SMPTE TIME CODE TUTORIAL
&
ADDITIONAL DATA ENCODED BY C&A

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TIME

The world's major time keeping organizations, including the National institute of Standards and Technology (NlST, formerly known as the National Bureau of Standards or NBS) and the Naval Observatory (USNO) in the US help keep the time-of-day, or Universal Coordinated Time (UTC), consistent throughout the world.

Although the frequency of these atomic clocks is very precise, our normal measures of time are not perfectly synchronous with the Earth's rotation and revolution around the sun. This is why we require leap years in our calendar. Thus, the actual time-of-day requires periodic adjusting in order to remain synchronous, often done by addling a "leap second" every six or 12 months. Without such corrections, the time-of-day and seasons would slowly drift and, eventually, the sun would be setting at 3:00 in the afternoon and Christmas would seemingly end up in August.

Atomic clocks can independently and locally maintain precise frequency and, therefore, absolute time, but they can only obtain precise time-of-day (UTC) from one of the many standards organizations throughout the world.

In North America there are radio and telephone systems in place which can provide accurate time-of-day to within one millisecond (1/1000th second). Satellite and radio navigation systems can even provide microsecond (1/1000000th second) or better accuracy. Since these systems can access precise time-of-day, they are said to be **traceable** to UTC via the atomic clocks at institutions such as NlST, USNO, and NRC.

SMPTE TIME CODE

To simplify audio and video tape editing, the Society of Motion Picture and Television Engineers (SMPTE) developed a time "code" standard. This time code is basically a digital data encoding method devised originally for use on audio and video tape. 'Time Code" will refer to this SMPTE standard in this application note.

Time Code's digital encoding simply applies an "address" to each video frame. This address is also associated with time since it runs from 0 to 29 frames per second, 0 to 59 seconds per minute, 0 to 59 minutes per hour, and 0 to 23 hours per day. Therefore there are 30 x 60 X 60 x 24 or 2,592,000 unique addresses in every 24-hour day.

The SMPTE standard refers to both a longitudinal track format and a video vertical interval format. The longitudinal Time Code (LTC) is typically used in both video and audio applications, and may be recorded as a standard audio level signal. Transmission is via a two-wire twisted pair. The vertical interval Time Code (VlTC) places the data on video lines during the vertical interval. Its transmission, via 75 ohm coaxial cable, is co-incident with the associated video signal. The data is the same for both formats the transmission medium is the only major difference between the two. All further discussion will refer to the longitudinal format.

USER BITS

A further feature of the SMPTE Time Code specification is the presence of a number of empty bits, referred to as user bits. There are a total of 32 user bits grouped as 8 sections of 4 bits each. These spare data bits may be used to contain a secondary time value or some additional information, such as the date or a time offset. There is no specification for the information which may be placed in these user bits.

DETAILED DISCUSSION

Following is a link to an excellent detailed discussion of the SMPTE time codes.

http://www.philrees.co.uk/articles/timecode.htm

YEAR 2000 COMPLIANCE INFORMATION.

The BCD year encoded by the GPS-200 will recycle to 00 on January 1, 2000 at 00:00:00. Systems decoding date from the GPS-200 SMPTE signal should be prepared to accommodate this event and correctly identify the year 2000.

ADDITIONAL OPERATIONAL INFORMATION ENCODED BY THE GPS-200

Freewheeling flag: Bit 4; 1=Freewheeling, 0=Normal operation

Simulation flag: Bit 5; 1=Time simulation active, 0=Normal operation

Daylight time flag: Bit 7; 1=Daylight savings time applied to generate time, 0=No daylight time

Critical time flag: Bit 36; 1=Valid for critical timing applications, 0=Not valid for critical timing

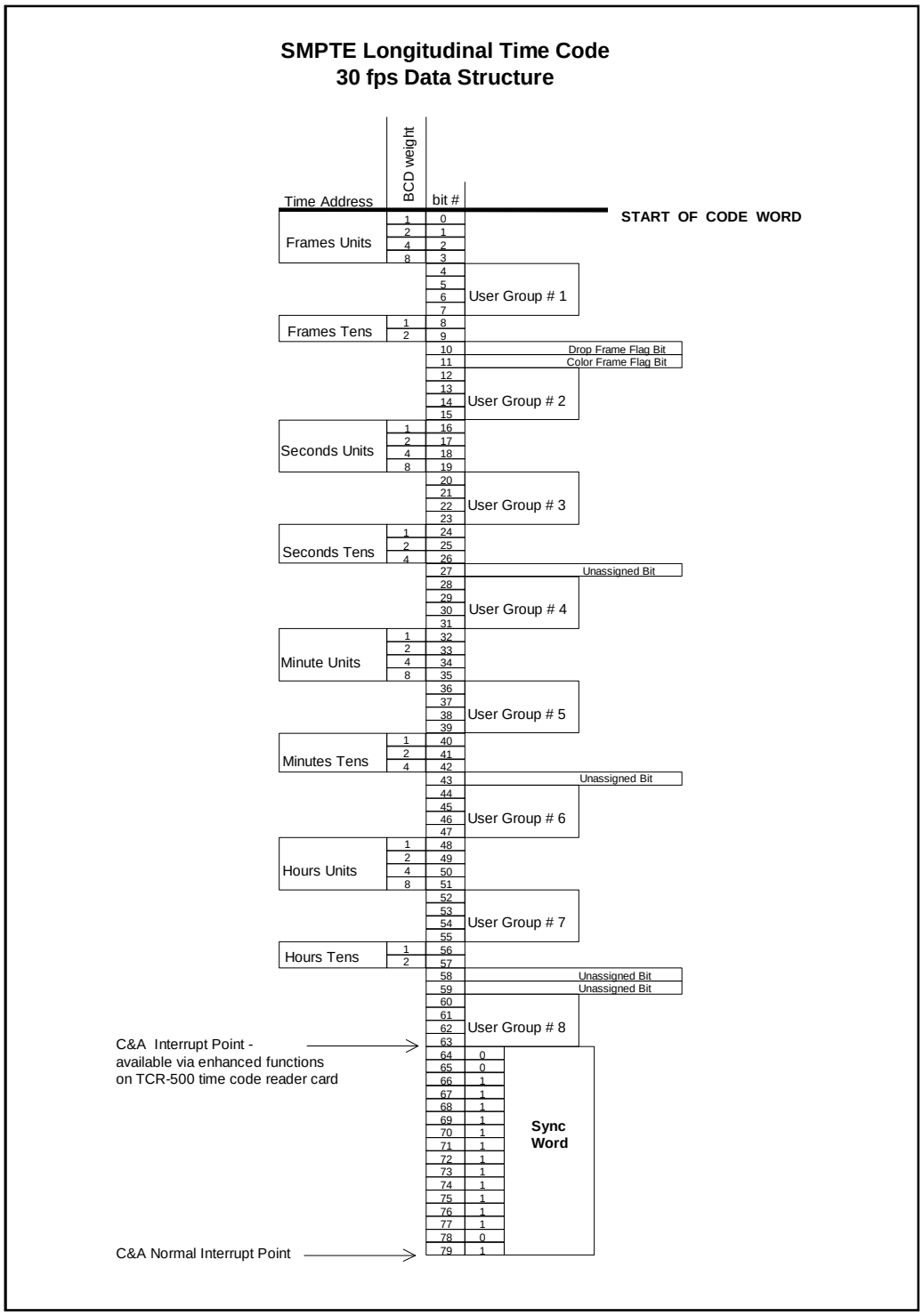
Convergence flag: Bit 37; 1=Time convergence in progress, 0=Normal operation

Last reset flag: Bit 38; 1=Unit power-on, 0=Other

Free-running flag: Bit 39; 1=Free-running operation, 0=Normal operation (using GPS)

SMPTE_FRAME/WORD_DIAGRAM

The figure below shows the location of each bit in one SMPTE - LTC - 30 fps frame or word.



DATA ENCODED WITHIN THE SMPTE LINEAR TIME CODE

TIME ENCODING AS DEFINED BY SMPTE AND IMPLEMENTED BY THE GPS-200

Units Frames: Bits 0-3; bit BCD arranged 1, 2, 4, 8. Count 0 - 9.

Tens Frames: Bits 8-9; bit BCD arranged 1, 2. Count 0 - 2.

Units Seconds: Bits 16-19; 4 bit BCD arranged 1, 2, 4, 8. Count 0 - 9.

Tens Seconds: Bits 24-26; 3 bit BCD arranged 1, 2, 4. Count 0-5.

Units Minutes: Bits 32-35; 4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

Tens Minutes: Bits 40-42; 3 bit BCD arranged 1, 2, 4. Count 0-5.

Units Hours: Bits 48-51, 4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

Tens Hours: Bits 56-57, 2 bit BCD arranged 1, 2. Count 0-2.

The time address contains six reserved bits. Two of the bits, namely bit 10 and bit 11, are used for identification of the Drop Frame Flag and the Color Frame Flag. The remaining four bits, namely bits 27, 43, 58, and 59, are currently unassigned. Since the time code output of the GPS-200 contains time-of-day information only, these six bits are set to zero.

DATE ENCODING AS DEFINED BY LEITCH AND IMPLEMENTED BY THE GPS-200

Units Days: Bits 12-16; 4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

Tens Days: Bits 28-29; 2 bit BCD arranged 1, 2. Count 0-3.

Units Months: Bits 20-23; 4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

Tens Months: Bit 30; 1 bit BCD. Count 0-1.

Units Years: Bits 44-47; 4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

Tens Years: Bits 60-63; 4 bit BCD arranged 1, 2, 4, 8. Count 0-9.