Natural Development Server

Natural Development Server for z/OS (Batch)

Version 9.2.3

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ADABAS & NATURAL

This document applies to Natural Development Server Version 9.2.3 and all subsequent releases.

Specifications contained herein are subject to change and these changes will be reported in subsequent release notes or new editions.

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Preface

This documentation applies to Natural Development Server (product code NDV) for z/OS (Batch).

Natural Development Server for z/OS is released together with Natural for Mainframes. It has the same version number as Natural for Mainframes.

For information on changes, enhancements or new features in this version of Natural Development Server, see the *Release Notes* in the corresponding Natural for Mainframes documentation.

Introducing Natural Development Server	Describes purpose and functionality of Natural Development Server which is used in conjunction with NaturalONE or Natural for Windows (as a client) in a Natural Single Point of Development (SPoD) environment.
Development Server File	Describes purpose and use of the Natural Development Server file, a central dictionary file that is structurally identical to the Natural system file `FDIC`.
Natural Development Server on Mainframes	Describes concept and architecture of Natural Development Server.
Prerequisites	Describes prerequisites that apply when you install Natural Development Server on a mainframe computer.
Installing the Natural Development Server	How to install Natural Development Server under the operating system z/OS (Batch).
Configuring the Natural Development Server	How to configure Natural Development Server.
Operating the Natural Development Server	How to operate Natural Development Server.
Monitor Client NATMOPI	Describes the Monitor Client NATMOPI, a character-based command interface for monitoring the various types of servers that are provided in a mainframe Natural environment.
HTML Monitor Client	Describes the HTML Monitor Client, a monitor interface that supports any web browser as a user interface for monitoring the various types of servers that are provided in a mainframe Natural environment.
SPoD-Specific Limitations and Considerations	Describes the limitations which are due to the different capabilities of the graphical user interface available on the local site and the character-based user interface that exists on the remote site. In addition, this document includes hints which are important for the efficient use of the remote development facilities.
Natural Development Server Frequently Asked Questions	Contains frequently asked questions concerning Natural Development Server.

Natural Development Server CICS Adapter	Describes the optional Natural Development Server CICS Adapter, which is required if you want to use Natural Development Server in a CICS environment.
Natural Development Server IMS Adapter	Describes the optional Natural Development Server IMS Adapter, which is required if you want to use Natural Development Server in an IMS TM environment.

Related Documentation

- Natural Single Point of Development documentation
- NaturalONE documentation
- Natural for Windows documentation
- Natural for Mainframes documentation

1 About this Documentation

Document Conventions

Convention	Description
Bold	Identifies elements on a screen.
`Monospace font`	Identifies service names and locations in the format *`folder.subfolder.service`*, APIs, Java classes, methods, properties.
`Italic`	Identifies: Variables for which you must supply values specific to your own situation or environment. New terms the first time they occur in the text. References to other documentation sources.
`Monospace font`	Identifies: Text you must type in. Messages displayed by the system. Program code.
{ }	Indicates a set of choices from which you must choose one. Type only the information inside the curly braces. Do not type the { } symbols.
|	Separates two mutually exclusive choices in a syntax line. Type one of these choices. Do not type the | symbol.
[ ]	Indicates one or more options. Type only the information inside the square brackets. Do not type the [ ] symbols.
...	Indicates that you can type multiple options of the same type. Type only the information. Do not type the ellipsis (...).

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- Open and update support incidents.
- Add product feature requests.

Data Protection

Software GmbH products provide functionality with respect to processing of personal data according to the EU General Data Protection Regulation (GDPR). Where applicable, appropriate steps are documented in the respective administration documentation.

2 Introducing Natural Development Server

This chapter describes the purpose and the functions of Natural Development Server (product code NDV) which are used in conjunction with NaturalONE or Natural for Windows (as client) in a Natural Single Point of Development (SPoD) environment.

Purpose of Natural Development Server

Natural Development Server enables you to use NaturalONE or the Natural Studio development environment provided by Natural for Windows to develop and test Natural applications in a remote Natural mainframe environment running under the operating system z/OS (Batch).

For more information on NaturalONE and remote development, see

- NaturalONE documentation (describes the SPoD client side; how to manage offloaded Natural objects in the Eclipse workspace, and also how to modify them directly on a development server).
- Natural Single Point of Development documentation (general information).

For more information on Natural Studio and remote development, see

- Natural for Windows documentation or Help system (describes the SPoD client side; how to manage Natural objects directly on a development server).
- Natural Single Point of Development documentation (general information).

With Natural version 9 on Mainframe and Linux, NaturalONE and the Natural Development Server are integrated into Natural. The Natural editors (program editor, data editor and map editor) are disabled. As NaturalONE and Natural Development Server licenses are integrated with Natural, they can be activated with the Natural (NAT) license key. This does not apply to Natural for Windows.

Remote Development Functions

Establishing a Connection between Client and Server

A connection to an active development server can be established by mapping it in the client (that is, in NaturalONE or Natural Studio). A dialog will be shown for setting up the connection in which you have to specify the following information:

Server

Host name	The host name defines the remote node name where the server is running (or the IP address of the server).
Server port	The server port defines the TCP/IP port number for the development server.
Environment name	The environment name can be used to give the addressed server a logical (descriptive) name. If this box is left blank, a default name will be created automatically.

Startup

Session parameters	If dynamic parameters are required for your development server, specify them in this text box. Otherwise, leave this text box blank. **Note:** Specifying a parameter string in this text box causes the profile specification of the NDV configuration parameter `DEFAULT_PROFILE` to be overwritten. For more information on how to configure a Natural Development Server for SMARTS on z/VSE, see *Single Point of Development* > *Natural Development Server for z/VSE* > *Natural Development Server for z/VSE (SMARTS/Com-plete)* > *Configuring the Natural Development Server*.
User ID	Your user ID is automatically provided.
Password	If Natural Security is installed on the development server, specify the required password in this text box. Otherwise, leave this text box blank.

These settings are transferred to the selected Natural Development Server and evaluated to create an exclusive Natural session that is responsible for executing all development requests for that environment. Once you have sucessfully mapped a development server, the Natural objects of the connected remote development environment are shown in NaturalONE or Natural Studio.

Using the Remote Development Functionality

You can use the entire functionality of NaturalONE or Natural Studio to create, edit, stow or execute Natural objects on the remote Natural environment. You can map to multiple environments from one NaturalONE or Natural Studio. Each mapped environment owns a Natural session on the Natural Development Server, even if you map multiple environments on the same server.

When you are working with NaturalONE, it is recommended that you work in the so-called "local mode". In local mode, the sources are no longer stored or modified directly on the development

server. The central place for keeping the sources is now the Eclipse workspace which is connected to a version control system.

3 Development Server File

This chapter describes purpose and use of the Natural Development Server file, a central dictionary file that is structurally identical to the Natural system file FDIC.

Purpose of the Development Server File

As Natural stores its data in system files, Natural Development Server stores its data in the system file that is assigned to the Natural parameter FDIC, a logical system file which is called the “development server file”.

The development server file is used as a central dictionary file for storing Natural applications and the links to objects making up an application. It also holds object locking information. This information is not bound to certain groups of application developers, but has an impact on the entire application development of an enterprise. Therefore, this file should be available only once, to ensure that the application definitions and locking states are kept consistent.

Note: The documentation of a Predict Program object, with the object's implementation pointer completely filled (i.e. Natural member name, library name, user system file number, and user system file database id), is deleted when the Natural member is deleted in an NDV environment. By default, the switch "**Delete documentation with deletion of Natural member**" is initialized with "Y", i.e. deleting the existing documentation. If you wish to keep the documentation set this new switch to "N".

Relations between FDIC and the Development Server File

The development server file layout corresponds to the file layout of the Natural system file FDIC used by Predict. This means that the central dictionary file can also be used to hold Predict data, but Predict is not a prerequisite for using the development server file. This enables you to use your existing application documentation in the application definitions of the remote development environment.

Unique Development Server File

It is of vital importance that the various remote development environments that can be mapped use a common and unique development server file.

Non-compliance with this requirement may give rise to inconsistencies in object locking and in the applications existing in the application workspace.

NTDYNP Macro

To prevent the FDIC parameter from being overwritten when a Natural Development Server is mapped, you are strongly recommended to prevent the NTDYNP macro from being used to specify FDIC as a dynamic parameter.

Under Natural Security

In a Natural Development Server that is protected by Natural Security, the use of another FDIC file in the application workspace is prevented if the application security profiles are activated. See also *Application Protection* in the *Natural Security* documentation.

4 Natural Development Server on Mainframes

This chapter describes the concept and the architecture of the Natural Development Server (product code NDV) which is designed for use under z/OS (Batch).

In addition, an optional Natural Development Server CICS Adapter is available that enables Natural Development Servers for z/OS or SMARTS/VSE to be used with a CICS TP monitor.

Development Server Concept

A Natural Development Server is a multi-user, multi-tasking application. It can host Natural sessions for multiple users and execute their requests concurrently.

The concept is based on the "serverized" Natural runtime system. Its architecture comprises a server front-end stub (development server stub `NATRDEVS`) that uses the Natural front-end to dispatch Natural sessions and to execute functionality within these sessions.

The Natural remote development server architecture basically consists of:

- **Front-end stub**

  The stub `NATRDEVS` is launched to initialize a Natural Development Server. It listens for incoming transactions and dispatches the appropriate Natural session for executing the transaction.

- **Front-end**

  The front-end is called (together with the Natural runtime system) by the front-end stub for session initialization/termination, request execution and session roll-in/roll-out.

- **Gateway module**

  The module `NATGWSTG` provides for interaction between the Natural runtime system and the front-end stub. `NATGWSTG` is already included in the Natural nucleus and is called by the Natural runtime system to exchange the necessary request data.

- **Transaction processors**

  Transaction processors are called by the front-end stub. The application logic of each individual transaction is implemented within a transaction processor.

- Natural Driver

  Natural is driven by the Natural Com-plete interface `NCF-SERV`.

- **Server monitor**

  A monitor task allows the administrator to control the server activities, to cancel particular user sessions or to terminate the entire server, etc.

Front-End Stub NATRDEVS

The multi-user, multi-tasking, front-end stub `NATRDEVS` is launched to initialize a Natural Development Server.

Stub Description

The task executing the server initialization (`TMain`) basically is the main listener which waits for incoming requests from the remote development client (Natural Studio). It owns a session directory to manage multiple clients (users) and their corresponding remote Natural sessions. `TMain` has the task to accept all incoming requests and to dispatch them to other subtasks (`TWork`). The process is as follows:

- First, a **Map Environment** command issued by the user on the client side (in the **Tools** menu of Natural Studio) connects to `TMain` to establish a connection.
- Next, `TMain` inserts the client into its session directory, attaches a new `TWork` subtask and passes the connection to TWork.
- `TWork` processes the request (indeed initializes a new Natural session if the client sends a `CONNECT` request) and replies to the client.
- After the reply, `TWork` listens on that connection for successive requests of that particular client. `TWork` remains active until the user on the client (Natural Studio) side switches the focus to a different environment (the local or a different mapped environment).
- If the user activates the environment again, `TMain` launches a new `TWork` subtask that resumes the existing Natural session from the previous TWork.

That is, each client owns one subtask `TWork` on the Natural Development Server and multiple remote Natural sessions (one for each mapped environment). This subtask remains active as long as the mapped environment on Natural Studio is the currently active environment. Each remote Natural session remains active until the user disconnects/unmaps the corresponding environment on the client side. Consequently, a Natural session can be executed under different subtasks if the user switches among multiple environments.

Natural System Variables Used

Within a Natural Development Server session, the following Natural system variables are used:

- `*TPSYS` contains `SERVSTUB`,
- `*DEVICE` contains `VIDEO`,
- `*SERVER-TYPE` contains `DEVELOP`.

Natural I/O Handling

The Natural runtime system allows I/O execution in the same way as in an online environment:

- A Natural Development Server intercepts the I/O and sends the 3270 data stream to Natural Studio.
- Natural Studio internally starts a terminal emulation window and passes the 3270 stream to that window.
- After I/O execution, the I/O data is sent back to the server.
- The front-end stub invokes the front-end to continue processing after I/O.

Front-End

The Natural front-end required for a Natural Development Server is a Natural batch front-end driver, which should be LE enabled. See sample installation jobs for details.

The Natural front-end required for executing the Natural sessions under control of CICS is the Natural remote front-end `NATCSRFE` that is delivered with the Natural Development Server. For further information, refer to ***Introducing the Natural Development Server CICS Adapter*** in the *Natural Development Server CICS Adapter* documentation.

Transaction Processors

The transaction processors are Natural programs in the library `SYSLIB` that process transactions (for example, "save source", "get library list") requested by the remote development client. The transaction processors are invoked by the front-end stub.

Gateway Module

The gateway module `NATGWSTG` is already included in the Natural nucleus.

For CICS support, the Natural Development Server distribution medium in addition contains the remote gateway modules `NATSRGND`/`NATLRGND`. Theses modules are responsible for transmitting the NDV-relevant data between a Natural Development Server and the Natural session running in CICS.

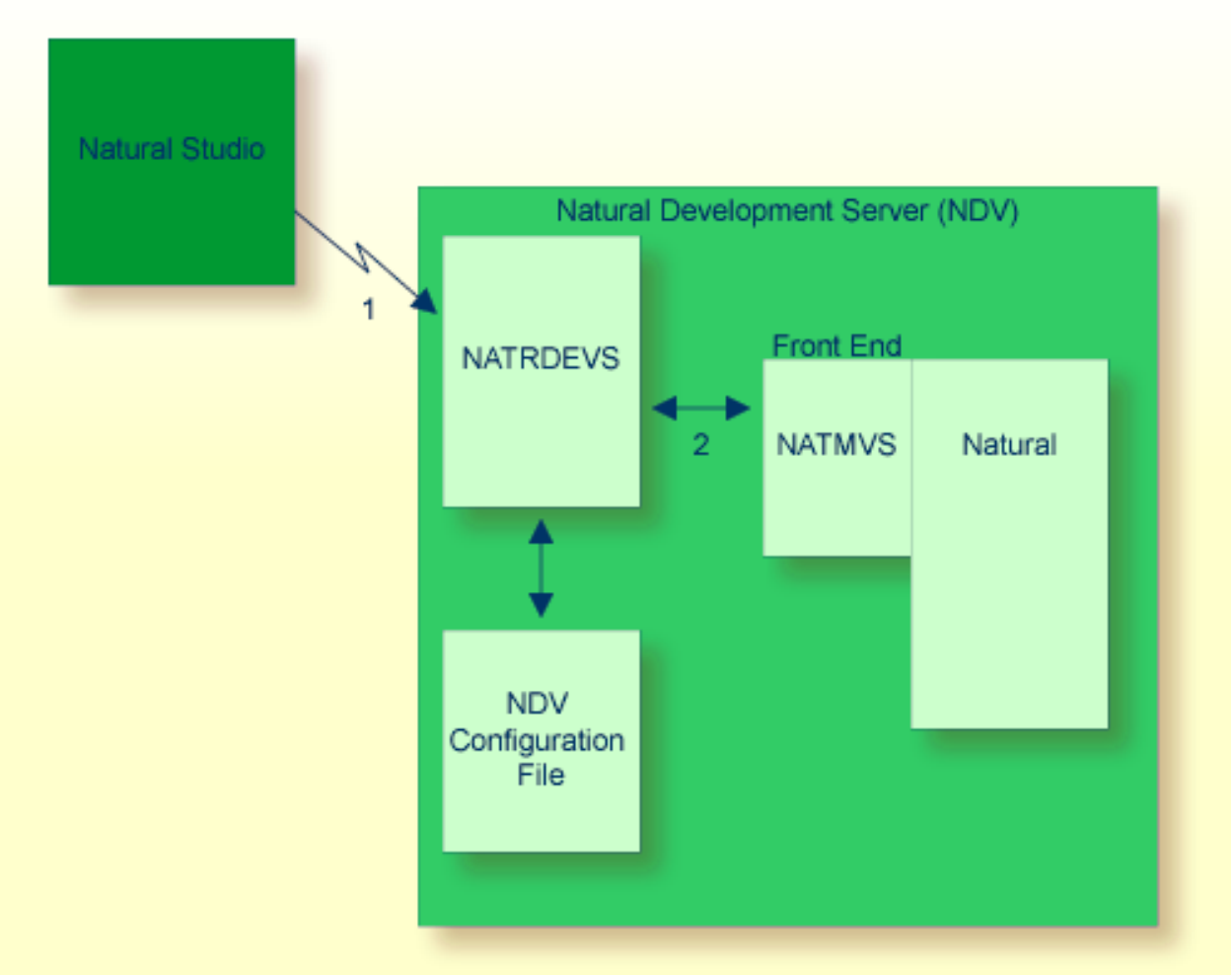
For more information, refer to the Natural Development Server CICS Adapter documentation.

Server Monitor

To enable the administrator to monitor the status of the Natural Development Server, a monitor task is provided which is initialized automatically at server startup. Using the **monitor commands**, the administrator can control the server activities, cancel particular user sessions, terminate the entire server, etc. See *Operating the Development Server*.

Product Interaction

The following figure illustrates the interaction of Natural Studio used as a remote development client with a Natural Development Server.



1. Natural Studio (the client) sends a remote development request to the Natural Development Server (NDV) using the port number specified with the NDV configuration parameter `PORT_NUMBER`.
2. The Natural Development Server dispatches the Natural session using the Natural front-end you have specified with the NDV configuration parameter `FRONTEND_NAME` (`NATMVS` in this example).

5 Prerequisites

This chapter describes the prerequisites that apply when you install a Natural Development Server (product code NDV) on a mainframe computer.

General Prerequisites for NDV Installation

- The currently applicable version of Natural for Mainframes must be installed; refer to Empower at ***https://empower.softwareag.com/***.

  Important: Any user-written exits not written in Natural and used within a Natural Development Server environment must be reentrant and thread-safe (capable to run in a multitasking environment).

- If you are using Predict and you have to migrate to a Predict version specified under *Natural and Other Software AG Products* in the current *Natural Release Notes for Mainframes*, you are strongly recommended to migrate to the newer Predict version *before* you install the Natural Development Server.

  Important: If you do not migrate to a Predict version specified under *Natural and Other Software AG Products* in the current *Natural Release Notes for Mainframes* before starting the Natural Development Server installation, you will have to define a new Natural system file `FNAT` and a new Development Server File (`FDIC`). The current version of Natural for Mainframes and the desired additional products must have been loaded on the Natural system file `FNAT` before you start the installation of the Natural Development Server.

- To use other Software AG products in conjunction with the Natural Development Server, refer to the section *Software AG Product Versions Required with Natural* in the current *Natural Release Notes for Mainframes* for the required version.
- The Software AG Editor must be installed. You are recommended to set the size of the editor buffer pool to 1024 KB.

  If you are using System Maintenance Aid (SMA), the necessary modules are linked when the SMA parameter `SAG-EDITOR` is set to `Y` (Yes). This is the default.

  If you are installing without SMA, see Installation for z/OS, *Installing Software AG Editor*.
- The prerequisites for the operation of a remote development client must be fulfilled in addition. Natural for Windows or NaturalONE must have been installed on the PC client. For information on the applicable version of Natural for Windows, refer to Empower at ***https://empower.softwareag.com/***.
- Natural Development Server Version 9.2 is compatible with all supported versions of Natural for Mainframes, Natural for Windows and NaturalONE.

Note: For information about plug-ins and add-on products available, refer to Empower at *https://empower.softwareag.com/* and the section *Natural and Other Software AG Products* in the current *Natural Release Notes for Mainframes*.

Prerequisites for NDV for z/OS (Batch)

In addition to the **general prerequisites** described above, the following operating-system-specific prerequisites apply:

- z/OS must be installed.

  Version as specified under *Operating/Teleprocessing Systems Required* in the current *Natural Release Notes for Mainframes*.
- To prevent the formation of endless loops in user programs running under NDV, specify a reasonable value for Natural profile parameter `MT` (Maximum CPU Time).

Prerequisites/Restrictions for NDV CICS Adapter

The Natural Development Server must have been installed on z/OS.

In addition, the following prerequisites and restrictions apply to the Natural Development Server CICS Adapter:

- CICS must be installed.

  Version as specified under *Operating/Teleprocessing Systems Required* in the current *Natural Release Notes for Mainframes*.
- CICS TCP/IP and the CICS listener must be enabled. Refer to *CICS TCP/IP Socket Interface Guide*.
- The current version of Natural for Mainframes and the corresponding Natural CICS Interface must be installed.
- Natural must not be used with the Natural profile parameter `ADAMODE` (Adabas Interface Mode) set to `0`; this settings would cause an excessive number of Adabas user queue elements (UQE) per Natural session.

  With the NDV CICS Adapter, it is recommended to use `ADAMODE=1` or `ADAMODE=2`. If you have to use `ADAMODE=0` or `ADAMODE=3`, then it is recommended to use the configuration parameters `RFE_CICS_TA_INIT_TOUT` and `RFE_CICS_KEEP_TA` in the Natural Development Server configuration file.

Prerequisites/Restrictions for NDV IMS Adapter

The Natural Development Server must have been installed on z/OS.

In addition, the following prerequisites and restrictions apply to the Natural Development Server IMS Adapter:

- IMS TM must be installed.

  Version as specified under *Operating/Teleprocessing Systems Required* in the current *Natural Release Notes for Mainframes*.
- The IMS listener must be enabled. Refer to *z/OS Communications Server IP IMS Socket Guide*.
- The current version of Natural for Mainframes and the corresponding Natural IMS TM Interface must be installed.
- Natural must not be used with the Natural profile parameter `ADAMODE` (Adabas Interface Mode) set to `0`; this setting would cause an excessive number of Adabas user queue elements (UQE) per Natural session.

  With the NDV IMS Adapter, it is recommended to use `ADAMODE=1` or `ADAMODE=2`.

6 Installing the Natural Development Server on z/OS (Batch)

This chapter describes how to install a Natural Development Server (product code NDV) on the operating system z/OS (Batch).

Prerequisites

For details, refer to the section ***Prerequisites***.

Content of the Development Server Distribution Medium

The installation medium contains the datasets listed in the table below. The sequence of the datasets and the number of library blocks needed are shown in the *Software AG Product Delivery Report*, which accompanies the installation medium.

Dataset Name	Contents
NDV*vrs*.OBJS	Contains the object modules of the development server. See ***Natural Development Server on Mainframes***.
NDV*vrs*.SYSF	Contains the FDT of the Development Server File (the layout is identical with PRD*vrs*.SYSF provided with a Predict version as specified under *Natural and Other Software AG Products* in the current *Natural Release Notes*).
NDV*vrs*.JOBS	Example installation jobs.

The notation *vrs* in dataset names represents the version, release and system maintenance level of the product.

For the currently applicable versions refer to Empower at ***https://empower.softwareag.com/***.

Installation Procedure

Step 1: Allocate the development server LOAD library

(Job I008, Step 8410)

Step 2: Create a development server configuration file and sample Clist

(Job I009, Step 8410, 8420, 8430)

Step 8410 creates a sample `NDVCONFG` for the batch server.

Step 8420 creates a sample `CLIST` to `PING` and `TERMINATE` a Natural Development Server.

Step 8430 creates a sample batch job to `PING` and `TERMINATE` a Natural Development Server.

The following parameters of the configuration file have to be defined. For the other parameters, the default values may be used:

`FRONTEND_NAME`	Specify the name of the Natural Development Server front-end module you generate in **Step 6**.
`PORT_NUMBER`	Specify the TCP/IP port number under which the server can be connected.

For a description of the parameters, refer to ***Configuring the Natural Development Server***.

Step 3: Load FDIC system file (optional)

(Job I050, Step 8403)

If you do not use Predict at all or if you have not yet migrated to a Predict version as specified under *Natural and Other Software AG Products* in the current *Natural Release Notes for Mainframes*, create the development server file, using the dataset `NDV`*`vrs`*`.SYSF`.

The layout of the **Development Server File** (`FDIC`) corresponds to the layout of the Predict Version 4.3 or above dictionary file.

Note: If you have a Predict version installed as specified under *Natural and Other Software AG Products* in the current *Natural Release Notes for Mainframes*, you can ignore this step.

Step 4: Link the object modules into the NDV load library

(Job I054, Step 8410)

The NDV object modules must be linked with the necessary runtime extensions of your batch installations into executable load modules.

See sample job `NDVI054` on dataset `NDV`*`vrs`*`.JOBS`.

Step 5: Create the NDV server front-end module

(Job I060, Steps 8410, 8420, 8430)

- Job I060, Step 8410, start the batch program `IEBUPDATE` and store `NDVPARM`.
- Job I060, Step 8420, assemble and link the parameter module `NDVPARM`.
- Job I060, Step 8430, link the NDV server front-end module.

Note: If you have Natural subproducts for IBM database access installed, for example, Natural for DB2, Natural for DL/I, Natural for VSAM, you need to adjust the link job to include `ATRRCSS` from `SYS1.CSSLIB` in order to enable the use of `SYNCPOINT/ROLLBACK` functionalities.

Step 6: Copy DDMs and processing rules to FDIC (optional)

If you use a Predict system file `FDIC` as Development Server File (`FDIC`), ignore this step.

If a Predict version as specified under *Natural and Other Software AG Products* in the current *Natural Release Notes for Mainframe* has not been installed or if you do not use a Predict system file `FDIC` as Development Server File (`FDIC`), you have to copy the existing DDMs and processing rules to the Development Server File (`FDIC`), using the copy function of the Natural utility `SYSMAIN`.

Step 7: Create server startup JCL

(Job I200, Step 8415)

Described in the section *Configuring the Natural Development Server*. See sample member `NDVSTART` on dataset `NDV`*`vrs`*`.JOBS`.

Sample:

```
//         PROC SRV=SAGNDV
//NDV      EXEC PGM=NATRDEVS,
// REGION=4000K,TIME=1440,PARM='POSIX(ON),TRAP(ON,NOSPIE)/&SRV'
//STEPLIB  DD   DISP=SHR,DSN=NDVvrs.LOAD
//         DD   DISP=SHR,DSN=SAGLIB.SMALOAD
//SYSUDUMP DD   SYSOUT=X
//CEEDUMP  DD   SYSOUT=X
//CMPRINT  DD   SYSOUT=X
//STGCONFG DD   DISP=SHR,
//              DSN=NDV.CONFIG(&SRV)
//STGTRACE DD   SYSOUT=X
//STGSTDO  DD   SYSOUT=X
//STGSTDE  DD   SYSOUT=X
```

Note: The NDV server account must be defined in the z/OS Linux System Services (OE segment). If the server account is not defined, the server ends with `U4093` and system message `CEE5101C` in the trace file.

Step 8: Debug a Natural batch job with Debug Attach for NaturalONE

(Job I200, Step 8418)

Sample JCL:

```
//NATEX    EXEC PGM=NATvrsBA,REGION=8M
//STEPLIB  DD DSN=SAGLIB.NDVvrs.LOAD,DISP=SHR
//         DD DSN=SAGLIB.SMALOAD,DISP=SHR
//         DD DSN=SAGLIB.ADAvrs.LOAD,DISP=SHR
//         DD DSN=CEE.SCEERUN,DISP=SHR
//*
//CMPRMIN  DD *
DBGAT=(ACTIVE=ON,CLID=CLIENT,HOST=DASSERV,PORT=2500)
RCA=(NATATDBG) RCALIAS=(NATATDBG,NATADvrs)
//*
//DDCARD   DD *
 ADARUN DB=001,DE=3390,SVC=249
//*
//SYSPRINT DD SYSOUT=*
//CMPRINT  DD SYSOUT=*
//CMSYNIN  DD *
MYLIB,DBA,DBA
MYPROG
FIN
/*
```

Step 9: NDV Clients must be defined to Natural Security

If Natural Security (NSC) is installed:

- The NDV initial user ID (default ID is `STARGATE`) must be defined in Natural Security with a valid default library. Refer also to NDV configuration parameter `INITIAL_USERID`. Alternatively, you can define the Natural profile parameter `AUTO=OFF` (automatic logon) for NDV.
- Each client user ID must be defined in Natural Security.

If the NDV initial user ID is not defined, the NDV server initialization aborts with a NAT0856 error message.

If an NDV client is not defined, the map environment returns an NSC error.

If you logon to the server from an NDV client, make sure that the user who is defined in Natural Security has a default library or a private library defined. Otherwise, error message NAT0815 will occur.

Step 10: NDV Clients must be defined to the server host

If you configure the NDV server to use an external security system (see NDV configuration parameter `SECURITY_MODE`), the NDV clients must be defined to the external security system.

7 Configuring the Natural Development Server

This chapter describes how to configure a Natural Development Server for z/OS (Batch).

Configuration Requirements

A Natural Development Server for z/OS (Batch) requires the following z/OS language environment parameter configuration:

Parameter	Definition	
POSIX(ON)	Enables a Natural Development Server to access the POSIX functionality of z/OS. If you start a Natural Development Server server with POSIX(OFF), it terminates immediately with a user abend U4093 and the system message EDC5167. IBM supplies the default OFF.	
TRAP(ON,NOSPIE)	Defines the abend handling of the LE/370 environment:	
	ON	Enables the Language Environment condition handler.
	NOSPIE	Specifies that the Language Environment will handle program interrupts and abends via an ESTAE, that is, the Natural abend handler will receive control to handle program interrupts and abends.
	If you do not specify TRAP(ON,NOSPIE), the Natural abend handling does not work properly. IBM supplies the default (ON,SPIE).	
TERMTHDACT(UADUMP)	Defines the level of information that is produced in case of an abend. The option UADUMP generates a Language Environment CEEDUMP and system dump of the user address space. The CEEDUMP does not contain the Natural relevant storage areas. IBM supplies the default (TRACE).	
ENVAR(TZ=...)	The ENVAR option enables you to set Linux environment variables. The only environment variable applicable for the Natural Development Server is TZ (time zone). This variable allows you to adjust the timestamp within the Natural Development Server's trace file to your local time. Example (minus 1 hour daylight saving time): `ENVAR(TZ=CET-1DST) CET`	

You can set the z/OS language environment parameters:

- With the PARM parameter specified in the EXEC card of the Natural Development Server startup job. The length of the options is limited by the maximum length of the PARM parameter.
- Assemble an LE/370 runtime option module CEEUOPT and link it to the Natural Development Server load module.

External Security Configuration

If you configure the NDV server to impersonate the NDV clients in the NDV server (NDV configuration parameter SECURITY_MODE set to IMPERSONATE or IMPERSONATE_LOCAL), the NDV server must run "program-controlled". Under RACF, the following definitions are required for the NDV server:

- The resource BPX.SERVER must be defined and the NDV server account must have READ access to this resource.
- The LOAD datasets defined in the NDV startup job definition must be defined to the program class "**".

```
ralt program ** addmem('natural load library') uacc(read)
ralt program ** addmem('NDV load library'//NOPADCHK) uacc(read)
ralt program ** addmem('user load library'//NOPADCHK) uacc(read)
```

- SETR WHEN(PROGRAM) REFRESH

Additionally, each client connecting to the server must be defined in RACF and must be granted to use the z/OS Linux System Services.

NDV Configuration File

A configuration file is allocated to the name <*serverid*>C (for example, NDVS1C) or STGCONFG alternatively.

The configuration file is a text file located on a dataset or on an HFS file under z/OS.

The configuration file contains the server configuration parameters in the form of a *keyword=value* syntax. In addition, it may contain comments whose beginning is marked with a hash symbol (#).

See also the ***NDV Configuration File Example*** shown below.

NDV Configuration Parameters

The following NDV configuration parameters are available:

- CPU_TIME_TRACE
- CPU_TIME_HISTORY
- DBG_CODEPAGE
- DEFAULT_PROFILE
- FORCE_IPV4

- FRONTEND_NAME
- FRONTEND_OPTIONS
- FRONTEND_PARAMETER
- HANDLE_ABEND
- HOST_NAME
- HTPMON_ADMIN_PSW
- HTPMON_PORT
- IGNORE_PRESENT_SERVER
- INITIAL_USERID
- KEEP_TCB
- MINIMUM_STUDIO_VERSION
- O4I
- PARMCHECK
- PASSWORD_MIXEDCASE
- PORT_NUMBER
- SECURITY_MODE
- SECURITY_CACHING
- SECURITY_SYSLOG
- SECURITY_TIMEOUT
- SESSION_PARAMETER
- SESSION_PARAMETER_MIXED_CASE
- SESSION_TIMEOUT
- TERMINAL_EMULATION
- THREAD_NUMBER
- THREAD_SIZE
- TRACE_FILTER
- TRACE_LEVEL
- UNICODE_SOURCE
- UPPERCASE_SYSTEMMESSAGES

CPU_TIME_TRACE

This optional configuration parameter specifies a time limit of central processing unit (CPU) time of a transaction. Transactions with a higher CPU time usage than the specified time limit are traced in the trace file. Trace level 30 is required to enable the trace. There are two types of traces: one that shows the CPU time of a single transaction and one that shows the CPU time of an entire session.

Note: A session consists of several transactions.

Example of traces of session DEBE5E3816036616:

```
04 14:21:34 00000052 Execute cpu time of session DEBE5E3816036616: 0.001295 s
04 14:25:51 00000052 Total cpu time of session DEBE5E3816036616: 0.063536 s
```

The value of CPU_TIME_TRACE applies also to the CPU_TIME_HISTORY parameter if specified.

The parameter can be changed dynamically in the configuration menu of the HTML Monitor.

Value	Explanation
time-limit	CPU time limit in seconds written as a decimal. Valid values are from 0,0 to 65535,0.
120,0	120,0 seconds. This is the default value.

Example:

```
CPU_TIME_TRACE=1,0
```

The setting in the example traces transactions and sessions with higher CPU time usage than 1,0 seconds.

CPU_TIME_HISTORY

This optional configuration parameter specifies a buffer that stores the specified number of transactions with the highest central processing unit (CPU) time values.

The entries are sorted by CPU time in descending order. Each stored entry contains the CPU time, the session ID, the day and time, the user ID and type of transaction executed.

The list can be displayed with the HTML Monitor Client in a browser window or with Monitor Client NATMOPI. The number of stored entries can be filtered by setting a CPU time limit with CPU_TIME_TRACE. The parameter can be changed dynamically in the configuration menu of the HTML Monitor.

Value	Explanation
time_history_integer	Stores the number of highest CPU time values provided. The values are sorted by CPU time in descending order. Valid values are from 1 to 100, and NO.
NO	CPU time history is off. This is the default value.

Example:

```
CPU_TIME_HISTORY=32
```

The setting in the example stores the 32 highest CPU time values sorted by cpu time.

DBG_CODEPAGE

This optional configuration parameter specifies the translation table to be used by the remote debugger. By default, the remote debugger uses the code page `IBM-1047`, whereas the Natural Development Server uses `TABA1/2`.

Value	Explanation
`USER`	Use the Natural translation tables `TABA1/2`.

No default value is provided.

Example:

```
DBG_CODEPAGE=USER
```

DEFAULT_PROFILE

This optional configuration parameter defines a default profile.

Value	Explanation
string	The following syntax applies: *profile-name,dbid,fnr,password,cipher-code* **Note:** Specifying a parameter string in the **Session Parameters** text box of the **Map Environment** dialog box in Natural Studio overwrites this default profile.

No default value is provided.

Example:

```
DEFAULT_PROFILE=RDEVS,10,930
```

The setting in the example defines that, if no parameters are defined in the **Map Environment** dialog box of Natural Studio, the session is started with the Natural profile parameter `PROFILE=(RDEVS,10,930)`.

Related parameter: `SESSION_PARAMETER`.

FORCE_IPV4

This configuration parameter applies to z/OS.

This parameter allows you to enforce the use of communication method IPV4.

Value	Explanation
YES	Enforce the use of communication method IPV4.
NO	First try communication method IPV6. If this fails give an error message and use communication method IPV4. This is the default value.

FRONTEND_NAME

This configuration parameter specifies the name of the Natural front-end to be used to start a Natural session. The front-end resides on a PDS member.

Value	Explanation
frontend-name	Natural front-end to be used. Maximum length: 8 characters.

No default value is provided.

Example:

```
FRONTEND_NAME=NATvrsSV
```

- where *vrs* stands for the version, release, system maintenance number.

Note: When working with the CICS Adapter FRONTEND_NAME=NATCSRFE is mandatory. When working with the IMS Adapter FRONTEND_NAME=NATISRFE is mandatory.

FRONTEND_OPTIONS

The values of this configuration parameter may be used to specify additional options for the Natural front-end.

Value	Explanation
01	Do not use the Roll Server. This is the default value.
02	Clean up roll file at server termination.
04	Write GTF trace.
08	Write ETRACE.
10	Front-end automatic termination.
20	Write console information.

You may combine the above options as desired in that you add their values and set the result as shown in the example below.

Example:

```
FRONTEND_OPTIONS=07
```

The setting in this example enables the Options `01`, `02` and `04`.

FRONTEND_PARAMETER

This optional configuration parameter contains additional Natural front-end parameters as specified in the Startup Parameter Area.

Value	Explanation
parameter-name	You can define multiple parameters. Each parameter specification is a pair of 8-character strings, the first containing the parameter keyword and the second the parameter value, for example: `FRONTEND_PARAMETER = 'MSGCLASSX       '`

No default value is provided.

For further information, refer to the section *Natural in Batch Mode* in the Natural *Operations for Mainframe* documentation.

Example:

```
FRONTEND_PARAMETER='MSGCLASSX       '
```

The setting in this example specifies that the default output class for `CMPRINT` is `X`.

HANDLE_ABEND

If an abend occurs in the server processing outside the Natural processing the abend is not trapped by the Natural abend handling. For this reason the NDV server has its own abend recovery.

It is recommended that you leave this parameter on its default value in order to limit the impact of an abend to a single user. If you set the value of this parameter to `NO`, any abend in the server processing terminates the complete server processing. That is, it affects all users running on that server.

Value	Explanation
YES	Trap abends in the server processing, write a snap dump and abort the affected user. This is the default value.
NO	Suspend the server abend handling.

Example:

```
HANDLE_ABEND=NO
```

HOST_NAME

This optional configuration parameter is necessary only if the server host supports multiple TCP/IP stacks.

Value	Explanation
host-name	If HOST_NAME is specified, the server listens on the particular stack specified by HOST_NAME, otherwise the server listens on all stacks.

No default value is provided.

Example:

```
HOST_NAME=node1
```

or

```
HOST_NAME=157.189.160.55
```

HTPMON_ADMIN_PSW

This configuration parameter defines the password required for some monitor activities (for example, Terminate Server) performed by the **HTML Monitor Client**.

Value	Explanation
any character string	The password to be entered at the HTML Monitor Client for some monitor activities.

No default value is provided.

Example:

```
HTPMON_ADMIN_PSW=GHAU129B
```

HTPMON_PORT

An NDV server can be configured to host an HTTP monitor task which serves the **HTML Monitor Client** running in a web browser. It is not required to run this monitor task on each server. A single task allows you to monitor all servers running at one node.

This configuration parameter defines the TCP/IP port number under which the server monitor task can be connected from a web browser.

Value	Explanation
1 - 65535	TCP/IP port number.

No default value is provided.

Example:

```
HTPMON_PORT=3141
```

IGNORE_PRESENT_SERVER

An NDV server allocates a so-called “server environment” which contains the server dependent common resources. This environment is unique for each server and relates to the NDV server name.

If an NDV server with NDV CICS Adapter ends abnormally, it might leave a stuck NDV server environment within the CICS region. This causes that a restart of the server fails with error message NAT9913.

If you start an NDV server with `IGNORE_PRESENT_SERVER=YES`, it might damage an already running server which is using the same server name and the same CICS region.

Value	Explanation
YES	Terminate existing CICS server environment.
NO	Abort server initialization if a CICS server environment already exist. This is the default value.

Example:

```
IGNORE_PRESENT_SERVER=YES
```

INITIAL_USERID

At server initialization, the Natural Development Server creates a temporary Natural session to obtain the properties of the installed Natural environment.

This configuration parameter specifies the user ID to be used for this Natural session.

Value	Explanation
userid	The specified value must not exceed 8 characters, otherwise it is truncated.
STARGATE	This is the default value.

Example:

```
INITIAL_USERID=NDVINITU
```

See also *NDV Clients must be defined to Natural Security* (in the Natural Development Server *Installation* documentation).

KEEP_TCB

By default, the remote Natural session of a mapped environment terminates its TCB whenever you switch the focus within Natural Studio to a different mapped environment. If you toggle the focus back, the remote session is dispatched using a different TCB.

The maximum number of active TCBs is equal to the number of connected clients.

The configuration parameter KEEP_TCB specifies whether the remote Natural session should use the same TCB during its entire lifetime. This is required if you use Adabas and the Adabas parameter ADANAME is set to ADAUSER or if you want to access DB2. It could also be required if you access 3GL programs which need to be executed under the same TCB for successive calls.

Value	Explanation
YES	The remote Natural session uses the same TCB during its entire lifetime.
NO	This is the default value.

Example:

```
KEEP_TCB=YES
```

MINIMUM_STUDIO_VERSION

This parameter defines a minimum version of Natural Studio which is required to operate with the NDV server. This parameter assists in performing a preliminary validation if all clients use a minimum Natural Studio version. This can be useful to smoothly upgrade to a NDV version that does not support clients whose version is below the minimum Natural Studio version.

Value	Explanation	
vvmmpp	The Studio Version (5-6 digits), where:	
	vv	Version number (1 or 2 digits).
	mm	System maintenance level (2 digits).
	pp	Patch level (2 digits).
61100	This is the default value.	

Example:

```
MINIMUM_STUDIO_VERSION=62100
```

O4I

This parameter allows you to collect server data for Optimize for Infrastructure.

Value	Explanation
YES	Collect server data for Optimize for Infrastructure.
NO	Do not collect server data for Optimize for Infrastructure. This is the default value.

Example:

```
O4I=YES
```

PARMCHECK

This parameter allows you to perform a parameter check of Natural session parameters after the server is up. The check is done by mapping to Natural. If a problem occurs, a message is written to the NDV server trace, and the server is terminated immediately. In such cases, session parameters (SESSION_PARAMETER) can be corrected. To avoid termination of the server in case of invalid Natural parameters, the parameter check can be switched off.

This parameter does not apply with SECURITY_MODE=IMPERSONATE, IMPERSONATE_LOCAL, or IMPERSONATE_REMOTE.

Value	Explanation
YES	Perform parameter check after the server is up. This is the default value.
NO	Avoid parameter check after the server is up.

Example:

```
PARMCHECK=NO
```

PASSWORD_MIXEDCASE

This parameter allows you to define whether passwords specified in the **Map Environment** dialog are translated into upper case or not.

This parameter does only apply with SECURITY_MODE=IMPERSONATE, IMPERSONATE_LOCAL or IMPERSONATE_REMOTE.

Value	Explanation
YES	Passwords remain in mixed case.
NO	Passwords are translated into upper case. This is the default value.

Example:

```
PASSWORD_MIXEDCASE=YES
```

PORT_NUMBER

This configuration parameter defines the TCP/IP port number under which the server can be connected.

Value	Explanation
1 - 65535	TCP/IP port number.

No default value is provided.

Example:

```
PORT_NUMBER=3140
```

SECURITY_MODE

The Natural Development Server offers a security concept that also covers the operating system resources. The client credentials are validated at the operating-system-depending security system and the client request is executed under the client's account data.

Using the SECURITY_MODE parameter, you can specify at which rank (Batch or CICS) you want to impersonate the activities of an NDV client.

Note concerning Natural for DB2 (Batch Server only): In order to be able to run the Natural Development Server with impersonation enabled, you must have linked the DB2 interface module DSNRLI (instead of DSNALI) to the Natural nucleus.

Value	Explanation
IMPERSONATE_LOCAL	Impersonation is done within the Natural Development Server environment. If the session is dispatched in a remote TP environment (for example, in CICS using the NDV CICS Adapter), it is still executed anonymous. The client must be defined in the security system of the NDV server. It is not required to define the client in a remote TP environment. See also ***External Security Configuration***.
IMPERSONATE_REMOTE	No impersonation is done within the Natural Development Server environment. If the session is dispatched in a remote TP environment, the client is impersonated. The client must be defined in the security system of the remote TP environment. See also NDV security exit NATUXRFE and the section ***Product Interaction*** in the *Natural Development Server CICS Adapter* documentation. **Note:** Under CICS, please verify the correct installation of the module NATUXRFE. A Map Environment attempt with a valid user ID and an invalid password should fail with a NAT0873 error. **Note:** Not supported with NDV IMS Adapter.
IMPERSONATE	Impersonation is done within the Natural Development Server environment and in a remote TP environment. The client must be defined in the security system of the NDV server and in the remote TP environment.

Note: For a batch server SECURITY_MODE=IMPERSONATE and SECURITY_MODE=IMPERSONATE_LOCAL are the same.

SECURITY_MODE requires Natural Security (NSC).

No default value is provided.

Example:

```
SECURITY_MODE=IMPERSONATE
```

SECURITY_CACHING

SECURITY_CACHING applies only to a Natural Development Server for z/OS (Batch), and pertains to SECURITY_MODE being set to IMPERSONATE_LOCAL.

SECURITY_CACHING is intended for server environments where password changes occur frequently. Commonly, each client action in NaturalONE starts a new server session and the password is checked each time. At worst, this requires the client to enter a new password for each client action.

In order to allow for the client to experience a smooth workflow, information about the client is stored in a client list. Based on the stored information, access is therefore possible without having to repeat entering new passwords. The duration of validity of a client entry can be set using the parameter SECURITY_TIMEOUT.

The client list stores the user Id and Host (IP Address), the time of login and the time of last access, together with a hash value of the password. The hash value of the password is generated by the sha1 algorithm. During the first login, the user is authorized and an ACEE is generated, which is also saved in the client list. For each subsequent accesses of the same user, only the hash value of the saved password is compared to the hash value of the sent password. If both passwords match, the session is started with the saved ACEE. If the hash values of the passwords are not the same, the user is prompted to enter a password.

To create an ACEE, SECURITY_CACHING requires the Natural Authorized Services Manager for the execution of authorized services of the z/OS Security Server RACF.

Value	Explanation
YES	Credential of a client is cached.
NO	Credential of a client is not cached. This is the default value.

Example:

```
SECURITY_CACHING=YES
```

SECURITY_SYSLOG

Write a console message in case of security problems with external security. One line is written to the console, for example 'Aug-23 16:22:46.77 SO305217 BPXM023I (INITUSER) SERVERID - Invalid userid specified.' More information about the reason can be found in the appropriate trace or error log of the server.

The parameter applies to z/OS Batch servers only.

Value	Explanation
YES	Write security message to console.
NO	Do not write security message to console. This is the default value.

Example:

```
SECURITY_SYSLOG=YES
```

SECURITY_TIMEOUT

`SECURITY_TIMEOUT` only applies, if `SECURITY_CACHING` is set.

Cancels active client when the `SECURITY_TIMEOUT` parameter is met. Checks for clients active longer than `n` minutes once a day at HH:MM (24 hours) or every `n` minutes.

The server will not start if an invalid `SECURITY_TIMEOUT` parameter is given.

Value	Explanation

`hh:mm,n <numeric value greater than 0 or equal 0>`
 	
or
 	
`m <numeric value greater than 0>, n <numeric value>0 or equal 0>`
	If format is `hh:mm`, check once a day at `hh:mm` for sessions more than `n` minutes active. If `n` is equal `0` each client is canceled.
	
	or
	
	If format is a numeric value, check every `m` minutes for sessions more than `n` minutes active. If `n` is equal `0` each client is canceled.

Examples:

```
SECURITY_TIMEOUT=19:30,480
```

Every day at 19:30 cancel clients logged on for more than 480 minutes.

```
SECURITY_TIMEOUT=19:30,0
```

Every day at 19:30 cancel all clients.

```
SECURITY_TIMEOUT=360,480
```

Every 360 minutes cancel clients logged on for more than 480 minutes.

SESSION_PARAMETER

This optional configuration parameter defines session parameters that precede the parameter string either specified in the **Map Environment** dialog of Natural Studio or defined by default by the configuration parameter DEFAULT_PROFILE.

Value	Explanation
parameter-string	This string may extend across several lines. A plus sign (+) at the end of a string line denotes that another line follows.

No default value is provided.

Example 1:

```
SESSION_PARAMETER='NUCNAME=NATNUCvr' +
  'PROFILE=(NDVPARM,18006,48),ADAMODE=0,' +
  'BPI=(TYPE=NAT,SIZE=6044),BPI=(TYPE=EDIT,SIZE=2048)', +
  'BPI=(TYPE=SORT,SIZE=1024)'
```

- where *vr* stands for the version and release number.

Example 2:

```
SESSION_PARAMETER=FNAT=(10,930)
```

The setting in the second example defines that every session on this Natural Development Server is started with the session parameter FNAT=(10,930) appended to the user-specified parameters or the definitions in the configuration parameter DEFAULT_PROFILE.

SESSION_PARAMETER_MIXED_CASE

This optional configuration parameter can be used to allow session parameters and URL specifications in mixed case.

Value	Explanation
YES	Session parameters remain in mixed case.
NO	Session parameters are translated into upper case. This is the default value.

SESSION_TIMEOUT

Cancel inactive sessions when the `SESSION_TIMEOUT` parameter is met. Check for sessions inactive longer then *n* minutes once a day at `HH:MM` (24 hours) or every *n* minutes.

The server will not start if an invalid `SESSION_TIMEOUT` parameter is given.

Value	Explanation
`hh:mm,n <numeric value greater than 0>` or `m <numeric value greater than 0>,n <numeric value>0>`	If format is `hh:mm`, check once a day at `hh:mm` for sessions more than *n* minutes inactive. or If format is a numeric value, check every *m* minutes for sessions more than *n* minutes inactive.

Examples:

```
SESSION_TIMEOUT=19:30,480
```

Every day at 19:30 cancel sessions more than 480 minutes inactive.

```
SESSION_TIMEOUT=360,480
```

Every 360 minutes cancel sessions more than 480 minutes inactive.

TERMINAL_EMULATION

This configuration parameter defines the terminal emulation to be used for processing the Natural I/O. This definition applies to all clients using that server.

Value	Explanation
`WEBIO`	Use the Web I/O Interface as terminal emulation.
`3270`	Use the 3270 terminal emulation. This is the default value.

Example:

```
TERMINAL_EMULATION=WEBIO
```

THREAD_NUMBER

This configuration parameter specifies the number of physical storage threads to be allocated by the Natural front-end, that is, the number of sessions that can be executed in parallel.

Note: This parameter is obsolete when the Natural Development Server CICS Adapter or the Natural Development Server IMS Adapter is used.

Value	Explanation
thread-number	Number of physical storage threads to be allocated. **Note:** This number does not limit the number of sessions within the server, but the number of sessions which can be in execution status concurrently. The number of sessions is limited by the size of the Natural swap medium.
3	This is the default value.

Example:

```
THREAD_NUMBER=5
```

THREAD_SIZE

This configuration parameter specifies the size of each physical storage thread which contains the Natural session data at execution time.

Note: This parameter is obsolete when the Natural Development Server CICS Adapter or the Natural Development Server IMS Adapter is used.

Value	Explanation
thread-size	Size (in KB) of each physical storage thread.
500	This is the default value.

Example:

```
THREAD_SIZE=800
```

TRACE_FILTER

This optional configuration parameter enables you to restrict the trace by a logical filter in order to reduce the volume of the server trace output, for example:

```
TRACE_FILTER="Client=(KSP P*)"
```

Each request of the user ID `KSP` and each request of the user IDs starting with a `P` are traced.

See ***Trace Filter*** in the section *Operating the Natural Development Server*.

TRACE_LEVEL

Value	Explanation
trace-level	See ***Trace Level*** in the section *Operating the Natural Development Server*.
0	This is the default value.

Example:

```
TRACE_LEVEL=0x00000011
```

or alternatively

```
TRACE_LEVEL=31+27
```

The setting in the example switches on **Bits 31 and 27**.

UNICODE_SOURCE

This configuration parameter is used to define whether the NDV server accepts source files in Unicode or not.

Sources transmitted in unicode are not converted using the Natural ASCII-to-EBCDIC translation tables `TABA1/TABA2`. All characters in the source file are supported without maintaining the Natural translation tables.

A transmission in Unicode, however, increases the CPU consumption of the server significantly.

Value	Explanation
YES	Transfer sources in Unicode.
NO	Transfer sources in ASCII. No code page support for Natural sources. This is the default value.

Example:

```
UNICODE_SOURCE=YES
```

UPPERCASE_SYSTEMMESSAGES

This configuration parameter is used to enable or disable the translation of all NDV error messages and trace outputs to uppercase. This feature is for customers who are using character sets with no lowercase characters defined.

Value	Explanation
YES	Enable uppercase translation.
NO	Disable uppercase translation. This is the default value.

NDV Configuration File Example

```
 # This is a comment
SESSION_PARAMETER=profile=(stgqa,10,930) fuser=(10,32)
DEFAULT_PROFILE=DEFPROF
THREAD_NUMBER=2
THREAD_SIZE=700
FRONTEND_NAME=NATOS31L       # and another comment
PORT_NUMBER=4711
```

NDV Server Datasets

The Natural Development Server requires the following datasets:

STGCONFG	Defines the server configuration file.
STGTRACE	The server trace output.
STGSTDO	The stdo dataset.
STGSTDE	The stde error output.

Alternatively, you can qualify each dataset name by the server ID.

NDVS1C	Defines the server configuration file for the server NDVS1.
NDVS1T	The server trace output for the server NDVS1.
NDVS1O	The stdo dataset for the server NDVS1.
NDVS1E	The stde error output for the server NDVS1.

NDV User Exits (Coded in Natural)

Natural Single Point of Development provides the following user exits for mainframes:

NDV-UX01	This exit is invoked before a Natural source object or a DDM is edited. It can be used to reject editing of certain sources. The source code of this exit is delivered in the library SYSLIB and named NDV-SX01 *).
NDV-UX02	This exit is invoked before a Natural object, a DDM or a user error message is deleted, copied or moved (including the context menu functions Cut, Copy and Paste). It enables the rejection of further processing of this object, similar to the user exit MAINEX01 of SYSMAIN in Natural for Mainframes. The source code of this exit is delivered in the library SYSLIB and named NDV-SX02 *).
NDV-UX03	This exit provides flags for special settings within the Natural Development Server. See the source code of this exit for available flags. The source code of this exit is delivered in the libary SYSLIB and is named NDV-SX03 *).

*) The sources of these user exit routines are named NDV-SX*nn*, where *nn* denotes the number of the user exit routine.

To make a user exit routine available

1 Copy the source code from SYSLIB into a user library.

2 Catalog it under the name NDV-UX*nn*.

3 Copy it back into the Natural system library SYSLIB.

The name of each user exit source is different from the name of the corresponding cataloged object. This guarantees that the object is not affected if the user exit source is overwritten by an installation update.

For further details, see the source code of the user exit routines NDV-SX*nn* in the Natural system library SYSLIB.

Other NDV User Exits

Apart from the NDV user exits that are coded in Natural, the following user exit exists:

User Exit NSECUX01

This user exit is applicable only when the parameter SECURITY_MODE is set to IMPERSONATE_LOCAL or IMPERSONATE.

This user exit allows you to adapt the user ID used for the RACF login. It is useful if the RACF user IDs and the user IDs used in Natural differ according to a standardized rule. For example, each RACF user ID is the corresponding Natural user ID preceded by two dollar signs ($$).

If the exit (the loadmodule NSECUX01) is found in the NDV load library concatenation, it is called using standard linkage conventions (direct branch using BASR instructions) before the user is validated against RACF.

The following parameters are passed to the exit:

Name	Format	In/Out	Description
sUid	CL64	I/O	User ID to be modified for RACF login.

The exit is called using standard linkage conventions.

Sample user exit implemented in C:

```
#include <string.h>
#include <stdio.h>
#  pragma linkage (NSECUX01, FETCHABLE)
void NSECUX01(char sUid[64])
{
char sUidTemp[64];
  printf("Uex got usid:%s\n", sUid);
  strcpy(sUidTemp, sUid);
  sprintf(sUid, "$$%s", sUidTemp);
  printf("Uex ret usid:%s\n", sUid);
  return;
}
```

The exit above extends each user ID by two preceding dollar signs ($$) when it is used for RACF login.

Encrypted Communication

Communication between NaturalONE and NDV servers can be encrypted by using an SSL or (preferably) a TLS protocol.

On the server side, encryption is enabled by using the AT-TLS component of the z/OS Communications Server. AT-TLS allows you to encrypt and secure the TCP/IP communication between client and server without any changes on the server side. If you want to use encrypted communication mode, you must define a set of rules concerning the NDV server job for the policy agent (PAGENT) configuration file of AT-TLS. Encrypted communication requires a certificate associated with encryption on the server side. This encryption certificate must either be included in a RACF keyring or stored in a key database located on the z/OS USS POSIX file system.

Use the ZOSMF utility for maintaining the PAGENT.

For detailed information on AT-TLS, refer to the z/OS Communications Server documentation from IBM.

SSL/TLS Support

SSL/TLS over AT-TLS

SSL/TLS support for the Natural development server is based on the z/OS Communication Server component AT-TLS (Application Transparent-Transport Layer Security).

AT-TLS provides SSL/TLS encryption as a configurable service for sockets applications. It is realized as an additional layer on top of the TCP/IP protocol stack, which exploits the SSL/TLS functionality in nearly or even fully transparent mode to sockets applications. AT-TLS offers three modes of operation. See *z/OS Communications Server, IP Programmer's Guide and Reference*. Chapter: *Application Transparent Transport Layer Security (AT-TLS)*.

These modes are:

- **Basic**

  The sockets application runs without modification in transparent mode, unaware of performing encrypted communication via AT-TLS. Thus legacy applications can run in secured mode without source code modification.

- **Aware**

  The application is aware of running in secured mode and is able to query TLS status information.

- **Controlling**

  The sockets application is aware of AT-TLS and controls the use of AT-TLS encryption services itself. This means, the application is able to switch between secured and non secured communication.

Natural development server uses the Basic mode for its SSL/TLS implementation. That is, a server configured as SSL/TLS server rejects requests from non-secured clients.

Maintenance of Certificates under z/OS

Certificates, which are to be used with AT-TLS, can be maintained in two ways under z/OS. They are stored either in RACF key rings or in key databases, which are located in the z/OS Linux file system. Which of these proceedings actually applies is defined in the AT-TLS Policy Agent Configuration file for the z/OS TCP/IP stack, which is used by the Natural HTTPS client.

IBM delivers a set of commonly used CA root certificates with each z/OS system delivery. If key rings are going to be used to hold server certificates, those root certificates must be manually imported into the key rings by the system administrator. If IBM delivers newer replacements for expired root certificates, all affected key rings have to be updated accordingly.

Unlike key rings, key databases contain the current set of root certificates automatically after they have been newly created. However, the need for maintaining always the latest set of root certificates applies to the key database alternative as well.

Using RACF Key Rings

In RACF, digital certificates are stored in so-called key rings. The RACF command `RACDCERT` is used to create and maintain key rings and certificates, which are contained in those key rings.

See *z/OS Security Server RACF Security Administrator's Guide*, Chapter: *RACF and digital certificates - RACF and key rings*, and *z/OS Security Server RACF, Command Language Reference*, Chapter: *RACF command syntax - RACDCERT*.

Using Key Databases

Alternatively to RACF, certificates can be kept in key databases, which reside in the z/OS Linux services file system. For the creation and maintenance of key databases, the `GSKKYMAN` utility has to be used.

See *z/OS Cryptographic Services PKI Services Guide and Reference*, Chapter: *Appendix B. Using a gskkyman key database for your certificate store*.

How to configure TCP/IP for AT-TLS?

Proceed as follows:

1. In the TCP/IP configuration file, set the option `TTLS` in the `TCPCONFIG` statement.
2. Configure and start the AT-TLS Policy Agent. This agent is called by TCP/IP on each new TCP connection to check if the connection is SSL/TLS.
3. Create the Policy Agent file containing the AT-TLS rules. The Policy Agent file contains the rules to stipulate which connection is SSL/TLS.

See also *z/OS Communications Server: IP Configuration Guide*, Chapter: *Application Transparent Transport Layer Security data protection*.

The Sample Policy Agent file defines the server with the job name starting with `NDVDEV` and listening at port 4843 to use SSL/TLS.

The sample expects the certificate database on the HFS file */u/admin/CERT.kdb*.

```
TTLSRule                          ConnRule01~1
{
  LocalAddrSetRef                 addr1
  RemoteAddrSetRef                addr1
  LocalPortRangeRef               portR1
  RemotePortRangeRef              portR2
  Jobname                         NDVDEV*
  Direction                       Inbound
  Priority                        255
  TTLSGroupActionRef              gAct1~NDV_Server
  TTLSEnvironmentActionRef        eAct1~NDV_Server
  TTLSConnectionActionRef         cAct1~NDV_Server
}
TTLSGroupAction                   gAct1~NDV_Server
{
  TTLSEnabled                     On
}
TTLSEnvironmentAction             eAct1~NDV_Server
{
  HandshakeRole                   Server
  EnvironmentUserInstance         0
```

```
  TTLSKeyringParmsRef             keyR1
}
TTLSConnectionAction              cAct1~NDV_Server
{
  HandshakeRole                   Server
  TTLSCipherParmsRef              cipher1~AT-TLS__Silver
  TTLSConnectionAdvancedParmsRef  cAdv1~NDV_Server
}
TTLSConnectionAdvancedParms       cAdv1~NDV_Server
{
  CertificateLabel                NDV_TEST_CERT
}
TTLSKeyringParms                  keyR1
{
  Keyring                         /u/admin/CERT.kdb
  KeyringStashFile                /u/admin/CERT.sth
}
TTLSCipherParms                   cipher1~AT-TLS__Silver
{
  V3CipherSuites                  TLS_RSA_WITH_DES_CBC_SHA
  V3CipherSuites                  TLS_RSA_WITH_3DES_EDE_CBC_SHA
  V3CipherSuites                  TLS_RSA_WITH_AES_128_CBC_SHA
}
IpAddrSet                         addr1
{
  Prefix                          0.0.0.0/0
}
PortRange                         portR1
{
  Port                            4843
}
PortRange                         portR2
{
  Port                            1024-65535
}
```

How to Verify AT-TLS Configuration?

Check Policy-Agent job output `JESMSGLG` for:

```
EZZ8771I PAGENT CONFIG POLICY PROCESSING COMPLETE FOR <your TCP/IP address space>: ↩
TTLS
```

This message indicates a successful initialization.

Check Policy-Agent job output `JESMSGLG` for:

```
EZZ8438I PAGENT POLICY DEFINITIONS CONTAIN ERRORS FOR <your TCP/IP address space>: ↩
TTLS
```

This message indicates errors in the configuration file. Check the *syslog.log* file for further information.

Does the configuration rule cover the server?

Try to connect the server and check *syslog.log* for:

```
EZD1281I TTLS Map   CONNID: 00018BED LOCAL: 10.20.91.61..4843 REMOTE: ↩
10.20.160.47..4889 JOBNAME: NDVDEVvr USERID: NDVSRV TYPE: InBound STATUS: Enabled ↩
RULE: ConnRule01~1 ACTIONS: gAct1 eAct1~NDV_Server cAct1~NDV_Server
```

The above entry indicates that the connection to Port 4843 is SSL/TLS enabled.

Frequently Asked Questions

Is there more information about problem determination?

See *z/OS Communications Server, IP Diagnosis Guide*, Chapter: *Diagnosing Application Transparent Transport Layer Security (AT-TLS)*

How to switch on P-agent trace?

See *z/OS Communications Server, IP Configuration Reference*, Chapter: *Syslog deamon*, and *z/OS Communications Server, IP Configuration Guide*, Chapter: *Base TCP/IP system – TCP/IP Customization - Configuring the syslog daemon (syslogd)*.

Error at connection establishment

Find return code RC and corresponding `GSK_` function name in P-agent trace.

Get description of the return code from *z/OS Cryptographic Services, System Security Sockets Layer Programming*, Chapter: *: messages and codes – SSL function return codes*.

Sample trace with `trace=255`:

```
EZD1281I TTLS Map   CONNID: 00002909 LOCAL: 10.20.91.61..1751 REMOTE: ↩
10.20.91.117..443 JOBNAME: KSP USERID: KSP TYPE: OutBound STATUS: A
EZD1283I TTLS Event GRPID: 00000003 ENVID: 00000000 CONNID: 00002909  RC:    0 ↩
Connection Init
EZD1282I TTLS Start GRPID: 00000003 ENVID: 00000002 CONNID: 00002909 Initial ↩
Handshake ACTIONS: gAct1 eAct1 AllUsersAsClient HS-Client
EZD1284I TTLS Flow  GRPID: 00000003 ENVID: 00000002 CONNID: 00002909  RC:    0 Call ↩
GSK_SECURE_SOCKET_OPEN - 7EE4F718
EZD1284I TTLS Flow  GRPID: 00000003 ENVID: 00000002 CONNID: 00002909  RC:    0 Set ↩
GSK_SESSION_TYPE -  CLIENT
EZD1284I TTLS Flow  GRPID: 00000003 ENVID: 00000002 CONNID: 00002909  RC:    0 Set ↩
```

```
GSK_V3_CIPHER_SPECS -  090A2F
EZD1284I TTLS Flow  GRPID: 00000003 ENVID: 00000002 CONNID: 00002909  RC:    0 Set ↩
GSK_FD - 00002909
EZD1284I TTLS Flow  GRPID: 00000003 ENVID: 00000002 CONNID: 00002909  RC:    0 Set ↩
GSK_USER_DATA - 7EEE9B50
EZD1284I TTLS Flow  GRPID: 00000003 ENVID: 00000002 CONNID: 00002909  RC:  435 Call ↩
GSK_SECURE_SOCKET_INIT - 7EE4F718
EZD1283I TTLS Event GRPID: 00000003 ENVID: 00000002 CONNID: 00002909  RC:  435 ↩
Initial Handshake 00000000 7EEE8118
EZD1286I TTLS Error GRPID: 00000003 ENVID: 00000002 CONNID: 00002909 JOBNAME: KSP ↩
USERID: KSP RULE: ConnRule01  RC:  435 Initial Handshake
EZD1283I TTLS Event GRPID: 00000003 ENVID: 00000002 CONNID: 00002909  RC:    0 ↩
Connection Close 00000000 7EEE8118 ↩
```

Generation of a Natural development Server Certificate

Under z/OS, SSL/TLS certificates can be produced with the Linux System Services utility `GSKKYMAN`. The following steps have to be executed for the production of a new certificate, which is to be used for the SSL/TLS secured communication between Natural Web I/O Interface client and server:

1. Start a shell session out of TSO or connect via telnet to the z/OS Linux shell.
2. Start `GSKKYMAN`.
3. Create a new – or open an existing key database.
4. Create a self-signed certficate, for example, of type "User or server certificate with 2048-bit RSA key".
5. Export the certificate to a (HFS) file. Choose Base64 ASN.1 DER as export format.

This generated file can now be copied to the Natural development server client(s) using FTP with ASCII transfer format. On the client side, the received file should be stored with the file name suffix *.CER*. The certificate can now be used by the Natural development server client.

For more information on how to import the certificate, see the documentation of NaturalONE, *Natural for Ajax > Configuration and Administration Configuring SSL*.

If certificates are kept in a RACF key ring, the generated certificate has to be imported into the appropriate key ring using the `RADCERT` command.

Certificates, which are produced on a different platform, for example, on a Windows PC, can be imported into a RACF key ring or into a key database as well.

Detailed information about the use of the `GSKKYMAN` utility can be found in the IBM Communications server documentation, e.g in the following manuals:

z/OS Communications Server, IP Configuration Guide

or

z/OS Cryptographic Services, System Secure Sockets Layer Programming

For the generation of certificates under Windows, a free downloadable utility named Ikeyman is available on several websites. Ikeyman is an IBM product as well and maps the functionality of `GSKKYMAN` to the Windows platform.

Configuring Port Sharing

The TCP/IP port sharing component of the z/OS TCP/IP Communications subsystem allows multiple listeners to listen on the same combination of port and IP address. To enable this in the TCP/IP stack, you must add the `SHAREPORT` or `SHAREPORTWLM` keyword to the PORT profile statement that reserves the TCP port for the server instances. You can find detailed information in section *PORT Statement*, chapter *TCP/IP profile (PROFILE.TCPIP) and Configuration Statements* of the IBM manual *z/OS Communications Server: IP Configuration Reference* found on their official website.

You can start the NDV server as explained in section ***Starting the Natural Development Server***. You must define the used port with the `PORT_NUMBER` parameter in the configuration file of the NDV server. If port sharing is enabled, the started task can be executed multiple times to start multiple instances of an NDV server that listens on the same port.

Note: All servers must be started with the same configuration file.

- Server ID
- Reliability
- Scheduling
- TRACE, STDOUT, and STDERR

Server ID

Since the server ID is used to identify a server in the server directory, you must set a unique server ID. The server ID is passed as a parameter to the NDV server. You must set the parameters in the PARM card of the started task. For example:

```
//NDVSRV  EXEC PGM=NATRDEVS,REGION=0M,TIME=20,
//  PARM=('POSIX(ON) STACK(64K,32K,ANY,FREE) TRAP(ON,NOSPIE) ',
//    'TERMTHDACT(UADUMP),ENVAR(TZ=CET+0DST) /SERVERID')
```

Reliability

If multiple NDV servers are listening on a port and one server fails, the workload can still be done by the remaining servers. From a user point of view, the service offered by the NDV server remains available.

Scheduling

If a request for a new connection arrives, it is in the responsibility of the z/OS operating system to pass the request to one of the listening servers. The connections are distributed across the available servers using a weighted round-robin distribution based on the Servers' accept Efficiency Fractions (SEFs). Once a session is started, it is executed on this server, until it is finished.

You can identify a session in the trace file with the following piece of code:

```
Start of Session:
26 10:16:45 00000000E Worker task active, SID=DED9D087D842B606, client: USER

End of session:
26 10:21:53 00000000E Worker task disconnect, client: USER
26 10:21:53 00000000E Free LTCB...and finish
```

TRACE, STDOUT, and STDERR

Each server has its own `STGTRACE`, `STGSTDO`, and `STDSTGE`, which are part of the job log of each server. It is possible to redirect the output of the files to a sequential dataset, but you must ensure that each server is assigned its own sequential dataset. Otherwise, the output of the files cannot be assigned to a particular server.

8 Operating the Natural Development Server

This chapter describes how to operate a Natural Development Server under z/OS (Batch).

Starting the Natural Development Server

The development server can be started as a “started task”:

```
//NDVSRV  PROC
//KSPSRV   EXEC PGM=NATRDEVS,REGION=4000K,TIME=1440,
// PARM=('POSIX(ON)/NDVSRV1')
//STEPLIB  DD DISP=SHR,DSN=NDVvrs.LOAD
//         DD DISP=SHR,DSN=NATvrs.LOAD
//CMPRINT  DD SYSOUT=X
//STGCONFG DD DISP=SHR,DSN=NDVvrs.CONFIG(SRV1)
//STGTRACE DD SYSOUT=X
//STGSTDO  DD SYSOUT=X
//STGSTDE  DD SYSOUT=X
```

- where

vrs is the version, release, system maintenance level number of NDV or Natural.

For the currently applicable versions refer to Empower ***https://empower.softwareag.com/***.

Note: `PARM=('POSIX(ON)/NDVSRV1')` - `POSIX(ON)` is required for a proper LE370 initialization, and `NDVSRV1` is the name of the server for the communication with the monitor client.

The name of the started task must be defined under RACF and the z/OS Linux System Services.

Terminating the Natural Development Server

The Natural Development Server can be terminated from within the **Monitor Client NATMOPI**, see ***Monitor Commands***.

Active Natural Sessions are canceled by issuing `cancel session` commands. If, at the time of the Natural Development server shutdown, no Natural session is active on that Natural Development server, then no `cancel session` command is issued. Canceling active batch server sessions in Natural requires authorized services provided by the Authorized Services Manager (ASM). If the ASM is not started, those sessions cannot be canceled.

Natural Development server only uses the `cancel session` command for sessions that are currently executing a Natural session (e.g. using **Run As/Debug As**) or using the **Natural Command Console for Mainframes**. It is only required for active Natural sessions that are not sitting on a terminal I/O. They must either be sitting on a wait inside Natural or looping.

Monitoring the Natural Development Server

To enable the administrator to monitor the status of the Natural Development Server, a monitor task is provided which is initialized automatically at server startup. Using the monitor commands described below, the administrator can control the server activities, cancel particular user sessions, terminate the entire server, etc.

Monitor Communication

To communicate with the monitor, you can use the monitor client `NATMOPI`; see ***Monitor Client NATMOPI***. Or you can use the HTML Monitor Client that supports standard web browser; see ***HTML Monitor Client***.

Alternatively, you can use the operator command `MODIFY` to execute the monitor commands described below in the section ***Monitor Commands***. The output of the executed monitor command will be written to the system log.

Example:

```
F jobname,APPL=ping
```

sends the command `ping` to the NDV server running under the job *jobname*.

Monitor Commands

The Natural Development Server supports the following monitor commands:

Monitor Command	Action
`ping`	Verifies whether the server is active. The server responds and sends the string `I'm still up`
`terminate`	Terminates the server.
`abort`	Terminates the server immediately without releasing any resources.

Monitor Command	Action
`set` *`configvariable value`*	With the `set` command, you can modify server configuration settings. For example, to modify `TRACE_LEVEL`: `set TRACE_LEVEL 31+30+15`
`list sessions`	Returns a list of active Natural sessions within the server. For each session, the server returns information about the user who owns the session, the session initialization time, the last activity time and an internal session identifier (*`session-id`*).
`list cputime`	Returns a list of transactions with highest CPU time usage, sorted by CPU time in descending order. See `CPU_TIME_HISTORY` and `CPU_TIME_TRACE` to enable CPU time history.
`cancel session` *`session-id`*	Cancels a specific Natural session within the Natural Development Server. To obtain the session ID, use the monitor command `list sessions`. Canceling active batch server sessions in Natural requires authorized services provided by the Authorized Services Manager (ASM). If the ASM is not started, those sessions cannot be canceled.
`cleanup`	Cancel sessions that are inactive longer than specified in configuration parameter `SESSION_TIMEOUT`. For more information on how to configure a Natural Development Server for SMARTS on z/VSE, see Single Point of Development > Natural Development Server for z/VSE > Natural Development Server for z/VSE (SMARTS/Com-plete) > Configuring the Natural Development Server.
`help`	Returns help information about the monitor commands supported.

Runtime Trace Facility

For debugging purposes, the server code has a built-in trace facility which can be switched on, if desired.

- Trace Medium
- Trace Configuration

- Trace Level

Trace Medium

A remote development server writes its runtime trace to the logical system file `SYSOUT` of the `FSIO` task.

Trace Configuration

The trace is configured by a **trace level** which defines the details of the trace. Once a trace is switched on, it can be restricted to particular clients or client requests by specifying a **trace filter**, see also NDV configuration parameter `TRACE_FILTER`.

Every Natural session is provided with a 32-bit trace status word (TSW) which defines the trace level for this session. The value of the TSW is set in the NDV configuration parameter `TRACE_LEVEL`. A value of zero means that the trace is switched off.

For more information on how to configure a Natural Development Server for SMARTS on z/VSE, see Single Point of Development > Natural Development Server for z/VSE > Natural Development Server for z/VSE (SMARTS/Com-plete) > Configuring the Natural Development Server.

Trace Level

Each bit of the TSW is responsible for certain trace information. Starting with the rightmost bit:

Bit 31	Trace main events (server initialization/termination, client request/result).
Bit 30	Detailed functions (session allocation, rollin/rollout calls, detailed request processing).
Bit 29	Dump internal storage areas.
Bit 28	Session directory access.
Bit 27	Dump request/reply PAL buffer.
Bit 26	Free.
Bit 25	Dump I/O buffer.
Bit 24	Free.
Bit 23	Request processing main events.
Bit 22	Request processing detailed functions.
Bit 21	Remote debugger main events.
Bit 20	Remote debugger detailed functions.
Bit 19-16	Free.
Bit 15	Trace error situations only.
Bit 14	Apply trace filter definitions.
Bit 13	Trace start and termination of the server only.
Bit 12	Trace start and termination of the client sessions only. Even if bit 13 is set.

Bit 11-08	Free.
Bit 07-01	Free.
Bit 00	Reserved for trace-level extension.

Trace Filter

It is possible to restrict the trace by a logical filter in order to reduce the volume of the server trace output.

- The filter can be set with the configuration parameter `TRACE_FILTER`.
- The filter may consist of multiple *`keyword=filtervalue`* assignments separated by spaces.
- To activate the filter definition, the trace bit 14 in the trace status word (see ***Trace Level***) must be set.

The filter keyword is:

`Client`	Filters the trace output by specific clients.

The following rules apply:

- If a keyword is defined multiple times, the values are cumulated.
- The value must be enclosed in braces and can be a list of filter values separated by spaces.
- The values are not case sensitive.
- Asterisk notation is possible.

Example:

```
TRACE_FILTER="Client=(KSP P*)"
```

Each request of the user ID `KSP` and each request of the user IDs starting with a `P` are traced.

9 Monitor Client NATMOPI

Introduction

The Monitor Client NATMOPI is a character-based command interface for monitoring the various types of servers that are provided in a mainframe Natural environment. Each of these servers has its own set of monitor commands which is described in the corresponding server documentation. In addition, a set of directory commands is available which can be used independent of the server type. One NATMOPI can be used to monitor different server types.

Command Interface Syntax

Basically the syntax of the command interface consists of a list of options where each option can/must have a value. For example:

```
-s <server-id> -c help
```

where -s and -c are options and <server-id> and help are the option values.

It is possible to specify multiple options, but each option can have only one value assigned.

The command options available are listed below.

Command Options Available

Words enclosed in <> are user supplied values.

Command Option	Action
-s <server-id>	Specify a server ID for sending a **monitor command**. If the server ID is not unique in the server directory, NATMOPI prompts the user to select a server.
-c <monitor command>	Specify a **monitor command** to be sent to the server ID defined with the -s option
-d <directory command>	Specify a **directory command** to be executed.
-a	Suppress prompting for ambiguous server ID. Process all servers which apply to the specified server ID.
-h	Print NATMOPI help.

Monitor Commands

These are commands that are sent to a server for execution. The monitor commands available depend on the type of server, however, each server is able to support at least the commands `ping`, `terminate` and `help`.

For further commands, refer to *Operating the Natural Development Server* where the corresponding **server commands** are described.

Directory Commands

Directory commands are not executed by a server, but directly by the monitor client `NATMOPI`.

You can use the directory commands to browse through the existing server entries and to remove stuck entries.

The following directory commands are available. Words enclosed in <> are user supplied values and words enclosed in `[]` are optional.

Directory Command	Action
`ls [<server-id>]`	List all servers from the server directory that apply to the specified server ID. The server list is in short form.
`ll [<server-id>]`	Same as `ls`, but the server list contains extended server information.
`rs [<server-id>]`	Remove server entries from server directory. **Note:** If you remove the entry of an active server, you will loose the ability to monitor this server process.
`cl [<server-id>]`	Clean up server directory. This command pings the specified server. If the server does not respond, its entry will be removed from the directory.
`ds`	Dump the content of the server directory.
`lm`	List pending IPC messages.

Command Examples

Example: Ping a Server in Different Environments

Server in z/OS (started task or batch mode):

- Execute `NATMOPI` in batch job:

```
NATMOPI,PARM=('-sServerName -cPING')
```

Sample job:

```
//SAGMOPI  JOB  SAG,CLASS=K,MSGCLASS=X
//NATEX EXEC PGM=NATMOPI,REGION=3000K,
// PARM=('-Sname -CPING')
//* PARM=('-H')
//STEPLIB  DD DISP=SHR,DSN=NATURAL.XXXvr.LE.LOAD
//         DD DISP=SHR,DSN=CEE.SCEERUN
//SYSOUT   DD   SYSOUT=X
//SYSPRINT DD   SYSOUT=X
//*
```

Where *XXX* is the Natural Development Server product code (NDV) and *vr* is the two-digit version number.

- Execute `NATMOPI` in TSO (Command):

```
NATMOPI -sServerName -cPING
```

The NDV load library must be included in the steplib of TSO.

Further Command Examples:

`natmopi -dls`	List all servers registered in the directory in short format.
`natmopi -dcl TST -ls TST`	Clean up all servers with ID `TST*` (ping server and remove it, if it does not respond), and list all servers with ID `TST*` after cleanup.
`natmopi -sSRV1 -cping -sSRV2 -sSRV3 -cterminate`	Send command `ping` to `SRV1`. Send command `terminate` to `SRV2` and `SRV3`.

`natmopi -cterminate -sSRV1 ↩ -cping -sSRV2 -sSRV3`	Is equivalent to the previous example. That is, `NATMOPI` sends the command following the `-s` option to the server. If no `-c` option follows the `-s` option, the first `-c` option from the command line will be used.
`natmopi -sSRV1 -cterminate -a`	Send command `terminate` to `SRV1`. If `SRV1` is ambiguous in the server directory, send the command to all `SRV1` servers without prompting for selection.

10 HTML Monitor Client

Introduction

The HTML Monitor Client is a monitor interface that supports any web browser as a user interface for monitoring the various types of servers that are provided in a mainframe Natural environment. Each of these servers has its own set of monitor commands which are described in the corresponding server documentation. The HTML Monitor Client enables you to list all existing servers and to select a server for monitoring.

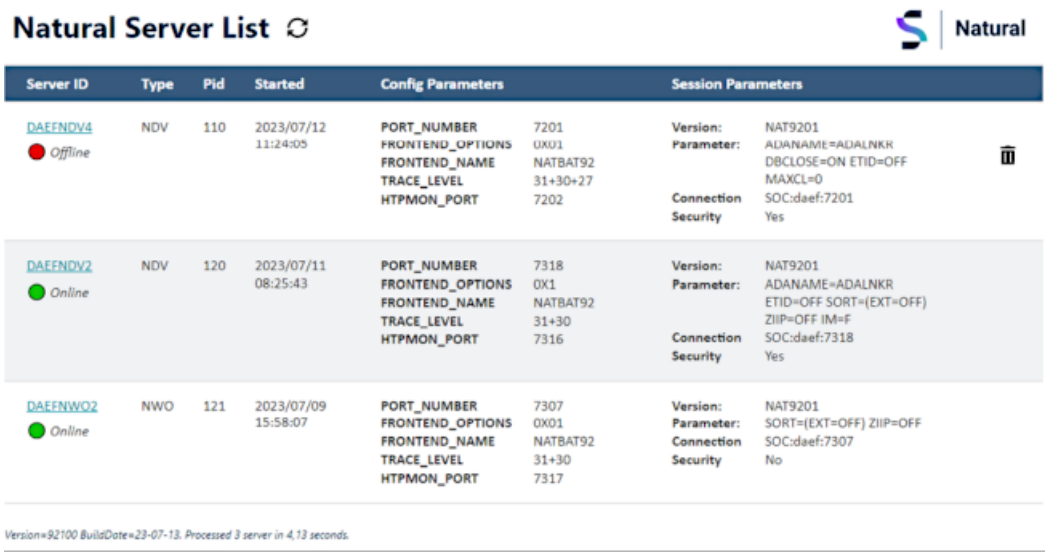
Prerequisites for HTML Monitor Client

To run the HTML Monitor Client, any server must host an HTTP Monitor Server. The HTTP Monitor Server is a subtask that can run in any Web I/O Interface server address space. It is configured with the NWO server configuration parameter `HTPMON_PORT` and `HTPMON_ADMIN_PSW`. An HTTP Monitor Server is accessible through a TCP/IP port number and can monitor all servers running on the current node (for SMARTS: running within the current SMARTS). Although it is not necessary, you can run multiple HTTP Monitor Servers on one node. But each one needs an exclusive port number.

Server List

Open your web browser and connect the HTTP Monitor Server using the following URL: `http://`*`nodename`*`:`*`port`*, where *`nodename`* is the name of the host on which the Natural Development Server hosting the monitor is running. And *`port`* is the port number the administrator has assigned as the monitor port in the NDV configuration file.

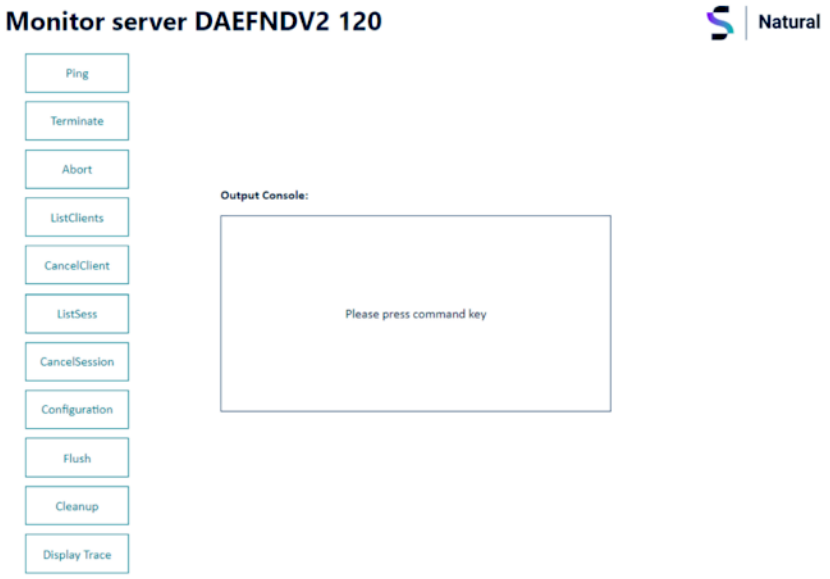
Example



The server list consists of online and offline servers. The offline servers represent potentially dead server entries which can be deleted from the server directory by choosing the **Remove** icon. **Remove** appears only for offline servers. “Potentially dead” means that the HTTP Monitor Server “pinged” the server while assembling the server list, but the server did not answer within a 10 seconds timeout. Thus, even if you find a server entry marked offline, it still might be active but could not respond to the ping. Choosing **Remove** does not terminate such a server but removes its reference in the monitor directory. Hence, it cannot be reached by the monitor anymore.

Choosing a link of the server ID opens a window for monitoring the selected server. Clicking the link with the left mouse button opens the server in a popup window. Clicking the link with the right mouse button opens the server monitor either in a new tab or in a new browser window, depending on the selection in the context menu.

Server Monitor



With the buttons, you can perform the labeled monitor commands.

The selection box allows you to modify the server configuration parameters. If you select a parameter for modification, it has a predefined value. This predefined value does not reflect the setting of the server because it is a sample value.

You can cancel sessions by selecting the session ID in the **SessionId** column and choosing **CancelSession**.

ListSess shows currently connected sessions. Connected sessions are either permanent connections to Natural Studio or temporary connections to NaturalONE. In case of NaturalONE, a connected session is a session that currently executes a Natural session (for example using **Run As/Debug As**), waits on an I/O screen or uses the **Natural Command Console for Mainframes**.

In conjunction with Security Caching (see parameter *SECURITY_CACHING*) the following buttons are available:

ListClients displays the clients that are logged in, including the following information (from left to right):

- Number of client entry
- UserId - UserId of the client
- Host - IP Address of the client
- LogonTime - Time of first login of the client
- LastActivity - Time of last access of the client
- St - Status of the client:

  A - Client successfully validated by RACF
  N - Client not validated by RACF

CancelClient deletes a client and forces a new password prompt. To delete a client from the list, select the number assigned to the client and choose **CancelClient**, or enter the number of the client after choosing **CancelClient**.

In conjunction with CPU time trace (see parameters *CPU_TIME_HISTORY* and *CPU_TIME_TRACE*) the following button is available:

CPU Time displays transactions with the highest CPU time usage. The entries are sorted by CPU time usage in descending order. A stored entry includes the following information (from left to right):

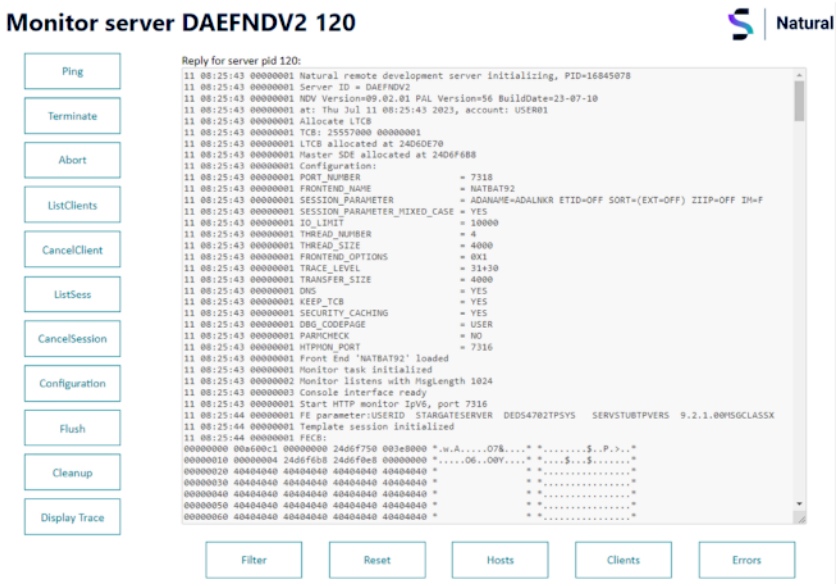
- Number of CPU time entry
- CPU time value
- Session ID
- Day and time of entry
- User ID
- Transaction

For detailed analysis about transactions in trouble the appropriate trace can be used.

Display Trace provides basic filter functions for the trace output of a server. The trace output is loaded completely into a HTML page. In case of very large trace files, loading the files might load with a delay. To refresh the content of the trace, for example if new lines were written, press **Display Trace** again.

Each trace line consists of day number, time, thread ID, and message text. The thread ID is an increasing number starting with 0 or 1 (main thread). Each new thread gets a new ID. The main thread starts several new threads like HTTP Monitor, Console Interface, or Main Listener. Each request from a client (like NaturalOne) creates a new thread. Therefore, it is possible to filter particular client sessions.

You can also use well-known browser functions, such as cut and paste or find, to navigate inside a trace.



- Filter

  Enter a text to filter the trace. Only lines containing the filter text are displayed.

- Reset

  Filter value is being reset. The entire loaded trace is displayed again.

- Hosts

  Predefined filter that shows the IP address and, if known, the name of all hosts that had logged into the Server. You can now, for example, display the progress of a particular session by selecting a thread ID and clicking the **Filter** button.

- Clients

  Predefined filter that shows the name of clients that had logged into the Server. As in the previous function, you can now, for example, display the progress of a particular session by selecting a thread ID and clicking the **Filter** button.

- Errors

  Predefined filter that shows errors that occur on the Server. You can now, for example, display the progress of a particular session by selecting a thread ID and clicking the **Filter** button.

Example:

Filter trace for clients, select the thread ID of a particular client session, and click **Filter**. You will see all trace lines of this particular client session.

11 SPoD-Specific Limitations and Considerations

When you are working with Natural Single Point of Development, you will encounter a few limitations which are due to the different capabilities of the graphical user interface available on the local site and the character-based user interface that exists on the remote site. In addition, this document includes hints which are important for the efficient use of the remote development facilities.

Editor Features With SPoD

You can use Natural's Single Point of Development with different versions of Natural on a variety of platforms. Depending on the server environment you are using together with Natural for Windows (client), the editors offer different features. For further information, refer to the section *Editor Features With SPoD* in the Natural for Windows *Editors* documentation.

Limitations

- Remote Debugging

Execution of Programs Calling CICS-Related 3GL Programs

The Natural Development Server CICS Adapter must be used to execute programs calling 3GL programs which in turn use CICS-specific information or issue CICS-specific calls (`CICS EXEC ...`).

Execution of Programs Accessing DL/I Databases

To execute programs accessing DL/I databases, the Natural Development Server CICS Adapter must be used.

Execution of Programs Accessing DB2 Databases

In the case of an access to DB2 from a program executed on the Natural Development Server, the user ID for the database access is not the client's user ID, but the job or task name of the development server's started task.

Exception: If you run the Natural Development Server with impersonation enabled (see NDV configuration parameter `SECURITY_MODE`), the user ID for database access is the client's user ID. Impersonation with DB2 requires that, instead of the interface module `DSNALI`, the module `DSNRLI` is linked to the Natural nucleus.

Back-End Program

Except under z/OS in batch mode, if a back-end program has been specified (for example, by means of the Natural profile parameter `PROGRAM`), it is not invoked if the Natural session is executing on a Natural Development Server.

System Commands

- System Command SYSDDM
- System Commands Unavailable for Remote Development

System Command SYSDDM

The system command `SYSDDM` is not available, since the DDMs are listed in the tree view under the node DDM, and because all functions of the utility `SYSDDM` are available by using Natural Studio's context menu or menu bar.

System Commands Unavailable for Remote Development

The following system commands are not available, since their use would make no sense with a graphical user interface:

- `EDT`
- `HELLO`
- `MAINMENU`

System Commands Entered Directly on the Development Server

All system commands which are not entered in the user interface of Natural Studio are executed directly by the Development Server without control of Natural Studio. As a result, the character-based representation of the corresponding command appears in the terminal emulation window. This is the case when the `STACK TOP COMMAND` mechanism is used or when a system command is directly entered inside the terminal emulation window.

During the mapping phase any `STACK` commands entered in the text box **Session Parameters** are processed within Natural Studio and the corresponding Natural Studio windows are used.

It is even possible to invoke the mainframe editors. However, this may lead to inconsistencies (see also *Object Locking* in the Natural for Windows documentation). Therefore, you are strongly recommended to use only Natural Studio's GUI editors.

The commands `HELLO` and `MAINMENU` do not cause a screen output on the development server side, since this would not make any sense in the SPoD environment. Instead of the menu-driven user interface, the dialogs provided in Natural Studio are used.

Profile Parameters

CP Parameter

The Natural profile parameter setting `CP=AUTO` is not supported in a SPoD environment. (`AUTO` means that the code page name from the user terminal is taken, if available.)

Terminal Commands

Using terminal commands in a SPoD environment is only possible within the terminal emulation window. Entering terminal commands in the command line of Natural Studio is not possible.

Moving/Copying Error Messages

Moving and copying of error messages is different in remote and local environments:

- When error messages are moved or copied within the remote environment or are moved or copied from the local to the remote environment or vice versa: the error messages involved are merged, that is,
  - error messages which already exist in the target environment are replaced,
  - messages which do not exist in the source library are kept in the target library,
  - messages which do not exist in the target library are added.
- When error messages are moved or copied within the local environment, the messages involved are handled on file level, that is,
  - all error messages (that is, files) of a language are deleted and
  - the file from the source library is created anew in the target library.

LIST DDM, EDIT DDM

In contrast with a pure Natural mainframe environment, that is, without remote development from Natural Studio, the command `EDIT DDM` is available also from a user library. This means that it is not necessary to expand the DDM node in the tree view to be able to edit a specific DDM. However, when Natural Security is used, the use of the commands `LIST DDM` and `EDIT DDM` can be restricted only via the security profile of the mainframe Natural utility `SYSDDM`.

Maps Containing GUI Elements

Maps containing GUI elements can be moved or copied from the local environment to a remote environment. However, the GUI elements are not displayed when the map is being tested or executed on the remote environment.

Field Sensitive Maps

For these maps, the consistency check for a map field is made as soon as the user input has been entered. Field sensitive maps can be moved or copied from the local environment to a remote environment. However, a field sensitive map cannot be tested or executed on a remote mainframe environment.

Resources

On the mainframe, objects of type resource can be handled (displayed, copied, deleted, etc.). See *Using Non-Natural Files - Resources* in the Natural *Programming Guide*.

By default, resouces are not handled by Natural Development Server for performance reasons; that is, resources are normally *not* displayed.

If you want Natural Development Server to handle resources, use the user exit `NDV-UX03` (source: `NDV-SX03`), which allows you to enable/disable the display of resources in Natural Studio for all or certain users only.

The server behaves in the following way: If the user exit exists and the flag `DISPLAY-RESOURCES` contained therein is set (`Y`), the server checks in the Library Statistical Record whether the number of resources is greater than 0. If so, the library is searched also for resources.

Dialogs

Dialogs can be stored on the mainframe. Therefore it is possible to move or copy dialogs from the local environment to a remote environment. Private resource files of a dialog will not be moved or copied together with the dialog. It is also possible to list dialogs in a remote environment. New dialogs cannot be created and dialogs cannot be edited in a remote environment.

Natural ISPF Macros and Recordings

As the object types Natural ISPF Macro and Recording available with Natural for Mainframes cannot be processed by Natural Studio, they will not be displayed in the tree view of the library work space. If a library consists only of such object types, the library will be displayed nevertheless in the tree view, but without any subnodes.

If a library containing such object types is deleted, then the objects of these two specific object types will not be deleted and the library will continue to be displayed in the tree view.

Objects of the types Natural ISPF Macro and Natural ISPF Recording cannot be linked to an application.

SYSLIB/SYSLIBS

The restricted libraries `SYSLIB`/`SYSLIBS` of the server are not shown in Natural Studio's tree view, because a logon to these libraries is not possible. These libraries can be modified only by using a Natural utility such as `SYSMAIN` or the Object Handler.

Allow Lower Case Input in Program Editor of Natural Studio

Natural Studio's program editor is case-sensitive, that is, lower case input will be included in the program source in lower case. The compiler on the Natural Development Server, however, expects upper case code in its normal setting. This issue can be fixed by setting the compiler option `LOWSRCE=ON`. But this setting will have specific side effects which should be noticed. Refer to the `CMPO` profile parameter in the Natural *Parameter Reference*.

Terminal Emulation

The terminal emulation supports 3270 Model 2 screens. The support of 3270 Model 3, 4 and 5 screens is planned for one of the next versions of Natural Single Point of Development.

Dependencies between XRef Evaluation and Predict

If you are using dynamic language assigned when calling other objects such as `INPUT USING MAP 'MAP1&'`, the connection between caller and called object cannot be retrieved by using XRef Evaluation.

Natural on the mainframe supports case-sensitive calls to other objects such as `PERFORM SUBROUTINE`. With the current version of SPoD, this may lead to strange results when, in XRef Evaluation, trees are expanded and it is not possible to request case-sensitive calls with the filter dialog.

Remote Debugging

When the remote debugging facility was implemented, the goal was not to provide any new functions, but to support the existing essential debugging functions under the Natural Development Server. These functions are:

- Stepmode
- Breakpoints
- Watchpoints
- Display and modification of variables and their contents during a break.

Generally, it was intended to provide for compatibility between the debug functionality that exists in a Natural on mainframes and a Natural on PC. Hence, the current state of development constitutes the lowest possible common denominator. Especially the debug statistics as supported on mainframes are not yet supported in a remote debug environment.

Which Differences Exist in Debugging in a Mainframe Environment and in Natural Studio?

The following tables provide an overview of differences that exist between Natural debugging in a mainframe environment and debugging in Natural Studio.

Explanation of the table headings:

MF	Describes debugging functionality available or not available in a mainframe Natural environment.
SPoD	Describes debugging functionality available or not available in a Natural Single Point of Development environment using Natural Studio as a development client and a mainframe Natural Development Server.
PC	Describes debugging functionality available or not available in Natural Studio (stand alone).

- **Restarting a Debug Process**

MF	The restart function is not supported.
SPoD	The restart function is not supported.
PC	Debug on PC offers a special restart function which is not available for remote debugging on mainframe.

- **EXIT from Debugger**

MF	System command `RUN`: leave the Natural Debugger. The program execution continues.
	System command `STOP`: both debugging and execution are terminated.
SPoD	Stop command in Debug menu: debug mode terminates, program execution stops.
PC	Stop command in Debug menu: debug mode terminates, program execution stops.

STEP OVER

MF	Syntax of `STEP SKIPSUBLEVEL` is used instead of `STEP OVER`.
SPoD	`STEP OVER` is applicable for called objects on a different level (`CALLNAT`, etc). It is not applicable for internal subroutines.
PC	`STEP OVER` is supported for any called objects and, in addition, for internal subroutines.

Set Next Statement (Natural Studio Context Menu Command)

MF	Not applicable.
SPoD	Not supported.
PC	Supported. Allows you to continue the execution at a chosen line.

System Variables: Display/Modify

MF	System variables can be displayed, but cannot be modified.
SPoD	System variables can be displayed, but cannot be modified.
PC	System variables can be displayed and modified.

Display of Binary Variables

MF	Either alphanumeric or hexadecimal display of binary variables can be selected. In alphanumeric display, binary variables with lengths ranging from 1 to 4 are interpreted and displayed as numerical values. Binary variables with lengths > 4 are displayed in alphanumeric representation.
SPoD	Binary variables are always represented as hexadecimal values.
PC	Binary variables are always represented as hexadecimal values.

Modify Dynamic Variables

MF	During the debug process, the content of a dynamic variable can be modified in the given length. Modification of length of dynamic variable during debug is not supported.
SPoD	Content of dynamic variable can be modified in given length.
PC	Both content and length of dynamic variable can be modified during the debug process.

Maximum Length when Displaying Variable Values

MF	Displays full content of variable; long variables are displayed in chunks of maximally 256 bytes. If Unicode is used: max. 256 bytes = 128 characters.
SPoD	Displays maximally 253 bytes. If Unicode is used: max. 252 bytes = 126 characters.
PC	Displays maximally 253 characters.

Maximum Length of Watchpoint Variables

MF	Maximally 253 bytes. If Unicode is used: max. 252 bytes = 126 characters.
SPoD	Maximally 253 bytes. If Unicode is used: max. 252 bytes = 126 characters.
PC	Maximally 253 characters.

Watchpoint: Display of Break Line

MF	After the watchpoint has been registered, the Debugger marks the preceding (already executed) statement.
SPoD	After the watchpoint has been registered, the Debugger stops at the current position in the program. This is the statement to be executed next.
PC	After the watchpoint has been registered, the Debugger stops at the current position in the program. This is the statement to be executed next.

Several Watchpoint Breaks per Line of Program

MF	Multiple breaks on the same line may arise for the same watchpoint variable (because of different watchpoint operators). The hit counter is incremented accordingly.
SPoD	Multiple breaks on the same line may arise for the same watchpoint variable (because of different watchpoint operators). The hit counter is incremented accordingly.
PC	Several watchpoint definitions for the same variable result in a maximum of one break per line, hit counts of all watchpoint definitions are incremented.

Breakpoint Definition

MF	Breakpoints can only be defined for programs which are found in the current library or in any steplib.
SPoD	Breakpoints can only be defined for programs which are found in the current library or in any steplib.
PC	Breakpoints for programs can be defined in any library (not necessarily in the current library or steplib).

Breakpoints BEG and END

MF	The symbolic breakpoints `BEG` and `END` (first and last executed statement) are supported.
SPoD	Breakpoints `BP-BEG` and `BP-END` are not supported.
PC	Breakpoints `BP-BEG` and `BP-END` are not supported.

Debugging of Programs which are Called through the Stack

MF	Stacked programs can be debugged when any breakpoint or watchpoint has been defined, but they cannot be entered automatically in step mode.
SPoD	Programs on stack can be entered in step mode.
PC	Programs on stack can be entered in step mode.

Edit/Stow a Program during Debug

MF	A NAT0932 (program version) error appears if during the debug process the debugged program was stowed and loaded into the buffer pool.
SPoD	A NAT0932 (program version) error appears if during the debug process the debugged program was stowed and loaded into the buffer pool.
PC	Change and stow of program during debug is possible.

Call Stack

MF	The debug command `OBJCHAIN` displays a list of active programs and their levels.
SPoD	The current program and its level are displayed in the call stack window.
PC	All active programs and their levels are displayed in the call stack window.

Performance Considerations

Progress Information

The working situation displayed in the library workspace of Natural Studio is based on the representation of the entire user system files.

The tree view window opens when the user connects to the Natural Development Server. For this, the entire system file has to be analyzed and the corresponding information has to be transferred from the Natural Development Server to the Natural Studio client. In the case of very large system files, the build-up of the tree view window can be very time consuming. Status information displayed in the status bar keeps the user informed about the progress of the screen build-up operation. This is to avoid the impression that the connection to the Natural Development Server might be interrupted.

Tip: Switch on the status bar using the **View > Status Bar** function of the menu bar. Make sure that the transfer rate of your network is 100 Mbit/s at minimum.

Filter Definition

Another possibility to reduce the amount of data read while mapping the environment is to supply filter definitions on system file or library level.

Tip: In the context menu of a system file and library node it is possible to apply filter definitions. Using these definitions on the client side, you can limit the number of libraries/objects displayed in the tree view.

Refresh Options

In the default configuration of Natural Studio, all operations which result in a modification of the system file, for example, moving or copying objects, but also a `SAVE` or `STOW` command, will cause the tree view window contents to be refreshed, which can be a very time consuming process in the case of very large system files.

Tip: By default, the **Refresh** function is set to **Full automatic refresh**. Change the automatic refresh function by choosing **Optimized automatic refresh** or **No automatic refresh** in the context menu.

Since the tree view of the application workspace displays only the objects that are linked to the application, the build-up of its tree view screen is consequently considerably faster, which is another advantage of using the application workspace.

Object Lists on Mainframes

In mainframe environments, libraries may contain a huge number of objects. Expanding such a library in a tree node in the NaturalONE Server view or in the Natural Studio views can take a long time.

Tip: Install the hyperdescriptor as described in *NaturalONE in a Nutshell* > *Performance Aspects* in the NaturalONE documentation. The hyperdescriptor is also used by Natural Studio. It can significantly improve the database access required for reading object names the Natural system file.

Library Statistical Record

In a Natural Single Point of Development environment, either local Natural libraries are accessed or Natural Studio requests the library statistical data from the remote development server. In the local environment, the data are stored persistently in the FILEDIR structure of the library. In the case of a mainframe development server, Natural objects are stored in system files in the database and the requested statistical data of a library are not stored permanently.

In order to reduce the number of Adabas calls and to improve the performance, a statistical record has been introduced.

The program `NDVCSTAR` is provided to initialize a complete system file, a range of libraries or a single library on a system file with the **Library Statistical Record**s, see ***Initialization of Library Statistical Records***.

Concept

In a Natural Single Point of Development environment, a library statistical record is created and maintained for every library of the `FUSER` or `FNAT` system file. This statistical record resides on the same system file where the library resides and contains the following information for every library:

- Total number of objects
- Total number of all sources
- Total number of all cataloged objects
- Total number of objects for every object type
- Accumulated size of all sources
- Accumulated size of all cataloged objects
- Accumulated size of sources for every object type

- Accumulated size of all cataloged objects for every object type

Supported object types:

- Program
- Map
- GDA
- LDA
- PDA
- Subroutine
- Helproutine
- Subprogram
- Copycode (source only)
- Text (source only)
- Command Processor
- Dialog (source only)
- Class
- Error Message (source only)
- Function
- Adapter
- Resource

When Natural Studio requests the statistics for a library the first time, the library statistical record is created and saved in the appropriate system file. Once the library statistical record has been built, all requests from Natural Studio will be satisfied by reading and sending the contents of the statistical record instead of rebuilding the complete library statistics.

When the user initiates an explicit refresh for a library, the statistical record is rebuilt completely.

Data Consistency

The library statistical record of a mainframe development server is supported only in a Single Point of Development environment. The statistical record is always up to date if all system file modifications are initiated in this environment.

All commands or operations triggered by Natural Studio which will modify the system files (add new object or copy, move, delete, rename object, etc.) will update the library statistical record on the development server.

In addition, the library statistical record is regenerated if an object list for the whole library is requested or the statistical record for a given object type is updated if an object list for this type is requested.

To ensure consistency of the data in the library statistical records of your FNAT and FUSER system files, you are strongly recommended to make changes on the same FNAT and FUSER system file used in a Single Point of Development environment exclusively in that environment.

Caution: When working with Natural Studio, care must be taken to start all commands or utilities from within Natural Studio. It is not admissible to issue system commands in the terminal emulation window, for example, at a MORE prompt or in a command line. In such a case, the library statistical data might become inconsistent. The same is true if you start a server application that directly changes the FNAT or FUSER system file.

Such inconsistencies may be resolved after the next regeneration (implicit rebuild via get object list or explicit refresh) of the library statistical record is forced.

Restrictions

Statistical records cannot be used for read-only system files. In this case, the old behavior is used.

Initialization of Library Statistical Records

In order to initialize the Library Statistical Records of a a complete system file, a range of libraries or a single library on a system file you can invoke the program NDVCSTAR.

The following options are provided:

Option	Meaning		Default value
Library name range	Possible values:		*
	blank or * (asterisk)	All libraries.	
	value>	All libraries with names greater than or equal to *value*.	
	value<	All libraries with names less than or equal to *value*.	
DBID, FNR	The database ID (DBID) and file number (FNR) of the system file where the Natural libraries are stored. If no values (or 0) are specified, the current FUSER or FNAT system file is used.		0,0
Password, Cipher	The password and cipher code of the Adabas file where the Natural libraries are stored.		None
Update existing records	Specifies whether existing Library Statistical Records are to be processed. Possible values:		N

Option	Meaning		Default value
	Y (yes)	Regenerate existing Library Statistical Records.	
	N (no)	Skip existing Library Statistical Records.	
Display library names	Specifies whether a processing message of the library currently processed is to be displayed. Possible values:		1
	Y (yes)	Display processing messages.	
	N (no)	Display only error messages.	

To invoke the program NDVCSTAR

- At a NEXT/MORE prompt or in a Natural command line, enter NDVCSTAR and press ENTER.

To execute the program NDVCSTAR in batch mode

- Enter NDVCSTAR followed by the desired options.

  Examples:

```
NDVCSTAR *,1,47,,,N,Y
```

  On the system file with DB=D=1, FNR=47, this command creates, for all libraries that do not yet have a Library Statistical Record, a new one. Any existing library statistical records are skipped. For every library found, a processing message is displayed.

```
NDVCSTAR ABC*,,,,,Y,Y
```

  This command creates or regenerates the library statistical record on the current FUSER system file for all libraries that start with ABC. For every library found, a processing message is displayed.

Accessing Work Files

This topic is discussed in the Natural Operations for Mainframes documentation. Refer to *Natural as a Server under z/OS, Print and Work File Handling with External Datasets in a Server Environment*.

CICS-Specific Limitations when Using the NDV CICS Adapter

This topic is discussed in the Natural Operations for Mainframes documentation. Refer to *Natural as a Server under CICS*.

Natural Documentation and Online Help

The following restrictions apply to the Natural documentation and the Windows-based online help when you are using a Natural Development Server (NDV) for remote development:

- The online help currently available with Natural Studio contains only the Natural for Windows documentation and the SPoD client documentation.
- Therefore this online help may describe Natural features which are not or not yet supported on the mainframe platform.
- Natural features that are available only on mainframes are missing.
- Particularly in the sections dealing with the Natural programming language, minor but important differences due to hardware platforms, operating systems, TP monitors, etc. may exist.

We ask you to refer to the Natural for Mainframes documentation set for full details.

12 Natural Development Server Frequently Asked Questions

This chapter contains frequently asked questions concerning the Natural Development Server (NDV) under z/OS (Batch).

Natural Development Server starts and terminates immediately

At server initialization, the Natural Development Server

- allocates central control blocks,
- opens the datasets `STGTRACE`, `STGSTDO`, `STGSTDE`, `STGCONFG`,
- obtains the configuration file,
- loads the Natural front-end,
- initializes the first Natural session and
- launches the TCP/IP listener task.

If one of these steps fails, the server will not be able to continue and will terminate immediately.

Analyze the trace output (`STGTRACE`) or the error output (`STGSTE`) to find out the problem.

`STGTRACE`, `STGSTDO`, `STGSTDE` are synonyms for *`serverid`*`E`, *`serverid`*`O` and *`serverid`*`T`.

Which dataset should I analyze to get error information?

STGSTE	Contains only error output. Each record consists of 2-4 lines, depending on whether it is a Natural error, a system error or an NDV stub error. ■ Natural Error 1. DayOfMonth Time TaskId UserId 2. TaskId NDV Error: error classification 3. Natural FrontEnd error or Natural runtime error 4. Natural error text ■ System Error 1. DayOfMonth Time TaskId UserId 2. TaskId NDV Error: error classification 3. TaskId Sys Error: System error text ■ NDV Stub Error 1. DayOfMonth Time TaskId UserId 2. TaskId NDV Error: error classification

STGTRACE	Contains NDV trace information and error information. Each trace record contains DayOfMonth Time TaskId trace information text. The string PrintError in the trace information text prefixes errors.
STGSTO	Content of the configuration file allocated to STGCONFG.
SYSOUT	Messages from LE runtime system.

Trace output shows: Cannot load Natural front-end ...

The Natural front-end specified by the NDV configuration parameter `FRONTEND_NAME` was not found in the load library concatenation. See *Single Point of Development* > *Natural Development Server for z/VSE* > *Natural Development Server for z/VSE (SMARTS/Com-plete)* > *Configuring the Natural Development Server*.

Trace output shows: Transport initialization failed, EDC8115I address already in use

The TCP/IP port number specified by the NDV configuration parameter `PORT_NUMBER` is already in use by another process. See *Single Point of Development* > *Natural Development Server for z/VSE* > *Natural Development Server for z/VSE (SMARTS/Com-plete)* > *Configuring the Natural Development Server*.

How do I get information about which process occupies a port number?

TSO command `NETSTAT (PO 4712)` displays connections of Port 4712. The first column of the list refers to the task that owns the port. Or enter the z/OS Linux System Services command `netstat -P4712`.

The task that occupies a port number is not active but the port is still occupied. How do I drop the stuck connections?

Enter TSO command `NETSTAT (PO` *`nnnn`*`)` to list connections for port *nnnn*.

Output of the `NETSTAT (PO 4712)` command:

```
EZZ2350I MVS TCP/IP NETSTAT CS V2R8       TCPIP NAME: DAEFTCP2        06:45:19

EZZ2585I User Id  Conn     Local Socket           Foreign Socket         State

EZZ2586I -------  ----     ------------           --------------         -----

EZZ2587I SAGNDV31 000031CC 157.189.160.55..4712   192.168.40.11..3152    Establsh

EZZ2587I SAGNDV31 000005E9 0.0.0.0..4712          0.0.0.0..0             Listen

EZZ2587I SAGNDV31 000031CD 157.189.160.55..4712   192.168.40.27..4250    Establsh

EZZ2587I SAGNDV31 000031D5 157.189.160.55..4712   157.189.164.133..2906  Establsh

EZZ2587I SAGNDV31 000031D8 157.189.160.55..4712   157.189.164.152..1099  Establsh
```

`User Id`	The job that uses port `4712`.
`Conn`	Connection ID.
`Foreign Socket`	Connected clients.
`State`	Connection status.

If State contains FinWait, you need not drop that connection, because connections of that status do not prevent a Natural Development Server from using that port.

To drop the connection, enter the MVS command `VARY TCPIP,DAEFTCP2,DROP,000005E9`.

Where `DAEFTCP2` must match your TCP/IP job name (`TCPIP NAME: DAEFTCP2`) in the first line of the `NETSTAT` output) and `000005E9` is the connection ID in the column `Conn`.

Trace output shows: Error at: Template runtime connect

When a Natural Development Server initializes, it starts a Natural session using the session parameter(s) defined by the NDV configuration parameter `SESSION_PARAMETER`. The profile definition of the NDV configuration parameter `DEFAULT_PROFILE` is appended. For more information on how to configure a Natural Development Server for SMARTS on z/VSE, see *Single Point of Development > Natural Development Server for z/VSE > Natural Development Server for z/VSE (SMARTS/Com-plete) > Configuring the Natural Development Server*.

If the initialization of the template session fails, the server terminates immediately. The original error can be found below the message `Error at:Template runtime connect`.

Typical error situations could be:

- No Natural buffer pool defined.
- Natural system file `FNAT` not accessible.

- Natural profile parameter `ITERM=ON` (Session Termination in Case of Initialization Error).
- NDV initial user ID not defined.

NDV task abends with User Code 4093 and SYSOUT Message CEE5101C

The account of the Natural Development Server is not defined in z/OS Linux System Services. If you start the Natural Development Server as a started task, the member name of the started task must be defined under z/OS Linux System Services. If you start the Natural Development Server as a batch job, the user that submits the job must be defined under z/OS Linux System Services.

Required LE runtime options

IBM Language Environment (LE) runtime options that must be specified to operate a Natural Development Server.

Note: These recommendations apply to the region of the NDV server. They do not apply to the CICS region if the NDV CICS adapter is used.

`POSIX(ON)`	Enables the Natural Development Server to access the POSIX functionality of z/OS. If you start a Natural Development Server with `POSIX(OFF)`, it terminates immediately with a user abend U4093 and the system message EDC5167. IBM supplies the default `OFF`.
`TRAP(ON,NOSPIE)`	Defines the abend handling of the IBM Language Environment. `ON` enables the Language Environment condition handler. `NOSPIE` specifies that Language Environment will handle program interrupts and abends via an `ESTAE`, that is the Natural abend handler will receive control to handle program interrupts and abends. If you do not specify `TRAP(ON,NOSPIE)` the Natural abend handling does not work properly. IBM supplies the default `ON,SPIE`.
`TERMTHDACT(UADUMP)`	Defines the level of information that is produced in case of an abend. The option `UADUMP` generates a Language Environment `CEEDUMP` and system dump of the user address space. The `CEEDUMP` does not contain the storage areas relevant to Natural. IBM supplies the default `TRACE`.

Useful LE runtime options

IBM Language Environment (LE) runtime options to monitor and tune Natural Development Servers.

Note: These recommendations apply to the region of the NDV server. They do not apply to the CICS region if the NDV CICS adapter is used.

`RPTOPTS(ON)`	Prints LE runtime option settings to `SYSOUT` after server termination.
`HEAPPOOLS`	The `HEAPPOOLS` run-time option is used to control an optional heap storage management algorithm, known as heap pools. Refer also to *Language Environment for z/OS & VM Programming Reference*. The setting of this parameter depends on NDV functionality mostly used by NDV clients. A good value to start with is: `HEAPP=(ON,40,3,80,7,224,7,528,3,1344,8,2048,8)`
`ALL31(ON)`	Specify `ALL31(ON)` if your entire Natural environment runs in 31-bit mode to prevent LE switching addressing mode.
`STACK(64K,16K,ANY,FREE)`	Specify the `ANY` option if your entire Natural environment runs in 31-bit mode. This enables LE to allocate the storage for the `STACK` segment above the 16 MB line. The `STACK` segment above 16 MB increases the number of subtasks you can create within the NDV region. The initial and extend size (64 KB and 16 KB in the example) should be determined for your own environment by using the LE storage report generated when you specify `RPTSTG(ON)`.
`HEAP(800K,64K,ANY,FREE,,)`	Initial heap storage (see `STACK` option).
`ANYHEAP(1300K,200K,ANY,FREE)`	Library heap storage (see `STACK` option).
`RPTSTG(ON)`	Generates, after server termination, a report of the storage the server used. At the end of the report, it suggests cell sizes for the `HEAPPOOLS` option. This option decreases performance of the server. Use it only as an aid to find best settings for `HEAPPOOLS` definition.
`ENVAR(TZ=...)`	The `ENVAR` option enables you to set Linux environment variables. The only environment variable applicable for the Natural Development Server is `TZ` (time zone). Example: `ENVAR(TZ=CET-1DST) CET` - 1 hour daylight saving time

How do I pass LE runtime options?

1. With the PARM parameter specified in the EXEC card of the NDV startup job. The length of the options is limited by the maximum length of the PARM parameter.

```
...
//NDV EXEC PGM=NATRDEVS,
// PARM='RPTOPTS(ON)/server-id'
...
```

2. Assemble an LE runtime option module CEEUOPT and link it to the NDV load module.

```
//KSPLNDV  JOB  KSP,CLASS=K,MSGCLASS=X
//*
//* RELINK NDV SERVER WITH LE RUNTIME OPTIONS
//*
//*****************************************************************
//* STEP1: ASSEMBLE LE RUNTIME OPTION MODULE
//*
//STEP1 EXEC PGM=ASMA90,PARM='DECK,NOOBJECT'
//SYSPRINT DD SYSOUT=*
//SYSUT1   DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSUT2   DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSUT3   DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSPUNCH DD DSN=&&TEMPOBJ(CEEUOPT),DISP=(,PASS),UNIT=SYSDA,
// SPACE=(TRK,(1,1,1)),DCB=(BLKSIZE=3120,LRECL=80,DSORG=PO)
//SYSLIB   DD DSN=CEE.SCEEMAC,DISP=SHR                    <<<<<<
//         DD DSN=SYS1.MACLIB,DISP=SHR                    <<<<<<
//SYSIN    DD *
CEEUOPT  CSECT
CEEUOPT  AMODE ANY
CEEUOPT  RMODE ANY
         CEEXOPT ENVAR=(TZ=CET-1DST),                                  X
               HEAPPOOLS=(ON,40,50,80,90,224,80,528,50,1344,90,2048,   X
               90),                                                    X
               POSIX=(ON),                                             X
               RPTOPTS=(ON)
         END
/*
//*****************************************************************
//* STEP1: LINK RUNTIME OPTION MODULE
//*
//STEP2    EXEC  PGM=IEWL,
//         PARM='NCAL,RENT,LIST,XREF,LET,MAP,SIZE=(9999K,96K)'
//SYSPRINT DD  SYSOUT=*
//SYSUT1   DD  UNIT=SYSDA,SPACE=(TRK,(5,5))
//SYSLMOD  DD  DSN=&&CEEOBJ(CEEUOPT),DISP=(,PASS),UNIT=SYSDA,
// SPACE=(TRK,(1,1,1))
```

```
//SYSLIB   DD  DSN=&&TEMPOBJ,DISP=(OLD,PASS)
//SYSLIN   DD  *
 INCLUDE SYSLIB(CEEUOPT)
  ENTRY  CEEUOPT
   ORDER CEEUOPT
 NAME CEEUOPT(R)
/*
//*******************************************************************
//* STEP3: RELINK NDV SERVER WITH RUNTIME OPTION MODULE
//*
//STEP3    EXEC PGM=IEWL,
//         PARM='RENT,XREF,LIST,LET,REUS,SIZE=(300K,64K),CASE=MIXED,
//               AMODE=31,RMODE=ANY'
//SYSUT1   DD  UNIT=(SYSDA),SPACE=(TRK,(10,4))
//SYSLMOD  DD  DISP=SHR,DSN=NATURAL.NDV.LOAD      <<<<<<
//SYSPRINT DD  SYSOUT=X
//NDVLOAD  DD  DISP=SHR,DSN=NATURAL.NDV.LOAD      <<<<<<
//CEELOAD  DD  DISP=SHR,DSN=&&CEEOBJ
//SYSLIN     DD *
 REPLACE CEEUOPT
 INCLUDE NDVLOAD(NATRDEVS)
 INCLUDE CEELOAD(CEEUOPT)
 NAME NATRDEVS(R)
/*
```

The lines marked with `<<<<<<` must be adapted to your environment.

Definitions required in Natural Security

- Each client must be defined in Natural Security (NSC) if the Transition Period Logon flag in NSC is set to `NO`. Otherwise, your **Map Environment** attempt fails with a NAT0873 error.
- You must define an NDV initial user ID (default ID is `STARGATE`) unless you run with Natural profile parameter `AUTO=OFF` (no automatic logon).
- Each user must have either a default library or a private library. Otherwise, your **Map Environment** attempt will fail with a NAT1699 error.
- You must not specify a startup program that executes an I/O statement or stacks a `LOGON`, `LOGOFF` or `RETURN` command, because the program is executed whenever you change the focus to that library within the tree view.
- If you add a new user, you must specify a password for this user. Otherwise, his/her **Map Environment** attempt will fail with a NAT0838 error.

I do not get a NAT0954 even if I specify DU=OFF

The IBM Language Environment (LE) runtime option `TRAP` must be set to `TRAP(ON,NOSPIE)`.

Map Environment fails with a NAT3048

Specify session parameter `ETID=' '`. If you are using Natural Security, clear the ETID (Adabas User Identification) definition for that user.

Map Environment fails with Stub RCnn

Stub return codes are raised by the NDV front-end stub, if it detects a logical processing error when dispatching the NDV request. The NDV trace output contains detailed information about the reason for the error.

The following stub return codes are possible:

Code	Meaning, Reason, Action
1	`Error during session reconnect` (for future use).
2	`Cannot create new session directory entry or subtask.` When Natural Studio executes a **Map Environment** command, the Natural Development Server allocates an entry in its session directory and creates a new subtask. If one of these actions fails, the Stub `RC 2` is raised. **Reason:** ■ Region size (virtual storage below 16 MB) for the Natural Development Server is too small, ■ Number of subtasks exceeds the limit specified by the z/OS Linux System Services parameter `MAXTHREADS`. **Action:** Increase region size or `MAXTHREADS`, or distribute the clients to several Natural Development Servers. To save memory below 16 MB, you can also specify the `ANY` option of the LE parameter `STACK` (refer to ***Useful LE runtime options***). The number of active tasks can be displayed using the z/OS system command `D OMVS,PID=` *`process-id`* (where *`process-id`* is the process id of the Natural Development Server). The value of `MAXTHREADS` can be displayed with `D OMVS,OPTIONS`.
3	`Cannot initialize new session.`

Code	Meaning, Reason, Action
	This error occurs if a storage allocation for internal NDV control buffers fails due to a lack of virtual memory above 16 MB. **Reason:** Virtual memory above 16 MB too small. **Action:** Increase the virtual memory above 16 MB, decrease the number of physical storage threads, configure NDV to use the Natural roll server, or distribute the clients to several Natural Development Servers.
4	`Session execution failed.` Internal error. Natural Studio uses an invalid session identifier to process a request. **Reason:** ■ When a **Map Environment** command is issued, the session ID already exists. ■ The Natural session with the specified ID is not initialized. **Action:** Locate the defective session ID in the server trace file and **cancel** it using the **monitor task**, or restart your Natural Studio session.
5	`I/O execution not allowed.` In some situations, a Natural I/O is prohibited at the Natural Development Server. **Reason:** ■ I/O execution during `LOGON` request. ■ I/O execution while a transaction processor is executing. **Action:** Locate the I/O buffer in the server trace file to find out which I/O should be processed. Check for any startup program specified for the library you want to logon to.
6	Not applicable.
7	`Error during I/O execution.` The Natural Development Server cannot finish a terminal I/O. **Reason:** ■ Virtual memory above 16 MB too small. ■ I/O reply buffer sent by Natural Studio is invalid. **Action:**

Code	Meaning, Reason, Action
	Increase the virtual memory above 16 MB. If the I/O reply buffer is invalid, contact Software AG support.
8	`Protocol element missing.` Internal error, contact Software AG support.
9	`NDV not installed on Natural system file.` Natural Development Server cannot execute the Natural module `TRPRO` located on library `SYSLIB`. **Reason:** ■ The NDV modules were not loaded on the system file `FNAT`. **Action:** Use the Natural utility INPL to load the NDV modules.
10	`LOGON command required.` If you execute a program on the Natural Development Server that executes a `LOGOFF` (or a `RETURN` when no `SETUP` record is available), the logon library is undefined. In an online environment, the Natural Security logon screen is displayed in this situation. Under NDV, the Natural session rejects all requests except a `LOGON` command. This applies only if Natural Security is installed. You can issue a `LOGON` command either via the command line or by clicking on any library in your tree view.

Special characters are not translated correctly

The ASCII-to-EBCDIC translation for NDV uses the Natural translation tables `TABA1/TABA2`. These tables are automatically or manually adapted at the customer's site.

Automatic Adaptation of Translation Tables

Automatic adaptation of the Natural translation tables `TABA1/TABA2` takes place if the following Natural profile parameters are set:

- `CFICU=ON` and
- `CP=`*`value`*

  where *`value`* can be any value except `OFF` or `AUTO`.

For further information on possible settings, see the corresponding profile parameter descriptions in the Natural *Parameter Reference* documentation.

At session initialization (when you map to the NDV server) Natural automatically adapts its conversion tables TABA1/TABA2 according to the CP parameter definition and the code page used at the client. To verify if the conversion tables have been adapted, set NDV TRACE_LEVEL=31, connect to the NDV host via Natural Studio, and review the NDV trace file.

Each Map Environment starts with:

```
11 07:58:02 00000003 Got new connection
```

some lines down you find:

```
11 07:58:02 00000005 Client codepage: windows-1252
11 07:58:02 00000005 Client operation = 18
```

and again some lines down you find:

```
11 07:58:03 00000005 TABA1/TABA2 adapted according CP definitions
```

which indicates that the table has been adapted.

Manual Adaptation of Translation Tables

The translate tables can be modified as follows:

1. Modify source member NTTABA1/NTTABA2 on the Natural distribution library. Reassemble NATCONFG and relink the Natural nucleus.
2. Specify the Natural session parameter TABA1/TABA2.

Manual adaptation requires setting CP=OFF. It also requires that TERMINAL_EMULATION=WEBIO be off. As a result, you cannot use the statements REQUEST DOCUMENT and PARSE.

Automatic and manual adaptation are mutually exclusive. If the automatic adaptation is effective, any TABA1/TABA2 definitions are discarded. You can use either the automatic or the manual update but not a mix of both.

Do not use Natural Studio session parameters as an approach to permanently implementing these changes. You run the risk that different clients may use different translations, and this could corrupt source code the clients share. It is better to maintain the translation centrally. You can do this in two different ways:

1. Maintain the Natural parameter module, or
2. Use the NDV configuration parameter SESSION_PARAMETER.

   This affects the SPoD users only.

Characters are not displayed correctly in the terminal emulation of Natural Studio

In Natural Studio, see also Tools / Options / Workspace / Terminal emulation setting in Natural Studio. The default (Latin) may not be the correct choice. For instance, in the US, you probably want to select “United States”.

A simple Natural program on the mainframe can reveal the EBCDIC representation of a character which is not converting correctly:

```
#A(A1) = '{'
WRITE #A(EM=H)
END
```

If none of the available code pages applies to your needs, it is possible to adapt one of the `N3270_USER 3270` translation tables in the `etc` directory. Details are in the *Natural for Windows* product documentation.

The web-site ***http://www.tachyonsoft.com/uc0000.htm*** is a good resource for finding valid EBCDIC and ASCII values for a given character (glyph) in various code pages.

How do I find out which hexadecimal value must be specified for TABA1/TABA2?

Run the following program on your Natural for Windows locally.

```
#A(A1) = '{'
WRITE #A(EM=H)
END
```

Output is `7B`.

Run the program on a mainframe (edit the program with the Natural mainframe editor). Output is `75`, assuming that you use a German EBCDIC table. If you use a US EBCDIC table, the output will be `C0`.

Start your Natural Development Server session with `TABA1=(75,7B)` and `TABA2=(7B,75)`.

The modifications of TABA1/TABA2 do not apply to sources listed in the remote debugger

Specify the NDV configuration parameter `DBG_CODEPAGE=USER`.

For more information on how to configure a Natural Development Server for SMARTS on z/VSE, see Single Point of Development > Natural Development Server for z/VSE > Natural Development Server for z/VSE (SMARTS/Com-plete) > Configuring the Natural Development Server.

Accessing work files

This topic is discussed in the Natural *Operations for Mainframes* documentation. Refer to *Natural as a Server under z/OS, Print and Work File Handling with External Datasets in a Server Environment*.

I have problems when accessing DB2

Ensure that your Natural Development Server is started with the configuration parameter `KEEP_TCB=YES`.

If you run the Natural Development Server with impersonation enabled (see NDV configuration parameter `SECURITY_MODE`), ensure that you have linked the interface module `DSNRLI` (instead of `DSNALI`) to the Natural nucleus.

Are there any Natural profile parameter settings required for NDV?

The following Natural profile parameter values are required for NDV:

- `ETID=OFF` is required to allow multiple Natural sessions for each client.
- `DBCLOSE=ON` is required to remove database resources immediately after session termination rather than to keep them until they are removed due to a timeout.
- `ITERM=OFF` is required to continue with the Natural Development Server initialization, even if session initialization errors occur.
- `AUTO=ON/AUTO=OFF` (Automatic Logon) has a different behavior under Natural Single Point of Development. In an online Natural environment, this parameter controls whether you are prompted for your user ID and password or whether your user ID is treated to be a trusted user ID from the TP environment. With Natural Single Point of Development, you must always specify your user ID and password in the Map Environment dialog.

- The Natural profile parameter MT (Maximum CPU Time) is required to avoid endless loops within user programs. If you run a Natural session under NDV with MT=0, there is no timeout handler that interrupts a looping Natural program. The NDV server is still responding to other clients but with an excessive CPU time consumption. This applies only to NDV servers under z/OS Batch.

The NDV server consumes a lot of CPU time even if only a few clients are using it

If you run your NDV server without a CPU time limit on session level, a Natural program might run into an endless loop. Issue a server command `list sessions` and examine whether any of the listed sessions has the status code "IO" (under the column header St. in the list output). The character I means that the client owns an initialized session, and the O flags mean that the client occupies a thread and is currently executing.

If a second `list sessions` command results in an "IO" for the same client with an unaltered Last Activity, it is probably a stuck or looping client. You can try to cancel the session using a `CANCEL SESSION` server command. If the cancelation fails, a restart of the NDV server is required.

If the `list sessions` function does not show a stuck or looping client, cancel the NDV server by using the `DUMP` option, and consult Software AG support.

You can define a CPU time limit for NDV servers under z/OS Batch with the Natural profile parameter `MT`. `MT=3` defines a maximum CPU time limit of 3 seconds.

I get a NAT0873 internal error at user authentication for Map Environment

Please check the system messages in your NDV job output for the error message `ICH408I USER(…)` with `BPX.SERVER CL(FACILITY)` and `INSUFFICIENT ACCESS AUTHORITY` in the NDV Job output. This message indicates that the NDV server account `(USER(…)` in the ICH408I message) has no read access to the facility `BPX.SERVER`.

I get a NAT0920 Program … cannot be loaded (CEE3518)

Please check the system messages in you NDV job output for the error message `ICH422I THE ENVIRONMENT CANNOT BECOME UNCONTROLLED` and `CSV042I REQUESTED MODULE … NOT ACCESSED. THE MODULE IS NOT PROGRAM CONTROLLED`. This message indicates that the load module … is not defined as "program controlled". Please define the corresponding load library to the program class "**".

I receive a NAT0873 and the server trace logs 'Sys Error, errno:163 errno2:0x0BE80820 EDC5163I SAF/RACF extract error'

The client is not granted to use z/OS Linux System Services. Please check if the client has an OE segment. And if you have defined the OMVSAPPL, each client must have read access to OMVSAPPL.

The server fails to start with return code 4 and in the error log I find 'Transport initialization failed'

Probably the TCP/IP environment is in error. See the system error message after the error log entry and ask your system programmer(s) for assistance.

Listing mainframe objects in a view needs a long time

Opening a node in the **Natural Server** view or in the Natural Studio views in a mainframe environment can take a long time if a huge number of objects are contained in a library. See ***Object Lists on Mainframes*** in *SPoD-Specific Limitations and Considerations*.

13 Natural Development Server CICS Adapter

The following topics apply if you want to use the Natural Development Server in a CICS TP monitor environment:

Introducing the Natural Development Server CICS Adapter	Describes the purpose and the functions of the Natural Development Server CICS Adapter.
Installing the NDV CICS Adapter under z/OS (Batch)	How to install the CICS connection for a Natural Development Server running under z/OS in batch mode.
Configuring the Natural Development Server CICS Adapter	How to configure the CICS connection for a Natural Development Server running on z/OS in batch mode.
NDV CICS Adapter Frequently Asked Questions	Contains frequently asked questions concerning the Natural Development Server CICS Adapter.

See also ***SPoD-Specific Limitations and Considerations*** for information on CICS-related topics.

14 Introducing the Natural Development Server CICS Adapter

This chapter describes the purpose and the functions of the Natural Development Server (NDV) CICS Adapter.

Purpose of the Natural Development Server CICS Adapter

The Natural Development Server CICS Adapter is designed for a Natural Single Point of Development context where it enables the use of a Natural Development Server (product code NDV), running under z/OS in batch mode within a CICS TP monitor environment.

See also:

- Natural Single Point of Development
- Natural Development Server for z/OS

Remote Development Functions

The Natural Development Server CICS Adapter enables you to execute a Natural Single Point of Development session within CICS.

In the **Tools** menu, Natural Studio offers you a command named **Map Environment**. This command enables you to open a Natural session on a remote development server.

If you configure the remote development server for use in conjunction with the Natural Development Server CICS Adapter, this Natural session is not hosted by the remote development server, but it is dispatched remotely within a specified CICS region.

CICS Support

The CICS support is not implemented within the front-end stub `NATRDEVS`. For dispatching the Natural sessions in CICS, the development server continues to run in batch mode or under SMARTS. But it uses the remote front-end `NATCSRFE` that is delivered with the Natural Development Server to dispatch the Natural sessions in CICS. That is, depending on the installed front-end, a development server dispatches the sessions locally (NATMVS for batch mode) or remotely (`NATCSRFE` for CICS).

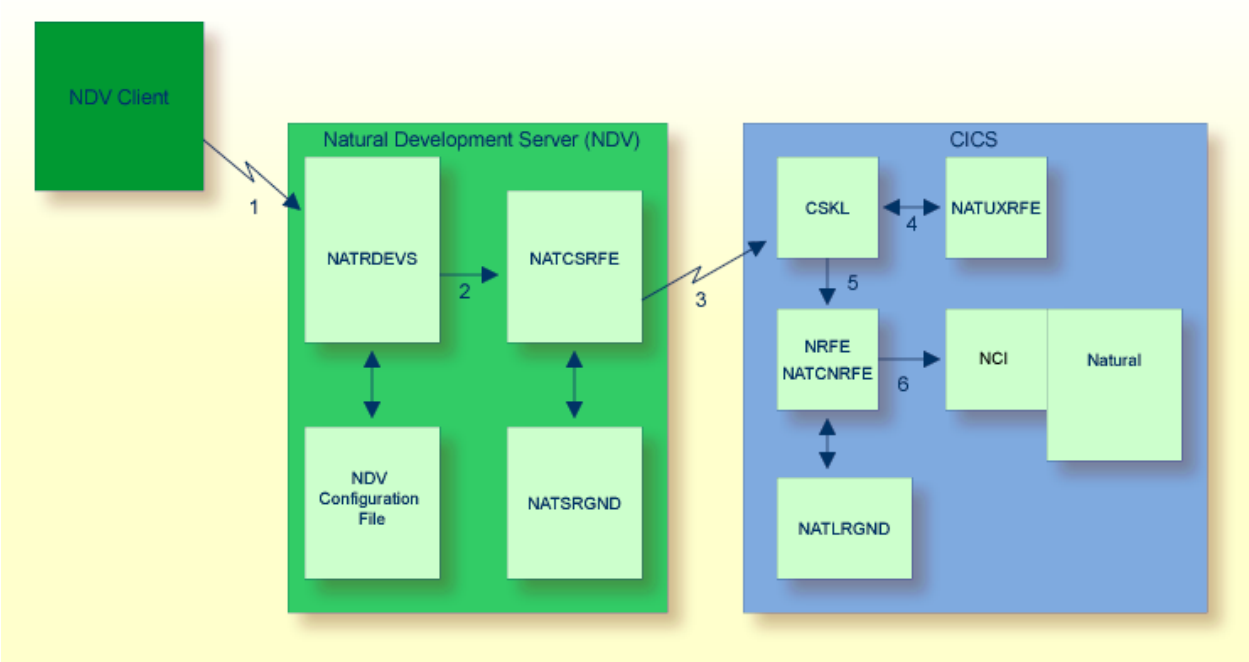
`NATCSRFE` in turn accepts the Natural request from `NATRDEVS` and transfers it to a configured CICS environment using the CICS Socket Interface. Within the CICS environment, a CICS Natural transaction is launched that processes the Natural request and returns the result. Thus it is not necessary to execute the entire development server under CICS. Only small working units (Natural requests such as "save source" or "get library list") are transferred to CICS for execution.

The Natural Development Server CICS Adapter comprises the following components:

NATCSRFE	The remote front-end called by the Natural Development Server to dispatch a Natural request. It is loaded into the development server address space.
NATCNRFE	The counterpart of NATCSRFE. NATCNRFE runs in the CICS address space. It is started by the IBM-provided standard listener of the CICS Socket Interface (refer also to *TCP/IP V3R1 for MVS: CICS TCP/IP Socket Interface Guide* and *TCP/IP for z/VSE V1R5 IBM Program Setup and Supplementary Information*).
NATSRGND/NATLRGND	Transmits the NDV-relevant data between Natural Development Server and the Natural session running in CICS. NATSRGND must be loaded into the Natural Development Server address space and NATLRGND into the CICS address space.
NATUXRFE	This user exit obtains the client credentials from the Natural Development Server and authenticates then with a CICS VERIFY PASSWORD request. If the request succeeds, the CICS listener launches the NDV transaction under the client account (impersonation).

Product Interaction

The following figure illustrates the interaction between Natural Studio as a remote development client, the Natural Development Server and the CICS environment involved.



1. Natural Studio sends the remote development request to the Natural Development Server using the port number specified with the Natural Development Server configuration variable PORT_NUMBER.
2. The Natural Development Server dispatches the Natural session using the Natural front-end you have specified with the Natural Development Server configuration variable FRONTEND_NAME. Specify NATCSRFE in order to use the Natural Development Server CICS Adapter.
3. NATCSRFE transmits the request to the host/port specified with the Natural Development Server configuration variable RFE_CICS_TA_HOST / RFE_CICS_TA_PORT. You must configure the CICS-supplied standard listener CSKL to listen at this port.
4. If the Natural Development Server is configured to perform remote impersonation (SECURITY_MODE=IMPERSONATE/IMPERSONATE_REMOTE), NATUXRFE is called to authenticate the client. If the authentication succeeds, CSKL launches the CICS transaction NRFE under the account of the client (impersonated).
5. CSKL launches the CICS transaction you have specified with the Natural Development Server configuration parameter RFE_CICS_TA_NAME (NRFE in this example). This transaction must be defined to use the program NATCNRFE.
6. NATCNRFE finally dispatches the Natural session using the Natural CICS front-end you have specified with the Natural Development Server configuration parameter RFE_CICS_FE_NAME.
7. The Natural Development Server will use Internet Protocol IPv6 if available. If an IPv6 connection to the CICS adapter is not possible, IPv4 will be used.

15 Installing the Natural Development Server CICS Adapter under z/OS (Batch)

This chapter describes how to install the CICS connection for a Natural Development Server (NDV) running under z/OS in batch mode.

Prerequisites

For details, refer to the section *Prerequisites*.

Installation Procedure

To install the Natural Development Server CICS Adapter, perform the following steps:

Step 1: Customize CICS

(Job I005, Steps 8405, 8406, 8410, 8411)

The Natural Development Server load library must be defined in the CICS `DFHRPL` concatenation.

The CICS TCP/IP environment can be customized using the configuration macro `EZACICD` in the `EZACONFG` configuration data set or the configuration transaction `EZAC`. This section describes the usage of the transaction `EZAC`.

Customize the standard listener `CSKL` of the CICS socket interface using the CICS transaction `EZAC,ALTER,LISTENER` and, on the second screen, define `NATUXRFE` in the `SECEXIT`.

For impersonation with pass phrases an enhanced listener is required. Customize an existing enhanced listener or define a new one using the CICS transaction `EZAC,DEFINE,LISTENER` with `TRANID CSEL` (or another name of your choice) and `FORMAT ENHANCED`. Customize this enhanced listener by altering the settings on the second screen as follows:

```
CSTRANid     ===> NRFE
CSSTTYPe     ===> KC
CSDELAY      ===> 000000
MSGLENgth    ===> 000
PEEKDATa     ===> NO
MSGFORMat    ===> EBCDIC
USEREXIT     ===> NATUXRFE
GETTID       ===> NO
USERID       ===>
```

The definition of `SECEXIT=NATUXRFE` is mandatory when an enhanced listener is used or when the Natural Development Server is started with impersonation (parameter `SECURITY_MODE`).

Start the listener using the CICS transaction `EZAO`.

To use the IPv6 internet protocol, additionally set AF=INET6.

The following CICS resource definitions are required:

1. Define the CICS transaction for the remote front-end. This transaction name is an arbitrary name which must be defined in the NDV configuration parameter RFE_CICS_TA_NAME. This document uses the transaction name NRFE.

```
DEFINE TRANSACTION(NRFE) GROUP(ndvgroup)
PROGRAM(NATCNRFE)
TWASIZE(128)
RESTART(NO)
TASKDATAKEY(USER)
TASKDATALOC(ANY)
```

2. Define the programs NATCNRFE, NATLRGWO and NATUXRFE:

```
DEFINE PROGRAM(NATCNRFE) GROUP(ndvgroup)
LANGUAGE(C) DATALOCATION(ANY) EXECKEY(USER)
```

```
DEFINE PROGRAM(NATLRGWO) GROUP(ndvgroup)
LANGUAGE(C) DATALOCATION(ANY) EXECKEY(USER)
```

```
DEFINE PROGRAM(NATUXRFE) GROUP(ndvgroup)
LANGUAGE(LE370) DATALOCATION(ANY) EXECKEY(CICS)
```

NATUXRFE must be defined with EXECKEY(CICS) because the transaction CSKL is defined with TASKDATAKEY(CICS) and the program NATUXRFE is part of the calling chain initiated by CSKL. This also applies if another transaction defined with TASKDATAKEY(CICS) is used to invoke NATUXRFE.

In addition, when using the CICS open transaction environment (OTE), set the following parameters for NATCNRFE and NATUXRFE:

```
API(OPENAPI)
CONCURRENCY(REQUIRED)
```

This is required, for example, if the parameter OTE=YES is set for the configuration macro EZACICD with TYPE=CICS for the CICS region, or if the parameter is set with the transaction EZAC,ALTER,CICS.

The values of API, CONCURRENCY and EXECKEY for NATCNRFE must be the same as for the environment-dependent nucleus of Natural because Natural is called by NATCNRFE using standard linkage conventions (direct branch using a BASR instruction) instead of an EXEC CICS LINK command.

You need not adapt the program definition of NATLRGWO for the CICS OTE.

3. For DB2 access, a DB2 plan name must be defined. If you have not specified a DB2 plan name for pool threads in the DB2CONN resource definition, the transaction specified in RFE_CICS_TA_NAME and its associated DB2 plan name must be defined to CICS with a DB2TRAN and/or DB2ENTRY resource definition.

   Note: The dynamic plan selection provided by the Natural for DB2 interface must not be used.

4. For DB2 access, the authorization ID under which the NDV CICS transaction is accessing DB2 must have the necessary privileges for DB2 access. The authorization ID to be used is specified in the DB2ENTRY resource definition. If you choose the USERID option, the user ID of the CICS system will be used because the NDV CICS transactions are running under the user ID of the CICS system.

The sample JCL containing the following member defines all necessary CICS entries:

- NDVCONFC

Step 2: Create member for CICS server

- Job I009, Step 8411, create member NDVCONFC for CICS server

Step 3: Link the object modules into the NDV load library

(Job I054, Step 8420)

The NDV object modules must be linked with the necessary runtime extensions of your CICS installations into executable load modules.

Notes:

1. The module NATCNRFE applies to two different products, the Natural Development Server and the Natural Web I/O Interface Server (NWO). So if you have already installed NWO, the module NATCNRFE might already be there. However, it does not matter if you reinstall NATCNRFE with the Natural Development Server because the resulting module from either installation is the same.
2. The module NATCSRFE (referenced in the configuration via FRONTEND_NAME=NATCSRFE) has already been linked in the prior steps of batch installation.

See sample job NDVI054 on dataset NDV*vrs*.JOBS.

Step 4: Create startup procedure

Job I200, Step 8416, create startup procedure for CICS server

Step 5: Customize the Development Server

In order to dispatch the NDV Natural sessions in CICS, you must adapt the configuration file of your development server running under z/OS in batch mode. For this purpose, two sample JCL members (NDV `IOO9C` and NDV `CONFC`) are available.

Refer to *Configuring the Natural Development Server CICS Adapter* and to *Configuring the Natural Development Server*.

16 Configuring the Natural Development Server CICS Adapter

This chapter describes how to configure the CICS connection for a Natural Development Server (product code NDV) running on z/OS or under SMARTS on z/VSE.

Configuration File

After the installation of the NDV CICS Adapter is complete, the configuration of the NDV CICS Adapter has to be done in the Natural Development Server configuration file of the corresponding Natural Development Server.

To enable the CICS Adapter, specify the remote front-end module in the NDV configuration parameter `FRONTEND_NAME` (`FRONTEND_NAME=NATCSRFE`).

Configuration Parameters

The following CICS-relevant configuration parameters exist:

- RFE_CICS_TA_NAME
- RFE_CICS_FE_NAME
- RFE_CICS_TA_HOST
- RFE_CICS_TA_PORT
- RFE_CICS_TA_INIT_TOUT
- RFE_CICS_KEEP_TA
- RFE_CICS_TRACE

RFE_CICS_TA_NAME

This configuration parameter specifies the CICS transaction to be used for starting the remote front-end in CICS. This transaction must be defined in CICS and must refer to the program `NATCNRFE`. See also ***Installing the NDV CICS Adapter under z/OS***.

Note: At logon, this transaction name can be overridden by the user in order to switch to a different CICS transaction on a mainframe. See *Dynamically Changing the CICS Transaction Name when Starting a Session* in the section *Accessing a Remote Development Environment* in the *NaturalONE* documentation.

Default Value	none
Example	`RFE_CICS_TA_NAME=NRFE`

RFE_CICS_FE_NAME

This configuration parameter specifies the Natural CICS nucleus you have installed with the applicable Natural for Mainframes installation under CICS. This program must be defined in CICS. For further information, see Empower at ***https://empower.softwareag.com/***.

Default Value	none
Example	`RFE_CICS_FE_NAME=NCI`*`vr`*`NUC`

See also the Natural *Installation for Mainframes* documentation, *Installing the Natural CICS Interface*, *Customize CICS*.

RFE_CICS_TA_HOST

This configuration parameter specifies the TCP/IP address of the host the desired CICS is running. This parameter can be omitted if the development server and CICS are running on the same TCP/IP node.

Default Value	The host address of the development server.

Example	`RFE_CICS_TA_HOST=node1`
	
	or
	
	`RFE_CICS_TA_HOST=157.189.160.55`

RFE_CICS_TA_PORT

This configuration parameter specifies the TCP/IP port of the CICS supplied listener.

You can acquire this port number using the CICS supplied transaction `EZAC`. The CICS command `EZAC DISPLAY LISTENER` shows the definitions of the CICS standard listener.

Note: This port number is not used in Natural Studio to map to a remote development server. This port number (and the `RFE_CICS_TA_HOST` definition) is used internally by the development server to communicate with the CICS region.

Possible Values	1 - 65535
Default Value	none
Example	RFE_CICS_TA_PORT=3010

RFE_CICS_TA_INIT_TOUT

If Natural Studio sends a request to a Natural Development Server that is configured to use the CICS remote front-end, the remote front-end launches a CICS transaction (NRFE) for processing the request. The CICS transaction in turn listens to the TCP/IP to receive the data from the development server required for processing the request.

This configuration parameter specifies the timeout value (in seconds) a launched transaction waits until the expected request data arrive from the development server. If this timeout expires, the request aborts with a NAT9940 error.

Default Value	5
Example	RFE_CICS_TA_INIT_TOUT=20

Note: Do not define a value below 5.

RFE_CICS_KEEP_TA

For each request sent by Natural Studio, the Natural Development Server opens a TCP/IP connection to the CICS region and launches a CICS transaction (NRFE) for processing the request. With RFE_CICS_KEEP_TA=YES, the CICS transaction remains active for processing further requests of the same client. This saves the overhead for creating the TCP/IP connection and transaction initialization for successive requests, but consumes more resources within the CICS region due to waiting transactions.

The transaction wait time (for successive requests) is limited by RFE_CICS_TA_INIT_TOUT. That is, if the time slice between two successive requests exceeds the time specified by RFE_CICS_TA_INIT_TOUT, the CICS transaction and the TCP/IP connection is terminated independent of the RFE_CICS_KEEP_TA definition.

RFE_CICS_TA_INIT_TOUT=5 is a reasonable value to reuse transactions for multiple requests initiated by a single action in Natural Studio and to save CICS resources if Natural Studio waits for the next action of the user.

Default Value	None
Example	RFE_CICS_KEEP_TA=YES

RFE_CICS_TRACE

This configuration parameter specifies the trace level for the remote front-end.

The trace level is similar to the trace implemented for the development server. It is a bit string where each bit is responsible for a certain trace information:

Bit 31	Trace main events (transaction initialization/termination, request processing).
Bit 30	Detailed functions.
Bit 29	Dump internal storage areas.
Bit 27	Dump buffer header exchanged between development server and CICS.
Bit 26	Dump entire buffer exchanged between development server and CICS.
Bit 25	Dump the Natural Development Server relevant buffer only (remote gateway buffer).
Bit 23	Trace error situations only.
Bit 07	Activate trace in the development server region.
Bit 06	Activate trace in the CICS region.
Bit 00	Reserved for trace-level extension.

The trace destination is the data set defined for STDOUT.

Default Value	0
Example	RFE_CICS_TRACE=31+27+7 Dump main events and buffer header in the CICS region (Bits 31 + 27 + 7).

The following is a sample development server configuration file using the Natural Development Server CICS Adapter:

```
   # the development server parameter
SESSION_PARAMETER=PROFILE=(NDV,10,930)
FRONTEND_NAME=NATCSRFE         # use the CICS Adapter front-end
PORT_NUMBER=4711               # the port number used by Natural Studio

   # the CICS Adapter parameter
RFE_CICS_TA_NAME=NRFE          # the CICS transaction for remote front-end
RFE_CICS_TA_PORT=3010          # the port of the CICS listener
                               # no RFE_CICS_TA_HOST is defined. This requires
                               # that CICS runs on the same node as the
                               # development server.
RFE_CICS_FE_NAME=NCI41NUC      # the name of the installed Natural CICS nucleus
RFE_CICS_TA_INIT_TOUT=20       # transaction timeout is 20 seconds
```

Note: The development server parameters THREAD_NUMBER and THREAD_SIZE are obsolete when the NDV CICS Adapter is used.

NDV CICS Adapter User Exits

User Exit NRFEUX01

Many customer environments have 3-GL front-ends in their Natural for CICS installation which get control before Natural for CICS gets active in order to prepare the CICS environment for Natural for CICS.

With the NDV CICS Adapter, such a 3-GL front-end is not called.

A user-exit NRFEUX01 is called by the NDV CICS Adapter before Natural for CICS is invoked. Any functionality necessary to prepare the CICS environment for Natural for CICS can be implemented in that exit.

The exit is called before session initialization, before roll-in, after roll-out and after session termination. Special attention must be payed if the exit maintains any resources related to the task number. Under the Natural Development Server, the CICS task number can change during the lifetime of a Natural session. These resources must be saved at roll-out indexed by the session ID. At roll-in these resources must be obtained using the session ID and reallocated under the current task number. The session ID is a unique identifier of a Natural session. This identifier is passed to the exit.

The user exit NRFEUX01 is called by NATCNRFE with EXEC CICS LINK. The exit must return with EXEC CICS RETURN. This exit has the following COMAREA layout:

Name	Format	In/Out	Description
Eye	CL8	I	Eyecatcher NATRFE01. The exit should abort if the first six bytes of the eyecatcher do not match. The 01 suffix may increase if the area is expanded at the end. So the exit should accept any number between 01 and 99.
SID	XL8	I	Unique session identifier. A Natural session under Natural Development Server does not necessarily run under one task. The task number may change at each roll-out/roll-in sequence. The only unique identifier of a session is the SID.
EVNT	XL1	I	Current event. Session start (x'00'), end (x'01'), roll-in (x'02'), roll-out (x'03').

Name	Format	In/Out	Description
	XL3		Unused.
RC	F	O	The return code of the exit (not equal to 0 means session abort).
ETXTL	F	O	Length of the following error text. A maximum of 80 characters is transmitted to the client. Any longer text is truncated.
ETXT	A	O	Error text to be returned to the client. This area is allocated by the exit and released by NATCNRFE.
SPRML	F	I/O	Length of following session parameter.
SPRM	A	I/O	Session parameter can be modified by the exit. If the length is not appropriate, the exit can release the memory space pointed by SPRM and allocate a larger space.
UID	CL8	I	The user ID of the NDV client.

To install the user exit, implement the program NRFEUX01 and define it to CICS.

Sample User Exit:

```
* ================================================================
* NDV CICS Adapter sample user exit NRFEUX01
* At each invocation this sample writes a line to the CICS log.
* If the user-ID is KSP1, it appends the session parameter with the
* string SPRMFORKSP1.
* If the user-ID is KSP2, it aborts the session with an error message.          ↩

* ================================================================
NRFEUX01 DFHEIENT CODEREG=(11),DATAREG=(13),EIBREG=(12)
NRFEUX01 AMODE 31
NRFEUX01 RMODE ANY
         EXEC CICS GETMAIN SET(10) FLENGTH(WK#L)
         CLC   EIBRESP,DFHRESP(NORMAL)
         BNE   RFEM0101                bif error, issue message
         USING WORK,RA
         EXEC CICS ADDRESS COMMAREA(9)
         C     R9,=XL4'FF000000'
         BE    RFEM0102                bif no commarea, issue message
*        ---------------------------------------------------------
*        Validate input parameter
*        ---------------------------------------------------------
         USING COMA,R9
         CLC   CA#EYE,=C'NATRFE'
         BNE   RFEM0103                bif unknown area, issue message
         CLI   CA#EYEV,C'0'
         BL    RFEM0103                bif unknown area, issue message
         CLI   CA#EYEV,C'9'
         BH    RFEM0103                bif unknown area, issue message
         CLI   CA#EYEV+1,C'0'
```

```
         BL    RFEM0103                 bif unknown area, issue message
         CLI   CA#EYEV+1,C'9'
         BH    RFEM0103                 bif unknown area, issue message
         SLR   RF,RF
         ST    RF,CA#RC                 set good return code
*        ---------------------------------------------------------
*        Perform action depending the given event
*        ---------------------------------------------------------
         SLR   R1,R1
         ICM   R1,B'0001',CA#EVENT
         SLL   R1,2                     *4
         C     R1,MAXEVENT
         BH    RFEM0104                 unknown event, issue message
         B     RFEX0020(R1)
RFEX0020 DS    0H
         B     RFEX0100                 Session start
         B     RFEX0200                 Session end
         B     RFEX0300                 Session rollin
         B     RFEX0400                 Session rollout
MAXEVENT DC    A(*-4-RFEX0020)

RFEX0100 DS    0H
*        ---------------------------------------------------------
*        Session start. Allocate resources for that user/SID
*        ---------------------------------------------------------
         CLC   CA#USID,=CL8'KSP1'
         BNE   RFEX0150
*        ---------------------------------------------------------
*        Append given session parameter with TSTPRMS
*        ---------------------------------------------------------
         LA    R1,L'TSTPRMS             my param len
         A     R1,CA#PARML              + existing param len
         LA    R1,1(,R1)                + one delimiter blank
         ST    R1,WK#PARML
         EXEC CICS GETMAIN SET(4) FLENGTH(WK#PARML)
         ST    R4,WK#PARM
         ICM   R1,B'1111',CA#PARML
         BZ    RFEX0105                 bif no existing parms
         L     R0,WK#PARM
         L     R2,CA#PARM
         LR    R3,R1
         MVCL  R0,R2                    move existing params
         LR    R4,R0
         MVI   0(R4),C' '               delimit with one blank
         LA    R4,1(,R4)
RFEX0105 DS    0H
         MVC   0(L'TSTPRMS,R4),TSTPRMS  append with TSTPRMS

         ICM   R2,B'1111',CA#PARM
         BZ    RFEX0110                 bif no memory allocated
         EXEC CICS FREEMAIN DATAPOINTER(2)
RFEX0110 DS    0H
```

```
         MVC   CA#PARM,WK#PARM          return new memory
         MVC   CA#PARML,WK#PARML        return new length
RFEX0150 DS    0H
         CLC   CA#USID,=CL8'KSP2'
         BNE   RFEX0180
*        ---------------------------------------------------------------
*        Abort this session
*        ---------------------------------------------------------------
         LA    R1,L'ATXT
         ST    R1,WK#PARML
         EXEC CICS GETMAIN SET(1) FLENGTH(WK#PARML)
         ST    R1,WK#PARM
         MVC   0(L'ATXT,R1),ATXT
         LA    R1,4
         ST    R1,CA#RC
RFEX0180 DS    0H
         B     RFEX1000

RFEX0200 DS    0H
*        ---------------------------------------------------------------
*        Session end. Deallocate resources for that user/SID
*        ---------------------------------------------------------------
         B     RFEX1000

RFEX0300 DS    0H
*        ---------------------------------------------------------------
*        Session rollin. Obtain resources by SID and index by task,
*                        Task has possibly changed.
*        ---------------------------------------------------------------
         B     RFEX1000
RFEX0400 DS    0H
*        ---------------------------------------------------------------
*        Session rollout. Index resources by SID, task may change.
*        ---------------------------------------------------------------
         B     RFEX1000

RFEX1000 DS    0H
         MVI   WK#TEXT1,C' '
         MVC   WK#TEXT1+1(L'WK#TEXT1-1),WK#TEXT1

         LA    R1,WK#TEXT1
         MVC   0(8,R1),=C'RFEUX01 '
         LA    R1,8(,R1)

         MVC   0(L'CA#SID,R1),CA#SID
         LA    R1,L'CA#SID(,R1)
         MVI   0(R1),C' '
         LA    R1,1(,R1)

         MVC   0(L'CA#USID,R1),CA#USID
         LA    R1,L'CA#USID(,R1)
         MVI   0(R1),C' '
```

```
         LA    R1,1(,R1)

         SLR   R2,R2
         ICM   R2,B'0001',CA#EVENT
         SLL   R2,3                    *8
         LA    R2,EVNT(R2)
         MVC   0(L'EVNT,R1),0(R2)


         EXEC CICS WRITEQ TD QUEUE(=C'CSSL') FROM(WK#TEXT1),           +
                                             LENGTH(L'WK#TEXT1)
         B     RFEX9000


TST      DC    C'NREFUX01 Was active'

*        ---------------------------------------------------------------
*        Home section
*        ---------------------------------------------------------------
RFEX9000 DS    0H
         LTR   RA,RA
         BZ    RFEX9010                bif no work area aquired
         EXEC CICS FREEMAIN DATAPOINTER(10)
RFEX9010 DS    0H
         EXEC CICS RETURN

RFEM0101 DS    0H
         EXEC CICS WRITEQ TD QUEUE(=C'CSSL') FROM(MSG1) LENGTH(L'MSG1)
         B     RFEM9000
RFEM0102 DS    0H
         EXEC CICS WRITEQ TD QUEUE(=C'CSSL') FROM(MSG2) LENGTH(L'MSG2)
         B     RFEM9000
RFEM0103 DS    0H
         EXEC CICS WRITEQ TD QUEUE(=C'CSSL') FROM(MSG3) LENGTH(L'MSG3)
         B     RFEM9000
RFEM0104 DS    0H
         EXEC CICS WRITEQ TD QUEUE(=C'CSSL') FROM(MSG4) LENGTH(L'MSG4)
         B     RFEM9000
RFEM9000 DS    0H
         B     RFEX9000

* ================================================================
* Constants
* ================================================================
MSG1     DC    C'RFEUX01 Getmain failed'
MSG2     DC    C'RFEUX01 Cannot address commarea'
MSG3     DC    C'RFEUX01 COMMAREA layout not supported'
MSG4     DC    C'RFEUX01 COMMAREA event not supported'
EVNT     DS    0CL8
         DC    CL8'START'
         DC    CL8'FIN'
         DC    CL8'ROLLIN'
```

```
         DC    CL8'ROLLOUT'
TSTPRMS  DC    C'SPRMFORKSP1'
ATXT     DC    C'KSP2 aborted by my exit'
         LTORG

* ======================================================================
* DSECTs
* ======================================================================
COMA     DSECT
CA#EYE   DS    CL6                     'NATRFE'
CA#EYEV  DS    CL2                     > x'F0F1'
CA#SID   DS    CL8                     the unique session identifier
CA#EVENT DS    XL1                     the session event
EV_START EQU   0                       Session start
EV_END   EQU   1                       Session end
EV_ROLIN EQU   2                       Session rollin
EV_ROLOU EQU   3                       Session rollout
         DS    XL3
CA#RC    DS    F                       Exit return code
CA#ETXTL DS    F                       Error text len
CA#ETXT  DS    A                       Error text
CA#PARML DS    F                       Profile parameter len
CA#PARM  DS    A                       Profile Parameter
CA#USID  DS    CL8                     The Natural user ID
WORK     DSECT
WK#TEXT1 DS    CL80
WK#PARM  DS    F
WK#PARML DS    F
WK#L     EQU   *-WORK
*
R0       EQU   0
R1       EQU   1
R2       EQU   2
R3       EQU   3
R4       EQU   4
R5       EQU   5
R6       EQU   6
R7       EQU   7
R8       EQU   8
R9       EQU   9
RA       EQU   10
RB       EQU   11
RC       EQU   12
RD       EQU   13
RE       EQU   14
RF       EQU   15
         END ↩
```

17 NDV CICS Adapter Frequently Asked Questions

This chapter contains frequently asked questions concerning the Natural Development Server CICS Adapter under z/OS.

Under which CICS user ID does the NDV transaction run within the CICS region?

The NDV transaction (the NDV Natural session) runs under the CICS region userid.

This is the same user ID as your CICS standard listener (`CSKL`) uses.

I receive a NAT9940 (NAT9939) starting my NDV server.

The NAT9940 message in fact should be a NAT9939 message. This will be corrected with Patch Level 01 (NDV212PL01). The NAT9939 message indicates an error in the communication between the NDV server environment and the CICS environment. The general layout of the message is a text describing the error which may be followed by a condition code (CC), if applicable.

The most important NAT9939 errors are listed below. Many errors not listed here are internal errors.

- **ConfigError: ...missing or invalid**
  A mandatory configuration variable for the Natural Development Server CICS Adapter is not defined in the NDV configuration file.
- **Cannot bind Socket**
  The port specified with `RFE_CICS_TA_PORT` is not in a listen state on the node specified with `RFE_CICS_TA_HOST`. Probably the CICS TCP/IP standard listener is configured to use a different port or the listener is not running.
- **Timeout at connection establishment**
  The CICS transaction launched by the NDV server did not respond within the time specified in `RFE_CICS_TA_INIT_TOUT`. Examine CICS message log for potential messages regarding this transaction.
- **Partner closed connection**
  Unexpected abort of the connection by either of the partners (NDV server or CICS transaction). Examine CICS message log and NDV server trace for preceding error messages regarding this request. If you are using TCP/IP V1.5.C under z/VSE, apply TCP/IP fix ZP15C204.
- **Invalid reply on connection establishment.**
  The CICS transaction launched by the NDV server did not initialize correctly. Examine CICS message log for potential messages regarding this transaction. Possible reason: The transaction defined with `RFE_CICS_TA_NAME` is not defined correctly within CICS.

- **Cannot load NDV Remote Gateway DLL**
  The remote gateway DLL `NATSRGND/NATLRGND` cannot be loaded within the NDV server/CICS region. Possible reason: Module cannot be found on load library concatenation or CICS PPT entry missing.
- **Cannot load NCI front-end**
  The Natural CICS front-end specified with `RFE_CICS_FE_NAME` cannot be loaded. Examine CICS message log error messages regarding this program. Possible reason: Module cannot be found on load library concatenation or CICS PPT entry missing.

18 Natural Development Server IMS Adapter

The following topics apply if you want to use the Natural Development Server in an IMS TM environment:

Introducing the Natural Development Server IMS Adapter	Describes the purpose and the functions of the Natural Development Server IMS Adapter.
Installing the NDV IMS Adapter under z/OS (Batch)	How to install the IMS TM connection for a Natural Development Server running under z/OS in batch mode.
Configuring the Natural Development Server IMS Adapter	How to configure the IMS TM connection for a Natural Development Server running on z/OS in batch mode.

19 Introducing the Natural Development Server IMS Adapter

This chapter describes the purpose and the functions of the Natural Development Server IMS Adapter.

Purpose of the Natural Development Server IMS Adapter

The Natural Development Server IMS Adapter is designed for a Natural Single Point of Development context where it enables the use of a Natural Development Server (product code NDV), running under z/OS in batch mode, within an IMS TM environment.

See also:

- Natural Single Point of Development
- Natural Development Server for z/OS

Remote Development Functions

The Natural Development Server IMS Adapter enables you to execute a Natural Single Point of Development session within an IMS TM environment, providing access to resources controlled by IMS TM as DB2 or DL/I databases.

In the **Tools** menu, Natural Studio offers you a command named **Map Environment**. This command enables you to open a Natural session on a remote development server.

If you configure the remote development server for use in conjunction with the Natural Development Server IMS Adapter, this Natural session is not hosted by the remote development server, but it is dispatched remotely within an MPP region using a specified transaction code.

IMS TM Support

The IMS TM support is not implemented within the front-end stub `NATRDEVS`. For dispatching the Natural sessions in IMS TM, the development server continues to run in batch mode. But it uses the remote front-end `NATISRFE` that is delivered with the Natural Development Server to dispatch the Natural sessions in IMS TM. That is, depending on the installed front-end, a development server dispatches the sessions locally (`NATMVS` for batch mode) or remotely (`NATISRFE` for IMS TM).

`NATISRFE` in turn accepts the Natural request from `NATRDEVS` and transfers it to a configured IMS TM environment, using the IMS installation provided BMP Listener. The IMS Listener launches in a dedicated MPP region a non conversational Natural transaction that processes the Natural request and returns the result. Thus it is not necessary to execute the entire development server

under IMS TM. Only small working units (Natural requests such as "save source" or "get library list") are transferred to IMS TM for execution.

The Natural Development Server IMS Adapter comprises the following components:

NATISRFE	The remote front-end called by the Natural Development Server to dispatch a Natural request. It is loaded into the development server address space.
NATINRFE	The counterpart of NATISRFE. NATINRFE runs in an MPP region. It is launched by the IBM-provided IMS Listener (refer also to *z/OS Communications Server IP IMS Socket Guide*).
NATSRGND/NATLRGND	Transmits the NDV-relevant data between Natural Development Server and the Natural session running in IMS TM. NATSRGND must be loaded into the Natural Development Server address space and NATLRGND into the MPP region.

Product Interaction

The following description explains the interaction between Natural Studio as a remote development client, the Natural Development Server and the IMS TM environment involved:

1. Natural Studio sends the remote development request to the Natural Development Server using the port number specified with the Natural Development Server configuration variable PORT_NUMBER.
2. The Natural Development Server dispatches the Natural session using the Natural front-end you have specified with the Natural Development Server configuration variable FRONTEND_NAME. Specify NATISRFE in order to use the Natural Development Server IMS Adapter.
3. NATISRFE transmits the request to the host/port specified with the Natural Development Server configuration variable RFE_IMS_TA_HOST / RFE_IMS_TA_PORT. You must configure the IBM provided BMP Listener to listen at this port.
4. The BMP Listener launches the IMS TM transaction you have specified with the Natural Development Server configuration parameter RFE_IMS_TA_NAME. This transaction must be specified in the configuration of the IMS Listener.
5. The server transaction first retrieves the transaction initialization message. TIM contains the necessary information to do the TAKESOCKET and passes it to NATINRFE. NATINRFE does the TAKESOCKET and establishes the TCP/IP conversation with NATISRFE.
6. NATINRFE finally dispatches the Natural IMS front-end, which establishes a Natural server session.

20 Installing the Natural Development Server IMS Adapter

This chapter describes how to install the IMS TM connection for a Natural Development Server (abbreviated: “NDV Server”) running under z/OS in batch mode.

Notation *vrs* or *vr*:

When used in this document, the notation *vrs* or *vr* represents the relevant product version (see also *Version* in the *Glossary* of the Natural documentation).

Prerequisites

For details, refer to the section ***Prerequisites***.

Example Jobs

The example installation jobs are contained in the data set `NDV`*vrs*`.JOBS` and are prefixed with the product code. The data set is provided on the installation medium for the Natural Development Server.

Installation Procedure

Perform the following steps:

Step 1: Customize the IMS Listener

See *z/OS Communications Server IP IMS Socket Guide* for the description of

- how to set up and operate the IMS Listener,
- how to use the IMS TCP/IP control statements.

Note: The port number of the IMS Listener is to be used later on in the NDV configuration parameter `RFE_IMS_TA_PORT`.

Step 2: Install the Server Transaction

It is assumed that the Natural IMS TM Interface is already installed. Thus, this step describes the additional steps which are necessary to create the Natural Development environment.

Step 2.1: Adapt the Transaction Code Table

(Job I055, Steps 2555, 2556)

- In `NIITRTAB`, add the following entry:

```
        NIMTRNTG TRANCODE=NATvrsAD,TYPE=SFE,                          X
              NIIPENT=ENVNDV00,                                       X
              PSBNAME=NIIvrsAD
```

- Assemble and link the transaction code table.

Step 2.2: Adapt the NIIPARM Parameter Module

(Job I055, Steps 2580, 2581)

- In the Natural IMS TM Interface parameter module `NIIPARM`, add a new entry:

```
        NIMPARM ENTRYNM=ENVNDV00,                                     X
              THBELOW=NO,                                             X
              THSIZE=1536000     (1500K)
```

- Assemble and link the parameter module.

Step 2.3: Relink the Natural IMS TM Interface Module

(Job I055, Step 2582)

Relink the Natural IMS TM interface module `NIIvrsIF`.

Step 2.4: Build the Server Interface

(Job I070, Steps 2586, 2587)

- Create the source `NIISFE`, which contains a call to macro `NIMDRIV`:

```
NIMDRIV                                                          X        ↩

      TYPE=SFE,                The NDV server front-end        X
      NIINAME=NIIvrsIF         THE NII INTERFACE MODULE
END
```

- Assemble and link the server interface.

Step 2.5: Natural IMS TM Parameter Module

(Job I080, Steps 2500, 2510)

- Build the Natural IMS TM parameter module.
- Assemble and link the Natural IMS TM parameter module.

Step 2.6: Link the Server Front-End

(Job I080, Step 2586)

Link the server front-end.

Ensure that the name of the server front-end matches the value specified with the `PSBNAME` parameter for the `NIMTRNTG` macro in installation step 2.1 above.

Step 3: Customize IMS TM

- Define the PSB for the server transaction.

  As a minimum requirement you need a TP PCB. In order to access DL/I databases from the server transactions, the specific DB PCBs have to be added.

  Define the application of the server transaction in the stage1 input. The transaction is a single mode, single segment non-conversational transaction.

  Example:

```
APPLCTN PSB=NIIvrsAD,PGMTYPE=TP,SCHDTYP=PARALLEL
  TRANSACT CODE=NATvrsAD,MODE=SNGL,                              X
      MSGTYPE=(SNGLSEG,NONRESPONSE,4)    ↩
```

- Adapt the MPP region.

  In the JCL of the MPP region, add the `SYSTPCD` DD statement.

  See *z/OS Communications Server IP IMS Socket Guide* for the description on how to configure TCPIP.DATA.

- Concatenate the dataset containing the NDV load library to the `STEPLIB` DD statement.

Before starting the Natural Development Server IMS Adapter installation, set the SMA parameter `NDV-SRV-IMS` to `Y` (yes).

To install the Natural Development Server IMS Adapter, perform the following steps:

Step 4: Create Member for NDV Server

(Job I009, Step 8412)

- Create member `NDVCONFI` for the NDV server.

Step 5: Link the Object Modules into the NDV Load Library

(Job I054, Step 8440)

Notes:

1. The module `NATINRFE` applies to two different products: the Natural Development Server (NDV) and the Natural Web I/O Interface Server (NWO). So if you have already installed NWO, the module `NATINRFE` might already be there. However, it does not matter if you reinstall `NATINRFE` with NDV because the resulting module from either installation is the same.
2. The module `NATISRFE` (referenced in the configuration via `FRONTEND_NAME=NATISRFE`) has already been linked in the prior steps of batch installation.

Step 6: Create Startup Procedure

(Job I200, Step 8417)

- Create the startup procedure for the NDV server.

Step 7: Customize the Development Server

In order to dispatch the NDV Natural sessions in IMS, you must adapt the configuration file of your development server running under z/OS in batch mode. For this purpose, two sample JCL members (NDV `I009I` and NDV `CONFI`) are available.

Refer to *Configuring the Natural Development Server IMS Adapter* and to *Configuring the Natural Development Server*.

21 Configuring the Natural Development Server IMS Adapter

This chapter describes how to configure the IMS connection for a Natural Development Server running on z/OS.

Configuration File

After the installation of the Natural Development Server IMS Adapter is complete, the configuration of the Natural Development Server IMS Adapter has to be done in the Natural Development Server configuration file of the corresponding Natural Development Server.

To enable the Natural Development Server IMS Adapter, specify the remote front-end module in the NDV configuration parameter `FRONTEND_NAME`:

```
FRONTEND_NAME=NATISRFE.
```

Configuration Parameters

The following IMS-relevant configuration parameters exist:

- RFE_IMS_TA_NAME
- RFE_IMS_TA_HOST
- RFE_IMS_TA_PORT
- RFE_IMS_TRACE

RFE_IMS_TA_NAME

This configuration parameter specifies the IMS transaction to be used for starting the remote front-end in IMS TM. This transaction must be defined in IMS TM and must refer to the program `NATINRFE`. See also *Customizing the IMS TM Environment* in *Installing the NDV IMS Adapter* in the *Installation for z/OS* documentation.

Default Value	none
Example	`RFE_IMS_TA_NAME=NAT`*`vrs`*`AD`

RFE_IMS_TA_HOST

This configuration parameter specifies the TCP/IP address of the host the desired IMS TM is running. This parameter can be omitted if the development server and IMS TM are running on the same TCP/IP node.

Default Value	The host address of the development server.

Example	`RFE_IMS_TA_HOST=node1`
	
	or
	
	`RFE_IMS_TA_HOST=157.189.160.55`

RFE_IMS_TA_PORT

This configuration parameter specifies the TCP/IP port of the IMS supplied listener.

Note: This port number is not used in Natural Studio or NaturalONE to map to a remote development server. This port number (and the `RFE_IMS_TA_HOST` definition) is used internally by the development server to communicate with the IMS region.

Possible Values	`1 - 65535`
Default Value	none
Example	`RFE_IMS_TA_PORT=3020`

RFE_IMS_TRACE

This configuration parameter specifies the trace level for the remote front-end.

The trace level is similar to the trace implemented for the development server. It is a bit string, where each bit is responsible for a certain trace information:

Bit 31	Trace main events (transaction initialization/termination, request processing).
Bit 30	Detailed functions.
Bit 29	Dump internal storage areas.
Bit 27	Dump buffer header exchanged between development server and IMS TM.
Bit 26	Dump entire buffer exchanged between development server and IMS.
Bit 25	Dump the Natural Development Server relevant buffer only (remote gateway buffer).
Bit 23	Trace error situations only.
Bit 07	Activate trace in the development server region.
Bit 06	Activate trace in the IMS MPP region.
Bit 00	Reserved for trace-level extension.

The trace destination is the data set defined for STDOUT.

Default Value	0
Example	RFE_IMS_TRACE=31+27+7 Dump main events and buffer header in the IMS MPP region (Bits 31 + 27 + 7).

The following is a sample development server configuration file using the Natural Development Server IMS Adapter:

```
   # The development server parameter
SESSION_PARAMETER=PROFILE=(NDV,10,930)
FRONTEND_NAME=NATISRFE         # Use the IMS Adapter front-end.
PORT_NUMBER=4711               # The port number used by Natural Studio.

   # The IMS Adapter parameter
RFE_IMS_TA_NAME=NATvrsAD       # The IMS transaction for remote front-end.
RFE_IMS_TA_PORT=3020           # The port of the IMS listener.
                               # No RFE_IMS_TA_HOST is defined. This requires
                               # that IMS runs on the same node as the
                               # development server. ↩
```

Note: The development server parameters THREAD_NUMBER and THREAD_SIZE are obsolete when the Natural Development Server IMS Adapter is used.