What time is the Super Bowl throughout the Solar System?

The kick off for the biggest football game on *our* planet is scheduled for 6:30PM ET/3:30PM PT on February 3rd, 2019. But that's a really Earth-biased way of looking at things. Maybe some *other* planets would like to know when they can watch the Rams take on the Patriots on Sunday.

Figuring out how long that delay will be isn't as simple as adjusting timezones. As theoretical physicist Carlo Rovelli points out in *Sports Illustrated*, even light takes some small amount of time to travel from kick off to the people in the stands in Mercedes-Benz Stadium in Atlanta and to the cameras capturing the game. It takes even longer for that signal to travel from there out into the world.

What time would the game begin for an observer on Mars?
Now let's say that NASA decided to broadcast radio coverage of the game out to the various planets and spacecraft in our Solar System. Perhaps the space agency decided to use the Deep Space Network, an array of radio telescopes located all over the world tasked with beaming and capturing signals from spacecraft. What time would the game begin for an observer on Mars, if we used the DSN to broadcast coverage to the Red Planet's surface?

To figure this out, we can use a handy online tool NASA created for its New Horizons mission, which flew by Pluto in 2015. The tool generates various coordinates and information for the bodies in our Solar System, based on where they're located at certain moments in time. And one of the things it can tell us is how long it takes light to travel from Atlanta to the center of Saturn or some other planet. (Radio waves travel at the speed of light, about 186,000 miles per second.)



One of the Deep Space Network antennas at the Goldstone Observatory in California
Image: NASA/Doug Ellison

To get started, we need to use the right inputs. The tool should default to "OBSERVER," which indicates that we're *observing* this from Earth. Next we want to pick our target body. For now, let's use Mars, which has the designation [499]. That will tell you how long it takes for radio waves from the game to reach the center of Mars. If you prefer a different part of the planet, you can pick the Mars Barycenter, which is the center of gravity between Mars and its two moons. You do you.

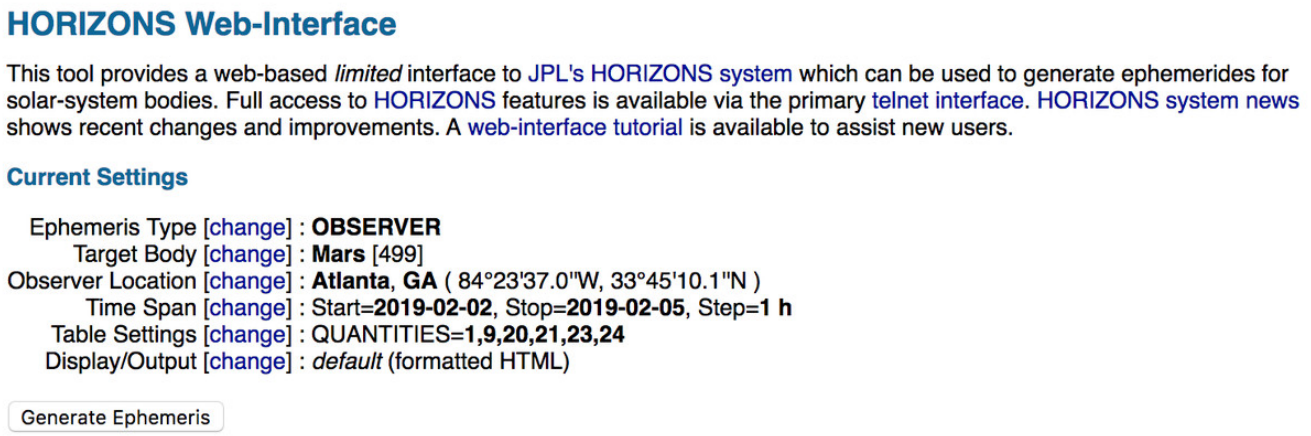
Next we need to pick the observer location. I've chosen Atlanta, Georgia, because that's where the game is. Now if we're using the DSN to broadcast this coverage to space, there will be a slight delay; the radio waves from Mercedes-Benz Stadium will need to travel to whichever radio telescope is used to blast out the signal. But the time it would take for that, coupled with any electronic lag time, would be a small fraction of a second, according to Jonathan McDowell, an

astrophysicist at Harvard who taught me how to use this tool. (Thanks Jonathan!) So the delay is negligible.

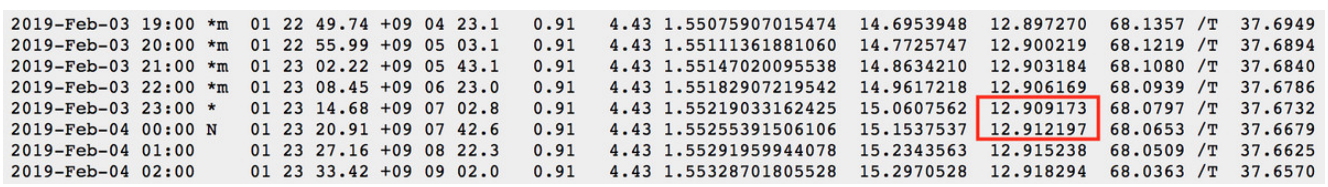
Now we want our timespan. NASA operates in Coordinated Universal Time, or UTC, so kick off would technically begin at 11:30PM UTC on Sunday, February 3rd. I've inputed a time span between February 2nd and February 5th. (The tool won't let you just select February 3rd.)

Under step size, I've set it to hour increments. This tells the program to pull data for every hour between February 2nd and February 5th. You can also set it to minute increments to get the exact time at 6:30PM ET, but you'll just be sifting through a lot of data.

And finally, the most important input of all is under the Table Settings. You want to choose number 21 on that menu, which indicates one-way light-time to each destination. For our example, this is what all the inputs should look like:



Click "Generate Ephemeris" and a whole bunch of data should pop up. But if you scroll down to February 3rd at 11:30PM UTC, the information we want is waiting for us. According to the tool, It would take about 12.9 minutes for initial radio coverage from kick off to reach the center of Mars.



I’ve taken the liberty of making a few more approximate light-time calculations for the other planets and a few spacecraft in our Solar System. Here’s how long it would take for radio waves to reach each location after kick off.

Planets

Mercury: 11.45 minutes

Venus: 7.4 minutes

Jupiter: 48.39 minutes

Saturn: 90.69 minutes, or an hour and a half

Uranus: 167.21 minutes, or two hours and 47 minutes

Neptune: 256 minutes, or four hours and 16 minutes

Pluto (I know, I know, it’s a dwarf planet. We can debate this later): 288 minutes, or four hours and 48 minutes

Spacecraft

BepiColombo: 2.52 minutes

Parker Solar Probe: 15.5 minutes

Juno: 48.69 minutes

New Horizons: 369.41 minutes, or six hours and nine minutes

Voyager 1: 1,206.39 minutes, or 20 hours and six minutes

Now hopefully the entire Solar System can enjoy Super Bowl Sunday, on time.

https://www.theverge.com/2019/2/3/18207387/what-time-super-bowl-2019-start-game-liii-solar-system-space