Longpath experiment receiving beacon OA4B (Lima – Perù)

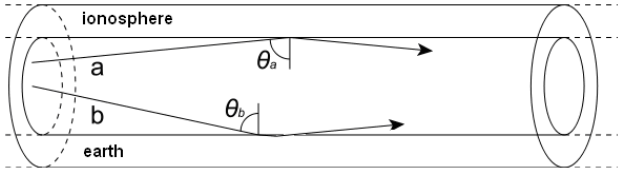
A waveguide model of the ionosphere

I used Faros software with a very fast internet connection (14 MB) and very precise clock, this software is able to detect and recognise the short path, long path or abnormally path. I conducted some experiments to highlight possible hypotheses of ducting ionospheric propagation. The beacon signal of OA4B was received over long path, with a skip of about 30,000 km but at the same time the signal was weaker over short path. The path was open simultaneously on 14 mhz and 18 Mhz bands. At the same time was detected the beacon ZL6B from New Zealand and VK6RPB from Perth - Australia. It highlights a possible wave guide in the Ionosphere. As the three beacons are over the same geodetic line. This mean a sort of wave circuit or guided propagation inside the ionosphere even possible during a minimum solar cycle.
This propagation opening is very short because the conditions that support propagation changes rapidly. May be is possible an adding action of gray line enhancements.

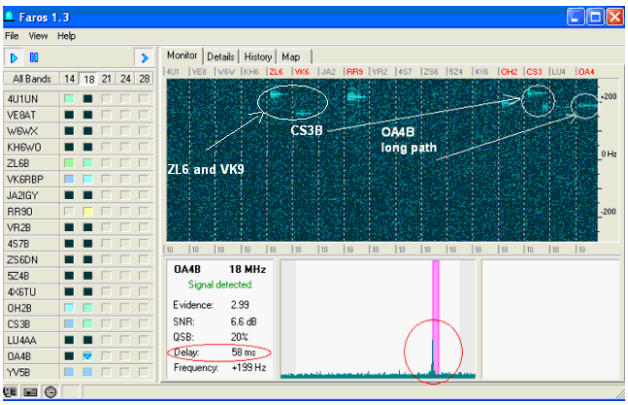
Observation: suspected of multiple detection of beacon CS3B : propagation was open via short path and long path , infact CS3B is over the same geodetic line linking the four beacons detected. But first of all I watch the outstanding reception of OA4B from both paths. This is also evidenced by spectral analysis of the signal received from beacon OA4B in the figure below.

- Ducting hypothesys: Ionosphere like a waveguide. In certain situation propagation could be support by ionospheric duct, where the signal is trapped, with very low loss or even a possible gain. We need any more research to prove this idea of propagation and we go on with more studies.

- The ionosphere like a whispering gallery.

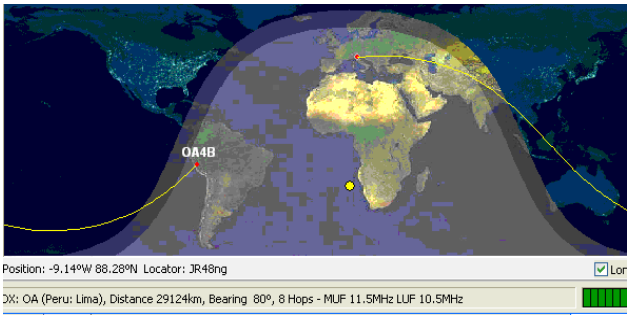


Date: 12.12.2008
UTC 11.30

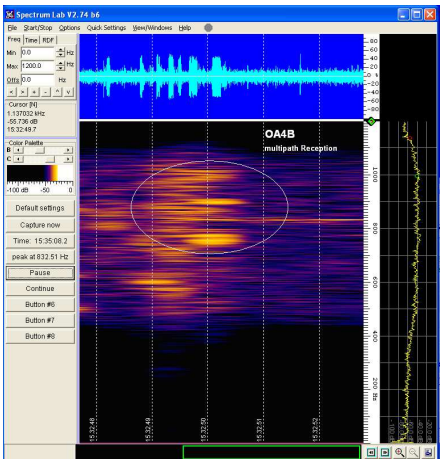


The Ionosphere as a Whispering Gallery
By Budden, K. G.; Martin, H. G.
Proceedings of the Royal Society of London. Series A, Mathematical and Physical Sciences, Volume 265, Issue 1323, pp. 554-569

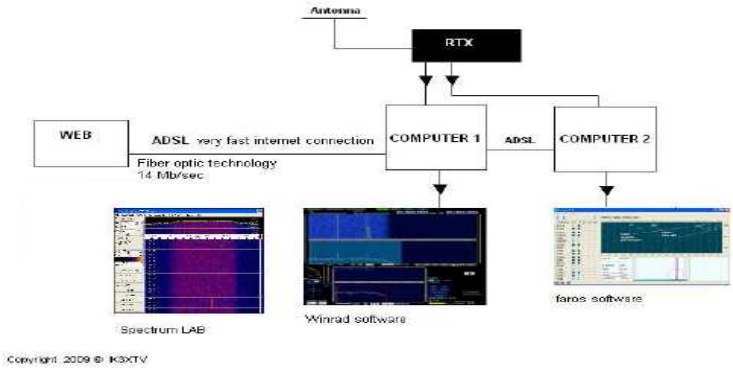
The propagation of radio waves of very low frequency to great distances is conveniently treated by regarding the space between the earth and the ionosphere as a wave-guide. Several authors have found that the least attenuated modes are profoundly affected by the earth's curvature. This effect is investigated for several models of the ionosphere. It is found, in particular, that for frequencies greater than about 30 ke/s some modes are possible for which the energy is concentrated in a region near the base of the ionosphere, and the field strength near the ground is small. It is useful to think of such modes as being composed of waves repeatedly reflected at the inside spherical surface of the ionosphere, the rays being chords of this sphere. By analogy with sound waves these modes are called `whispering gallery modes'. The theory uses wave admittance and reflexion coefficient variables because these satisfy differential equations which are convenient for integration using a digital computer. The curvature of the earth is allowed for by using the method of the modified refractive index, but the earth's magnetic field is neglected. Formulae for the mode condition and the excitation of the various modes by a transmitter are given and discussed. A new way of dealing with an ionosphere having a continuous electron density profile is presented. The results of some numerical calculations are given both for a sharply bounded homogeneous ionosphere and for an exponential profile of electron density.



spectrographic analysis of the received signal made with the software spectrum lab in order to
shows a trace of multi-path, the signal coming from both directions.



Technical equipment:



Software tools:
Faros Alex Shovkoplyas VE3NA
http://www.dxatlas.com/faros

WSJT (JT65A mode in HF) di Joe Taylor, K1JT
http://www.physics.princeton.edu/pulsar/K1JT/

WSPR di Joe Taylor, K1JT
http://www.physics.princeton.edu/pulsar/K1JT/wspr.html

SPECTRUM LAB di DL4YHF's Spectrum Lab
http://freenet-homepage.de/dl4yhf/spectra1.html

Reefrences

VLF Sferics Propagating in the Earth-ionosphere Waveguide di
AB Bhattacharya (piersproceedings China)
Wikipedia