Measuring Time

The advent of Daylight Savings Time is always a small shock for me. I eventually recover and settle to it. But this year as I watch the sky lighten at 6:45am I think about it differently.

Our measurement of time is based on two universal (basic to our solar system) facts: (1) the Earth revolves around the Sun in an elliptical orbit and (2) the Earth revolves on its own axis. We call the duration of the Earth's revolution on its axis a *day* and the duration of its revolution around the Sun a *year*. That each year is composed of 365 1/4 days is an observable fact. That a day is divided into 24 hours is a convenience.

Midnight is the moment when one day ends and the next begins. An oddity about our time measurement is that, while we use a decimal or base 10 number system, we don't use the zero. As a result, the first minute of a new day is named 12:01 instead of 0:01.

Our system for numbering the hours has changed over time. Today we have Standard Time and Daylight Savings Time. They differ by the placement of Midnight in the dark hours. "Midnight" suggests a point that is equidistant between sunset and sunrise, a definition held by the ancient Romans, but today it is just a number (12:00AM). DST differs from ST by one hour: Midnight is shifted one hour later, thus causing the sunrise and sunset to happen one hour later. Now, on March 19 under DST, sunrise is at 7:15am and sunset at 7:21pm. So the nighttime point that is equidistant between the two is 1:18am. What we call 12 midnight is not the central point in the night hours—and this is the thought that worried me this morning.

If it were still Standard Time, sunrise would be 6:15am, sunset 6:21pm, and the nighttime point that is equidistant between the two 12:18am. In this analysis it appears that Standard Time more accurately reflects the traditional understanding of midnight. But . . . this is true for Marin County on this date, but a location with a substantially different latitude and longitude will have a different relationship between sunrise, sunset, and the clock.

http://www.esrl.noaa.gov/gmd/grad/solcalc/ is the federal National Oceanic & Atmospheric Administration Solar Calculator. Use the map to pinpoint your location so the latitude and longitude correctly reflect your location. Change the date from the default if desired. Check if DST is in effect. Then the times of sunrise and sunset will be correct for your location.

Location	*Date in 2015*	*Time*	*Sunrise*	*Sunset*	*Night-time Hours*	*Equidistant midnight*
San Rafael, CA	January 4	ST	7:26am	5:05pm	14:21	12:15am
do.	March 19	DST	7:15am	7:21pm	11:53	1:18am
do.	March 20 (vernal equinox)	DST	7:11am	7:24pm	11:47	1:17am
do.	June 21 (summer solstice)	DST	5:48am	8:36pm	9:12	1:12am
do.	September 23 (autumnal equinox)	DST	6:59am	7:06pm	11:53	1:03am
do.	December 22 (winter solstice)	ST	7:23am	4:55pm	13:28	11:39pm

Different locations have different numbers of night-time hours and an equidistant midnight:
Miami, Florida on September 23 has 11:54 night-time hours and midnight at 1:13am.

From this it is apparent that if all times were in ST, the equidistant midnight would always be fairly close to 12:00am. The furthest away from 12:00am I found it for my location is 21 minutes. It is in DST that the equidistant midnight moves an hour or more past 12:00am.

If you wanted the equidistant midnight close to 12:00am year-round, you would want to abandon DST.

How I calculated the traditional midnight:

1. Calculate number of night-time hours (using the 12 hour time convention) = 12:00 less sunset plus sunrise, or (12:00 + sunrise) - sunset. In my first example: (12:00 + 7:15) - 7:21 = 11:54.
2. Divide number of night-time hours in half. Example: 11:54 ÷ 2 = 5:57 .
3. Add half night-time hours to sunset. Example: 7:21 + 5:57 = 12:78 or 1:18am.