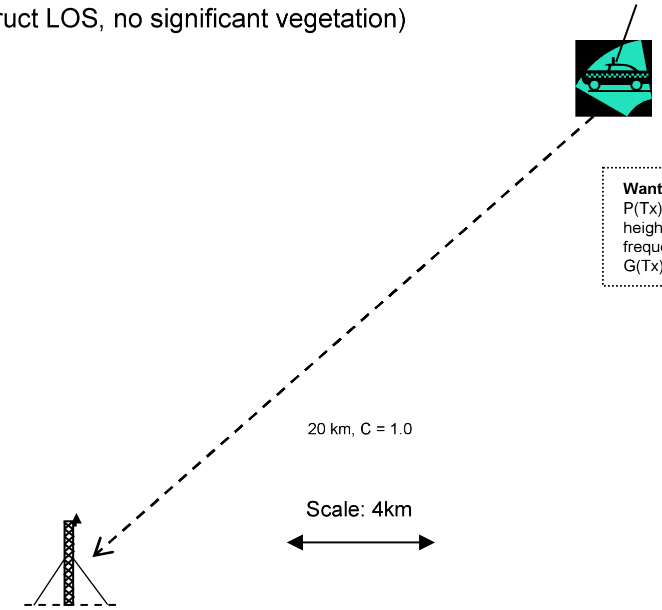
Co-sited Tx and Rx Interference – CIV-GND-VHFUHF-INT-2 scenario 2a

Initial scenario with ‘wanted’ VHF Tx to Rx on base station mast

Baseline obstruction version (flat terrain, no buildings high enough to obstruct LOS, no significant vegetation)
‘suburban’ noise level > receiver sensitivity S(Rx)

- The initial scenario shows a typical vehicle mounted VHF mobile Tx of moderate power, transmitting to a base station dipole antenna mounted at 30m height near the top of a base station mast.
- The bandwidth is 25kHz, typical for VHF and the receiver is externally noise limited.
- There is adequate SNR margin at the base station for a connectivity of 1.0.
- It is planned to place a low power (<1W) Tx on the same mast with a different centre frequency but a very small portion of its bandwidth overlapping with the wanted Tx.



Wanted Tx
P(Tx) = 20W
height (Tx) = 3m
frequency = 250 MHz, BW = 25kHz
G(Tx) = 0 (omnidirectional antenna gain)

Base Station Rx
frequency = 250 MHz, BW = 25kHz
G(Rx) = 0 dB (omnidirectional dipole antenna)
height (Rx) = 30m
noise = -114dBm at f = 250MHz and BW = 25kHz

- Connectivity (C) for a link is related to the signal to noise (SNR) at the Rx.
- This is related to the received signal strength from the Tx, the Rx sensitivity (S) and the external radio noise.
- For example a 10dB SNR results in C = 0.9, with connection 90% of the time and outage 10% of the time.
- The higher the SNR, the higher the connectivity.

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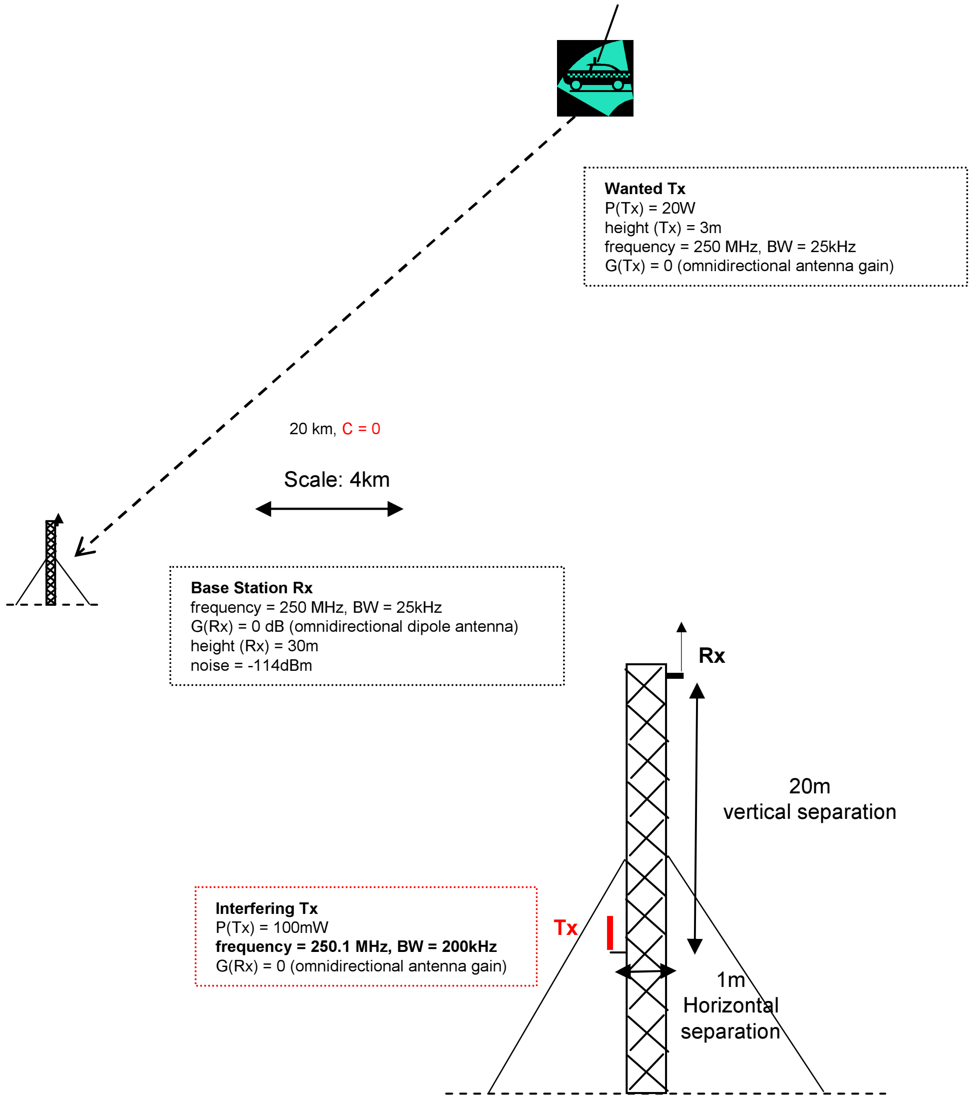
Co-sited Tx and Rx Interference – CIV-GND-VHFUHF-INT-2 scenario 2b

Addition of possible VHF ‘interferer’ Tx to base station mast, co-sited with ‘wanted’ VHF Rx.

- A low power (100mW) Tx and dipole antenna is placed on the same mast as the Rx antenna, 20 metres below it and 1 metre across from it.
- The Tx has a different centre frequency (250.1 MHz) but a small portion (12.5kHz) of its 200kHz bandwidth overlaps with the wanted Tx 25kHz bandwidth at the top end.
- Even though it may seem this small Tx power and bandwidth overlap would not affect the reception of the wanted mobile Tx, it actually has a *signal strength in the Rx bandwidth significantly more than the wanted signal* at the Rx antenna. **Hence the connectivity is reduced to zero.**
- The vertical separation required to reduce the Tx signal to the same as the wanted signal at the Rx is 70 metres, which is not possible with this mast. Even then the connectivity is still just on zero and the wanted link is still not operational. To lift connectivity to 0.8, the vertical separation would need to be 105 metres, which is also not possible with this mast.

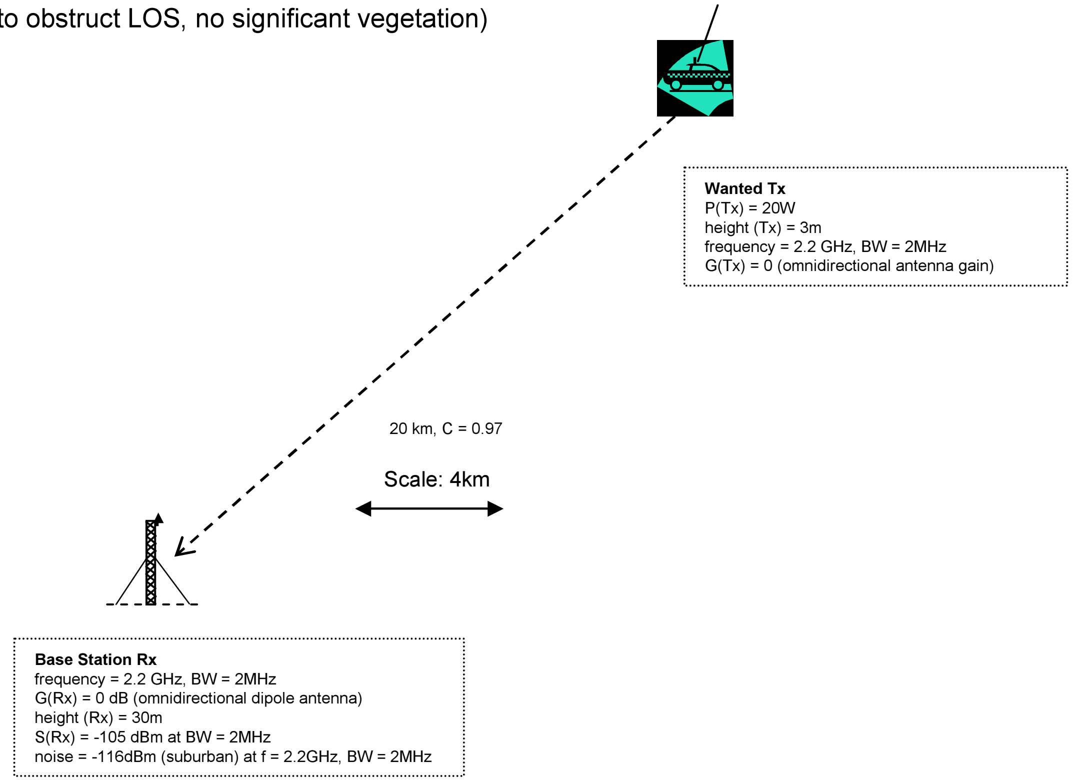


Co-sited Tx and Rx Interference – CIV-GND-VHFUHF-INT-2 scenario 2c

Initial scenario with ‘wanted’ UHF Tx to Rx on base station mast

Baseline obstruction version (flat terrain, no buildings high enough to obstruct LOS, no significant vegetation)
receiver sensitivity S(Rx) > ‘suburban’ noise level

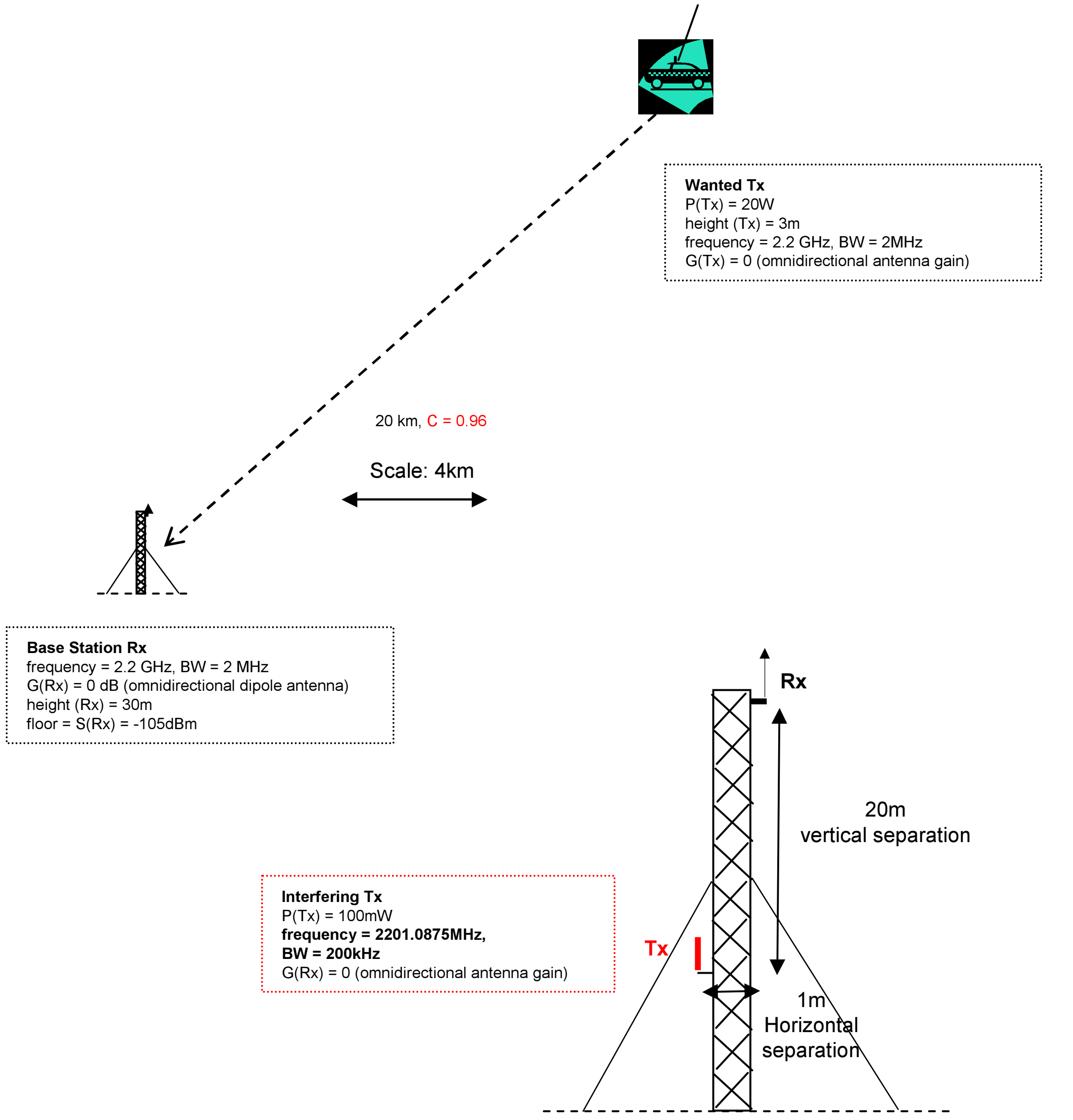
- It is interesting to examine the same scenario at UHF, rather than VHF, in this case 2.2 GHz (2,200 MHz). At UHF, a wider bandwidth (BW) is possible and in this case it is 2MHz (2,000 kHz) for the wanted link.
- The background noise floor is lower at this higher frequency, but the wider Rx BW allows more noise in so the level in the Rx is similar. However the much wider BW increases the Rx sensitivity by more and it is above the background noise, so the system is internally noise limited and S(Rx) is the noise floor.
- The free space loss is higher for UHF than VHF, but ground reflection is lower, and the signal strength at the Rx is the same. Because the noise floor is higher than the VHF case, the SNR is lower and hence connectivity is lower at 0.97.
- It is decided to place a low power UHF transmitter on the mast with the same amount of bandwidth overlap as the VHF case.



Co-sited Tx and Rx Interference – CIV-GND-VHFUHF-INT-2 scenario 2d

Addition of possible 'interferer' UHF Tx to base station mast, co-sited with 'wanted' UHF Rx.

- A low power (100mW) UHF Tx and dipole antenna is placed on the same mast as the UHF Rx antenna, 20 metres below it and 1 metre across from it.
- The Tx has a different centre frequency (2201.0875 MHz) but the same portion (12.5kHz) of the same 200kHz bandwidth as the VHF case overlaps with the wanted Tx 2MHz bandwidth, again at the top end.
- In contrast with the VHF case, the isolation between Tx and Rx antennas, with the same vertical and horizontal separations, is far higher due to the shorter wavelengths (14cm versus 1.2m).
- The interference from the Tx at the Rx is only slightly higher than the Rx sensitivity S(Rx), and the connectivity is very slightly reduced to C = 0.96.
- **So the shorter wavelengths at UHF can be seen to make Tx-Rx isolation easier for the same size masts.**
- If the interferer Tx frequency were moved so it was completely within the Rx bandwidth, to 2200.5 MHz for example, then the interferer signal at the Rx would be well above the Rx sensitivity but still less than the wanted signal, and the connectivity would be reduced to C = 0.37.



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