

Operation

Natural for DL/I operates as a standard DL/I application.

Prior to running a Natural application, a PSB must be scheduled. The method for scheduling PSBs varies depending on the actual environment (see the relevant sections under PSB Scheduling), but as for any other DL/I application, PSB scheduling is a requirement.

This section covers the following topics:

- Procedure NATPSB
 - Procedure NATDBD
 - Procedure NATUDF
 - Generation of DDMs from DL/I Segment Types
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Procedure NATPSB

Every PSB required by DL/I to accommodate Natural requests must be processed by the Natural batch utility NDPBNSB0. This utility stores DL/I PSB information, in a form suitable for Natural, on the FDIC system file. This information is referred to as NSB control block. A batch procedure called NATPSB has been established for this purpose.

A sample NATPSB job has been included in the source library from the installation tape. The information used to create NSB control blocks comes from the actual PSBGEN source. It is essential that the same input is used for the NATPSB procedure as was used for the DL/I PSBGEN. Otherwise, unpredictable results are likely.

The NATPSB job is a three step procedure:

- The first step executes the normal DL/I PSBGEN procedure. This step is included to guarantee compatibility between DL/I and Natural.
- The second step performs another assembly and link of the PSBGEN source, this time using macros supplied by Natural.
- The final step executes the Natural batch utility NDPBNSB0, which uses the linked PSB module from the previous step to create NSB control blocks which are stored on the FDIC system file. NDPBNSB0 dynamically loads the Natural module NDLB0002, which therefore must be present in an allocated load library.

Natural requires one or more PSBs for batch and/or online processing. Depending on application requirements, the PSB can be switched during a Natural session. Each PSB describes all user views that can be used to access DL/I databases from Natural programs if this PSB is active. A PSB must contain one or more program communication blocks (PCBs) for each DBD to be accessed. Since Natural only uses the single positioning option on PCBs, Natural programs that maintain two or more independent positions in a database require a PCB (of the appropriate type) for each separate position.

If this requirement is not fulfilled, Natural for DL/I issues the runtime error message:

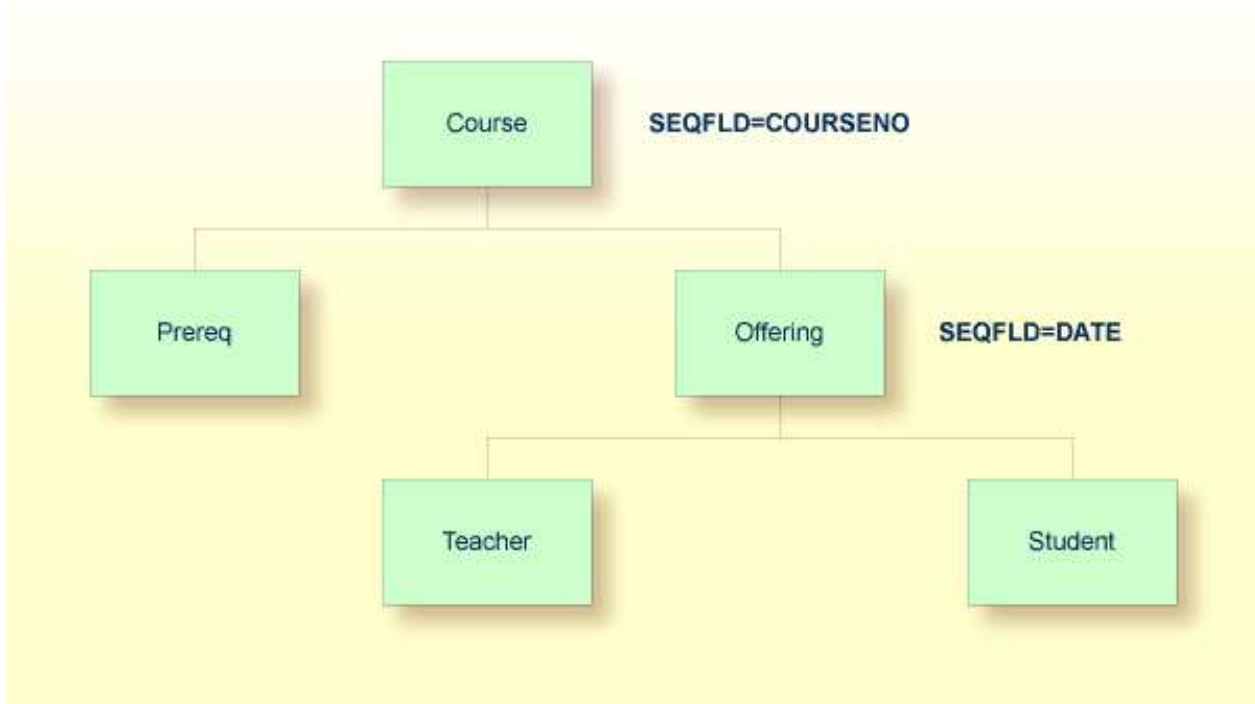
NAT3789 Active PSB contains too few PCBs for program execution.

The PCB in use must have segment sensitivity and the appropriate PROCOPT parameter specified for Natural, to be able to perform a segment update.

Nested I/O loops (FIND or READ) in Natural programs frequently require separate positions in the same database to be maintained. To reduce the number of PCBs needed, as many I/O loops as possible should be closed before opening subsequent I/O loops.

Consider the following sample DL/I database:

Sample Education Database ED00DBD:



The following Natural program based on the above database requires two PCBs:

```

READ ED00DBD-COURSE BY COURSENO
  FIND ED00DBD-PREREQ WITH COURSENO-COURSE = COURSENO
    FIND ED00DBD-OFFERING WITH COURSENO-COURSE = COURSENO
    LOOP
  LOOP
LOOP
END
  
```

The first PCB is used to maintain position on the COURSE and PREREQ segments. A second PCB is required for the OFFERING segment since the FIND loop has not been terminated for the PREREQ segment prior to invoking a FIND on the OFFERING segment. By closing the first FIND loop prior to opening the second one, this program would only require one PCB.

Natural selects the PCB to be used for a database request in the following manner:

1. Natural selects the first PCB in the PSB with the correct DBD name and the appropriate PROCSEQ parameter (if applicable).
2. Natural then determines if the PCB can be used for the request or if there is a conflict due to current database positioning.
3. If there was a positioning conflict or the PCB did not contain the correct DBD name or PROCSEQ parameter, Natural would continue scanning the PSB.
4. If the database search request refers to a secondary index, Natural attempts to use a PCB with the corresponding PROCSEQ parameter. If there is no PCB of this type in the PSB, Natural tries to use a PCB without the PROCSEQ parameter. In this case, it is assumed that the INDICES parameter has been coded in the appropriate SENSEQ statement.
5. If no eligible PCB could be found, an error message would be generated.

In general, PCBs for use by Natural can have different PROCOPT parameters. However, if there are two or more PCBs in the PSB referring to the same DBD, these PCBs must appear consecutively in the PSB source and they must specify the same SENSEG statements and same PROCOPT parameters. They can, however, have different PROCSEQ parameters.

When locating an eligible PCB, Natural disregards the PROCOPT parameter of the PCB. The first free PCB is selected independently of the PROCOPT parameter, so that if the chosen PCB has a PROCOPT that does not support the request, an error message that corresponds to a DL/I status code is returned.

Natural assumes that all PCBs with the same DBD name and the same PROCSEQ parameter contain the same SENSEG statements as the first PCB. If this is not true and a PCB is selected that does not contain a SENSEG statement for the segment being referenced, an error message that corresponds to a DL/I status code is returned.

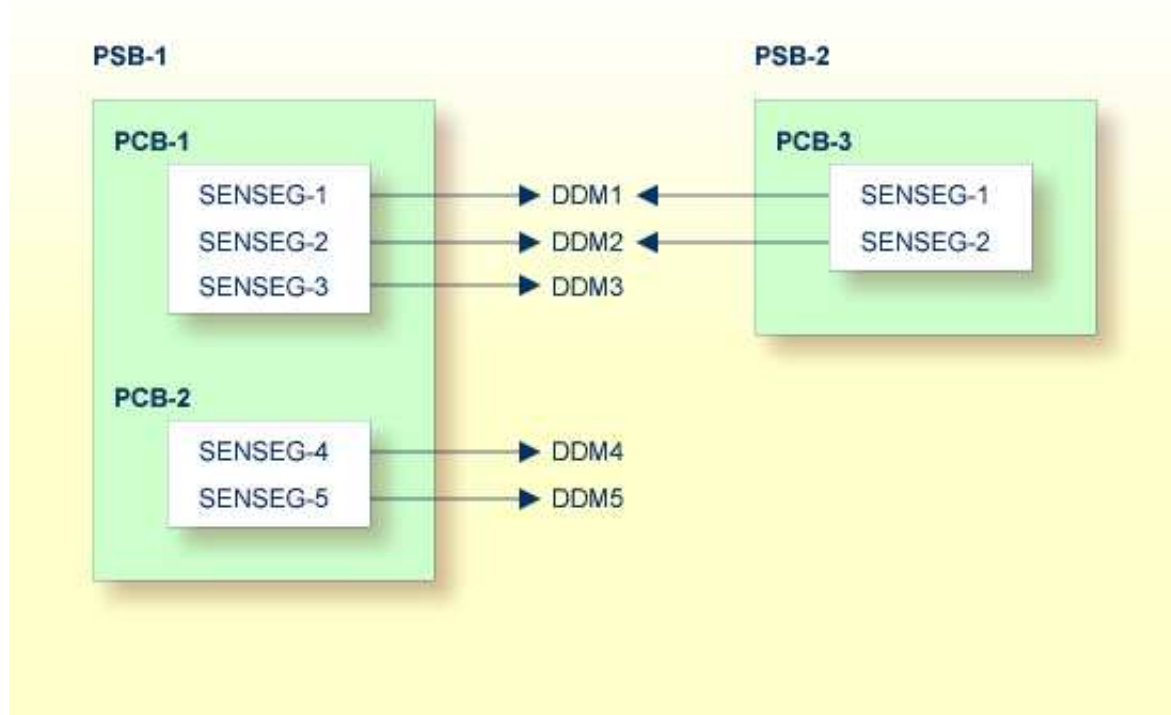
The following example PSB and Natural program demonstrate that the sequence of the PCBs, referring to the same DBD, may affect Natural programs if the PROCOPT= parameters are different:

```
PCB    TYPE=DB, DBDNAME=ED00DBD, PROCOPT=GO, . . .
SENSEG NAME=COURSE
SENSEG NAME=OFFERING, PARENT=COURSE
PCB    TYPE=DB, DBDNAME=ED00DBD, PROCOPT=A, . . .
SENSEG NAME=COURSE
```

The following program requires two PCBs: the first PCB is used for the READ loop (which reads all COURSE segments) and the second nested FIND loop (which finds one offering to a given course); the second PCB is used for the first FIND loop (which updates a specific COURSE segment). The program does not work if the order of the two PCBs is reversed.

```
READ COURSE BY COURSENO
  FIND (1) COURSE WITH COURSENO = '120'
    UPDATE WITH TITLE = 'Natural'
  LOOP
  FIND (1) OFFERING WITH COURSENO-COURSE = COURSENO (0010)
    DISPLAY COURSENO-COURSE
  LOOP
LOOP
END
```

The following figure shows the logical connections between DL/I PSBs, PCBs, sensitive segment types and Natural DDMs:



Natural DDMs which are derived from segment descriptions in the DBD correspond to DL/I segment types.

Since each DL/I application program requires the specification of its sensitive segment types, an appropriate PSB must be scheduled before Natural program execution. A PSB can be scheduled at the start of a Natural session or at any time during the session.

If, in the configuration shown in the diagram above, PSB-2 has been scheduled, only the DDMs DDM1 and DDM2 are accessible to Natural application programs. If an attempt is made to use DDM5, for example, Natural for DL/I returns the error message:

NAT3768 PCB with requested DBD not found in NSB.

Procedure NATDBD

Every DL/I database structure, both physical and logical, which is supposed to be used by Natural, must be processed by the Natural batch utility NDPBNDB0.

This utility stores DL/I database information on the FDIC system file, in a form suitable for Natural. This information is referred to as *NDB control block*. A batch procedure called NATDBD has been established for this purpose.

A sample NATDBD job has been included in the source library from the installation tape. The information used to create NDB control blocks comes from the actual DBDGEN source. It is essential that the same input is used for the NATDBD procedure as was used for the DL/I DBDGEN. Otherwise, unpredictable results are likely.

The NATDBD job is a three step procedure:

- The first step executes the normal DL/I DBDGEN procedure. This step is included to guarantee compatibility between DL/I and Natural.
- The second step performs another assembly and link of the DBDGEN source, this time using macros supplied by Natural.
- The final step executes the Natural batch utility NDPBNDB0, which uses the linked DBD module from the previous step to create NDB control blocks which are stored on the FDIC system file. NDPBNDB0 dynamically loads the Natural module NDLB0001, which therefore must be present in an allocated load library.

The NATDBD procedure assigns a short name of two bytes to each DL/I field; that is, to each field defined in the DBD. All field short names are generated in the range from NA to Z9, which means that up to $13 * (26 + 10) = 468$ DL/I fields can be managed per DBD. DL/I short names are generated uniquely within an NDB.

When replacing an NDB, NATDBD reassigns short names in a consistent way; that is, the same short name to the same field name. In addition, the UDFs are maintained, where the new NDB contains the new DL/I layout followed by the old UDF layout, which means that UDFs are not deleted by NATDBD. It is the administrator's responsibility to edit the segment description after NATDBD has been executed, in order to modify the UDFs accordingly.

Using Logical Databases with Natural

The following information must be considered when using logical databases with Natural:

- Execute the NATDBD procedure for a logical database only after successful execution of the procedure for the physical databases referred to. In other words, if the input DBD is a "logical" DBD, the NDBs generated from the "physical" DBDs must already be stored in the Natural FDIC system file to correctly generate the NDB control blocks related to this segment.
- When a segment specifying the SOURCE=keyword is processed by the NATDBD procedure, the related "physical" DBD must already be stored in the Natural FDIC system file.

If the SOURCE=keyword is specified (in one or more segments) in a "physical" DBD, which means that one or more logical virtual child segments are involved (recursively or not), the NATDBD procedure run against this DBD stores the NDB structure on the Natural FDIC system file even if one or more physical DBDs referred to by the SOURCE=keywords have not already been stored.

In this case, the logical virtual child segments whose source DBD is not yet in the Natural FDIC system file as well as their descendants are not accessible to the user since Natural has marked these segments as inhibited. An appropriate Natural error message is issued indicating the name(s) of the related physical DBD(s) that need to be stored into the Natural system file.

If the logical relationship is the result of a recursive database structure, the NATDBD procedure for the physical DBD must be run at least twice: the first time, the NDB is stored on the Natural system file with the undefined segment marked as inhibited; the second time, the reference to the SOURCE segment is resolved.

If multiple physical databases are logically related, the NATDBD procedure must be run for each of these physical databases and then rerun for any database that contained logical child segments marked as inhibited.

- If the SOURCE=keyword is specified in a "logical" DBD and one or more source DBDs are not found in the Natural FDIC system file while running the NATDBD procedure, the NDB structure is not stored and an appropriate error message is returned.
- If an attempt is made to generate a DDM for a segment whose NDB control blocks are not in the Natural FDIC system file, a Natural error message is returned.

Using Index Databases with Natural

The following information must be considered when using index databases with Natural:

- To access a secondary index database as data, the secondary index database must be defined as an independent physical database to both DL/I and Natural.
- The NATDBD procedure need not be executed for primary or secondary index DBDs.

Procedure NATUDF

The DBDGEN source usually does not define all fields within a segment. Additional segment fields called User-Defined Fields (UDFs) can be entered as part of creating the DDMs. UDFs define the additional data in the segment that can be referenced by a Natural program. UDFs can be generated online using Predict or the Natural utility SYSDDM, or they can be generated in batch mode using the NATUDF procedure.

The NATUDF procedure invokes the batch utility NDPBCUDF, which stores segment description layout information on an FDIC system file.

Important:

Before NDPBCUDF can be executed, the DL/I DBD must have been stored as an NDB on the FDIC system file, and a DBID and FNR must have been assigned (with Predict or SYSDDM) to each segment concerned. Otherwise, NDPBCUDF cannot read the segments concerned.

The input for this utility is provided by the segment description read from a work file. This work file contains segment identification statements and segment field descriptions.

You can format data by using either delimiter mode (IM=D) or forms mode (IM=F); see also the IM profile parameter in the Natural Parameter Reference documentation. In delimiter mode, the delimiter character can be used. In forms mode (for example, if input is passed from other programs), input data fields are assumed to be in contiguous storage and must be filled up to the internally defined full length.

One line is required for the segment identification statement, and two lines are required for each segment field description.

The section below covers the following topics:

- Segment Identification Statement

- Segment Field Description

Segment Identification Statement

One line has to be supplied for each segment being defined. The following syntax is used (the parameters must be specified in the sequence shown below):

FUNC= (*function*) , DBD=*dbd-name* , SEGM=*segment-name*

<i>function</i>	Function to be applied to the segment: ADD to create a new segment layout; REP to replace an existing segment layout; MOD to add or modify fields without deleting existing fields not present in the input file; END to indicate termination of the UDF redefinition.
<i>dbd-name</i>	A 1 to 8 character alphanumeric DBD name; that is, the name of the DL/I DBD which owns the segment to be defined.
<i>segment-name</i>	A 1 to 8 character alphanumeric name of the DL/I segment to be defined.

Segment Field Description

The segment identification statement has to be followed by at least one segment field description. The following syntax is used for each field to be defined (the parameters must be specified in the sequence shown below):

FUNC=FLD , NAME=*fnam* , TYPE=*type* , LEVEL=*lev* , LENGTH=*lgh* , MAXOCC=*moc* , VAR=*var*
FUNC=STR , BEGIN=*begin*

After each FLD card, a STR card must be coded, except for the last FLD card, which is specified with four dollar signs (\$\$\$\$) in the field name. After this last FLD card, an END card must be coded.

<i>fnam</i>	The name of the field being defined. This must be an alphanumeric value of 1 to 19 bytes. The value "\$\$\$\$" closes the definition of the current segment.
<i>type</i>	The UDF field format (1 character). The following formats can be specified: A, B, F, P, U, N, S.
<i>lev</i>	The field level (1 digit).
<i>lgh</i>	The field length (4 digits).
<i>moc</i>	The maximum occurrence (3 digits) of the field (only applicable for a multiple-value field or a periodic group).
<i>var</i>	Possible values: V variable field length N fixed field length
<i>begin</i>	The starting position of the field being redefined. This can be specified either in terms of bytes relative to the beginning of the segment or as a field name of the DL/I field being redefined. The value must be alphanumeric and 1 to 19 characters long (32 bytes in forms mode, as the field is 32 characters long in this mode).

The short name is automatically assigned by the utility in the range from AA to G9, excluding EA to E9. The range from HA to M9 is reserved for UDFs of logical child segments. Thus, up to 216 fields can be provided as input, which is the maximum number of UDF fields.

For further information on UDF field parameters, please refer to DL/I Services.

Delimiter Mode (IM=D) Example:

```

FUNC=REP, DBD=ED02DBD, SEGM=COURSE
FUNC=FLD, NAME=GENG1, TYPE=N, LEVEL=1, LENGTH=5
FUNC=STR, BEGIN=11
FUNC=FLD, NAME=DUM1, TYPE=A, LEVEL=1, LENGTH=6
FUNC=STR, BEGIN=TITLE
FUNC=FLD, NAME=DUM2, TYPE=A, LEVEL=1, LENGTH=6
FUNC=STR, BEGIN=DESCRIPN
FUNC=FLD, NAME=GENG3, LEVEL=1, MAXOCC=2
FUNC=STR, BEGIN=GENG1
FUNC=FLD, NAME=GRU21, TYPE=N, LEVEL=2, LENGTH=1
FUNC=STR
FUNC=FLD, NAME=GRU22, TYPE=A, LEVEL=2, LENGTH=2
FUNC=STR
FUNC=FLD, NAME=GRU23, TYPE=N, LEVEL=2, LENGTH=3
FUNC=STR
FUNC=FLD, NAME=$$$$
FUNC=REP, DBD=ED02DBD, SEGM=COURSE
FUNC=FLD, NAME=DUM41, TYPE=B, LEVEL=1, LENGTH=9
FUNC=STR, BEGIN=DESCRIPN
FUNC=FLD, NAME=DUN2, LEVEL=1, MAXOCC=2
FUNC=STR, BEGIN=TITLE
FUNC=FLD, NAME=GRU21, TYPE=N, LEVEL=2, LENGTH=1
FUNC=STR
FUNC=FLD, NAME=GRU22, TYPE=A, LEVEL=2, LENGTH=2
FUNC=STR

```



```

FUNC=FLD , NAME=GRU23 , TYPE=N , LEVEL=2 , LENGTH=3
FUNC=STR
FUNC=FLD , NAME=$$$$
FUNC=END

```

Forms Mode (IM=F) Example:

```

ADDDBD1      SEGM1
FLD          1FIELD-1          000A0012N000
STR
FLD          1FIELD-ANY       000A    N000
STRFIELD-1
FLD          2FIELD-ANY2      000A0024N000
STR
FLD          $$$$
STR
REPDBD2      SEGM2
FLD          1NEW-FIELD-NAME   000A0012N000
STR
FLD          $$$$
END

```

Sample JCL:

```

//NATUDF     JOB      . . . . .
//NATUDF     EXEC    PGM=NATBATCH , PARM=' . . . '
//STEPLIB   DD      DSN= . . .
//          DD      DSN= . . .
//SYSUDUMP   DD      DUMMY
//CMPRINT   DD      SYSOUT=Y
//DDCARD    DD      DSN=NAT23n . SRCE ( ADAPARM ) , DISP=SHR
//CMSYNIN   DD      *
LOGON SYSDDM
NDPBCUDF
FUNC=REP , DBD=ED02DBD , SEGM=COURSE
FUNC=FLD , NAME=DUM1 , TYPE=A , LEVEL=1 , LENGTH=6
FUNC=STR , BEGIN=TITLE
FUNC=FLD , NAME=DUM2 , TYPE=A , LEVEL=1 , LENGTH=6
FUNC=STR , BEGIN=DESCRIPN
FUNC=FLD , NAME=$$$$
FUNC=END
FIN

```

Generation of DDMs from DL/I Segment Types

DDMs that represent DL/I segment types are generated from information contained in the NDB and UDF control blocks. These DDMs contain all fields that have been defined for the segment, both in the NDB and in the UDF.

In addition, the DDMs contain the fields from the ancestor segments that have been defined in the DBDGEN for these segments. Ancestor segments are defined as segments that form the hierarchical path from the root segment down to the current segment. Ancestor segment fields that might have been defined in the DBDGEN for a segment include sequence fields, secondary index fields and search fields.

The DDM for a DL/I segment contains all fields that could be specified in the segment search argument (SSA), all fields that are available as part of the key feedback area and any segment I/O fields as well. Each DDM, therefore, contains all the fields that Natural requires to automatically build the concatenated key for the segment.

Once all fields have been defined for a specific segment DDM, the corresponding Natural DDM can be generated and cataloged (stored) on the Natural FDIC system file. This is done either with Predict or with the Natural utility SYSDDM.

If you do not have Predict installed, use the SYSDDM function DL/I Services to generate Natural DDMs from DL/I segment types. This function is invoked from the main menu of SYSDDM.