

# Adabas

## Adabas for zIIP

Version 8.5.4

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This document applies to Adabas Version 8.5.4 and all subsequent releases.

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

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## Preface

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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 processors (GP) to System z Integrated Information Processors (zIIP).

Offloading work from the GPs will free up some of their capacity. This helps decrease the total cost of operation (TCO) of the GPs 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 Review
- Adabas SAF Security
- Adabas Transaction Manager
- Adabas Vista
- Event Replicator for Adabas

Furthermore, Adabas for zIIP supports the following Adabas utilities:

- ADACHK
- ADACMP
- ADAINV
- ADALOD
- ADAORD
- ADAREP
- ADARES
- ADASAV

■ ADAULD

For more information on how Adabas Review and Event Replicator for Adabas support offloading workload to zIIPs, see their respective documentation sets.

<b>Prerequisites</b>	Requirements for zIIP support by Adabas.
<b>Current Limitations</b>	Currently limited functionality.
<b>General Information on zIIP Processing</b>	Brief description of zIIP processing.
<b>Adabas for zIIP Processing: Concepts</b>	Explanations of the TCB and SRB processes and the WLM enclaves Adabas requires for zIIP processing.
<b>Monitoring zIIP Usage</b>	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

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## Document Conventions

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

## Online Information and Support

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### Product Documentation

You can find the product documentation on our documentation website at <https://documentation.softwareag.com>.

### Product Training

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- Ask questions and find answers in our discussion forums.
- Get the latest Software GmbH news and announcements.
- Explore our communities.
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- Download products, updates and fixes.
- Search the Knowledge Center for technical information and tips.
- Subscribe to early warnings and critical alerts.
- Open and update support incidents.
- Add product feature requests.

## Data Protection

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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.

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# 2 Prerequisites

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## Prerequisites for Installation

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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 Add-ons (including zIIP)* in the *Installation for z/OS* documentation.

# 3

## Current Limitations

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

- MODE=SINGLE
- MONITOR
- SMGT=YES is supported, but the SMGT abend handler is disabled. If an abend occurs, the Adabas nucleus will go down, as if SMGT=NO.

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.



# 4 General Information on zIIP Processing

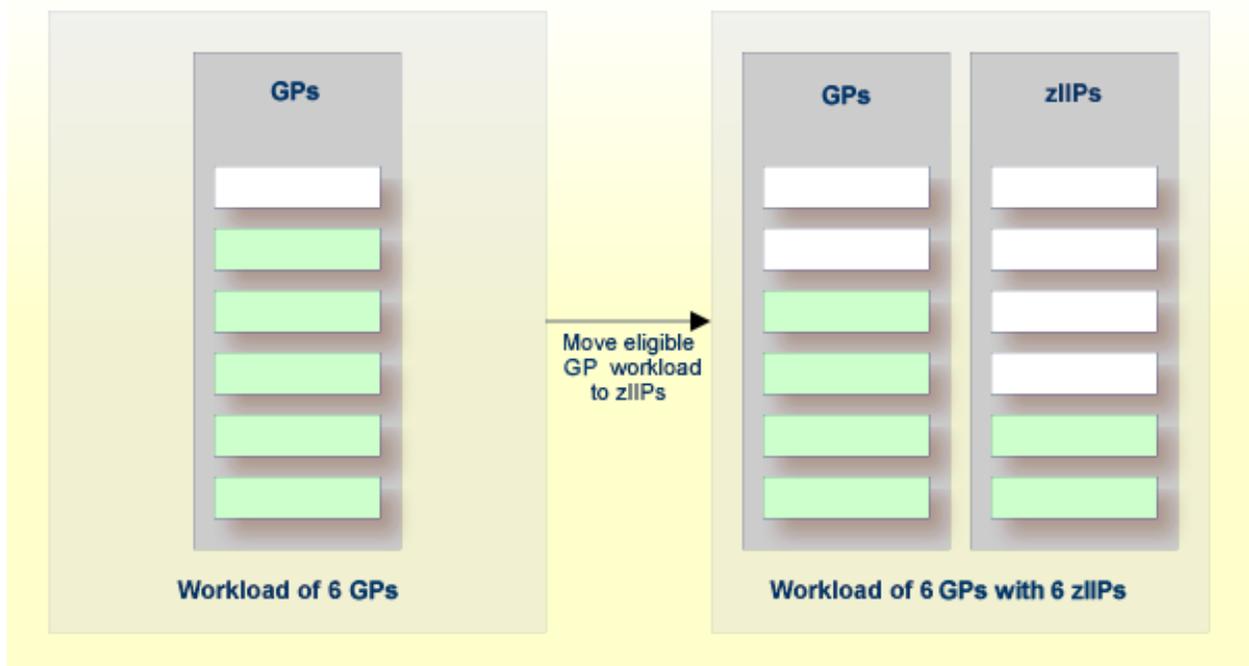
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The IBM System z Integrated Information Processor (zIIP) is a specialty engine designed to offload eligible workload from a GP (general processor) to a zIIP.

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



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# 5 Adabas for zIIP Processing: Concepts

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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 or utility address space. It is deleted when the Adabas nucleus or utility job step terminates.

## TCB/SRB Switches

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When an Adabas nucleus or utility is started with the ADARUN parameter `ZIIP` set to YES, the nucleus or utility 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

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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

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The purpose of Adabas for zIIP is to reduce the Adabas CPU consumption on general processors (GP) 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 GPs and zIIPs and for which reasons it has executed on GPs. This chapter provides information on how to view and understand these zIIP-related statistics.

## zIIP-Related Statistics

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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,
- on the Adabas Online System Session Monitoring / Display Interval Utilization / zIIP Statistics menu and
- in the utility protocol (on DDPRINT)

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

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

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 processors (GP) on the **Session Monitoring / Display Interval 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
Total CPU time	The total CPU time (GP plus zIIP) consumed by any dispatchable unit (TCB or SRB) running in the Adabas address space, comprising the non-enclave GP times and all enclave GP times and zIIP times
Non-enclave GP times	The total CPU time (on general processors) consumed by any TCB in the Adabas address space that was not a member of a Workload Manager (WLM) enclave
All enclave GP times	The total CPU time on general processors consumed by any dispatchable unit (TCB or SRB) in the Adabas address space that was a member of a WLM enclave
All enclave zIIP times	The total CPU time on zIIPs consumed by any SRB in the Adabas address space that was a member of a WLM enclave, normalized to GP speed
<b>All enclave zIIP times (%)</b>	The percentage of the total CPU time that the Adabas address space consumed on zIIPs, calculated as: All enclave zIIP times / Total CPU time * 100
<b>Total enclave CPU time</b> <sup>[*]</sup>	The total CPU time consumed by the WLM enclave created by Adabas for its entire session, comprising the CPU times consumed on GPs and on zIIPs
Enclave GP time	The CPU time of the WLM enclave created by Adabas that was consumed on general processors
Enclave zIIP time	The CPU time of the WLM enclave created by Adabas that was consumed on zIIPs, normalized to GP speed
<b>Enclave zIIP time (%)</b> <sup>[*]</sup>	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 <sup>[*]</sup>	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 GP
Enclave zIIP 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 time on GP	The CPU time of the enclave that Adabas was eligible to execute on zIIPs but instead consumed on GPs because no zIIP was available
<b>Eligible zIIP time on GP (%)</b> <sup>[*]</sup>	The percentage of the eligible zIIP CPU time that Adabas instead consumed on GPs, calculated as: Eligible zIIP CPU time on GP / Eligible zIIP CPU time * 100

Statistic	Description
Potential enclave zIIP time (%)	This line is displayed only if the LPAR has no zIIPs (at the time the processor configuration was queried) and the Adabas enclave did not consume any CPU time on zIIPs. It shows the percentage of the enclave CPU time that Adabas could have offloaded to zIIPs, had there been any, calculated as: Eligible zIIP CPU time / Total enclave CPU time * 100
<b>Mode switches</b> <sup>[**]</sup>	The number of times Adabas switched into SRB mode to become eligible for execution on a zIIP or switched into TCB mode to perform operations that were incompatible with SRB mode
<b>Parallel requests</b> <sup>[*]</sup>	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
<b>Parallel requests per TCB pause</b> <sup>[*]</sup>	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)
<b>Extended statistics</b>	
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
<b>Pause for wait</b> <sup>[*]</sup>	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
<b>SRB/TCB scheduling by type of work</b>	
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 "Mode Switches" 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

Statistic	Description
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 GP service units	The GP 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 GP speed
GPs	The number of general processors (GP) managed by the operating system
zIIPs	The number of System z Integrated Information Processors (zIIP) managed by the operating system
zIIP SMT threads	The number of simultaneous multithreading (SMT) threads per zIIP core
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 GPs, if the GPs are throttled

Utilities running with ZIIP=YES print similar statistics in their DDPRINT output dataset.

[\*] These numbers are also included in the regular SYNS-60 Nucleus statistic and SYNS-5B Session end / session interval statistics checkpoints.

[\*\*] The number of switches into TCB mode is also included in the regular SYNS-60 Nucleus statistic and SYNS-5B Session end / session interval statistics checkpoints. It typically is half of the total number of mode switches.



#### Notes:

1. The "All enclave zIIP times (%)" figure shows in a nutshell how much of the CPU consumption by Adabas was actually offloaded to zIIPs.
2. Adabas creates a Workload Manager enclave for its main task TCB and its companion SRB. It reports the CPU times on zIIPs and general processors consumed in this enclave under "Total enclave CPU time". Other tasks in the Adabas address space — such as the subtasks used by Adabas Review, the Natural subtasks used by Adabas Stored Procedures and Triggers — as well as system SRBs used for asynchronous event processing (I/O completion, cross-memory posts, XCF/XES exits used in Adabas Cluster Services, etc.) run outside this enclave. The subtasks may in fact create their own enclaves and report their CPU time statistics separately. The CPU times for all enclaves, tasks and SRBs running in the Adabas address space are shown under "Total CPU time" at the top of these statistics.
3. Take into account that the TCB/SRB mode switches and parallel requests generate overhead that is also attributed to the GP and zIIP CPU times of Adabas for zIIP. For a more accurate assessment how much CPU time Adabas for zIIP saves on GPs, run the same, representative test workload both with ZIIP=YES and ZIIP=NO and compare the GP CPU times consumed in both scenarios. The GP CPU time savings will typically depend on the type of workload pro-

cessed by Adabas, particularly the rate and level of parallelism with which Adabas commands arrive.

4. If the "Eligible zIIP CPU time on GP (%)" 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 continues to run in TCB mode and not to use zIIPs anymore, the then following processing will be charged to the TCB and counted under "All enclave GP times" and "Enclave GP CPU time". The proportions of "All enclave zIIP times (%)" and "Enclave zIIP CPU time (%)" will decrease correspondingly. These percentages show 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 address space

Total CPU time                0:30:39.829
Non-enclave GP times          0:01:01.619
All enclave GP times          0:01:33.964
All enclave zIIP times        0:28:04.245
All enclave zIIP times (%)    91.54

zIIP-related statistics for Adabas enclave

Total enclave CPU time        0:29:38.210
Enclave GP time               0:01:33.964
Enclave zIIP time             0:28:04.245
    
```

Enclave zIIP time (%)	94.71
Eligible zIIP CPU time	0:28:17.199
Enclave zIIP time	0:28:04.245
Eligible zIIP time on GP	0:00:12.953
Eligible zIIP time on GP (%)	0.76
Mode switches	2,064
Parallel requests	2,238,428
No free element for request	0
Parallel requests per TCB pause	2.38
Extended statistics	
Pause SRB	336
Release SRB	1
Pause TCB	939,160
Release TCB	939,495
Pause for wait	4,752,060
Release from wait	5,048,526
SRB/TCB scheduling by type of work	
EXCPs	2,239,015
Miscellaneous	118
Operator commands	8
Sequential writes	287
Timer services	490
User exit 8	574
Enclave GP service units	11,147,006
Enclave zIIP service units	10,557,975
GPs	2
zIIPs	1
zIIP SMT threads	2
zIIP normalization factor	10.97

See [Understanding the zIIP-Related Statistics](#) above for information and advice on how to interpret these statistics.

