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Edited by
Vevek Ram
FOREWORD

This book is a collection of papers presented at the National Research and Development Conference of the Institute of Computer Scientists and Information Technologists, held on 26 & 27 September, at the Interaction Conference Centre, University of Natal, Durban. The Conference was organised by the Department of Computer Science and Information Systems of The University of Natal, Pietermaritzburg.

The papers contained herein range from serious technical research to work-in-progress reports of current research to industry and commercial practice and experience. It has been a difficult task maintaining an adequate and representative spread of interests and a high standard of scholarship at the same time. Nevertheless, the conference boasts a wide range of high quality papers. The program committee decided not only to accept papers that are publishable in their present form, but also papers which reflect this potential in order to encourage young researchers and to involve practitioners from commerce and industry.

The organisers would like to thank IBM South Africa for their generous sponsorship and all the members of the organising and program committees, and the referees for making the conference a success. The organisers are indebted to the Computer Society of South Africa (Natal Chapter) for promoting the conference among its members and also to the staff and management of the Interaction Conference Centre for their contribution to the success of the conference.

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AUTOMATED NETWORK MANAGEMENT USING ARTIFICIAL INTELLIGENCE

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Abstract
Automating network management is regarded as a prerequisite for further plant automation. Artificial intelligence techniques, such as case based reasoning, topological reasoning and automated learning enable automated network and plant operations and also support tool development for general automation.

1 INTRODUCTION
The approach presented here was initiated by Sumitomo Metals and IBM Japan in 1987. It has achieved a satisfactory level of automated network operations in 1989. Since then the main emphasis lies with tool development for plant operations automation and cooperation enablers.

2 AUTOMATING AUTOMATION
2.1 Case-based Reasoning for Network Automation
The implementation of a computerized helpdesk via case-based reasoning was used a vehicle to achieve the automation of network functions, such as performance monitoring, defective path bypassing and overcoming slowdown effects by buffer size management. Since the AAAI-91 the productivity increase in knowledge engineering by separating knowledge into generic and episodic knowledge is studied worldwide and led among many others to Petrak's VIE-CBR[1].

2.2 Multimeda Front-Ends for Network Management Systems
Shared knowledge of network data enable the most productive use for network management, if skill differences in interpretation through different users are bridged by multimedia support.

2.3 Integrating a Communications Network for Manufacturing Applications
The EPRIT Project 7096 Computer Integrated Manufacturing and Engineering(CIME) started in 1993 and is based on an open software platform and using standard interfaces (MAP 3.0). The network management component supports the configuration of the network, monitors its performance, localizes and diagnoses defects and suggests repair actions. Flexible manufacturing is supported by Agile Intelligent Manufacturing Systems (AIMS). Those comprise self-controlling production islands and autonomous-cooperative structures supporting man-machine communication. The peripheral system parts such as CAD, production planning and maintenance are fully integrated[5].

2.4 Group Decision Support and Quality Management
The quality of a product or a service is ensured through quality control measurements (ISO9001) and guidance (ISO8402). Total quality management changes the focus from the defect-free product to the process. Permanent quality monitoring and improvement becomes an obligation of top management. Process improvements require the participation of all people engaged in the process. The performance of networks is benchmarked against service level agreements. Deviations may necessitate negotiations for new agreements if technical solutions are out of sight. Lincoln[1] argues: "The parallel between the structures of advanced production plants and Japanese organization is explained by the substitution in both cases of a social for a technological imperative." Greene R.[2] describes the AI based social delivery vehicles suitable for this approach: auxiliary knowledge engineers, application qualification tours, tool courses, group readings and coding sessions in AI and cognition improvement trainings.
SUMITOMO METALS NETWORK AUTOMATION

In 1988 Sumitomo Metals needed to control more than 1000 terminals attached to dual IBM hosts in an SNA environment with response time requirements below 0.8 seconds. NetView is the product family offering SNA Management Services. The used version resides on hosts and supports management tasks, such as configuration, problem and change management, performance monitoring and tuning, accounting and general network operation. All managed objects are connected to VTAM mostly via NCP. VTAM is the control point for management. NetView monitors the network via Session Awareness(SAW), receipt of VTAM messages, reports from the network components and NetView's command capability. The protocol used is the Network Management Transport Vector(NMVT). Filters can be applied to the NMVT messages. In order to support Sumitomo's RYO VTAM a gateway has been built to make the non-SNA devices emulate SNA devices. NMVT does not have such a clean information model as Internet's SNMP and ISO CMIP. Corresponding to their information model but less structured the NMVT carries protocol messages and their permitted values require lengthy search procedures. Alert and Response Time monitoring were the major applications for NMVT. Basic Alert subvector and Generic Alert Subvector identify among others alerttype, cause of alert and component type. The actual response data is contained in the RTM subvector. Syntax and semantics of the various objects and their attributes are defined at multiple places and make specifications hard to manage. The availability of products for all seven SNA-layers was decisive for the chosen approach.

AUTOMATED OPERATIONS USING AI

4.1 A Model for Managing Communication Objects

On the level of the information model no correspondence between SNA's NMTV patchwork and TCP/IP's Management Information Base(MIB) was achieved and the so the ISO standard Abstract Syntax Notation One(ASN.1) was not applied for describing the NMTV protocol. The identification of OPS5(=KnowledgeTool) modules with network management agents allowed dividing the function of network monitoring into logical modules. Automated Network Administration <=> Management Application(Management Agent) <=> Managed Object(Monitoring Agent).

The Management Agent employs a Summarization Monitoring Agent(NetView) to collect and filter the network monitoring information from various Monitoring Agents which are responsible for one or multiple managed objects. All these functions are provided through Netview.

4.2 The Access to Monitoring Agents

Each network addressable unit in a SNA environment is called a node. In a node there is always a Monitoring Agent, which the SNA terminology calls Physical Unit(PU). A Management Agent is a pre-configured listener for the monitored information. The change of pre-selected states in the managed objects triggers events which are forwarded to the listener without an explicit read request. The events are conveyed in terms of event codes and event arguments, similar to error codes of computer programs. The accessible information is modeled as hierarchical objects, the attributes having complicated data types. The protocol allows searching by filters or browsing through the hierarchy.

5. Case Based Reasoning for Helpdesk Functions

This function is achieved by a 'fusion' of database and expert system technology. The structure of each LHS in a rule is restricted to three conditions fitting into a mask of 214 bytes each and the RHS is restricted to maximally three actions with maximally 199 bytes, thus allowing the storage of all rules in a relational database. This allows a straightforward implementation of a learning helpdesk through rule updates in the relational rule data base.

BIBLIOGRAPHY