# Hexagonal and Pentagonal Fractal Multiband Antennas

### These antennas could be suitable for multifunctional wireless-communication products.

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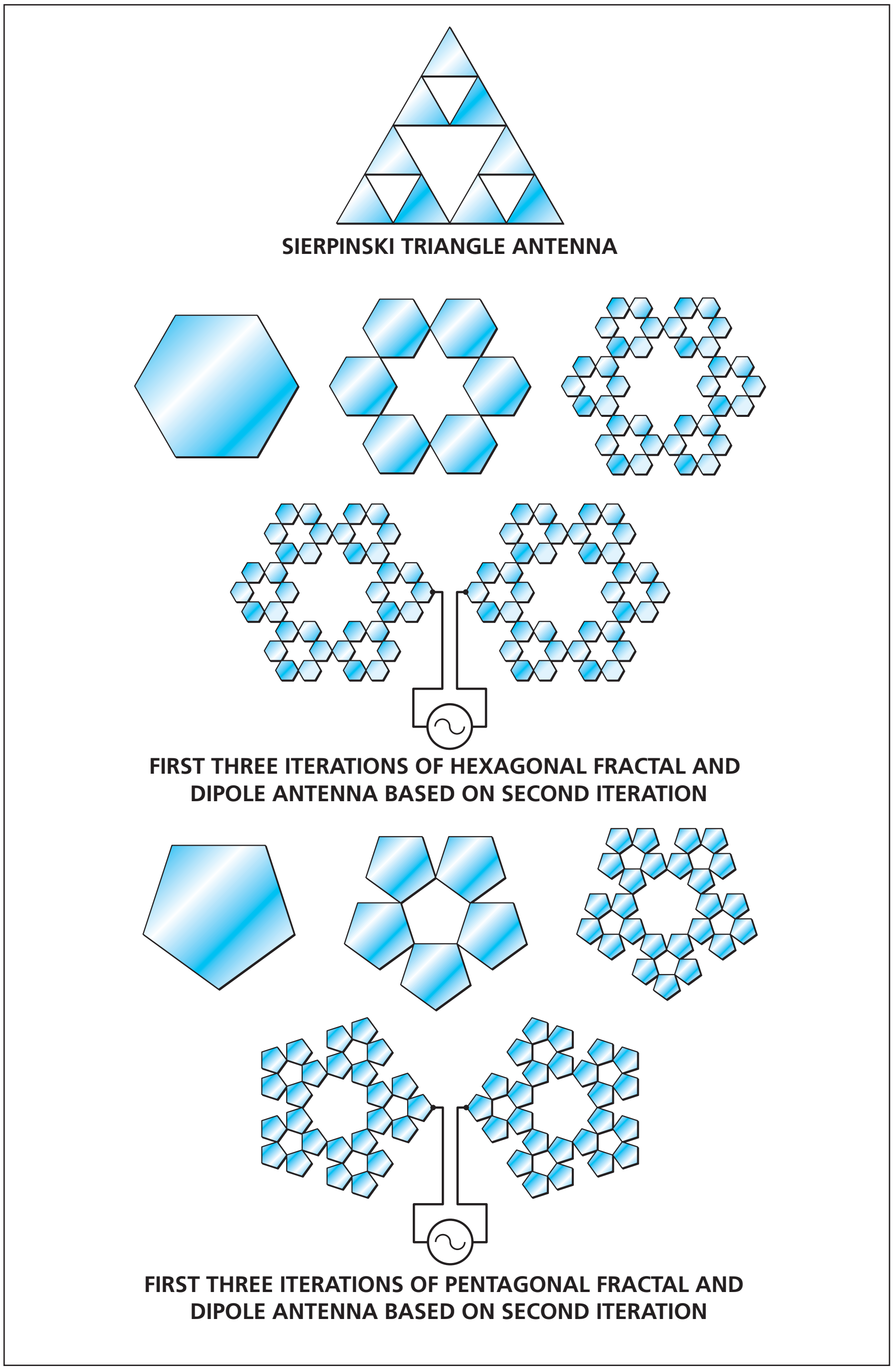
Multiband dipole antennas based on hexagonal and pentagonal fractals have been analyzed by computational simulations and functionally demonstrated in experiments on prototypes. These antennas are capable of multiband or wide-band operation because they are subdivided into progressively smaller substructures that resonate at progressively higher frequencies by virtue of their smaller dimensions. The novelty of the present antennas lies in their specific hexagonal and pentagonal fractal configurations and the resonant frequencies associated with them. These antennas are potentially applicable to a variety of multiband and wide-band commercial wireless-communication products operating at different frequencies, including personal digital assistants, cellular telephones, pagers, satellite radios, Global Positioning System receivers, and products that combine two or more of the aforementioned functions.

Perhaps the best-known prior multiband antenna based on fractal geometry is the Sierpinski triangle antenna (also known as the Sierpinski gasket), shown in the top part of the figure. In this antenna, the scale length at each iteration of the fractal is half the scale length of the preceding iteration, yielding successive resonant frequencies related by a ratio of about 2. The middle and bottom parts of the figure depict the first three iterations of the hexagonal and pentagonal fractals along with typical dipole-antenna configuration based on the second iteration. Successive resonant frequencies of the hexagonal fractal antenna have been found to be related by a ratio of about 3, and those of the pentagonal fractal antenna by a ratio of about 2.59.

*This work was done by Philip W. Tang of* **Kennedy Space Center** *and Parveen Wahid of the University of Central Florida. Further information is contained in a TSP (see page 1). KSC-12393/482*




**Hexagonal and Pentagonal Fractal Antennas** complement the Sierpinski triangle antenna as options for design of multiband and wide-band wireless-communication products.