URBAN ART-ART Path Loss Model

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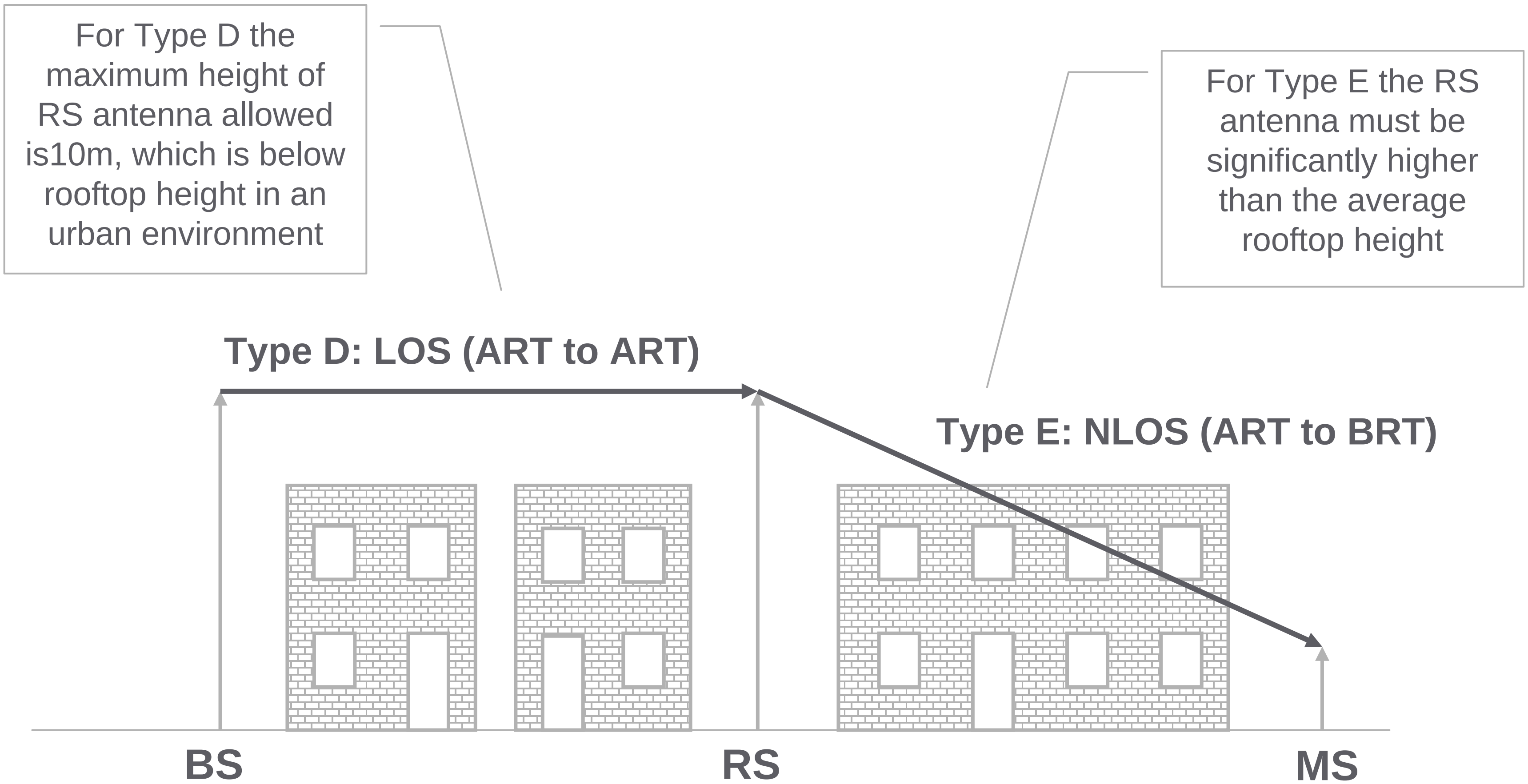
Purpose:
To address the missing path loss model in 802-16j-06-013r1 by including a path loss model for Urban ART-ART case

Introduction

- The Type D LOS pathloss model specified in IEEE 802.16j-06/013r1 for ART to ART propagation is not suitable for use in an urban environment
  - Average rooftop heights in the urban environment are greater than the maximum receive antenna height of 10m allowed by the Type D LOS pathloss model
- Furthermore, the Type D LOS pathloss model is incompatible with the Type E COST 231 Walfisch-Ikagami pathloss model specified in IEEE 802.16j-06/013r1 for ART to BRT NLOS propagation in an urban environment
  - The Type E NLOS pathloss model requires that the height of the base station antenna be greater than the average rooftop height to avoid large prediction errors

Incompatibility of Type D and Type E Pathloss Models in an Urban Environment



Urban LOS ART to ART Pathloss Model

- An additional category of pathloss model is proposed, specifically for use in an urban environment where the transmit (e.g., BS) and receive (e.g., RS) antennas are located above rooftop
- The model is based on the COST 231 Walfisch-Ikagami pathloss model, modified to remove the rooftop to street diffraction component

Urban LOS ART to ART Pathloss Model

> The basic transmission loss is composed of two terms: free space loss (L_0) and multiple screen diffraction loss (L_{msd})
  - The rooftop-to-street diffraction and scatter loss (L_{rts}) component of the NLOS COST 231 Walfisch-Ikagami model is neglected

$$L = \begin{cases} L_0 + L_{msd} & \text{for } L_{msd} > 0 \\ L_0 & \text{for } L_{msd} \le 0 \end{cases}$$

Free Space Loss

> The free space loss is given by:

$$L_0(dB) = 32.4 + 20\log(d / km) + 20\log(f / MHz)$$

Multiscreen Diffraction Loss

> For the multiscreen diffraction term various parameters have to be defined that describe the environment:
  - Base station antenna height, h_{Base}
  - Average rooftop height, h_{Roof}
  - Building separation (building centre-to-building centre) b

> The multiple screen diffraction term represents the propagation over multiple rooftops and this is given by the following expression:

$$L_{msd} = L_{bsh} + k_a + k_d \log\left(\frac{d}{km}\right) + k_f \log\left(\frac{f}{MHz}\right) - 9\log\left(\frac{b}{m}\right)$$

L_{bsh}

- The term L_{bsh} describes the dependence of the loss on the height of the BS antenna

$$\Delta h_{Base} = h_{Base} - h_{Roof}$$

$$L_{bsh} = \begin{cases} -18\log\left(1+\dfrac{\Delta h_{Base}}{m}\right) & \text{for } h_{Base} > h_{Roof} \\ 0 & \text{for } h_{Base} \le h_{Roof} \end{cases}$$

k_a

- The term k_a represents the increase of the path loss for base station antennas below the rooftops of the adjacent buildings

$$k_a = \begin{cases} 54 & \text{for } h_{Base} > h_{Roof} \\ 54 - 0.8\dfrac{\Delta h_{Base}}{m} & \text{for d} \geq 0.5\text{km and } h_{Base} \leq h_{Roof} \\ 54 - 0.8\dfrac{\Delta h_{Base}}{m}\dfrac{d/km}{0.5} & \text{for d} < 0.5\text{km and } h_{Base} \leq h_{Roof} \end{cases}$$

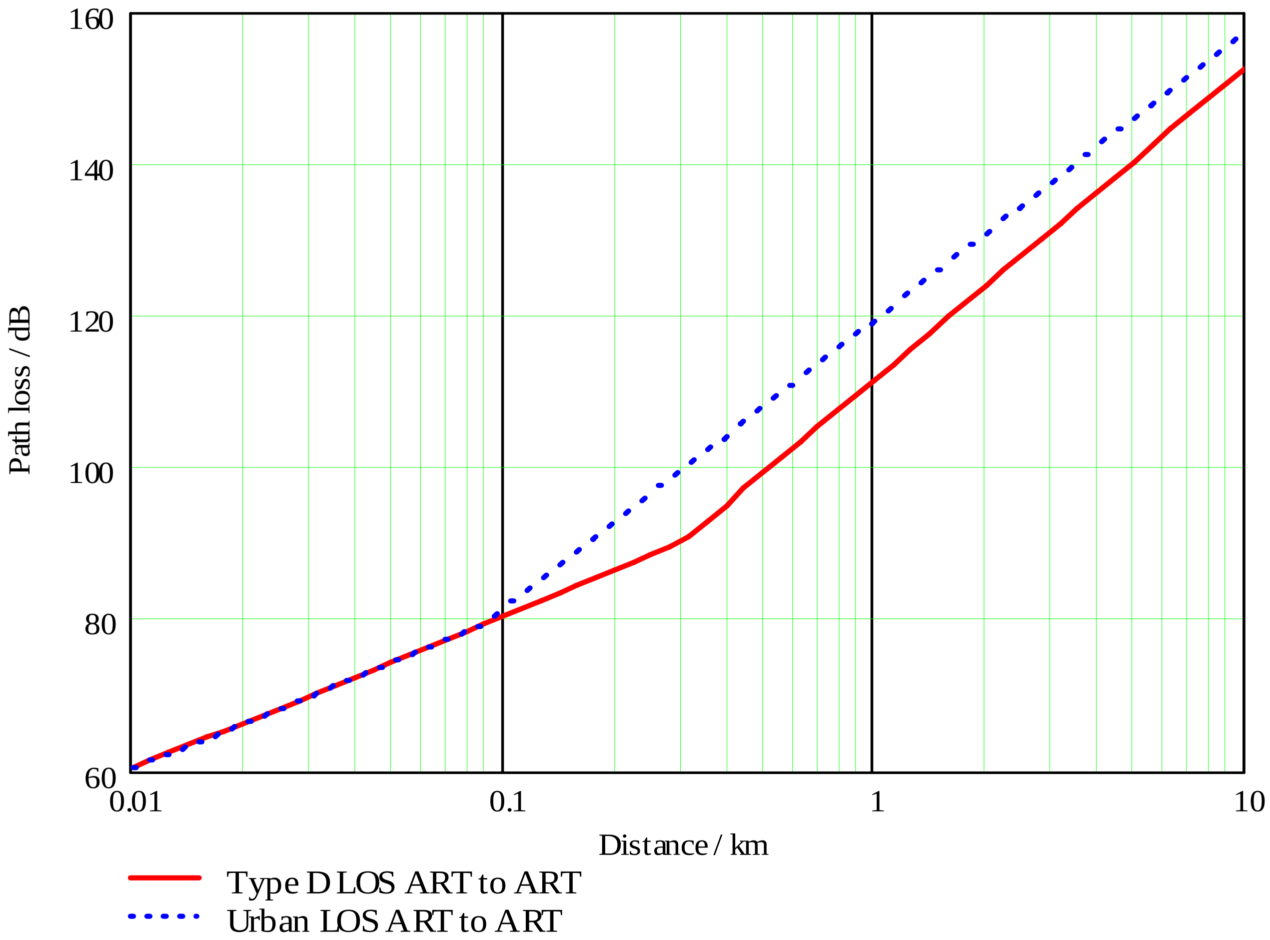
k_d and k_f

> The terms k_d and k_f control the dependence of the multi-screen diffraction loss on distance and radio frequency, respectively

$$k_d = \begin{cases} 18 & \text{for } h_{Base} > h_{Roof} \\ 18 - 15\dfrac{\Delta h_{Base}}{h_{Roof}} & \text{for } h_{Base} \le h_{Roof} \end{cases}$$

$$k_f = -4 + 1.5\left(\frac{\text{f/MHz}}{925} - 1\right)$$

Comparison of Type D and Proposed Urban LOS ART to ART Pathloss Models



b : 60m
h_{Roof} : 25m
h_{Base} : 30m
h_{RS} : 30m