Methods and tools for development of distributed embedded systems based on TCP/IP environment.

The aim of the thesis is to examine the capabilities for realization of distributed embedded systems (DES) using multi-tier client/server architecture and standard TCP/IP communication. A multi-tier reference model for integration of business information systems and automation systems is proposed. An application layer protocol is developed for data extraction in controller networks (CNDEP). Main research is targeted towards evaluation of the adaptation of multi-tier architecture and technologies for realization of its tiers.

An analytical model is developed for performance evaluation of Fast/Gigabit Ethernet as communication media in networks of embedded systems. It is based on the mathematical apparatus of Network Calculus for determination of upper bounds of virtual delay and backlog in network nodes (e.g. routers, switches). The buffer utilization and delay of manageable switches with CoS performance are evaluated through simulation using Network Simulator (NS-2). Prioritization of the traffic classes in the switch is based on 1P3Q1T strategy – an expedite queue and three Weighted-Round-Robin queues with weights respectively 70/25/5%. The simulation scenario and analytical model are based on the presumption that four packet flows run in the networks: periodic with small sized packets and represents the monitoring and control traffic; aperiodic with small sized packets and represents the alarms and event-driven traffic; aperiodic with medium sized packets; represents configuration of devices; sporadic with big sized packets; represents background bulk traffic (e.g. FTP, HTTP).

The proposed protocols and models are verified trough test-bed experiments in specially built experimental network. It consists of test servers, manageable switch and embedded platforms from different classes with wide range of hardware and software capabilities. A classification of service policy is applied to the switch and the behavior of the traffic from the controllers is observed.