**Delivery Exercise A**

1) Propagation basics

1a) What is EIRP?

1a) Select three to four very important characteristics of any antenna and describe these including clear definitions if applicable.

1c) Derive an expression for free space loss. What is the fee-space loss in dB for a 20 GHz link from the geostationary orbit to Kjeller in Norway?

1d) Why is it important to model the noise in the receiver? A satellite receiver usually has an amplifier very close to the antenna. Why? Discuss it in terms of a cascaded network.

2) Wire antenna
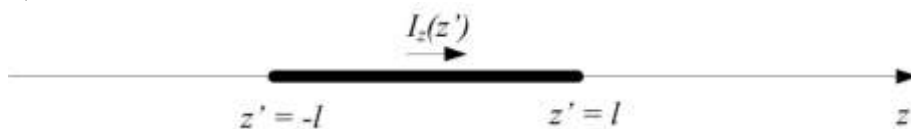
The figure shows a straight wire antenna of length $2l$ from $z'=-l$ to $z' = l$. The current distribution on the antenna is

$$I_z(z') = I_0 e^{-jk_0 z'}$$

where I_0 is constant and k_0 is the wave number in free space.

2a) Find the electric far-field.

2b) How long must the antenna be to get N lobes within $0 < \theta < \pi$? N is a positive whole number. Find an approximate simple expression for the number of lobes as function of l/λ, where λ is the wave length.

2c) Sketch the radiation diagram, i.e., the E-field relative amplitude as function of the angle θ for the cases $l/\lambda = 1$ and $l/\lambda = 3$.

3) Macro cell coverage

A mobile network operator wishes to provide 95 % successful communication at the fringe of macro cell coverage and analyses two cases of 6 dB and 10 dB location variability.

3a) What are the required fade margins?

3b) What is the average availability over the whole cell, assuming a path loss exponent of 4?

3c) Discuss the effects in link budget calculations if shadowing is neglected.