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RIGHTSIZING ACADEMIC COMPUTER APPLICATIONS AT KFUPM

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ABSTRACT. KFUPM is in the process of decentralizing its academic computing environment, a process referred to as rightsizing or downsizing. The rightsizing process began more than two years ago during which time KFUPM has gained much valuable experience. This paper describes this ongoing process. VM-based applications are being ported on smaller machines running a combination of UNIX and DOS/Windows. This paper discusses the motivation and goals of rightsizing, the approach taken in its implementation, and describes its phases. The planning and implementation procedures used could be applicable to other establishments who are considering such a process.

1. INTRODUCTION

Rightsizing computer applications was adopted, more than two years ago, as a strategic direction for the Data Processing Center (DPC) at KFUPM. The definition of the term *rightsizing* varies among professionals in the computer field. The clearest definition to rightsizing is probably the one given in the DATAPRO report [1] and is as follows: *Rightsizing is the complete- but phased- replacement of the entire Information Systems (IS) infrastructure including: hardware, systems software, and application redesign to gain a performance, operations, and maintenance advantage.* An important question arises from this definition: why replace the entire IS infrastructure? The truth of the matter is that computer technology has advanced so rapidly in the last few years that most existing IS infrastructures are relatively ineffective and costly to operate and maintain. Rightsizing in phases would provide gradual but stable new services to users and control the cost of IS. However, rightsizing is not a "one size fits all" solution. There are many characteristics of systems that would be good candidates for rightsizing. A loosely integrated system that requires intelligence at the desktop is an excellent candidate [2].

The mainframe environment is the main target of the rightsizing process. Traditionally, mainframes have been very expensive to operate and maintain because they provided many functions that could not be matched by smaller systems. However, mainframe functions can now be easily substituted with other platforms [3]. Open systems [4] and client servers [5] are almost the de facto target systems. Netware and UNIX are representative of some of the open systems today [6,7], which is why many computing centers are replacing their mainframe environments with a combination of Netware and UNIX environments. Many of these centers have successfully implemented such changes, making significant savings in operation and maintenance costs. Details of two sites are given in references [8,9]. This trend has forced the big computer vendors to provide rightsizing solutions, but on their own

terms [10]. Many books have been written on this subject, one such is listed as referer [11].

This paper describes the experience gained in rightsizing the academic computing environment at KFUPM. In the next section it describes the motivation and goals of rightsizing at KFUPM in general and the findings of the initial feasibility study. Section three describes the implementation procedure of the preliminary rightsizing steps which were necessary to build the basic computing infrastructure for rightsizing the mainframe system. These steps were completed by the end of 1994 and positive results are already appearing. The critical and most important phase of rightsizing at KFUPM is described in section four. This phase involves replacing the mainframe with a UNIX-based machine and expanding the computing infrastructure. This phase is still being implemented. It is hoped that the plan and implementation procedure used in this paper motivates similar centers to do likewise. The benefits are much greater than the deficiencies.

2. FEASIBILITY STUDY AND GOALS

The wide use of personal computers and UNIX workstations and the massive reduction in price/performance ratio was the main motivation behind considering an alternative computing environment at KFUPM. The University computing environment consists of two main systems. One is dedicated to administrative applications such as student information systems, personnel and payroll, material management, library, and financial resources. This system uses an IBM 3090/150E running MVS/XA. The other system is dedicated to academic applications, see Table 1, and uses an AMDAHL 5850 running VM/SP5. Both systems use a unified SNA network throughout the University campus and are linked together and share many computer peripherals. As we will see later in this section the rightsizing process is aimed at the academic computer applications.

Table 1: Academic Applications at KFUPM

Application Name	Description
Mailer System	Electronic Mail System
FORTRAN	Programming Language
C	Programming Language
IMSL	Integrated Math & Stat. Library
GDDM	Graphics Package
SAS	Statistical Analysis System
SQL/DS	Data base management system
CHEMSHARE	Chemical Process simulation
GEOSTAT	Geo statistical package
CALCOMP	Graphics Library
CSMP	Continuous system Modeling
ICES/STRUDL	Integrated Civil Eng. System
ECAP	Electric Circuit Analysis Program
IPSA	Integrated Power System Analysis
ORTEP	Chemical Compounds
SHELX	Chemistry
Surface II	Contouring package

The DPC initiated a rightsizing feasibility study to evaluate its existing IS at the end of 1992. The feasibility study aimed to achieve the following goals:

- (a) Assess the computing infrastructure, facilities and services for both administrative and academic systems and compare them to those in other centers of academic excellence [12].
- (b) Study alternatives to upgrade these facilities; this to be done by taking into consideration the cost benefits and developments made in the area of open-systems and rightsizing computer applications at similar computing centers.

The major findings of this study were:

- The academic computing environment of KFUPM would be an excellent candidate for rightsizing.
- Rightsizing the academic computing environment of KFUPM would provide a better and more cost effective services for the users.
- The cost of rightsizing the academic computing environment of KFUPM would be comparatively less than the cost of upgrading the existing VM machine and its software applications.
- The academic software applications would be available on more than one target computer platform.
- Rightsizing the administrative applications at KFUPM would not be feasible at the time of the study.

The feasibility study was based on case studies of similar computing configurations, and literature and local market surveys, some of which are listed in the references.

Based on the above findings, the rightsizing process was adapted as a strategic direction for the academic computing environment. The rightsizing process aimed to achieve the following goals:

- (a) To build a computing infrastructure and acquire computer facilities to provide the KFUPM community with world-class computing services. This infrastructure should be modular and scaleable.
- (b) To gain from the price/performance ratio reduction by reducing the cost of acquiring new machines and operating and maintaining computer hardware.
- (c) To gain from the open-systems concept by reducing the cost of software licensing.

With a limited IS budget, the challenge was to come up with a balanced formula that could achieve the above three goals without compromising our main goal of providing the best possible computing services. The answer was to plan the rightsizing process well and to do it in phases. The first priority was to build a computer infrastructure that enhanced the use of PCs and UNIX workstations. Such an infrastructure allows personal computers and workstations to be networked throughout the campus resulting in shared computer resources and providing better computer services. The next step should be to phase out the academic computing environment, which consists of the AMDAHL 5850 running the VM/SP5

operating system and all applications running on it. The next section will describe the implementation of the infrastructure that enhances the use of PCs on campus.

3. PRELIMINARY RIGHTSIZING STEPS AT KFUPM

The implementation of rightsizing the academic computing environment began in 1993. Three projects were completed by the end of 1994, forming a major part of the needed infrastructure and expertise.

In the first project, a token ring (TR) backbone computer network with 6 links to academic buildings was established. This network uses fiber-optic cables consisting of two pairs of 62.5/125 mm and runs at a speed of 16 Mbps. The total length of the fiber cables is 4K meters. This project also included the establishing of 11 PC labs consisting of 177 486-based machines. The machines in each lab are connected by a network running Netware 3.11. A Macintosh lab was also established consisting of 17 machines. These labs are distributed among most academic buildings and are connected to the TR backbone network. Inter-Connectivity was also established among all the servers in these labs which means that computer software and hardware can be shared through the backbone. The backbone is also connected to the mainframe SNA network. This provides access to both mainframes from any PC attached to the TR network.

In the second project two more backbone links and two Netware networks were established. One serves the main library and the other serves the College of Industrial Management (CIM). These two projects were completed by the end of 1993.

In the third project, the backbone was expanded to 10 links and more than one hundred PCs were added to the academic computing resources of KFUPM. A list of most PC labs available at KFUPM is shown in Table 2; this list does not include the PC labs managed by some academic departments. A very important step taken and completed in this phase was to internally cable two major academic buildings. The internal cabling system connects smaller networks to departments within buildings and these networks are then connected to the backbone. The internal cabling system covers all offices, rooms, and auditoria of the DPC building and the College of Computer Science and Engineering (CCSE). Two large academic departments, namely EE and ME and one science department, Earth Sciences, are also included in this cabling system. The number of installed access points or ports, is approximately 300.

The cabling system consists of RJ-45 outlets in the offices and level 5 UTP 4-pair cables that are connected to a patch panel and an area hub. Each department has its own area hub(s) which is (are) then connected to a master hub that gives access to the TR backbone. UNIX workstations were also added to the network to enable UNIX users to remotely login to these machines. This phase was completed at the end of 1994. The current KFUPM network is shown in Figure 1.

The backbone network and its associated Netware networks and the cabling system provided the initial infrastructure for rightsizing the applications running on the VM.

This network will have a significant effect on teaching and research at KFUPM as it provides access to a unified computer network that is shared by the whole university community. It

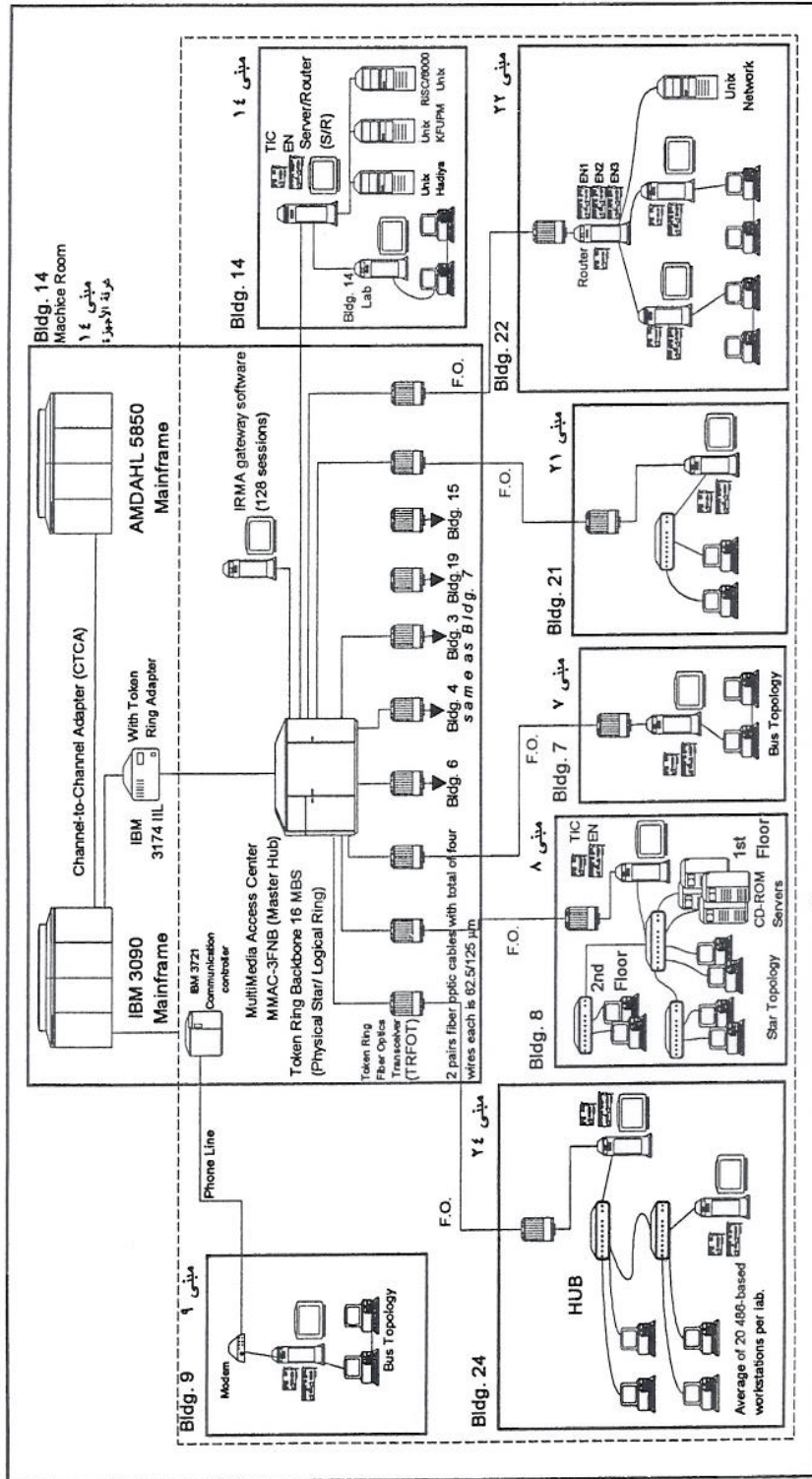


Figure1: KFUPM Integrated Computer Network

provides resource sharing which includes software packages and peripherals. It also enhances electronic communication through e-mail, file-transfer, remote login and many other services.

Table 2: PC Labs at KFUPM

Lab No.	No of PCs	Local Network	Backbone Connection	UNIX access	Function	College/Dept.
3	15	Yes	Yes	Yes	Teaching	CES/CE,PETR,CHE
4	15	Yes	Yes	Yes	Public	All departments
6	25	Yes	Yes	Yes	Teaching	CS/Physics
7	15	Yes	Yes	Yes	Teach./Pub.	CES/Electrical Eng.
8	10	Yes	Yes	Yes	Public	Library CD-ROM
9	25	Yes	No	No	Teaching	All departments
14-1	15	Yes	Yes	Yes	Teach./Pub.	All departments
14-2	8	Yes	No	Yes	Teach./Pub.	MAC lab
19	15	Yes	Yes	Yes	Teach./Pub.	CED/All
22	15	Yes	Yes	Yes	Teach./Pub.	CES/Mech. Eng.
24	25	Yes	Yes	Yes	Teach./Pub.	CIM/All
39	50	Yes	No	No	Teaching	CS/Math. dept.
SD	20	Yes	No	No	Public	Student Dorms

4. RIGHTSIZING THE VM SYSTEM

The critical and most important phase in the rightsizing process is to phase out the VM system. This phase involves two major steps: first, to replace the VM hardware and software by a new open-systems computing environment; second, to replace the VM SNA network with a new backbone and backplane networks.

4.1 Phasing Out the VM System

This step includes phasing out all hardware, software, and to help users to adjust to the new system. Switching to a new operating system requires the support of KFUPM users as they will be the main beneficiaries of the new system. For this purpose, a questionnaire was sent to all academic departments to obtain their views regarding the phasing out of the VM system and replacing it with an open system such as UNIX. The response was very encouraging. All academic departments supported this change. Our next step was to select a system that conforms to open system standards. We conducted a literature and local market survey of the available open UNIX-based systems. The main UNIX vendors were contacted to assess KFUPM's computing environment and to forward a proposal to replace the VM system. Four main vendors forwarded comprehensive initial proposals, namely, Digital, Sun, IBM, and NCR.

Based on our literature survey and the proposals forwarded from vendors, a generic set of specifications for the new computing environment was developed. The specifications included a main server, a UNIX workstation lab, a PC to replace each VM terminal, and further expansion to the backbone and internal cabling of academic buildings. The exact requirements of capacity, speed, memory, peripherals, system software, and compliance with

open-system standards were determined by a capacity planning procedure conducted by the DPC. These specifications were then announced for bidding purposes.

We received many proposals, few of which conformed to the original specifications. We selected the IBM solution to replace the VM system with an AIX V3.2.5 system. This IBM version of UNIX is a complete and stable operating system that provides all the services offered by the VM system. The new system has some features that distinguishes it from all the others. These features include: direct connectivity with the existing VM and MVS systems, the ability to use some of the existing peripherals, and the availability of tools and support for transferring VM files to AIX files. These three very important features are seen as being critical to the success of the rightsizing process. Other features are listed in Table 3.

Table 3: Features of the New Main Server at KFUPM

Hardware Features	Software Features
POWER2 Based	AIX/6000 V3.2.5
Clock speed 71.5MHz	Supports up to 256 concurrent users
256 MB Main memory	AIX Windows/6000
26GB Disk space	TCP/IP
CD ROM drive	SMIT
3.5 inch Drive	NFS
5GB tape drives	Disk mirroring support
1 MB L2 cache	Arabic support
Block Multiprotocol Adapter	Graphics Interface tool kit
Token Ring adapter	AIX FORTRAN
Ethernet adapters	AIX SDE
Asynchronous adapters	C/C++ Power Bench
Serial ports	SNA Server/6000
SCSI-2 controllers	ESSL
S/370 channel emulator adapter	C
Parallel adapters	AIX print service facility/6000
Battery Backup unit	Utilities software

The two systems, VM and AIX, will run in parallel for a minimum of six months. This period will be used for VM users to transfer to the new system and to fine tune it and stabilize the computing services. The DPC will provide the necessary support for VM users to transfer successfully to the new system in the form of an extensive awareness program, full documentation, and individual help for users. Details on the usage and utilization of the new system will be described in a future paper.

4.2 Network Expansion

Providing remote access to the new AIX machine is extremely important for the success of the rightsizing process. VM users previously accessed the system from any building on campus via the SNA network. A dial-up facility consisting of 20 lines was also available. The rightsizing process must provide alternative ways, not only of replacing the SNA network, but also of enhancing system accessibility by providing access from faculty offices and from any point on campus.

We recognized the importance of this step at an early stage, which is why we began by building a computing infrastructure as presented in section 3. Providing access to a faculty office requires two levels of networking. The first level is to connect the building to the backbone TR network through fiber optic cables. Currently, 10 out of 13 academic buildings are connected to this backbone. The rightsizing project involves connecting the other three buildings.

The second level is to internally cable a building to provide access to the individual rooms. Currently three out of the 13 buildings are internally cabled. The rightsizing project involves cabling 8 more academic buildings. It is important to mention that the design of this step is involved and time-consuming. A network team from the DPC studied the floor layout of each of these buildings together with the room assignments and functions, and produced a design that satisfies both the technical and functional requirements. This involved determining the exact locations of the area hubs and the master hub. A network will be established for each department with one or more network segments. These segments will then be concentrated into a master hub that will serve the whole building and provide access to the TR backbone. This process was repeated for each building and completed over a period of three months.

This network expansion will provide individual access points to the great majority of the University community. The total number of access points will be 1200 distributed among 11 academic buildings.

5. CONCLUSION

This paper presents the process of rightsizing the academic computing environment at KFUPM. This process started in 1992 and is still in progress. The results and findings are reported for helping managers and technical staff responsible for similar centers to gain from the KFUPM experience. The planning and the implementation techniques used in this process could be very useful for planning and implementing similar rightsizing projects.

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تطوير القاعدة التقنية والصناعية
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