Femtocells - The Green Solution?

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Cellular networks use a surprisingly large amount of power: approximately 2% of UK energy - about the same as aviation. Yet while greenhouse emissions of flying are very public/controversial, the wireless energy use is less visible.

Of this, some is retail premises, some is office use, a significant portion is data centers and servers - but about 60% is the macro network.

Each macrocell might use 3-5KW. The shocking thing is how horribly inefficient basestations are: because of the need for linearity and power backoff, high PAPR and the way high power RF works efficiencies of 10-20% are not uncommon. Worse, that waste 80-90% is heat in the PA, which then needs air-conditioning and chillers, which in turn need energy (approx 4:1 - so to send 1W over the air, 5W is wasted). Finally, of course, of that 1W very little is useful: most of the power is lost in long distance travel, or used to heat up walls as the transmitter tries to "blast" through thick walls. Interestingly 2.0G GSM was more efficient as it was a constant amplitude modulation.

A femtocell turns this on its head. It puts a small, low-power basestation where the users are - so eliminates need for long-distance high-power transmitters. A typical femtocell might only have a 100mW PA, and draw 5W total - compared to 5KW for a macrocell. Because the femto is near the users, you need less power to reach them -- and yet it still delivers better data rates. Adding ten femtocells to a single macrocell in a network can increase effective data rate 12x - yet increase power by only 1%.

An analysis by OFCOM (UK regulator) and Plextek considered the deployment of femtocells in the home to provide indoor 3G coverage. It concluded that femtocells could have an operational energy advantage ratio of about 7:1 over the hypothetical alternative of expanding the macrocell network to provide approximately similar indoor coverage. The scenario, based on 8 million femtocells for all operators, saves 490 GWh/year.