

# Multiple usage of CD-ROMs in a multi CD-NET from Meridian Data.

**Performance in Practice, evaluated with Medline of Cambridge Scientific Abstracts**

## Introduction

About five years ago the first CD-ROM workstation with Medline of CSA was introduced in the Medical Library of the Erasmus University Rotterdam. After a short period it turned out that only one system was not sufficient and more CD-ROM workstations were gained. In the meantime microcomputers were introduced in almost all departments of the faculty. As a consequence end-users wished to consult Medline at their office or laboratory. In order to meet such demand a connection is needed between the local microcomputer and the CD-player in the library. It is also necessary to change the compact disks from a distance; for that purpose a multi-CD-player is necessary.

The beginning of 1991 in the Faculty of Medicine and Health Sciences of the Erasmus University Rotterdam an Ethernet network was built. At the end of 1991 there were about 1,400 connections to the network. At the same time multi-CD-players became available. By coupling a multi-CD-player to the network it can be accessed by more end-users at the same time.

Not all 1,400 connections of the network are expected to use the system for literature searches. Not taking administrators and technicians into account, about 500 staff members will be regular end-users of the system for searching literature. Probably a maximum of 10 to 20 persons will

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simultaneously use the multi-CD-player.

The following questions arise:

- A to what extent shall a person who is searching for literature notice other end-users of the system. It might be expected that process times will be affected by the total number of end-users.
- B how many end-users of the faculty have actually logged in and searched for literature during the last eight months? How many were simultaneously searching?

## Materials and Methods

In January 1991 CD-NET with five stacked CD-players from Meridian Data was available for testing purposes. It was connected to the network with the CD-roms for the years 1976, 1978, 1987, 1989, 1990 (January-July) of Medline of CSA. As workstations 16 AT microcomputers (Olivetti M280 with hard disk) were connected to the network.

In the tests, situations were simulated in which somebody is searching references with one workstation while other end-users are searching or downloading with other workstations. Therefore one workstation was used with standard functions on the CD-ROM for 1987. The time needed for performing these standard functions was measured. In the mean time a number of other workstations (the number varying

from 0 to 15) were busy with long-lasting activities. Such a long duration was necessary in order to maintain a constant situation during measurements. This was achieved by retrieving references using a non-specific search question for the other workstations: searching a single wildcard takes more than one hour. In practice such a worst case is not quite real: other end-users are keying in search terms, reading resulting references, thinking about other terms, etc.

Question A: what is the effect on the search-time when more than one workstation is busy with searching MEDLINE on CD-ROM.

Standard test functions were:

- 1 searching with realistic search profiles; these were recalled as macros in order to avoid taking into account the time needed for typing the search terms. Sixteen profiles of different sizes were available.
- 2 downloading of large sets of references.

The test situations were:

- 1 one workstation searches references with standard profiles, while other workstations were searching “\*” (constant test situation); search time needed for eight different profiles is measured.
- 2 all workstations searching on the same disk, each using a realistic profile; times measured for each workstation/profile combination is determined separately and with all workstations started at the same time (no constant situation).
- 3 one workstation searching with standard profiles while other workstations are downloading large sets of references (constant situation).

All determinations were performed once. In order to show trends, the search times for a

number of profiles were averaged.

The tests were performed in collaboration with the computer- and automation-department ERC/COH of the Erasmus University Rotterdam.

## Results and Conclusions

Test 1: all workstations searching on the same CD-ROM (1987)

It was evaluated whether the search time is influenced by the total number of simultaneously searching workstations. With one workstation eight search profiles were run separately and the search-times were measured. No other workstations were active. Then one other workstation was starting with searching “\*”, on the same CD-ROM. The search-times for the eight search profiles were determined again. This was repeated until all 16 workstations were searching simultaneously, 15 workstations searching for a wildcard and one for real profiles. The search-times of the eight search profiles, when respectively 1, 2, 3, 4, 5, 7, 11, and 16 workstations were active, are given in table 1. The numbers include the measuring workstation. The mean search time for the eight profiles was calculated.

The mean search times of the columns 2, 3, 4, 5, 7, 11 and 16 were divided by the mean search time of column 1 in order to calculate relative duration factors. These factors are given in the columns “REL”.

Conclusion: the present results suggest that the search-time of a search-profile is prolonged by a factor five when fifteen other workstations are searching simultaneously using a very long-lasting profile.

Test 2: all workstations using real profiles on the same CD-ROM.

It doesn't seem realistic to have the additional workstations searching for the specific question “\*”, as in test 1. Therefore all 16 workstations were started simultaneously, each searching for a different real profile. The resulting search-times are shown in Table 2.

Search pro-file	total number of active workstations (incl. measuring-station)							
	1	2	3	4	5	7	11	16
M9	50	58	67	71	66	152	189	232
M10	45	60	57	65	71	100	155	202
M8	37	50	52	58	99	121	134	183
M1	35	46	62	72	92	108	125	164
M5	24	33	36	58	69	84	104	139
M3	18	23	30	36	45	55	69	91
M14	18	18	27	30	33	49	68	106
M4	15	20	27	33	38	48	54	74
mean	30.0	38.5	44.8	52.9	64.1	89.6	112.3	148.9
rel.	1.0	1.3	1.5	1.8	2.1	3.0	3.7	5.0

Table 1. In column 1 the search-time of eight separate profiles are shown.

In column 2 and the next columns only one workstation is searching for a real profile while an increasing number of workstations are searching for an “\*”.

search pro-file	search time (sec)		rel. duration factor simult./separ.
	separat.	simultan.	
M2	174	345	1.9
M12	88	243	2.7
M15	69	247	3.5
M13	64	233	3.6
M6	61	242	3.9
M7	47	247	5.2
M10	45	198	4.4
M9	42	202	4.8
M8	38	175	4.6
M11	38	197	5.1
M1	36	164	4.5
M16	25	128	5.1
M5	24	-	-
M3	17	99	5.8
M4	16	118	7.3
M14	16	126	7.8
mean	50.0	197.6	4.7

In column 2 the search time of a search profile is given. In column 3 the search times of the same profiles are shown when all 16 workstations were simultaneously busy. The searching was performed on the disk of 1987.

A relative duration factor was calculated by dividing the search times of the simultaneously used profiles and the search times of the separately used profiles.

For some reason one of the workstations (searching with profile 5) halted reporting an error. This did not have any consequence

for usages of the CD-ROM, the other workstations continued with the searching processes.

Conclusion: for the shorter search profiles the duration factor (=5) is about the same as in test 1 (table 1) where the other workstations are searching “\*”. In test 2 the situation is stationary for the profiles of short duration, while for the profiles of longer duration the situation changes: the number of busy workstations decreases during the test. So with increasing time the search proces will accelerate, resulting in smaller relative duration factors. This means that practically all the profiles of longer duration will finish in acceptable times.

Test 3: the effect of downloading on the search-time.

In this test the search-time of a real search profile was measured while the other 15 workstations were already busy with downloading. This test was performed eight times with different search-profiles. Searching and down-loading was performed on the disk of 1987. In table 3 the results are listed.

Column	1	2	
	separat	on 1 disk in 1 field 15 downl.	
	t(sec)	t (sec)	REL
M9	50	120	2.4
M10	45	125	2.7
M8	37	88	2.3
M1	35	101	2.8
M5	24	-	-
M3	18	41	2.2
M14	16	82	5.1
M4	15	37	2.4
mean	30.0	84.9	2.9

Table 3. In column 1 the search-times for each of the eight search-profiles is given.

Column 2 shows search-times of the eight search-profiles when the 15 workstations were downloading large sets of references

from the CD-ROM of 1987 to the hard disks of the workstations.

Specific search times were divided by the separately determined search times (column 1) in order to calculate relative duration factors. These factors are given in the columns 'REL'.

Conclusion: the above results suggest that workstations busy with downloading do not affect the search-time as much as if all fifteen were searching as was shown in Table 1.

## General Discussion

Searching references is not a continuous process: one is typing the key-words, the results are displayed and read, or one is thinking about the next action. The presumption that the search-times are largely prolonged as a consequence of multiple usage of the CD-NET-system, is expected to be less important than in the worst case situations presented in these tests. An elongation of the searching times by a factor 5 in the worst case situation (with 16 searching workstations searching on the same CD-ROM and in the same field) is considered acceptable.

Taking the presented results of this study and related considerations and experience in foreign libraries into account, the Faculty of Medicine and Health Sciences of the Erasmus University Rotterdam decided to purchase a 14-CD-player/server system of CD-NET and to connect it to the network of the faculty.

Question B: how many end-users of the faculty have actually logged in and searched for literature during the last eight months? How many were simultaneously searching?

As already mentioned there are 1400 connections in the network and probably 500 potential end-users. In the office or laboratory the end-user can start a search on the CSA MEDLINE with a single command on the microcomputer. For convenience the

Computer Department installed the SABER MENU driven system. The moment the application is started, the system verifies all relevant parameters. The SABER MENU includes an additional help program SABER-METER which includes a logfile. As soon as an end-user starts a menu-function, the logfile collects several data: the starting time, the logoff, the consulted CD-ROMS, the account number, etc. The frequency and time-duration of which the CD-ROM of the eight recent years were used, are given in table 4. Searches of less than one minute are not feasible and are therefore not taken into account. The same was done with searches longer than one hour, because it was possible that somebody forgot to logoff the computer after searching.

Table 4. In column 3 the number of search-actions in the months November 1991 until June 1992 are shown. These actions were performed on the MEDLINE CD-ROM of 1981 till June 1992. In column 5 the total number of search-hours in that particular month is given.

month	number of working days	number of actions	actions per day	number of hours
Nov 1991	22	1738	79.0	724
Dec 1991	18	1296	72.0	613
Jan 1992	20	1586	79.3	743
Feb 1992	22	2382	108.3	945
Mar 1992	22	2055	93.4	955
Apr 1992	22	2103	95.6	1000
May 1992	14	1132	80.8	595
Jun 1992	21	1827	87.0	925

During the months March, April, May and June 7117 searches were done (table 4). However the SABER-MENU stated that during these four months on only two occasions were 12 end-users simultaneously busy in searching or downloading. Thus as expected the search-times will be rarely extensively prolonged.

Conclusion: Despite the high frequency of use of the MEDLINE on CD-ROM (table 4) the duration of the search-times (tables 1 and 2) are acceptable for end-users in the faculty.