

MASTER OF SCIENCE IN COMPUTER SCIENCE

NETWORK CONFIGURATION USING XML

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The primary goal of this thesis is to investigate the use of the Extensible Markup Language (XML) as a network configuration language. Network configuration is a difficult and time-consuming task. Current network configuration solutions are based on proprietary configuration languages and parsers. XML is a platform-neutral data representation language and worldwide standard. It potentially advantageous to use XML to configure networks. However, XML was not developed for network configuration. A new XML based configuration solution for the Server and Agent Active Network Management System (SAAM) is provided to marshal evidence that XML can be used effectively as a network configuration language.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: XML, Quality of Service, Network Configuration, Next Generation Internet, Networks

A NEW PARADIGM FOR MIGRATING TO CONVERGED INTEROPERABLE NETWORKS

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In both the military and the commercial sector, requirements for interoperability between systems have grown. The fact that requirements change rapidly in the information age and that customer needs are unknown and often impossible to correctly predict has created the need for an architecture for communication systems that affords flexibility and interoperability. As an alternative to solving the interoperability problem for individual systems, the thesis introduces an object-based network interoperability model in which every system should be designed as a network object. In this thesis a case study of replacing technologies for the existing IPv4 protocol is presented.

At the same time that the demand for interoperability increases, the customer demands that modern communication solutions like telephony- and video-conferencing is implemented to incur savings. Evolving constraint-based routing technology for implementation of a multi-service network that can support full communication interoperability is also investigated as part of this thesis. As a practical example, the Norwegian Defense InterLAN (a nationwide military WAN in Norway) is used to discuss architectural issues and the techniques for migration strategies towards multiservice networks.

DoD KEY TECHNOLOGY AREA: Command, Control, and Communications

KEYWORDS: Networking, Interoperability, Communication, Converging Networks, Real-Time Services, Quality of Service, Multi-Service Networks, IPv6

ARCHITECTURAL DESIGN AND PROTOTYPING OF A WEB-BASED WARGAME SIMULATION FOR CAMPAIGN PLANNING EXERCISES

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The Campaign Planning Exercise (CAMPEX) War Game is being used for the training of the students of the Air War College in the area of the Air Campaign Planning and the Ground Forces Deployment. The CAMPEX life cycle started in 1986 and the last version was released in 1994. Microsoft Basic Version 7.10 Professional Development System was used for its development. CAMPEX was not designed or developed with the Object Oriented Technique, so further extension and its use as component for Distributed Components Applications is not feasible.

TRADOC Analysis Center (TRAC) of Monterey plans to use a collection of old Wargames as Components of a Distributed Embedded Application. The CAMPEX Employment Module is the first wargame that will form one of the components of this application, so the redesign and implementation of CAMPEX Employment Module with Object-Oriented Technique is necessary. This thesis examines the distributed component architectures available to support the Distributed Embedded Application, re-engineers the CAMPEX Employment Module into an object-oriented design, and validates its requirements via a prototype developed using ACCESS2000. The new design will be the basis for re-engineering the other wargame planning software for the Air War College.

DoD KEY TECHNOLOGY AREAS: Battlespace Environments, Computing and Software, Modeling and Simulation

KEYWORDS: Battlespace Environments, Distributed Components Architecture, Object-Oriented Design, Modeling and Simulation

EFFECTIVE SPATIALLY SENSITIVE INTERACTION IN VIRTUAL ENVIRONMENTS

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Effective interaction techniques are critical for productive use of virtual environments for business, manufacturing, and training. This thesis addresses the need to match the dimensionality of tasks performed in a virtual environment to the dimensionality of the techniques used to perform the tasks.

In order to demonstrate the performance benefits of matching the dimensionality of task and technique, an experiment was conducted in which twenty-seven subjects were asked to perform a series of two and three-dimensional tasks. Subjects were required to perform all tasks using only three-dimensional techniques, then only two-dimensional techniques, and finally a combination of both techniques.

The results clearly showed that matching the dimensionality of the task to the dimensionality of the interaction technique achieved the best performance in a virtual environment. Of 27 subjects, 90% preferred to use a technique whose dimensionality matched the requirements of the task. More importantly, 100% demonstrated improved performance when the dimensionality of task and technique matched.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Human Systems Interface, Modeling and Simulation

KEYWORDS: Virtual Environments, Interaction, Interaction Techniques

EXAMINATION OF THE INTERNET MESSAGE ACCESS PROTOCOL (IMAP) TO FACILITATE USER-FRIENDLY MULTI-LEVEL E-MAIL MANAGEMENT

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Information systems within the Department of Defense (DoD) need trustworthy enforcement of critical security policies against sophisticated attackers. Data, such as e-mail, is processed on these systems on a daily basis. Since this data may contain sensitive information, special handling is required to prevent unauthorized disclosure. For these reasons, a high assurance Multi-Level secure (MLS) Local Area Network (LAN) was developed to control the sharing of information at different security levels.

A challenge in multi-level environments is to provide a usable and meaningful interface to users via the e-mail clients. These e-mail clients interact with the high assurance server running on the MLS LAN. The high assurance server returns information at security levels at or below those of the client. An e-mail client is only able to write and manipulate mail at its level. Therefore, client systems should provide users with feedback regarding operations they are able to perform.

In this research, six criteria were established to examine e-mail clients. These criteria evaluated messages displayed to users via the e-mail clients. All of the e-mail clients was able to satisfy at least one of the established criteria.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Multi-Level Secure (MLS), Local Area Network (LAN) Discretionary Access Control (DAC) Policy, Mandatory Access Control (MAC) Policy, Commercial-Off-The-Shelf (COTS), Internet Access Message Protocol (IMAP), POP (Post Office Protocol)

TRUST AND ITS RAMIFICATIONS FOR THE DOD PUBLIC KEY INFRASTRUCTURE (PKI)

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In order to incorporate trust into e-commerce, public key cryptography, and basic communication, one must understand and effectively manage trust. Various internet security protocols have attempted to address this lack of trust. However, these protocols do not incorporate the user's trust into these protocols. Computational models of trust have been developed in an attempt to automate the logic, variables, and thought processes that a human performs when making a trust-decision. Due to the fact that trust is based on a subjective belief, the models require the assignment of metrics to belief variables or attributes that will have value when evaluating trust. These models address the notion of trust in many different ways and both their definitions and metrics vary significantly. This thesis evaluates the various trust models. It is necessary to understand how trust is defined in each model in order to evaluate how well the operation of a system based on the model satisfies the requirements of the users. Trust models are evaluated based on their characteristics, environmental references, metrics, variables used, and outputs. This thesis concludes with the assessment of a practical application of a trust model to the DoD's PKI system.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Trust Models, Trust Management, Public Key Infrastructure (PKI), Computer Security

COMPUTER SCIENCE

A TASK ANALYSIS OF PIER SIDE SHIP-HANDLING FOR VIRTUAL ENVIRONMENT SHIP-HANDLING SIMULATOR SCENARIO DEVELOPMENT

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Researchers at the Naval Air Warfare Center Training Systems Divisions (NAWCTSD) in Orlando, FL have developed a testbed for the Conning Officer Virtual Environment (COVE) Ship-Handling Simulator. The purpose of this task analysis was to provide a workable document that they could use in the development of pier side ship-handling scenarios for their simulator. The task analysis not only identified the general procedures and methodologies used by a conning officer during pier side ship-handling evolutions but also provided inventories of the perceptual cues that were used specifically for these evolutions.

The approach taken was to use a Goals, Operators, Methods, Selection Rules (GOMS)-like model to represent the logical sequence of methods used by the conning officer. Critical Cue Inventories (CCI) were then developed to supplement the GOMS model by providing a list of the cues used along with detailed descriptions of why the cue was used and how it was visually or audibly identified. The accuracy of the pier side ship-handling task analysis was then validated by interviewing Surface Warfare Officers with several years of ship-handling experience by using the Critical Decision Method (CDM) knowledge elicitation process.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation, Human Systems Interface, Computing and Software

KEYWORDS: Ship-Handling, Virtual Reality, Task Analysis, Surface Warfare, Computer Simulation, Pier Side Evolutions, Computer Graphics, Virtual Environment

ANALYSIS AND DESIGN OF A UNIVERSAL TRAFFIC NETWORK

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As the field of computer networking has evolved, so too has the use of these networks. Modern networks must be capable of performing more than simple data transfer. To be of value, a network must be able to handle the convergence of different types of traffic – voice, video, and data – and the Quality of Service requirements associated with each type.

This thesis performs a detailed analysis of the different types of traffic, the two primary transmission media, fiber optical and copper based connections, and the connection-orientation technology to route the traffic. Presented in this thesis is a fiber-based hybrid network consisting of Asynchronous Transfer Mode at the backbone layer and Frame Relay and Passive Optical Networking at the local access layer. The proposed Universal Traffic Network, based on present-day technology, is a viable solution to the challenge imposed by the convergence of different traffic types.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Modeling and Simulation

KEYWORDS: Computer Networks, Asynchronous Transfer Mode, Frame Relay, SONET, Fiber Optics, Passive Optical Networks, Gigabit Ethernet, Multimedia Communication, Transmission Media

COMPUTER SCIENCE

DESIGN OF A DYNAMIC MANAGEMENT CAPABILITY FOR THE SERVER AND AGENT BASED ACTIVE NETWORK MANAGEMENT (SAAM) SYSTEM TO SUPPORT REQUESTS FOR GUARANTEED QUALITY OF SERVICE TRAFFIC ROUTING AND RECOVERY

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The use of interconnected networks has permeated most aspects of society. Along with this explosion in the use of computer networks the demands for increasingly capable applications has placed great demands upon the network transport protocols to ensure to the user high throughput, reliable service, and virtual real-time response. The current Internet, the descendent of the Advanced Research Projects Agency Network, is routed in the Transport Control Protocol/Internet Protocol. This protocol stack has no mechanism for providing guarantees to network clients regarding the quality of service provided. Further, the routing of traffic across the network is router centric, providing no mechanism for optimization of resource allocation to client service requirements. This thesis provides a method for dynamically controlling the allocation of network resources within an autonomous system by a central server. The algorithm significantly improves the performance of the server over the previous prototype and enables the server to add or remove routers from the network topology on the fly in response to status messages from the participating routers.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Next Generation Internet, Integrated Service, Guaranteed Service, Differentiated Service, Best Effort Service, Quality of Service, Flows, Networks, Routing, Path Information Base, Link State Advertisement, Network Resource Allocation

THORN: A STUDY IN DESIGNING A USABLE INTERFACE FOR A GEO-REFERENCED DISCRETE EVENT SIMULATION

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This thesis evaluates the usability of THORN, a system for displaying a discrete event simulation model in a geographic information system. THORN was developed to enhance the planning phase of Operational Maneuver from the Sea. The goals of this study were to test the system against usability criteria and provide a benchmark for future testing. The purpose of this analysis was to (1) create a system for viewing discrete event simulations fused with geo-referenced spatial information, (2) determine the system's usability, (3) identify problem areas in the graphical user interface, and (4) provide a proof of concept for incorporating usability in the design of military planning tools. The study's scenario is based on the principles outlined in the white paper Operational Maneuver from the Sea. The study tested whether THORN met the usability objectives of (a) 90% successful tasks completion, (b) ease-of-use ratings of "somewhat easy" or better, and (c) satisfaction ratings of "somewhat satisfied" or better. THORN met all of these usability objectives.

DoD KEY TECHNOLOGY AREAS: Command, Control, and Communications, Computing and Software, Modeling and Simulation

KEYWORDS: Operational Maneuver from the Sea, GIS, Simulation, Software Components

IMPLEMENTATION AND EVALUATION OF A NETWORK ACCESS PROTOCOL

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Traditional Ethernet networks are wired networks. There is now an increasing need, however, for hosts on the network to be mobile without losing network connectivity. This is where wireless technology comes in. The basic idea is to allow a portable device, equipped with an Ethernet transceiver, to relocate while “connected” to the network. Connected here means being within radio range of another transceiver, called an access point, which acts as a relay for the portable device. Its relocation is entirely transparent. Currently, there is a standard that defines how wireless devices communicate within a Local Area Network. This standard is called IEEE 802.11. The standard, however, is not scalable due to the level at which security is handled.

This thesis examines an alternative security solution, the Network Access (NA) Protocol, developed by Associate Professor Dennis Volpano. It runs on mobile devices and designated hosts called bridges and has the potential to scale up to meet the demands of mobility while ensuring secure network access.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Mobile IP, Wireless Computing, IP Mobility Support, IP Encapsulation, IpSec, IPChains, Home Agent, Mobile Host, Foreign Agent, Tunneling, Care-of-Address, MAC, IEEE 802.11, Route Optimization, Intra-Subnet Roaming

AN AD HOC WIRELESS MOBILE COMMUNICATIONS MODEL FOR SPECIAL OPERATIONS FORCES

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The digitization of the battlefield enables special operators to use improved communications supported by computer networks across a range of missions. The communications paradigm is evolving toward mobile wireless ad hoc networks. This development enables an autonomous system of mobile nodes supporting peer-to-peer communications in forward-deployed military networks. Ad hoc networks have to establish a reliable, secure, instant, and usually temporary, communication infrastructure and to be able to access in a global communications infrastructure.

Our model describes a global communication network supporting the special operator in mobile wireless communications. The main purpose is to provide a handheld wireless communications node which is capable of transferring voice, data, and imagery to and from parallel and vertical command structures within an environment replete with electronic countermeasures. The model will support the representation of requirements such as throughput, quality of service with low power consumption, and low probability of detection/interception. Special Forces are moving toward using commercial-off-the-shelf products and services based on availability and cost effectiveness.

Using GloMoSim tool, simulations for a direct action scenario are ran and the efficiency of on-demand and table-driven routing protocols under different bandwidths and communications loads is compared.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Special Operation Forces, Ad Hoc, Wireless, Mobile Communications, Information Operations, Electromagnetic Pulse Weapons, EMP

A MAIL FILE ADMINISTRATION TOOL FOR A MULTI-LEVEL HIGH ASSURANCE LAN

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Department of Defense official communications often require special protections to prevent accidental disclosure to unauthorized personnel. A Multilevel High Assurance LAN provides a framework for secure electronic communications, and obviates the need for multiple single level networks. A high assurance trusted computing base (TCB), allows untrusted commercial off-the-shelf (COTS) software, such as an Internet Message Access Protocol (IMAP) server, to run untrusted while access to the file system is mediated by the TCB. Control of creation and deletion of hierarchical structured objects, such as those in the file system, is based on the ability to write to the directory containing the object. For a mail server, this directory structure corresponds to a mailbox hierarchy. The mailbox hierarchy must be designed to allow users to read, create, and send mail at multiple levels. The purpose of this research is to develop a trusted process that automatically creates the mailbox hierarchy for any system user. A Mail File Administration Tool for a Multi-Level High Assurance LAN allows administrators to easily set up IMAP-compatible mailboxes for each user. The tool assists in the management of the file structure and enables account administration for multiple LAN users and group accounts at multiple security levels.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Electronic Mail, Multi-Level, High Assurance, IMAP

REQUIREMENTS REUSE IN SUPPORT OF THE AVIATION MISSION PLANNING SYSTEM MIGRATION TO THE JOINT MISSION PLANNING SYSTEM

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Developing correct, complete, consistent and clearly defined requirements is expensive and time-consuming, but is critical to the success of software development. Existing written requirements represent a vast source of domain knowledge that a software analyst can extract for the design of new systems. This thesis describes a modeling process and tool set to identify similar requirements in two requirement documents. The methods developed were tested in a comparison of the Aviation Mission Planning System (AMPS) legacy software and the new Joint Mission Planning System (JMPS). The analysis process creates domain entities, a requirements repository, and statistical matching information for a domain analyst to evaluate reuse potential. Several key tools were automated. The results show that the proposed process and tools significantly shorten the time needed to reuse software requirements.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Human Systems Interface

KEYWORDS: Requirements Reuse, Keyword Matching, Aviation Mission Planning System, Joint Mission Planning System, Domain Modeling, Domain Analysis

**DESIGN AND IMPLEMENTATION OF A PLATFORM INDEPENDENT
PROTOTYPE SPECIFICATION EDITOR**

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The Computer Aided Prototyping System (CAPS) developed by the Computer Science Department, Naval Postgraduate School, is an integrated set of tools that is used for rapid prototyping of real time systems. The PSDL editor, a key component of CAPS, allows users to specify prototype design graphically through data flow diagrams and data flow component property menus, and automatically translates the graphical objects into textual specification written in the Prototype System Description Language (PSDL).

This thesis builds upon the previous work done on the CAPS editor design and develops an improved Java based graphic/text editor for the PSDL. New functionality is added to increase the user friendliness of the editor and maintain design consistency in real time. The new enhanced editor provides undo/redo and other essential editing functionality, automatic completion of stream types, as well as automatic checking and propagation of the timing constraints.

The new editor is more powerful than ever. It tested successfully in classroom to generate prototype and has been used as a tool for software engineering graduate students to design their computer aided prototype project.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Computer-Aided Rapid Prototyping, Software Specification, Real Time System, Graphic Editor, Java