Web-based Universal Micropayment System
A Service-oriented Design Using Enterprise Architecture Approach

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Statement of Originality

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

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Date:
Abstract

The e-commerce of low-value online content, like music and videos, has generated considerable revenues worldwide over the past few years, and the market for these micropayments is expected to continue to grow substantially. To allow ‘pay-per-use’ for such content, Micropayment Systems (MPSs) are playing an important role.

Research on MPSs began along with the Internet boom a decade ago, when a number of trial systems appeared, but none achieved great successes. The main reason for the failures was not the limitation of the technologies involved, but user resistance: people had simply been used to getting online content for free. In addition, the transaction costs were rather too high.

The second wave of MPS developments occurred during recent years, when online content available for a small charge became quite popular on the Internet. Many systems dedicated to processing micropayment transactions on the Web emerged, such as PepperCoin, BitPass, ClickandBuy, etc. However, no single system has yet gained wide acceptance among online merchants and consumers, due to the fact that most systems are running locally with limited user base. The current situation has resulted in many problems because various MPSs are concurrently used and competing with each other on the Internet market. Accordingly, recent research efforts in this area have tended to shift towards social and human, rather than technical, issues.
One of the main problems encountered in current micropayment practice on the Internet is that both merchants and consumers are forced to use multiple systems, manage multiple accounts and trust different system operators. In this study, a possible approach to overcome this problem is proposed. It involves a Universal Micropayment System (UMS), which would incorporate the various MPSs, allowing users (both merchants and customers) to use the systems of their choice without the need for multiple accounts or having to change their habits. The main objective of the research is to design and develop the UMS architecture for universal payments, in terms of functionality and payment protocol, allowing the existing MPSs to comply with it without changing their original functionalities.

In order to achieve this objective, an Enterprise Architecture (EA) approach was adopted as the design principle to guide the process of dealing with system requirements, conceptual framework, implementation and measurements. The EA approach was further segmented into three levels – enterprise viewpoint, business viewpoint and solution viewpoint. In the process, three major questions emerged:

1. What system is required?
2. What should the system look like?
3. How to develop the system and measure its performance?

To address these three questions, further detailed approaches – such as a strategic approach for requirement identification, a service-oriented approach for the system design, and a case study approach for system development – were adopted and developed.
The outcome of this research may contribute to the development of system integrations and future design of MPSs. The core element of the design of the proposed UMS is a generic and systematic interconnection approach to enable cross-system interactions among the existing MPSs. It determines an optimised method of integrating the payment services of these systems into a universal level by standardising multiple payment interactions. The service-oriented design of the UMS architecture and protocol ensures high scalability and system compatibility, and may make it acceptable to a wide range of users.

The proposed system also enables protected data exchange at universal transactions and minimises security and related threats for both users and system brokers without overhead computational burden and significant time lag for cross-system payments. The lightweight design of universal payment service allows the participating MPSs to comply with this service without changing their local functionalities and users’ payment habits. Furthermore, the implementation of the proposed UMS and its protocol demonstrates the achievability of a universal micropayment system. Consequently, the conceptual design of the UMS and its services may promote the development of Internet commerce involving micropayments by means of simple, low cost, secure and efficient universal payment portal and protocol.
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Acronyms

ATM   Automated Teller Machine
B2C   Business to Consumer
DES   Data Encryption Standard
DEI   Data Exchange Initiation
DEP   Data Exchange Point
EA    Enterprise Architecture
EFTPOS Electronic Funds Transfer at Point of Sale
HTTP  HyperText Transfer Protocol
HTTPS Secure Hypertext Transfer Protocol
ID    Identifier
ISP   Internet Service Provider
iKP   Internet Keyed Payment Protocol
MD5   Message Digest 5
MPS   Micropayment System
MSB   Micropayment System Broker
P2P   Person-to-Person
PKI   Public Key Infrastructure
RSA   Rivest-Shamir-Adelman, a public key encryption algorithm
SET   Secure Electronic Transaction
SHA   Secure Hash Algorithm
SI    Service Initiation
SSL   Secure Socket Layer
TLS   Transport Layer Security
TTP   Trusted Third Party
UAL   Universal Access Layer
UMP   Universal Micropayment Portal
UMS   Universal Micropayment System
Uni-Pay-Req Universal Payment Request
Uni-Pay-Resp Universal Payment Response
Uni-Trans-Req Universal Transaction Request
Uni-Trans-Resp Universal Transaction Response
Uni-Verif-Req Universal Verification Request
Uni-Verif-Resp Universal Verification Response
URL   Universal Resource Locator
UTL   Universal Transaction Layer
W3C   World Wide Web Consortium
3W    World Wide Web
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