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MODERN SOFTWARE DEVELOPMENT FOR BUS STATION ACTIVITIES

Belgrade Bus Station (BBS) is one of the bigest bus station in the Europe. The paper presents the main characteristics of unified software development process applied to software development for Integral Information System of the Belgrade Bus Station (IISBBS). Information subsystem of Traffic, supporting basic bus station activities, is the main one. The requirements for Traffic subsystem availability were very high, so this subsystem is designed to provide high level of operations.

NOWOCZESNE OPROGRAMOWANIE DLA DZIAŁALNOŚCI PRZEDSIĘBIORSTW KOMUNIKACJI AUTOBUSOWEJ

Belgradzkie Przedsiębiorstwo Komunikacji Autobusowej jest jedną z największych firm autobusowych w Europie. Referat przedstawia podstawowe właściwości ujednoliconego oprogramowania zintegrowanego systemu informacyjnego w belgradzkim Przedsiębiorstwie Komunikacji Autobusowej. System informacyjny związany z ruchem drogowym wspiera działalność firm autobusowych. Wymagania dla systemu związanego z ruchem drogowym są bardzo wysokie.

1. INTRODUCTION

The classical approach to software system development, so-called "the waterfall model" [1], describes seven steps like system requirements, software requirements, analysis, program design, coding, testing, operations. The modern software project management approach to development process is object-oriented unified software development process. It is an iterative and incremental process that keeps the focus through all development steps to the customer requirements. One of the major activities is testing in every phase and iteration of software development to verify the achievement at any software build.

The paper will consider general requirements for the IISBBS development and describe its design and implementation solution. The emphasis will be put at the subsystem of traffic that includes "mission critical" application for selling and booking tickets. This subsystem is

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designed to provide high level of operation because the requirements for system availability were very high.

2. BBS INFORMATION SYSTEM

The IISBBS should cover and support all main business fields of the Belgrade Bus Station enterprise: arrivals and departures of passengers and buses at the main Belgrade bus station, and then the other applications and functions like food services and trade. The whole information system consists of the following subsystems (11): Traffic, Bus services, Tourist services, Goods and material input-output management, Accounting and financial affairs, Salaries, Human resources management, Plan and analysis, Business managing system, Administration of information system, Common business objects [3].

IISBBS is designed through object-oriented unified software development process [2]. Each software subsystem is implemented in three-tiered architecture: user interface layer (presentation layer), application layer and data layer (Fig. 1).

The infrastructure of the IISBBS is realized covering three city distance business locations [3]. This whole System includes 80 workstations, four server machines and appropriate communications equipments (routers, switches of layer two and three, hubs, modems) and others.

We would like to emphasize there was the customer request for simultaneous work of 50 clients (30 desk ticketing sites and 20 others). Part of the System – bus arrivals terminal should to be wireless connected to the network.

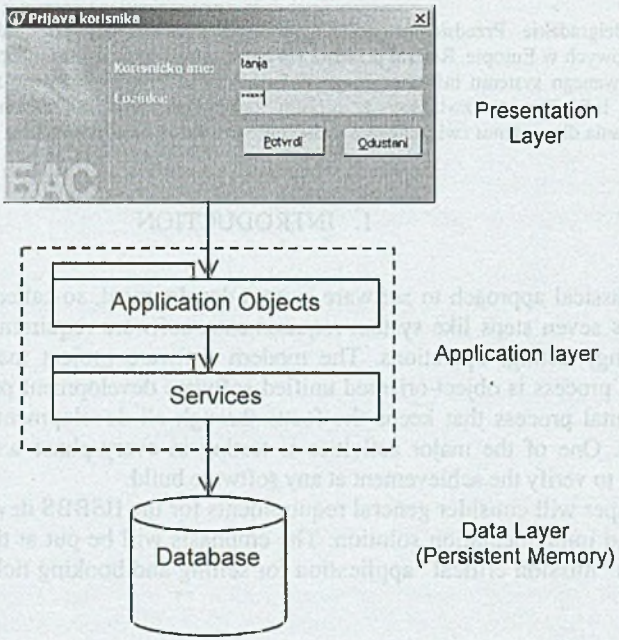

Fig.1. Generic three-tiered software architecture

The requirement for subsystem Traffic availability is very high, so the IISBBS is designed to provide high level of operations. From reliability point of view, the basic system function (the selling and booking tickets) is in parallel configuration (provided by two servers in cluster, switches and redundant optical backbone) – Fig. 2 [3]. The functions of the servers are divided so that one cluster server machine covers the implemented applications and the second covers database management system functions. In the case of one server failure, the other overtakes full system functioning. Additionally to parallel server operation, the stand by computer (server 3 at the Fig. 2) for some critical functions, is provided. A parallel data bus is implemented.

The implementation and deployment of the IISBBS are planned for realization in two phases (the first phase covers the basic BBS business functions and the second one extended business functions like Tourist services). The first phase is in the process of the finalization.

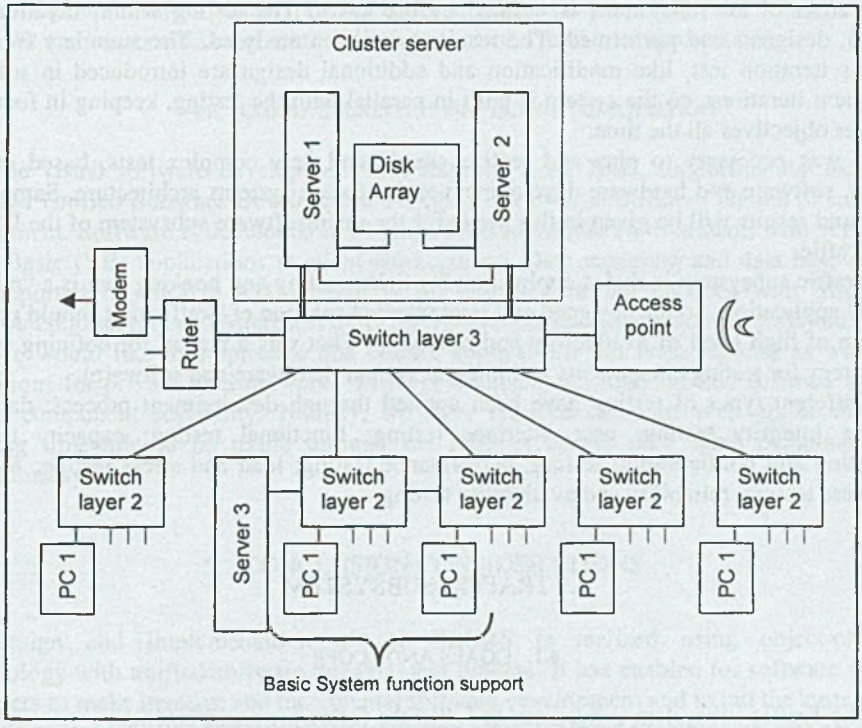

Fig.2. Basic System function infrastructure layout

LOLA Institute and S-Soft, as software developers, provided system for development purpose (design, implementation, testing), while complete verification testing (software, hardware, integrity) has been performed at the customer (BBS) infrastructure.

3. MAIN CHARACTERISTICS OF METHODOLOGY

Object-oriented approach to IISBBS development is used aiming at components development of the information system. This should enable IISBBS to be open for further functional and technological development, as well as to reduce the costs of software maintenance.

Main characteristics of the methodology applied based at the Unified Software Development Process [2] are that is based on the use cases, software system architecture centric and based on iterative and incremental development process which enables spiral development and openness of the designed system. Every phase of software development life cycle is defined by activities and output with proper system model presentation in Unified Modeling Language (UML) notification [4]. Implementation of IISBBS is oriented to the Microsoft three-tiered architecture of distributed software components. Functional specification of all subsystems is defined by use cases. The testing within iteration was planned, designed and performed. The results have been analysed. The summary from the previous iteration test, like modification and additional design are introduced in software subsequent iterations, so the system is built in parallel with the testing, keeping in focus the customer objectives all the time.

It was necessary to plan and realize simple and very complex tests, based on test strategy, software and hardware development and software systems architecture. Samples of testing and results will be given in this paper for the main software subsystem of the IISBBS – the Traffic.

Traffic subsystem includes application for ticket selling and booking that is a "mission critical" application. So the designed and implemented solution of Traffic that should provide a system of high level of availability and reliability. That was a reason for defining system test strategy for testing components and integral system (hardware and software).

Different types of testing have been applied through development process: data and database integrity testing; user interface testing; functional testing; capacity testing; installation and configuration testing; performance testing; load and stress testing; security and access testing, reliability and availability testing.

4. TRAFFIC SUBSYSTEM

4.1. GOALS AND SCOPE

The Traffic subsystem is designed to fulfill the following requirements:

- Traffic should be integrated into IISBBS and should successfully respond to the demands of passengers and transporters.
- It should offer information for quick and high quality decision making.
- It should enable the development of value-added services to the clients.
- It should help "BBS" to become the leader in providing logistic support to the passengers and transporters.

- Application software of Traffic should be designed by object-oriented approach and should support iterative-incremental lifecycle of software development.
- Application software of Traffic should be designed and realized in three-tiered architecture of distributed software components.
- Designed and implemented solution of Traffic should be a system with the high level of availability and reliability, since the selling and booking of tickets is a "mission critical" application.

The Traffic subsystem is realized with the following applications: Departures/arrivals timetable, Price list, Departures and buses changes, Ticket selling and booking, Depo of tickets, Entrance at departure platform, «Big screen» (visual presentation of arrivails information), Control and analysis. Operation of this subsystem needs interfaces with other subsystems like is Accounting anf financial affairs (control of daily income, main treasure control, control of cheques etc.), Human resources management (Employees), Common business objects (business partners, lists of codes, destinations-places etc.) and Administration of IS (jobs and responsibilies of employees for usage of a particular application).

4.2. CHARACTERISTICS OF TECHNICAL SOLUTION

The visual software development tool Rational Rose 2000, supporting the usage of UML and Unified Software Development Process, was used in different phases of software development. Software is developed in Microsoft Visual Studio environment, with Windows Visual Basic (VB) applications at client workstations. Data modeling and data base design was supported by ERWin 4.0. System is implemented in the network with Microsoft Windows 2000 servers and Microsoft SQL 2000 servers (database management system).

We would like to emphasize that client's applications has been realized as windows applications for private BBS network. However designed and implemented software system enables component resubality. Namely, we have realized dynamic Web application for searching timetable to be usade through the Internet access with same components at application layer.

5. CONCLUSION CONSIDERATIONS

Design and implementation of the IISBBS is realized using object-oriented methodology with unified software development process. It has enabled for software system developers to make iterative and incremental software development and to put the system into production after one or more iterations completion when required functionality was achieved. Subsystems specification, defined by use cases and scenarios of their realization, enabled software testing and verification continuously. This specially expressed benefits in development of the Traffic subsystem that included "mission critical" application for selling and booking of tickets. This kind of software systems development tremendously reduce risk for both the customers and the developers of complex software systems. The software system is continuously being tested together with the customer. Verification and validation of

software during all phases of development is performed aiming at software to reach required functionality and performances of the systems in operation.

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