

Bash changes

This article is an **incomplete overview** of changes to Bash over time. Not all changes are listed, just the ones most likely to be useful for normal scripting. The overviews are categorized by topic and ordered by version.

A useful starting point is the NEWS file (<https://github.com/bminor/bash/blob/master/NEWS>) in bash sources. If you have more detailed information, or historical information about Bash versions earlier than V2, feel free to mail me, or use the discussion below.

Status: 5.1 (alpha)

Shell options

Note that the `shopt` builtin command first appeared in Bash 2.0.

For this topic, see also

- [List of shell options](#)
- [The set builtin command](#)

Feature or change description	Appeared in Bash version	See also/remarks
posix (for <code>set -o</code>)	1.14.0	
hostcomplete	2.0-alpha3	
expand_aliases	2.0	
huponexit	2.02-alpha1	
nocaseglob	2.02-alpha1	
extglob	2.02-alpha1	together with extended globbing, KSH88
restricted_shell	2.03-alpha	
xpg_echo	2.04-beta1	
progcomp	2.04-alpha1	
no_empty_command_completion	2.04	
login_shell	2.05a-alpha1	

Feature or change description	Appeared in Bash version	See also/remarks
nolog (for set -o)	2.05a	
gnu_errfmt	3.0-alpha	
force_ignore	3.0-alpha	
failglob	3.0-alpha	
extquote	3.0-alpha	unsure – verify!
extdebug	3.0-alpha	
pipefail (for set -o)	3.0	
functrace (for set -o)	3.0	
errtrace (for set -o)	3.0	
nocasematch	3.1-alpha1	
dirspell	4.0-alpha	
globstar	4.0-alpha	
checkjobs	4.0-alpha	
autocd	4.0-alpha	
set -e effects more intuitive	4.0	not directly specified by POSIX, but in consensus with POSIX WG
compat40	4.1-beta	
lastpipe	4.2-alpha	only works with job control disabled
compat41	4.2-alpha	
globasciiranges	4.3-alpha	enable "character range globbing" to always act as if in C locale
compat42	4.3-alpha	
compat43	4.4-alpha	
compat44	5.0-alpha	
localvar_inherit	5.0-alpha	local variables inherit preceeding scope values if they have the same name
syslog_history	5.0-alpha	send history lines to syslog (undocumented, default off) if syslog is supported
assoc_expand_once	5.0-alpha	expand associative array subscripts only one

Feature or change description	Appeared in Bash version	See also/remarks
globasciiranges	5.0-beta	New default: on (default may be configured at compile time)
localvar_inherit	5.0-beta	guard code against inheriting from an incompatible data type
checkwinsize	5.0-beta2	New default: on
shift_verbose	5.0-beta2	Default on when in POSIX mode

General (all/many builtins)

Feature or change description	Appeared in Bash version	See also/remarks
generally return 2 on usage error	2.0	
generally accept -- (end of options)	2.0	
(where applicable) implement a -p option to produce reusable output	2.0	shopt and umask builtins were fixed to support that in 2.02

printf

For this topic, see also

- The printf command

Feature or change description	Appeared in Bash version	See also/remarks
new printf command	2.02-alpha1	
respects 0.. and 0x.. prefixed numbers	2.04-beta1	consistency with arithmetic
POSIX® length specifiers j , t and z	2.05a-alpha1	ISO C99
POSIX® flag ' '	2.05a-alpha1	
conversion a and A	2.05a-rc1	if provided by the underlying printf(3)
conversion F	2.05a-rc1	
conversion n	2.05a-rc1	

Feature or change description	Appeared in Bash version	See also/remarks
new option <code>-v</code>	3.1-alpha1	
escape sequences <code>\"</code> and <code>\?</code>	3.0-beta1	
modified option <code>-v</code> to assign to individual array elements	4.1-alpha	
conversion <code>(...)T</code>	4.2-alpha	support <code>strftime(3)</code> date/time format; uses current time
<code>\unNNN</code> and <code>\UNNNNNNNNN</code> escape sequences	4.2-alpha	for: <code>printf</code> , <code>echo -e</code> , <code>\$'...'</code>

Conditional expressions and test command

For this topic, see also

- The conditional expression
- The classic test command

Feature or change description	Appeared in Bash version	See also/remarks
<code>test</code> : <code>-o</code> , <code>==</code> , <code><</code> and <code>></code>	2.0	
<code>test</code> : <code>-N</code>	2.02	
<code>[[...]]</code> : new	2.02-alpha1	KSH93
<code>[[...]]</code> : regex support (<code>=~</code>)	3.0-alpha	
<code>[[...]]</code> : quotable right-hand-side of <code>=~</code> forces string matching	3.2-alpha	for consistency with pattern matching
<code>[[...]]</code> : <code><</code> and <code>></code> operators respect locale	4.1-alpha	for consistency, since 4.1-beta: ensure you have set compatibility to >4.0 (default)
<code>test</code> / <code>[[</code> / <code>[[</code> : <code>-v</code>	4.2-alpha	check if a variable is set
<code>test</code> / <code>[[</code> / <code>[[</code> : <code>-v</code>	4.2-alpha	support array syntax to check for elements
<code>test</code> / <code>[[</code> / <code>[[</code> : <code>-N</code> accepts nanoseconds	5.1-alpha	
<code>test</code> / <code>[[</code> / <code>[[</code> : <code>-v</code> accepts positional parameters	5.1-alpha	

Other builtins and keywords

Builtin	Feature or change description	Appeared in Bash version	See also/remarks
bashbug	new	1.14.0	
select	new	1.14.0	
disown	new	2.0	
shopt	new	2.0	The shopt builtin command
declare	new options -a and -F	2.0	
enable	builtin has basic plugin support (dlopen)	2.0	
exec	options -l , -c and -a	2.0	
read	options -p , -e and -a	2.0	The read builtin command
readonly	option -a	2.0	Arrays
time	new keyword	2.0	
shopt	-p (reusable output)	2.02	
umask	-p (reusable output)	2.02	
complete	new	2.04-devel	for and together with support for programmable completion
compgen	new	2.04-devel	for and together with support for programmable completion
read	options -t , -n , -d , -s	2.04-devel	The read builtin command
for ((...;...;...))	new	2.04-devel	KSH93
set	print shell functions in a format reusable as input	2.05-beta1	
for	allow an empty word list	2.05a-alpha1	
read	new option -u	2.05b-alpha1	The read builtin command

Builtin	Feature or change description	Appeared in Bash version	See also/remarks
caller	new	3.0	The caller builtin command
coproc	new	4.0-alpha	
declare	new options <code>-l</code> and <code>-u</code>	4.0-alpha	together with case-changing expansion forms
case	new action list terminators <code>;;&</code> and <code>;&</code>	4.0-alpha	ksh93: only <code>;& .</code> zsh and mksh: <code>;; .</code> mksh: all 4, <code>(;;&</code> is undocumented Bash compatibility)
read	changed <code>-t</code> (fractional seconds)	4.0-alpha	
mapfile	new	4.0-alpha	
read	new option <code>-i</code>	4.0-alpha	
compopt	new	4.0-alpha	
read	modified option <code>-t</code> to test for data	4.0-beta	
read	new option <code>-N</code>	4.1-alpha	
mapfile	changed behaviour regarding history spamming	4.1-alpha	
declare	new option <code>-g</code>	4.2-alpha	
mapfile	calls the callback with an additional argument: The line (data)	4.2-alpha	
cd	new option <code>-e</code>	4.2-alpha	
echo	<code>\unnnn</code> and <code>\UNNNNNNNNN</code> escape sequences	4.2-alpha	for: <code>printf</code> , <code>echo -e</code> , <code>\$'...'</code>
exec	option <code>-a</code> to give a <code>argv[0]</code> string	4.2-alpha	
time	allowed as a command by itself to display timing values of the shell and its children	4.2-alpha	POSIX change
help	<code>help</code> now searches exact topic-strings (i.e. <code>help read</code> won't find <code>readonly</code> anymore)	4.3-alpha	

Builtin	Feature or change description	Appeared in Bash version	See also/remarks
return	accept negative values as return value (e.g. <code>return -1</code> will show as (8 bit) 255 in the caller)	4.3-alpha	
exit	accept negative values as return value (e.g. <code>return -1</code> will show as (8 bit) 255 in the caller)	4.3-alpha	
read	<code>read</code> skips NUL (<u>ASCII</u> ()) Code 0) in input	4.3-alpha	
declare	new option <code>-n / +n</code> to support nameref variable type	4.3-alpha	
wait	new option <code>-n</code> to wait for the next background job to finish, returning its exit status.	4.3-alpha	
read	<code>read</code> checks first variable argument for validity before trying to read inout	4.3-beta	
help	attempts substring matching (as it did through bash-4.2) if exact string matching fails	4.3-beta2	
fc	interprets option <code>-0</code> (zero) as the current command line	4.3-beta2	
cd	new option <code>-@</code> to browse a file's extended attributes (on systems that support <code>0_XATTR</code>)	4.3-rc1	
kill	new option <code>-L</code> (upper case ell) to list signals like the normal lowercase option <code>-l</code> (compatibility with some standalone <code>kill</code> commands)	4.4-beta	
mapfile	new option <code>-d</code>	4.4-alpha	
wait	new option <code>-f</code>	5.0-alpha	
history	option <code>-d</code> allows negative numbers to index from the end of the history list	5.0-alpha	
umask	allows modes greater than octal 777	5.0-alpha	
times	honors current locale settings when printing decimal points	5.0-alpha	

Builtin	Feature or change description	Appeared in Bash version	See also/remarks
kill	New options <code>-n</code> <code>SIGNUMBER</code> and <code>-s</code> <code>SIGNAME</code>	5.0-beta2	The kill builtin command
select	Support for an empty wordlist following <code>in</code>	5.0-beta2	
read	Option <code>-e</code> (use <code>ReadLine</code> to obtain input) now works with arbitrary file descriptors (given by <code>-u</code> option)	5.1-alpha	
trap	<code>-p</code> option prints signals with <code>SIG_DFL/SIG_IGN</code> on shell start (POSIX mode)	5.1-alpha	
unset	automatically tries to unset a function if the given name is an invalid variable name	5.1-aplha	
wait	option <code>-n</code> now accepts a list of jobs	5.1-alpha	
wait	new option <code>-p</code> <code>NAME</code> to store PID/JobID (useful when waiting for a list of jobs)	5.1-alpha	
local	new option <code>-p</code> to print local variables in the current scope	5.1-alpha	
ulimit	new option <code>-R</code> to get/set <code>RLIMIT_RTTIME</code> resource	5.1-alpha	

Builtin variables

Feature or change description	Appeared in Bash version	See also
HISTCMD	1.14.0	interactive usage
PS1 , PS2 , PATH , and IFS are unsettable	2.0	
DIRSTACK array variable	2.0	
PIPESTATUS array variable	2.0	
BASH_VERSIONINFO array variable	2.0	

Feature or change description	Appeared in Bash version	See also
HOSTNAME	2.0	
SHELLOPTS	2.0	
MACHTYPE	2.0	
GLOBIGNORE	2.0	
HISTIGNORE	2.0	
respect LC_ALL	2.0	
respect LC_MESSAGES	2.0	
respect LC_CTYPE	2.0	
respect LC_COLLATE	2.0	
respect LANG	2.0	
GROUPS array variable	2.01	
GROUPS unsettable/takes (discarded) assignments	2.04	
FUNCNAME	2.04	
respect LC_NUMERIC	2.04	
TMOUT	2.05b	
BASH_REMATCH	3.0	together with regex support in <code>[[...]]</code>
BASH_ARGC	3.0	debugger support
BASH_ARGV	3.0	debugger support
BASH_SOURCE	3.0	debugger support
BASH_LINENO	3.0	debugger support
BASH_SUBSHELL	3.0	debugger support
BASH_EXECUTION_STRING	3.0	debugger support
BASH_COMMAND	3.0	debugger support
HISTTIMEFORMAT	3.0	
COMP_WORDBREAKS	3.0	
respect LC_TIME	3.1	
BASHPID	4.0-alpha	Added to mksh R41.
PROMPT_DIRTRIM	4.0	
BASH_XTRACEFD	4.1-alpha	

Feature or change description	Appeared in Bash version	See also
BASHOPTS	4.1-alpha	
FUNCNEST	4.2-alpha	
HISTSIZE	4.3-alpha	can be set to negative values for unlimited history length
HISTFILESIZE	4.3-alpha	can be set to negative values for unlimited history file size
CHILD_MAX	4.3-alpha	max. number of exit status of children the shell remembers
BASH_COMPAT	4.3-alpha	set shell compatibility levels
EPOCHSECONDS	5.0-alpha	expands to the time in seconds since Unix epoch
EPOCHREALTIME	5.0-alpha	expands to the time in seconds since Unix epoch with microsecond granularity
BASH_ARGV0	5.0-alpha	get/set \$0
PATH	5.0-alpha	Possibility to set a static path for use in a restricted shell (at compile time)
HISTSIZE	5.0-beta	Default can now be set at runtime
SRANDOM	5.1-alpha	New random generator for 32bit numbers (using various methods in the backend)
ARGV0	5.1-alpha	Respected when set in initial shell environment, then initially used to set \$0
BASH_REMATCH	5.1-alpha	Not readonly anymore
PROMPT_COMMANDS	5.1-alpha	New array variable. List of commands to be executed like PROMPT_COMMAND
SECONDS	5.1-alpha	Assignment using arithmetic expressions (is nominally an integer variable)
RANDOM	5.1-alpha	Assignment using arithmetic expressions (is nominally an integer variable)
LINENO	5.1-alpha	Not an integer variable

Quoting, expansions, substitutions and related

For this topic, see also

- Parameter expansion.

Feature or change description	Appeared in Bash version	Remarks
Support for integer-indexed arrays	2.0	relevant builtins also got array support
<code>\${PARAMETER//PATTERN/REPLACEMENT}</code>	2.0	
<code>\${PARAMETER:OFFSET:LENGTH}</code>	2.0	
<code>\${!PARAMETER}</code> (indirection)	2.0	
<code>"..."</code> (localized strings)	2.0	
<code>'...'</code> (ANSI-C-like strings)	2.0	
<code>\xNNN</code> in <code>'...'</code> (and <code>echo -e</code>)	2.02-alpha1	
<code>\$(< FILENAME)</code> (file content)	2.02-alpha1	
globbing (<code>fnmatch()</code>) capable of POSIX® character classes etc.	2.02-alpha1	
extended globbing	2.02-alpha1	KSH88
globbing inside array mass-assignment: <code>ARRAY=(*.txt)</code>	2.03-alpha	
<code>'...\''</code> escaped single quote inside ANSI-C-like strings	2.04-devel	KSH93
<code>\${!PREFIX*}</code> (parameter name expansion)	2.04	KSH93
<code>'...'</code> expands <code>\cx</code> (Control-x)	2.05b	
<code>[:class:]</code> syntax for pattern matching	2.05b	KSH93
<code>\${!ARRAY[@]}</code> (array index expansion)	3.0-alpha	KSH93
<code>{x..y}</code> (range brace expansion)	3.0-alpha	
<code>'...'</code> expands <code>\xNNN</code> (Hexdigits)	3.0	
<code>+=</code> operator for arrays and strings	3.1-alpha1	
<code>\${PARAMETER//PATTERN/REPLACEMENT}</code> behaviour changed	3.2-alpha	anchoring for global substitution is no longer allowed, changes the way old syntax may work
<code>\${@:0:x}</code> includes <code>\$0</code>	4.0-alpha	
Support for associative arrays	4.0-alpha	relevant builtins also got associative array support

Feature or change description	Appeared in Bash version	Remarks
case modification operators for expansions	4.0-alpha	
<code>{0x...0y}</code> (zeropadding brace expansion)	4.0-alpha	
numerically indexed arrays can be accessed (on expansion time) from the end using negative indexes	4.1-alpha	
<code>\unnnn</code> and <code>\unnnnnnnnn</code> in <code>\$'...'</code>	4.2-alpha	for: <code>printf</code> , <code>echo -e</code> , <code>\$'...'</code>
<code>\${PARAMETER:OFFSET:LENGTH}</code> : Negative <code>LENGTH</code> values are used as offset from the end of the string	4.2-alpha	Substrings only for Bash and ksh93. Works also for argument expansions in zsh. ksh93 can use <code>\${arr[n...-m]}</code> .
Word expansions like <code>\${foo##bar}</code> understand indirect variable references	4.3-beta	
Transformations	4.4	
Process substitution now works in POSIX mode	5.1-alpha	
New transformations: <code>U</code> , <code>u</code> , <code>L</code>	5.1-alpha	Case-transformation
New transformation: <code>K</code>	5.1-alpha	Display associative arrays as key/value pairs

Arithmetic

For this topic, see also

- Arithmetic expressions
- Arithmetic expansion

Feature or change description	Appeared in Bash version	Remarks
<code>((...))</code>	2.0-beta2	KSH93
ternary operator	2.0	
base 64 integer constants	2.0	the max. base before is unknown. Anybody?
deprecated <code>\$[...]</code> in favor of <code>\$((...))</code>	2.0	
exponentiaition operator <code>(**)</code>	2.02-alpha1	

Feature or change description	Appeared in Bash version	Remarks
comma operator <code>EXPR, EXPR</code>	2.04-devel	
pre- and postfix operators	2.04-devel	

Redirection and related

For this topic, see also

- [Redirection](#)

Feature or change description	Appeared in Bash version	Remarks
socket redirection (<code>/dev/tcp/</code> , <code>/dev/udp/</code>)	2.04-devel	
<code>OS()</code> /filesystem-independent support for <code>/dev/std(in out err)</code> and <code>/dev/fd/*</code>	2.04	
socket redirection accepts service names	2.05	
<code>[n]<&word-</code> and <code>[n]>&word-</code> FD-duplicate/closing	2.05b-alpha1	KSH93
Here strings: <code><<< WORD</code>	2.05b-alpha1	
<code> &</code> (synonym for <code>2>&1 </code>)	4.0-alpha	
<code>&>></code> (equiv. to <code>>>FILE 2>&1</code>)	4.0-alpha	
<code>{varname}</code> style automatic file descriptor allocation	4.1-alpha	ksh93
<code>{varname[idx]}</code> fd allocation accepts array subscripts and special-meaning variables	4.3-alpha	ksh93

Misc

Feature or change description	Appeared in Bash version	See also/remarks
DEBUG trap	2.0	
ERR trap	2.05a	KSH93
Support for multibyte characters: Unicode / UTF8	2.05b	
RETURN trap	3.0	ksh93 EXIT trap evaluates in caller scope (for function name <code>{ }</code>). Bash RETURN in same scope.

Feature or change description	Appeared in Bash version	See also/remarks
<code>command_not_found_handle</code> handler function	4.0-alpha	
official introduction of switchable "compatibility levels"	4.0-alpha	<code>compat31</code> was introduced in a 3.2 version, mainly because of the incompatibilities that were introduced by the changed <code>=~</code> operator
<code>[[...]]</code> and <code>((...))</code> conditional commands are subject to the <code>ERR</code> trap and <code>set -e</code> feature	4.1-alpha	
<code>ACL()</code> support for file status checks	4.1-alpha	
Assignment to negative array indices	4.3-alpha	ksh93, zsh
<code>declare / typeset -n</code>	4.3-alpha	Support for nameref variable type, a variable referencing another one by name
shells started to run process substitutions now run any trap set on <code>EXIT</code>	4.3-beta	
process substitution does not inherit the <code>v</code> flag	5.0-alpha	
<code>ERR</code> trap	5.0-alpha	Reports more reliable line numbers
Variable assignment	5.0-beta	Assignments preceeding a special builtin that changes variable attributes are not propagated back unless compatibility mode is 44 or lower

Discussion