DISRUPTIVE SPACE TECHNOLOGY

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In 1997 "The Innovator's Dilemma" by Clayton M. Christensen became a popular book in the small satellite and launch vehicle communities. But like the weather, every one talks about "Disruptive Technology" but few do anything about it. In the '70s and '80s, people were looking for "Paradigm Shifts," and since the resurrection of Donald Rumsfeld, a recent watchword has been "Transformational Technology." But today's buzzword is now "Responsive Space Systems."

What does all this mean? It means buyers or users of space systems are craving innovative, timely, reliable, and affordable systems with state-of-the-art technology, not billion dollar pork barrel jobs programs that take five years to think about, then ten or more years to build, therefore relying on heavy, power-hungry, twenty year old technology.

To illustrate the current schizophrenia surrounding space technology, a pair of Transformational (laser) Communications paper studies, worth $472 million each, have recently been initiated. This billion dollars worth of paper studies is due in 2007, but already the contractors are saying they might be late! Ironically, it is likely that a set of three microsats, at only $7 million each, utilizing industry standard laser communications technology in a space-based Wide Area Network configuration, could be flying before those studies are complete. This is disruptive technology – it disrupts business as usual by leaping ahead of currently available or planned products.

Last year saw some good examples of truly disruptive small sat technology and human space flight technology, and more is on the drawing boards for implementation in the next few short years.

In January of 2003, NASA launched CHIPSat, a UNEX program won by a science team at Berkeley. SpaceDev designed the mission and the spacecraft, and built, tested and operated CHIPSat after its launch. The original fixed price for CHIPSat was $4.9 million, and it was to be developed over a period of only two years. After NASA lost two Mars missions, headquarters implemented an overly tough review regime, which

contributed to a total cost of about $7.5 million, and a development time of about three years instead of two – still cheap and fast by then existing standards.

Some Proud Fathers of CHIPSat

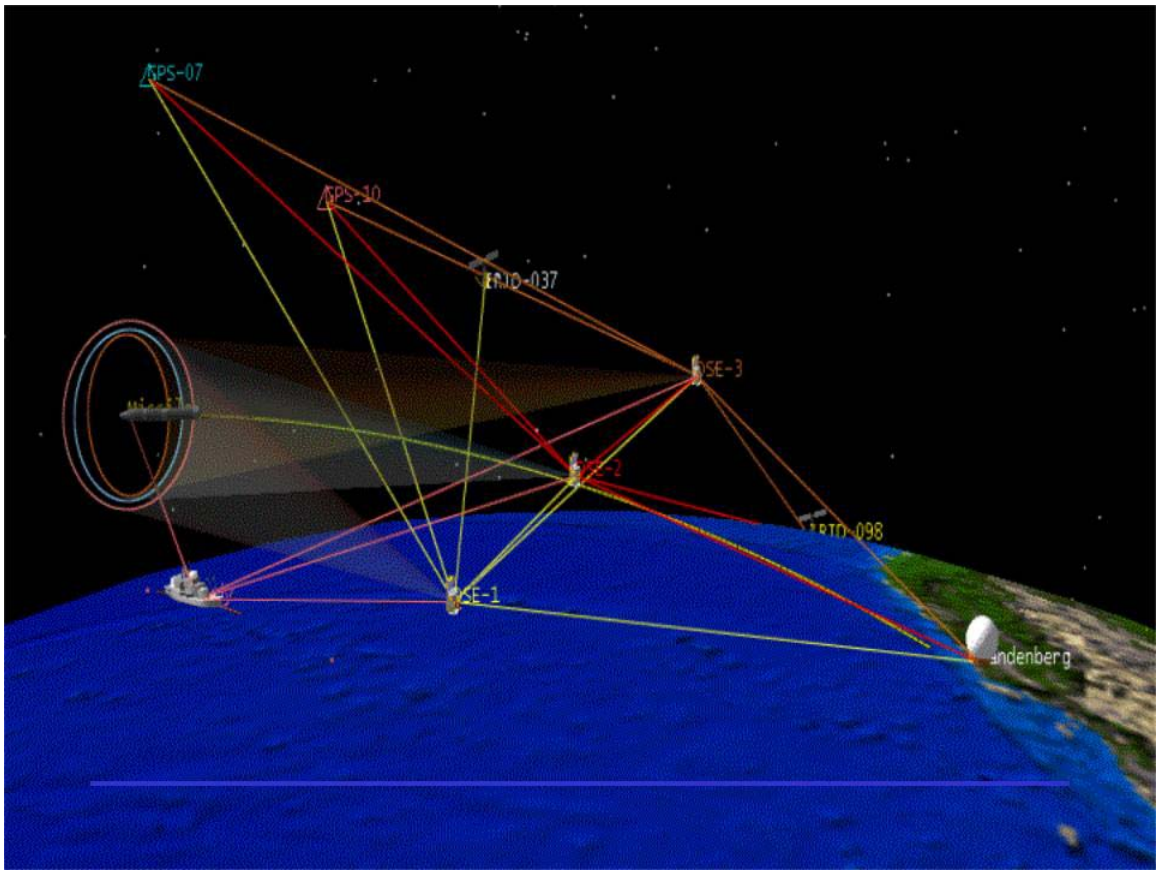
Upon its successful launch, CHIPSat became this country's smallest high performance low cost satellite, the world's first orbiting Internet node, and the world's first satellite whose mission control and operations center can be any laptop computer located anywhere in the world that has a dial tone.

Furthermore, flying in the face of the perceived need of the old "heritage" concept, nothing on CHIPSat had flown before – none of the hardware, and none of the software.

SpaceDev developed most of the critical subsystems from scratch, including our miniature high performance flight computer, our modular power conditioning and distribution system, our general purpose microsat operating system, and our Internet-based command and control software. We also developed space qualified an S-band transmitter and receiver, and successfully flew Dynacon's then unproven ACS system. With four reaction wheels to permit pointing and tracking of CHIPSat's targets, CHIPSat has been an unqualified success and has exceeded its planned life, and continues to do science for UCB and NASA. This is an example of disruptive space technology.

In March of this year, the Missile Defense Agency awarded a contract worth up to $43 million to SpaceDev to develop up to two sets of three formation flying microsats. At an average price of about $7 million each, these microsats will be cheaper than CHIPSat, yet will provide about twice the performance and capabilities of CHIPSat. This is disruptive technology, much like in the microcomputer industry, when you purchase a new computer every few years, you pay about the same, but get dramatically increased performance and capabilities.

SpaceDev is consciously bringing the microcomputer way of doing business to the space industry, which has been bogged down for decades in the old mainframe way of thinking that bigger is better.

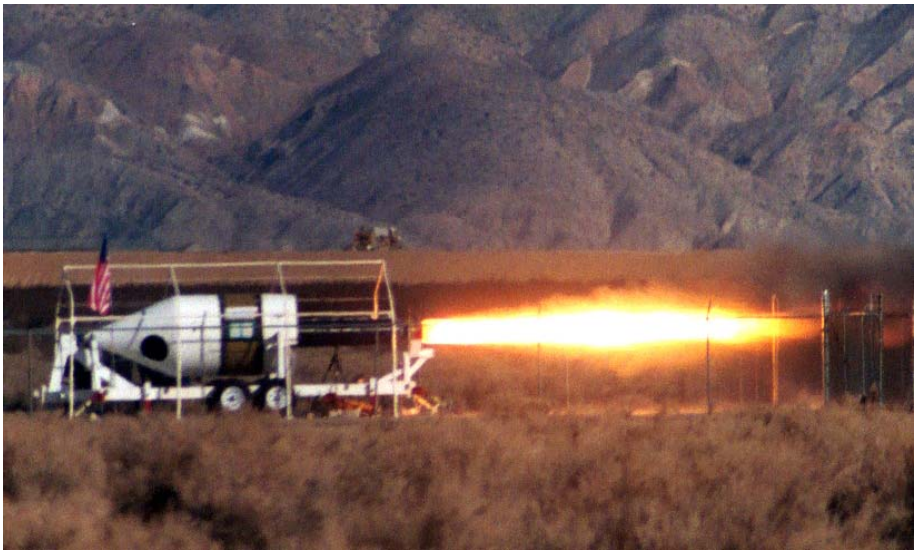


Local Are Networked, Formation-flying High PEWrformance Microsats for MDA

In 1999, Burt Rutan of Scaled Composites contacted SpaceDev and inquired about obtaining a rocket motor for a small space ship he was thinking about developing to win the $10 million X-Prize. After months of iterative design modifications to the motor and space ship, one fully integrated design for SpaceShipOne emerged, capable of winning the X-Prize, and using unique and proprietary hybrid rocket motor technology designed, developed and produced by SpaceDev.

A major aerospace company representative testified before the "President's Commission On Implementation of United States Space Exploration Policy" that they had developed the only new rocket motor in the United Space in the last thirty years, that it cost only $500 million, and took only five years. He then indicated that they could "man rate" it in a few more years and for a couple of hundred million dollars.

Following this testimony was SpaceDev, which described that with only $1 million, and within one year of being awarded a propulsion contract, SpaceDev successfully developed and test fired the world's largest hybrid rocket of its kind. After only two years of development, SpaceShipOne launched its first human toward space, powered by SpaceDev technology, and in less than three years, SpaceShipOne, powered by SpaceDev, created the world's first private sector astronaut.. The Paul Allen SpaceShipOne team went from concept to man in space in three years for less than $30 million, less than it takes the government to even think about a serious project. In comparison to the typical aerospace giant way of doing things, this is a good example of disruptive technology.



First Firing of World's Largest Hybrid Rocket Motor of its Kind

SpaceDev Hybrid Technology at Work - First Powered Flight on December 17, 2003

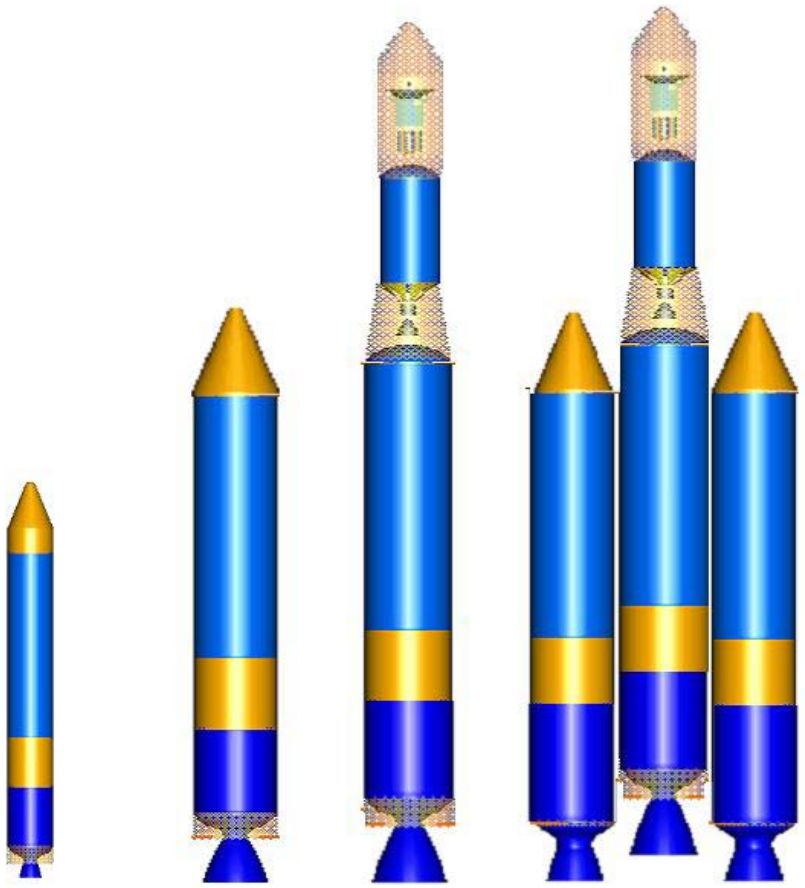
SpaceDev is currently under contract with the Air Force to develop a family of small, low cost, responsive expendable launch vehicles.

Included in the SpaceDev Streaker™ family are: two sounding rockets or targets; an air launch capability to orbit one 60 kg microsat like CHIPSat for less than $3 million; and the ground launched version capable of orbiting 1,000 pounds for less than $5 million.

The orbit insertion stage of Streaker is a variation of the space tug being developed by SpaceDev for the Air Force, and based on successful motors developed under an earlier NRO contract. This motor was recently test fired at SpaceDev facilities in Poway, California.

The upper stage will produce about the same thrust as our technology proven for SpaceShipOne, but will be packaged differently for Streaker.

The Common Core Booster will combine six existing techniques and technologies to produce hybrid performance equaling solid rocket motors, and exceeding that of pressure fed LOX Kerosene, while retaining their non-explosive nature and other positive aspects of hybrid rocket technology.



SpaceDev High Performance Streaker Family of Expendable Small Launch Vehicles

SpaceDev plans to incrementally evolve a space plane design through a series of development cycles, from towed, to sub-orbital and finally to orbit. This country is in need of an affordable and safe human transportation to orbit, and I believe SpaceDev has the technology to get us there safely and affordably in the not too distant future. That would truly be disruptive technology.

At SpaceDev, we believe that a space technology revolution is already underway, and we are happy to be a small part of it. Over the next decade I believe that all human space flight will be conducted in the private sector, that commercial deep space science missions will become common, that commercial space habitats will be orbiting earth and that near earth objects will begin to be utilized for their natural resources, in a variation on the theme popularized by Bob Zubrin in 1996 as "living off the land." Only with such disruptive developments, primarily in the private sector, will humanity finally be able to soar above the horizons of Earth to the Moon, the Asteroids and Mars, and beyond to the starts. And the exciting things is, we can all help make this happen, in our own lifetimes.