

# How does 5G penetrate its signal in to buildings?



**Rupert Baines**

VP marketing at Picochip. Pioneered femtocells. Worked on WiMAX, WCDMA/HSPA and LTE. · Author has **11.7K** answers and **28.4M** answer views · 4y

Same way as any other radio wave does

5G is designed to work using lots of different frequencies, from <1GHz (which travel a long way, easily penetrate buildings) through the 1–3GHz we normally use for cellular to the <6GHz “millimetre wave” which do not go very far and will not penetrate into building

Lower frequencies go further, penetrate better - but have less spectrum and so less capacity

Higher frequencies have more capacity but are worse for coverage

It is a portfolio



**Kurt Behnke**

Former Telecom R&D and Manager Operations at Ericsson (company) (1997–2017) · Author has **5.6K** answers and **7.6M** answer views · 3y

Microwave radiation is attenuated a lot by building walls. That’s mainly due to its interaction with metal and with water (water as part of the concrete crystal structure). You know that effect from microwave ovens. 2G, 3G, 4G and 5G are all of the same kind, when looked at simply as radiation. It is just a whole lot weaker than your microwave cooker.

The attenuation depends on frequency. Low frequencies get through much better than high frequencies (we are talking here about the relevant 500 MHz to 5 GHz spectrum). At 1 GHz you can expect a loss of 5 to 15 decibel of power (meaning a level of about 1/3 to 1/30 after passing through the wall); with 500 MHz it is half the loss, with 5 GHz it is much more. There is a water resonance line at 20 GHz, so going up above 20 GHz things get a bit better again. That’s why they have chosen to start a new frequency band for 5G at 28 GHz (so-called New Radio). But the general attenuation level even in air of these “millimeter waves” is so high that they can basically only be used for small cells with a few hundred meter range max.

The solution with 5G is: There is (like with 4G or even more than in 4G ) a whole bunch of frequency bands allocated across the whole admissible spectrum.

- use low for long range (rural areas, with only few towers to be deployed)
- use traditional bands (like current 3G, which will be switched off sooner or later) for penetration scenarios like we have today
- use 3 GHz+ for densification in dense urban areas, and on highways/ railways, where you only have to cover a line, not an area.

- use small cells in 28Ghz+ in inner cities, in sports stadiums and arenas, plus indoors in office building, shopping malls etc
- For residential homes this is way too expensive, so probably we will go into WLAN offload (ie. automatic roaming into home WLAN networks, and control of the public network).