

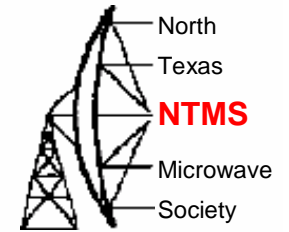
Doppler – How to use it?

Al Ward

W5LUA

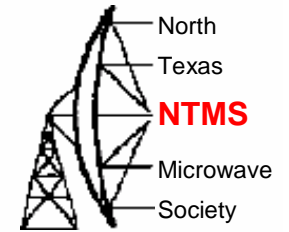
July 30, 2008

Outline



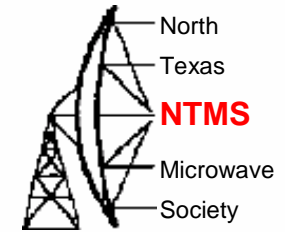
- Summary of what doppler is
- How to use the numbers when running random vs scheduling
- How it applies to both CW and Digital QSOs

The Doppler Effect



- Doppler effect is the change in frequency of a signal that occurs as a result of the source and the observer moving relative to each other.
- As the source and/or observer are moving closer to each other , the frequency will increase and as the source and/or observer are moving further away from each other the frequency will decrease.
- The doppler effect scales proportionally with frequency

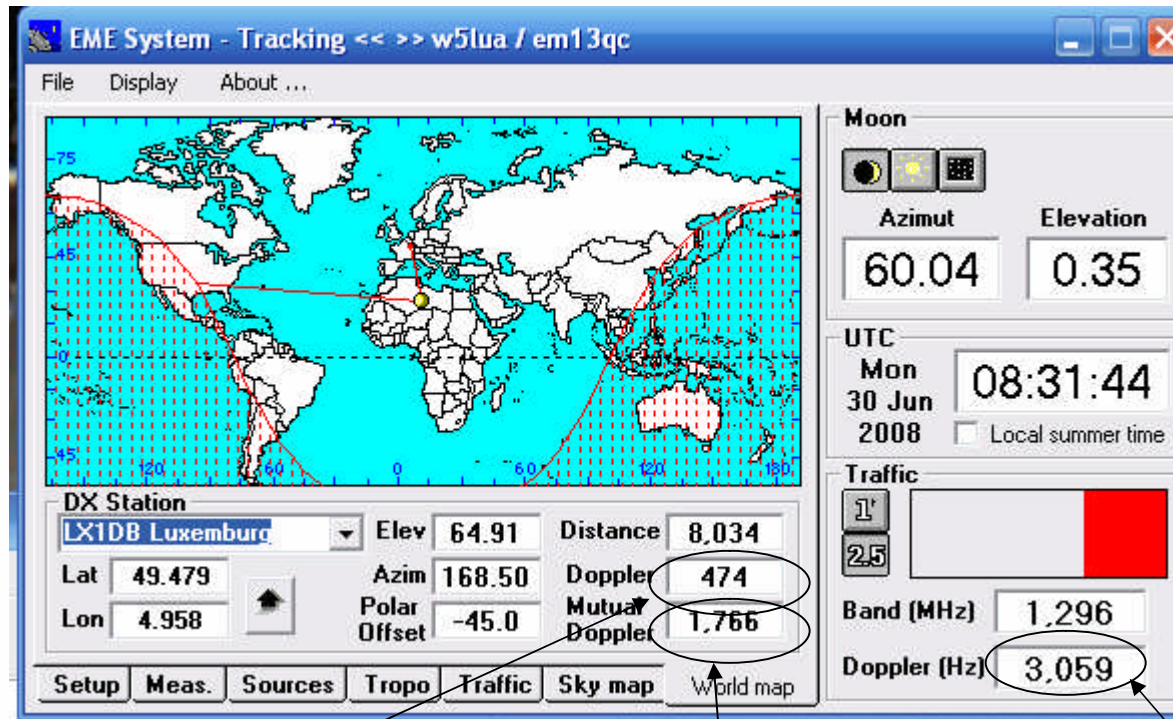
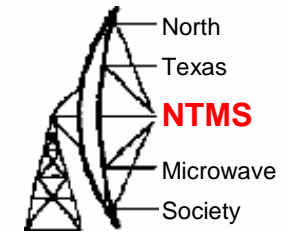
The Doppler Effect



- Since the relative angular velocity of the earth is faster than the orbit of the moon, the doppler is at a maximum at both moon rise and moon set and zero around zenith.
- Therefore... at moon rise the doppler shifted signal will be highest in frequency (positive) gradually decreasing to zero offset from the transmitted frequency at zenith and continuing to decrease to its lowest frequency (negative) at moon set.
- Slight hook effect at the edges of the earth

F1EHN EME Program at W5LUA

Moon rising at W5LUA and near zenith at LX1DB

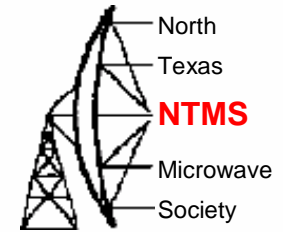


Self Doppler at LX1DB

Mutual Doppler

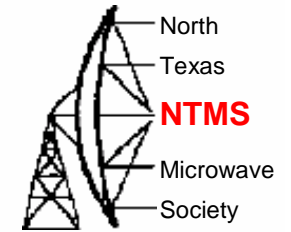
Self Doppler at W5LUA

Random Operation on CW



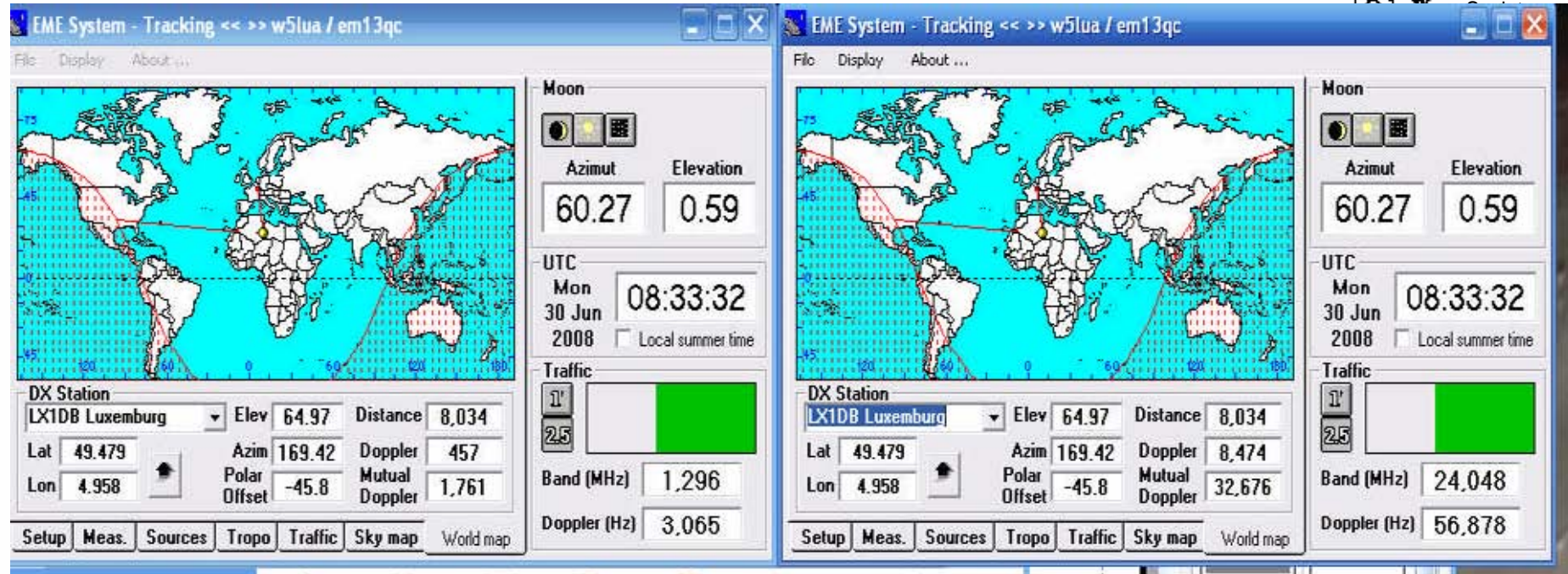
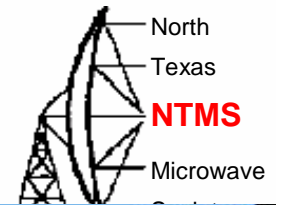
- Random operation on CW is fairly straightforward – simply “net” your echoes on the frequency of the station calling CQ
- Even if you can’t hear your own echoes, you know from the “self” doppler where your echoes would be if you could hear them
- More important is the fact that the “bigger” station most likely hear you and he will be tuning pretty close to the frequency at which he hears his own echoes

Random Operation on CW



- Station "A" in North America says he is setting his echoes on say 1296.010 or 10368.100 MHz – For other stations in North America that are very near the same location, other stations will find station "A" very near the "claimed" frequency
- Any station that is a significant distance away from station "A" will find "station " at a significantly different frequency especially at 10 GHz. This is a result of the "self doppler" being different at different locations, especially when traversing continents
- Solution – Never spot your echo frequency. Simply spot your exact transmit frequency, only then will any station any where (from a known QTH), on any frequency be able to find your signal based on the "mutual" doppler" frequency

Comparison of the Doppler between 1296 and 24048 MHz



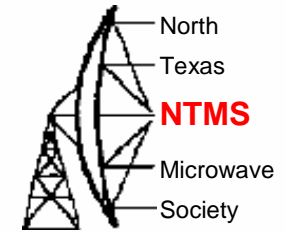
Moon Rising at W5LUA and nearly at Zenith at LX1DB

Self Doppler – W5LUA +56.9 kHz, LX1DB +8.5 kHz

If we are both transmitting on 24048.100 MHz, then my echoes will be on .1569 and Willi's will be on .1085

Mutual Doppler is +32.7 kHz and is the same for both of us – What does this mean and how is it calculated?

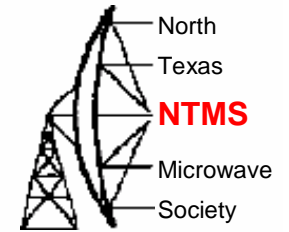
Scheduled Operation on CW



- Self Doppler – W5LUA +56.9 kHz, LX1DB +8.5 kHz
- If we are both transmitting on 24048.100 MHz, then my echoes will be on .1569 on my dial and Willi's will be on .1085 on his dial
- Mutual Doppler is +32.7 kHz and is the same for both of us
- Mutual Doppler is calculated from the arithmetic mean or average of the individual stations self doppler
- Mutual Doppler =

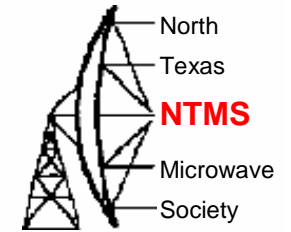
$$(\text{Station \#1 Doppler} + \text{Station \#2 Doppler}) / 2$$
- The mutual doppler frequency is the exact frequency at which Willi and I will both hear each other – therefore we will both hear each other on 24048.1327 MHz
- This also means that Willi will appear to be $56.9 - 32.7 = 24.2$ kHz below my echoes on my receiver and I will appear to be $32.7 - 8.5 = 24.2$ kHz above his echoes on his receiver
- Therefore when scheduling it is best just to transmit on the “exact” sked frequency and just tune to the “mutual doppler” frequency for the scheduled station – pretty simple...and it still works at 47 GHz!

Sked Operation on Digital



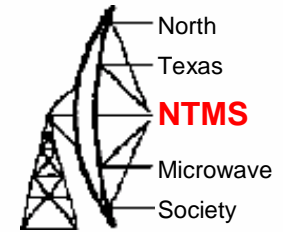
- Usually both stations will follow similar guidelines as done on CW, i.e. both stations will transmit on the sked frequency and tune to the “mutual doppler” frequency
- Most amateurs on the same continent will find skeded stations close to their “self doppler” frequency but when working continent to continent one should tune to the “mutual doppler” frequency – sometimes makes it difficult to tail-end but sure makes it easier for “skedded” stations to find each other.

Random Operation on Digital



- Most amateurs “spot” their CQ frequency on the logger – on 1296 amateurs in Europe usually find most of the replies on or near their self doppler frequency but what about listening for NA and or JA/VK, etc?
- My first response would be similar to what I would do on CW, i.e. place my echoes on the frequency on which I see them and they should be able to find me. I would “normally” not transmit on their announced CQ frequency – Is this the acceptable trend on random?
- I note that Bodo DL3OCH chose to have me transmit on his transmit frequency when I was calling him on random – not my first choice but Bodo knew where I would be according to “mutual doppler” – I chose to call him on my “self doppler” frequency – Which approach is best?

Summary



- CW – random, use “self doppler” offset for transmit
- CW – sked, use “mutual doppler” offset on receive
- Digital – random, use “self doppler” offset for transmit
- Digital – sked, use “mutual doppler” offset on receive
- Other thoughts?