

Natural Buffer Pool

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Buffer Pool under Windows

Since Natural generates reentrant Natural object code, it is possible that a single copy of a Natural object can be executed by more than one user at the same time. For this purpose, each object is loaded only once from the system file into the Natural buffer pool, instead of being loaded by every caller of the object.

Thus, the purpose of the Natural buffer pool is to share Natural objects between several Natural users working on the same computer. It is a pool of storage into which programs compiled with Natural are loaded in preparation for execution. They are moved into and out of the buffer pool as Natural users request Natural objects.

Objects in the buffer pool can be programs, subprograms, maps, global data areas, local data areas, parameter data areas and copycodes. Local data areas, parameter data areas and copycodes are only placed in the buffer pool for compilation purposes.

When a Natural object is loaded into the buffer pool, a control block is allocated for that object. This control block contains information such as the name of the object, what library or application it belongs to, what database ID and Natural system file number the object was retrieved from, and certain statistical information (for example, the number of users who are concurrently executing a program).

Resource sharing requires that access to the buffer pool is coordinated among all users. Several system resources are necessary to accomplish this. For example, shared memory on a UNIX operating system is used to store the objects and their administrative information. To synchronize access to these objects, a set of semaphores is used. The amount of available shared memory and the number of semaphores is configured statically in the operating system, and as a result, it may be necessary to change system parameters and to recreate the operating system kernel for your installation. Further information about these topics is system-dependent and is described in the Natural installation manual for your UNIX computer. For OpenVMS, the buffer pool uses a standard locking mechanism which does not need to be configured by the administrator.

Several instances of the Natural buffer pool can be started on one computer, depending on the individual requirements. It is also possible to run different versions of the buffer pool on one computer without any problems. These buffer pools have nothing in common, except that they run on the same computer.

When a user executes a program, a call is made to the buffer pool manager. The directory entries are searched to see if the program exists. If it does not exist in the buffer pool, a copy is retrieved from the appropriate library and loaded into the buffer pool.

When a Natural object is being loaded into the buffer pool, a new directory entry is defined to identify this program, and one or more other Natural objects which are currently not being executed may be deleted from the buffer pool in order to make room for the newly loaded object.

For this purpose, the buffer pool maintains a record of which user is currently using which object, and it detects situations in which a user exits Natural without releasing all its objects. It dynamically deletes unused or out-of-date objects to accommodate new objects belonging to other applications.

When you are using the Natural buffer pool, only minimum restrictions must be considered:

- When a Natural session hangs up, do not terminate it by using WindowsNT Task Manager
- If this process is performing changes to the buffer pool internal data structures, an interruption may occur at a stage where the update is not fully completed. If the buffer pool internal data structures are inconsistent, this could have negative effects.

Note:

This can only happen when the Natural nucleus is executing buffer pool routines.

Setting up the Buffer Pool under Windows NT

The buffer pool is set up by making various specifications with the Natural Configuration Utility.

To start the Natural Configuration Utility

- From the "Start" menu, choose "Programs", then "Natural *version*", then "Natural *version* Configuration Utility".
- Select the "Local Configuration File" and then "Buffer Pool Assignments".
- A dialog is displayed in which you can make the following buffer pool specifications:
 - Buffer Pool ID (BP or BPID)** = the name of the buffer pool.
 - BPSIZE** = size (in MB) of the buffer pool.
 - MAXUSER** = maximum number of concurrent processes.
 - BPNLE** = number of directory entries.

Windows NT Service

Natural for Windows NT uses a service to start the Buffer Pool Server when the PC is booted.

Natural for Windows NT is installed with the default buffer pool NATBP, which is also used as the default buffer pool name at Natural start up.

You can modify the service configuration to meet your requirements. The following commands are available in the Command Line Interface.

Natural Buffer Pool Service Commands

- Install Service
- Remove Service
- Start Service
- Start the Specified Buffer Pool
- Stop Service
- Stop the Specified Buffer Pool
- Create New Buffer Pool To Be Started by the Service
- Delete Specified Buffer Pool from the Service
- Define Whether Specified Buffer Pool Is To Be Started When the Service Is Started
- Display the Buffer Pools Defined for the Service and Whether These Buffer Pools Are To Be Started When the Service Is Started
- Display Whether the Specified Buffer Pool Is To Be Started When the Service Is Started
- Display Status of All Buffer Pools - Active or Not Active
- Display Status of a Specified Buffer Pool - Active or Not Active

Install Service

NATBPSVC INSTALL *manual (default) / automatic*

Two parameters are available: manual (default) and automatic.

Manual: Service is installed and must be started manually (either from the Start Service command or from the "Services" dialog in the "Control Panel").

Automatic: Service is installed and automatically started when the PC is booted.

Example for manual:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Install
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Natural version Bufferpool Service successfully installed
%NATBPSVC-I: Path of binary is F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE
%NATBPSVC-I: Startup mode of Natural version Bufferpool Service is 'Manual'
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Example for automatic:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Install Automatic
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Natural version Bufferpool Service successfully installed
%NATBPSVC-I: Path of binary is F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE
%NATBPSVC-I: Startup mode of Natural version Bufferpool Service is 'Automatic'
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Remove Service

NATBPSVC REMOVE

Remove the service from the system.

Example:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Remove
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Natural version Bufferpool Service successfully removed
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Start Service

NATBPSVC START

Start service if not yet active, and also start all created buffer pools (with parameter Start=Yes). See commands Create and Set.

Example:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Start
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Starting Natural version Bufferpool Service .
%NATBPSVC-I: Natural version Bufferpool Service started
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Start the Specified Buffer Pool

NATBPSVC START *bufferpool-name*

Starts the specified buffer pool. If the service has not been started (automatically at boot time or manually by the user) an error message is displayed.

Example:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Start NATBP
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Send request to Natural version Bufferpool Service
%NATBPSVC-I: Bufferpool 'NATBP' successfully started
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Stop Service

NATBPSVC STOP

Stops the service and stops all previously started buffer pools.

Example:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Stop
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Stopping Natural version Bufferpool Service
%NATBPSVC-I: Natural version Bufferpool Service stopped
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Stop the Specified Buffer Pool

NATBPSVC STOP *bufferpool-name*

Example:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Stop NATBP
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Send request to Natural version Bufferpool Service
%NATBPSVC-I: Bufferpool 'NATBP' successfully stopped
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Create New Buffer Pool To Be Started by the Service

NATBPSVC CREATE *bufferpool-name*

The Service checks whether the buffer pool with the specified name is defined in Natural parameter file.

Example:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Create NATBP
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: New Bufferpool 'NATBP' created
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Delete Specified Buffer Pool from the Service

NATBPSVC DELETE *bufferpool-name*

Example:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Delete NATBP
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Bufferpool 'NATBP' deleted
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Define Whether Specified Buffer Pool Is To Be Started When the Service Is Started

NATBPSVC SET *bufferpool-name* start= *yes/no*

The default is "no".

Examples:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Set NATBP Start=Yes
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Configuration successfully set
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

or

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Set NATXY Start=No
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Configuration successfully set
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Display the Buffer Pools Defined for the Service and Whether These Buffer Pools Are To Be Started When the Service Is Started

NATBPSVC SHOW

Display configuration parameters for all buffer pools.

Example:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Show
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Settings for Natural version Bufferpool Service:
%NATBPSVC-I: Number of Bufferpools is 1
%NATBPSVC-I: Settings for Bufferpool 'NATBP'      : START=Yes
%NATBPSVC-I: Settings for Bufferpool 'NATXY'     : START=No
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Display Whether the Specified Buffer Pool Is To Be Started When the Service Is Started

NATBPSVC SHOW *bufferpool-name*

Display configuration parameters for specified buffer pool.

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Show NATBP
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Settings for Bufferpool 'NATBP' : START=Yes
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Display Status of All Buffer Pools - Active or Not Active

NATBPSVC STATUS

Example:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Status
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Send request to Natural version Bufferpool Service
%NATBPSVC-I: NATBP is active
%NATBPSVC-I: NATXY is not active
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

Display Status of a Specified Buffer Pool - Active or Not Active

NATBPSVC STATUS *bufferpool-name*

Example:

```
F:\SAG\NAT\Vnnn\BIN\NATBPSVC.EXE Status NATBP
%NATBPSVC-I: Natural version Bufferpool Service configuration startup
%NATBPSVC-I: Send request to Natural version Bufferpool Service
%NATBPSVC-I: NATBP is active
%NATBPSVC-I: Natural version Bufferpool Service configuration done
```

NATBPMON Utility

This utility should not be generally accessible to all users of Natural, because its use can cause damage to the work of other users of the buffer pool.

The purpose of the Natural utility NATBPMON is to monitor the buffer pool's activity during its operation. NATBPMON can also be used to shut down the buffer pool, when Natural must be stopped on a computer.

NATBPMON collects information on the current state of your Natural buffer pool.

The buffer pool contains Natural objects (such as maps, programs and subprograms). When an object is invoked, Natural tries to find the object in the buffer pool. If the object is found in the buffer pool, it will be executed without accessing the system file where it is stored. If the object is not found in the buffer pool, the system file containing the object will be accessed, the object copied, and the copy placed in the buffer pool.

All objects in the buffer pool are node-specific and if an object is updated or changed in one node, the object will automatically be deleted from the buffer pool running on this node. But if the same object exists in the buffer pool of another node, the object in the buffer pool of the other node remains unchanged.

How to Invoke NATBPMON

You invoke the NATBPMON utility by selecting the Natural Buffer Pool Monitor in the Natural Program group or by choosing Run from the Windows NT Start Menu:

...*Vnnn*\Bin\natbpmon.exe

By default, the buffer pool "NATBP" is used. If another buffer pool is to be used, you invoke NATBPMON as follows:

...*Vnnn*\Bin\natbpmon.exe BP=*buffer-pool-name*

Once you have invoked NATBPMON, the following prompt is displayed in a DOS box:

NATBPMON>

NATBPMON Commands

NATBPMON provides several commands, which you enter at the NATBPMON. The prompt individual commands are described below.

CLEAR

```
CLEAR
```

This is a synonym of the ZERO command.

CORPSES

```
CORPSES
```

The CORPSES command is used to display the list of "corpses".

A "corpse" is an object that has been deleted, but was still being used in the buffer pool when its deletion took place.

Once this object is no longer being used, it will automatically disappear from the list of "corpses".

Note:

The column "cusr" (described with the DIR command) indicates if an object is being used.

DELETE

```
DELETE { PATTERN | * }
```

The DELETE command is used to delete an object from the buffer pool.

All objects can be deleted from a buffer pool by using an asterisk (*).

A *pattern* is used to specify a collection of objects, similar to current operating systems which allow the specification of a class of files with wildcards. For details on how to specify a *pattern*, see the DIR command below.

DIR

DIR { PATTERN | * }

The DIR command is used to display a directory containing all objects in a buffer pool.

This list of objects contains the following information:

Column	Explanation
indx	A number that the NATBPMON utility automatically assigns to an object when it is loaded into the buffer pool.
cusr	The current number of users that are using an object in the buffer pool.
pusr	The peak number of concurrent activations of an object in the buffer pool.
nusg	The number of times an object has been activated in the buffer pool.
g	Specifies if an object is being loaded into the buffer pool from the system file and will have either of the following values: 0 - The object is not being loaded. 1 -The object is being loaded.
size	Specifies the size (in bytes) of an object in the buffer pool.
KeyN	Specifies the following information about an object: The name of the object. L -The library in which the object is located. K -The kind of object (G=generated object module; S=source; D=part of FILEDIR.SAG). T -The object type (which is "blank" in the case of "D" in the K field).

When the DIR command is issued, all objects in the pool will be displayed in a notation similar to the following:

```
NATBPMON>dir
indx:  index of the element
cusr:  current number of concurrent users
pusr:  peak number of concurrent users
nusg:  number of usages
g   :  set if object is generating
```

```
indx  cusr  pusr  nusg  g   size  key
```

```
1    0    1    4    0    920    (N="SEL-MAP" L="DEMO" K='G' T='M')
2    0    1    2    0    3096    (N="EMWND" L="DEMO" K='G' T='P')
3    0    1    4    0    604    (N="HDR" L="DEMO" K='G' T='P')
4    0    1    7    0    412    (N="MMUPROG1" L="RPA" K='G' T='P')
5    0    1    5    0    372    (N="MMUPROG2" L="RPA" K='G' T='P')
6    0    1    4    0    372    (N="MMUPROG3" L="RPA" K='G' T='P')
```

To select some objects, it is possible to restrict the values of certain key fields by specifying a matching pattern expression.

To restrict the allowed field values of a given field, the following pattern notation must be used:

name=expression

You can specify multiple patterns by separating them with a comma.

The specified patterns must all match their corresponding fields in order to accept the entire key.

The expression accepts the specification of the wildcard characters "*" and "?".

The character "*" matches any sequence of characters (also none), and the wildcard character "?" matches exactly one character.

To select all objects of type "P" in the sample above, the following command would be used:

DIR T=P

To select all programs in the demo library, the following command would be used:

DIR T=P, L=DEMO

To select all objects containing an "M" in their name, the following command would be used:

DIR N=*M*

The special pattern "*" exists, which matches all objects stored in the buffer pool. To select all objects, the following command can be used:

DIR *

DUMP

DUMP

Do not use this command unless you are requested to do so by Software AG Support.

The DUMP command is used for error analysis.

EXIT

EXIT

The EXIT command is used to exit the NATBPMON utility.

HELP

HELP

The HELP command is used to display a list of all available NATBPMON commands.

PARAM

Is used to display the Natural Buffer Pool settings.

```
NATBPMON> param
Active since .....: 11-03-2002 09:49:09.87, Version 1.3(435)
Last time cleared .....: 11-03-2002 09:49:09.87

Bpid .....: NATBP
Shmkey.....: NAT411BPSEM_0X14111111
Semkey.....: NAT411BPSEM_0X14111111
Memsize .....:10485760
Maxusers .....: 10
```

QUIT

QUIT

The QUIT command is used to exit the NATBPMON utility; it is a synonym for EXIT.

SHUTDOWN

SHUTDOWN

The SHUTDOWN command is used to shut down the buffer pool.

No new users will be able to use the buffer pool once this command has been issued.

The NATBPMON utility is able to run with the pool, which has the status shutdown "pending" (All commands are available with shutdown "pending").

STATUS

STATUS

The STATUS command is used to display statistical information about the buffer pool.

The following statistics are displayed:

```
NATBPMON> status
Active since .....: 11-03-2002 09:52:09.87, Version 1.3(435)
Last time cleared .....: 11-03-2002 09:52:09.87
Bpid .....: NATBP
Allocated memory (bytes) .....: 1256436 Current users .....: 2
Smallest allocation .....: 20 Peak users .....: 2
Largest allocation .....: 145404 Dead users purged .....: 4
Free memory (bytes) .....: 9229336
Smallest free .....: 15996
Largest free .....: 6355900

Dormant objects .....: 204 Smallest object (bytes) .....: 316
Active objects .....: 0 Largest object (bytes) .....: 43048
Generating objects .....: 0 Total object sizes .....: 1072570
Obsolete objects .....: 0

Attempted locates .....: 126396 Stored objects .....: 0
Attempted fast locates .....: 60116 Loaded objects .....: 3126
Successful fast locates .....: 55528 Activated objects .....: 114323
Percent .....: 92.37 Aborted loads .....: 0

Dormant objects purged .....: 0 Peak parallel activations ...: 2
Object reuse factor .....: 36.57
NATBPMON>
```

Explanation of the individual statistics:

General Information	
Active since	Date and time when the buffer pool was started and the version number of the buffer pool.
Last time cleared	Date and time when the buffer pool was most recently cleared.
BPID	Buffer pool ID.
Memory Allocation	
Allocated memory (bytes)	Sum total of all allocated memory.
Smallest allocation	Smallest amount of allocated memory.
Largest allocation	Largest amount of allocated memory.
Free memory (bytes)	Sum total of all free memory.
Smallest free	Smallest amount of contiguous free memory.
Largest free	Largest amount of contiguous free memory.
User Statistics	
Current users	Number of users currently using the buffer pool.
Peak users	Peak number of users that have been using the buffer pool.
Dead users purged	Number of inactive users that have been deleted from the buffer pool.
Object Use Statistics	
Dormant objects	Number of available, but inactive objects. These objects are in the buffer pool, but are not being used. They are available for later use.
Active objects	Number of active objects. These objects are currently in use by one of the buffer pool users.
Generating objects	Number of objects that are currently being loaded into the buffer pool. These objects will become available as soon as the load operation completes.
Obsolete objects	Number of objects that are to be deleted from the buffer pool, but are still being used. These object can be displayed by using the CORPSES command.
Object Size Statistics	
Smallest object (bytes)	Size of smallest object in the buffer pool.
Largest object (bytes)	Size of largest object in the buffer pool.
Total object sizes	Total size of all objects in the buffer pool.
Locate Statistics	
Attempted locates	Number of object locates. This is the number of object activations when the former location of an object was known.
Attempted fast locates	Number of attempted activations with known slot. This is the number of object activations when the former location of an object was known. It is highly probable that an object can be found in the same place in the buffer pool when it is reactivated.
Successful fast locates	Number of successful fast locates.
Percent	Percentage of successful fast locates.

Object Loading Statistics	
Stored objects	The number of objects stored in the buffer pool. This is the number of objects that were stored into the buffer pool and which were not loaded from the system file.
Loaded objects	The number of objects loaded from the system file.
Activated objects	The number of objects activated from the buffer pool.
Aborted loads	The number of load operations that were aborted due to memory shortages within the buffer pool, or due to other events.
General Loading Statistics	
Objects purged	The number of unused objects deleted from the buffer pool to make room for newly loaded ones.
Peak parallel activations	The maximum number of parallel activations of one of the objects in the buffer pool.
Object reuse factor	Average number of times an object was reactivated. This number is the ratio of the number of object activations to the number of objects loaded into the buffer pool.

WHO

WHO

The WHO command is used to display a list of all users who are using the buffer pool.

The following statistics are displayed:

Statistic	Explanation
index	A number that the NATBPMON utility automatically assigns to each buffer pool user.
tid	The user ID, terminal ID and process ID of a process using the buffer pool.

ZERO

ZERO

The ZERO command is used to reset to "0" all counters that are displayed by the STATUS command.

Buffer Pool Trouble Shooting

The following is a typical command output example with the explanation what went wrong during its execution.

Problem

Either Natural or the NATBPMON utility cannot be started.

Examples

You chose from the Start Menu Run ... `\Vmmn\bin\Natural`

```
Natural Startup Error 16: Unable to open buffer pool.  
Buffer Pool error: "unexpected system call error occurred" (20)  
Buffer pool could not attach to the global shared memory.
```

You chose from the Start Menu Run ... `\Vmmn\bin\NATBPMON`

```
Cannot get shared memory  
Buffer Pool error: "unexpected system call error occurred" (20)  
Buffer pool could not attach to the global shared memory.
```

These two examples describe one of the most typical problems you are likely to encounter as a Natural administrator or user. These problems occur when you start Natural or the NATBPMON utility, and the buffer pool is not active.

Solution

Start the buffer pool service.