Optimized Usage of Network Resources based on Context Information

Utz Roedig and Cormac J. Sreenan

Mobile & Internet Systems Laboratory (MISL), University College Cork, Ireland

Email: {u.roedig, c.sreenan}@cs.ucc.ie

Abstract

Today an efficient (cost-effective) design and usage of networks is of particular importance. As more and more computer systems become context-aware the question of how context information can be used to improve computer networks arises.
In this poster we describe how context information can be used to optimize the usage of resources in a computer network. By means of a mobile payment system we show how these optimization method can be applied.

Introduction

The available resources in computer networks, e.g. the available bandwidth, are a costly and therefore limited good. To provide a service with an agreed Quality of Service (QoS) it has to be decided at which time certain network resources are used. The goal is to provide an agreed QoS using the least network resources. Today many services use and/or produce context information. This context information is normally used within an IT-system to improve the offered services. Additionally, it is also possible to use the available context information to optimize the usage of network resources. This can be achieved by two different approaches described below:

Approach I

Many procedures exist that can be used to optimize the dimensioning and usage of network resources (e.g. network design, traffic engineering, explicit resource reservation). Regardless of the procedure that is chosen to plan and assign the resources, a prediction of the expected network access and usage is necessary. The more accurate this prediction is the better the usage of network resources.

> *Context can be used to enrich the information used to predict network access and usage.*

Approach II

Network efficiency also depends on how accurate the necessary QoS is specified. Often it is difficult for the user or application to determine and specify the QoS needs correctly. If the QoS is set unnecessarily high, network resources are wasted.

> *Context can be used to refine the necessary Quality of Service (QoS).*

Definitions

Within the poster the following definitions of the terms context and context-aware are used:

Context *is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and application themselves [Dey00].*

A system is **context-aware** *if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task [Dey00].*

References

[Dey00] Anind K. Dey. *Providing Architectural Support for Building Context-Aware Applications*. PhD thesis, College of Computing, Georgia Institute of Technology, December 2000.

[ePSOe] The electronic Payment Systems Observatory (ePSO). The epso database on e-payment systems. http://epso.jrc.es/paysys.html.

Mobile Phone Payment Systems

It is assumed that in the future customers will use their mobile phones, in conjunction with a mobile payment system, to carry out payments. Mobile payments enable the user to make payments directly to a third party in the same way as by using a credit card. The mobile phones can be used to replace the credit card and the credit card terminal. Therefore payments can take place anywhere, away from the recipient and the bank.
Currently different prototypes exist and field trials are being carried out to evaluate them [ePSOe]. The following section describes and categorizes the different existing mobile payment systems.

System Structure

A mobile payment system can be divided into two main parts . The mobile device, usually a mobile phone, and the payment infrastructure:

Mobile Device (Front-End)

The mobile device is normally considered to be a mobile phone but it might be also a different device (e.g. a PDA or laptop computers). Most payment systems can be used with a standard mobile phone. However some payment systems require a modification of the phone, e.g. to increase system security.

Payment Infrastructure (Back-End)

The back-end normally consists of a distributed system that is capable of receiving, transmitting and processing the payment transactions. Normally large parts of the back-end are shared with conventional (credit card) payment infrastructures. Therefore the main purpose of the back-end system is the transportation of the payment data between front-end and the conventional payment infrastructure.

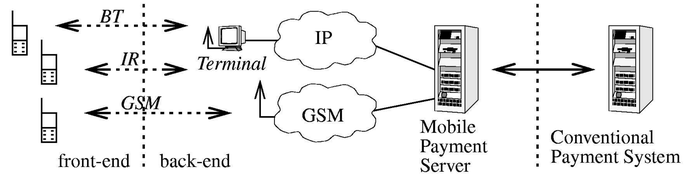

Figure 1: Parts of a mobile payment system.

System Classification

Different existing mobile payment systems can be distinguished and classified by the communication method used between front-end and back-end:

- **Link Types -** Different link types can be used for the communication: Bluetooth (BT), Infrared (IR) or Global System for Mobile Communications (GSM).
- **Methods and Protocols -** Different methods/protocols can be used on the link to pass the payment information: SMS, Voice, GPRS, or proprietary methods.

The following combinations are mainly used today to build payment systems:

- **Mobile Payment, GSM -** Most mobile payment systems use the GSM network to transmit the payment data between front-end and back-end. Often the payment data exchanged between front-end and back-end is transmitted via SMS messages.
- **Proximity Payment, BT, IR -** Some mobile payment systems use the infrared (or in the future the bluetooth) capabilities of a mobile phone to pass the payment data. To use these payment systems the customer has to be in range (proximity) of a terminal.

Realization

At the MISL we plan to implement parts of a mobile payment system. The resulting system will have the following characteristics:

- Combination of mobile (GSM) and proximity (Bluetooth) based payment systems.
- Integration with the existing FEXCO payment system (Conventional Payment System).

Optimization

Goal is to optimize the the usage of network ressources for a QoS requirement by the usage of context information.

Optimization Example Using Approach I

Depending on the context of the front-end and and/or the back-end, it can be decided which interface should be used for the communication between front-end and back-end. The following context information in a context-aware payment system can be used:

- User location
- Location and intension of other users
- Time of day

Result: The QoS requirement can be fulfilled using less network ressources because a better link selection is possible.

Optimization Example Using Approach II

Transactions that are sent via a local link are passed by the terminal to the payment server. Depending on the transaction context, it can be decided to cache transactions in the terminal. The following context information in a context-aware payment system can be used:

- Transaction amount
- Past user behavior

Example calculation: the following assumptions are used

- Weibull distribution of transaction amount
- Terminal cachesize of 100 transactions
- Link cost of 15 cent per transaction, 10000 transactions

The usage of context allows to select an appropriate cache threshold.

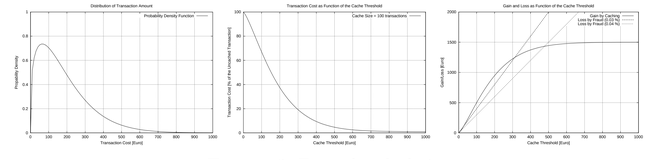

Figure 2: Example calculation

Result: The QoS requirement can be stated more precise resulting in the usage of less network ressources.

Outlook

In the future the following tasks will be carried out:

- **Implementation -** Software for mobile phones, terminal software, interface between back-end and conventional payment system.
- **Analysis -** Real-world application, simulation for larger scenarios.

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