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Redbooks Paper

IBM ~ iSeries Software Limits/Capability Statement

Introduction

The tables in this document list the limits or maximum values corresponding to OS/400 V5R2.
You can find the limits for OS/400 V5R1, V4R5, V4R4, and V4R2 at:

http://publib.boulder.ibm.com/pubs/html/as400/v5r1/ic2924/tstudio/tech_ref/syslimit/index.htm

The limits for V4R5 and V4R4 are published as part of the Additional Materials available for the *IBM*

~ *iSeries Handbook*, GA19-5486, on the Redbooks FTP Web site at:

ftp://www.redbooks.ibm.com/redbooks/GA195486/limitv45.pdf   (for V4R5)
ftp://www.redbooks.ibm.com/redbooks/GA195486/limitred.pdf   (for V4R4)

The limits are also documented under the topic **Operating System-> General** in the Support Line
Knowledge Base. You can locate the Knowledge Base at:

http://as400service.ibm.com/supporthome.nsf/Document/10000051

On the Knowledge Base site, you may also find the limits documents by searching for the following
document numbers:

- 23921042 (for V5R1)
- 19690531 (for V4R5)
- 15704052 (for V4R4)
- 12761736 (for V4R2)

You can find V4R2 information in Appendix A of the IBM Redbook *The System Administrator's
Companion to AS/400 Availability and Recovery*, SG24-2161. You can download this publication
from the IBM Redbooks Web site at:

http://www.redbooks.ibm.com/pubs/pdfs/redbooks/sg242161.pdf

OS/400 V5R2 maximum capacities

Exceeding system limitations can cause an application or system outage. These limitations can be difficult to predict. However, an administrator can avoid these types of outages by being aware of the system limitations and maximum capacities in advance.

The following tables itemize some of the capacity limitations and restrictions that can affect the availability of large systems and their applications. For example, an online application halts when the size of a file or the number of its members reaches the size limitation.

These tables list the limits or maximum values corresponding to V5R2. Changes or additions since V5R1 are highlighted in *italics*. If you are viewing this document online, you'll notice that the changes or additions also appear in the color red. Some of these maximum values are different (lower) on prior releases. Also, there are environments or configurations where the actual limit may be less than the stated maximum. For example, certain high-level languages can have more restrictive limits.

> **Note:** The values listed in these tables represent theoretical limits, not thresholds or recommendations. Approaching some of these limits may be unreasonable and can degrade performance. Therefore, practical limits may be lower, depending on system size, configuration, and application environment.

Database and SQL limits

DB2 UDB for iSeries - Database Manager limits	Value
Most columns in a table (number of fields in a record)	8,000
Most columns in a view (number of fields in a record)	8,000
Maximum number of parameters in a function	90
Maximum number of parameters in a procedure [1]	254
Maximum length of a row without LOBs including all overhead (number of bytes in a record)	32,766
Maximum length of a row with LOBs including all overhead (number of bytes in a record)	3,758,096,383
Maximum size of a table (number of bytes in a database physical file member)	1 TB
Maximum size of an index (number of bytes in an access path) [2]	1 TB
Most rows in a table (number of records in a database physical file member)	4,294,967,288
Longest index key (size of key for database files)	2,000
Most columns in an index key (number of key fields in a database file)	120
Most indexes on a table (number of access paths on a database physical file member)	~ 4,000
Most tables referenced in an SQL statement (number of members that can be joined)	256
Most tables referenced in an SQL view (number of physical file members in a logical file member)	32
Most host variable declarations in a precompiled program [3]	Amount of storage
Most host variables and constants in an SQL statement [4]	*4,096*

[1] Procedures with PARAMETER STYLE SQL are limited to 90 parameters. SQL procedures with PARAMETER STYLE GENERAL are limited to 253. Procedures with PARAMETER STYLE GENERAL WITH NULLS are limited to 254. External procedures with PARAMETER STYLE GENERAL are limited to 255. The maximum number of parameters is also limited by the maximum number of parameters allowed by the licensed program used to compile the external program.

[2] If ACCPTHSIZ(*MAX4GB) is specified, then the access paths associated with that file can only occupy a maximum of four gigabytes (4,294,966,272 bytes) of auxiliary storage.

[3] In RPG/400 and PL/I programs when the old parameter passing technique is used, the limit is approximately 4000. The limit is based on the number of pointers allowed in the program. In all other cases, the limit is based on architectural constraints within the operating system.

[4] *If the statement is not read-only, the limit is 2048. The limit is approximate and may be less if very large string constants or string variables are used. For V5R1 and earlier, the limit is approximately 2048.*

Longest host variable used for insert or update	32,766
Longest SQL statement	*65,535*
Most elements in a select list [5]	~ 8,000
Most predicates in a WHERE or HAVING clause	4,690
Maximum number of columns in a GROUP BY clause	120
Maximum total length of columns in a GROUP BY clause	2,000
Maximum number of columns in an ORDER BY clause	10,000
Maximum total length of columns in an ORDER BY clause	10,000
Maximum size of an SQLDA	16,777,215
Maximum number of prepared statements	Amount of storage
Most declared cursors in a program	Amount of storage
Maximum number of cursors opened at one time	Amount of storage
Most tables in a relational database	Amount of storage
Maximum number of constraints on a table	300
Maximum levels allowed for a subselect	32
Maximum length of a comment	2,000
Maximum length of a path [6]	3,483
Maximum number of schemas in a path	268
Maximum number of rows changed in a unit of work (number of records locked in a single transaction under commitment control)	~ 500,000,000
Maximum number of triggers on a table	300
Maximum number of nested trigger invocations	200
Maximum procedures with result sets waiting to be fetched	100
Maximum length of a password	*128*
Maximum number of locators in a transaction	*250,000*
Maximum number of savepoints active at one time	*Amount of storage*
Maximum number of simultaneously allocated CLI handles in a process [7]	*80,000*
Maximum number of members in a physical or logical file	32,767
Maximum number of database format and directory objects that can be on a system to successfully execute a Reclaim Storage (RCLSTG) command [8]	~ 1,572,500
Maximum number of database objects that can be in use at one time	~ 500,000

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[5] The limit is based on the size of internal structures generated for the parsed SQL statement.

[6] *For DRDA, the length of a path is limited to 255 bytes.*

[7] *The maximum number of allocated handles per DRDA connection is 500.*

[8] Directory objects contain information about the relationships between database files. Refer to the Display Database Relations (DSPDBR) command for more information.

DB2 UDB for iSeries - SQL identifier limits	Value
Longest alias name	128
Longest authorization name	10
Longest column label	60
Longest correlation name	128
Longest cursor name	18
Longest host identifier	64
Longest savepoint name	*128*
Longest server name	18
Longest SQL routine label	128
Longest statement name	18
Longest table, package, or alias label	50
Longest unqualified schema name	10
Longest unqualified column name	30
Longest unqualified constraint name	128
Longest unqualified data type name	128
Longest unqualified external program name [9]	10
Longest unqualified function name	128
Longest unqualified nodegroup name	10
Longest unqualified package name	10
Longest unqualified procedure name	128
Longest unqualified specific name	128
Longest unqualified SQL parameter name	128
Longest unqualified SQL variable name	128
Longest unqualified table, view, and index name	128
Longest unqualified trigger name	128
Unqualified system column name	10
Unqualified system table, view, and index name	10

DB2 UDB for iSeries - Numeric limits	Value
Smallest BIGINT value	-9 223 372 036 854 775 808
Largest BIGINT value	+9 223 372 036 854 775 807
Smallest INTEGER value	-2 147 483 648
Largest INTEGER value	+2 147 483 647
Smallest SMALLINT value	-32 768
Largest SMALLINT value	+32 767
Largest decimal precision	31
Smallest FLOAT value	$\sim -1.79 \times 10^{308}$
Largest FLOAT value	$\sim +1.79 \times 10^{308}$
Smallest positive FLOAT value	$\sim +2.23 \times 10^{-308}$

[9] For a service program entry point name, the limit is 279. For REXX procedures, the limit is 33.

	Value
Largest negative FLOAT value	$\sim -2.23 \times 10^{-308}$
Smallest REAL value	$\sim -3.4 \times 10^{38}$
Largest REAL value	$\sim +3.4 \times 10^{38}$
Smallest positive REAL value	$\sim +1.18 \times 10^{-38}$
Largest negative REAL value	$\sim -1.18 \times 10^{-38}$

DB2 UDB for iSeries - String limits	Value
Maximum length of BLOB	2,147,483,647
Maximum length of CHAR [10]	32,765
Maximum length of VARCHAR [10]	32,739
Maximum length of CLOB	2,147,483,647
Maximum length of C NUL-terminated [10]	32,739
Maximum length of GRAPHIC [10]	16,382
Maximum length of VARGRAPHIC [10]	16,369
Maximum length of DBCLOB	1,073,741,823
Maximum length of C NUL-terminated graphic [10]	16,369
Maximum length of character constant	32,740
Maximum length of a graphic constant	16,370
Longest concatenated character string [10]	32,765
Longest concatenated graphic string [10]	16,369

DB2 UDB for iSeries - Date and time limits	Value
Smallest DATE value	0001-01-01
Largest DATE value	9999-12-31
Smallest TIME value	00:00:00
Largest TIME value	24:00:00
Smallest TIMESTAMP value	0001-01-01 - 00.00.00.000000
Largest TIMESTAMP value	9999-12-31 - 24.00.00.000000

DB2 UDB for iSeries - Datalink limits	Value
Maximum length of DATALINK	32,718
Maximum length of DATALINK comment	254

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[10] *If the column is NOT NULL, the maximum is one more.*

Journal limits

Journal limits	Value
Maximum size of a single journal receiver	~ 1 TB
Maximum length of a single journal entry (bytes)	4,000,000,000
Maximum sequence number for journal entries	9,999,999,999
Maximum number of objects that can be associated with one journal [11]	250,000
Maximum number of objects allowed on a single APYJRNCHG or RMVJRNCHG command	65,535
Maximum number of remote journal target systems for broadcast mode	255

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[11] This maximum includes objects whose changes are currently being journaled, objects for which journaling was ended while the current receiver was attached, and journal receivers that are or were associated with the journal while the current journal receiver is attached. If the number of objects is larger than this maximum, journaling does not start.

Communications limits

General communications configuration limits	Value
Maximum number of communications configuration objects that can be varied online at IPL	32,767
Maximum number of communications configuration objects that can be in a varied on state	64,926
Recommended maximum number of devices allocated to an interactive or communications subsystem	250 to 300
Maximum number of device descriptions for display devices per subsystem [12]	*~25,000*
Maximum number of virtual devices that can be specified as automatically configured (QAUTOVRT system value)	32,500 or *NOMAX
Maximum Communications/LAN hardware capabilities	See the *IBM* ~ *iSeries Handbook*, GA19-5486

SNA communications limits	Value
Maximum number of SNA controllers per LAN line plus the network controller	256
Maximum number of SNA CDs across a Frame Relay's NWI lines	256
Maximum number of lines per Frame Relay NWI	256
Maximum number of logical channels per X.25 line	256
Maximum number of controllers on SDLC multidrop lines	254
Maximum number of communication arbiters (maximum value of QCMNARB system value)	99
Maximum number of active sessions per APPC mode	512
Maximum number of modes per APPC device (or APPN location) [13]	14
Maximum combined number of APPC devices (in any state) and APPN devices (in varied on state)	25,300
Maximum number of APPN intermediate sessions	9,999
Maximum number of devices per APPC controller	254
Maximum number of switched lines per APPC controller	64
Maximum size of APPN local location list	476
Maximum size of APPN remote location list	1,898

[12] *Removing generic workstation types in workstation entries can help avoid this limit. For example, the *ALL workstation type allows the subsystem to allocate all of the valid workstations on the system. Note that WRKSTNTYP(*ALL) is the default for some IBM-supplied subsystem descriptions.*

[13] An APPN location refers to all devices that have the same values for RMTLOCNAME, RMTNETID, and LCLLOCNAME.

Maximum size of asynchronous network address list	294
Maximum size of asynchronous remote location list	32,000
Maximum size of retail pass-through list	450
Maximum size of SNA pass-through group	254

TCP/IP communications limits	Value
Maximum number of interfaces per line	2,048
Maximum number of interfaces per system	16,384
Maximum number of routes per system	65,535
Maximum number of ports for TCP	65,535
Maximum number of ports for UDP	65,535
Maximum TCP receive buffer size	8 MB
Maximum TCP send buffer size	8 MB
Maximum size of a transmission unit on an interface	16,388 bytes
Maximum number of TELNET server jobs	*200*
Maximum number of TELNET server sessions (non-SSL)	Maximum number of interactive jobs
Maximum number of TELNET server sessions using SSL protocol	*~ 1,000,000*
Default maximum number of socket and file descriptors per job [14]	200
Maximum number of socket and file descriptors per job	~ 524,000
Maximum number of socket descriptors on the system	~ 46,420,000
Maximum size of database files for FTP	1 TB
Maximum size of integrated file system files for FTP	Amount of storage
Maximum number of recipients for SMTP	14,000
Maximum number of simultaneous inbound connections for SMTP	~ 32,000 (1 connection per prestart job)
Maximum number of simultaneous outbound connections for SMTP	~ 32,000 (1 connection per prestart job plus 1 listening)
Maximum number of MX records handled by MX resolver (Client) for SMTP	80
Maximum document size for SMTP	2.1 GB
Maximum number of active threads per HTTP Server	9,999
Maximum number of connections that can be displayed using WRKTCPSTS or NETSTAT commands	32,767

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[14] The default can be changed with DosSetRelMaxFH() - Change the Maximum Number of File Descriptors. (See *OS/400 UNIX-Type APIs* in the iSeries V5R2 Information Center at: http://publib.boulder.ibm.com/iseries/v5r2/ic2924/index.htm Click the links **Programming-> APIs-> API Finder** and then search on "UNIX-Type APIs".)

Communications trace service tool limits	Value
Maximum amount of storage allocated for a single communications trace buffer	*1 GB*
Maximum total amount of storage allocated for all communications trace buffers	*4 GB*
Maximum number of active traces per multiline IOP on pre-V4R1 IOP hardware (limit is removed with new V4R1 IOP hardware)	2
Maximum record size when using the TRCTCPAPP trace tool for Host Server and DDM/DRDA Server	6,000 bytes

Work management limits

Work management limits	Value
Maximum number of jobs on the system	485,000
Maximum number of active subsystems	32,767
Maximum number of jobs in a subsystem	32,767
Maximum number of prestart jobs initially started when subsystem started	9,999
Maximum number of spooled files per job	999,999
Maximum amount of temporary auxiliary storage that can be specified for a job	2 TB or *NOMAX
Maximum number of active memory storage pools	64

Security limits

Security limits	Value
Maximum number of entries for a user profile [15] [16] [17]	*10,000,000*
Maximum number of objects that can be secured by an authorization list	2,097,070
Maximum number of private authorities to an authorization list [18]	*9,999,999*
Maximum number of entries in a validation list	2,147,483
Maximum number of user profiles on a system	~ 340,000
Maximum length of a password	128
Maximum number of profile handles in a job	*~20,000*
Maximum number of profile tokens on the system	*~2,000,000*

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[15] A user profile contains four categories of entries: 1) every object owned by the profile, 2) every private authority that the profile has to other objects, 3) every private authority that other profiles have to objects owned by this profile, and 4) every object for which this profile is the primary group. The sum of these categories equals the total number of entries for the profile.

[16] OS/400 maintains internal user profiles that own objects that are shared or cannot be assigned to a single individual user (for example, QDBSHR owns shared database objects such as database formats, access paths, and so on). These internal user profiles are subject to the same limits as any other user profile on the system.

[17] Using authorization lists or group profiles reduces the number of private authorities and helps avoid this limit (see *Security - Reference*, SC41-5302).

[18] Limit is due to the maximum number of entries allowed for the user profile that owns the authorization list (one less because a category 01 entry is used for the ownership of the authorization list).

Save and restore limits

Save and restore limits	Value
Maximum number of related internal objects that can be saved in a single save operation [19]	~ 65,500
Maximum number of names in a save or restore command specifying which objects or libraries to include or exclude in the save or restore operation [20]	300
Maximum number of concurrent save or restore operations	Limited only by available machine resources
Maximum size of an object that can be saved	~ 1 TB
Maximum size of a save file	~ 1 TB

[19] Some examples of related objects are:

- All database file objects in a library that are related to each other by dependent logical files.
- All database file objects in a library that are journaled to the same journal when using the save-while-active function.
- All objects in a library when SAVACT(*LIB) is specified.
- All objects in a library when saving to a diskette device.

For most object types, one internal object is saved for each OS/400 object. Some exceptions are:

- Subsystem descriptions:
  Nine internal objects per subsystem description.
- Database files:
  * If the physical file is not keyed, add one internal object per member.
  * If the physical file is keyed, add two internal objects per member.
  * If the physical file has constraints, add one internal object per constraint.
  * *If the physical file has triggers, add one internal object for the file.*
  * *If the physical or logical file has column level authorities, add one internal object for the file.*
  * If you use ACCPTH(*YES) on the save command, add one internal object for each logical file in the save request.

Note: This information is for estimation purposes only. The actual number of internal objects in your library may be higher or lower due to other variables.

[20] Using generic names to specify groups of objects or libraries can help avoid this limit.

File system limits

File system limits	Value
Maximum number of libraries in the system part of the library list	15
Maximum number of libraries in the user part of the library list [21]	250
Maximum number of objects in a library	~ 360,000
Maximum number of documents and folders (DLOs) in a user ASP	349,000
Maximum number of DLOs in a folder	65,510
Maximum size of a document	2 GB - 1
Maximum cumulative number of objects across the "root" (/), QOpenSys, and user-defined file systems of ASPs 1 through 32	*2,147,483,647*
Maximum cumulative number of objects across the user-defined file system(s) for each independent ASP	*2,147,483,647*
Maximum number of user-defined files systems in an independent ASP	*~ 4,000*
Maximum number of directories in one Type1 directory in the "root" (/), QOpenSys, or user-defined file systems	32,765
Maximum number of directories in one Type2 directory in the "root" (/), QOpenSys, or user-defined file systems	*999,998*
Maximum number of Type1 directory links for an object in the "root" (/), QOpenSys, or user-defined file systems	32,767
Maximum number of Type2 directory links for an object in the "root" (/), QOpenSys, or user-defined file systems	*1,000,000*
Maximum size of a stream file	256 GB
Default maximum number of file and socket descriptors per job [22]	200
Maximum number of file and socket descriptors per job	~ 524,000
Maximums for directory levels, path names, and object attributes and links	See *Integrated File System Introduction*, SC41-5711
Maximum number of files that the File Server can have open at one time [23]	*16,776,960*

[21] There are compatibility considerations for application programs that retrieve library lists and are not prepared for the longer lists. For more details, see *Memorandum to Users: Version 5 Release 1* at: http://publib.boulder.ibm.com/pubs/html/as400/v5r1/ic2924/info/rzaq9.pdf

[22] Default can be changed with DosSetRelMaxFH() - Change the Maximum Number of File Descriptors. (See *OS/400 UNIX-Type APIs* in the iSeries V5R2 Information Center at: http://publib.boulder.ibm.com/iseries/v5r2/ic2924/index.htm Click the links **Programming-> APIs-> API Finder** and then search on "UNIX-Type APIs".)

[23] This limit is cumulative across all File Server jobs (QPWFSxxxx and QZLSFILE jobs) on the system. When a file is closed, it no longer counts toward the limit. Client Access, AS/400 NetServer, Network Station bootup (keeps over 200 files open, unless using Compact Flash Memory (only requires about 25 files)) and applications, and QFileSvr.400 file system can be affected by this limit.

Cluster limits

Cluster limits	Value
Maximum number of cluster nodes	128
Maximum number of clusters per system	*1*

OptiConnect for OS/400 limits	Value
Maximum number of systems that can be connected using OptiConnect for OS/400	64
Maximum number of logical connection paths that can be established between two systems using OptiConnect for OS/400 [24]	6
Maximum number of active jobs that can communicate with any one system using OptiConnect for OS/400 [25]	16,382
Maximum total number of active jobs on one system that can use OptiConnect for OS/400 [25]	262,135
Maximum number of TCP/IP subnets per system [26]	8

HSL OptiConnect Loop Limits	Value
Maximum number of HSL OptiConnect Loops on a system	*14 (12 optical)*
Maximum number of systems that can be connected on a single HSL OptiConnect Loop [27]	*3*
Maximum number of I/O towers and Integrated xSeries Adapter cards on a single HSL OptiConnect Loop [27]	*4*

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[24] Only two of the six logical connection paths can use SPD Bus adapters (others must be HSL).

[25] The following jobs count toward OptiConnect job limits: DDM/DRDA source jobs (user jobs), DDM/DRDA target jobs on server, DB2 multisystem system jobs, APPC controllers and TCP/IP interfaces using OptiConnect (type *OPC, count as two jobs for each controller or interface), jobs using ObjectConnect over OptiConnect, and jobs using OptiMover API and active Remote Journals. Some of these uses are transient for the duration of a function (for example, ObjectConnect SAVRSTxxx), and some are more long term (for example, DDM conversations until reclaimed by RCLDDMCNV or ending the job).

[26] The following interfaces count as TPC/IP subnets: each OptiConnect TCP/IP interface with no associated local interface (ADDTCPIFC keyword LCLIFC(*NONE)) and each unique interface associated with an OptiConnect TCP/IP interface.

[27] *If more than two systems are on an HSL OptiConnect Loop, then no I/O towers or Independent xSeries Adapter cards are allowed on the same loop.*

Maximum HSL cable length	*250 meters (optical), 15 meters (copper)*

SPD OptiConnect limits	Value
Maximum number of systems per hub	14
Maximum SPD cable length	500 meters (1063 Mbps) or 2 kilometers (266 Mbps)

Miscellaneous limits

Miscellaneous limits	Value
Maximum system and I/O hardware configurations and capacities	See *IBM* ∾ *iSeries Handbook*, GA19-5486
Maximum number of DASD arms	*2,047*
Minimum number of DASD arms required for acceptable performance [28]	See *iSeries Disk Arm Requirements*
Maximum number of basic user ASPs	31
Maximum number of independent ASPs	*223*
Maximum number of logical partitions	32 (up to *10* per processor on selected models)
Maximum database size for Domino	256 GB
Maximum size of a user space [29]	16,773,120 bytes
Maximum size of a user index [30]	*1 TB*
Maximum size of a data queue	2 GB
Maximum size of a message queue [31]	16 MB (~75,000 messages)
Maximum number of new messages of any one message type on a message queue	Limited only by size of message queue
Maximum number of records for each version of the history log	65,535
Maximum number of unique Volume IDs displayed/printed in Product Activity Log's Removable Media Lifetime Statistics for each Media Option	*5,000*
Maximum number of input fields that can be specified for a display file	256

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[28] See *iSeries Disk Arm Considerations* in the Resource Library on the iSeries Performance Management Web site at: http://www-1.ibm.com/servers/eserver/iseries/perfmgmt/resource.htm

[29] Listed size is the maximum when the machine is allowed to choose the alignment. Absolute maximum size of a user space is 16,776,704 bytes.

[30] *To create a 1 TB capable user index when using the QUSCRTUI API, specify a value of "1" for the Index Size Option. Otherwise, the size limit will be 4 GB.*

[31] As of V4R3, message queue QSYSOPR is shipped with a message queue full action of *WRAP. When the message queue is full, the oldest informational and answered messages are removed from the message queue to allow space for new messages to be added. If the removing of the informational and answered messages does not provide enough space, then unanswered inquiry messages are removed until there is space to add the new message. The default reply is sent before an unanswered inquiry message is removed. For more information, see the MSGQFULL parameter on the CHGMSGQ command.

Interprocess Communication (IPC) limits	Value
Maximum number of Single UNIX Specification message queues on the system	2,147,483,646
Maximum size of a Single UNIX Specification message queue	16,773,120 bytes
Maximum size of a single message on a Single UNIX Specification message queue	65,535 bytes
Maximum number of semaphore sets on the system	2,147,483,646
Maximum number of semaphores per semaphore set	65,535
Maximum number of shared memory segments on the system	2,147,483,646
Maximum size of a teraspace shared memory segment	4,294,967,295 bytes
Maximum size of a resizeable teraspace shared memory segment	268,435,456 bytes
Maximum size of a nonteraspace shared memory segment	16,776,704 bytes
Maximum size of a resizeable nonteraspace shared memory segment	16,773,120 bytes

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