



Software Group | Enterprise Networking and Transformation Solutions (ENTS)

# CS z/OS CICS Sockets Open Transaction Environment (OTE)

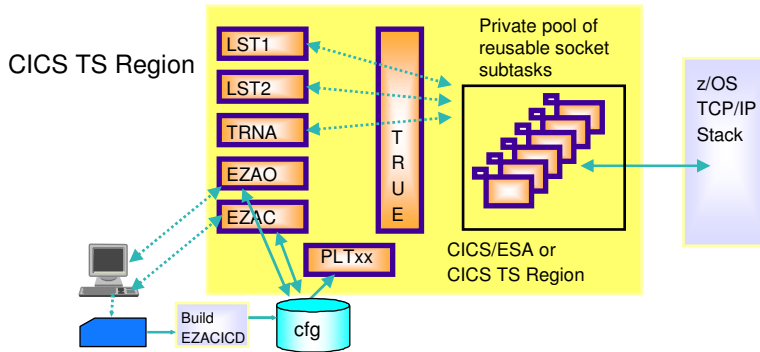
## What is the CICS quasi-reentrant TCB?

- **The CICS quasi-reentrant (QR) Task Control Block (TCB) is the TCB where the customers application work is processed.**
  
- **Programs are said to be quasi-reentrant programs because they take advantage of the behavior of the CICS dispatcher and the QR TCB.**
  - ┆ There is only ever one CICS task active under the QR TCB.
    - The same program can be executed by multiple CICS tasks
    - Only one of those CICS tasks is active at any given point in time
  
- **Quasi-reentrant programs running under the QR TCB are safe in the knowledge that they are the only CICS user task running at that instance.**
  - ┆ Can access shared resources such as the CICS Common Work Area (CWA)
  - ┆ Can access shared storage obtained via EXEC CICS GETMAIN SHARED
  - ┆ Running under the QR TCB guarantees serialized access to shared resources
  
- **The QR TCB structure limits multi-processing.**
  - ┆ One of the key reasons why multiple CICS regions are typically deployed for scalability in a multiprocessor environment.

## Subtasking method - private: NTASKS

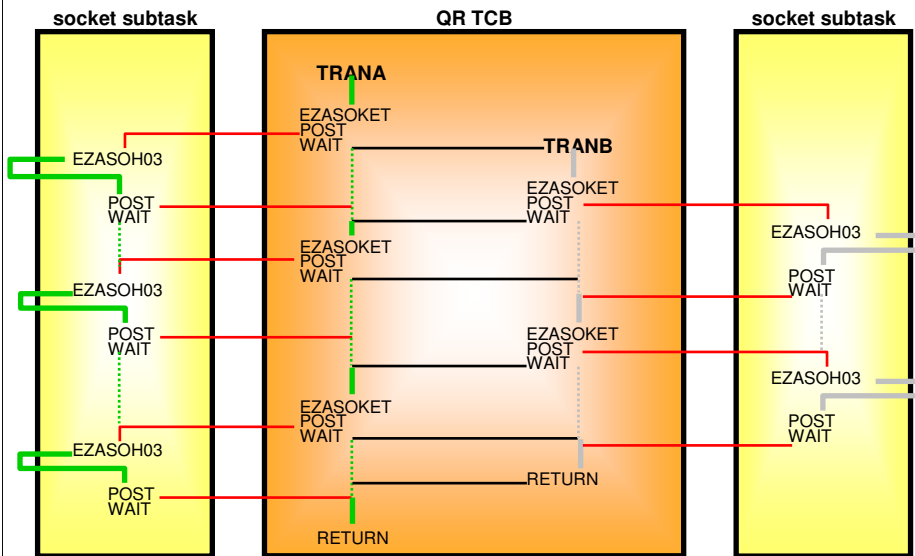
> **The current subtasking method IP CICS Sockets uses is that of a privately managed pool of MVS TCBs.**

- › Determined by what is coded for the NTASKS configuration option
- › Established when IP CICS Sockets is initialized
  - New TCBs are dynamically generated
    - If the subtask pool is defined too small for the IP CICS Sockets workload
    - The task is a listener
    - The same TCB will be DETACHED when the task using it has ended



### EZASOKET transactions in CICS/TS 1.3

NTASK=2



## What is CICS Open Transaction Environment?

➤ **CICS TS Open Transaction Environment (OTE) introduces a new class of Task Control Blocks (TCBs) called an open TCB, which can be used by applications.**

- Characterized by the fact it is assigned to a CICS task for the life of the CICS task
- Multiple OTE TCBs may run concurrently in CICS

➤ **There are several modes of open TCBs, used to support various functions.**

- Java in CICS, for example employs a type of OTE TCB commonly referred to as "J8"
- Open API Task Related User Exits employ the "L8" TCB

➤ **There is no sub-dispatching of other CICS tasks under the open TCB.**

- An application executing under an open TCB can issue non CICS API requests that may involve the TCB being blocked.
- Blocking is allowed because only this TCB is halted, and not the whole of CICS
  - This is what happens if a blocking EZASOKET request is issued under the QR TCB.
    - Blocking means the TCB is halted, the TCB is not being dispatched.
- Examples of non CICS APIs would be:
  - MVS services
    - GETMAIN
    - MVS UNIX System Services POSIX functions.
  - DB2 SQL
  - MQSeries

## What is CICS Open Transaction Environment? *(continued)*

- **Since multiple tasks can potentially access shared resources simultaneously when executing under an OTE TCB, applications that access shared resources must bear the responsibility of ensuring the integrity of those resources by implementing an appropriate serialization technique.**
  - ┆ For example, a counter in the CICS common work area (CWA)
- **CICS assumes responsibility for ensuring the integrity of the resources it manages.**
  - ┆ Either the CICS TS code has been amended to run on multiple TCBs safely
    - temporary storage requests
  - ┆ Or CICS TS will ensure the code runs on the QR TCB
    - File Control requests.
- **Therefore the use of non-threadsafe CICS commands that must run on the QR TCB has a performance penalty (due to the need to switch TCBs), but there is no risk to data integrity.**
- **If the same quasi-reentrant program would run in an OTE environment, multiple instances of this program could execute at the same time.**
  - ┆ The counter value in the CWA could be changed by multiple executors at the same time and one instance would never be sure about the counter value when it stops or gets suspended.

## What is threadsafe?

### ➤ **“threadsafe application”**

↳ A collection of application programs that employ an agreed-upon form of serialized access to shared resources.

### ➤ **A program written to “threadsafe standards” is a program that implements the agreed-upon serialization techniques.**

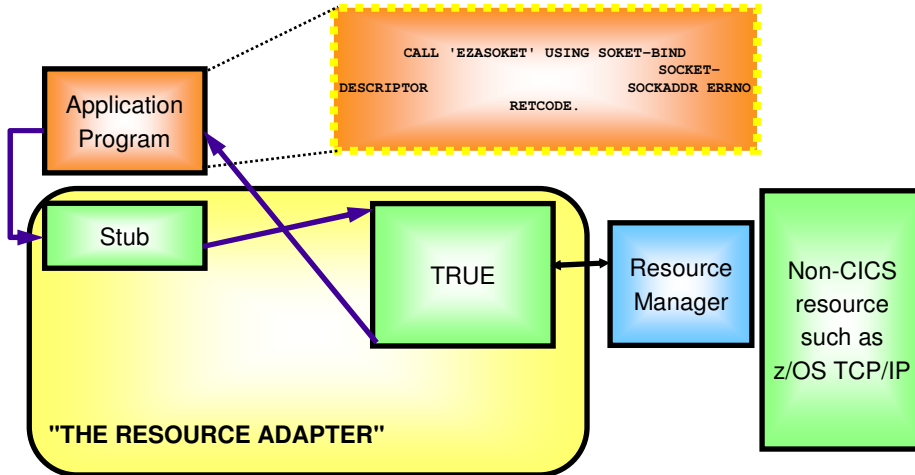
➤ **It is important to understand a single program operating without the agreed-upon serialization technique can destroy the predictability and therefore integrity of an entire system of otherwise threadsafe programs.**

➤ **Therefore, an application system cannot be “threadsafe” until all programs that share a common resource implement that application’s threadsafe standards.**

## The CICS resource adapter concept

➤ A CICS resource adapter is a mechanism used to allow CICS programs access to non-CICS resources.

┆ In the case of IP CICS Sockets, a call to EZASOKET will invoke the adapter:

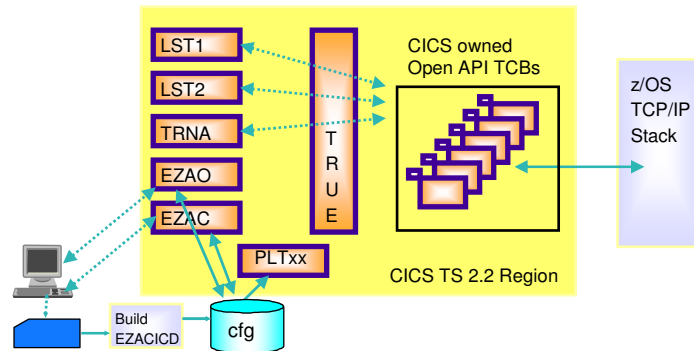




## Subtasking method - Open API

- When exploiting OTE, the IP CICS Sockets Task Related User Exit (TRUE) will be enabled as Threadsafe. When it is invoked by an EZASOCKET call, CICS will switch the task from the QR TCB to an L8 TCB.
- The L8 TCBs are solely managed by CICS TS. The active L8 TCB pool size is limited by the CICS MAXOPENTCBS System Initialization parameter. The CICS ACTOPENTCBS will indicate the number of L8 TCBs in use at any instance.

CICS TS Region





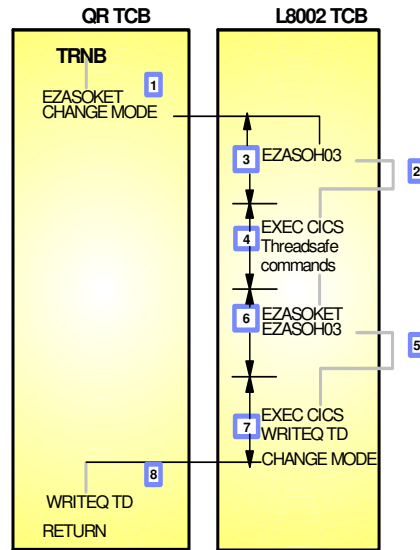
## CICS Sockets in z/OS V1R7 may optionally be based on OTE

### Allow IP CICS Sockets to exploit CICS OTE

- Task Related User Exit
  - Max 2000 L8 TCBs (configurable)
- APIs
  - EZASOKET
  - EZACICSO
  - C
- Listener
  - Standard and Enhanced listener
  - IPv4 and IPv6 versions
- Utility programs
  - EZACIC04, EZACIC05, EZACIC06, EZACIC08, EZACIC12, EZACIC14, and EZACIC15

### Note:

- To exploit CICS Sockets OTE:
  - Update the listener security exit routine
  - Make sure CICS Sockets applications are threadsafe
- CICS TS 2.3 level is recommended (2.2 will work!)





## Update CICS configuration for OTE - MAXOPENTCBS

> **CICS TS must be upgraded to at least V2R2 with any Open Transaction Environment and threadsafe PTFs applied. IP CICS Sockets will perform a runtime check to ensure this environment exists before the interface is enabled.**

> **MAXOPENTCBS is a CICS TS configuration option that is used to limit the size of the Open API, L8, TCB pool. Its range is from 1-2000 with a default of 12. When the number of tasks using L8 TCBs reaches MAXOPENTCBS, then any new work will be suspended by CICS TS until tasks end or MAXOPENTCBS is increased.**

Remember, TCB storage is allocated from Local System Queue Area (LSQA). MAXOPENTCBS can be set by using the CEMT Set Dispatcher MAXOpentcbs(nnnn) command.

```
File Edit Edit_Settings Menu Utilities Compilers Test Help
-----
EDIT          DCICS.V2R3M0.SYSIN (DFH$SIPT) - 01.83          Columns 00001 00080
Command ==>>_____ Scroll ==>> CSR
000021 MXT=260                Set maximum tasks to 32
000022 DSALIM=16M
000023 EDSALIM=640M
000024 SPOOL=YES              System spooling interface is required
000025 MAXOPENTCBS=260        Limit of Open API TCB in pool
000026 FORCEQR=NO             Do not force threadsafe pgms to QR TCB
000027 MCT=SO                Monitor Control Table for Sockets
000028 MN=ON                 Monitor Control on at initialization
000029 MNEXC=ON              Exception class monitoring is active
000030 MNPER=ON              Performance class monitoring is active
```

## Update CICS configuration for OTE - FORCEQR

➤ **FORCEQR is a CICS TS configuration option that causes CICS TS to force all user application programs that are specified as threadsafe to run under the CICS QR TCB, as if they were specified as quasi-reentrant programs.**

┆ FORCEQR=NO is the default.

┆ FORCEQR=YES is to be used to help in the threadsafe program conversion. FORCEQR can be dynamically changed by using CEMT Set SYStem (Force|NOForce) command.

➤ **It is recommended that FORCEQR be set to NO on a production level CICS.**

```
File Edit Edit_Settings Menu Utilities Compilers Test Help
-----
EDIT          DCICS.V2R3M0.SYSIN (DFH$SIPT) - 01.83          Columns 00001 00080
Command ==>_____ Scroll ==> CSR
000021 MXT=260          Set maximum tasks to 32
000022 DSALIM=16M
000023 EDSALIM=640M
000024 SPOOL=YES          System spooling interface is required
000025 MAXOPENTCBS=260    Limit of Open API TCB in pool
000026 FORCEQR=NO        Do not force threadsafe pgms to QR TCB
000027 MCT=SO          Monitor Control Table for Sockets
000028 MN=ON          Monitor Control on at initialization
000029 MNEXC=ON        Exception class monitoring is active
000030 MNPER=ON        Performance class monitoring is active
000031 AUXTR=OFF        Activate auxiliary trace
000032 AUXTRSW=NEXT     Permit one switch for auxiliary trace datasets
000033 PLTPI=SI        PLT for System Initialization programs
000034 PLTSD=SD        PLT for Shutdown programs
```

## Configure IP CICS Sockets for OTE

### > OTE

A value of YES causes the IP CICS Sockets task-related user exit to execute using the CICS Open Transaction Environment.  
A value of NO causes IP CICS Sockets to continue executing EZASOKET calls on an MVS subtask managed by the IP CICS Sockets interface.

If OTE=YES, then the values of NTASKS, DPRTY and TERMLIM will be forced to zero if specified.

### > OTE is supported on CICS/TS V2R2M0 and higher.

If OTE=YES is specified on a pre-CICS/TS V2R2M0 system, then the IP CICS Sockets interface will fail initialization.

### > When OTE=YES is specified, CICS TS will switch all calls from the QR TCB to an L8 TCB

All EZASOKET calls  
All IP CICS C Socket functions

### > IP CICS Sockets applications must be

Coded using threadsafe programming practices as defined by CICS and  
Defined to CICS as threadsafe

```

EDIT ---- CFGOTE JCL A1 ----- COLUMNS 001 080
COMMAND ==>                                SCROLL ==> CSR
000075 CICS1A  EZACICD TYPE=CICS,           Generate configuration record      X
000076          APPLID=CICS1A,             APPLID of CICS                   X
000077          TCPADDR=TCPCS,             Address space name for TCP/IP     X
000078          CACHMIN=0,                 Minimum refresh time for CACHE   X
000079          CACHMAX=20,                Maximum refresh time for CACHE   X
000080          CACHRES=5,                  Maximum number of active resolvers X
000081          OTE=YES,                    Use Open Transaction Environment  X
000082          TCBLIM=12,                  TCBLIM=12                         X
000083          TRACE=NO,                   No tracing needed                 X
000084          ERRORTD=TCPM                 Name of TD queue for error messages

```



## Configure IP CICS Sockets for OTE - TCBLIM

### ➤ TCBLIM

- / Specifies the maximum number of open TCBs that can be used by the IP CICS Sockets interface.
- / Listeners will not be subject to this limitation; however, they will be subject to CICS's MAXOPENTCBS.
  - This allows listeners to be started thereby prohibiting a possible denial of service.
  - If MAXOPENTCBS is reached
    - Then no more open API TCBs are available in the CICS region and
    - The IP CICS Sockets task-related user exit cannot obtain an open TCB for its use
- / If OTE=NO and TCBLIM>0, then TCBLIM will be forced to 0.
- / IP CICS Sockets supports a TCB limiting mechanism to manage its use of the L8 TCBs.
- / When TCBLIM is 0, no limiting factor is imposed.
  - TCBLIM=0 is the default.
- / When TCBLIM is set to the same value as MAXOPENTCBS, it will never be enforced due to CICS's management of the L8 pool size.
- / When a CICS region is at MAXOPENTCBS, any new work exploiting an Open API enabled TRUE will wait until an L8 TCB becomes available either through task end or by increasing MAXOPENTCBS
  - The EZAO.SET.CICS transaction can be used to change TCBLIM dynamically
- / Listeners defined to the IP CICS Sockets interface are not subject to TCBLIM but are subject to MAXOPENTCBS



## L8 TCB management for CICS Sockets

➤ The IP CICS Sockets Operator transaction can be used to inquire about the following:

- ⌋ The current CICS MAXOPENTCBS setting
- ⌋ The current number of L8 TCBs in use
- ⌋ The current IP CICS Sockets TCBLIM setting
- ⌋ The current number of L8 TCBs that are subject to TCBLIM
- ⌋ The current number of tasks that are queued by TCBLIM
- ⌋ The current queue depth of tasks that have been queued by TCBLIM

```
EZAO, INQUIRE, CICS                                APPLID = CICS1A

TRACE          ===== NO                        Trace CICS Sockets
MAXOPENTCBS    ===== 00260                      CICS Open API, L8, TCB Limit
ACTOPENTCBS    ===== 00000                      Active CICS Open API, L8, TCBs
TCBLIM        ===== 00000                      Open API TCB Limit
ACTTCBS       ===== 00000                      Number of Active Open API TCBs
QUEUEDEPTH    ===== 00000                      Number of Suspended Tasks
SUSPENDHWM    ===== 00000                      Suspended Tasks HWM

PF 3  END                                           12  CNCL
```

## IP CICS Sockets components - threadsafe or not

➤ **The following IP CICS Sockets programs are threadsafe:**

- EZACIC01 - Task Related User Exit
- EZACIC02 - Listener
  - The Listener will incur less TCB switching if run on CICS TS V2R3
- EZACIC12 - WLM Registration/Deregistration
- EZACICME - Message module
- Sample programs
  - EZACICAC - Sample IPv4 child server
  - EZACIC6C - Sample IPv6 child server
  - EZACICSC - Sample COBOL child server
- Utility programs
  - EZACIC04, EZACIC05, EZACIC06, EZACIC08, EZACIC09, EZACIC14, EZACIC15
- Application stub
  - EZACIC17

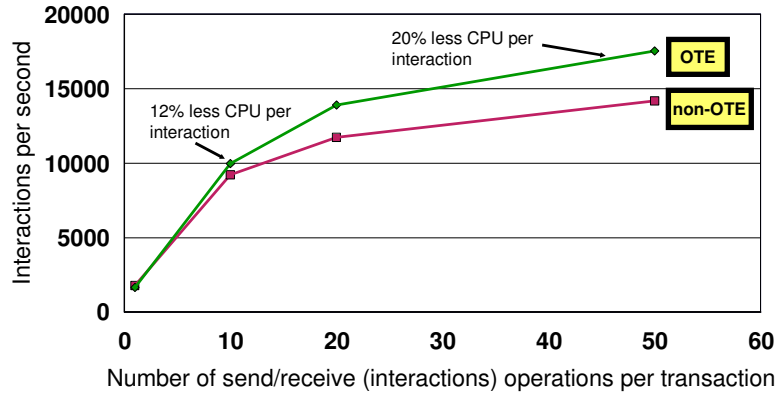
➤ **The following IP CICS Sockets programs do not need to be threadsafe:**

- EZACIC00 - Operator
- EZACIC03 - MVS subtask
- EZACIC20 - PLT program
- EZACIC21 - Initialization
- EZACIC22 - Termination
- EZACIC23 - Configuration
- EZACIC25 - Domain Name Service
  - This is not marked as threadsafe as it will always incur a TCB switch due to non-threadsafe CICS commands.
- EZACIC07 is the non-reentrant application stub providing C socket support for non-reentrant C CICS programs.  
Application programs using the EZACIC07 application stub cannot be defined as threadsafe. Use EZACIC17 instead.



## CICS Sockets - OTE vs. non-OTE - performance

### CICS Sockets Transactions OTE vs. non-OTE



- CICS Sockets transactions that issue many sockets calls and/or use both SQL and sockets calls will see most benefit from using OTE

## CICS CPU time

➤ Be aware of CICS CPU time changes:

f QR INCLUDES 1 + 8

f L8 CPU time includes the following CPU times

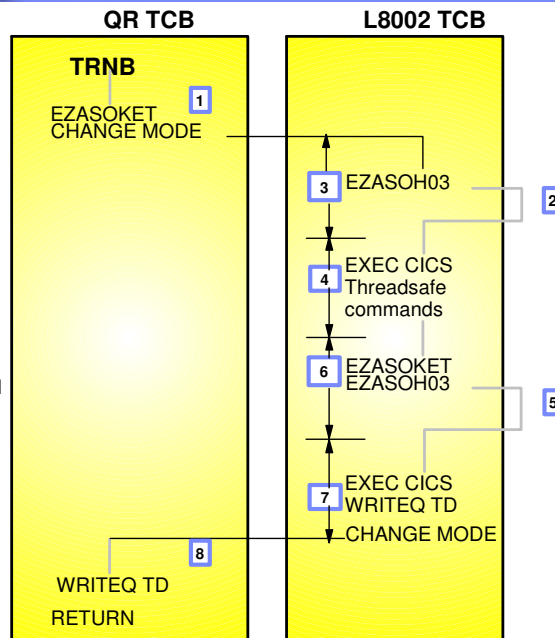
- OPEN TCB time, processing accessing TRUE and running application code
  - Includes 3 + 4 + 6 + 7
- Time spent in Sockets Extended
  - Includes times 2 + 5

f MS CPU

- CO, RO, etc. TCBs

f USER CPU includes QR, L8, MS

- 1+2+3+4+5+6+7+8+MS





## Things to think about

- If you specify a listener user/security exit, then it must be coded to threadsafe programming standards and defined to CICS as CONCURRENCY(THREADSAFE) to prevent a TCB switch and ensure shared resource integrity.
- Child server transaction program must be coded to threadsafe programming standards and defined to CICS as CONCURRENCY(THREADSAFE) to prevent TCB switching and ensure shared resource integrity.
- Use the CICS supplied load module scanner program, DFHEIDTH, to locate non-threadsafe CICS commands in your programs

```
#####  
# CICS LOAD MODULE SCANNER FILTER TABLE - THREADSAFE INHIBITORS      #  
# This table identifies commands which "may" cause the program not to #  
# be threadsafe in that they allow accessibility to shared storage and #  
# the application must have the necessary synchronization logic in     #  
# place to guard against concurrent update.                            #  
#####  
# The extract command obtains the address and length of the global    #  
# work area for the GLUE or TRUE.                                      #  
#####  
EXTRACT EXIT GASET *  
GETMAIN SHARED *  
ADDRESS CWA *  
ASKTIME *                   # Threadsafe in CICS TS V2R3  
FORMATIME *                 # Threadsafe in CICS TS V2R3  
SYNCPOINT *  
WRITE JOURNALNAME  
WRITE FILE  
WRITEQ TD
```

## Things to think about

- **Reassemble any user-written programs using any of the external IP CICS Sockets macros:**
  - ┆ EZACICA - IP CICS Sockets control blocks
  - ┆ EZACICSX - Listener security/user exit COMMAREA layout
  
- **The following APAR is required to exploit CICS Sockets OTE**
  - ┆ CICS TS V2R2 and V2R3
    - PQ93953 - CICS EXEC CICS SET TASK PURGE OR FORCEPURGE CMD PROCESSING FAILS
  - ┆ PTFs
    - UK01007 for CICS TS R2.2
    - UK01008 for CICS TS R2.3
  
- **The solution to the following APARs is recommended to enable best sockets performance in an OTE environment:**
  - ┆ APARs OA13252 and OA13278
  
- **Reference the following for more information on threadsafe programming practices:**
  - ┆ CICS TS documentation library
  - ┆ IBM Redbook - "*Threadsafe considerations for CICS*", SG24-6351
  - ┆ Share presentation - "What Does It Mean to be Threadsafe In CICS Transaction Server R2.2?" by Jim Grauel



# Trademarks, Copyrights and Disclaimers

The following terms are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both:

IBM	CICS	IMS	MQSeries	Tivoli
IBM logo	Cloudscape	Informix	OS/390	WebSphere
e/logo/business	DB2	iSeries	OS/400	xSeries
AIX	DB2 Universal Database	Lotus	pSeries	zSeries

Java and all Java-based trademarks are trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.

Microsoft, Windows, Windows NT, and the Windows logo are registered trademarks of Microsoft Corporation in the United States, other countries, or both.

Intel, ActionMedia, LANDesk, MMX, Pentium and ProShare are trademarks of Intel Corporation in the United States, other countries, or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Linux is a registered trademark of Linus Torvalds.

Other company, product and service names may be trademarks or service marks of others.

Product data has been reviewed for accuracy as of the date of initial publication. Product data is subject to change without notice. This document could include technical inaccuracies or typographical errors. IBM may make improvements and/or changes in the product(s) and/or program(s) described herein at any time without notice. Any statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only. References in this document to IBM products, programs, or services does not imply that IBM intends to make such products, programs or services available in all countries in which IBM operates or does business. Any reference to an IBM Program Product in this document is not intended to state or imply that only that program product may be used. Any functionally equivalent program, that does not infringe IBM's intellectual property rights, may be used instead.

Information is provided "AS IS" without warranty of any kind. THE INFORMATION PROVIDED IN THIS DOCUMENT IS DISTRIBUTED "AS IS" WITHOUT ANY WARRANTY, EITHER EXPRESS OR IMPLIED. IBM EXPRESSLY DISCLAIMS ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT. IBM shall have no responsibility to update this information. IBM products are warranted, if at all, according to the terms and conditions of the agreements (e.g., IBM Customer Agreement, Statement of Limited Warranty, International Program License Agreement, etc.) under which they are provided. Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products in connection with this publication and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. IBM makes no representations or warranties, express or implied, regarding non-IBM products and services.

The provision of the information contained herein is not intended to, and does not, grant any right or license under any IBM patents or copyrights. Inquiries regarding patent or copyright licenses should be made, in writing, to:

IBM Director of Licensing  
 IBM Corporation  
 North Castle Drive  
 Armonk, NY 10504-1785  
 U.S.A.

Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. All customer examples described are presented as illustrations of how those customers have used IBM products and the results they may have achieved. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput or performance improvements equivalent to the ratios stated here.

© Copyright International Business Machines Corporation 2005. All rights reserved.

Note to U.S. Government Users - Documentation related to restricted rights-Use, duplication or disclosure is subject to restrictions set forth in GSA ADP Schedule Contract and IBM Corp.