

# How Cell Phones Work

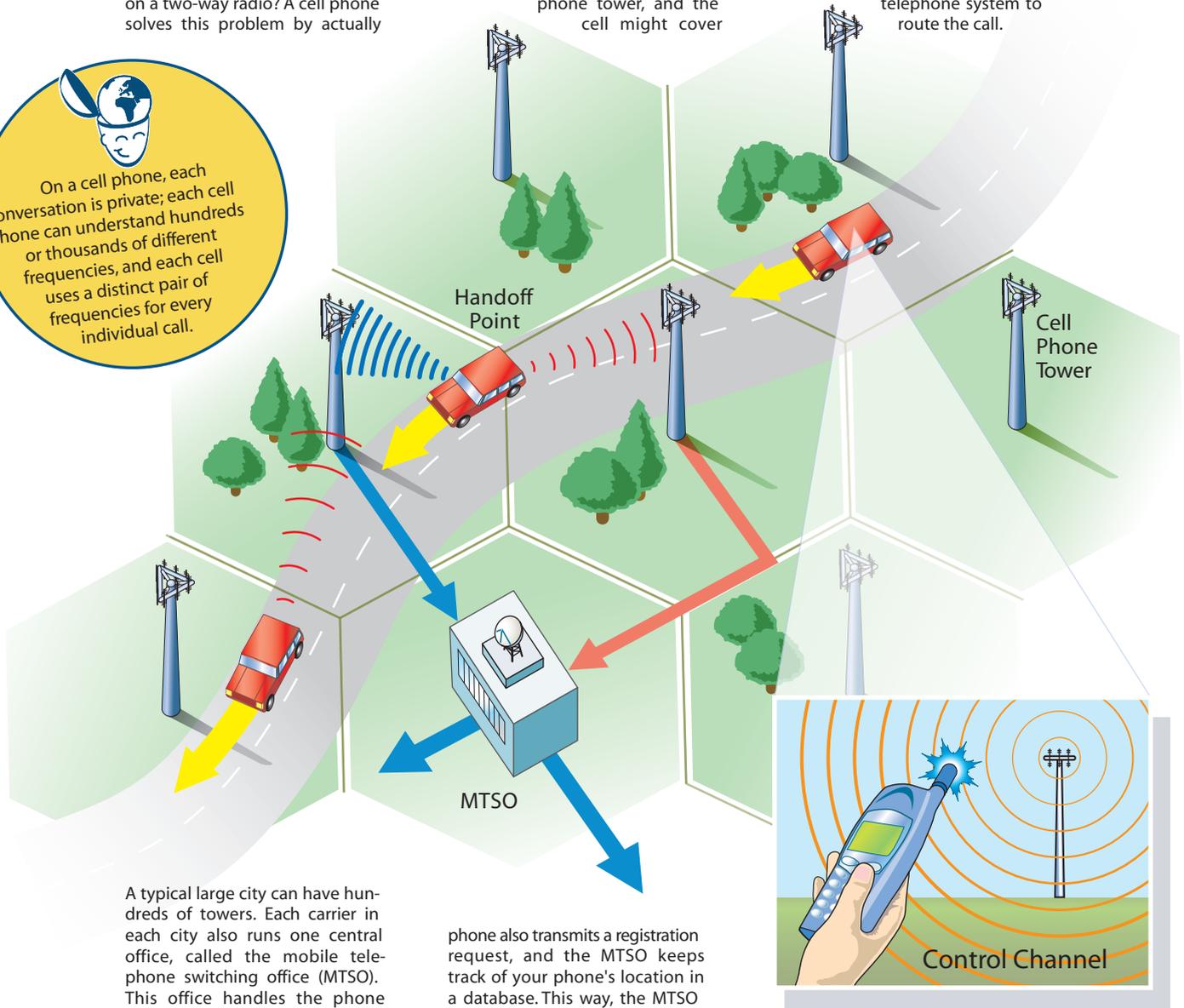
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Millions of people all over the world use cell phones everyday. These handy devices have had an amazing impact on our daily lives. It turns out that your cell phone is an absolutely amazing two-way radio. • You know how you have to push a button to talk on a two-way radio? A cell phone solves this problem by actually

having two radios working at the same time – one to transmit your voice, and the other to let you hear the caller. • The cell phone system divides a city into a set of cells (often thought of as hexagons on a hexagonal grid). In the center of each cell is a cell phone tower, and the cell might cover

an area with a diameter of 2 or 3 miles around the tower. With a two-way radio you have to transmit directly to another two-way radio, but with a cell phone you always transmit to the tower. The tower then connects you to the normal land-based telephone system to route the call.

On a cell phone, each conversation is private; each cell phone can understand hundreds or thousands of different frequencies, and each cell uses a distinct pair of frequencies for every individual call.



A typical large city can have hundreds of towers. Each carrier in each city also runs one central office, called the mobile telephone switching office (MTSO). This office handles the phone connections to the normal land-based phone system – and it controls all of the towers in the region. • When you first power up a cell phone, it listens for a control channel, which is a special frequency that the phone and tower use to talk to one another about things like call setup and channel-changing. If the phone can't find a control channel, it knows it's out of range and displays a no-service message. Upon powering up, the

phone also transmits a registration request, and the MTSO keeps track of your phone's location in a database. This way, the MTSO knows which cell you're in when it wants to ring your phone. When the MTSO gets a call for your phone, it looks in its database to see which cell you're in and picks a frequency pair that your phone will use in that cell to take the call. The MTSO communicates with your phone over the control channel to tell it what frequencies to use, and when your phone and the tower switch on those frequencies, the call is connected. You are talking

to another person on a two-way radio at this point! • The cool part about cell phones happens as you're driving down the highway while talking. The tower you're connected to sees your signal strength decreasing. Another tower sees it increasing. To do the handoff, the tower tells your phone to switch frequencies, and the phone starts using the new tower.