

College of Graduate Studies and Research

Doctoral Dissertation Defense Announcement

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Abstract

Webmail server design and implementation on a bare PC poses daunting challenges and innovative opportunities that are revolutionary in server designs. Making the Webmail server secure through the Transport Layer Security (TLS) makes the design even more immense for a bare PC. This thesis focused on the design, implementation, performance and security analysis of a Webmail server that runs on a bare PC, without an operating system (OS) or kernel. The bare PC approach poses numerous design challenges which are solved in this research. Secure Webmail servers are complex, large and require intricate components to develop. As a result a lean system was developed for this research. The lean concept proliferates through architecture, design and implementation of the Webmail server. The lean concept also helps to build small protocol suit, intertwining of protocols, limited requirement space, simple user interfaces and minimal design options. The dissertation provides a detail architectural design, steps of implementation, experimental setup and the results of experiments conducted in a LAN and WAN environments. The performance of the bare PC Webmail server is compared with conventional Webmail servers. Performance is evaluated by measuring the processing time for login requests; inbox requests with a varying number of emails; and composing emails, retrieving email messages and sending attachments of various sizes. The throughput for various email sizes, stress test, the processing time, response time with a varying number of connections, and the total time, the average processing time for the POST command with a varying number of users, the CPU Utilization and load distribution are all measured and analyzed. The results show that the performance of the bare PC Webmail server is significantly better than that of the OS-based servers.

Designing secure systems on a bare PC is a major milestone that must be crossed. The TLS protocol in its own dimension is a complicated protocol that needs thorough understanding in order to build on a bare PC platform. The secure Webmail server development of bare PC posed many demanding hurdles that needed careful attention. Issues with encryption/decryption algorithms, handshake, and certificate verification, private/public key and key cutting algorithms needed to be resolved. Novel design features of the server include intertwining the TLS, HTTP and TCP protocols to reduce inter-layer communication overhead, and using a separate TLS task per connection to improve performance. This novel architectural and design features could be used as a basis for developing future high performance systems. It could also serve as a stepping stone to the development of new paradigms in the computing environment.

