GEOPOLITICS OF THE SATELLITE INDUSTRY

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ABSTRACT
This paper situates the international satellite industry within three lines of contemporary geographic thought. Second, it reviews the industry's Cold War origins. Third, it explains changing international regulatory structures of satellites, particularly Intelsat, which control access to and use of the technology. Fourth, it summarises the changing role of satellites in the post-Cold War era, including the impacts of deregulation, rising competition between Intelsat and national and commercial providers, and the heated rivalry between satellites and fibre optic carriers. Throughout, it emphasises the ways in which terrestrial power relations alter access and applications to this sector.

Key words: Satellites, telecommunications, information technology, geopolitics

Satellites and earth stations comprise a critical, often overlooked, part of the global telecommunications infrastructure. While most treatments typically depict this topic in technologically-deterministic, apolitical terms, access to satellite technology mirrors, reinforces, and occasionally transforms terrestrial power-geometries of states in the world-system. Although satellites circulate in outer space, their origins and impacts occur very much on the ground: Demonstrating and explaining this fact is the central goal of this analysis.

The paper opens by conceptually situating satellites within contemporary geographic theorisations of knowledge, space and power. Second, it reviews the nature of satellite technology and its historical development during the Cold War. Next, it turns to the international regulation of this industry, particularly the International Satellite Organisation (Intelsat). The fourth section considers satellites in the post-Cold War era, including the impacts of global deregulation and privatisation, rising competition between Intelsat and national and commercial satellite service providers, and the heated contest between satellites and fibre optics.

THEORISING SATELLITES

Satellites are conceptually situated here within three overlapping bodies of literature that address the changing ways in which the technology has been deployed by states and firms, its socio-economic consequences, and their epistemological implications. Because there exist excellent summaries of these literatures elsewhere they are not recapitulated in depth here; rather, a brief synopsis demonstrates their applicability in this particular context.

First, the political economy of information and communication technology (Morley & Robins 1995; Warf 1995; Graham & Marvin 1996; Hugill 1999) points to the ways in which satellites are wrapped up with changing relations of power and legitimation. In addition to national governments, satellites are used by telecommunications companies, multinational corporations, and the global media for data transmission, telephone traffic and broadcasting of television and radio programmes. These systems are integral to what Castells (1996) labels the 'informational mode of production', the space of flows characteristic of an information-intensive and hypermobile world economy. The politics of the satellite

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industry may be approached through regulation theory (Leyshon 1992; Feldman 1997; Boyer & Saillard 2002), in which the stability of market relations is maintained, however tenuously, by state intervention, even at the global scale, which is necessary to provide institutional cohesiveness and minimise negative externalities. Regulatory structures must accommodate the mixed needs for co-operation and competition among various groups of providers and consumers, including states and corporations (Demac 1986).

Second, the paper draws upon critical geopolitics (Agnew & Corbridge 1995; O'Tuathail 1996, 2000), which emphasises the social origins of statecraft and how hegemony and territoriality are constructed. Politically, satellites have long comprised a major component of national espionage efforts, constituting what Poster (1990, p. 121) calls a superpanopticon, 'a system of surveillance without walls, windows, towers, or guards'. Throughout the Cold War, satellites were instrumental in what O'Tuathail (1996) calls the discursive scripting of geographic space, its ideological construction by politicians, military planners, and the media that engaged in an indiscriminate 'othering' of the communist foe. Today, global satellite transmissions of television and radio traffic threaten national controls over information flows. Morley & Robins (1995, p. 43) argue 'satellite broadcasting threatens to undermine the very basis of present policies for the policing of national space'.

Third, the paper invokes post-structural analyses of spatial discourses and representations (Wood 1992; Gregory 1994; Cosgrove 2001; Pickles 2003), which underscore the multiple, complex and contingent ways in which spatial knowledge is simultaneously reflective and constitutive of social formations. Because the producers and users of satellite technology are concentrated in Europe and North America, the industry is inescapably intertwined with the Western domination of the global information infrastructure. For example, the world's largest media companies rely heavily on communications satellites to provide a largely standardised diet of television and video programmes around the world (Myers 1999), what Appadurai (1990) calls a global 'mediascape'. Clark (1997, p. 126) maintains that globalised satellite broadcasting of television homogenises the viewing options of consumers:

> Irrespective of where they live, audiences around the world are fed a broadly similar diet of television. The same kind of programmes are scheduled at the same times of the day . . . Soap operas and quiz shows account for most of the daytime slots while children's programmes predominate in the early evening. These are followed by family viewing, the mid-evening news, drama, sport and adult television. The significance of this standard format is that it generates demand for particular types of programming, much of which is international in origin.

Satellites images comprise what Lefebvre (1974) famously calls representations of space through which dominant ideologies are expressed and naturalised. Cosgrove (1994) argued that far from comprising politically neutral representations, satellite photography legitimated and sustained a discourse of 'one earth' effectively encompassed by one country, the United States. Finally, Litfin (1997) maintains satellites are inherently masculinist in sustaining the view of a single, dispassionate, all-knowing Cartesian observer.

TECHNOLOGY AND HISTORICAL ORIGINS OF THE SATELLITE INDUSTRY

Satellites appear in a variety of sizes and capacities. Large satellites capable of handling international traffic sit 35,700 km (22,300 miles) high in geostationary orbits, which are by far the most valuable orbital slots because only in that narrow sliver of space do satellites and the earth travel at the same speed relative to each other, making the satellite a stable target for signals transmitted from earth stations (Frieden 1996). Because such orbital arcs are scarce, their distribution is strictly controlled through international organisations (Smith 1987; Hudson 1990; Hart 1991). A broad-beam geostationary satellite can transmit to (i.e. leave a 'footprint' over) roughly 40 per cent of the earth's surface, so that only three or four are sufficient to provide global coverage. Because the cost of satellite transmission is not related to distance, the technology is commercially competitive in rural or low density areas (e.g. remote islands), where high marginal costs dissuade other types of providers such as fibre optics (Giget 1994; Goldstein 1998; Warf 2006).

Source: compiled by author from CIA Factbook. Accessed at <http://www.odci.gov/cia/publications/nsolo/factbook>.

Figure 1. *Distribution of earth stations capable of international traffic.*

The terrestrial counterpart of the satellite is the earth station, of which there are tens of millions located worldwide, ranging in diameter from half a metre to 30 metres. The vast majority however, only receive and do not transmit information (i.e. downlink only). When microwave signals are sent over great lengths and become broadly diffused, large, powerful antennas are needed to transmit them. The distribution of the world's 483 publicly-owned earth stations designed for international traffic in 2004 (Figure 1) reveals they are concentrated in the wealthiest countries, particularly the United States, which, with 70, has vastly more than any other state.

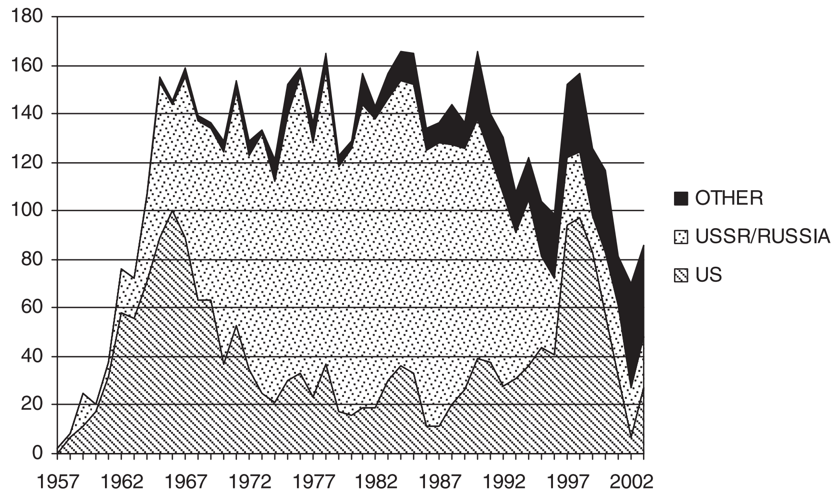
Starting with the Soviet Union's launch of Sputnik in 1957, satellites played a key role during the Cold War (Stares 1985; Burrows 1986; Richelson 1990; Devorkin 1992; Edwards 1996). The first US satellite, Explorer I, was put into orbit one year later. The Pentagon's series of 95 spy satellites launched under the Corona project revolutionised Western understanding of the USSR (Galloway 1972; Cloud 2001), allowing the location and magnitude of missile silos to be pinpointed (Peebles 1997; Day *et al.* 1998; Richelson 2001). The United Nations' Outer Space Treaty of 1967 attempted to limit the militarisation of space, an inconvenience to military planners that has largely been cast aside. Today, satellites form the core of the US Defense Department's C^3 (command, control and communications) infrastructure (Gaffney 2000).

Table 1. *Changing maximum resolution of satellite imagery.*

Year	Satellite	Centimetres
1970	Landsat	6,000
1980	Discoverer	3,000
1985	ER2/AVIRIS	1,000
1992	SPOT	100
1999	KH-11	10
2001	KH-7	5

Sources: Broad (1995a); Silber (1999); Pae (2001).

The visual power of satellites is expressed in terms of the length of the smallest feature that analysts can see when photographic processing is pushed to its limits. The accuracy of military satellite imagery improved steadily over time (Table 1). Thus, early Landsat photos of the 1970s had a resolution of 60 metres (Mack 1990), while the current generation of spy satellites can identify objects five centimetres in length. When satellites were the exclusive purview of the military, nations jealously hid their surveillance



Source: United Nations Registry of Space Objects. Accessed at <http://planet4589.org/space/un/un_key.html>.

Figure 2. *International satellite launches, 1957–2003.*

abilities (Broad 1995c); today, commercial providers boast openly about their systems' powers of resolution.

Gradually, civilian applications assumed an increasingly important role in the industry. The major difference between military and civilian applications involved the shift from surveillance to communications; although the technology remains important in both respects for military purposes, in the civilian domain communications remain dominant. In 1962, the United States launched Telstar, the world's first communications satellite (Jansky & Jeruchim 1987). The first privately owned satellite, Early Bird (Intelsat 1), was launched in 1965 and operated by Western Union. NASA initiated the Syncom series, which allowed television companies to begin satellite transmission of programmes, ultimately leading to an explosion of home satellite broadcasting (Inglis 1991). The first Soviet civilian satellite, Molniya, launched in 1965, was intended for purely domestic communications, in contrast to Early Bird, which was designed for international purposes. Between the late 1950s and 2004, roughly 5,500 satellites have been launched, including 1,854 by the United States and 3,183 by the USSR/Russia (Figure 2). However, other countries eventually acquired this capacity as well (Figure 3): In 1973, Canada inaugurated the Anik satellite; France followed with the Spot and Telecom in the 1970s and 1980s, respectively (Broad 1995a); in 1977, Italy launched Sirio, and Japan the Sakura (Hudson 1990).

REGULATING THE GLOBAL SATELLITE INDUSTRY

International regulation has long been important in shaping access to satellite technology, market structure, pricing and uses (Smith 1987; Hudson 1990). The international regulation of telecommunications dates back to the International Telegraph Union in 1865, which later evolved into the International Telecommunications Union (ITU). A key issue in international regulation concerns orbital 'parking spots', particularly the coveted 'geostationary gold', which are allocated by the ITU. The ITU confronts a dilemma between states already occupying slots and newer entrants, typically developing countries, which argue early users enjoy an unfair advantage and call for abolition of the currently existing 'first come, first served' policy (Martinez 1985). Because the total number of orbital slots is limited by the physics of rotation and problems of bandwidth spillover, the growth in satellites has generated increasingly crowded conditions, with fewer

Source: compiled by author from United Nations Registry of Space Objects. Accessed at <http://planet4589.org/space/un/un_key.html>.

Figure 3. *Total satellite launches, 1957–2003.*

degrees of orbital arc between them (Rothblatt 1982).

Two related issues closely associated with international regulation concern the allocation of electromagnetic frequency spectra and spill-overs from satellite footprints. The former, the ITU's most successful area of jurisdictional competence, is accomplished through the World Administrative Radio Conference (WARC). Often signal footprints exceed the borders of a target country. States that seek to restrict imports of foreign media – including much of the Muslim world – have typically found it impossible to assert national controls over global flows of information beamed from above. Such 'externalities' point to the eroding distinction between the foreign and the domestic that communications technology has accelerated (Agnew & Corbridge 1995).

Two regulatory regimes characterise the changing political and economic organisation of the satellite industry. The first consists of the state-dominated system dominated by the International Satellite Organisation (Intelsat), which coincided with the post-war Fordist boom, the Pax Americana and the Cold War. This era witnessed national ownership of most telecommunications systems via government monopolies (Graham & Marvin 1996). The second, more recent, regulatory regime consists of the neoliberal, privatised and deregulated system characteristic of the contemporary age of post-Fordist flexible production, one associated with the decline of Intelsat's monopoly, the rise of national and private carriers, and the challenge of fibre optics. While no simple dichotomy exists, for each era contains elements of the other, an examination of each regime sheds light on the multiple avenues through which terrestrial politics are projected to new heights, in this case literally.

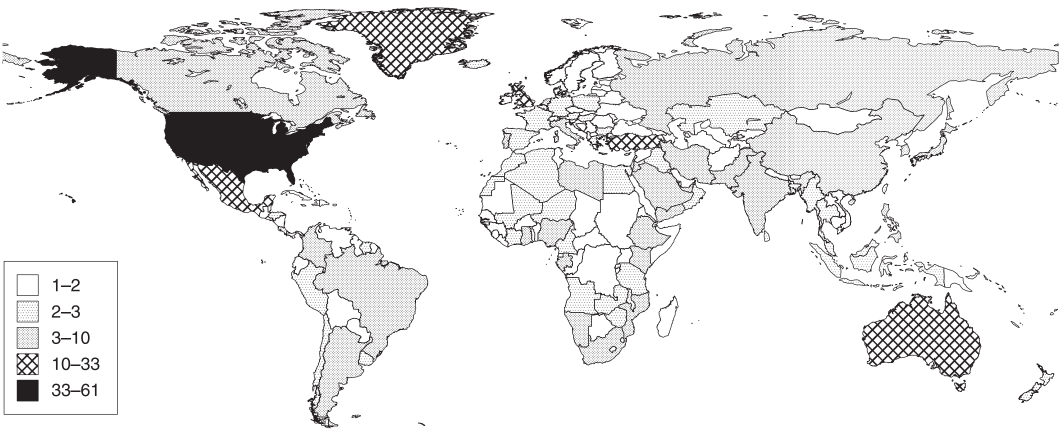
By far the largest and most comprehensive organisation involved in the regulation of global satellite traffic is Intelsat, headquartered in Washington, DC (Kildow 1973). Intelsat's origins lay in US government attempts to expedite the entry of commercial providers in the satellite market (Hudson 1990). In 1962, Congress passed the Communications Satellite Act establishing the privately-owned Communications Satellite Corporation (Comsat), which enjoyed a monopoly over international satellite service to and from the United States for the next generation (Galloway 1972). Comsat became the nucleus of Intelsat in 1964, with Early Bird providing its early fleet, and originally owned half of its shares. The organisation started with 19 signatories, all from the economically developed world, but excluded the Soviet bloc; today, 201 states are represented.

Intelsat is not regulated by any public body and is accountable only to its national members, which are stockholders (Hudson 1990). Voting power is concentrated in the Board of Governors, in which representation is proportionate

Table 2. *Distribution of international satellites, earth stations, and Member states, 2005.*

	Number of earth stations	Percentage of earth stations	Number of satellites	Member states
Intelsat	433	79.0	25	201
Intersputnik	32	5.8	8	25
Inmarsat	42	7.7	4	28
Arabsat	18	3.3	3	17
Eutelsat	23	4.2	24	23
Total	548	100.0	64	

Sources: Compiled by author from CIA Factbook, <http://www.odci.gov/cia/publications/nsolo/factbook> and various other sources.



Source: compiled by author from CIA Factbook. Accessed at <http://www.odci.gov/cia/publications/nsolo/factbook>.

Figure 4. *Distribution of Intelsat Earth stations.*

to shares of ownership: The United States is the largest contributor, responsible for almost a quarter. Today it remains by far the world's largest provider of domestic as well as international satellite services and dominant regulator of orbits and frequencies. It owns and operates a fleet of 25 high-powered spacecraft in geosynchronous orbit, far more than any other network; indeed, Intelsat boasts of being virtually the only truly global satellite system. Most international telephone calls (which generate two thirds of its revenues) are routed through Intelsat's satellites, each of which carries tens of thousands of voice circuits, although international television transmission is its most rapidly growing source of revenue. Other services include radio, integrated digital services, business-to-business services, rural community services, news gathering and weather reports. Intelsat's 433 earth stations, comprising 79 per cent of those capable of transmitting international traffic (Table 2), give it a near-monopoly status. The distribution of earth stations (Figure 4) reflects international discrepancies in wealth and power between economically developed and underdeveloped nations; the United States, with 61 stations, dwarfs any other nation.

Because Intelsat's members were allied with the United States during the Cold War, it was viewed by the Soviet Union as an instrument of US domination over the world's telecommunications network (Hudson 1990). To counteract

Intelsat, the USSR developed Intersputnik, headquartered in Moscow. Intersputnik did not begin operations until 1974, and today consists of eight geostationary satellites and 32 earth stations capable of international traffic. Traffic on the Intersputnik system, however, is only a fraction of Intelsat's. During the Cold War, Intersputnik's members were limited to the USSR and client states in Eastern Europe as well as Iraq and Syria. With the collapse of the USSR in 1991, the geography of Intersputnik became more complicated as other nations sought access to its network, including the United States, Canada, Japan and China, while the central Asian republics dropped out. Thus, the cessation of the Cold War blurred conventional geographic divisions in the regulatory order, producing new, more complex spatialities of belonging and exclusion.

Other, smaller satellite systems were erected to complement Intelsat. Concerned about insufficient coverage of maritime regions, the International Maritime Organisation initiated Inmarsat in 1973 to provide maritime satellite services (Doyle 1977). Because maritime communications are a low-volume and low-revenue market, they were ignored by Intelsat (Frieden 1996). Headquartered in London, Inmarsat is a nonprofit co-operative of 28 countries, including the United States, Russia, China, India, Japan, Australia, Brazil and most of Europe. Today, its network consists of four geostationary satellites and 23 earth stations that assist aviation and shipping firms, including distress calls, ship-to-shore and ship-to-ship communications, weather updates and providing safety information. In this way, Inmarsat represents a global attempt to rationalise one of the world's last unruly open spaces not yet fully brought under the gaze and control of international capital.

The European Telecommunications Satellite Organisation (CEPT) formed Eutelsat in 1977 to complement Intelsat services over the European continent, including television, telephony and data communications for computer networking. Co-ordinated by the European Space Agency and headquartered in Paris, Eutelsat wholesales its capacity (24 satellites and 23 earth stations) to national carriers, which in turn sell it to retailers (Hudson 1990). The end of the Cold War allowed Eutelsat to expand into Eastern Europe, so that today 23 nations are members.

In 1976, the Arab League formed Arabsat; with only 17 members, three satellites, and 18 earth stations, however, Arabsat is small, and its capacity is largely underutilised (Akwule 1992). Half of its shares are owned by Saudi Arabia (Hudson 1990). Political differences among Arab nations have hindered its growth: for example, Egypt was barred from membership between 1979 and 1989 because it signed the Camp David Accords. Given the authoritarian control exerted by many Arab governments over flows of information, frequent prohibitions exist against imports of satellite programmes deemed immoral or decadent (Anderson 2003). Finally, other regional systems include the Regional African Satellite Communications System (Rascom), and in South America, the Condor Alliance of Andean Nations (Frieden 1996).

This brief overview demonstrates the changing regulatory organisation of the industry, its intractably geographical nature, and the contradictions and changing boundaries between state and market imperatives. Despite the fact that satellites were designed to annihilate space via instantaneous communications, uneven social and spatial access to and control over satellite technology has been a key feature since its inception.

SATELLITES IN THE POST-COLD WAR ERA: THE NEOLIBERAL TURN

Telecommunications has been a key industry in the global triumph of neoliberalism as hypermobile corporate capital became increasingly reliant upon electronic information (Schiller 1999; Salin 2000). This transformation included deregulation and a steady shift in the provision of telecommunications services worldwide from the public to the private sector, in which they are less often provided as part of national efforts to serve the public interest and increasingly allocated on an ability-to-pay basis (Graham & Marvin 1996). This change was paralleled by the gradual erosion of the Intelsat monopoly, the proliferation of private carriers, and the growth of fibre optics (Payne 1998). Thussu (2001) argues that privatisation and deregulation widen the discrepancy between the world's information have and have-not nations.

The United States took the lead in satellite deregulation. In 1972, the Federal Communications Commission (FCC) announced its 'open skies' policy, allowing any party to apply for orbital slots, effectively initiating the era of privately-owned domestic commercial satellites (Kinsley 1976). In 1979, restrictions were lifted on licensing requirements, minimum antenna diameters, and the rate ceilings charged by common carriers. In 1985, the FCC allowed a private satellite carrier, Orionsat, to compete directly with Intelsat for the first time (Jansky & Jeruchim 1987). In 1997, limitations on the services that international satellite service providers could offer in the Unites States were abolished.

At the same time, the number of new satellites launched declined (from 166 in 1984 to 70 in 2002), a reflection of rising costs and decreased budgets for the US and Soviet/Russian space programmes. The space shuttle disasters of Challenger in 1986 and Columbia in 2003 slowed US space efforts, opening an opportunity for European, particularly French, providers. However, the dwindling supply has been augmented by the growing technological capacity of newer satellites with substantially greater transmission capacity.

As privatisation ended decades of government monopoly on orbital espionage, many countries became fearful of the repercussions of diffused surveillance capacities. For example, private earth stations are banned in homes in China, Malaysia and Singapore (Lee & Wang 1995). The unhampered flow of satellite traffic across national borders wreaks havoc with traditional notions of national sovereignty. As Achilleas (2002, p. 37) notes, 'Television by satellite involves high political and legal stakes because of two underlying principles long considered to be antinomic: freedom of information and sovereignty'. Some states argue that satellite traffic interferes with their internal affairs, as when Malaysia and Indonesia complain that Australian television portrays their governments in an unflattering light. Numerous governments attempt to limit flows of information across their borders using signal interference.

Rivals to Intelsat include national satellite systems. Indonesia launched several generations of its Palapa ('Unity') satellites in the 1980s to provide services to all 27 provinces, and recently began to sell them to neighbouring countries as well (Parapak 1993; Gibbins 1994). India initiated the Indian National Satellite System (Insat) to provide low-cost educational services to remote villages (Agrawal 1984). In the 1990s India put into orbit three Insat satellites, thus joining the small group of states that not only build but launch these devices (Mistry 1998). Brazil's BrazilSat system leased its first satellite in 1974 and launched two more in the 1980s, expanding its domestic network with 21 earth stations, 17 of which are located in the Amazon River basin. In the same vein, Mexico, China, France, Turkey and Thailand all initiated national satellite systems, some with their own launch capabilities. Unlike complementary networks such as Inmarsat or Eutelsat, national satellite systems are designed explicitly to bypass Intelsat.

Intra-industry rivals to Intelsat also include private satellite companies. Given the high fixed costs and barriers to entry into the satellite industry, particularly launch costs (Jussawala 1984; Macauley 1986; Snow 1987), few private firms took early advantage of deregulation. However, as entry costs declined, the industry has become steadily commercialised (Achilleas 2002). Orionsat first filed an application with the FCC to compete with Intelsat in 1983, and had two satellites in operation by 1994, serving the trans-Atlantic market. The second private provider, Panamsat (Pan-American Satellite Corporation), was founded in 1988, with one satellite, by president Reynold Anselmo to 'bust open' the Intelsat monopoly in Latin America. The 20 largest fixed satellite service providers, including Intelsat, reveal a diversity of companies (Table 3). Aerospace firms have been key players in this process, frequently through consortia (Cole 1997; Price 1998; Vartabedian 1998). Lockheed Martin, for example, purchased Comsat for $2.7 billion, in the process acquiring 24 per cent of Intelsat stock; it also purchased 15 geostationary orbital slots from Intersputnik. These systems represent the further intrusion and dominance of market imperatives in what had once been a sector aligned purely along the prerogatives of national security (Florini 1988).

A rapidly growing market segment for satellite services is the explosive growth of mobile telephones, which now out-number landlines worldwide (Evans 1998). Wireless technology (mobile phones and satellite television) was made feasible through the deployment of a series of small Direct Broadcast Satellites (DBS) that can transmit directly to small rooftop antennae or cellular towers (Maral & Bousquet 2002; Pratt

Table 3. *Largest 20 fixed satellite service providers, 2001.*

Operator	HQ Country	Number of Satellites	Revenues ($ millions)
Intelsat	United States	22	1,100
PanAmSat	United States	21	1,000
SES Global	Luxembourg	13	666
Eutelsat	France	18	650
SES Americom	United States	16	522
Loral Skynet	United States	7	324
JSAT	Japan	8	298
New Skies	Netherlands	6	209
Telesat Canada	Canada	5	201
Space Communications	Japan	4	170
Arabsat	Saudi Arabia	3	155
Star One	Brazil	5	130
Satmex	Mexico	2	128
AsiaSat	China	3	124
Telenor	Norway	3	121
Shin Satellite	Thailand	3	116
Hispasat	Spain	3	81
SingTel	Australia	5	73
Korea Telecom	S. Korea	3	76
Russian Satellite Communications	Russia	11	61

Source: *Space News Business Report* 7 July, 2005. Accessed at <http://www.space.com/spacenews/>.

et al. 2002). Unlike large, expensive, geostationary satellites, DBS can orbit in a variety of orbits designed to maximise the flexibility and utilisation rate of the network (Pool 1998). The growth of the wireless market gave the satellite industry a new lease on life. However, the risks associated with such ventures are aptly illustrated by Motorola's Iridium venture, which in 1999 was forced into bankruptcy by its clumsy and cost-ineffective technology.

In the face of these challenges, Intelsat attempted to reassert its once-hegemonic position by renewing its 'natural monopoly' argument, rationalised by the assumption of a single, nonfungible output for satellite services (Demac 1986). Intelsat emphasises the economies of scale its system permits, and focuses on markets in which fibre optic lines are inefficient, including point-to-multipoint broadcasting and remote areas (Galloway 1987). Nonetheless, in 1999 the US Congress initiated the process of privatising both Intelsat and Inmarsat, including an organisational restructuring to facilitate direct access and investment by private parties, de-averaging global prices, and allowing current owners to sell their shares. Inmarsat soon became the world's first international treaty organisation to transform itself into a private company (Thussu 2001). Similarly, in 2001, Intelsat reinvented itself as a private company owned by stockholders, which was then sold to a consortium of private firms, completing the privatisation process (Noguchi 2001). This transition was not unchallenged by governments that failed to share the American faith in neoliberalism; as Frieden (1996, p. 209) remarks, 'Many other nations expressed skepticism or resentment over what they considered a heavy-handed attempt by the United States to dismantle the cooperative model for providing the ubiquitous international satellite capacity it was instrumental in creating'.

The privatisation of the satellite industry also entailed the commodification of images, so that satellite data and photographs that were once the exclusive province of secretive intelligence communities have been released to anyone who can pay for them (Lane 1996). Private providers found a growing market among real estate developers, utilities, shipping and airline firms, petroleum companies and agribusiness. In 1986, the French company Spot Image began sale of satellite images with 10 metre resolution (Monmonier 2002, p. 10). The first Bush administration granted licences for private craft with a three-metre resolution (Broad 1995a, b). In 1999, Ikonos successfully began sale of high-resolution remotely sensed images, and Space Imaging launched the Ikonos system, which offers images via the Internet 30 minutes after the satellite camera shutter has clicked. In the same vein, the United States began to turn its spy satellites to civilian purposes such as measuring cloud cover, sea ice, deserts, flood and earthquake damage, and tropical rain forest destruction (Broad 1995c). Military satellites have been used for boundary surveys, to detect marijuana fields, as 'digital leashes' tied to ankle bracelets of prisoners confined to home, and in the development of location-based services. Opponents of the commercial sale of satellite images object on the grounds that satellite images constitute 'dual-use' technology applicable to both military and non-military purposes (Monmonier 2002).

Finally, the satellite industry as a whole has been besieged by mounting competition from fibre optics carriers, the mode of choice for many large service firms (Giget 1994; Graham 1999; Warf 2006). The competitive ability between satellites and fibre optics varies with transmission distance; generally, satellites are more cost-effective for very long distances (Langdale 1991; Akwule 1992). However, fibre optics allows for greater security, and are heavily favoured by large corporations for data transmissions and electronic funds transfer systems (Goldstein 1998). Capacity growth in the fibre optics industry has been particularly explosive, and transmission costs have dropped accordingly, which extended the break-even distance with satellite competitors, sharply eroding the latter's market share. Today, fibre optics carriers represent 86 per cent of worldwide transmission capacity (up from 16% in 1988), including 87 per cent across the Pacific and 80 per cent across the Atlantic Ocean (Warf 2006). Deregulation, heightened competition within the industry, and devastating inroads by fibre optics carriers have led to a recent slump in the satellite industry (Landler 1995; Pollack 1999; Feder 2003), including weak demand and bankruptcies.

Does the rise of fibre optics indicate that satellites have become irrelevant? There are several grounds for disputing this assertion. The military surveillance functions of satellites remain critical. Large geostationary satellites still remain a major avenue for international transmission, particularly for the mass media, and are still critically important in large, low density regions, such as Siberia, Canada, the Brazilian Amazon, the Pacific Ocean and many rural areas. Finally, the growth of the wireless market relies on satellites, albeit a new generation.

CONCLUDING COMMENTS

Satellites reflect, and in turn feed back into, terrestrial politics in many ways. Born of Cold War rivalry, satellites played a key role in the militarisation of space. Although the military's role in the satellite industry has declined, it continues to remain an important segment distinct from civilian applications. In civilian markets, satellites play a key role as communication devices in international transmissions of voice, video and data traffic, all of which reflect the growth of information societies around the world and their steady integration through the global market. Castells' (1996) well-known 'space of flows' would be impossible without the skein of earth stations and orbital platforms that lie at the heart of this industry. The geography of large international earth stations reflects the schism between the developed and underdeveloped worlds, and, to a lesser extent, the legacy of the Cold War. Hence, while satellites float thousands of kilometres overhead, the determinants of access and use are firmly grounded in terrestrial politics.

To minimise externalities and allocate prime orbital slots, global flows of information require international forms of regulation. The largest organisation for the provision of international satellite services is Intelsat, traditionally perceived as a mechanism for the assertion of US hegemony over the industry during the Cold War. Digital neoliberalism and the worldwide deregulation of the industry eroded Intelsat's monopoly status and shifted control over the technology from national monopolies to private capital. Thus, the power of capital to allocate satellite resources has expanded while national security concerns, the industry's traditional raison d'être, have been progressively eclipsed, but not removed entirely. In short, satellites, whether military or corporate, do not simply reflect the world's geopolitics, they are simultaneously *constitutive* of it, blurring the boundaries between earth and space, the global and the local, the public and the private.

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