Lecture Notes in Computer Science

Edited by G. Goos and J. Hartmanis

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3rd Conference of the European Cooperation in Informatics
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Editors

Arie Duijvestijn
Onderafdeling Informatica, Technische Hogeschool Twente
Postbus 217, 7500 AE Enschede, The Netherlands

Peter Christian Lockemann
Fakultät für Informatik, Universität Karlsruhe
Zirkel 2, D–7500 Karlsruhe 1, Germany

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F O R E W O R D

It is with the greatest sadness that I have taken over from my deceased friend Klaus Samelson the chairmanship of this conference. Klaus Samelson has pursued with great energy the aims of the European Cooperation in Informatics. The conference will be mourning his untimely death: in particular one of the lectures on October 21, 1981 will be a Memorial Lecture in honour of this pioneer of computing.

My particular thanks go to the Programme Committee under the chairmanship of Prof. A.J.W. Duijvestijn (Enschede, The Netherlands), to the Organizing Committee under the chairmanship of Prof. M. Paul (Munich, Germany), and to the GI-Coordinator, Prof. W. Brauer (Hamburg, Germany).
The Technical University of Munich with its Faculty of Mathematics and Informatics, represented by the Institut für Informatik, which is hosting the conference, is also to be thanked, as well as a number of organizations which have given moral and financial support.

I hope the participants will have a fruitful meeting in an atmosphere of Munich friendliness.

F.L. Bauer

EDITORS' PREFACE

Computer systems of the eighties will look different from those of the seventies. Micro-electronics and modern communication technology will provide for increasing data processing and transmission power at decreasing cost. This trend is counter-balanced by the soaring software cost which can only be controlled by higher productivity in software construction. The progress achieved in these areas will have a profound effect on future computer systems.

To explore the trend in all these areas, to discuss the interrelationships between them, to offer solutions to currently recognized problems and to identify the most pressing issues of the future, a large community of informatics experts from the academic world, industry and government gathered for the third Conference of the European Cooperation in Informatics, held in Munich on October 20-22, 1981. A number of eminent speakers presented overviews over a wide range of relevant topics as well as in-depth studies of detailed problems. The program committee is grateful to all invited speakers who readily accepted our invitations. The committee also thanks all authors who submitted papers and contributed to the success of the conference.

For the first time the conference was held in conjunction with a national conference, the eleventh Annual Conference of the Gesellschaft für Informatik. The combination of the two conferences has added to the attraction by covering a wider spectrum of interesting topics, and by contributing further papers to the main topic of trends in information processing systems. The papers of the national conference can be found in separate proceedings. It was fortunate for the conference that an International Computer Fair was held in Munich at the same time, giving the conference participants the opportunity to acquaint themselves how far the trends have already progressed in practice.

This book contains the invited papers (or their extended abstracts) and the submitted papers selected for the conference. Subjects covered include various aspects of software engineering, distributed and database systems, programming languages, data communication, new computer architectures and performance analysis.

Elsewhere the reader will find the names of the Program Committee members, who fulfilled their role with admirable dedication. In selecting the papers, the committee had the help of many wellknown specialists, and we wish to thank all of them for their contributions.

The plans for the conference were initiated by Klaus Samelson, who so suddenly died in the midst of his scientific activities. Klaus Samelson was one of the driving forces behind the European Cooperation in Informatics.
His loss has been acutely felt by the international informatics community. To him go our special thanks and memories.

A.J.W. Duijvestijn.

P.C. Lockemann.

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ARCHITECTURE FOR OFFICE AUTOMATION

by James L. Cox
IBM Corporation
Boulder, Colorado, USA

ABSTRACT

The development of architecture which will facilitate office automation by enabling various office machines to cooperate in performing office system functions is examined. The goals and objectives for the initial steps toward an automated office system are related to an enumeration of the specific architectures which will be required. A general description of the capability of each architecture is given along with a discussion of specific architectural requirements and key problem areas. Some examples of architectural solutions to key problems are given. Specifically the approaches taken to the problem of precise architectural definition as it relates to text architecture are discussed. Finally some thoughts on future office system requirements and their architectural implications are given. This paper attempts to enumerate considerations and in some cases approaches to solutions for the office systems architecture problem. The contents are based on approximately three years of office systems architecture development work involving a variety of actual office products.

ARCHITECTURE FOR OFFICE AUTOMATION

INTRODUCTION

In attempting to discuss the architectural problems which are implicit in office automation, one must first attempt to describe the function of an "office" and examine those parts of that function which are candidates for "automation". An office may be defined as a function within a business enterprise where information is collected, analysed and exchanged with the goal of improving some aspect of the enterprise. One may examine the common aspects of information flow in an office without regard for the specific function which any given office serves in a given enterprise.

A business enterprise may be viewed as a collection of "offices". These offices are not rooms but logical organizational entities each of which have a functional purpose within the business. Small businesses typically have large functions such as sales and manufacturing as offices in the sense described. Larger businesses would typically define offices at a finer granularity; for example, manufacturing might be composed of functions like purchasing, parts, assembly, and control. Each office accomplishes its goals through a process of information synthesis and decision making. Information must be collected, analysed, communicated, stored, retrieved and presented in the process of an office achieving its function within a business.

Therefore, one may assert that the primary objective of an office is the efficient collection, exchange, retrieval and presentation of information such that people can make timely decisions concerning the function of the office. All offices are critically dependent on efficient communication to enable them to carry out their function. Information must be effectively communicated among members of the same office in order to insure that the common goals of that office are being effectively pursued and that the proper input for decision making exists. Communications between the office and other organizations are

equally important and these communications often represent the actual work product of the office. It is on the effectiveness of these communications that the success or failure of the office depends. Storage and retrieval of information are vital elements of the function of an office because they provide means by which redundant work can be avoided in the future as well as the means to preserve the process of decision making for future improvement.

Historically the focus of office automation has been in two areas. The preparation of material for viewing by human beings is one area. This includes typing and report preparation activity. The automation direction in the typing area has been to automate certain portions of the typist's task with the goal of increasing the productivity of the typist. There are many products and manufacturers competing for the business of typist automation or "Word Processing". The report preparation area has also spawned many report generator programs and display oriented data base systems. The second area where a significant amount of automation has been focused is the area of business and technical data processing. The many applications of computers to the problems of science and industry is in essence an office automation component. These applications represent the collection of data and its processing and presentation in a form that is intended to be understandable by human decision makers. I will not focus on data processing applications as office automation opportunities in this paper but instead will discuss those primarily people driven systems which are the backbone of all office systems today.

The basic unit of office communication is the document. The document may consist of a one or two page memorandum or a multipage report. Documents are created, modified, approved, distributed, stored and destroyed. The architecture work discussed in this paper will address these phases of a document's life. As has been mentioned earlier one of the primary thrusts of today's office automation has been the improvement of typing efficiency by typing automation or word processing. The word processing machines help essentially clerical personnel to be more efficient in the creation and modification of documents. While these machines have captured the document information in electronic form, it is obvious that the remaining phases of a document's existence should be addressed.

OFFICE SYSTEM

An office system may be thought of as a collection of office machines which may be linked together as desired by the office or business enterprise for the purpose of improving the efficiency of an office or set of offices. The phrase "as desired" is significant because there are an arbitrarily large number of possible office systems. Each actual office or business may have different goals and requirements for its office system. It is unlikely that a single total system can be designed which will satisfy all the system requirements for all offices. One office may begin by simply replacing its normal typewriters with advanced function typewriters or word processing machines. Another office may require a large and complex communication system for electronic document distribution. The architecture for office automation must provide for the connection of a number of machines which each perform different office functions to one another. This architectural property will allow each individual office to construct the office system most responsive to its needs.

The functions required of machines which are to cooperate to form an office system are many and varied. Today there are machines that cover the function spectrum from advanced typewriters to large integrated systems which perform word processing or text functions as well as classical data processing functions. It is important architecturally to provide a means by which each of these machines can connect to other machines and be able to supply needed function for each other on request. For example, an advanced function typewriter should be able to connect to an electronic document distribution "machine" for the purpose of sending or receiving documents in addition to its normal function of assisting in the creation and editing of documents. A word processing machine should be able to connect to a document storage and retrieval system so that documents may be "filed" for later searching and retrieval. A set of architectures are required to support the ability of different machines to connect and functionally cooperate. The spectrum of architectures consists of communication, function requests and document content architectures.

There are many types of communications architectures. In IBM we assume that Systems Network Architecture (SNA)[1] is the primary means of two systems communicating data between themselves. There is currently a great deal of design activity and interest in Local Area Networks or "in

house" communications systems. These local networks will be the primary means of connecting office machines into a system within an office or business enterprise. The common carriers will provide the communications services that are required between business enterprises and standards such as Teletex will be important for document communication in this area. Any communication system which can provide transportation of data between two points with no undetected errors can be used as the basic means of communication for office systems. Of course, all machines must use the same one and that is only a necessary condition for office machines to communicate; however, it is far from sufficient.

The function request architecture provides the capability for one machine to ask another to distribute a document or store a document or search for documents which satisfy certain requirements or perform any function which might be required. In order to achieve goals like this the function request architecture must define precise syntax and semantics for the desired functions. In IBM's approach to office systems this function request architecture is called Document Interchange Architecture or DIA[2]. For electronic document distribution, DIA is analogous to the envelope which contains the letter in a traditional mail system. DIA has provision for addressing the recipients of the document as well as parameters which describe the kind of service required and whether successful delivery should provoke a response. In DIA the document is a syntactic element of the architecture called the document unit. The document unit contains a document profile which describes the standard properties common to all documents and the document content which is the architected form of the document itself. DIA is intended to be the architectural framework in which future office functions are requested and accomplished by loosely coupled office machines.

Document content architectures[2] describe the actual format and meaning of the information which represents the document itself. The document content architectures which are initially required are revisable form text and final form text. Revisable form text is the architecture which is suitable for the creation and subsequent editing or modification of documents. Final form text is an architecture used for the distribution of documents; it is not intended for modification and has properties which enable it to be received and presented by a wide set of receiving devices. It also has the property that all presentations of the document are identical. These two document content architectures provide the function necessary for the creation,