Argos Location Processing
New features

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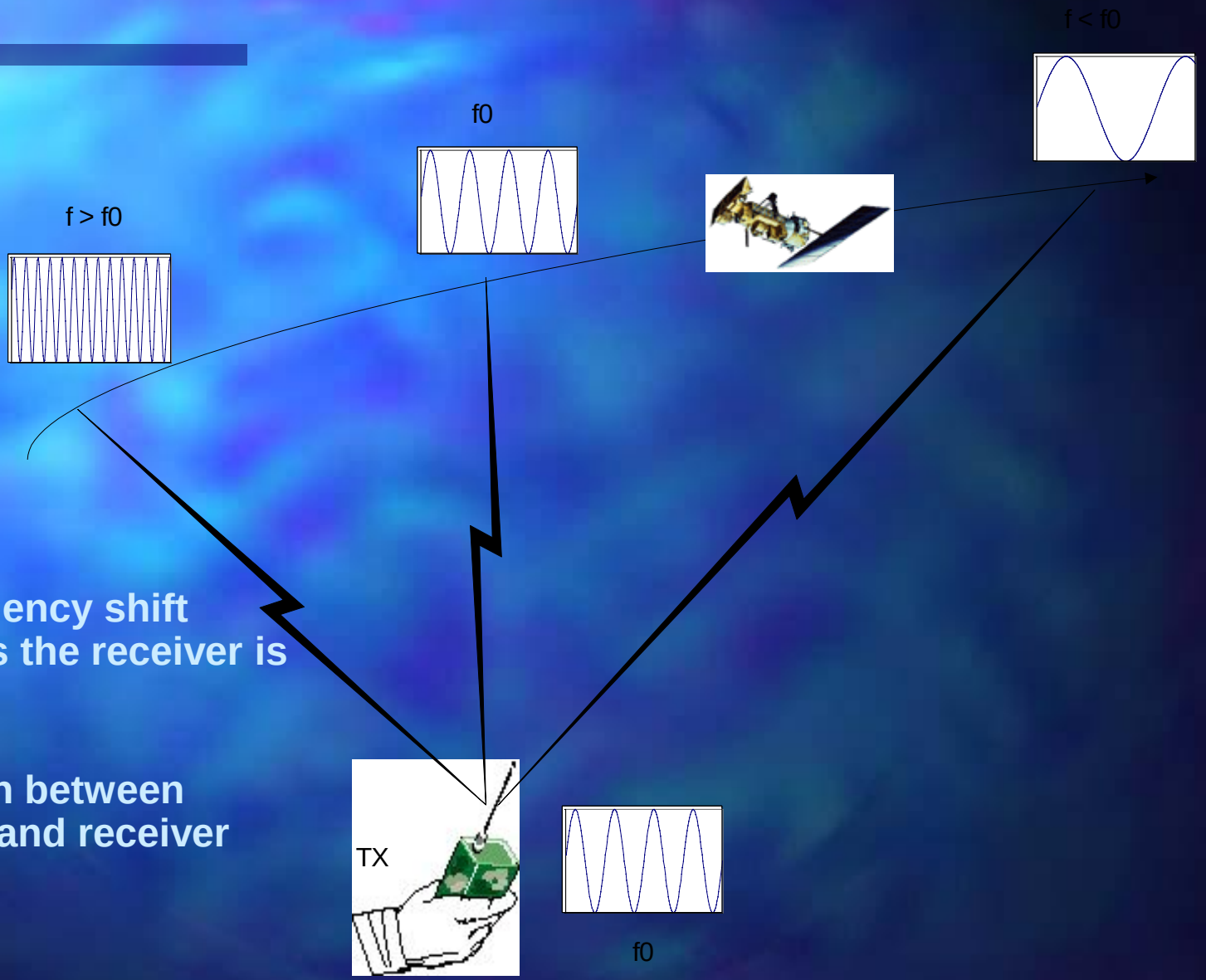
Argos Location Processing

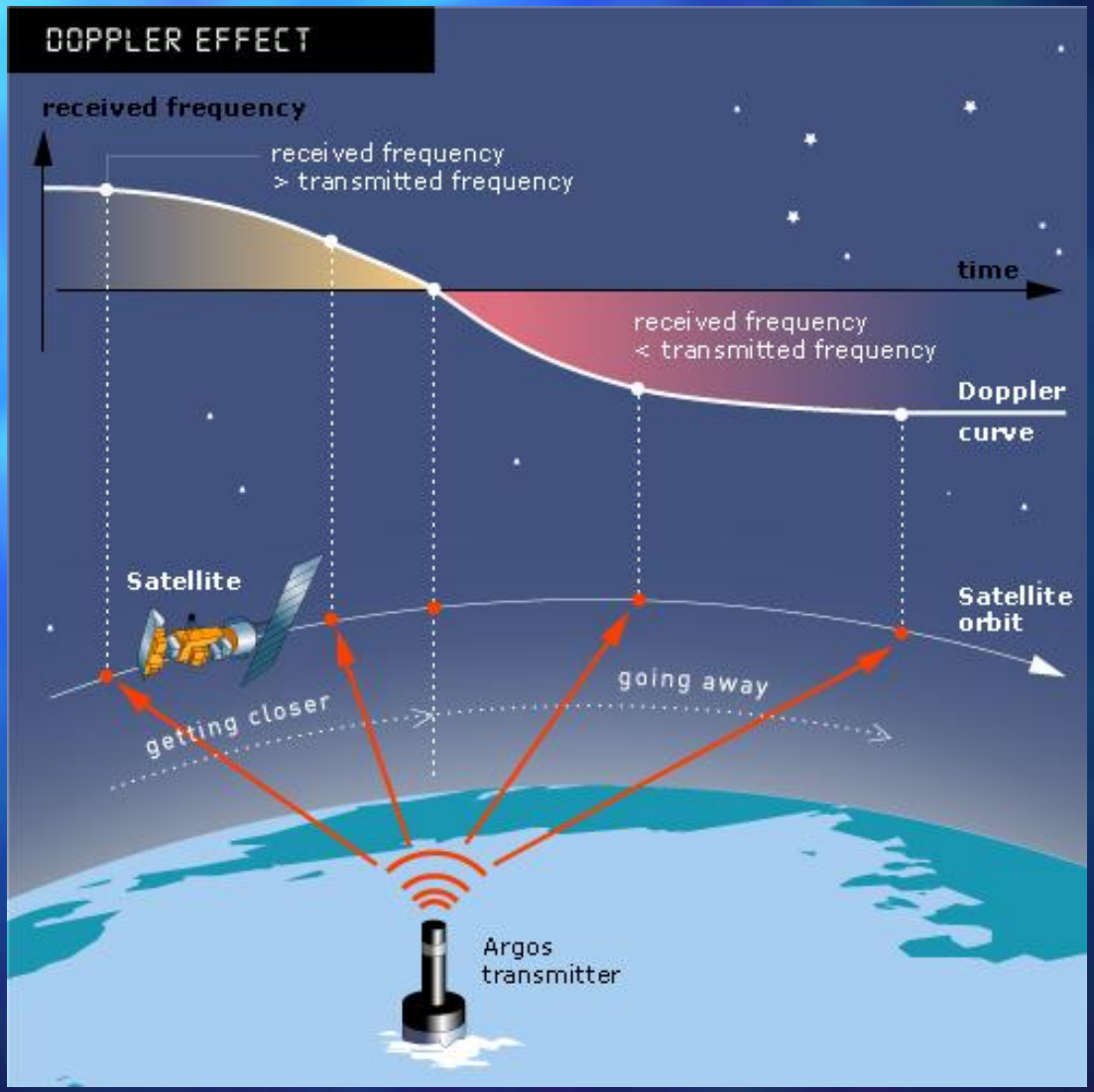
- Location processing : principles
- Location processing : how does it work?
- Argos + GPS positions
- Data provided
- Improving Location
- Conclusion: getting better locations

Doppler effect

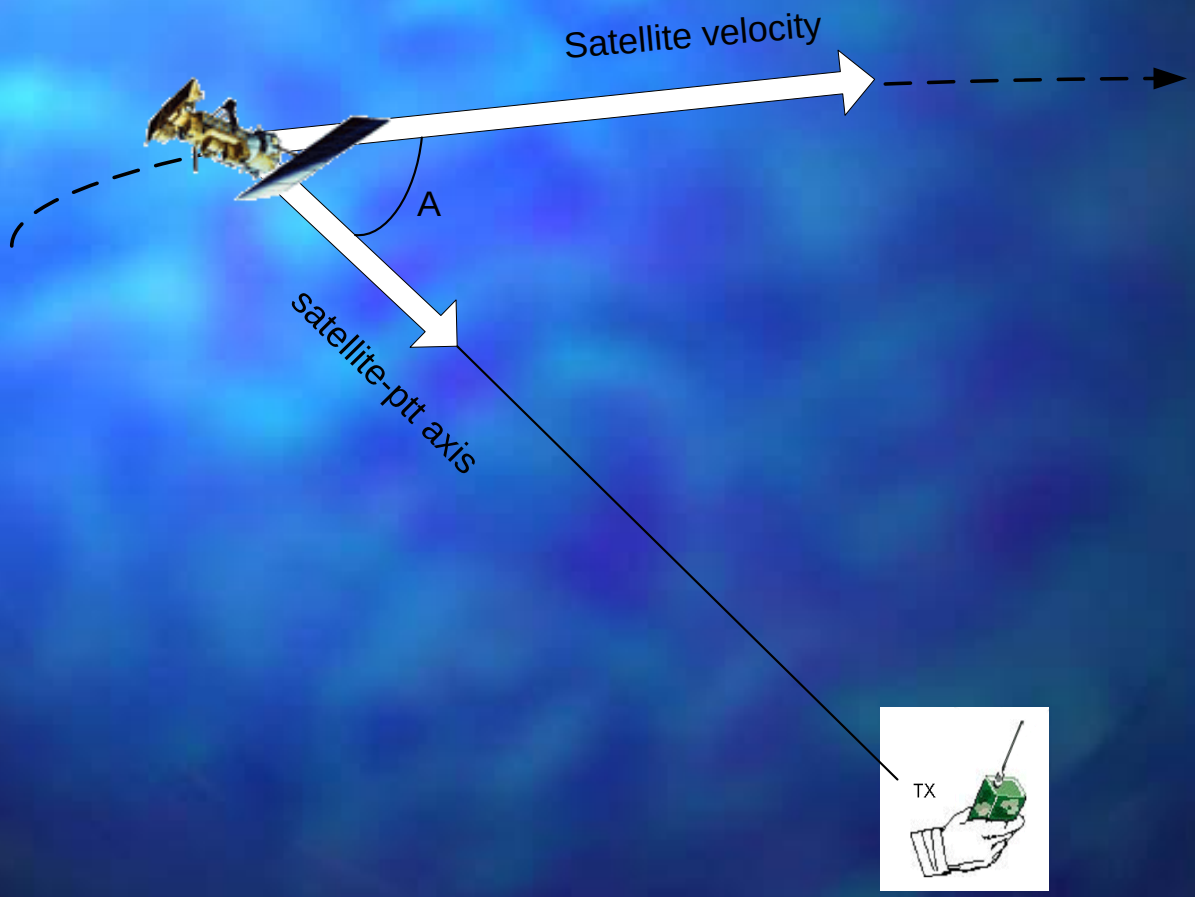


- Apparent frequency shift observed as the receiver is moving
- Relative motion between transmitter and receiver

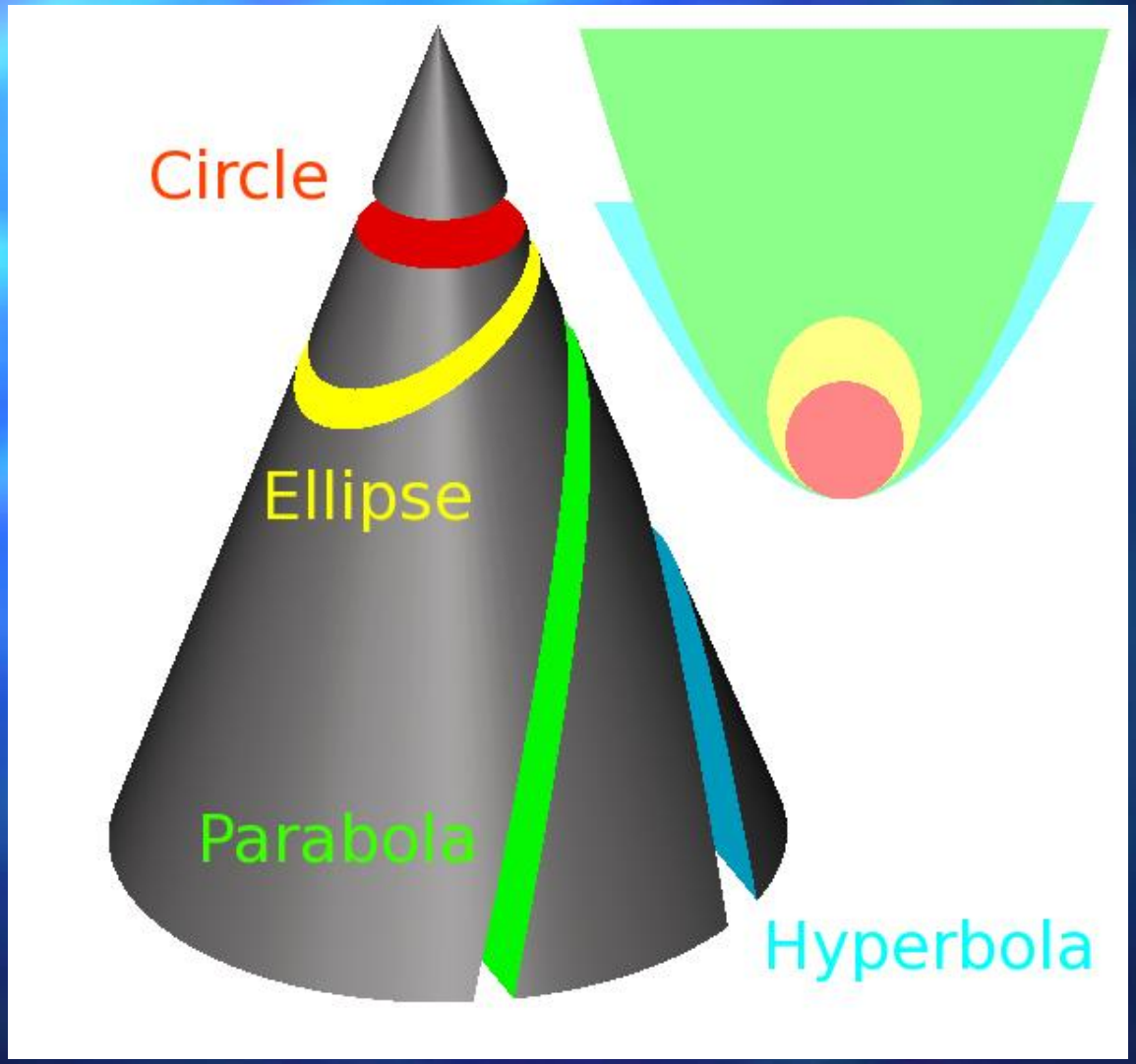
Doppler effect



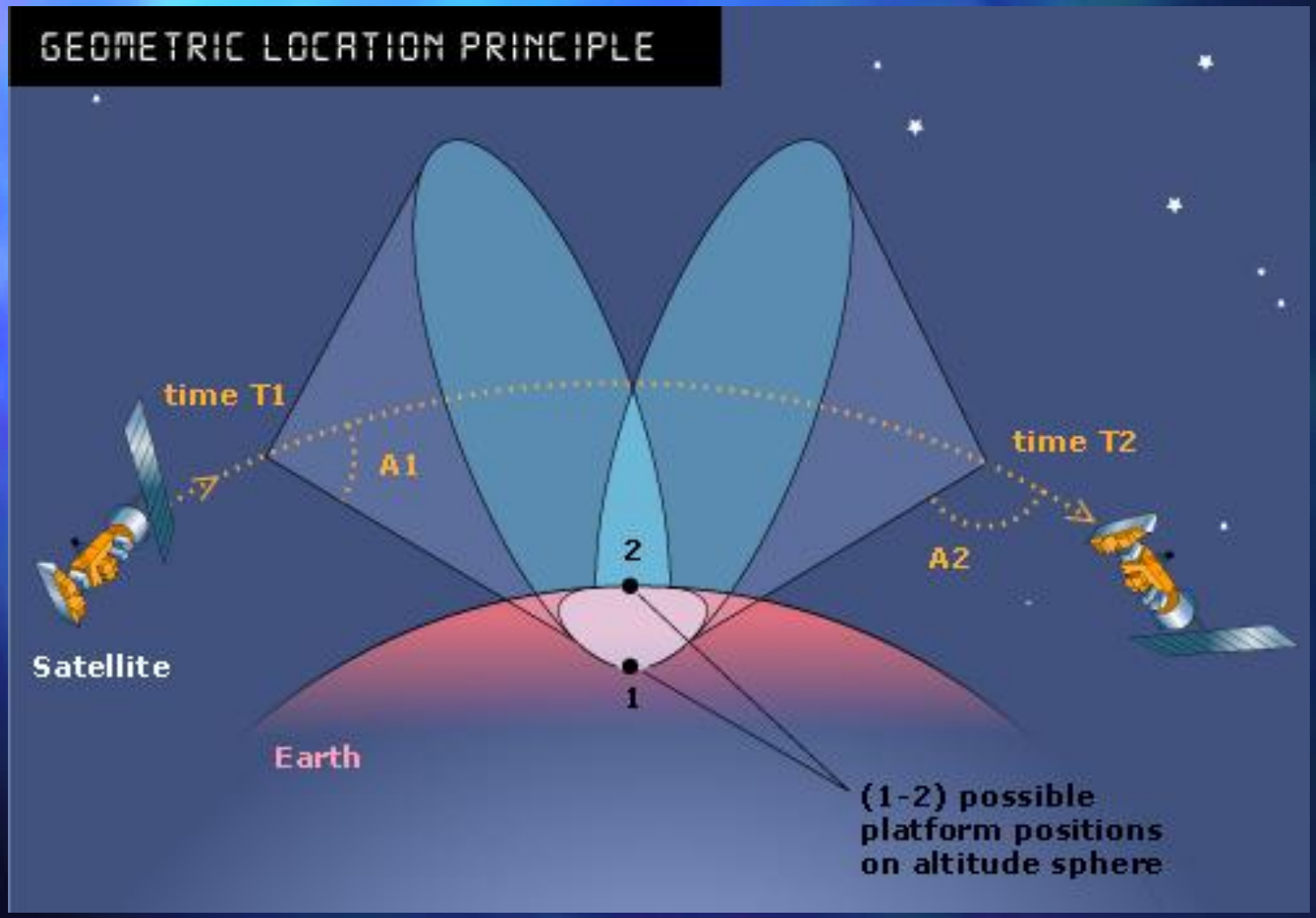
Doppler effect : Each Message Received Tells us the Tag is somewhere on a Cône



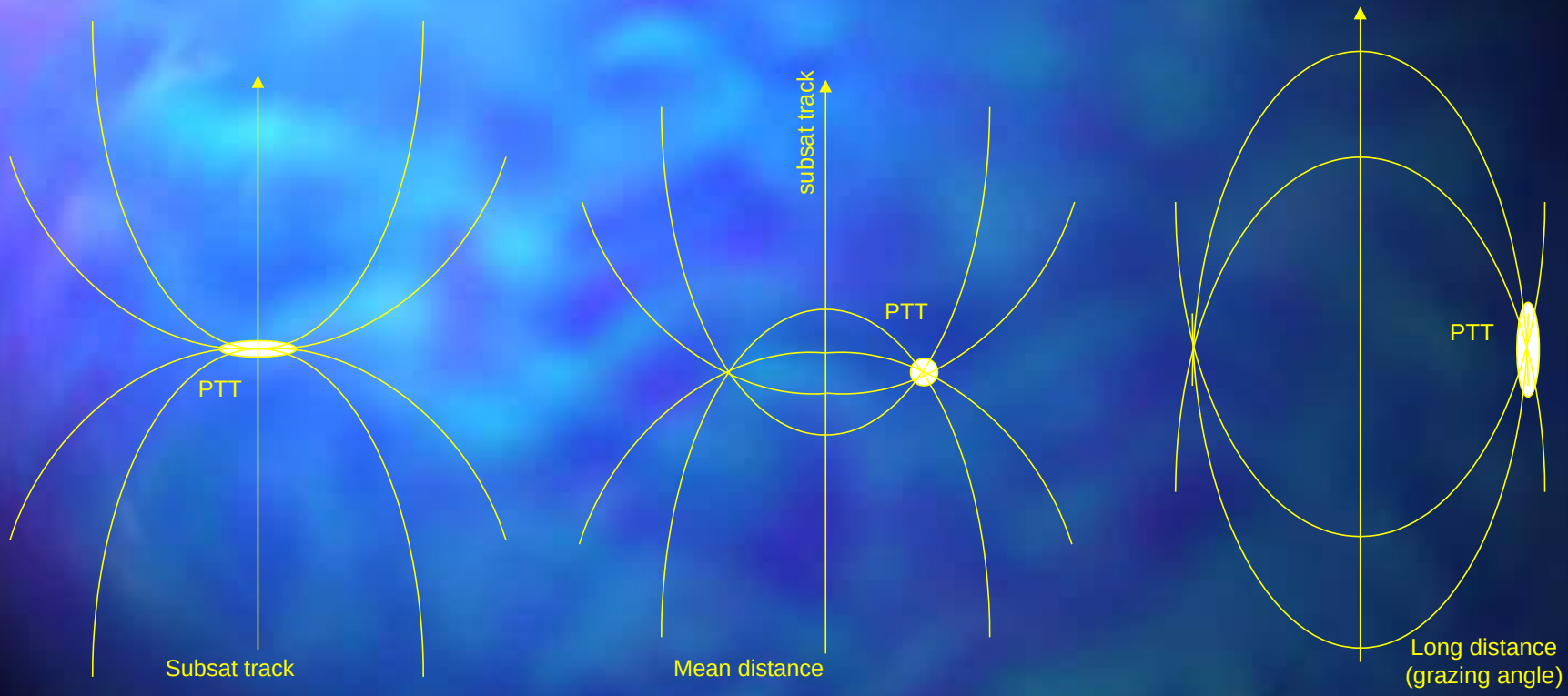
Some geometry : intersection between a plan and a conic surface



Intersection with Altitude Sphere: Two Solutions!!



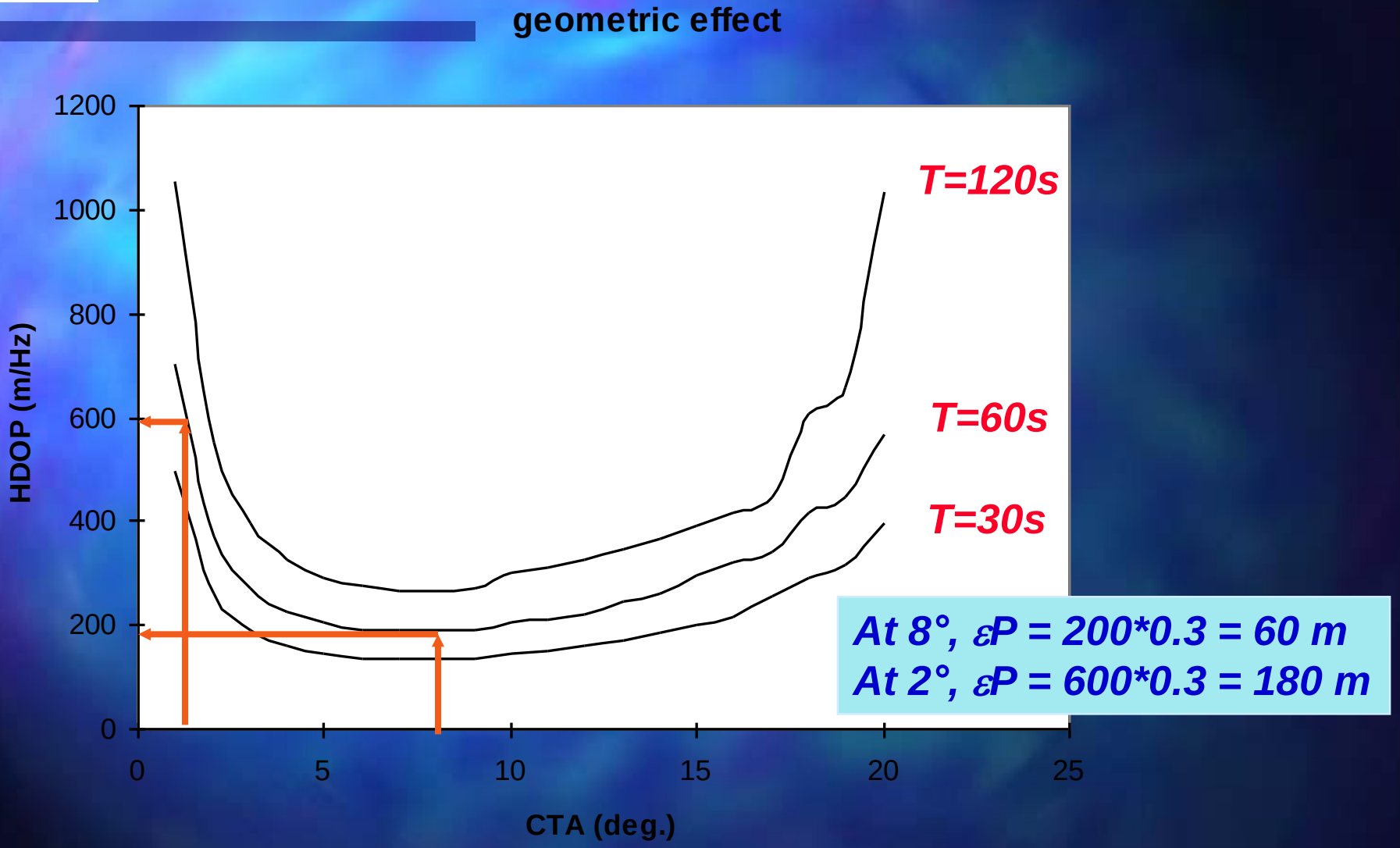
Position quality varies with Satellite Pass Geometry versus the Transmitter



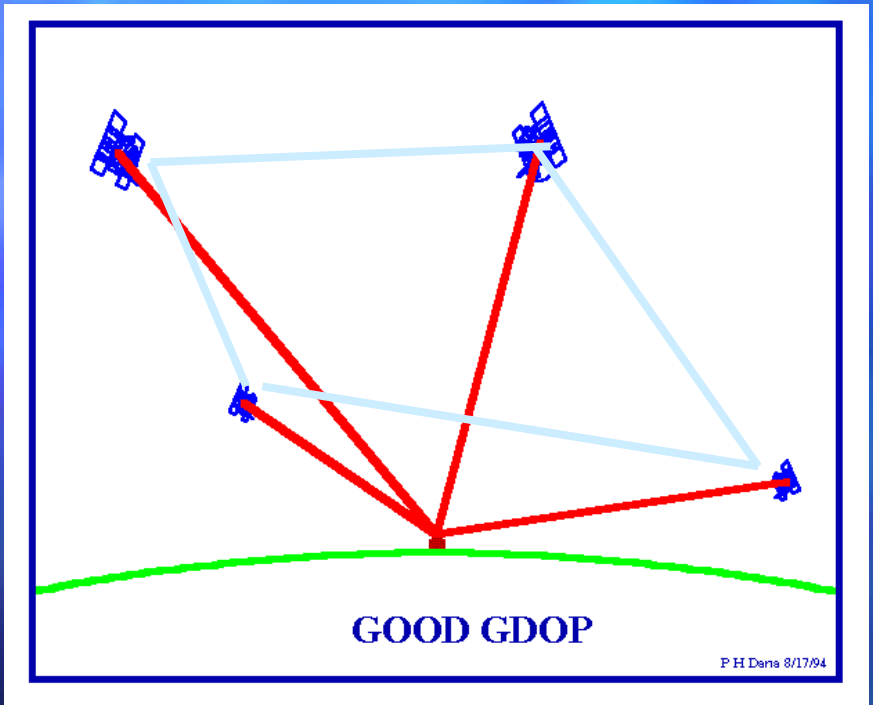
IsoDoppler lines: one line correspond to one message collected – ie one frecuency measured

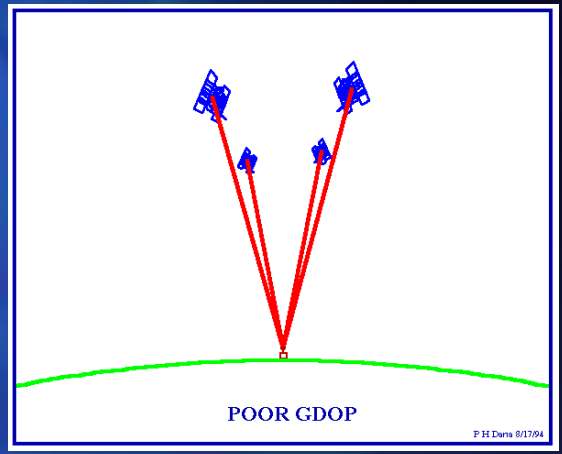
Accuracy varies with PTT Distance to Track (CTA)

Doppler model algorithm: Geometrical Effect



Analogy with GPS

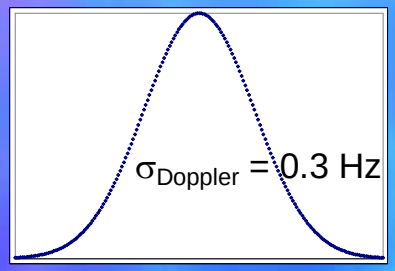


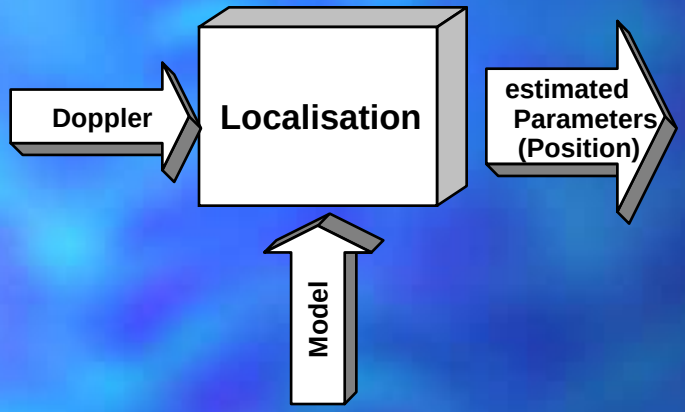


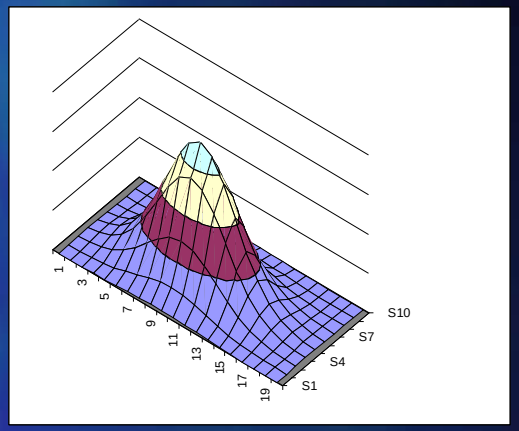
Idem for 4 satellites at grazing angle

To maximize the volume

Argos location processing : principle







3 Unknowns

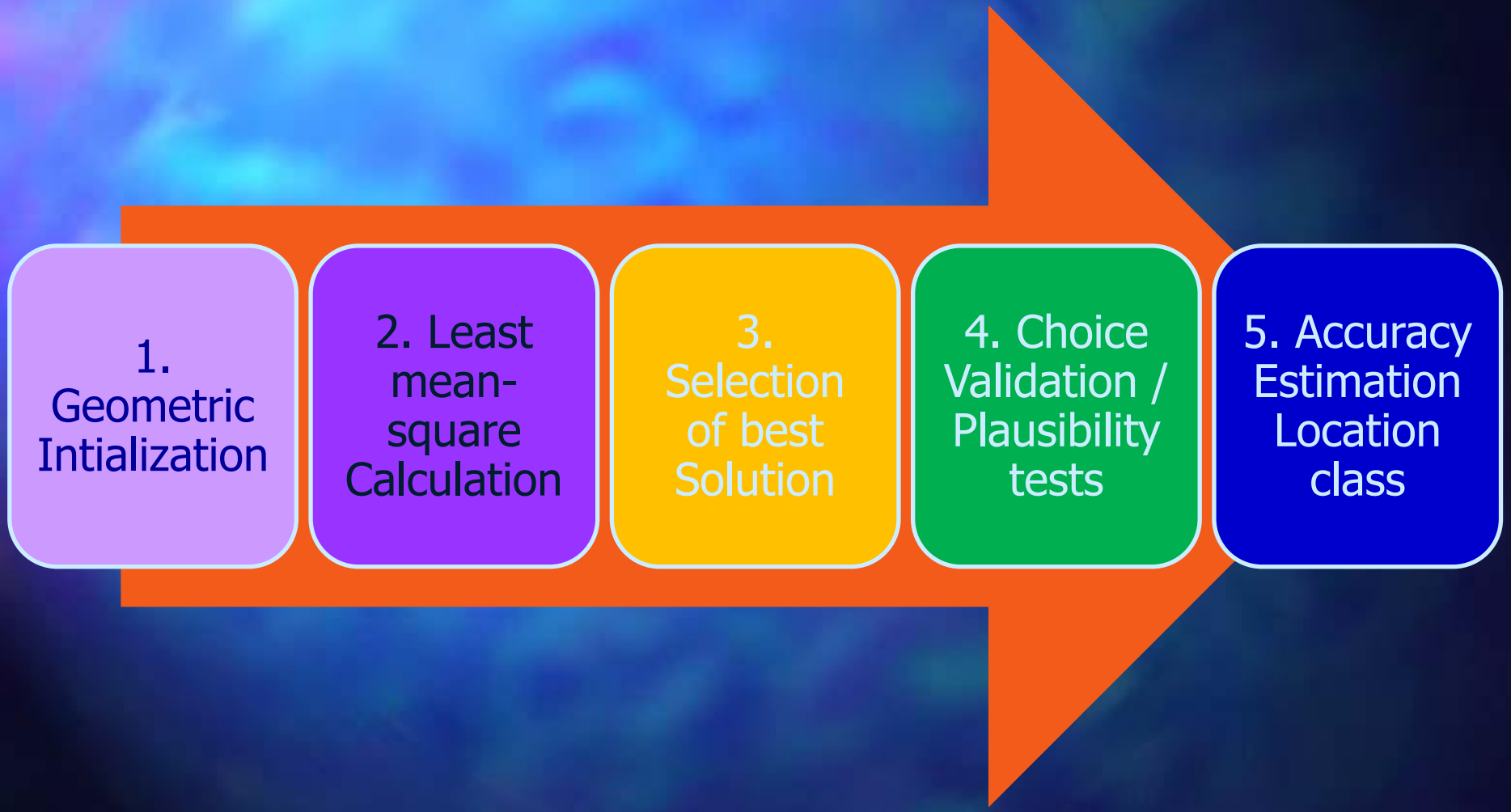
- ***Position: Latitude, Longitude***
- ***Transmitter exact frequency at the time of Satellite pass***

- ***Altitude is assumed to be known***

- ***Each Argos Message provides one Doppler -> 1 Equation***

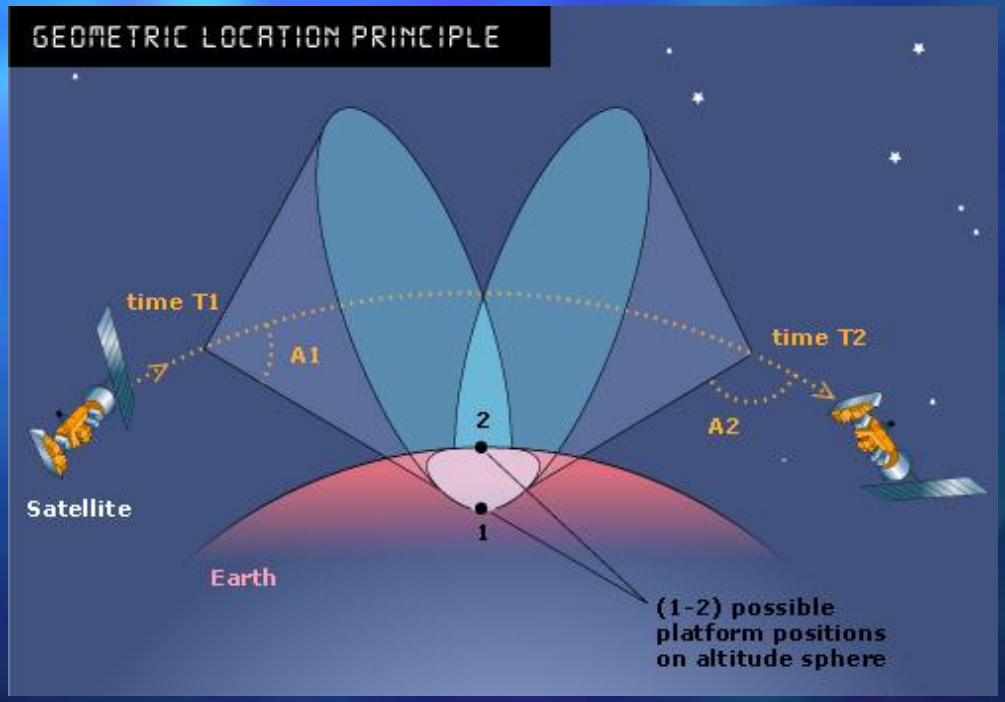
- ***4 Equations/ 4 Messages or more are needed to estimate Position Accuracy***

Complete Localisation Processing (4 messages received at least)



Step 1: Geometric Initialization

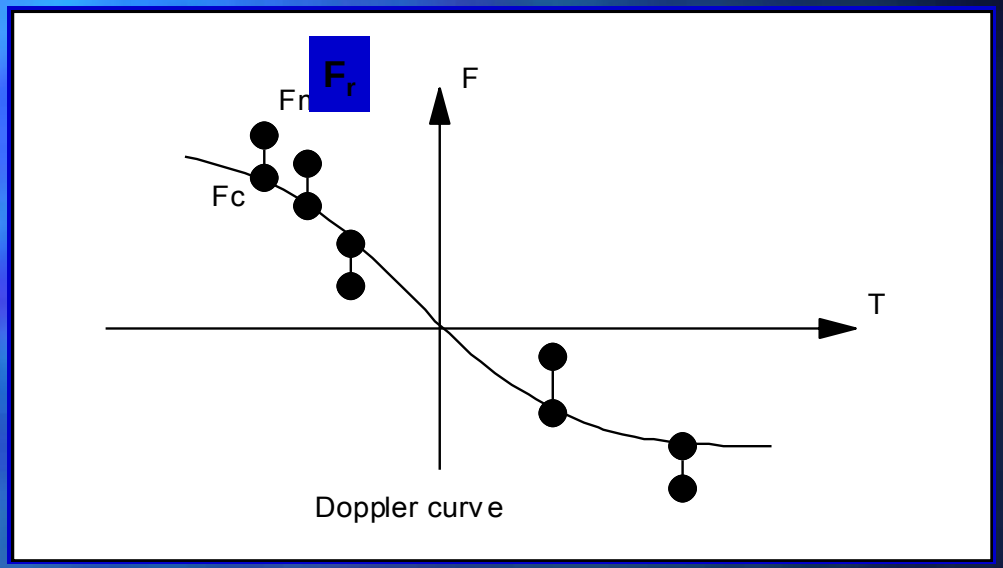
- The transmitter frequency is supposed to be known
- **Two** initial locations are calculated from the first and last Doppler measurements of the satellite pass



Step 2 - Least-squares calculation

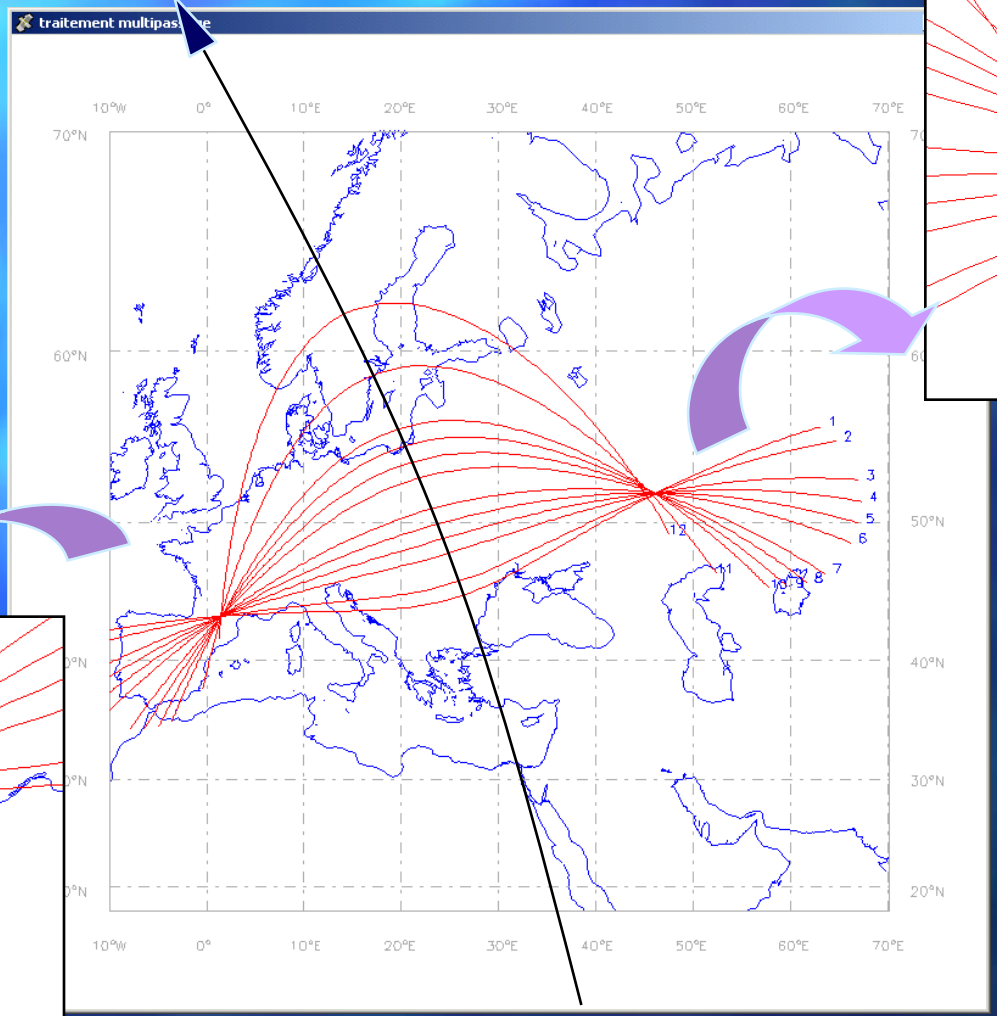
Minimize the distance between the Measured Doppler data and the Theoretical Doppler curve for each initial solution

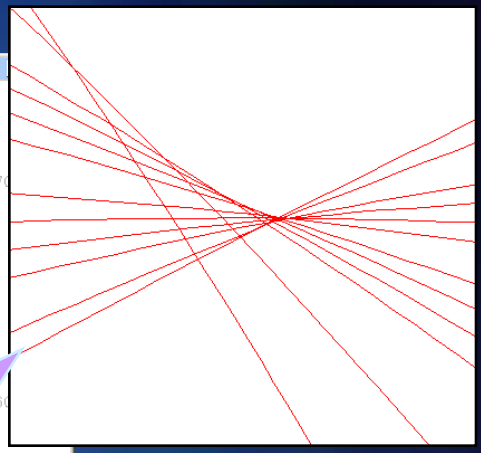
The iterative processing stops when the residual error does not change significantly from an iteration to the next one

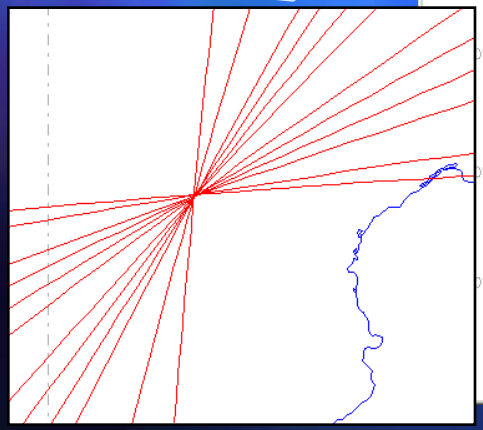


Result of the calculation (<u>for each initial location</u>) :
- Longitude, latitude, Tx Frequency and residual error (IC = internal consistency

Step 3: Selection of best solution







Step 3 – Choice Validation -Plausibility Tests – 2 tests OK required for Loc distribution

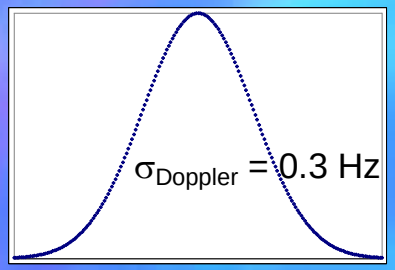
Minimum residual error (=<4 msgs)
Solution chosen has the minimum residual error

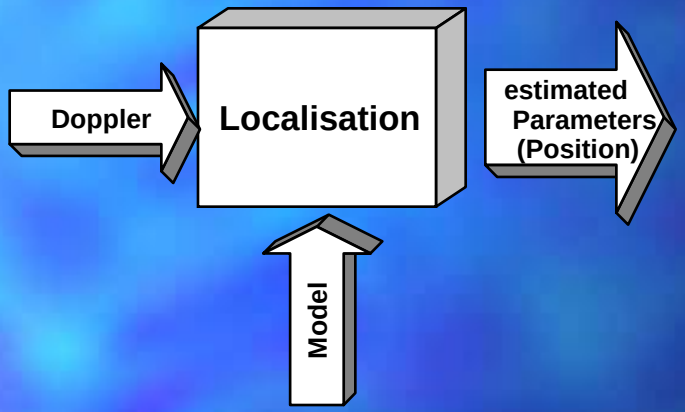
Best Tx Frequency continuity
Delta Frequency between previous and current locations is **minimum**

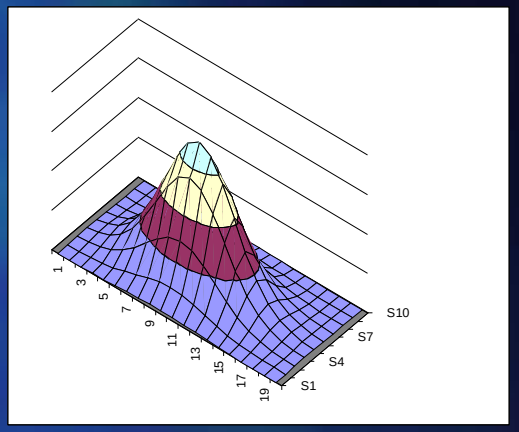
Distance Test
Shortest distance from previous Loc

Speed Test
Speed is below Max Speed

Step 4 – Accuracy Estimation, Modeling the Error

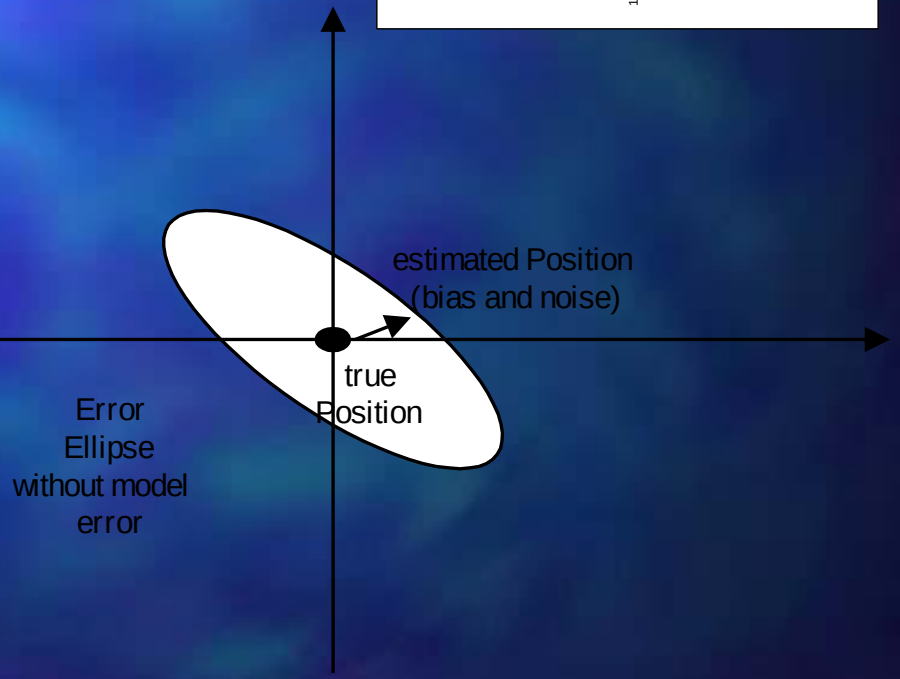




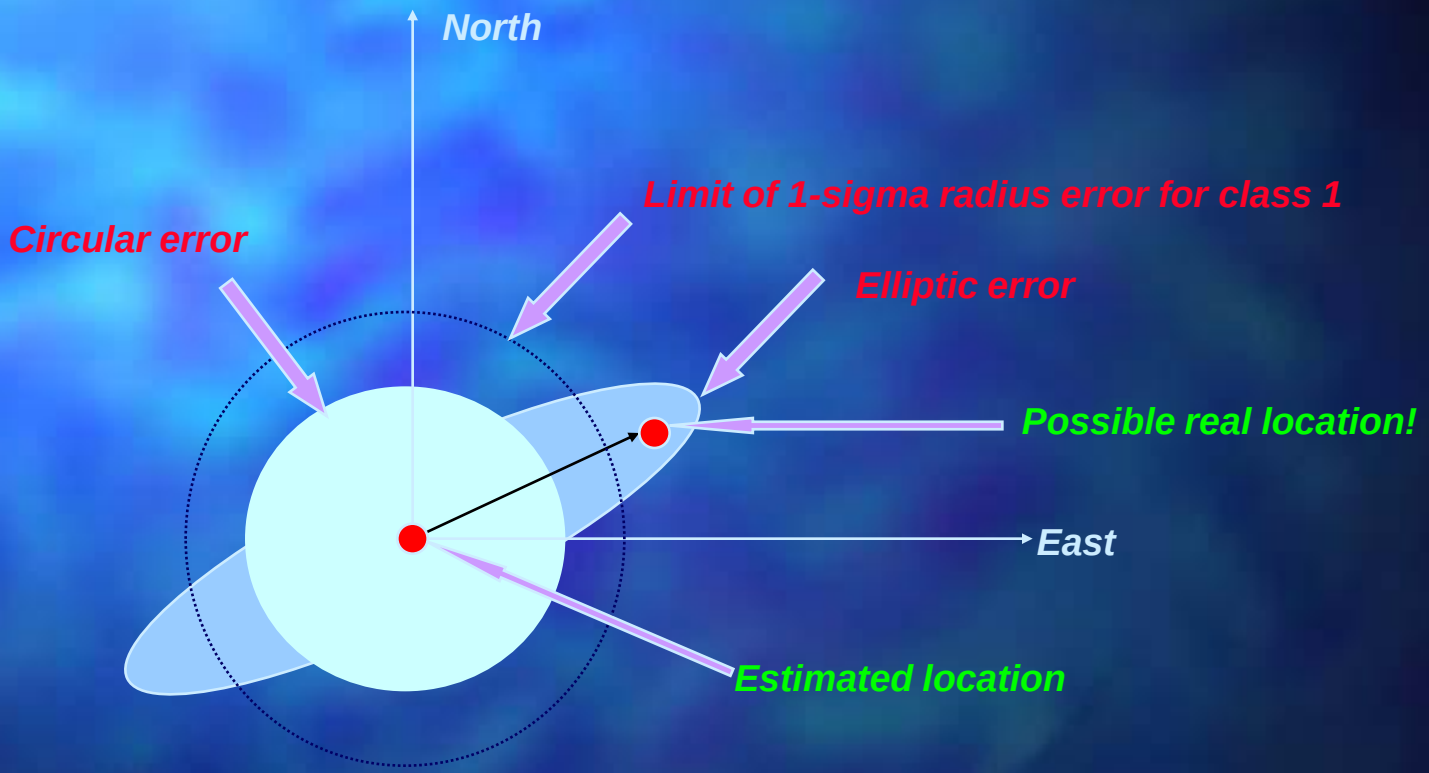


$$\sigma_{\hat{\chi}} = GDOP \cdot \sigma_z$$

only with a gaussian noise



Step 4 - Location classes are based on estimated Circles of error



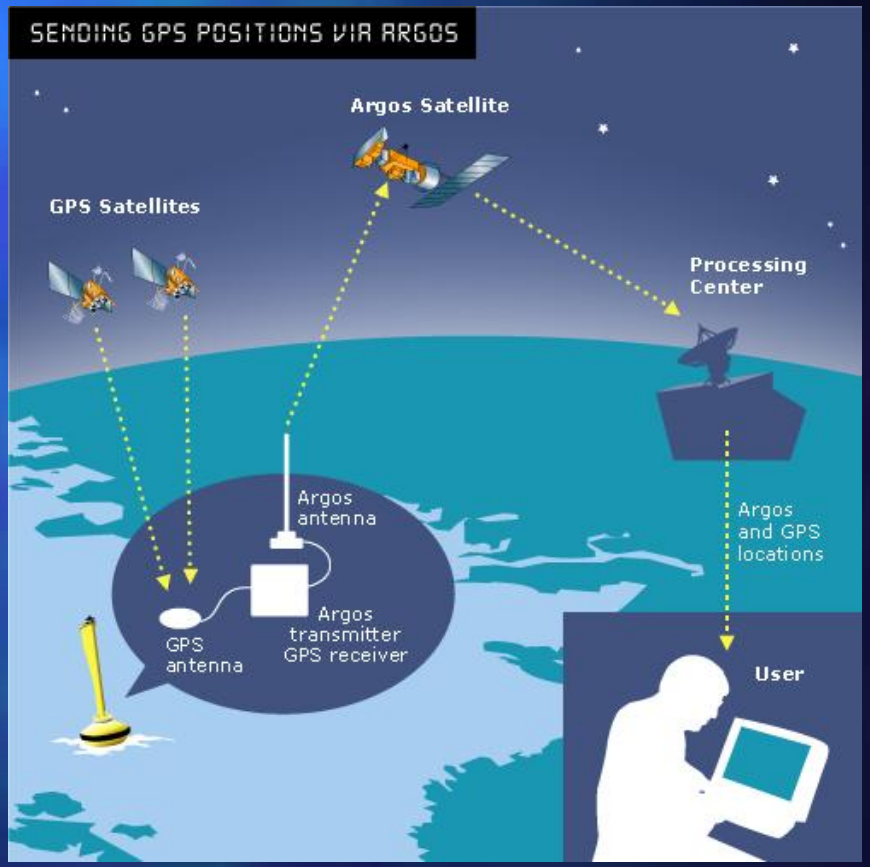
- Circle surface = Ellipse surface

GPS Location Decoding

GPS decoding

If manufacturer format is provided, CLS processes & displays the GPS positions

- *Speed test are applied to remove bad GPS locations*
- *GPS Positions marqued as class « G »*
- *All positions available on same supports (ArgosWeb, data files, Archives…)*
- *Accessible on Google Earth*



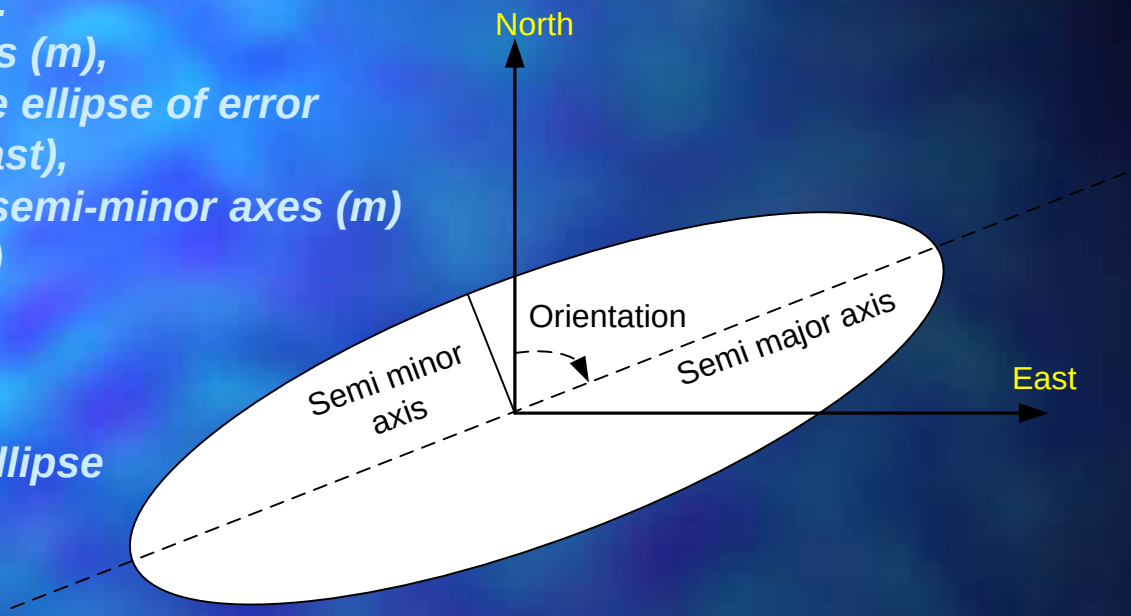
Data provided: Location Classes

CLASS	Type	Nbr of Msgs	Accuracy (m)
G	GPS	1	10 to 100
3	Doppler	4 or more	<250
2	Doppler	4 or more	<500
1	Doppler	4 or more	<1500
0	Doppler	4 or more	>1500
A	Doppler	3	Unknown
B	Doppler	2	Unknown

For More Details: Ellipse of Error

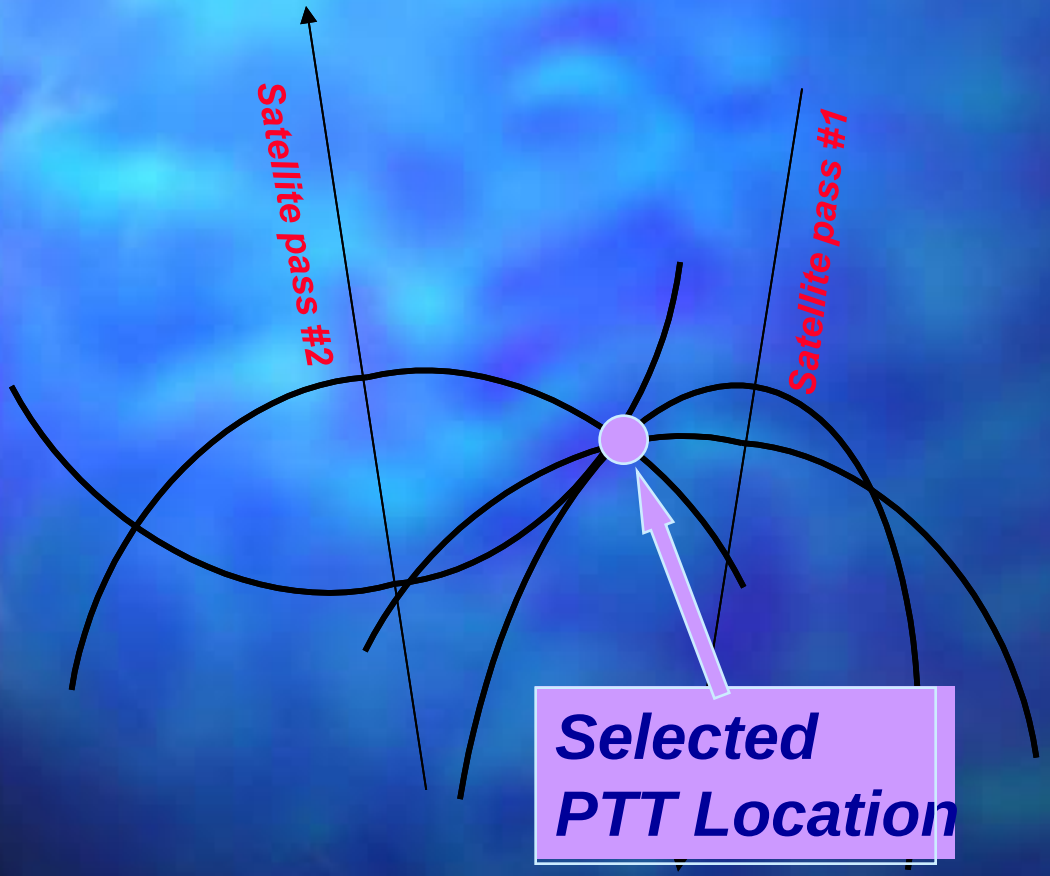
- *For class 0, 1,2,3 locations:*
  - *Estimated error radius (m),*
  - *The parameters of the ellipse of error*
    - *direction (deg/East),*
    - *semi-major and semi-minor axes (m)*
  - *GDOP (*) (unit : m/Hz)*

- *For class A and B:*
  - *The direction of the ellipse*
  - *GDOP*



*** Geometric Dilution of Precision (GDOP) is a term used to characterize the geometric strength of satellite configuration on location accuracy. Argos location accuracy depends on the quality of the transmitter (frequency stability) as well as the GDOP. As a general rule, a smaller GDOP value indicates a more accurate position.**

Multi-pass location (manual, on request)



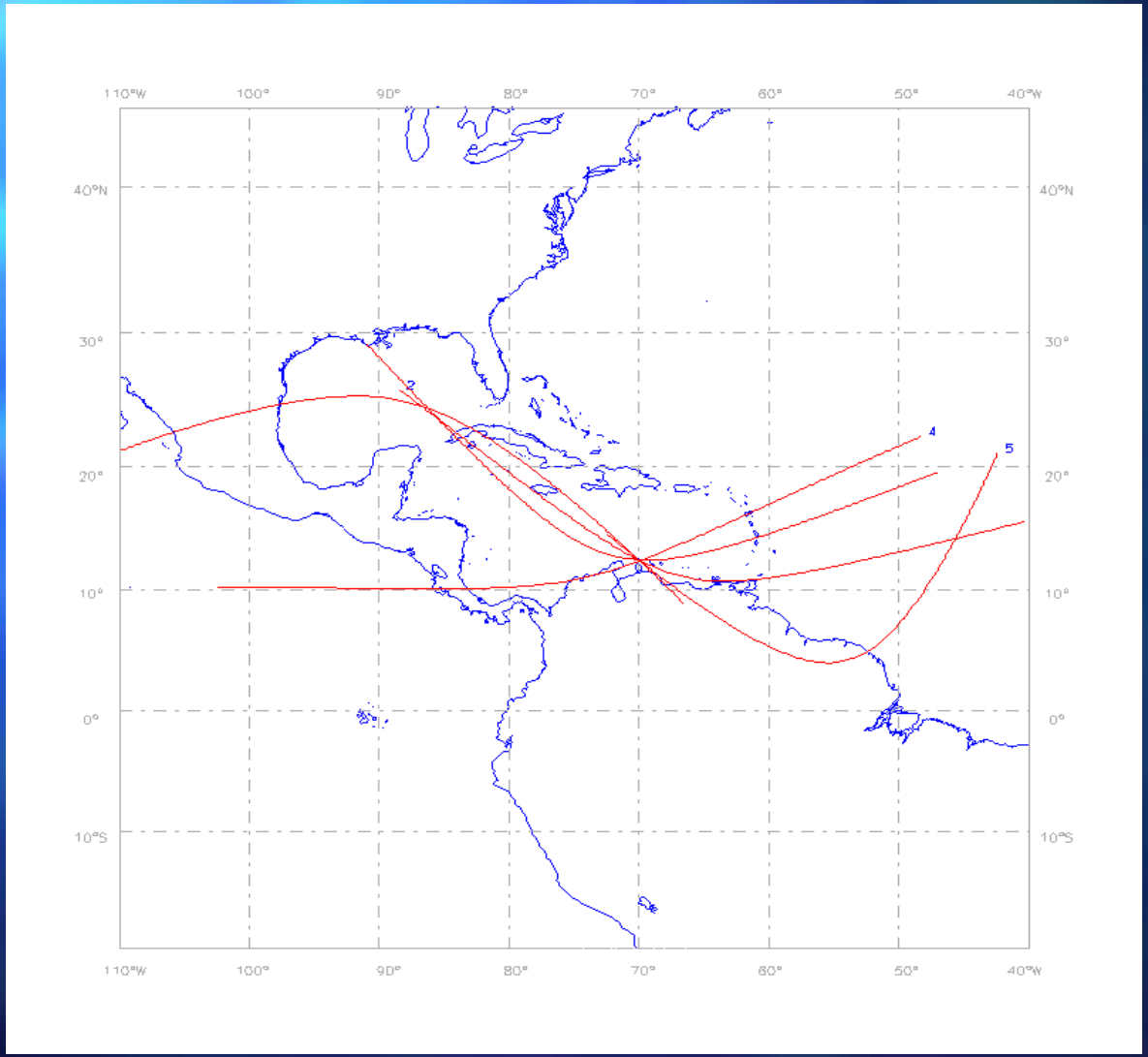
One satellite pass over the transmitter with only 2 messages

No or poor location !

With Multipas/Multisat

(Better) Location available !

Example



How to get better results?

- Carefully select your tag (Argos only, GPS…..)
- Apply max possible Transmitter power (Tag performance varies depending on the area on earth)
- Tune Tag duty cycle: performance is related to the mission (duty cycle, Transmission power, frequency…)
- CLS can help you with manufacturers
- Take benefit of all CLS tools: ArgosWeb, multisatellite position, ellipses of error ….

Thank You for your attention

Photo : Sandra Ferraroli

photo : Jean-Yves Georges (CEPE, Strasbourg)

- Who said I would be easy to Track?