

Server Sky – Computation and Power in Orbit

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“Space Solar Power is a great dream, achievement of which is a great necessity for the 21st century world.”

- Dr. APJ Abdul Kalam

The problem: Data centers consume almost 3% of US electrical power, and this fraction doubles every 5 years. The demand grows faster than efficiency improvements. Power generation is not growing to meet this increase in demand. Energy production scales with mechanical structure and land/habitat, which suffer from dis-economies of scale.

New possibilities: The sun produces 384 trillion terawatts which nature cannot use. Solar cells in space can be very thin, need no mechanical structure, and do not rob the biosphere of energy. Recent advances in solar cell materials and VLSI radiation hardness permit ultralight gram-scale satellites. There are no barriers to scaling power-to-weight ratios by more than one million over terrestrial solar, and one hundred thousand over traditional satellites.

Server Sky converts space solar power into computation with arrays of thousands of tiny solid-state satellites. Each paper-thin server-sat is 20 cm across, 50 microns thick, and weighs 3 grams. Each is powered by a large solar cell, propelled and steered by light pressure, networked and located by microwaves, and cooled by black body radiation.

Server-sats are stacked by the thousands in solid cylinders, and launched into *6400 kilometer altitude* equatorial orbits. They are deployed into precisely located and actively stabilized three dimensional arrays, with spacings of about 10 meters. A large array may contain a *million server-sats*, with *megawatts* of power for computation and radios. Phased array transmitters are synchronized to produce narrow beams to hundreds of kilometer-sized receiver footprints simultaneously. Thousands of arrays communicate with ground receivers and each other.

The market: Initial technological developments will be licensed to existing industry. First server sky deployments will be for satellite and space debris tracking, with potential billion dollar per year revenues. Next, computation and internet markets will include global high bandwidth rural connections, cell phone system augmentation (education, speech recognition, translation, “sound web”), data centers for power-starved or insecure regions of the world. Very large arrays will someday beam power directly to local electrical grids, providing instantaneous terawatt-level peak power worldwide with zero environmental impact. Solar system resources permit continued rapid growth and new market development for centuries.

The focus will be on Moore's Law market and technology growth. While startup will be challenging, early participants will dominate the global economy decades from now.

The Oregon opportunity: Server-sats can be mass produced with existing semiconductor technologies. Highly automated solar-cell manufacturing plants, such as Solar World in Oregon, are uniquely capable of handling 50 micron thick server-sats. Other Oregon companies such as Merix, Intel, Triquint, Maxim, and others can provide substrates, processors, flash memory, radios, power control, and other chips to be bonded to the server-sat. As the economic downturn deepens, server sky provides new markets with unlimited growth potential, providing jobs while protecting the environment.

Server-Sat

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