



# Service-Oriented Solution Framework for Internet Banking

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## ABSTRACT

*This paper describes a service-oriented solution framework designed for Internet banking in financial services. A pragmatic approach is developed to help migrate conventional n-tier e-commerce systems to a service-oriented computing paradigm, composed of Service-Oriented Architecture (SOA), Integration (SOI), Process (SOP), and Management (SOM). This comprehensive framework comprises Service Patterns, Architecture Process, Hybrid Methodology, Service-Oriented Enterprise Model, and Solution Platform. E-business patterns are applied to categorize diverse online services, which form the baseline for subsequent selection justifications of appropriate technologies, products/tools, and infrastructure. A multi-level architecture process is developed to cope with the architecture complexity in a disciplined way. Furthermore, a hybrid methodology is designed to leverage the benefits of both top-down and bottom-up approaches, in which a converging layer is conceived to incorporate the latest technologies such as portal, process orchestration, Web services, service aggregations, business rule engine, and so forth. In the enterprise model, common business functionalities are built as shared services to be reused across lines of business as well as delivery channels, and the Internet channel-specific SOA is defined by applying the hybrid methodology. Finally, a holistic solution platform is introduced to address the key design artifacts in the implementation of service-oriented solutions. Challenges of conflicting specifications and immature cutting-edge technologies are also discussed in the context.*

**Keywords:** *application software; architecture types; bottom-up design; conceptual model; electronic commerce; enterprise modeling; Internet commerce; IS development methodologies; online banking; online collaboration; software design; systems development techniques; Web applications; Web services; Web technologies*

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## INTRODUCTION

Large financial institutions generally have a heterogeneous information technology (IT) environment, resulting from a long history of mergers and acquisitions with aging infrastructure and architecture. They are finding

themselves ill prepared to deliver timely enhancements or quick new product rollouts. The required migration to a customer-centric view, coupled with the need for quicker turnaround time for systems enhancements and releases, requires a more agile solution model and pro-

cess as well as tighter integration with the business domain model. Banks must be able to tie together dynamic transactions occurring through different channels and lines of business, which are typically supported by multiple systems. Banking processes tend to converge on a platform that is scalable, flexible, and positioned for easy growth as well as one that supports multiple customer channels and customer-centric views.

Wachovia Corporation, one of the five largest banks in the U.S., is facing the same challenges. The financial services provided by the bank are accessible through a variety of servicing channels — branch offices, automated teller machines (ATMs), telephony voice response unit (VRU), call centers, snail mail, fax, e-mails, and the Internet, to name a few. The online services accessed through Web browsers have played an increasingly critical role in the overall customer relationship management (CRM). The Internet channel has become an integral part of the business services as more and more customers use online services like online banking and bill pay in their banking activities. The next level's goal is to present a holistic view of services and products to customers and prospects, and implement long-duration transactional processes with the session statefulness capability across delivery channels.

A number of diversified IT systems have been built or acquired over the years to support a variety of banking business processes. Through the evolution and maturing of various technologies and products, drastically different platforms, architectures, techniques, tools, and programming languages have been used, resulting in a complicated mix of applications in legacy monolithic, client/server, n-tier thin client, n-tier rich client, message-oriented, pervasive computing, and distributed computing models. The demanding challenges are how to change the mindset to build new applications in a service-oriented manner, how to migrate the existing systems to a service-oriented paradigm, and how to converge the IT assets to provide holistic services to various delivery

channels. Several prevailing frameworks and process models have been evaluated, such as Zachman Framework (Zachman, 2002), Rational Unified Process (RUP) (Kruchten, 2003), Extended Enterprise Architecture Framework (E2AF) (IFEAD, 2004), The Open Group Architectural Framework (TOGAF) (TOGAF, 2003), and Model-Driven Architecture (MDA) (OMG, 2002). Zachman Framework is largely data-driven and is well suited for planning and management rather than detailed technical designs of an individual system. RUP is a heavyweight process-oriented approach primarily for software development, lacking a broad coverage on inter-application integration, application portfolio, system engineering, and infrastructure aspects. E2AF takes a similar approach as Zachman Framework by using a 2-D matrix with a focus on the architecture. TOGAF has a fairly comprehensive scope on the major elements in the architecture design. It is targeted to the enterprise architecture area. MDA emphasizes the platform-independent model in addition to the platform-specific model but it is limited to the qualitative architecture description at the conceptual level. Other related works have also been investigated and justified (Albin, 2003; Bass, Clements, & Kazman, 1998; Broemmer, 2002; Carbone, 2004; Dustdar, Gall, & Schmidt, 2004; Erl, 2004; Fowler, 2003; Frankel, 2003; Giaglis, 2001; Gronmo & Solheim, 2004; Gulzar & Ganeshan, 2003; Jorstad, Thanh, & Dustdar, 2004; McGovern, 2003; McGovern, Ambler, Stevens, Linn, Sharan, & Jo, 2003; Schekkerman, 2003; Sessions & Sickler, 2003; Shan et al., 2004; Zimmermann, Tomlinson, & Peuser, 2003). It turns out that these works serve different purposes with different structures and are based on different principles in different scopes. None of them can be directly applied to define a systematic approach for service-oriented solution design in order to meet the business needs in the Internet banking sector.

## COMPREHENSIVE APPROACH

A comprehensive framework is designed in this paper with pragmatic methods to facili-

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