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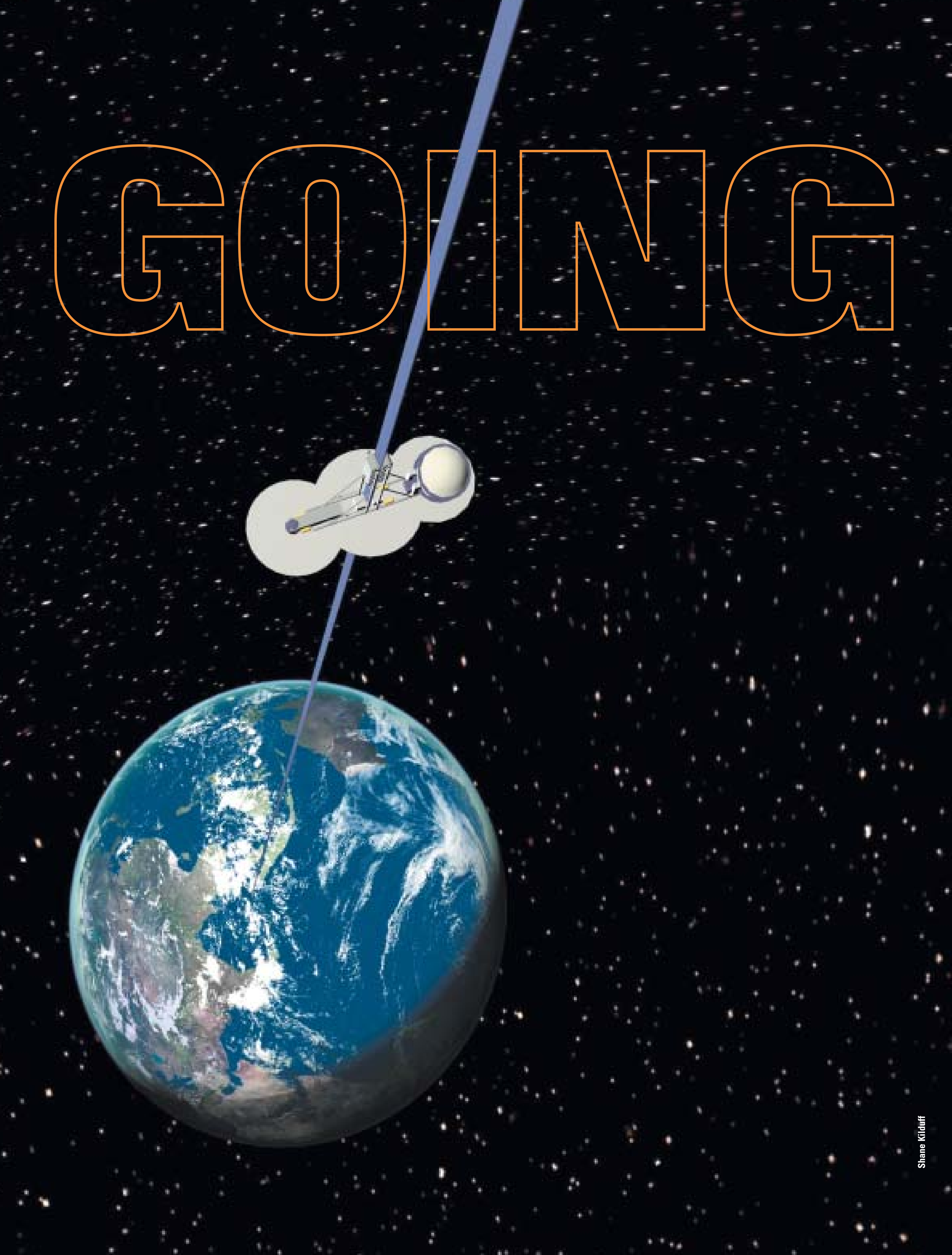


Shane Kilduff

UP?

Space Elevator: A 21st Century Solution for Space Transportation

BY FRANK SIETZEN, JR. AD ASTRA EDITOR-IN-CHIEF

Of all of the suggested solutions to today's high cost of sending people and payloads into space, most consist of variations of a common theme. A form of rocket propulsion is needed to lift these assets and materials into space and onwards toward orbital flight. Once there, more rockets are used to insert the payload—be it shuttle or satellite—into its final orbital destination.

Rockets, rockets, and more rockets. Usually, the debate on their final form centers around expendable or reusable, solid fueled or liquid fueled (or nuclear as well).

But what if a potential solution to the high cost of space flight wasn't a rocket at all?

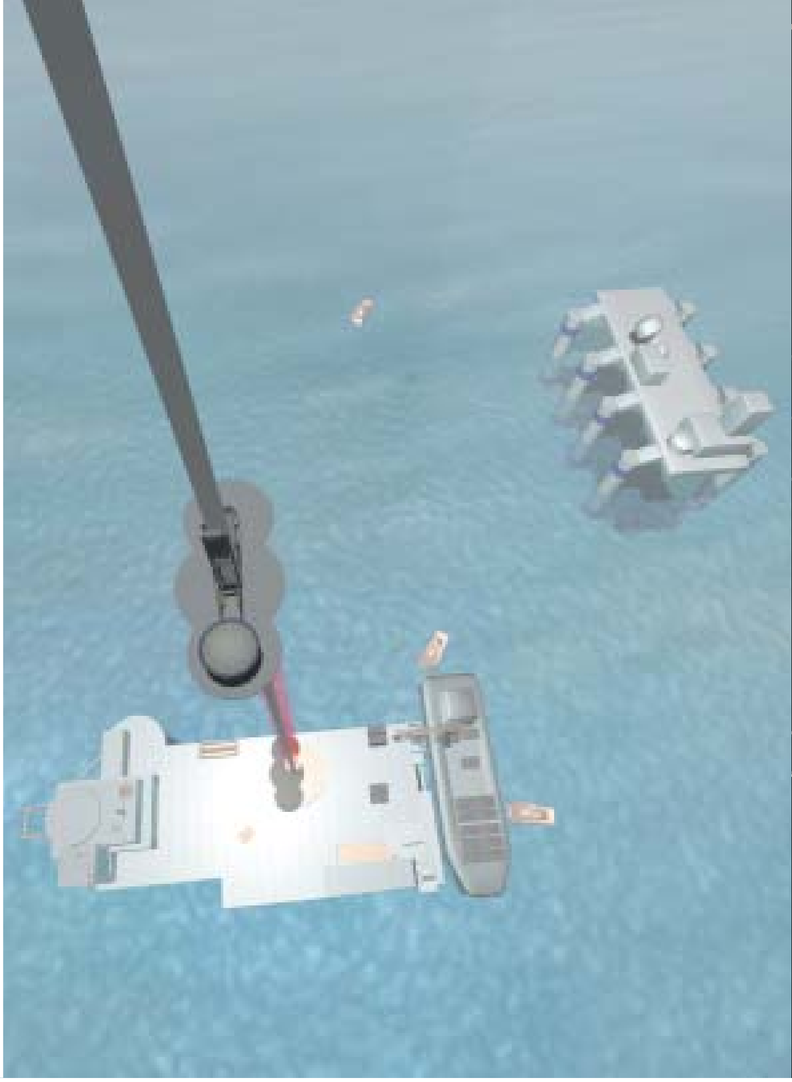
What if it were . . . an elevator in space? One end solidly on terra firma. The other some 22,500 miles up at the high of geostationary orbit. And instead of using rocket fuel, this elevator used a unique fiber to run cabling that hauled freight up and down from Earth to space, just like, well, an elevator.

Enter the space elevator project, surprisingly not an entirely new idea but one that, for the first time, is the subject of a serious business plan and research initiative. Don't let its $10 billion price tag put you off. The space elevator just might be an idea whose time is, while maybe not today, just around the corner. And while its actual construction may lie beyond existing technologies, designing it and seriously studying the feasibility of such a device would heavily stretch our industry and science, not to mention engineering, concepts. And, after all, isn't that what we would want from a far out space project? And before you stifle a snicker, consider this as well: NASA's Institute for Advanced Concepts reviewed the technical data behind the space elevator concept, and pronounced it doable with current or near-term future technology. So maybe it's not so far out as one might think!

SO WHAT EXACTLY IS THIS IDEA?

As proposed by Dr. Bradley C. Edwards of High Lift Systems, a Seattle-based technology firm that is promoting the elevator concept, the space elevator would consist of a carbon-fiber ribbon that has one of its ends attached to the Earth and the other in space, higher than geostationary orbit (some 35,800 km. in space). The stresses of gravitational pull, plus the outward-forcing centripetal acceleration would act to keep the ribbon taut. Once the ribbon is in place in space, machinery can move up and down from the surface to its spaceborn end, moving equipment and other machinery. Releasing materials at the ribbon's far end could send satellites beyond the Earth's orbit towards the planets or the Moon. Platforms at various locations on the ribbon's height could also be used as facilities to service or repair the "climbers," mechanical robots whose job it would be to keep watch on the ribbon. The ribbon itself is proposed to be made of a special, carbon-nanotube-composite material that Edwards is also researching and promoting.

The ocean-going anchor platform is shown with a cargo vessel near-by and the ribbon extending vertically.



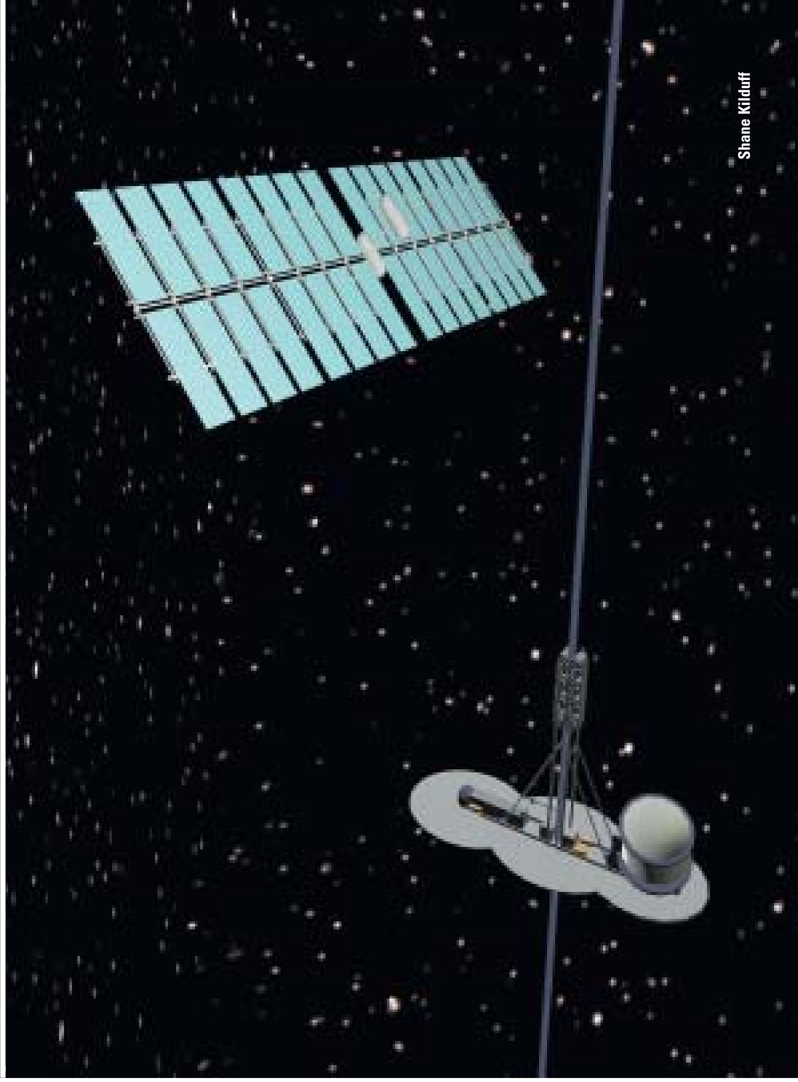
The major components of the space elevator are shown. The climber is in the foreground ascending the ribbon, the ocean-going anchor station is at the bottom of the image and one of the power beaming platforms is shown in the upper right of the image.

According to Edwards, here's how the elevator would be assembled in space:

First, a tiny carbon ribbon about 10 to 20 centimeters wide and only microns in thickness would be deployed from high geostationary orbit, using four booster rockets for launch and a magnetoplasmadynamic upper stage. This initial ribbon would be capable of supporting weighted payloads up to 990 kg. Robot climbers would be sent up the ribbon once every three or four days adding small ribbons alongside the first. Edwards envisions about 230 of these robots at work initially. Slowly, these climbers build up the bulk and capability of the space ribbon, until, in about two to three years, it would be capable of supporting 20,000 kg of payload. Power to run these climbers would be beamed up from the Earth using a free-electron laser and a package of adaptive optics and dishes. Once converted to electrical power, this power would propel conventional magnets and electrical motors, activating a set of rollers that would move the climbers up and down, at speeds up to 200-km/per hour. The equipment and climbers used in the elevator's initial construction would become, in essence, counterweights at the space end of the structure. Edwards says he envisions a floating platform, adapted from today's Sea Launch barge used to launch Zenit rockets in the Pacific Ocean, as the Earth anchor. "We think the biggest risk we face would be from meteor strikes and atomic (oxygen) erosion," Edwards predicts. High Lift Systems is currently researching various ways to mitigate the risk of the damages.

To produce a 20,000 kg capacity elevator would require enough ribbon material to stretch out 100,000 km. The ribbon must be manufactured and tested, the project's biggest technical challenge since nothing made of such material—not to mention that long—has ever been manufactured. Edwards points to transoceanic cables and other textile materials as having posed similar challenges. The carbon nanotubes would be made up of individual fibers 10 microns in diameter lying side by side, interconnected by tape sandwiches spaced every 10 cm along the ribbon's length.

The space elevator climber is shown ascending the ribbon to high-Earth orbit. The circular structures are photo arrays, the drive section is seen as two treads sandwiching the ribbon, and the command and control components are the small box structures. The payload, a satellite, is shown on the lower half of the climber.



The climber is shown in the foreground with a solar power satellite in the background. The space elevator would enable the construction of solar powered satellites such as the one shown for clean, unlimited energy.

NASA researchers looked at ways to begin a "flight demonstration" of the elevator idea, using tethered balloons anchored 1,000 miles high as prototypes of the concept. Such tests would gather data on the carbon fiber's actual durability and ways to perform upgrades and repairs.

So why would a space elevator help solve the cost equation of access to space?

High Lift Systems says that the elevator would be capable of lifting large and fragile structures into orbit, such as solar satellites or inflatable space modules for astronauts. Factories for the production of biological products and vaccines, and other buildings —actual buildings—could be hauled into space using the elevator system.

Edwards is also looking at "son of" space elevator: a second-generation system with a 100,000 kg capability that could foster building a massive city at geostationary orbit, home to hundreds of space settlers.

"I became interested in this idea when I read somewhere that a space elevator could not be built 'for 300 years.'" That, said Edwards, seemed like "an awful thing for anyone to say," since he had been reading and researching the concept. His research led first to a scientific paper, then a formal proposal to NASA for a detailed study. Now, armed with that data and a continuing interest in both the concept and the carbon nanotube material by government agencies and defense officials, Edwards' firm is continuing to refine the concept and seek investors to fund the next step, manufacturing tests of the ribbon materials and possible balloon tests of the anchoring technology.

Is the space elevator a possible solution to settling space, and/or reducing the high cost of high life?

Only the future will determine that. Recently, NASA Administrator Sean O'Keefe called his agency to research and develop projects that "will push not only the state of the art, but our concept of what is feasible and what is attainable. . .that is in NASA's best traditions"

Maybe the time has come for a space elevator research demonstrator to do all of the above.