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Rocky Enterprise Linux 9.2 Manual Pages on command 'adjtimex.2'

\$ man adjtimex.2

ADJTIMEX(2) Linux Programmer's Manual ADJTIMEX(2)

NAME

adjtimex, clock_adjtime, ntp_adjtime - tune kernel clock

SYNOPSIS

```
#include <sys/timex.h>

int adjtimex(struct timex *buf);

int clock_adjtime(clockid_t clk_id, struct timex *buf);

int ntp_adjtime(struct timex *buf);
```

DESCRIPTION

Linux uses David L. Mills' clock adjustment algorithm (see RFC 5905). The system call `adjtimex()` reads and optionally sets adjustment parameters for this algorithm. It takes a pointer to a `timex` structure, updates kernel parameters from (selected) field values, and returns the same structure updated with the current kernel values. This structure is declared as follows:

```
struct timex {
    int modes;     /* Mode selector */
    long offset;   /* Time offset; nanoseconds, if STA_NANO
                  status flag is set, otherwise
                  microseconds */
    long freq;     /* Frequency offset; see NOTES for units */
    long maxerror; /* Maximum error (microseconds) */
    long esterror; /* Estimated error (microseconds) */
    int status;    /* Clock command/status */
```

```

long constant; /* PLL (phase-locked loop) time constant */
long precision; /* Clock precision
                (microseconds, read-only) */
long tolerance; /* Clock frequency tolerance (read-only);
                see NOTES for units */
struct timeval time;
    /* Current time (read-only, except for
       ADJ_SETOFFSET); upon return, time.tv_usec
       contains nanoseconds, if STA_NANO status
       flag is set, otherwise microseconds */
long tick; /* Microseconds between clock ticks */
long ppsfreq; /* PPS (pulse per second) frequency
              (read-only); see NOTES for units */
long jitter; /* PPS jitter (read-only); nanoseconds, if
             STA_NANO status flag is set, otherwise
             microseconds */
int shift; /* PPS interval duration
           (seconds, read-only) */
long stabil; /* PPS stability (read-only);
            see NOTES for units */
long jitcnt; /* PPS count of jitter limit exceeded
            events (read-only) */
long calcnt; /* PPS count of calibration intervals
            (read-only) */
long errcnt; /* PPS count of calibration errors
            (read-only) */
long stbcnt; /* PPS count of stability limit exceeded
            events (read-only) */
int tai; /* TAI offset, as set by previous ADJ_TAI
         operation (seconds, read-only,
         since Linux 2.6.26) */
/* Further padding bytes to allow for future expansion */

```

```
};
```

The `modes` field determines which parameters, if any, to set. (As described later in this page, the constants used for `ntp_adjtime()` are equivalent but differently named.) It is a bit mask containing a bitwise-or combination of zero or more of the following bits:

ADJ_OFFSET

Set time offset from `buf.offset`. Since Linux 2.6.26, the supplied value is clamped to the range (-0.5s, +0.5s). In older kernels, an `EINVAL` error occurs if the supplied value is out of range.

ADJ_FREQUENCY

Set frequency offset from `buf.freq`. Since Linux 2.6.26, the supplied value is clamped to the range (-32768000, +32768000). In older kernels, an `EINVAL` error occurs if the supplied value is out of range.

ADJ_MAXERROR

Set maximum time error from `buf.maxerror`.

ADJ_ESTERROR

Set estimated time error from `buf.esterror`.

ADJ_STATUS

Set clock status bits from `buf.status`. A description of these bits is provided below.

ADJ_TIMECONST

Set PLL time constant from `buf.constant`. If the `STA_NANO` status flag (see below) is clear, the kernel adds 4 to this value.

ADJ_SETOFFSET (since Linux 2.6.39)

Add `buf.time` to the current time. If `buf.status` includes the `ADJ_NANO` flag, then `buf.time.tv_usec` is interpreted as a nanosecond value; otherwise it is interpreted as microseconds.

The value of `buf.time` is the sum of its two fields, but the field `buf.time.tv_usec` must always be nonnegative. The following example shows how to normalize a timeval with nanosecond resolution.

```
while (buf.time.tv_usec < 0) {
    buf.time.tv_sec -= 1;
    buf.time.tv_usec += 1000000000;
}
```

ADJ_MICRO (since Linux 2.6.26)

Select microsecond resolution.

ADJ_NANO (since Linux 2.6.26)

Select nanosecond resolution. Only one of ADJ_MICRO and ADJ_NANO should be specified.

ADJ_TAI (since Linux 2.6.26)

Set TAI (Atomic International Time) offset from `buf.constant`.

ADJ_TAI should not be used in conjunction with ADJ_TIMECONST, since the latter mode also employs the `buf.constant` field.

For a complete explanation of TAI and the difference between TAI and UTC, see BIPM <http://www.bipm.org/en/bipm/tai/tai.html>?

ADJ_TICK

Set tick value from `buf.tick`.

Alternatively, modes can be specified as either of the following (multibit mask) values, in which case other bits should not be specified in modes:

ADJ_OFFSET_SINGLESHOT

Old-fashioned `adjtime(3)`: (gradually) adjust time by value specified in `buf.offset`, which specifies an adjustment in microseconds.

ADJ_OFFSET_SS_READ (functional since Linux 2.6.28)

Return (in `buf.offset`) the remaining amount of time to be adjusted after an earlier ADJ_OFFSET_SINGLESHOT operation. This feature was added in Linux 2.6.24, but did not work correctly until Linux 2.6.28.

Ordinary users are restricted to a value of either 0 or ADJ_OFFSET_SS_READ for modes.

Only the superuser may set any parameters.

The `buf.status` field is a bit mask that is used to set and/or retrieve status bits associated with the NTP implementation. Some bits in the mask are both readable and settable, while others are read-only.

STA_PLL (read-write)

Enable phase-locked loop (PLL) updates via ADJ_OFFSET.

STA_PPSFREQ (read-write)

Enable PPS (pulse-per-second) frequency discipline.

STA_PPSTIME (read-write)

Enable PPS time discipline.

STA_FLL (read-write)

Select frequency-locked loop (FLL) mode.

STA_INS (read-write)

Insert a leap second after the last second of the UTC day, thus extending the last minute of the day by one second. Leap-second insertion will occur each day, so long as this flag remains set.

STA_DEL (read-write)

Delete a leap second at the last second of the UTC day. Leap second deletion will occur each day, so long as this flag remains set.

STA_UNSYNC (read-write)

Clock unsynchronized.

STA_FREQHOLD (read-write)

Hold frequency. Normally adjustments made via ADJ_OFFSET result in dampened frequency adjustments also being made. So a single call corrects the current offset, but as offsets in the same direction are made repeatedly, the small frequency adjustments will accumulate to fix the long-term skew.

This flag prevents the small frequency adjustment from being made when correcting for an ADJ_OFFSET value.

STA_PPSSIGNAL (read-only)

A valid PPS (pulse-per-second) signal is present.

STA_PPSJITTER (read-only)

PPS signal jitter exceeded.

STA_PPSWANDER (read-only)

PPS signal wander exceeded.

STA_PPSERROR (read-only)

PPS signal calibration error.

STA_CLOCKERR (read-only)

Clock hardware fault.

STA_NANO (read-only; since Linux 2.6.26)

Resolution (0 = microsecond, 1 = nanoseconds). Set via ADJ_NANO, cleared via ADJ_MICRO.

STA_MODE (since Linux 2.6.26)

Mode (0 = Phase Locked Loop, 1 = Frequency Locked Loop).

STA_CLK (read-only; since Linux 2.6.26)

Clock source (0 = A, 1 = B); currently unused.

Attempts to set read-only status bits are silently ignored.

clock_adjtime ()

The `clock_adjtime()` system call (added in Linux 2.6.39) behaves like `adjtimex()` but takes an additional `clk_id` argument to specify the particular clock on which to act.

ntp_adjtime ()

The `ntp_adjtime()` library function (described in the NTP "Kernel Application Program API", KAPI) is a more portable interface for performing the same task as `adjtimex()`. Other than the following points, it is identical to `adjtimex()`:

- * The constants used in modes are prefixed with "MOD_" rather than "ADJ_", and have the same suffixes (thus, `MOD_OFFSET`, `MOD_FREQUENCY`, and so on), other than the exceptions noted in the following points.
- * `MOD_CLKA` is the synonym for `ADJ_OFFSET_SINGLESHOT`.
- * `MOD_CLKB` is the synonym for `ADJ_TICK`.
- * There is no synonym for `ADJ_OFFSET_SS_READ`, which is not described in the KAPI.

RETURN VALUE

On success, `adjtimex()` and `ntp_adjtime()` return the clock state; that is, one of the following values:

`TIME_OK` Clock synchronized, no leap second adjustment pending.

`TIME_INS` Indicates that a leap second will be added at the end of the UTC day.

`TIME_DEL` Indicates that a leap second will be deleted at the end of the UTC day.

`TIME_OOP` Insertion of a leap second is in progress.

`TIME_WAIT` A leap-second insertion or deletion has been completed. This value will be returned until the next `ADJ_STATUS` operation clears the `STA_INS` and `STA_DEL` flags.

`TIME_ERROR` The system clock is not synchronized to a reliable server. This value is returned when any of the following holds true:

- * Either `STA_UNSYNC` or `STA_CLOCKERR` is set.
- * `STA_PPSSIGNAL` is clear and either `STA_PPSFREQ` or `STA_PPSTIME` is set.
- * `STA_PPSTIME` and `STA_PPSJITTER` are both set.
- * `STA_PPSFREQ` is set and either `STA_PPSWANDER` or `STA_PPSJITTER` is set.

The symbolic name `TIME_BAD` is a synonym for `TIME_ERROR`, provided for backward compatibility.

Note that starting with Linux 3.4, the call operates asynchronously and the return value usually will not reflect a state change caused by the call itself.

On failure, these calls return -1 and set errno.

ERRORS

EFAULT buf does not point to writable memory.

EINVAL (kernels before Linux 2.6.26)

An attempt was made to set buf.freq to a value outside the range (-33554432, +33554432).

EINVAL (kernels before Linux 2.6.26)

An attempt was made to set buf.offset to a value outside the permitted range. In kernels before Linux 2.0, the permitted range was (-131072, +131072). From Linux 2.0 onwards, the permitted range was (-512000, +512000).

EINVAL An attempt was made to set buf.status to a value other than those listed above.

EINVAL The clk_id given to clock_adjtime() is invalid for one of two reasons. Either the System-V style hard-coded positive clock ID value is out of range, or the dynamic clk_id does not refer to a valid instance of a clock object. See clock_gettime(2) for a discussion of dynamic clocks.

EINVAL An attempt was made to set buf.tick to a value outside the range 900000/HZ to 1100000/HZ, where HZ is the system timer interrupt frequency.

ENODEV The hot-pluggable device (like USB for example) represented by a dynamic clk_id has disappeared after its character device was opened. See clock_gettime(2) for a discussion of dynamic clocks.

EOPNOTSUPP

The given clk_id does not support adjustment.

EPERM buf.modes is neither 0 nor ADJ_OFFSET_SS_READ, and the caller does not have sufficient privilege. Under Linux, the CAP_SYS_TIME capability is required.

ATTRIBUTES

For an explanation of the terms used in this section, see attributes(7).

????????????????????????????????????????????????????????????

?Interface ? Attribute ? Value ?

????????????????????????????????????????????????????????????

?ntp_adjtime() ? Thread safety ? MT-Safe ?

????????????????????????????????????????????????????????????

CONFORMING TO

None of these interfaces is described in POSIX.1

`adjtimex()` and `clock_adjtime()` are Linux-specific and should not be used in programs intended to be portable.

The preferred API for the NTP daemon is `ntp_adjtime()`.

NOTES

In `struct timex`, `freq`, `ppsfreq`, and `stabil` are ppm (parts per million) with a 16-bit fractional part, which means that a value of 1 in one of those fields actually means 2^{-16} ppm, and $2^{16}=65536$ is 1 ppm. This is the case for both input values (in the case of `freq`) and output values.

The leap-second processing triggered by `STA_INS` and `STA_DEL` is done by the kernel in timer context. Thus, it will take one tick into the second for the leap second to be inserted or deleted.

SEE ALSO

`clock_gettime(2)`, `clock_settime(2)`, `settimeofday(2)`, `adjtime(3)`, `ntp_gettime(3)`, `capabilities(7)`, `time(7)`, `adjtimex(8)`, `hwclock(8)`

NTP "Kernel Application Program Interface" ?<http://www.slac.stanford.edu/comp/unix/package/rtems/src/ssrIApps/ntpNanoclock/api.htm>?

COLOPHON

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