COMPARISON OF PROPAGATION LOSSES AT 900 MHZ AND 2100 MHZ

This is a brief comparison of propagation losses of electromagnetic radiation at 900 MHz and 2100 MHz.

Outdoor propagation losses at 900 MHz were modelled by the Okamura-Hata model.

Outdoor propagation losses at 2100 MHz were modelled by the COST231-Hata model, due to parameter range validity issues. Future work includes the use of the COST231 Walfisch-Ikegami model.

Comparison of propagation losses as a function of propagation distance are shown in Figure 1.

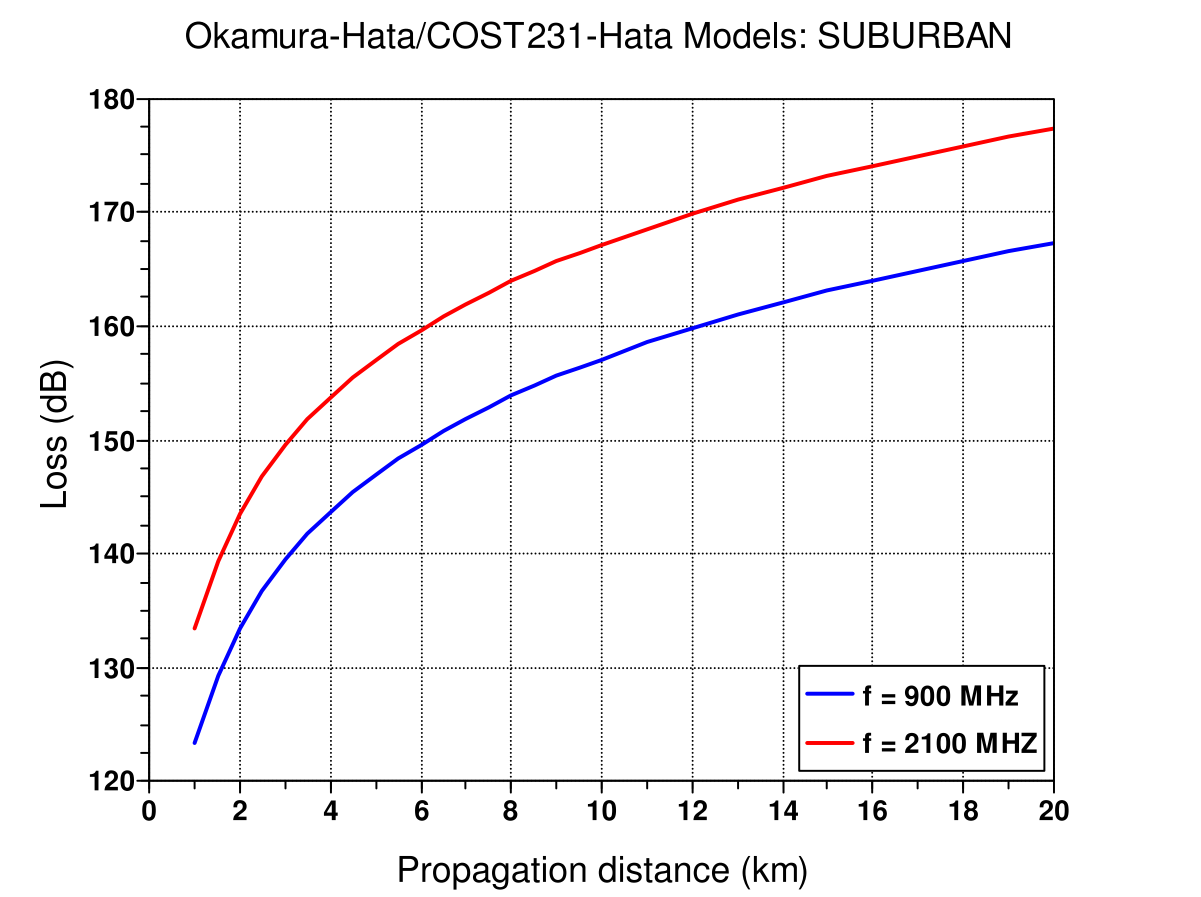

Figure 1

Indoor propagation losses at 900 MHz and 2100 MHz can be modelled by the ITU indoor attenuation model. This model is not highly accurate, but it is sufficiently well suited for the present purpose.

Figure 2 shows the expected attenuation at 900 MHz and 2100 MHz in an “office area” scenario.

For the relatively short indoor propagation distances, losses at the two frequencies are roughly equal.

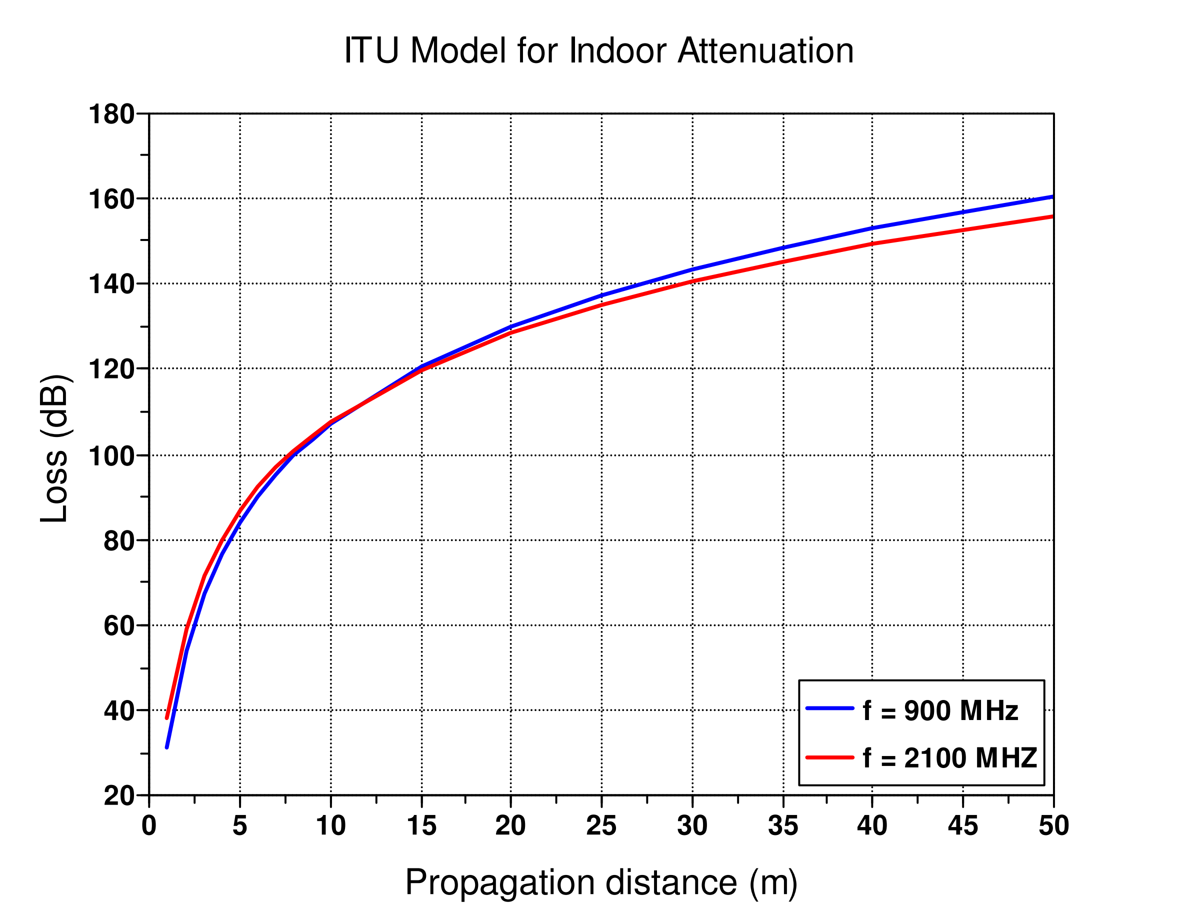

Figure 2

We now consider a more realistic scenario for comparing the propagation losses at the two different frequencies:

- Signal will first propagate from the transmitter in an outdoor environment,
- It will then suffer building penetration loss,
- After which it will continue propagation to the receiver in an indoor environment.

We use the following parameter values for this full path scenario:

- Signal propagates at 900 MHz and 2100 MHz outdoors for a fixed distance of 1 km
- Building penetration loss is given by the Qualcomm Deployment Guidelines as:
    - 14.2 dB @ 900 MHz
    - 12.8 dB @ 2100 MHz
- Signal propagates at 900 MHz and 2100 MHz indoors for a distance of 1 – 5 m in a typical office scenario.

Figure 3 shows the total path propagation loss at 900 and 2100 MHz. As expected, the main difference is in the outdoor propagation losses. Indoor propagation loss is roughly the same at 900 and 2100 MHz, and in the context of the total propagation loss, the building penetration loss difference is negligible.

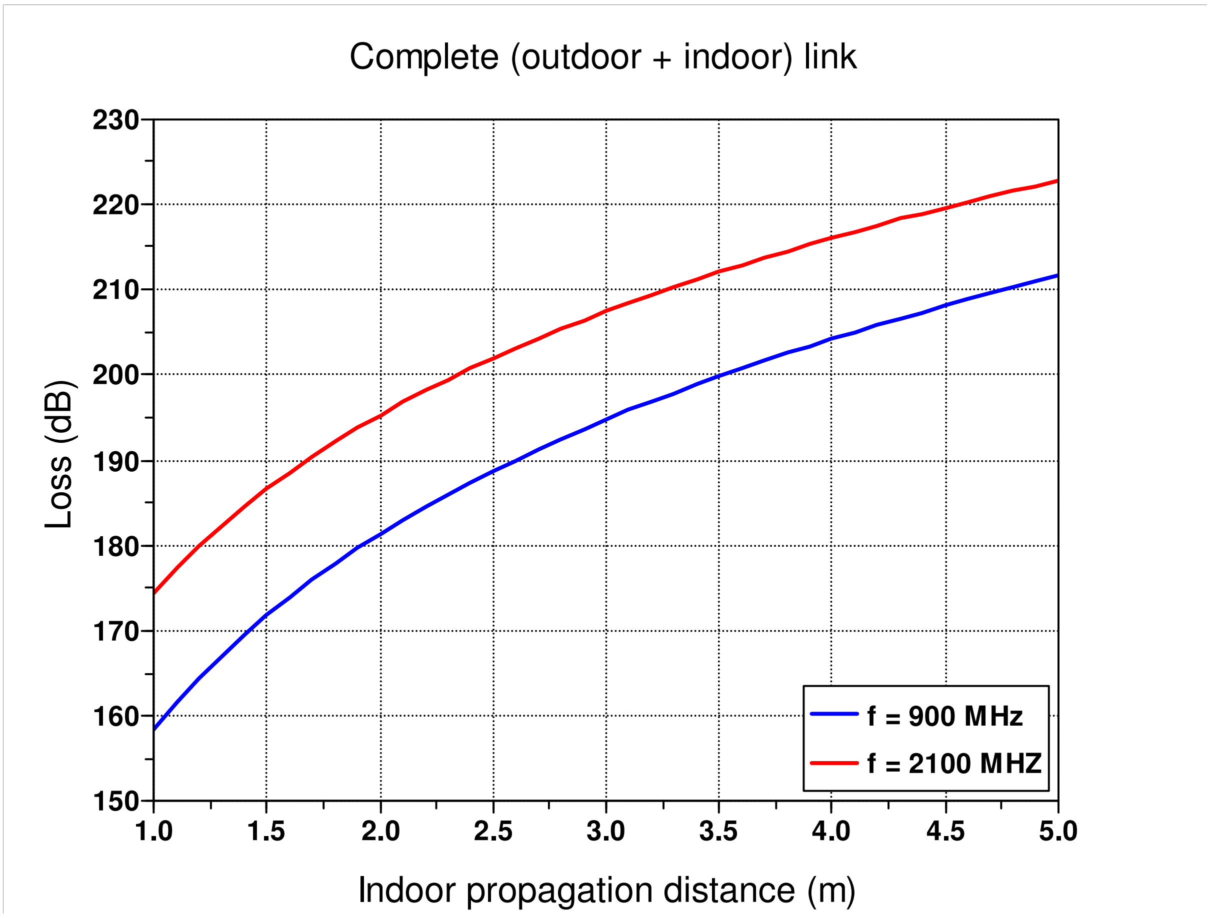

Figure 3

The approximate 10 dB difference between the loss at 900 MHz and 2100 MHz still translates into an important infrastructural advantage. Assuming simple circular cells, the number of base stations (*N*) required to cover an area (*Area*) is given by:

$$N = \frac{Area}{\pi \cdot r^2}$$

where *r* is the cell radius. Cell radius is determined by the max allowed path loss.

Fewer base stations are required at 900 MHz due to smaller propagation losses. The ratio of required number of base stations in the two cases can be expressed as

$$N_R = \frac{N_{2100}}{N_{900}} = \left(\frac{r_{900}}{r_{2100}}\right)^2$$

If target propagation loss is 150 dB, Figure 1 shows that the corresponding propagation distance at 900 MHz is 6 km, while it is 3 km at 2100 MHz. From the above equation, $(6\text{ km}/3\text{ km})^2 = 4$ times more base stations are required at 2100 MHz to cover the same physical area.

VERSION HISTORY

Version 1 (30 MAR 2009): First release.