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### ***Rocky Enterprise Linux 9.2 Manual Pages on command 'ntp\_adjtime.3'***

**\$ man ntp\_adjtime.3**

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\_OFF?

SET\_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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