LORAN (Long Range Navigation)- Hyperbola
• LORAN stands for **Long Range Navigation** system.

• It is a network of land based radio transmitters.

• The system is connected to three stations in a chain. One station acts as the “master” and the other two are called secondary stations.
How the systems works?

• The LORAN system works when each station sends out signals, traveling at a certain speed, moving at specific time intervals.

• These signals reach the Loran receiver, located on the ship. By analyzing these time delays, we are able to calculate the difference in distance from the ship to the master station and from the ship to one of the secondary stations.
The hyperbola is the set of all points the difference of whose distances from two distinct points are constant.

- **Foci** - Distinct fixed points
- **Branches** - Two disconnected parts
- **Transverse axis** - The line connecting the vertices and midpoint (center).
How is the Hyperbola used?

• The hyperbola has a unique distance property that helps locate the ship.

• In the picture above, M and S\(_1\) are the focal points of one hyperbola. M and S\(_2\) are the focal points of the second hyperbola. Where these hyperbola meet is the location of the ship.
Navigation System History/Reason for choosing this application

• This application was first used in the 1940’s during World War II.

• Recently it has been discontinued because of more useful ways of navigation like GPS.

• I chose this application because hyperbolas seemed really interesting to me and the use entire process of finding the distance using this complicated conic was really intelligent.

• This system is still useful today because if the GPS systems fails there is still this way of navigation as a backup.

• It also serves as a reminder of how we can take certain parts of math and use them to our advantage.

• LORAN uses a strong signal, which is difficult to jam, and is an independent and complementary system to other forms of electronic navigation, which helps ensure availability of navigation signals.