Appendix B – Signal Modelling

B1. Generic Scenario

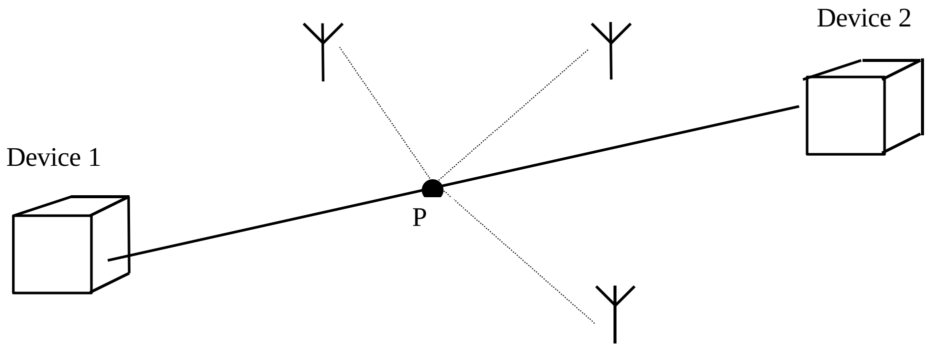

Figure B1: Generic cable and load model.

Figure B1 shows the simple generic scenario used in initial stages of modelling, consisting of a simple wired network with a number of mobile radio emitters spaced around it. The effect of the combined signal from the various radio emitters on a cable with a shielded device at each end is investigated. We take a single point P on the wire and look at the combined signal at this point P.

The RF sources will cause the propagation of a current along the wire and into the devices at each end. The effect of the induced current on the victim devices is described in Section 2 of the main report.

In Section 3 of the report we identify the features of the transmitted signals which pose a threat to electromagnetic compatibility with the device and characterise the features of individual transmitted signals and ensembles of signals, in the context of the threat to likely victim devices, including power, frequency and modulation induced aspects such as envelope power and bandwidth.

The processes involved are assumed to be linear and therefore, by the principle of superposition, the summation of signals can take place at any stage and in any order.

For initial consideration of these effects, a radiated signal appropriate to a system utilising MSK modulation is assumed although GMSK is considered in later stages of the work (see Appendix D).

A computer-based method for modelling the ensemble of electromagnetic emissions from a number of RF emitters was developed and used to simulate situations such as that shown in the above Figure B1 in two stages as follows:

Initially a single source near a wire is examined by modelling the signal at many points ("probe positions") along the wire.

As an example, a single RF source at a distance of 5m away from a cable of length 1.2m was modelled as shown in Figure B2.

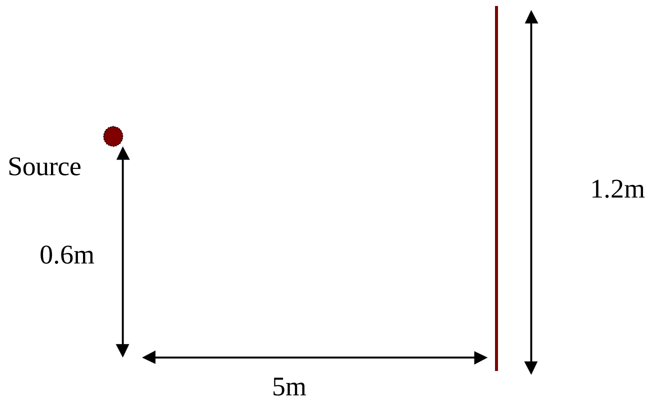

Figure B2: Simple single source model.

The source is assumed to be the origin of the coordinate system used.

We next assumed that the source emitted a more realistic signal than a simple CW carrier; initially a carrier transmitting a fixed data stream utilising MSK modulation and later considering the more complex case of GMSK.

After generating the MSK signal we propagated it using line of sight propagation to the wire. We examined 41 points on the wire and modelled the signal at each of these points.
The 41 points were taken to be evenly spaced by 0.03 m along the wire, starting with probe position 1 = (5,-0.6,0) and the second probe position = (5,-0.57,0) etc.....
These probe positions are represented in the following diagram by dots.

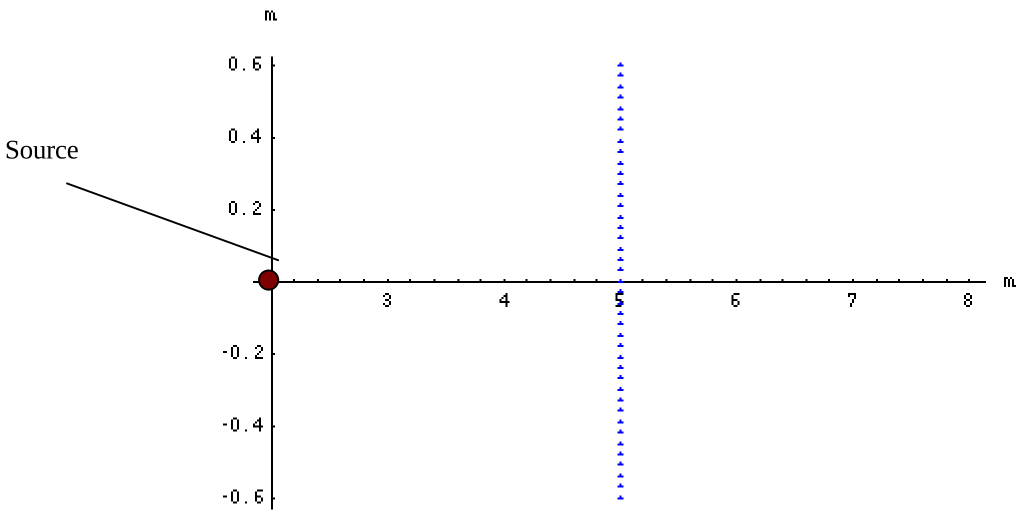

Figure B3: The single wiremodel represented by a number of probe positions.

Taking each of the 41 probe positions in turn, we generate the MSK signal at the source and then, using Line of Sight propagation we find the signal at this given probe position.

Once we have obtained the propagated signal we then sample this and produce a Fourier transform of the total signal at each probe.

B2. Test Model Set-up

In order to more closely model a realistic situation, a ground plane and a corner in the cable are now introduced into the model. We have also introduced signal normalisation.

The following diagram shows the test set-up with dimensions given in metres.

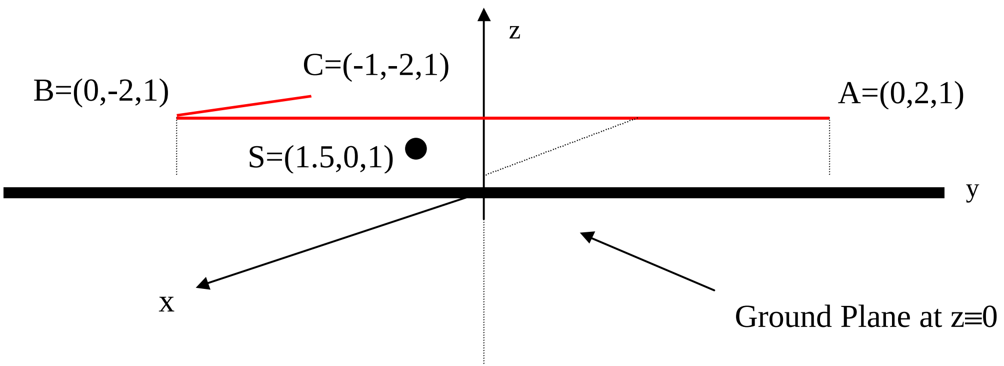

Figure B4: A cable and ground-plane model.

In reality it is likely that there will be a semiconductor device at the end, C, of the cable.

Taking into account the effect of the ground plane we need to look at image sources. We will have effectively, an image source positioned at the reflection of the real source in the ground plane, i.e. we have a second source at (-1.5, 0, -1). This image source will have the same frequency, phase and directional vector as the real source, and so has the same signal as the real source.

The power in the signal has been normalised to 2W (Since GSM phones work on 2W radiated power).

The program calculates the total signal at each probe in the direction of the probe, again for an assumed MSK modulated data stream. This signal is then sampled and a Fourier transform of this sampled signal is performed which provides the frequency components of the signal.

The final stage was then to repeat the modelling with more sources in the vicinity of the cable, the resulting Fourier transform data being passed to York University for inclusion as input data for the cable coupling models.