UNIVERSITY OF Southampton

Re-sourcing History

The Cold War and the Birth of Satellite Communications

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Introduction

This resource pack is designed to support A-level teaching and learning activities on the history of the Cold War, in particular by encouraging students to explore the significance of the Cold War in stimulating and shaping developments in the field of global communications. The legacies of the Cold War in terms of driving policy-makers to embrace the ideal of instantaneous worldwide communications are all around us today, below ground or on the ocean floor in the form of high-speed fibre optic cables, above us in the form of communication satellites. This pack introduces students to the geopolitical and security rationales behind American investments in civilian and defence satellite communications in the first thirty years of the Cold War.

Source 1:

Chapter 2: The Significance of a Satellite Vehicle
Attempting in 1946 to estimate the values to be derived from a development program aimed at the establishment of a satellite circling the earth above the atmosphere is as difficult as it would have been, some years before the Wright brothers flew at Kitty Hawk, to visualize the current uses of aviation in war and in peace. Some of the fields in which important results are to be expected are obvious; others, which may include some of the most important, will certainly be overlooked because of the novelty of the undertaking.

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The Satellite as a Communications Relay Station – Long-range radio communication, except at extremely low frequencies (of the order of a few kc/secs), is based entirely on the reflection of radio waves from the ionosphere. Since the properties of the earth's ionized layer vary profoundly with the time of day, the season, sunspot activity, and other factors, it is difficult to maintain reliable long-range communication by means of radio. A satellite offers the possibility of establishing a relay station above the earth, through which long-range communications can be maintained independent of any except geometrical factors.

The enormous bandwidths attainable at microwave frequencies enable a very large number of independent channels to be handed with simple equipment, and the only difficulty which the scheme appears to offer is that a low-altitude (300 mile) satellite would remain in the view of a single ground station only for about 2100 miles of its orbit.

For communications purposes it would be desirable to operate the satellites at an altitude greater than 300 miles. If they could be at such an altitude (approximately 25,000 miles) that their rotational period was the same as that of the earth, not only would the "shadow" effect of the earth be greatly reduced, but also a given relay station could be associated with a given communication terminus on the earth, so that the communication system problem might be very greatly simplified.

Source: Douglas Aircraft Company, 'Preliminary Design of An Experimental World-Circling Spaceship,' 2 May 1946

Questions to consider:

In the mid-1940s, particularly as a result of the German V2 missile program, rockets were able to advance beyond the threshold of space, but the achievement of using such a rocket to deliver a satellite into a stable orbit was still a decade away. Nevertheless, US military leaders and military contractors were beginning to think

about the potential benefits of such satellites, including in the realm of communications.

- How would the use of a satellite transform the existing art of long-range communication?
- What sort of system would optimize those benefits?

Source 2:

1. It is the unanimous opinion of the Task Force working members that the satellite communication system proposed by Dr. H.A. Rosen is technically feasible, is possible of realization within close to the estimated price and schedule, has great potential economic attractiveness and should not encounter too serious legal or political obstacles.

2. The Task Force has, of necessity, concentrated on technical aspects of the program and has not been able to make an adequate market survey. The phraseology, "great potential economic attractiveness" is justified by the following:

a. A rapidly increasing demand for new long-distance communication facilities is being created by: (1) Population increase, (2) Shrinkage of travel time via commercial jet aircraft, (3) Increasing foreign industrialization and international commerce, (4) Increasing military communication loads, and (5) Forthcoming decrease in HF communication capability because of the declining sunspot cycle. Rather than being able to open more HF radio circuits to carry the increasing traffic, new circuits (cable, scatter or satellite) will be needed to pick up perhaps a third of the traffic now carried by HF circuits.

b. The Bell System, which formerly depended on radio for intercontinental phone circuits, has been investing heavily and profitably in long submarine cables; four in the past few years. The first trans-Atlantic phone cable provided thirty-six circuits (about 140 kc bandwidth), cost about $30,000,000.00, and reportedly paid out in its first two years. A second transAtlantic cable soon will be placed in service at a reported cost of $40,000,000.00, presumably for a similar number of circuits. Tropospheric scatter radio chains are comparable in cost and are geographically constrained.

c. Comparing the proposed satellite system ($5,000,000.00 for 4500 kc bandwidth) with submarine cable, it could carry up to thirty times as much traffic at one-sixth the investment!

Source: S.G. Lutz to A.V. Haeff, 'Commercial Satellite Communication Project: Preliminary Report of Study Task Force,' Hughes Aircraft Company, 22 October 1959

Questions to consider:

The successful launch into orbit of the Soviet Sputnik satellite in 1957 prompted U.S. political, military and business leaders to devote more attention to the possibilities of exploiting the high ground of space. In this document, the Hughes Aircraft Company reflected on those possibilities with respect to communication – and specifically for developing and marketing its own satellite system concept.

- What broader social factors had created a lucrative market for long-distance communication facilities?

- Why was long-distance communication via satellite preferable to alternative technologies?

Source 3:

The commercial application of communication satellites, hopefully within the next several years, will bring all the nations of the world closer together in peaceful relationships as a product of this nation's program of space exploration.

The world's requirements for communication facilities will increase several fold during the next decade and communication satellites promise the most economical and effective means of satisfying these requirements.

Increased facilities for overseas telephone, international telegraph, and other forms of long-distance person-to-person communications, as well as new facilities for transoceanic television broadcasts, through the use of man-made satellites, will constitute a very real benefit to all the peoples of the world.
….
To achieve the early establishment of a communication satellite system which can be used on a commercial basis is a national objective which will require the concerted capabilities and funds of both Government and private enterprise and the cooperative participation of communications organizations in foreign countries.

Various agencies of Government, including the Department of State, the Department of Defense and the Office of Civil and Defense Mobilization, have important interests and responsibilities in the field of communications.

With regard to communication satellites, I have directed the National Aeronautics and Space Administration to take the lead within the Executive Branch both to advance the needed research and development and to encourage private industry to apply its resources toward the earliest practicable utilization of space technology for commercial civil communications requirements. In carrying out this task NASA will cooperate closely with the Federal Communications Commission to make certain that the high standards of this nation for communications services will be maintained in the utilization of communication satellites.

Source: President Dwight D. Eisenhower, 'Statement by the President Concerning Commercial Use of Communication Satellites,' 1 January 1961

Questions to consider:

The Eisenhower administration found it difficult to integrate all the new possibilities presented by satellite communications into a coherent policy. Business corporations, the U.S. military and the recently created National Aeronautics and Space Administration (NASA) were all manoeuvring to ensure that their interests were represented in whatever policy was developed. Would the American communication satellite programme be run by the government or by private enterprise? If by the government, what would take precedence: civilian or military use?

- What did President Eisenhower emphasize as the chief benefit resulting from the development of satellite communications over the next decade?

- What kind of satellite communication system does this document chiefly discuss? Why?

- What do you make of the paragraph beginning: 'Various agencies of Government….'?

Source 4:

National Purpose

Science and technology have progressed to such degree that communication through use of space satellites has become possible.
The President has recognized this potentiality and has requested that it be translated into an actuality. In his Message on the State of the Union, the President invited all nations to join with us in a new communication satellite program. On May 25, the President asked the Congress for $50 million of additional funds to accelerate "the use of space satellites for world-wide communications." Again, on June 15, the President requested the Space Council "to make the necessary studies and government-wide policy recommendations for bringing into optimum use at the earliest practicable time, operational communications satellites."

Hence, the national purpose and intent have been made clear.

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The present status of the communication satellite programs, both military and civil, is that of research and development. Neither the arrangements between government and industry for research and development nor the government participation as to preparation of a plan or plans for ownership and operation of a commercial system have contained any commitments as to the operational system.

A communications system using satellites is made up of a number of interconnected parts, of which the satellites are but one part. The full system includes message origination facilities, ground sending stations, ground receiving stations, and message delivery facilities—in addition to the satellites used for continuous receipt and relay of messages. We already have an elaborate communications system between the United States and some parts of the world. Communication satellites must be integrated into the existing system. Adding communication satellites to this system would permit substantially increasing the coverage, increasing the capacity for communication, and enabling television and high speed data, as well as voice and record, to be transmitted and received over great distances.

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New Uses and Reduced Rates: It is an objective that satellites make available for general use new and expanded international communications services. Transmission of records, voice, and television over great distances should facilitate the exchange of information and ideas throughout the world. These new and expanded uses should, at the earliest possible time, be made available through an economical system, the lower costs of which will be reflected in overseas communication rates. Anticipated greater use and lower costs per channel in a communication satellite system may make lower rates practicable.

Global Coverage: A system of communications designed for "global" coverage is to be contrasted with a system limited to connecting heavy traffic markets and subject to expansion only in response to added demands of sufficient volume as to be profitable per se. Rather, a "global" system is one with the potential and the objective to provide efficient communication service throughout the whole world as soon as technically feasible, including service where individual portions of the coverage are not profitable or even have no expectation of future profit. It is a national objective to have such a global system operable as soon as possible within the limits of technology.

Source: National Aeronautics and Space Council, 'Communications Satellites,' 14 July 1961

Questions to consider:

In April 1961, the USSR achieved another world first – sending a man, cosmonaut Yuri Gagarin, into orbit and bringing him safely back to earth. Concerned about the effect of this Soviet triumph on international opinion, the new U.S. President, John F. Kennedy, committed his country to sending a man to the moon by the end of the decade. But he also regarded the development of a global communication satellite system as a national priority.

- What role would be played by the government in the development of a communication satellite system?

- What kind of international communication satellite system did the Kennedy administration prefer? Can you explain that preference?

Source 5:

Courier Communications Satellite from R&D Progress Report Number Three 1961 US Army

Source: U.S. Army Research and Development Progress Report No. 3: 'Courier Communications Satellite,' 1961. Available for viewing at: https://www.youtube.com/watch?v=rsjVN-cAe1A

Questions to consider:

In October 1960, the U.S. Air Force launched the Courier communication satellite into low earth orbit. Courier, developed by the U.S. Army Signal Corps, was primarily a delayed repeater satellite: that is, it received and stored a signal received from one Earth ground station, and then later replayed that signal back to a different ground station. This film describes the Courier project.

- What vision of modern warfare is evoked to explain the value of Courier?
- What else could do Courier besides store a signal and retransmit it later? What value might that additional capacity have for the military services when integrated into a future satellite system?

Source 6:

GENERAL: It is the policy of the United States to support the development of a single global commercial communications satellite system to provide common carrier and public service communications. The intent of the United States to exploit space technology for the service of all mankind, and to promote its use in support of peace, understanding and world order has been stated clearly in legislation and in Administration speeches and official releases. The U.S. Government is committed to use global commercial communications facilities for general governmental communications purposes wherever commercial circuits of the type and quality needed to meet government requirements can be made available on a timely basis and in accordance with applicable tariff or, in the absence of Federal Communications Commission jurisdiction, at reasonable cost. Separate satellite communications facilities including surface terminals may be established and maintained by the U.S. Government to meet those unique and vital national security needs which cannot be met by commercial facilities. The capacity of these separate facilities shall at all times be limited to that essential to meet such unique needs. These policies underlie the spirit and the letter of the Communications Satellite Act of 1962, its legislative history and the position of the United States in the negotiations leading to the signing of agreements establishing interim arrangements for a global commercial communications satellite system.

Provisions for the establishment of the global commercial communications satellite system and a U.S. national defense communications satellite system consistent with these policies have now advanced to the point where it is desirable to amplify and interpret these policies in order to guide United States relations with other countries in the development of communications satellite capabilities, particularly with respect to providing technology and assistance therefor.

Source: National Security Action Memorandum No. 388, 'Policy Concerning U.S. Assistance in the Development of Foreign Communications Satellite Capabilities,' 25 August 1965

Questions to consider:

By the mid-1960s, the US government had developed a relatively clear sense of the architecture of a global commercial communications satellite system, but the ability of that system to serve the needs of the US military was much less certain.

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- Having emphasized the potential for space technology to serve the cause of peace, the US government was now envisaging what sort of communication satellite system?

- What do you think the ‘unique and vital national security needs’ were that could not ‘be met by commercial facilities’?

Source 7

CAPE KENNEDY, June 16 (UPI) – A Titan 3-C rocket put eight satellites into orbits high above the Equator today.

The Air Force rocket placed seven communication satellites and a research satellite one by one in perfect paths 20,941 miles above the earth.

The 100-pound radio relay stations are expected to furnish jam-resistant communications between Washington and United States forces around the world. Almost immediately after the launching, the Air Force control center here reported that all eight spacecraft were working well.

"It was a really outstanding mission," a spokesman said. "Everything looks extremely good."

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Two more eight-in-one shots, in August and in the fall, will raise the total of military "switchboard" satellites to 22 to guarantee almost uninterrupted radio links around the world.

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At their altitude, the orbital speed of each satellite is only slightly faster than earth's rotation and it will take them about 12 days to creep around earth.
Each of the satellites, able to link ground stations 10,000 miles apart, is expected to work for at least a year and a half.

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Source: 'Titan 3-C Orbits Satellites for Pentagon Radio Net,' *New York Times*, 17 June 1966

Questions to consider:

In June 1966, the first elements of an initial US defense communication satellite system were launched into orbit. Many details of the system remained secret.

- What kind of orbit were the satellites placed in and why?
- What was the significance of the term 'jam-resistant communications'?

Source 8:

SUMMARY

The hazards to the future success of the International Consortium (INTELSAT) and ComSat appear to be increasing and becoming more serious. Knowledgeable students of the situation are privately expressing the thought that it is entirely possible that INTELSAT may fall apart in favor of a series of regional systems.

If this were to occur it would mean:

· A massive setback in future growth and easy access in international telecommunications.

· The loss of the soundest, simplest, lowest cost system of international telecommunication which can make the largest contribution to world peace and understanding.

· A reversion to reactionary concepts of rich nation domination of zones of communication influence, increased length and lower quality of transmission paths, and higher consumer costs.

· A very serious prestige loss to the United States.

· Financial loss to the shareholders of ComSat.

The most serious threats to INTELSAT and ComSat which are described in the following pages have not yet reached critical or unmanageable stage. But over optimism, lack of vigorous action, or actions which aggravate these trends can cause these problems to rapidly get beyond control.

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THE HAZARDS AHEAD

These are fundamental problems in the field of satellite communications which have national importance and which can profoundly affect the economic, social, and political objectives of this Nation. These problems arise from many sources but may be generally categorized as follows:

1. Interests that conflict with the global system;
2. The impact of U.S. domestic communications issues;
3. The “limited objectives” syndrome;
4. Fear of U.S. domination;
5. The general disorder of U.S. international communications.

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INTERESTS THAT CONFLICT WITH THE GLOBAL SYSTEM

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National Ambitions of Foreign Governments

Several foreign nations, notably France, feel that they must develop their own communications satellite capability as rapidly as possible to reinforce national

prestige. An important motive for individual nationalistic control of communications satellites stems from a desire to continue to exercise cultural and political leadership in traditional areas of influence without intervention by an international body such as INTELSAT.

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FEAR OF U.S. DOMINATION

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Leadership in INTELSAT Administration and Management

At present the U.S., through the Communications Satellite Corporation, serves as Chairman of the Interim Communications Satellite Committee, provides the Manager for all technical operations of INTELSAT, and has a controlling voting interest of 54 percent in most decisions of the Consortium. Many foreign nations feel that this is an unacceptable domination of INTELSAT by the U.S. We are already experiencing pressure within the Consortium to reduce the influence of the U.S. and to strip COMSAT of its administrative and technical control. This will undoubtedly be an important point in the 1969 renegotiations.

Source: J.D. O'Connell, (President Lyndon B. Johnson's special assistant for telecommunications) 'A Global System of Satellite Communications: The Hazards Ahead,' 8 February 1967

Questions to consider:

In 1962, the US government had established the privately-owned but federally regulated Communication Satellite Corporation (COMSAT) to develop a US commercial communication satellite system with global reach. COMSAT represented the United States in INTELSAT, a consortium of eleven countries with interests in global telecommunications set up in 1964. The function of INTELSAT was to run the global commercial communications satellite system in a manner that reflected those various national interests, but COMSAT proved to be the dominant player.

- Why was the future of INTELSAT under threat?
- Why was the survival of INTELSAT so important to the United States?

Source 9:

INTRODUCTION

The idea of using an earth-orbiting satellite as a microwave relay point between two earth terminals is an old one. However, only during the last decade has the science of space technology advanced to the point where such a proposal could be given serious consideration. Such communication satellites have obvious advantages in handling unique and vital military communications. The flexibility of a system that can implement military command between ground terminals 9000 miles apart and simultaneously permit communications over the next hill has much to recommend it. An additional advantage to a satellite communication system is the fact that ground terminal equipment may be located near the area in which communications are required, thus obviating the need for long land circuit "tails." By the use of ground terminals that are transportable or even mobile, a flexible configuration may be retained. This flexibility is especially important in "contingency situations" where a critical situation in a foreign country may vastly increase the need for reliable communications for an undefined period of time. Conventional communication methods in such situations, in addition to taking a long time to establish, require that much fixed equipment be left behind should the situation change. In the case of communication links established via satellite, ground terminals may be removed and the satellite itself may be repositioned to cover a different part of the earth.

It has become convenient to discuss military communication satellite systems in terms of whether they are for strategic or tactical communications. Such terms serve chiefly as descriptive designators, since most satellites can be used for either type of system. Strategic systems have come to mean an orbiting system of satellites (either stationary or in random orbits) associated with a number of earth terminals in such a way that communications can be established over any link in which a satellite is mutually visible to two or more ground stations. A tactical system, on the other hand, is generally considered to be one employed especially for localized tactical communications. In general, the satellite itself may differ from a strategic system in that it is especially designed to work with highly portable or even mobile ground stations. Such terminals might be aboard aircraft, carried on mobile land vehicles, or, as has been demonstrated, carried by a two-man "back-pack" team.

Source: Virgil W. Wall (Aerospace Corporation), Air Force Report No. SAMSO-TR-68-116: 'Military Communication Satellites,' January 1968

Questions to consider:

Partly as a result of the ongoing war in Vietnam, the US military was exploring how communication satellites could be used to connect not just major military installations but also combat units on the move.

1) What was the difference between a strategic and tactical communication satellite system?

2) What was the principal requirement of a tactical military communication satellite system?

Source 10:

The Department of Defense has also been actively developing its own private system of military communications satellites. On June 16, 1966 a Titan III-C launched the first eight satellites in the Initial Defense Communications Satellite Program (IDCSP) into sub-synchronous orbit (about 100 miles below synchronous). At this altitude the satellites slowly drift easterly at about 24° a day. To date 26 of these 100-pound IDCPS satellites have been placed into orbit. Their principal objective has been to establish an initial experimental military comsat network.

Each IDCSP satellite is designed to operate with a variety of terminals from fixed 60-foot-antenna earth stations, to 18-foot transportable stations, down to 6-foot shipboard terminals. The satellite can handle up to eight simultaneous carriers. Because of the low radiated power (2 watts), non-directive antenna, and small earth stations, the largest capacity per carrier is only eleven voice channels. (There are a total of eight carriers used, and the total number of voice channels is limited to 23.) Also, since the ring of slowly moving satellites occasionally bunches together, coverage gaps are left between tracking earth stations.

Partially because of these limitations, the Defense Department announced in June, 1968 its decision to proceed with an advanced Phase II Defense Satellite Communications System that would employ large stationary satellites with directed antennas. Since the IDCSP satellites incorporate six-year timers to turn the satellite off, the advanced system (DSCS-II) must go into service by late-1971. In sharp contrast to IDCSP, DSCS-II will have a capacity of several thousand voice channels.

Source: Francis A. Gicca, 'Communications Satellites – Success in Space,' *Electronics World*, July 1969

Questions to consider:

By the late 1960s, the US military was looking to develop a more advanced defense communication satellite system.

1) What were the limitations of the current system?

2) How would the projected advanced system transcend those limitations?

Document 11

Source: Air Force Systems Command Staff Film Report 273, 'Defense Satellite Communications System,' 1977. Available for viewing at https://www.youtube.com/watch?v=oJsR1I7ikDM

Questions to consider:

By the mid-1970s, the second-generation US defense satellite communications system (DSCS II) was in place. This film describes the system.

1) What features of the DSCS allow it to achieve global coverage?

2) Who do you think was the principal audience for the film, and what image of the DSCS was it intended to convey?

Further reading

Joseph N. Pelton, 'The History of Satellite Communications,' in John Logsdon (ed.), *Exploring the Unknown: Selected Documents in the History of the U.S. Civilian Space Program: Volume III: Using Space* (Washington, D.C.: NASA History Division, 1998): https://history.nasa.gov/SP-4407/vol3/cover.pdf (open access)