FUJITSU

Description Paper
Net-Storage Guide
BS2000 (from OSD V9)

Content

1. Terms

In the context of Net-Storage, the following terms are used in BS2000 OSD/BC:

Net Server
This is a file server in the worldwide computer network which provides storage space (Network Attached Storage, NAS) for use by other servers and offers the corresponding file server services.

Net-Storage
This is the storage space provided in the computer network by a net server and used by external servers. Net-Storage can be a file system or simply a node in the file system of the net server. Net-Storage (to be more exact: the shared directory) is made available in BS2000 OSD/BC via the command MOUNT-NET-STORAGE and mounted on the Net-Client.

Net Client
Implements access to Net-Storage for the operating system that wants to use it. The Net-Client transforms the BS2000 file accesses together with the BS2000 subsystem ONETSTOR to the corresponding Unix file accesses and executes them on the net server via NFS. For server units /390 of SE Servers the bs2netsagent process, which represents the net client runs on an HNC; for server units x86 of SE Servers the net client or bs2netsagent resp. runs on the X2000 of the server unit.

Net-Storage Volume
Net-Storage volumes represent Net-Storage in BS2000 OSD/BC. They are configured via the command ADD-NET-STORAGE-VOLUME and assigned to a pubset. A directory in the shared file system of the net server is configured and assigned to a local data pubset (SF or SM pubset) as a Net-Storage volume.
Net-Storage volumes are addressed via their volume serial number (VSN) and the volume type NETSTOR. The directory name in the shared file system of the net server corresponds to the VSN of the Net-Storage volume.
A Net-Storage volume (to be more exact: the directory with the name of the Net-Storage volume) contains the following:
- A file system label (file name .FSL) and a file catalog (file name .BS2FSCAT) with the meta data of the files stored on Net-Storage
- The user files of file type *BS2000 (see next section for more information)
- The user-specific directories which include the *NODE-FILE user files (see next section for more information).

Files on Net-Storage
From the BS2000 viewpoint, two basic types of file processing are offered on Net-Storage:
- Pure BS2000 processing, file type: BS2000
  This type of processing was introduced with BS2000/OSD V9. Users can save all types of BS2000 files (PAM, SAM, ISAM, PLAM) on Net-Storage, apart from files with PAM-Key, work files, temporary files and file generation groups. Systems other than BS2000 systems may not modify these files.

- Joint file processing of BS2000 and open systems, file type: node file
  As of BS2000 OSD/BC V10, users can store files in user-specific directories within Net-Storage volumes and process them together with open systems. And vice versa, UNIX systems can create files in these directories which can be imported to BS2000 and processed. A file does not have a specific structure from a Unix/Linux/Windows viewpoint. This corresponds in BS2000 to the file format PAM (BLKCNTRL=NO). A new attribute (FILE-TYPE = *NODE-FILE) has been introduced in BS2000 OSD/BC V10 to identify these files. This file type can be processed as PAM files from BS2000 OSD/BC V10. From BS2000 OSD/BC V11 also the text based processing of node files by means of the access method of SAM is enabled.
  Node files can only be used on SE servers.

Architecture
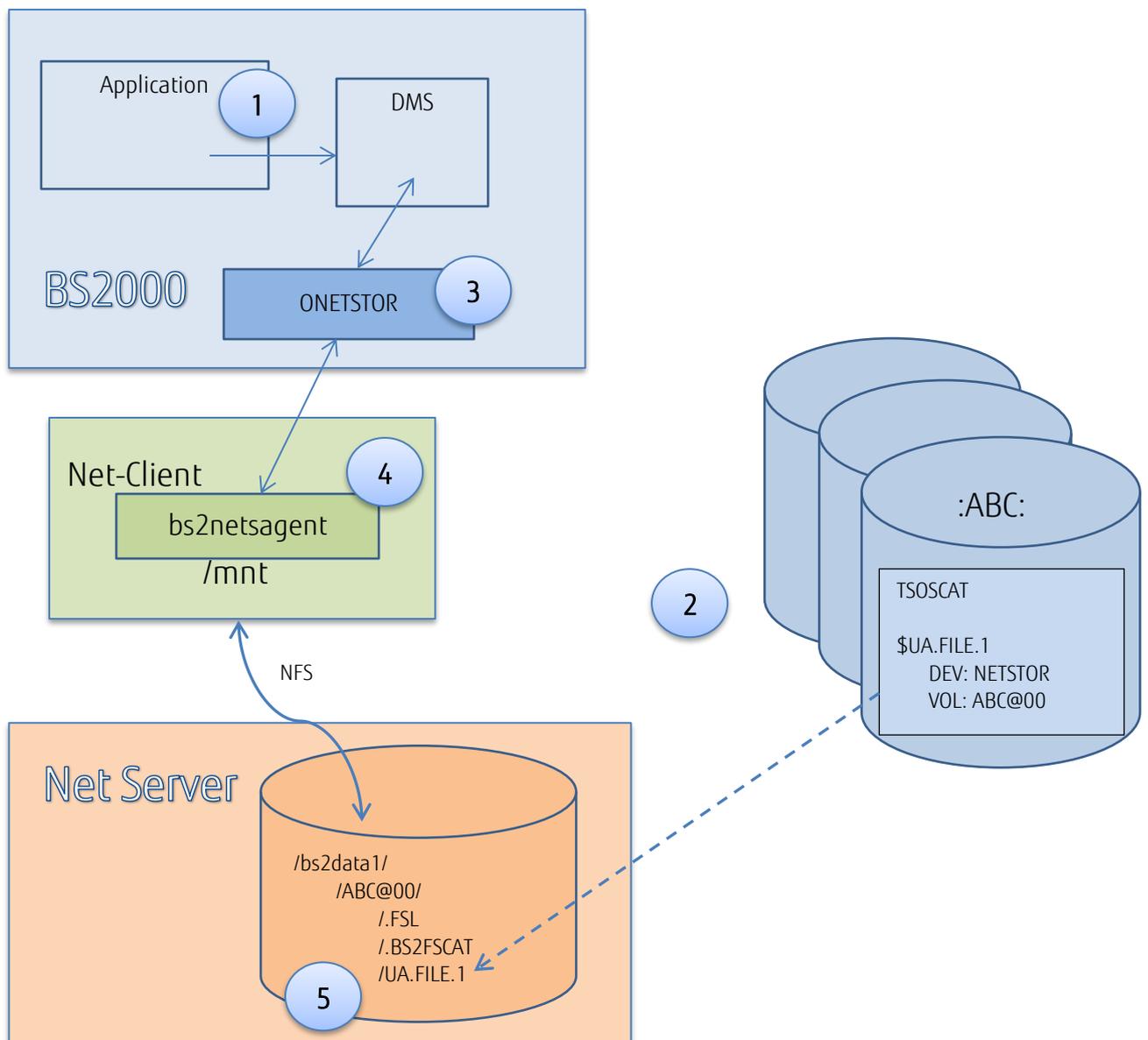
Image 1

An application (1) accesses a file via the DMS. The DMS recognizes that the file is located on Net-Storage via the catalog entry in TSOSCAT on the pubset(2). The file on the net server (5) is accessed via NFS via the subsystem ONETSTOR (3) and the net client (4). The process that performs the tasks of the Net-Client is the so called bs2netsagent.

2. Configuration

In order to enable the use of Net-Storage in BS2000, a connection (node, line) must be defined in BS2000 and the net client must be defined as end system (processor).

The connection between BS2000 and net client on the HNC or X2000 is via LOCLAN. For /390 architecture the LOCLAN connection to the HNC is implemented by fibre channel. For x86 architecture the LOCLAN is a software connection. The connections are configured in the SE Manager by *Devices -> <se server> (SE <model>) -> <unit> (SU<model>) -> BS2000-Devices,* folder *LAN.* In case of SU /390 the device addresses need to be configured by IOGEN (see 2.2). This configuration refers only the accessibility (read/write channel and device MNs respectively) of the HNC or X2000.
The configuration of the Net-Client itself is done by the menu *Hardware -> Units -> <se server> (SE <model>) -> <unit> (HNC or SU<x86> resp.) -> Management,* folder *Net-Storage.*

The required permissions must be configured on the net server; the user and group ID permitted for access must be entered accordingly on the net client for the bs2netsagent (Net-Storage accesses), this is also valid for the NFSv4 domain name.
In addition the interface of the HNC or X2000 respectively must be entered, which implements the connection to the Net-Storage (Net-Storage connection properties and addresses, details see chapter 2.6).

BS2000

192.168.152.24

LOCLAN

192.168.152.12

HNC / X2000

bs2netsagent (UID/GID)

Net-Client

172.17.67.90

IP-Network

172.17.67.120

NFS-Server

Net-Server

Net-Storage-Volume

Net-Storage
UID:GID   /bs2data1/
        /ABC@00
        /.FSL
        /.BS2FSCAT
            /U.FILE.1
            /U.FILE.2   FILE-TYPE=*BS2000
            /V.DATEI.X
        /HUGO
            /FILE.X
            /FILE.Y
        /FRITZ   FILE-TYPE=*NODE-FILE
            /FILE.A
   /FILE.B
            /FILE.C
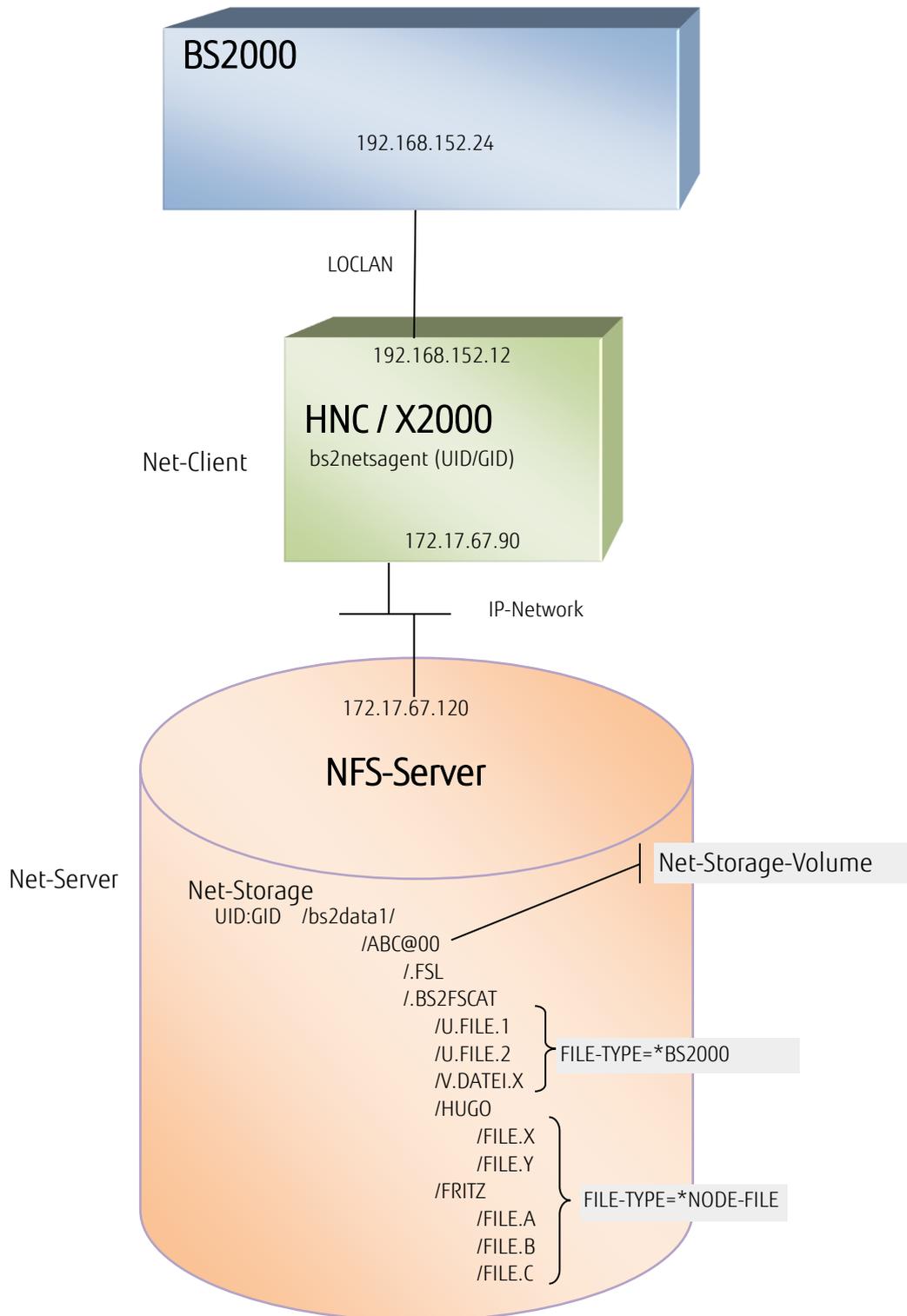
Figure 2

2.1. Access Permissions for BS2000 Interoperability with Open Systems.

The NFS server system administrator configures a share for a specific user (with ETERNUS CS: file group). In the example in figure 3, this user has the user and group number (UID:GID) 7890:2222.
This user and group number is configured on the net client for the bs2netsagent net client process. The process thus receives authorization to access the share and to create directories and files; it is thus the owner of the Net-Storage volume to be created under the share and its included *BS2000 files and BS2000 user-specific directories.

The BS2000 system administrator mounts the share in the BS2000 via MOUNT-NET-STORAGE. The mount is by BS2000 net client under root. The following is valid depending on the NFS version:
If the NFS server supports the NFSv4 protocol, the mount is automatically executed in version 4 or else in protocol version NFSv3.
When using NFSv4 the users must also be entered in an LDAP or AD directory service with user and group numbers. The NFS-Server must be connected to this LDAP directory service. NFSv3 does not necessarily require the use of LDAP or AD.

```
BS2000 OSD/BC V10
/MOUNT-NET-STORAGE
SYSSRPM:
HUGO 1005:100
FRITZ 1010:100
```

```
Linux:
mount –t nfs nfs-server:/fgbs2/NET001/HUGO /home/hugo
mount –t nfs nfs-server:/fgbs2/NET001/FRITZ /home/fritz
/home/hugo/      1005:100
/home/fritz/     1010:100
```

```
Net-Client    (HNC/X2000)
bs2netsagent 7890:2222
        /mnt
```

uid and gid of the bs2netsagent are configured with the GUI of the SE manager, or for older systems by the CLI command bs2netsConf

User specific directories

```
Net-Server    Net-Storage
/fgbs2/                      rwxr-xr-x  7890:2222
  NET001/                    rwx--x--x  7890:2222
    .FSL                     rw-------  7890:2222
    .BS2FSCAT                rw-------  7890:2222
    HUGO/                    rwx------+ 7890:2222
      FILE.1                 rw-------  1005:100
    FRITZ/                   rwx------+ 7890:2222
      FILE.1                 rw-------  1010:100
```

```
#getfacl HUGO
# file: HUGO
# owner: 7890
# group: 2222
user::rwx
user:1005:rwx
group::r-x
mask::rwx
other::r-x
```

Image 3

Net-Storage node files are stored in user-specific directories, i.e. files which can be processed by BS2000 and by Unix/Linux systems. These directories have the name of the respective BS2000 user ID (upper case letters) and are automatically configured by the BS2000 with the initial creation of a node file.

When creating such a directory, the POSIX-ACLs, i.e. the read, write and execute permissions, are set for the respective BS2000 user. The net client accesses the files in the user-specific directories (node files) via the user and group number of the corresponding user ID. The system administrator must compare the user and group numbers in BS2000 against those in the open systems and, using MODIFY-POSIX-USER-ATTRIBUTES (USER- and GROUP-NUMBER) enter them in the user catalog of the pubsets, to which the Net-Storage volumes have been assigned.

When the user-specific directory has been created on the BS2000-side, files can also be created on the Unix/Linux-side which can then be imported to the BS2000 catalogs (TSOSCAT und BS2FSCAT) via IMPORT-NODE-FILE.
The BS2000 protection measures (USER-ACCESS, ACCESS, password protection, BACL, GUARDS) are only effective in BS2000.
From the UNIX viewpoint, the mechanisms apply which the file system provides regarding ownership (UID:GID, rwx for user, group, other) as well as POSIX-ACLs. However, if the minimum access rights of the file from UNIX/Linux shown in figure 3 are restricted, access can be prevented from the BS2000-side, which is then reported to the user via the corresponding messages (e.g. permission denied).

2.2. BS2000 IO Configuration

The generation of the IO configuration on S servers is via the utility IOGEN (see manual System Installation). A CTL instruction and two DVC instructions (for the read and write channels respectively) are specified for HW generation of the HNC.

Example of a generation instruction to connect the HNC via an FC switch on the FC channel A4:

```
CTL C0,,(A4,0,10000000C954F718)
DVC 4D20,6D,A,0000,(C0)
DVC 4D21,6D,A,0001,(C0)
```

or

```
CTL C0,,(A4,0,10000000C954F718)
DVC 4D20,6D,A,0000,(C0),MULT=2
```

The connections are configured by the SE Manager *Devices -> <se server> (SE <model>) -> <unit> (SU<model>) -> BS2000-Devices,* folder *LAN*.

The configuration on SQ servers is via the SQ-Manager BS2000 devices -> devices -> LAN. A LOCLAN LAN device is required for Net-Storage.

2.1   BCAM Generation

From a BCAM viewpoint, only the following must be described regarding the above physics:

(1) The connection of the BS2000 node and line
Either an HNC in the case of S servers or a channel adapter in the case of an SQ server which does not differentiate BCAM in the description (see below "Defining the line" and SHOW-BCAM-ENVIRONMENT OWN-IP-ADDRESS 192.168.152.24)

(2) The processor on a node must be described with the address with which it must be reached from the BS2000. The BS2000 communication partner is the net client with the running bs2netsagent (PROCESSOR-NAME: LOCFCAP and IP address: 192.168.152.12) which controls access to the files stored on the NFS server (the addresses in the IP network of the NFS server and the NFS server itself are not known to BCAM).

(3) Settings must be made for optimum use of the transport system
LPDU Link-Layer Protocol Data Unit (determined by the device)
TSDU Transport Service Data Unit (set for processor)

The following BCAM commands are used for description and can be saved in the SOF or a CALL-BCAM-COMMAND file to restart BCAM.

DEFINE NODE
```
/CREATE-NODE NODE-NAME=LOCFCCAP        see (1)
```

DEFINE THE LINE

```
/CREATE-LINE LINE-NAME=LOCFCCAP -       see (1)
/ ,IP-ADDRESS=192.168.152.24/24 -
/ ,L2-PROTOCOL=*CSMACD( -
/  NODE-NAME=LOCFCCAP -
/ ,WRITE-DEVICE=4D20 -
/ ,READ-DEVICE=4D21 –
/ ,SLOW-POLL=ON -
/ ,MAX-LPDU-SIZE=*BY-DEVICE -        see (3)
/ )
```

DEFINE PROCESSOR/ROUTE (AT THE NODE)

```
/CREATE-PROCESSOR PROCESSOR-NAME=LOCFCAP -       see (2)
/ ,MAX-TDSU-SIZE=65530                           see (3)
/
/CREATE-ROUTE ROUTE-NAME=LOCFCAP -
/ ,PATH=*NODE( -
/  NODE-NAME=LOCFCCAP -
/  ,LINE-NAME=LOCFCCAP -
/  ,L3-PROTOCOL=*IP( -
/  ,IP-ADDRESS=192.168.152.12 -
/  ))
```

ACTIVATE LINE AND NODE

```
/ACTIVATE-LINE LINE-NAME=LOCFCCAP
/BCIN NODE=LOCFCCAP
```

The output of the BCAM objects, that have been created to describe this partial configuration, is via:

```
/SHOW-BCAM-ENVIRONMENT PROCESSOR=LOCFCAP, INFORMATION=*ADDRESS

SHOW-BCAM-ENVIRONMENT                                2012-06-06 08:46:11
Route "LOCFCAP " of Processor "LOCFCAP "
 Host:              S170G04 , *NORMAL    *ACTIVE
   Own-IP-Address   192.168.152.24/24
  Line:             LOCFCCAP            *ACTIVE,*WORKING
   Mnemonic         4D20,4D21
  Node:             LOCFCCAP, *NORMAL    *ACTIVE
 Route:             LOCFCAP             *ACTIVE,*READY,*WORKING
   IP-Address       192.168.152.12
  Processor:        LOCFCAP             *ACTIVE
```

CONFIGURE REDUNDANCY

The net client (on HNC!) can be redundantly configured on SU /390. Make the BCAM configuration of the second HNC accordingly and define as redundant net client via SET-NET-CLIENT-ALTERNATE. (see below under "Utilization in BS2000: Mounting remote file systems").

2.4   BS2000 User Administration

The user and group numbers (USER-NUMBER and GROUP-NUMBER) must be entered in the user catalog of the pubset on which the files are cataloged so that users can save the files as node files and process them on Unix/Linux systems, or vice versa to access the BS2000 files created by these systems. The user and group numbers must be aligned with the UID and the GID of the corresponding Unix/Linux system users.
Enter via:

```
/MODIFY-POSIX-USER-ATTRIBUTES USER-IDENTIFICATION=<name 1..8>, -
             /PUBSET=<catid 1..4>, -
             /USER-NUMBER=<integer 0..60002>, -
             /GROUP-NUMBER=<integer 0..60002>
```

(Note: Irrespective of the use of Net-Storage node files, the assignment of the user and group number to the BS2000 user ID of the home pubset user catalog is relevant for the BS2000 POSIX! Keeping the numbers per user identical on all pubsets is recommended.)

2.5   Net Server

The system administrator of the NFS server configures a share on the NFS server and defines the owner (user and group number) that is to receive the access permission to this share. These must match the numbers for the net client process set with bs2netsConf set -u on the HNC or X2000 (see section below "User ID and group ID of the bs2netsagent process").

The configuration of the share (file group) is via GUI with ETERNUS CS. Further mount options are configured here: Read/write access, authorized hosts, etc.

Notes:
- Details about the configuration of your NFS server are in the appropriate documentation.
- For security reasons, the mount option no_root_squash should not be set. If access from the client side is via root, it would also access with root rights in the released file system. However, the root_squash mount option is used for access with the rights of the ID "nobody".
- Secure mode: The standard sys (=specified user ID) is used as a secure mode for the authentication of a NFS connection.
- Under NFSv4, the net server requires a link to an LDAP directory service.
- The NFS server shares that are accessible for BS2000 can be output from BS2000 via LIST-NET-DIRECTORIES.

2.6 Net Client

2.6.1 Configuration on the SE server:

On SE servers, the net client settings are installed via the graphic interface of the SE Manager. The SE Manager facilitates central, web-based management of the entire SE infrastructure and most of the peripherals used by the SE server units.

The data network DANPU01 with uplink to the customer LAN is intended for the connection of net storage. Both HNCs and Server Units x86 (SU300) are preconfigured with a LAN connection to DANPU01 when the SE server is delivered.

The public data networks are configured in the SE Manager via Hardware -> IP Networks -> Data Network Public -> DANPU<nr>. The table "NetUnit Information" shows the units configured on the network.

The following figure shows the configuration of the DANPU01 network of an SE server with redundant NetUnit, 2 HNCs and one SU300:

In the designation of the port names with the unit name (HNC1, HNC2, Su1SE2) as prefix, S<n>P<m> stands for "Slot n" "Port m".

Configure Net-Storage via Hardware -> Server/Units -> <se server> (SE <model>) -> <unit> (HNC or SU300<model>) -> Management, Folder -> Net-Storage.

Example HNC:

Changes in the menus can be made having clicked on the pen symbol.

Access:
The user ID and group ID are set via which the net client jobs are processed on the net server. They are the owner IDs of the share to be mounted on the net server and must be agreed with the net server system administrator. The default-value 0 should not be used for data protection reasons.

Configuration of NFSv4 domain:
LDAP is only necessary if NFSv4 is in use and node files are to be stored which are to be accessed by external systems. The corresponding users must be in the LDAP server directory. Information about the LDAP server configuration is at the end of this section.

Net-Storage connection properties and add connection:
The following defines the PCI connections via which Net-Storage can be reached, whether a dynamic address should be assigned (check DHCP), or whether a static address should be entered ("Add IP address").

On an HNC, the PCI port "Slot 2" "Port 1" is already preconfigured on the first public data network DANPU01 (DAta Net PUblic 01) when the SE server is delivered.

Procedure:

First the PCI port must be added to DANPU01 via the button "Add connection":
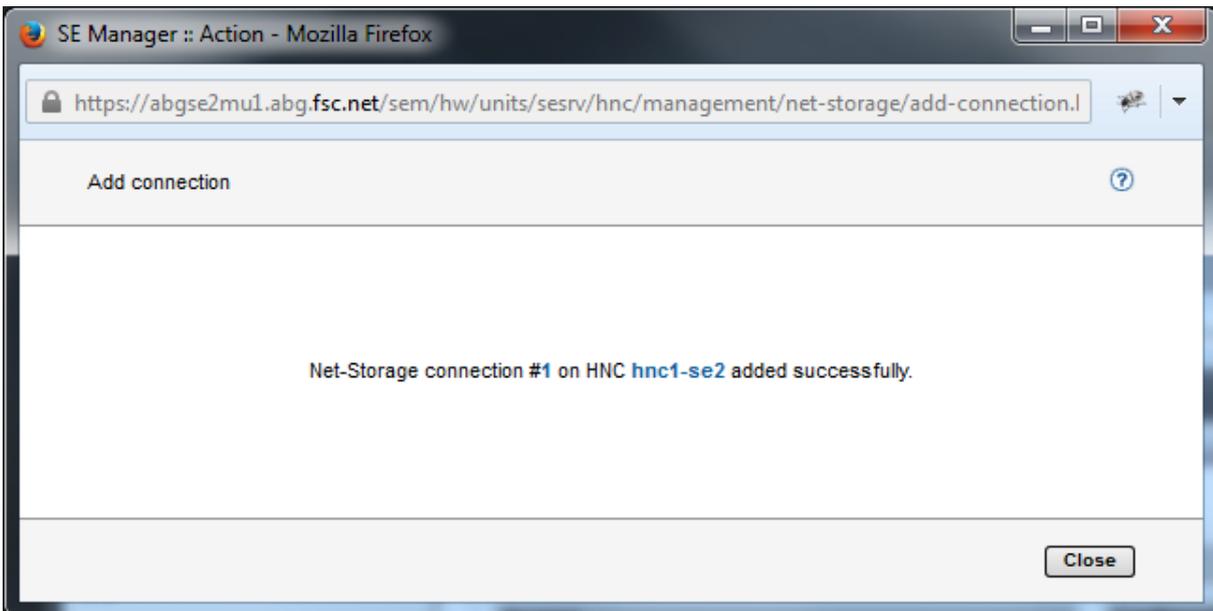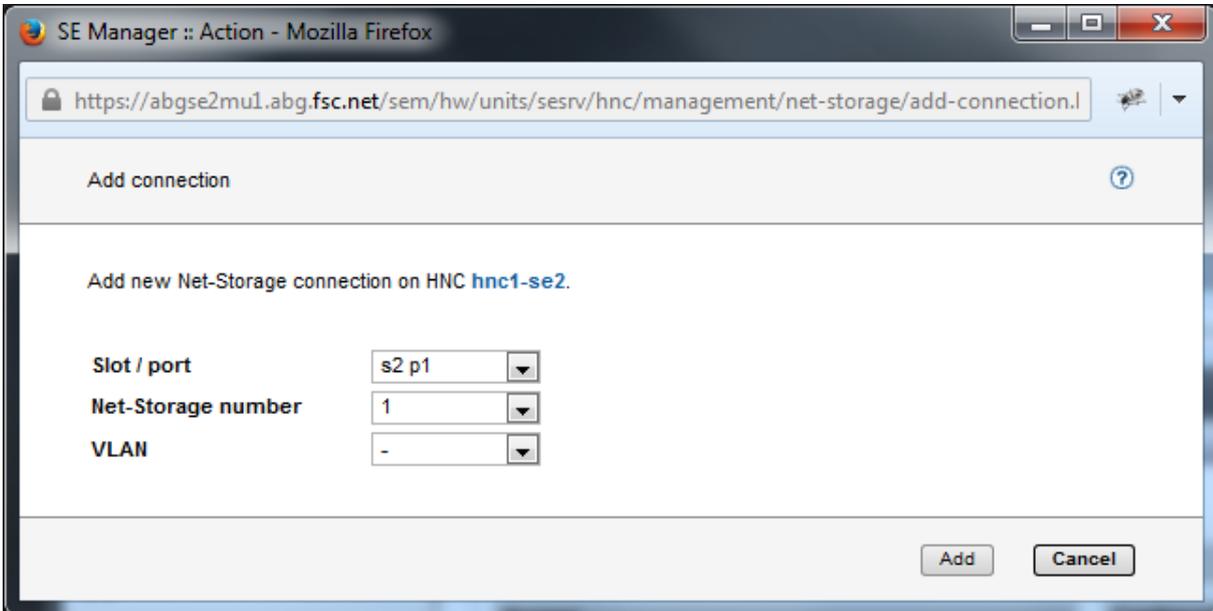
If the IP address is to be assigned dynamically, it is sufficient to tick DHCPv4 or DHCPv6 with the pencil symbol for the now displayed connection "NETSTOR01".

Via the button "Add IP address" a static IP address can be entered:

SE Manager :: Action - Mozilla Firefox

https://abgse2mu1.abg.**fsc.net**/sem/hw/units/sesrv/hnc/management/net-storage/add-address.htm

Add IP address

NETSTOR01 IP address **172.17.67.89/22** on HNC **hnc1-se2** added successfully.

Close
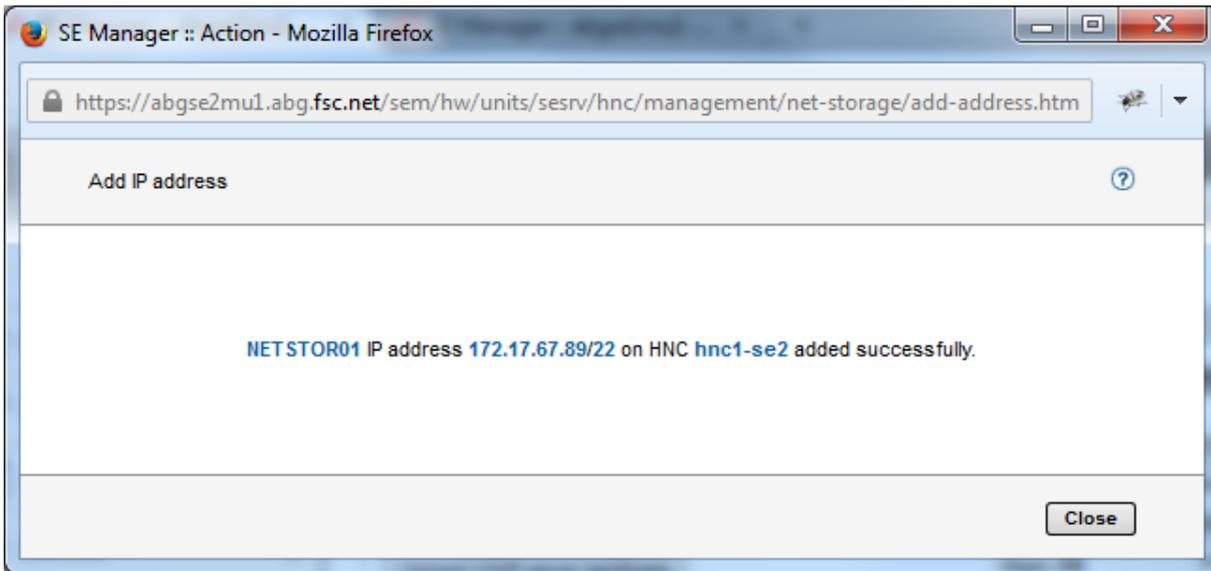
SE Manager

Management Unit (abgse2mu1) [Abg-DC6]

IP configuration | Routing & DNS | **Net-Storage**

HNC hnc1-se2: Net-Storage accesses

Access		Configuration of NFSv4 domain	
User ID	7013	Domain	localdomain
Group ID	2003		

HNC hnc1-se2: Net-Storage connection properties

Add connection

Connection	Slot / port	VLAN	Properties			
NETSTOR01	s2 p1	-	☐ DHCPv4	☐ IPv6	☐ Autoconf	☐ DHCPv6

Total: 1

HNC hnc1-se2: Net-Storage connection addresses

Add IP address

Connection	IP address	Mask	VLAN	MAC address	Conf.	
Filter	Filter	Filter	Filter	Filter	Filter	
LOCLAN	192.168.151.12	-	-	0A:00:14:10:80:FF	-	
NETSTOR01	172.17.67.89	/22	-	A0:36:9F:28:2A:39	static	

Total: 2

Sidebar navigation:
Dashboard
Systems
Applications
Devices
Hardware
Units
  abgse2 (SE700)
    EM2 (SU700)
    abgse2mu1 (MU)
    abgse2mu2 (MU)
    hnc1-se2 (HNC)
      Information
      Management
      Service
    hnc2-se2 (HNC)
    hnc3-se2 (HNC)
    su300se2 (SU300)
    abgqa500 (AU47)
    abgqa600 (AU47)
  abgse4 (SE710)
IP networks
  Data Network Public
  Data Network Private

If the net server is not in the same network as HNC or X2000, a router must also be defined. This is done via the tab "Routing & DNS".

In an SE server with redundant NetUnit and second HNC, a Net-Storage connection should also be set up on the HNC2 (also on slot 2, port 1) for reasons of high availability.

Example SU300:

An SU300 is preconfigured at the factory with slot 1 port 1 on the first public data network DANPU01. The following figure shows the net storage configuration of an SU300 with dynamically assigned IPv4 address.

Further details about the configuration of net client are in the current manual "Operate and Manage SE series Business Servers".

2.6.2 Configuration of S and SQ servers:

With S servers, the net client runs on an HNC-IV 91853 or HNC-V 91854 as of V2.0A03 or V5.3A04 for SQ servers on X2000. These versions are installed by Service. These versions only permit the use of Net-Storage in the manner released in BS2000/OSD V9.

In order to use Net-Storage node files (as of BS2000 OSD/BC V10) a minimum of HNC-V 91854 as of HNC V2.1A01 is required, or X2000 V5.3A07 is required for SQ servers. SAM node files can only be processed from BS2000 OSD/BC V11 and only on SE Servers.

In contrast to SE servers with the SE manager GUI, the system administrator configures the net client with S servers on the HNC Manager, and with SQ servers on the SQ Manager using the following CLI commands:

2.6.2.1   LOCLAN address and MTU

Communication between the BS2000 and the bs2netsagent is via LOCLAN.
LOCLAN is automatically configured during installation. The LOCLAN address can be displayed with

```
#  bs2netsConf list -l
```

The system administrator can define another LOCLAN network address via the following command:

```
 #  bs2netsConf set -l <loclan-net address>
```

The LOCLAN address must also be modified to the new value, e.g. after upgrading and reimporting an older
configuration data backup (192.168.15x ; x corresponds to host ID).
The LOCLAN network is always a network with the prefix 24 (which corresponds to network mask 255.255.255.0)
and its own address 12. The MTU is scanned by BS2000 (see section BCAM generation CREATE-LINE …
MAX-LPDU-SIZE=*BY-DEVICE).

2.6.2.2   Configuration of LAN for NFS

Communication between HNC or X2000 and the NFS server is via a LAN connection. The NFS server is generally
in the production network; in this case, a LAN connection on a PCI slot is used. This can be either the LAN
connector already used or a spare one. An IP address must always be assigned via which bs2netsagent can
communicate with the NFS server. This is via the command:

```
# bs2netsConf set -i <ip-addr/prefix> -p s<x>p<y> [-m <mtu>]
```

whereby <x> and <y> is the slot or the port number. This command can also be used to modify the MTU size
(sensible values: 1500 for standard frames and 9000 for jumbo frames).
The current settings are output via

```
# bs2netsConf list -i
```

For further details, see the description under: bs2netsConf   info

2.6.2.3   Routing

The configuration of a router can be carried out via the following command:

```
#  bs2netsConf set -r <target address/prefix> -g <router>
```

and the output:

```
# bs2netsConf list -r
```

2.6.2.4   UserId and group ID of the bs2netsagent process

The net client authenticates itself to the net server (NFS server) via its (external) IP address (not the LOCLAN
address! In the example in figure 2, this would be IP address 172.10.1.2). Access to the shared directory in the

NFS server is permitted according to the user ID and the group ID. The user ID and group ID must be agreed with the administrator of the NFS server(s).

```
# bs2netsConf  set -u <userid>:<groupid>
```

As the bs2netsagent can only be assigned one user ID and group ID, the same user IDs and group IDs must also be assigned on the net servers for all the directories shared for this net client.
The current values are displayed via

```
# bs2netsConf list -u
```

If no ID is assigned, access is via uid and gid 0(=root).
More information about the command bs2netsConf can be obtained on the CLI using:
`# bs2netsConf`   ((without additional options) outputs an overview of the command
`# bs2netsConf info [-e]` outputs a detailed explanation of the options (-e in English)

<u>Caution:</u> `bs2netsConf set -u` stops and restarts the bs2netsagent of the net client. A umount is executed for all existing mounts. This terminates all accesses from the BS2000. To prevent data loss it is important to umount all mounted shares in BS2000 before changes of the configuration are performed.

2.6.2.5 Activate the LDAP client
In order to use node files, the bs2netsagent must be given access to a directory service in order to implement the access rights for interoperability with the open systems. LDAP is only necessary if NFS V4 is uses and user-specific files (node files) are to be stored which are to be accessed by external systems. The corresponding users must be in the LDAP server directory. Only access to the LDAP server is configured in X2000 or on the HNC. Only one LDAP server can be entered.

The NFSv4 domain needs to be the same as for the NFS server.
For NFSv3 there is nothing to configure.

2.6.2.6 DNS
In the BS2000, the NFS server to be mounted can be specified via the IP address or FQDN (Fully Qualified Domain Name). When specifying FQDN, the net client must ensure the resolution in an IP address. A DNS server must be specified via the HNC manager or the SQ manager.

2.7 Configure LDAP Server for Node Files with NFSv4
In order to ensure that access to node files – functions when using NFSv4–, an additional attribute "NFSv4Name" is compulsory in an LDAP POSIX account, in which the UID number is entered. The POSIX group can also be extended by the attribute "NFSv4Name", but this is currently <u>not</u> compulsory
   The attribute NFSv4Name comprises the user name and the NFSv4 domain <user@nfsv4domain>.
An entry in an LDAP directory could be as follows: "NFSv4Name: hugo@localdomain". If not available, the LDAP scheme must be extended with the attribute NFSv4Name. The attribute definition of NFSv4Name is below:
```
 attributetype ( 1.3.6.1.4.1.250.1.61
         NAME ( 'NFSv4Name')
         DESC 'NFS version 4 Name'
         EQUALITY caseIgnoreIA5Match
```

```
            SYNTAX 1.3.6.1.4.1.1466.115.121.1.26
            SINGLE-VALUE)
```

The LDAP server must be configured so that the net server and the net client have read access to the LDAP directory.

The two following object classes must be entered. The object class NFSv4RemotePerson contains the NFSv4Name, uidNumber and gidNumber

```
objectclass ( 1.3.6.1.4.1.250.1.60 NAME 'NFSv4RemotePerson'
              DESC 'NFS version4 person from remote NFSv4 Domain'
              SUP top STRUCTURAL
              MUST ( uidNumber $ gidNumber $ NFSv4Name )
              MAY ( cn $ description) )

 objectclass ( 1.3.6.1.4.1.250.1.63 NAME 'NFSv4RemoteGroup'
              DESC 'NFS version4 group from remote NFSv4 Domain'
              SUP top STRUCTURAL
              MUST ( gidNumber $ NFSv4Name )
              MAY ( cn $ memberUid $ description) )
```

The NFSv4Name attribute guarantees a one-to-one linking between the NFSv4 domain and the uidNumber of a local user. Below is a short example for an entry "hugo" in an LDAP directory:

```
# hugo, S170G04, netstorage, osd.fts.net
dn: uid=hugo,ou=S170G04,o=netstorage,dc=osd,dc=fts,dc=net
objectClass: posixAccount
objectClass: NFSv4RemotePerson
cn: Hugo Hugomann
uid: hugo
loginShell: /bin/bash
homeDirectory: /home/hugo
uidNumber: 2002
gidNumber: 2222
NFSv4Name: hugo@localdomain
```

2.8 Further Information

If a firewall is between net client and net server, note that the ports 2049 and 111 (RPC) for NFS must be opened for TCP and UDP. A change in the standard port 2049 is currently not planned.

During maintenance work (e.g. software update or new installation) and configuration changes with bs2netsConf, make sure that Net-Storage (which is operated via the respective net client) is disconnected beforehand from all connected BS2000 systems via the BS2000 command UMOUNT-NET-STORAGE.

3 Usage in BS2000 – Brief Overview

Having implemented the above configuration steps, Net-Storage can now be used in BS2000. Proceed as follows (operand values of the commands in the examples correspond to the examples in figures 2 and 3):

3.1 Mount the Remote File System

The remote file system is mounted via MOUNT-NET-STORAGE. The mount is initiated in the net client.

```
/MOUNT-NET-STORAGE DIRECTORY='/bs2data1',-
                 /NET-SERVER=*IP(172.17.67.120),-
                 /NET-CLIENT=*IP(192.168.152.12)
```

SHOW-NET-STORAGE provides an overview of the mounted shares and, if necessary, any existing Net-Storage volumes.

A redundant net client can be added as follows:
```
/SET-NET-CLIENT-ALTERNATE CLIENT=*IP(192.168.152.12),-
                         /ALTERNATE-CLIENT=*IP(192.168.154.12)
```
If the net client fails, there is an automatic switchover to the alternative net-client.

3.2 Creating Net-Storage Volumes

Net-Storage volumes are created on the mounted Net-Storage via ADD-NET-STORAGE-VOLUME. The Net-Storage volume is permanently assigned to *one* pubset.

```
/ADD-NET-STORAGE-VOLUME  VOLUME=*STD,PUBSET=ABC,-
                        /DIRECTORY='/bs2data1',SERVER=*IP(172.17.67.120)
```

A volume with the name ABC@00 is assigned to the pubset ABC. This is implemented by creating a directory with the name ABC@00 under the share /bs2data1 of the NFS server with the IP address 172.17.67.120. The administration files .FSL and .BS2FSCAT are created in this directory. An administration entry for the Net-Storage volume is created on the pubset ABC .

Instead of the standard name derived from the pubset name, the system administrator can assign any volume name for the Net-Storage volume. Several Net-Storage volumes can be defined for a pubset. The volume names must be unique in the system; if there is already a private disk with the same VSN, the access to the Net-Storage volume is preferred by the system.

SHOW-PUBSET-NET-STORAGE displays the Net-Storage volumes assigned to a pubset (this command can also be used by non-privileged users).

Further hints:

Net-Storage can be assigned to both SF- and SM-Pubset, however not to a Home-PVS.
The assignment of the Net-Storage volumes to a pubset is retained beyond EXPORT-/IMPORT-PUBSET and shutdown/startup.
Net-Storage volumes can also be assigned to shared pubsets. The creation of the volumes needs to be done at the master system; the slave systems gain access to the newly created volume by entering the same statement ADD-NET-STORAGE-VOLUME. This is only necessary in the context of creation of the Net-Storage-Volume, to allocate the volume by NDM. Later after shutdown/startup or EXPORT-/IMPORT-PUBSET respectively the allocation is done automatically by the system.

After a system restart, make sure that MOUNT-NET-STORAGE is only executed after BCAM has been started and the subsystem ONETSTOR has been loaded.

It is sensible - before importing a pubset (IMPORT-PUBSET) which has been assigned to the Net-Storage volume, to make it available in the system via MOUNT-NET-STORAGE. This ensures that its data is immediately available after IMPORT-PUBSET.

3.3 Create, Import and Process Files on Net-Storage

Create *BS2000 files (as of OSD V9)

```
/CREATE-FILE
:ABC:$USER.FILE.1,SUPPORT=*PUBLIC-DISK(STORAGE-TYPE=*NEt-STORAGE)
```

If several Net-Storage volumes exist for a pubset, the volume (in this example volume NET001) can be specified as follows:

```
/CREATE-FILE :ABC:$USER.FILE.1,-
        /SUPPORT=*PUBLIC(STORAGE-CLASS=*NONE(VOLUME=NET001, -
                        /DEVICE-TYPE=NETSTOR))
```

Create *NODE-FILE   files for interoperability with open systems (as of OSD V10)

```
/CREATE-FILE :ABC:$USER.FILE.1, -
      /SUPPORT=*PUBLIC-DISK(STORAGE-TYPE=*NET-STORAGE(FILE-TYPE=*NODE-FILE))
```

or short:
```
/CRF :ABC:$USER.FILE.1,FILE.TYPE=*NODE
```

respectively:

```
/CREATE-FILE :ABC:$USER.FILE.1, -
      /SUPPORT=*PUBLIC-DISK(STORAGE-TYPE=*NET-STORAGE(FILE-TYPE=*NODE-FILE),-
      /STORAGE-CLASS=*NONE(VOLUME=NET001,DEVICE-TYPE=NETSTOR))
```

From now on, the file can be accessed via its path names. The storage location of the file is completely transparent for the application.

BS2000 saves node files in user-specific directories within Net-Storage volumes (see the example in figure 3: directories of users HUGO or FRITZ). BS2000 creates a user-specific directory the first time a node file is created for a user and automatically sets the required ACLs for access. Open systems can also create files in these directories.

Import of node files that were created by open systems into BS2000 catalogs.

If files were created by open systems in user specific directories, these files need to be imported into the BS2000 catalogs TSOSCAT and BS2FSCAT before they can be processed by BS2000.

From BS2000 OSD/BC V11 the user can specify, if a node file should be catalogued as PAM or SAM file:

```
/IMPORT-NODE-FILE VOLUME=NET0001, FILE-NAME=$USER.FILE.1, -
     /FILE-STRUCTURE = *SAM, PUBSET=ABC
```

To specify FILE-STRUCTURE = *SAM is recommended, if the file should be processed as a text.
And vice versa, node files can be removed from the BS2000 catalogs via EXPORT-NODE-FILE (see EXPORT-FILE) without deleting them in the user-specific directory on Net-Storage. LIST-NODE-FILES is used to obtain information about the files (which can be imported) in the user-specific directories of a Net-Storage volume. Only files with names that meet the BS2000 file name conventions are output.

```
/LIST-NODE-FILES VOLUME=NET001, USER-DIR=*OWN, NODE-FILE-NAME=*

%NET001/USER/
%-rw-------      0 Oct 28 09:18 ABC.1
%-rw-r--r--      6 Mar 21 13:58 FILE.TXT
%-rw-------      0 Oct 17 13:31 SYSOUT.REPORT.1
```

3.4 File Processing

BS2000 supports the processing of node files by means of the access methods PAM (from OSD V10) and SAM (from OSD V11).

3.4.1 PAM node file processing

PAM node files are non-structured data, i.e. NK-PAM files from the BS2000 viewpoint. They can be read/write accessed via the UPAM access method. A node file can be any size up to a maximum of 4TB, i.e. in contrast to BS2000 disks there is no restriction to a multiple number of PAM blocks. This is already guaranteed with the previous PAM macros. The UPAM call to write is, for example:

```
PAM fcbadr, WRT, LEN = <STD|(STD,n)|length>, …
```

i.e. with LEN=STD or STD,n   a multiple number of standard blocks of 2048 bytes is transferred; LEN=length transfers data of the specified length for node files

Example:
```
OPEN   fcbadr,OUTIN
PAM    fcbadr,WR,… ,LEN=STD        (corresponds to 2048 Byte)
PAM    fcabdr,WR, …,LEN=50
CLOSE  fcbadr
```
In this example the file on the NAS after CLOSE has a size of 2048 + 50 = 2098 bytes.

In order to write the exact file size of a BS2000 files, a new field was introduced in the catalog entry: the Last Byte Pointer (LBP) - analog to Last Page Pointer (=Highest-Used-Page) which points to the last valid page of a file - and the LBP points to the last valid byte of the last logical block. (A logical block has the size BLKSIZE=(STD,n), i.e. consists of n * PAM pages (n*2048 Byte)). The value of the LBP can be determined via the

macro FSTAT (field: OUTALBP). It is always supplied with node files. With PAM files on public space the LBP is only supplied if the caller sets the flag LBP_required with OPEN in P1FCB (support of this interface as of BS2000 OSD/BC V10 KP2/15).

If the application reads the file as far as end-of-file with LEN=(STD,x), it always receives complete PAM blocks – both with files on disk as well as on Net-Storage or as node files. The area of validity in the last logical block is displayed with the LBP.
If the application reads the file with LEN=<length>, it receives the data in the specified length.

As node files can also be processed by open systems, the properties of these files in the BS2000 catalog are outdated in certain circumstances. Any necessary update of values such as file size, LPP (=Highest-Used-Page), LBP and CHANGE-DATE occur as part of OPEN processing which is why the updated values are not available to the application until after OPEN. Updates can also be made outside OPEN/CLOSE via IMPORT-NODE-FILE REPLACE=*NODE-FILE-UPDATE.

Further details concerning the introduction of the last byte pointer can be found under:
http://docs.ts.fujitsu.com/dl.aspx?id=22aafa65-9393-4a28-95fd-4959fc6aa77d

3.4.2 SAM node file processing

a) Access method SAM:

There are two key differences between the processing of node files using the SAM access method and the processing of SAM files in the traditional public space - which in practice can mostly be neglected, these are specifically:

1. Whereas SAM records within SAM files in the public space may automatically contain any type of data, including binary, SAM node files are primarily intended for the purposes of text processing; when transferring logical SAM blocks, the net-client removes the characteristic SAM related structural information such as the BLKCTRL field and length fields and executes a code conversion from EBCDIC into either ASCII or ISO character sets. This is generally not possible where any binary content is concerned - at least not without any loss of information.

2. All SAM files stored on a traditional disc will be read from within the same block/record structure where they were previously written. In the file's description, the user may make a note of the retrieval addresses for each of the records allowing them to access these at a later point in time.
It may further be added to the description of SAM node files that the SAM method of access, processes information in a block-oriented manner. However, in transferring the data to the NAS, the net-client removes the BLKCTRL field and length fields, so that the data is stored in a byte stream as would generally be the case for open systems. The individualized records are separated using a line feed (LF, x'0A'). The mapping of which record number was written to which block number was governed for the duration of the writing process between OPEN and CLOSE. That is to say, the application can be pointed back (SETL) to a block that has already been written to and subsequently overwritten. Furthermore, it is not mandatory to write a complete block, but may rather, as previously be closed with the macro RELSE; a following record (PUT) shall then appear in the next SAM block. This record will in any case be attached, without a gap, to the previous one within the NAS file system. After closing and then re-reading the file upon opening, the net-client prepares the data for SAM; standard SAM blocks are once more created from the byte stream of the Unix file and sent to the BS2000; by utilizing the

BLKCTRL field and records, including fields indicating record length, the data is once again converted into the specified EBCDIC code. However, the original structure cannot be recreated. This means that only the sequence of the records may be guaranteed: individual records within the same block as well as record numbers cannot be read as they were written. In this way, retrieval addresses are as a rule no longer valid following a CLOSE and a re-OPEN.

In order to prevent any inadvertent processing of SAM files as node files through the use of legacy applications - which are dependent upon full compatibility in terms of retrieval addresses - a new flag SAM_NODE_FILE_ENABLE (FCB+B9(+6): ID1SNFEN) has been introduced which the caller must implement ahead of the OPEN process within the FCB associated with the file.

An application that sets this bit signals to the operating system that it can both process SAM node files and also recognize their characteristics.

In its processing of SAM node files, BS2000 is supported by the following components:

EDTU from V17.0D20
SHOW-FILE from V17.1B30
LMS/LMSCONV V3.5B
openFT from V12.1A
CRTE from V11.0A
SYSFILE of OSD V11
HSMS/ARCHIVE V11.0A

The user creates a node file as described in 3.3 and will then be able to process the file using either the aforementioned program or one they have written themselves.

As previously described when processing PAM node files, the SAM node files of systems in the outside world may be changed, e.g. extended or overwritten. The file properties FILESIZE, LPP and CHANGE-DATE are updated within the context of OPEN and are only then made available to the caller as current.

The largest SAM node file size that may be processed is 32GB. Having said that, the size of file that can be processed is limited by the number of logical SAM blocks that are required to allow it to be processed by BS2000. This limit is set at 16,777,216 blocks. Should more blocks be required, the OPEN will be rejected. The specific max. file size will for this reason depend in individual cases upon the length of records used as well as what fill capacity may be achieved within the SAM blocks. Based on this and depending upon the length of the records to be processed, the max. file size will be between 13 and 32GB.

In the case of an IMPORT-NODE-FILE, the logical block size (BLKSIZE) will be set at STD,16 so that large records may also be processed without issue (32k). The opposite also applies, where SAM node files are created in BS2000, the use of larger blocks is recommended (BLKSIZE=(STD,16)).

Code conversion:
The user can in the case of SAM node files specify by file, a character set for the data on the NAS - the Net-Coded Character-Set or NETCCS. The net-client then performs the conversion from the file's specified CCS into the

NETCCS. In order to simplify the system administrator process for the user of setting up and selecting the character sets, the below procedure was introduced:

Similar to the Class-2-Parameter HOSTCODE as well as the CCSN of a user, as of OSD V11, both a Class-2-Parameter NETCODE as well as a NETCCSN will be introduced to the user entry.
When creating a new user, the NETCCSN is selected from the CLASS2OPT NETCODE and deployed in the user entry, just as has been common practice to date for the CCSN.
The CLASS2OPT NETCODE, or rather the NETCCSN within the user entry, controls which NETCCS the SAM node file will contain as standard at the point it is created:

NETCCSN	resulting file property/conversion: NETCCS of a file in CREATE-FILE
*ISO	Depending on the CCS of the file, a standard conversion is performed from EBCDIC to ISO8859x; within this context: EDF03IRV, EDF03DRV, EDF04IRV and EDF04DRV -> ISO88591 EDF04x -> ISO8859x with x = 1,2,..,9,F Even where a user specifies a 7-bit character set as the CCS, internally, an 8-Bit code table will be used. That is to say, in place of CCS EDF03IRV, EDF041 will be adopted and instead of EDF03DRV, EDF04DRV will be utilized.
*NO-CONV	No conversion will be performed, i.e. NETCCS = CCS.
<name_1..8>	When creating a new file, the assigned NETCCSN will be registered in the file attributes. Self-defined character sets may be assigned in XHCS.

In addition to the standardized procedure for querying the NETCCS of the file - as described, when creating the file (CREATE-FILE) the user can specify the NETCCSN themselves or amend it using MODIFY-FILE-ATTRIBUTES. If data is being written by BS2000 for the first time, the file's NET-CODED-CHARACTER-SET should undergo no further changes; the next time it is read could result in an error in the code conversion associated with the data, or where the file has been extended, data containing potentially incompatible code sets may have been added to the beginning of the file.
Solely conversions from EBCDIC to ISO character sets are supported; by way of further qualification, conversions to UTF character sets are also unsupported. With the UTF character set as the CCS, data processing is performed automatically without the need for code conversions (e.g.: CCS=UTF8, NETCCS=UTF8).

b) UPAM access method:
    SAM node files can be processed two ways in conjunction with UPAM:
- **In SAM mode**, in reading the SAM blocks, the UPAM access method acts as if the file were located in a traditional Pubset (public space). For this purpose the net-client prepares the byte stream associated with the Unix file into SAM blocks as described above. Here too, the flag SAM_NODE_FILE_ENABLE (ID1SNFEN) must be introduced, in order to open the file in a writable format; this is not required for purely read access.

- **In Raw Mode**, the net-client provides the data associated with the SAM node file in the same form as it is stored on the UFS. This form of access is significantly quicker as no conversion is necessary. The size of the file to be processed can from the UPAM perspective be quickly determined from the inode properties. This mode of processing is utilized by, for example, HSMS in order to be able to secure the file in a performant manner. To activate this method of processing, the application must place the flag UPAM_RAW_ACCESS (FCB+B9(+7): ID1URWAC) next to the flag SAM_NODE_FILE_ENABLE (FCB+B9(+6): ID1SNFEN).

3.5 Guidance on selected BS2000 commands:

COPY-FILE further supports the copying of SAM files onto Net-Storage as a SAM node file; here too, the user must first create the target file on the Net-Storage using CREATE-FILE FILE-TYPE=*NODE-FILE. In this way the user can specify the target character set as NETCCS, alternatively a NETCCSN will be automatically assigned as described above (3.4.2 Code Conversion). When copying a SAM node file to a public disc, the attribute NETCCS will not be carried over; on the other hand, when a SAM node file is copied over a SAM node file the NETCCSN of the source file will be carried over to the target file, that is to say any potential NETCCSN related discrepancy with the target file shall be overwritten.

COMPARE-DISC-FILE supports SAM node files. SAM node files may be compared with SAM node files as well as SAM node files with SAM files on a public disc.

CONCATENATE-DISC-FILES likewise supports SAM node files. Where SAM node files are concatenated, the files must match in terms of the NETCCS attribute. Where SAM files on a public disc are to be concatenated to SAM node files, it must be possible to convert the source character set into the target character set as per the above stated rules.

4. Notes on Products and Components

4.1. HSMS

HSMS permits the saving and restoring of SAM node files. In place of the commands to save (BACKUP-FILES), long term archival (ARCHIVE-FILES) and to export (EXPORT-FILES), the new operand SAVE-SAM-STRUCTURE = *YES/ *NO offers a choice between the two processing modes that follow:

1. SAVE-SAM-STRUCTURE = *NO is the quickest way of saving files: the file is saved in raw mode and in an unstructured form; no SAM structures are created and no code conversion is performed. SAM node files saved in this way may only be restored to being SAM node files.

2. SAVE-SAM-STRUCTURE = *YES: when transferring data, the net-client inserts the SAM structures within the data stream and where required performs a code conversion into EBCDIC. As a result the backup runs slower than with the operand SAVE-SAM-STRUCTURE = *NO. SAM node files backed up in this way can be restored to a public space (Operand: NEW-SUPPORT).

SAM files on a public disc can be restored as SAM node files (Operand: NEW-SUPPORT).

The structure of SAM files is not as standard preserved in the backing up (BACKUP-FILES) of SAM node files (Performance!). The SAM structure is preserved as standard when SAM node files are backed up for the purposes of long term archival and data transfer (ARCHIVE-FILES, EXPORT-FILES), this ensures that the data can be restored or imported to a system, which does not have access to Net-Storage.

HSMS reports may also be stored as SAM node files; the report file is to be created accordingly ahead of the HSMS run.

4.2. SYSFILE

SYSFILE is able to access SAM node files, which, for example, may contain procedures as well as data entered (SYSCMD and SYSDTA). The user may redirect logging output to SAM node files. The procedure is more or less standard, with the exception that first of all a file must be created on the Net-Storage before either SYSOUT or SYSLST may be assigned. If the character set needed on the Net-Storage is different from the standard one, the user will still need to specify the appropriate NETCCSN as a Net-Coded-Character-Set within CREATE-FILE or make the change by using MODIFY-FILE-ATTRIBUTES. As already mentioned, the creation of the file as well as the setting up of the CCSN or the NETCCSN must take place before either the file is opened or SYSOUT or SYSLST are assigned!

Within the output of node files, SYSFILE suppresses binary control characters within the first column of a record, e.g. linefeeds (x'01', x'02' -> are replaced by blank x'40'; form feed x'C1' = A is kept). These elements would affect the appearance of applications in the open systems world.

4.3. EDT/EDTU

SAM node files are supported by EDTU. Ahead of writing a file to the Net-Storage it must first be created as a node file and set up with the appropriate character sets.

4.4. BS2ZIP

BS2ZIP is able to create ZIP archives as PAM node files, permitting open systems to gain access to them.
The user must first of all create a node file on the Net-Storage. BS2ZIP will then be able to open it with write access and add files to the zip archive. An already existing zip archive can also be copied to this file. BS2ZIP cannot add SAM node files to a zip archive.

Example:

```
/CREATE-FILE :ABC:$USER.FILE.ZIP,VOLUME=NET001,FILE-TYPE=*NODE
/START-ZIP
//OPEN-ZIP-CONTAINER CONTAINER=:ABC:$USER.FILE.ZIP,MODE=*UPDATE,-
//    FORMAT=*WINZIP-COMPATIBLE
//ADD-FILE FROM-FILE=:X:$TSOS.BGF.REPORT.1, CHARACTER-CON=*TO-WIN-ANSI,-
//    DATA-TYPE=*CHARACTER
//END
```

4.5. CONVERT-TO-PDF

For PDF files only the PAM format is intended for node files.
Example:
```
/CREATE-FILE :ABC:$USER.FILE.ZIP,VOLUME=NET001,FILE-TYPE=*NODE
/CONVERT-FILE-TO-PDF FILE-NAME=<filename>,FORMAT=*PAM
```