System i

Availability
Maximum capacities

Version 6 Release 1

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Note

Before using this information and the product it supports, read the information in “Notices,” on page 15.

This edition applies to version 6, release 1, modification 0 of IBM i5/OS (product number 5761–SS1) and to all subsequent releases and modifications until otherwise indicated in new editions. This version does not run on all reduced instruction set computer (RISC) models nor does it run on CISC models.

Contents

Maximum capacities

If you exceed system limitations, you might experience an application outage or a system outage. Avoid these types of outages by being aware of the maximum capacities and system limitations in advance.

System limitations can be difficult to predict. This topic collection can help you understand your system's maximum capacity. The tables in this topic collection 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 for the current release. Some of these maximum values are different (lower) on previous releases. There are environments or configurations where the actual limit can be less than the stated maximum. For example, certain high-level languages can have more restrictive limits. These limits can range from a certain number of objects to memory limitations. Memory limitations are measured in megabytes, gigabytes, and terabytes, where 1 MB equals 1 048 576 bytes, 1 GB equals 1 073 741 824 bytes, and 1 TB equals 1 099 511 627 776 byte

Note: The values listed in this topic collection represent theoretical limits, not thresholds or recommendations. Approaching some of these limits might degrade system performance. Therefore, practical limits might be lower, depending on system size, configuration, and application environment.

What's new for V6R1

Read about new or significantly changed information for the Maximum capacities topic collection.

Maximum capacities provides users and administrators with system limits for many i5/OS® functions. The purpose of this information is to aid in planning and managing how system limits can affect your system operations.

Updated system limits

For V6R1, Maximum capacities has been updated to reflect new system limits for several i5/OS functions.

How to see what's new or changed

To help you see where technical changes have been made, this information uses:

- The » image to mark where new or changed information begins.
- The « image to mark where new or changed information ends.

In PDF files, you might see revision bars (|) in the left margin of new and changed information.

To find other information about what's new or changed this release, see the Memo to users.

PDF file for Maximum capacities

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Related reference

"Related information for Maximum capacities" on page 13
IBM® Redbooks™ publications, Web sites, and other information center topic collections contain information that relates to the Maximum capacities topic collection. You can view or print any of the PDF files.

Cluster limits

The i5/OS system limits for clusters include cluster software limits, OptiConnect limits, high-speed link (HSL) OptiConnect loop limits, and system product division (SPD) OptiConnect limits.

Table 1. Cluster software limits

Cluster software limits	Value
Maximum number of nodes in a cluster	128
Maximum number of nodes in a recovery domain in a cluster resource group	128
Maximum number of clusters that a node may be a member of	1
Maximum number of IP addresses per cluster node	2
Maximum number of data port IP addresses per recovery domain node	4
Maximum number of site names per device cluster resource group	2
Maximum number of configuration objects per cluster resource group	256
Maximum number of application restarts	3
Maximum number of nodes that can be configured in a cluster with the System i™ Navigator Simple Cluster Management interface	4

Table 2. OptiConnect (Option 23 of i5/OS) limits

OptiConnect limits	Value
Maximum number of systems that can be connected using OptiConnect	64
Maximum number of logical connection paths that can be established between two systems using OptiConnect [1]	16
Maximum number of OptiConnect open connections between any two systems using OptiConnect [2]	16 382

Table 2. OptiConnect (Option 23 of i5/OS) limits (continued)

OptiConnect limits	Value
Maximum total number of active jobs on a system that can use OptiConnect [2]	262 135
Maximum number of TCP/IP subnets per system that can be configured to use OptiConnect[3]	8

Notes:

1. Only 2 of the 16 logical connection paths can use SPD Bus adapters (others must be HSL).
2. An OptiConnect open connection is an active communications link between a job or task on one system and a job or task on another system. Using the WRKOPCACT command, you can determine the number of current open connections by adding the 'Users' count under the Client Statistics View to the Agents count under the Server Statistics View. With this command, you can view the jobs and tasks associated with individual OptiConnect open connections by selecting F14 (Jobs and Tasks).
3. The following count as TCP/IP subnets:
   - Each OptiConnect TCP/IP interface with no associated local interface (ADDTCPIFC keyword LCLIFC(*NONE))
   - Each unique interface associated with an OptiConnect TCP/IP interface

Table 3. HSL OptiConnect Loop limits

HSL OptiConnect Loop limits	Value
Maximum number of HSL OptiConnect Loops on a system	See IBM eServer™ i5 and iSeries™ System Handbook on the Redbooks Web site  [2].
Maximum number of systems that can be connected on a single HSL OptiConnect Loop [1]	3
Maximum number of I/O towers and IXA cards on a single HSL OptiConnect Loop [1]	4
Maximum HSL cable length	250 meters (optical), 15 meters (copper)

Notes:

1. If more than two systems are on an HSL OptiConnect Loop, then no I/O towers or IXA cards are allowed on the same loop.
2. You can also review the High Availability and Clusters Web site for more information about designing a high availability solution.

Table 4. SPD OptiConnect limits. Use this table to learn about SPD OptiConnect system limits.

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

Communications limits

The i5/OS system limits for communications include general communications configuration limits, SNA limits, TCP/IP limits, and communications trace service tool limits.

Table 5. General communications configuration limits

General communications configuration limits	Value
Maximum number of communications configuration objects that can be in a varied on state[1]	Approximately 100 000

Table 5. General communications configuration limits (continued)

General communications configuration limits	Value
Recommended maximum number of devices allocated to a communications subsystem	250 to 300
Maximum number of device descriptions for display devices per subsystem[2]	Approximately 74 000
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 IBM eServer i5 and iSeries System Handbook on the Redbooks Web site  .
Notes: 1. A maximum of 32 767 communications configuration objects can be varied online at initial program load (IPL) per communications arbiter system job (see QCMNARB system value). 2. 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.	

Table 6. SNA communication limits

SNA communication limits	Value
Maximum number of SNA controllers per LAN line plus the Network controller	256
Maximum number of SNA CDs across a frame relay network'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 node	512
Maximum number of modes per APPC device (or APPN location)[1]	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	9999
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	1898
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

Table 6. SNA communication limits (continued)

SNA communication limits	Value
Note: 1. An APPN location refers to all the devices that have the same values for RMTLOCNAME, RMTNETID, and LCLLOCNAME.	

Table 7. TCP/IP communication limits

TCP/IP communication limits	Value
Maximum number of interfaces per line	2048
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	8MB
Maximum TCP send buffer size	8MB
Maximum size of a transmission unit on an interface	16 388 bytes
Maximum number of TELNET server jobs	200
Maximum number of pass-through server jobs	100
Maximum number of TELNET server sessions	Maximum number of virtual devices
Default maximum number of socket and file descriptors per job [1]	200
Maximum number of socket and file descriptors per job	2 500 000
Maximum number of socket descriptors on the system	Approximately 46 420 000
Maximum size of database files for FTP	1 terabyte
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	Approximately 32 000 (1 connection per prestart job)
Maximum number of simultaneous outbound connections for SMTP	Approximately 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	9999
Maximum number of connections that can be displayed using WRKTCPSTS or NETSTAT commands	32 767
Maximum number of L2TP tunnels per system	200
Maximum number of calls per L2TP tunnel	200
Note: Default can be changed with DosSetRelMaxFH() - Change the Maximum Number of File Descriptors (see UNIX-Type APIs in the information center).	

Table 8. Communications trace service tool limits

Communications trace service tool limits	Value
Maximum amount of storage allocated for a single communications trace buffer	1 GB

Table 8. Communications trace service tool limits (continued)

Communications trace service tool limits	Value
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	6000 bytes

Database and SQL limits

Several types of i5/OS system limits are related to database and SQL.

To view the limits for the Structured Query Language (SQL), see SQL limits. These limits include identifier length limits, numeric limits, string limits, datetime limits, datalink limits, and database manager limits.

To view the limits for database file sizes, see Database file sizes. These limits include the number of bytes in a record, number of key fields in a file, number of physical file members in a logical file member, among others.

File system limits

This topic contains the values for the system limits that are related to file systems. They include limits on the number of documents in a folder, the size of a document, the size of a stream file, and others.

Table 9. 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[1]	250
Maximum number of objects in a library	Approximately 360 000
Maximum number of documents and folders in a user auxiliary storage pool (ASP)	349 000
Maximum number of documents and folders 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 systems for each independent ASP	2 147 483 647
Maximum cumulative number of user-defined file systems in ASPs 1 through 32	2 147 483 647
Maximum number of user-defined file systems in an independent ASP	Approximately 4000
Maximum number of directories in one *TYPE1 directory in the "root" (/), QOpenSys, or user-defined file systems	32 765

Table 9. File system limits (continued)

File system limits	Value
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	Approximately 1 TB
Default maximum number of file and socket descriptors per job[2]	200
Maximum number of file and socket descriptors per job	2 500 000
Maximum for directory levels, path names, and object attributes and links	See the File system comparison topic in the information center. See Qp0lProcessSubtree()--Process a Path Name and QlgProcessSubtree()--Process a Path Name (using NLS-enabled path name) for more information.
Maximum number of directory levels when processing objects within a subtree using the Qp01ProcessSubtree() and QlgProcessSubtree() APIs and most integrated file system commands	See Maximum number of file and socket descriptors per job in this table. See Qp0lProcessSubtree()--Process a Path Name and QlgProcessSubtree()--Process a Path Name (using NLS-enabled path name) for more information.
Maximum length (in bytes) of a path name when processing objects within a subtree using the Qp01ProcessSubtree() and QlgProcessSubtree() APIs and most integrated file system commands	16 773 116
Maximum number of directory (folder) levels when deleting a directory (folder) using System i Navigator[5]	300
Maximum number of directory (folder) levels when viewing a directory's (folder's) total data size and contents properties using System i Navigator	300
Maximum number of files that the System i Access File Server can have open at one time[3]	16 776 960
Maximum number of scan descriptors per job[4]	Approximately 524 000

Notes:

1. There are compatibility considerations for application programs that retrieve library lists and are not prepared for the longer lists. For more details, see the V5R1 Memo to Users.
2. Default can be changed with DosSetRelMaxFH() - Change the Maximum Number of File Descriptors (see UNIX-Type APIs in the information center.)
3. This limit is cumulative across all file server jobs (QPWFSxxxx, QZLSFILE and QZLSFILET jobs) on the system. After a file is closed, it no longer counts toward the limit. Some applications that can be affected by this limit are System i Access, i5/OS NetServer™, Network Station®startup (which keeps over 200 files open, unless using Compact Flash Memory, which only requires about 25 files) and applications, and the QFileSvr.400 file system.
4. For more information about scan descriptors, see Integrated File System Scan on Open Exit Program in the API topic collection.
5. The Remove Directory (RMVDIR) command with SUBTREE (*ALL) specified can be used to delete directories exceeding this limit. See Remove Directory (RMVDIR) for more information.

Journal limits

Some i5/OS system limits relate to journals, such as the size of a journal receiver, the length of a single journal entry, and the maximum sequence number for journal entries.

Table 10. Journal limits

Journal limits	Value
Maximum size of a single journal receiver	Approximately 1 terabyte
Maximum length of a single journal entry (bytes)	4 000 000 000 bytes
Maximum length of a single journal entry that can be written using the Send Journal Entry (QJOSJRNE) API	15 761 440 bytes
Maximum sequence number for journal entries	18 446 744 073 709 551 600
Maximum number of objects that can be associated with one journal[1]	10 000 000
Maximum number of objects allowed on a single APYJRNCHG or RMVJRNCHG command	10 000 000
Maximum number of journal receivers allowed in a range of receivers on a journal command	1024
Maximum number of remote journal target systems for broadcast mode	255
Maximum number of active commitment definitions with object-level changes that can be processed concurrently by an APYJRNCHG or APYJRNCHGX command	1023
Note: 1. This maximum includes objects whose changes are currently being journaled, and journal receivers that are associated with the journal. If the number of objects is larger than this maximum, journaling does not start.	

Save and restore limits

Some i5/OS system limits relate to save and restore, such as limits for the size of a save file and the size of an object that can be saved.

Table 11. Save and restore limits

Save and restore limits	Value
Maximum number of related objects that can be saved or restored in a single save operation[1]	Approximately 111 000
Maximum number of related internal integrated file system objects that can be saved in a single operation[3]	Approximately 500 000
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[2]	300
Maximum number of concurrent save or restore operations	Limited only by available machine resources
Maximum size of an object that can be saved	Approximately 2 TB
Maximum size of a save file	Approximately 2 TB
Maximum size of description data saved for a file[4]	Approximately 16 MB

Table 11. Save and restore limits (continued)

Save and restore limits	Value
Notes: 1. All database file objects in a library that are related to each other by dependent logical files are considered to be related objects. Starting in V5R4, all database files in a library that have referential constraints are considered to be related objects when using the save-while-active function. A database file object consists of one or more internal objects. A maximum of approximately 500 000 related internal objects can be saved in a single save operation. One internal object is saved for each database file object, along with the following additional internal objects: • If the physical file is not keyed, add 1 internal object per member. • If the physical file is keyed, add 2 internal objects per member. • If the physical file has unique or referential constraints, add 1 internal object per constraint. • If the physical file has triggers, add 1 internal object for the file. • If the physical or logical file has column level authorities, add 1 internal object for the file. • If you use ACCPTH(*YES) on the save command, add 1 internal object for each logical file in the save request. 2. Using generic names to specify groups of objects or libraries can help avoid this limit. For the LIB, OMITLIB and OMITOBJ parameters on save commands, you can use the Command User Space (CMDUSRSPC) parameter to raise the limit to 32 767 simple or generic names. 3. Example of related internal integrated file system objects are objects with multiple hard-coded links or Java programs attached to a stream file. 4. When you perform a save operation, the system creates a list of the objects and their descriptions that it saves. The system saves this list with the objects for use when it displays the save media or restores the objects. The list is an internal object that is not accessible to user programs. The system requires that all description data saved for a file must be contained in the same 16 MB internal object. This data includes information about the file, its formats, and its members. For database physical files with dependent logical files, the data also includes information about the logical files, if access paths are saved. If your save operation fails because the description data for a file has exceeded the size of a 16 MB internal object, you need to divide the members of the file among multiple files and save these files. Because the system might try to put the description data for more than one file in the same 16 MB internal object, you might need to use separate save commands to save these files.	

Security limits

Some i5/OS system limits relate to security, such as limits on the length of passwords and the number of user profiles on a system.

Table 12. Security limits

Security limits	Value
Maximum number of entries for a user profile[1, 2, 3]	50 000 000
Maximum number of objects that can be secured by an authorization list	16 777 215
Maximum number of private authorities to an authorization list[4]	9 999 999
Maximum number of entries in a validation list	2 147 483
Maximum number of user profiles on a system	Approximately 340 000
Maximum length of a password	128
Maximum number of profile handles in a job	Approximately 20 000
Maximum number of profile tokens on the system	Approximately 2 000 000
Maximum amount of storage in the system and basic user ASPs, or in each Independent ASP, for permanent objects owned by a single user profile	8 terabytes

Table 12. Security limits (continued)

Security limits	Value
Notes: 1. A user profile contains four categories of entries: 1) every object owned by the profile, 2) every private authority the profile has to other objects, 3) every private authority to objects owned by this profile that other profiles have, 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. 2. The operating system 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. 3. Using authorization lists or group profiles reduces the number of private authorities and helps avoid this limit (see the Security topic in the information center). 4. 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).	

Work management limits

There are i5/OS system limits that are related to work management, such as limits on the number of jobs on a system, the number of active subsystems, and the number of jobs in a subsystem.

Table 13. Work management and spooled file limits

Work management and spooled file 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	9999
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
Maximum number of spooled files per job	999 999
Maximum number of spooled files in the system and basic user ASPs	Approximately 2 610 000
Maximum number of spooled files in each independent ASP	Approximately 10 000 000
Maximum number of records for a printer file	2 147 483 647
Maximum page number that can be displayed for a spooled file using the DSPSPLF command [1]	9999
Maximum page count that can be displayed for a spooled file using the WRKSPLF, WRKOUTQ, or WRKJOB OPTION(*SPLF) command [2]	99 999
Maximum number of writers that can be active at the same time	Approximately 43 600
Notes: 1. If the page count exceeds 9999, the display still shows page number 9999. The System i Navigator interface does not have this limitation and shows the correct page number. 2. If the page count exceeds 99 999, then ++++++ is displayed instead. The System i Navigator interface does not have this limitation and shows the correct page count.	

Miscellaneous limits

There are some other i5/OS system limits, such as the number of basic disk pools, the size of a user space, and the size of a message queue.

Table 14. Miscellaneous limits

Miscellaneous limits	Value
Maximum system and I/O hardware configurations and capacities	See IBM eServer i5 and iSeries System Handbook on the Redbooks Web site  .
Maximum number of disk arms per partition	2700
Minimum number of disk arms required for acceptable performance.	See Performance Papers and Articles in the Resource Library on the Performance Management  Web site.
Maximum number of connections to a disk unit in an Enterprise Storage Server®	8
Maximum combined number of disk arms and redundant connections to disk units[1]	Approximately 2800
Maximum number of basic user ASPs	31
Maximum number of independent ASPs	223
Maximum number of logical partitions	See Logical partitions in the information center.
Maximum database size for Domino®	256 GB
Maximum size of a user space[2]	16 773 120 bytes
Maximum size of a user index[3]	1 TB
Maximum size of a data queue or a user queue[4]	2 GB
Maximum size of a message queue[5]	16 MB (approximately 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 program messages that can be created in a job [6]	4 294 967 293
Maximum number of records for each version of the history log	10 000 000
Maximum number of unique Volume IDs displayed/printed in Product Activity Log's Removable Media Lifetime Statistics for each Media Option	5000
Maximum number of input fields that can be specified for a display file	256

Table 14. Miscellaneous limits (continued)

Miscellaneous limits	Value
Maximum total size of concurrently used teraspace address ranges per job	Approximately 64 TB
Range of user-defined double-byte characters that can be defined and maintained using the character generator utility (CGU) for Japanese	Hexadecimal 6941 through 7FFE

Notes:

1. The maximum number of disk arms per partition is limited to 2700.
2. 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.
3. 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.
4. The maximum size of a data queue that can be created through the data queue host server is 16 megabytes.
5. 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.
6. If the job has multiple threads, then the limit is the number of messages allowed in each thread.

Table 15. Interprocess Communication (IPC) limits

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 that can be created on the system	2 147 483 646
Maximum size of a teraspace shared-memory segment created by using the shmget() function	4 294 967 295 bytes
Maximum size of a teraspace shared-memory segment created by using the shmget64() function	17 450 452 123 648 bytes
Maximum size of a resizeable teraspace shared-memory segment	268 435 456 bytes
Maximum size of a nonteraspace shared-memory segment	16 776 960 bytes
Maximum size of a resizeable nonteraspace shared-memory segment	16 773 120 bytes

Related information for Maximum capacities

IBM Redbooks publications, Web sites, and other information center topic collections contain information that relates to the Maximum capacities topic collection. You can view or print any of the PDF files.

IBM Redbooks

OS/400 Maximum Capacities  contains information regarding system limits for V5R2.

Web sites

- Maximum capacities 
  Use this Web site to view information regarding system limits for V5R4.
- OS/400® maximum capacities 
  Use this Web site to view information regarding system limits for V5R3.
- OS/400 Maximum Capacities 
  Use this Web site to view information regarding system limits for V5R1, V4R5, V4R4, and V4R2.

Other information

- i5/OS Clusters technology
- Getting started with System i communications
- Files and file systems
- Journal management
- Backup and recovery
- Security
- Work management

Related reference

"PDF file for Maximum capacities" on page 1
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Appendix. Notices

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