IBM

IBM Application Delivery Foundation for z Systems Common Components

Customization Guide and User Guide

Version 1.11.0

Note

Before you read this document, look at the general information under Notices on page cxxxiii.

Edition notice

This edition (published October 2026) applies to Version 1 Release 11 Level 0 of IBM® Application Delivery Foundation for z/OS® Common Components (program number 5655-IPV), and to Version 17 Release 1 Modification Level 0 of IBM® File Manager for z/OS® (program number 5755-AD3), IBM® Fault Analyzer for z/OS® (program number 5755-AD2), z/OS® Debugger (program number 5724-T07), IBM® Application Performance Analyzer for z/OS® (program number 5755-A04), and to all subsequent releases and modifications until otherwise indicated in new editions.

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Preface

This document provides information about IBM® Application Delivery Foundation for z/OS® Common Components.

It is intended for people who are responsible for installing, configuring, and using ADFz Common Components. You should have a working knowledge of:

- z/OS® operating system
- system programming
- configuration of servers

In these topics, ADFz Common Components is also referred to as ADFzCC.

Summary of changes

This edition of the document provides information applicable to IBM Application Delivery Foundation for z/OS® Common Components Version 1 Release 11. Changes to the latest release are indicated by a "|" change bar in the left margin of the page in the PDF format of the documentation.

Latest service: For details of the APARs that have been addressed in this release, see Latest PTFs for ADFz Common Components.

New features and enhancements in V1.11.0, October 2026

This version of the documentation contains minor clarifications and corrections, as well as the following new support:

- Added host-side support for JSON Web Token (JWT) authentication in the ADFzCC server . See topic Using JWT authentication on page 17.

New features and enhancements in V1.10.0, June 2026

This version of the documentation contains minor clarifications and corrections, as well as the following new support:

- Added a new configuration keyword ATTLS_ERROR_ACTION.
- The encrypted communication now requires ATTLS=YES when SSL_REQUIRED is not NO.
- SPAWN_TIME now defaults to 600 seconds if omitted, zero, or less, and values below 7 are invalid. See the following updated sections: Configuration file keyword descriptions on page 11, Setting SSL/TLS encrypted communications on page 18, Using AT-TLS for encrypted communications on page 19, and Update sample IPVCONFG on page 21.
- Added new ADFzCC server messages to ADFzCC server messages on page 106.

New features and enhancements in V1.10.0, February 2026

This version of the documentation contains minor clarifications and corrections.

New features and enhancements in V1.10.0, October 2025

This version of the documentation contains minor clarifications and corrections, as well as the following new support:

- A future release will require the configuration and use of Application Transparent Transport Layer Security (AT-TLS) for encrypted communication for SSL_REQUIRED keyword values other than SSL_REQUIRED=NO. See Configuration file keyword descriptions on page 11 and Using AT-TLS for encrypted communications on page 19.

New features and enhancements in V1.10.0, June 2025

This version of the documentation contains minor clarifications and corrections.

New features and enhancements in V1.10.0, March 2025 (refresh)

This version of the documentation contains minor clarifications and corrections, as well as the following new support:

- ADFz Common Components provides a Microsoft Visual Studio Code extension to centralize functionality used by other extensions that are based on the ADFz Common Components such as IBM File Manager for z/OS VS Code extension and IBM Fault Analyzer for z/OS VS Code extension. For more information about downloading the extension, see the IBM ADFz Common Component for z/OS Microsoft Visual Studio Code extension on Visual Studio Marketplace.

October 2024 V1.10.0, First edition

This version of the documentation contains minor clarifications and corrections, as well as the following significant change relative to the previous version:

- You can now specify the **KEEPALIVE** keyword in the ADFz Common Components server configuration file to customize the number of seconds of inactivity that pass before TCP/IP begins sending keep-alive probes. See Configuration file keyword descriptions on page 11 for details about this new keyword.

Chapter 1. Introduction to IBM ADFz Common Components

IBM® ADFz Common Components consists of these major features:

- ADFzCC server
- IPVLANGX, IPVLANGP, and IPVLANGO
- Interactive Panel Viewer

These features can be used by the IBM® Application Delivery Foundation for z/OS® family of products.

ADFzCC server

The ADFzCC server is an extensible server program that runs on a z/OS® system to serve clients. Multiple clients can connect to a single instance of the server program and request a service by invoking a specific extension of the server. The server needs to be customized to install various extensions. Without installing the extensions, the ADFzCC server program alone does not serve any purpose.

The following products use the ADFzCC server :

IMS transaction isolation extension

See *IBM® z/OS® Debugger Customization Guide V16.0* for details on customization.

Fault Analyzer plug-in for Eclipse

See *Fault Analyzer for z/OS® User's Guide and Reference V17R1 (SC27-9040)* for details on customization.

File Manager plug-in for Eclipse

See *File Manager for z/OS® Customization Guide V17R1 (SC27-9041)* for details on customization.

File Manager for CICS®

See *File Manager for z/OS® Customization Guide V17R1 (SC27-9041)* and *File Manager for z/OS® User's Guide and Reference for CICS® V17R1 (SC27-9045)* for details on customization.

File Manager Remote Services

See *File Manager for z/OS® Customization Guide V17R1 (SC27-9041)* "Preparing for File Manager Remote Services" for details on customization.

Application Performance Analyzer plug-in for Eclipse

See *Application Performance Analyzer for z/OS® Customization Guide V14.1 (SC27-8401)* for details on customization.

For more information about configuring the product-specific extensions to the ADFzCC server , see the product-specific customization guide.

IPVLANGX, IPVLANGP, and IPVLANGO

IPVLANGX, IPVLANGP, and IPVLANGO provide utility programs that undertake various functions.

Currently, the following products use one or more of these utilities:

- Fault Analyzer for z/OS®
- z/OS® Debugger
- Application Performance Analyzer for z/OS® (APA)

Here is more information about each utility:

IPVLANGX

A utility program that converts a compiler listing, or SYSADATA file, to a special format ADFz side file, in the remainder of this document referred to as a *"LANGX side file"*, or simply a *"LANGX file"*. A LANGX side file is typically a lot smaller in size than a compiler listing. (See IPVLANGX compiler listing to side file conversion utility on page 85 for details.)

IPVLANGP

A utility program that creates a readable listing from a LANGX side file, a SYSDEBUG side file generated by using the COBOL or PL/I TEST(SEPARATE) option, or a COBOL program object containing DWARF debugging information generated by the TEST(SOURCE) option (see IPVLANGP side file formatting utility on page 91 for details).

This listing might be useful if side files, rather than compiler listings, are kept in order to conserve DASD space. The utility program is able to format the side file in a way that resembles the original compiler listing.

IPVLANGP also supports the setting of z/OS® Debugger Deferred Breakpoints.

IPVLANGO

A utility program used to create new LANGX side files to support the Automatic Binary Optimizer (see IPVLANGO Automatic Binary Optimizer LANGX file update utility on page 99 for details).

Interactive Panel Viewer

The Interactive Panel Viewer feature enables ISPF-based applications to display panels under CICS®.

The following products use the Interactive Panel Viewer feature:

Fault Analyzer for z/OS®

See the topic about installing non-ISPF interfaces to access *Fault Analyzer for z/OS® history files in the Fault Analyzer for z/OS® User's Guide and Reference V17R1 (SC27-9040)*.

File Manager for CICS®

See *File Manager for z/OS® Customization Guide V17R1 (SC27-9041)* for details on customization.

Chapter 2. ADFzCC server overview

ADFzCC server runs a process that identifies a connection request on a specific port. ADFzCC server can be started manually, or during an IPL, by running a customized procedure. A sample procedure, IPVSRV1, is supplied in the sample library hlq.SIPVSAM1.

Multiple servers might be simultaneously run, provided different port numbers are used for each server.

For participating products that use the ADFzCC server , the server negotiates SSL-encrypted communications if configured to do so, then verifies the client user ID and authentication credentials. Supported authentication credentials include a password, or passphrase, or a JSON Web Token (JWT). If valid, the server creates a new process for that user.

The ADFzCC server consists of a main program module, IPVSRV, and supporting message and API-related modules.

IPVSRV requires a parameter string '**port family trace**' where:

port

Describes the port number that is used to bind and accept incoming connections.

family

The addressing family to bind to. For example, `AF_INET`, or `AF_INET6`.

trace

N, T, D, U, or omitted. This parameter specifies the level of tracing to be performed by the server, and is intended only for diagnostic purposes. N is for no tracing, while T or D produce IPVTRACE, or STDOUT, outputs of undocumented messages that show flow and processing details for diagnostic purposes. U produces trace entries showing user connections to participating ADFz products.

Sample server procedure

The ADFzCC server is recommended to run as a started task, although it might be run as a job.

A sample procedure, IPVSRV1, is supplied in the hlq.IPVSAM1 data set. Copy the procedure to your procedure library.

```
//IPVSRV1  PROC PORT=2800,FAMILY='AF_INET',TRACE=N
//*******************************************************************
//* Copyright = Licensed Materials - Property of IBM                *
//*                                                                 *
//*             5755-AD3                                            *
//*                                                                 *
//*                 Copyright IBM Corp. 2006, 2017.                 *
//*             All Rights Reserved.                                *
//*                 Copyright HCL Technologies Ltd. 2017, 2026.     *
//*             All Rights Reserved.                                *
//*                                                                 *
//*             US Government Users Restricted Rights -             *
//*             Use, duplication or disclosure restricted by        *
//*             GSA ADP Schedule Contract with IBM Corp.            *
//*                                                                 *
//* Status = IBM Application Delivery Foundation for                *
//*          z Systems Common Components, release 1.11.               *
```

```
//*                                                                    *
//*********************************************************************
//* FAMILY=AF_INET|AF_INET6   for TCP/IP V4 or V6 socket and bind
//* TRACE=N|D|U   No server trace, detailed trace or
//* user connection trace
//*
//* This is not a complete JCL procedure. It requires customisation
//* steps before running. To customise,
//* 1. Customise the IPVCONFG member
//* 2. Customise and run the IPVMKDIR sample job to match
//* 3. replace IPV with your high level qualifier for the ADFzCC product
//* 4. Uncomment and replace CEE for your hlq for the LE C runtime
//*    if SCEERUN is not in the site linklist
//*
//RUN      EXEC PGM=IPVSRV,REGION=40M,
//            PARM=('&PORT &FAMILY &TRACE')
// SET IPV=IPV                                  >== Update HLQ
//* Common component authorised library
//STEPLIB  DD DISP=SHR,DSN=&IPV.SIPVMODA        >== ADFzCC APF LIBRARY
//*        DD DISP=SHR,DSN=CEE.SCEERUN          >== LE C RUNTIME
//SYSPRINT DD SYSOUT=*
//IPVTRACE DD SYSOUT=*                          >== OUTPUT if Tracing
//STDOUT   DD SYSOUT=*
//* Server wide, then participating product configurations
//CONFIG   DD DISP=SHR,DSN=&IPV.SIPVSAM1(IPVCONFG)
**************************** Bottom of Data **************************
```

Startup, shutdown, and activity tracing

The server is controlled using the START (S), STOP (P) and MODIFY (F) z/OS® system commands. These commands are typically issued on a z/OS® system console.

Use `START procname` to start the server.

Use `STOP procname` to stop the server.

To enable activity tracing, usually as an IBM® support request, the following modify command can be used:

```
F procname,APPL=TRACEON
```

To disable activity tracing, the following modify command can be used:

```
F procname,APPL=TRACEOFF
```

To display the release and PTF level of the running server, the following modify command can be used:

```
F procname,APPL=VER
```

Configuration file keyword descriptions

The configuration data might contain line comments. Line comments begin with either an asterisk (*) or a hash/pound (#) character, and continue to the end of the line. When configuration involves data set names that include hash/pound (#), such characters must be escaped using a backslash (\) so that they are not interpreted as comments.

SAFJWT_APPLID=*applid* (Optional)

FEKAPPL is a default value.

Specifies the application ID used by z/OS SAF when validating JWTs received by the ADFzCC server . The value must be 1 to 8 characters. If this parameter is omitted, FEKAPPL is used.

ATTLS_ERROR_ACTION=*STOP_SERVER/STOP_SESSION* (Optional)

STOP_SERVER is a default value.

This controls the behavior of the ADFzCC server server when an AT-TLS error is encountered. If STOP_SERVER is specified, or if the parameter is omitted, the server shuts down the listener. If STOP_SESSION is specified, only the failing client session is closed and the server continues to run. This keyword must be specified before SPAWN_PARMS_SECTION.

APPLID=*applid* (Optional)

The ADFzCC server uses C runtime services to switch user context when spawning processes for requesting clients that provide a valid user ID and password. These services are associated with the OMVSAPPL resource (or the IPVAPPL resource if PASSTK is specified) of the APPL class by default, if the APPL class is active. If this is the case, the authenticating user ID must have READ access to the OMVSAPPL or IPVAPPL resource of the APPL class.

Alternatively, your configuration file can specify APPLID=*applid*, where *applid* is a 1- to 8-character resource name defined to the APPL class. When APPLID is configured, the ADFzCC server will use the specified APPL class *applid* rather than OMVSAPPL or IPVAPPL.

The APPLID parameter must be specified under the CONFIG=DEFAULT configuration.

Important: This parameter refers to a RACF APPL class profile and is not related to VTAM APPL definitions.

ATTLS=YES|NO (Optional)

The Application Transparent Transport Layer Security (AT-TLS) feature of z/OS® Communication Server can be used to secure communications between the ADFzCC server and connecting clients. See Using AT-TLS for encrypted communications on page 19 for more details.

If encrypted communication is required, and SSL_REQUIRED is set to a value other than NO, ATTLS=YES must be specified.

CONFIG=*name*

name is the name of the configuration as specified by the client. At least one configuration is expected with a name of DEFAULT. Other configuration keywords apply to the current CONFIG name, in top-down order.

KEEPALIVE=nnn (optional)

The number of seconds of inactivity that must pass before TCP/IP begins sending keep-alive probes to determine whether the other system is still reachable. If this keyword is not specified, the number of minutes specified on the TCP/IP **TCPCONFIG INTERVAL** parameter is used. Valid values are in te range 60 - 2147460 (seconds).

MIXEDCASEPASS=YES|NO (optional, default is NO)

Determines whether uppercase translation is performed for incoming passwords for this system. If this system supports mixed case passwords, set this to YES and specify this keyword in the CONFIG=DEFAULT section.

PASSTK=*nnn* (Optional)

The server can be configured to use PassTickets to start sessions for authenticated clients. If you specify the PASSTK parameter in your configuration, the server will generate and use PassTickets for requesting clients that provide a valid user ID and a valid password or passphrase. JWT authentication uses PassTicket internally after JWT validation and does not require the PASSTK parameter to be specified.

After successfully connecting to the server, a client can start new sessions for the period in minutes specified by *nnn* without having to re-authenticate. Allowable values are 1 to 720 (12 hours). If PASSTK is specified without a value, the default is 480 (8 hours).

If PASSTK is not specified, PassTickets will not be generated for the normal client PassTicket reuse function. JWT authentication can still used PassTicket internally after successful JWT validation. This feature is primarily to facilitate multifactor authenticator (MFA) clients. See Using PassTickets on page 17 for more details.

The PASSTK parameter must be specified under the CONFIG=DEFAULT configuration.

SSL_REQUIRED=YES|TLSV1.2|TLSV1.3|NO (Optional, default is NO)

Determines whether SSL/TLS encrypted communications are mandatory for the server and the desired protocol level. SSL/TLS communications are achieved by using the System SSL APIs. The default protocol level is TLS 1.2 when YES is specified.

To use TLS 1.2, clients must be at level 14.1.0 or later. To use TLS 1.3, clients must be at level 15.1.0 or later.

If encrypted communication is required, and SSL_REQUIRED is set to a value other than NO, ATTLS=YES must be specified.

SPAWN_ACCT=accountdata

Allows specification of the account data used for the spawned address space. This is as per the _BPX_ACCT_DATA environment variable discussed in the z/OS® UNIX™ System Services Planning manual.

SPAWN_PARMS_SECTION

This entry marks the beginning of extra parameters that are passed to the spawned process. The contents of this area are determined by the products that use the server.

SPAWN_PROGRAM=PROGRAM

Specification of the program that is launched for the client connection. The server checks the existence of the named program. If you want to specify the name of a z/OS® UNIX™ executable file, rather than a load module in a STEPLIB data set, include the path. Otherwise, the server creates a sticky bit file in the WORKDIR specified location. Sticky bit is the mechanism in the z/OS® UNIX™ file system of indicating that this file is a load library member. The program is launched as a UNIX System Services process, but can be a traditional z/OS® program.

SPAWN_REGIONSZ=nnn (optional, default is to inherit the region size of the server)

Determines the region size (in MB) for the launched process. Participating products being launched have their own recommendations for this sizing.

SPAWN_STEPLIB=steplib1:steplib2 (optional)

Allows specification of the run libraries that are used for the spawned address space. Support for continuing library specifications is provided by ending a line with the colon character.

If the run libraries are not all APF authorized, you must ensure that the _BPX_SHAREAS environment variable is set to NO to avoid a potential abend S306. The server will then spawn the participating products in their own address space. You can add a STDENV DD statement to set the environment variable in the server procedure. For example:

```
//STDENV *
_BPX_SHAREAS=NO
/*
```

SPAWN_TIME=nn

Allows specification of the CPU time limit, in seconds, used for the spawned address space. If SPAWN_TIME is omitted a default value of 600 seconds is used. Values below 7 seconds are invalid.

WORKDIR=/path

The CONFIG=DEFAULT set of parameters needs the WORKDIR=path keyword. This keyword specifies where the server can write semi-permanent (existing at least while the server task is running) files. A sample job, IPVMKDIR is supplied in the sample library to create this path.

Chapter 3. Customizing the ADFzCC server

This chapter provides you with instructions on how to customize the ADFzCC server . In brief, this consists of the following general checklist:

- APF authorize the SIPVMODA library
- Add programs in SIPVMODA to program control
- Add user for server started task
- Add task to STARTED class
- Add sample IPVSRV1 to system procedure library
- Permit server user/group to BPX.SERVER facility
- Permit server user/group to CSF* profiles (if used)
- Permit connecting users/groups to OMVSAPPL or an equivalent resource (if used).
- Update sample IPVCONFG
- Create matching WORKDIR by running job IPVMKDIR
- Review address space timeout settings
- Configure the TCP/IP stack affinity

Required authorizations

The STEPLIB hlq.SIPVMODA must be APF-authorized.

Associate the started task that is used to run the ADFzCC server with a user ID that has an OMVS segment. If the BPX.SERVER facility is active give the user ID READ access to it, otherwise the user ID requires superuser access. Make sure write access to the z/OS® UNIX™ directory is available, as specified by the WORKDIR= configuration parameter. Edit and run the job IPVMKDIR in the sample library (IPV.SIPVSAM1) to create this directory. Furthermore, any users logging in to the ADFzCC server require read access to this location. Similarly, if you configure the ADFzCC server to a key database of your own creation, the ADFzCC server and any users who log into it require read access to the specified key database.

Products that make use of the SPAWN_JOBNAME configuration keyword require the following authorizations. The user ID of the ADFzCC server must be permitted to the BPX.SUPERUSER resource of the FACILITY class and must have READ access to the BPX.JOBNAME resource, if it is defined.

The ADFzCC server uses C runtime services to switch user context when spawning processes for requesting clients that provide a valid user ID and password. These services are associated with the OMVSAPPL resource (or the IPVAPPL resource if PASSTK is specified) of the APPL class by default, if the APPL class is active. If this is the case, the authenticating user ID must have READ access to the OMVSAPPL or IPVAPPL resource of the APPL class.

Alternatively, your server configuration can specify APPLID=*applid*, where *applid* is a user-defined resource name defined to the APPL class. When APPLID is configured, the ADFzCC server will use the specified *applid* rather than OMVSAPPL. If PassTickets are used, the default resource name is IPVAPPL, however this can also be overridden by the APPLID configuration parameter. In all cases, authenticating users must have READ access to the appropriate resource of the APPL class (if it is active).

If enhanced program security is enabled, at a minimum the following programs must be defined to program control, unless BPX.DAEMON.HFSCTL was set up:

- IPVSRV
- IPVMSGT
- IPVCMENU
- IPVCMJPN
- UIPVMSGT
- IPV0LVL

Alternatively, define all ADFzCC server programs in the library IPV.SIPVMODA to program control, rather than specifying individual programs.

If enhanced program security is enabled, IPVSRV must be defined with the MAIN attribute, using the APPLDATA operand on the PROGRAM profile.

Example commands for RACF®

To activate program control if not already active, use the following command:

```
SETROPTS WHEN(PROGRAM)
```

To add all ADFzCC server programs in a library to program control, use the following command:

```
RDEFINE PROGRAM IPV* ADDMEM('IPV.SIPVMODA'//NOPADCHK) UACC(READ)
```

In addition, the following command is required for alias member UIPVMSGT:

```
RDEFINE PROGRAM UIPVMSGT ADDMEM(’IPV.SIPVMODA’//NOPADCHK) UACC(READ)
```

To add individual programs, use the following command:

```
RDEFINE PROGRAM IPVSRV ADDMEM('IPV.SIPVMODA'//NOPADCHK) UACC(READ)
```

To refresh, use the following command:

```
SETROPTS WHEN(PROGRAM) REFRESH
```

Note: If you are using Japanese, then include the module IPVCMJPN in program control.

If RACF®, or an equivalent security product is implemented, the ADFzCC server (IPVSRV1) started task must also be defined to the STARTED class. For example, to add IPVSRV1 as an STC, the RACF® commands in the example that is shown here could be used, where `IPVSRV1` is the name of your ADFzCC server procedure and *userid* is the userid that the started task runs under:

```
RDEFINE STARTED IPVSRV1.* STDATA(USER(userid))

SETROPTS RACLIST(STARTED) REFRESH
```

For more information about started tasks and security, see the z/OS® Security Server RACF® Security Administrator's Guide, or equivalent documentation for your security product.

Multi-Factor Authentication (MFA)

When clients initially connect to the ADFzCC server they are prompted for a user ID and a password or passphrase. If the credentials are valid, the client can start sessions on the relevant z/OS system as the nominated user.

Rather than prompting for the user ID and password each time a new session is required, the plug-in client reuses the initial user ID and password. This can pose a problem for Multi-Factor Authentication users as their password or passphrase is typically single-use only. Consequently, reusing a credential will likely fail.

To support Multi-Factor Authentication users, the ADFzCC server provides support for PassTickets. For more information about PassTickets, refer to the documentation for RACF or your equivalent security product.

Using JWT authentication

The ADFzCC server supports authentication using a JSON Web Token (JWT) supplied by a compatible client. The JWT is validated by z/OS SAF using the application ID specified by the SAFJWT_APPLID configuration keyword.

The default value of SAFJWT_APPLID is FEKAPPL. Specify a different application ID if the SAF JWT configuration for your environment uses another application ID.

The user ID supplied by the client must match the user ID returned by SAF for the JWT. JWT authentication cannot be combined in the same authentication request with a password, password change, or client PassTicket.

After successful JWT validation, the ADFzCC server generates a PassTicket and uses it to establish the user security environment. The application ID used for this PassTicket is the application ID supplied by the client, if present, otherwise the APPLID configuration value, if specified, or IPVAPPL by default.

Sample IPVCONFG - CONFIG=DEFAULT

- JWT authentication application ID. FEKAPPL is the default.
- Change this value only if the SAF JWT configuration uses a different application ID.
- SAFJWT_APPLID=FEKAPPL

Using PassTickets

The ADFzCC server can be configured to use PassTickets for authenticated clients.

To exploit this feature, a client must first authenticate with a valid user ID and password or passphrase. Following a successful authentication, the server generates and use PassTickets for requesting clients. Such requests are valid for the period (in minutes) specified by the PASSTK configuration parameter.

To enable the use of PassTickets, complete the following steps:

1. Specify the PASSTK parameter in your ADFzCC server configuration file. For a description of the parameter, see Configuration file keyword descriptions on page 11.
2. The ADFzCC server must run APF-authorized. For more information about APF authorization and PassTickets, refer to the documentation for RACF or your equivalent security product.
3. PassTickets are generated in association with an APPLID. For ADFzCC, the default APPLID is IPVAPPL.

   If the APPL class is active, connecting users must have READ access to the relevant APPLID resource name in the APPL class. The APPLID resource name can be overridden by the APPLID parameter in the ADFzCC server configuration file, in which case, authorization checks are performed against the configured APPLID resource name.
4. The server started task user ID must have the following authorizations to generate PassTickets:

   ```
   SETROPTS CLASSACT(PTKTDATA)
   SETROPTS RACLIST(PTKTDATA)
   RDEF PTKTDATA IPVAPPL SSIGNON(KEYMASKED(yourmaskvalue))
   RDEF PTKTDATA IRRPTAUTH.IPVAPPL.* UACC(NONE)
   PERMIT IRRPTAUTH.IPVAPPL.* ID(your.userid) ACCESS(UPDATE) CLASS(PTKTDATA)
   SETR RACLIST(PTKTDATA) REFRESH
   ```

   If the server has the necessary authority, message IPV0052I is generated at startup, otherwise, message IPV0050S is generated.

Note: This feature primarily exists to facilitate multi-factor authentication (MFA) clients. Your MFA environment might require additional authorizations to use PassTickets. Refer to the instructions on using MFA with PassTickets in the documentation for IBM® Z Multi-Factor Authentication or equivalent MFA product.

Setting SSL/TLS encrypted communications

Important: Encrypted communication now requires the use of AT-TLS. If SSL_REQUIRED is set to a value other than NO, ATTLS=YES must also be specified. See Using AT-TLS for encrypted communications on page 19 for more information.

The sample IPVCONFG configuration file member can be configured for encrypted communications by specifying SSL_REQUIRED and ATTLS=YES under the CONFIG=DEFAULT section. For example:

```
SSL_REQUIRED=YES
 ATTLS=YES
```

To use other versions of TLS, see Configuration file keyword descriptions on page 11 for additional values that can be specified for the SSL_REQUIRED keyword. If TLS encryption is not required in your environment, comment out this line and uncomment the next line (or alter your existing line to `SSL_REQUIRED=NO`). If TLS is required, replace SSL_REQUIRED=YES with SSL_REQUIRED=TLSVxxx, where TLSVxxx is one of the supported TLS versions listed in the description of SSL_REQUIRED in Configuration file keyword descriptions on page 11.

If you are using ICSF and have protected resources through the CSFSERV facility class, the server user or group id needs to be permitted to the resource, for example:

```
PERMIT  CSF*  CLASS(CSFSERV)
           ID(groupid)  ACCESS(READ)
```

For more details see the *Cryptographic Services ICSF Administrator's Guide*.

Considerations when using TLS 1.3

To use **TLS 1.3** for communication between clients and the ADFzCC server , specify **SSL_REQUIRED=TLSV1.3** and **ATTLS=YES** in the server configuration.

The **SSL_REQUIRED** protocol value must match a protocol supported by the configured AT-TLS rules. For more information on using AT-TLS, see Using AT-TLS for encrypted communications on page 19.

Using AT-TLS for encrypted communications

The Application Transparent Transport Layer Security (AT-TLS) feature of z/OS® Communication Server is required to secure communications between the ADFzCC server and connecting clients when encrypted communication is enabled. If the SSL_REQUIRED configuration parameter is set to a value other than NO, the server configuration must also specify the ATTLS parameter to the value 'Y'. For example:

```
ATTLS=Y
```

You can optionally specify ATTLS_ERROR_ACTION to control how the server responds when an AT-TLS error is encountered. The default is STOP_SERVER. STOP_SESSION is specified, only failing client session is closed and server continues to run.

Using AT-TLS requires the configuration of z/OS® Communications Server and policy agent rules to enable TLS protection of inbound connections to the ADFzCC server and subsequent data flows between the client and server. Your security administrator or system programmer can create this configuration in accordance with your installation standards and ensure that the z/OS® Communication server policy agent is running to provide AT-TLS services.

To establish an AT-TLS environment, take the following steps:

Note: Particulars might vary by installation.

1. Change the z/OS® Communication Server profile TCPCONFIG statement to activate the AT-TLS function. For example:

   ```
   TCPCONFIG  TTLS  ; Required for AT-TLS
   ```

   Optionally, installations might also change the z/OS® Communication Server profile AUTOLOG statement to automate starting the policy agent (PAGENT), which is needed to effect AT-TLS rules. For example:

   ```
   AUTOLOG
         PAGENT  ; POLICY AGENT, required for AT-TLS
   ENDAUTOLOG
   ```

2. Create the z/OS® Communication Server policy agent (PAGENT) configuration to establish AT-TLS rules for inbound connections to the ADFzCC server . For example:

```
TTLSRule                      rule_ADFzCC
{
 LocalPortRange               2800
 Direction                    Inbound
 TTLSGroupActionRef           grp_ADFzCC
 TTLSEnvironmentActionRef     env_ADFzCC
}
TTLSGroupAction               grp_ADFzCC
{
 TTLSEnabled                  On
}
TTLSEnvironmentAction         env_ADFzCC
{
HandshakeRole                 Server
TTLSKeyRingParms
{
 Keyring                      ADFzCC.KEYRING
}
TTLSEnvironmentAdvancedParms
{
  TLSv1.3                     On
  HandshakeTimeout            30
  ApplicationControlled       On
 }
TTLSCipherParms
 {
   V3CipherSuites4Char 13021301
 }
TTLSSignatureParms
 {
   ServerKeyShareGroups 00230024002500290030
 }
TTLSGskAdvancedParms
 {
   GSK_SESSION_TICKET_SERVER_ENABLE Off
 }
}
```

Note:

The **ApplicationControlled** parameter must be on for the ADFzCC server . In addition, if **SSL_REQUIRED** is set to a value other than NO, **ATTLS=Y** must be specified and **SSL_REQUIRED** must be set to a valid protocol value. The protocol that is chosen must match a protocol that is supported by the AT-TLS rules that are specified in the AT-TLS configuration TTLSEnvironmentAdvancedParms statement. For example:

```
SSL_REQUIRED=TLSv1.3
```

A *HandshakeTimeout* value of 30 seconds is recommended. If using a LocalAddr* (LocalAddr, LocalAddrRef, LocalAddrSetRef, LocalAddrGroupRef) statement within your rule to limit the IP addresses on which the ADFzCC server listens, you must ensure that the statement allows connections to the server on address 127.0.0.1.

In addition, the IPVSRV STC user will require access to the keystore that is identified on the **Keyring** parameter of the TTLSKeyRingParms statement. For more information on cipher specifications, key share groups, and certificate types

supported for TLS 1.3, see https://www.ibm.com/docs/en/zos/2.4.0?topic=protocols-required-updates-enable-tls-v13-protocol-support.

3. Start the z/OS® Communications Server policy agent.

Note: If your policy agent configuration, or the key ring or keystore that is identified in the policy agent configuration is changed, restart the policy agent.

Clients such as z/OS® Explorer will be prompted to trust the server certificate identified in the AT-TLS configuration if the certificate is not registered as trusted.

Clients such as File Manager Remote Services might require that the remote server CA certificate is imported as a SITE certificate on the client z/OS® system for establishing trust of the remote system.

Update sample IPVCONFG

The CONFIG ddname in the ADFzCC server JCL procedure provides parameters that can be used to configure the ADFzCC server on startup. A sample configuration member is provided in IPV.SIPVSAM1(IPVCONFG), and the member can be customized as required.

The File Manager configuration in the sample configuration member specifies parameter SPAWN_PROGRAM=FMNCSEP. This program allows File Manager to run authorized and ensures that the File Manager plug-in can:

- Perform auditing
- Access tapes
- Use remote services

For more information on setting up IPV server to allow the use of File Manager for z/OS®, see the section about the File Manager for z/OS® plug-in for Eclipse in the *File Manager for z/OS® Customization Guide*.

Update the sample configuration member to suit your site, according to the comments in that member. In general terms, review the following items in the config file:

- Alter ddname=SYSOUT=H to suitable classes for your site. For example, for tracing activity, the CONFIG=DEFAULT section contains a SPAWN_DD=IPVTRACE=SYSOUT=H card that other configurations inherit and write trace output (if activated) to. Adjust this class to a class suitable for your site.
- Alter SPAWN_STEPLIB data set names to the installation high-level qualifiers for the relevant libraries. The SPAWN_STEPLIB statement is not required if all of the libraries are already in the linklist for your site.
- If a configuration makes use of the SPAWN_JOBNAME statement, then all address spaces that are launched for that connection type run with that specified jobname (the owner of each job reflects the user that is logged in).
- Do not alter CONFIG=name and SPAWN_PROGRAM=name values unless otherwise detailed in the participating product's documentation.
- If encrypted communication is required, and SSL_REQUIRED is set to a value other than NO, specify ATTLS=YES. Encrypted communication without AT-TLS is not supported.

- You can optionally specify ATTLS_ERROR_ACTION before SPAWN_PARMS_SECTION to control how the server responds when an AT-TLS error is encountered. Valid values are STOP_SERVER and STOP_SESSION. The default is STOP_SERVER.
- If SPAWN_TIME is omitted, or specified as 0 or less, the server uses a default value of 600 seconds. Values from 1 through 6 are invalid and cause a severe configuration error.
- If JWT authentication is used and the SAF JWT application ID is not FEKAPPL, specify SAFJWT_APPLID with the application ID configured for JWT validation on the system.
- JWT authentication requires the server authority needed to generate the PassTicket that is used after successful JWT validation.

The configuration file supports the setting and reference of substitution variables in the following form:

```
$VAR=value
```

For setting these variables, specify the above form before the first CONFIG statement, or between the CONFIG and SPAWN_PARMS_SECTION statements. If using concatenations for the CONFIG DD, the first CONFIG refers to the statements in the first of the concatenations.

In following statements in the configuration, occurrences of '$VAR' are replaced by the 'value' specified. This could be used to represent high level qualifiers that are repeated in the configuration file. For example, set the value:

```
$IPVHLQ=SYS1.IPV
```

Then allow a reference in a following statement, such as:

```
SPAWN_STEPLIB=$IPVHLQ.SIPVMODA
```

The sample IPVCONFG makes use of this for high level qualifiers but it could also be used for other substitutions as desired.

Create matching WORKDIR by running job IPVMKDIR

The IPVMKDIR job creates a work directory to be used with the server. It is supplied in the sample library hlq.SIPVSAM1.

IPVMKDIR creates a directory hierarchy in the following form:

```
/etc/ipv/v1610/ipvsrv1
```

You can alter this to suit your site. You must update the WORKDIR statement in the server configuration to refer to the created directory. A unique path is recommended.

Tip: Do not use `/tmp` as a directory location.

The files in the work directory must be owned by the user ID of the ADFzCC server . The IPVMKDIR job issues the chown command to set the owner of the files and any sub-directories within the work directory. It is recommended to use a unique work directory that is not used by other program products. The file system containing the work directory must allow the user ID to be changed through the SETUID attribute. If the file system is mounted with the NOSETUID attribute, the APF extended attribute set by the IPVMKDIR job is ignored, resulting in abend code EC6 when connecting to the ADFzCC server .

Note: The IPVMKDIR job is expected to run with superuser authority. That is, IPVMKDIR must have READ access in the FACILITY class to BPX.SUPERUSER and BPX.FILEATTR.APF. The job will try to set the sticky bit attribute and the APF extended attribute. If these file attributes are not set correctly, attempts to start sessions using the ADFzCC server might fail with authorization errors or abend code EC6. After running this job you can check the extended file attribute in the job output or use the ls -E z/OS® UNIX™ command. For more information, see the IPVMKDIR sample member.

As an alternative to running the IPVMKDIR job, you can manually create the working directory and its contents by executing the following steps in z/OS® UNIX™ System Services:

1. Start an OMVS session as superuser.
2. Create the working directory. For example:

   ```
   mkdir /etc/ipv/v1610/ipvsrv1
   ```

3. Create the set of session files in the working directory using the touch command:

`touch FMNCSEP`	*File Manager for z/OS®*
`touch CAZLCS01`	*Application Performance Analyzer for z/OS®*
`touch IDIGMAIN`	*Fault Analyzer for z/OS®*
`touch IPVVRFY`	*ADFz Common Components*

4. Set the APF file attributes for File Manager and APA session files:

   ```
   extattr +a FMNCSEP
   extattr +a CAZLCS01
   ```

5. Set the file ownership of the work directory and session files:

   ```
   chown <IPVSRV> /etc/ipv/v1610/ipvsrv1
   chown <IPVSRV> /etc/ipv/v1610/ipvsrv1/FMNCSEP
   chown <IPVSRV> /etc/ipv/v1610/ipvsrv1/CAZLCS01
   chown <IPVSRV> /etc/ipv/v1610/ipvsrv1/IDIGMAIN
   chown <IPVSRV> /etc/ipv/v1610/ipvsrv1/IPVVRFY
   ```

   Where <IPVSRV> is the user ID that will run the ADFzCC server started task.
6. Set the file permissions for the work directory and session files:

   ```
   chmod 755 /etc/ipv/v1610/ipvsrv1
   chmod 755 FMNCSEP
   chmod 755 CAZLCS01
   chmod 755 IDIGMAIN
   chmod 755 IPVVRFY
   ```

7. Set the sticky bit file attribute for all session files:

   ```
   chmod +t FMNCSEP
   chmod +t CAZLCS01
   chmod +t IDIGMAIN
   chmod +t IPVVRFY
   ```

Related information

Mounting file systems

z/OS® UNIX System Services Command Reference

Check address space timeout

When an address space is launched for a client, and it has completed its current function, the address space is waiting for TCP/IP communications from the peer. In line with this, the client address space might be subject to an s522 abend if waiting longer than the active site settings for job wait time. The job wait time is controlled by the `JWT` parameter of the `SMFPRMxx` member, but might also be set to never time out by the site settings for `MAXCPUTIME` in the site's `BPXPRMxx` member. Set these parameters as needed by the site.

Add ports to TCPIP reservation list

Add the ports for the server, or servers, you want to run to the reserved port list in your TCPIP configuration data.

Configuration considerations for IBM® Explorer for z/OS® (z/OS® Explorer)

The port number that is used by the ADFzCC server must be specified in the `rse.env` directive `PD_SERVER_PORT` statement as follows:

```
PD_SERVER_PORT=nnnn
```

where *nnnn* is the port number.

`rse.env` is located in `/etc/zexpl/`. For more details, see /etc/zexpl/rse.env.

Configuring TCP/IP stack affinity

About this task

When multiple TCP/IP stacks are in use on the system, you can specify the desired ADFzCC stack on the started task.

1. Create a new PDSE data set with LRECL=80 and RECFM=FB. For example:

   ```
   <hlq>.EXMP.CONFIG
   ```

2. Create a new member in the data set, for example, `<hlq>.EXMP.CONFIG(TCPDATA)`. In the new member, include the following line:

   ```
   TCPIPJOBNAME TCPIPPRD
   ```

   where *TCPIPPRD* is the name of the desired TCP/IP stack.

3. In the IPVCONFIG member , for example, `<hlq>.EXMP.CONFIG(IPVCONFIG)`, add the following line to each product's SPAWN_PARMS_SECTION:

```
SPAWN_DD=SYSTCPD=<hlq>.EXMP.CONFIG(TCPDATA)
```

4. Restart the ADFzCC started task for the changes to take effect.

Chapter 4. Options

For the IPVLANG utilities, you can specify installation-wide default options in the IPVCNF00 parmlib configuration member.

You can create a member IPVCNF00 in SYS1.PARMLIB, or any other data set that is part of the logical parmlib concatenation.

Note: If not providing general READ access to data sets in the logical parmlib concatenation, then an IPVOPTLM configuration-options module can be used to specify an alternative data set, as explained in Using an IPVOPTLM configuration-options module on page 27.

If you do not specify an option, then it takes either the product default (as indicated on the syntax diagram for each option), or has no value at all.

Options that are specified in the IPVCNF00 parmlib configuration member are subject to these syntax rules:

- Only columns 1 - 71 are processed.
- Options can be specified anywhere in a line. They do not have to start in column 1.
- You can use a blank or a comma as a delimiter.
- Options can be continued across any number of lines
- Options specifications are not case-sensitive—all options are converted to uppercase.

- Comments are permitted anywhere and can be nested. The characters "`/*`" identify the beginning of a comment, and "`*/`" identify the end.

Option descriptions

The following explains each option in detail.

EventProcessingExit

Use the EventProcessingExit option to define an exit that is to be invoked to perform asynchronous event processing. For more information, see ADFzCC event processing on page 102.

Figure 1. Syntax

```
►►─ EventProcessingExit( exit-name ) ─►◄
```

exit-name

The name of an Event Processing user exit that contains an LE fetchable function of the same name. The maximum length of the name is 8 characters.

If this option is changed, ADFz products that use the Event Processing user exit are affected.

Locale

Figure 2. Syntax

```
  ┌──────────── NOLOCALE ────────────┐
►►┤                                  ├►◄
  └── LOCALE( locale-name ) ─────────┘
```

The Locale option specifies the locale to be used for cultural environment-dependent presentation.

The locale name that is specified can be one of those supplied with z/OS® C/C++ for the setlocale() runtime function. For a list of locale names, see *z/OS® C/C++ Programming Guide*, "Appendix D. Locales Supplied with z/OS® C/C++".

Specifying the NoLocale option is the equivalent to specifying Locale(C).

The following are affected by the Locale option:

IPVLANGP source code comments

Characters in source code comments which are considered non-printable given the current locale are shown as periods.

Fault Analyzer for z/OS®

Affected are things like date and time formatting, collating sequences of sorted information, and determination of non-printable characters which are shown as periods.

Note: If used, the equivalent Fault Analyzer for z/OS® Locale option overrides the IPVCNF00 Locale option specification.

Using an IPVOPTLM configuration-options module

An optional IPVOPTLM configuration-options module can be used to provide settings which are required before reading the IPVCNF00 parmlib member.

The name of the configuration-options load module must be IPVOPTLM, and it must be placed in an APF-authorized library. Place the library in LNKLST so that the IPVOPTLM load module can be found. The recommended library is IPV.SIPVMODA.

A sample job to create an IPVOPTLM configuration-options load module is provided as member IPVOPTLM in data set IPV.SIPVSAM1.

Individual settings in the IPVOPTLM configuration-options module are specified using the IPVOPT macro, as explained in the sample job. The only available setting is:

IPVCNFDS

To accommodate installations that do not provide general READ access to SYS1.PARMLIB (or any one of the data sets in the logical parmlib concatenation), an alternative data set *dsname* can be specified as follows:

```
IPVOPT IPVCNFDS,dsname
```

For example, to specify TOOLS.PARMLIB as an alternative data set name:

```
IPVOPT IPVCNFDS,TOOLS.PARMLIB
```

Chapter 5. Quick start guide for compiling and assembling programs for use with the ADFz family of products

These topics describe the minimal steps that are required to prepare your programs for use with the Application Delivery Foundation for z/OS® family of products. They provide instructions for a single compilation method for organizations that are using some combination of z/OS® Debugger, Fault Analyzer, and Application Performance Analyzer (APA).

For more detailed information on working with particular products, refer to the following topics:

- Part 2. *"Preparing your program for debugging"* of the *IBM® z/OS® Debugger User's Guide*
- Part 2. *"Fault Analyzer Installation and Administration"* of the *Fault Analyzer for z/OS® User's Guide*
- Appendix B. of the *Application Performance Analyzer for z/OS® User's Guide*

z/OS® Debugger, Fault Analyzer, and APA are designed to use load modules and other files that are produced by IBM® compilers. You must compile your programs with certain compiler options so that they produce load modules and files that these products can use.

In these topics the term 'source information files' refers to the types of files that are used by z/OS® Debugger, Fault Analyzer, and APA. The different kinds of source information files that are discussed include:

- SYSDEBUG files
- LANGX files
- Compiler listings
- DWARF files
- Expanded source files

Different compilers generate different kinds of source information files. If you use more than one compiler, you might have more than one type of source information library.

When you compile your programs with the compiler options described in these topics, you can use the load modules and source information files that are created by the compilers as follows:

- Prepare the module for debugging using z/OS® Debugger. z/OS® Debugger lets you work with program statements and variables.

  When a program is compiled with the right options, the module that is produced by the compiler can be debugged and a source information file, which contains program statements, can be produced. When you use z/OS® Debugger to debug a program, the source information file is used to display the program source statements in the source window.

  Depending on the source language and compiler that are used, the load module, the source information file, or the DWARF file contains information about statements and variables, such as offsets and lengths, and contains information that allows the debugger to locate statements and variables in storage. If you do not compile with the

correct compiler options, debugging is limited to something called 'disassembly' mode, where machine code is displayed, but no source statements or variables.

- Use Fault Analyzer to automatically pinpoint the source statement that caused an abend, and show the values of variables in your programs at the time of an abend.
- Use APA to show precisely which program statements are using the most CPU time and wait time. Use this information to tune your applications.

Updating your build process

If one or more ADFz products were recently installed on your system, the program build processes might not have been updated yet. Updating build processes is an important and necessary part of implementing the ADFz family of products.

In many organizations there is clear ownership of these build processes. In other organizations, it might not be obvious who makes the changes. Many sites use standard compilation processes or PROCs that your system administrators maintain and have updated to prepare programs for the ADFz family of products. In this case, find out what processes have been made available and how to use them. In other organizations, developers maintain their own compilation JCL or PROCs to compile programs. In this case, update your own compilation JCL to prepare your programs for use with ADFz products as described below.

Start by researching what is required for each compiler individually. For example, the changes that are required for Enterprise COBOL for z/OS®, Enterprise PL/I for z/OS®, C/C++ and Assembler are all slightly different.

In general, there are three changes that might be needed to enable compiler JCL to produce programs that can be used by ADFz products:

1. Specify compiler options that are required by the ADFz family of products.
2. Code the JCL to produce and save the source information files that ADFz products need. Newer compilers can generate the required source information files directly. Some older compilers require an extra step in the compilation job to run a special utility program that produces the needed file.
3. In certain environments, it is advantageous to include a special z/OS® Debugger module into the application load module during the link-edit step. In most cases this special module is optional, but it can simplify starting z/OS® Debugger for certain types of programs. For certain older compilers running in certain environments, you must include a special module to enable z/OS® Debugger.

Updating your promotion process

Typically, when a program is tested, program load modules are promoted through different stages before reaching production.

For example, when a new program is compiled for the first time, it might be placed into a test load library. After unit testing is completed, perhaps the compiled program is promoted to a QA environment. Finally, it is promoted into production. On your system, you might know these stages by different names, such as Unit test, System test, and Model office.

Consider whether you want the ability to use z/OS® Debugger, Fault Analyzer, and Application Performance Analyzer for z/OS® throughout your program's lifecycle. Even if you do not plan to use z/OS® Debugger with production programs, Fault Analyzer and APA are useful in those stages. To enable the ADFz products at each stage, update your promotion processes to retain the source information files. Promotions can be accomplished by performing a recompile, a copy, or a move. Perform the same steps with your source information files that you perform with your load modules or object modules. For each load library or object library, have a corresponding set of source information libraries. Whenever you promote a load module or object module, promote the source information file as well. This ensures that the source information file is available for Fault Analyzer and APA, and you can continue to take advantage of the ADFz products at all stages of your program's lifecycle.

Preparing your programs

Each compiler produces different kinds of source information files, and each of the ADFz products reads different kinds of files.

It can be time-consuming to research all the different combinations, but for each compiler, there is a suggested method that is described below. If you use the suggested method, your programs are ready to take full advantage of the ADFz family of products.

Enterprise COBOL for z/OS® Version 6 or later programs

The following table shows various compiler options that can be used to prepare Enterprise COBOL for z/OS® Version 6 programs for use with the ADFz family of products (z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the program object produced is suitable for a production environment. Program objects suitable for a production environment have no significant runtime overhead.

The table shows what is required for **full** function.

Table 1. Examples of compiler options and source information files that are supported by ADFz family of products for Enterprise COBOL for z/OS® Version 6

Compiler options	Source information file type produced	Is the program object production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer®	Options supported and suggested for APA
TEST(SOURCE, NOSEP)	NOLOAD class in the object	Yes	Supported	Supported	Supported
TEST(SOURCE, SEPARATE)	SYSDEBUG	Yes	Supported	Supported	Supported
NOTEST(DWARF, SOURCE, SEPARATE)	SYSDEBUG	Yes	Not Supported	Supported	Not Supported

Table 1. Examples of compiler options and source information files that are supported by ADFz family of products for Enterprise COBOL for z/OS® Version 6 (continued)

Compiler options	Source information file type produced	Is the program object production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer®	Options supported and suggested for APA
NOTEST, LIST, MAP, SOURCE, NONUMBER, XREF(SHORT)	Listing	Yes	Not Supported	Supported	Supported

Enterprise COBOL for z/OS® Version 5 programs

The following table shows various compiler options that can be used to prepare Enterprise COBOL for z/OS® Version 5 programs for use with the ADFz family of products (z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the program object produced is suitable for a production environment. Program objects suitable for a production environment have no significant runtime overhead.

The table shows what is required for **full** function.

Table 2. Examples of compiler options and source information files that are supported by ADFz products for Enterprise COBOL for z/OS® Version 5

Compiler options	Source information file type produced	Is the program object production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
TEST(SOURCE)	NOLOAD class in the object	Yes	Supported	Supported	Supported
NOTEST, LIST, MAP, SOURCE, NONUMBER, XREF(SHORT)	Listing	Yes	Not Supported	Supported	Supported

Enterprise COBOL for z/OS® Version 4 programs

The following table shows various compiler options that can be used to prepare Enterprise COBOL for z/OS® Version 4 programs for use with the ADFz family of products (z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the load module produced is suitable for a production environment. Load modules suitable for a production environment have no significant runtime overhead.

Table 3. Examples of compiler options and source information files that are supported by ADFz products for Enterprise COBOL for z/OS® Version 4

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
TEST (NOHOOK, SEPARATE, EJPD), LIST, MAP, SOURCE, NONUMBER, XREF(SHORT)	SYSDEBUG	Yes	Suggested for production and test		
NOTEST, LIST, MAP, SOURCE, NONUMBER, XREF(SHORT)	Compiler listing	Yes	N/A	Supported	Supported
NOTEST, LIST, MAP, SOURCE, NUMBER, XREF(SHORT)		Yes	N/A	Supported	N/A
LIST, MAP, SOURCE, NONUMBER, XREF(SHORT)	LANGX file	Yes	Not supported	Supported	Supported
LIST, MAP, SOURCE, NONUMBER, NOTEST, NOOPT, XREF	LANGX file	Yes	Supported	Supported	Supported

Preparing Enterprise COBOL for z/OS® Version 4 programs

Perform the following steps for compiling your Enterprise COBOL for z/OS® Version 4 programs using the compiler options suggested in Table 3: Examples of compiler options and source information files that are supported by ADFz products for Enterprise COBOL for z/OS Version 4 on page 33:

1. Create libraries (PDSE is suggested unless PDS is required in your organization) for SYSDEBUG files. Create one or more SYSDEBUG libraries for each environment, such as test, and production.
2. Create a corresponding SYSDEBUG library for each load library. Specify `LRECL=(80 to 1024),RECFM=FB,BLKSIZE=(multiple of lrecl < 32K)`.
3. For all programs in both test and production environments, specify the following compiler options: `TEST(NOHOOK,SEPARATE,EJPD),LIST,MAP,SOURCE,NONUMBER,XREF(SHORT)`.

The `TEST` compiler option is required if you plan to use z/OS® Debugger to debug a program. The `TEST` option is optional if you plan to use Fault Analyzer for z/OS® or Application Performance Analyzer for z/OS®.

The `SEPARATE` suboption produces a SYSDEBUG file.

`NOHOOK` and `SEPARATE` produce a production-ready module that can still be debugged.

If the `OPT` option is also used, `EJPD` might reduce optimization but enables the debugger's `JUMPTO` and `GOTO` commands. These commands are disabled when `OPT` and `NOEJPD` are both used.

4. When the `TEST` option is not used, save the compiler listing in a file, or use the IPVLANGX utility program to create a LANGX file. To minimize JCL changes, IPVLANGX has aliases to match names. These are:

   z/OS® Debugger

   EQALANGX

   Fault Analyzer for z/OS®

   IDILANGX

   Application Performance Analyzer for z/OS®

   CAZLANGX

   Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS® can use compiler listings and LANGX files to provide source-level support.
5. The `LIST`, `MAP`, `SOURCE`, and `XREF` options are needed only if a compiler listing or a LANGX file is used to provide source information to Fault Analyzer for z/OS® or Application Performance Analyzer for z/OS®. If a SYSDEBUG file is used with these products or if you are not using Fault Analyzer for z/OS® or Application Performance Analyzer for z/OS®, the `LIST`, `MAP`, `SOURCE`, and `XREF` options are optional.
6. The `NONUMBER` compiler option is needed only if a compiler listing file is used to provide source information to Application Performance Analyzer for z/OS®. If a SYSDEBUG file is used with Application Performance Analyzer for z/OS®, or if you are not using Application Performance Analyzer for z/OS®, the `NONUMBER` option is optional.
7. Code a SYSDEBUG DD in the JCL of the compiler step:

   ```
   //SYSDEBUG DD DSN= SYSDEBUG.pds(pgmname),DISP=SHR
   ```

   Save the SYSDEBUG file that is produced by the compiler in the SYSDEBUG library and specify a member name that is equal to the program name of your application program. This file is the source information file for z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®.
8. Modify the promotion process to promote SYSDEBUG files. When a load module is promoted, for example from test to production, promote the corresponding SYSDEBUG file or files. A promotion can be a recompile, copy, or move. Perform the same steps with the SYSDEBUG file that you perform with the module during promotion.
9. Optionally, include a z/OS® Debugger Language Environment® (LE) exit module into the load module during the linkage editor step. This inclusion is one way to enable z/OS® Debugger panel 6 in ISPF, a simple panel-driven method to start the debugger automatically when a program runs, without JCL changes, based on the program name

and user ID. Use module EQADBCXT for batch programs (including IMS™ batch), EQADICXT for IMS/TM programs and EQADDCXT for DB2® stored procedures. Do not include the exit module for CICS® programs.

You can also use module EQAD3CXT for batch programs, IMS/TM, IMS™ BTS programs, and DB2® type MAIN stored procedures.

Sample JCL for compiling Enterprise COBOL for z/OS® Version 4 programs

Here is a JCL example for compiling an Enterprise COBOL for z/OS® Version 4 program for use with the IBM® Application Delivery Foundation for z Systems family of products. This sample is a generic sample, and might not meet all your requirements to generate your modules.

Notice that the `TEST` compiler option is specified. Code the correct suboptions of the `TEST` compiler option for the version of the compiler that you are using. You can also code any other compatible compiler options that are required by your programs.

Also. notice that a SYSDEBUG DD statement was coded. This statement indicates the source information file that the compiler produces. It refers to a SYSDEBUG library that is a PDS or PDSE. The member name must be the same as the program name.

For Enterprise COBOL for z/OS®, these are the only required changes.

However, there is an optional change in the linkage editor step. The example shows that a special Language Environment® exit module is included in the application load module. Although this is exit module not required, it enables the use of z/OS® Debugger panel 6, which makes the debugger easier to start in some environments. If you prefer to use panel 6 to start z/OS® Debugger, this method is one way to enable it. If you do not plan to use z/OS® Debugger panel 6, then do not include an exit module.

```
//*     - - -  ADD A JOB CARD ABOVE THIS LINE  - - -
//*
//*  SAMPLE JCL TO PREPARE AN ENTERPRISE COBOL PROGRAM
//*  FOR THE IBM ZSERIES ADFz PRODUCTS:
//*     FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//*  NOTES:
//*
//*   COMPILER:
//*    1. A TEST COMPILER PARM IS REQUIRED FOR DEBUG TOOL
//*    2. COMPILER PARM TEST(NOHOOK,SEPARATE,EJPD) HAS ADVANTAGES:
//*         - THE MODULE IS READY FOR DEBUG TOOL
//*         - THE MODULE IS PRODUCTION-READY (NO RUN-TIME OVERHEAD)
//*         - A SYSDEBUG FILE IS CREATED THAT CAN BE USED BY DT,FA,APA
//*    3. COMPILER PARMS LIST,MAP,SOURCE,XREF ARE REQUIRED IF YOU PLAN
//*       TO USE THE COMPILER LISTING WITH FA OR APA, OR IPVLANGX
//*
//*   BINDER (LINKAGE EDITOR):
//*    4. THE INCLUDE FOR MODULE EQAD?CXT IS *OPTIONAL*.  IT IS AN
//*       LE EXIT MODULE THAT CAN BE USED TO START DEBUG TOOL.
//*       UNDERSTAND THE METHODS AVAILABLE FOR STARTING DEBUG TOOL,
//*       AND CHOOSE WHETHER YOU WANT TO USE THE LE EXITS.
//*         IF YOU USE THIS METHOD, LOAD THE CORRECT EXIT MODULE:
//*            EQADBCXT: FOR BATCH PROGRAMS
```

```
//*            EQADICXT: FOR ONLINE IMS PROGRAMS
//*            EQADDCXT: FOR DB2 STORED PROCEDURES (OF TYPE MAIN AND SUB)
//*           (for SUB this is supported only for invocations through call_sub)
//*            (DO NOT INCLUDE AN EXIT FOR CICS PROGRAMS)
//*            YOU CAN ALSO USE MODULE EQAD3CXT FOR BATCH PROGRAMS, ONLINE IMS
//*            PROGRAMS, AND DB2 TYPE MAIN STORED PROCEDURES.
//*
//*  SET PARMS FOR THIS COMPILE:
//*  --------------------------
//   SET MEM=SAM1                            PROGRAM NAME
//   SET COBOLLIB='IGY.V4R1.SIGYCOMP'        COBOL COMPILER LOADLIB
//   SET DTLIB='EQAW.SEQAMOD'                DEBUG TOOL LOADLIB
//   SET LELIB='CEE.SCEELKED'                LE LINKEDIT LIBRARY
//   SET UNITDEV=SYSALLDA                    UNIT FOR TEMP FILES
//*
//*  ****************************
//*        COMPILE STEP
//*  ****************************
//COMPILE  EXEC PGM=IGYCRCTL,REGION=0M,
//   PARM=('TEST(NOHOOK,SEPARATE,EJPD),LIST,MAP,XREF(SHORT),NONUMBER,SOURCE')
//STEPLIB  DD DISP=SHR,DSN=&COBOLLIB
//SYSIN    DD DISP=SHR,DSN=&SYSUID..ADLAB.SOURCE(&MEM)
//SYSLIB   DD DISP=SHR,DSN=&SYSUID..ADLAB.COPYLIB
//SYSPRINT DD DISP=SHR,DSN=&SYSUID..ADLAB.LISTING(&MEM)
//SYSDEBUG DD DISP=SHR,DSN=&SYSUID..ADLAB.SYSDEBUG(&MEM)
//SYSLIN   DD DISP=(MOD,PASS),DSN=&&LOADSET,UNIT=&UNITDEV,
//            SPACE=(80,(10,10))
//SYSUT1   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT2   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT3   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT4   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT5   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT6   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT7   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//*
//CBLPRINT  EXEC PGM=IEBGENER,REGION=0M
//SYSPRINT  DD SYSOUT=*
//SYSUT1    DD DSN=&SYSUID..ADLAB.LISTING(&MEM),DISP=SHR
//SYSUT2    DD SYSOUT=*
//SYSIN     DD DUMMY
//*  **********************************
//*        LINK-EDIT (BINDER) STEP
//*  **********************************
//LKED EXEC PGM=IEWL,REGION=0M,COND=(5,LT,COMPILE),PARM='LIST,XREF'
//SYSLIB   DD DISP=SHR,DSN=&LELIB
//DTLIB    DD DISP=SHR,DSN=&DTLIB
//SYSLMOD  DD DSN=&SYSUID..ADLAB.LOAD(&MEM),DISP=SHR
//SYSLIN   DD DISP=(OLD,DELETE),DSN=&&LOADSET
//*  INCLUDING A DEBUG TOOL LE EXIT (EQADBCXT, EQADDCXT, EQADICXT, OR EQAD3CXT)
//*  IS OPTIONAL.
//*  AN EXIT ENABLES STARTING DEBUG TOOL USING THE USER EXIT DATA SET UTILITY
//*  (ONE OF THE DEBUG TOOL ISPF UTILITIES)
//*  //        DD *
//*   INCLUDE DTLIB(EQADBCXT)
//SYSPRINT DD SYSOUT=*
//SYSUT1   DD UNIT=&UNITDEV,DCB=BLKSIZE=1024,SPACE=(1024,(200,20))
```

Enterprise COBOL for z/OS® Version 3 and COBOL for OS/390® and VM programs

The following table shows various compiler options that can be used to prepare Enterprise COBOL for z/OS® Version 3 and COBOL for OS/390® and VM programs for use with the IBM® Application Delivery Foundation for z Systems family of products (z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the load module produced is suitable for a production environment. Load modules suitable for a production environment have no significant runtime overhead.

Table 4. Examples of compiler options and source information files that are supported by ADFz products for Enterprise COBOL for z/OS® Version 3 and COBOL for OS/390® and VM

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
TEST(NONE, SYM, SEPARATE), LIST, MAP, SOURCE, NONUMBER, XREF(SHORT)	SYSDEBUG	Yes	Suggested for production and test		
NOTEST, LIST, MAP, SOURCE, NONUMBER, NOOPT, XREF(SHORT)	Compiler listing	Yes	N/A	Supported	Supported
NOTEST, LIST, MAP, SOURCE, XREF(SHORT), NUMBER		Yes	N/A	Supported	N/A
LIST, MAP, SOURCE, NONUMBER, XREF(SHORT)	LANGX file	Yes	Not supported	Supported	Supported
LIST, MAP, SOURCE, NONUMBER, NOTEST, NOOPT, XREF	LANGX file	Yes	Supported	Supported	Supported

Preparing Enterprise COBOL for z/OS® Version 3 and COBOL for OS/390® and VM programs

Perform the following steps for compiling your Enterprise COBOL for z/OS® Version 3 and COBOL for OS/390® and VM programs using the compiler options suggested in Table 4: Examples of compiler options and source information files that are supported by ADFz products for Enterprise COBOL for z/OS Version 3 and COBOL for OS/390 and VM on page 37:

1. Create libraries (PDSE is suggested unless PDS is required in your organization) for SYSDEBUG files. Allocate one or more SYSDEBUG libraries for each environment, such as test, and production.
2. Create a corresponding SYSDEBUG library for each load library. Specify `LRECL=(80 to 1024),RECFM=FB,BLKSIZE=(multiple of lrecl < 32K)`.
3. For all programs in both test and production environments, use `TEST(NONE,SYM,SEPARATE),LIST,MAP,SOURCE,NONUMBER,XREF(SHORT)`.

   `TEST` is required by z/OS® Debugger.

   The `SEPARATE` suboption produces a SYSDEBUG file. Specifying `NONE` with `SEPARATE` produces a production-ready module that can still be debugged.

   If `OPTIMIZE` is specified, the debugger `JUMPTO` and `GOTO` commands are disabled. These commands are enabled when `NOOPTIMIZE` is specified.
4. The `LIST`, `MAP`, `SOURCE`, and `XREF` options are needed only if a compiler listing or a LANGX file is used to provide source information to Fault Analyzer for z/OS® or Application Performance Analyzer for z/OS®. If a SYSDEBUG file is used with these products, or if you are not using Fault Analyzer for z/OS® or Application Performance Analyzer for z/OS®, the `LIST`, `MAP`, `SOURCE`, and `XREF` options are optional.
5. The `NONUMBER` compiler option is needed only if a compiler listing file is used to provide source information to Application Performance Analyzer for z/OS®. If a SYSDEBUG file is used with Application Performance Analyzer for z/OS®, or if you are not using Application Performance Analyzer for z/OS®, the `NONUMBER` option is optional.
6. Code a SYSDEBUG DD in the JCL of the compiler step.

   ```
   //SYSDEBUG DD DSN= SYSDEBUG.pds(pgmname),DISP=SHR
   ```

   Save the SYSDEBUG file that is produced by the compiler in the SYSDEBUG library and specify a member name that is equal to the program name of your application program. This file is the source information file for z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®.
7. Modify the promotion process to promote SYSDEBUG files. When a load module is promoted, for example from test to production, promote the corresponding SYSDEBUG file or files. A promotion can be a recompile, copy, or move. Perform the same steps with the SYSDEBUG file that you perform with the module during promotion.
8. Optionally, include a z/OS® Debugger Language Environment® exit module into the load module during the linkage editor step. This inclusion is one way to enable z/OS® Debugger panel 6 in ISPF, a simple panel-driven method to start the debugger automatically when a program runs, without JCL changes, based on the program name and user ID. Use module EQADBCXT for batch programs (including IMS™ batch), EQADICXT for IMS/TM programs and EQADDCXT for DB2® stored procedures. Do not include the exit module for CICS® programs.

   You can also use module EQAD3CXT for batch programs, IMS/TM, IMS™ BTS programs, and DB2® type MAIN stored procedures.

Sample JCL for compiling Enterprise COBOL for z/OS® Version 3 programs

Here is a JCL example for compiling an Enterprise COBOL for z/OS® Version 3 program for use with the ADFz family of products. This example is a generic sample, and might not meet all your requirements.

Notice that a `TEST` option is specified. Code the correct suboption of the `TEST` compiler option for the version of the compiler that you are using. You can also code any other compatible compiler options that are required by your programs.

Also, notice that a SYSDEBUG DD statement was coded. This statement indicates the source information file that the compiler produces. It refers to a SYSDEBUG library that is a PDS or PDSE. The member name must be the same as the program name.

For Enterprise COBOL for z/OS®, these are the only required changes.

However, there is an optional change in the linkage editor step. The example shows that a special Language Environment® exit module is included in the application load module. Although this exit module is not required, it enables the use of z/OS® Debugger panel 6, which makes the debugger easier to start in some environments. If you prefer to use panel 6 to start z/OS® Debugger, this method is one way to enable it. If you do not plan to use z/OS® Debugger panel 6, then do not include an exit module.

```
//*     - - -  ADD A JOB CARD ABOVE THIS LINE  - - -
//*
//*  SAMPLE JCL TO PREPARE AN ENTERPRISE COBOL PROGRAM
//*  FOR THE IBM ZSERIES ADFz PRODUCTS:
//*     FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//*  NOTES:
//*
//*   COMPILER:
//*    1. A TEST COMPILER PARM IS REQUIRED FOR DEBUG TOOL
//*    2. COMPILER PARM TEST(NONE,SYM,SEP) HAS THREE ADVANTAGES:
//*         - THE MODULE IS READY FOR DEBUG TOOL
//*         - THE MODULE IS PRODUCTION-READY (NO RUN-TIME OVERHEAD)
//*         - A SYSDEBUG FILE IS CREATED THAT CAN BE USED BY DT,FA,APA
//*    3. COMPILER PARMS LIST,MAP,SOURCE,XREF ARE REQUIRED IF YOU PLAN
//*       TO USE THE COMPILER LISTING WITH FA OR APA, OR IPVLANGX
//*    4. COMPILER PARM NOOPT IS OPTIONAL.  HOWEVER, THE DEBUG TOOL
//*       COMMANDS JUMPTO AND GOTO WILL NOT BE AVAILABLE IF
//*       THE OPT PARM IS USED
//*
//*   BINDER (LINKAGE EDITOR):
//*    5. THE INCLUDE FOR MODULE EQAD?CXT IS *OPTIONAL*.  IT IS AN
//*       LE EXIT MODULE THAT CAN BE USED TO START DEBUG TOOL.
//*       UNDERSTAND THE METHODS AVAILABLE FOR STARTING DEBUG TOOL,
//*       AND CHOOSE WHETHER YOU WANT TO USE THE LE EXITS.
//*         IF YOU USE THIS METHOD, LOAD THE CORRECT EXIT MODULE:
//*            EQADBCXT: FOR BATCH PROGRAMS
//*            EQADICXT: FOR ONLINE IMS PROGRAMS
//*            EQADDCXT: FOR DB2 STORED PROCEDURES (OF TYPE MAIN AND SUB)
//*           (for SUB this is supported only for invocations through call_sub)
//*            (DO NOT INCLUDE AN EXIT FOR CICS PROGRAMS)
//*            YOU CAN ALSO USE MODULE EQAD3CXT FOR BATCH PROGRAMS, ONLINE IMS
//*            PROGRAMS, DB2 TYPE MAIN STORED PROCEDURES.
//*
//*  SET PARMS FOR THIS COMPILE:
//*  ---------------------------
//   SET MEM=SAM1                             PROGRAM NAME
//   SET COBOLLIB='IGY.V3R4.SIGYCOMP'         COBOL COMPILER LOADLIB
//   SET DTLIB='EQAW.SEQAMOD'                 DEBUG TOOL LOADLIB
//   SET LELIB='CEE.SCEELKED'                 LE LINKEDIT LIBRARY
```

```
//   SET UNITDEV=SYSALLDA                    UNIT FOR TEMP FILES
//*
//*  ****************************
//*        COMPILE STEP
//*  ****************************
//COMPILE  EXEC PGM=IGYCRCTL,REGION=0M,
//   PARM=('TEST(NONE,SYM,SEPARATE),LIST,MAP,SOURCE,NONUMBER,XREF(SHORT)')
//STEPLIB  DD DISP=SHR,DSN=&COBOLLIB
//SYSIN    DD DISP=SHR,DSN=&SYSUID..ADLAB.SOURCE(&MEM)
//SYSLIB   DD DISP=SHR,DSN=&SYSUID..ADLAB.COPYLIB
//SYSPRINT DD DISP=SHR,DSN=&SYSUID..ADLAB.LISTING(&MEM)
//SYSDEBUG DD DISP=SHR,DSN=&SYSUID..ADLAB.SYSDEBUG(&MEM)
//SYSLIN   DD DISP=(MOD,PASS),DSN=&&LOADSET,UNIT=&UNITDEV,
//            SPACE=(80,(10,10))
//SYSUT1   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT2   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT3   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT4   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT5   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT6   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT7   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//*
//CBLPRINT  EXEC PGM=IEBGENER,REGION=0M
//SYSPRINT  DD SYSOUT=*
//SYSUT1    DD DSN=&SYSUID..ADLAB.LISTING(&MEM),DISP=SHR
//SYSUT2    DD SYSOUT=*
//SYSIN     DD DUMMY
//*  **********************************
//*        LINK-EDIT (BINDER) STEP
//*  **********************************
//LKED EXEC PGM=IEWL,REGION=0M,COND=(5,LT,COMPILE),PARM='LIST,XREF'
//SYSLIB   DD DISP=SHR,DSN=&LELIB
//DTLIB    DD DISP=SHR,DSN=&DTLIB
//SYSLMOD  DD DSN=&SYSUID..ADLAB.LOAD(&MEM),DISP=SHR
//SYSLIN   DD DISP=(OLD,DELETE),DSN=&&LOADSET
//*  INCLUDING A DEBUG TOOL LE EXIT (EQADBCXT, EQADDCXT, EQADICXT OR EQAD3CXT)
//*  IS OPTIONAL.
//*  AN EXIT ENABLES STARTING DEBUG TOOL USING THE USER EXIT DATA SET UTILITY
//*  (ONE OF THE DEBUG TOOL ISPF UTILITIES)
//*  //        DD *
//*   INCLUDE DTLIB(EQADBCXT)
//SYSPRINT DD SYSOUT=*
//SYSUT1   DD UNIT=&UNITDEV,DCB=BLKSIZE=1024,SPACE=(1024,(200,20))
```

COBOL for MVS™ and VM programs

The following table shows various compiler options that can be used to prepare COBOL for MVS™ and VM programs for use with the ADFz family of products (z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the load module produced is suitable for a production environment. Load modules suitable for a production environment have no significant runtime overhead.

Table 5. Examples of compiler options and source information files that are supported by ADFz products for COBOL for MVS™ and VM

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
TEST(ALL, SYM), LIST, MAP, SOURCE, NOOPT, NONUMBER, XREF(SHORT)	Compiler listing	No	Suggested for test. (Using z/OS® Debugger in production for this compiler is not suggested.)		
NOTEST, LIST, MAP, SOURCE, NONUMBER, XREF(SHORT)		Yes	N/A	Suggested for production	
NOTEST, LIST, MAP, SOURCE, NONUMBER, XREF(SHORT)	LANGX file	Yes	N/A	Supported	Supported

Preparing COBOL for MVS™ and VM programs

Perform the following steps for compiling your COBOL for MVS™ and VM programs:

1. Create libraries (PDSE is suggested unless PDS is required in your organization) for compiler listing files. Allocate one or more compiler listing libraries for each environment, such as test and production.
2. Create a corresponding listing library for each load library. Specify `LRECL=133,RECFM=FBA,BLKSIZE=(multiple of lrecl < 32K)`.
3. For all programs, such as batch, CICS®, and IMS™:
   - In test environments, specify compiler options `TEST(ALL,SYM),NOOPT,LIST,MAP,SOURCE,NONUMBER,XREF(SHORT)` to create a module that can be used with z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®.

     `TEST` is required for z/OS® Debugger.

     The `ALL` suboption adds debug hooks, which add some runtime overhead.

     `SYM` stores symbolics data that is required by z/OS® Debugger into the module, which can make it significantly larger.

     The other options format the compiler listing as required by z/OS® Debugger, Fault Analyzer for z/OS®, and Application Performance Analyzer for z/OS®.

- In production environments, specify compiler options `NOTEST,LIST,MAP,SOURCE,NONUMBER,XREF(SHORT)` to create a production-ready module that can be used with Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS® (but not z/OS® Debugger). Specify `OPTIMIZE` if preferred.

  `NOTEST` disables source level debugging with z/OS® Debugger, but can provide better performance and smaller module size.

  The other options (except `OPTIMIZE`) format the compiler listing as required by Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®.

4. Modify the SYSPRINT DD in the JCL of the compiler step to refer to a file.

   ```
   //SYSPRINT DD DSN= compiler.listing.pds(pgmname),DISP=SHR
   ```

   Save the compiler listing in a file in the compiler listing library and specify a member name that is equal to the program name of your application program. This file is the source information file for z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®.
5. Modify the promotion process to promote compiler listing files. When a load module is promoted, for example, from test to production, promote the corresponding compiler listing file or files. A promotion can be a recompile, a copy, or a move. Perform the same steps with the compiler listing file that you perform with the module during promotion.
6. Optionally, include a z/OS® Debugger Language Environment® exit module into the load module during the linkage editor step. This inclusion is one way to enable z/OS® Debugger panel 6 in ISPF, a simple panel-driven method to start the debugger automatically when a program runs, without JCL changes, that is based on the program name and user ID. Use module EQADBCXT for batch programs (including IMS™ batch), EQADICXT for IMS/TM programs and EQADDCXT for DB2® stored procedures. Do not include the exit module for CICS® programs.

   You can also use module EQAD3CXT for batch programs, IMS/TM, IMS™ BTS programs, and DB2® type MAIN stored procedures.

Sample JCL for compiling COBOL for MVS™ and VM programs

Here is a JCL example for compiling a COBOL for MVS™ and VM program for use with the ADFz family of products. This sample is a generic sample, and might not meet all your requirements.

Notice that a `TEST` option is specified. Code the correct suboptions of the `TEST` compiler option for the version of the compiler that you are using. You can also code any other compatible compiler options that are required by your programs.

Also, notice that the SYSPRINT DD refers to a permanent file. This file is the source information file that the compiler produces. It refers to a listing library that is a PDS or PDSE. The member name must be the same as the program name. For COBOL for MVS™ and VM, these are the only required changes.

However, there is an optional change in the linkage editor step. The example shows that a special Language Environment® exit module is included in the application load module. Although this exit module is not required, it enables the use of z/OS® Debugger panel 6, which makes the debugger easier to start in some environments. If you prefer to use panel 6 to start z/OS® Debugger, this method is one way to enable it. If you do not plan to use z/OS® Debugger panel 6, then do not include an exit module.

```
//*     - - -  ADD A JOB CARD ABOVE THIS LINE  - - -
//*
//*  SAMPLE JCL TO PREPARE A COBOL FOR MVS AND VM PROGRAM
//*  FOR THE IBM ZSERIES ADFz PRODUCTS:
//*     FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//*  NOTES:
//*
//*   COMPILER:
//*    1. A TEST COMPILER PARM IS REQUIRED FOR DEBUG TOOL
//*    2. COMPILER PARMS LIST,MAP,SOURCE,XREF ARE REQUIRED IF YOU PLAN
//*       TO USE THE COMPILER LISTING WITH FA OR APA, OR IPVLANGX
//*    3. COMPILER PARM NOOPT IS OPTIONAL.  HOWEVER, THE DEBUG TOOL
//*       COMMANDS JUMPTO AND GOTO WILL NOT BE AVAILABLE IF
//*       THE OPT PARM IS USED
//*
//*   BINDER (LINKAGE EDITOR):
//*    4. THE INCLUDE FOR MODULE EQAD?CXT IS *OPTIONAL*.  IT IS AN
//*       LE EXIT MODULE THAT CAN BE USED TO START DEBUG TOOL.
//*       UNDERSTAND THE METHODS AVAILABLE FOR STARTING DEBUG TOOL,
//*       AND CHOOSE WHETHER YOU WANT TO USE THE LE EXITS.
//*         IF YOU USE THIS METHOD, LOAD THE CORRECT EXIT MODULE:
//*            EQADBCXT: FOR BATCH PROGRAMS
//*            EQADICXT: FOR ONLINE IMS PROGRAMS
//*            EQADDCXT: FOR DB2 STORED PROCEDURES (OF TYPE MAIN AND SUB)
//*           (for SUB this is supported only for invocations through call_sub)
//*            (DO NOT INCLUDE AN EXIT FOR CICS PROGRAMS)
//*           YOU CAN ALSO USE MODULE EQAD3CXT FOR BATCH PROGRAMS, ONLINE IMS
//*            PROGRAMS, DB2 TYPE MAIN STORED PROCEDURES.
//*
//*  SET PARMS FOR THIS COMPILE:
//*  ---------------------------
//   SET MEM=SAM1                            PROGRAM NAME
//   SET COBOLLIB='IGY.SIGYCOMP'             COBOL COMPILER LOADLIB
//   SET DTLIB='EQAW.SEQAMOD'                DEBUG TOOL LOADLIB
//   SET LELIB='CEE.SCEELKED'                LE LINKEDIT LIBRARY
//   SET UNITDEV=SYSALLDA                    UNIT FOR TEMP FILES
//*
//*  ****************************
//*        COMPILE STEP
//*  ****************************
////COMPILE  EXEC PGM=IGYCRCTL,REGION=0M,
//   PARM=(NOTEST,LIST,MAP,SOURCE,NONUMBER,XREF(SHORT)')
//STEPLIB  DD DISP=SHR,DSN=&COBOLLIB
//SYSIN    DD DISP=SHR,DSN=&SYSUID..ADLAB.SOURCE(&MEM)
//SYSLIB   DD DISP=SHR,DSN=&SYSUID..ADLAB.COPYLIB
//SYSPRINT DD DISP=SHR,DSN=&SYSUID..ADLAB.LISTING(&MEM)
//SYSDEBUG DD DISP=SHR,DSN=&SYSUID..ADLAB.SYSDEBUG(&MEM)
//SYSLIN   DD DISP=(MOD,PASS),DSN=&&LOADSET,UNIT=&UNITDEV,
//            SPACE=(80,(10,10))
//SYSUT1   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT2   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT3   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT4   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT5   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT6   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT7   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//*
```

```
//CBLPRINT  EXEC PGM=IEBGENER,REGION=0M
//SYSPRINT  DD SYSOUT=*
//SYSUT1    DD DSN=&SYSUID..ADLAB.LISTING(&MEM),DISP=SHR
//SYSUT2    DD SYSOUT=*
//SYSIN     DD DUMMY
//*  ********************************
//*        LINK-EDIT (BINDER) STEP
//*  ********************************
//LKED EXEC PGM=IEWL,REGION=0M,COND=(5,LT,COMPILE),PARM='LIST,XREF'
//SYSLIB   DD DISP=SHR,DSN=&LELIB
//*** DTLIB    DD DISP=SHR,DSN=&DTLIB
//SYSLMOD  DD DSN=&SYSUID..ADLAB.LOAD(&MEM),DISP=SHR
//SYSLIN   DD DISP=(OLD,DELETE),DSN=&&LOADSET
//*  INCLUDING A DEBUG TOOL LE EXIT (EQADBCXT, EQADDCXT, EQADICXT OR EQAD3CXT)
//*  IS OPTIONAL.
//*  AN EXIT ENABLES STARTING DEBUG TOOL USING THE USER EXIT DATA SET UTILITY
//*  (ONE OF THE DEBUG TOOL ISPF UTILITIES)
//*  //        DD *
//*   INCLUDE DTLIB(EQADBCXT)
//SYSPRINT DD SYSOUT=*
//SYSUT1   DD UNIT=&UNITDEV,DCB=BLKSIZE=1024,SPACE=(1024,(200,20))
```

VS COBOL II programs

If you are currently using the `TEST` option to compile your programs, consider using `NOTEST`. Using `NOTEST` allows you to take advantage of z/OS® Debugger functionality that is not available when compiling with the `TEST` option. Examples of z/OS® Debugger functions that are available when compiling with the `NOTEST` option include the automonitor feature and using `AT ENTRY` *program name* breakpoints. Compiling with `NOTEST` also allows you to generate a module that can be debugged but does not incur extra overhead when running without the debugger.

The following table shows various compiler options that can be used to prepare VS COBOL II programs for use with the ADFz family of products (z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the load module produced is suitable for a production environment. Load modules suitable for a production environment have no significant runtime overhead.

Table 6. Examples of compiler options and source information files that are supported by ADFz products for VS COBOL II

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
NOTEST, LIST, MAP, SOURCE, XREF, NONUMBER, NOOFFSET	Compiler listing	Yes	N/A	Supported	Supported
NOTEST, LIST, MAP, SOURCE, XREF, NUMBER		Yes	N/A	Supported	N/A

Table 6. Examples of compiler options and source information files that are supported by ADFz products for VS COBOL II

(continued)

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
NOTEST, LIST, MAP, NOOPT, SOURCE, XREF, NONUMBER	LANGX file	Yes	Suggested for production and test		

Preparing VS COBOL II programs

Perform the following steps for compiling your VS COBOL II programs using the compiler options suggested in Table 6: Examples of compiler options and source information files that are supported by ADFz products for VS COBOL II on page 44:

1. Allocate libraries (PDSE is suggested unless PDS is required for your organization) for LANGX files. Allocate one or more LANGX libraries for each environment, such as test and production.
2. Create a corresponding LANGX library for each load library. Specify `LRECL=1562 or greater,RECFM=VB,BLKSIZE= lrecl +4 to 32k`.
3. For all programs, such as batch, CICS®, and IMS™, in both test and production environments, compile with `NOTEST,LIST,MAP,NOOPT,SOURCE,XREF,NONUMBER` compiler options.
4. Modify the SYSPRINT DD in the compiler step to refer to a file. It can be either a permanent or temporary file. This file is the input to the IPVLANGX utility.
5. Add a step after the compiler step to run the ADFz IPVLANGX utility. This utility program reads the compiler listing and generates a LANGX file. This file is the source information file for z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®. Save the LANGX file in the LANGX file library and specify a member name that is equal to the program name of your application program.
6. If the module is linked with Language Environment® services, optionally include a z/OS® Debugger Language Environment® exit module into the load module during the linkage editor step. This approach is one way to enable the z/OS® Debugger panel 6 in ISPF, a simple panel-driven method to start the debugger automatically when a program runs, without JCL changes, based on the program name and user ID. Use module EQADBCXT for batch programs (including IMS™ batch), EQADICXT for IMS/TM programs and EQADDCXT for DB2® stored procedures. Do not include the exit module for CICS® programs or if the module is not linked with Language Environment® services (it is linked with COBOL II runtime services).

You can also use module EQAD3CXT for batch programs, IMS/TM, IMS™ BTS programs, and DB2® type MAIN stored procedures.

7. Modify the promotion process to promote LANGX files. When a load module is promoted, for example, from test to production, promote the corresponding LANGX file or files. A promotion can be a recompile, copy, or move. Perform the same steps with the LANGX file that you perform with the module during promotion.

Sample JCL for compiling VS COBOL II programs

Here is an example of JCL for compiling a VS COBOL II program for use with the ADFz family of products. This sample is a generic sample, and might not meet all your requirements.

Notice the compiler options that are used and notice that the compiler listing is passed to an added step that generates a LANGX file. The compiler listing can be stored in a permanent file or can be passed in a temporary file. For VS COBOL II, these are the only required changes.

However, there is an optional change in the linkage editor step. The example includes a special Language Environment® exit module in the application load module. Although this exit module is not required, it enables the use of z/OS® Debugger panel 6, which makes the debugger easier to start in some environments. If you prefer to use panel 6 to start z/OS® Debugger, this inclusion is one way to enable it. If you do not plan to use z/OS® Debugger panel 6, then do not include an exit module. Do not include the exit module for CICS® programs or if the module is not linked with Language Environment® services (it is linked with COBOL II runtime services).

```
//*     - - -  ADD A JOB CARD ABOVE THIS LINE  - - -
//*
//*  SAMPLE JCL TO PREPARE A VS COBOL II PROGRAM
//*  FOR THE IBM ZSERIES ADFz PRODUCTS:
//*     FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//*  NOTES:
//*
//*   COMPILER:
//*    1. COMPILER OPTIONS LIST,MAP,SOURCE,XREF ARE REQUIRED IF YOU
//*       PLAN TO USE THE LISTING WITH AN ADFz PRODUCT, OR TO
//*       PROCESS THE LISTING WITH THE IPVLANGX UTILITY
//*    2. COMPILER OPTION NOTEST IS SUGGESTED FOR ALL COBOL II
//*       PROGRAMS, EVEN IF IBM DEBUG TOOL FOR Z/OS WILL BE USED
//*
//*   BINDER (LINKAGE EDITOR):
//*    3. IN THIS EXAMPLE, THE MODULE IS LINKED WITH LANGUAGE
//*       ENVIRONMENT RUNTIME SERVICES. THIS IS CONTROLLED BY THE
//*       LIBRARY OR LIBRARIES SPECIFIED IN THE SYSLIB DD IN THE
//*       BINDER STEP.
//*    4. THE INCLUDE FOR MODULE EQAD?CXT IS *OPTIONAL*.  IT IS AN
//*       LE EXIT MODULE THAT CAN BE USED TO START DEBUG TOOL.
//*       UNDERSTAND THE METHODS AVAILABLE FOR STARTING DEBUG TOOL,
//*       AND CHOOSE WHETHER YOU WANT TO USE THE LE EXITS.
//*         IF YOU USE THIS METHOD, LOAD THE CORRECT EXIT MODULE:
//*            EQADBCXT: FOR BATCH PROGRAMS
//*            EQADICXT: FOR ONLINE IMS PROGRAMS
//*            EQADDCXT: FOR DB2 STORED PROCEDURES (OF TYPE MAIN AND SUB)
//*           (for SUB this is supported only for invocations through call_sub)
```

```
//*         (DO NOT INCLUDE AN EXIT FOR CICS PROGRAMS, OR FOR
//*          PROGRAMS LINKED WITH THE COBOL II RUNTIME SERVICES
//*          INSTEAD OF LANGUAGE ENVIRONMENT RUNTIME SERVICES)
//*          YOU CAN ALSO USE MODULE EQAD3CXT FOR BATCH PROGRAMS, ONLINE IMS
//*          PROGRAMS, DB2 TYPE MAIN STORED PROCEDURES.
//*
//*  SET OPTIONS FOR THIS COMPILE:
//*  ---------------------------
//   SET MEM=SAMII1                          PROGRAM NAME
//   SET COB2COMP='IGY.V1R4M0.COB2COMP'      COBOL II COMPILER LIB
//   SET DTLIB='EQAW.SEQAMOD'                DEBUG TOOL LOADLIB
//   SET LELKED='CEE.SCEELKED'               LE LINK LIBRARY
//   SET LELIB='CEE.SCEERUN'                 LE RUNTIME LIBRARY
//   SET UNITDEV=SYSALLDA                    TEMP data set UNIT
//   SET LANGX='IPVLANGX'                    IPVLANGX UTILITY PROGRAM
//   SET LANGXLIB='IPV.SIPVMODA'             LIB FOR IPVLANGX UTILITY
//*    NOTE: USE THE IPVLANGX FACILITY SHIPPED WITH THE COMMON COMPONENT.
//*
//*  ****************************
//*        COMPILE STEP
//*  ****************************
//COMPILE  EXEC PGM=IGYCRCTL,REGION=4M,
//   PARM=('NOTEST,LIST,MAP,NOOPT,SOURCE,XREF,NONUMBER',
//         'RES,APOST,LIB,DYNAM,NORENT,NOSSRANGE')
//STEPLIB  DD DISP=SHR,DSN=&COB2COMP
//SYSIN    DD DISP=SHR,DSN=&SYSUID..ADLAB.SOURCE(&MEM)
//SYSLIB   DD DISP=SHR,DSN=&SYSUID..ADLAB.COPYLIB
//SYSPRINT DD DISP=SHR,DSN=&SYSUID..ADLAB.LISTING(&MEM)
//SYSLIN   DD DISP=(MOD,PASS),DSN=&&LOADSET,UNIT=&UNITDEV,
//            SPACE=(80,(10,10))
//SYSUT1   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT2   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT3   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT4   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT5   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT6   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT7   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//*
//CBLPRINT  EXEC PGM=IEBGENER,REGION=0M
//SYSPRINT  DD SYSOUT=*
//SYSUT1    DD DSN=&SYSUID..ADLAB.LISTING(&MEM),DISP=SHR
//SYSUT2    DD SYSOUT=*
//SYSIN     DD DUMMY
//*
//* **********************************
//* STEP TO GENERATE A LANGX FILE
//* **********************************
//LANGX EXEC PGM=&LANGX,REGION=32M,
//   PARM='(COBOL ERROR 64K CREF'
//STEPLIB  DD DISP=SHR,DSN=&LANGXLIB
//         DD DISP=SHR,DSN=&LELIB
//LISTING  DD DSN=&SYSUID..ADLAB.LISTING(&MEM),DISP=SHR
//IDILANGX DD DISP=SHR,DSN=&SYSUID..ADLAB.EQALANGX(&MEM)
//*
//*  **********************************
//*        LINK-EDIT (BINDER) STEP
//*  **********************************
//LKED EXEC PGM=IEWL,REGION=0M,COND=(5,LT,COMPILE),PARM='LIST,XREF'
```

```
//SYSLIB   DD DISP=SHR,DSN=&LELKED
//DTLIB    DD DISP=SHR,DSN=&DTLIB
//SYSLMOD  DD DSN=&SYSUID..ADLAB.LOAD(&MEM),DISP=SHR
//SYSLIN   DD DISP=(OLD,DELETE),DSN=&&LOADSET
//*  INCLUDING A DEBUG TOOL LE EXIT (EQADBCXT, EQADDCXT, EQADICXT OR EQAD3CXT)
//* IS OPTIONAL
//*  AN EXIT ENABLES STARTING DEBUG TOOL USING THE USER EXIT DATA SET UTILITY
//*  (ONE OF THE DEBUG TOOL ISPF UTILITIES)
//*  //        DD *
//*   INCLUDE DTLIB(EQADBCXT)
//SYSPRINT DD SYSOUT=*
//SYSUT1   DD UNIT=&UNITDEV,DCB=BLKSIZE=1024,SPACE=(1024,(200,20))
```

OS/VS COBOL programs

The following table shows various compiler options that can be used to prepare OS/VS COBOL programs for use with the ADFz family of products (z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the load module produced is suitable for a production environment. Load modules suitable for a production environment have no significant runtime overhead.

Table 7. Examples of compiler options and source information files that are supported by ADFz products for OS/VS COBOL

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
DMAP, NOCLIST, NOLST, PMAP, SOURCE, VERB, XREF(SHORT)	Compiler listing	Yes	N/A	Supported	Supported
(LIST, NOPMAP) or (CLIST, NOPMAP) or (CLIST, PMAP)		Yes	N/A	Supported	N/A
NOBATCH, NOCLIST, NOCOUNT, DMAP, NOLST, PMAP, SOURCE, NOSYMDMP, NOTEST, NOOPT, VERB, XREF(SHORT)	LANGX file	Yes	Suggested for production and test		

Preparing OS/VS COBOL programs

Perform the following steps for compiling your OS/VS COBOL programs:

1. Allocate libraries (PDSE is suggested unless PDS is required for your organization) for LANGX files. Allocate one or more LANGX libraries for each environment, such as test and production.
2. Create a corresponding LANGX library for each load library. Specify `LRECL=1562 or greater,RECFM=VB,BLKSIZE= lrecl +4 to 32k`.
3. For all programs, such as batch, CICS®, and IMS™, in both test and production environments, compile with the `NOBATCH, NOCLIST, NOCOUNT, DMAP, NOLST, PMAP, SOURCE, NOSYMDMP, NOTEST, NOOPT, VERB, XREF(SHORT)` compiler options. The module is production-ready and can be debugged using z/OS® Debugger.
4. Modify the SYSPRINT DD in the compiler step to refer to a file. It can be either a permanent or temporary file. This is the input to the IPVLANGX utility.
5. Add a step after the compiler step to run the ADFz IPVLANGX utility. This utility program reads the compiler listing and generates a LANGX file, which is the source information file for z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®. Save the LANGX file in the LANGX file library, and specify a member name that is equal to the program name of your application program.
6. Modify the promotion process to promote LANGX files. When a load module is promoted, for example, from test to production, promote the corresponding LANGX file or files. A promotion can be a recompile, copy, or move. Perform the same steps with the LANGX file that you perform with the module during promotion.

Sample JCL for compiling OS/VS COBOL programs

Here is a JCL example for compiling an OS/VS program for use with the ADFz family of products:

```
//*     - - -  ADD A JOB CARD ABOVE THIS LINE  - - -
//*
//*  SAMPLE JCL TO PREPARE AN OS VS COBOL PROGRAM
//*  FOR THE IBM ZSERIES ADFz PRODUCTS:
//*     FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//*  NOTES:
//*
//*   COMPILER:
//*    -  COMPILER PARMS DMAP,NOCLIST,NOLST,PMAP,SOURCE,VERB,XREF
//*       ARE REQUIRED IF YOU PLAN TO USE THE COMPILER LISTING WITH
//*       ADFz AND/OR PROCESS IT WITH IPVLANGX
//*
//*   A STEP THAT PROCESSES THE SYSADATA FILE,
//*   AND CREATES A LANGX FILE IS NEEDED.
//*
//*  SET PARMS FOR THIS COMPILE:
//*  --------------------------
// SET MEM=SAMOS1                       PROGRAM NAME
// SET OSVSCOMP='IGY.VSCOLIB'           OS VS COBOL COMPILER LIBRARY
// SET LELIB='CEE.SCEELKED'             LE LINKEDIT LIBRARY
// SET UNITDEV=SYSALLDA                 UNIT FOR TEMP FILES
// SET SCEERUN='CEE.SCEERUN'            LANGUAGE ENVIRON SCEERUN LIB
// SET LANGX='IPVLANGX'                 IPVLANGX UTILITY PROGRAM
// SET LANGXLIB='IPV.SIPVMODA'          LIBRARY FOR IPVLANGX UTILITY
//*    NOTE: USE THE IPVLANGX FACILITY SHIPPED WITH THE COMMON COMPONENT.
//*
//*  ****************************
//*        COMPILE STEP
//*  ****************************
//COMPILE  EXEC PGM=IKFCBL00,REGION=4M,
```

```
//   PARM=('DMAP,NOCLIST,NOLST,NOOPT,SOURCE,VERB,XREF(SHORT)')
//*   FOR DT (CHECK DEFAULTS): NOBATCH,NOCOUNT,PMAP,NOSYMDMP,NOTEST
//STEPLIB  DD DISP=SHR,DSN=&OSVSCOMP
//SYSIN    DD DISP=SHR,DSN=&SYSUID..ADLAB.SOURCE(&MEM)
//SYSLIB   DD DISP=SHR,DSN=&SYSUID..ADLAB.COPYLIB
//SYSPRINT DD DISP=SHR,DSN=&SYSUID..ADLAB.OSVSCOB.LISTING(&MEM)
//SYSLIN   DD DISP=(MOD,PASS),DSN=&&LOADSET,UNIT=&UNITDEV,
//            SPACE=(80,(10,10))
//SYSUT1   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT2   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT3   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT4   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT5   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT6   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//SYSUT7   DD SPACE=(80,(10,10),,,ROUND),UNIT=&UNITDEV
//*
//CBLPRINT  EXEC PGM=IEBGENER,REGION=0M
//SYSPRINT  DD SYSOUT=*
//SYSUT1    DD DSN=&SYSUID..ADLAB.OSVSCOB.LISTING(&MEM),DISP=SHR
//SYSUT2    DD SYSOUT=*
//SYSIN     DD DUMMY
//*
//*  **********************************
//*     STEP TO GENERATE LANGX FILE
//*  **********************************
//LANGX    EXEC PGM=&LANGX,REGION=32M,
//  PARM='(COBOL ERROR 64K CREF'
//STEPLIB  DD DISP=SHR,DSN=&LANGXLIB
//         DD DISP=SHR,DSN=&SCEERUN
//LISTING  DD DSN=&SYSUID..ADLAB.OSVSCOB.LISTING(&MEM),DISP=SHR
//IDILANGX DD DISP=SHR,DSN=&SYSUID..ADLAB.EQALANGX(&MEM)
//*
//*  **********************************
//*        LINK-EDIT (BINDER) STEP
//*  **********************************
//LKED EXEC PGM=IEWL,REGION=0M,COND=(5,LT,COMPILE),PARM='LIST,XREF'
//SYSLIB   DD DISP=SHR,DSN=&LELIB
//SYSLMOD  DD DSN=&SYSUID..ADLAB.LOAD(&MEM),DISP=SHR
//SYSLIN   DD DISP=(OLD,DELETE),DSN=&&LOADSET
//SYSPRINT DD SYSOUT=*
//SYSUT1   DD UNIT=&UNITDEV,DCB=BLKSIZE=1024,SPACE=(1024,(200,20))
```

Enterprise PL/I Version 3.7 and later programs

The following table shows various compiler options that can be used to prepare Enterprise PL/I Version 3.7 and later programs for use with the ADFz family of products (z/OS® Debugger, IBM® Fault Analyzer for z/OS® and IBM® Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the load module produced has no significant runtime overhead and therefore is suitable for a production environment.

Table 8. Examples of compiler options and source information files that are supported by ADFz products for Enterprise PL/I Version 3.7 and later

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
For Enterprise PL/I Version 3.7: TEST(ALL, SYM, NOHOOK, SEPARATE, SEPNAME, AALL), NOPT, AGGREGATE, ATTRIBUTES (FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL) For Enterprise PL/I Version 3.8 and later: TEST(ALL, SYM, NOHOOK, SEPARATE, SEPNAME), LISTVIEW (AALL), NOPT, AGGREGATE, ATTRIBUTES (FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL)	SYSDEBUG file used by z/OS® Debugger and Fault Analyzer for z/OS®. LANGX file used by Application Performance Analyzer for z/OS®	Although the module is larger than a module compiled with the NOTEST option, you can use the module in production if needed.	Suggested for test. You can also use these options in a production environment if the increased load module size is not an issue.		
AGGREGATE, ATTRIBUTES (FULL), NOBLKOFF, LIST, MAP, NEST, NOTEST, NONUMBER, OFFSET,	Compiler listing	Yes	N/A	Supported	N/A
	LANGX file	Yes	N/A	Suggested for production and test	

Table 8. Examples of compiler options and source information files that are supported by ADFz products for Enterprise PL/I Version 3.7 and later

(continued)

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
OPTIONS, SOURCE, STMT, XREF(FULL)					

Preparing Enterprise PL/I Version 3.7 and later programs

Perform the following steps for compiling your Enterprise PL/I Version 3.7 and later programs:

1. Create a library (PDSE is suggested unless PDS is required for your organization) for SYSDEBUG files.
   This library is only needed in test environments where debugging is performed using `LRECL=(80 to 1024),RECFM=FB,BLKSIZE=(multiple of lrecl < 32K)`.
2. Allocate one or more LANGX libraries for each environment, such as test and production.
3. Create a corresponding LANGX library for each load library. Specify `LRECL=1562 or greater,RECFM=VB,BLKSIZE= lrecl +4 to 32k`.
4. For all programs, such as batch, CICS®, and IMS™:
   - In test environments:
     - When using the Enterprise PL/I Version 3.7 compiler:

       For all programs, specify the following compiler options:
       `TEST(ALL,SYM,NOHOOK,SEPARATE,SEPNAME,AALL), NOPT, AGGREGATE, ATTRIBUTES(FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL)`.
     - When using the Enterprise PL/I Version 3.8 and later compilers:

       For all programs, specify the following compiler options: `TEST(ALL,SYM,NOHOOK,SEPARATE,SEPNAME), LISTVIEW(AALL), NOPT, AGGREGATE, ATTRIBUTES(FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL)`.

   `TEST`(…) and `NOPT` are required by z/OS® Debugger.

   The `SEPARATE` suboption produces a SYSDEBUG file. Save the SYSDEBUG file that is created by the compiler for z/OS® Debugger and optionally, IBM® Fault Analyzer for z/OS®.

   The `AALL (AFTERALL)` suboption of `TEST` or `LISTVIEW` stores program source information in the SYSDEBUG file that contains information after the last preprocessor, such as macros and INCLUDEs. This expanded source information is available in the source window of z/OS® Debugger while debugging.

The other options format the compiler listing as required for the IPVLANGX utility.

Consider using the `TEST(ALL,NOHOOK,SEPARATE)` options for best performance and to produce a module that can be debugged. Depending on the policies in your organization, the module can be considered for production.

- In production environments:
  - When using the Enterprise PL/I Version 3.7 or later compiler:

    For all programs, specify `NOTEST, AGGREGATE, ATTRIBUTES(FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL)`.

  `NOTEST` disables z/OS® Debugger, but produces a smaller load module.

  The other options format the compiler listing as required for the IPVLANGX utility to produce a production-ready module that can be used with IBM® Fault Analyzer for z/OS® and IBM® Application Performance Analyzer for z/OS® (but not z/OS® Debugger).

5. When a `TEST(…SEPARATE)` option is used, code a SYSDEBUG DD in the second compiler step as follows:

```
//SYSDEBUG DD DSN= sysdebug.pds(pgmname),DISP=SHR
```

This is the source information file for z/OS® Debugger, and optionally, IBM® Fault Analyzer for z/OS®. Save it in the SYSDEBUG library, and specify a member name that is equal to the primary entry point name or CSECT name of your application program.

6. Modify the SYSPRINT DD in the compiler step. This file is the compiler listing. Write the listing to either a permanent or temporary file. This file is the input to the IPVLANGX utility.

Note: This compiler typically renames CSECTs according to an internal compiler algorithm. Therefore, it is not recommended to store PL/I compiler listings or side files using CSECT names as they might not be found by IBM® Application Performance Analyzer for z/OS® or IBM® Fault Analyzer for z/OS®. Instead, use the primary entry point name.

7. Add a step after the compile step to run the IPVLANGX utility. This utility reads the compiler listing and generates a LANGX file. This file is the source information file for IBM® Fault Analyzer for z/OS® and IBM® Application Performance Analyzer for z/OS®. Save the LANGX file in the LANGX file library, and specify a member name that is equal to the primary entry point name of your application program.
8. Modify the promotion process to promote LANGX files. When a load module is promoted, for example, from test to production, promote the corresponding LANGX file or files. A promotion can be a recompile, copy, or move. Perform the same steps with the LANGX file that you perform with the module during promotion.
9. If you compile with the TEST option and promote these modules into production, promote the SYSDEBUG file for your production environment.
10. Optionally, include a z/OS® Debugger Language Environment® exit module into the load module during the linkage editor step. This approach is one way to enable z/OS® Debugger panel 6 in ISPF, a simple panel-driven method to start the debugger automatically when a program runs, without JCL changes, based on the program name and

user ID. Use module EQADBCXT for batch programs (including IMS™ batch), EQADICXT for IMS/TM programs and EQADDCXT for DB2® stored procedures. Do not include the exit module for CICS® programs.

You can also use module EQAD3CXT for batch programs, IMS/TM, IMS™ BTS programs, and DB2® type MAIN stored procedures

Sample JCL for compiling Enterprise PL/I for z/OS® Version 3.7 or later programs

Here is a JCL example for compiling an Enterprise PL/I for z/OS® Version 3.7 or later program for use with the ADFz family of products.

```
//* - - - ADD A JOB CARD ABOVE THIS LINE - - -
//*
//* SAMPLE JCL TO PREPARE AN ENTERPRISE PL/I V3.7 OR LATER
//* PROGRAM FOR THE IBM ZSERIES ADFz PRODUCTS:
//* FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//* NOTES:
//*
//* COMPILER:
//* 1. COMPILER PARMS TEST IS REQUIRED FOR DEBUG TOOL
//* 2. COMPILER PARM NOPT IS RECOMMENDED FOR DEBUG TOOL
//* 3. COMPILER PARM:
//*     TEST(ALL,SYM,NOHOOK,SEPARATE,SEPNAME,AALL) (V3.7)
//*     TEST(ALL,SYM,NOHOOK,SEPARATE,SEPNAME),LISTVIEW(AALL), (V3.8+)
//*    IS USED BECAUSE:
//*    - THE MODULE IS READY FOR DEBUG TOOL
//*    - NOHOOK DOES NOT HAVE RUN-TIME CPU OVERHEAD. HOWEVER, THE
//*      MODULE IS LARGER BECAUSE OF STATEMENT TABLE
//*    - A SYSDEBUG FILE IS CREATED THAT CAN BE USED BY DT,FA,APA
//* 4. COMPILER PARMS AGGREGATE,ATTRIBUTES(FULL),NOBLKOFF,LIST,
//*    MAP,NEST,NONUMBER,OPTIONS,SOURCE,STMT,XREF(FULL) ARE NEEDED
//*    TO PROCESS THE COMPILER LISTING WITH IPVLANGX
//*
//* BINDER (LINKAGE EDITOR):
//* 5. THE INCLUDE FOR MODULE EQAD?CXT IS OPTIONAL. IT IS AN
//*    LE EXIT MODULE THAT CAN BE USED TO START DEBUG TOOL.
//*    UNDERSTAND THE METHODS AVAILABLE FOR STARTING DEBUG TOOL,
//*    AND CHOOSE WHETHER YOU WANT TO USE THE LE EXITS.
//*    IF YOU USE THIS METHOD, LOAD THE CORRECT EXIT MODULE:
//*      EQADBCXT: FOR BATCH PROGRAMS
//*      EQADICXT: FOR ONLINE IMS PROGRAMS
//*      EQADDCXT: FOR DB2 STORED PROCEDURES (OF TYPE MAIN AND SUB)
//*           (for SUB this is supported only for invocations through call_sub)
//*    (DO NOT INCLUDE AN EXIT FOR CICS PROGRAMS)
//*     YOU CAN ALSO USE MODULE EQAD3CXT FOR BATCH PROGRAMS, ONLINE IMS
//*          PROGRAMS, DB2 TYPE MAIN STORED PROCEDURES.
//*
//* SET PARMS FOR THIS COMPILE:
//* --------------------------
//  SET MEM=PADSTAT                   PROGRAM NAME
//  SET PLICOMP='IBMZ.V3R7.SIBMZCMP'  PLI COMPILER LOADLIB
//  SET DTLIB='EQAW.SEQAMOD'          DEBUG TOOL LOADLIB
//  SET LEHLQ='CEE'                   LE HIGH LVL QUALIFIER
//  SET UNITDEV=SYSALLDA              UNIT FOR TEMP FILES
//  SET LANGX='IPVLANGX'              IPVLANGX UTILITY PROGRAM
```

```
//  SET LANGXLIB='IPV.SIPVMODA'       LIBRARY FOR IPVLANGX UTILITY
//*    NOTE: USE THE IPVLANGX FACILITY SHIPPED WITH THE COMMON COMPONENT.
//*
//ALLOCOBJ EXEC PGM=IEFBR14 ALLOC OBJ LIB IF NEEDED
//OBJ DD DSN=&SYSUID..ADLAB.OBJ,SPACE=(CYL,(3,1,15)),
// DSORG=PO,RECFM=FB,LRECL=80,BLKSIZE=8000,DISP=(MOD,CATLG)
//*
//* ****************************************
//* COMPILE STEP
//* ****************************************
//COMPILE EXEC PGM=IBMZPLI,REGION=0M,
// PARM=('+DD:OPTIONS')
//* THE +DD:OPTIONS PARAMETER IS USED TO DIRECT THE COMPILER TO
//* GET THE COMPILATION OPTIONS FROM THE OPTIONS DD STATEMENT
//OPTIONS  DD *
TEST(ALL,SYM,NOHOOK,SEPARATE,SEPNAME,AALL),LIST,MAP,SOURCE,
XREF(FULL),NOBLKOFF,AGGREGATE,ATTRIBUTES(FULL),NEST,OPTIONS,NOPT,
STMT,NONUMBER,OFFSET
/*
//*  Note: The above options are for Enterprise PL/I Version 3.7
//*        For Enterprise PL/I Version 3.8+, change the TEST option
//*        to  TEST(ALL,SYM,NOHOOK,SEPARATE,SEPNAME), and add the
//*        LISTVIEW(AALL) option
//STEPLIB  DD DSN=&PLICOMP,DISP=SHR
//         DD DSN=&LEHLQ..SCEERUN,DISP=SHR
//SYSIN    DD DISP=SHR,DSN=&SYSUID..ADLAB.SOURCE(&MEM)
//SYSLIB   DD DISP=SHR,DSN=&SYSUID..ADLAB.COPYLIB
//SYSPRINT DD DISP=SHR,DSN=&SYSUID..ADLAB.ENTPLI.LISTING(&MEM)
//SYSDEBUG DD DISP=SHR,DSN=&SYSUID..ADLAB.SYSDEBUG(&MEM)
//SYSUT1   DD SPACE=(CYL,(5,2),,CONTIG),DCB=BLKSIZE=1024,UNIT=&UNITDEV
//SYSLIN   DD DSN=&SYSUID..ADLAB.OBJ(&MEM),DISP=SHR
//*
//PLIPRINT EXEC PGM=IEBGENER,REGION=0M
//SYSPRINT DD SYSOUT=*
//SYSUT1   DD DSN=&SYSUID..ADLAB.ENTPLI.LISTING(&MEM),DISP=SHR
//SYSUT2   DD SYSOUT=*
//SYSIN    DD DUMMY
//*
//* **********************************
//* STEP TO GENERATE LANGX FILE
//* **********************************
//LANGX EXEC PGM=&LANGX,REGION=32M,
// PARM='(PLI ERROR 64K CREF'
//STEPLIB  DD DISP=SHR,DSN=&LANGXLIB
//         DD DISP=SHR,DSN=&LEHLQ..SCEERUN
//LISTING  DD DSN=&SYSUID..ADLAB.ENTPLI.LISTING(&MEM),DISP=SHR
//IDILANGX DD DISP=SHR,DSN=&SYSUID..ADLAB.EQALANGX(&MEM)
//*
//* **********************************
//* LINK-EDIT (BINDER) STEP
//* **********************************
//LINK EXEC PGM=IEWL,PARM=(LET,MAP,LIST),REGION=0M
//SYSLIB   DD DSN=&LEHLQ..SCEELKED,DISP=SHR
//DTLIB    DD DSN=&DTLIB,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSLMOD  DD DISP=SHR,DSN=&SYSUID..ADLAB.LOAD(&MEM)
//SYSUT1   DD UNIT=SYSDA,SPACE=(TRK,(10,10))
//SYSLIN   DD DSN=&SYSUID..ADLAB.OBJ(&MEM),DISP=(OLD,PASS)
```

```
//*  INCLUDING A DEBUG TOOL LE EXIT (EQADBCXT, EQADDCXT, EQADICXT OR EQAD3CXT)
//* IS OPTIONAL. THE EXIT ENABLES STARTING DEBUG TOOL WITH THE
//* USER EXIT DATA SET UTILITY (ONE OF THE DEBUG TOOL ISPF UTILITIES)
//*
//* //  DD *
//* INCLUDE DTLIB(EQADBCXT)
```

Enterprise PL/I Version 3.5 and Version 3.6 programs

The following table shows various compiler options that can be used to prepare Enterprise PL/I Version 3.5 and Version 3.6 programs for use with the ADFz family of products (z/OS® Debugger, IBM® Fault Analyzer for z/OS® and IBM® Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the load module produced has no significant runtime overhead and therefore is suitable for a production environment.

Table 9. Examples of compiler options and source information files that are supported by ADFz products for Enterprise PL/I Version 3.5 and Version 3.6

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
Preprocess (1st stage) to expand source, In compile (2nd stage): For Enterprise PL/I Version 3.5: TEST(ALL, SYM, NOHOOK, SEPARATE), NOPT, AGGREGATE, ATTRIBUTES (FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL) For Enterprise PL/I Version 3.6: TEST(ALL, SYM, NOHOOK, SEPARATE, SEPNAME), NOPT, AGGREGATE,	SYSDEBUG file used by z/OS® Debugger and Fault Analyzer for z/OS®. LANGX file used by Application Performance Analyzer for z/OS®	Although the module is larger than a module compiled with the NOTEST option, you can use the module in production if needed.	Suggested for test. You can also use these options in a production environment if the increased load module size is not an issue.		

Table 9. Examples of compiler options and source information files that are supported by ADFz products for Enterprise PL/I Version 3.5 and Version 3.6

(continued)

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
ATTRIBUTES (FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL)					
AGGREGATE, ATTRIBUTES (FULL), NOBLKOFF, LIST, MAP, NEST, NOTEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL)	Compiler listing	Yes	N/A	Supported	N/A
	LANGX file	Yes	N/A	Suggested for production and test	

Preparing Enterprise PL/I Version 3.5 and Version 3.6 programs

Perform the following steps for compiling your Enterprise PL/I Version 3.5 and Version 3.6 programs:

1. Create a library (PDSE is suggested unless PDS is required for your organization) for SYSDEBUG files.
   This library is only needed in test environments where debugging is performed using `LRECL=(80 to 1024),RECFM=FB,BLKSIZE=(multiple of lrecl < 32K)`.
2. Allocate one or more LANGX libraries for each environment, such as test and production.
3. Create a corresponding LANGX library for each load library. Specify `LRECL=1562 or greater,RECFM=VB,BLKSIZE= lrecl +4 to 32k`.
4. Run a two-stage compile. The first stage preprocesses the program, so the IBM® Application Delivery Foundation for z Systems family of products have access to fully expanded source code with INCLUDEs and macros. The second stage compiles the program. For all programs, such as batch, CICS®, and IMS™:
   - In the first compile stage, in both test and production environments, specify compiler options `MACRO,MDECK,NOCOMPILE,NOSYNTAX,INSOURCE` to expand INCLUDEs and macros. The output SYSPUNCH DD is the input SYSIN DD to the second compile stage.
   - In the second compile stage, in test environments,

- When using the Enterprise PL/I Version 3.5 compiler:

  For all programs, specify the following compiler options: `TEST(ALL,SYM,NOHOOK,SEPARATE), NOPT, AGGREGATE, ATTRIBUTES(FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL)`.

- When using the Enterprise PL/I Version 3.6 compiler:

  For all programs, specify the following compiler options: `TEST(ALL,SYM,NOHOOK,SEPARATE,SEPNAME), NOPT, AGGREGATE, ATTRIBUTES(FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL)`.

`TEST`(...) and `NOPT` are required by z/OS® Debugger.

The `SEPARATE` suboption produces a SYSDEBUG file. Save the SYSDEBUG file that is created by the compiler for z/OS® Debugger (and optionally, Fault Analyzer).

The other options format the compiler listing as required for the IPVLANGX utility.

Consider using `TEST(ALL,SYM,NOHOOK,SEPARATE)` for best performance and to produce a module that can be debugged. Depending on the policies in your organization, the module can be considered for production.

- In the second compile stage, in production environments, specify compiler options `NOTEST, AGGREGATE, ATTRIBUTES(FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL)`.

Note: The above options can be used with both the Enterprise PL/I Version 3.5 and Version 3.6 compilers.

`NOTEST` disables z/OS® Debugger, but produces a smaller load module.

The other options format the compiler listing as required for the IPVLANGX utility to produce a production-ready module that can be used with Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS® (but not z/OS® Debugger).

5. When a `TEST(...SEPARATE)` parm is used, code a SYSDEBUG DD in the second compiler step as follows:

```
//SYSDEBUG DD DSN= sysdebug.pds(pgmname),DISP=SHR
```

This is the source information file for z/OS® Debugger, IBM® Application Performance Analyzer for z/OS® and optionally, IBM® Fault Analyzer for z/OS®. Save it in the SYSDEBUG library, and specify a member name that is equal to the primary entry point name or CSECT name of your application program.

6. Modify the SYSPRINT DD in the second compiler stage. This file is the compiler listing. Write the listing to either a permanent or temporary file. This file is the input to the IPVLANGX utility.

Note: This compiler typically renames CSECTs according to an internal compiler algorithm. Therefore, it is not recommended to store PL/I compiler listings or side files using CSECT names as they might not be found

by IBM® Application Performance Analyzer for z/OS® or IBM® Fault Analyzer for z/OS®. Instead, use the primary entry point name.

7. Add a step after the compile step to run the IPVLANGX utility. This utility reads the compiler listing and generates a LANGX file. This file is the source information file for IBM® Fault Analyzer for z/OS® and IBM® Application Performance Analyzer for z/OS®. Save the LANGX file in the LANGX file library, and specify a member name that is equal to the primary entry point name of your application program.
8. Modify the promotion process to promote LANGX files. When a load module is promoted, for example, from test to production, promote the corresponding LANGX file or files. A promotion can be a recompile, copy, or move. Perform the same steps with the LANGX file that you perform with the module during promotion.
9. If you compile with the TEST option and promote these modules into production, promote the SYSDEBUG file for your production environment.
10. Optionally, include a z/OS® Debugger Language Environment® exit module into the load module during the linkage editor step. This approach is one way to enable z/OS® Debugger panel 6 in ISPF, a simple panel-driven method to start the debugger automatically when a program runs, without JCL changes, based on the program name and user ID. Use module EQADBCXT for batch programs (including IMS™ batch), EQADICXT for IMS/TM programs and EQADDCXT for DB2® stored procedures. Do not include the exit module for CICS® programs.

    You can also use module EQAD3CXT for batch programs, IMS/TM, IMS™ BTS programs, and DB2® type MAIN stored procedures

Sample JCL for compiling Enterprise PL/I Version 3.5 or Version 3.6 programs

Here is a JCL example for compiling an Enterprise PL/I for z/OS® Version 3.5 or Version 3.6 program for use with the ADFz family of products.

```
//*     - - -  ADD A JOB CARD ABOVE THIS LINE  - - -
//*
//* SAMPLE JCL TO PREPARE AN ENTERPRISE PL/I V3.5 OR
//* ENTERPRISE PL/I V3.6 PROGRAM FOR THE IBM ZSERIES
//* FOR THE IBM ZSERIES ADFz PRODUCTS:
//* FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//* NOTES:
//*
//* COMPILER:
//* 1. A 2-STAGE COMPILE IS PERFORMED. STAGE 1 (PREPROCESS) IS
//*    DONE TO EXPAND INCLUDES AND MACROS IN THE PROGRAM, SO THAT
//*    THE SYSDEBUG FILE CREATED IN STAGE 2 (COMPILE) HAS ALL STMTS.
//* 2. COMPILER PARMS TEST AND NOPT ARE REQUIRED FOR DEBUG TOOL
//* 3. COMPILER PARM TEST(ALL,SYM,NOHOOK,SEP) (V3.5) OR
//*    TEST(ALL,SYM,NOHOOK,SEP,SEPNAME) (V3.6) IS USED BECAUSE:
//*    - THE MODULE IS READY FOR DEBUG TOOL
//*         - NOHOOK DOES NOT HAVE RUN-TIME CPU OVERHEAD. HOWEVER, THE
//*           MODULE IS LARGER BECAUSE OF STATEMENT TABLE
//*         - A SYSDEBUG FILE IS CREATED THAT CAN BE USED BY DT,FA,APA
//*    4. COMPILER PARMS AGGREGATE,ATTRIBUTES(FULL),NOBLKOFF,LIST,
//*       MAP,NEST,NONUMBER,OPTIONS,SOURCE,STMT,XREF(FULL) ARE NEEDED
//*       TO PROCESS THE COMPILER LISTING WITH IPVLANGX
//*
```

```
//*   BINDER (LINKAGE EDITOR):
//*    5. THE INCLUDE FOR MODULE EQAD?CXT IS OPTIONAL.  IT IS AN
//*       LE EXIT MODULE THAT CAN BE USED TO START DEBUG TOOL.
//*       UNDERSTAND THE METHODS AVAILABLE FOR STARTING DEBUG TOOL,
//*       AND CHOOSE WHETHER YOU WANT TO USE THE LE EXITS.
//*         IF YOU USE THIS METHOD, LOAD THE CORRECT EXIT MODULE:
//*            EQADBCXT: FOR BATCH PROGRAMS
//*            EQADICXT: FOR ONLINE IMS PROGRAMS
//*            EQADDCXT: FOR DB2 STORED PROCEDURES (OF TYPE MAIN AND SUB)
//*           (for SUB this is supported only for invocations through call_sub)
//*            (DO NOT INCLUDE AN EXIT FOR CICS PROGRAMS)
//*     YOU CAN ALSO USE MODULE EQAD3CXT FOR BATCH PROGRAMS, ONLINE IMS
//*          PROGRAMS, DB2 TYPE MAIN STORED PROCEDURES.
//*  SET PARMS FOR THIS COMPILE:
//*  ---------------------------
//   SET MEM=PADSTAT                      PROGRAM NAME
//   SET PLICOMP='IBMZ.V3R5.SIBMZCMP'     PLI COMPILER LOADLIB
//   SET DTLIB='EQAW.SEQAMOD'             DEBUG TOOL LOADLIB
//   SET LEHLQ='CEE'                      LE HIGH LVL QUALIFIER
//   SET UNITDEV=SYSALLDA                 UNIT FOR TEMP FILES
//   SET LANGX='IPVLANGX'                 IPVLANGX UTILITY PROGRAM
//   SET LANGXLIB='IPV.SIPVMODA'          LIBRARY FOR IPVLANGX UTILITY
//*    NOTE: USE THE IPVLANGX FACILITY SHIPPED WITH THE COMMON COMPONENT.
//*
//ALLOCOBJ EXEC PGM=IEFBR14              ALLOC OBJ LIB IF NEEDED
//OBJ   DD DSN=&SYSUID..ADLAB.OBJ,SPACE=(CYL,(3,1,15)),
//  DSORG=PO,RECFM=FB,LRECL=80,BLKSIZE=8000,DISP=(MOD,CATLG)
//*  ****************************************
//*     PREPROCESS STEP (COMPILE STAGE 1)
//*  ****************************************
//PRECOMP  EXEC PGM=IBMZPLI,REGION=0M,
//   PARM=('MACRO,MDECK,NOCOMPILE,NOSYNTAX,INSOURCE')
//STEPLIB  DD   DSN=&PLICOMP,DISP=SHR
//         DD   DSN=&LEHLQ..SCEERUN,DISP=SHR
//SYSIN    DD   DISP=SHR,DSN=&SYSUID..ADLAB.SOURCE(&MEM)
//SYSLIB   DD   DISP=SHR,DSN=&SYSUID..ADLAB.COPYLIB
//SYSPRINT DD   SYSOUT=*
//SYSUT1   DD   SPACE=(1024,(200,50),,CONTIG,ROUND),DCB=BLKSIZE=1024,
//              UNIT=&UNITDEV
//SYSPUNCH DD DISP=(MOD,PASS),DSN=&&SRC1,UNIT=&UNITDEV,
//            SPACE=(80,(10,10))
//*
//*  ****************************************
//* COMPILE STEP (COMPILE STAGE 2)
//* ****************************************
//COMPILE EXEC PGM=IBMZPLI,REGION=0M,
// PARM=('+DD:OPTIONS')
//* THE +DD:OPTIONS PARAMETER IS USED TO DIRECT THE COMPILER TO
//* GET THE COMPILATION OPTIONS FROM THE OPTIONS DD STATEMENT
//OPTIONS  DD *
TEST(ALL,SYM,NOHOOK,SEPARATE),LIST,MAP,SOURCE,XREF(FULL),
NOBLKOFF,AGGREGATE,ATTRIBUTES(FULL),NEST,OPTIONS,NOPT,
STMT,NONUMBER,OFFSET
/*
//*  Note: The above options are for Enterprise PL/I Version 3.5
//*        For Enterprise PL/I Version 3.6, change the TEST option
//*        to:  TEST(ALL,SYM,NOHOOK,SEPARATE,SEPNAME)
//STEPLIB  DD DSN=&PLICOMP,DISP=SHR
```

```
//         DD DSN=&LEHLQ..SCEERUN,DISP=SHR
//SYSIN    DD DSN=&&SRC1,DISP=(OLD,PASS)
//SYSLIB   DD DISP=SHR,DSN=&SYSUID..ADLAB.COPYLIB
//SYSPRINT DD DISP=SHR,DSN=&SYSUID..ADLAB.ENTPLI.LISTING(&MEM)
//SYSDEBUG DD DISP=SHR,DSN=&SYSUID..ADLAB.SYSDEBUG(&MEM)
//SYSUT1   DD SPACE=(CYL,(5,2),,CONTIG),DCB=BLKSIZE=1024,UNIT=&UNITDEV
//SYSLIN   DD DSN=&SYSUID..ADLAB.OBJ(&MEM),DISP=SHR
//*
//PLIPRINT  EXEC PGM=IEBGENER,REGION=0M
//SYSPRINT  DD SYSOUT=*
//SYSUT1    DD DSN=&SYSUID..ADLAB.ENTPLI.LISTING(&MEM),DISP=SHR
//SYSUT2    DD SYSOUT=*
//SYSIN     DD DUMMY
//*
//*  **********************************
//*     STEP TO GENERATE LANGX FILE
//*  **********************************
//LANGX    EXEC PGM=&LANGX,REGION=32M,
//  PARM='(PLI ERROR 64K CREF'
//STEPLIB  DD DISP=SHR,DSN=&LANGXLIB
//         DD DISP=SHR,DSN=&LEHLQ..SCEERUN
//LISTING  DD DSN=&SYSUID..ADLAB.ENTPLI.LISTING(&MEM),DISP=SHR
//IDILANGX DD DISP=SHR,DSN=&SYSUID..ADLAB.EQALANGX(&MEM)
//*
//* **********************************
//* LINK-EDIT (BINDER) STEP
//* **********************************
//LINK EXEC PGM=IEWL,PARM=(LET,MAP,LIST),REGION=0M
//SYSLIB DD DSN=&LEHLQ..SCEELKED,DISP=SHR
//DTLIB DD DSN=&DTLIB,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSLMOD DD DISP=SHR,DSN=&SYSUID..ADLAB.LOAD(&MEM)
//SYSUT1 DD UNIT=SYSDA,SPACE=(TRK,(10,10))
//SYSLIN DD DSN=&SYSUID..ADLAB.OBJ(&MEM),DISP=(OLD,PASS)
//*  INCLUDING A DEBUG TOOL LE EXIT (EQADBCXT, EQADDCXT, EQADICXT OR EQAD3CXT)
//*  IS OPTIONAL.  THE EXIT ENABLES STARTING DEBUG TOOL WITH THE
//*  USER EXIT DATA SET UTILITY (ONE OF THE DEBUG TOOL ISPF UTILITIES)
//*  //        DD *
//*   INCLUDE DTLIB(EQADBCXT)
```

Enterprise PL/I Version 3.4 and earlier programs

The following table shows various compiler options that can be used to prepare Enterprise PL/I Version 3.4 and earlier programs for use with the ADFz family of products (z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the load module produced has no significant runtime overhead and therefore is suitable for a production environment.

Table 10. Examples of compiler options and source information files that are supported by ADFz products for Enterprise PL/I Version 3.4 and earlier

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
Preprocess (1st stage) to expand source, In compile (2nd stage): TEST(ALL), NOPT, AGGREGATE, ATTRIBUTES (FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL))	Expanded source file used by z/OS® Debugger, LANGX file used by Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®	No	Suggested for test. (Using z/OS® Debugger in production for this compiler is not recommended.)		
AGGREGATE, ATTRIBUTES (FULL), NOBLKOFF, LIST, MAP, NEST, NOTEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL))	Compiler listing	Yes	N/A	Supported	N/A
	LANGX file	Yes	N/A	Suggested for production and test	

Preparing Enterprise PL/I Version 3.4 and earlier programs

Perform the following steps for compiling your Enterprise PL/I Version 3.4 and earlier programs:

1. Create a library (PDSE is suggested unless PDS is required for your organization) for expanded source files. This library is only needed in test environments where debugging is performed. The library can be any RECFM / LRECL / BLKSIZE supported as input by the compiler.
2. Allocate libraries (PDSE is suggested unless PDS is required for your organization) for LANGX files. Allocate one or more LANGX libraries for each environment, such as test or production.
3. Create a corresponding LANGX library for each load library. Specify `LRECL=1562 or greater,RECFM=VB,BLKSIZE= lrecl +4 to 32k`.
4. Run a 2-stage compilation. The first stage preprocesses the program, so that ADFz products have access to fully expanded source code with INCLUDEs and macros. The second stage compiles the program.

- In the first compilation stage, in both test and production environments:
  - Specify compiler options `MACRO,MDECK,NOCOMPILE,NOSYNTAX,INSOURCE` to expand INCLUDEs and macros.
  - Save the output, the expanded source file, in a permanent file in the expanded source file library and specify *member name* = *program name*. This file is the source information file for z/OS® Debugger. The output SYSPUNCH DD is the input SYSIN DD to the second compiler stage.
- In the second compilation stage, for all programs, such as batch, CICS®, and IMS™:
  - In test environments, specify compiler options `TEST(ALL), NOPT, AGGREGATE, ATTRIBUTES(FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL)`.

    `TEST(ALL)` and `NOPT` are required by z/OS® Debugger. Debug hooks are inserted, which add some runtime overhead. Symbolic data that is required by z/OS® Debugger is also stored in the module, which can make it larger.

    The other options format the compiler listing as required for the IPVLANGX utility.
  - In production environments, specify compiler options `NOTEST, AGGREGATE, ATTRIBUTES(FULL), NOBLKOFF, LIST, MAP, NEST, NONUMBER, OFFSET, OPTIONS, SOURCE, STMT, XREF(FULL))`.

    `NOTEST` disables z/OS® Debugger, but provides the best performance. This produces a production-ready module that can be used with Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS® (but not z/OS® Debugger).

    The other options format the compiler listing as required for the IPVLANGX utility.

5. Modify the SYSPRINT DD in the second compilation stage. This file is the compiler listing. Save the compiler listing to either a permanent or temporary file. This file is the input to the IPVLANGX utility.

   Note: This compiler typically renames CSECTs according to an internal compiler algorithm. Therefore, it is not recommended to store PL/I compiler listings or side files using CSECT names as they might not be found by Application Performance Analyzer for z/OS® or Fault Analyzer for z/OS®. Instead, use the primary entry point name.

6. Add a step after the compilation step to run the IPVLANGX utility. The IPVLANGX utility reads the compiler listing and generates a LANGX file, which is the source information file for Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®. Save the LANGX file in the LANGX file library, and specify a member name that is equal to the primary entry point name or CSECT name of your application program.
7. Modify the promotion process to promote LANGX files. When a load module is promoted, for example, from test to production, promote the corresponding LANGX file or files. A promotion can be a recompile, copy, or move. Perform the same steps with the LANGX file that you perform with the module during promotion.
8. Optionally, include a z/OS® Debugger Language Environment® exit module into the load module during the linkage editor step. This approach is one way to enable z/OS® Debugger panel 6 in ISPF, a simple panel-driven method to start the debugger automatically when a program runs, without JCL changes, based on the program name and user ID. Use module EQADBCXT for batch programs (including IMS™ batch), EQADICXT for IMS/TM programs and EQADDCXT for DB2® stored procedures. Do not include the exit module for CICS® programs.

You can also use module EQAD3CXT for batch programs, IMS/TM, IMS™ BTS programs, and DB2® type MAIN stored procedures

9. For CICS® applications only, if the z/OS® Debugger DTCN transaction is used to start z/OS® Debugger, link edit the z/OS® Debugger CICS® startup exit module EQADCCXT into the application load module to enable z/OS® Debugger in CICS®. This link edit is not needed if using the CADP transaction instead of DTCN.

Sample JCL for compiling Enterprise PL/I for z/OS® Version 3.4 or earlier programs

Here is a JCL example for compiling an Enterprise PL/I for z/OS® Version 3.4 or earlier program for use with the ADFz family of products.

```
//*     - - -  ADD A JOB CARD ABOVE THIS LINE  - - -
//*
//*  SAMPLE JCL TO COMPILE WITH ENTERPRISE PLI V3.4 AND PREVIOUS
//*  FOR THE IBM ZSERIES ADFz PRODUCTS:
//*     FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//*  NOTES:
//*
//*   COMPILER:
//*    1. A 2-STAGE COMPILE IS PERFORMED.  STAGE 1 (PREPROCESS) IS
//*       DONE TO EXPAND INCLUDES AND MACROS IN THE PROGRAM, SO THAT
//*       A SOURCE FILE IS CREATED FOR DEBUG TOOL THAT HAS ALL STMTS.
//*    2. COMPILER PARM TEST AND NOPT ARE REQUIRED FOR DEBUG TOOL
//*    3. COMPILER PARMS AGGREGATE,ATTRIBUTES(FULL),NOBLKOFF,LIST,
//*       MAP,NEST,NONUMBER,OPTIONS,SOURCE,STMT,XREF(FULL) ARE NEEDED
//*       TO PROCESS THE COMPILER LISTING WITH IPVLANGX
//*
//*   BINDER (LINKAGE EDITOR):
//*    4. THE INCLUDE FOR MODULE EQAD?CXT IS OPTIONAL.  IT IS AN
//*       LE EXIT MODULE THAT CAN BE USED TO START DEBUG TOOL.
//*       UNDERSTAND THE METHODS AVAILABLE FOR STARTING DEBUG TOOL,
//*       AND CHOOSE WHETHER YOU WANT TO USE THE LE EXITS.
//*         IF YOU USE THIS METHOD, LOAD THE CORRECT EXIT MODULE:
//*            EQADBCXT: FOR BATCH PROGRAMS
//*            EQADICXT: FOR ONLINE IMS PROGRAMS
//*            EQADDCXT: FOR DB2 STORED PROCEDURES (OF TYPE MAIN AND SUB)
//*           (for SUB this is supported only for invocations through call_sub)
//*            (DO NOT INCLUDE AN EXIT FOR CICS PROGRAMS)
//*     YOU CAN ALSO USE MODULE EQAD3CXT FOR BATCH PROGRAMS, ONLINE IMS
//*          PROGRAMS, DB2 TYPE MAIN STORED PROCEDURES.
//*
//*  SET PARMS FOR THIS COMPILE:
//*  ---------------------------
//   SET MEM=PTEST                        PROGRAM NAME
//   SET PLICOMP='IBMZ.V3R4.SIBMZCMP'     PLI COMPILER LOADLIB
//   SET DTLIB='EQAW.SEQAMOD'             DEBUG TOOL LOADLIB
//   SET LEHLQ='CEE'                      LE HIGH LVL QUALIFIER
//   SET UNITDEV=SYSALLDA                 UNIT FOR TEMP FILES
//   SET LANGX='IPVLANGX'                 IPVLANGX UTILITY PROGRAM
//   SET LANGXLIB='IPV.SIPVMODA'          LIBRARY FOR IPVLANGX UTILITY
//*    NOTE: USE THE IPVLANGX FACILITY SHIPPED WITH THE COMMON COMPONENT.
//*
//ALLOCOBJ EXEC PGM=IEFBR14              ALLOC OBJ LIB IF NEEDED
```

```
//XSOURCE DD DSN=&SYSUID..ADLAB.EXPANDED.SOURCE,SPACE=(CYL,(3,1,15)),
//  DSORG=PO,RECFM=FB,LRECL=80,BLKSIZE=8000,DISP=(MOD,CATLG)
//OBJ   DD DSN=&SYSUID..ADLAB.OBJ,SPACE=(CYL,(3,1,15)),
//  DSORG=PO,RECFM=FB,LRECL=80,BLKSIZE=8000,DISP=(MOD,CATLG)
//*  ****************************************
//*     PREPROCESS STEP (COMPILE STAGE 1)
//*  ****************************************
//PRECOMP  EXEC PGM=IBMZPLI,REGION=0M,
//   PARM=('MACRO,MDECK,NOCOMPILE,NOSYNTAX,INSOURCE')
//STEPLIB  DD   DSN=&PLICOMP,DISP=SHR
//         DD   DSN=&LEHLQ..SCEERUN,DISP=SHR
//SYSIN    DD   DISP=SHR,DSN=&SYSUID..ADLAB.SOURCE(&MEM)
//SYSLIB   DD   DISP=SHR,DSN=&SYSUID..ADLAB.COPYLIB
//SYSPRINT DD   SYSOUT=*
//SYSUT1   DD   SPACE=(1024,(200,50),,CONTIG,ROUND),DCB=BLKSIZE=1024,
//             UNIT=&UNITDEV
//SYSPUNCH DD DISP=SHR,DSN=&SYSUID..ADLAB.EXPANDED.SOURCE(&MEM)
//*
//*  ****************************************
//*     COMPILE STEP (COMPILE STAGE 2)
//*  ****************************************
//COMPILE EXEC PGM=IBMZPLI,REGION=0M,
// PARM=('+DD:OPTIONS')
//* THE +DD:OPTIONS PARAMETER IS USED TO DIRECT THE COMPILER TO
//* GET THE COMPILATION OPTIONS FROM THE OPTIONS DD STATEMENT
//OPTIONS  DD *
TEST(ALL),LIST,MAP,SOURCE,XREF(FULL),
NOBLKOFF,AGGREGATE,ATTRIBUTES(FULL),NEST,OPTIONS,NOPT,
STMT,NONUMBER,OFFSET
/*
//STEPLIB  DD DSN=&PLICOMP,DISP=SHR
//         DD DSN=&LEHLQ..SCEERUN,DISP=SHR
//SYSIN    DD DISP=SHR,DSN=&SYSUID..ADLAB.EXPANDED.SOURCE(&MEM)
//SYSLIB   DD DISP=SHR,DSN=&SYSUID..ADLAB.COPYLIB
//SYSPRINT DD DISP=SHR,DSN=&SYSUID..ADLAB.ENTPLI.LISTING(&MEM)
//SYSUT1   DD SPACE=(CYL,(5,2),,CONTIG),DCB=BLKSIZE=1024,UNIT=&UNITDEV
//SYSLIN   DD DSN=&SYSUID..ADLAB.OBJ(&MEM),DISP=SHR
//*
//PLIPRINT  EXEC PGM=IEBGENER,REGION=0M
//SYSPRINT  DD SYSOUT=*
//SYSUT1    DD DSN=&SYSUID..ADLAB.ENTPLI.LISTING(&MEM),DISP=SHR
//SYSUT2    DD SYSOUT=*
//SYSIN     DD DUMMY
//*
//*  **********************************
//*     STEP TO GENERATE LANGX FILE
//*  **********************************
//LANGX    EXEC PGM=&LANGX,REGION=32M,
//  PARM='(PLI ERROR 64K CREF'
//STEPLIB  DD DISP=SHR,DSN=&LANGXLIB
//         DD DISP=SHR,DSN=&LEHLQ..SCEERUN
//LISTING  DD DSN=&SYSUID..ADLAB.ENTPLI.LISTING(&MEM),DISP=SHR
//IDILANGX DD DISP=SHR,DSN=&SYSUID..ADLAB.EQALANGX(&MEM)
//*
//* **********************************
//* LINK-EDIT (BINDER) STEP
//* **********************************
//LINK EXEC PGM=IEWL,PARM=(LET,MAP,LIST),REGION=0M
```

```
//SYSLIB DD DSN=&LEHLQ..SCEELKED,DISP=SHR
//DTLIB DD DSN=&DTLIB,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSLMOD DD DISP=SHR,DSN=&SYSUID..ADLAB.LOAD(&MEM)
//SYSUT1 DD UNIT=SYSDA,SPACE=(TRK,(10,10))
//SYSLIN DD DSN=&SYSUID..ADLAB.OBJ(&MEM),DISP=(OLD,PASS)
//*  INCLUDING A DEBUG TOOL LE EXIT (EQADBCXT, EQADDCXT, EQADICXT OR EQAD3CXT)
//*  IS OPTIONAL.  THE EXIT ENABLES STARTING DEBUG TOOL WITH THE
//*  USER EXIT DATA SET UTILITY (ONE OF THE DEBUG TOOL ISPF UTILITIES)
//*  //        DD *
//*   INCLUDE DTLIB(EQADBCXT)
```

PL/I for MVS™ and VM and OS PL/I programs

The following table shows various compiler options that can be used to prepare PL/I for MVS™ and VM programs and OS PL/I programs for use with the ADFz family of products (z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the load module produced has no significant runtime overhead and therefore is suitable for a production environment.

For the test environment, you need both the listing and the LANGX file (for Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). In production, only the LANGX file is suggested.

Table 11. Examples of compiler options and source information files that are supported by ADFz products for PL/I for MVS™ and VM and OS PLI

Compiler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
TEST(ALL), AGGREGATE, ATTRIBUTES (FULL), ESD, LIST, MAP, NEST, NOPT, OPTIONS, SOURCE, STMT, XREF(FULL)	Compiler listing	No	Suggested for test. Using z/OS® Debugger in production for this compiler is not recommended.	Supported	Supported
	LANGX file	No	N/A	Supported	N/A
NOTEST, AGGREGATE, ATTRIBUTES (FULL), ESD, LIST, MAP, NEST, OPTIONS, SOURCE, STMT, XREF(FULL)	Compiler listing	Yes	N/A	Supported	Suggested for production and test
	LANGX file	Yes	N/A	Suggested for production and test	N/A

Preparing PL/I for MVS™ and VM programs and OS PL/I programs

Perform the following steps to compile your PL/I for MVS™ and VM programs and OS PL/I programs:

1. Create a library (PDSE is suggested unless PDS is required for your organization) for compiler listing files. This library is only needed in test environments where debugging is performed. Specify `LRECL=125 minimum,RECFM=VBA,BLKSIZE= lrecl+4 to 32k`.
2. Allocate libraries (PDSE is suggested unless PDS is required for your organization) for LANGX files. Allocate one or more LANGX libraries for each environment, such as test and production.
3. Create a corresponding LANGX library for each load library. Specify `LRECL=1562 or greater,RECFM=VB,BLKSIZE= lrecl +4 to 32k`.
4. For all programs, such as batch, CICS®, and IMS™:
   - In test environments, specify compiler options `TEST(ALL), NOPT, AGGREGATE, ATTRIBUTES(FULL), ESD, LIST, MAP, NEST, OPTIONS, SOURCE, STMT, XREF(FULL)`.

     `TEST(ALL)` and `NOOPT` are required by z/OS® Debugger. `TEST` adds debug hooks, which add some runtime overhead. Symbolic data that is required by z/OS® Debugger is stored in the module, which can make it larger.

     The other options format the compiler listing as required by z/OS® Debugger and by the IPVLANGX utility.
   - In production environments, specify compiler options `NOTEST, AGGREGATE, ATTRIBUTES(FULL), ESD, LIST, MAP, NEST, OPTIONS, SOURCE, STMT, XREF(FULL)`.

     `NOTEST` disables z/OS® Debugger, but provides the best performance.

     The other options format the compiler listing as required for the IPVLANGX utility.

     This produces a production-ready module that can be used with Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS® but not z/OS® Debugger.
5. Modify the SYSPRINT DD in the compiler step. This parameter is the compiler listing. Save this to a permanent file. The compiler listing is the input to the IPVLANGX utility and is the source information file for z/OS® Debugger.

   Note: This compiler typically renames CSECTs according to an internal compiler algorithm. Therefore, it is not recommended to store PL/I compiler listings or side files using CSECT names as they might not be found by Application Performance Analyzer for z/OS® or Fault Analyzer for z/OS®. Instead, use the primary entry point name.

6. Add a step after the compiler step to run the IPVLANGX utility. This utility reads the compiler listing and saves a LANGX file. This file is the source information file for Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®. Save it in the LANGX file library and specify a member name that is equal to the primary entry point name of your application program.
7. Modify the promotion process to promote LANGX files. When a load module is promoted, for example, from test to production, promote the corresponding LANGX file or files. A promotion can be a recompile, copy, or move. Perform the same steps with the LANGX file that you perform with the module during promotion.

8. Optionally, include a z/OS® Debugger Language Environment® exit module into the load module during the linkage editor step. This approach is one way to enable z/OS® Debugger panel 6 in ISPF, a simple panel-driven method to start the debugger automatically when a program runs, without JCL changes, based on the program name and user ID. Use module EQADBCXT for batch programs (including IMS™ batch), EQADICXT for IMS/TM programs and EQADDCXT for DB2® stored procedures. Do not include the exit module for CICS® programs.

   You can also use module EQAD3CXT for batch programs, IMS/TM, IMS™ BTS programs, and DB2® type MAIN stored procedures

9. For CICS® applications only, if the z/OS® Debugger DTCN transaction is used to start z/OS® Debugger, link edit the z/OS® Debugger CICS® startup exit module EQADCCXT into the application load module to enable z/OS® Debugger in CICS®. This link edit is not needed if using the CADP transaction instead of DTCN.

Sample JCL for compiling PL/I for MVS™ and VM programs

Here is a JCL example for compiling a PL/I for MVS™ and VM program for use with the ADFz family of products.

```
//*     - - -  ADD A JOB CARD ABOVE THIS LINE  - - -
//*
//*  SAMPLE JCL TO PREPARE A PLI FOR MVS AND VM PROGRAM
//*  FOR THE IBM ZSERIES ADFz PRODUCTS:
//*     FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//*  NOTES:
//*
//*   COMPILER:
//*    1. COMPILER PARM TEST IS REQUIRED FOR DEBUG TOOL
//*    2. COMPILER PARMS AGGREGATE,ATTRIBUTES(FULL),ESD,LIST,
//*       MAP,NEST,OPTIONS,SOURCE,STMT,XREF(FULL) ARE NEEDED
//*       FOR ADFz TO PROCESS THE COMPILER LISTING
//*
//*   BINDER (LINKAGE EDITOR):
//*    3. THE INCLUDE FOR MODULE EQAD?CXT IS OPTIONAL.  IT IS AN
//*       LE EXIT MODULE THAT CAN BE USED TO START DEBUG TOOL.
//*       UNDERSTAND THE METHODS AVAILABLE FOR STARTING DEBUG TOOL,
//*       AND CHOOSE WHETHER YOU WANT TO USE THE LE EXITS.
//*         IF YOU USE THIS METHOD, LOAD THE CORRECT EXIT MODULE:
//*            EQADBCXT: FOR BATCH PROGRAMS
//*            EQADICXT: FOR ONLINE IMS PROGRAMS
//*            EQADDCXT: FOR DB2 STORED PROCEDURES (OF TYPE MAIN AND SUB)
//*           (for SUB this is supported only for invocations through call_sub)
//*            (DO NOT INCLUDE AN EXIT FOR CICS PROGRAMS)
//*     YOU CAN ALSO USE MODULE EQAD3CXT FOR BATCH PROGRAMS, ONLINE IMS
//*          PROGRAMS, DB2 TYPE MAIN STORED PROCEDURES.
//*  SET PARMS FOR THIS COMPILE:
//*  --------------------------
//   SET MEM=PADSTAT                      PROGRAM NAME
//   SET PLICOMP='IEL.V1R1M1.SIELCOMP'    PLI COMPILER LOADLIB
//   SET DTLIB='EQAW.SEQAMOD'             DEBUG TOOL LOADLIB
//   SET LEHLQ='CEE'                      LE HIGH LVL QUALIFIER
//   SET UNITDEV=SYSALLDA                 UNIT FOR TEMP FILES
//   SET LANGX='IPVLANGX'                 IPVLANGX UTILITY PROGRAM
//   SET LANGXLIB='IPV.SIPVMODA'          LIBRARY FOR IPVLANGX UTILITY
//*    NOTE: USE THE IPVLANGX FACILITY SHIPPED WITH THE COMMON COMPONENT.
//*
```

```
//ALLOCOBJ EXEC PGM=IEFBR14              ALLOC OBJ LIB IF NEEDED
//OBJ   DD DSN=&SYSUID..ADLAB.OBJ,SPACE=(CYL,(3,1,15)),
//  DSORG=PO,RECFM=FB,LRECL=80,BLKSIZE=8000,DISP=(MOD,CATLG)
//*
//*  ****************************************
//*     COMPILE STEP
//*  ****************************************
//*
//COMPILE  EXEC PGM=IEL1AA,REGION=6M,
// PARM=('TEST(ALL),NOPT,AGGREGATE,ATTRIBUTES(FULL),ESD,LIST,MAP,',
//       'NEST,OPTIONS,SOURCE,STMT,XREF(FULL)')
//STEPLIB  DD   DSN=&PLICOMP,DISP=SHR
//SYSIN    DD   DISP=SHR,DSN=&SYSUID..ADLAB.SOURCE(&MEM)
//SYSLIB   DD   DISP=SHR,DSN=&SYSUID..ADLAB.COPYLIB
//SYSPRINT DD   DISP=SHR,DSN=&SYSUID..ADLAB.PLIMVS.LISTING(&MEM)
//SYSUT1   DD   SPACE=(CYL,(1,1)),UNIT=SYSDA
//SYSLIN   DD DSN=&SYSUID..ADLAB.OBJ(&MEM),DISP=SHR
//*
//PLIPRINT  EXEC PGM=IEBGENER,REGION=0M
//SYSPRINT  DD SYSOUT=*
//SYSUT1    DD DSN=&SYSUID..ADLAB.PLIMVS.LISTING(&MEM),DISP=SHR
//SYSUT2    DD SYSOUT=*
//SYSIN     DD DUMMY
//*
//*  **********************************
//*     STEP TO GENERATE LANGX FILE
//*  **********************************
//LANGX    EXEC PGM=&LANGX,REGION=32M,
//  PARM='(PLI ERROR 64K CREF'
//STEPLIB  DD DISP=SHR,DSN=&LANGXLIB
//         DD DISP=SHR,DSN=&LEHLQ..SCEERUN
//LISTING  DD DSN=&SYSUID..ADLAB.PLIMVS.LISTING(&MEM),DISP=SHR
//IDILANGX DD DISP=SHR,DSN=&SYSUID..ADLAB.EQALANGX(&MEM)
//*
//* **********************************
//* LINK-EDIT (BINDER) STEP
//* **********************************
//LINK EXEC PGM=IEWL,PARM=(LET,MAP,LIST),REGION=0M
//SYSLIB DD DSN=&LEHLQ..SCEELKED,DISP=SHR
//DTLIB DD DSN=&DTLIB,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSLMOD DD DISP=SHR,DSN=&SYSUID..ADLAB.LOAD(&MEM)
//SYSUT1 DD UNIT=SYSDA,SPACE=(TRK,(10,10))
//SYSLIN DD DSN=&SYSUID..ADLAB.OBJ(&MEM),DISP=(OLD,PASS)
//*  INCLUDING A DEBUG TOOL LE EXIT (EQADBCXT, EQADDCXT, EQADICXT OR EQAD3CXT)
//*  IS OPTIONAL.  THE EXIT ENABLES STARTING DEBUG TOOL WITH THE
//*  USER EXIT DATA SET UTILITY (ONE OF THE DEBUG TOOL ISPF UTILITIES)
//*  //        DD *
//*   INCLUDE DTLIB(EQADBCXT)
```

z/OS® XL C and C++ programs

The following table shows various compiler options that can be used to prepare z/OS® XL C and C++ programs for use with the ADFz family of products (z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the load module produced has no significant runtime overhead and therefore is suitable for a production environment.

Table 12. Examples of compiler options and source information files that are supported by ADFz products for C and C++

Compiler options	Output produced	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer for z/OS®	Options supported and suggested for APA
Preprocess (1st stage) to expand source: PP(COMMENTS, NOLINES) Compile (2nd stage): DEBUG (FORMAT (DWARF), NOHOOK, SYMBOL, FILE (location)), LIST, LONGNAME, NOOFFSET, GONUMBER[1]	• Expanded source file • DWARF file (used by z/OS® Debugger, Fault Analyzer for z/OS®, and Application Performance Analyzer) • Compiler listing (can be used by Application Performance Analyzer and Fault Analyzer for z/OS® when DWARF is not available)	Supported. You can use it for production if the OPT compile option is not used. Full functionality available.	Supported. Use of the OPT compile option might result in incorrect source line being reported. Full functionality available.	Supported.
	• .mdbg file[2]	Recommended. You can use it for production if	Supported. Use of the OPT compile option might result	Not supported.

1. The FORMAT(DWARF) option is supported for z/OS® Version 1.6 and higher.
2. For C and C++ programs that are compiled with z/OS® XL C/C++, Version 1.10 or later, if you specify the FORMAT(DWARF) suboption of the DEBUG compiler option, the load modules are smaller and you can create .mdbg files with captured source using the CDADBGLD utility.

   z/OS® Debugger needs only the .mdbg file to debug your program.

Table 12. Examples of compiler options and source information files that are supported by ADFz products for C and C++

(continued)

Compiler options	Output produced	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer for z/OS®	Options supported and suggested for APA
		the OPT compile option is not used. Full functionality available.	in incorrect source line being reported. Full functionality available.	
Preprocess (1st stage) to expand source: PP(COMMENTS, NOLINES) Compile (2nd stage): DEBUG (FORMAT (DWARF), HOOK (LINE, NOBLOCK, PATH), SYMBOL, FILE (location)), LIST, LONGNAME, NOOPT, NOOFFSET, GONUMBER [1]	• Expanded source file • DWARF file (used by z/OS® Debugger and Fault Analyzer for z/OS®) • Compiler listing (used by Application Performance Analyzer)	Supported. Full functionality available. Use in production not recommended.	Supported. Full functionality available.	Supported.
	• .mdbg file[2]	Supported. Full functionality available. Use in production not recommended.	Supported. Full functionality available.	Not supported.
Preprocess (1st stage) to expand source: PP(COMMENTS, NOLINES) Compile (2nd stage): TEST, AGGREGATE[3], NOIPA, LIST, NESTINC (255), NOOFFSET, NOOPT,	• Expanded source file (used by z/OS® Debugger) • Compiler listing (used by Fault Analyzer	Supported. Use in production not recommended.	Supported. Use in production not recommended. Variables not reported.	Supported. Use in production not recommended.

Table 12. Examples of compiler options and source information files that are supported by ADFz products for C and C++

(continued)

Compiler options	Output produced	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer for z/OS®	Options supported and suggested for APA
SOURCE, XREF, LONGNAME, GONUMBER	for z/OS® and Application Performance Analyzer)			
	• Expanded source file (used by z/OS® Debugger) • LANGX file (used by Fault Analyzer for z/OS® and Application Performance Analyzer)	Supported. Use in production not recommended.	Supported. Use in production not recommended. Variables not reported.	Supported. Use in production not recommended.
NOTEST, AGGREGATE[3], NOIPA, LIST, NESTINC (255), NOOFFSET, NOOPT, SOURCE, XREF, LONGNAME	• Compiler listing (used by Fault Analyzer for z/OS® and Application Performance Analyzer)	Not supported.	Supported. Suggested for production and test. Variables not reported.	Supported. Suggested for production and test.
	• LANGX file (used by Fault Analyzer for	Not supported.	Supported. Suggested for production and	Supported. Suggested for production and test.

3. For C++, do not use the AGGREGATE keyword. Use ATTRIBUTES instead.

Table 12. Examples of compiler options and source information files that are supported by ADFz products for C and C++

(continued)

Compiler options	Output produced	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer for z/OS®	Options supported and suggested for APA
	z/OS® and Application Performance Analyzer)		test. Variables not reported.	
UNIX™ System Services compile -g	• DWARF file (used by z/OS® Debugger, Fault Analyzer for z/OS®, and Application Performance Analyzer)	Supported.	Supported.	Supported.
	• .mdbg file[2]	Supported.	Supported.	Not supported.

Preparing z/OS® XL C and C++ programs

Perform the following steps for compiling your z/OS® XL C and C++ programs:

1. Create a library (PDSE is suggested unless PDS is required for your organization) for expanded source files. This library is only needed in test environments where debugging is performed. This can be any RECFM / LRECL / BLKSIZE supported as input by the compiler.
2. Allocate libraries (PDSE is suggested unless PDS is required for your organization) for compiler listing files. Allocate one or more compiler listing libraries for each environment, such as test and production.
3. Create a corresponding listing library for each load library. Specify LRECL=133,RECFM=FBA,BLKSIZE=(multiple of lrecl up to 32k) or LRECL=137 or greater, RECFM=VBA,BLKSIZE= lrecl+4 to 32k.
4. Run a 2-stage compilation. The first stage preprocesses the program, so that ADFz products have access to fully expanded source code. The second stage compiles the program.

- In the first compilation stage, in both test and production environments:
  - Specify compiler options `PP(COMMENTS,NOLINES)` to expand INCLUDEs and macros. The output is SYSUT10 DD, which is the expanded source file and is the input for the second compiler stage. Note that DB2® programs containing SQL statements cannot use the PP option directly. If used, the behavior is undefined. Follow z/OS® Debugger instructions to Processing SQL Statements first. See *z/OS® Debugger V14.1 User's Guide*, Chapter 8. "Preparing a DB2® program", section "Processing SQL statements".

  Modify the SYSUT10 DD to enable z/OS® Debugger, by saving it in an expanded source library and specify a member name that is equal to the primary entry point name or CSECT name of your application program.
- You can prepare your program with a one-stage compilation, skipping the expanding source preprocessing step recommended above. If you do this, you need to be aware of the following:
  - Case 1: If there are no executable statements in the header file, the header file is not included in the captured source that is saved in the mdbg file and is not available for browsing during a z/OS® Debugger session. All other z/OS® Debugger functionality is still available.
  - Case 2: If there are executable statements in the header file, the header file is included in the captured source that is saved in the mdbg file and is available for browsing during a z/OS® Debugger session.
- For all programs, such as batch, CICS®, and IMS™, for the second compilation stage, refer to Table 12: Examples of compiler options and source information files that are supported by ADFz products for C and C++ on page 70 for the appropriate options.

5. Modify the SYSCPRT DD in the second compiler stage to refer to a file. This file is the compiler listing and is the source information file for Application Performance Analyzer for z/OS®. Save it in the compiler listing library and specify a member that is equal to the CSECT name of your application program.

```
//SYSCPRT DD DSN=compiler.listing.pds(csect-name),DISP=SHR
```

Note:
To facilitate source support in Fault Analyzer, CSECTs in C programs should be named using the following statement:

```
#pragma csect(code, "csect_name")
```

where, if using a PDS(E), *csect_name* matches the compiler listing or LANGX file member name. This enables the side file search to automatically locate compiler listings. Without named CSECTs, C compiler listings can only be located by using the compiler listing read user exit or the compiler listing prompt. For details see the *"Compiler Listing Read user exit"* and *"Prompting for compiler listing or side file"* topics in the *IBM Fault Analyzer for z/OS User's Guide*.

6. Modify the promotion process to promote compiler listing files. When a load module is promoted, for example, from test to production, promote the corresponding compiler listing file or files. A promotion can be a recompile, copy, or move. Perform the same steps with the compiler listing file that you perform with the module during promotion. You also need to promote any file that is related to the compilation, not just the listing. So you need to promote, for example, dbg and mdbg files.

7. Optionally, include a z/OS® Debugger Language Environment® exit module into the load module during the linkage editor step. This approach is one way to enable z/OS® Debugger panel 6 in ISPF, a simple panel-driven method to start the debugger automatically when a program runs, without JCL changes, based on the program name and user ID.

   Use module EQAD3CXT for batch programs, IMS/TM, IMS™ BTS programs, and DB2® type MAIN stored procedures.

8. For CICS® applications only: if the z/OS® Debugger DTCN transaction is used to start z/OS® Debugger, link edit the z/OS® Debugger CICS® startup exit module EQADCCXT into the application load module to enable z/OS® Debugger in CICS®. This link edit is not needed if using the CADP transaction instead of DTCN.

Sample JCL for compiling z/OS® C programs with TEST

Here is a JCL example for compiling a z/OS® C program for use with the ADFz family of products.

```
//* ADD A JOB CARD HERE
//*
//*
//*  SAMPLE JCL TO PREPARE A Z/OS C PROGRAM USING TEST WITH HOOKS
//*  FOR THE IBM ZSERIES ADFz PRODUCTS:
//*     FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//*  NOTES:
//*
//*   COMPILER:
//*    1. A 2-STAGE COMPILE IS PERFORMED.  STAGE 1 (PREPROCESS) IS
//*       DONE TO EXPAND INCLUDES AND MACROS IN THE PROGRAM AND TO
//*       PRODUCE AN EXPANDED SOURCE FILE.
//*    2. THE EXPANDED SOURCE FILE IS RETAINED.  IT IS USED BY
//*       DEBUG TOOL.
//*    2. COMPILER PARMS TEST AND NOOPT ARE REQUIRED FOR DEBUG TOOL.
//*    3. COMPILER PARMS AGGREGATE, NOIPA, LIST, NOOFFSET, SOURCE,
//*       AND XREF(FULL) ARE NEEDED TO FORMAT THE COMPILER LISTING
//*       SO THAT IT CAN BE PROCESSED WITH IPVLANGX
//*
//*   A STEP RUNS TO PRODUCE A LANGX FILE FOR FAULT ANALYZER AND APA.
//*    NOTE: USE THE IPVLANGX FACILITY SHIPPED WITH THE COMMON COMPONENT.
//*
//*   BINDER (LINKAGE EDITOR):
//*    1. AN INCLUDE FOR MODULE EQAD?CXT IS OPTIONAL.  IT IS AN
//*       LE EXIT MODULE THAT CAN BE USED TO START DEBUG TOOL.
//*       UNDERSTAND THE METHODS AVAILABLE FOR STARTING DEBUG TOOL,
//*       AND CHOOSE WHETHER YOU WANT TO USE THE LE EXITS.
//*         IF YOU USE THIS METHOD, INCLUDE THE CORRECT EXIT MODULE:
//*            EQADBCXT: FOR BATCH PROGRAMS
//*            EQADICXT: FOR ONLINE IMS PROGRAMS
//*            EQADDCXT: FOR DB2 STORED PROCEDURES (OF TYPE MAIN AND SUB)
//*           (for SUB this is supported only for invocations through call_sub)
//*            (DO NOT INCLUDE AN EXIT FOR CICS PROGRAMS)
//*     YOU CAN ALSO USE MODULE EQAD3CXT FOR BATCH PROGRAMS, ONLINE IMS
//*          PROGRAMS, DB2 TYPE MAIN STORED PROCEDURES.
//*
//*  SET PARMS FOR THIS COMPILE:
//*  ---------------------------
//*       CPRFX: THE PREFIX THE C COMPILE IS INSTALLED UNDER
//*       LEPRFX: THE PREFIX FOR THE LE RUNTIME AND LINK LIBS
```

```
//*       DTPRFX: THE PREFIX OF THE DEBUG TOOL SEQAMOD LIBRARY
//*       LANGXLIB: THE PROGRAM OBJECT LIBRARY FOR THE COMMON COMPONENT
//*
//    SET CPRFX=CBC
//    SET LEPRFX=CEE
//    SET DTPRFX=EQAW
//    SET LANGXLIB=IPV.SIPVMODA
//*
//*******************************************************************/
//* CREATE C COMPILER LISTING SYSPRINT, EXPANDED SOURCE DEBUG,      */
//* AND EQALANGX FILES                                              */
//*******************************************************************/
//ALLOC EXEC PGM=IEFBR14
//LISTING DD DSN=&SYSUID..ADLAB.CLST,
//           DISP=(MOD,CATLG),
//           DCB=(DSORG=PO,RECFM=VBA,LRECL=137,BLKSIZE=0),
//           SPACE=(TRK,(20,20,50)),UNIT=SYSDA
//DBGSRC  DD DSN=&SYSUID..ADLAB.CDBG,
//           DISP=(MOD,CATLG),
//           DCB=(DSORG=PO,RECFM=FB,LRECL=80,BLKSIZE=0),
//           SPACE=(TRK,(20,20,50)),UNIT=SYSDA
//LANGX   DD DSN=&SYSUID..ADLAB.EQALANGX,
//           DISP=(MOD,CATLG),
//           DCB=(DSORG=PO,RECFM=VB,LRECL=1562,BLKSIZE=0),
//           SPACE=(TRK,(40,40,50)),UNIT=SYSDA
//*                                                                 *
//*****************************************************************
//*-----------------------------------------------------------------
//*  COMPILE STEP1: GENERATE EXPANDED C SOURCE FILE IN THE DD
//*                 SYSUT10
//*-----------------------------------------------------------------
//COMP1   EXEC PGM=CCNDRVR,REGION=0M,
// PARM=('PP(COMMENTS,NOLINES)')
//STEPLIB  DD  DSNAME=&LEPRFX..SCEERUN2,DISP=SHR
//         DD  DSNAME=&CPRFX..SCCNCMP,DISP=SHR
//SYSMSGS  DD  DUMMY,DSN=&CPRFX..SCBC3MSG(EDCMSGE),DISP=SHR
//SYSLIB   DD  DSNAME=&LEPRFX..SCEEH.H,DISP=SHR
//         DD  DSNAME=&LEPRFX..SCEEH.SYS.H,DISP=SHR
//         DD  DSNAME=&SYSUID..ADLAB.COPYLIB,DISP=SHR
//SYSPRINT DD  SYSOUT=*
//SYSOUT   DD  SYSOUT=*
//SYSCPRT  DD  SYSOUT=*
//SYSUT1   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//SYSUT5   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT6   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT7   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT8   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT9   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=VB,LRECL=137,BLKSIZE=882)
//SYSUT10  DD  DISP=SHR,DSN=&SYSUID..ADLAB.CDBG(TMC01A)
//SYSUT14  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT16  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
```

```
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT17  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSLIN   DD  DUMMY
//SYSIN    DD  DSNAME=&SYSUID..ADLAB.SOURCE(TMC01A),DISP=SHR
//*
//*-------------------------------------------------------------------
//*  COMPILE STEP2: COMPILE THE EXPANDED SOURCE FILE WITH THE DEBUG
//*                 COMPILER OPTION TEST
//*-------------------------------------------------------------------
//COMP2   EXEC PGM=CCNDRVR,REGION=0M,
//  PARM=('TEST, AGGREGATE, NOIPA, LIST, NESTINC(255),',
//    ' NOOFFSET, NOOPT, SOURCE, XREF, LONGNAME')
//STEPLIB  DD  DSNAME=&LEPRFX..SCEERUN2,DISP=SHR
//         DD  DSNAME=&CPRFX..SCCNCMP,DISP=SHR
//         DD  DSNAME=&LEPRFX..SCEERUN,DISP=SHR
//SYSMSGS  DD  DUMMY,DSN=&CPRFX..SCBC3MSG(EDCMSGE),DISP=SHR
//SYSLIB   DD  DSNAME=&LEPRFX..SCEEH.H,DISP=SHR
//         DD  DSNAME=&LEPRFX..SCEEH.SYS.H,DISP=SHR
//SYSCPRT  DD  DISP=SHR,DSN=&SYSUID..ADLAB.CLST(TMC01A)
//SYSOUT   DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUT1   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//SYSUT5   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT6   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT7   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT8   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT9   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=VB,LRECL=137,BLKSIZE=882)
//SYSUT10  DD  SYSOUT=*
//SYSUT14  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT16  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT17  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSLIN   DD DSN=&&TEMOBJ1(TMC01A),DISP=(,PASS),UNIT=SYSDA,
// SPACE=(TRK,(20,20,20)),DCB=(RECFM=FB,BLKSIZE=3120,LRECL=80,DSORG=PO)
//SYSIN    DD  DSNAME=&SYSUID..ADLAB.CDBG(TMC01A),DISP=SHR
//*
//*-------------------------------------------------------------------
//* LINK STEP: LINK THE COMPILED OBJECT DECK
//*-------------------------------------------------------------------
//LKED EXEC PGM=IEWL,PARM=(LET,MAP,LIST)
//SYSLIB DD DSN=&LEPRFX..SCEELKED,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSLMOD DD DISP=SHR,DSN=&SYSUID..ADLAB.LOAD
//SYSUT1 DD SPACE=(TRK,(10,10)),UNIT=SYSDA
//OBJECT DD DISP=(OLD,PASS),DSN=&&TEMOBJ1
//* DTLIB DD DSN=&DTPRFX..SEQAMOD,DISP=SHR
//SYSLIN DD *
 INCLUDE OBJECT(TMC01A)
 ENTRY CEESTART
```

```
 NAME TMC01(R)
/*
//*  INCLUDING A DEBUG TOOL LE EXIT (EQADBCXT, EQADDCXT, EQADICXT OR EQAD3CXT)
//*  IS OPTIONAL.  THE EXIT ENABLES STARTING DEBUG TOOL WITH THE
//*  USER EXIT DATA SET UTILITY (ONE OF THE DEBUG TOOL ISPF UTILITIES).
//*  AN INCLUDE CAN BE ADDED TO SYSLIN IN THE APPRORIATE SEQUENCE:
//*   INCLUDE DTLIB(EQADBCXT)
//*************************************************************
//* GENERATE THE TMC01A EQALANGX FILE
//*************************************************************
//LANGX1   EXEC PGM=IPVLANGX,REGION=32M,
//  PARM='(C ERROR'
//STEPLIB  DD DISP=SHR,DSN=&LANGXLIB
//         DD DISP=SHR,DSN=&LEPRFX..SCEERUN
//LISTING  DD DSN=&SYSUID..ADLAB.CLST(TMC01A),DISP=SHR
//IDILANGX DD DSN=&SYSUID..ADLAB.EQALANGX(TMC01A),DISP=(OLD)
```

Sample JCL for compiling z/OS® C++ programs

Here is a JCL example for compiling a z/OS® C++ program for use with the ADFz family of products.

```
//* ADD A JOB CARD HERE
//*
//*
//*  SAMPLE JCL TO PREPARE A Z/OS C++ PROGRAM USING DWARF WITHOUT HOOKS
//*  FOR THE IBM ZSERIES ADFz PRODUCTS:
//*     FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//*  NOTES:
//*
//*   COMPILER:
//*    1. A 2-STAGE COMPILE IS PERFORMED.  STAGE 1 (PREPROCESS) IS
//*       DONE TO EXPAND INCLUDES AND MACROS IN THE PROGRAM AND TO
//*       PRODUCE AN EXPANDED SOURCE FILE.
//*    2. THE EXPANDED SOURCE FILE IS RETAINED.  IT IS USED BY
//*       THE MDBG CREATE ROUTINE TO CAPTURE THE SOURCE.
//*    2. COMPILER PARMS ARE SPECIFIED TO GENERATE A DWARF FILE WITH
//*       NOHOOKS.  OTHER OPTIONS ARE SPECIFIED TO FULFILL FA, DT AND
//*       APA REQUIREMENTS.
//*
//*   BIND:
//*    1. AN INCLUDE FOR MODULE EQAD?CXT IS OPTIONAL.  IT IS AN
//*       LE EXIT MODULE THAT CAN BE USED TO START DEBUG TOOL.
//*       UNDERSTAND THE METHODS AVAILABLE FOR STARTING DEBUG TOOL,
//*       AND CHOOSE WHETHER YOU WANT TO USE THE LE EXITS.
//*         IF YOU USE THIS METHOD, INCLUDE THE CORRECT EXIT MODULE:
//*            EQADBCXT: FOR BATCH PROGRAMS
//*            EQADICXT: FOR ONLINE IMS PROGRAMS
//*            EQADDCXT: FOR DB2 STORED PROCEDURES (OF TYPE MAIN AND SUB)
//*           (FOR SUB THIS IS SUPPORTED ONLY FOR INVOCATIONS THROUGH CALL_SUB)
//*            (DO NOT INCLUDE AN EXIT FOR CICS PROGRAMS)
//*          YOU CAN ALSO USE MODULE EQAD3CXT FOR BATCH PROGRAMS, ONLINE IMS
//*          PROGRAMS, DB2 TYPE MAIN STORED PROCEDURES.
//*
//*   MDBG:
//*    AN MDBG FILE IS CREATED FOR DEBUG TOOL. IT WILL CONTAIN ALL THE
//*    ROUTINES IN THE PROGRAM OBJECT WITH DBG FILES AND THE CAPTURED
//*    SOURCE. IN ORDER TO USE THIS FILE IN DEBUG TOOL, THE DEBUG TOOL
```

```
//*    SESSION NEEDS TO HAVE THE EQAOPTS MDBG COMMAND SET TO YES.
//*
//*  SET PARMS FOR THIS COMPILE:
//*  --------------------------
//*       CPRFX: THE PREFIX THE C++ COMPILE IS INSTALLED UNDER
//*       LEPRFX: THE PREFIX FOR THE LE RUNTIME AND LINK LIBS
//*       DTPRFX: THE PREFIX OF THE DEBUG TOOL SEQAMOD LIBRARY
//*
//    SET CPRFX=CBC
//    SET LEPRFX=CEE
//    SET DTPRFX=EQAW
//*
//*******************************************************************/
//* CREATE C++ COMPILER LISTING SYSPRINT, EXPANDED SOURCE DEBUG,    */
//* DBG AND MDBG files.                                             */
//*******************************************************************/
//ALLOC EXEC PGM=IEFBR14
//LISTING DD DSN=&SYSUID..ADLAB.CLST,
//           DISP=(MOD,CATLG),
//           DCB=(DSORG=PO,RECFM=VBA,LRECL=137,BLKSIZE=0),
//           SPACE=(TRK,(20,20,50)),UNIT=SYSDA
//DBGSRC  DD DSN=&SYSUID..ADLAB.CDBG,
//           DISP=(MOD,CATLG),
//           DCB=(DSORG=PO,RECFM=FB,LRECL=80,BLKSIZE=0),
//           SPACE=(TRK,(20,20,50)),UNIT=SYSDA
//DBG     DD DSN=&SYSUID..ADLAB.DBG,
//           DISP=(MOD,CATLG),
//           DCB=(DSORG=PO,RECFM=FB,LRECL=80,BLKSIZE=0),
//           SPACE=(TRK,(40,40,50)),UNIT=SYSDA
//MDBG    DD DSN=&SYSUID..ADLAB.MDBG,
//           DISP=(MOD,CATLG),
//           DCB=(DSORG=PO,RECFM=FB,LRECL=80,BLKSIZE=0),
//           SPACE=(TRK,(40,40,50)),UNIT=SYSDA
//*                                                                 *
//*****************************************************************
//*-----------------------------------------------------------------
//*  COMPILE STEP1: GENERATE EXPANDED C++ SOURCE FILE IN THE DD
//*                 SYSUT10
//*-----------------------------------------------------------------
//COMP1   EXEC PGM=CCNDRVR,REGION=0M,
// PARM=('PP(COMMENTS,NOLINES)')
//STEPLIB  DD  DSNAME=&LEPRFX..SCEERUN2,DISP=SHR
//         DD  DSNAME=&CPRFX..SCCNCMP,DISP=SHR
//SYSMSGS  DD  DUMMY,DSN=&CPRFX..SCBC3MSG(EDCMSGE),DISP=SHR
//SYSLIB   DD  DSNAME=&LEPRFX..SCEEH.H,DISP=SHR
//         DD  DSNAME=&LEPRFX..SCEEH.SYS.H,DISP=SHR
//         DD  DSNAME=&SYSUID..ADLAB.COPYLIB,DISP=SHR
//SYSPRINT DD  SYSOUT=*
//SYSOUT   DD  SYSOUT=*
//SYSCPRT  DD  SYSOUT=*
//SYSUT1   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//SYSUT5   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT6   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT7   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
```

```
//SYSUT8   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT9   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=VB,LRECL=137,BLKSIZE=882)
//SYSUT10  DD  DISP=SHR,DSN=&SYSUID..ADLAB.CDBG(TMC01A)
//SYSUT14  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT16  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT17  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSLIN   DD  DUMMY
//SYSIN    DD  DSNAME=&SYSUID..ADLAB.SOURCE(TMC01A),DISP=SHR
//*
//*-------------------------------------------------------------------
//*  COMPILE STEP2: COMPILE THE EXPANDED SOURCE FILE WITH THE DEBUG
//*                 COMPILER DEBUG(FORMAT(DWARF, NOHOOK))
//*-------------------------------------------------------------------
//COMP2   EXEC PGM=CCNDRVR,REGION=0M,
//  PARM=('/CXX DEBUG(FORMAT(DWARF), NOHOOK, SYMBOL),',
//    ' LIST, LONGNAME, NOOFFSET')
//STEPLIB  DD  DSNAME=&LEPRFX..SCEERUN2,DISP=SHR
//         DD  DSNAME=&CPRFX..SCCNCMP,DISP=SHR
//         DD  DSNAME=&LEPRFX..SCEERUN,DISP=SHR
//SYSMSGS  DD  DUMMY,DSN=&CPRFX..SCBC3MSG(EDCMSGE),DISP=SHR
//SYSLIB   DD  DSNAME=&LEPRFX..SCEEH.H,DISP=SHR
//         DD  DSNAME=&LEPRFX..SCEEH.SYS.H,DISP=SHR
//SYSCPRT  DD  DISP=SHR,DSN=&SYSUID..ADLAB.CLST(TMC01A)
//SYSOUT   DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUT1   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//SYSUT5   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT6   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT7   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT8   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT9   DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//   DCB=(RECFM=VB,LRECL=137,BLKSIZE=882)
//SYSUT10  DD  SYSOUT=*
//SYSUT14  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT16  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSUT17  DD  UNIT=SYSDA,SPACE=(32000,(30,30)),
//             DCB=(RECFM=FB,LRECL=3200,BLKSIZE=12800)
//SYSLIN   DD DSN=&&TEMOBJ1(TMC01A),DISP=(,PASS),UNIT=SYSDA,
// SPACE=(TRK,(20,20,20)),DCB=(RECFM=FB,BLKSIZE=3120,LRECL=80,DSORG=PO)
//SYSIN    DD  DSNAME=&SYSUID..ADLAB.CDBG(TMC01A),DISP=SHR
//*
//*-------------------------------------------------------------------
//* BIND STEP: BIND THE COMPILED OBJECT DECK INTO A PDSE
//*-------------------------------------------------------------------
//BIND EXEC PGM=IEWL,PARM=(LET,MAP,LIST)
//SYSLIB DD DSN=&LEPRFX..SCEELKED,DISP=SHR
```

```
//       DD DSN=&LEPRFX..SCEECPP,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSLMOD DD DISP=SHR,DSN=&SYSUID..ADLAB.LOADPDSE
//SYSUT1 DD SPACE=(TRK,(10,10)),UNIT=SYSDA
//OBJECT DD DISP=(OLD,PASS),DSN=&&TEMOBJ1
//* DTLIB DD DSN=&DTPRFX..SEQAMOD,DISP=SHR
//SYSLIN DD *
 INCLUDE OBJECT(TMC01A)
 ENTRY CEESTART
 NAME TMC01(R)
/*
//*
//*-------------------------------------------------------------------
//* BUILD MDBG STEP
//*-------------------------------------------------------------------
//DBGLD EXEC PGM=CDADBGLD,REGION=1500K,
//      PARM=('ENVAR("LIBPATH=/usr/lib")/VERSION CAPSRC')
//STEPLIB  DD DISP=SHR,DSN=&LEPRFX..SCEERUN2
//         DD DISP=SHR,DSN=&LEPRFX..SCEERUN
//SYSIN    DD DISP=SHR,DSN=&SYSUID..ADLAB.LOADPDSE(TMC01)
//SYSMDBG  DD DISP=SHR,DSN=&SYSUID..ADLAB.MDBG(TMC01)
//SYSPRINT DD SYSOUT=*
//SYSOUT   DD SYSOUT=*
/*
```

Assembler programs

The following table shows various assembler options that can be used to prepare programs for use with the ADFz family of products (z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®). The methods suggested in the following table indicate whether the load module produced is suitable for a production environment. Load modules suitable for a production environment have no significant runtime overhead.

Table 13. Examples of assembler options and source information files that are supported by ADFz products for Assembler

Assembler options	Source information file type produced	Is the load module production ready?	Options supported and suggested for z/OS® Debugger	Options supported and suggested for Fault Analyzer	Options supported and suggested for APA
ADATA	SYSADATA file	Yes	N/A	Supported	Supported
ADATA	LANGX file	Yes	Suggested for production and test		

Preparing Assembler programs

Perform the following steps for assembling your programs:

1. Allocate libraries (PDSE is suggested unless PDS is required for your organization) for LANGX files. Allocate one or more LANGX libraries for each environment, such as test and production.
2. Create a corresponding LANGX library for each load library. Specify LRECL=1562 or greater,RECFM=VB,BLKSIZE= lrecl+4 to 32k.
3. For all programs, such as batch, CICS®, and IMS™, in both test and production environments, specify `ADATA`.

   `ADATA` instructs the assembler to produce a SYSADATA file, which contains source and symbolic data about the program. This produces a production-ready module that can be debugged using z/OS® Debugger. `ADATA` does not affect the contents of the assembled module.

4. Add a SYSADATA DD in the assembler step. This file is created by the assembler and it can be a permanent or temporary file. Specify `LRECL=8188 or greater,RECFM=VB,BLKSIZE= lrecl+4 to 32k`. This file is the input to the IPVLANGX utility.
5. Add a step after the assembler step to run the IPVLANGX utility. The IPVLANGX utility reads the SYSADATA file and creates a LANGX file. The LANGX file is the source information file for z/OS® Debugger, Fault Analyzer for z/OS® and Application Performance Analyzer for z/OS®.
6. Save the LANGX file in the LANGX file library, and specify a member name that is equal to the CSECT name.
7. Modify the promotion process to promote LANGX files. When a load module is promoted, for example, from test to production, promote the corresponding LANGX file or files. A promotion can be a recompile, copy, or move. Perform the same steps with the LANGX file that you perform with the module during promotion.
8. If the assembler program is Language Environment-enabled, optionally include a z/OS® Debugger Language Environment® exit module into the load module during the linkage editor step. This approach is one way to enable z/OS® Debugger panel 6 in ISPF, a simple panel-driven method to start the debugger automatically when a program runs, without JCL changes, based on the program name and user ID. Use module EQADBCXT for batch programs (including IMS™ batch), EQADICXT for IMS/TM programs and EQADDCXT for DB2® stored procedures. Do not include the exit module for CICS® programs.

   You can also use module EQAD3CXT for batch programs, IMS/TM, IMS™ BTS programs, and DB2® type MAIN stored procedures

9. For CICS® programs only: If the program is a CICS® main program, is enabled for Language Environment®, and the z/OS® Debugger DTCN transaction is used to start z/OS® Debugger, then supplied module EQADCCXT must be included in the load module during the linkage editor step.

Sample JCL for assembling a program

Here is a JCL example for assembling a program for use with the ADFz family of products.

```
//*     - - -  ADD A JOB CARD ABOVE THIS LINE  - - -
//*
//*  SAMPLE JCL TO PREPARE AN ASSEMBLER PROGRAM
//*  FOR THE IBM ZSERIES ADFz PRODUCTS:
//*     FAULT ANALYZER, DEBUG TOOL, AND APPLICATION PERF. ANALYZER
//*
//*  NOTES:
//*
//*   ASSEMBLER:
//*    1. AN ADATA PARM IS REQUIRED TO PRODUCE A SYSADATA FILE
```

```
//*
//*   A STEP THAT PROCESSES THE SYSADATA FILE,
//*   AND CREATES A LANGX FILE IS NEEDED.
//*
//*   BINDER (LINKAGE EDITOR):
//*    1. AMODE / RMODE CAN BE CODED AS NEEDED BY THE PROGRAM.  THEY ARE
//*       NOT REQUIRED FOR ADFz.
//*
//*  SET PARMS FOR THIS COMPILE:
//*  ---------------------------
//   SET MEM=ASAM1                        PROGRAM NAME
//   SET Language EnvironmentHLQ='CEE'    Language Environment HIGH LVL QUALIFIER
//   SET UNITDEV=SYSALLDA                 UNIT FOR TEMP FILES
//   SET LANGX='IPVLANGX'                 IPVLANGX UTILITY PROGRAM
//   SET LANGXLIB='IPV.SIPVMODA'          LIBRARY FOR IPVLANGX UTILITY
//*    NOTE: USE THE IPVLANGX FACILITY SHIPPED WITH THE COMMON COMPONENT.
//*
//*  *********************************
//*      ASSEMBLER STEP
//*  *********************************
//ASM1 EXEC  PGM=ASMA90,COND=(4,LT),REGION=32M,
//      PARM='ADATA,OBJECT'
//SYSIN    DD DISP=SHR,DSN=&SYSUID..ADLAB.SOURCE(&MEM)
//SYSPRINT DD SYSOUT=*
//SYSLIN   DD DISP=SHR,DSN=&SYSUID..ADLAB.OBJ(&MEM)
//SYSADATA DD DISP=SHR,DSN=&SYSUID..ADLAB.SYSADATA(&MEM)
//SYSLIB  DD  DSN=SYS1.MODGEN,DISP=SHR
//        DD  DSN=SYS1.MACLIB,DISP=SHR
//        DD  DSN=&LEHLQ..SCEEMAC,DISP=SHR
//SYSUT1  DD  DISP=(NEW,DELETE),DSN=&&SYSUT1,SPACE=(1700,(900,450)),
//     UNIT=&UNITDEV
//SYSUT2  DD  DISP=(NEW,DELETE),DSN=&&SYSUT2,SPACE=(1700,(600,300)),
//     UNIT=&UNITDEV
//SYSUT3  DD  DISP=(NEW,DELETE),DSN=&&SYSUT3,SPACE=(1700,(600,300)),
//     UNIT=&UNITDEV
//*
//*  *********************************
//*     STEP TO GENERATE LANGX FILE
//*  *********************************
//LANGX    EXEC PGM=&LANGX,REGION=32M,
//  PARM='(ASM ERROR'
//STEPLIB  DD DISP=SHR,DSN=&LANGXLIB
//         DD DISP=SHR,DSN=&LEHLQ..SCEERUN
//SYSADATA DD DSN=&SYSUID..ADLAB.SYSADATA(&MEM),DISP=SHR
//IDILANGX DD DSN=&SYSUID..ADLAB.EQALANGX(&MEM),DISP=SHR
//*
//*  *********************************
//*        LINK-EDIT (BINDER) STEP
//*  *********************************
//LINK     EXEC PGM=IEWL,PARM='MAP',REGION=0M
//SYSLIB   DD DSN=&LEHLQ..SCEELKED,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSLMOD  DD DISP=SHR,DSN=&SYSUID..ADLAB.LOAD(&MEM)
//SYSUT1   DD UNIT=SYSDA,SPACE=(TRK,(10,10))
//SYSLIN   DD DSN=&SYSUID..ADLAB.OBJ(&MEM),DISP=SHR
//         DD *
     MODE AMODE(31),RMODE(24)
```

```
     ENTRY ASAM1
//*
```

Chapter 6. IPVLANGX compiler listing to side file conversion utility

IPVLANGX is a utility program that converts a compiler listing, or SYSADATA file, to a LANGX side file.

Creating side files using IPVLANGX

Use the IPVLANGX program to create a side file from a compiler listing.

The sample JCL in Figure 3: Sample JCL to compile a COBOL program and store the side file on page 86 is provided as member IPVSCMPS in the IPV.SIPVSAM1 data set. It performs the following steps:

- Compiles a COBOL program.

  Note: You can only compile one program per compile step in order to name the compiler listing PDS(E) member (if using a partitioned data set), and to ensure that only one compiler listing is written to the output file. Nested COBOL programs are not supported.

- Executes IPVLANGX to process the listing and store it as a side file where the ADFz products can access it. (For return codes issued by IPVLANGX, see IPVLANGX return codes on page 127.)
- Writes the listing as part of the job output.

Figure 3. Sample JCL to compile a COBOL program and store the side file

```
//IPVSCMPS JOB (GSF),'GENERATE.SIDE.FILE',NOTIFY=&SYSUID.,
//         MSGCLASS=X,CLASS=A,MSGLEVEL=(1,1)
//         JCLLIB ORDER=(IGY.V2R1M0.SIGYPROC) <== INSTALLATION
//*                                                IGYWCLG PROC
//*
//*************************************************************/
//* THIS JOB RUNS A COBOL COMPILE PLUS PRODUCES A SIDE FILE  */
//* FROM A PROGRAM LISTING THAT THE ADFz PRODUCTS CAN        */
//* USE FOR OBTAINING SOURCE INFORMATION.                    */
//* THE COMPILE OUTPUT IS THEN WRITTEN TO SYSUT2 IN THE      */
//* IEBGENER STEP.                                           */
//*************************************************************/
//*
//CBLRUN   EXEC IGYWC,PARM.COBOL='LIST,MAP,Source,XREF'
//COBOL.SYSIN DD DATA,DLM='##'
⋮
(Program source not shown)
⋮
##
//COBOL.SYSPRINT DD DSN=&&COBLIST(IPVSCBL1),
//         DISP=(,PASS),SPACE=(TRK,(10,5,5),RLSE),
//         DCB=(RECFM=FBA,LRECL=133,BLKSIZE=0)
//*
//IPVLANGX EXEC PGM=IPVLANGX,REGION=4096K,
// PARM='IDISCBL1 (COBOL ERROR'
//LISTING  DD  DISP=(OLD,PASS),DSN=&&COBLIST ❶
//IDILANGX DD  DISP=SHR,DSN=IPV.IPVLANGX     ❷
//SYSUDUMP DD  SYSOUT=*
//*
//IEBGENER EXEC PGM=IEBGENER,REGION=4096K
//SYSUT1   DD  DISP=OLD,DSN=&&COBLIST(IPVSCBL1)
//SYSUT2   DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSIN    DD  *
/*
```

After you have created and stored a side file, there is no benefit to ADFz products in retaining the listing.

If you already have listings, you can turn them into side files. Here is sample JCL to do this conversion (it is provided as member IPVSFILE in the IPV.SIPVSAM1 data set):

Figure 4. Sample JCL to create a side file from a COBOL listing

```
//IPVLANGX JOB (C97),'IPVLANGX',MSGCLASS=X,
//         CLASS=A,NOTIFY=&SYSUID
//*************************************************************
//* This job produces a side file from a program listing that
//* the ADFz products can use for obtaining source information.
//* This particular example is set up for a COBOL extraction
//* from IPV.LISTING.COBOL(COBOLA) to IPV.IPVLANGX
//*************************************************************
//IPVLANGX EXEC PGM=IPVLANGX,REGION=4096K,
// PARM='COBOLA (COBOL ERROR'
//LISTING  DD  DISP=SHR,DSN=IDI.LISTING.COBOL ❶
//IDILANGX DD  DISP=SHR,DSN=IDI.IPVLANGX      ❷
//SYSUDUMP DD  SYSOUT=*
```

Notes:

❶

DDname must be LISTING for all types of compiler listings, or SYSADATA for an assembler ADATA file.

❷

DDname must be IDILANGX for the output LANGX side file. The data set must be sequential or PDS(E), RECFM=VB, LRECL≥1562.

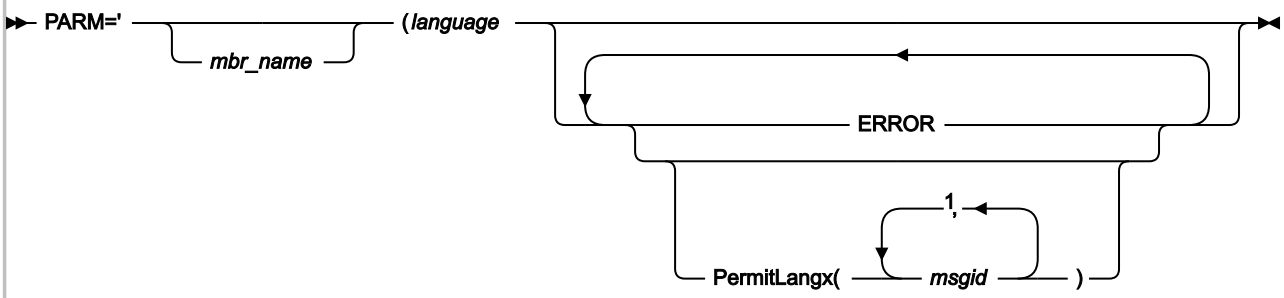
Refer to the documentation for the individual ADFz products for information about how to provide the LANGX side file for processing.

A compiler listing is the only data format that IPVLANGX accepts as input, with the exception of SYSADATA for assembler.

IPVLANGX parameters

The PARM string passed to IPVLANGX should contain:

Figure 5. Syntax



Notes:

[1] Either comma or blank character is permitted as delimiter.

where:

mbr_name

The compiler listing or ADATA file member name in the input data set identified by the LISTING DD name (for a compiler listing) or the SYSADATA DD name (if an ADATA file). This parameter is optional. If omitted, the JCL must specify for the compiler listing or ADATA file, either a sequential data set, or a PDS(E) data set with member name. Also, the output IPVLANGX member is named according to the input program name. In the case of COBOL, for example, this name is the name found on the PROGRAM-ID source line.

language

The language of the compiler listing or ADATA file, as:

- COBOL
- PLI
- C
- ASM

ERROR

An optional parameter that provides more diagnostics on variables for which information is incomplete.

PermitLangx(*msgid*, …)

An optional parameter that specifies message IDs for compiler error messages which should be ignored. For details, see *IBM® Fault Analyzer for z/OS® User's Guide and Reference*. Chapter 33 *"Options"*, section *"PermitLangx"*.

Including an IPVLANGX step in your SCLM translator

If you use Software Configuration and Library Manager (SCLM) to manage your application software, consider including an IPVLANGX step in your SCLM translator. LANGX side files generally take up less disk space than compiler listings. The following examples show an IPVLANGX step inserted into a High Level Assembler and a COBOL SCLM translator.

High Level Assembler SCLM example

This example is included in data set IPV.SIPVSAM1 as member IPVSCLMA.

```
*          SYSADATA DDNAME used in HLASM step.
*          (* SYSADATA *)
           FLMALLOC  IOTYPE=W,DDNAME=SYSADATA,RECFM=VB,RECNUM=9000,    C
               LRECL=8188,BLKSIZE=8192,PRINT=Y
*
*
* IPVLANGX BUILD TRANSLATOR
*
           FLMTRNSL  CALLNAM='IPVLANGX',                               C
               FUNCTN=BUILD,                                           C
               COMPILE=IPVLANGX,                                       C
```

```
                DSNAME=IPV.SIPVMODA,                                    C
                VERSION=3.5.2,                                          C
                GOODRC=0,                                               C
                PORDER=1,                                               C
                OPTIONS='@@FLMMBR(ASM ERROR'
 *
 *          (* SYSADATA *)
            FLMALLOC  IOTYPE=U,DDNAME=SYSADATA
 *
 *          (* IDILANGX *)
            FLMALLOC  IOTYPE=P,DDNAME=IDILANGX,DFLTTYP=IDILANGX,        C
                KEYREF=OUT2,BLKSIZE=27998,LRECL=1562,RECFM=VB,          C
                RECNUM=10000,DIRBLKS=50,DFLTMEM=*
```

COBOL SCLM example

This example is included in data set IPV.SIPVSAM1 as member IPVSCLMC.

```
*********************************************************************
*        --COPY SYSPRINT FILE TO LISTING
* The COPYFILE EXEC, in dataset PDFTDEV.PROJDEFS.EXEC contains the
* following:
*
* /* REXX */
* /*********************************************************************/
* /* Copy file I to file O.  Both are assumed to be pre-allocated.      */
* /*********************************************************************/
* PARSE UPPER ARG I","O .
* "EXECIO * DISKR "I" (STEM R. FINIS "
* "EXECIO * DISKW "O" (STEM R. FINIS "
* RETURN
*
********************************************************************
*
         FLMTRNSL   CALLNAM='COPY FILES      ',                       C
               FUNCTN=BUILD,                                          C
               COMPILE=COPYFILE,                                      C
               DSNAME=PDFTDEV.PROJDEFS.EXEC,                          C
               CALLMETH=TSOLNK,                                       C
               VERSION=1.0,                                           C
               PORDER=1,                                              C
               OPTIONS=(SYSPRINT,LISTING),                            C
               GOODRC=0

           FLMALLOC  IOTYPE=W,RECFM=VBA,LRECL=133,                    C
               RECNUM=90000,DDNAME=LISTING
*
           FLMTRNSL  CALLNAM='IPVLANGX',                              C
               FUNCTN=BUILD,                                          C
               COMPILE=IPVLANGX,                                      C
               DSNAME=IPV.SIPVMODA,                                   C
               VERSION=3.5.2,                                         C
               GOODRC=0,                                              C
               PORDER=1,                                              C
```

```
               OPTIONS='@@FLMMBR(COBOL ERROR'
*
*          (* LISTING *)
           FLMALLOC  IOTYPE=U,DDNAME=LISTING
*
*          (* IDILANGX *)
           FLMALLOC  IOTYPE=P,DDNAME=IDILANGX,DFLTTYP=IDILANGX,        C
               KEYREF=OUT2,BLKSIZE=27998,LRECL=1562,RECFM=VB,          C
               RECNUM=10000,DIRBLKS=50,DFLTMEM=*
```

Chapter 7. IPVLANGP side file formatting utility

A utility program, IPVLANGP, is provided, which can be used to create a readable listing from one of the following:

- A LANGX side file.
- For Enterprise PL/I, a SYSDEBUG side file that is generated by using the PL/I TEST(SEPARATE) or PL/I (NOSEP SOURCE) compiler option.
- For Enterprise PL/I Version 6 or later a load module that is generated by using the PL/I TEST(NOSEPARATE SOURCE) compiler option.
- For Enterprise COBOL, a SYSDEBUG side file that is generated by using the COBOL TEST(SEPARATE) option.
- For Enterprise COBOL Version 5 or later, a program object containing DWARF debugging information generated by using the TEST(SOURCE) or NOTEST(SOURCE) option.
- For Enterprise COBOL Version 6, a SYSDEBUG side file that is generated by using the COBOL TEST(SEPARATE SOURCE) or NOTEST(SEPARATE SOURCE) option.

This approach might be useful if side files, rather than compiler listings, are kept in order to conserve DASD space. The utility program is able to format the side file or program object debugging information in a way that resembles the original compiler listing.

IPVLANGP can be executed in a number of different ways:

- As an ISPF option 3.4 (Data Set List Utility) line command against a sequential LANGX side file or COBOL or PL/I SYSDEBUG side file data set, or if the data set is partitioned, as a line command against a member of the data set. For Enterprise COBOL Version 5 and PL/I Version 6, IPVLANGP can also be issued against a program object member of a PDSE load library.

  If a sequential COBOL or PL/I SYSDEBUG side file data set is used, or if the member of a partitioned COBOL or PL/I SYSDEBUG side file data set does not match any PROGRAM-ID named program contained within it, then a prompt is displayed which permits a program name to be specified.

  When a COBOL Version 5 or PL/I Version 6 program object contains more than one compile unit, a prompt is displayed to select the desired program.

  All LANGX side files that are contained in a sequential data set, or a partitioned data set member, are displayed, regardless of whether these match the member name or not.

  The output is written to a temporary data set and displayed using ISPF EDIT.
- From a Fault Analyzer ISPF interface display, using the Services action-bar pull-down menu, and selecting the *"IPVLANGP Side File Formatting Utility"* option. A prompt is displayed, from which you specify the data set to be formatted.

  The output is presented in an ISPF display, but may be copied to a data set using the COPY command.
- As a batch job, like the following:

```
//PRTLANGX JOB ...
//STEP1    EXEC PGM=IPVLANGP,PARM='parms'
//SYSPRINT DD   SYSOUT=*
```

The PARM string passed to IPVLANGP should contain:

Figure 6. Syntax

```
►► PARM=' data_set_name ──┬──────────────────────┬──►◄
                          └─ PROG: program_name ─┘
```

where:

data_set_name

The name of a sequential LANGX side file or COBOL or PL/I SYSDEBUG side file data set, or if the data set is partitioned (as is the case for program objects), the data set name with member name included in parentheses.

Examples:

```
MY.SYSDEBUG.SEQ.DS
MY.IPVLANGX.PDS.DS(MYPROG)
```

program_name

For COBOL, the name of a PROGRAM-ID named program contained within a SYSDEBUG side file or V5 program object. For PL/I, the name of a main PROCEDURE contained within a SYSDEBUG side file or V6 program object.

The formatted listing is written to the SYSPRINT DD. Normal listing file attributes, such as variable-blocked record format and logical record length of 137, are generally appropriate.

When source code comments contain non-printable characters, specify a LOCALE with an appropriate code set for source code translation. The IPVLANGP header shows the LOCALE and code set that are in effect (see Locale on page 27).

Deferred Breakpoints Feature

Start IPVLANGP with the *"bkp"* parameter for a COBOL or PL/I SYSDEBUG file, a COBOL LANGX file, a COBOL Version 5 program object containing DWARF debugging information, or a PL/I Version 6 program object containing C_PLISRC class data. You can also start it from z/OS® Debugger Utilities or Fault Analyzer for z/OS® Services menus. Here it is started from an ISPF member list:

```
 Menu  Functions  Confirm  Utilities  Help
 ------------------------------------------------------------------------------
 DSLIST            JERRYBL.IPVLANGX                      Row 0000001 of 0000023
 Command ===> ____________________________________________ Scroll ===> CSR
            Name     Prompt       Size   Created          Changed          ID
 __________ AFPBIM
 __________ AFPBITM
 __________ AFPLDOVL
 __________ ASMHOLE
 ipvlangp   COBEX1   bkp ❶
 __________ COBOV1
 __________ COBTINY
 __________ CPPTST1
 __________ DACBB030
 __________ DACVD002
 __________ DAGOTST
 __________ HRHP702C
 __________ NAMUCSM
 __________ OSVSC01
 __________ PLIPARM
 __________ PLIPARME
 __________ PLIPARM1
  F1=Help    F3=Exit    F5=Rfind   F7=Up      F8=Down    F9=Swap   F10=Left
 F11=Right  F12=Cancel
```

❶

The *"bkp"* parameter enables setting of deferred breakpoints.

IPVLANGP then prompts for the z/OS® Debugger Repository and the program's load module name (default is program name):

```
  Menu  Functions  Confirm  Utilities  Help
_ ┌──────────────────────────── Deferred Breakpoints ────────────────────────┐
D │                                                                          │
C │  IPVLANGP requires the name of the z/OS Debugger Repository and a load   │
  │  module name for program COBEX1                                          │
_ │                                                                          │
_ │  Repository (PDS/E) . . PRINT.PDS ❷                                      │
_ │  Load Module  . . . . . COBEX1                                           │
_ │                                                                          │
I │   F1=Help     F3=Exit    F12=Cancel                                      │
_ └──────────────────────────────────────────────────────────────────────────┘
__________ COBTINY
__________ CPPTST1
__________ DACBB030
__________ DAGOTST
__________ HRHP702C
__________ NAMUCSM
__________ OSVSC01
__________ PLIPARM
__________ PLIPARME
__________ PLIPARM1
 F1=Help    F3=Exit    F5=Rfind   F7=Up      F8=Down    F9=Swap   F10=Left
F11=Right  F12=Cancel
```

❷

The Repository data set name is saved in an ISPF variable and is automatically initialized to the last used data set name on subsequent invocations.

The main IPVLANGP panel now appears:

```
 File  Services
 ____________________________________________________________________________
 IPVLANGP                                                    Line 1 Col 1 80
 Command ===> ____________________________________________ Scroll ===> CSR

                                IPVLANGX Print Utility V1R7M0 (AI41974 2015/08/
                                ----------------------------------------------

 Program Name . . . . . . . . : COBEX1
 Data Set Name. . . . . . . . : JERRYBL.IPVLANGX(COBEX1)
 Options in Effect. . . . . . : NoLocale
 Compiler name. . . . . . . . : IBM Enterprise COBOL for z/OS  4.2.0
 Date of Compile. . . . . . . : 2015-04-30
 Time of Compile. . . . . . . : 12.52.1130
 Date of IPVLANGX extraction. : 2015-07-06
 Time of IPVLANGX extraction. : 11.43.2206

 Source listing
 --------------
 ____________________________________________________________________?
 | Place cursor on an executable source line number or label to add a | -+----5-
 | breakpoint                                                        |
 ____________________________________________________________________| own
 F10=Left     F11=Right
```

Any existing breakpoints for the program are retrieved from the repository. Line (Stmt) numbers where breakpoints are set will be highlighted, for example lines 173 and 175 in the following example:

```
 File  Services
 ____________________________________________________________________________
 IPVLANGP                                                   Line 176 Col 1 80
 Command ===> ____________________________________________ Scroll ===> CSR

   00091C    000171                    PERFORM CALC-TAX.
             000173                CALC-TAX.
   00093E    000174                    IF ELECTRIC
   000954    000175                      COMPUTE BASE-AMOUNT = PRICE / CC
   00097E    000176                      COMPUTE TAX-AMOUNT = PRICE / BASE-AMOUNT
   00097E    000177                    ELSE
   0009AC    000178                      COMPUTE BASE-AMOUNT = CC / CYLINDERS
   0009D6    000179                      IF KW < 150
   0009EA    000180                        MOVE 10 TO BASE-AMOUNT
   0009EA    000181                      ELSE
   0009F4    000182                        MOVE 20 TO BASE-AMOUNT
   0009FA    000183                        IF ZERO-100 < 5
   000A0E    000184                          ADD 5 TO BASE-AMOUNT
   000A0E    000185                        ELSE
   000A2C    000186                          IF RED
   000A3E    000187                            ADD 2 TO BASE-AMOUNT
   000A3E    000188                          ELSE
  F1=Help      F3=Exit      F5=RptFind   F6=AddBkp    F7=Up        F8=Down
 F10=Left     F11=Right
```

Breakpoints can be added or viewed by pressing PF6, which is sensitive to the cursor position:

- With the cursor on a Line (Stmt) number, a popup appears allowing a new line or label breakpoint to be added, or an existing breakpoint to be modified (or cleared).
- If the cursor is outside of the source area (for example, on the command line), a list of existing breakpoints is shown allowing one or more to be worked with.

In the following example, PF6 is pressed with the cursor on the command line:

```
 File  Services
 ─────────────────────────────────────────────────────────────────────────────?
│Breakpoints                                                   Line 1 Col 1 76 │
│                                                                              │
│S to select breakpoints to work with:                                         │
│s 000173 AT EVERY 10 FROM 1 TO 9 LABEL CALC-TAX;                              │
│_ 000175 AT EVERY 10 FROM 9 TO 1 LINE 175 WHEN cc=0;                          │
│                                                                              │
│*** Bottom of data.                                                           │
│                                                                              │
│                                                                              │
│                                                                              │
│                                                                              │
│                                                                              │
│                                                                              │
│                                                                              │
│                                                                              │
│Command ===> ____________________________________________ Scroll ===> CSR_    │
│ F1=Help     F3=Exit     F5=RptFind  F7=Up       F8=Down     F12=Cancel       │
 ──────────────────────────────────────────────────────────────────────────────
0008F4    000167                     MOVE ZERO TO TAX-AMOUNT.
0008FA    000168                     PERFORM REDO-TAX.
          000170                 REDO-TAX.
00091C    000171                     PERFORM CALC-TAX.
          000173                 CALC-TAX.
00093E    000174                     IF ELECTRIC
000954    000175                       COMPUTE BASE-AMOUNT = PRICE / CC
00097E    000176                       COMPUTE TAX-AMOUNT = PRICE / BASE-AMOUNT
00097E    000177                     ELSE
0009AC    000178                       COMPUTE BASE-AMOUNT = CC / CYLINDERS
0009D6    000179                       IF KW < 150
0009EA    000180                         MOVE 10 TO BASE-AMOUNT
0009EA    000181                       ELSE
0009F4    000182                         MOVE 20 TO BASE-AMOUNT
0009FA    000183                         IF ZERO-100 < 5
000A0E    000184                           ADD 5 TO BASE-AMOUNT
000A0E    000185                         ELSE
000A2C    000186                           IF RED
000A3E    000187                             ADD 2 TO BASE-AMOUNT
000A3E    000188                           ELSE
 F1=Help      F3=Exit      F5=RptFind   F6=AddBkp    F7=Up        F8=Down
F10=Left     F11=Right
```

As shown, breakpoints are listed in z/OS® Debugger command format.

Enter the 'S' line command to work with one or more existing line or label breakpoints. Here, the line 173 breakpoint is selected:

```
  File  Services
┌──────────────────────────────────────────────────────────────────────────────?
│ Breakpoints                                                  Line 1 Col 1 76  │
│  ┌──────────────────────────────────────────────────────────────────────────────?
│ S │ Add Label Breakpoint                                      Line 1 Col 1 76  │
│ s │                                                                            │
│   │ Label:                                                                     │
│   │   000173 CALC-TAX.                                                         │
│ * │                                                                            │
│   │   EVERY   10        FROM 1        TO 9        ❸                            │
│   │   Action  playback enable                                                  │
│   │           ____________________________________________                     │
│   │           ____________________________________________                     │
│   │                                                                            │
│   │ Clear breakpoint? N  (Y/N)                                                 │
│   │                                                                            │
│ C │ Press ENTER to change/clear breakpoint.                                    │
└──  │  Command ===> ____________________________________________ Scroll ===> CSR  │
000  │  F1=Help     F3=Exit     F5=RptFind  F7=Up       F8=Down    F12=Cancel     │
000  └──────────────────────────────────────────────────────────────────────────────┘
          000170                REDO-TAX.
00091C    000171                    PERFORM CALC-TAX.
          000173                CALC-TAX.
00093E    000174                    IF ELECTRIC
000954    000175                      COMPUTE BASE-AMOUNT = PRICE / CC
00097E    000176                      COMPUTE TAX-AMOUNT = PRICE / BASE-AMOUNT
00097E    000177                    ELSE
0009AC    000178                      COMPUTE BASE-AMOUNT = CC / CYLINDERS
0009D6    000179                      IF KW < 150
0009EA    000180                        MOVE 10 TO BASE-AMOUNT
0009EA    000181                      ELSE
0009F4    000182                        MOVE 20 TO BASE-AMOUNT
0009FA    000183                        IF ZERO-100 < 5
000A0E    000184                          ADD 5 TO BASE-AMOUNT
000A0E    000185                        ELSE
000A2C    000186                          IF RED
000A3E    000187                            ADD 2 TO BASE-AMOUNT
000A3E    000188                          ELSE
 F1=Help      F3=Exit      F5=RptFind   F6=AddBkp    F7=Up        F8=Down
F10=Left     F11=Right
```

The Add Label Breakpoint popup is used to add, change or clear a label breakpoint.

❸

Line and label breakpoints may specify an EVERY clause and an Action.

```
  File  Services
 ┌──────────────────────────────────────────────────────────────────────────────?
 │ Breakpoints                                                  Line 1 Col 1 76  │
 │  ┌──────────────────────────────────────────────────────────────────────────────?
 │ S │ Add Label Breakpoint                                      Line 1 Col 1 76  │
 │ s │                                                                            │
 │   │ Label:                                                                     │
 │   │   000173 CALC-TAX.                                                         │
 │ * │                                                                            │
 │   │   EVERY   10        FROM 1        TO 9                                     │
 │   │   WHEN    cc = 0                                    ❹                      │
 │   │           ____________________________________________                     │
 │   │           ____________________________________________                     │
 │   │   Action  playback disable                                                 │
 │   │           ____________________________________________                     │
 │   │           ____________________________________________                     │
 │ C │ Clear breakpoint? N  (Y/N)                                                 │
 └──┘                                                                            │
000  │ Press ENTER to change/clear breakpoint.                                     │
000  │                                                                            │
     │ *** Bottom of data.                                                        │
000  │                                                                            │
     │  Command ===> ____________________________________________ Scroll ===> CSR  │
000  │  F1=Help     F3=Exit     F5=RptFind  F7=Up       F8=Down    F12=Cancel     │
000  └──────────────────────────────────────────────────────────────────────────────┘
00097E    000176                      COMPUTE TAX-AMOUNT = PRICE / BASE-AMOUNT
00097E    000177                    ELSE
0009AC    000178                      COMPUTE BASE-AMOUNT = CC / CYLINDERS
0009D6    000179                      IF KW < 150
0009EA    000180                        MOVE 10 TO BASE-AMOUNT
0009EA    000181                      ELSE
0009F4    000182                        MOVE 20 TO BASE-AMOUNT
0009FA    000183                        IF ZERO-100 < 5
000A0E    000184                          ADD 5 TO BASE-AMOUNT
000A0E    000185                        ELSE
000A2C    000186                          IF RED
000A3E    000187                            ADD 2 TO BASE-AMOUNT
000A3E    000188                          ELSE
 F1=Help      F3=Exit      F5=RptFind   F6=AddBkp    F7=Up        F8=Down
F10=Left     F11=Right
```

Similarly, the Add Line Breakpoint popup is used to add, change or clear (delete) a line breakpoint.

❹

Line breakpoints may also specify a WHEN condition.

On exiting IPVLANGP, the following popup appears:

```
  File  Services
 ──────────────────────────────────────────────────────────────────────────?
 │ Save Breakpoints for Program COBEX1                       Line 1 Col 1 76 │
 │                                                                           │
 │ Select one of the following:                                              │
 │   1. Save breakpoints                                                     │
 │   2. Exit without saving new or changed breakpoints                       │
 │   3. Clear all breakpoints for this program                               │
 │                                                                           │
 │ Breakpoints:                                                              │
 │ 000173 AT EVERY 10 FROM 1 TO 9 LABEL CALC-TAX playback enable;            │
 │ 000175 AT EVERY 10 FROM 9 TO 1 LINE 175 WHEN cc=0 playback disable;       │
 │                                                                           │
 │ *** Bottom of data.                                                       │
 │                                                                           │
 │                                                                           │
 │                                                                           │
 │ Command ===> ____________________________________________ Scroll ===> CSR  │
 │  F1=Help     F3=Exit     F5=RptFind  F7=Up       F8=Down    F12=Cancel   │
 ─────────────────────────────────────────────────────────────────────────────
0008F4    000167                    MOVE ZERO TO TAX-AMOUNT.
0008FA    000168                    PERFORM REDO-TAX.
          000170                REDO-TAX.
00091C    000171                    PERFORM CALC-TAX.
          000173                CALC-TAX.
00093E    000174                    IF ELECTRIC
000954    000175                      COMPUTE BASE-AMOUNT = PRICE / CC
00097E    000176                      COMPUTE TAX-AMOUNT = PRICE / BASE-AMOUNT
00097E    000177                    ELSE
0009AC    000178                      COMPUTE BASE-AMOUNT = CC / CYLINDERS
0009D6    000179                      IF KW < 150
0009EA    000180                        MOVE 10 TO BASE-AMOUNT
0009EA    000181                      ELSE
0009F4    000182                        MOVE 20 TO BASE-AMOUNT
0009FA    000183                        IF ZERO-100 < 5
000A0E    000184                          ADD 5 TO BASE-AMOUNT
000A0E    000185                        ELSE
000A2C    000186                          IF RED
000A3E    000187                            ADD 2 TO BASE-AMOUNT
000A3E    000188                          ELSE
 F1=Help      F3=Exit      F5=RptFind   F6=AddBkp    F7=Up        F8=Down
F10=Left     F11=Right
```

Breakpoints are saved back to the Repository in XML format. Use DTU to convert the breakpoint XML definitions to a z/OS® Debugger commands file ready for use with the next debug session.

Deferred Breakpoints also feature in Fault Analyzer's COBOL Explorer.

Chapter 8. IPVLANGO Automatic Binary Optimizer LANGX file update utility

The Automatic Binary Optimizer for z/OS® (ABO) product optimizes COBOL object code. See the *IBM Automatic Binary Optimizer for z/OS User's Guide* for the eligible compilers.

ABO optimization results in code changes that render any existing compiler listing or side file unusable with the optimized program. The IPVLANGO utility creates LANGX file members that can be used to provide source-level debugging of the optimized program with ADFz products such as Fault Analyzer, z/OS® Debugger, and APA. New LANGX file members can be created from compiler listings, SYSDEBUG side files (COBOL V4 or earlier), or existing LANGX files.

The sample job step in Figure 7: Sample job step to create an 'optimized' LANGX side file on page 100 takes the listing transforms file from a previous ABO step and merges it with one or more LANGX file members to create 'optimized' LANGX members. (Refer to ABO documentation for the complete optimization JCL, which this sample job step can be appended to.) If the listing transforms file is a PDS(E), it must specify a member name. In Figure 7: Sample job step to create an 'optimized' LANGX side file on page 100, the input is a LANGX data set (DD:IPVLANGX); alternatively, it could be a compiler listing (DD:IPVLCOB) or a SYSDEBUG data set (DD:IPVSYSDB).

As ABO can process multiple programs in a single invocation, the listing transforms file has a PROC section for each optimized program. To accommodate this, compiler listing, SYSDEBUG, and LANGX data set DDs should specify a PDS(E) data set without a member name. The input PDS(E) should contain a member for each PROC in the listing transforms file. Likewise, the output LANGX PDS(E) contains a member for each PROC in the listing transforms file.

The IPVLANGO utility uses the following DDs:

LISTING

The (input) ABO listing transforms file that was written in the ABO step to SYSPRINT. This can be a sequential data set, a PDS(E) member, or a concatenation.

IPVLANGX | IPVLCOB | IPVSYSDB

The original (input) side file that represents one or more unoptimized programs. This must be a PDS(E) that contains a member for each program. Multiple data sets can be provided by specifying a concatenation. Do not specify a member name. Use one of these DDs depending on the input side file format.

IPVLANGO

The new (output) LANGX side file that represents one or more optimized programs. This must be a VB PDS(E) with LRECL>=1562 and must not be the same data set as the one specified for IPVLANGX. A member is written for each PROC in the listing transforms file. Do not specify a member name. Note that this data set cannot subsequently be used as input to the IPVLANGO utility.

SYSPRINT

A log of procedures processed and any problems encountered. IPVLANGO returns 0 if there are no problems.

Figure 7. Sample job step to create an 'optimized' LANGX side file

```
//LANGO EXEC PGM=IPVLANGO
//LISTING DD DISP=SHR,DSN=*.OPT.SYSPRINT   <--- Input ABO transforms file
//IPVLANGX DD DISP=SHR,DSN=JERRYBL.BINOPT.LANGX
//IPVLANGO DD DISP=SHR,DSN=JERRYBL.BINOPT.LANGX.ABO
```

Chapter 9. Maintaining ADFz Common Components

Take the following steps to apply maintenance to ADFz Common Components:

1. If ADFzCC SMP/E target libraries are in LINKLIST, remove them from LLA and VLF control before you perform the SMP/E APPLY. The removal is to avoid errors when modules are loaded from LINKLIST because SMP/E compressed or added extents to the libraries.
2. Perform SMP/E APPLY.
3. If the updated ADFzCC modules are in LPA, do one of the following actions:
    - IPL with CLPA
    - Perform dynamic updates as follows:
        - If the IPVLANGX module is placed in LPA by using the command SETPROG, which is opposed to placing IPV.SIPVLPA1 in LPA, take the following actions:
            a. Issue the following command:

            ```
            SETPROG LPA,DELETE,MOD=IPVLANGX),FORCE=YES
            ```

            For complete information about the command SETPROG, see MVS™ System Commands.

            b. Issue the following command:

            ```
            F LLA,REFRESH
            ```

            c. Optional: To add the IPVLANGX module to LPA and regain the region size space advantage, issue the following command:

            ```
            SETPROG LPA,ADD,MOD=(IPVLANGX),DSN=LNKLST
            ```
        - If IPV.SIPVLPA1 is included in your LPALIST, issue the following command:

        ```
        SETPROG LPA,ADD,MOD=(IPVLANGX),DSN=LNKLST
        ```

Chapter 10. ADFzCC event processing

ADFzCC event processing is a feature that allows any products or systems including the ADFz family of products to send data to an asynchronous installation-written back-end for processing. Do not send sensitive information by using this feature. The validity of all data is the responsibility of the users.

The ADFzCC event processing feature includes the following items:

- Sender load module IPVEPSND
- Receiver load module IPVEPRCV
- IPVCNF00 option EVENTPROCESSINGEXIT
- The Event Processing user exit

Sender load module IPVEPSND

The IPVEPSND load module contains the fetchable LE function IPVEPSND(). It spawns an extra BPX batch address space in which the module IPVEPRCV runs asynchronously.

This module transfers data to IPVEPRCV via stdin, and any debug information is passed back to it via stdout if the debug mode is active.

If this feature is enabled via the EventProcessingExit option, ADFz products> transparently call IPVEPSND to perform event processing.

Note: If the debug mode is activated, IPVEPRCV does not run asynchronously to IPVEPSND.

Usage

IPVEPSND, the fetchable LE function IPVEPSND(), is defined as:

```
int IPVEPSND(char *ProdID, char *UsrPgm, char *BufPtr, char *DbgDDn);
```

The parameters are defined as follows:

ProdID

The product ID. For example: the Fault Analyzer product ID is “IDI"; the File Manager product ID is “FMN".

UsrPgm

The user program name. For the ADFz family of products, the user program name is obtained via the `EVENTPROCESSINGEXIT` option.

BufPtr

The buffer pointer. The 31-bit address of a storage buffer to be passed to the Event Processing exit in the following format:

Byte 0-3

Total data length

Byte 4

Segment data

Byte 0-1

Segment length

Byte 2

Segment data

Repeat segment length and segment data for all segments

DbgDDn

The debug DDname.

The returned int value includes the following descriptive bytes:

Byte 0

IPVEPSND return code (0 = successful).

Byte 1

IPVEPRCV return code (0 = successful). This byte is valid only if the debug DDname is specified.

Byte 2-3

User exit return code. This byte is valid only if the debug DDname is specified.

Example

```
""""
void *fetch_ptr;
typedef void exit_U(char *ProdID, char *UsrPgm, void *BufPtr, char *DbgDDn);
#pragma linkage(exit_U, OS)
exit_U *exit_ep;
char *exit_name;
char event_data[1024];
char *data_item1 = Fred=Yes;
char *data_item2 = Barney=No;
int i;

i = 4;
*(short *)&event_data[i] = strlen(data_item1);
memcpy(data_buffer + i + 2, data_item1, strlen(data_item1));
i += (2 + strlen(data_item1));

*(short *)&event_data[i] = strlen(data_item2);
memcpy(data_buffer + i + 2, data_item2, strlen(data_item2));
i += (2 + strlen(data_item2));

*(int *)&event_data[0] = i;
```

```
// Set exit_name to the current EVENTPROCESSINGEXIT option value...

fetch_ptr = (void *)fetch("IPVEPSND");
if (fetch_ptr) {
  exit_ep = (exit_U *)fetch_ptr;
  exit_ep("XYZ", exit_name, event_data, 0);
}
```

Receiver load module IPVEPRCV

The IPVEPRCV load module is internal. It is the load module that is executed in the BPX batch address space that is spawned by IPVEPSND().

IPVEPRCV provides an interface to the user exit that is specified via the EVENTPROCESSINGEXIT option.

IPVCNF00 option EVENTPROCESSINGEXIT

Use the EventProcessingExit option to specify the name of the exit to be invoked to process an event. For more information, see EventProcessingExit on page 26.

The Event Processing user exit

The exit name that is specified in the IPVEPSND *UsrPgm* parameter must be a fetchable LE function with the following format:

```
int exit_name(char *ProdID, char *BufPtr);
```

The *ProdID* and *BufPtr* are the same as specified for IPVEPSND.

The user exit load module must be available via the normal search path, that is, JOBLIB, STEPLIB, LINKLIST, and so on.

The user exit is invoked in problem state, that is, key 8.

For ADFz products, the exit name is specified via the EventProcessingExit option.

Example customer event processing user exit

The following code is a stub example of an exit written in C that can be specified via the EVENTPROCESSINGEXIT option, named as IPVEPXIT.

```
#pragma linkage(IPVEPXIT, fetchable)

#include <string.h>

int IPVEPXIT(char *ProdID, char *BufPtr) {

  if (!BufPtr) {
    printf("BufPtr is null! Exiting...\n");
```

```
    return;
  }

  if (strcmp(ProdID, "IDI")) {

    //Event from Fault Analyzer has been detected.
    //processFAEvent(BufPtr);  ...

  } else if (strcmp(ProdID, "FMN")) {

    //Event from File Manager has been detected.
    //processFMEvent(BufPtr);  ...

  } else if (strcmp(ProdID, "ABC")) {

    //Event from application ABC has been detected.
    //processABCEvent(BufPtr); ...

  }
}
```

Appendix A. Messages

The following information is provided for each ADFzCC server message:

- The message identifier.
- The text of the message.
- An explanation of the message.
- The required user response.

Messages have a unique alphanumeric identifier with the following format:

```
IPVnnnns
```

where:

nnnn

Is a 4-digit number.

s

Is a severity level indicator with the following meanings:

- I - Informational
- W - Warning
- S - Severe

ADFzCC server messages

IPV0054S

KEEPALIVE parameter expresses an invalid timeout value.

Explanation: The **KEEPALIVE** parameter in the CONFIG DD expresses an invalid value. The value should express a positive integer that specifies a timeout period in seconds for inactive TCP connections, and must be within the range of 60 to 2147460. If this parameter is not specified, the timeout period specified on the system **TCPCONFIG DEFAULTKEEPALIVE** parameter is used. Note that after the keep alive period has expired, TCP/IP will attempt to verify whether the client is still active before terminating the session.

System action: The ADFzCC server is shut down.

User response: Change the configuration to use a valid **KEEPALIVE** value.

IPV0055W

ATTLS_ERROR_ACTION value '%s' is invalid; using default STOP_SERVER.

Explanation: The ATTLS_ERROR_ACTION parameter in the CONFIG contained an unrecognized value. The server ignored this setting and reverted to the default behavior, ATTLS_ERROR_ACTION=STOP_SERVER, which terminates the listener when an AT-TLS error occurs.

System action: The server continues to run with ATTLS_ERROR_ACTION=STOP_SERVER.

User response: Correct the configuration and specify either STOP_SESSION or STOP_SERVER on the ATTLS_ERROR_ACTION keyword.

IPV0056S

SSL_REQUIRED specified, but ATTLS is not enabled.

Explanation: The configuration specifies a value other than NO for the SSL_REQUIRED parameter, but the ATTLS parameter is not set to YES.

System action: The ADFzCC server is shut down.

User response: If encrypted communication is required, specify ATTLS=YES and ensure that an appropriate AT-TLS rule is configured for the server port.

IPV0057S

SPAWN_TIME must be at least 7.

Explanation: The configuration specifies a value for the SPAWN_TIME parameter that is less than the minimum valid value of 7 seconds.

System action: The ADFzCC server is shut down.

User response: Specify a value of 7 or greater for SPAWN_TIME, or omit the parameter to use the default value of 600 seconds.

IPV0001I

Server on port %i exiting

Explanation: The server is finished processing. Either errors occurred during startup, running, or the server is responding to a shutdown command.

System action: The server finishes processing.

User response: If the shutdown was unexpected, examine previous messages for the cause.

IPV0002I

Error establishing SSL environment: %i

Explanation: An error occurred while establishing the SSL environment.

System action: The ADFzCC server attempts to continue.

User response: Examine previous messages for reasons for environment failure. If previous messages do not help, contact IBM® support.

IPV0003S

Console modify/stop interface failed rc=%i, errno=%i error= %s

Explanation: An error occurred while establishing the console interface.

System action: The ADFzCC server exits.

User response: Examine the provided error for reasons for failure. If previous messages do not help, contact IBM® support.

IPV0004I

Number of configurations %i

Explanation: During start or configuration refresh, the CONFIG data was read and the specified number of configurations were recognized.

System action: None.

User response: If the number of configurations is unexpected, check the CONFIG concatenations and contents.

IPV0005I

Config number %i startup %s

Explanation: During start or configuration refresh, the configuration specified an initial program to run.

System action: None.

User response: None.

IPV0006W

System call rc=%i error=%s

Explanation: A call to run a program according to a configuration failed.

System action: None.

User response: None.

IPV0007W

Expected a portnumber integer. Received %s

Explanation: The server expects an integer portnumber as the first parameter.

System action: The server attempts to continue starting, using port 2800.

User response: Check the invocation parameter for the server.

IPV0008W

Expected AF_INET or AF_INET6. Received %s

Explanation: The server expects the address family type as the second parameter.

System action: The server attempts to continue starting, using the AF_INET family.

User response: Check the invocation parameter for the server.

IPV0009I

Using address family %s.

Explanation: The server is using the specified address family.

System action: None.

User response: None.

IPV0010I

Using port %i.

Explanation: The server is using the specified port number.

System action: None.

User response: None.

IPV0011S

listen() error: %s

Explanation: The listen call failed with the specified error.

System action: The server is shut down.

User response: Correct the listed error if possible and restart the server.

IPV0012W

Spawn failure for %s. Error: %s __errno2 = %08x

Explanation: The attempt to spawn the specified program failed with the listed error and error code.

System action: The server continues to run.

User response: Examine the error and possibly examine the CONFIG file ensuring that customization occurred correctly.

IPV0013W

Missing value for keyword '%s'

Explanation: While reading the CONFIG file, an expected value for a keyword was missing.

System action: The server continues to run.

User response: Check the CONFIG file for the specified keyword and specify an appropriate value.

IPV0014W

Failure to acquire storage for configuration instance %i

Explanation: While preparing configurations, a failure to acquire storage occurred.

System action: The server attempts to continue to run.

User response: Check the REGION specification for the server. Increase and restart the server.

IPV0015I

ADFzCC server Running on port %i.

Explanation: Console message to indicate that the server is now accepting connections.

System action: None.

User response: None.

IPV0016I

Established SSL environment.

Explanation: The call to System SSL to initialize an environment was successful.

System action: None.

User response: None.

IPV0017W

Unable to create temporary file %s. %s

Explanation: The call to create a temporary file for a configuration failed.

System action: The server attempts to continue, however the configuration might be unusable.

User response: Examine the file path and error condition as shown. Correct the configuration file or update the directory permissions and restart or refresh the server.

IPV0018W

Unable to verify dsn %s

Explanation: The existence of data set %s in a STEPLIB= value could not be verified.

System action: The server attempts to continue, however the configuration might be unusable.

User response: Examine the named data set and ensure that it is the correct name. If necessary, update the configuration file and restart or refresh the server.

IPV0019W

Unable to open CONFIG %s

Explanation: During startup, or a refresh command, the DD CONFIG was unable to be opened.

System action: If this occurs during initial start of the server, the server terminates. During a refresh, no new configurations are loaded.

User response: Examine the error and the CONFIG data sets to ensure that they exist. If necessary, update the configuration file and restart or refresh the server.

IPV0020I

REFRESH completed, %i configs processed.

Explanation: A REFRESH console command has now completed. The server has re-read the configurations as specified in the CONFIG DD.

System action: None.

User response: None.

IPV0021W

REFRESH found errors in new configs, not activated.

Explanation: A REFRESH console command was issued, but during reading of the CONFIG DD, some errors occurred.

System action: The server continues with its prior configuration.

User response: Check the server output for possible further information on the problems that are found in the CONFIG file(s)

IPV0022S

Creation of key database at %s failed, error %s

Explanation: The configuration specifies that the server create a certificate to be used, however an error as described occurred when attempting to create the key database.

System action: The server terminates.

User response: f the error is an IO error, check the specified location for enough space (65KB). Otherwise, check that the location is writeable. To specify an alternate location, set the configuration keyword WORKDIR to the directory to be used.

IPV0023S

Creation of self-signed certificate failed, error %s

Explanation: The configuration specifies that the server create a certificate to be used, however an error as described occurred when attempting to create the self-signed certificate in the key database.

System action: The server terminates.

User response: Check the listed error and check documentation for the gsk_create_self_signed_certificate API.

IPV0024I

Traceon received, trace already active.

Explanation: The Server received a modify command to turn on tracing, but it is already on.

System action: None.

User response: None.

IPV0025I

Traceon received, trace turned on.

Explanation: The Server received a modify command to turn on tracing and has done so. Trace output goes to the IPVTRACE file(DD) if present, or to the STDOUT file if not.

System action: None.

User response: None.

IPV0026I

Traceoff received, trace already off.

Explanation: The Server received a modify command to turn off tracing but it is already off.

System action: None.

User response: None.

IPV0027I

Traceoff received, trace turned off.

Explanation: The Server received a modify command to turn off tracing and has done so.

System action: None.

User response: None.

IPV0028I

Unrecognized modify command.

Explanation: The Server received a modify command, but did not recognize it.

System action: None.

User response: Check that modify contained one of the valid requests; TRACEON, TRACEOFF, VER or REFRESH.

IPV0029W

Client config name %s not found in CONFIG DD content.

Explanation: The Server received a client connection request for the named config, but no matching CONFIG=name statement was found in the data that was contained in the CONFIG DD concatenation.

System action: The client connection request is refused.

User response: Check that the configurations referenced by the CONFIG DD for the server, contain a CONFIG=name section.

IPV0030I

API start PID=processid

Explanation: A process (processid) launched by the common server has invoked the common server subordinate API to start the environment setup and handshake with client.

System action: None.

User response: None.

IPV0031I

API closure PID=processid

Explanation: A process has invoked the common server subordinate API to close the environment setup and client connection.

System action: None.

User response: None.

IPV0032I

ADFzCC server Release=%s PTF=%s

Explanation: In response to the VER modify command, the server lists its release and PTF level information.

System action: None.

User response: None.

IPV0033W

Unknown token %s with value %s for CONFIG=%s

Explanation: While processing the configuration file, an unrecognized token/value pair was found.

System action: The invalid token is ignored and processing attempts to continue.

User response: Review the configuration file for the named token. Look for a misspelling or incorrect token or value.

IPV0041W

Maximum user variables (500) reached when processing token %s, value %s in configuration %s

Explanation: The limit of substitution values has been reached.

System action: The server attempts to continue, however the configurations might be unusable.

User response: Examine the number of $token=value pairs present in the configuration file and reduce to less than 500.

IPV0042W

Unable to stat file %s.

Explanation: The server is unable to check the configuration launch file entry.

System action: The server attempts to continue, however this launch configuration is unusable.

User response: Examine the file path and ensure that the setup was completed correctly. Most likely the file or directory path is not owned or correctly permitted in order for this server instance to access the named file. The WORKDIR configuration step of installation needs to be checked and rerun.

IPV0043W

Not owner of launch file %s.

Explanation: The server is not the owner of a configuration launch file entry.

System action: The server attempts to continue, however this launch configuration is unusable.

User response: Examine the file path and ensure that the setup was completed correctly. Correct the condition by ensuring that the file owner is updated to the userid of the server. The file system that the file is mounted on needs to allow SETUID for the owner to be changed with the chmod command.

IPV0044W

Launch file %s is not marked as sticky.

Explanation: A configuration launch file has not been created correctly.

System action: The server attempts to continue, however this launch configuration is unusable.

User response: Examine the file path and WORKDIR location. If the WORKDIR is correct, the installation configuration step for the WORKDIR might need to be rerun.

IPV0045S

Configuration specifies AT-TLS, but AT-TLS rule is missing or invalid.

Explanation: The configuration specifies ATTLS=Y, but an AT-TLS rule for the inbound connection was not found or was not 'ApplicationControlled'.

System action: The ADFzCC server is shut down.

User response: Contact your security administrator or system programmer to verify the AT-TLS configuration of your installation.

IPV0046S

AT-TLS specified, but no protocol provided by SSL_REQUIRED parameter.

Explanation: The configuration specifies ATTLS=Y, but the SSL_REQUIRED parameter does not specify a protocol value.

System action: The ADFzCC server is shut down.

User response: Contact your security administrator or system programmer to verify that the ADFzCC server configuration of your installation specifies a valid protocol that is supported by your AT-TLS configuration.

IPV0047S

Insufficient storage available.

Explanation: An attempt to acquire storage failed because insufficient storage was available.

System action: The ADFzCC server is shut down.

User response: Check your system for any task using excessive storage. Restart the server when sufficient storage is available.

IPV0048S

SYSOUT=* not permitted in configuration.

Explanation: The configuration file specified by the CONFIG DD statement uses SYSOUT=*, which cannot be resolved by a started session.

System action: The ADFzCC server is shut down.

User response: Change the configuration member to specify a valid SYSOUT class.

IPV0049S

PASSTK parameter expresses an invalid timeout value

Explanation: The PASSTK parameter in CONFIG DD expresses an invalid value. The PASSTK value should express a positive integer that specifies a timeout period in minutes for a client to use PassTickets following a successful log on. The default is 480 (8 hours).

System action: The ADFzCC server is shut down.

User response: Change configuration to use a valid PASSTK value.

IPV0050S

Attempt to verify PASSTICKET environment failed, rc=*nn*

Explanation: The attempt to verify PASSTICKET authority failed. The server does not have sufficient authority to generate PASSTICKETs. *nn* is the return code from the PassTicket generation routine. A return code of 16 means the server is not APF authorized.

System action: The ADFzCC server is shut down.

User response: Ensure that the execution environment meets the prerequisites for PASSTICKET generation and then restart the server.

IPV0051I

Verifying server PASSTICKET authority

Explanation: The server configuration indicates that PASSTK services are required. The server must verify that it has sufficient authority to satisfy client PASSTK requests.

System action: The ADFzCC server verifies that it has PASSTICKET authority.

User response: None.

IPV0052I

Server PASSTICKET authority verification successful

Explanation: The ADFzCC server has verified that it has sufficient authority to satisfy client PASSTK requests.

System action: The ADFzCC server continues to run.

User response: None.

IPV0053S

APPLID parameter has an invalid value length

Explanation: APPLID configuration parameter value has an invalid length. The APPLID value should be between 1 and 8 characters. The value represents a resource name in the APPL class, and clients connecting to the ADFzCC server must have READ access to this resource if the APPL class is active.

System action: The ADFzCC server is shut down.

User response: Change the configuration to use a valid APPLID value.

IPVLANGX messages

These messages are issued by the IPVLANGX program, which is used internally by Fault Analyzer or invoked by the user when creating side files.

IDISF8001I

IPVLANGX Version *version* (Release *release*)

Explanation: This message shows the IPVLANGX program identification, version, and release date.

System action: Processing continues.

User response: None

IDISF8002I

Output file: *member_name DDname*

Explanation: This message identifies the file to which the extract data information is written by IPVLANGX. The *member_name* field is not included in the message if using a sequential file.

System action: Processing continues.

User response: None

IDISF8003I

... scanning *txt1*

Explanation: This message indicates that the information that was specified in *txt1* is being read from the associated file and processed.

System action: Processing continues.

User response: None

IDISF8004I

... checking *txt1*

Explanation: This message indicates that the information t at was specified in *txt1* is checked for consistency.

System action: Processing continues.

User response: None

IDISF8005I

txt1 Pass *dec2* processing begins

Explanation: This message indicates pass *dec2* of the multi-pass processing task that is specified in *txt1* is now being performed.

System action: Processing continues.

User response: None

IDISF8006I

Post-processing begins

Explanation: This message indicates that all necessary information was read from the associated files, and post-processing of this information is being performed.

System action: Processing continues.

User response: None

IDISF8007I

... matching *txt1*

Explanation: This message indicates that the information that was specified in *txt1* is now being correlated.

System action: Processing continues.

User response: None

IDISF8008I

... performing *txt1*

Explanation: This message indicates that the processing step specified in *txt1* is now being performed.

System action: Processing continues.

User response: None

IDISF8010I

txt1 records scanned: *dec2*

Explanation: This message indicates that *dec2* records were read from the *txt1* file when the current compile unit was processed by IPVLANGX.

System action: Processing continues.

User response: None

IDISF8011I

...Symbols *txt1*.. *dec2*

Explanation: This message indicates that the current compile unit contained *dec2* symbols with characteristics of type *txt1*

System action: Processing continues.

User response: None

IDISF8012I

...Long Name Resolution IDs: *dec1*

Explanation: This message indicates that the current compile unit contained *dec1* Long Name Resolution Identifiers.

System action: Processing continues.

User response: None

IDISF8013I

...Total symbols: *dec1*

Explanation: This message indicates that the current compile unit contained *dec1* symbols.

System action: Processing continues.

User response: None

IDISF8014I

Records written to output file: *dec1*

Explanation: This message shows the number of records of extract data information which were written to the output file.

System action: Processing continues.

User response: None

IDISF8015I

Operation completed for this compile unit

Explanation: Processing was completed for the current compile unit.

System action: Processing continues if extra compile units are present.

User response: None

IDISF8016I

txt1 member_name DDname

Explanation: This message identifies the input file(s) which were processed by IPVLANGX The *txt1* field is normally *"Input file:"* or *"Input files:"*. The *member_name* field is not included in the message if using a sequential file.

System action: Processing continues.

User response: None

IDISF8017I

Operation completed for this extract file

Explanation: This message is the last message to be displayed by IPVLANGX, and indicates that processing is completed for this IPVLANGX extract data file.

System action: Processing has completed.

User response: None

IDISF8018I

txt1 bytes scanned: *dec2*

Explanation: This message indicates that *dec2* bytes of data were read from the *txt1* file when the current compile unit was processed by IPVLANGX.

System action: Processing continues.

User response: None

IDISF8020I

...Blocks of dead code eliminated..... *dec1*

Explanation: This message indicates that *dec1* blocks of code which had been removed by optimization by the compiler have been identified. The source code and variables that are associated with these blocks have been eliminated from the extract data.

System action: Processing continues.

User response: None

IDISF8050W

Argument missing for *txt1* option. *txt2*

Explanation: The argument for IPVLANGX option *txt1* was not found during processing of the IPVLANGX invocation parameters.

System action: The default argument for the *txt1* option is assumed.

User response: If you are using IPVLANGX directly to create a side file, specify the invocation options as explained in IPVLANGX compiler listing to side file conversion utility on page 85. If the message is issued during fault analysis, contact your IBM® service representative.

IDISF8051S

Argument/Option too long, "*txt1*"

Explanation: The invocation parameter *txt1* is not recognized as a valid IPVLANGX argument (or option). It exceeds the maximum length of a valid argument (or option), and might be spelled incorrectly.

System action: Processing is terminated.

User response: If you are using IPVLANGX directly to create a side file, specify the invocation options as explained in IPVLANGX compiler listing to side file conversion utility on page 85. If the message is issued during fault analysis, contact your IBM® service representative.

IDISF8052S

Argument/Option not recognized, "*txt1*"

Explanation: The invocation parameter *txt1* is not recognized as a valid IPVLANGX argument (or option).

System action: Processing is terminated.

User response: If you are using IPVLANGX directly to create a side file, specify the invocation options as explained in IPVLANGX compiler listing to side file conversion utility on page 85. If the message is issued during fault analysis, contact your IBM® service representative.

IDISF8055S

A left parenthesis was found inside options

Explanation: An extra left parenthesis (after the initial left parenthesis which signals the start of the IPVLANGX options) was encountered during processing of the IPVLANGX invocation parameters.

System action: Processing is terminated.

User response: If you are using IPVLANGX directly to create a side file, specify the invocation options as explained in IPVLANGX compiler listing to side file conversion utility on page 85. If the message is issued during fault analysis, contact your IBM® service representative.

IDISF8056S

No file name was specified

Explanation: The PDS or PDSE data set member name of the primary program information file from which source and variable data is to be extracted was not found during processing of the IPVLANGX invocation parameters.

System action: Processing is terminated.

User response: If you are using IPVLANGX directly to create a side file, specify the invocation options as explained in IPVLANGX compiler listing to side file conversion utility on page 85. If the message is issued during fault analysis, contact your IBM® service representative.

IDISF8057S

Argument/Option already specified, "*txt1*"

Explanation: The argument (or option) *txt1* was encountered more than once during processing of the IPVLANGX invocation parameters.

System action: Processing is terminated.

User response: If you are using IPVLANGX directly to create a side file, specify the invocation options as explained in IPVLANGX compiler listing to side file conversion utility on page 85. If the message is issued during fault analysis, contact your IBM® service representative.

IDISF8058S

Argument/Option "*txt1*" conflicts with previous Argument/Option

Explanation: A conflict between the argument (or option) *txt1* and another previously specified argument (or option) was detected during processing of the IPVLANGX invocation parameters.

System action: Processing is terminated.

User response: If you are using IPVLANGX directly to create a side file, specify the invocation options as explained in IPVLANGX compiler listing to side file conversion utility on page 85. If the message is issued during fault analysis, contact your IBM® service representative.

IDISF8059I

Application language not specified, option "*txt1*" assumed

Explanation: In the absence of an IPVLANGX option which explicitly specifies the application programming language, the IPVLANGX option *txt1* was assumed.

System action: Processing continues.

User response: If you are using IPVLANGX directly to create a side file, specify the invocation options as explained in IPVLANGX compiler listing to side file conversion utility on page 85. If the message is issued during fault analysis, contact your IBM® service representative.

IDISF8100S

txt1 contains NO recognized records

Explanation: The input file that was identified in *txt1* did not contain the expected records. This could happen if, for example, the IDIADATA DDname was accidentally directed at a compiler listing data set.

System action: Processing is terminated.

User response: Ensure that the input file that was used is correct.

IDISF8103S

txt1 has unrecognized records following last valid section

Explanation: The input file for IPVLANGX (the compiler listing) contains more output than just from the compile step. That is, there might be precompiler or postcompiler output, such as from a DB2® precompiler step or a link-edit step. Once this information is removed, the message is no longer be produced and the side file should be created as expected.

System action: Processing is terminated.

User response: Ensure that the input file that was used is correct.

IDISF8110W

Compiler option(s) incorrectly specified

Explanation: The format of the input file is insufficient for IPVLANGX processing because one or more of the required compiler options have not been specified.

System action: Processing is terminated.

User response: Recompile the module with the required compiler options as specified in Preparing your programs on page 31.

IDISF8114S

txt1 required for source support - fatal

Explanation: *txt1* specifies the compiler options that are required for a successful IPVLANGX execution. Source code information cannot be complete without these options. This message might be preceded by message IDISF8110W.

System action: Processing is terminated.

User response: Recompile the module with the required compiler options as specified in Preparing your programs on page 31.

IDISF8115W

txt1 required for symbol support

Explanation: *txt1* specifies the compiler options that are required for a successful IPVLANGX execution. Source code information cannot be complete without these options. This message is preceded by message IDISF8110W.

System action: Processing continues, however, the analysis report might be missing information.

User response: Recompile the module with the required compiler options as specified in Preparing your programs on page 31.

IDISF8116W

txt1 required for structure/union support

Explanation: *txt1* specifies the compiler options that are required for a successful IPVLANGX execution. Source code information cannot be complete without these options. This message is preceded by message IDISF8110W.

System action: Processing continues, however, the analysis report might be missing information.

User response: Recompile the module with the required compiler options as specified in Preparing your programs on page 31.

IDISF8120W

txt1 detected. *txt2* option assumed

Explanation: The format of the input file indicates that the specified option is no longer in effect.

System action: Processing continues, assuming an appropriate option to match the format of the input file.

User response: Use the correct compiler option, or make the compiler directive which adjusted the compiler option visible to IPVLANGX, as appropriate. If the problem persists, contact your IBM® service representative.

IDISF8130S

File not found "*txt1*"

Explanation: The IPVLANGX input compiler listing or SYSADATA file *txt1* could not be found to allow IPVLANGX processing to begin.

System action: Processing is terminated.

User response: Correct the file specification, or make the file available to IPVLANGX, as appropriate. If the problem persists, contact your IBM® service representative.

IDISF8131S

Files not found "*txt1*", and "*txt2*"

Explanation: The IPVLANGX extract data file could not be found using either the primary file identifier *txt1*, or the alternative file identifier *txt2* to allow IPVLANGX processing to begin.

System action: Processing is terminated.

User response: Correct the file specification, or make the file available to IPVLANGX, as appropriate. If the problem persists, contact your IBM® service representative.

IDISF8132S

Input or Output file format invalid

Explanation: The attributes or contents of a file have been found to be inappropriate, during IPVLANGX processing. One or more preceding messages identify the file which was being processed when the error occurred or the reason for the failure. Reasons for this message might be error messages in the input compiler listing or missing required compiler options. For details on required compiler options, refer to Preparing your programs on page 31.

System action: Processing is terminated.

User response: Correct the problem that was identified in the preceding message. If the problem persists, contact your IBM® service representative.

IDISF8133S

File DD not allocated "*txt1*"

Explanation: The Data Definition (DD) for the *txt1* file was found to be unallocated.

System action: Processing is terminated.

User response: Allocate the file, using a JCL DD statement, or TSO ALLOCATE statement, as appropriate. If the problem persists, contact your IBM® service representative.

IDISF8134S

File DDs not allocated "*txt1*", and "*txt2*"

Explanation: The Data Definitions (DDs) for both the primary *txt1* file and the alternative *txt2* file were found to be unallocated.

System action: Processing is terminated.

User response: Allocate the file, using a JCL DD statement, or TSO ALLOCATE statement, as appropriate. If the problem persists, contact your IBM® service representative.

IDISF8135S

txt1 file incorrectly defined

Explanation: The attributes of the *txt1* file have been examined, and found to be inappropriate.

System action: Processing is terminated.

User response: Ensure that the correct data set was specified in the *txt1* file allocation. If the correct data set was specified, the data set was allocated with incorrect attributes, in which case it must be reallocated. If the problem persists, contact your IBM® service representative.

IDISF8136S

Premature *txt1* End-of-File encountered

Explanation: IPVLANGX had begun scanning the *txt1* file data, but the file ended before all expected data records had been scanned.

System action: Processing is terminated.

User response: Ensure that the correct data set was specified in the *txt1* file allocation. If the correct data set was specified, the file might have been truncated and must be replaced with the complete data. If the problem persists, contact your IBM® service representative.

IDISF8137S

txt1 disk/directory is full

Explanation: There is insufficient space to write further records to the *txt1* file.

This might be caused by :

- PDS directory has no free entries
- data set has maximum number of extents
- insufficient free space on the DASD volume for another extent

System action: Processing is terminated.

User response: Determine the resource which is exhausted, and correct as appropriate. If the problem persists, contact your IBM® service representative.

IDISF8138T

Insufficient virtual memory available

Explanation: There is insufficient free storage for IPVLANGX to continue processing.

System action: Processing is terminated.

User response: Free up virtual storage which is in use, or make more virtual storage available, as appropriate. If the problem persists, contact your IBM® service representative.

Note: IPVLANGX uses storage above the 16MB line, if it is available.

IDISF8139S

File is TERSEd or PACKed "*txt1*"

Explanation: The specified file was found to have a Fixed record format, and 1024-byte record length. It was likely compressed using TERSE or COPYFILE.

System action: Processing is terminated.

User response: Restore the file to its original format, using the appropriate utility program. If the problem persists, contact your IBM® service representative.

IDISF8150T

Maximum number of symbols exceeded

Explanation: The maximum number of symbols that a single compile unit can contain is 65534. This limit is exceeded by the current compile unit.

System action: Processing is terminated.

User response: Reduce the number of symbols below the limit. If the problem persists, contact your IBM® service representative.

IDISF8152W

Incomplete info for symbol "*txt1*" (ident: *dec2*)

Explanation: During the extraction process, complete information was not available for the symbol shown. The extract data for unrelated symbols and program source is not affected.

System action: Processing continues.

User response: Use IPVLANGX to format the extract data, and determine the missing information. Given this, examine the IPVLANGX input file(s) and determine the cause of the problem. If the problem persists, contact your IBM® service representative.

IDISF8158T

Invalid COBOL source column indicators - fatal

Explanation: Expected source column indicators were not found in the COBOL listing.

System action: Processing is terminated.

User response: Check if the attributes of file read have changed from those of the original compiler listing file.

IDISF8231S

Missing *txt1* ESD information

Explanation: The name of a CSECT could not be determined.

System action: Processing continues but analysis might be incomplete.

User response: Ensure that CSECTs are named in accordance with the requirements in Preparing your programs on page 31.

IDISF8233S

Unable to determine identity of unnamed PC Section

Explanation: The name of a CSECT could not be determined.

System action: Processing continues but analysis might be incomplete.

User response: Ensure that CSECTs are named in accordance with the requirements in Preparing your programs on page 31.

IDISF8250A

SYSADATA input record *record-number*, invalid ESDID ignored

Explanation: An invalid ESDID was encountered on a SYSADATA record read. The ESDID was ignored.

System action: Processing continues.

User response: None.

IPVLANGX return codes

The following return codes are issued by IPVLANGX:

RC

Meaning

0

Operation successful, output file was written.

0*xxx*

Error was discovered while parsing arguments/options. *xxx* can have these values:

1

Token too long

2

Left parenthesis found inside options

3

Unknown option

1*xyy* or 2*xyy*

Error occurred during scan of compiler listing or SYSADATA file.

3*xyy*

Error occurred while writing output file.

For return codes 1*xyy*, 2*xyy*, and 3*xyy*, the values for *xyy* are:

0*yy*

yy is the return code from the file WRITE routine

1*yy*

yy is the return code from the file OPEN routine

2*yy*

yy is the return code from the file READ routine

3*yy*

yy is the return code from the file WRITE routine

4*yy*

yy is the return code from the file POINT routine

5*yy*

yy is the return code from the memory ALLOCATE routine

6*yy*

yy is the return code from the memory FREE routine

7*yy*

yy is the return code from the file CLOSE routine

8*yy*

yy is the return code from the file NOTE routine

Examples of IPVLANGX return codes

0310

Compiler listing file is not in the expected format. A possible reason is that the required compiler options have not been used.

1128

Input compiler listing file could not be found. A possible reason is that a member name of a PDS(E) data set has not been specified, either in the parameters for IPVLANGX, or added to the data set name of the PDS(E).

3128

Output IPVLANGX file could not be found, or the attributes of an existing file do not match those required by IPVLANGX (RECFM=VB and LRECL≥1562). Ensure the DDname used is IDILANGX.

3315

One or more records that were written to IPVLANGX were truncated due to insufficient logical record length. The minimum required logical record length for the IPVLANGX data set is 1562 bytes. Unpredictable results might occur if attempting to use the truncated side file as input.

Appendix B. Troubleshooting

Error scenarios and tracing

If the installed library has not been added to program control, this message appears in the JESMSGLG for the server task:

```
ICH420I PROGRAM IPVSRV FROM LIBRARY IPV.V1R10.SIPVMODA CAUSED
THE ENVIRONMENT TO BECOME UNCONTROLLED.  BPXP014I ENVIRONMENT MUST
BE CONTROLLED FOR SERVER (BPX.SERVER) PROCESSING.
```

Messages similar to the following might be generated if the user connecting to the server does not have read access to the SIPVMODA library:

```
ICH408I USER(BILLMAN ) GROUP(USERCOD ) NAME(MANDELLA, BILL ) 218
IPV.V1R10.SIPVMODA CL(DATASET ) VOL(COD035)
INSUFFICIENT ACCESS AUTHORITY
FROM IPV.V1R10.* (G)
ACCESS INTENT(READ ) ACCESS ALLOWED(NONE )
IEC150I 913-38,IFG0194E,BILLMAN,OS390,ISP19502,8E10,COD035,IPV.V1R10.SIPVMODA
```

Messages on SYSLOG at the time of attempted connection, like the ones that are shown here, are generated when the relevant CONFIG contains an invalid library, or is missing a library from the SPAWN_STEPLIB statement:

```
IEA995I SYMPTOM DUMP OUTPUT
SYSTEM COMPLETION CODE=EC6  REASON CODE=0B26C032
 TIME=11.37.04  SEQ=38113  CPU=0000  ASID=00ED
 PSW AT TIME OF ERROR  070C3000   82C44CE8  ILC 2  INTC 0D
   NO ACTIVE MODULE FOUND
   NAME=UNKNOWN
   DATA AT PSW  02C44CE2 - C06C18F2  0A0D41B0  D4D0180B
   AR/GR 0: 00000000/00000026_00000648   1: 00000000/00000000_04EC6000
         2: 01FF000C/00000000_0B26C032   3: 00000000/00000000_8286F5B8
         4: 00000000/00000000_00000000   5: 00000000/00000000_00000000
         6: 01FF000C/00000000_00000700   7: 01FF000C/00000000_09BFC3F8
         8: 00000000/00000000_11F4B610   9: 00000000/00000000_163031FF
         A: 00000000/00000000_11F4B610   B: 01FF000C/00000000_7FFC3A00
         C: 00000000/00000000_02C47AC0   D: 00000000/00000000_16302200
         E: 00000000/00000000_82C44CB0   F: 00000000/00000000_0B26C032
 END OF SYMPTOM DUMP
```

If the above are not occurring, but connections are still not successful, shut down the server and start it again with tracing active. If using the supplied sample, this can be done on the start command. For example, S IPVSRV1,TRACE=D. This produces trace entries in the server task on the IPVTRACE DD.

A typical trace, with SSL active, before connections are made, looks similar to the one shown here. The main entries of interest confirming startup was successful are highlighted:

```
2018-11-29-10:54:39.442 [IPVSRV:266] Server built at: Nov 29 2018 10:54:03
2018-11-29-10:54:39.601 [IPVSRV:952] Record in length:1903
2018-11-29-10:54:39.601 [IPVSRV:969] Token: CONFIG Value: DEFAULT
2018-11-29-10:54:39.601 [IPVSRV:989] Config DEFAULT allocated.
2018-11-29-10:54:39.601 [IPVSRV:969] Token: SSL_REQUIRED Value: YES
2018-11-29-10:54:39.601 [IPVSRV:969] Token: WORKDIR Value: /etc/ipv/v1610/ipvsrv1
2018-11-29-10:54:39.602 [IPVSRV:1070] Confirmed temporary write access ok dir=/etc/ipv/v1610/ipvsrv1.
```

```
2018-11-29-10:54:39.602 [IPVSRV:969] Token: SPAWN_STEPLIB Value: IPV111SVC.BUILD.LOAD ...
2018-11-29-10:54:39.602 [IPVSRV:969] Token: CONFIG Value: FM
2018-11-29-10:54:39.602 [IPVSRV:989] Config FM allocated.
2018-11-29-10:54:39.602 [IPVSRV:969] Token: SPAWN_PROGRAM Value: FMNCSEP
2018-11-29-10:54:39.602 [IPVSRV:1089] Creating temp filename.
2018-11-29-10:54:39.602 [IPVSRV:1106] Created temporary spawn image file ok.
2018-11-29-10:54:39.602 [IPVSRV:1116] spawn_program /etc/ipv/v1610/ipvsrv1/FMNCSEP
2018-11-29-10:54:39.602 [IPVSRV:1117] spawn_fn FMNCSEP
2018-11-29-10:54:39.602 [IPVSRV:969] Token: SPAWN_JOBNAME Value: FMCLIENT
2018-11-29-10:54:39.602 [IPVSRV:969] Token: SPAWN_STEPLIB Value: FMN.V17R1M0.OPTIONS...
2018-11-29-10:54:39.602 [IPVSRV:969] Token: SPAWN_PARMS_SECTION Value:
2018-11-29-10:54:40.495 [IPVSRV:1956] Environment open rc=0 Handle=16AB09A8 Ha=16AA6490
2018-11-29-10:54:40.495 [IPVSRV:1965] Set SSLV2 off rc=0
2018-11-29-10:54:40.495 [IPVSRV:1973] Set SSLV3 off rc=0
2018-11-29-10:54:40.495 [IPVSRV:1982] Set TLSV1 off rc=0
2018-11-29-10:54:40.495 [IPVSRV:1997] Certfile=/etc/ipv/v1610/ipvsrv1/IPVSRVC3-IPVCERT.kdb
2018-11-29-10:54:40.495 [IPVSRV:1998] Set keyring rc=0
2018-11-29-10:54:40.495 [IPVSRV:2006] Set pw rc=0
2018-11-29-10:54:40.511 [IPVSRV:2014] Environment init rc=0 Handle=16AB09A8
2018-11-29-10:54:40.511 [IPVSRV:281] Mixed case password support is off
2018-11-29-10:54:40.512 [IPVSRV:1902] Set socket linger rc=0
2018-11-29-10:54:40.512 [IPVSRV:1906] Set socket reuseaddr rc=0
2018-11-29-10:54:40.512 [IPVSRV:1910] Set socket keepalive rc=0
2018-11-29-10:54:40.512 [IPVSRV:301] Launching accept thread socket 0, listen code 0
2018-11-29-10:54:40.512 [IPVSRV:513] Acceptor thread running.
2018-11-29-10:54:40.512 [IPVSRV:527] About to accept.
```

If the highlighted statements are similar to the example that is shown here, all rc=0, then try to connect.

Several trace entries that are created by the server are similar to the ones that are shown here. Again, those that are of interest are highlighted.

```
2018-11-29-10:55:02.943 [IPVSRV:543] Connect received.
2018-11-29-10:55:02.943 [IPVSRV:549] Set client socket linger rc=0
2018-11-29-10:55:02.944 [IPVSRV:570] Thread launch
2018-11-29-10:55:02.944 [IPVSRV:527] About to accept.
2018-11-29-10:55:02.944 [IPVSRV:428] Conversation thread started.
2018-11-29-10:55:02.944 [IPVSRV:451] Server and peer on different hosts.
2018-11-29-10:55:02.944 [IPVSRV:1461] Outgoing message length=111, message=SSL=Y,
SERVERVERSION=01.01,SERVERNAME=IPVSRVC3,SYSNAME=z/OS,NODENAME=FMD2,
RELEASE=11.00,VERSION=01,MACHINE=2094
2018-11-29-10:55:02.944 [IPVSRV:1524] Sent 115 bytes
2018-11-29-10:55:02.945 [IPVSRV:2028] gsk_secure_socket_open rc=0
2018-11-29-10:55:02.945 [IPVSRV:2040] Set native socket rc=0
2018-11-29-10:55:02.945 [IPVSRV:2049] Set keyring label ADFzCC Server
                                  Certificate rc=0
2018-11-29-10:55:02.945 [IPVSRV:2058] Set session type rc=0
2018-11-29-10:55:03.980 [IPVSRV:2081] Secure socket init rc=0
2018-11-29-10:55:03.980 [IPVSRV:1328] RecvSSL
2018-11-29-10:55:04.191 [IPVSRV:1360] Header indicates length 50
2018-11-29-10:55:04.722 [IPVSRV:1423] Incoming message: >>user=PROWSE3 pass=AXXXXXXX
config=UTCAPI DEBUG=YES<<
2018-11-29-10:55:04.723 [IPVSRV:1640] Uppercasing password 8 chars
2018-11-29-10:55:04.723 [IPVSRV:588] process_launch trying to match config UTCAPI.
2018-11-29-10:55:04.723 [IPVSRV:657] Parms: SOCKETH=00000001 ....
2018-11-29-10:55:04.723 [IPVSRV:658] Steplib: STEPLIB=IPV16SVC ...
2018-11-29-10:55:04.723 [IPVSRV:1828] Authenticated ok for user PROWSE3.
2018-11-29-10:55:04.724 [IPVSRV:1461] Outgoing message length=7, message=AUTH=Y
2018-11-29-10:55:04.724 [IPVSRV:1524] Sent 11 bytes
2018-11-29-10:55:05.282 [IPVSRV:702] gsk_secure_socket_close okay
2018-11-29-10:55:05.285 [IPVSRV:739] Spawned /etc/ipv/v1610/ipvsrv1/IDIGMAIN Process 83886421
2018-11-29-10:55:05.285 [IPVSRV:745] Close client sock rc=0
```

If the Spawned trace line is present, check the SYSLOG at the time of the spawn for any messages that are issued by a started task. If there are no log messages, then look for output that is produced by the spawned user. For instance, in the example that is shown here, the user PROWSE3 has generated some output. Once you have this information, and the server's IPV TRACE output, contact IBM® support.

Appendix C. Support resources

Use these resources to find product details, fixes, and support.

Search knowledge bases

- Download a Program Directory:
  - Program Directory for Application Delivery Foundation for z/OS Common Components
  - Program Directory for IBM File Manager for z/OS
  - Program Directory for IBM Fault Analyzer for z/OS
- Get up-to-date details about installing, customizing, and using these products:
  - Application Delivery Foundation for z/OS Common Components Customization Guide and User Guide
  - Fault Analyzer User's Guide and Reference
  - File Manager Customization Guide
  - File Manager User's Guide and Reference
  - File Manager User's Guide and Reference for DB2
  - File Manager User's Guide and Reference for CICS
  - File Manager User's Guide and Reference for IMS

Get the latest PTFs

- ADFz Common Components
- Fault Analyzer for z/OS
- File Manager for z/OS
- z/OS Debugger
- IBM Developer for z/OS Enterprise Edition
- Application Performance Analyzer for z/OS

Collect diagnostic data

Before you contact Support, be ready to answer these questions:

- What software versions are you running?
- Do you have logs, traces, and messages related to the problem?
- Can you re-create the problem? If so, how do you re-create the problem?
- Did you make hardware, operating system, or networking software changes?
- Do you have a workaround for the problem?

Contact Support

Open a case, chat with Support, or connect to resources and communities through https://www.ibm.com/mysupport.

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