

Time Zones

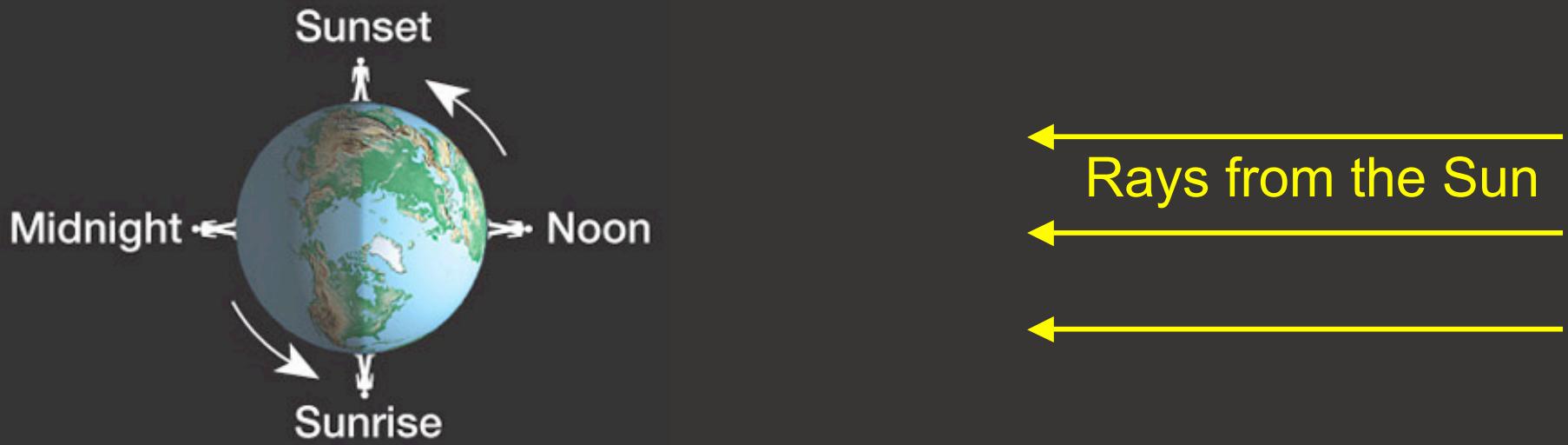
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Learning goals

- Students should be able to
- Explain time zones as a function of longitude
- Calculate time differences between different locations
- Demonstrate corrections for daylight savings time

Why we have time zones

- At the same instant that it's noon for us it's midnight for others



(Looking “down” at the North Pole)

Time zones

- Are based on solar noon - when the subsolar point crosses your meridian
- Local solar time worked until railroads
 - Each town set its own time based on solar noon
- Consistent time zones are required for trains, phones, etc.
- We all set clocks to solar time of a “central meridian”
 - All towns set their clocks to solar noon of nearest central meridian

Time zones

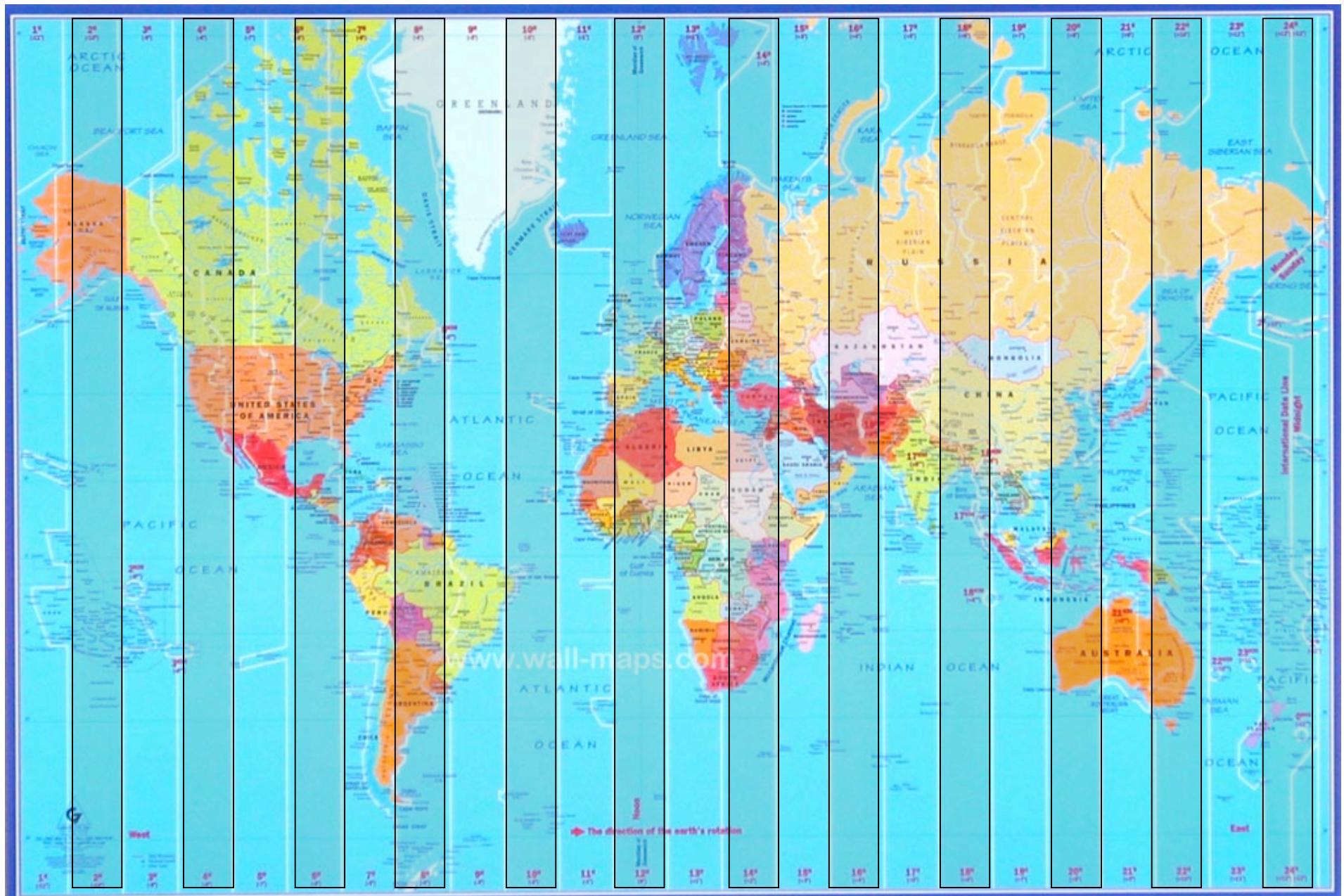
- We generally use 24 time zones, all using the same “minute hand” on the clock and just varying the “hour hand”
- This means there are 24 central meridians around the globe
- Width of a time zone?
 - (360 degrees of longitude around the Earth divided by 24 time zones
 - = 15 degrees of longitude per time zone)

Locations of Time Zones

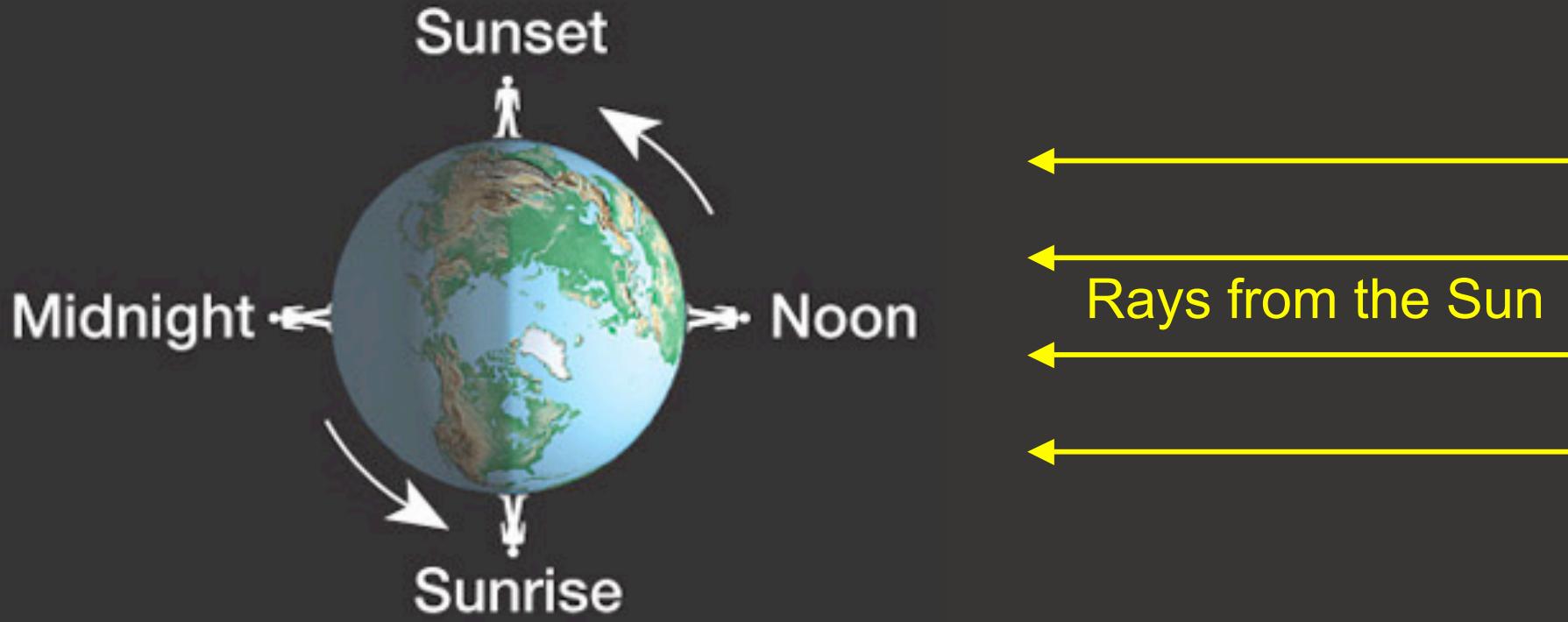
- Standard or “Nautical” time zones are 15 degrees of longitude wide.
- The first central meridian is the Prime Meridian, 0° E/W.
- The next central meridians are at 15° E and 15° W.
 - A town at 6° W pretends to be on the Prime Meridian, and sets its clocks to noon when the sun crosses 0° E/W.
 - A town at 9° W pretends to be at 15° W, and sets its clocks to noon when the sun crosses the time zone’s central meridian of 15° W.

Nautical Time Zones

150°W 120°W 90°W 60°W 30°W 0°E/W 30°E 60°E 90°E 120°E 150°E 180°E/W



Where is it earlier / later?



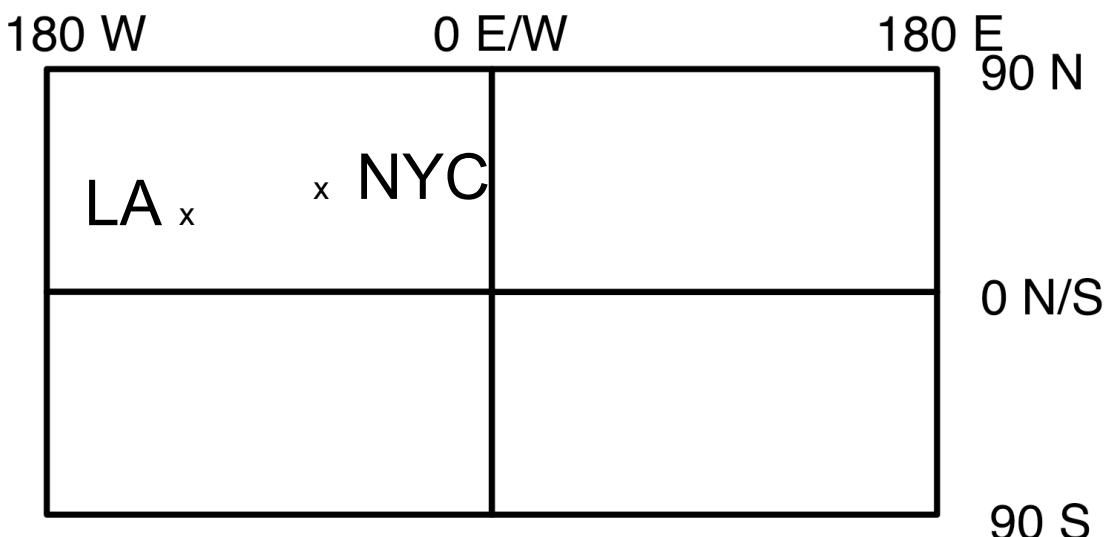
- Comparing two locations, the one to the East will experience noon before the one to the West.
- On the East Coast of the US it is already 3pm when it's noon in LA.

Mechanics

- Time zones progress one hour later each 15° east
- one hour earlier each 15° west
- What happens to the date at midnight?
 - The date changes, right?
 - Same thing happens at the International Date Line
 - When it's 2:00 pm Monday at 175°E , it's 2:00 pm Sunday at 175°W

Sample problems

- When given a city location, you can orient yourself using a basic map like this one.
 - LA is at $34^{\circ}\text{N} \times 118^{\circ}\text{W}$
 - NYC is at $41^{\circ}\text{N} \times 74^{\circ}\text{W}$



Sample problems

- What is the central meridian of LA?
 - LA is at $34^{\circ}\text{N} \times 118^{\circ}\text{W}$
 - Closest number to 118 that is evenly divisible by 15 is 120 - so 120°W
- What is the central meridian of NYC?
 - NYC is at $41^{\circ}\text{N} \times 74^{\circ}\text{W}$
 - Closest number to 74 that is evenly divisible by 15 is 75 - so 75°W

Sample problems

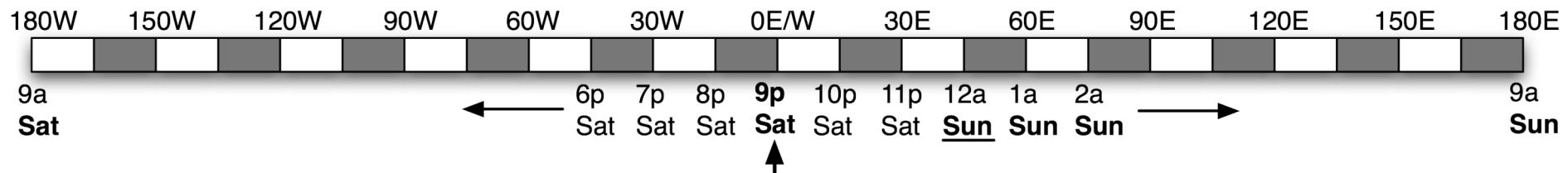
- What time is it in LA when it is noon in Greenwich, England on the Prime Meridian?
 - LA's central meridian is 120°W
 - $120^{\circ}\text{W} / 15^{\circ}$ per time zone = 8 time zones
 - The time is earlier to the west, right?
 - Noon minus eight hours = 4 am in LA

Sample problems

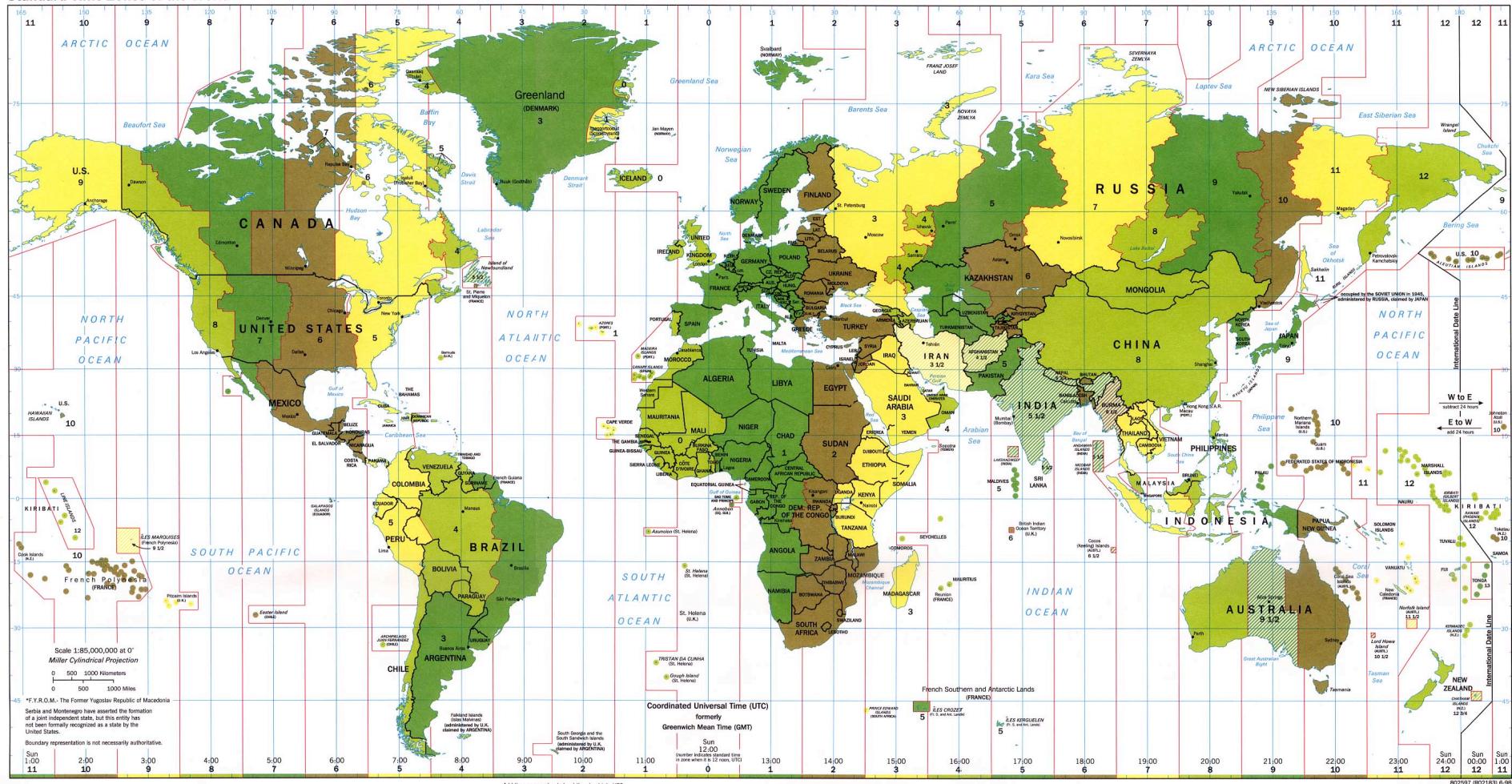
- What time is it in Greenwich, UK when it is noon in New York?
 - NYC's central meridian is 75°W
 - $75^{\circ}\text{W} / 15^{\circ}$ per time zone = 5 time zones
 - The time is later to the east, right?
 - Noon plus five hours = 5 pm in Greenwich, UK

Sample Problems

- Another way to do this is to use a number line marked in 15° increments.
- When it's 9pm Sat in Greenwich, it's 10pm one time zone east, and 8pm one time zone west.
- Note that the time zone centered on 45°E has switched to the next day



Standard Time Zones of the World

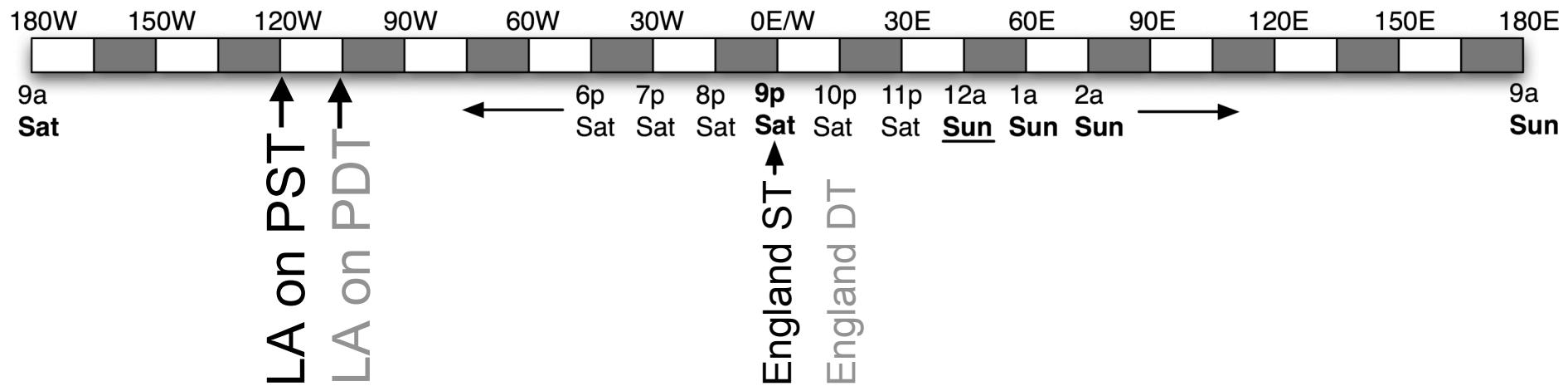


• http://www.lib.utexas.edu/maps/world_maps/time_zone_world_98.jpg

- Time zone boundaries on land are usually distorted to match political boundaries.

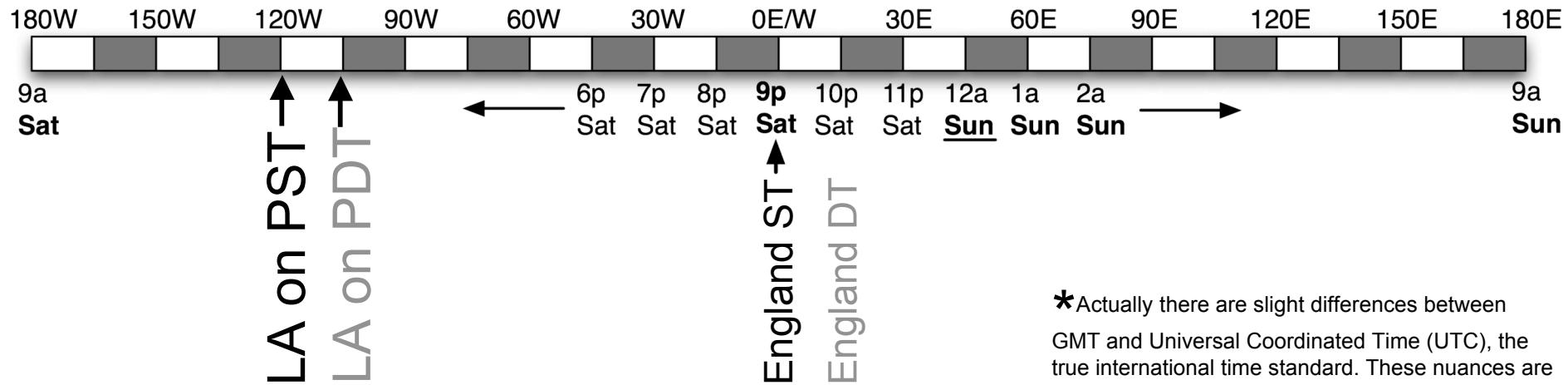
Daylight Savings Time

- We pretend to live 15° east of actual
- The central meridian for LA on Pacific Standard Time (PST) is at 120°W , but we use 105°W (Denver) on Pacific Daylight Time (PDT)



Daylight Savings Time

- Greenwich Mean Time (GMT) is the standard by which all world clocks are set.*
- GMT *never* switches to daylight time.
- PST = GMT – 8 hours
- PDT = GMT – 7 hours



*Actually there are slight differences between GMT and Universal Coordinated Time (UTC), the true international time standard. These nuances are beyond the scope of this course.

Daylight Savings Time

- We use daylight savings time in the spring and summer (March/April - October)
- We use standard time in late Fall and Winter, when days are shorter
- All countries that use daylight time do so in their summers, though the dates that they spring forward and fall back differ.
- Remember that summer in the southern hemisphere occurs during our winter and vice versa.

Conclusions

- Time zones are a function of longitude
- Nautical time zones are 15° wide
- Actual time zones on land are gerrymandered to match political boundaries
- Time differences can be calculated on a number line