software AG

Entire Net-Work

Entire Net-Work for zIIP

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ADABAS & NATURAL

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Preface

This document provides information on Entire Net-Work for zIIP, a selectable unit of Entire Net-Work that enables Entire Net-Work to make use of IBM's zIIP engine. Entire Net-Work for zIIP enables Entire Net-Work on z/OS to offload part of its 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 Entire Net-Work for zIIP may result in performance benefits by increasing the throughput for certain workloads.

Entire Net-Work for zIIP supports the following Drivers:

- CTCA
- FCTC
- TCPI
- TCPX
- VTAM
- XCF

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

> **Note:** The 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: Variables for which you must supply values specific to your own situation or environment. New terms the first time they occur in the text. References to other documentation sources.
`Monospace font`	Identifies: Text you must type in. Messages displayed by the system. Program code.
{ }	Indicates a set of choices from which you must choose one. Type only the information inside the curly braces. Do not type the { } symbols.
|	Separates two mutually exclusive choices in a syntax line. Type one of these choices. Do not type the | symbol.
[ ]	Indicates one or more options. Type only the information inside the square brackets. Do not type the [ ] symbols.
...	Indicates that you can type multiple options of the same type. Type only the information. Do not type the ellipsis (...).

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2   Prerequisites

Prerequisites for Installation

All prerequisites for installation are described in *Installing Entire Net-Work for zIIP* in the *Installation* documentation.

3   Current Limitations

1. Entire Net-Work for zIIP is incompatible with the following Drivers:

   - SSL
   - SSLI

   If either the SSL or SSLI Driver is defined, zIIP support is disabled for the session.

2. If the TCPI or TCPX Driver is used, the API parameter must be set to OES (`API=OES`). If `API=HPS` is specified, zIIP support is disabled for the session.

3. The FCTC Driver parameter COMPAT must be set to N. If `COMPAT=Y` is specified, zIIP support is disabled for the session.

   Note that as of this release the default for COMPAT has been changed to N.

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 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:
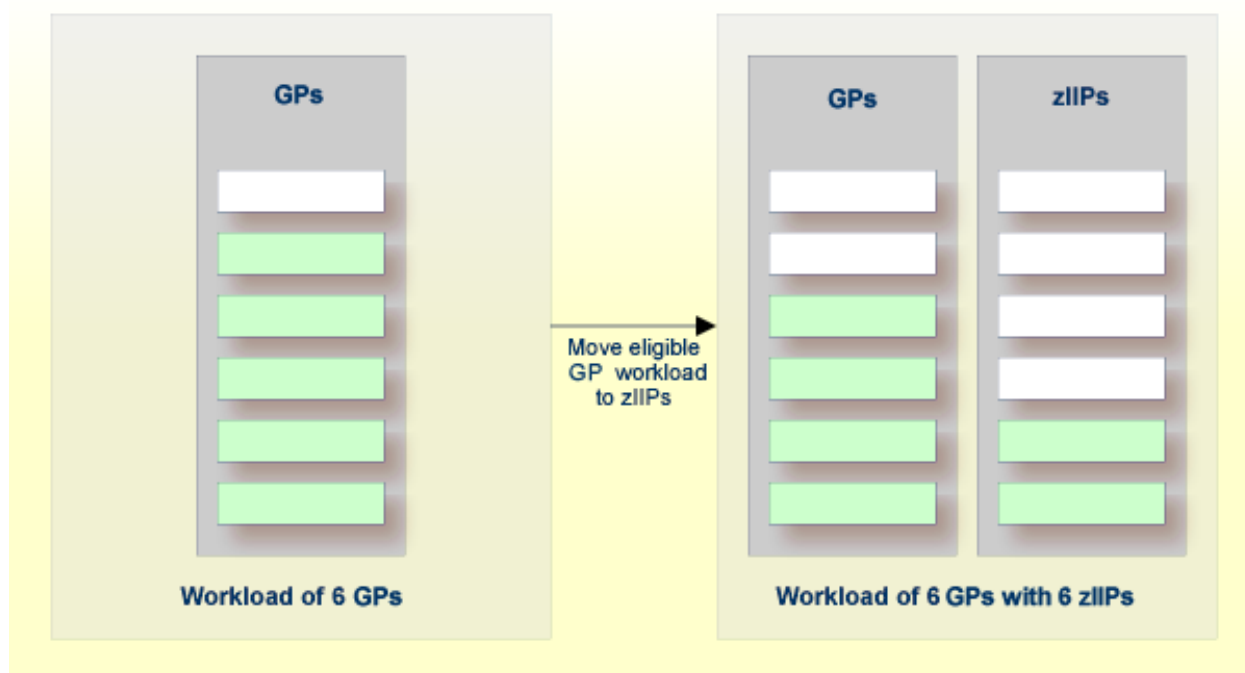
5   Entire Net-Work for zIIP Processing: Concepts

This chapter provides information on how Entire Net-Work 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 Entire Net-Work 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, Entire Net-Work 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 Entire Net-Work for zIIP processing is bound to the Entire Net-Work nucleus or utility address space. It is deleted when the Entire Net-Work nucleus or utility job step terminates.

TCB/SRB Switches

When an Entire Net-Work 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 Entire Net-Work logic. The SRB cannot perform all operations that the TCB can do, though. Broadly, there are two categories of operations that Entire Net-Work 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.

Entire Net-Work 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, Entire Net-Work 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 Entire Net-Work 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 Entire Net-Work is high and allows for sufficient parallelism in its processing. The choice between mode switches and parallel requests is made by Entire Net-Work; it cannot be controlled via configuration parameters.

6   Monitoring zIIP Usage

The purpose of Entire Net-Work for zIIP is to reduce the Entire Net-Work CPU consumption on general processors (GP) by offloading part of the processing to System z Integrated Information Processors (zIIP). Entire Net-Work 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

Entire Net-Work for zIIP shows zIIP-related statistics

- in the Entire Net-Work session statistics that are printed when the nucleus terminates,

- when the Entire Net-Work operator command DISPLAY STATS is given from an operator console,

- when the Entire Net-Work operator command DISPLAY ZSTATS is given from an operator console

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

Understanding the zIIP-Related Statistics

An Entire Net-Work 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 Entire Net-Work 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 Entire Net-Work 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 Entire Net-Work 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 Entire Net-Work address space that was a member of a WLM enclave, normalized to GP speed
All enclave zIIP times (%)	The percentage of the total CPU time that the Entire Net-Work address space consumed on zIIPs, calculated as: All enclave zIIP times / Total CPU time * 100

Statistic	Description
Total enclave CPU time	The total CPU time consumed by the WLM enclave created by Entire Net-Work 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 Entire Net-Work that was consumed on general processors
Enclave zIIP time	The CPU time of the WLM enclave created by Entire Net-Work that was consumed on zIIPs, normalized to GP speed
Enclave zIIP time (%)	The percentage of the enclave CPU time that Entire Net-Work consumed on zIIPs, calculated as: Enclave zIIP time / Total enclave CPU time * 100
Eligible zIIP CPU time	The CPU time that Entire Net-Work 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 Entire Net-Work 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 Entire Net-Work was eligible to execute on zIIPs but instead consumed on GPs because no zIIP was available
Eligible zIIP time on GP (%)	The percentage of the eligible zIIP CPU time that Entire Net-Work instead consumed on GPs, calculated as: Eligible zIIP CPU time on GP / Eligible zIIP CPU time * 100
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 enclave did not consume any CPU time on zIIPs. It shows the percentage of the enclave CPU time that could have offloaded to zIIPs, had there been any, calculated as: Eligible zIIP CPU time / Total enclave CPU time * 100
Mode switches	The number of times Entire Net-Work 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
Parallel requests	The number of times Entire Net-Work 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
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

Statistic	Description
Pause for wait	The number of times Entire Net-Work had no work to do (i.e., was waiting for I/Os, new commands, or other events)
Release from wait	The number of times Entire Net-Work 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 "Mode Switches" and "Parallel requests" reported above. Only categories with nonzero counts are shown. A selection of typical categories follows:	
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
SET ZIIP operator command	The number of times operator command `SET ZIP=YES/NO` resulted in a mode switch
ADATMZ call	The number of times ADATMZ was called in TCB mode, performed via switches to TCB mode and back to SRB mode
SAF call	The number of times an SAF authorization call was made in TCB mode, performed via switches to TCB mode and back to SRB mode
User exit	The number of times a Net-Work user exit was called in TCB mode, performed via switches to TCB mode and back to SRB mode
FCTC Open/Close	The number of times a mode switch was performed to open or close the Driver or a Link
FCTC Wait	The number of times a mode switch was performed to issue a WAIT. May happen during link open or disconnect.
FCTC Purge	The number of times a mode switch was performed to make a PURGE call. May happen during link disconnect.
FCTC Calldisp 1	The number of times a mode switch was performed to issue CALLDISP. CALLDISP is used when the main task must be paused to allow the Disabled Interrupt Exit (DIE) to complete an operation. This number should be small compared to the number of commands sent and received.
FCTC Calldisp 2	The number of times a mode switch was performed to issue CALLDISP. CALLDISP is used when the main task must be paused to allow the Disabled Interrupt Exit (DIE) to complete an operation. This number should be small compared to the number of commands sent and received.

Statistic	Description
CTCA Open/Close	The number of times a mode switch was performed to open or close the Driver or a Link
CTCA Wait	The number of times a mode switch was performed to issue a WAIT. May happen during link open or disconnect.
CTCA Purge	The number of times a mode switch was performed to make a PURGE call. May happen during link disconnect.
CTCA Calldisp 1	The number of times a mode switch was performed to issue CALLDISP. CALLDISP is used when the main task must be paused to allow the Disabled Interrupt Exit (DIE) to complete an operation. This number should be small compared to the number of commands sent and received.
CTCA Calldisp 2	The number of times a mode switch was performed to issue CALLDISP. CALLDISP is used when the main task must be paused to allow the Disabled Interrupt Exit (DIE) to complete an operation. This number should be small compared to the number of commands sent and received.
XCF Open	The number of times a mode switch was performed to open the Driver or a Link
XCF Close	The number of times a mode switch was performed to close the Driver or a Link
VTAM Open	The number of times a mode switch was performed to open the Driver or a Link
VTAM Close	The number of times a mode switch was performed to close the Driver or a Link
TCP Open	The number of times a mode switch was performed to open the Driver or a Link
TCP Resolve	The number of times GETHOSTBYNAME or GETHOSTBYADDR was called in TCB mode, performed 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 Entire Net-Work session.)
Enclave GP service units	The GP CPU service units accumulated by the enclave created by Entire Net-Work
Enclave zIIP service units	The zIIP CPU service units accumulated by the enclave created by Entire Net-Work, 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.

Notes:

1. The "All enclave zIIP times (%)" figure shows in a nutshell how much of the CPU consumption by Entire Net-Work was actually offloaded to zIIPs.

2. Entire Net-Work 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 Entire Net-Work address space — such 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 CPU times for all enclaves, tasks and SRBs running in the Entire Net-Work 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 Entire Net-Work for zIIP. For a more accurate assessment how much CPU time Entire Net-Work 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 processed by Entire Net-Work.

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, Entire Net-Work 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 Entire Net-Work 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 Entire Net-Work commands (reported higher up in the session statistics), indicates the level of parallelism that Entire Net-Work could utilize to process multiple commands concurrently. The higher the ratio of commands plus I/Os over "pauses for wait", the more work Entire Net-Work 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 Entire Net-Work - 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 Entire Net-Work for zIIP to influence the interplay between the SRB and the TCB.

8. If the ZIIP parameter is changed to NO during an Entire Net-Work session, requesting that Entire Net-Work continue to run in TCB mode and not 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 Entire Net-Work 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 Entire Net-Work session statistics:

```
NET0200I: zIIP-related statistics for Net-Work address space
NET0200I: Total CPU time 0:00:38.884
NET0200I:  Non-enclave GP times 0:00:05.514
NET0200I:  All enclave GP times 0:00:01.558
NET0200I:  All enclave zIIP times 0:00:31.812
NET0200I:  All enclave zIIP times (%) 81.81
NET0200I: zIIP-related statistics for Net-Work enclave
NET0200I:  Total enclave CPU time 0:00:33.370
NET0200I:  Enclave GP time 0:00:01.558
NET0200I:  Enclave zIIP time 0:00:31.812
NET0200I:  Enclave zIIP time (%) 95.33
NET0200I:  Eligible zIIP CPU time 0:00:31.818
NET0200I:  Enclave zIIP time 0:00:31.812
NET0200I:  Eligible zIIP time on GP 0:00:00.006
NET0200I:  Eligible zIIP time on GP (%) 0.01
NET0200I: Mode switches 36,904
NET0200I: Parallel requests 36
NET0200I:  No free element for request 0
NET0200I:  Parallel requests per TCB pause 4.50
NET0200I: Extended statistics
NET0200I:  Pause SRB 31
NET0200I:  Release SRB 1
NET0200I:  Pause TCB 8
NET0200I:  Release TCB 38
NET0200I:  Pause for wait 0
NET0200I:  Release from wait 0
NET0200I: SRB/TCB scheduling by type of work
NET0200I:  Miscellaneous 2
NET0200I:  Operator commands 2
NET0200I:  Sequential writes 36
NET0200I:  Timer services 7,830
NET0200I:  User exit 8 72
NET0200I:  ADATMZ call 28,996
NET0200I: Enclave GP service units 184,795
NET0200I: Enclave zIIP service units 176,165
NET0200I: GPs 6
NET0200I: zIIPs 1
NET0200I:  zIIP SMT threads 2
NET0200I: zIIP normalization factor 10.97
```

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