# Adabas for zIIP

Version 8.3.5

April 2018

ADABAS & NATURAL

This document applies to Adabas for zIIP Version 8.3.5 and all subsequent releases.

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



**Document ID: ADAMF-ZIIP-835-20200221**

# Table of Contents

# Preface

This document provides information on Adabas for zIIP, a selectable unit of Adabas that enables Adabas to make use of IBM's zIIP engine. Whether running the basic Adabas nucleus, Adabas Cluster Services, or Adabas Parallel Services, Adabas for zIIP enables Adabas on z/OS to offload part of the Adabas workload from the mainframe's general central processors (GCP) to System z Integrated Information Processors (zIIP).

Offloading work from the GCPs will free up some of their capacity. This helps decrease the total cost of operation (TCO) of the GCPs and makes room for running additional workload on them. Furthermore, the use of Adabas for zIIP may result in performance benefits by increasing the throughput for certain workloads.

Adabas for zIIP supports other selectable units that are integrated into the Adabas nucleus:

- Adabas Caching Facility
- Adabas Cluster Services
- Adabas Delta Save Facility
- Adabas Fastpath
- Adabas Online System
- Adabas Parallel Services
- Adabas SAF Security
- Adabas Transaction Manager
- Adabas Vista
- Event Replicator for Adabas (in Adabas source databases)

Adabas nuclei running with Adabas Review enabled are supported, but the Review subtasks do not currently run on zIIPs. Also, the Adabas Review Hub, the Event Replicator Server (Reptor) and the Adabas utilities do not currently support execution on zIIPs.

| | |
|---|---|
| **Prerequisites** | Requirements for zIIP support by Adabas. |
| **Current Limitations** | Currently limited functionality. |
| **General Information on zIIP Processing** | Brief description of zIIP processing. |
| **Adabas for zIIP Processing: Concepts** | Explanations of the TCB and SRB processes and the WLM enclaves Adabas requires for zIIP processing. |
| **Monitoring zIIP Usage** | System information, reports and statistics available for controlling and evaluating zIIP-enabled Adabas sessions. |

**Note:** The Adabas parameters mentioned in this documentation are described in the *Parameter Reference* documentation, unless otherwise noted.

# 1 About this Documentation

## Document Conventions

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

## Online Information and Support

### Software AG Documentation Website

You can find documentation on the Software AG Documentation website at **http://documentation.softwareag.com**. The site requires credentials for Software AG's Product Support site Empower. If you do not have Empower credentials, you must use the TECHcommunity website.

### Software AG Empower Product Support Website

If you do not yet have an account for Empower, send an email to empower@softwareag.com with your name, company, and company email address and request an account.

Once you have an account, you can open Support Incidents online via the eService section of Empower at **https://empower.softwareag.com/**.

You can find product information on the Software AG Empower Product Support website at **https://empower.softwareag.com**.

To submit feature/enhancement requests, get information about product availability, and download products, go to **Products**.

To get information about fixes and to read early warnings, technical papers, and knowledge base articles, go to the **Knowledge Center**.

If you have any questions, you can find a local or toll-free number for your country in our Global Support Contact Directory at **https://empower.softwareag.com/public_directory.asp** and give us a call.

**Software AG TECHcommunity**

You can find documentation and other technical information on the Software AG TECHcommunity website at **http://techcommunity.softwareag.com**. You can:

- Access product documentation, if you have TECHcommunity credentials. If you do not, you will need to register and specify "Documentation" as an area of interest.
- Access articles, code samples, demos, and tutorials.
- Use the online discussion forums, moderated by Software AG professionals, to ask questions, discuss best practices, and learn how other customers are using Software AG technology.
- Link to external websites that discuss open standards and web technology.

## Data Protection

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

# 2 Prerequisites

## Prerequisites for Installation

zIIP support by Adabas requires that Adabas for zIIP (including an extra product license) is installed at your site.

All prerequisites for installation are described in *Installing Adabas for zIIP* in the *Installation for z/OS* documentation.

# 3 Current Limitations

There are functional limitations with Adabas for zIIP. The following ADARUN parameters and values are not supported:

- `MODE=SINGLE`
- `MONITOR`
- `UEX3`
- `SMGT=YES` is supported, but the abend handler is disabled and the Adabas nucleus will come down when an abend occurs.

If a parameter or value not supported by Adabas for zIIP is specified in combination with ZIIP=YES, Adabas aborts its session start with PARM-ERROR 128.

At this time, while Adabas for zIIP supports Adabas nuclei for databases that serve as the source of replication data, it does not support the Event Replicator Server that receives and processes replication data.

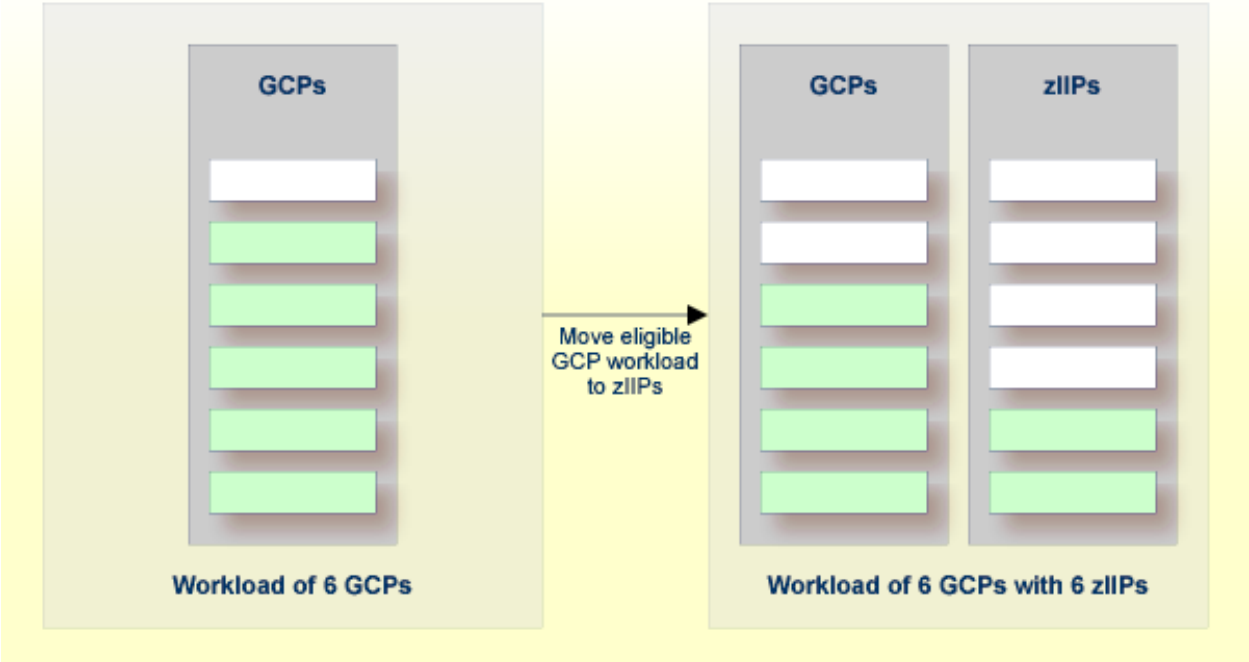
# 4 General Information on zIIP Processing

The IBM System z Integrated Information Processor (zIIP) is a specialty engine designed to offload eligible workload from a GCP (general central processor) to a zIIP.

Offloading workload to a zIIP helps optimize resource capacities and free up part of the GCPs for new workloads, while lowering the mainframe TCO (total cost of ownership). GCPs are more expensive than zIIPs, both in their direct cost and in their impact on software license costs. Also, GCPs may run throttled, whereas zIIPs always run at full speed.

For detailed information on the zIIP, refer to the appropriate IBM literature.

The simple graphic below illustrates the purpose of the zIIP:



# 5 Adabas for zIIP Processing: Concepts

This chapter provides information on how Adabas enables zIIP support.

In general, a z/OS application runs as a dispatchable unit managed using a TCB (task control block). It is said to run "under a TCB" or "in TCB mode". Running an application on a zIIP requires a dispatchable unit managed using an SRB (service request block). SRB code is said to run "under an SRB" or "in SRB mode".

To become eligible for running on a zIIP, an SRB must be assigned to an "enclave" managed by the z/OS Workload Manager (WLM). An enclave is a WLM transaction that can span multiple dispatchable units (TCBs and SRBs) in one or more address spaces and that WLM reports on and manages as a unit. When Adabas for zIIP starts, it creates an enclave consisting of its main TCB and an SRB and configures the SRB to be eligible for running on a zIIP. Generally, Adabas for zIIP runs in SRB mode (eligible for execution on a zIIP) whenever possible and in TCB mode whenever necessary.

The WLM enclave created and used by Adabas for zIIP processing is bound to the Adabas nucleus address space. It is deleted when the Adabas nucleus job step terminates.

## TCB/SRB Switches

When an Adabas session is started with the ADARUN parameter `ZIIP` set to YES, the nucleus starts an SRB in parallel to its main TCB, places the TCB in a wait state, and continues processing in the SRB. The SRB may run on a zIIP, as directed by the Workload Manager, and executes the bulk of the Adabas logic. The SRB cannot perform all operations that the TCB can do, though. Broadly, there are two categories of operations that Adabas for zIIP cannot perform in SRB mode:

- Certain system services, in particular those that perform input/output operations
- Code not owned by Software AG (supplied by the installation or a third party)

Whenever the SRB cannot perform an operation, it may "pass the baton" to the TCB by taking the TCB out of its wait and putting itself into a wait state. The TCB then proceeds at the point where the SRB left off and performs the operation. When the operation has finished, the TCB takes the SRB out of its wait and puts itself into a wait state again. These steps are called "switch to TCB mode" and "switch to SRB mode", respectively.

Adabas for zIIP performs an operation in TCB mode either by switching to TCB mode before and back to SRB mode after the operation or by issuing a request to the TCB to perform the operation in parallel while the SRB continues other processing (see also ***Parallel Requests*** below).

## Parallel Requests

As described in *TCB/SRB Switches* above, Adabas for zIIP may switch to TCB mode to perform an operation that it cannot do in SRB mode, and switch back to SRB mode after the operation. Alternatively, the SRB may issue a request to the TCB to perform the operation in parallel while the SRB continues processing other work. Roughly, the procedure to use parallel requests functions as follows:

1. The SRB needs to perform an operation that requires TCB mode.
2. The SRB issues a request to the TCB to perform the operation in parallel and takes the TCB out of its wait state.
3. If necessary, the SRB puts the current nucleus thread into a wait state.
4. The SRB looks for other work to do - other threads or new commands.
5. At the same time, the TCB, coming out of its wait state, processes the parallel request given to it.
6. When the TCB has finished processing a parallel request, it checks whether the SRB has meanwhile issued another request. If so, it processes that request too, and repeats this step.
7. When the TCB has processed all parallel requests and the SRB has not requested a switch to TCB mode, the TCB enters a wait state again.

Whether Adabas performs a TCB-mode operation via a mode switch or a parallel request depends on the type of operation. Generally, operations that may occur very frequently are performed via parallel requests. This is more efficient than mode switches if (and only if) the workload given to Adabas is high and allows for sufficient parallelism in its processing. The choice between mode switches and parallel requests is made by Adabas; it cannot be controlled via configuration parameters.

# 6 Monitoring zIIP Usage

The purpose of Adabas for zIIP is to reduce the Adabas CPU consumption on general central processors (GCP) by offloading part of the Adabas processing to System z Integrated Information Processors (zIIP). Adabas for zIIP offers statistics about how much CPU time it has consumed on GCPs and zIIPs and for which reasons it has executed on GCPs. This chapter provides information on how to view and understand these zIIP-related statistics.

## zIIP-Related Statistics

Adabas for zIIP shows zIIP-related statistics

- in the Adabas session statistics that are printed when the nucleus terminates,
- for an ADADBS REFRESHSTATS utility function, in the resulting interval statistics,
- when the Adabas operator command DZSTAT is given from an operator console,
- in the output of the ADADBS OPERCOM DZSTAT utility function, and
- on the Adabas Online System Session Utilization / zIIP statistics menu.

A small subset of selected statistical figures is also produced in the regular SYNS-60 Nucleus statistic checkpoints and shown

- in the output of the ADAREP CPEXLIST utility function.

See *Understanding the zIIP-Related Statistics* below for information on how to interpret these statistics.

## zIIP in Adabas Online System

Adabas Online System displays the ZIIP parameter on the **Display Parameters** function.

If Adabas was started with ZIIP=YES, Adabas Online System allows modifying the ZIIP parameter at runtime - setting it to NO and subsequently back to YES - on the **Modify Parameters** menu.

Adabas Online System displays statistics about the execution of Adabas in TCB mode and SRB mode and about the CPU time consumed on System z Integrated Information Processors (zIIP) and general central processors (GCP) on the **Session Utilization / zIIP statistics** menu.

See *Understanding the zIIP-Related Statistics* below for information on how to interpret these statistics.

## Understanding the zIIP-Related Statistics

Adabas for zIIP prints the full set of zIIP-related statistics in the Adabas session statistics when the nucleus terminates. The same statistics or a subset are displayed at other occasions, as described in section *zIIP-Related Statistics* above.

An Adabas nucleus started with ADARUN parameter ZIIP=YES prints the zIIP-related statistics during termination at the end of its session statistics. They show the following information:

| Statistic | Description |
|---|---|
| General central processors (GCP) | The number of general central processors (GCP) managed by the operating system |
| Integrated Information Processors (zIIP) | The number of System z Integrated Information Processors (zIIP) managed by the operating system |
| zIIP SMT threads | The number of simultaneous multithreading (SMT) threads in the zIIPs |
| zIIP normalization factor | The factor by which zIIP CPU times have been multiplied by z/OS to be comparable with the CPU times of the GCPs, if the GCPs are throttled |
| **Total enclave CPU time** [*] | The total CPU time consumed by the Workload Manager enclave created by Adabas for its entire session, comprising the CPU times consumed on GCPs and on zIIPs |
| Enclave GCP CPU time | The CPU time of the enclave that Adabas consumed on GCPs |
| Enclave zIIP CPU time | The CPU time of the enclave that Adabas consumed on zIIPs |
| **Enclave zIIP CPU time (%)** [*] | The percentage of the enclave CPU time that Adabas consumed on zIIPs, calculated as: Enclave zIIP time / Total enclave CPU time * 100 |
| Eligible zIIP CPU time [*] | The CPU time that Adabas was eligible to execute on zIIPs, comprising the actual Enclave zIIP CPU time and the Eligible zIIP CPU time on GCP |
| Enclave zIIP CPU time | The CPU time of the enclave that Adabas consumed on zIIPs (same as the 'Enclave zIIP CPU time' under 'Total enclave CPU time') |
| Eligible zIIP CPU time on GCP | The CPU time of the enclave that Adabas was eligible to execute on zIIPs but instead consumed on GCPs because no zIIP was available |
| **Eligible zIIP CPU time on GCP (%)** [*] | The percentage of the eligible zIIP CPU time that Adabas instead consumed on GCPs, calculated as: Eligible zIIP CPU time on GCP / Eligible zIIP CPU time * 100 |
| **Switches into SRB mode** | The number of times Adabas switched into SRB mode to become eligible for execution on a zIIP |
| **Switches into TCB mode** [*] | The number of times Adabas switched into TCB mode to perform operations that were incompatible with SRB mode |
| **Parallel requests** [*] | The number of times Adabas requested that the TCB perform an operation in parallel to its own processing in SRB mode |
| No free element for request | The number of times the SRB had to wait for a free request element until it could issue a parallel request to the TCB |

| Statistic | Description |
|---|---|
| **Parallel requests per TCB pause** [*] | The average number of parallel requests processed by the TCB until it had to pause and wait for more work, calculated as: Parallel requests / Pause TCB (below) |
| **Extended statistics** | The following extended statistics were introduced for internal reporting and may be changed or removed in future releases. |
| Pause SRB | The number of times the SRB was waiting for work |
| Release SRB | The number of times the SRB was released to continue processing |
| Pause TCB | The number of times the TCB was waiting for work |
| Release TCB | The number of times the TCB was released to continue processing |
| **Pause for wait** [*] | The number of times Adabas had no work to do (i.e., was waiting for I/Os, new commands, or other events) |
| Release from wait | The number of times Adabas was released to continue processing after an event had occurred |
| **SRB/TCB scheduling by type of work** | The following statistics "by type of work" show why the processing mode (SRB or TCB mode) was switched or a parallel request was issued. They indicate the reasons for the "Switches into SRB mode", "Switches into TCB mode", and "Parallel requests" reported above. Only categories with nonzero counts are shown. A selection of typical categories follows: |
| EXCPs | The number of direct-access input/output operations to the database container datasets (ASSO, DATA, WORK, PLOG, etc.), in most cases issued via parallel requests to the TCB |
| Miscellaneous | The number of other, infrequent operations that required execution in TCB mode, performed via switches to TCB mode and back to SRB mode |
| Operator commands | The number of operator commands whose processing required execution in TCB mode, performed via switches to TCB mode and back to SRB mode |
| Sequential writes | The number of writes to a sequential dataset (e.g., DDPRINT), in most cases issued via parallel requests to the TCB |
| Timer services | The number of timer operations that required execution in TCB mode, performed via switches to TCB mode and back to SRB mode |
| User exit N | The number of times user exit N was called. User exits (including hyperexits and collation descriptor exits) are always called in TCB mode. User exits that may be called frequently are invoked via parallel requests; others, via switches to TCB mode and back to SRB mode |
| … | (Other types of work that must be performed in TCB mode are reported if they occurred in the Adabas session.) |
| Enclave GCP service units | The GCP CPU service units accumulated by the enclave created by Adabas |
| Enclave zIIP service units | The zIIP CPU service units accumulated by the enclave created by Adabas, normalized to GCP speed |

[*] These numbers are also included in the regular SYNS-60 Nucleus statistic checkpoints.

**Notes:**

1. The "Enclave zIIP CPU time (%)" shows in a nutshell how much of the CPU consumption in the Workload Manager enclave created by Adabas was actually offloaded to zIIPs
2. To assess the zIIP CPU percentage properly, take into account that this number covers only the CPU time consumed by dispatchable units belonging to the enclave created by Adabas for zIIP - that is, by the Adabas main task TCB and its companion SRB. It does not cover CPU time consumed by dispatchable units that belong to other enclaves or to no enclave at all - such as the subtasks used by Adabas Review, the Natural subtasks used by Adabas Stored Procedures and Triggers, and system SRBs used for asynchronous event processing (I/O completion, cross-memory posts, XCF/XES exits used in Adabas Cluster Services, etc.). Therefore, the percentage of CPU time consumed on zIIPs relative to the total CPU time consumed by all dispatchable units in the Adabas address space tends to be lower than the percentage relative to the enclave CPU time.
3. Also take into account that the TCB/SRB mode switches and parallel requests generate overhead that is also attributed to the GCP and zIIP CPU times of Adabas for zIIP. For a more accurate assessment how much CPU time Adabas for zIIP saves on GCPs, run the same, representative test workload both with ZIIP=YES and ZIIP=NO and compare the GCP CPU times consumed in both scenarios. The GCP CPU time savings will typically depend on the type of workload processed by Adabas, particularly the speed and level of parallelism with which Adabas commands arrive.
4. If the "Eligible zIIP CPU time on GCP (%)" is non-negligible, it suggests that the available zIIPs in the host system are over-allocated. If their free capacity was higher, Adabas for zIIP could offload more of its work to the zIIPs.
5. The number of "Parallel requests per TCB pause" indicates the level of parallelism that Adabas for zIIP could utilize by stringing TCB-mode operations together. A number close to 1 indicates low parallelism; a greater number, higher parallelism and a greater reduction of overhead.
6. The "Pause for wait" count, relative to the number of I/Os (reported in the zIIP-related statistics under "EXCPs") and Adabas commands (reported higher up in the session statistics), indicates the level of parallelism that Adabas could utilize to process multiple commands concurrently. The higher the ratio of commands plus I/Os over "pauses for wait", the more work Adabas was able to do without pause (such as waiting for I/O completion or for the arrival of a new command).
7. The counts of mode switches and parallel requests depend on the workload processed by Adabas - in particular, the number of system service calls that require TCB mode, the number of user exit calls, and the inherent parallelism of the workload. Aside from changing these aspects, little can be done in the configuration of Adabas for zIIP to influence the interplay between the SRB and the TCB.
8. If the ZIIP parameter is changed to NO during an Adabas session, requesting that Adabas continue to run in TCB mode and not use zIIPs anymore, the then following processing will be charged to the TCB and counted under "Enclave GCP CPU time". The proportion of "Enclave zIIP CPU time (%)" will decrease correspondingly. This percentage shows how much of the Adabas workload was actually executed on zIIPs, not how much could have been executed on zIIPs under other circumstances.

### Example zIIP-Related Statistics

The following example output illustrates the zIIP-related statistics in the Adabas nucleus session statistics:

```
zIIP-related statistics for Adabas main task


General central processors (GCP)                              2
Integrated Information Processors (zIIP)                      1
 zIIP SMT threads                                             2
zIIP normalization factor                                10.97

Total enclave CPU time                                0:08:32.935
 Enclave GCP CPU time                                 0:00:44.624
 Enclave zIIP CPU time                                0:07:48.311
 Enclave zIIP CPU time (%)                                  91.30

Eligible zIIP CPU time                                0:07:51.376
 Enclave zIIP CPU time                                0:07:48.311
 Eligible zIIP CPU time on GCP                        0:00:03.064
 Eligible zIIP CPU time on GCP (%)                           0.65

Switches into SRB mode                                      320
Switches into TCB mode                                      320
Parallel requests                                     4,845,711
 No free element for request                                  0
 Parallel requests per TCB pause                           8.36

Extended statistics

Pause   SRB                                                 152
Release SRB                                                   1
Pause   TCB                                             579,625
Release TCB                                             579,776
Pause   for wait                                      1,574,231
Release from wait                                     1,471,128

SRB/TCB scheduling by type of work

EXCPs                                                   505,555
Miscellaneous                                                30
Operator commands                                             8
Sequential writes                                           125
Timer services                                              244
User exit 2                                                   6
User exit 8                                                 250
User exit 11                                          4,340,133

Enclave GCP service units                             3,215,424
Enclave zIIP service units                            2,935,690
```

See *Understanding the zIIP-Related Statistics* above for information and advice on how to interpret these statistics.