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Supplemental Information – Path loss calculation

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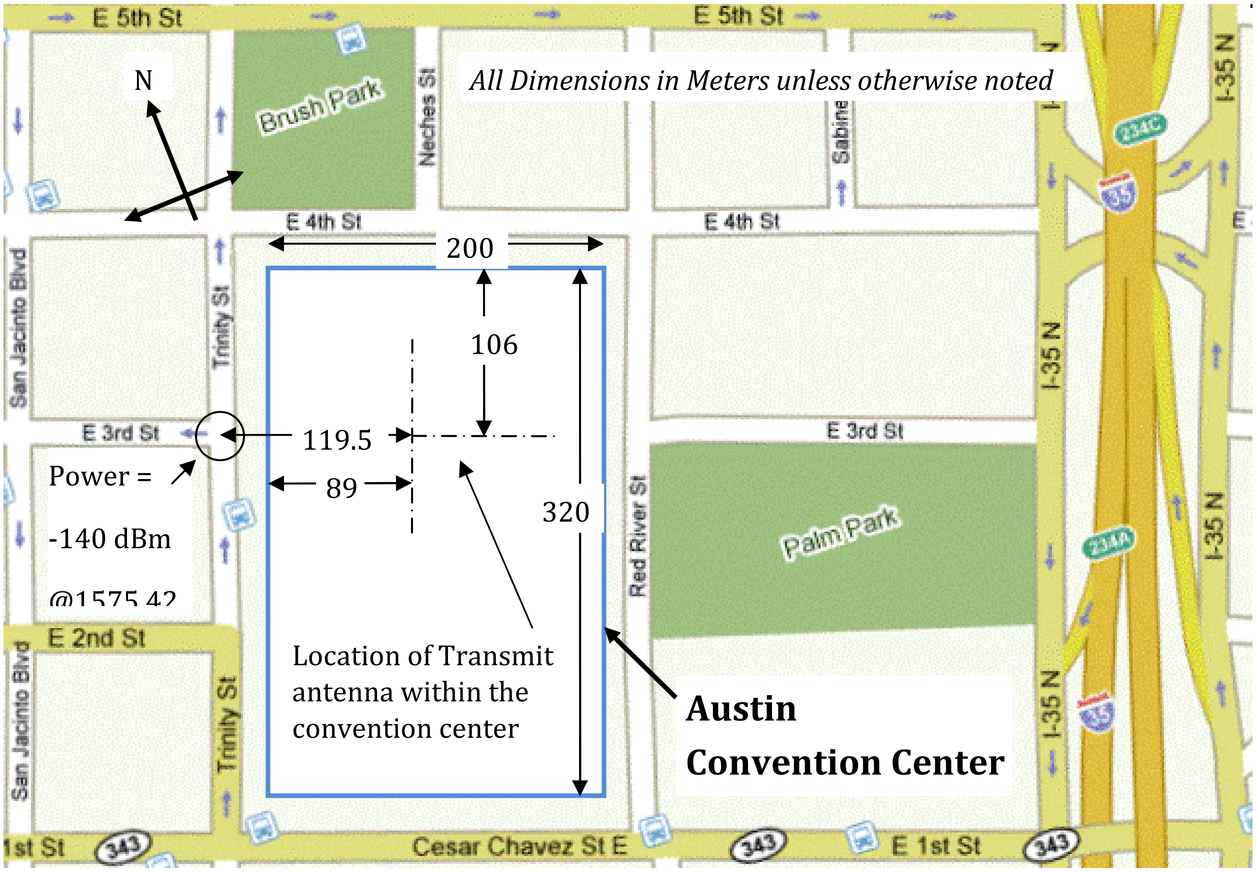

Figure 1: Austin convention Center at 30° 15' 48" N Latitude, 97° 44' 26" W. Longitude

We must calculate the theoretical path loss from the transmit antenna to the nearest point at 100' from the building exterior (see figure 1). The transmit antenna is 89 meters from the outer wall and 119.5 meters from the circled region in figure 1. The path loss, according to the Friis formula is:

$$(1) \quad loss(dB) = 10*\log(Gt*Gr(\lambda/4\pi d)^2)$$

Where f = frequency (MHz) and Gt and Gr are the transmit and receive antenna gains and d is the distance . According to NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management (MRP), section 8.3.28, devices radiating GPS frequencies must comply with section 6:

> "The maximum equivalent isotropically radiated power (EIRP) must be such that the calculated emissions are no greater than -140 dBm/24 MHz as received by an isotropic antenna at a distance of 100 feet (30 meters) from the building where the test is being conducted. The calculations showing compliance with this requirement must be provided with the application for frequency assignment and should be based on free space propagation with no allowance for additional attenuation (e.g., building attenuation.)"

Assuming isotropic radiation (G=1) on both transmit and receive antennas, the Friis formula in (1) predicts a path loss of $10*\log((.190/4*\pi*119.5)^2)$ = 78 dB.

Working backwards from the -140 dBm constraint in NTIA MRP 8.3.28 section (6), the allowed power input to an isotropic transmit antenna is -140 + 78 = -62 dBm. Because the transmit antenna has a maximum gain of +3 dBi, the maximum transmit power cannot exceed **-65 dBm.**

[1] From J. S. Lee and L. E. Miller, *CDMA Systems Engineering Handbook*. Boston: Artech House, 1998; and NTIA's LMS calculator help file.