Engineering of e-Business Applications & Infrastructure and Applications for the Mobile Internet

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1. Introduction

In this paper, we report on the results of two workshops. We first discuss the workshop on "Engineering of e-Business applications". Then we focus on the workshop on "Infrastructure and Applications for the Mobile Internet".

2. Engineering of e-Business Applications

Software development is expensive and time consuming. Software projects often run out of time and over budget. While this holds for every kind of application it becomes even more severe for e-business applications. Higher time-to-market pressure and application requirements (e.g. security, portability) make the engineering process a big challenge for developers and project managers. Successful e-Business applications must base on a variety of standards while still being innovative. The management of risks is difficult due to immature technologies. Technology changes require continuous adaptation of software that is often delayed because the required knowledge and skills is not available.

New approaches like global distribution leading to the creation of virtual corporations could provide solutions but cannot applied without a deep understanding of the engineering process itself.

The 1st Workshop on Engineering of e-Business applications brought together researchers from different areas of e-business application development. The main purpose was to collect useful characterizations of this kind of application, its engineering processes, current shortcomings, and requirements. Based on this we had a look on future directions worth for further investigation.

2.1. Overview on the papers

The workshop had a total of 15 submissions and accepted 6 full papers. Two submissions were accepted as short papers.

The following papers were accepted for publishing and presented in the workshop:

- **Service-oriented modeling for e-business applications components**
  Giacomo Piccinelli, Mathias Salle, and Christian Zirpins propose a service-oriented componentization of e-business systems as a way to close the gap with the business models they support. They present a process-based technique adopted for component modeling that is based on an EIB compliant infrastructure.

- **Using Milos For Dependency Management In UML-based SE-Processes**
  Martin Schaaf, Fawsy Bendeck, and Philip Nour show that the integration of two flexible technologies like MILOS and UML together with the ability for appropriate tailoring is especially useful in highly dynamic domains like e-Business engineering. The presented approach extends the change management capabilities of MILOS by incorporating relevant change information from UML documents.

- **Attendance or providing added value: A study of the structure of cooperative e-business applications**
  Lech Krzanik and Jari T. Karvonen discuss conditions for the structure of cooperative e-business applications that provide added value. They introduce the concept of a virtual model-based cooperative engineering support and report the implementation supporting product development.
2.2. Discussions & Results

The workshop was held together with the workshop "Infrastructure and Applications for the Mobile Internet" and structured into six sessions. Four sessions were assigned to our workshop. Each of these sessions contained two paper presentations and at least 30 minutes for discussion related to the presentations. Additionally, we reserved two time-slots of about 70 minutes for general discussions about e-Business application engineering driven by the following two fundamental questions:

1. E-Business-Application: A marketing buzzword or a new kind of software?

2. E-Business Application Engineering: An engineering discipline in its own right or already covered by "traditional" SE-methodologies?

In the following we give an overview on the results of the discussions. We start with some basic characteristics of e-Business applications from a conceptual perspective commonly agreed by the workshop participants. We continue with the technical perspective and conclude with some characteristics of the engineering process. All of these issues need further investigation. The goal of this first workshop on e-Business application engineering was to develop a common view among the workshop participants, to collect the various experiences, to identify typical characterizations of e-Business applications, and to discuss their impact on the engineering process.

2.2.1. The context of e-business applications

In the following, we give the fundamental objectives that form (among others) the context of e-Business application engineering. Due to the very general nature of these objectives, the context is not a good starting point for any kind of characterization but for evaluation:

E-Business applications integrate business processes (often: across companies). They shall enable new revenue streams instead of only substituting already existing ones or streamline existing business processes. So far, only few existing applications reach the goal of increasing the speed and quality of services. Communication and standardization aspects are very important.

2.2.2. E-Business Applications: A technical Perspective

From the technical point of view, all workshop participants have agreed to the following as a set of criteria characterizing e-Business applications:

- E-Business applications are distributed applications utilizing web-technology.
- Security, scalability, and support for heterogeneous platforms are fundamental issues.
E-Business applications are often based on evolving or immature technologies but not necessarily restricted to current technology. Design should start with a service-oriented approach.

2.2.3. Additional risks

The development of e-business applications usually involves the following additional risks:

- Control of application components may reside outside the company.
- Third party systems may not work.
- Component integration from outside sources.
- Immature, fast-changing technologies risk.
- Problems to find experienced developers.
- Quality may suffer because of time-to-market pressure.
- Extra engineering requirements for security, communication, interoperability and others.

2.2.4. Processes for engineering of e-business applications

The following characteristics of the development processes of e-business applications have been identified:

- Time-to-market pressure.
- Focus on standards.
- Sometimes/often: Lightweight development processes.
- Holistic approaches. Incremental development and deployment to adapt to changing business needs.
- Security/privacy issues need to be resolved.
- Additional product metrics: (e.g. Hit metrics) are needed.
- Some metrics change in importance (e.g. reliability by the increased number of users).

2.3. Conclusions

This workshop has shown a variety of interesting research directions that may stimulate the area of e-Business engineering.

Higher-level service oriented modeling or concepts transferred from the area of agent-based systems are good starting points for separating the business logic from the implementation and the underlying technology. Again, fundamental changes are expected within the near future based on wireless technologies.

Systems allowing a faster application testing or supporting the management of the development process can help to ensure the quality and to minimize additional risks even under the pressure of short time-to-market cycles.

The problem of finding the necessary human resources is a big issue and can be tackled by virtual marketplaces allowing the distribution of projects among different companies or "e-lancers" that offer their services.

Integrating all these new approaches into an engineering methodology that incorporates also verification and evaluation strategies will remain an interesting future research topic as well as further investigating each particular approach. We hope that we can continue our collaboration within this workshop in the next year.

3. Infrastructure and Applications for the Mobile Internet

Wireless equipment manufacturers and service providers have recently been devoting an enormous amount of effort towards the goal of enabling mobile access to the Internet. For example, the Palm VII PDA now offers mobile Internet service, and cellular/PCS providers are rapidly deploying WAP (wireless application protocol) service. In Japan, iMode has become a big hit. Rather than building entirely new infrastructure, the trend is to overlay the existing cellular and PCS infrastructure with these new abilities.

At the same time that the infrastructure is being created for ubiquitous mobile access to the Internet, e-businesses are searching for the best ways to leverage the new infrastructure. Traditional Internet portals such as Yahoo! are creating WML (wireless markup language) versions of their services, while other businesses are offering wireless access to stock quotes, movie listings, and airline reservations. Soon anything that can be purchased on the Internet will be purchasable using a PDA or cellular phone through a web-based interface. Multi-billion dollar companies such as Openwave have staked their entire business plan on the success of the mobile Internet by offering microbrowser and WAP gateway technologies. Although e-commerce is certainly the driving force motivating rapid deployment of the mobile Internet, the new technology will benefit other areas of society, such as health-care, public-safety, and education.

The purpose of this workshop was to discuss trends in infrastructure and application development that related to the mobile Internet. In the workshop, we discussed the benefits and shortcomings of using the current wireless infrastructure to deliver Internet services to the mobile user. We looked ahead towards third- and even fourth-generation systems to see if they will meet the future
needs of the mobile Internet. We discussed technologies related to the mobile Internet, and identified applications that can benefit from these services, particularly in healthcare.

### 3.1. Overview of the papers

The paper of Kirda et al discussed challenges and open problems faced by Web developers in adapting services to support mobile access. In general, it is desirable to separate layout, content, and business logic. Although this is a good first-order solution to the problem of adapting content to the mobile Internet, the business logic cannot always be directly reused, and database queries must often be reprogrammed to produce output that is suitable for the small displays of mobile devices. Thus, a new methodology is needed to partition the processes further. There is currently a lack and a growing need for methodologies and tools for multi-device enabled Web services. Adaptation is the key to mobile information access and mobile Internet service must be device-aware in order to meet new challenges such as varying display sizes, low bandwidth connections and technical problems due to memory limitations.

Software-defined-radios (SDRs), which can be used to implement dynamic nodes on the network, were considered in the paper by Robert and Reed. Since the SDR concept allows a radio to be described by its software, each radio can change its operation in real time to suit the needs of the network. Although SDRs can expand the capabilities of a network, they create a host of challenges due to the requirement for the network to absorb multiple types of dynamically changing nodes. These problems can be addressed by using object oriented programming and object brokers.

Fourth-generation wireless systems were considered in the paper of Woerner and Howlader. Although the deployment of 3-G systems is stalled, interest in a fourth generation is inevitable. A key theme of 4-G is the seamless integration of wireless networks. The same infrastructure will be used for high performance applications such as web surfing (the sports car) and for less demanding applications such as vending machines automatically ordering new inventory (the cheap car). The realization of 4-G will require advanced signal processing technologies, including efficient configurable devices and low power analog-to-digital converters. Finally, it was mentioned that there may be a paradigm shift away from fixed infrastructure networks and towards multi-hop peer-to-peer (i.e. ad hoc) networks.

Image utilization issues were covered in the paper of Chisalita and Shahmehri. The key differences between the way conventional and mobile devices utilize images were discussed. Three options for displaying images were described: reduce, divide, or replace. A particular image utilization model suitable for mobile devices was proposed. Future work involves adaptability and voice support.

The final two papers describe healthcare-related applications of the mobile Internet. The paper by Singureanu describes how mobile devices can be used to facilitate clinical trials, which are required for the approval of any new drug or treatment. The idea is to give WAP-enabled PDAs to the clinicians and WAP-enabled cell phones to the subjects, so that they can routinely, quickly, and accurately complete their reports. The paper by Bharadwaj et al considers the use of mobile devices to facilitate the approval process commonly used by HMOs. However, security and authentication remains an issue before mobile devices can be widely accepted as part of the approval process.

### 3.2. Conclusions

With the mobile Internet, the available resources are both limited and variable. Limitations exist in the size and resolution of the display, the bandwidth available for downloading data and images, the amount of power available, and the flexibility of the interface and user input devices. Because different mobile devices have different capabilities, one size indeed does not fit all. With the mobile Internet, it is not always possible to use the same paradigm and business engine that would be used over the conventional Internet. Mobile services that are aware of the capabilities of the client and can automatically adapt to these new capabilities should be crafted. Adaptability in the devices themselves could be achieved by using the concept of the software-defined-radio.

Security is a big issue that needs further investigation. Because the signals are being transmitted over the air, it is all too easy to intercept transmissions. Furthermore, since the origins of the transmissions are not entirely known, it is easy to spoof signals. Thus, not only is it important to protect the integrity of the data, it is also critical to provide reliable authentication in the form of digital signatures.

In conclusion, many applications can benefit from wireless service. Many interesting technologies, such as 4-G wireless and SDRs, lie on the horizon. However, a lot of work remains before the full potential of the mobile Internet can be realized.
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