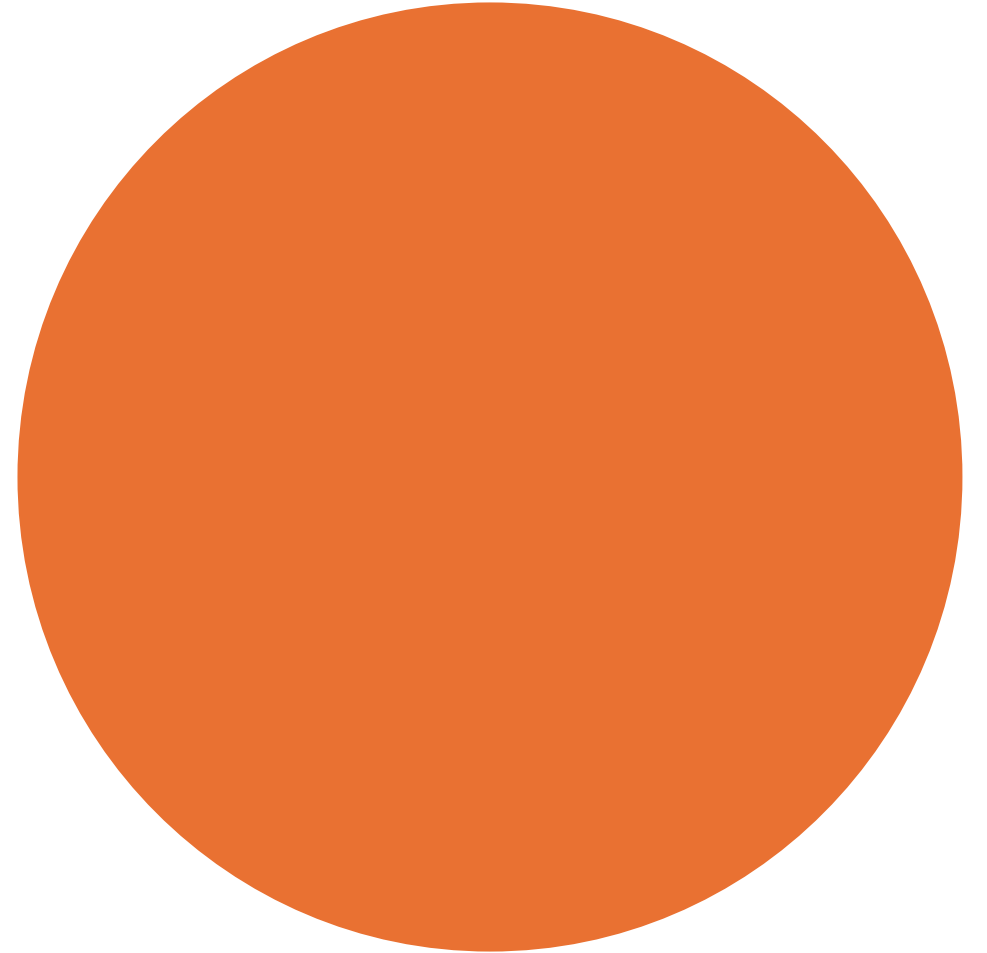


Ch10: Time



Kinds of Time in Linux

1. Real Time

1. **Calendar Time:** time measured from some standard point (timestamp files or databases).
2. **Elapsed Time (Wall Clock Time):** time measured from some fixed point in the life of a process (periodic events).

2. Process Time: This is the amount of CPU time used by a process (performance monitoring).



Epoch Time (Unix Time)

The number of seconds which have passed since **00:00:00 UTC on Thursday, 1 January 1970**, which is referred to as the Unix epoch. Unix time is typically encoded as a signed integer.

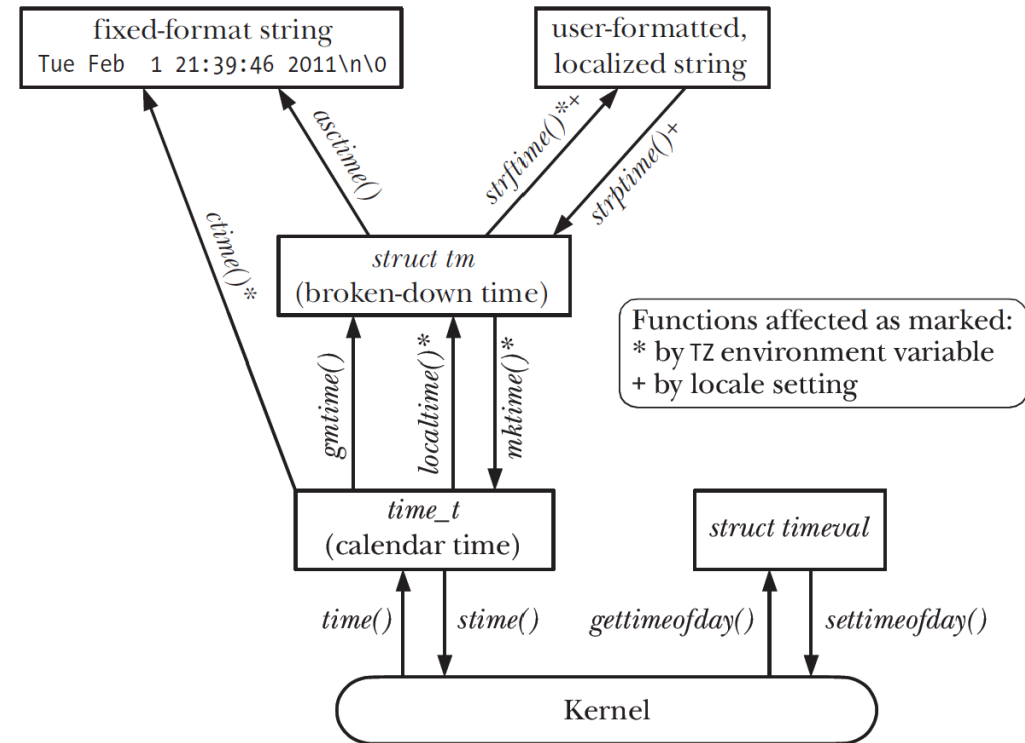
On 32-bit machine, the time can range from **13 December 1901 20:45:52 to 19 January 2038 03:14:07 (YEAR 2038 problem - Y2K38 superbug).**



Unix time passed 1 000 000 000 seconds on 2001-09-09T01:46:40Z.^[1] It was celebrated in Copenhagen, Denmark at a party held by the [Danish UNIX User Group](#) at 03:46:40 local time.

Time Functions

- **Reading time from kernel**
 - `gettimeofday()`
 - `time()`
- **Time-conversion functions**
 - **Printable format - `ctime()`**
automatically accounts for local timezone and DST settings when performing the conversion.
 - **Broken-Down Time – `gmtime()`, `localtime()`**



Time zones

- **How are different time zones and DST regimes handled in Linux?**
 - LibC handles everything
 - `/etc/share/zoneinfo` - time zone info.
 - `/etc/localtime` - local time for the system.
 - `man 5 tzfile` - format of timezone files.
 - `man zic` - zone information compiler.
 - `man zdump`
 - `TZ env var` - influences the functions `ctime()`, `localtime()`, `mktime()`, and `strftime()`.



Locales

- **What is locale?**
 - World contains Several thousand languages, different conventions for displaying information (such as numbers, currency, amounts, dates, and times).
 - “subset of a user’s environment that depends on language and cultural conventions.”
 - A **locale** is a set of parameters that defines the user's language, region and any special variant preferences that the user wants to see in their user interface.
- **Internationalization (i18n) and localization**
 - Write a program once, run it everywhere, it should do the right thing.
- **Locale categories (see `man setlocale` or `man 5 locale`)**



Setting Locales

- **man setlocale**
- **Environment Variables**
 - `LANG=de_DE ./show_time`
 - `LANG=de_DE LC_TIME=it_IT ./show_time`
 - `LC_ALL=fr_FR LC_TIME=en_US ./show_time`
- **Locale information are maintained in files in standard formats**
 - `/usr/share/locale`
 - **Hierarchy:** `language[_territory[.codeset]][@modifier]`
 - `locale/locale -av`

Updating the system clock

- `settimeofday()`
- `stime()`
 - Rarely used by application programs (*Network Time Protocol daemon is doing the job*).
 - Deleterious effects on applications (e.g., `make`).
- `adjtime()`
 - Causes the system clock to gradually adjust to the desired value.

Jiffies

- A jiffy was originally the time between two ticks of the system timer interrupt.
- **It is not an absolute time interval unit**, since its duration depends on the clock interrupt frequency of the hardware platform.
- Kernel configuration: `CONFIG_HZ`
 - The size of a jiffy is defined by the constant HZ.
- Read Jiffies from user space:
 - `sudo grep -E "^cpu|^jiff" /proc/timer_list;`

Process Time

- The amount of CPU time used by a process since it was created.
- It consists of two components:
 - User CPU time is the amount of time spent executing in user mode.
 - System CPU time is amount of time spent executing in kernel mode on behalf of the program (system calls, page faults, ..).
- Retrieving process time info
 - `times()` – time of the process and its children. Divide the return value by `sysconf(_SC_CLK_TCK)`.
 - `clock()` – returns the total CPU time used by the process in `CLOCKS_PER_SEC` unit.

