accomplish a given business objective, they are known as a business process. A business process may extend across one or more organisations. The description of the sequence of activities that make up a business process is called an orchestration.

Other terms such as choreography, flow composition, and workflow have been applied to this area and all, essentially, describe the same thing – the way in which separate Web Services can be brought together in a consistent manner to provide a higher value service. Orchestration includes the management of the transactions between the individual services, including any necessary error handling, as well as describing the overall process.

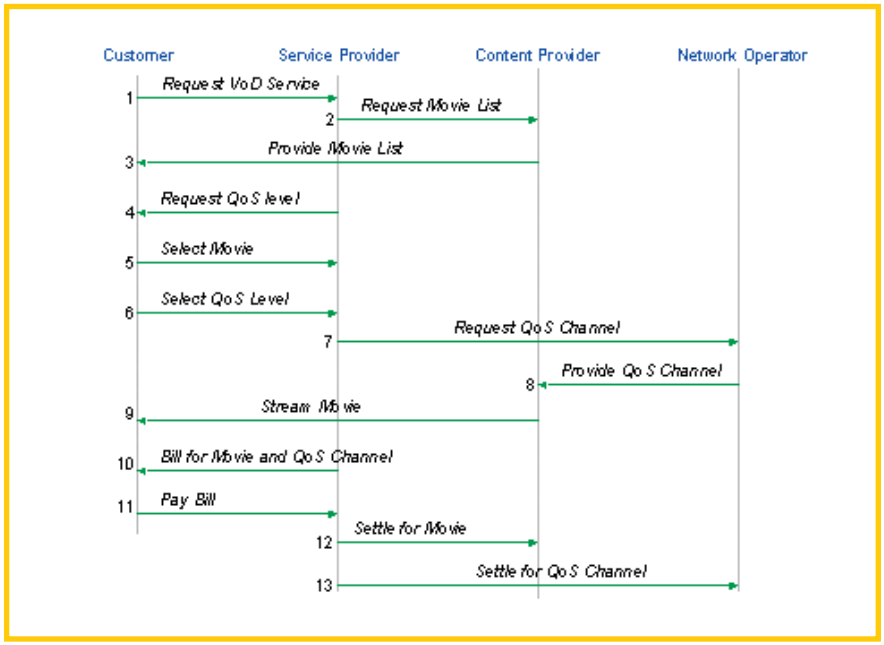

Diagramme: Video on Demand message sequence

Orchestration can therefore be considered as a construct between an automated process and the individual services which enact the steps in the process.

Thus, business processes are on the higher level of orchestration, and concrete implementations of these business processes are on the lower level. Orchestration provides a technology to map these different topics. To summarise, the orchestration describes a business process from each interactions between two services to complete cases that links together these individual service interactions.

An example of orchestration

To elucidate what orchestration is, let us consider a video-on-demand service. A customer requests to view a movie at home via a broadband connection to a network operator (NO). The service is operated by a service provider (SP), who has a settlement arrangement with a movie content provider (CP), as well as the NO. The message sequence is shown in the diagramme.

Orchestration in this scenario can be considered to be the means by which the service is automated. Without orchestration of the interactions between the four actors in the system, they would have to be co-ordinated manually. The service provider can reduce operational costs by using an automated means of co-ordination.

Orchestration standards

There are two types of orchestration, one dedicated to Web Services, while the other applies for business processes, as shown in the table. It is important to consider Web Service orchestrations in relation to the business orchestrations because they can be adopted in the business processes. (see table)

BPSS BPML RosettaNet XPDL BTP EDOC	CommerceONE	WSFL XLANG WSCL WSCI BPEL4WS	
Business orchestration standards	**Business orchestration proprietary**	**Web Services orchestration proprietary**	**Web Services orchestration Standards**

Table: Orchestration specifications

Now, let us introduce the three most promising orchestration specifications:

WSCI
The Web Service Choreography Interface (WSCI) is an XML-based interface description language that describes the flow of messages exchanged by a Web Service interacting with other Web Services. It has been jointly developed by BEA Systems, Intalio, SAP AG, and Sun Microsystems. The specification was issued in May 2002.

BPEL4WS or BPEL
Business Process Execution Language for Web Services (BPEL4WS or BPEL) specification has been announced by IBM, BEA Systems, and Microsoft. BPEL combines IBM's Web Services Flow Language and Microsoft's XLANG specifications, superseding both these specifications. BPEL is supported by two complementary specifications – WS-Transaction and WS-Coordination.

BPML
BPML (Business Process Management Language) is a specification from the BPMI.org (Business Process Management Initiative Organisation). BPML aims at providing a comprehensive means of specifying the process of an enterprise. BPMI.org and ebXML are addressing complementary aspects of e-business process management. While ebXML Business Process Specification Schema (BPSS) provides a standard way for describing the public interface of an e-business process, BPML provides a standard way for describing their private implementation.

Crucial role in telcos' business

To do business on the web, a company cannot only offer services as Web Services since its customers or partners will not be able to make use of them unless these services consist of only atomic and totally independent operations. If compound services are offered, the customer needs to know the order of the operations and the relation between operations. A defined orchestration of operations is required.

In addition, the Web Services are quite often not stand-alone but stem from quite complex internal processes and orchestration is strictly required. It is therefore concluded that orchestration is necessary for enabling business with Web Services.

Orchestration is especially important to telecommunications operators (telcos). Across the world, telcos are facing declining revenues from traditional voice and data services and are looking to newer content-based, application-based, multi-media services as a way to boost revenues. Unless telcos are prepared to invest heavily in the content and applications themselves, they will need to partner with content providers and application providers in order to deliver services to users. These partnerships can lead to extended value chains, with a number of businesses taking part. Further, orchestration brings business agility that enables telcos to quickly adapt to customer needs and market conditions.

For example, a simple video-on-demand (VoD) service requires commercial arrangements to be established between the telco, the VoD service provider, the content provider, and the end user. Many of the interactions between these parties can be provided using Web Services in which case there is an immediate requirement for some means with which to tie the overall business process together. This is where Web Services orchestration comes in.

Conclusion

Web Services are at the crossroads. The basic standards have been agreed across the industry. However, for Web Services to bring true business benefit to companies that wish to orchestrate their Web Services with those of their trading partners, a specification for that orchestration must be agreed. This is especially true for telcos wishing to offer high value services involving other partners. Currently, the best prospect for achieving a common specification appears to be with the W3C consortium. Without the inclusion of the proprietary, company driven BPEL4WS specification, however, W3C might find it hard to succeed.

For more details about Web Service Orchestration, please visit the Web page of Eurescom study P1242 at **www.eurescom.de/public/projects/P1200-series/p1242.**

Security mechanisms for Web Services

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Introducing Web Services to systems is in many cases synonymous to exposure of information and data. Systems connected to the Internet are especially vulnerable to new threats from a security viewpoint, where 7x24 availability is expected. This article touches briefly though the most frequently used security mechanisms for Web Services.

Securing databases and registries

When introduction Web Services to existing systems, security should address the effect of exposing systems that were earlier isolated. Many databases and registries either have been or at least have the basic characteristics of such isolated or stand-alone systems.

Securing communications

However, protecting data locally only solves a minor part of the problem. The major challenge that is introduced by the Web Service security requirements is to secure data transport between the different components. Combining mechanisms at different levels of the Web Services protocol stack can help secure data transport (see figure).

HTTP Security (HTTPS)

The combined protocol HTTP/TLS or SSL is often referred to as HTTPS (see figure). SSL was originally developed by Netscape for secure communication on the Internet, and was built into their browsers. SSL version 3 was then adopted by IETF and standardised as the Transport Layer Security (TLS) protocol.

Use of Public Key Infrastructure (PKI) for session key exchange during the handshake phase of TLS has been quite successful in enabling Web commerce in recent years.

TLS also has some known vulnerabilities: it is susceptible to man-in-the-middle attacks and denial-of-service attacks.

SOAP security

SOAP (Simple Object Access Protocol) is designed to pass through firewalls as HTTP. This is disquieting from a security point of view. Today, the only way we can recognise a SOAP message is by parsing XML at the firewall. The SOAP protocol makes no distinction between reads and writes on a method level, making it impossible to filter away potentially dangerous writes. This means that a method either needs to be fully trusted or not trusted at all.

The SOAP specification does not address security issues directly, but allows for them to be implemented as extensions. As an example, the extension SOAP-DSIG defines the syntax and processing rules for digitally signing SOAP messages and validating signatures. Digital signatures in SOAP messages provide integrity and non-repudiation mechanisms.

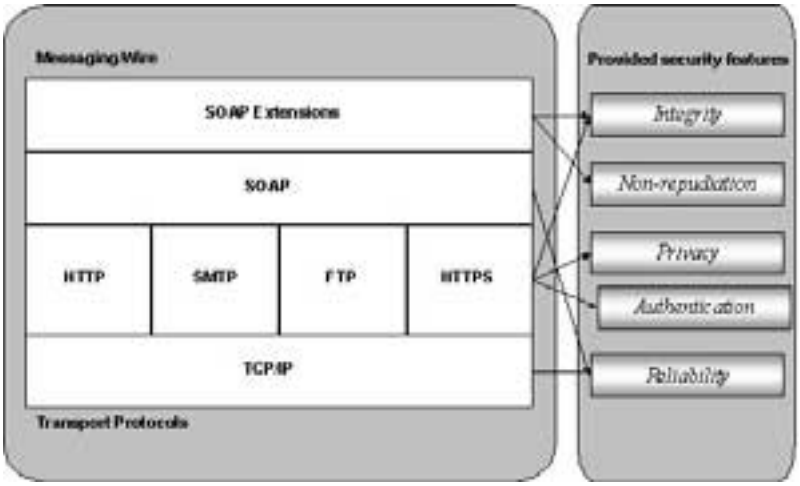

Figure: SOAP and secure data transport

Public Key Infrastructure (PKI) – a transparent giant

PKI key management provides a sophisticated framework for securely exchanging and managing keys. The two main technological features, which a PKI can provide to Web Services, are:

- Encryption of messages: by using the public key of the recipient
- Digital signatures: non-repudiation mechanisms provided by PKI and defined in SOAP standards may provide Web Services applications with legal protection mechanisms

Note that the features provided by PKI address the same basic needs as those that are recognised by the standardisation organisations as being important in a Web Services context.

In Web Services, PKI mainly intervenes at two levels:

- At the SOAP level (non-repudiation, integrity)
- At the HTTPS level (TLS session negotiation, eventually assuring authentication, integrity and privacy)

Conclusion

To summarise, SOAP is a simple protocol, completely independent from platform and programming language. Unfortunately, simplicity comes with a cost. SOAP deliberately dodges firewall filtering by tunnelling over HTTP, and since SOAP calls are so diverse, they are unpractical to filter and audit. So, uncritical use of SOAP will represent a security risk.

Use of HTTPS provides privacy, integrity and authentication mechanisms to secure SOAP communication. On the downside, despite the possibility of TCP session resumption, HTTPS is significantly slower than HTTP run alone.

PKI is a proven concept and already widely adopted in browser-server interaction on the Web. PKI can thus facilitate and enable transport level security in Web Services. Furthermore, because of its propitious scaling properties, PKI seems to be an indispensable component in the future of Web Services.

Further information:
http://www.w3.org/TR/SOAP/
http://www.w3.org/TR/SOAP-dsig/
http://soapclient.com/soapsecurity.html

eircom – Irish connections

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Eircom Ltd. is the premier provider of fixed line telecommunications in the Republic of Ireland. The company has been through many incarnations: government department, state corporation (Telecom Eireann, 1984), public flotation (eircom plc. in 1999), and private company (buy-out by Valentia Telecommunications Ltd. in 2001). Its successful mobile arm, eircell, was sold to Vodafone in 2000. eircom has a state-of-the-art digital core network, thanks to considerable investment over the past two decades. Attention is now focussing on the access network and the need to remove perceived bottlenecks in order to provide increased capacity and advanced services to end customers.

Eircom currently has about 1.6 million fixed-line telephony customers and provides a range of IN and ISDN based services. There is also an extensive leased-line network, an ATM network, and an overlay business IP network. Much of the current core network planning activities centre on rationalising these into a uniform multiservice network.

Countering competition

Fixed-line competition comes mainly from EsatBT, though the downturn in the telecoms market has lessened the competitive threat from other challengers, like, for instance, cable TV companies. Growth in fixed lines has slowed, but traffic is continuing to increase due mainly to dial-up data. The eircom ISP, eircomNet, is the largest Irish provider of residential and business Internet access. An aggressive DSL rollout is now being pursued to capture fixed data traffic and provide vital broadband capacity to SMEs. Wireless LAN field trials are also being undertaken with a view to launching a service in the second half of 2003.

As a fixed-line provider, eircom is acutely aware of the migration of voice traffic to mobile networks. The two major mobile operators are Vodafone and O2 with a much smaller third operator, Meteor. Eircom has stated that it will re-enter the mobile area once a non-compete agreement with Vodafone has lapsed, and options for this are now being examined.

Support services

Eircom has also invested heavily in OSS, as these systems are crucial for the rapid deployment and maintenance of high quality services. The usual difficulties of integrating disparate management systems still remain, but great progress has been made in standardisation and the development of more off-the-shelf products. Providing top-level customer care is a major but necessary task in order to guarantee customer loyalty in an increasingly volatile market.

Consolidation

Eircom has not escaped the effects of the downturn in the telecommunications sector. The company had not acquired any 3G licences and was in a stronger financial position than those who had. Nevertheless, there was an urgent need to review all activities in the light of a falling market. Many new ventures in the multimedia area were curtailed and expansion in the UK halted. Strong expenditure controls (current and capital) were implemented. The takeover by Valentia also triggered a major re-organisation along a wholesale/retail split. Employee numbers are falling, and the target is a reduction to 6,000 by 2006.

Cost reduction is one element in improving the company's performance, but there are limits to how far it can be carried. Revenue growth through new innovative products provides a more future-proof way of guaranteeing future success. The development of new products in turn requires a commitment to innovation and research.

Research activities

Eircom, then Telecom Eireann, joined Eurescom when it was set-up in 1991. This was a recognition that collaborative research offered the best way forward for a small company with limited internal research resources. Most of the work was done through Broadcom Eireann Research, a company jointly owned by Telecom Eireann (45%), Ericsson (45%), and Trinity College Dublin (10%). Broadcom also participated in EU funded programmes on behalf of its shareholders.

Participation in Eurescom projects provided valuable knowledge in key areas that later became mainstream products, for example IN, ATM, and network management. Eircom personnel also participated directly in many of Eurescom's strategic studies.

However, the downturn in the telecommunications sector is affecting all areas in eircom, and research is no exception. A major winding-down of Broadcom at the end of 2001, deprived eircom of its main medium to longer-term research resource. Internally the number of personnel directly engaged in full-time research has fallen from 10 (2001) to 4. The nature of the research has changed to reflect shorter-term requirements, so there is now a greater emphasis on supporting product development. Nevertheless, eircom remains a committed member of Eurescom and will spread participation in projects and studies over as many internal units as possible. This is seen as an important way of disseminating results and creating a wider appreciation of research activities. There is also a new internal initiative to foster innovation and this too should help boost any downstream research activities.

Outlook

The outlook for the telecommunications sector remains uncertain, but eircom intends to maintain its position in the Irish market and to progressively introduce new innovative products. There is also the task of re-entering the mobile market at some stage. Hopefully the telecommunications market will recover and help create a new impetus in research activity. This will also ensure the continued participation by eircom in Eurescom to the mutual benefit of both parties.

Further information about eircom is available at **www.eircom.ie**

"Most important equipment is the couch"

Eurescom workshop on broadband services in the future home presented stunning insights

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The Eurescom Workshop 'Broadband and Wireless Services in the Future Home' in Heidelberg was the first event of its kind that focused on both technological and business aspects of the smart home from a network operator perspective. From 20th to 21st March, around 60 international researchers and developers discussed the latest advances in technologies and service concepts for the networked home. The result: innovative visions, controversial discussions, and stunning insights.

Visions for service platforms

The central element of visions for the networked intelligent home is the service platform, which was covered in a number of presentations. Dr. Josef Noll, senior researcher from Telenor and Eurescom project leader, presented the vision of Eurescom project P1206 for broadband services in the intelligent wireless home. Stressing the need for personalisation, he said: "The user must be provided with a personalised, open and secure service platform whose maintenance is transparent to him or her."

This vision was complemented by a presentation from Hans Werner Bitzer, technical project leader of Deutsche Telekom's TeleHome project, which defines and realises core services and applications based on the open OSGI standard. "Networked homes will be 'intelligent' to the degree to which they are connected to external networks in a secure way and to a service platform that aggregates, offers and delivers trusted services optimised for individual local infrastructures," Mr Bitzer said.

Christian Ollivry from the regulations affairs department of Motorola presented some key elements for broadband service development. He explained that broadband is a priority for the community development because it improves not only communication and entertainment, but also productivity, efficiency, and employment. Despite these advantages, many local communities, he said, were still hesitating to invest in this area. Mr Ollivry's conclusion: "To foster broadband deployment local community governance must be the project driver of the public-private partnership."

Intelligent user friendly services

At the workshop, a number of advanced home services were presented. The Spanish HOGAR project, for example, includes a small laboratory of future home services, where the following services are already been tested and evaluated: remote maintenance and management of white goods (FAGOR), home automation using commercial solutions, Telemedicine and Telecare, e-learning, entertainment and residential services portal (Telefonica I+D). Another example presented at the workshop is the Dutch Xhome project, in which KPN, Lucent, Ericsson, and TNO collaborate. Xhome has demonstrated the feasibility of a platform for secure, personalised multimedia-content exchange by developing applications in the health care sector. In Xhome, patients can better communicate with their friends and family, search and find multimedia information, and get instructions about the treatment, remote diagnosis, and medical advice.

Current technologies and standards

One of the central questions at the workshop was: are the current technologies and standards solving the technical issues? It emerged that home network technologies are quite varied and may overwhelm an unprepared user. To mention only some of them: Ethernet, Wireless Lan (IEEE 802.11), X10 (powerline), Bluetooth, CEBus, Firewire (IEEE1394).In this context, there was widespread agreement that the gateway supporting the home services should not add to the complexity of the transmission technologies. Therefore, the home gateway should be as standardised and open as possible.

Dr. Dimitar Valtchev, CTO of Prosyst software AG and member of OSGI, presented principles and specifications of OSGI, the Open Service Gateway. According to a number of experiences from HOGAR, TeleHome and other projects, OSGI presented a very practical, attractive approach for the realisation of the Smart Home, according to Dr. Valtchev. He said: "OSGI has very interesting key features for the different actors in home networking. It allows dynamic software updates, remote control, remote maintenance, remote diagnostics as well as data exchange. It is secure, identifiable and trusted." MHP (Multimedia Home Platform) is another industry standard that provides for interactive services especially for broadcast streams (e.g. PVR-functionality). MHP is based on open standards and utilises existing DVB specifications.

Integration of home and car

Providing services to the home may be the first priority of stakeholders in the area. But the next step, which must be thought of already now is to ensure the continuity of service between the home and other environments. Taking the example of the car, Myriam Boué from France Telecom said: "The car can be seen as a particular room of the house that sometimes leaves it. Based on this idea France Telecom developed personal services called CH@R services to be accessed from the vehicle to the home, from the home to the vehicle so that the user can always access his or her personal environment".

Provocative views at the panel

Under the title "The Win-Win situation for the user, operator, equipment and service providers" the panel participants discussed the theme of advanced services provision. The central question was: who should start to pave the way for broadband and wireless services to the home and to educate the user? Although most of the technology is already there, no big promoting action has been undertaken yet to promote the broadband and wireless services to the home, the panelists agreed. David Kennedy stated that the responsibility of educating the user lies with the players who will benefit from the home services and networks market. Telcos, who will certainly take the role of the "service aggregator operator" as well as end devices manufacturers, could invest in this area, he said.

This led to another controversial question: is it the role of the operator to subsidise the home service gateways? Before investing in home service platforms, operators should get hints whether there will be a killer application and, if so, which one. Dr. Valtchev believes that services related to health care and elderly people at home could boost the development of home service platforms, whereas Pearse Connolly, Business Director of Zonavi (owned by Canal Digital), thinks that interactive TV content will enter the home quite rapidly. Another question that emerged in the discussion: how much personalisation does the customer need? Per-

sonalisation is a sensitive issue as Anders Spilling from Telenor underlined: "There is a thin red line between useful services and annoying, nagging features".

The final provocative statement by Pearse Connolly brought the participants from the heights of advanced technology down to earth: "When we design applications for our customers, the central and most important equipment we have to take into account is the couch."

The conclusion of the panel discussion was that there is still some work to be done before most of the homes can benefit from open service platforms, which will provide them with advanced broadband services at a reasonable price. As one of the most urgent activities the panel participants identified the homework for the different actors to start accustoming the user to these advanced services.

From the left: Pierre Plaza (Telefónica), Dr. Monira Abu El-Ata (Swisscom), Dr. Dimitar Valtchev (ProSyst Software AG).

The workshop presentations, all of them highly rated by the participants, are now available on CD-ROM. The CD-ROM contains the streaming of oral presentations of the speakers with the synchronised PowerPoint slides as they were presented at the workshop. In addition, the CD-ROM contains all slides in easy-to-read and printable PDF format.

The CD-ROM can be ordered on-line at **www.eurescom.de/public/Events/Wireless-Mar2003/WorkshopAgenda.asp**

Focus on broadband from a European perspective

Interview with Heinz Brüggemann about the Eurescom Summit 2003

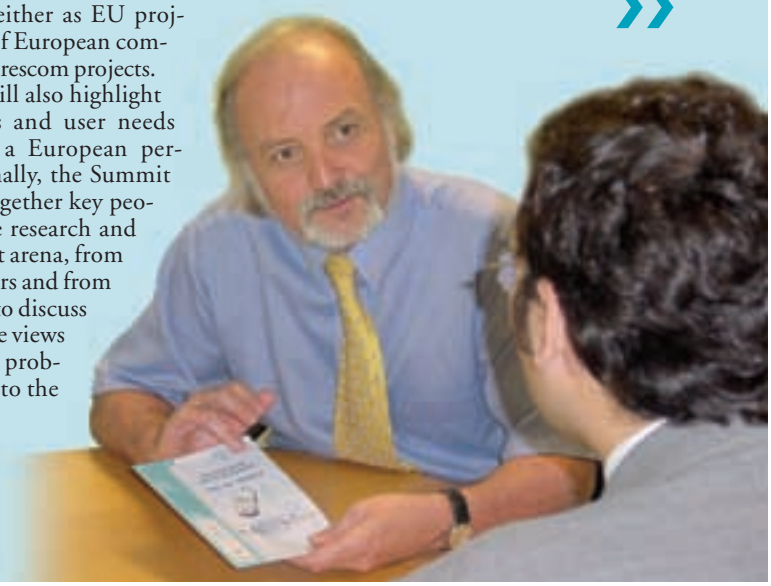
The Eurescom Summit 2003 in Heidelberg, one of this year's most important collaborative R&D events in telecommunication, is casting its shadow before. At the deadline of this issue, the paper selection process for the event in September was just in its final stage – the right time to talk to one of the leading figures behind the scene. Heinz Brüggemann is Programme Manager at Eurescom and chief organiser of the Eurescom Summit 2003. He also had a leading role in the organisation of the first Eurescom Summit in 2001.

Mr Brüggemann, what is the central topic of this year's Eurescom Summit?
When we launched the new concept of an annual major conference in 2001, we had the idea to organise a major overview on state-of-the-art development and research in broadband technologies for the next generations. In one year the main focus should be on the applications and services related aspects while in the following year the focus should change to more network related aspects.

This year, we have the major focus on the evolution of applications and services for broadband technologies. Besides technologies for application and service evolution a major focus should be on user aspects, as we are convinced that user needs have to be satisfied by new services before new business is possible.

The central topic of the event has also been addressed by a number of other telecoms conferences. What distinguishes the Eurescom Summit?
Broadband technologies, in particular related to mobile services, are certainly a key topic in today's telecoms business, and there are a number of conferences related to similar aspects as our Summit. The Eurescom Summit should not be considered as a competing event, but rather as a complement to other established conferences. The Summit places particular emphasis on activities carried out in Europe, either as EU projects, R&D of European companies, or Eurescom projects. The event will also highlight user aspects and user needs more from a European perspective. Finally, the Summit will bring together key people from the research and development arena, from manufacturers and from user groups to discuss and exchange views on common problems related to the evolution of broadband services in Europe.

This is already the third Summit. In which way has the Summit evolved since the first conference in 2001?
Compared to the first event in 2001, which had not yet been established and known to a broad community, we recognise now a considerable evolution of the Summit 2003. The Eurescom Summit has become well known and well recognised as an important event. This is indicated by a number of requests and contacts from major European and non-European organisations. We are very confident that we can offer a world-class event. »



How good was the yield of submitted and selected papers compared to the previous Summits?
Compared to our first event the number of submitted papers has doubled. Furthermore, the quality has considerably increased. To assure an even higher quality level we only accepted 50 per cent of the submitted papers. This tough selection process guarantees that we will have a very good programme. We are also satisfied with the broad spectrum of paper topics, which enables us to design a programme which covers a wide range of different areas.

Based on your knowledge of the papers, what do you think will be the most important topic of the Summit?
The most challenging aspects are dealing with the question, which services are the most interesting ones for the users and what are the business perspectives for those services. We will also have leading-edge presentations on content provision and content protection, aspects that are becoming increasingly important for content providers. A significant number of papers will discuss interoperability and service building aspects of mobile services and between mobile and fixed domains.

Which significance does the exhibition have for the Summit?
There have already been several interesting exhibitions announced, especially from projects that will have paper presentations in addition. This is always very insightful for participants, as they can more easily understand an issue that has been presented at the conference.

What do you expert from the Summit?
I am sure that Summit 2003 will become an important milestone for us. We are looking forward to having leading researchers discuss the cutting-edge topics of telecoms, bringing new insights that will get the telecoms industry back on the growth path. I am convinced that our participants will see a very interesting event and certainly will be satisfied with our Summit 2003.

The interview was conducted by Milon Gupta.

Location Awareness

A comprehensive and user centred approach for Location Based Services

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The Eurescom project P1208 LOCAWA is working on Location Based Services (LBS) with a focus on presentation techniques and usability aspects. By this work LOCAWA aims at increasing the acceptance of LBS at the user community. LOCAWA has developed and implemented a number of prototype services that will be used to test presentation techniques and usability aspects. The ensuing field trial will be done to gain profound experience for the commercial deployment of location aware services.

Selecting realistic scenarios for LBS

P1208 has started by selecting realistic user scenarios in terms of usability and acceptance, combined with an analysis of their technical feasibility. The latter means that the project team has taken into account the various technical constraints that relate to devices, platforms, operating systems, programming languages, protocols, and wireless access technologies. Figure 1 gives an overview of the various technology and usability aspects that were taken into account.

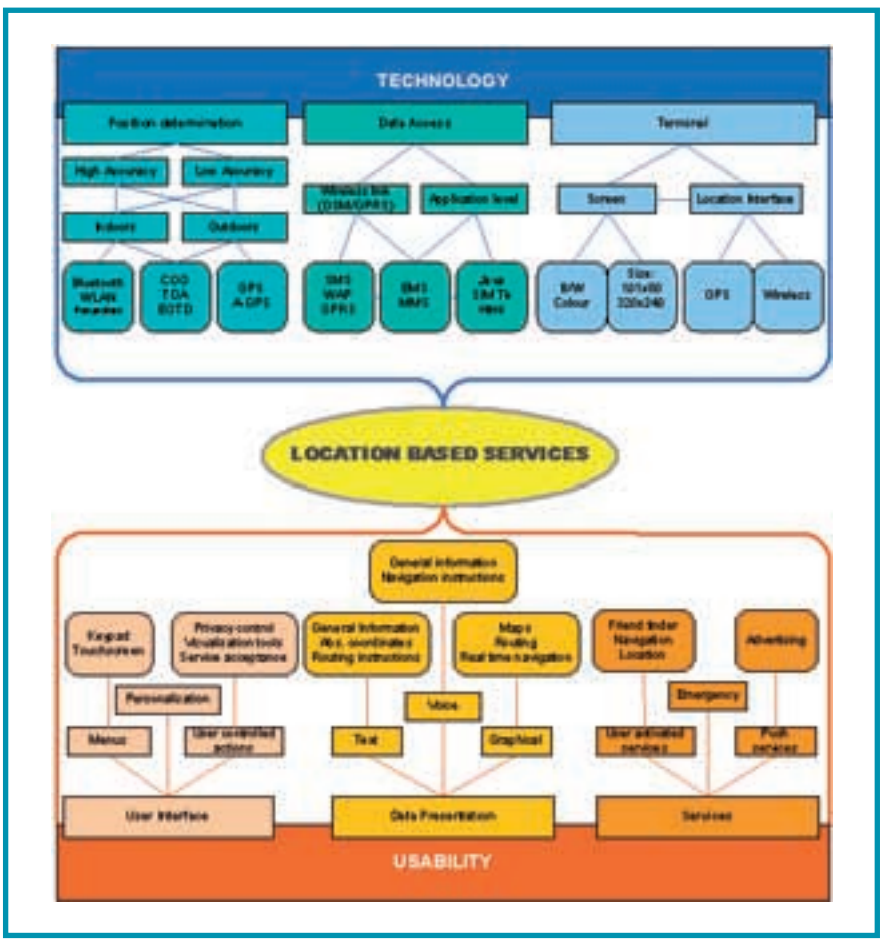

Figure 1: technology and usability aspects of Location Based Services

The work started with a creative brainstorming on LBS and the circumstances in which they can be useful. Six different scenarios were defined, which were grouped according to their target customers – private and business – and according to convergence aspects. These convergence aspects consider the natural combination of private and business lives as well as the mixed usage of both fixed network and mobile network devices.

For each of these six scenarios a number of concrete services, location technologies, supporting technologies, and required terminals were defined. The outcome was a wide list of services that were analysed and evaluated against a number of criteria of which the most important ones were:

- Is the service location dependent?
- Can it improve the usability of an already deployed service?
- Is the implementation of the services technically feasible at present?

From this evaluation process, the following five location based services were identified: Routing, location finder, proximity analysis, people finder, and traffic information.

These five services were merged into a single final scenario in which a user could benefit from using the selected services in real life situations.

Usability requirements

The analysis of usability requirements helped to specify usage cases, storyboards and implementation guidelines. Tasks and context analysis as well as usability measurements from the LOCAWA field trial are part of this. A task analysis has been carried out for each identified LOCAWA service. Considering the limited input capabilities of mobile devices it has become increasingly important that the user can access the service without complicated menu selection or browsing.

A context analysis has also been carried out for each LOCAWA service. In this analysis, different situations for service usage have been defined. For the use of mobile services it is very important whether the user is in a quiet place without distraction, in a noisy environment, or even driving. These situations have strong implications on the user interface and the selected presentation methods.

LOCAWA platform architecture

For implementing the field trial, the complete system architecture was designed (see figure 2). This took into account the goals identified during the scenario conception, in particular for meeting the usability criteria for the selected services. Technical aspects were considered in the sense that the architecture and trials should be as close to reality as possible.

One of the major challenges was to combine the existing technologies to make the architecture convenient for various LBS, considering different presentation ways, end devices, and transport technologies. Another design criterion for the architecture was to enable scalability and to define module interfaces to content providers.

Technical constraints

Unfortunately, there is no single mobile terminal that comprises all necessary features for full LBS capabilities in terms of usability, processing facilities, access technology, operating system, and programming language. The same situation applies for location determing technologies. Currently, there exists no location technology that combines adequate accuracy and low costs in implementation both at network infrastructure and mobile device level. Furthermore, due to current economical uncertainties operators keep investments in network infrastructures as low as possible, not deploying the equipment required for more accurate positioning. Operators will only decide to deploy LBS, if technology standards and business models are well defined and agreed between the major players.

Privacy and roaming

Can LBS be successful before clear standards are defined and roaming is possible? This is a crucial question to which there is no simple answer. LBS can only be fully successful, if standards and roaming issues are well defined and implemented, so that interoperability can be fully achieved. When this stage is reached, surely LBS will reach a peak of efficiency and user acceptance. But in the meantime, however, LBS can only be reasonably successful within a single operator's market. This actual situation is limiting, because no operator is prepared to do large investments before all technologies are defined and mature enough. Current implementations of LBS, no matter how simple they are, show that LBS can be operated successfully. These operators are doing something essential: they are trying to gain the customer's confidence.

Privacy and security are fundamental aspects in LBS. This topic has to be managed both at technical and marketing level. The technical level is closely related to security, but there are also other technical aspects in managing privacy issues, like defining and maintaining the user's personal privacy settings. They determine, when a user allows positioning to take place, or when a service should be active. At marketing level the right operator policy regarding LBS must be chosen, aiming at selecting the right service partners, being able to manage agreements with all parties involved, and finally by informing customers about all relevant factors. Customers need to feel that their privacy is not jeopardised in any way.

Conclusions

LOCAWA has underlined the necessity for finding the right method of service delivery and data presentation as a basis for commercially viable and successful LBS offerings. Different types of presentations should be combined whenever convenient to offer the presentation type most accepted by the user, independent of service type, user context and technical limitations.

Service developers are encouraged to launch trials based on real life scenarios in order to meet real user needs. To meet this goal, users should be involved in the trial development process to provide reliable information for a usability-oriented requirement analysis of the services usages, including separate approaches regarding tasks, contexts and user requirements. There is a necessity to provide filtered and personalised services to avoid an overflow of information towards the user.

You can find more information about P1208 LOCAWA at **www.eurescom.de/public/projects/P1200-series/p1208/**

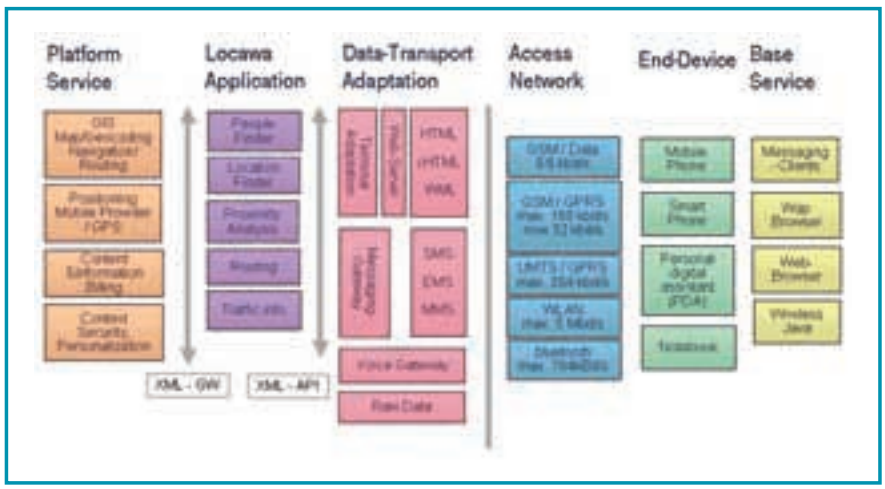

Figure 2: LOCAWA platform architecture

Future access networks – as easy as Ethernet?

Eurescom study EASY explored the opportunities

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Ethernet has proven itself in the corporate Intranets and the local area networks (LAN) as a layer-2 transport technology for IP, which is the widely accepted service platform of the future. Recently, Ethernet made its way into the metropolitan area part of the network, so it is present at the edge of the core network as well. Furthermore, Ethernet is the technology of choice to connect PCs and other end-consumer devices to the network. This makes Ethernet a natural choice for the access network as a layer-2 transport technology.

Ethernet is already widely deployed in the broadband access network in conjunction with DSL and ATM. Eurescom study EASY (P1245) investigated the potential future role of Ethernet in the access network. This included add-on functionality, for example the virtual local area network (VLAN), and its use in conjunction with other emerging technologies such as multi-protocol label switching (MPLS).

The study assessed Ethernet based access network solutions from the incumbent providers' perspective. The main objectives were to:

- Identify the likely services that need to be supported.
- Identify the functionality required from Ethernet access networks.
- Identify the possible impact of Ethernet access networks on the core network.
- Provide a survey of Ethernet based access network solutions proposed.
- Provide a basic economic analysis to assess the benefits of Ethernet in the access network.

The study covered the following three main areas:

- Functionality required from Ethernet access networks and the likely impact on core networks.
- Different Ethernet based access network solutions, with a special focus on IEEE's 'Ethernet in the First Mile' (EFM) model (figure 1).
- Economic analysis and assessment of the implementation of Ethernet-based access networks.

Functionality and challenges

Ethernet is quickly evolving in order to provide the features required in a carrier environment. However, there is still a considerable way to go until Ethernet is carrier-grade, meaning suitable for building Ethernet based access networks and sufficiently standardised for mass-market deployment. Critical additional features, which are required, include limiting the multi-access nature of Ethernet, ensuring scalability, supporting quality of service (QoS) and redundancy. Promising solutions for these features have been put forward at different standardisation fora, but for the time being no agreement has been reached yet, and they remain under discussion.

One of the major design considerations is the control of layer-2 visibility between individual subscribers. This separation means that customers can reach each other only through a layer-3 device, even if they are on the same Ethernet segment. The currently available solution for separation is based on the VLAN concept and additional filtering of layer-2 frames. The most promising and future proof concept, the usage of MPLS, is currently being investigated at the Internet Engineering Task Force (IETF). Many vendors offer alternative proprietary techniques for customer separation, but their standardisation and interoperation is questionable.

Regarding scalability the major problem is the limited VLAN tag space. The IEEE 802.1Q standard allows a maximum of 4096 VLANs, which is insufficient for a large service provider. To overcome the VLAN tag space problem, some manufacturers currently supply equipment that increases the available VLAN tag space through various 'tag-stacking' schemes.

QoS has always been a central issue in service provider networks. For Ethernet, however, this has never been a real concern and traditionally Ethernet has not been associated with any specific QoS mechanisms. The IEEE 802.1p standard defines a methodology for introducing traffic class priorities at layer-2, based on existing priority fields or on the IEEE 802.1Q VLAN standard. However, the interoperation of IEEE 802.1p based QoS control and IP based QoS control requires further study.

Mesh topology can be chosen in different parts of the access network in order to improve reliability. In bridged layer-2 networks, a loop-free environment should be ensured using the Spanning-Tree Protocol (STP). The STP standard was designed for situations in which recovering connectivity after an outage within a minute was considered to be adequate. However, many of today's telecommunication services require that an alternative path is provided in a much shorter time. Several proposals (e.g. IEEE 802.1s, 802.1w, 802.1ad, 802.17, etc.) have been put forward at standardisation bodies aiming to overcome this limitation, but a common framework is still missing.

Ethernet based networks also imply challenges regarding operations and maintenance (OAM). SNMP (Simple Network Management Protocol) based management, management traffic isolation, and topology change restriction are the key elements of successful OAM. In addition, there are some unique problems in Ethernet based networks, which should be addressed during operation as well. These include, for example, the impact of unidirectional links or slow connectivity for user ports.

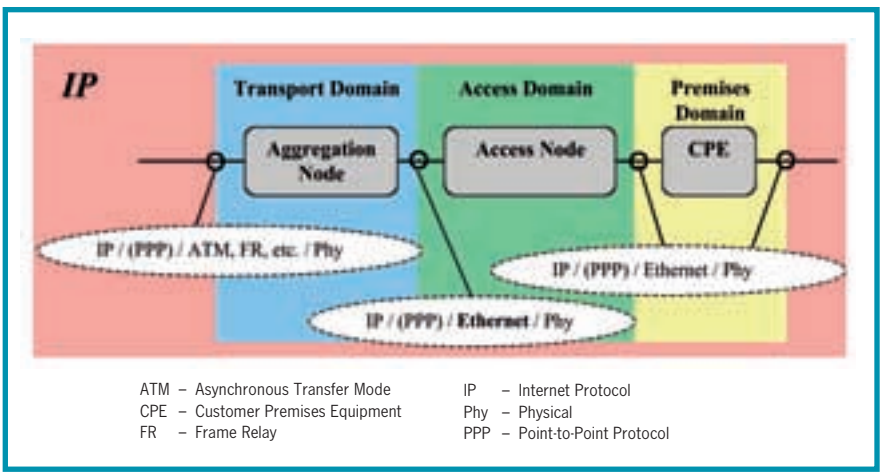
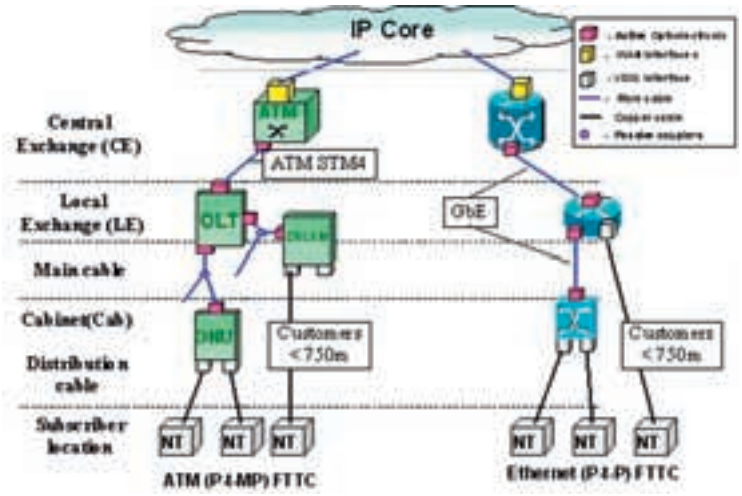


Figure 1: IEEE EFM Architecture



ATM	– Asynchronous Transfer Mode	OLT	– Optical Line Terminal
DSLAM	– Digital Subscriber Line Access Multiplexer	ONU	– Optical Network Unit
		P-t-MP	– Point-to-Multipoint
FTTC	– Fibre to the Cabinet	P-t-P	– Point-to-Point
GbE	– Gigabit Ethernet	STM	– Synchronous Transfer Mode
IP	– Internet Protocol	VDSL	– Very high bit rate Digital Subscriber Line
NT	– Network Termination	WAN	– Wide Area Network

Figure 2: Comparison of ATM and Ethernet based FTTC architectures

Ethernet in the First Mile (EFM)

From the architecture point of view, EFM does not have any new protocol aspect. EFM simply describes the methodology and the functional aspects to adapt Ethernet to different physical media. Architectural aspects are not addressed.

IEEE, DSL Forum, and FS-VDSL/ITU-T (Full Service-Very-high-bit-rate Digital Subscriber Line) describe reference architectures for DSL and PON (Passive Optical Network). These approaches have in common that they all look at EFM as a stand-alone solution and do not give any guidance regarding how to evolve from a legacy access network to an EFM scenario. The P1245 study has investigated this issue and developed a likely evolution scenario based on a gradual, phased approach.

The study has also considered, whether the Customer Premises Equipment (CPE) functionality can be simplified the way EFM describes it, and found that the EFM approach looks feasible.

The study concluded that the deployment of a pure Ethernet based access network for the mass market seems only reasonable in a greenfield scenario.

The key concepts, which contributed to this conclusion, are:

- The issues and complications involved in migrating an existing ATM based access network for the mass market to a pure Ethernet based access network.
- The fact that at present operators can offer carrier grade Ethernet services through DSL.

On the other hand, we expect EFM to play a significant role in building LANs in a metropolitan area network to provide LAN interconnection services for business customers, but this can be a separate, dedicated solution.

Techno-economic analysis

The investment levels for point-to-point Ethernet and ATM-based point-to-multipoint Fibre To The Cabinet (FTTC) architectures (Figure 2), serving both business and residential customers, are in general in the same order. The total investments for point-to-point and point-to-multipoint Ethernet compared to the point-to-multipoint ATM Fibre To The Home/Office (FTTH/O) architectures, serving both business and residential market segments, are in general in the same order, as well.

In the case of ATM PON (APON), the PON interfaces are slightly less expensive compared to Ethernet PON, but the CPE terminations are more costly.

In summary, Ethernet based access networks do not alter the economic conclusions that

- FTTC is only viable in dense urban and urban areas and
- FTTH/O is only viable in dense urban areas.

Further information about the EASY study can be found at **www.eurescom.de/public/projects/P1200-series/p1245/**

Open document standards

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One of the earliest applications for computers was simple document editing, storage and printing. Soon the capability to easily create documents, process them and manage the multitude of different forms a document could have, grew into a nightmare for any desktop application user. The information technology industry continues to offer a large number of different solutions and formats to capture information. Is there light at the end of the tunnel and hope for a more standardised way to capture, process and store information?

A document is something that can be used to supply evidence or information. In other words, a document is a writing that contains information. That is probably why we call computers also information systems in the wider sense. And the flexibility and programmability of computers opened the door to the numerous different ways to process information and thus capture it in documents.

A bit of history

As early as in the late 1960's information systems' specialists started to introduce control codes into electronic manuscripts that caused a document to be formatted in a particular way. In 1969, IBM started an integrated law office information system, which led to the invention of the Generalized Markup Language (GML) as a means of allowing the text editing, formatting, and information retrieval subsystems to share documents. In the 1980's and after a rather long standardisation process the Standard Generalized Markup Language (SGML) was published by ISO in 1986 (ISO 8879:1986).

SGML is a method for creating interchangeable, structured documents allowing to assemble a single document from many sources (such as word processor files, database queries, graphics, video clips, etc.) and define a document structure using a special grammar called a Document Type Definition (DTD). Furthermore it allowed adding markup to show the structural units

in a document and validating that the document follows the structure that is defined in the DTD.

Although SGML was the method of choice for large documents and document assemblies in the scientific world it never really found wide acceptance in the mass market. This market was soon dominated by software companies that offered proprietary but easy to use solutions like Microsoft Office applications and Adobe PDF (Portable Document Format).

The role of the World Wide Web

The Hyper Text Markup Language (HTML), a simple and static derivative of SGML, can be seen as one of the main enablers of the Internet in the early 1990's. It was soon recognised that the static nature of HTML was by far not enough to describe documents and their structure that had to be presented on paper or on screens of different sizes and resolutions. Although conceived in the 1970's, SGML was good enough to give birth to a subset called the Extensible Markup Language (XML), published as a W3C Recommendation in 1998.

Both SGML and XML are 'meta' markup languages, i.e. languages by which one can define a concrete markup language. In the case of electronic documents, this is a language for the definition of the structure of documents.

Requirements

One can very easily formulate requirements for an open electronic document standard for simple text documents:

- Suitable format for transmission over the Internet
- Capabilities for automatic archiving of documents
- Long-term readability of the format
- Capabilities for easy information retrieval
- Capabilities for document integrity and traceability of access
- Capabilities to observe different security and privacy policies
- Independence of the text-editing platform
- Safe format (i.e. not offering a platform of its own for the spread of viruses)

Taking into account specific requirements of certain domains, like government, electronic business, justice, the list of requirements grows out of scope of this tutorial.

With XML the way to an open standard for widely applicable and acceptable electronic document exchange seems for the first time a reachable target. Obviously there is a high demand for such a standard as can be deduced by the increasing number of electronic business transactions between:

- private individuals
- citizens and government
- administrations
- commercial enterprises and
- commercial enterprises and their clients
- and essentially any type of legal entity

Applications of XML

Since XML was published by the W3C in 1998 a very large number of initiatives took the opportunity to standardise on the way different domains which manage information. In most cases in the past, the domain specific knowledge and information and its representation required a proprietary way of managing this information. This tutorial cannot possibly list all initiatives. Only some applications and initiatives are briefly introduced below.

In computer science and technology the DocBook appears to be a widespread and well-accepted DTD and is particularly well suited for books and technical papers in this domain. Currently the DocBook DTD is maintained by the DocBook Technical Committee of the OASIS consortium.

The Open Office XML Format technical committee was established with the purpose to create an open, XML-based file format specification for office applications meeting requirements suitable for office documents containing text, spreadsheets, charts, and graphical documents.

The UK's e-Government Interoperability Framework (e-GIF) sets out the government's technical policies and standards for achieving interoperability and information systems coherence across the public sector. One of the key policy decisions in the UK 'e-GIF' program is identified as the adoption of XML as the primary standard for data integration and presentation on all public sector systems.

VoiceXML (Voice eXtensible Markup Language) is a standard for making Internet content and information accessible via voice and phone. VoiceXML is an example of non text-based information that can be structured with XML. Voice applications that benefit from VoiceXML are automated speech recognition systems, text-to-speech applications, and others.

The OASIS consortium, a global not-for-profit organisation, hosts on its Web site a very large list of applications and initiatives based on XML (http://xml.coverpages.org/xmlApplications.html).

Conclusion

Information technology is about to give the information society the right capabilities for a free and unimpeded exchange of electronic documents. The technology vehicle to provide these capabilities is the Extensible Markup Language (XML), which originates in concepts of the late 1960's. It is one more example of the value of standardisation for the information society.

You can find more information on the OASIS consortium at
www.oasis-open.org

Eurescom's way ahead

General Assembly discussed new approach to collaborative projects

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This year's annual General Assembly meeting took place on 14 May at the Eurescom premises in Heidelberg. One of the main items, besides approving the accounts for the fiscal year 2002, was paving the way for new businesses.

A changed project landscape

As part of the new business model, Eurescom has been diversifying its business and offers its projects and programme management services also to third parties. The future Eurescom project landscape will therefore consist of three parts clearly separated from each other:

- A Eurescom Study Programme
- A Eurescom Project Programme
- A Third Party Programme

Fast results through studies

Studies are an efficient and effective tool to raise topics for discussion and perform initial strategic research on them. The reason is that they are focused, can be set-up at short notice and are short in duration. The results are available after only a few months. Studies have traditionally looked into new technologies and their potential applications in the wider area of telecommunications. The General Assembly suggested to enlarge their scope to also encompass techno-economic issues. In the techno-economic field collaborative studies can be successful means for lowering barriers for the take-up of existing and/or new services, and for providing decision support to choose the right technical solutions developed and brought to the market by manufacturers as examples of what they would like to see addressed. The GA also stressed the importance of an early forecast of disruptive events and technologies and the assessment of their impacts on telecommunication businesses.

Collaborative projects in a changing environment

Eurescom projects are increasingly competing with other collaborative programmes. Since the launch of the 6th Framework Programme of the European Union in November 2002, companies are targeting much of their human resources on the preparation of proposals for this programme. To avoid conflicts of interest and overlaps, the GA suggested to target Eurescom projects more on the systems view and on boundary issues where a collaboration within operators is deemed necessary to ensure a smooth end-to-end provision of services at quality standards that European operators are known for.

Pro-active role towards FP6

Eurescom has taken a pro-active role towards the EU 6th Framework Programme since the very beginning. In the early phases of FP6 Eurescom concentrated on the role as a broker of ideas. This led to several submissions of Expressions of Interests.

Following the first call for proposals Eurescom has acted as a locator of participants exploring the opportunities to partners that sought our assistance, and as facilitator of concrete initiatives.

At submission stage Eurescom has been acting as co-ordinator of several proposals, IPs as well as STREPS and SSAs, and as consortium partner with particular responsibility for administrative management and dissemination activities. The General Assembly took note of the energetic approach that Eurescom and telcos in general have taken for the 1st Call. The situation at the end of the 5th Framework Programme, when only 10 percent of the resources went to the 12 most active telcos compared to 25 percent to 12 most active suppliers and 16 percent to academia, was not deemed acceptable by the GA, considering the importance of the operators in the industry sector.

CELTIC – a new collaborative telecoms initiative

To overcome the societal, economical and technical challenges and to allow Europe to keep its position in the competitive telecommunications industry, a new European initiative in support of R&D in telecommunications is being launched. Partners are industry, academia and public authorities. The initiative is called CELTIC (Co-operation for sustained European Leadership in Telecommunications). The General Assembly welcomed its launch and the support that telcos have given to it. The General Assembly asked Eurescom to continue its support to the initiative with the aim of having it accepted as a EUREKA cluster project in October 2003. In this case, first projects could be launched in the beginning of 2004. Eurescom is providing the secretariat for CELTIC in its set-up phase. Further information on CELTIC can be found in this issue of *Eurescom mess@ge* under 'European issues'.

A new approach to collaborative projects

In this changed project landscape with new programmes and funding possibilities, the General Assembly honoured the idea of jointly identifying the issues to be solved in a collaborative way. The target is to have a maximum efficiency while optimising the funding. The General Assembly expressed the view that Eurescom offers the best mechanism to achieve this target.

New Eurescom projects

The Eurescom work programme 2003 is growing. Four new projects and one new study started between March and May. More studies will have been kicked off by end of June.

GENIE – GMPLS and MPLS in Enhanced IP Networks (P1305)

Multi-Protocol Label Switching (MPLS) is one of the most successful technologies of the last couple of years. Most carriers have implemented MPLS in their IP backbone networks by now, and it is very likely – if not certain – that MPLS in combination with Traffic Engineering (TE) will become the next generation routing model for IP networks. However, the MPLS evolution path is still far from completion and new opportunities and challenges lie ahead for network carriers. One of these challenging future tasks is the implementation of an IP based unified control plane for the optical backbone networks based on an appropriate extension of MPLS, the so-called 'Generalised Multi-Protocol Label Switching' (GMPLS) technology. This optical control plane is intended to provide operators with simpler, faster and more flexible provisioning of optical facilities and resources in optical networks.

In the meantime, the MPLS network concept evolves in other directions also to embrace other developments, such as mobile IP, IPv6 and new access technologies.

The project will develop guidelines for carriers, who are in the process of interconnecting their MPLS networks, upgrading their MPLS network infrastructure, or introducing GMPLS. The results will help decision-makers with the comparison of different technology trends and implementations, as well as with statements regarding the opportunities and disadvantages that migrating to GMPLS presents.
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BIZCOOL – Business to business interaction with Web Services and ebXML (P1306)

As the Internet has increasingly become an international marketplace, accepted standards for the exchange of business-related information are needed. The ebXML standard is the most promising candidate to be used in the B2B business. ebXML will, in the first step, allow businesses to describe themselves and to find information about potential business partners in an automated manner. In a second step this can be extended to achieving agreements about business transactions. The project will focus on small and medium sized enterprises (SME). For SMEs it is crucial not only to find the right partners for doing business, but also to integrate their IT-Systems in building up an integration platform and in aligning their business processes.

The main goal of this project is to examine XML-based business process frameworks such as ebXML. Prototype services will be defined and implemented in a trial. Furthermore, B2B integration scenarios and relevant business models will be assessed.
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MultiDeli – Multi Devices Service Delivery (P1307)

The basic idea behind MultiDeli is the conviction that the increasing complexity and multitude of new services will not be manageable anymore with one single terminal. Even if terminals are becoming more sophisticated and complex there will always be different requirements for terminals, e.g. a small sized terminal for mobile use, or a home based device with a large screen or with high quality audio, and so on. A one-fits-all terminal would, most likely not even be in the interest of a user, because its operation may become too complicate, or simply, because they may be inconvenient in particular cases. A more acceptable approach would be that a user could change from one terminal to a better-suited one without even to think about how this has to be done and within a running session.

MultDeli builds on the successful Eurescom project 'DUS – Device Unified Services' (P1101) that has developed some convincing solutions to integrate a variety of terminals into a single service environment and to allow automatic and smooth transition from one to the other terminal type. MultiDeli will look into some still open issues, like the auto detection of devices, content adaptation to different terminal types, audio/ video session management, PDA platform adaptation, and SIP protocol inclusion. Related to user aspects the project will also look into user access configuration and profiling issues.
For more information contact:
Heinz Brüggemann, brueggemann@eurescom.de

FRAPESA – Framework for personalisation of services and applications in next generation mobile services (P1308)

The aim of FRAPESA is to produce a framework for personalization of services and applications in next generation information services. This framework will take into account the provision of precise and situation-based information and its easy and intuitive access while considering the personal wishes of the service users.

The project will generate new knowledge about technological models and business models as well as about user aspects, like personalisation and privacy. The roles of actors and processes in the business model of their interaction will be analysed to improve their collaboration.

In addition, the personalisation process and the content preparation process will be considered. This aims at exploring mechanisms, which give the most value to users while protecting their privacy and minimising the risk of abuse.
For more information contact:
Valérie Blavette, blavette@eurescom.de

Risk management in bandwidth and wholesale services and the issue of bandwidth pricing (P1342)

Telecommunication companies face a whole variety of risks. Developing methodologies to address these risks is of fundamental importance. Because of the wide ranging risks the study chose to start by focusing on the management of risks associated with bandwidth and wholesale services, and by looking at the issue of bandwidth pricing. Nevertheless, the study will include a general overview of the different sources of risk and a scenario analysis.

The study aims at establishing the state-of-the-art on the subject of risk management in general, and at focusing on market risk in core network resources investments in particular. The study will examine risk measurement methodologies based on the use of financial tools such as the Value-at-Risk, for example. One of the main results of the study will be a solid framework to address the type of risks telecom actors face and to determine how they can be quantified and hedged. This framework can be considered as the very first step towards a standardisation of risk measures. The study also plans to make proposals for further studies or a full-fledged project regarding risk management in telecommunications.
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European leadership in telecoms

The CELTIC Initiative

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How will Europe maintain global leadership in telecoms? Leading network operators, manufacturers, R&D organisations, and public institutions from all over Europe have found the answer: through increased co-operation. In January, 80 of their representatives met at Alcatel headquarters in Paris to plan a new, industry-driven European initiative for collaborative R&D in telecommunications. The name of this initiative is CELTIC, which stands for 'Co-operation for sustained European Leadership in Telecommunications'. CELTIC is a proposal for a new EUREKA R&D programme dedicated to communication techniques, systems and services.

The need for an industry-driven R&D programme

Telecommunications is a vital driving force for increased productivity and economic growth. The sector is of fundamental importance to the full development of the knowledge-based society. To make the vision of a knowledge based society in Europe real, the European telecoms industry has to implement technological innovations and completely new, service-driven business models within the next few years. The amount of work the industry must do to achieve this is huge. If they fail, the negative economic impact could be severe – so for Europe, the stakes are high.

To succeed, the relevant European players in industry and academia need to have significant R&D programmes. FP6 is not enough! It is particularly important to focus on specific applied research if the industry is to be able to develop and implement the necessary technology. This is vital if Europe is to keep the technological and economic leadership established through developments like GSM.

The current downturn of the telecommunications business makes it very difficult to maintain R&D, especially applied research, at the level required. Today, the main objective of the European telecommunications industry is to maintain European competitiveness in telecommunications beyond the present business crisis. We must invest in research and development so that European companies will be well placed when the economic situation improves. If we do so, the European telecommunications sector will be in a reasonable position to respond to the economic upturn. If we don't, obviously, we will fall behind.

How to keep European telecoms competitive

A new pan-European initiative in support of R&D in telecommunications must be launched, involving industry, academia and the public authorities. With the CELTIC Initiative, the major telecoms players in Europe have taken an important step towards a new pan-European R&D programme, which will go some of the way towards maintaining European competitiveness in telecommunications, as well as ensuring European leadership in the digital society.

CELTIC is unique in that it will concentrate on a comprehensive system and services solution approach, which is a unique requirement of the telecommunications sector. If the telecommunications sector is not supported and successful in getting this system view correct from the start, the potential for advanced networks and services, to benefit society both economically and socially, will be much reduced.

CELTIC is proposed as a EUREKA 'cluster project'. Europe has proven that it can run major collaborative programmes leading to global leadership positions in the ICT area. The outstanding example of this approach in Europe is the development of the GSM standards and equipment. As a EUREKA programme, CELTIC would complement existing EUREKA programmes, the framework programmes of the European Commission, and the various national R&D programmes.

The added value of CELTIC

The unique role and the added value of CELTIC can be identified in the development of pre-competitive comprehensive 'integrated communication system solutions', including platforms and test vehicles. This concept will be at the core of a CELTIC Pan-European Laboratory, which will enable the trial and evaluation of service concepts, technologies, and system solutions.

The CELTIC programme will encompass pre-development and experimentation of broadband and multimedia services, applications and equipment, including their control, operation, administration and management. The programme should bring the necessary support to the European telecommunications playground during the coming years, so that it successfully achieves the needed transition from an infrastructure and connection driven industry (at large today), to a services and applications driven industry. The objective is to design and perform experiments on integrated system solutions that complement the traditional segmented technology trial approach.

CELTIC intends to deliver results that, after further specific development, will be directly transferable into products, services and applications that are in line with short-medium term priorities. In doing this, CELTIC is highly complementary to the medium to long-term approach currently addressed by the 6th Framework Programme for R&D of the European Commission.

The CELTIC time frame

The time frame planned for the CELTIC Initiative is five years. The budget required should be in the order of to €1 billion per year, comprising of an equal mix of public funding and private investment.

The objective is to have the first projects starting early 2004. A budget of € 400 million, i.e. about € 200 million of private investment and € 200 million of public funding, would be required in 2004 to be in line with this overall requirement. The founding members of the CELTIC Initiative are currently working with the public authorities of EUREKA countries to define an agreeable budget to start the CELTIC programme by end of 2003. In this effort they are supported by a number of other potential participants in future CELTIC projects.

CELTIC and Eurescom

Many Eurescom members are already active within the CELTIC Initiative, and more are expected to participate in the near future. On behalf of these members, Eurescom is providing support for the CELTIC office, and we hope that this will become a formal arrangement once CELTIC is formally launched as a new EUREKA programme. CELTIC will seek EUREKA approval in October 2003.

Further information about CELTIC

The CELTIC initiative recently produced the 'Purple Book', which is the second official document of the CELTIC Initiative describing the technical content of the programme. This Purple Book has been compiled from contributions from a large number of technical experts who have worked together to define the priorities and outline a roadmap for the evolution of communication technologies for Europe. As many new contributions and project ideas will be gathered during the summer of 2003, the goal now is to release a second version of the CELTIC Purple Book in September 2003.

More information related to the CELTIC Initiative may be found at **www.celtic-initiative.org**

new project results

STUDIES

P1147 DIRECT - The potential of peer-to-peer interaction
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P1241 Cooltown-like architecture and telecoms networks
Deliverable 1 · Cooltown-like architecture and telecoms networks · Eurescom Study Programme confidential

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Deliverable 1 · ebXML-opportunities for telcos in the SME market · Eurescom Study Programme confidential

P1243 Perspectives and potential of the ebXML-standard for small- and medium-sized enterprises (SMEs)
Deliverable 2 · New e-business opportunities for SMEs · Eurescom Study Programme confidential

P1243 Perspectives and potential of the ebXML-standard for small- and medium-sized enterprises (SMEs)
Technical Information 1 · Cost-benefit analysis: The main cost drivers and benefits of implementing ebXML in SMEs · Eurescom Study Programme confidential

P1245 Ethernet Based Access Networks (EASY)
Deliverable 1 · Ethernet Based Access Networks · Eurescom Study Programme confidential

P1245 Ethernet Based Access Networks (EASY)
Deliverable 2 · Ethernet Based Access Networks Presentation · Eurescom Study Programme confidential

APPLICATIONS AND SERVICES

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Technical Information 9 · FSAN-Radio Integration Aspects · For full publication

P1015 FREEHANDS – Fibre and Radio Enhanced IntEgration in Heterogeneous Access Networks for Delivery of broadband Services
Technical Information 10 · Management and QoS issues in multi-technology access networks · Eurescom confidential

P1015 FREEHANDS – Fibre and Radio Enhanced IntEgration in Heterogeneous Access Networks for Delivery of broadband Services
Technical Information 11 · Laboratory Tests about Interoperability between FSAN and Radio Point-to-MultiPoint Systems · Eurescom confidential

P1015 FREEHANDS – Fibre and Radio Enhanced IntEgration in Heterogeneous Access Networks for Delivery of broadband Services
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Submarines in your body

How the combination of nano-technology and mobile communications will revolutionise medicine

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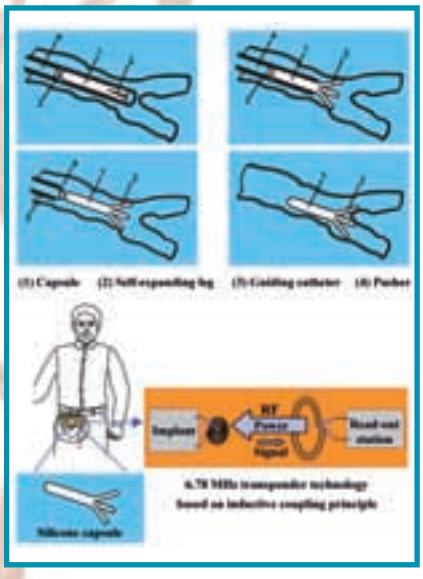
Already in 1959, the legendary physicist and pioneer of nano-technology Richard P. Feynman suggested in a visionary speech that "it would be interesting in surgery if you could swallow the surgeon". What then sounded like a fantastic idea from a science-fiction novel is now close to becoming a reality.

The idea of a nano-machine travelling through a patient's vessels, checking and even repairing body functions, originated from Feynman's student Albert R. Hibbs. Initially, it was only taken serious by Hollywood producers.

Fantastic voyage

In the 1966 movie "Fantastic Voyage", shrunken doctors in a micro-size submarine travelled through the bloodstream of a dying scientist. It was only since the 1980s that miniaturisation at nano scales became feasible. A nanometre (nm) is a billionth of a metre – 100,000 times smaller than a hair's diameter. Just to grasp how incredibly small this is, imagine a tennis ball compared to the Earth and you roughly have the difference between a nanometre and a metre. In the 1980s, researchers focused on ever smaller semiconductors and new materials at molecular levels. Just four years ago, in 1999, scientists at Cornell University managed to manufacture nanochoppers of metal and silicone, which move thanks to tiny propellers, driven by the enzyme ATPase.

In 2000, German micromechanics firm microTEC designed a tiny submarine, 0,5 mm in diameter and 4 mm in length, for cruising through arteries. It is equipped with sensors for monitoring body functions, but could also deliver a cargo of drugs to an affected area. However, the company expected that it would take until 2006 until the nano-submarine is technically mature to be used on humans. Technical problems to be overcome are the size of available microchips and the danger of damaging the walls of the arteries with the miniature submarine's propellers. Another item is the precise steering of the nano-vehicle. Thus, it will take some more time, until the "fantastic voyage" of a nano-submarine can start – without shrunken doctors, of course.

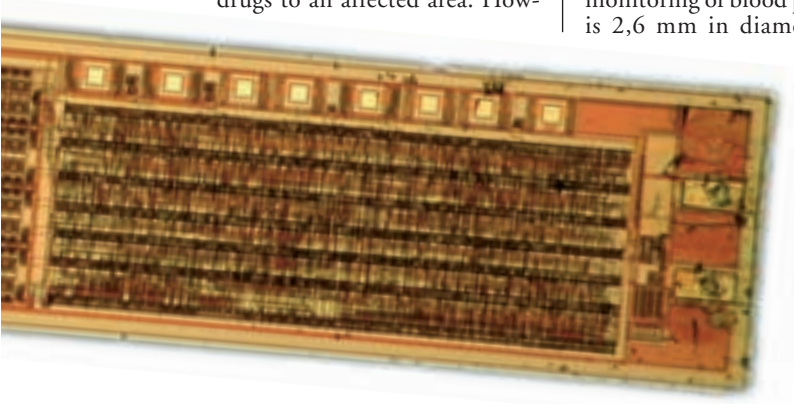


Source: U. Schnakenberg, Th. Schmitz-Rode: Intravascular pressure monitoring system, Aachen 2002

However, mechanical sensors on micro-level, which can be implanted in a patient's body for measuring body functions, are already available.

Monitoring blood pressure

In February, a research team from Aachen University of Technology presented an implantable silicone capsule for wireless monitoring of blood pressure. The capsule is 2,6 mm in diameter and 20 mm in length, relatively big from a nano point of view, but small enough to be fixed with a guiding catheter in the branching of an artery. The capsule contains a pressure sensor chip and an antenna. It sends the blood pressure data as modulated signals over a distance of 3 cm with a data rate of 12.3 kbits/s to an external read-out station using the Radio Frequency Identification (RFID) technology. The implant receives power from the read-out station through inductive coupling of a high-frequency field using 6.78 MHz transponder technology.



Gateway in the belt buckle

From there it is only a small step to a useful telemedicine application. This is where mobile telecommunications technology enters the stage. It would be relatively simple to merge the read-out station with a mobile communications device. The combined device would serve as a personal health gateway and could be, for instance, integrated in the patient's belt buckle. What sounds like playful gadgetry for geeks could become a life-saver for everyone. Imagine a patient with high blood pressure and an increased risk of a heart attack. As soon as blood pressure would exceed a critical mark, the patient's doctor would be notified by SMS and could take immediate action.

Visions for nano-telemedicine

In the next evolutionary step, the implant would not be just a passive sensor, but an active medical vehicle which could take immediate action in an emergency case, for instance by emitting a drug to counter a heart attack. This action could be triggered off remotely by an electronic doctor, who could react much faster than a real doctor on the basis of the patient's stored health data. Smart nano-implants would not have to be limited to blood-pressure, but could cover almost any critical body function which requires monitoring. Though this might still sound like science-fiction fantasies, it will be technically feasible before the end of the decade. So, we should better begin discussing the social implications of nano-telemedicine, before the technology is there and society is not prepared to use it because of unresolved issues, like privacy and security of health data.

Hibbs' and Feynman's vision is becoming reality. The connected miniature surgeon will be there soon, and you better start getting accustomed to the thought of a smart nano-device in your body.

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