Source: **Motorola**
Title: **SCM Urban Canyon Model Verification**
Document for: **Discussion**

1. SUMMARY

The urban canyon model, which is described in the current version of the SCM text[1], is examined and simulation results are described for validation purposes.

Results indicate a match to expected values.

Since the Urban Canyon model gathers its statistics from a mix of locations, the canyoning effects are diluted, limiting the occurrence of the very narrow spreads that are characteristic of the effect. Some potential ideas are presented to modify the model accordingly.

2. URBAN CANYON PROPAGATION MODELS

In [2] and [3], an Urban Canyon model was presented which was based on measurements in a dense urban non-line-of-sight area. From these measurements, as seen in Figure 1, the canyon effects can be seen to varying degrees. In this figure the direction of arrival is shown for the six strongest paths. From this measurement data, calculations with the per-path AS = 35˚ produce an average composite AS = 68.7˚.

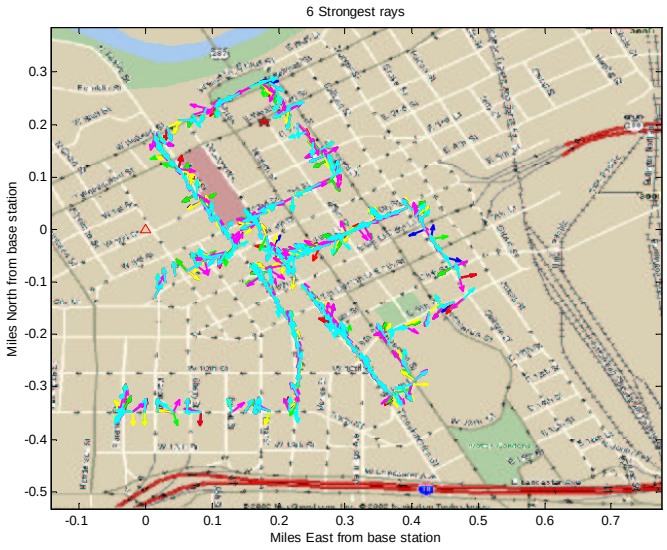

Figure 1, Measurements showing Urban Canyon directional effects

In the model, a multi-step procedure[1] is given, which characterizes the AoAs of the various delayed paths, resulting an AoAs for the six path components.

In the first step, a random street orientation is chosen, and the AoA of the strongest path is selected from the CDF shown in Figure 2.

This figure is plotted from 0-180˚ with negative angles being equally likely. Several regions can be seen. At 0˚ and 180˚, there is a high probability of seeing AoAs of +/- 15 degrees. (Note that this is the average AoA and does not include the 35˚ per-path angle spread.) At

around 90˚ there is a high probability of seeing signals coming from side streets, between buildings, or the rooftops of shorter buildings.

After this AoA is established, the AoAs of the remaining paths are chosen from a second CDF shown in Figure 3, where the reference angle of zero degrees is set to be the direction of the AoA of the strongest path.
This figure illustrates the relative behavior of the various paths with respect to the strongest path. Note that there is a high probability of seeing paths that are aligned with the strongest path.

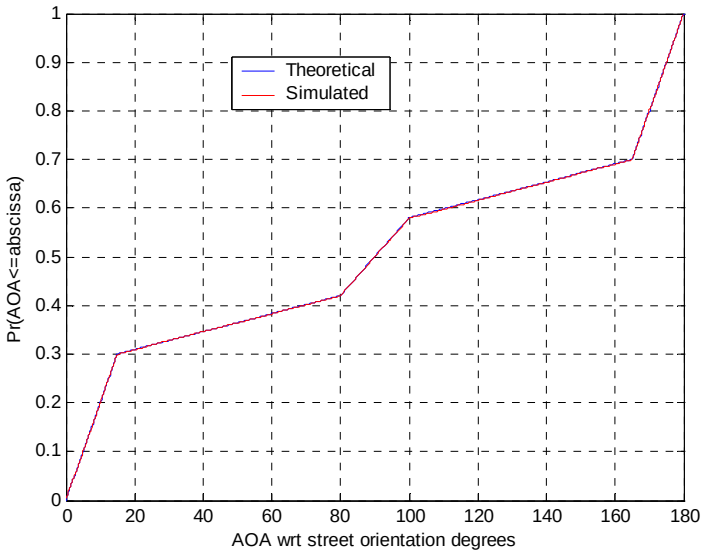

Figure 2, CDF of the strongest path

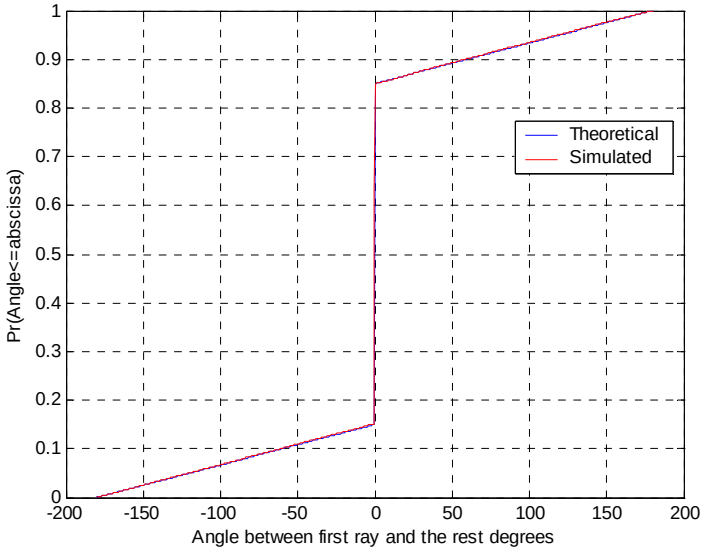

Figure 3, CDF of paths 2-6

As shown in Figures 2 & 3, the simulated data is drawn from the theoretical distributions represented by the CDFs, and easily reproduces these distributions as shown.

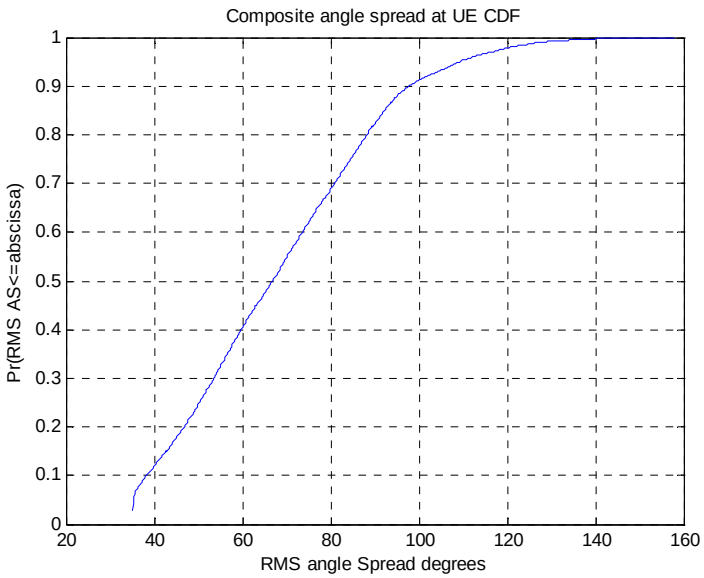

Figure 4 Simulated composite AS at UE CDF

From the model, Figure 4 illustrates the composite AS at the UE. The mean value is 68˚, which is very close to the result from the measured data used to establish the statistics of the urban canyon model. From this data, the measured value was 68.7˚.

Although the model is matching the overall measurements as expected, the percentage of very narrow canyoning effects is limited. This is due to the statistics being collected across numerous locations. As a possible way to improve the model, a % of locations with statistics that represent the urban canyon may be defined. Then a more narrow set of AoAs would be applied. This may be the subject of another contribution.

3. CONCLUSION

The SCM Urban Canyon model was simulated according to the specifications in [1].

Results for composite UE AS match the values from measurements. The mean value was simulated to be 68˚, with the original calculations from measurements being 68.7˚.

A possible improvement to the model is proposed, where the % of locations that experience Urban Canyon effects would be set as a parameter, then statistics which more closely model the Urban Canyon would be used for those locations.

4. REFERENCES

[1] SCM Ad-Hoc, SCM-083, "SCM Text ver 2.1", Teleconference, December 19th, 2002.

[2] Motorola, SCM-067, "Urban Canyon & Parameters", Quebec City, October 22nd, 2002.

[3] Motorola, SCM-064, "Polarization and Path Statistics", Teleconference, October 10th, 2002.