Shared space: The ethics of satellite use

by Robert S. Bachelder in the July 1, 2008 issue

At 6:18 p.m. EDT on May 19, 1998, the primary control processor of the Galaxy 4 satellite failed. Twenty-two thousand miles below, millions of Americans discovered that their pagers and credit cards no longer worked. The failure disrupted video feeds, meaning that CBS, Reuters news service and National Public Radio had to scramble to find an alternate means of transmitting their programs. Since then, the world has come to rely even more on satellites. Today any major problem with the Global Positioning System would disrupt fire, ambulance and police operations around the world and paralyze the global financial system.

Satellites are also indispensable for assessing the environmental crisis; they monitor remote areas of the planet, including oceans, that would otherwise go unobserved. When the Intergovernmental Panel on Climate Change announces that sea levels have risen at an average rate of 3.1 millimeters annually since 1993, that Greenland glaciers are melting faster than previously thought, and that higher ocean temperatures are reducing the growth of microscopic plants central to the marine food web, the panel is basing its assessments on satellite data. Satellite information enables public officials to track and evaluate agricultural conditions, map and develop natural resources, manage scarce water supplies, study population growth and migration patterns, monitor fish movements and biodiversity, and forecast disease outbreaks.

The Outer Space Treaty of 1967 established a moral foundation for satellite and other human-generated activity in space. The treaty affirms that “the exploration and use of outer space shall be carried out for the benefit of and in the interests of all countries, irrespective of their degrees of economic or scientific development, and shall be the province of all mankind.”

Since then, however, the international community has veered off course, offering little leadership and neglecting or even creating several serious problems, including the commercialization of the satellite industry. One result is that even as most of our leaders finally agree that climate change may be the most significant moral challenge of our time, researchers are finding it difficult to obtain information they need to study the environment.

The good news is that Earth observation data from satellites operated by U.S. government agencies, including NASA and the National Oceanic and Atmospheric Administration (NOAA), are available to users around the world for the modest cost of reproduction and dissemination. Anyone can obtain the complete, 15-gigabyte history of U.S. meteorological observations since 1948 from the National Climate Data Center, including all of the satellite information, for just $4,000. It’s a different story with private companies, however, which are playing a growing role in data acquisition because they are manufacturing and operating costly satellite systems. These companies charge whatever they think the market will bear, and most foreign governments have adopted their commercial pricing policies. A scientist hoping to purchase a complete set of meteorological records from Germany, for example, should be prepared to spend $1.5 million.

This trend toward commercialization has torpedoed important research projects. NOAA official Peter Weiss tells about a team at the India Institute of Technology in New Delhi that was developing a method to forecast the monsoons that can leave millions homeless in any given year. The team wanted to find out if the onset, strength and duration of monsoons could be reliably predicted, and decided to compare climate model output data with the actual observation records of monsoons. The U.S. gave the group 30 years of data, including satellite information, at virtually no cost, but the European Center for Medium-Range Weather Forecasts quoted a price that the team could not afford. The institute’s researchers pleaded with the European center to grant them free access in view of their project’s importance, but they were refused. Weiss asks: What is the economic and social harm to over 1 billion people in Southeast Asia when such research is stalled?

Gilberto Câmara of Brazil’s National Institute for Space Research says the growing practice of viewing all nations as paying customers is restricting the ability of poor countries to obtain data that are critical for sustainable development. Today an oil company may know more about a country’s resources than the nation’s own policymakers. Political scientist Ronald Deibert observes that the commercialization of satellite data is deepening the existing divisions between those nations that have capital and technical expertise and those that do not.

To its credit, the U.S. has been countering this trend by putting pressure on the commercial satellite companies that it licenses. The U.S. requires that when these companies are imaging nations, they must make some of the data available to those nations at reasonable prices. At the same time, however, the trend in the U.S. is toward greater commercialization. The Bush administration and its legislative allies have supported the private satellite industry's aggressive efforts to expand its control over data acquisition and dissemination. In 2003, legislators passed bills that directed government agencies to use commercial satellite data to the maximum extent feasible. In 2004, these bills were countered with another that would have awarded local and state governments grant money to use NASA satellite data for forest management, weather forecasting and land-use planning. Opponents argued that the bill would subsidize unfair government competition with private companies. It was defeated.

The Bush administration has also cut spending for NASA's and NOAA's Earth sciences programs, including satellite missions, by 30 percent. U.S. satellites and instruments produce almost two-thirds of the world's Earth observation data, but the number of sensors monitoring climate factors such as solar radiation and water vapor could drop by 40 percent by the end of this decade (many of these instruments have already exceeded their nominal lifetimes). This will leave important gaps in scientific understanding about such concerns as transcontinental air pollution, changes in ecosystem structures and functions, the occurrence of extreme events such as earthquakes, and the impact of climate change on human health. The American Association for the Advancement of Science calls these developments a "crisis in Earth observation from space."

Because the free market is the most efficient instrument we have for utilizing resources and responding to material needs, policymakers are right to promote a strong commercial satellite sector; we all benefit from the best new applications in Earth observation and telecommunications, most of which are coming from private companies. GeoEye initiated a new era in Earth observation in 1999, for instance, when it launched its IKONOS satellite and set the standard for high-resolution imaging.

The National Research Council confirms these benefits in a report that says that privatizing data collection makes sense under certain conditions. But where do we draw the line between satellite data as a public good that should be produced and disseminated by government, and satellite data as a private interest that should be subject to free-market pricing? It is clear that society has lurched too far in the direction of commercialization when scientists are deprived of essential information, and when some goods—including the human and natural environments—have become commodities.

A second problem in space is the looming specter of weaponization. Although technologically advanced nations rely upon satellites for conducting military operations on the ground, at sea and in the air, they have yet to position weapons in outer space. In other words, space is currently militarized but not yet weaponized. The Bush administration has plans to change this. Insisting that American spacecraft are potentially vulnerable to a Pearl Harbor–style attack, the administration contends that we must eventually deploy weapons in space in order to deter prospective enemies or to retaliate against attackers. The U.S. defense budget contains research and development programs for space weapons.

Even civilian analysts who are not enthusiastic about weaponizing space, such as Michael O'Hanlon of the Brookings Institution, believe it is inevitable because treaties banning space weapons would be unverifiable. The potential dual-use nature of some spacecraft—for both military and civilian purposes—is already a headache for arms control advocates. An automated space rendezvous robot, for example, which is being developed by several countries for repair or resupply missions, could be converted into an attack weapon with the flick of a joystick as the robot approaches a spacecraft. O'Hanlon urges that flight testing and deployment of anti-satellite (ASAT) weapons and space-based laser interceptors be delayed as long as possible, since these steps would accelerate weapons development by other nations and generate significant amounts of orbital debris.

The informal ban on weapons-testing that had been in effect since the end of the cold war was shattered when China fired an ASAT at one of its old polar-orbiting satellites in January 2007. The test was probably a warning that China will contest American efforts to achieve military dominance in space. It confirmed the opinion of the U.S. defense establishment that an arms race is inevitable, and in February 2008 the U.S. Navy fired an Aegis missile at a dying reconnaissance satellite orbiting above the Pacific. The Pentagon said the maneuver was necessary to prevent the satellite from releasing a toxic cloud of hydrazine gas as it fell to earth. Analysts such as Harvard astrophysicist Jonathan McDowell say that there was no danger and that the exercise was intended to test U.S. capabilities and serve as a warning to China.

As ethicist Glenn Stassen observes, a good way to reduce the likelihood of armed conflict is to identify and strengthen cooperative forces and trends already at work in the international system. John Clay Moltz of the Center for Non-Proliferation Studies at the Monterrey Institute and Joan Johnson-Freeze of the Naval War College contend that international activity in space can be shaped to become a positive sum game for all nations. They urge the U.S. to pursue a policy of cooperative threat reduction toward China and other potential space rivals.

China has expressed an interest in space cooperation with the U.S. If NASA and private American space companies partnered with China on select projects, they could shape China's space policy in ways that are more congenial to U.S. interests. A similar strategy was effective in dealing with weapons of mass destruction after the Soviet Union collapsed in the 1990s, when the West was concerned that Russia and the Ukraine would export weapons technologies to hostile states. To provide an incentive to comply with its nonproliferation goals, the U.S. engaged the two nations in joint space projects, including the International Space Station.

Other multilateral initiatives could help reduce conflict. Michael Krepon of the Stimson Center says spacefaring nations should try to negotiate a code of conduct that establishes "rules of the road" for space that could improve safety for satellites by creating a space traffic management system. A similar approach worked when nations agreed to negotiate rules of the road for civil air traffic by creating the International Civil Aviation Organization in 1947.

Debris is the final problem in the expanding utilization of space—over four tons of it are in Lower Earth Orbit (LEO) alone, where Earth-observing satellites reside at an altitude of 800 kilometers. Objects range from obsolete satellites and discarded rockets to nuts and bolts.

The first fender bender in space was recorded in 1996 when a chunk from an old rocket collided with a French satellite. China's ASAT test created over 2200 fragments large enough to be tracked by the U.S. Space Surveillance System, and a debris cloud through which at least 102 satellites will have to pass on a regular basis. Since some fragments can travel at speeds ten times faster than a bullet from a high-powered rifle, a piece of metal no larger than a marble could disable a satellite. The flagship of NASA's Earth Observing System, the Terra satellite, has been forced to perform collision avoidance maneuvers.

Even if weapons-testing can be avoided, experts know that the risk level will grow exponentially if action is not taken. Heiner Klinkrad of the European Space Agency says spaceflight in LEO could become too hazardous to undertake in 50 years. By the end of the century, communications satellites in Geostationery Orbit (GEO), at 35,756 kilometers above the equator, will have a 40 percent chance of being struck by debris during their operational lifetimes, and chain reactions caused by colliding debris could make some orbits inaccessible for millennia.

Recently the Inter-Agency Space Debris Coordinating Committee (IADC) proposed a set of voluntary mitigation guidelines that would reduce the creation of new debris by half. It calls for operators to vent excess rocket fuel into space and switch off battery-charging lines when missions are completed to minimize the risk of explosions. The guidelines also advise operators to deorbit obsolete satellites from LEO and boost defunct GEO satellites into graveyard orbits to reduce overcrowding and the risk of collision.

The United States, France, Russia and the European Space Agency have voluntarily implemented these measures for government-sponsored space operations, but since the guidelines could add 15 to 20 percent to the cost of a mission, few private firms are likely to adopt them. This has been the experience with greenhouse gas emissions; many U.S. companies with poor records have been unwilling to take action without a legal mandate. If they are serious about reducing debris, member nations of IADC should incorporate the guidelines into the licensing and regulatory processes they use to approve private space launches. The space environment is a public good, and government action should protect this public good.

If some nations mandate compliance and others do not, however, companies will simply register their spacecraft in the states with more favorable laws. This already happens in ocean commerce. Ultimately, argues analyst Theresa Hitchens, we must negotiate an international treaty under the auspices of the United Nations—one that will establish legal standards applicable to all space operators.

Although the U.S. government leads the world in studying space debris and adopting voluntary mitigation standards, it is opposed to any international regulation of space activity through formal treaty commitments. We need an international treaty that is based on the principle of subsidiarity, which limits the role of central political authorities and ensures that local and private institutions are free to undertake functions they perform effectively. Subsidiarity also has had the historical effect of expanding the power of governmental institutions at the international level. It was explicitly incorporated in the Treaty of Maastricht, which authorizes the European Union to legislate at points at which an objective cannot be “sufficiently achieved” by member states acting alone, but will be “better achieved” by states acting in concert through the union.

Back in 1967, signatories to the Outer Space Treaty intended for space to become the province of all humankind. To reach this goal, the international community must execute a sharp midcourse correction to avoid the perils of commercialization, weaponization and pollution. An effective space policy will promote dissemination of satellite data to researchers and developing countries as a public good. It will foster diplomacy and peacemaking instead of weapons testing and deployment, and will protect the integrity of the space environment from further damage.