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What If You Could See Your Cellular Network?

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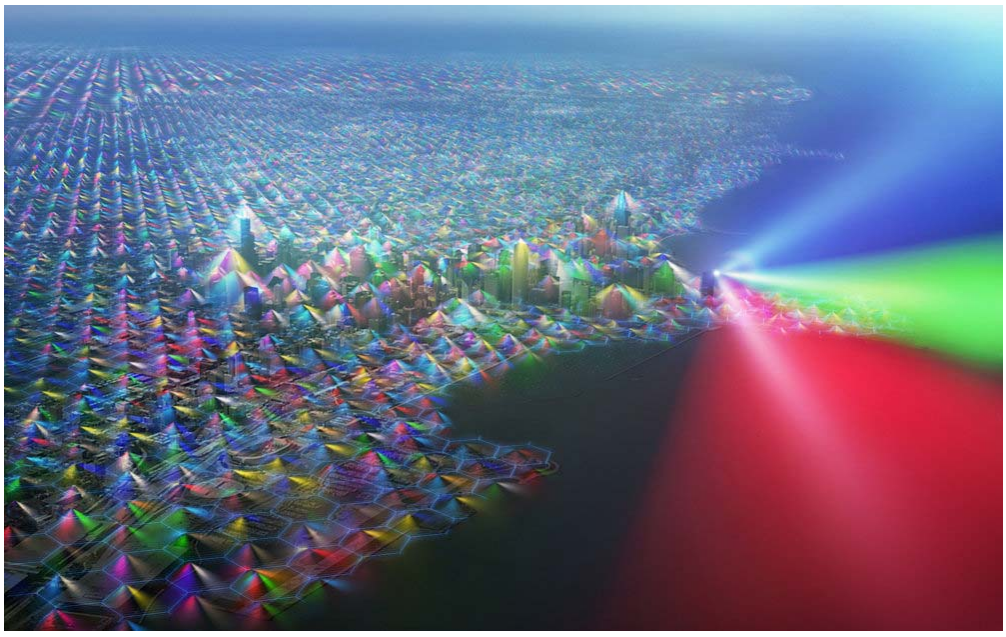
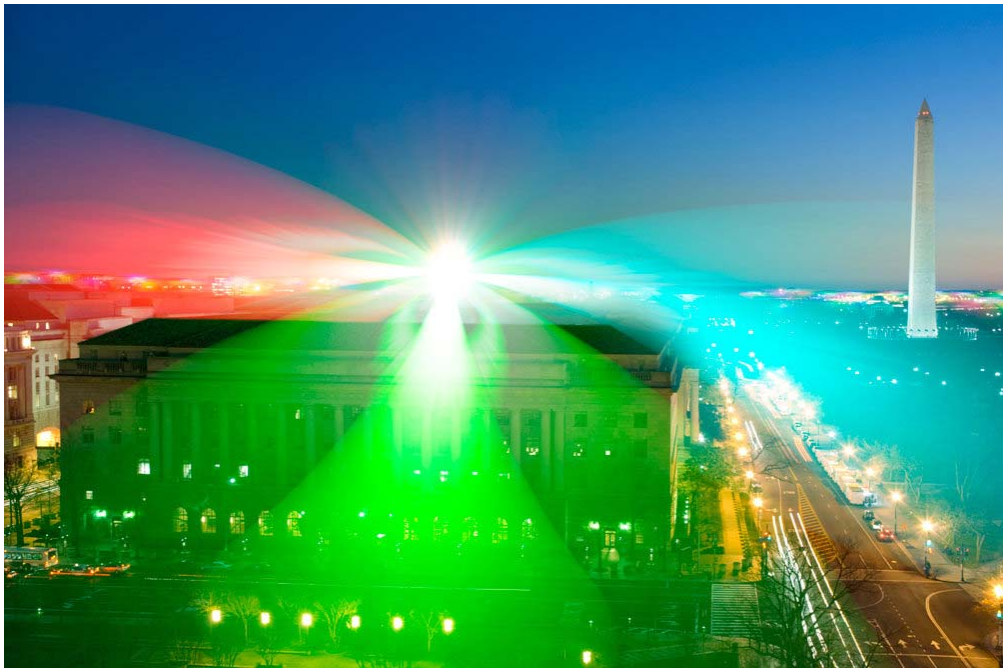
Your smartphone is an amazing piece of technology, but it would be nothing without a cellular network which gives you the ability to text, talk, and browse the web. You may not see the massive infrastructure used by your cellphone provider, but it's there. Here's what it would look like if you could see it…



A regular, hexagonal grid of cellular base-station sites is conceptualized for Chicago, with stations at the corners of the hexagons. The area within each sector antenna radiation pattern has different users being assigned different frequencies and their signals combine to form a single perceived color in that instant. Different channel combinations from sector to sector are indicated by different colors. The channel combinations shown are not static, but rather change rapidly in time as different users are assigned different channels. But, if you were to take a photo of these rapid changes, you'd likely see a wide array of colors as seen in the illustration. Near the downtown area more users are likely to be found and the hexagonal cells are smaller

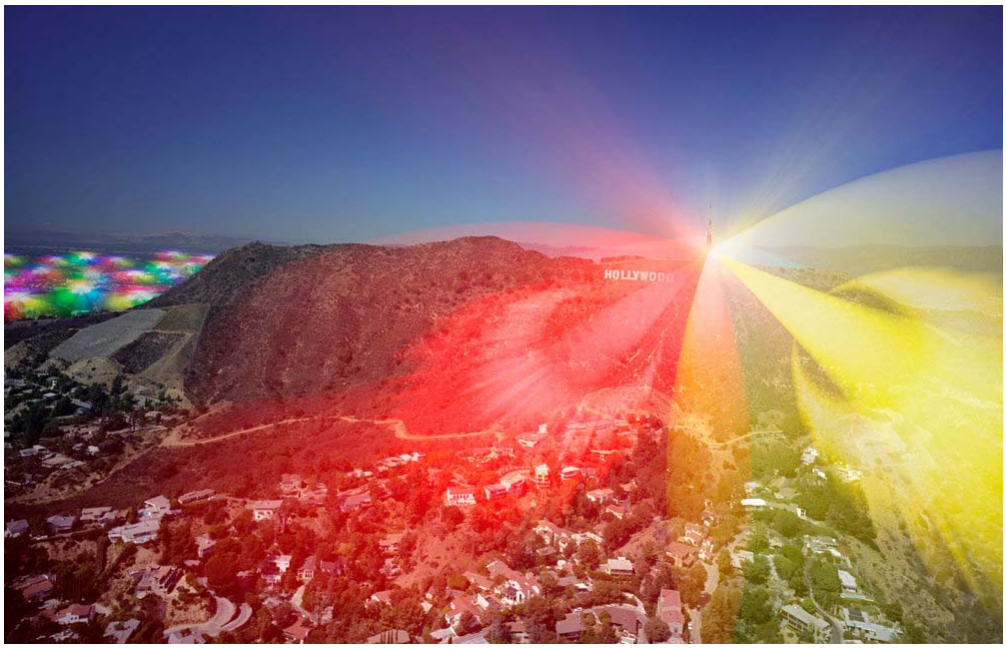
to serve approximately the same numbers of users found in larger cells elsewhere. Antenna signals extending beyond the original cells provide coverage over part of Lake Michigan.

Cell sites on top of buildings provide much wireless coverage for New York City. The hexagon pattern is a theoretical grid for antenna placement.



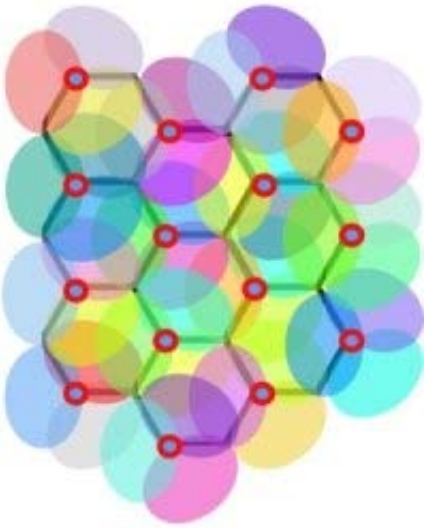
Pictorial representation of the coverage provided by a base station located at the Herbert C. Hoover Building in Washington

D.C. Hexagonal cells and their related coverage are also shown in the background. The area within each sector antenna has different users. Each user has a dedicated communication with the base station and each combination of these within a sector is represented by a different color. The communication with the base station is made possible by appropriately combining the frequencies within each band.



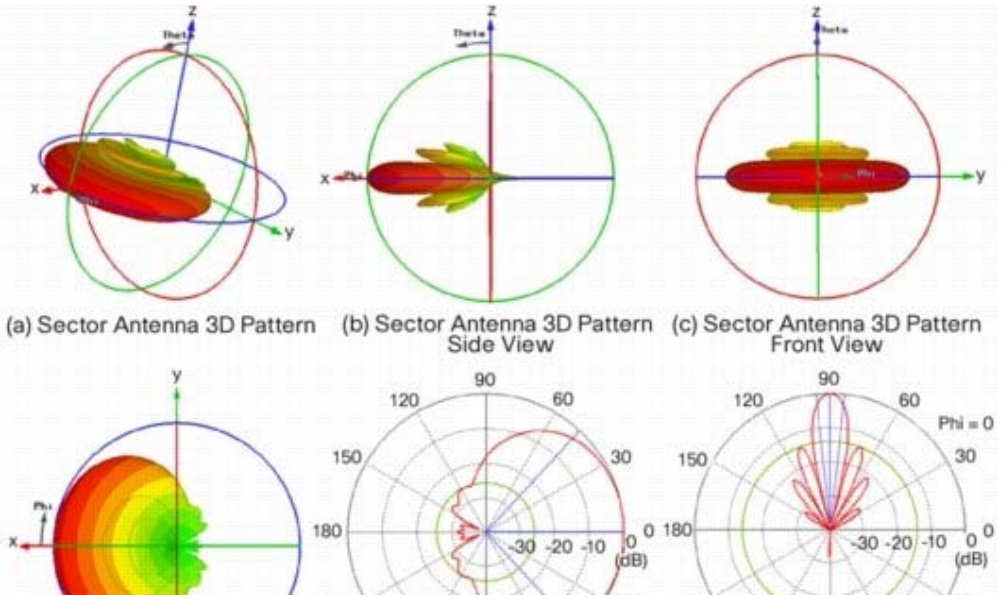
Artist rendering of how cellular signals might appear in the Hollywood Hills if we could see the electromagnetic radiation at these frequencies as we can in the visible spectrum. The long-distance tower is radiating three channel combinations in three directions indicated by the red, yellow and blue radiation patterns. In the background are cell stations each of which have 3 sector antenna radiation patterns as well.

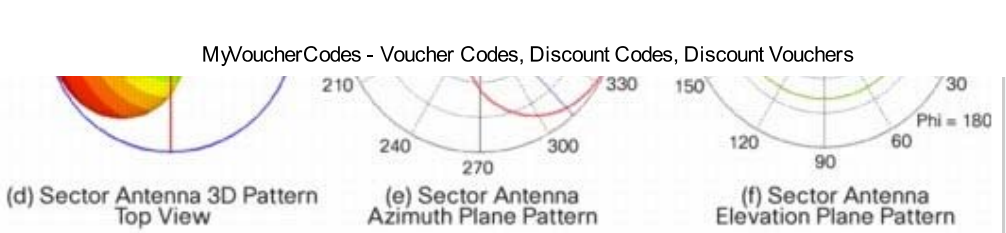
Sector radiation patterns from two hypothetical base-station sites on the Capitol. The strongest signals are at the center of the radiation patterns.



Cellular network base-station antenna locations laid out as red circles at the corners of a theoretical hexagonal grid. The top view shows radiation coming from each antenna into three sectors using different colors for different combination channels.

The above captions are made possible by Danilo Erricolo, Professor of Electrical Engineering and Computer Science, University of Illinois at Chicago. And by Fran Harackiewicz, Professor of Electrical and Computer Engineering, Southern Illinois University Carbondale, who teaches antenna theory and design.





(d) Sector Antenna 3D Pattern Top View (e) Sector Antenna Azimuth Plane Pattern (f) Sector Antenna Elevation Plane Pattern

The illustrations above approximate cell antenna radiation by assuming that each antenna has the above radiation pattern. The spotlights you see in the pictures are wide when viewed from the top and thin when viewed from the side because that's what a sector antenna radiation pattern looks like. Image courtesy of Cisco

Thanks to Dr. Marlin H. Mickle from the Swanson School of Engineering, Dr. Danilo Erricolo from the University of Illinois at Chicago, Dr. Pavel Nikitin from the University of Washington, Dr. Jung-Chih Chiao from The University of Texas at Arlington, Fran Harackiewicz from the Southern Illinois University Carbondaleand, and Dr. Dimitris E. Anagnostou from the South Dakota School of Mines and Technology for their expertize ensuring the most accurate representation of cellular network in the above graphical images.

Please email nickolaylamm@gmail.com for high resolution images.

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