Time Conversion and Time Formats

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Navigation and Ancillary Information Facility

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Time Systems and Kernels

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- Three time systems are commonly used in SPICE for inputs and outputs:
  - Coordinated Universal Time (UTC)
  - Spacecraft Clock (SCLK)
  - Ephemeris Time (ET, also referred to as Barycentric Dynamical Time, TDB)
- Two time systems are commonly used in SPICE for kernel data look-ups or for computations
  - Ephemeris Time (ET, TDB)
    - » Used in SPK, frames, PCK
    - » Used in high-level geometry interfaces
  - Ticks (encoded spacecraft clock)
    - » Used in the intermediate level CK interfaces
- The SPICE Leapseconds Kernel and Spacecraft Clock Kernel capture the near-term relationships between
  - UTC and ET (Leapseconds Kernel)
  - UTC or ET and SCLK (SCLK Kernel)
    - » The long-term relationships between these systems cannot be accurately predicted

Converting Time Strings

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- UTC, TDB, or TDT (TT) strings to Ephemeris Time
  - STR2ET (*string*, ET)
    - » Converts any string in a format recognized by SPICE
    - » Requires Leapseconds Kernel (LSK)
- Spacecraft Clock to Ephemeris Time
  - SCS2E (*scid*, *string*, ET)
    - » Requires Spacecraft Clock Kernel (SCLK)
    - » Normally requires Leapseconds Kernel (LSK) as well
      - To handle a very small (~2 msec.) difference between TDB and TT
- Spacecraft Clock to “Ticks” (used in the mid-level interfaces of the C-kernel system)
  - SCENCD (*scid*, *string*, TICKS)
    - » Requires Spacecraft Clock Kernel (SCLK)

Converting Numeric Times - 1

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- **Ephemeris Time to Time Strings**
  - TIMOUT (*et*, *fmtpic*, STRING)
    - » The input *fmtpic* is a specification giving the user great flexibility in setting the appearance of the output time string, and the time system used (UTC, TDB, TDT).
      - YYYY Mon DD, HR:MN:SC.### ::UTC
        - 1999 Jan 12, 23:28:28.289
      - YYYY Mon DD, AP:MN:SC.### ampm ::UTC-8 (PST)
      - 1999 Jan 12, 03:28:28.289 p.m. (PST)
      - See the header for the TIMOUT module
      - The module TPICTR may be useful in constructing a format picture specification from a sample string
    - » Requires Leapseconds Kernel
  - ET2UTC (*et*, *format*, *prec*, UTCSTR)
    - » The *format* input specifies calendar, DOY, or Julian Date format for UTCSTR
    - » Requires Leapseconds Kernel
  - ETCAL (*et*, STRING)
    - » STRING, fixed format ephemeris calendar time string
    - » No Leapseconds Kernel is required.

Converting Numeric Times - 2

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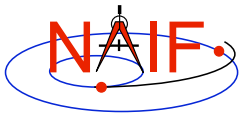
- **Example Time Stings and the Corresponding Format Picture**

• Times	• Format picture used (*fmtpic*)
`1999-283T12:28:29 (UTC)`	`YYYY-DOYTHR:MN:SC (UTC)`
`1999-283T12:29:33 (TDB)`	`YYYY-DOYTHR:MN:SC (TDB) ::TDB`
`Wed Nov 03, 19:29:05 1999`	`Wkd Mon DD, HR:MN:SC YYYY`
`465 B.C. Jan 12 03:15:23 p.m.`	`YYYY ERA Mon DD AP:MN:SC ampm`
`1987-11-03T04:29:58`	`YYYY-MM-DDTHR:MN:SC`
`04:28:55 A.M. June 12, 1982`	`AP:MN:SC AMPM Month DD, YYYY`
`Thursday November 04, 1999`	`Weekday Month DD, YYYY`
`DEC 31, 15:59:60.12 1998 (PST)`	`MON DD, HR:MN:SC YYYY (PST)::UTC-8`



Converting Numeric Times - 3

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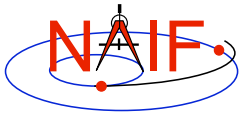
- **Ephemeris Time to Spacecraft Clock Strings**
  - SCE2S (*scid*, *et*, SCLKCH)
    - » Requires both LSK and SCLK
- **Ticks to Spacecraft Clock Strings**
  - SCDECD (*scid*, *sclkdp*, SCLKCH)
    - » Requires SCLK
    - » SCLK string examples:

```
1/1487147147.203   (Cassini, MGS)
1/05812:00:001     (Voyager 1 and 2)
```

- **Ephemeris Time to Local Solar Time Strings**
  - ET2LST(*et*, *body*, *long*, *type*, HR, MN, SC, TIME, AMPM)
    - » Requires SPK, PCK



Customizing the Time System

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- **Defaults**
  - Two digit year (a bad idea but supported):1969-2068
  - Time System: UTC
  - Calendar: Gregorian
- **Adjustments**
  - The one hundred year interval to which two digit years belong may be set. For example 1980-2079
  - Time Systems: UTC, TDB, TT (Terrestrial Time)
  - Calendar: Gregorian, Julian, or Mixed.
- **See TIMDEF or *Time Required Reading* (time.req) for details**

Layout of the Time System

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