RS-RS, and RS-MS NLOS Multihop Path Loss Model

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Purpose:
To further clarify the NLOS path model for RS-RS and RS-MS with a comparison to WINNER model

Introduction

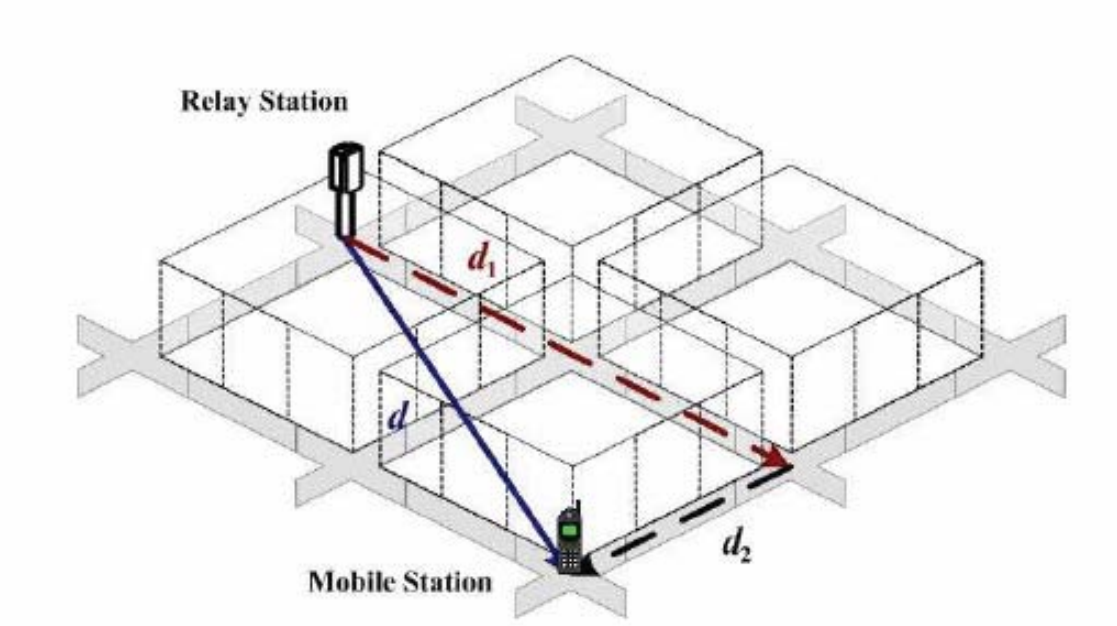
- In this contribution a comparison is made of path loss models for the RS-RS, or RS-MS link in a multihop network, where both ends of the link are below rooftop and are not located on the same street

RS-MS (NLOS)

RS and MS below rooftop and on different streets

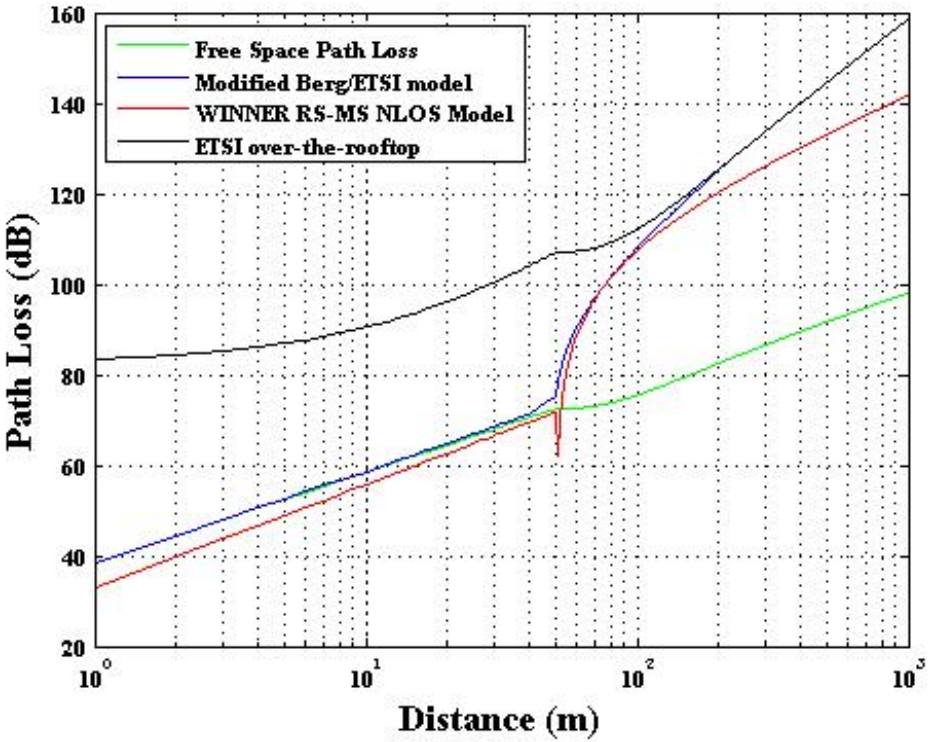
- For this case the WINNER [1] channel model for an urban microcell is proposed in [2], with a frequency correction factor:-

$$P(dB) = 65 + 0.096d_1 + (28 - 0.024d_1)\log(d_2) + 20\log\left(\frac{f(GHz)}{5}\right)$$



RS-MS (NLOS)

RS and MS below rooftop and on different streets



For the WINNER model and the modified Berg/ETSI model distance is the distance traversed around the streets. For free space loss and the ETSI over-the-rooftop loss distance is the Euclidean distance (straight line distance between RS and MS). Distance plotted is distance traversed around the streets.

- Plot shows a comparison of the WINNER channel model and the below rooftop model proposed in [4]*
  - d_1=50m
  - d_2=950m
- A discontinuity can be seen at the junction when going from the WINNER LOS to the WINNER NLOS model
- The model from [4] is a combination of:-
  - Advanced LOS model [3]
  - Berg NLOS model [4]
  - ETSI over-the-rooftop model [4]
- The model from [4] shows good agreement with measured results (see following slides)

$*\min(modified\_Berg, ETSI\_over\_the\_rooftop)$

Microcell path loss measurements
Central London

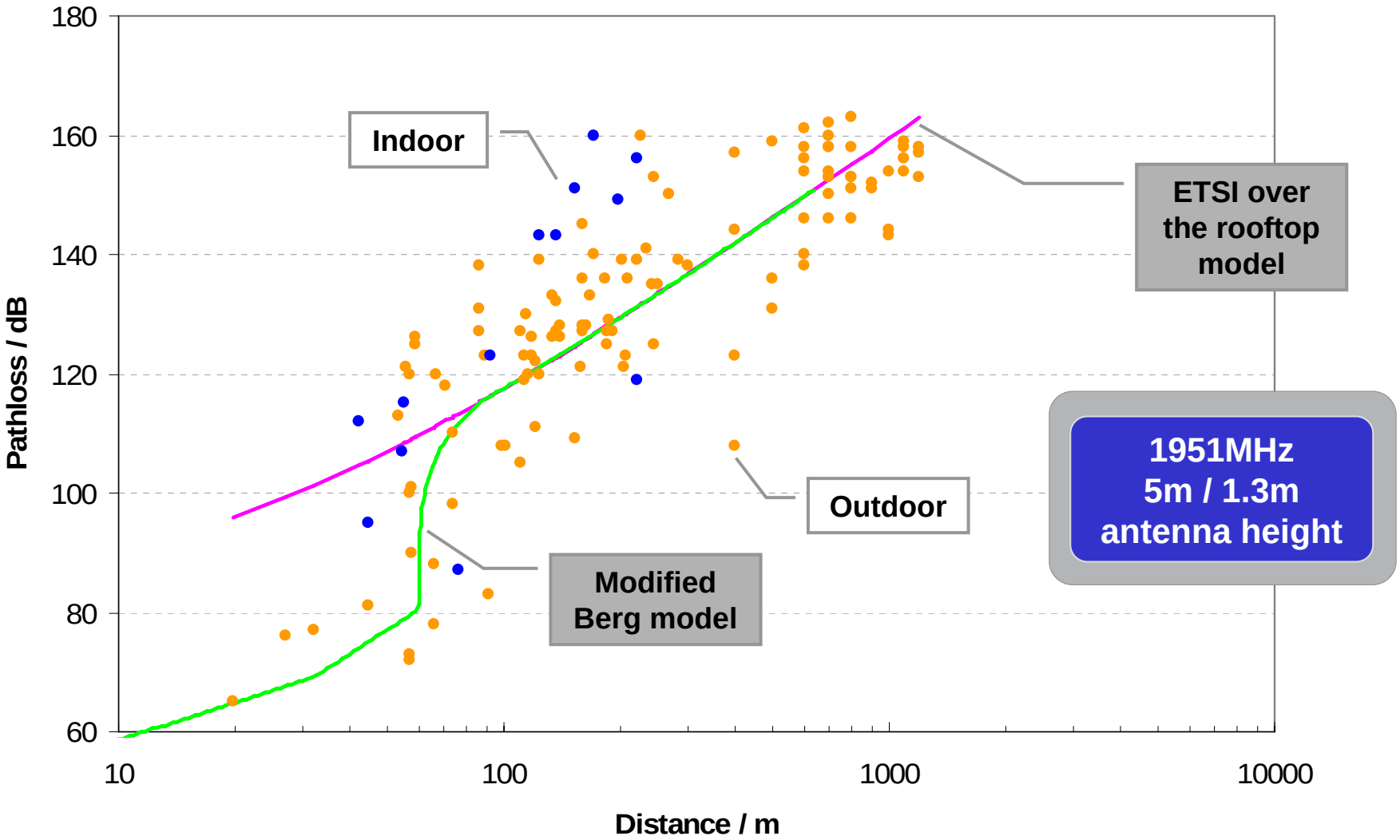
The “circular car park” base site

- The trial was in central London
- Three “base” sites were used, where the antenna was at a height of 5m

Gower Place mobile location

- The “mobile” was a trolley with an antenna height of ~1.3m

Microcellular Propagation Results



Microcellular Measurements
Conclusions

- Excellent agreement is observed between the predicted and measured values
  - The discontinuity in the modified Berg model at ~60m corresponds well with the dimensions of the street layout immediately surrounding the base site
  - Beyond 100m the ETSI over the rooftop model closely tracks the experimental measurements for outdoor locations
  - Comparison of indoor and outdoor locations suggests a penetration loss of ~12dB

Summary and Recommendations

- WINNER LOS and NLOS models have a discontinuity at the street junction and the NLOS model appears to underestimate the path loss
- Recommend modified Berg/ETSI path loss model for RS-MS NLOS case
  - Shows good agreement with measured results in central London at 2GHz

References

[1] ‘Final report on link level and system level channel models’, IST-2003-507581 WINNER, D5.4 v.1.4, Nov. 18th, 2005

[2] ‘Channel Models and Performance Metrics for IEEE 802.16j Relay Task Group’, D.Chen, I-Kang Fu, M.Hart, W.C.Wong, IEEE C802.16j-06/020, 1/5/2006

[3] ‘Advanced LOS Path Loss Model in Microcellular Mobile Communications’, Y.Oda, K.Tsunekawa, M.Hata, IEEE Trans VT-49, No.6, Nov. 2000, pp.2121-2125

[4] ‘Below Rooftop Path Loss Model’, Dean Kitchener et al., IEEE C802.16j-06/010, 1/5/2006