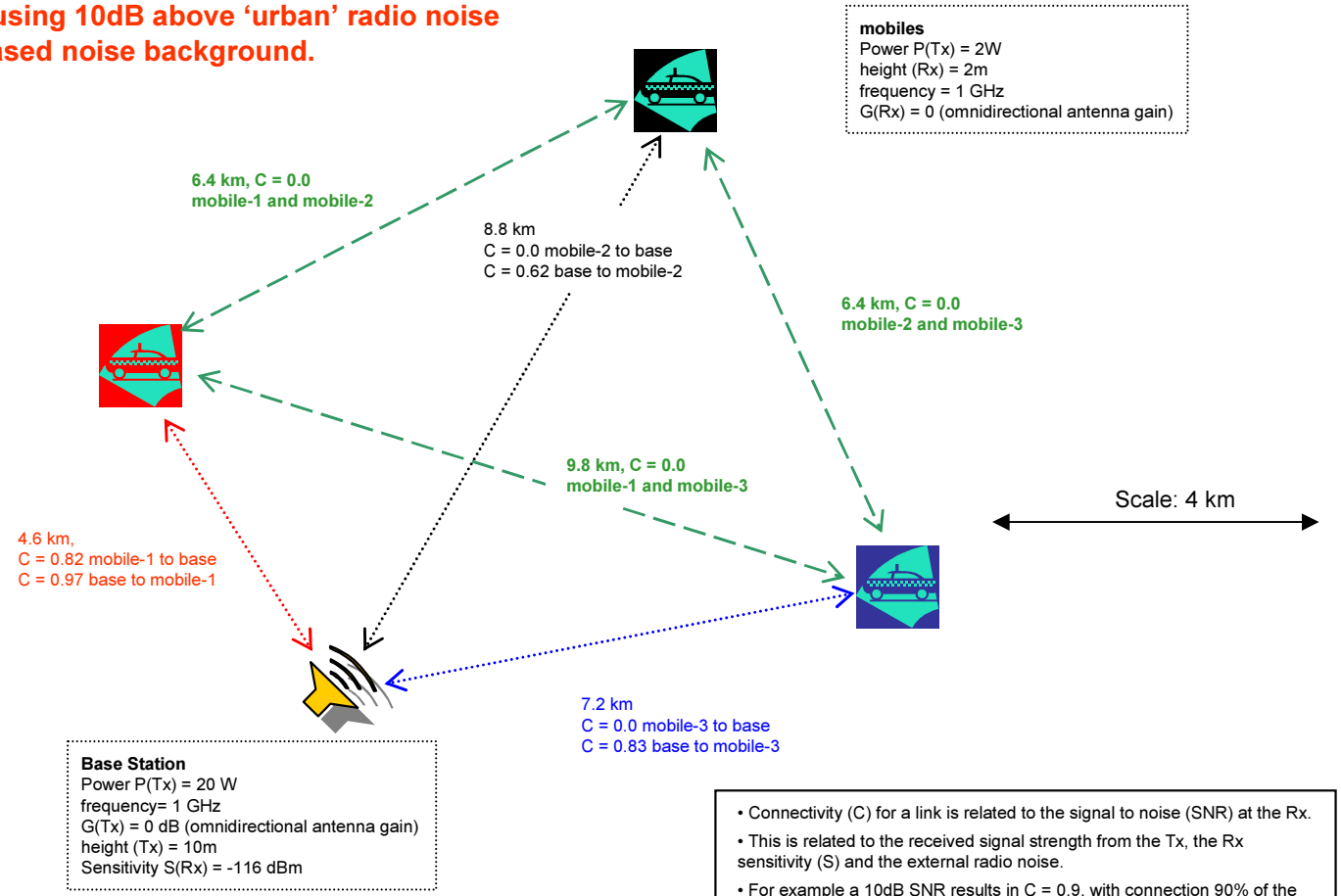
Network connectivity – Base Station and mobiles at UHF frequencies – scenario 5a

Baseline obstruction version (flat terrain <1m undulations, minimal buildings, no significant vegetation – forest/jungle)
All units using basic radios – Base station has better (higher power P(Tx), better sensitivity S(Rx)) than mobiles

Environmental noise > receiver sensitivity S(Rx), using 10dB above 'urban' radio noise levels. Exploring methods to overcome the increased noise background.

- At 1 Ghz the 'urban' noise level is -105 dBm for a typical 200kHz bandwidth, higher than the receiver sensitivity for the base station and mobiles. Hence the signal to noise ratio (SNR) and connectivity will be reduced.
- A higher noise floor than scenario 4 will be considered here, 10 dB above 'urban' levels.
- This noise floor is high enough to sever all mobile to mobile links and two out of three mobile to base links.



- 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.

Baseline Network Connectivity

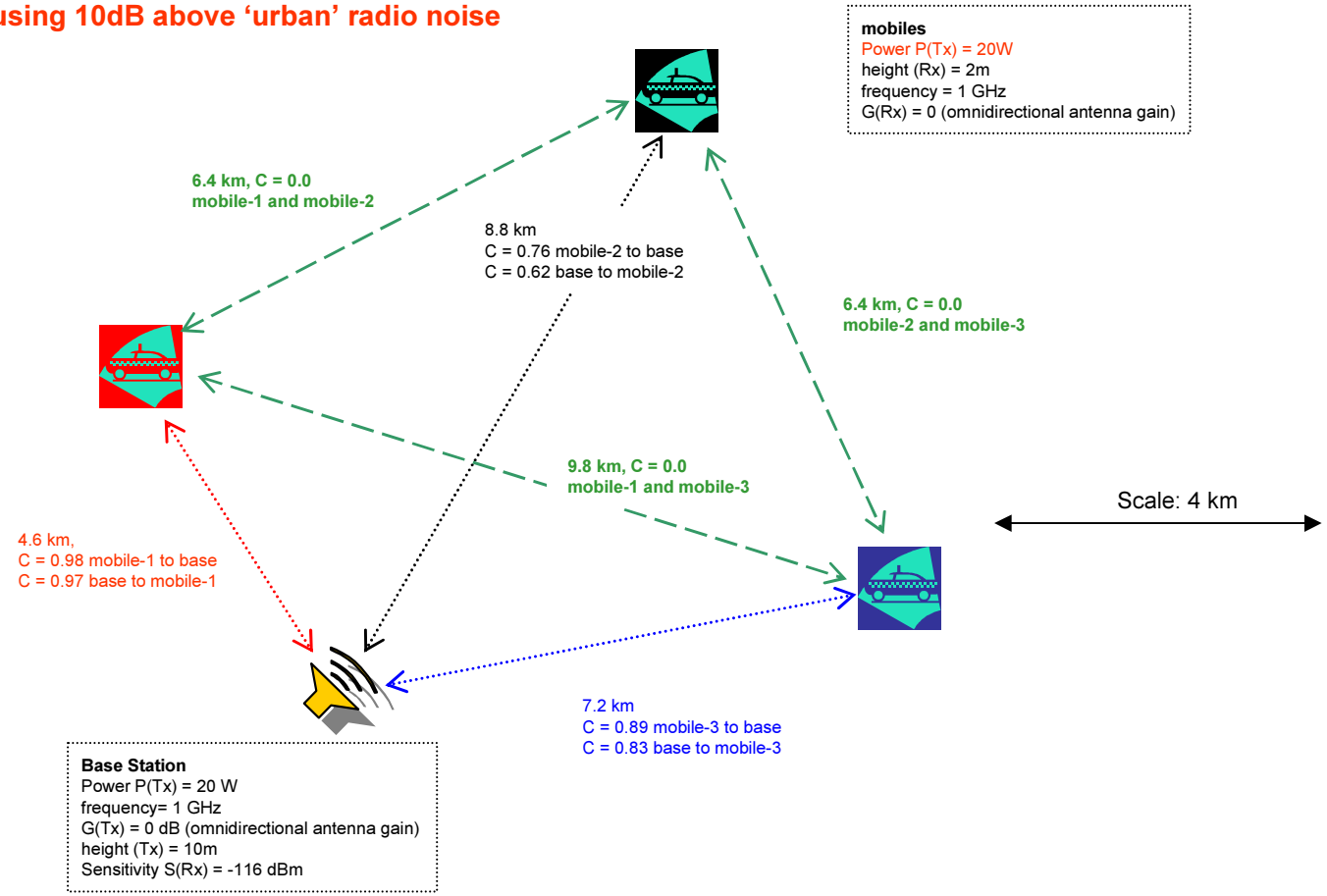
- For the 'centralised - duplex' (between mobiles and base station) sub-net the connectivity is 3.24 across the 6 links (54%).
- For the 'full' net the connectivity is also 3.24 across the 12 links (27%), due to the connectivity being lost between all pairs of mobiles, so the 'mobile to mobile' sub-net has a connectivity of zero.

Network connectivity – Base Station and mobiles at UHF frequencies – scenario 5b

Baseline obstruction version (flat terrain <1m undulations, minimal buildings, no significant vegetation – forest/jungle)
All units using basic radios – Base station has better (higher power P(Tx), better sensitivity S(Rx)) than mobiles

Environmental noise > receiver sensitivity S(Rx), using 10dB above 'urban' radio noise levels. Examine using higher transmitter power.

- Perhaps the most obvious modification to overcome background noise is higher transmitter power to provide great signal strength.
- As the connectivity from base-to-mobile is useable at P(Tx) = 20W the mobile transmitter powers have also been raised to 20W.
- The resultant mobile-to-base connectivities are slightly higher than base to mobile as there is no cable loss in the feed to an elevated antenna for the mobile.
- However the mobile-to-mobile links are not restored even though the power has been increased ten-fold. This is due to both ends of the link having antenna heights of only 2m.



Network Connectivity using higher P(Tx)

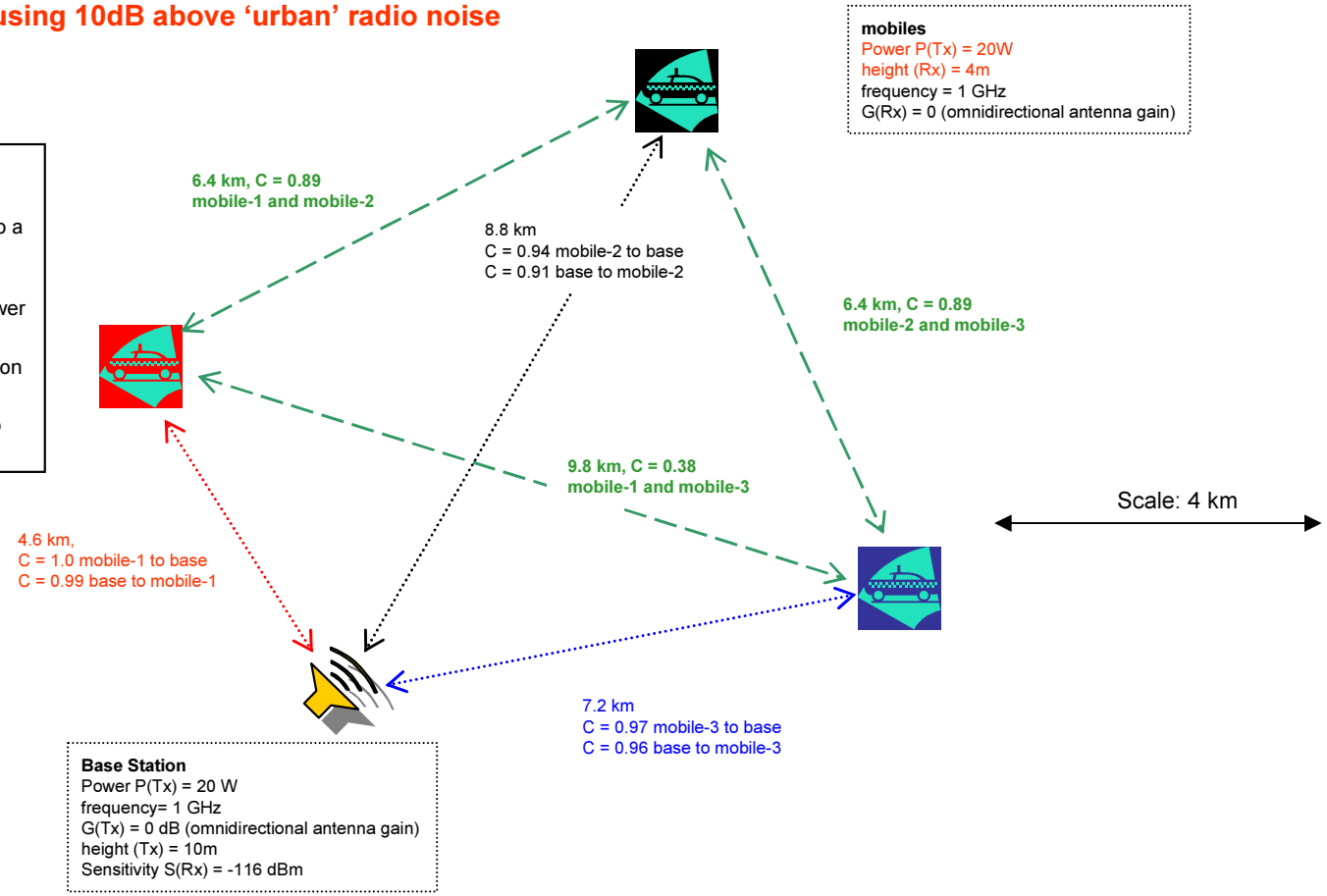
- For the 'centralised - duplex' (between mobiles and base station) sub-net, the connectivity is 5.05 (increased from 3.24) across the 6 links (84%, significantly increased from 54%).
- For the 'full' net the connectivity is also 5.05 across the 12 links (42%, increased from 27%), due to the connectivity being lost between all pairs of mobiles, so the 'mobile to mobile' sub-net has a connectivity of zero.

Network connectivity – Base Station and mobiles at UHF frequencies – scenario 5c

Baseline obstruction version (flat terrain <1m undulations, minimal buildings, no significant vegetation – forest/jungle)
All units using basic radios – Base station has better (higher power P(Tx), better sensitivity S(Rx)) than mobiles

Environmental noise > receiver sensitivity S(Rx), using 10dB above 'urban' radio noise levels. Examine using higher antenna mountings

- If the base of the antennas for the mobile are increased in height the connectivity will improve.
- However there are practical limits to what height mast can be attached to a mobile unit.
- Here the height is doubled to 4m which adds a small cable loss but the increased height offsets this loss considerably. The mobile transmitter power is left at the higher 20W value.
- The mobile-to-mobile link connectivities are restored to quite high levels on the two shorter paths and the longer path is useable albeit quite weak.
- The connections between mobiles and base have also been improved to levels above 0.9, strong enough for reasonable voice communications.



Network Connectivity using higher antenna mountings

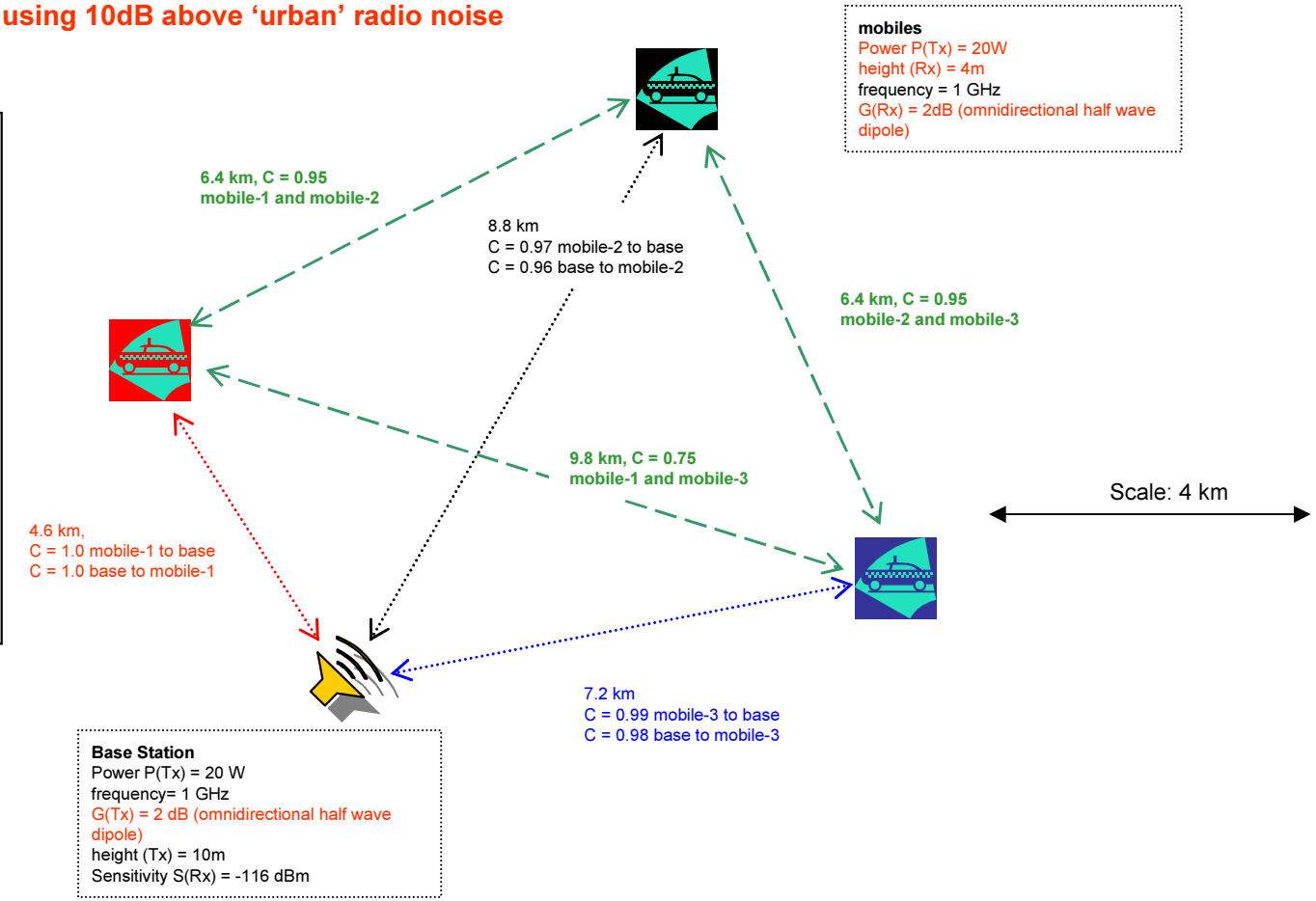
- For the 'centralised - duplex' (between mobiles and base station) sub-net, the connectivity is 5.77 (increased from 5.05) across the 6 links (96%, increased from 84%).
- For the 'full' net the connectivity is 10.1 across the 12 links (84%, increased from 42%), the 'centralised - duplex' sub-net (between mobiles and base station) provides 57% of that connectivity and the 'mobile-to-mobile' sub-net provides 43% (increased from 0% when antenna height was only 2m).

Network connectivity – Base Station and mobiles at UHF frequencies – scenario 5d

Baseline obstruction version (flat terrain <1m undulations, minimal buildings, no significant vegetation – forest/jungle)
All units using basic radios – Base station has better (higher power P(Tx), better sensitivity S(Rx)) than mobiles

Environmental noise > receiver sensitivity S(Rx), using 10dB above 'urban' radio noise levels. Examine using higher gain antennas

- The whip antennas used are fairly basic and may be improved upon with higher gain types.
- The drawback is that higher gain antennas often have a more complex and rigid structure than a whip and are hence possibly more prone to damage, particularly on a fast moving vehicle. However it is not implausible to mount such an antenna on a backpack or vehicle.
- Here a half wave dipole is tried with the higher 4m mounts and 20W transmitter power on the mobiles. The base station also uses this antenna.
- The increase in connectivity is most marked for the mobile-to-mobile subnet.
- The overall network connectivity (see below) is substantially higher than before any measures were taken and all the links are reasonable to very good.
- The improvement was not as marked as increasing antenna height but greater gain may be achieved by using a directional antenna such as a Yagi or Log-Periodic.
- The disadvantage of a directional antenna is that it needs to point at the other unit, requiring knowledge of it's position or at least direction.



Network Connectivity using higher G(Tx/Rx)

- For the 'centralised - duplex' (between mobiles and base station) sub-net, the connectivity is 5.9 (increased from 5.77) across the 6 links (98%, increased from 96%).
- For the 'full' net the connectivity is 11.2 across the 12 links (93%, increased from 84%), the 'centralised - duplex' sub-net (between mobiles and base station) provides 53% of that connectivity and the 'mobile-to-mobile' sub-net provides the remaining 47% (increased from 43% when antenna was a whip).