

From: Eric Jacobsen

To: Anthony Serafini

Date: December 22, 2011

Subject:

Message:

Response to email of 12/22/2011, Ref #15730:

Re: Clarifying our frequencies of interest.

We're looking at two different modes of communication; underground to surface (often called 'Cave Radio'), and underground-underground communication for in-cave or in-mine (we just call this UnderGround Radio or UGR).

For the ground-surface 'Cave Radio' applications we want to be able to use the frequencies historically used for this application which are generally between 80-200kHz. The most commonly used frequencies appear to be 87kHz, 115kHz and 185kHz, but our preference is to not be restricted to only these frequencies. There may be material dependencies on the optimal frequency within this range for different geological conditions, rock permeability, etc., and this is one of the areas we'd like to explore.

Some more information on previous and existing applications can be found in the following links:

<http://www.caves.org/section/commelect/splnsc/splnsc08.pdf> - Page 3 shows a list of the Voice 'Cave Radio' frequencies at the time (1987). The technology and frequencies haven't changed much.

<http://bcra.org.uk/creg/heyphone/> - These are still in use in some places, and apparently still use the 87kHz frequency.

We are investigating wireless coupling to such systems and will be radiating on-frequency but at low power levels (likely less than 300mW) compared to typical Cave Radio systems.

For the underground-underground application we wish to use frequencies from 300kHz to about 2MHz. The general selection of this range is due to previous research indicating 500kHz to be a generally optimal frequency when no metal infrastructure is present (e.g., a natural cave), but the frequency increases in the presence of metal infrastructure. This was characterized in the 1970s and can be seen here in work by Cory:

<http://198.246.98.21/niosh/mining/pubs/pdfs/h0366028.pdf>

We plan to investigate automatic, real-time methods of determining the optimum operating frequency for practical units, and also desire for the units to be usable outdoors for use by rescuers or operators near mine or cave entrances.

The potential for incidental outdoor use is the primary motivation for request for an Experimental License. The majority of testing (and expected ultimate use of the devices) will be in underground environments where interference to 3rd parties will be extremely unlikely.

The requirement for use of the 300kHz to 2MHz region is two-fold; First to adapt to the propagation properties of the local geology in an underground environment, and, second, to provide enough bandwidth for low-rate video streams (e.g., 1Mbps) for real-time rescuer to command center video capability.

There is no expected requirement for use of frequencies between 200kHz-300kHz, although we may

wish to explore those if so allowed.

Thanks,

Eric Jacobsen
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